International Vietnam Conference on Earth and Environmental Sciences

5th

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28

NOVEMBER

Quy Nhon
Vietnam



Conference Program and Abstracts



The 5th *international* Vietnam Conference on Earth and Environmental Sciences 2025 (iVCEES-2025)

November 24 – November 28, 2025

International Centre for Interdisciplinary Science and Education

Quy Nhon, Viet Nam

AGENDA

Time: November 24th – November 28th, 2025

Venue: International Centre for Interdisciplinary Science and Education (ICISE), Quy Nhon, Gia Lai, Vietnam

GENERAL AGENDA (Weekly schedule)

Monday, November 24: Arrival of most participants

15h30–19h00: Registration open at Seagull Hotel

Friday, November 28: Departure of most participants

Time	Activity
8:00	BUS leaving Seagull Hotel for ICISE
Tuesday 8:15–8:30 8:30–9:15 9:15–10:00	 Registration (continue) Opening Ceremony and Group Photo Keynote presentation (Prof. Phan Van Tan)
Wednesday–Thursday 8:30–10:00	 Keynote presentations
Friday – Saturday 8:30–10:00	 Special training session
10:00 – 10:30	Coffee break
10:30 – 12:00	Parallel Sessions
12:00 – 14:00 (**except Wednesday**) 12:00 – 13:30 (**Wednesday**)	LUNCH
14:00 – 15:30 (**except Wednesday**) 13:30 – 15:30 (**Wednesday**)	Parallel Sessions **POSTER Sessions** (except Special Session S8)
15:30 – 16:00	Coffee break
16:00 – 17:30	Parallel Sessions
18:00 – 19:00 (**until 20:00 on Tuesday for the banquet**)	DINNER (BANQUET on Tuesday)
19:00 (or 20:00 on Tuesday)	BUS leaving ICISE for Seagull Hotel

GENERAL AGENDA (Session Information)

Session	Time
Registration (continue)	Tuesday, 8:15–8:30
↖ **Plenary Session** (*Meeting room*: Conference Hall 1)	Tuesday - Thursday, 8:30–10:00
↖ **S1:** Solid Earth Sciences (*Meeting room*: Conference Hall 3)	Wednesday, 10:30–12:00 & 16:00–17:30 *Wednesday 13:30-15:30 (poster)*
↖ **S2:** Aquatic Sciences (*Meeting room*: Conference Hall 1)	Wednesday, 10:30–12:00 *Wednesday 13:30-15:30 (poster)* Thursday, 10:30–12:00
↖ **S3:** Advanced materials for sustainable environmental remediation (*Meeting room*: Conference Hall 3 - Tuesday Conference Hall 1 - Thursday)	Tuesday, 10:30–12:00 *Wednesday 13:30-15:30 (poster)* Thursday, 14:00–15:30
↖ **S4:** Biodiversity and Aquatic Resources (*Meeting room*: Conference Hall 4)	Tuesday, 10:30–12:00 *Wednesday 13:30-15:30 (poster)* Wednesday, 16:00–17:30
↖ **S5:** Hydrology and Water Resources (*Meeting room*: Conference Hall 4)	Tuesday, 14:00–15:30 Tuesday, 16:00–17:30 *Wednesday 13:30-15:30 (poster)* Wednesday 16:00-17:30
↖ **S6:** Remote Sensing and Applications (*Meeting room*: Conference Hall 3)	Tuesday, 16:00–17:30 *Wednesday 13:30-15:30 (poster)*
↖ **S7:** Emerging technologies & Interdisciplinary topics (*Meeting room*: Conference Hall 3 – Tuesday Conference Hall 4 - Wednesday)	Tuesday, 14:00–15:30 *Wednesday 13:30-15:30 (poster)* Thursday, 10:30–12:00
↖ **Special Session S8:** Natural Radioactivity in the Environment (*Meeting room*: Conference Hall 3)	Thursday, 10:30–12:00 & 14:00–15:30

	(Posters for this session are organized within the session itself; therefore, please put up your poster in the session room on Thursday morning)
↖ **Special Session S9:** Atmospheric Sciences and Regional Climate (*Meeting room*: Conference Hall 1)	Tuesday, 10:30–12:00, 14:00–15:30, 16:00–17:30 *Wednesday 13:30-15:30 (poster)* Wednesday, 16:00–17:30
↖ **Special Session S10:** Asia Climate Risk and Impact Strategic Workshop zoom (*Meeting room*: Conference Hall 2)	Tuesday–Thursday, 10:30–12:00 Tuesday–Thursday, 14:00–17:30
Special Training: the regional coupled modelling system (RegCM-SYMPHONIE) *Meeting room*: Conference Hall 4 (Thursday); Conference Hall 2 (Friday and Saturday)	Thursday, 10:30–12:00 & 14:00–17:30 Friday, 9:00–12:00 & 14:00–17:30 Saturday, 9:00–12:00 & 14:00–17:30

PLENARY SESSION

Meeting room: Conference Hall 1

Tuesday, November 25th

***Chair: Assoc. Prof. Ngo Duc Thanh**, University of Science and Technology of Hanoi*

Time	Title	Presenter
8:30 – 9:15	Welcoming remarks	**Assoc. Prof. Ngo Duc Thanh** *Chairman of the Scientific Committee*
	Welcoming remarks: ICISE	**Dr. Nguyen Huu Ha** *Deputy Director, Department of Science and Technology, Gia Lai province*
	Opening remarks: USTH	**Assoc. Prof. Tran Dinh Phong** *Vice Rector, University of Science and Technology of Hanoi*
	Opening remarks: from Special Session Asia Climate Risk and Impact Strategic Workshop	**Dr. Irene Lake** *Swedish Meteorological and Hydrological Institute*
	Group photo	
9:15 – 10:00	**Keynote:** Recent Advances to Future Pathways in Climate Studies in Southeast Asia	**Prof. Phan Van Tan** *VNU University of Science*

Wednesday, November 26th

***Chair: Dr. Do Xuan Hong**, Nong Lam University - HoChiMinh City*

8:30 – 9:15	**Keynote:** Innovative technologies for coastal monitoring	**Prof. Marco Abbiati** *Alma Mater Studiorum University of Bologna (currently the Science and Technology Counsellor at the Embassy of Italy to Vietnam)*
9:15 – 10:00	**Keynote:** Volcanism in Vietnam: the cause and the signification	**Assoc. Prof. Nguyen Hoang** *Institute of Earth Sciences, Vietnam Academy of Science and Technology*

Thursday, November 27th

***Chair: Dr. Tran Nguyen Hai**, Duy Tan University*

8:30 – 9:15	**Keynote:** Recycled Construction and Demolition Waste (CDW) for decentralized domestic wastewater treatment and resource recovery	**Prof. Tran Thi Viet Nga** *Faculty of Environmental Engineering, Hanoi University of Civil Engineering (HUCE)*
9:15 – 10:00	**Keynote:** Dimensions of Water Management in Extractive Industries	**Prof. Petra Schneider** *University of Applied Sciences Magdeburg-Stendal, Germany*

S1: SOLID EARTH SCIENCES

Meeting room: Conference Hall 3

***Convener: Nguyen Thuy Duong**, VNU University of Science, Vietnam*

Wednesday 10:30–12:00	**Parallel Session S1: Solid Earth Sciences** *Meeting Room*: Conference Hall 3 ***Chair: Duong Nguyen-Thuy**, VNU University of Science, Hanoi, Vietnam*	
10:30–11:00	An introduction to the new 1:1,000,000-scale geological and georesources map of Vietnam and the adjacent sea areas with a summary of its explanatory book	**Tri Van Tran** *Vietnam Union of Geological Sciences*
11:00–11:20	Updated U-Pb Zircon Ages Reveal Late Magmatic Pulse of the Emeishan Large Igneous Province in NW Vietnam	**Thuy Thanh Pham** *VNU University of Science, Ho Chi Minh City*
11:20–11:40	Multiscale High-Resolution Fault Zone Imaging Using Broadband Seismic Array and Distributed Acoustic Sensing (DAS) Data.	**Long Vinh Ha** *Institute of Earth Sciences, Academia Sinica, Taiwan*
11:40–12:00	Methodology and Evaluation of Local Magnitude (ML) Calculation for Northern Vietnam	**Bang Van Phung** *Department of Earth Science, National Central University, Taiwan*
Wednesday 16:00–17:00	**Parallel Session S1: Solid Earth Sciences** *Meeting Room*: Conference Hall 3 ***Chair: Duong Nguyen-Thuy**, VNU University of Science, Hanoi, Vietnam*	
16:00–16:20	Expanding the Paleoclimate Archive of Biển Hồ Maar Lake (Central Highlands, Vietnam): New Deep Core and Implications for ICDP-Level Drilling	**Huong Nguyen-Van** *VNU University of Science, Hanoi, Vietnam*
16:20–16:40	Collapse of underground galleries in gold-panning mines: Perception of stakeholders in the Doko Sub-Prefecture, Siguiri Prefecture, Republic of Guinea	**Ahmed Amara Konate** *Institut Supérieur des Mines et Géologie de Boké, Guinea*
16:40–17:00	The long-term impacts of catchment dynamics on water reservoirs: a case from a tropical lake - Ba Be lake in Vietnam	**Duong Nguyen-Thuy** *VNU University of Science, Hanoi, Vietnam*

Poster Presentation: S1: Solid Earth Sciences **Wednesday,** 13:30–15:30		**Poster code**
Tectono-magmatic evolution and mineral geochemistry of Late Permian to Early Oligocene granitic rocks from the Phan Si Pan Uplift and Tu Le Basin, NW Vietnam	**Thuy Thanh Pham** *Vietnam National University, University of Science, Ho Chi Minh City*	**S1.1**

S2: AQUATIC SCIENCES

Meeting room: Conference Hall 1

***Convener: Hoang Thi Thu Huong**, Hanoi University of Science and Technology -HUST)*

Wednesday 10:30–12:10	**Parallel Session S2 (1): Aquatic Sciences** *Meeting room:* Conference Hall 1 ***Chair: Hoang Thi Thu Huong**, Hanoi University of Science and Technology – (HUST), Vietnam*	
10:30–10:50	Ammonium Isotope Analysis for Low-Concentration Environmental Waters: Application to Hot Springs for Tracing Ammonium Contamination Sources	**Phùng Thị Lan Anh,** *University of Yamanashi, Japan*
10:50–11:10	Spatial Patterns and Characteristics of Dissolved Organic Matter along the Vietnamese Coast	**Dương Thị Quỳnh Mai,** *University of Science and Technology of Hanoi*
11:10–11:30	Bacterial Community Dynamics on Microplastic Surfaces: An In-Situ Investigation in the Mangrove Forest and Aquaculture Systems, Nam Dinh, Vietnam	**Vo Hoai Hieu,** *Phenikaa University*
11:30–11:50	Effectiveness of persulfate-catalyzed electrochemical oxidation for per-/polyfluoroalkyl substances (PFAS) removal toward safe drinking water	**Dao Van Tri** *Vietnamese-German University*
11:50–12:10	Seasonal variation and potential environmental risk of pharmaceutical residues in West Lake and Yen So Lake, Hanoi	**Phung Ngoc Phuong Linh,** *University of Science and Technology of Hanoi*
Thursday 10:30–12:30	**Parallel Session S2 (2): Aquatic Sciences** *Meeting room:* Conference Hall 1 ***Chair: Hoang Thi Thu Huong**, Hanoi University of Science and Technology – (HUST), Vietnam*	
10:30–10:50	Water reuse and recycling in Vietnam: Current status and challenges	**Hoang Thi Thu Huong,** *Hanoi University of Science and Technology (HUST)*
10:50–11:10	Characterizing Mekong and Redriver plume dynamics using recent remote sensing and in situ data	**Alexei Sentchev** *Univ. Littoral Cote d'Opale, France*
11:10–11:30	Modelling framework for marine plastic dispersion in tropical regions: toward the evaluation of uncertainties and exposure of coastal ecosystems	**Lisa Weiss** *LEGOS, Research Institute for Development (IRD)*
11:30–11:50	AI-Empowered IoT Acoustic Platform (WI.Plat) for Non-Revenue Water Reduction: A Field Pilot in Hai Duong, Vietnam	**Vo Duy Quy** *Vietnamese German University (VGU), Vietnam*

11:50–12:10	Effects of Macrophyte, Phytoplankton and Periphyton Dynamic on Eutrophication: Quebec Shallow lakes Assessment and Control Perspectives	**Nguyen Thi Thu Ha** *Hanoi University of Science and Technology*

Poster Presentaion: S2: Aquatic Siences **Wednesday,** 13:30–15:30		Poster code
Fluorescence-based characterization of dissolved organic matter (DOM) in Estonian surface and groundwater	**Nguyen Hoang Anh Chu** *Institute of Ecology, Tallinn University*	S2.1
Distribution and characteristic of microplastics in municipal and industrial wastewater treatment plants in Southern Vietnam	**Nguyen Thi Nhan** *Vietnamese-German University, Vietnam*	S2.2
Microplastics as Vectors of Antibiotic Resistance Genes in Urban Rivers: Evidence from Hanoi	**Dung Pham My** *Phenikaa University*	S2.3
Rapid Formation of Aerobic Granular Sludge under Feast–Famine Conditions in SBR: Evaluation of Powdered Activated Carbon (PAC)	**Tran Thi Thai Hang** *Vietnamese-German University*	S2.4

S3: ADVANCED MATERIALS FOR SUSTAINABLE ENVIRONMENTAL REMEDIATION

Meeting room: Conference Hall 3

Convener: Tran Nguyen Hai, *Duy Tan University*

Tuesday 10:30–12:10	**Parallel Session S3 (1): Advanced materials for sustainable environmental remediation** *Meeting room: Conference Hall 3* ***Chair: Tran Nguyen Hai,*** *Duy Tan University, Vietnam*	
10:30–10:50	Chitosan-based hydrogel capsules reinforced with nanomaterials for water treatment	**Tran Nguyen Hai** *Duy Tan University, Vietnam*
10:50–11:10	Integrated MBBR–photocatalysis system for textile dye degradation: a circular economy approach to overcome single-stage treatment limitations	**Vishav Kant** *Birla Institute of Technology and Science, United Arab Emirates*
11:10–11:30	Sensitivity analysis of geochemical parameters on porosity reduction in permeable reactive barrier–aquifer systems using THMC software	**Nguyen Thi Tuyet Han** *National Central University, Taiwan*
11:30–11:50	Pseudomonas putida–TiO_2 nanobio-conjugate immobilized in bacterial cellulose nanopaper for sustainable textile wastewater remediation	**Alok Pandya** *Gujarat Technological University, India*
11:50–12:10	Research on treating exhaust gases that contain aromatic VOCs (benzene and toluene) from waste tire pyrolysis systems	**Tran Thi Thu Hien** Quy Nhon University, *Vietnam*
Thursday 14:00–15:40	**Parallel Session S3 (2): Advanced materials for sustainable environmental remediation** *Meeting room: Conference Hall 1* ***Chairman: Tran Nguyen Hai,*** *Duy Tan University, Vietnam*	
14:00–14:20	Electrochemical treatment of microplastics in wastewater using novel fabricated Ti/SnO_2-Nb_2O_5 mesoporous electrodes	**Tran Le Luu** *Vietnamese German University, Vietnam*
14:20–14:40	Assessment of heavy metal accumulation in plant leaves and soil in selected areas within Adamson University, Manila, Philippines	**Joan Sta.Ana Awingan** *Adamson University, Philippines*

Poster Presentation S3: Advanced materials for sustainable environmental remediation Wednesday: 13:30-15:30		Poster code
Bismuth-modified biochar for efficient removal of environmental pollutants	**Luong-Pham Tang Cat** *Ho Chi Minh City University of Technology, Vietnam*	**S3.1**
Small-pore pure zeolite membranes for CO_2/CH_4 separation: a comprehensive review	**Truong Thi Truc Quyen** *University of Science, VNU-HCM, Vietnam*	**S3.2**
Fabrication of chitosan membranes derived from *Aspergillus niger* for the removal of heavy metals (chromium and iron) in wastewater	**Vo Hoang Duy** *University of Science, VNU-HCM, Vietnam*	**S3.3**

SESSION 4: BIODIVERSITY AND AQUATIC RESOURCES

***Convener: Girley S. Gumanao**, Davao del Norte State College, Philippines*

Tuesday 10:30-12:00	**Parallel Session S4: Biodiversity and Aquatic Resources** *Meeting Room: Conference Hall 4* ***Chair: Girley S.Gumanao, Davao del Norte State College***	
10:30-10:45	Species Diversity of Ants (Hymenoptera: Formicidae) in Barangay Malapad, Municipality of Real, Quezon, Philippines	**Ramon Antonio Agting Manalo** *Adamson University, Manila City, Philippines*
10:45-11:00	Distribution of Medically-Important Parasites and Species Diversity of Anurans Captured From the Selected Areas in Davao City, the Philippines	**Rauline Kayle P. Sabandal** *University of the Immaculate Conception, Davao City, Philippines*
11:00-11:15	The Impact of the Invasive Anuran *Rhinella marina* on the diet of endemic Philippine anurans: A local study in Davao City, Philippines	**Marian Dara T. Tagoon** *Central Mindanao University, Philippines*
11:15-11:30	Pagbantay Pigagikanan sang allug: Characterization of Baguan Headwater Watershed in Tarragona, Davao Oriental, basis for enhanced protection and management plan	**Elsa May Delima-Baron** *San Pedro College, Davao City, Philippines*
11:30-11:45	System Dynamics Modelling of the Carbon Storage Potential of a Mangrove Stand in Macajalar Bay, Misamis Oriental, Philippines	**Nezel Ann Lomoljo-Bantayan** *Davao del Norte State College, Philippines*
11:45-12:00	Diversity and Records of Mangrove Crabs (*Crustacea: Brachyura*) in Siargao Island, Philippines	**Nickel Jean S. Lagare-Sastine** *Davao del Norte State College, Philippines*
Wednesday 16:00-17:30	**Parallel Session S4: Biodiversity and Aquatic Resources** *Meeting Room: Conference Hall 4* ***Chair: Girley S.Gumanao, Davao del Norte State College***	
16:00-16:20	The Filtration Capacity of the Invasive Charru Mussel (*Mytella strigata*): Implications for Biofiltration in Philippine Waters	**Marjho Mae S. Cardoza** *University of Science and Technology of Southern Philippines, Philippines*
16:20-16:40	*Dischistodus perspicillatus* Behavior and Interaction with other Marine Species	**Kristine Joy S. Gumanao** *Davao del Norte State College, Philippines*
16:40-17:00	Community Structure of Reef Fishes in Artificial and Natural Reefs in Adecor Samal Island, Philippines	**Huyen Anh Vu** *University of Science and Technology of Hanoi, Hanoi, Vietnam*
17:00-17:20	Diet Composition and Feeding Behavior of *Protoreaster nodosus* (Linnaeus, 1758) in Samal Island, Philippines	**Anselmo G. Anobong Jr.** *Davao del Norte State College, Davao del Norte, Philippines*

17:20-17:40	Giant Clam, *Tridacna spp.* Restocking in Mindanao Island, Philippines	**Girley S. Gumanao** *Davao del Norte State College, Davao del Norte, Philippines*

Poster Presentation: S4 Biodiversity and Aquatic Resources **Wednesday: 13:30-15:30**		**Poster code**
High-Throughput Sequencing of Meiofaunal Community In Lake Apo, Bukidnon, Philippines Using 28S rRNA Gene	**Giselle B. Ramos** *North Eastern Mindanao State University, Tandag City, Surigao del Sur, Philippines*	**S4.1**
Morphological Characteristic and Taxonomic Composition of Marine Gastropods in The Intertidal Zones in Tandag City, Surigao Del Sur, Philippines	**Veronica B. Tañan** *North Eastern Mindanao State University, Tandag City, Surigao del Sur, Philippines*	**S4.2**
Diversity and Abundance of Echinodermata in Selected Areas of the Intertidal Zone in Marihatag, Surigao Del Sur	**Sherwin S. Sevilla** *North Eastern Mindanao State University, Tandag City, Surigao del Sur, Philippines*	**S4.3**
Optimizing Nutrient and Light Regimes for Shrimp Pond Wastewater Treatment by Spirulina platensis in High-Rate Algal Ponds (HRAPs)	**Trần Huy Nhơn** *University of Science, Ho Chi Minh City (VNU-HCM)*	**S4.4**
End-to-End Artificial Intelligence of Things (AIoT) Network for Salinity Monitoring: Predictive and Fault-Tolerant Capabilities	**Nguyen Gia Khiem** *Vietnamese-German University*	**S4.5**

S5: HYDROLOGY AND WATER RESOURCES

***Convener: Do Xuan Hong**, Nong Lam University - HoChiMinh City)*

Tuesday **14:00 – 15:30**	**Parallel Session S5 (1): Hydrology and Water Resources** *Meeting room:* Conference room 4 ***Chair: Dr. Do Xuan Hong**, Nong Lam University - Ho Chi Minh City (NLU)*	
14:00 – 14:20	The Effect of Upstream Variation, Climate Change, Sea Level Rise, and Overexploitation on the Groundwater Resource in Vietnamese Mekong Delta	**Duong Tran Anh** *Van Lang University*
14:20 – 14:40	Leveraging Remotely-sensed Soil Moisture Products for Global Drought Prediction and Planning	**Nguyen Tran Nhan Duc** *University of Virginia*
14:40 – 15:00	Interpretable AI for Flood Process Attribution and Prediction in Indian Catchments under Climate and Anthropogenic Influence	**Vaibhav Tripathi** *Indian Institute of Technology Roorkee*
15:00 – 15:20	UNESCO Indicators-based Flood Vulnerability Assessment in Nabunturan, Davao De Oro	**Princess Jade C Cajano** *Davao del Norte State College*
Tuesday **16:00 – 17:30**	**Parallel Session S5 (2): Hydrology and Water Resources** *Meeting room:* Conference room 4 ***Chair: Dr. Do Xuan Hong**, Nong Lam University - Ho Chi Minh City (NLU)*	
16:00 – 16:20	Combination Treatment Processes of Chitin Production Wastewater Containing High Salinity from Shrimp Scraps	**Tran Nguyen Van Nhi** *Institute of Biotechnology and Environment*
16:20 – 16:40	The Robust Role of Petrophysical Relationships in Quantifying Salinity in Heterogeneous Coastal Aquifers	**Công Thị Diệp** *Vietnamese Institute of Geosciences and Mineral Resources*
16:40 – 17:00	Water Quality Dynamics of Basai Wetland: Seasonal Analysis of Heavy Metals and Physicochemical Parameters	**Sushma** *Guru Gobind Singh Indraprastha University*
17:00 – 17:20	Surrogate Model Development for Groundwater Multispecies Contaminant Transport Using Machine Learning	**Nguyễn Thị Thu Uyên** *National Central University*
Wednesday **10:30 – 12:00**	**Parallel Session S5 (3): Hydrology and Water Resources** *Meeting room:* Conference room 4 ***Chair: Dr. Do Xuan Hong**, Nong Lam University - Ho Chi Minh City (NLU)*	
10:30 – 10:50	Application of Remote Sensing and Machine Learning for Monitoring Saltwater Intrusion in River Branches of the Lower Vietnamese Mekong Delta, Vietnam	**Le Van Quyen** *Vietnamese German University*

10:50 – 11:10	Climate Change, Flooding, and Agricultural Vulnerability: Predicting Economic Losses of Rice Production in the North Central Vietnam	**Phạm Quý Giang** *Ha Long University*
11:10 – 11:30	Levee Detection from High-Resolution Digital Elevation Models for Global River Modeling Applications	**Do Ngoc Khanh** *Shibaura Institute of Technology*
11:30 – 11:50	Solar radiation modification: potential impacts over the Global South	**Do Xuan Hong** *Nong Lam University - Ho Chi Minh City*

Poster Presentation: S5 Hydrology and Water Resources **Wednesday, 13:30-15:30**		**Poster code**
Assessing the impact of Stratospheric Aerosol Injection on Extreme Precipitation in Lam Dong Province Using Downscaled Climate Projections	Nguyen Dang Xuan Hien *Nong Lam University – Ho Chi Minh City*	**S5.1**
Advancing Decision Support Systems and Integrated Water Resources Management for Climate Adaptation in Northern and North Central of Viet Nam	Nguyen Thuy Tien *Vietnam Academy for Water Resources*	**S5.2**
Per- and Poly-fluoroalkyl (PFAS) Pollution in Groundwater in The Urbanized Area: A Case Study from Binh Duong Province, Vietnam	Huỳnh Đỗ Hiếu Như *Vietnamese-German University*	**S5.3**
Development of an Extreme Rainfall and Flood Analysis Method Integrating Meteorological and Hydrological Models: A case study of Da River Basin	Trần Phương Anh *Vietnam Academy for Water Resources*	**S5.4**
Assessing the Impacts of Climate Changes on Hydrological Regime at Ba River Basin Using CMIP6 Data	Nguyen Ba Thanh Son *Nong Lam University – Ho Chi Minh City*	**S5.5**
Short-term Inflow Forecasting Based on The Coupled Model (WRF – WEHY) for Hydropower Reservoir Operation: A Case Study in Da River Basin	Nguyen Thi Thu Thao *Vietnam Academy for Water Resources*	**S5.6**
Can The Capacity and Operation Rules of Multipurpose Reservoirs in Ba River Basin Cope with Future Flood Events?	Tran Ngoc Vinh *University of Michigan, Ann Arbor*	**S5.7**

S6: REMOTE SENSING AND APPLICATIONS

***Convener: Tong Si Son**, University of Science and Technology of Hanoi, USTH)*

Tuesday **16:00 – 17:30**	**Parallel Session S6 (1): Remote Sensing and Applications** *Meeting room:* Conference Hall 3 ***Chair: Tong Si Son,*** *University of Science and Technology of Hanoi (USTH)*	
16:00 – 16:15	Blue Space and Urban Heat Mitigation: Assessing Cooling Effect of Pond System	**Nguyen Quang Viet** *University of Sciences, Hue University, Vietnam*
16:15 – 16:30	Urbanization, Vegetation, and Soil Carbon Nexus: Remote Sensing and Ground-Based Insights from South Delhi, India	**Tanu Prakash** *Guru Gobind Singh Indraprastha University, India*
16:30 – 16:45	Machine Learning models for Flood Susceptibility Mapping: Case Study in Danang city	**Nguyen Van An** *University of Science and Education, The University of Danang, Vietnam*
16:45 – 17:00	Analysis Of Blue Carbon Potential in Mangrove Ecosystems of Bulu Hadik Village, Simeulue Island, Indonesia Using the Mangrove Vegetation Index Algorithm	**Nazli Raudhati** *IPB University, Indonesia*
17:00 – 17:15	Object-Based Machine Learning Classification For Plastic Greenhouses Indentification Using Planetscope Images: A Case Study In Da Lat, Vietnam	**Nguyen Ngoc Tuyen Nguyen** *Ngoc Tuyen VNUHCM-University of Science, Vietnam*
17:15 – 17:30	Vegetation Investigation Using UAV Imagery in Vietnam	**Tong Si Son** *University of Science and Technology of Hanoi (USTH), Vietnam*

Poster Session S6: Remote Sensing and Applications Wednesday, 13:30-15:30		Poster code
NDWI-based Monitoring of Riverbank Dynamics and Community Exposure in Phu Tho province, Northern Vietnam	**Minh Nguyen** *Hanoi School of Business and Management, VNU, Vietnam*	S6.1
Integration Of Unmanned Aerial Vehicles (Uavs) For Riverbank Erosion Assessment: A Case Study In Mỹ Xương Area, Đồng Tháp Province	**Vo Duy Quy** *Vietnamese German University (VGU), Vietnam*	S6.2
Performance assessment and Random Forest-based merging of Satellite Precipitation Products for hydrological applications in the Ba River basin	**Ly Tuan Minh** *Vietnam Academy of Water Resources, Vietnam*	S6.3
Comparative Evaluation of AHP and Advanced Machine Learning Models for Delineating Groundwater Potential Zones in Southern region of Delhi, India	**Deepanshi Tanwar** *Guru Gobind Singh Indraprastha University, India*	S6.4
High accuracy tea crop productivity estimation using UAV multispectral data	**Nguyen Hoang Long** *University of Science and Technology of Hanoi (USTH), Vietnam*	S6.5
Land use and land cover prediction using the Ca-Markov model in the Kon and Kylo river basins, South Central Coast Vietnam	**Phan Van Tho** *QuyNhon University*	S6.6

S7: EMERGING TECHNOLOGIES & INTERDISCIPLINARY TOPICS

***Convener: Ngo Duc Thanh**, University of Science and Technology of Hanoi (USTH)*

Tuesday **14:00 – 15:30**	**Parallel Session S7 (1): Emerging technologies & Interdisciplinary topics** *Meeting room:* Conference room 3 ***Chair: Tran Ba Quoc**, Duy Tan University*	
14:00 – 14:17	Towards an Integrated Fisheries Information System: Bridging Monitoring and Ecosystem-Based Management	**Anna Camille Conchon** *Collecte Localisation Satellites, France*
14:17 – 14:34	Machine learning-enhanced bioassay for accurate identification of salinity interference in freshwater toxicity assessment	**Duc Viet Nguyen** *School of Chemistry and Life Science, Hanoi University of Science and Technology*
14:34 – 14:51	A laboratory study effect of biotic and abiotic factors on cesium uptake and excretion in Asian Green Mussels (perna viridis)	**Duong Van Hao** *School of Interdisciplinary Sciences and Arts, Vietnam National University*
14:51 – 15:08	Source identification and quantification of potential toxic elements in urban road dust by Positive Matrix Factorization with integrated correlation and cluster analyses	**Tran Ba Quoc** *Duy Tan University*
15:08 – 15:25	Formation of Anaerobic Digestion Inhibitors During Thermal Hydrolysis of Primary and Waste Activated Sludge Mixtures	**Ngô Phương Linh** *Nha Trang University*
Thursday **16:00 – 17:30**	**Parallel Session S7 (2): Emerging technologies & Interdisciplinary topics** *Meeting room:* Conference room 4 ***Chair: Tran Anh Quan**, Hanoi University of Mining and Geology (HUMG)*	
16:00 – 16:15	Blue economy and the law: legal challenges for the sustainable marine biodiversity and use of aquatic resources in ASEAN	**Sushil Goswami** *Gujarat National Law University, India*
16:15 – 16:30	Total Economic Value Assessment of the Dong Van Karst Plateau UNESCO Global Geopark	**Nguyen Thi Oanh** *School of Interdisciplinary Studies and Arts, Vietnam National Univesity, Hanoi*
16:30 – 16:45	Value chain analysis of medicinal plants in Geoparks: Livelihoods of ethnic minorities	**Trinh Phuong Ngoc** *Tan Trao University*

	based on non-timber forest products (NTFPs) in Vietnam	
16:45 – 17:00	Tech Meets Ecology: Leveraging AI for Environmental Justice and Accountability in India	**Heena Goswami** *Gujarat National Law University, India*
17:00 – 17:15	First Investigation of Airborne Microplastics in Hanoi, Vietnam	**Thanh Nguyen Viet** *University of Sciences - Vietnam National University, Hanoi*
17:15 – 17:30	Traditional Knowledge in Healthcare System and Biodiversity Conservation in Tribal Communities of Northeast India	**Tuisem Shimrah** *Guru Gobind Singh Indraprastha University, India*

Poster Session S7: Emerging technologies & Interdisciplinary topics **Wednesday, 13:30-15:30**		**Poster code**
Probabilistic Health Risk Assessment of Household Exposure to PAHs from Air-Conditioner Filter Dust in Ho Chi Minh City	**Pham Le Khanh Bao** *University of Science, Vietnam National University - Ho Chi Minh City*	**S7.1**
Agricultural waste-derived biochar improves nitrogen removal and mitigates fouling in membrane bioreactor treating brackish aquaculture wastewater	**Duong Hoang Yen** *Vietnamese-German University*	**S7.2**
Carbon exchange dynamics and resource use efficiency of Cat Tien tropical forest: 10 years of eddy covariance flux tower observations	**Đỗ Phong Lưu** *Joint Vietnam-Russia Tropical Science and Technology Research Centre*	**S7.3**

SPECIAL SESSION S8:
NATURAL RADIOACTIVITY IN THE ENVIRONMENT

***Convener: Conrad Dorer**, Hochschule Magdeburg-Stendal, University of Applied Sciences, Germany)*

Thursday **10:30 – 12:00**	**Special Session S8 (1): Natural Radioactivity in the Environment** *Meeting room:* Conference room 3 ***Chair:*** **Conrad Dorer** *University of Applied Sciences Magdeburg-Stendal, Germany*

	Time	Presenter	Type	Title	Topic in one sentence
Round 01	10:30	Chair		**Introduction to the session**	
	1.1 - Regulatory Framework - NORM				
	10:30	**Dr. Huyen Thi Le (Vietnam)**	oral	Management of NORM waste from rare earths mining and processing in Vietnam: a potential governance pathway	The study argues that, as Vietnam plans to expand its rare earth sector, it urgently needs a comprehensive legal and regulatory system for the safe and effective management of NORM waste, and that practical elements from Australia, France, and the UK can be adopted to achieve this.
	10:50	**Dr. Ariel Humphrey (France-USA)**	oral	Updated legal and regulatory framework for Naturally Occurring Radioactive Materials (NORMs) in France: a review	2025 review of France's NORM regime—strong EU-aligned controls and ICPE integration, but gaps in land-use planning, transparency, and sector guidance—set against the ASN/IRSN merger into ASNR.
	1.2 - Poster session #1: Case Studies				
	11:10	**Msc. Ilsa Rosianna (Indonesia)**	Poster **S8.1**	Radiological Assessment from External Exposure: A Case Study at Tin Smelter in Bangka, Indonesia	We quantify external exposure along the tin smelting process: slag areas dominate dose rates, materials exceed 1 Bq/g for U-238/Th-232, and calculated worker doses remain under regulatory limits but still call for control measures.
	11:15	**Ms. Saowarak Musikawan (Thailand)**	Poster **S8.2**	Determination of 210Po in Foodstuffs Consumed at a Former Tin Mining Area in Thailand	We measured 210-Po in foods eaten near a former tin mine in Thailand and found markedly higher levels in seafood—especially squid and shrimp—driving the highest ingestion doses (up to ~5.3 mSv/year).
	1.3 - Environmental radioactivity and radon measurements (including poster session #2)				

	11:20	**Assoc. Prof. Chutima Kranrod (Thailand)**	Poster **S8.3**	Calibration of Passive Radon Progeny Monitors Using CR-39 Detectors: Evaluation of Conversion Factors in Indoor and Controlled Environments	We test a simple radon-progeny detector (CR-39) and set the "conversion numbers." These numbers change a lot in different places—because tiny ^{218}Po particles stick more to the detector—so each place needs its own calibration.
	11:25	**MSc. Do Thi Thu (Vietnam)**	Poster **S8.4**	Characterization of Radon level in soil gas in Cam Loc Mine of Khanh Hoa Province, Vietnam and a decline in indoor radon concentrations after none- exploitation of granite	Cam Loc before–after study: soil-gas mapping and indoor surveys show that after granite mining stopped, indoor radon fell to within Vietnamese and U.S. EPA limits.
	11:30	**Dr. Eka Djatnika Nugraha (Indonesia)**	oral	Nationwide Survey of Environmental Radioactivity in Indonesia	Indonesia's first nationwide baseline (2004–2024): 4,413 sites in 32 provinces mapped for ambient dose and soil radionuclides, revealing high natural radiation areas (e.g., Mamuju) to guide health policy and UNSCEAR reporting.
		Chair		Final Words Round01	

Thursday 14:00 – 15:30	**Special Session S8 (2): Natural Radioactivity in the Environment** *Meeting room:* Conference room 3 ***Chair:*** **Conrad Dorer** *University of Applied Sciences Magdeburg-Stendal, Germany*			
Round 02	**2.1 - Experiences from practice: Sampling & Remediation**			
14:00	**Dr. Christian Kunze (Germany)**	oral	Towards an adequate characterisation of NORM	This talk argues that practitioners (and regulators) should prioritize the physical-chemical understanding and sampling-led characterization of NORM over rule subtleties to avoid misinterpretation and misguided risk.

	14:20	**Mr. Lars Uhlig (Germany)**	oral	Remediation of Uranium Legacy Sites in Uzbekistan	Decades-old uranium legacies at Yangiabad and Charkesar were risk-assessed and, with EC/EBRD support, remediated in 2023–2025—sealing openings, stabilizing wastes, and cutting radiological and geotechnical risks while building local capacity.
	2.1 - Re-use and management NORM residues: the case of heavy mineral sands				
	14:40	**Dr. Nguyen Ba Tien (Vietnam)**	oral	Management and Reuse of NORM Wastes in Vietnam: A Case of Titanium Mining and Processing	Vietnam case study: status, legal framework, monitoring data, and concrete options to reuse NORM wastes from titanium sands—balancing radiological risks with circular-economy opportunities.
	15:00	**MSc. Conrad Dorer (Germany)**	oral	Re-use of NORM residues from Vietnam's heavy mineral sands: RENO-TITAN's approach and transferable lessons	RENO-TITAN maps the full radionuclide balance of Vietnam's heavy-mineral-sands chain and pilots reuse/disposal under national criteria to enable safe, circular valorisation of NORM residues—offering transferable lessons to other sectors.
		Chair		Final Words, short feedback round with participants	

SPECIAL SESSION S9:
ATMOSPHERIC SCIENCES AND REGIONAL CLIMATE

***Conveners: Ngo Duc Thanh**, USTH; **Faye Cruz**, Manila Observatory*

This session is dedicated to honoring the 70th anniversary of Professor Phan Van Tan, a leading climate and meteorological scientist in Vietnam's atmospheric sciences community

Tuesday **10:30 – 12:00**	**Special Session S9 (1): Atmospheric Sciences and Regional Climate** *Meeting room:* Conference room 1 ***Chair: Ngo Duc Thanh**, USTH*	
10:30– 10:45	***Opening speech of the session*** - ***Representative of VNU University of Science*** - ***Representative from former students***	
10:45 – 11:05	Ways to improve sub-seasonal to seasonal weather forecasting for Vietnam to strengthen early warning	**Andreas H. Fink** *Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany*
11:05 – 11:25	Sensitivity of CCAM climate simulations to aspects of cumulus parameterization	**John McGregor** *CSIRO Environment, Australia*
11:25 – 11:45	Hydro-Meteorological Forecasting for Water Management and Disaster Risk Reduction	**Trinh Tuan Long** *Vietnam Academy for Water Resources*
11:45 – 12:05	Implication of Bias-correction on the Projected Changes of Rainfall Extremes over Southeast Asia	**Liew Ju Neng** *Universiti Kebangsaan Malaysia*
Tuesday **14:00 – 15:30**	**Special Session S9 (2): Atmospheric Sciences and Regional Climate** *Meeting room:* Conference room 1 ***Chair: Trinh Tuan Long,** Vietnam Academy for Water Resources*	
14:00 – 14:17	Performance Evaluation of RegCM5 in Long-term Simulation of Impacts of Rapid Urbanization on Vietnam's High-Urbanized Areas at Convection Permitting Scale	**Nguyen Xuan Thanh** *USTH, Vietnam Academy of Science and Technology*
14:17 – 14:34	Assessing Future Heat Stress in Vietnam using physically-based Wet-Bulb Globe Temperature and High-resolution downscaled projections	**Dzung Nguyen-Le** *Department of Space and Earth Sciences, University of Science and Technology of Hanoi*

14:34 – 14:51	Extended-range prediction of monsoon onset over Vietnam using ECMWF-S2S data and cluster analysis	**Bùi Minh Tuân** *Hanoi University of Science, Vietnam National University*
14:51 – 15:08	Increasing compound heat and precipitation extremes and population exposure in a warming Vietnam	**Nguyen Duy Tung** *REMOSAT research group*
15:08 – 15:25	Impacts of Rapid Urbanization on Cloud Activity in Greater Ho Chi Minh over the Past 30 Years	**Nobuyasu Suzuki (presented by Prof. Hiroyuki Kusaka)** *Graduate School of Science and Technology, University of Tsukuba, Tsukuba, Japan*
Tuesday **16:00 – 17:40**	**Special Session S9 (3): Atmospheric Sciences and Regional Climate** Meeting room: Conference Room 1 ***Chair: Liew Juneng**, Universiti Kebangsaan Malaysia*	
16:00 – 16:20	Intraseasonal to interannual variability of the South Vietnam upwelling and the roles of wind, tides, rivers and chaotic variability: a review	**Marine Herrmann** *LEGOS, IRD, France*
16:20 – 16:40	SEA4C: Southeast Asia 4-km Climate dataset: Historical Reanalysis and Future Projection	**Tianyuan Ma** *presented by* **Prof. Fei Chen** *HongKong University of Science and Technology*
16:40 – 17:00	Seasonal Forecasting for Northeast Brazil with a simple GCM	**Nicolas Hall** *LEGOS, IRD, France*
17:00 – 17:20	Warm Tropical South Atlantic in 2023-24 and Its Impacts on South American Rainfall	**Aubains Hounsou Gbo** *Federal University of Ceara - Brazil*
17:20 – 17:40	A Global First-Order Estimate of the Impact of Anthropogenic Heat on Urban Air Temperature	**Do Ngoc Khanh** *Shibaura Institute of Technology*
Wednesday **16:00 – 17:40**	**Special Session S9 (4): Atmospheric Sciences and Regional Climate** Meeting room: Conference Room 1 ***Chair: Jing Xiang Chung**, Faculty of Science and Marine Environment, Universiti Malaysia Terengganu*	
16:00 – 16:20	Simulating City Scale Heat and Rainfall Climatology in Greater Kuala Lumpur using HRLDAS LSP-DS and RegCM4-NH	**Jing Xiang Chung** *Faculty of Science and Marine Environment, Universiti Malaysia Terengganu*
16:20 – 16:40	Urban Impacts on Precipitation in the Greater Ho Chi Minh City Metropolitan Area, Vietnam	**Shun Hasebe** *Graduate School of Science and Technology, University of Tsukuba, Tsukuba, Japan*

16:40 – 17:00	Unveiling the first two years atmospheric bulk deposition of mercury in central urban megacity southern Vietnam: Fluxes, influencing factors and washout effect	**Nguyen Ly Sy Phu** *VNUHCM-University of Science*
17:00 – 17:20	Hospital-based study on health effects of ambient PM2.5 exposure in urban areas of Ho Chi Minh City, 2019–2021	**Tran Cong Thanh** *VNUHCM-University of Science*
17:20 – 17:40	Application of Microbial Technology for Mitigating Air Pollution and Odor in Poultry Production Facilities	**Pham Chau Thuy** *University of Engineering and Technology, Vietnam National University, Hanoi*

Poster Session S9: Atmospheric Sciences and Regional Climate **Wednesday, 13:30-15:30**		**Poster code**
Atmospheric size-resolved trace elements in urban and industrial areas in Southern Vietnam: potential source, respiratory deposition and health risk	**Le Quoc Hau** *University of Science, Vietnam National University - Ho Chi Minh City*	**S9.1**
Revealing the discrepancy in potential driving factors of particulate-bound mercury between urban and suburban sites in a southeast asian megacity using generalized additive model	**Nguyen Duc Thanh** *University of Science, Vietnam National University - Ho Chi Minh City*	**S9.2**
Metal Contents in Cassia fistula Leaves: The First Preliminary Study from a Southern Vietnam Megacity	**Nguyễn Thanh Trang** *Faculty of Integrated Sciences, Fulbright University Vietnam*	**S9.3**
Numerical hail forecast in Northwest Vietnam: A case study	**Đoàn Mạnh Duy** *VNU University of Science*	**S9.4**
Identifying the unique characteristics of Tropical Storm Ondoy (2009) relative to other landfalling tropical cyclones over Luzon	**Martein Angela G. dela Cruz** *Ateneo de Manila University*	**S9.5**
Heatwaves' variation in Southeast Asia in period of 1983-2014	**Pham Thi Ly** *Institute of Earth Science, Vietnam Academy of Science and Technology*	**S9.6**
Spatiotemporal Trends in hot days in the North Central and Central Coastal Regions of Vietnam (2010-2024)	**Ngo Thi Thanh Huong** *NCHMF, Vietnam Meteorological Hydrological Administration*	**S9.7**
Future warming effects on extreme rainfall in Metro Manila using a pseudo global warming approach	**Enrico Alejandro S. Taña** *Manila Observatory*	**S9.8**
Size distribution of atmospheric particulate matters and charateristed of different size particles bound-PAHs at an urban location in Ho Chi Minh City: Preliminary results	**Nguyen Duy Dat** *Ho Chi Minh City*	**S9.9**
Changes in Temperature and Rainfall Extremes in Vietnam under Progressive Global Warming Levels from 1.5ºC to 4ºC	**Tran Anh Quan** *Hanoi Universtiy of Mining and Geology*	**S9.10**

First Insights into Compound Drought–Heatwave Events in Vietnam: Historical Characteristics and ENSO Linkages	**Hoang Thi Minh** *Ministry of Agriculture and Environment*	**S9.11**
Novel and disappearing climates under different Global Warming levels	**Nguyễn Thị Tuyết** *REMOSAT group*	**S9.12**
Two Centuries of Regional Climate Extremes: Insights via Multi-Scale Dynamical Downscaling	**Tam Nguyen Ngoc Minh** *University of Science and Technology of Hanoi*	**S9.13**
A Hybrid Approach for Seasonal Rainfall Forecasting Across Vietnam Using Convolutional Neural Networks and Dynamical Downscaling	**Phu Nguyen Duc** *Faculty of Meteorology, Hydrology and Oceanography, VNU University of Science, Vietnam National University, Ha Noi*	**S9.14**
Application of multi-source data to study air pollution during dry season in Ho Chi Minh City: The role of long-range pollution transport	**Nguyen Thi Thanh Thao** *University of Science - VNUHCM*	**S9.15**
Climate Classification of the Philippines using APHRODITE Data: A Comparison of SOM, K-Means, and Two-Phase SOM	**Edward Kyle L. Badua** *Manila Observatory*	**S9.16**

SPECIAL SESSION S10:
ASIA CLIMATE RISK AND IMPACT STRATEGIC WORKSHOP

***Conveners: Irene Lake**, Swedish Meteorological and Hydrological Institute; Laura Burgin, UK Met Office; Faye Cruz, Manila Observatory*

Meeting room: Conference Room 2

25 November 2025 (Tuesday)	
Session 1: Introduction	
10:30 - 12:00	Introduction to workshop Talk on climate and ethics Group activity: self-introduction and expectation setting
12:00 - 14:00	LUNCH
Session 2: Stakeholder needs and priorities	
14:00-15:30	Short presentations and panel discussion with representatives from: • Health sector • Water sector • Food sector • Communities • Youth • Climate science/services
15:30-16:00	COFFEE BREAK
Session 3: Fostering multi-sectoral dialogue	
16.00-17.30	Group activity to discuss goals, challenges, opportunities and best practices per sector

26 November 2025 (Wednesday)	
Session 3: Fostering multi-sectoral dialogue (Continued)	
10.30-12.00	Group activity: Multi-sectoral breakout groups to discuss ways to connect and synergize efforts/initiatives
12:00 - 13:30	LUNCH
Session 4: Best practices and opportunities for collaboration	

13.30-14:30	Panel discussion: Best practices on developing training programmes, knowledge products
14:30-15.30	Funders' panel
15:30-16:00	COFFEE BREAK
Session 5: Ways forward	
16:00-17:30	Group activity to discuss next steps/products/training programmes to address user needs

27 November 2025 (Thursday)	
Session 6: Synthesis	
10.30-12.00	Discuss conclusions and main building blocks of the pilot project/s
12:00 - 14:00	LUNCH
Session 7: Drafting the pilot project	
14.00-15.30	Drafting pilot project details and define proposal writing group
15:30-16:00	COFFEE BREAK
16.00-17:30	Discussion on next steps

SESSION

PLENARY SESSION

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SESSION

SOLID EARTH SCIENCES

AN INTRODUCTION TO THE NEW 1:1,000,000-SCALE GEOLOGICAL AND GEORESOURCES MAP OF VIETNAM AND THE ADJACENT SEA AREAS WITH A SUMMARY OF ITS EXPLANATORY BOOK

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ABSTRACT

Vietnam and its adjacent marine areas contain a complex geological framework composed of seven major super-sequences spanning from the Archean to the Phanerozoic. Each super-sequence comprises stratigraphic units, magmatic and metamorphic rocks, and records of their tectonic and geodynamic settings.

(I) Meso–Neoarchean Super-sequence: Exposed in the Phan Si Pan sub-terrane, this sequence includes biotite gneiss and amphibolite intruded by tonalite-trondhjemite-granodiorite (TTG) granitoids, with U-Pb zircon ages of 2900–2835 Ma.

(II) Paleoproterozoic Super-sequence: Characterized by two-mica–kyanite schists hosting the Sin Quyen IOCG copper deposit, mainly exposed along the western margin of the Red River. It also includes granosyenite and metagabbro intrusions (2325–2295 Ma) in the Hoang Lien Son Range and amphibole–sillimanite–garnet gneiss in the Nui Con Voi area, both overprinting metamorphosed to amphibolite–granulite facies.

(III) Middle Meso–Neoproterozoic Supersequence: Composed of biotite–granite–sillimanite plagiogneiss and graphite-bearing crystalline schist (Pt2–Pt31), exposed between the Song Chay and Song Hong fault zones. The Posen Batholith, an I-type granite dated 762–758 Ma, is part of the Hoang Lien Son–Ailaoshan arc linked to subduction along the Proto-Tethys margin of the Yangtze craton.

(IV) Neoproterozoic–Silurian Supersequence: Northern exposures include metapelitic turbidites with minor garnet-amphibolite (Pt3–Є1), phosphorite-rich carbonates (Є1), and shelf to deep-marine turbidites (Є2–O1) with diverse benthic fossils. In the Vietnam–Laos terrane, greenschists, and amphibolites are common. The Hiep Duc ophiolite complex (518–500 Ma) includes basalt to dacite metavolcanic and terrigenous–siliciclastic turbidites. Associated granitoids include I-type granites (476–470 Ma) of arc affinity and S-type orogenic granites (450–443 Ma), reflecting the closure of the Proto-Tethys via dual subduction beneath the Kon Tum and Vietnam–Laos terranes. Upper Silurian units are limited in extent but contain brachiopods, corals, fish, and plants similar to those found in South China assemblages.

(V) Devonian–Middle Permian Supersequence: Lies disconformably atop older rocks and consists of terrigenous to carbonate–siliceous sediments, with fossiliferous horizons marking the Frasnian–Famennian boundary in central Vietnam and the Famennian–Tournasian transition in the northeast. The Song Ma ophiolite complex (360–335 Ma) records a Paleo-Tethyan oceanic branch. Carbonate-platform deposits (C1v–P1w) are widely spread along with carbonate–siliceous sequences, volcanic rocks (andesite–basalt–rhyodacite), and I-type granites (300–270 Ma) formed the Mekong magmatic arc.

(VI) Upper Permian–Middle Jurassic Supersequence: In the north, Emeishan-type basaltic flows and intrusions (258–253 Ma) associated with intracontinental rifts. They are overlain by coal-bearing paralic deposits containing Cathaysia flora, interbedded with bauxite and calcareous shales straddling the Permian–Triassic boundary. In the Kon Tum terrane, granulite-grade rocks dominate. In contrast, in the Vietnam–Laos terrane, S-type granites (258–248 Ma) are associated with the Indosinian orogeny and thrusting in the Truong Son belt. Post-orogenic sequences include terrigenous–carbonate rocks, rhyodacite, and granites (245–230 Ma). In the north, Upper Triassic to Middle Jurassic sediments are primarily composed of coarse clastics, with coal beds and abundant plant fossils. In contrast, marine deposition persisted in southern regions during the Jurassic.

(VII) Upper Jurassic–Quaternary Super-sequence: Includes Cretaceous coarse red clastic deposits and calc-alkaline volcanic–plutonic rocks (120–95 Ma), along with a 90 Ma dyke system—all components of the Da Lat Cretaceous magmatic arc. Paleogene units comprise potassic–alkaline volcanic and intrusive rocks (35–25 Ma) of limited extent. Eocene–Oligocene sediments are mainly deltaic clastics deposited in syn-rift settings. Miocene–Quaternary sediments are post-rift shallow marine deposits forming part of the region's petroleum systems and are widely distributed across the East Sea. Diffuse Miocene–Quaternary basaltic fields (tholeiitic to alkaline) with bauxite–laterite weathering crusts developed in stages from 15.8 Ma to the present, both onshore and offshore.

Of the natural resources, the following categories may be worth listing:

Mineral resources, including both metallic and non-metallic, are highly diverse in terms of types and origin. The metallic mineral resources include Fe, Ni-Cu, W, and Cr-bearing ores forming industrial mines such as Thach Khe, Nui Phao W-multiple metal mine, and Ban Phuc Ni-Cu-Co mine. The largest resource among the base metals (Sb, Cu, Pb-Zn, and Sn) is Pb-Zn ore, with a series of deposits in the Cho Don-Cho Dien (Bac Kan) region. The Sin Quyen Cu-Au ore deposit (an IOCG type) is considered one of the region's largest mines. Valuable primary and placer tin ores are found in Quy Chau-Quy Hop, Son Duong, and Dalat. Light metals, such as Al and Ti, high great potential, including two popular deposit types: bauxite from sedimentary and volcanic weathering genesis. The first is discovered in North Vietnam, the latter is in the Western Highlands. The titanium is primarily coastal, placer ilmenite-bearing, found mainly in Ninh Thuan-Binh Thuan dune lithologies.

Precious native and placer gold is widely distributed, but a typical representative is the Phuoc Son – Bong Mieu gold mine, which has been mined for centuries.

The rare earth element group has high potential and is found in two major types. The lens-shaped hydrothermal origin was discovered in Lai Chau, Yen Bai, and Lao Cai. The other is ion-absorbed in weathered zones, recently explored and found in the Ben Den (Lao Cai) area.

Non-metallic mineral resources include apatite, barite, and fluorite. All are industrial mineral components. Apatite is associated with metamorphosed sediments in NW-SE-oriented bands in Lao Cai. Barite with a modest distribution area is discovered in northern Vietnam. Fluorite, in contrast, appears as accessory minerals in several rare earth and W-multiple metal ore deposits (e.g., Nui Phao mine).

Ceramic materials, including kaolin and feldspar, are found in industrial mines across Vietnam. Glass-quality sand with high reservoir is exposed in several coastal provinces in the northern and central regions. Additionally, the potential of dolomites and quartzites are considerable.

The most popular gemstones in Vietnam are ruby and sapphire, which are primarily found in the Red River and Song Ma basin regions, as well as in Quy Chau-Quy Hop (Nghe An), and the Western Vietnam Highlands.

Vietnam's energy resources include coal, oil, gas, uranium ore, and geothermal energy. Coal has been known to have been discovered and mined for a long time ago. Among the coal mines, the Quang Ninh Mesozoic coal basin, which has been exploited since the French colony, is the most valuable. Additionally, coal reservoirs in Tertiary basins, both onshore and offshore, in the shelf area and in the Red River basin, are promising.

Uranium ore deposits in sandstone strata found in Pa Rong-Pa Lua (Central region) are considered high potential. Oil and gas are primarily discovered in Tertiary sedimentary basins located on the continental shelf. The first oil and gas in Vietnam was discovered and exploited in the Cuu Long basin. Continental geothermal resources are exposed as hot spring sources, concentrated mainly in the coastal areas of the Central region. Several geothermal sources have been identified in association with Tertiary sedimentary basins in the shelf region.

In addition to the above-mentioned natural resources, water and geo-heritage resources can also be listed as valuable.

MULTISCALE HIGH-RESOLUTION FAULT ZONE IMAGING USING BROADBAND SEISMIC ARRAY AND DISTRIBUTED ACOUSTIC SENSING (DAS) DATA

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ABSTRACT

Fault zone complexities preserve critical information about the physical conditions and processes that govern earthquake nucleation and dynamic rupture. Imaging such structures at high resolution is essential for assessing their role in seismic hazard, yet this task remains challenging due to the limited coverage of conventional seismic networks. High-resolution fault zone studies require dense observational arrays and advanced methodologies capable of exploiting the full wavefield recorded in seismic data. Recent advances in broadband seismic instrumentation and the rapid development of Distributed Acoustic Sensing (DAS) have created new opportunities for multiscale imaging. These approaches utilize both high-quality earthquake and ambient noise recordings as well as existing telecommunication infrastructure, thereby expanding observational capacity in both regional and urban environments.

In this study, we present two independent case studies that illustrate the potential of these methods. First, we use data from a linear dense broadband seismic array across the Red River Shear Zone in northern Vietnam to investigate regional-scale structures. This experiment achieves an imaging resolution on the order of ~10 km, providing new constraints on the crustal architecture of a major lithospheric boundary in Southeast Asia. Second, we analyze DAS observations collected along a telecommunication fiber in the Taipei metropolitan area. In this urban setting, DAS enables structural imaging at scales of a few tens of meters, revealing the presence of possible shallow blind faults that are otherwise difficult to detect. While these case studies are independent and employ distinct datasets, together they demonstrate how broadband seismic and DAS techniques can probe fault zone structures at complementary spatial scales. Although these experiments are separate, the Taipei results highlight the potential of DAS to be applied in Vietnam. Integrating DAS with existing fiber infrastructure in the Red River region could greatly enhance the first experiment by providing fine-scale resolution complementary to regional seismic arrays. This combination of methodologies, even when deployed separately, underscores the promise of multiscale imaging strategies to advance our understanding of earthquake processes and to improve future seismic hazard assessment.

Keywords: *MCMC inversion, Northern Vietnam, Red River Shear Zone, Distributed Acoustic Sensing (DAS), Taipei metropolitan area, High-resolution seismic imaging.*

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METHODOLOGY AND EVALUATION OF LOCAL MAGNITUDE (ML) CALCULATION FOR NORTHERN VIETNAM

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ABSTRACT

This study develops a methodology for calculating local magnitude (ML) in Northern Vietnam using a bilinear geometrical spreading model with a transition at 70 km hypocentral distance, incorporating anelastic attenuation and station-specific corrections. Seismic amplitude data from regional earthquakes are analyzed, employing a mixed-effects regression to derive event and station correction terms. The dataset, sourced from earthquake catalogs and amplitude measurements in Northern Vietnam, includes records filtered for reliability, retaining events and stations with at least three records. Amplitudes are processed as the geometric mean of horizontal components, converted to millimeters, and modeled using a piecewise attenuation function to account for regional wave propagation variations. The bilinear model, with coefficients (n1 ~ 2.05), (n2 ~ 0.742), (a1 ~ -0.003, km-1), and (a2 ~ 0.0019, km-1), ensures continuity at the hinge point and significantly reduces residual bias compared to a single-curvature model, particularly at distances below 70 km (see **Figure 1**). The calculated (ML) values exhibit a strong linear relationship with reference (ML) values, with a slope of 0.98 and an intercept of 0.06, indicating high accuracy (see **Figure 2**). Station correction terms, ranging from -0.8 to 0.8, reveal significant site-specific amplification effects, with 75% of stations showing moderate corrections (-0.2 to 0.2). Comparison with other regional models (e.g., Southern California, Myanmar) shows the proposed model outperforms earlier formulations, particularly at short distances, though limitations persist beyond 400 km due to unmodeled surface wave effects. The methodology enhances (ML) estimation for regional seismic networks, improving seismic hazard assessment and supporting more reliable earthquake monitoring in Northern Vietnam.

Keywords: *Earthquake Local Magnitude, Northern Vietnam, Bilinear Geometrical Spreading, Earthquake Monitoring, and Mixed Effects Model.*

Acknowledgement: *we appreciate Dr. Cong-Nghia Nguyen and the staff of the Vietnam Academy of Science and Technology and Academia Sinica for collecting the data used in this study.*

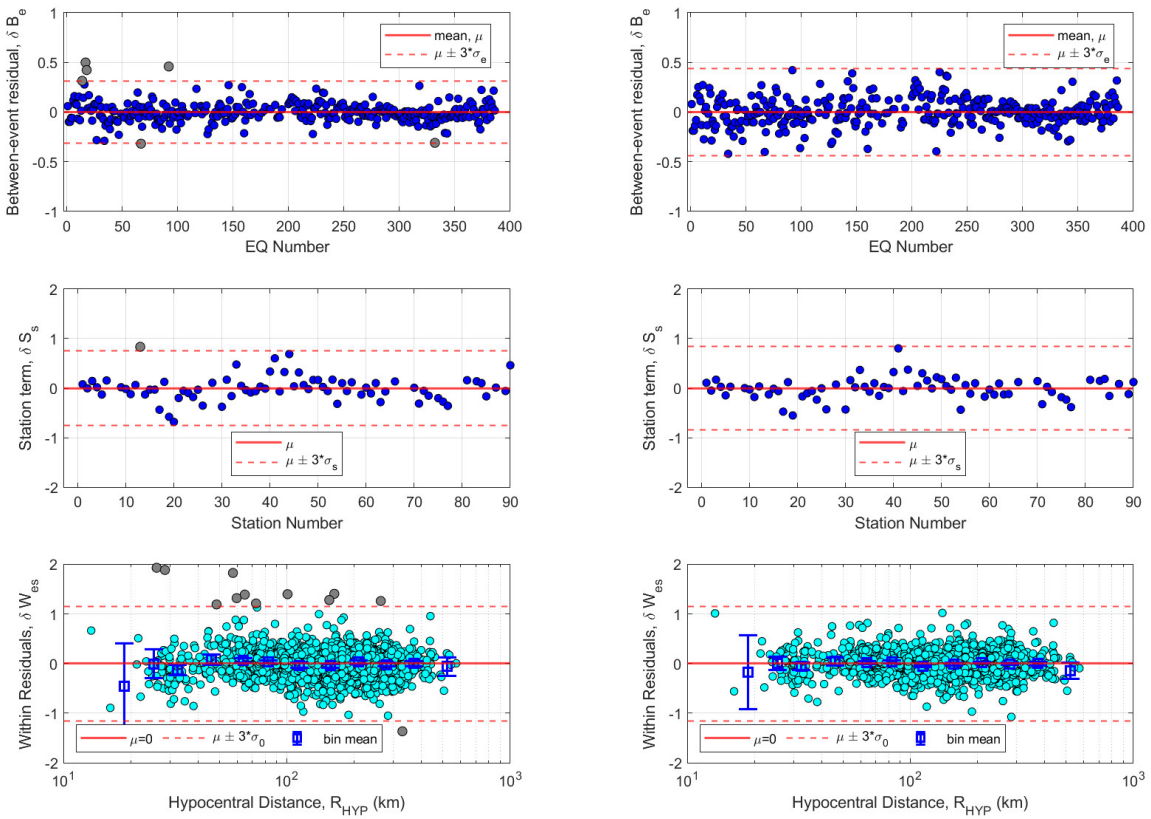


Figure 1. Comparison residual plot for (a) Stage I and (b) Stage II regression models. Between-event residual (δB_e) plotted against EQID, between-site residual (δS_s) plotted against STAID, and within residual (δW_{es}) plotted against the R_{HYP} distance.

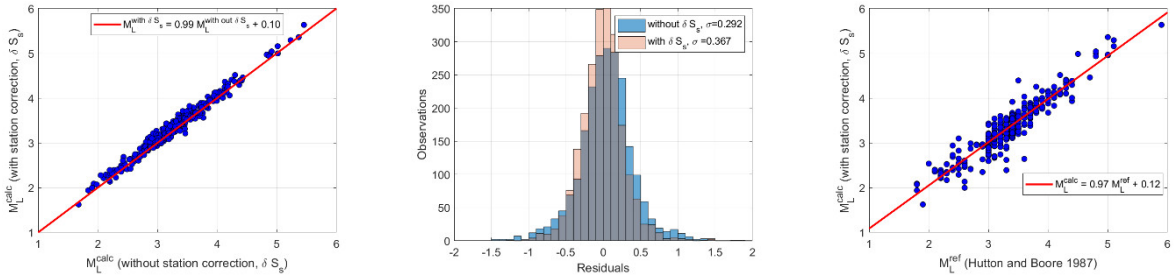


Figure 2. (a) Comparison of the M_L scale derived in this study with and without station correction term (δS_s), (b) histogram showing the residuals comparing the effects of station correction term on estimation of M_L, and (c) Between the Hutton and Boore (1987) scale (M_L^{ref}) and M_L derived with station correction term.

EXPANDING THE PALEOCLIMATE ARCHIVE OF BIỂN HỒ MAAR LAKE (CENTRAL HIGHLANDS, VIETNAM): NEW DEEP CORE AND MPLICATIONS FOR ICDP-LEVEL DRILLING

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ABSTRACT

Biển Hồ (14° 03' N, 108° 00' E), a volcanic maar lake in Vietnam's Central Highlands, is one of the most promising and underexplored archives for reconstructing tropical Asian paleoclimate. With limited historical records in Vietnam, sedimentary geoarchives such as Biển Hồ provide critical evidence for past monsoon variability, hydrological change, and extreme events. Between 2016 and 2021, our team recovered multiple gravity and piston cores of up to 25 m, which yielded a robust chronology extending back ~57 ka. Multiproxy analyses (paleomagnetism, radiocarbon, XRF, isotopes) documented significant climatic and environmental transitions, including vegetation changes across the Pleistocene-Holocene boundary and anthropogenic impacts on hydrology. These studies established Biển Hồ as a key site for paleoclimate research in Southeast Asia. In December 2024, we advanced to a 55 m piston core from the central basin (Fig. 1). Building on this success, in March 2025 the EOS team recovered a substantially deeper core at the same site. The lower section contains a hard, clay- and organic-rich layer with unusual spheroidal, pebble-like structures, interpreted as possible in situ weathering features linked to a prolonged dry phase. Beneath this unit, lighter, diatom-rich sediments indicate lacustrine conditions. Magnetic susceptibility rose sharply below 55 m, especially in the hard layer. A visible tephra at ~52 m (Fig. 2) may correspond to the ~95 ka Aira eruption (Japan), while the Toba tephra (~24.5 m) previously detected in other cores was not observed. These findings suggest that the Biển Hồ sedimentary archive extends at least to the Eemian Interglacial (~130 ka). However, given the regional basaltic volcanism (0.3–7 Ma), the total thickness of the sediment infill may be far greater, potentially preserving a continuous climate record spanning multiple glacial–interglacial cycles. Future priorities include seismic profiling to constrain sediment thickness and planning for ICDP-level deep drilling (>150 m). Such an effort could yield one of the longest continuous tropical paleoclimate archives worldwide, filling a critical gap in the global record of Quaternary monsoon dynamics.

Keywords: *maar lake, sediment coring, paleoclimate, Asian monsoon, Quaternary.*

Acknowledgement: *This research was supported by NAFOSTED (2025-2028, code: 105.08-2024.08), PI: Hướng Nguyễn-Văn, Environmental and climatic changes recorded by Vietnamese lacustrine sediments: past, present and future.*

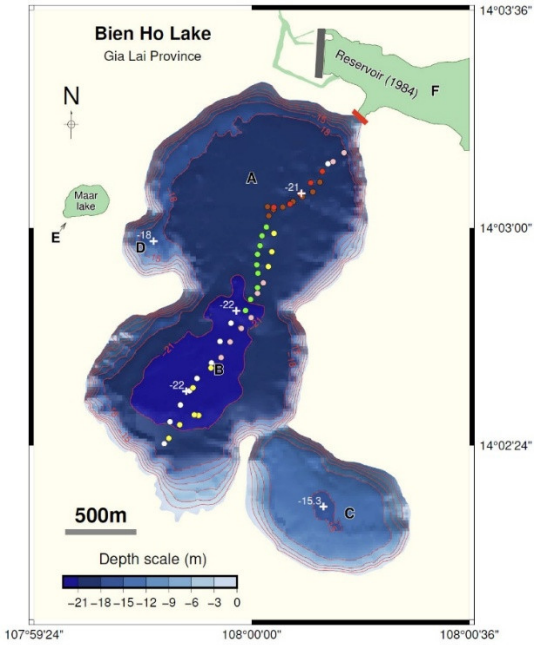


Figure 1. Biển Hồ lake bathymetry mapped from depth information of the 2016–2020 bathymetric survey. Core sites from 2016–2021 are located in the northern basin (A), while the deep coring campaigns in 2024–2025 were carried out in the central basin (B).

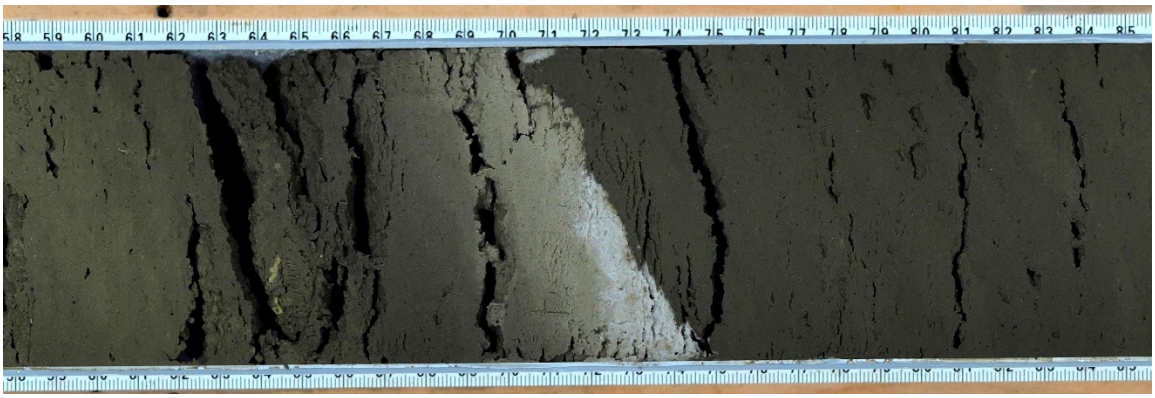


Figure 2. Photograph of the sediment core at ~52 m depth showing a visible tephra layer (light-colored band in the center of the image), which may correspond to the ~95 ka Aira eruption (Japan). The Toba tephra (~24.5 m), previously detected in other cores, was not observed in this sequence.

COLLAPSE OF UNDERGROUND GALLERIES IN GOLD-PANNING MINES: PERCEPTION OF STAKEHOLDERS IN THE DOKO SUB-PREFECTURE, SIGUIRI PREFECTURE, REPUBLIC OF GUINEA

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ABSTRACT

Artisanal gold mining is recognized as a long-standing activity in the Siguiri prefecture in general and the Doko sub-prefecture in particular. Despite its significant contribution to community development, it has disastrous consequences for both the environment and the lives of gold miners. The collapse of underground galleries as a result of gold panning is a phenomenon that plunges families into mourning in gold panning areas in Africa. Unlike other land movements, despite their dangerous nature, there has been almost no scientific interest in limiting the consequences of collapsing underground galleries in gold mines. Working to mitigate their effects is more than a necessity for those involved in gold panning. This study aims to understand the perceptions of those involved in gold panning regarding the conditions of occurrence and the main causes of underground gallery collapses, to formulate recommendations to the authorities and gold miners to minimize the risk of these accidents occurring and their impact. The methodology used was based on semi-structured and structured interviews. The results of this survey show that the human factor is certainly the main cause of accidents (collapse of underground galleries), but the design of structures without taking into account the study of the geomechanical properties of the ground, the weakness of the safety measures put in place and the absence of the State are not negligible factors. This study identified the causes and consequences of these accidents, as well as the responsibilities of those involved. To make artisanal mining a genuine economic lever that takes into account the sustainable development objectives of countries and communities, as well as the health and safety of those involved, we recommend the following:

- Application of legislation governing the gold panning sector in the country;
- Prohibiting the use of narcotics on sites and the use of metal detectors in pits;
- Formalization of safety instructions on sites;
- Education, awareness-raising and training for those involved in the sector;
- Reinforcement of Tomboloma teams to ensure compliance with security instructions;
- Support the Red Cross in its role of providing security and protection for gold miners;
- Strengthen the skills of the Red Cross team in risk diagnosis and first aid techniques;
- Establish a standard for sizing wells, taking into account the geomechanical properties of the soil;
- Create income-generating activities to reduce the number of gold miners on the sites.

Keywords: *Artisanal gold mining, Collapse of underground galleries, gold exploration.*

RECENT VOLCANIC ACTIVITY IN VIETNAM: THE CAUSE AND THE SIGNIFICANCE

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ABSTRACT

Volcanic eruptions have played a significant role in shaping the landscape of Vietnam, especially since the East Vietnam Sea began forming around 33 million years ago. This activity is linked to the collision of two massive tectonic plates—India and Eurasia—which caused the Earth's crust to stretch and break, creating dynamic conditions for magma to form and rise.

Scientists recognize three major phases of volcanic activity related to this event:

1. Before the Sea Opened (over 33 million years ago): Volcanic eruptions occurred in the northern areas of the East Vietnam Sea and in parts of southeast China.
2. While the Sea Was Forming (33 to 16 million years ago): Volcanic eruptions as the ocean floor was splitting apart, producing large volumes of lava similar in type to that found along today's mid-ocean ridges.
3. After the Sea Opened (from 16 million years ago to today): Volcanic activity spread across deep-sea basins, nearby islands like Hainan and the Philippines, and especially across the Indochina region, including Vietnam, as the land rose.

In Vietnam, these later volcanic eruptions began about 15.5 million years ago and continue in some places even today. The total area covered by these basalt lava flows is around 25,000 square kilometers. In some areas, the lava is only a few meters thick; in others, such as near Bien Ho in Pleiku, it reaches more than 400 meters.

There were three main eruption periods in Vietnam:

• 15.5–8 million years ago: Lava flows appeared mainly in the Central Highlands and the South Central Coast.
• 8–5 million years ago: Eruptions occurred in areas like the Pleiku, Dak Nong, Dak Lak plateaus, and other nearby regions.
• Less than 5 million years ago to present: Small, individual volcanoes appeared across the country, especially along the coast and offshore areas.

By studying rock chemistry and comparing different lava layers, scientists found that the sources of early and later volcanic eruptions came from various depths beneath the Earth (ranging from about 45 to 90 km), showing that these volcanic events were fed by separate magma systems.

Between the lava flows, layers of ash and volcanic debris can sometimes trap water—a vital source of groundwater in dry places like the Central Highlands. Over time, the lava rock also weathers into red basalt soil, which is very fertile. This soil supports crops like coffee, rubber, and pepper, and also contains valuable materials like aluminum, iron, and rare earth elements.

Vietnam's past volcanism has also left behind beautiful landscapes, including waterfalls such as Dray Sap, Gia Long, Trinh Nu (in Dak Nong), Dambri (Bao Loc), and Prenn (Da Lat). In some places, lava once flowed through riverbeds, creating unique underground lava caves. The Krong No lava cave system is one of these special places and is now part of a UNESCO Global Geopark.

In short, Vietnam's volcanic history is not only crucial for scientists—it has helped create the land we live on, the resources we depend on, and the beautiful landscapes that draw visitors from around the world. It's a living natural museum for researchers and nature lovers alike.

SESSION

AQUATIC SCIENCES

AMMONIUM ISOTOPE ANALYSIS FOR LOW-CONCENTRATION ENVIRONMENTAL WATERS: APPLICATION TO HOT SPRINGS FOR TRACING AMMONIUM CONTAMINATION SOURCES

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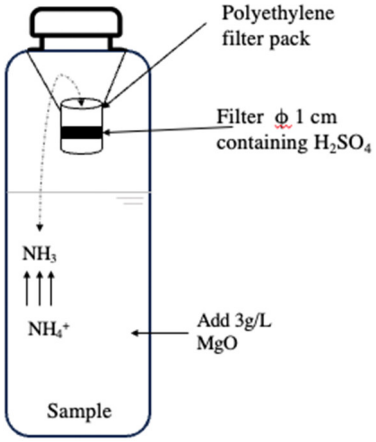
ABSTRACT

In this study, a diffusion technique was used to separate ammonium from aqueous samples, followed by oxidation to convert it to nitrate. Nitrate was then analyzed for nitrogen isotopes using the denitrified method and measured by an Isotope Ratio Mass Spectrometry (IRMS) system. Each step was carefully examined, particularly the oxidation process, in which a buffer solution was added to maintain a near-neutral pH. This precaution was critical because highly acidic or alkaline conditions can lead to nitrogen loss under high-temperature and high-pressure oxidation. The results indicate that the ammonium diffusion technique employed in this study with the optimized oxidation solution can yield precise and reproducible $\delta^{15}N$ values for low-concentration NH_4^+ water samples. Notably, our method requires only 10 μg of NH_4^+ for both diffusion and isotope analyses, which a significant improvement over conventional diffusion techniques, which typically require 50–150 μg. To evaluate potential matrix interferences, recovery tests using ammonium standards spiked into three different hot spring samples, which often contain low ammonium concentration alongside high concentrations of other chemical components, showed robust performance, with recovery rates ranging from 87% to 102%. These results confirm that our method remains unaffected by high ion concentrations in complex natural matrixes. Additionally, a comparative analysis with a published technique revealed no significant difference in the isotope results (paired *T*-test, $p < 0.01$), further validating our approach. The validated method was applied to several natural hot spring samples across Japan, and the ammonium isotope results contributed to clarifying the origin of ammonium in the natural hot springs at the investigated locations. A high-sensitivity analytical method was established that is efficient for analyzing ammonium isotopes in environmental water samples with low ammonium concentrations and enables the processing of large numbers of samples in a short time. The $\delta^{15}NH_4^+$ results contributed to elucidating the NH_4^+ sources, transport mechanisms at the study locations

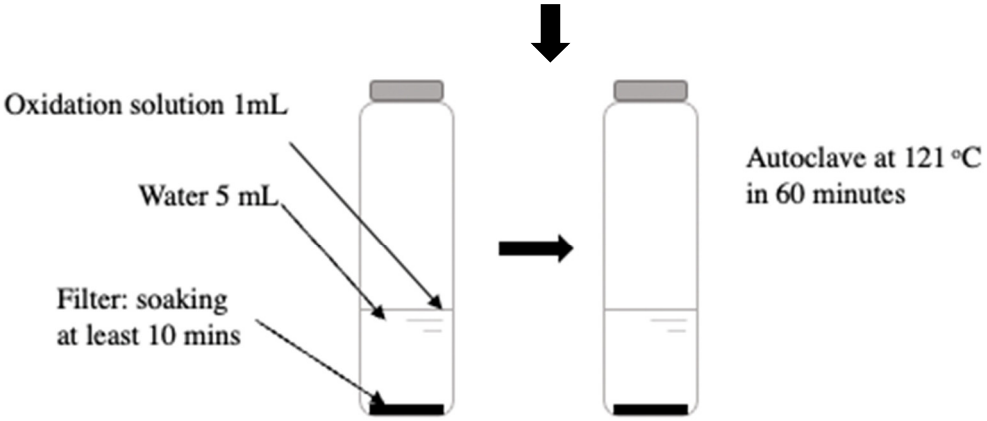
Keywords: *ammonium isotope, low-concentration NH_4^+, diffusion – oxidation - denitrifier bacteria - IRMS, sample matrix interference, natural hot spring, source identification.*

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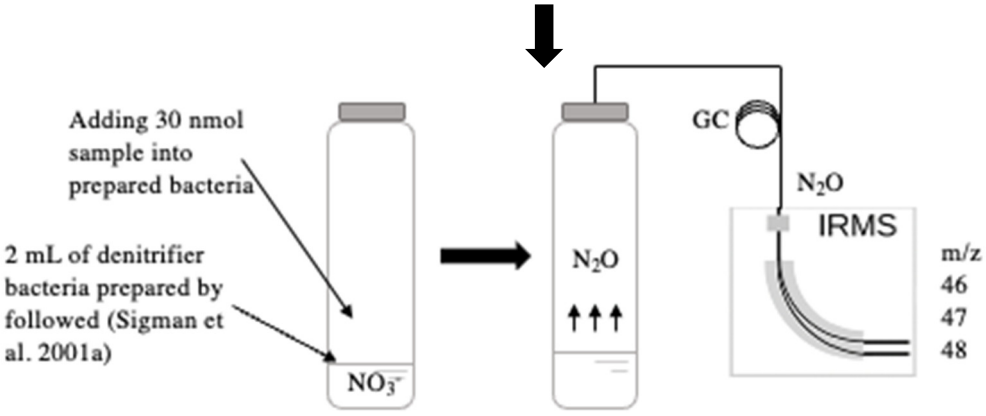
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Step 1: Gas phase diffusion



Step 2: Oxidation step



Step 3: Denitrified bacterial method for isotope measurement

Figure 1. Protocol development

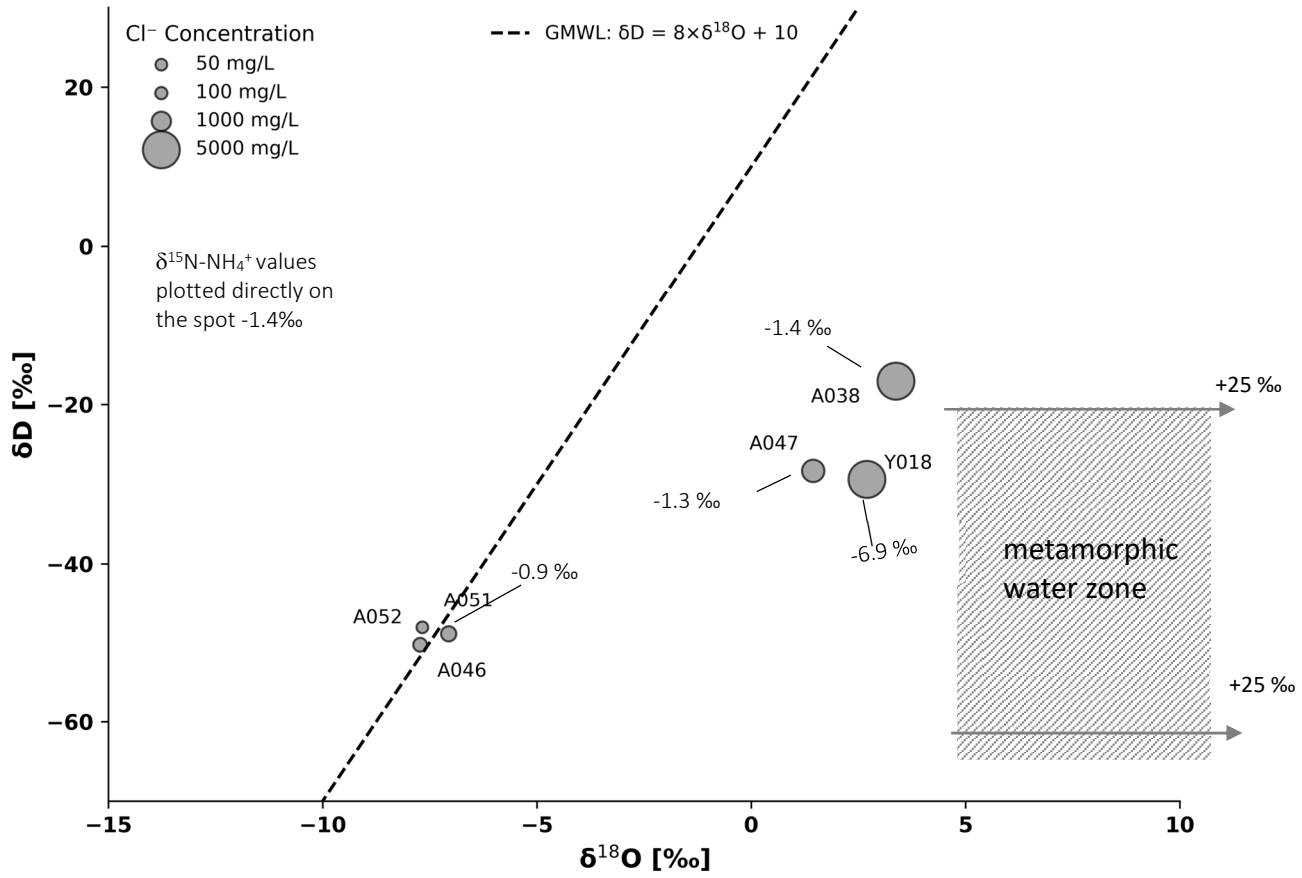


Figure 2. δD - $\delta^{18}O$ with Cl^- concentration plots of water samples from 5 hotspring and groundwater locations collected in this study. Dashed line shows the Global Meteoric Water Line (GMWL) [1]. Bold line box shows the range of δD and $\delta^{18}O$ value of "metamorphic water" [2].

SPATIAL PATTERNS AND CHARACTERISTICS OF DISSOLVED ORGANIC MATTER ALONG THE VIETNAMESE COAST

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ABSTRACT

Dissolved organic matter (DOM) is a key component of the river–estuary–ocean continuum, linking terrestrial and aquatic carbon cycles. Transported by rivers in both natural and anthropogenically influenced forms, DOM undergoes a range of biogeochemical transformations in aquatic environments. Globally, rivers in Southeast Asia—particularly those in Vietnam—export disproportionately high DOM fluxes to the ocean due to intense monsoonal variability, high sediment loads, and strong human pressures. However, the knowledge of DOM dynamics in these systems remain poorly characterized compared to other regions. To address this gap, we investigated dissolved organic carbon (DOC) as well as chromophoric and fluorescent DOM (CDOM and FDOM) along salinity gradients on Vietnam's coastline during the PLUME campaign (June-July 2024) at 86 sampling stations on board R/V ANTEA France. We focused on the Red River Mekong River deltas, and Saigon River estuary. DOC concentrations decreased from rivers (149–367 μM) to offshore waters (67–100 μM), exhibiting strong negative linear relationships with salinity, suggesting dilution and transformation of DOM along the river–ocean gradient. Both CDOM and FDOM indicated that DOM composition varied significantly along this gradient. In rivers and estuaries, DOM was dominated by aromatic, high-molecular-weight compounds, and the predominance of humic-like DOM reflected the influence of agricultural, aquaculture and urban inputs. Moving offshore, DOM showed decreasing molecular weight, likely due to photochemical and microbial degradation, with an increase in protein-like components, indicative of enhanced microbial production. These results provide critical insights into the sources and fate of DOM in tropical river–coastal systems of Vietnam, highlighting the combined influence of natural processes and anthropogenic activities in shaping DOM dynamics.

Keywords: *Vietnamese coastal areas, Red River deltas, Mekong River deltas, dissolved organic carbon, colored dissolved organic matter, fluorescent dissolved organic matter, PARAFAC*

BACTERIAL COMMUNITY DYNAMICS ON MICROPLASTIC SURFACES: AN IN-SITU INVESTIGATION IN THE MANGROVE FOREST AND AQUACULTURE SYSTEMS, NAM DINH, VIETNAM

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ABSTRACT

Microplastics (MPs) are now ubiquitous in global river systems and have been detected in freshwater organisms across multiple trophic levels. As novel substrates in aquatic environments, MPs can harbor microorganisms and facilitate the formation of distinct microbial communities known as the "plastisphere." This study investigated bacterial community assembly and dynamics on polyethylene (PE) and polystyrene (PS) microplastic surfaces compared to glass beads (control) in mangrove and aquaculture ecosystems of Nam Dinh, Vietnam. Our objective was to characterize microbial colonization patterns on different substrate materials and assess how environmental factors influence biofilm development in coastal aquatic systems.

Microplastic particles and glass beads were deployed in 316 stainless steel cages suspended in mangrove and aquaculture zones for seven months, with environmental monitoring instruments recording continuous data. Monthly sampling enabled DNA extraction and bacterial community analysis using 16S rRNA long-read sequencing on the PacBio Kinnex platform, with data processed following established PacBio workflows. Scanning electron microscopy (SEM) provided visual characterization of biofilm architecture on substrate surfaces.

SEM imaging revealed diverse biofilm structures featuring various bacterial morphologies (rods, cocci, filaments) embedded within extracellular polymeric substance (EPS) matrices that formed complex three-dimensional networks on microplastic surfaces. Alpha diversity analysis demonstrated that polystyrene supported the most diverse and temporally stable bacterial communities, with mean species richness of 897 (maximum 1,145 in June), Shannon diversity indices of 5.1–5.8, and low Simpson values (0.01–0.04), indicating high evenness with minimal dominance by individual taxa. Glass substrates harbored less diverse communities with mean richness of 303 species (peak of 937 in June), Shannon indices of 3.6–5.8, and higher Simpson values (0.01–0.06), reflecting greater temporal variability and stronger dominance patterns.

Taxonomic analysis revealed distinct colonization dynamics, with *Xanthobacter aminooxidans* exhibiting the highest relative abundance (RA) during initial colonization but disappearing in subsequent months, suggesting a pioneer species role in biofilm establishment. Substrate-specific taxa included *Ketobacter alkanivorans*, which was exclusively found on PE surfaces (RA 1.4–5.98%), and *Zhengella mangrovi*, detected only on PS substrates (RA 4.34% in March). Notably, several potentially pathogenic bacteria were identified at >1% RA, including *Agrobacterium radiobacter*, *Agromyces mediolanus*, *Cutibacterium acnes*, and *Staphylococcus epidermidis*.

Our findings demonstrate that microplastics function as novel and ecologically significant microhabitats in aquatic environments, supporting dynamic microbial communities with potential implications for pathogen and antimicrobial resistance gene dispersal. The detection of pathogenic bacteria within the plastisphere raises concerns about human health risks associated with microplastic pollution. These results emphasize the need for microplastics to be recognized as active biological vectors in coastal ecosystems. We recommend expanded research incorporating larger datasets, broader geographic sampling, and extended temporal studies to comprehensively evaluate the ecological and public health implications of microplastic-associated microbial communities.

Keywords: *bacterial community, biofilm formation, mangrove ecosystem, microplastics, One Health*

Acknowledgement: *This work was funded by the project 'Sources, Sinks and Solutions for Impacts of Plastics on Coastal Communities in Viet Nam' (NE/V006088/1) sponsored by the UKRI-GCRF via the programme 'Reducing the Impacts of Plastic Waste in Developing Countries', and the project funded by Nafosted "Potential risk assessment of trace metals and antibiotic microbial resistance associated with microplastic pollution to ecological systems" 105.99-2023.32.*

EFFECTIVENESS OF PERSULFATE-CATALYZED ELECTROCHEMICAL OXIDATION FOR PER-/POLYFLUOROALKYL SUBSTANCES (PFAS) REMOVAL TOWARD SAFE DRINKING WATER

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ABSTRACT

The persistence of per-/polyfluoroalkyl substances (PFAS) has raised significant environmental concerns due to their high stability, bioaccumulation and potential health risks. In Vietnam, PFAS originating from textile, electronics, and chemical manufacturing have been detected in water sources commonly used for drinking water production. Their presence has posed a major challenge to the current water supply safety, as conventional treatment processes are often ineffective at removing these highly persistent compounds. This study investigates the application of persulfate-catalyzed electrochemical oxidation (EC/PS) for degrading two representative PFAS, namely perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). An EC/PS experimental system was tested with titanium-boron doped diamond (Ti/BDD) and titanium-iridium oxide (Ti/IrO2) anodes to evaluate electrode performance, and further optimized using the Plackett-Burman and response surface methodology with central composite design (RSM-CCD) methods. Based on this approach, two quadratic models were established to predict the removal efficiencies of PFOA and PFOS with their accuracy validated by ANOVA analysis. Under the optimal conditions (current density 9.5 mA/cm2, sodium chloride concentration 2 g/L, PS catalyst concentration 4.2 g/L), the Ti/BDD anode achieved removal efficiencies of 96.48% for PFOA and 95.74% for PFOS. These experimental results closely matched the model predictions with an error of less than 4%. The hydrolytic degradation pathway of PFOA was further elucidated with 1H-perfluoroheptane (C7F15H, m/z 370) and perfluoroheptanoic acid (PFHpA, C6F13COO-, m/z 363) identified as intermediates within 60 reaction minutes. Importantly, the treated water met the U.S. EPA (2024) drinking water standards for PFOA, PFOS, chlorine (Cl2), and fluoride (F-), highlighting its suitability for practical applications. Overall, the EC/PS using the Ti/BDD electrode demonstrates high efficiency, scalability, and potential as an emerging technology for the degradation of PFAS, supporting safe and sustainable drinking water supply.

Keywords: *PFAS removal, persulfate catalyst, electrochemical oxidation, water treatment, drinking water safety.*

Acknowledgement: *This research is funded by the Vietnam Ministry of Education and Training (MOET) under grant number B2023-VGU-05.*

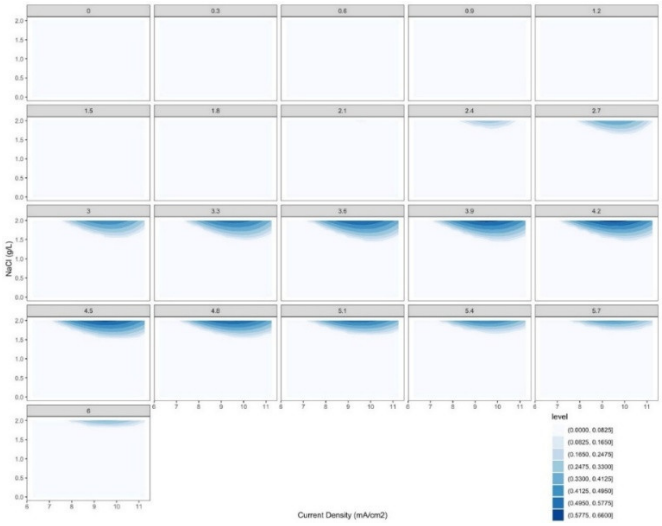


Figure 1. The desired efficiency of PFOA and PFOS with three variables expressing simultaneously (expressed as persulfate catalyst concentration - g/L)

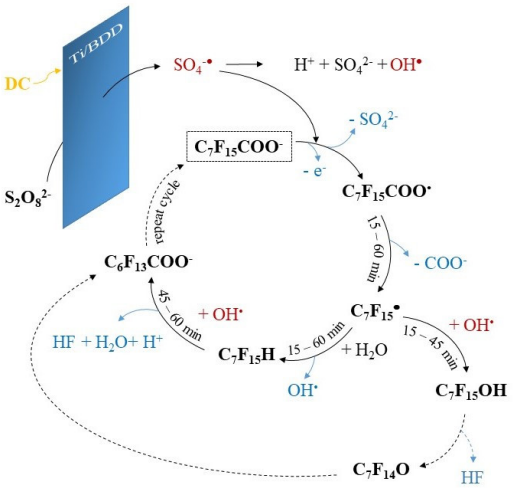


Figure 2. Decomposition pathway of PFOA through PS-catalyzed electrochemical oxidation.

SEASONAL VARIATION AND POTENTIAL ENVIRONMENTAL RISK OF PHARMACEUTICAL RESIDUES IN WEST LAKE AND YEN SO LAKE, HANOI

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ABSTRACT

Pharmaceuticals play a vital role in modern medicine, saving millions of lives by preventing and treating diseases. However, their extensive use has also raised environmental concerns, as many studies have shown that these compounds can adversely affect aquatic organisms and contribute to the growing problem of antibiotic resistance. This issue is particularly acute in Viet Nam, where antibiotic usage is often poorly regulated. Wastewater treatment infrastructure is also limited—municipal wastewater treatment plants (WWTPs) can handle only about 10% of the total municipal wastewater generated nationwide—meaning that large volumes of untreated or partially treated wastewater are discharged directly into rivers, lakes, reservoirs, and urban canals. Previous studies have reported the presence of pharmaceutical residues in various Vietnamese water bodies, yet information on their seasonal dynamics and potential ecological risks remains limited.

Against this backdrop, the present study investigated the occurrence and seasonal variation of 16 pharmaceutical residues—including paracetamol (analgesic), ciprofloxacin, ofloxacin, norfloxacin (quinolones), sulfamethoxazole, trimethoprim (sulfonamides), carbamazepine (anticonvulsant), azithromycin, clarithromycin, roxithromycin, spiramycin (macrolides), cefotaxime (cephalosporins), tetracycline, doxycycline, oxytetracycline (tetracyclines), and lincomycin (lincosamides)—in surface water from West Lake (WL) and Yen So Lake (YSL) in Hanoi. A total of 20 surface water samples were collected from each lake, with five samples taken every three months from January to December 2020, covering both dry and wet seasons during the COVID-19 pandemic. The analyses revealed that pharmaceutical residues were widely distributed in both lakes, with total concentrations ranging from 15.7–38.6 μg/L in WL and 21.3–49.9 μg/L in YSL. Norfloxacin was detected at the highest concentrations (0.83–21.2 μg/L in WL; 0.61–17.3 μg/L in YSL), while cefotaxime was absent in WL but detected in 7 of 20 YSL samples (0.05–2.1 μg/L). Most pharmaceutical groups, including quinolones, macrolides, and tetracyclines—tended to have higher concentrations in the wet season, likely due to increased runoff and wastewater discharge, with norfloxacin levels nearly doubling. In contrast, some compounds such as carbamazepine, ciprofloxacin, sulfamethoxazole, and trimethoprim showed higher concentrations in the dry season, possibly due to their greater environmental persistence or differing usage patterns. Ecological risk assessment indicated that several antibiotics, especially ciprofloxacin, norfloxacin, macrolides, tetracyclines, sulfonamides, and cephalosporins, posed moderate to high risks—particularly in YSL—where concentrations exceeded safety thresholds by up to 155-fold. These findings provide valuable insight into the seasonal behavior and ecological risks of pharmaceutical

residues in Hanoi's major lakes, informing strategies to protect aquatic environments and surrounding communities.

Keywords: *pharmaceutical residues, seasonal variation, UPLC-MS/MS, surface water, ecological risks.*

Acknowledgement: *The authors would also like to thank the LOTUS international joint laboratory and IRN SOOT-SEA, funded by the Institute of Research and Development (IRD).*

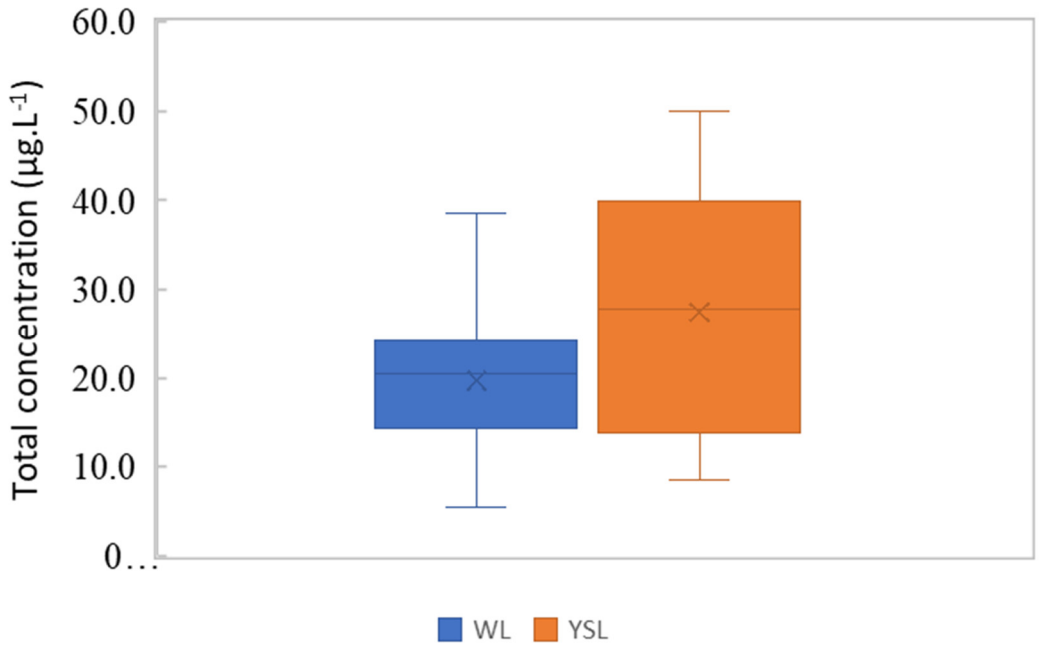


Figure 1. Total concentration of 16 pharmaceutical compounds in West Lake and Yen So Lake.

CHARACTERIZING MEKONG AND RED RIVER PLUME DYNAMICS USING RECENT REMOTE SENSING AND IN SITU DATA

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ABSTRACT

The transport and spatial distribution of materials discharged into the ocean by rivers are strongly influenced by river plume morphology and the frontal zones that bound plume areas. Accurately characterizing plume extent and identifying the locations of these frontal zones are essential for understanding the spatial distribution of biogeochemical tracers and the connectivity between source (river mouths) and offshore regions. We investigated the dynamics of Vietnam's two largest river plumes, the Mekong and Red river plumes, using recently acquired data from oceanographic campaigns (PLUME 2024, and 2022–2023 campaigns) complemented by remotely sensed velocity data. Analysis of these datasets revealed consistent circulation patterns under varying atmospheric forcing and highlighted the presence of submesoscale frontal structures within the plumes. Fronts were identified by extracting Lagrangian Coherent Structures (LCS) from surface velocity fields using finite-size Lyapunov exponents (FSLE). Large values in the attracting FSLE field (ridge lines) delineate zones of enhanced shear, providing insight into plume dynamics and mixing. The method and results of plume characterization from remote sensing was supported by comparisons with velocities obtained from surface drifter trajectories and acoustic Doppler current profiler (ADCP) measurements. These results have important implications for assessing horizontal dispersion, vertical motions, and mixing in river plume systems, which have major ecological and economic importance in Vietnam's coastal ocean regions.

Keywords: *River plume dynamics, PLUME campaign, Remote sensing, in-situ measurements.*

Acknowledgement: *We acknowledge the support from IRD (Institute of Research for Development) and CNRS and from CNES (French Spatial Agency) via the SWOT COCTO-FO project. This work is a contribution to the research activities of LMI LOTUS (http://lotus.usth.edu.vn).*

EFFECTS OF MACROPHYTE, PHYTOPLANKTON AND PERIPHYTON DYNAMIC ON EUTROPHICATION: QUEBEC SHALLOW LAKES ASSESSMENT AND CONTROL PERSPECTIVES

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ABSTRACT

In the dynamic ecosystems of shallow lakes, macrophyte, phytoplankton, and periphyton represent the principal primary producers, competing for light, nutrients and essential habitats. The balance among these groups is a critical determinant of lake states, considering whether a system maintains a clear-water condition, shifts to an alternative stable state, or develops into a eutrophic state. Macrophytes play a key role in stabilizing sediments, sequestering nutrients, reducing turbidity, and providing refuge for zooplankton, thereby limiting phytoplankton growth. They also provide substrate for periphyton, which contributes to overall primary production and biodiversity. Conversely, dense phytoplankton blooms diminish light penetration, constraining the growth of both macrophytes and periphyton. This study evaluates the community structure of macrophytes, phytoplankton, and periphyton to elucidate their interrelationships in shaping dominant pelagic productivity, nutrient cycling, and benthic–pelagic coupling. Field investigations conducted in four shallow lakes located in Sainte-Anne-des-Lacs, Quebec, during summer 2025 with the presence of distinct trophic conditions by simultaneously evaluating the community structure of macrophytes, phytoplankton, and periphyton. With low density and diversity of aquatic macrophytes, lakes Caron and Johanne exhibit high phytoplankton densities and biovolumes dominated by Cyanobacteria and small-sized, single-celled Chlorophyta, clearly indicative of eutrophic to hypertrophic conditions. In contrast, Lakes Schryer and Canard showed moderate phytoplankton densities and biovolumes with a balanced representation of algal groups, coinciding with abundant macrophyte coverage and diverse periphyton assemblages, characteristic of mesotrophic states. This methodological framework demonstrates potential for predicting temporal ecology trends and offers a more diagnostic tool for water quality management and restoration strategies.

Keywords: *Eutrophication, Macrophytes, Phytoplankton, Periphyton, Shallow lakes.*

Acknowledgement: *MITACS Globalink Research Internship.*

FLUORESCENCE-BASED CHARACTERIZATION OF DISSOLVED ORGANIC MATTER (DOM) IN ESTONIAN SURFACE AND GROUNDWATER

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ABSTRACT

Dissolved organic matter (DOM) plays a central role in aquatic ecosystems, influencing carbon cycling, nutrient transport, and water quality. However, little is known about DOM characteristics in Estonian surface and groundwater systems. This study combined dissolved organic carbon (DOC) measurements with fluorescence spectroscopy to investigate DOM composition across different regions of Estonia.

Excitation–emission matrix (EEM) data were analyzed using PARAFAC modeling in MATLAB, which identified three distinct fluorophores: two humic-like components of terrestrial origin and one tryptophan-like component representing protein-like DOM. In addition, fluorescence-derived indices (FI, HIX, BIX) were applied to assess DOM sources and transformations.

DOC concentrations showed marked spatial variability, from <2 to >40 mg L^{-1}. Higher DOC and HIX values generally corresponded to sites with strong terrestrial influence, whereas lower DOC coupled with higher FI suggested a greater microbial contribution in some groundwater systems. BIX values were consistently below 1, indicating limited recent biological production across most sampling sites. These combined signals show contrasts in DOM quantity and quality between regions and between surface and groundwater. Some waters were characterized by higher DOC and more humified material, while others indicated stronger microbial or autochthonous contributions, highlighting the influence of local environmental and hydrological settings.

This study represents the large-scale characterization of DOM in Estonian surface and groundwater using fluorescence-based techniques. The combined use of DOC and fluorescence parameters provides valuable insights into DOM sources and transformations, offering a foundation for further chemical analyses and high-resolution mass spectrometry. These findings contribute to a better understanding of DOM composition across different regions of Estonia.

Keywords: Estonian waters, dissolved organic matter, dissolved organic carbon, fluorescence, PARAFAC

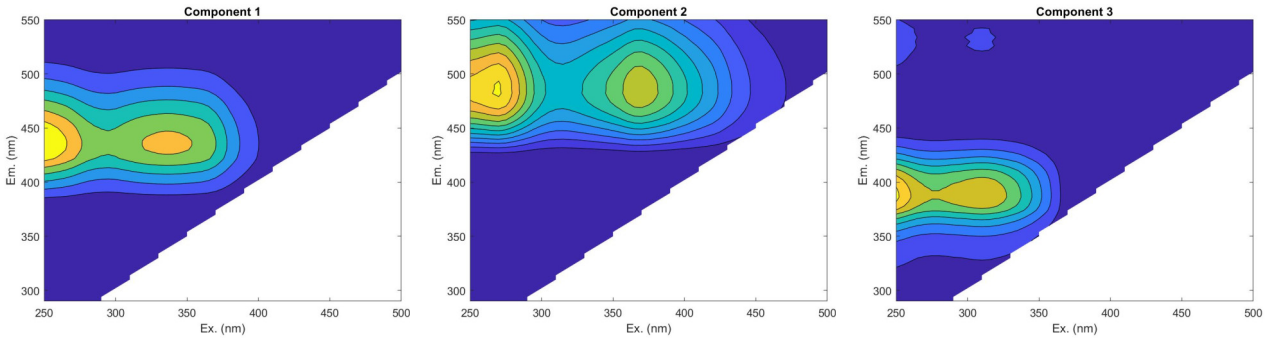


Figure 1. Three distinct fluorophores: two humic-like components (Component 1 and 2) and one tryptophan-like component (Component 3)

DISTRIBUTION AND CHARACTERISTIC OF MICROPLASTICS IN MUNICIPAL AND INDUSTRIAL WASTEWATER TREATMENT PLANTS IN SOUTHERN VIETNAM

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ABSTRACT

Microplastic contamination poses a significant threat to aquatic ecosystems. Wastewater treatment plants (WWTPs), despite implementing advanced technologies to minimize contaminants, still face the risk of MP residues remaining after undergoing multiple treatment processes. Both industrial and municipal WWTPs, therefore, need to be taken into account as potential sources of microplastic release into the environment. This study investigated the distribution of MPs in the influent and effluent of four large-capacity municipal and industrial WWTPs in Vietnam. The study found that the amount of microplastics (MPs) in municipal WWTPs ranged from 146 to 234 items/m3 in the influent and 35 to 62 items/m3 in the effluent, whereas in industrial WWTPs, the abundance ranged from 24 to 45 items/m3 and 6 to 17 items/m3, respectively. In both municipal and industrial WWTPs, the average efficiency of MP removal was approximately 71%. In addition, the majority of MPs identified in this study included a range of size, shape, color, and chemical compositions. The sizes of MPs varied highly from 0.3 to 5 mm, with abundant types such as fiber, fragment, film, and foam present in both the influent and effluent. Additionally, a range of colors were observed, including yellow, white, blue, transparent, pink, brown, grey, green, purple, red, orange, and black. By using Fourier Transform Infrared spectroscopy (FTIR), the main polymer compositions of MPs including polypropylene (PP), polyethylene (PE), nylon, polyvinyl chloride (PVC), and other polymer compositions, were determined in the four WWTPs. Although the microplastic removal efficiency of the four surveyed WWTPs was around 71%, the daily concentration of microplastics discharged into the environment remained significantly high, ranging from 2.4 × 104 to 6.8 × 104 MPs/day for industrial WWTPs and 5.95 × 105 to 1 × 106 MPs/day for municipal WWTPs. These results indicate that the concentration of MPs in municipal wastewater is significantly higher compared to industrial wastewater. Thus, the mentioned WWTP effluents result in a high volume of emissions in terms of MP pollution, with a significant daily discharge to the receiving source.

Keywords: *Microplastics, occurrence, municipal wastewater treatment plants, industrial wastewater treatment plants.*

Acknowledgement: *The present study was sponsored by The Ministry of Education and Training (MOET) under grant number B2024-VGU-05.*

MICROPLASTICS AS VECTORS OF ANTIBIOTIC RESISTANCE GENES IN URBAN RIVERS: EVIDENCE FROM HANOI

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ABSTRACT

Microplastics (MPs) are now ubiquitous in aquatic ecosystems due to the exponential growth of plastic production since the mid-20th century, raising serious environmental and health concerns. Alongside MPs pollution, antimicrobial resistance (AMR) has emerged as a critical global challenge. Microplastic surfaces in aquatic environments readily form biofilms, known as plastispheres, which can act as "hotspots" for antimicrobial-resistant bacteria (ARB) and genes (ARGs). These plastispheres facilitate horizontal gene transfer, thereby enhancing the spread of ARGs and amplifying the risks to both ecological and human health. However, empirical data on the role of MPs as vectors of ARGs remain limited globally, and particularly in Vietnam.

In this study, we investigated the potential of MPs to serve as vectors of ARGs in Hanoi's urban river system. Sediment samples were collected biweekly from June to October 2024 at three representative sites: (i) Kim Nguu River near a hospital discharge point (S1), (ii) Kim Nguu River just before Yen So wastewater treament plant (S2), and (iii) Set River before entering Yen So wastewater treatment plant (S3). MPs were isolated from sediments and analysed for microbial density, the presence of five ARGs (*parE, rsmA, oprN, rpsJ, mexF*), and the abundance of the two most prevalent genes.

Results showed that microbial density on MPs (7.75–9.89 log CFU/g) was approximately 100 times higher than in surrounding sediments (6.20–6.99 log CFU/g) across all sites. MPs also acted as concentrators of ARGs, with significantly higher detection frequency and concentrations than in sediments. Among the five genes, *parE* and *rsmA*—associated with fluoroquinolone resistance and multidrug resistance—were the most abundant. At S1, directly influenced by medical wastewater, *parE* and *rsmA* levels on MPs reached 6.03 and 6.38 log copies/g, respectively—about 1,000 times higher than in sediments.

This study also provides the evidence in Hanoi's rivers that MPs can act as vectors for ARGs and resistant microbes, underlining their role in the spread of AMR in urban environments. Further research is urgently needed to better understand these interactions and to inform effective risk management strategies.

Keywords: *Microplastics, antimicrobial resistance genes, urban rivers, environmental vectors, public health, Vietnam.*

Acknowledgement: *This work was funded by the project "Microplastic-Mediated Antimicrobial Resistance in Aquatic Ecosystems: One Health Implications" (Grant No. MOHIP-2024) and the project funded by Nafosted "Potential risk assessment of trace metals and antibiotic microbial resistance associated with microplastic pollution to ecological systems" (105.99-2023.22).*

RAPID FORMATION OF AEROBIC GRANULAR SLUDGE UNDER FEAST–FAMINE CONDITIONS IN SBR: EVALUATION OF POWDERED ACTIVATED CARBON (PAC)

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ABSTRACT

Aerobic granular sludge (AGS) is a dense, spherical microbial aggregate formed through the self- Aerobic granular sludge (AGS) is a dense, spherical microbial aggregate formed through the self-immobilization of activated sludge, offering rapid settling, compact morphology, and high pollutant removal efficiency. Despite these advantages, AGS formation typically requires an extended start-up period, which limits its practical application in full-scale wastewater treatment plants. This study investigates the effect of powdered activated carbon (PAC, 500 mg/L) on accelerating AGS formation under feast–famine conditions in sequencing batch reactors (SBRs) treating seafood processing wastewater (SPW). The results demonstrated that PAC supplementation significantly reduced the granulation time, with stable and compact granules formed within 38 days, compared to over 50 days in the control reactor. The PAC-amended system produced dense aggregates with a low sludge volume index (SVI < 50 mL/g) and excellent structural stability ($SVI_{30}/SVI_{10} \approx 1$), indicating strong settling properties and resistance to disintegration. Microscopic and morphological analyses confirmed that PAC particles were widely embedded within and attached to the granule surfaces, serving as nucleation sites, promoting microbial adhesion, and reinforcing the structural integrity of granules. In terms of pollutant removal performance, the PAC-assisted reactor achieved superior treatment efficiency, with over 98% COD removal, above 88% total nitrogen removal, and improved phosphorus uptake, whereas the control reactor without PAC attained only ~92% COD and ~75% nitrogen removal under identical conditions. These improvements can be attributed to PAC's dual role: accelerating AGS formation by providing microcarriers for microbial aggregation and enhancing pollutant removal by adsorbing inhibitory compounds present in SPW. Overall, the findings demonstrate that the combination of PAC supplementation and feast–famine operation represents an effective and practical strategy for rapid AGS start-up and the robust treatment of high-strength industrial wastewaters such as those generated by the seafood processing industry.

Keywords: *Aerobic granular sludge (AGS); Powdered activated carbon (PAC); Feast–famine conditions; Seafood processing wastewater (SPW); Rapid granulation; Sequencing batch reactor (SBR)*

Acknowledgement: *This research is funded by Vietnam National Foundation for Science and Technology Development (NAFOSTED) under grant number FWO.105-2022.03.*

SESSION III

ADVANCED MATERIALS FOR SUSTAINABLE ENVIRONMENTAL REMEDIATION

INTEGRATED MBBR–PHOTOCATALYSIS SYSTEM FOR TEXTILE DYE DEGRADATION: A CIRCULAR ECONOMY APPROACH TO OVERCOME SINGLE-STAGE TREATMENT LIMITATIONS

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ABSTRACT

Conventional single-stage wastewater treatment processes often fail to effectively remove complex dye pollutants, especially under real-world conditions. While advanced oxidation processes (AOPs), such as photocatalysis, can achieve high degradation efficiency, they are often energy-intensive, less effective in the presence of high organic loads, and unsuitable as standalone solutions for large-scale wastewater with fluctuating characteristics. Similarly, biological systems such as Moving Bed Biofilm Reactor (MBBR) are eco-friendly and cost-effective but limited in degrading recalcitrant dye molecules such as azo dyes.

To overcome these limitations, we developed a two-stage hybrid treatment strategy integrating MBBR and photocatalysis, aligned with circular economy principles. Sunfix Red, a widely used azo dye, was selected as the model contaminant. The MBBR was operated with different hydraulic retention times (HRTs) following a 25-day microbial colonization phase, with the 24-hour HRT showing optimal results (~75% COD removal, ~22% color reduction). The partially treated effluent was then subjected to photocatalysis using a novel, sustainable photocatalyst synthesized from medical waste fly ash. Process parameters were optimized using Central Composite Design (CCD) under Response Surface Methodology (RSM), achieving 95.2% COD and 99.26% color removal.

Material characterization (UV–DRS, FESEM, XRD, XPS, BET) confirmed the fly ash catalyst's photocatalytic activity due to its semiconducting oxides, microporosity, and active surface sites. This integrated system not only enhances overall degradation efficiency but also supports resource recovery and waste reuse. The study demonstrates a scalable, eco-efficient treatment solution for textile effluents, making a strong case for hybrid systems in sustainable wastewater management

Keywords: *Hybrid wastewater treatment, Photocatalysis, Moving Bed Biofilm Reactor (MBBR), Circular economy, Textile dye degradation.*

Acknowledgement: *Cross-disciplinary Research Framework (CDRF), Birla Institute of Technology and Science, Pilani*

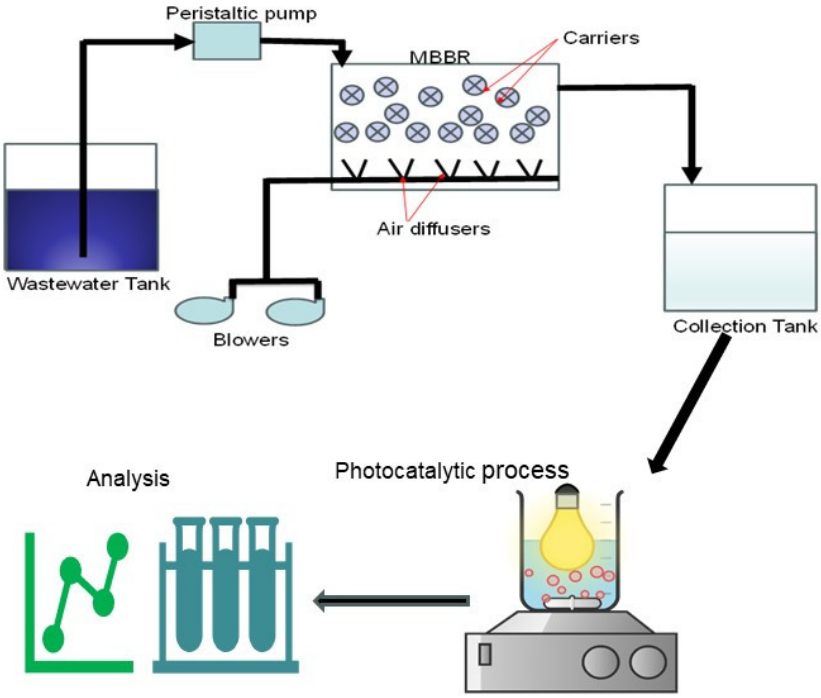


Fig. 1*. Schematic representation of integrated MBBR-photocatalysis system*

SENSITIVITY ANALYSIS OF GEOCHEMICAL PARAMETERS ON POROSITY REDUCTION IN PERMEABLE REACTIVE BARRIER–AQUIFER SYSTEMS USING THMC SOFTWARE

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ABSTRACT

A permeable reactive barrier (PRB) containing zero-valent iron (ZVI) is a widely applied in situ groundwater remediation technology that passively intercepts and treats contaminated plumes. However, secondary mineral precipitation within the PRB progressively reduces porosity and hydraulic conductivity, thereby altering hydrodynamic conditions. Such changes can redirect flow paths, modify residence times, and potentially cause bypass of the reactive zone. In this study, THMC software was employed to simulate porosity reduction in a PRB by capturing the coupled effects of fluid flow and geochemical reactions. The results show that porosity loss is most pronounced at the entrance face of the PRB, followed by a decline and stabilization beyond ~0.2 m into the barrier. The dominant mineral phases responsible for pore clogging are aragonite, siderite, and ferrous hydroxide, whose precipitation substantially decreases permeability. The simulations also highlight the strong influence of groundwater chemistry. Elevated bicarbonate concentrations significantly enhance carbonate mineral precipitation, resulting in pronounced porosity reduction. In addition, the study emphasizes the critical role of reaction kinetics, particularly the anaerobic iron corrosion rate coefficient. Variations in this parameter strongly govern Fe^{2+} and OH^- release, driving $Fe(OH)_2$ precipitation and accelerating pore blockage. Overall, this work demonstrates that THMC modeling is a valuable tool for elucidating the mechanisms of porosity evolution in PRBs, identifying key geochemical controls, and assessing long-term performance. These insights are essential for optimizing PRB design, operation, and service life in groundwater remediation.

Keywords: *THMC software; permeable reactive barrier (PRB); zero-valent iron (ZVI); porosity reduction.*

PSEUDOMONAS PUTIDA–TIO_2 NANOBIO-CONJUGATE IMMOBILIZED IN BACTERIAL CELLULOSE NANOPAPER FOR SUSTAINABLE TEXTILE WASTEWATER REMEDIATION

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ABSTRACT

The discharge of over 0.28 million tons of dye-laden textile effluent annually presents a profound environmental and public health hazard, worsening aquatic toxicity, ecological imbalance, and water resource degradation. Current treatment modalities are constrained by high operational costs, limited dye biodegradability, generation of secondary pollutants, and inadequate adaptability to effluent heterogeneity.

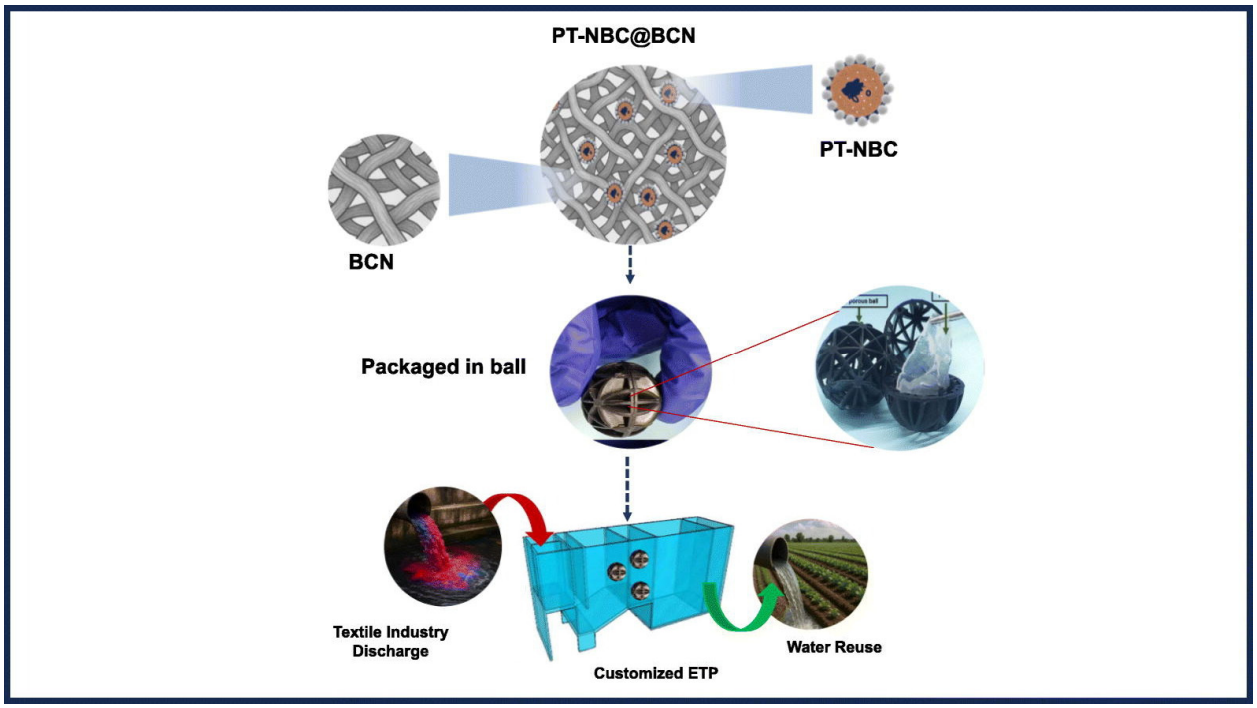
Addressing these limitations, we engineered a sustainable nano-bioremediation platform by conjugating *Pseudomonas putida* with TiO_2 nanoparticles (PT-NBC) and immobilizing the bio-nanoconjugates within a bacterial cellulose nanopaper matrix (BCN), forming PT-NBC@BCN. Comprehensive physicochemical and microscopic analyses confirmed the structural integrity and functional integration of the system.

Kinetic studies revealed adsorption behavior consistent with a pseudo-second-order model, while equilibrium data best fit the Dubinin–Radushkevich isotherm, suggesting chemisorption and a pore-filling mechanism. The system achieved up to 97% dye removal efficiency, accompanied by substantial reductions in chemical oxygen demand (90%) and biological oxygen demand (80%) under optimized conditions.

Phytotoxicity assays demonstrated significant mitigation of dye-induced plant toxicity, supporting the safe reuse of treated effluents for non-potable applications including urban landscaping, agriculture, artificial wetlands, and firefighting reservoirs. The robust performance and reusability of PT-NBC@BCN in pilot-scale deployment underscore its potential as a scalable and environmentally benign solution for textile wastewater remediation.

Beyond its lab-scale efficiency, this approach offers a promising step toward greener wastewater treatment. By reducing pollutant loads and supporting water reuse, it contributes to more sustainable and environmentally responsible industrial practices. This technology aligns with zero liquid discharge mandates and advances multiple sustainable development goals, particularly in water sustainability and clean industrial innovation.

Keywords: *Textile wastewater, nano-bioremediation, Pseudomonas putida, TiO_2 nanoparticles, bacterial cellulose*


PT-NBC@BCN
PT-NBC
BCN
Packaged in ball
Textile Industry
Discharge
Customized ETP
Water Reuse

RESEARCH ON TREATING EXHAUST GASES THAT CONTAIN AROMATIC VOCS (BENZENE AND TOLUENE) FROM WASTE TIRE PYROLYSIS SYSTEMS

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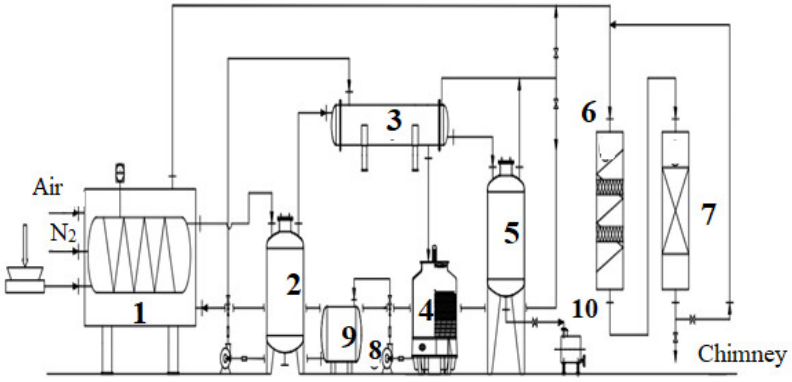
ABSTRACT

Waste rubber is a significant environmental concern globally. As a result, waste reduction and recycling are crucial components of an effective waste management strategy, as they help conserve natural resources and lessen the demand for valuable landfill space. Pyrolysis is regarded as a favorable and effective disposal method for waste tires. This environmentally friendly process involves thermal decomposition, converting waste tires into solid residue (char), liquid oil (pyro-oil), and gases at temperatures ranging from 300 to 900℃. In addition to its economic benefits, the exhaust gases produced during pyrolysis contain various volatile organic compounds (VOCs), particularly aromatic compounds, which pose serious risks to human health and the environment. Thus, the treatment of VOCs is of urgent importance.

The process for treating the exhausted gas mixture containing aromatic VOCs (toluene, benzene) from the waste tire pyrolysis process with a capacity of 3-5 m3/h (**Figure 1**). The waste tires were placed in a pyrolysis reactor, and the pyrolysis process was conducted at 550 °C. As the reaction occurred, the gas-liquid mixture was directed through a separator device acting as a dust-settling chamber. Subsequently, a condenser separated the mixture into oil and gas to recover the pyrolysis oil. The pyrolysis gas, which has a high calorific value, was used as fuel for heating the pyrolysis reactor and then mixed with air before being reintroduced to the outer part of the pyrolysis reactor to provide heat for the pyrolysis process. The exhausted gas mixture from the process was then directed through an oxidation tower, where oxidation reactions occurred at 250 °C using a 15% CoMnOx91/cordierite catalyst. Aromatic VOCs (benzene, toluene,...) from the gas mixture were oxidized into CO2 and H2O. Following this, the gas mixture passed through a cooler to cool the exhaust gas to 40 °C before going to an adsorption tower containing the 7% CuMnOx12/AC catalyst, which was finally released into the environment. The catalysts' catalytic activity was assessed using a system for treating exhausted gas (**Figure 1**) and determined by GC-MS. The results indicate that the 15% CoMnOx91/cordierite catalyst and the 7% CuMnOx12/AC catalyst exhibited high catalytic activity in oxidizing benzene and toluene, with benzene achieving over 99% and toluene reaching more than 97% after passing through the oxidation tower. However, benzene and toluene removal efficiency at the adsorption tower is relatively low. This can be attributed to the proximity of the oxidation and adsorption towers, leading to inefficient heat exchange. Compared to the laboratory results, the conversions of benzene and toluene on a pilot scale are notably higher (more than 99% benzene conversion, 97% toluene conversion) due to significantly lower inlet concentrations of both compounds. This outcome aligns with the laboratory results and

indicates that the catalyst system can effectively eliminate aromatic VOCs, such as benzene and toluene, even at high concentrations for typical treatment systems.

Key words: *Manganese -based catalyst, the oxidation – adsorption process, waste tire pyrolysis sytems*



1-pyrolysis reactor, 2-separator, 3-condenser, 4-cooling tower, 5-oil receiver, 6-oxidation tower, 7-adsorption tower, 8-pump, 9- water tank

Figure 1. The technical drawings of the exhaust gas treatment system

Acknowledgement:

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ELECTROCHEMICAL TREATMENT OF MICROPLASTICS IN WASTEWATER USING NOVEL FABRICATED TI/SNO_2-NB_2O_5 MESOPOROUS ELECTRODES

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ABSTRACT

Microplastic (MP) contamination has emerged as a pressing environmental issue due to its persistence, ecological risks, and incomplete removal by conventional wastewater treatment plants (WWTPs). In recent decades, electrochemical oxidation (EO) has emerged as a potential approach for eliminating refractory pollutants because of its ability to generate strong oxidizing agents directly at electrode surfaces. Therefore, this study aims to fabricate and investigate the potential application of novel mesoporous Ti/SnO_2-Nb_2O_5 electrodes for eliminating the detrimental influences of MPs effluents using the EO approach. Ti/SnO_2-Nb_2O_5 mesoporous electrodes were fabricated via a sol-gel method and characterized by scanning electron microscopy (SEM), x-ray diffraction (XRD), brunauer emmett teller (BET), cyclic voltammetry (CV), and linear scanning voltammetry (LSV) analyses. The degradation of polystyrene MPs was determined using fourier transform infrared spectroscopy (FTIR). Characterization results confirmed the successful formation of desirable mesoporous structures, with crystalline features indicated by diffraction peaks between 0.9° and 1.5°, pore sizes ranging from 4.25 to 5.83 nm, and a high BET surface area of 72.7 m^2/g. Electrochemical treatment experiments using polystyrene MPs revealed that templated electrodes achieved significantly higher MP removal (up to 35.3% ± 4.46%) compared to non-templated ones (14.5% ± 2.11%). This enhancement was attributable to the generation of reactive oxidants and free radicals ($^{\bullet}OH$, H_2O_2, O_3, and Cl_2), as well as enhanced oxygen evolution potential. FTIR analysis further indicated the loss of characteristic C-H and C=C peaks and the formation of C=O and O-H groups, confirming structural degradation of polystyrene MPs. These results suggest that $^{\bullet}OH$ radicals play a dominant role in cleaving C-H and C=C bonds, fragmenting polymer chains, and promoting oxidation, which ultimately leads to mineralization into CO_2 and H_2O. This study demonstrates the potential of mesoporous Ti/SnO_2-Nb_2O_5 electrodes as efficient EO materials for MP removal. In addition, these findings provide a foundation for selecting suitable materials when applying the EO method and highlight the potential of engineered electrochemical materials for enhancing MP removal in future wastewater management.

Keywords: *Microplastics, Ti/SnO_2-Nb_2O_5 electrodes, mesoporous, electrochemical oxidation.*

Acknowledgement: *The present study was sponsored by The Ministry of Education and Training (MOET) under grant number B2024-VGU-05.*

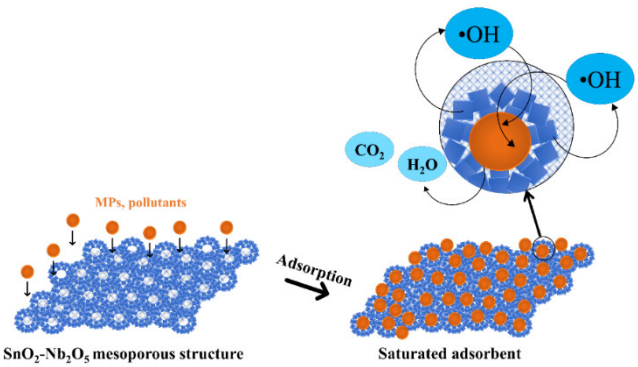


Figure. The properties and roles of mesoporous structures in pollutant treatment.

ASSESSMENT OF HEAVY METAL ACCUMULATION IN PLANT LEAVES AND SOIL IN SELECTED AREAS WITHIN ADAMSON UNIVERSITY MANILA, PHILIPPINES

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ABSTRACT

Urban air pollution, particularly from heavy metals, poses serious risks to both environmental and public health. It is well recognized that unchecked urbanization and population growth can lead to major issues including insufficient pollution management (Roy et al., 2020). Researchers have recently examined the buildup of harmful substances in plant components that have been demonstrated to efficiently absorb hazardous metals, such as leaves and bark (Gajbhiye et al., 2022). Plants have played a vital role in the accumulation of airborne pollutants within the environment. Both leaves and soil act as reservoirs for these contaminants where heavy metal accumulation can alter their properties. This study investigated the accumulation of heavy metals in plant leaves, soil, and road dust within Adamson University, Manila, to determine their potential as environmental bioaccumulators. Five heavy metals were analyzed: iron (Fe), copper (Cu), cadmium (Cd), zinc (Zn), and lead (Pb). Samples were collected from selected tree species, surface soil, and road dust in two key roadside areas—San Marcelino and Romualdez Streets. The concentration of heavy metals was quantified using Atomic Absorption Spectrophotometry (AAS). Results showed that Mangifera indica from Romualdez Street accumulated all five metals, and was the only species to absorb and accumulate Pb, suggesting its strong potential as a bioaccumulator of airborne heavy metal contamination (**Figure 1**). Syzygium cumini and Jatropha curcas also showed high accumulations of Fe and Cd, respectively. Soil sample analysis showed that both streets have accumulated the five heavy metal in its soil, with iron as its most accumulated metal (**Figure 2**). Road dust contributed significantly to the concentration of several metals, particularly in high-traffic areas. The findings emphasize the effectiveness of using trees as bioaccumulators for pollution removal and phytoremediation. By identifying plant species that can accumulate heavy metals from different sources, this study provides baseline data for future pollution assessments. Its efforts are aligned with environmental sustainability, public health protection, and urban planning strategies.

Keywords: bioaccumulator, heavy metals, foliar dust, phytoremediaton, AAS

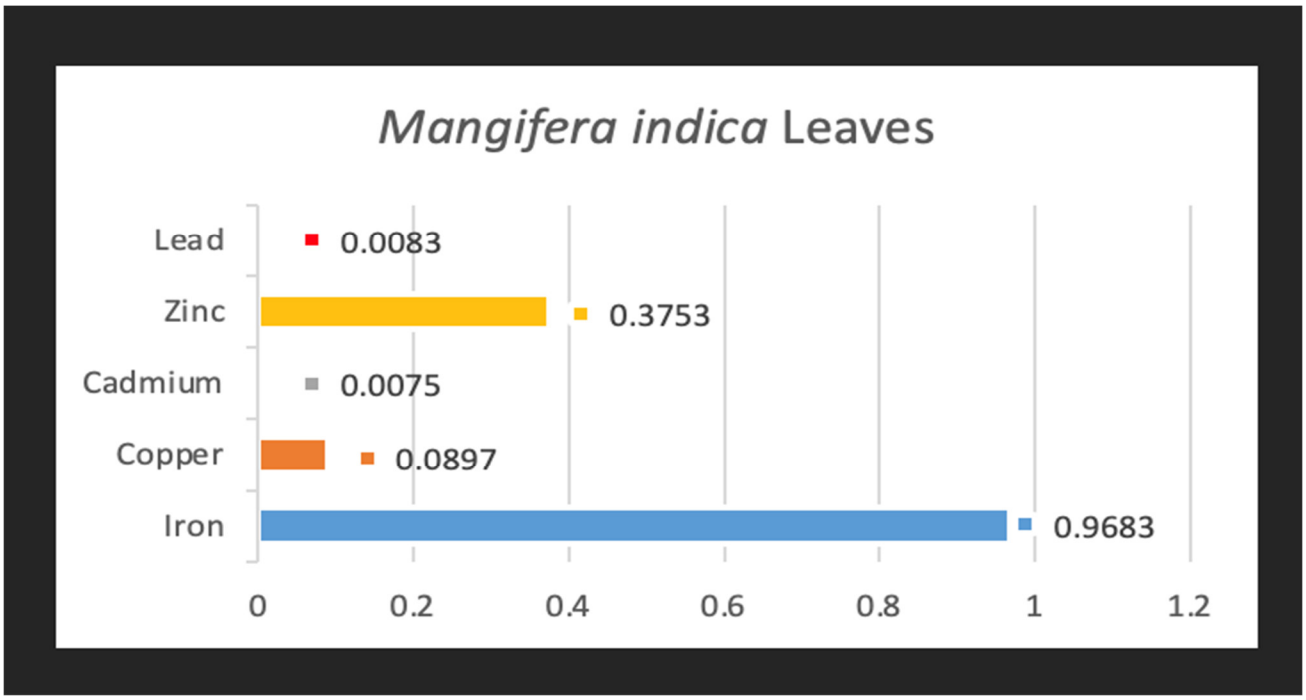


Figure 1. Romualdez Mangifera indica leaf samples

San Marcelino Street Soil Samples Romualdez Street Soil Samples

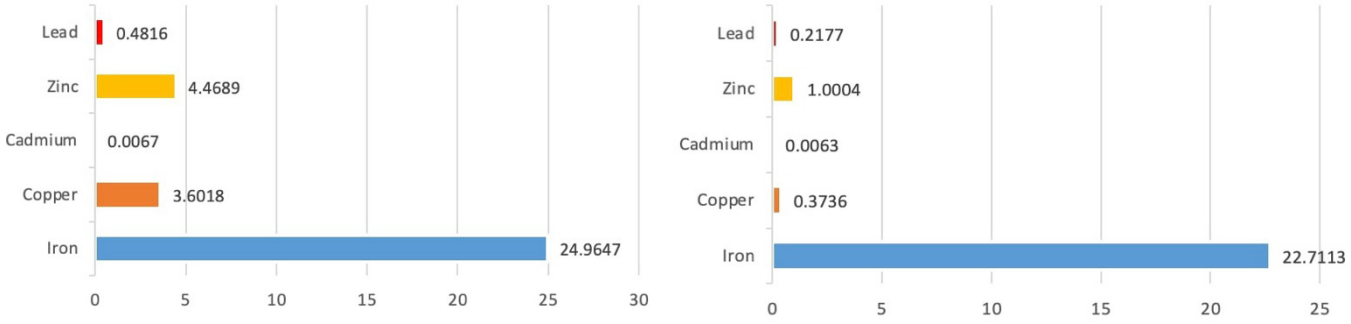


Figure 2. Soil samples between San Marcelino Street and Romualdez Street

BISMUTH-MODIFIED BIOCHAR FOR EFFICIENT REMOVAL OF ENVIRONMENTAL POLLUTANTS

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ABSTRACT

Water pollution caused by toxic contaminants such as heavy metals, dyes, and pharmaceutical residues has become a critical global challenge, threatening both environmental sustainability and human health. Among the emerging treatment technologies, biochar has attracted significant attention due to its low cost, eco-friendliness, porous structure, and tunable surface chemistry. However, pristine biochar often suffers from limited adsorption capacity and selectivity toward specific pollutants. To overcome these shortcomings, modification with functional metal species has been proposed as an effective strategy. In this study, we report the synthesis, characterization, and application of bismuth-modified biochar (Bi-BC) as an advanced material for efficient environmental remediation. The Bi-BC was prepared via a facile impregnation–calcination method, in which biochar derived from agricultural residues was doped with bismuth salts followed by thermal treatment. The introduction of bismuth species not only enhanced surface area and pore volume but also generated abundant oxygen-containing functional groups and active sites favorable for pollutant capture. Structural and chemical analyses including X-ray diffraction (XRD), scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), and Brunauer–Emmett–Teller (BET) surface area measurement confirmed the successful incorporation of Bi species and the significant improvement in surface textural properties. Batch adsorption experiments were conducted to evaluate the removal performance of Bi-BC toward representative pollutants such as phosphate (PO_4^{3-}). The adsorption kinetics followed a pseudo-second-order model, indicating chemisorption as the dominant mechanism, while the isotherm data fitted well with the Langmuir model, suggesting monolayer coverage on homogeneous sites. Thermodynamic analysis revealed that the adsorption processes were spontaneous and endothermic, driven by both electrostatic attraction and surface complexation. Overall, this work demonstrates that bismuth modification is a simple yet highly effective approach to engineer biochar into a multifunctional adsorbent with superior performance. The synergistic effect of porous carbonaceous structure and bismuth-based active sites enables the efficient removal of diverse pollutants, addressing urgent needs in sustainable water purification. Beyond adsorption, the unique electronic properties of bismuth further open opportunities for photocatalytic or electrochemical applications, offering a broader horizon for integrated environmental remediation technologies. This study not only provides scientific insights into the design of bismuth-functionalized biochar but also paves the way for its scalable utilization in real-world wastewater treatment.

Keywords: *Bismuth-modified biochar, adsorption, water treatment, phosphate removal, sustainable materials.*

Acknowledgement: *Luong C. T. Pham was funded by the Master, PhD Scholarship Programme of Vingroup Innovation Foundation (VINIF), code VINIF.2024.ThS.25. We acknowledge Ho Chi Minh City University of Technology (HCMUT), VNU-HCM for supporting this study.*

SMALL-PORE PURE ZEOLITE MEMBRANES FOR CO_2/CH_4 SEPARATION: A COMPREHENSIVE REVIEW

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ABSTRACT

Nowadays, the whole world is facing global sustainability challenges by rapid economic growth and population expansion, which demand the development of advanced materials and technologies for environmental remediation and renewable energy. In this context, zeolites have emerged as a promising candidates due to their exceptional molecular sieving ability, superior adsorption and ion-exchange capacities, outstanding hydrothermal stability, and cost-effectiveness. In particular, small-pore zeolites such as CHA, DDR, AEI and ERI are highly suitable for CO_2/CH_4 separation since their pore sizes are comparable to the kinetic diameters of these molecules, allowing for selective adsorption of diffusion. The increasing anthropogenic emissions of CO_2/CH_4 not only underscore the urgent need for effective carbon capture technologies at point sources but also highlight the necessity of natural gas purification and biogas upgranding to meet industrial and environmental standards. Recent advances in zeolite membrane synthesis – including seed-assisted methods, secondary growth techniques, and defect-mitigation strategies – have significantly improved membrane performance, particularly in terms of selectivity and permeance. Meanwhile, the development of zeotype materials such as SAPO and AlPO has further expanded the chemical composition and physicochemical properties available for CO_2/CH_4 separation. Therefore, investigating representative zeolite frameworks and small-pore zeolite membranes not only offers high efficiency is selective gas separation but also opens up great potential for applications in air pollution control, water purification, and especially CO_2 capture, thereby contributing to addressing the global sustainable development challenge.

Keywords: *Carbon capture and sequestration, Natural gas purification, Selective adsorption, Zeolite membranes, Biogas upgrading, separation...*

Acknowledgement: *This research is funded by University of Science, VNU-HCM under grant number UM2024-27.*

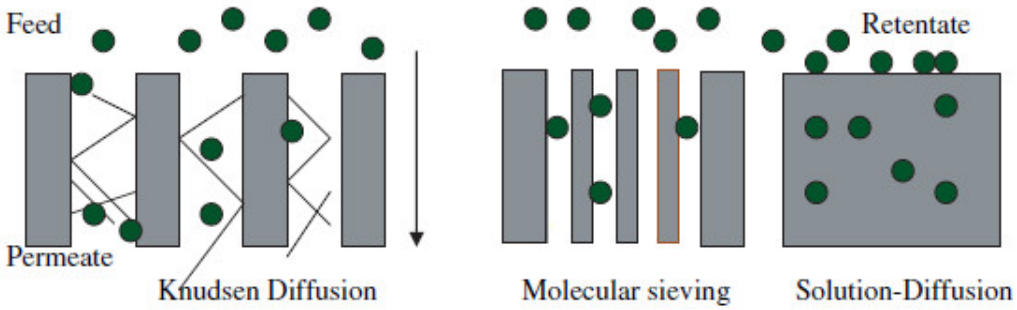


Figure 1. The mechanism of gas separation through membrane: diffuse Knudsen, molecular sieve and diffuse solution

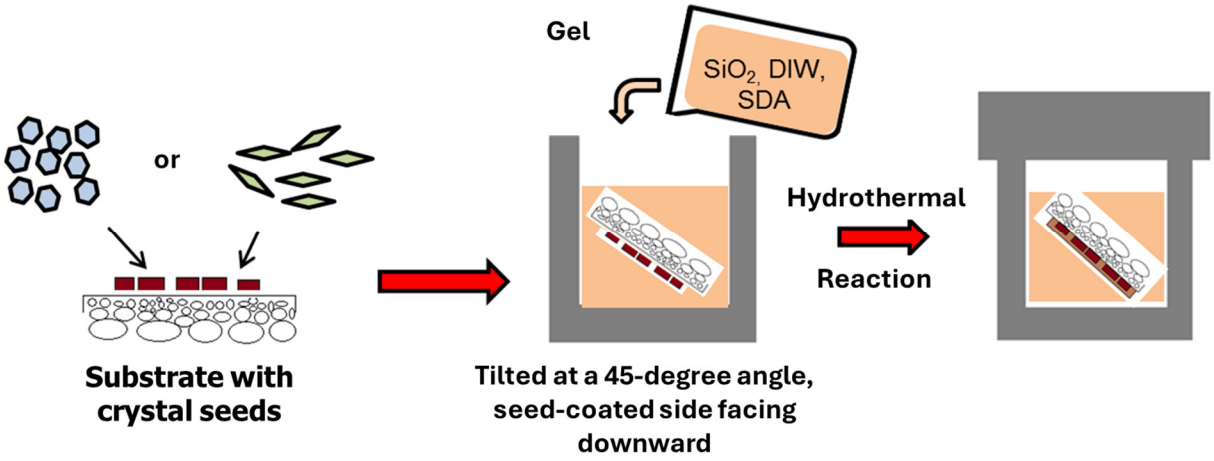


Figure 2. The process of fabricating Si-DDR membranes by the gel-assisted reaction method

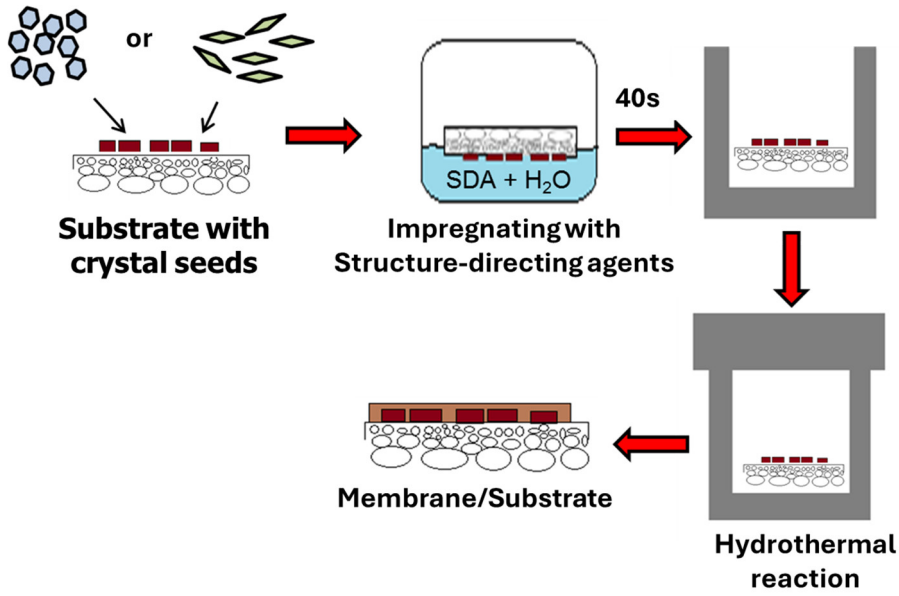


Figure 3. The process flow diagram for fabricating Si-DDR membranes by the non-gel reaction method.

FABRICATION OF CHITOSAN MEMBRANES DERIVED FROM *ASPERGILLUS NIGER* FOR THE REMOVAL OF HEAVY METALS (CHROMIUM AND IRON) IN WASTEWATER

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ABSTRACT

Heavy metal contamination has emerged as a pressing global environmental issue due to its potential for bioaccumulation and biomagnification within the food chain, thereby posing significant threats to human health and ecological integrity. This study investigated the development of adsorptive membranes synthesized from chitosan derived from *Aspergillus niger* (*A. niger*), a fungal strain isolated from shallots, for the adsorption of heavy metals in wastewater. The fungus was cultured in Potato Dextrose Broth (PDB) medium to obtain biomass, from which chitosan was subsequently extracted. The average yield of chitosan extraction was 38.69 ± 7.52% of the initial fungus biomass. To enhance stability, film-forming properties, and mechanical strength, the extracted chitosan was dissolved in 2% acetic acid and blended with a proportion of commercial chitosan. The resulting chitosan solution was then combined with bentonite suspensions at weight ratios of 90:10, 70:30, 50:50, and 30:70 (w/w) to fabricate chitosan/bentonite membranes. Structural and chemical analyses using Scanning Electron Microscopy (SEM) and Fourier-transform infrared spectroscopy (FT-IR) confirmed uniform phase distribution and the presence of characteristic functional groups. The applicability of the membranes was evaluated through swelling ratio, water absorption, antibacterial activity against *Bacillus subtilis*, and biodegradability. Notably, the membranes demonstrated high removal efficiency for Cr(VI) and Fe(II) at initial concentrations of 5 mg/L and 10 mg/L, respectively. Among the tested compositions, the membrane with a 50:50 chitosan-to-bentonite ratio achieved the highest performance, with removal efficiencies exceeding 80% for both metal ions. These results underscore the membrane's strong potential for application in the remediation of heavy metal-contaminated wastewater. The findings indicate that the fabricated chitosan/bentonite membranes exhibited not only effective metal adsorption capabilities but also antibacterial and biodegradable properties, presenting a sustainable alternative to conventional adsorbents such as activated carbon or natural clays.

Keywords: *Aspergillus niger, chitosan, bentonite, adsorption, heavy metals.*

Acknowledgement: *This research was funded by the University of Science, VNU-HCM, under The Scientific Research Incubation Program for Students (UM2024-21). The authors sincerely thank Faculty of Environment, University of Science, Vietnam National University Ho Chi Minh City, Viet Nam.*

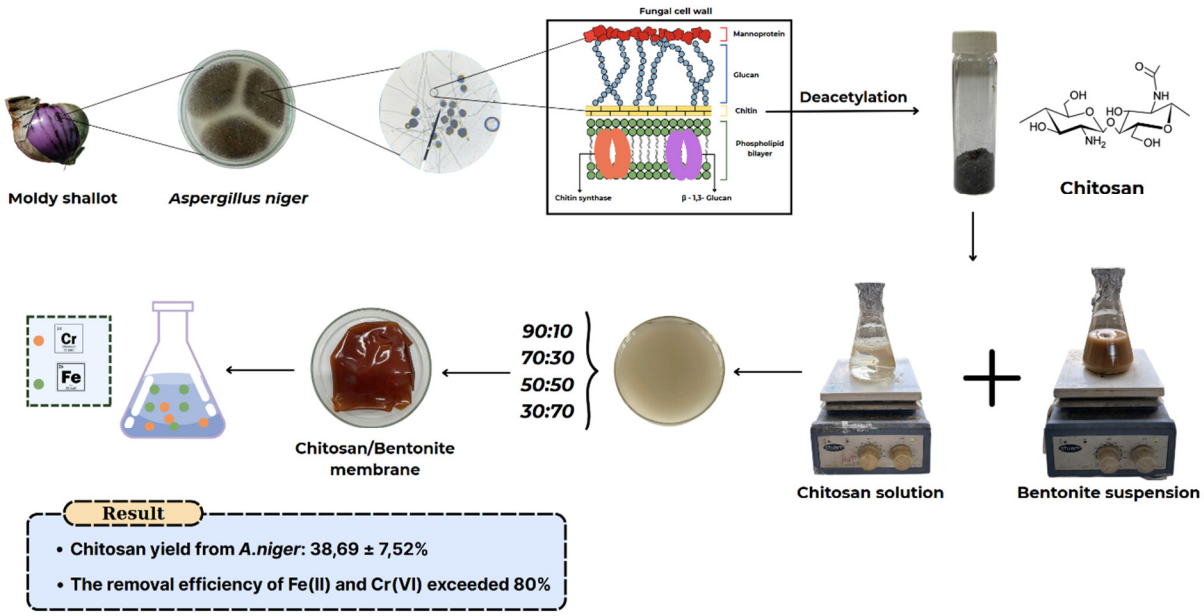


Figure. 1

SESSION IV

BIODIVERSITY AND AQUATIC RESOURCES

SPECIES DIVERSITY OF ANTS (HYMENOPTERA: FORMICIDAE) IN BARANGAY MALAPAD, MUNICIPALITY OF REAL, QUEZON, PHILIPPINES

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ABSTRACT

Ants, classified as insects belonging to the Order Hymenoptera and the Family Formicidae, are regarded as one of the most successful social insects present in an ecosystem. In the Philippines, ants are of particular interest due to the country's rich biodiversity and the presence of diverse entomological specimens across its many islands. In particular, at least 265 ant species are known to be found in Luzon, while 99 species are recorded in the islands of Mindanao (Gabisay et al., 2021). Ant species play a vital role in terms of ecological processes; their species are highly involved in nutrient cycling, seed dispersal, soil aeration, and habitat health indicators. They are highly responsive to ecological changes in the environment; these changes influence and impact their diversity and species distributions in a specific area. This study aimed to assess the species diversity and functional group composition of ants in Barangay Malapad, Municipality of Real, Quezon. Field sampling was conducted from March to April 2025 in two distinct habitat types: a riparian area (Station 1) and a secondary forest (Station 2). Standard collection techniques, including baiting and hand collection, were employed along 100-meter transects. Identification was done at the genus level using key references from one of the leading myrmecologists in the Philippines. The research obtained 1864 ant individuals representing 14 genera and five subfamilies under the family Formicidae. The genera Pheidole and Carebara were the most dominant across both sites (see **Figure 1**). Diversity analysis revealed that the secondary forest exhibited higher species diversity (Shannon-Weiner Index H′ = 1.549), while the riparian area showed lower diversity (H′ = 1.410). Environmental factors such as temperature and elevation also showed differences in the diversity of ant species, wherein higher temperature and lower elevation ranges have shown more species accumulation. At 34°C, 15 genera of ants were collected, while at 30°C, only 7 genera were recorded, showing substantial disparity between the two temperatures (see **Figure 2**). Ants are considered thermophilic; this shows that the distribution of ant species is mainly determined by their tolerance to heat. Therefore, these findings highlight the influence of habitat type on ant community composition and emphasize the ecological value of forested environments in supporting ant biodiversity.

Keywords: *Ant Diversity, Forest, Formicidae, Morphology, Ecology, Transect*

DISTRIBUTION OF MEDICALLY-IMPORTANT PARASITES AND SPECIES DIVERSITY OF ANURANS CAPTURED FROM THE SELECTED AREAS IN DAVAO CITY, THE PHILIPPINES

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ABSTRACT

The adaptability of anurans to diverse environments positions them as ideal hosts in the persistence of parasitic zoonoses. This study aimed to determine medically important parasite distribution from anurans in selected urban and rural areas of Davao City, the Philippines, to provide a basis for their zoonotic transmission. Convenience sampling was utilized in capturing anurans, followed by harvesting and processing of intestines and thigh muscles for wet mount microscopic identification of parasites. Among the collected anurans, more were females (72.55%) and adults (77.45%). This may suggest that the abundance of female and mature anuran populations make them the predominant reservoirs for medically important parasites in the area, potentially supporting the continuation of their life cycle; hence, a probable contributor to the persistence of human parasitoses. Distribution of the collected anurans revealed to be more abundant from the urban area (59.80%) than the rural area (40.20%). The Shannon-Wiener Diversity Index revealed a very low anuran diversity in both urban (H' = 0.144) and rural (H' = 1.42) areas suggesting an ecological imbalance in the selected areas. Parasitological assessment of five anuran species collected revealed high prevalence rates, with infections detected in *Rhinella marina* (90.54%), *Kaloula pulchra* (85.71%), *Polypedates leucomystax* (100%), *Hylarana grandocula* (100%), and *Kalophrynus sinensis* (50%), indicating widespread parasite occurrence across diverse amphibian hosts. The most prevalent parasites were *Spirometra* spp. (67.65%), Hookworms (20.59%), and *Capillaria* spp. (19.61%), all of which are known to be zoonotic, highlighting their threat to human health. Significant differences in terms of prevalence were observed in *Spirometra* spp. ($p = 0.037$) and Hookworms ($p = 0.003$) according to species of anurans. This may suggest that parasite distribution is influenced by host-specific factors, especially for *Spirometra* spp. and Hookworm spp. All four parasite prevalence rates were significant according to distribution (*Spirometra* spp. and *Capillaria* spp.: $p < 0.001$; Ascarid and Hookworms: $p = 0.002$). None showed significance according to anuran sex implying that both male and female anurans are equally capable of harboring parasites, increasing the probability of zoonotic transmission due to the wider scope of host selection. Only *Spirometra* spp. showed a significant difference according to the maturity stage ($p < 0.001$), which are considered to be significant due to their association with sparganosis – a parasitic disease that can infect amphibians and human hosts through ingestion or contact with contaminated water. With this, environmental proximity and cultural consumption of anurans highlights the risk of transmission and disease, especially that day-to-

day frog consumption customs in some places in the Philippines raise concerns about foodborne parasitic infections, particularly when food preparation is poor or insufficient. Correlating anuran parasitosis with human parasitosis through examination of stool specimens will enhance the determination and monitoring of parasitic zoonotic infection, and community education can serve as a critical intervention to emphasize environmental sanitation in prevalent areas and safe anuran preparation to minimize infection through consumption.

Keywords: *Anurans, Davao City, Medically-important parasites, Philippines, Wildlife Biology*

Acknowledgement: *We would like to extend our deepest gratitude to the following institutions who have greatly contributed to the success of this research study. To the College of Medical and Biological Sciences (CMBS) faculty and staff for their collective efforts to make this study possible. To the Department of Environment and Natural Resources XI, for granting permission to collect anurans in the designated areas of this study. Their support has facilitated the conduct of this research. To the Department of Science and Technology - Science Education Institute (DOST-SEI) Region XI, for supporting their undergraduate scholars by providing financial support through a thesis allowance. Their provision has proven their enthusiasm for the advancement of scientific knowledge. To the communities of Brgy. Bucana and Brgy. Tagakpan, for warmly welcoming the research proponents into their areas for the anuran collection. Your hospitality and cooperation have made this study possible. And above all, to the Almighty God, for the wisdom, guidance, and blessings that have accompanied the proponents throughout this research journey. His divine providence has been the source of the proponents' strength and inspiration.*



Figure 1. Collected Anuran individuals. A) Rhinella marina, B) Hylarana grandocula, C) Kaloula pulchra, D) Polypedates leucomystax, and E) Kalophrynus sinensis.

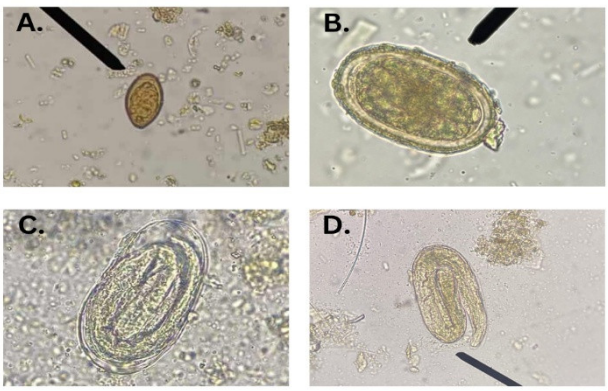


Figure 2. Parasites in Anuran Intestine under High Power Objective (400x). A) Spirometra spp. egg, B) Ascarid egg, C) Hookworm egg, D) Hookworm larvae.

THE IMPACT OF THE INVASIVE ANURAN *RHINELLA MARINA* ON THE DIET OF ENDEMIC PHILIPPINE ANURANS: A LOCAL STUDY IN DAVAO CITY, PHILIPPINES

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ABSTRACT

The distribution, diet, and niche overlap of anuran species collected from three sites (mossy forest, dipterocarp forest, and agroforest ecosystem) in Panigan-Tamugan Watershed in Barangay Carmen Baguio District, Davao City were determined by calculating ecological indices, performing diet composition analysis, and calculating for Pianka's Index, respectively. A total of 94 anurans were collected from all three sites and were represented by 14 species. The invasive *Rhinella marina* was found only in the agroforest ecosystem indicating that invasive frogs have not yet encroached forested sites. Results of the Shannon-Wiener's Diversity Index showed higher diversity in the agroforest ecosystem (H' = 1.910) where 8 species of frogs were captured. High dominance was observed in the mossy forest (D = 0.298). There were 20 food items that were identified in the stomach of the frogs and were categorized into: invertebrates, inorganic matter, and plant matter. The presence of amorphous substance indicates active digestion during the time of capture. Food items that made up the largest bulk of the diet of anurans belonged to Class Arachnida and Class Insecta (Coleoptera and Hymenoptera: Formicidae). Plant matter has high abundance among anurans that prefer the ground microhabitat due to accidental ingestion. Calculation for Pianka's Index showed high niche overlap of *Rhinella marina* with Philippine endemics *Ansonia muelleri* (0.97), *Hylarana grandocula* (0.98), *Occidozyga laevis* (0.95), and *Pelophryne brevipes* (0.90). The invasive *R. marina* shares the same habitat type with *H. grandocula* and *O. laevis* highlighting the possibility of the invasive anuran as important competitor for food resource for endemic anurans. This may also indicate direct competition of food items among anurans within the watershed.

Keywords: *anurans, Davao City, gut content, invertebrate prey items, niche overlap*

Acknowledgement: *The authors are thankful to the Obu-Manuvu Unified Ancestral Domain Tribal Council of Elders and Leaders, Inc., Koontayan 'To Obu-Manuvu of Carmen Inc. Forest Protection and Management Committee, EGIP Foundation, Inc., and Barangay Local Government Unit of Barangay Carmen in Baguio District for allowing the researchers access to the sites. Thanks also to the Department of Environment and Natural Resources-Region XI who issued the collection permit for voucher collection.*

Acknowledgment is also given to the Institutional Animal Care and Use Committee (IACUC) of Davao Medical School Foundation, Inc. for granting the IACUC permit and the Bantay Bukid of Barangay Carmen members for the assistance and guidance during the assessment.

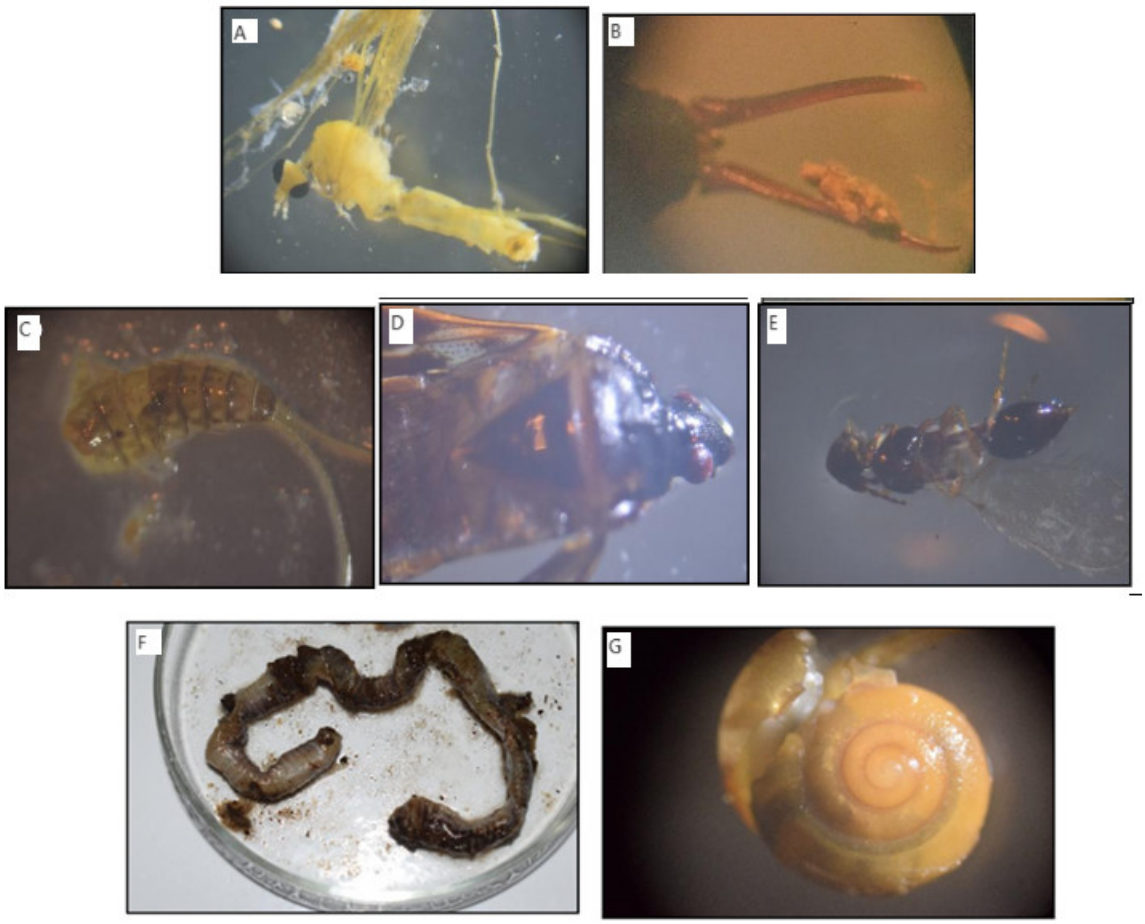


Figure 1. Food items collected from the stomach of Rhinella marina: A – Dermaptera, B – Diptera, C – Ephemeroptera, D – Hemiptera, E – Hymenoptera, F – Annelida, G - Mollusca .

PAGBANTAY PIGAGIKANAN SANG ALLUG: CHARACTERIZATION OF BAGUAN HEADWATER WATERSHED IN TARRAGONA, DAVAO ORIENTAL, BASIS FOR ENHANCED PROTECTION AND MANAGEMENT PLAN

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ABSTRACT

The study addressed the need for LGU Tarragona, Davao Oriental, for science-based data on water quality and biodiversity profile of Baguan headwater, the most significant and essential freshwater source in the municipality. Such data was highly significant for crafting the watershed's conservation, protection, and management plan, despite the watershed being declared a critical habitat of the critically endangered Philippine Eagle (*Pithecophaga jefferyi*). Field explorations were conducted last October and December 2022, which covered agro-forested and montane forests in Barangay Ompao, and the dipterocarp, montane, and transitional montane-mossy forests of Barangay Tomoaong. Water quality assessment results revealed that: biological oxygen demand (BOD)- 2.54 mg/L, phosphate concentration (0.03 mg/L and 0.305 mg/L), and fecal coliform count exceeded national acceptable standards for water quality. Surveyed sites in the Baguan watershed are still relatively heavily forested and are home to many plant and animal species known to occur only in Mindanao or the Philippines. One hundred genera of trees, 74 birds, eight bat species, six non-volant mammals, 16 frogs, and 10 reptiles were documented in all surveyed sites. Baguan headwater is also home to threatened species, including the critically endangered national bird (*P. jefferyi*), the endangered Mindanao hawk eagle (*Nisaetus pinskeri*), the endangered plant with the large flowers (*Rafflesia mira*), and the vulnerable species locally known as "bunul" (*Xanthostemon bracteatus)*. The forested area of Baguan headwater is an essential habitat for a possible new species, as specimens of two potentially novel species of lizards of the family Gekkonidae were recorded from the upper dipterocarp forest of Barangay Tomoaong. Although the water quality of the Baguan watershed appears to be acceptable for seven parameters, the high values for BOD, phosphate concentration, and the fecal coliform count imply activities on or surrounding the watershed, which, in the long run, may render the water quality unacceptable for use by the locals. Results of the water quality and biodiversity profiling of Baguan headwater suggest that the watershed is an essential habitat for several species of plants and animals, given its current state of having a good percentage of forested habitats where the bulk of the species were documented. However, it is essential to highlight that anthropogenic activities were also observed in the surveyed areas, which may put pressure on the existing

habitat of the watershed. Given the results of this study, data will be utilized to initiate sustainable measures to monitor the water quality of the Baguan watershed and ensure the community's safety, which is dependent on this resource. Given pressing threats to the habitat, the declaration of the Baguan watershed as a community watershed expanding its current protected area from 2,503.98 to 5,000 hectares will add a layer of protection to these species reliant on this important habitat. Lastly, the information generated from this study is directed as a basis for the prompt crafting and implementation of a sound, practical, and sustainable conservation, protection, and management plan of the Baguan watershed.

Keywords: *ecological conservation, freshwater, sustainable resource utilization, wildlife protection*

Acknowledgement: *Funding support of the study was made possible through the NRCP Science and Technology Experts Pool (NSTEP) Small R&D Grant for Mindanao, of the Department of Science and Technology (DOST) National Research Council of the Philippines (NRCP) afforded to Elsa May Delima-Baron. Logistics support was also provided to the team by the Local Government Unit of Tarragona, San Pedro College Management, and Davao Oriental State University Management. Permit to collect representative vouchers of wildlife was granted to Elsa May Delima-Baron by the Department of Environment and Natural Resources Office -XI (2022-18).*

SYSTEM DYNAMICS MODELLING OF THE CARBON STORAGE POTENTIAL OF A MANGROVE STAND IN MACAJALAR BAY, MISAMIS ORIENTAL, PHILIPPINES

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ABSTRACT

This study simulates the carbon sequestration potential of a reforested mangrove stand in El Salvador City, Misamis Oriental, Philippines. Specifically, this study aimed to determine how mangrove tree parameters affect optimal carbon storage potential of the *Rhizophora sp.* stand and how changes in these parameters over the next 30 years or more affect the carbon storage in the mangrove stand. System dynamics modelling was utilized in the treatment of the data to answer the objectives. The simulation suggests that the sequestration rate reached its peak rate after 22 years and gradually decreases until it reaches a rate of zero after 63 years. Furthermore, the carbon stocks were projected to be increasing through time, until it reaches the maximum carbon storage of 1.27 ton C/ha at 80 years old. Lastly, the sequestration rate was observed increasing as DBH and height reaches its maximum values and gradually decreases when height and DBH reaches an equilibrium.

Keywords: *biomass, carbon sequestration, diameter at breast height, mangrove stand, tree height, simulation model*

THE FILTRATION CAPACITY OF THE INVASIVE CHARRU MUSSEL (*MYTELLA STRIGATA*): IMPLICATIONS FOR BIOFILTRATION IN PHILIPPINE WATERS

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ABSTRACT

The invasive Charru mussel (*Mytella strigata*) (Fig. 1) is not native to the Philippines. Still, it has established significant populations in Manila South Harbor, posing a growing threat to aquaculture infrastructure in regions such as Tangub, Misamis Occidental, Philippines. While known for its broad salinity tolerance, its ecological impact, particularly its sediment filtration capacity, remains poorly quantified. This study investigated the filtration capabilities of *M. strigata* across different size classes and time durations to assess its potential role in biofiltration and its environmental impact. Mussels were grouped into three size classes (small: 4.0–4.5 cm; medium: 5.0–5.5 cm; large: 7.0–7.5 cm) and their sediment clearance rates were measured over 6, 12, and 24-hour periods. Results demonstrated that the small size class cleared the most sediment overall (55 mg/L) and achieved the highest clearance rate (7.12 $mg/L^{-1} \cdot Hr^{-1}$), closely followed by the large size class (45 mg/L cleared; 7.0 $mg/L^{-1} \cdot Hr^{-1}$). The peak clearance rate for all sizes occurred at 12 hours (Fig. 2). Statistical analysis revealed a significant difference in performance between small ($p = 0.008$) and large ($p = 0.000$) size classes compared to controls, but not for the medium class ($p = 0.090$). The findings confirm that *M. strigata* is a potent biofilter, with smaller individuals exhibiting unexpectedly high efficiency. This filtration capacity suggests a potential dual role for the invasive species: as a disruptive organism to aquaculture and a possible candidate for bioremediation in eutrophic waters. Further research should focus on its population-level effects on water clarity and nutrient cycling.

Keywords: *Mytella strigata, biofiltration, clearance rate, aquaculture impact, Philippines.*

Acknowledgement: *University of Science and Technology of Southern Philippines.*



Figure 1. Mytella strigata (Hanley, 1843) Charru mussel

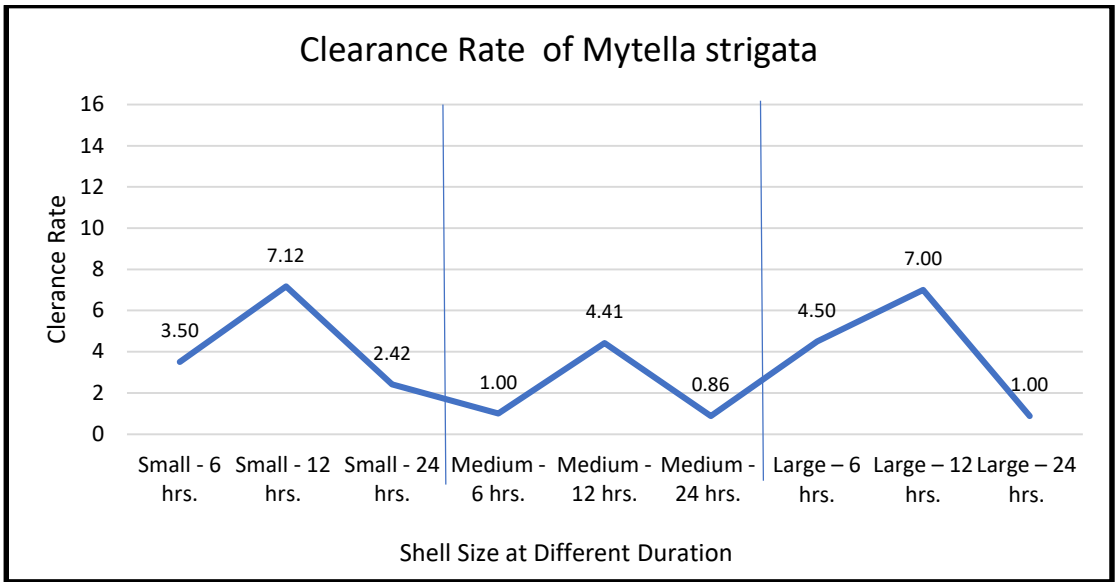


Figure 2. Clearance rate (mg L^{-1} h^{-1}) of the small, medium, and large Mytella strigata

DISCHISTODUS PERSPICILLATUS BEHAVIOR AND INTERACTION WITH OTHER MARINE SPECIES

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ABSTRACT

The white damsel, *Dischistodus perspicillatus* is notably a territorial and aggressive fish towards other organisms that may compete for space or resources within its habitat. The white damsel, *D. perspicillatus* was investigated in Samal Island, Philippines to describe its behavior and interaction with other species and identify potentially competing species within its territory. The fish behavior and interaction were observed on an hourly basis through snorkeling and SCUBA diving in the shallow areas, between 1-4 meters depth within the DNSC Marine Reserve Park. The observations were continuously conducted until theoretical saturation was reached. Observations were supported by underwater photos and videos. *D. perspicillatus* is a frequent feeder during daytime, but it feeds more frequently between noon to afternoon on encrusting algae on the hard corals and fine sand. It also feeds on ova of giant clam, *Tridacna gigas* during mass spawning events and drives away fish competitors. Other behaviors include pairing, body cleaning, carrying objects, pushing its caudal fin on sand and pinching invertebrates.

The fish demonstrated strong territorial behavior and aggression towards 11 fish species namely: Dascyllus melanurus, Dischostodus chrysopoecilus, Halichoeres chloropterus, Halichoeres scapularis, Parupeneus barberinus, Parupeneus pluerostigma, Pentapodus trivittatus, Pomacentrus pavo, Pomacentrus grammorhynchus, Scolopsis lineatus and Thalassoma lunare. The fish also attacks fish feeding associations that go near its territory. It is aggressive even towards its own species and even to humans. The D. perspicillatus has aggressive territorial behavior toward both conspecifics (same species) and heterospecifics (other fish species), but not preying on them. The white damsel fish's aggression may be attributed to its territorial defense of algal farms, which it actively cares, and protects from other fish species in its habitat.

Keywords: *Territorial behavior, aggression, diurnal, Philippines*

Acknowledgement: *The researcher would like to thank the Davao del Norte State College for the funding support.*

COMMUNITY STRUCTURE OF REEF FISHES IN ARTIFICIAL AND NATURAL REEFS IN ADECOR SAMAL ISLAND, PHILIPPINES

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ABSTRACT

This study evaluated and compared reef fish communities between Natural Reefs (NRs) and Artificial Reefs (ARs) in Adecor, Island Garden City of Samal, Davao Gulf, Southern Philippines. The research used Fish Visual Census (FVC) methods to survey 6 transects which included 3 for each reef type to evaluate species richness, as well as fish density, biomass and habitat complexity. A total of 47 species were recorded which belonged to 10 families and 30 genera. The study found NRs supported 40 fish species which demonstrated their habitat suitability compared to only 16 fish species found in ARs. The study revealed that NRs maintained higher density and biomass levels which measured 3863 ind./1000m^2 and 43.2 kg/1000m^2 compared to ARs with 727 ind./1000m^2 and 5.6 kg/1000m^2 respectively. The T-test demonstrated significant differences in fish density ($p=0.039<.05$) and biomass ($p=0.01<.05$) between the two reef types, NRs and ARs. The environmental parameters showed that NRs had better rugosity (0.4692) and wave energy reduction than ARs (5.85%) which demonstrated their superior structural complexity and ecological functionality. The study shows NR habitats possess superior ecological qualities than ARs. Thus, there is a need to develop better ARs designs which will better replicate natural ecosystem to boost reef biodiversity and fisheries productivity.

Keywords: *Reef Fish Communities, Natural Reefs (NRs), Artificial Reef (ARs), Fish Density and Biomass, Habitat Complexity.*

Acknowledgement: *Davao del Norte State College as funder of the study*

DIET COMPOSITION AND FEEDING BEHAVIOR OF *PROTOREASTER NODOSUS* (LINNAEUS, 1758) IN SAMAL ISLAND, PHILIPPINES

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ABSTRACT

The study was conducted to characterize the diet composition, feeding prevalence, correlate stomach eversion extent with diet variation and aboral expansion, and document feeding behavior of *Protoreaster nodosus* in Samal Island, Philippines. This study employed an opportunistic sampling between intertidal and subtidal habitats using a roving survey (2-4 weeks) and checked a total of 114 individuals between different times at morning (0800H-1000H), afternoon (1500H-1700H) and evening (2200H-2400H). A total of 19 diet types were identified and found within the cardiac stomach of *P. nodosus* (n=342) of which the top five (5) frequently consumed diets were sand, fleshy algae, epiphytes, rubbles, and *Thallasia hemprichii* across different times but it opportunistically prey on invertebrates like heart urchin at night, so they are generalist predators, eating microalgae, bivalves, snails and other small animals. In terms of diet category, macroalgae and sediment were relatively high and significantly different among the diets (ANOVA: $p<.05$). Feeding prevalence is consistently very high across different times morning, afternoon and evening but found no significance among them (ANOVA: $p>.05$) suggesting they are voracious feeder that spends most of its time feeding. The extent of stomach eversion had no correlation with diet variation ($r=0.09$) and had low correlation with aboral expansion ($r=0.27$). The unique feeding behaviors namely normal position, riding, trapping, engulfing, aboral expansion, and elevation, demonstrates body flexibility enabling the species to consume varied diet items of different sizes, shapes from different habitats. The findings demonstrated that *P. nodosus* is a generalist-opportunist feeder consuming on available diet immediate to its environment.

Keywords: *seastar, diet, feeding prevalence, behavior, regurgitation*

Acknowledgement: *The researcher expresses his profound gratitude to Research Extension and Production Unit and Institute of Advanced Studies through the DNSC-funded project: Reproduction, Feeding, and Predation of Seastars in Samal Island, for the funding support.*

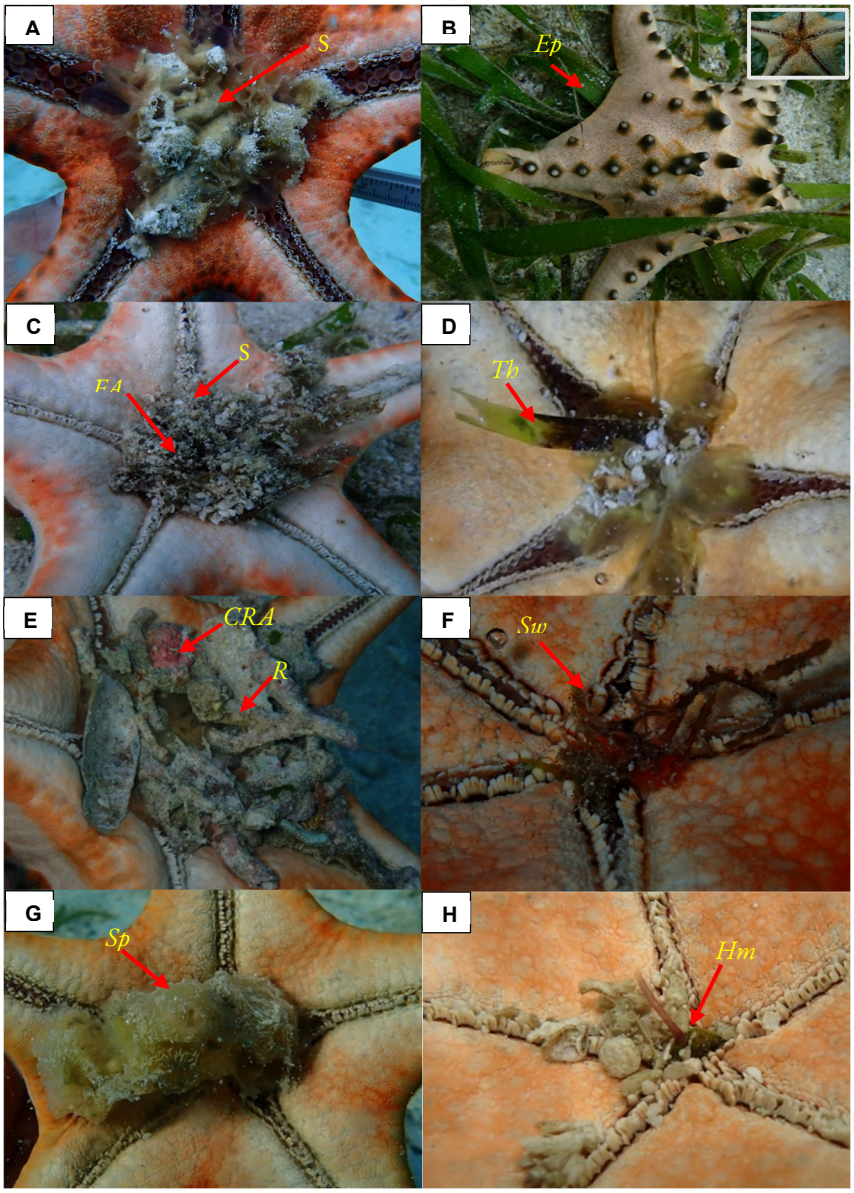


Figure 1. Common diet encountered on the oral surface of P. nodosus. (**A**. S=Sand; **B**.Ep=Epiphytes; **C**. FAl=Fleshy Alage; **D**. Th=Thalassia hemprichii; **E**. CRA=Coralline Red Alage & Ru=Rubbles; **F**. Sw=Seaweed; **G**. Sp=Sponge; **H**. Hm=Halophila minor

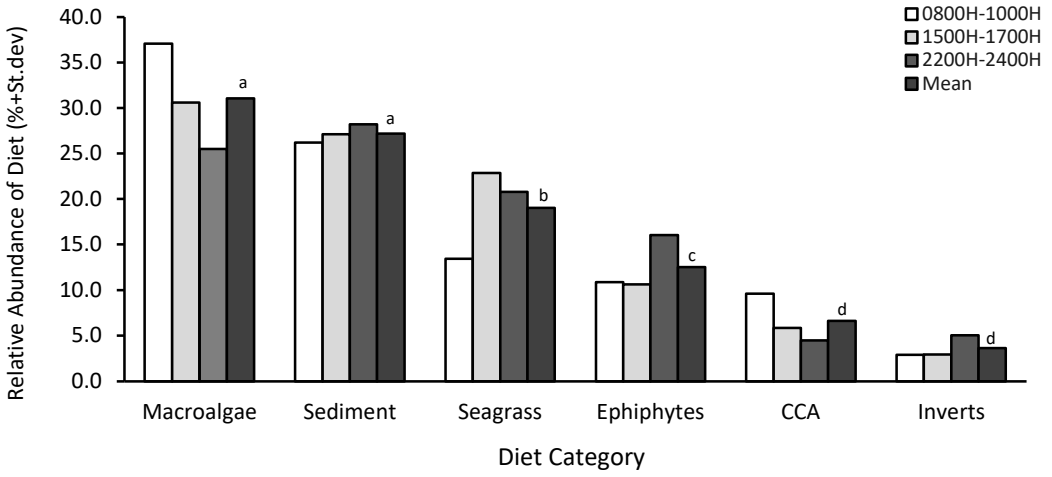


Figure 2. Mean of diet categories of P. nodosus in different three sampling time (n=114).

GIANT CLAM, *TRIDACNA SPP*. RESTOCKING IN MINDANAO ISLAND, PHILIPPINES

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ABSTRACT

Tridacna gigas and *Tridacna derasa*, the two largest bivalves are becoming locally extinct in the Philippines due to poaching and unregulated trade. Recently, IUCN has raised the conservation status of *T. gigas* from Vulnerable (VU) to Critically Endangered (CR) and *T. derasa* from Vulnerable (VU) to Endangered (EN). To increase the local stocks, the two species became the focus of nationwide restocking efforts of giant clams at over 40 restocking sites in the Philippines, which included the Marine Reserve Park (MRP), in Samal Island. After more than two decades, a study was conducted to assess the gains of giant clam restocking in Samal Island to assess the size structure of the broodstocks, reproduction and spawning, and recruitment of the species.

Giant clam broodstocks of *T. gigas* (n=860) and *T. derasa* (n=450) exist in restocking site, with mean and largest sizes of 75.9 ± 0.94 cm., 98cm and 41.58± 0.43cm., 54cm. respectively. Other species restocked in the MRP include *T. squamosa, T. maxima, T. noae and T. crocea.* Within the restocking site, mass spawning events of *T. gigas* (n=33) and *T. derasa* (n=22) were observed, releasing both eggs and sperm between 1500 to 1800 h, a few days before the full moon. The recruitment of *T. gigas* and *T. derasa* was also observed in reefs within and near the restocking site. Recruits of *T. gigas* (n=43) and *T. derasa* (n=15) with a mean size 14.9 ± 0.76 cm and 9.5 ± 0.66 cm respectively were found at 3.8 km north and 11.4 km south directions, all in the Western Side of the Island. *T. gigas* recruits were also located 6.4 km across the smaller Talikud Island. The presence of *T. gigas* and *T. derasa* recruits, near restocking sites and in-situ spawning observations in Samal Island may indicate that restocked clams are now able to supply larvae to adjacent reef areas.

The huge giant clam broodstock gave rise to Taklobo/Giant Clam Tours, an ecotourism that showcases *Tridacna spp*., the charismatic megafauna, and features its different species, their conservation status, and the indispensable role of marine protected areas in giant clam conservation. It became the banner tourism destination in Samal Island where it gained an increasing number of guests annually from 3,123 tourists in 2013 to 10,765 tourists in 2024 with a total of 129,615 guests from 38 countries worldwide. The successful restocking of giant clams for over 20 years, not only replenished degraded reef areas but it provided sustainable ecotourism and livelihood opportunities for coastal communities.

Keywords: *Marine Protected Areas, Samal Island, Restocking, Giant Clams*

Acknowledgements: *Department of Science and Technology - Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development* ***(DOST-PCAARRD),*** *University of the Philippines - Marine Science Institute* ***(UP-MSI),*** *Commission on Higher Education* ***(CHED)*** *and Davao del Norte State College* ***(DNSC)*** *for the funding and technical support.*

HIGH-THROUGHPUT SEQUENCING OF MEIOFAUNAL COMMUNITY IN LAKE APO, BUKIDNON, PHILIPPINES USING 28S RRNA GENE

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ABSTRACT

Environmental DNA (eDNA) metabarcoding has revolutionized meiofaunal biodiversity research, providing non-invasive, high-resolution analyses of benthic communities and overcoming challenges in morphological identification. This study employed 28S rRNA eDNA metabarcoding to investigate the diversity of meiofauna in Lake Apo, Bukidnon, Philippines and their correlations with environmental variables. The results showed that 28S rRNA gene effectively highlighted dominant groups, including Mollusca (24%), Annelida (16%), Ascomycota (15%), and Arthropoda (11%) across 31 detected phyla. However, phylum Nematoda, a typically dominant meiofaunal group in freshwater ecosystems, accounted for only 1% of the retrieved taxa, deviating from the expected trends. Furthermore, distinct taxa were observed associated with specific environmental gradients, suggesting niche differentiation within the lake. Species diversity was notably higher at site S4-SL, reflecting spatial variability in meiofaunal community structure. While 28S eDNA metabarcoding proves efficient in biodiversity assessments, its limitations, such as biased diversity estimates, highlight the need for complementary morphotaxonomic approaches. Moreover, this study also underscores the potential of eDNA metabarcoding for advancing meiofaunal research and monitoring aquatic ecosystem health while acknowledging its constraints.

Keywords: *environmental DNA, Lake Apo, Bukidnon, Next-Generation Sequencing, 28S rDNA*

Acknowledgement: *The Department of Science and Technology (DOST) through the Accelerated Science Technology Human Resource Development Program (ASTHRDP) is gratefully acknowledged for the financial support necessary to carry out this study.*

MORPHOLOGICAL CHARACTERISTIC AND TAXONOMIC COMPOSITION OF MARINE GASTROPODS IN THE INTERTIDAL ZONES IN TANDAG CITY, SURIGAO DEL SUR, PHILIPPINES

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ABSTRACT

Marine gastropods are among the most diverse and ecologically significant groups of mollusks, playing key roles in nutrient cycling, sediment dynamics, and marine food webs. However, their populations face increasing threats from climate change, habitat degradation, and overexploitation, thereby undermining ecosystem stability. Opportunistic sampling was conducted in three intertidal zones in Tandag City, a biodiversity-rich site that supports numerous invertebrate species and provides resources for local livelihoods. Despite the Philippines being recognized as a mega-diverse nation, research on mollusk diversity remains limited, underscoring the need for regional assessments. Collected gastropods were morphologically and taxonomically characterized, yielding a total of 105 species belonging to 29 families. Notable species included *Conus aristophanes*, *Rhinoclavis sinensis*, *Monetaria moneta*, *Turbo intercostalis*, *Harmonicus sponsalis*, *Conus milaris*, and *Monetaria annulus*, with Conidae, Cerithiidae, and Cypraeidae identified as the most dominant families. Among the study sites, Buenavista exhibited the highest diversity, followed by Mabua, while San Antonio recorded the lowest. Environmental factors such as salinity, water temperature, total dissolved solids (TDS), and pH were found to significantly influence gastropod community structure. Notably, many of the identified species remain classified as Not Evaluated by the IUCN, emphasizing the urgency of research on their population dynamics, ecological functions, and potential vulnerabilities. Overall, the findings highlight the ecological importance of intertidal zones as habitats for marine invertebrates, provide critical baseline data for conservation and management, and reinforce the need for sustainable coastal resource management in the region.

Keywords: *diversity, abundance, intertidal gastropod, environmental parameters*

DIVERSITY AND ABUNDANCE OF ECHINODERMATA IN SELECTED AREAS OF THE INTERTIDAL ZONE IN MARIHATAG, SURIGAO DEL SUR

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ABSTRACT

Echinoderms play vital ecological roles in marine ecosystems, contributing to nutrient cycling, sediment dynamics, and serving as indicators of environmental change. This study investigated the community structure of echinoderms across four intertidal sites in Marihatag, Surigao del Sur, Philippines. Low-tide sampling and taxonomic identification recorded 4,663 individuals representing the classes Asteroidea, Echinoidea, Holothuroidea, and Ophiuroidea. Species abundance and composition varied considerably among sites, with Ophiocoma scolopendrina and Synapta maculata emerging as the most abundant species. The clear differences in assemblage patterns highlights the influence of local environmental conditions and substrate characteristics in structuring echinoderm communities. These findings provide baseline data essential for biodiversity monitoring and emphasize the need for site-specific management strategies to support intertidal ecosystem conservation.

Keywords: *echinoderm diversity, intertidal ecosystems, community structure, biodiversity conservation*

OPTIMIZING NUTRIENT AND LIGHT REGIMES FOR SHRIMP POND WASTEWATER TREATMENT BY SPIRULINA PLATENSIS IN HIGH-RATE ALGAL PONDS (HRAPS)

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ABSTRACT

Wastewater pollution from shrimp aquaculture poses a significant environmental challenge, necessitating effective and sustainable treatment solutions. This study aimed to optimize the shrimp pond wastewater treatment capacity of *Spirulina platensis* (S.*platensis*) in High-Rate Algal Ponds (HRAPs) through the combined application of nutrient supplementation and light enhancement. The results demonstrated that the modified Zarrouk medium had yielded the highest growth performance, achieving a dry weight (DW) of 1123.43 ± 10.10 mg/L on day 14. Red light exceeded the performance of blue and white light, resulting in a DW of 1371.52 ± 15.76 mg/L, specific growth rate (SGR) of 0.18 ± 0.01 day^{-1}, doubling time (DT) of 3.93 ± 0.21 days, and biomass productivity (BP) of 94.87 ± 3.52 mg/L·day ($p < 0.05$). The HRAPs system, operated under red light and supplemented with modified Zarrouk medium, achieved removal efficiencies for chemical oxygen demand (COD) 85.44 ± 10.84%, total phosphorus (TP) (92.59 ± 9.63%), total nitrogen (TN) (89.10 ± 8.31%), nitrate nitrogen (NO_3^--N) (87.93 ± 9.32%), ammonium (NH_4^+-N) 94.62 ± 1.12%, total suspended solids (TSS) (91.00 ± 1.77%), and Coliforms 99.99 %. The *S. platensis* biomass effectively absorbed nutrients in its growth from a culture medium combining shrimp pond waste and heterotrophic microbial community. Biomass production of *S. platensis* reached a DW of 586.91 ± 145.12 mg/L and chlorophyll a of 4.62 ± 0.88 mg/L after 14 days. The findings also suggest that The HRAPs system utilizing *S. platensis* not only provides high wastewater treatment efficiency but also promotes green technology, supporting a circular economy through the reuse of algal biomass for agricultural and energy purposes. The results confirm the potential of HRAPs under optimized conditions as a sustainable, environmentally friendly solution for aquaculture wastewater treatment, with prospects for large-scale implementation.

Keywords: *Spirulina platensis, algae biomass, dry weight, HRAPs, shrimp pond wastewater.*

Acknowledgement: *The authors gratefully thank Vietnam National University Ho Chi Minh City—University of Science and Faculty of Environment for supporting the laboratory. This research is funded by the University of Science, VNU-HCM under grant the Scientific Research Incubation Program for Student (UM2024-20).*

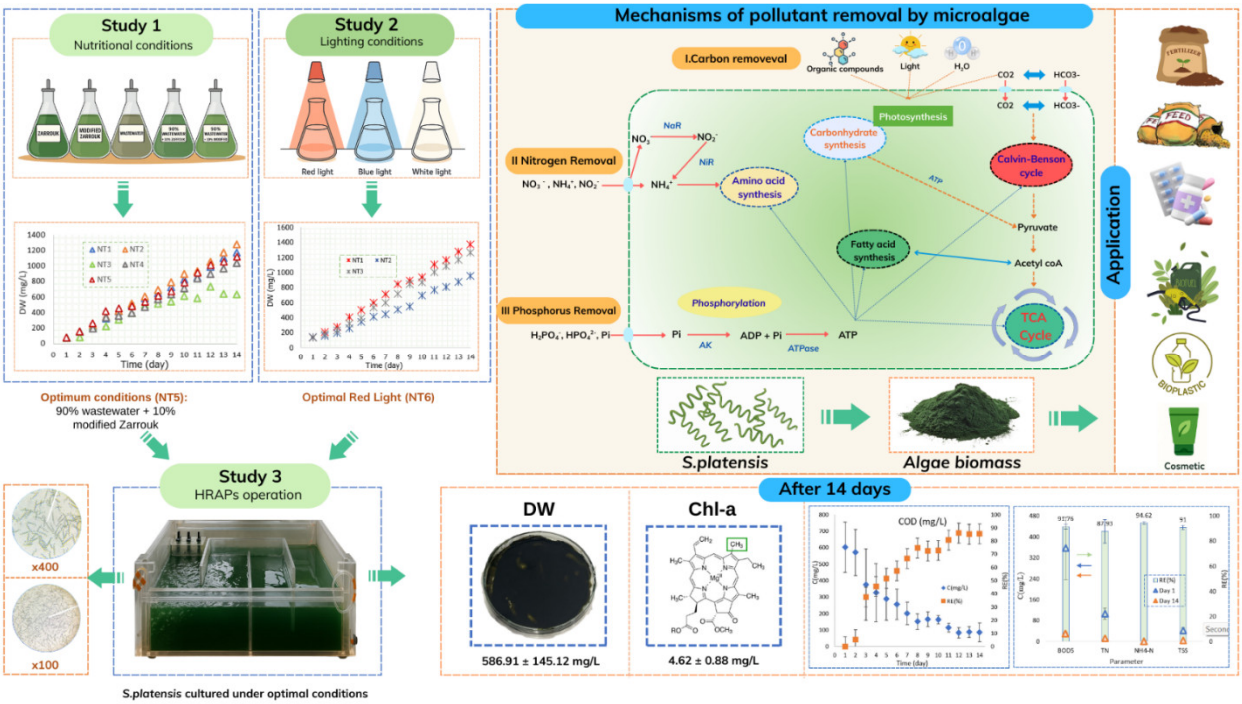


Figure. Graphical abstract

END-TO-END ARTIFICIAL INTELLIGENCE OF THINGS (AIOT) NETWORK FOR SALINITY MONITORING: PREDICTIVE AND FAULT-TOLERANT CAPABILITIES

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ABSTRACT

Water resources in coastal and deltaic regions are increasingly threatened by salinity intrusion and fluctuations in water quality parameters, which undermine freshwater ecosystems, agricultural productivity, and aquaculture resilience. Conventional hydrodynamic and numerical models provide valuable insights but face limitations where observational data are sparse or incomplete. Recent advances in artificial intelligence (AI) and Internet of Things (IoT) technologies offer new opportunities for real-time monitoring and forecasting. This study proposes the design and implementation of an AIoT buoy-based system for continuous salinity monitoring and anomaly prediction. The system integrates multi-parameter sensors, cloud-based data management (Advantech WISE-PaaS), and advanced machine learning models. Preprocessing techniques such as Empirical Mode Decomposition (EEMD) and Kernel Principal Component Analysis (kPCA) are employed to reduce noise and capture non-linear dynamics, while Long Short-Term Memory (LSTM) networks are used to forecast salinity and detect anomalies. The expected outcomes include improved early warning capacity, enhanced decision support for aquaculture and water resource management, and strengthened community resilience against salinity intrusion and other hydrological challenges.

Keywords: *Water quality monitoring; Salinity intrusion; Artificial Intelligence of Things (AIoT); Hydrology; Water resources management.*

Acknowledgement: *This research is funded by the Vietnam National Foundation for Science and Technology Development (NAFOSTED) under grant number 105.08-2023.40 and by the Vietnamese-German University for student research under grant number 2025.01 SV/HĐNCKH-VGU.*

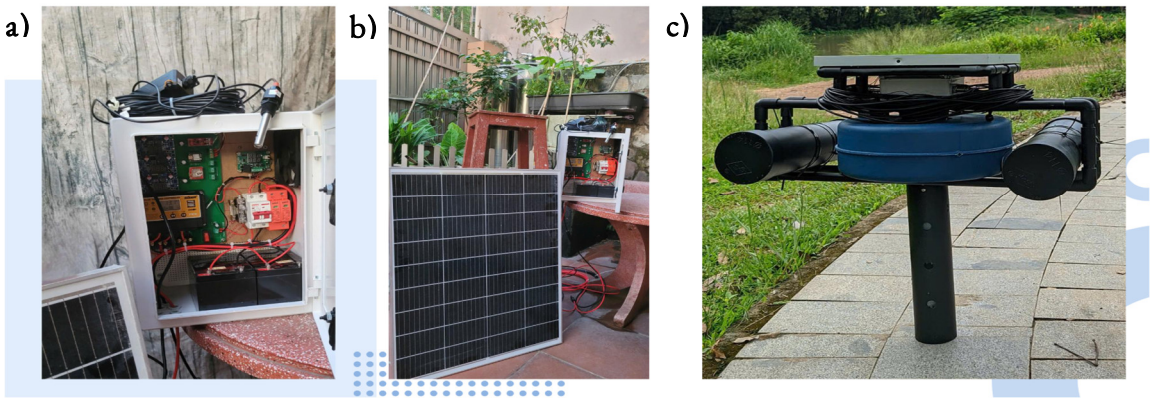
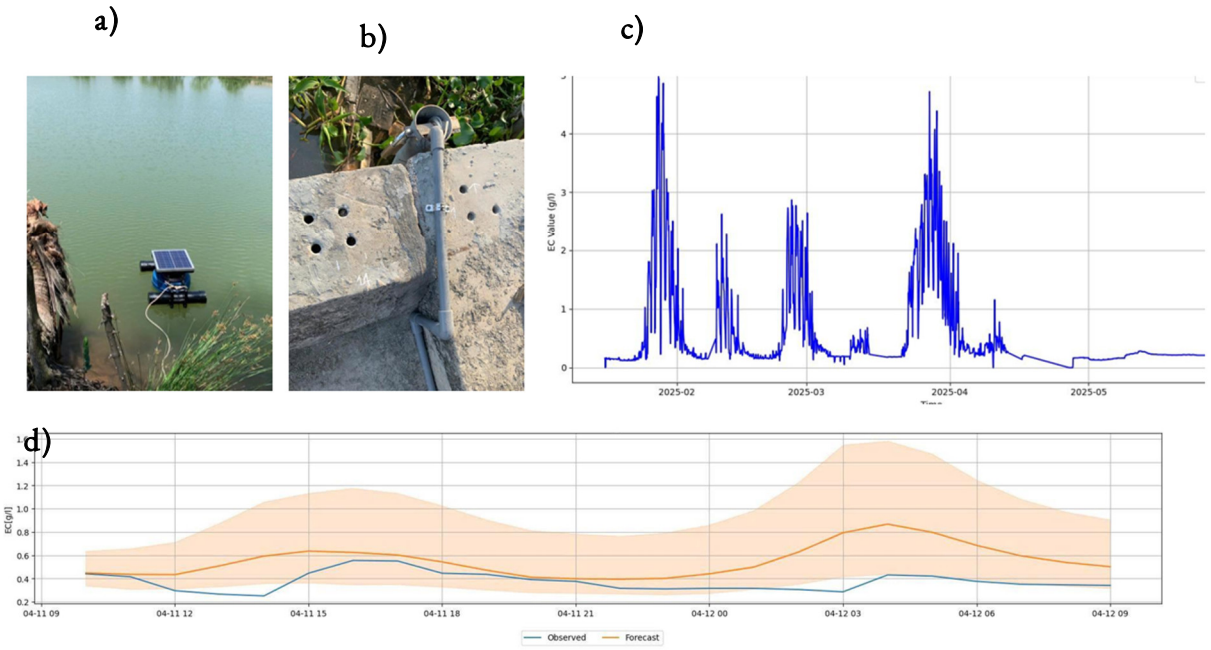


Figure 1. Prototype of the AIoT buoy-based salinity monitoring system.
(a) Control box containing microcontroller board, communication modules, and backup battery;
(b) Solar power system supplying energy for the buoy system;
(c) Floating buoy equipped with a salinity sensor for real-time monitoring.



MAE	0.178	MSE	0.051	RMSE	0.226

Figure 2. Deployment of BASWAP system: (a) floating solar-powered monitoring device, (b) sensor installation, and (c) recorded salinity variation (EC) over time (d) . Graph showing the performance of our AI models on data we recorded independently, which was NOT included in the training set.

SESSION V

HYDROLOGY AND WATER RESOURCES

THE EFFECT OF UPSTREAM VARIATION, CLIMATE CHANGE, SEA LEVEL RISE, AND OVEREXPLOITATION ON THE GROUNDWATER RESOURCE IN VIETNAMESE MEKONG DELTA

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ABSTRACT

Groundwater is a vital source of freshwater in the Vietnamese Mekong Delta (VMD), playing an indispensable role for the livelihoods of millions of people, especially in rural and coastal areas where alternative water sources are scarce and polluted. However, in recent years, the region's groundwater resources have come under increasing pressure due to a combination of natural and anthropogenic factors. Key stressors include upstream hydrological changes caused by dam construction and flow regulation, intensive groundwater overexploitation within the delta, land subsidence, and the growing impacts of climate change. These factors interact in complex ways, contributing to a steady decline in groundwater levels and storage, and raising serious concerns about long-term water security and land stability in the region.

This study aims to evaluate the combined effects of these stressors on groundwater dynamics in the VMD. Multiple scenarios were developed to represent different combinations of upstream water regulation, excessive local groundwater abstraction, land subsidence, and climate-related changes such as variations in precipitation and sea level rise. The MODFLOW module of the Groundwater Modeling System (GMS) was applied to simulate groundwater levels and storage for both baseline conditions in 2024 and future conditions in 2050. For the climate change component, two Rep resentative Concentration Pathways (RCPs), RCP4.5 and RCP8.5, were used to represent moderate and high-

emission scenarios, respectively. These scenarios allowed for a comprehensive assessment of how future climate-induced changes could affect groundwater recharge, storage, and overall availability.

Modeling results revealed a significant decline in groundwater levels and storage across all scenarios by 2050, with the most severe reductions occurring under scenarios that combine high groundwater extraction rates with limited upstream discharge and high-emission climate pathways. Groundwater overexploitation emerged as the primary driver of land subsidence, which is accelerating in many parts of the delta, particularly in low-lying coastal zones. This subsidence not only reduces land elevation, increasing flood risk, but also further disrupts groundwater recharge processes. Moreover, reduced rainfall and sea level rise associated with climate change are expected to intensify the problem, compounding water scarcity and increasing the vulnerability of both people and ecosystems in the region. Upstream developments, such as dam construction in the Mekong River basin, were found to significantly reduce downstream river discharge. This reduction in flow limits natural groundwater recharge from river-aquifer interactions, exacerbating aquifer depletion and contributing to a negative water balance across much of the delta. The combined effects of these drivers indicate that the current trajectory of groundwater use and management is unsustainable. The findings underscore critical trends and identifying future risks, this study provides valuable insights to support policymakers, water managers, and stakeholders in developing sustainable groundwater use plans that ensure water security for the Vietnamese Mekong Delta under increasing environmental and socio-economic pressures.

Keywords: *MODFLOW, groundwater levels, overexplotation, land subscidence, climate change, sea level rise*

Acknowledgement: *We would like to thank the Vietnam National Foundation for Science and Technology Development (NAFOSTED) for funding the research "Surface and groundwater interaction in the Mekong River Basin: Novel Ensemble Machine Learning Approaches", under Grant Number 105.06-2023.02.*

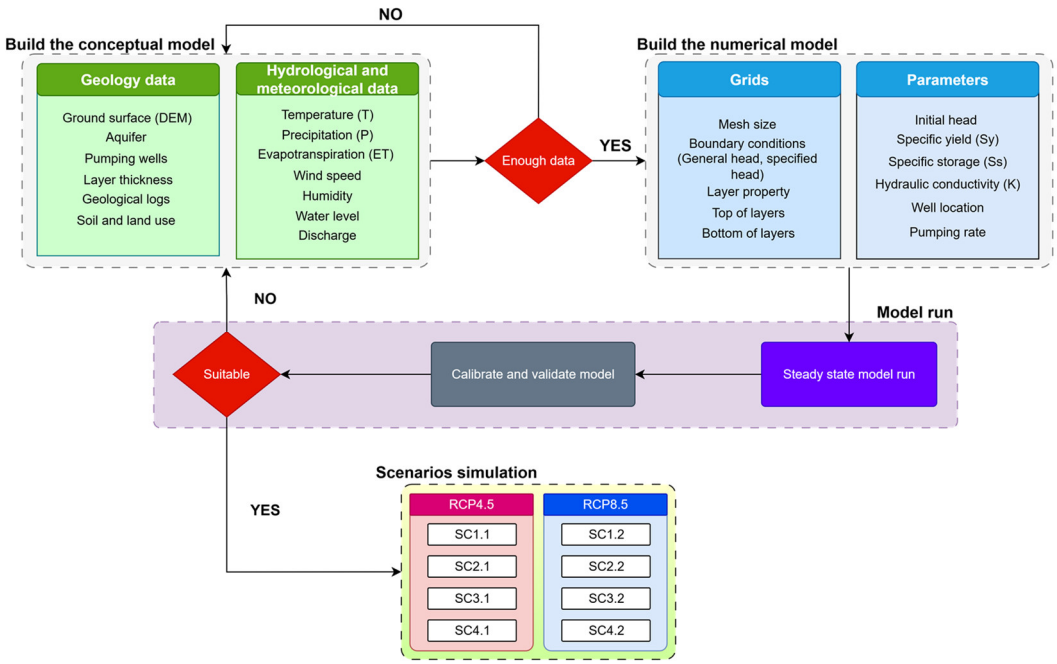


Figure 1. Methodological flowchart of MODFLOW model in this study.

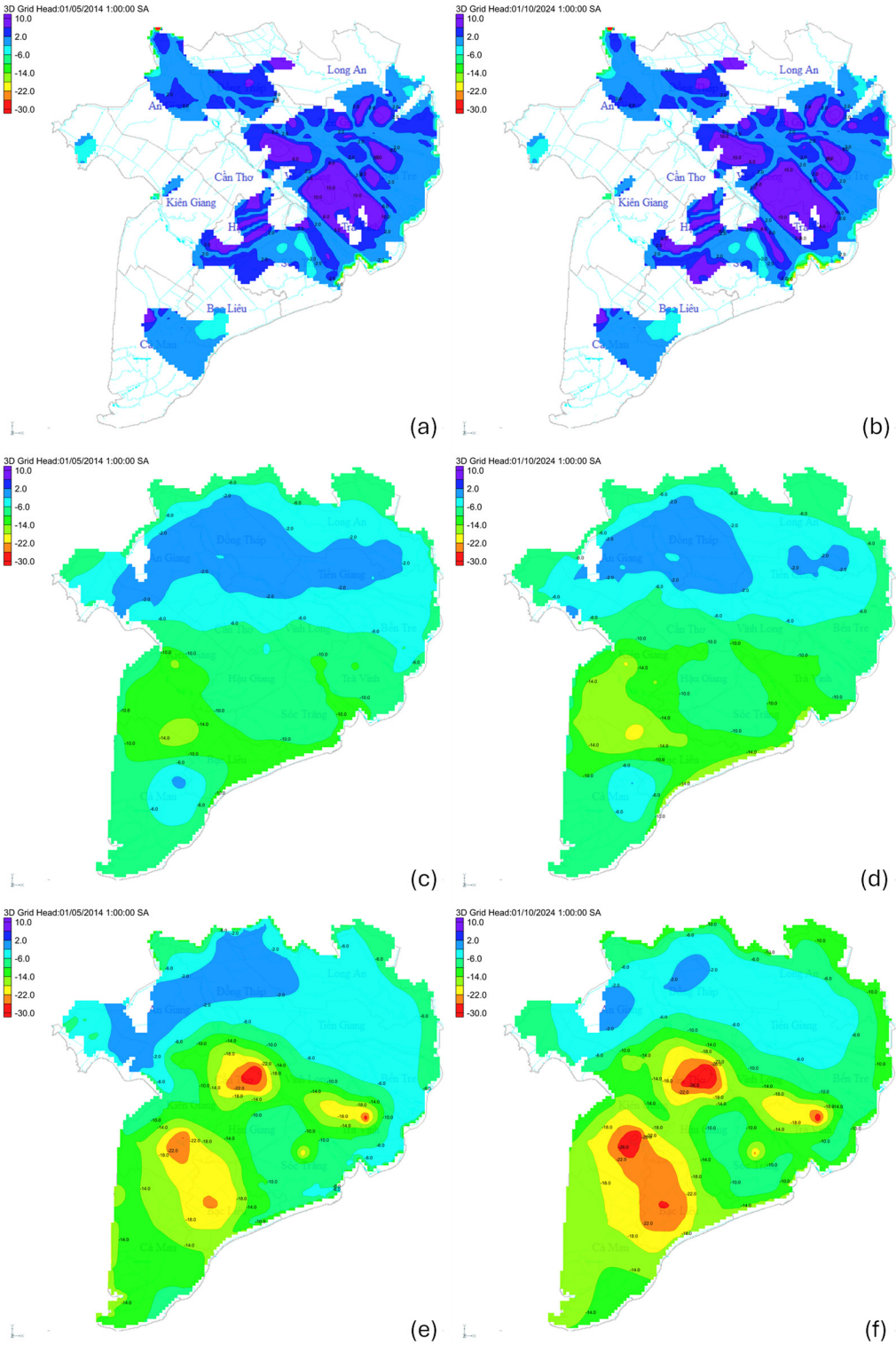


Figure 2. Comparison of absolute groundwater level in the qh (a, b), qp_3 (c, d) and qp_{2-3} (e, f) aquifers in 2014 (a, c, e), and 2024 (b, d, f).

INTERPRETABLE AI FOR FLOOD PROCESS ATTRIBUTION AND PREDICTION IN INDIAN CATCHMENTS UNDER CLIMATE AND ANTHROPOGENIC INFLUENCE

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ABSTRACT

Floods in Indian catchments emerge from a complex synergy of climatic variability, catchment characteristics, and human-modified landscapes. Despite growing hydro-climatic datasets, challenges persist in both understanding prevailing flood-generation mechanisms and crafting regionally adaptive prediction models through an interpretable lens. In response, this study introduces a process-based and explainable artificial intelligence framework to advance both flood-risk assessment and scientific understanding in data-scarce, hydrologically diverse regions. Utilizing the CAMELS-IND dataset, we analyzed 242 catchments to identify flood events via the USWRC methodology. Key flood-generation processes were classified by detecting soil moisture thresholds that influence runoff peaks—leveraging the PELT (Pruned Exact Linear Time) algorithm. To integrate socio-hydrological controls, catchments were clustered into four regimes: natural + wet, natural + dry, human-influenced + wet, and human-influenced + dry, based on aridity and reservoir influence indices. We further grouped catchments using cluster analysis on both static (e.g., topographical features, land-use categories) and dynamic factors (e.g., antecedent soil moisture, rainfall intensity). A cluster-specific TabNet deep-learning model was trained to forecast flood peak discharge. Model interpretability was enhanced using SHAP (SHapley Additive exPlanations) to quantify and compare the impact of various predictors across regimes. Results revealed pronounced regional variability: in natural-wet regimes, antecedent soil moisture dominated flood behavior, while in human-influenced dry catchments, rainfall intensity and human modification indices were more influential. Long-rain floods were most common in terms of event frequency, extreme occurrence, and volumetric contribution. This integrative framework, merging physically grounded classification with interpretable machine learning—promotes deeper scientific insight and practical predictive capability. It advances flood-risk understanding and adaptive strategy development for Indian catchments confronting evolving climate and land-use pressures.

Keywords: *Flood generation processes, Explainable artificial intelligence (XAI), TabNet deep learning, SHAP (SHapley Additive exPlanations), Socio-hydrological regimes*

UNESCO INDICATORS-BASED FLOOD VULNERABILITY ASSESSMENT IN NABUNTURAN, DAVAO DE ORO

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ABSTRACT

This study presents a spatial analysis of flood vulnerability in Nabunturan, Davao de Oro, by generating localized Flood Vulnerability Index (FVI) maps using the UNESCO-IHE framework. Twenty-seven validated indicators were organized across four components—Social, Economic, Environmental, and Physical—and classified under the dimensions of exposure, susceptibility, and resilience. Each indicator was normalized and weighted to calculate component-wise FVI scores, which were then aggregated to compute the Total FVI for each of the 28 barangays. The FVI scores were visualized through Geographic Information System (GIS) mapping to identify spatial patterns of flood risk. Results revealed that Barangay Basak recorded the highest Total FVI at 0.8294, followed by Sasa (0.7776), Libasan (0.6859), and Mipangi (0.6127), indicating critical levels of vulnerability driven by high exposure and weak resilience across multiple components. In contrast, Barangay Linda (0.0870) exhibited the lowest FVI due to stronger environmental and physical adaptive capacity. Several barangays—such as Anislagan, Matilo, and Cabacungan—also scored within the high vulnerability range, primarily due to poor physical infrastructure and limited economic capacity. The study highlights the value of component-wise and integrated FVI mapping in visualizing vulnerability disparities across localities. These results offer evidence-based insights to support barangay-level climate and disaster risk assessments and guide strategic investments in adaptation planning, infrastructure improvements, and localized early warning systems. The Total FVI maps serve as a practical decision-making tool for enhancing disaster resilience in Nabunturan and similarly flood-prone municipalities.

Keywords: *GIS-based Assessment, Climate Resilience, UNESCO-IHE Institute for Water Education, Flood Vulnerability Index, Disaster Risk Mapping*

Acknowledgement:

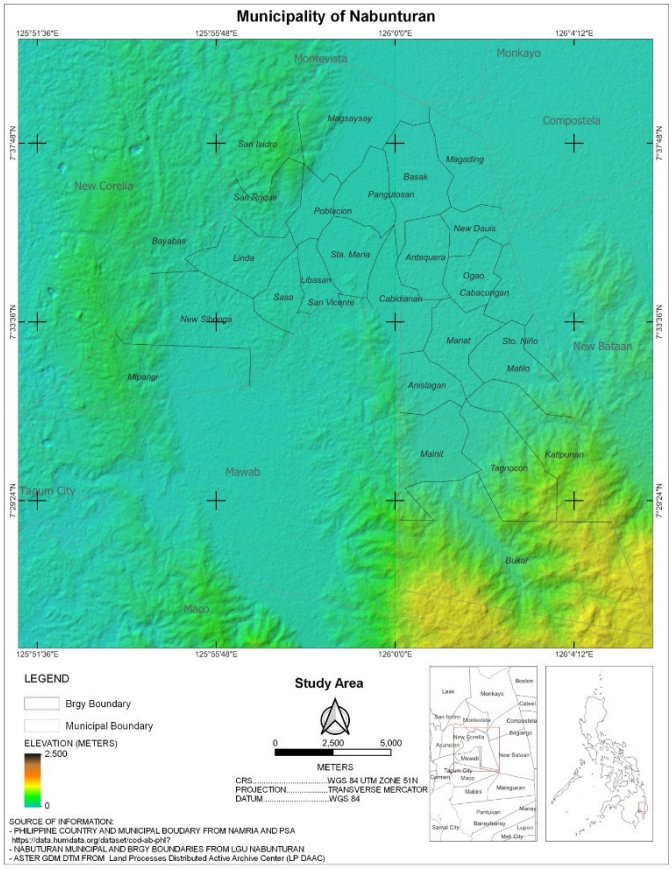


Figure 1 Map of Nabunturan, Davao de Oro, showing the 28 barangays covered in the study.

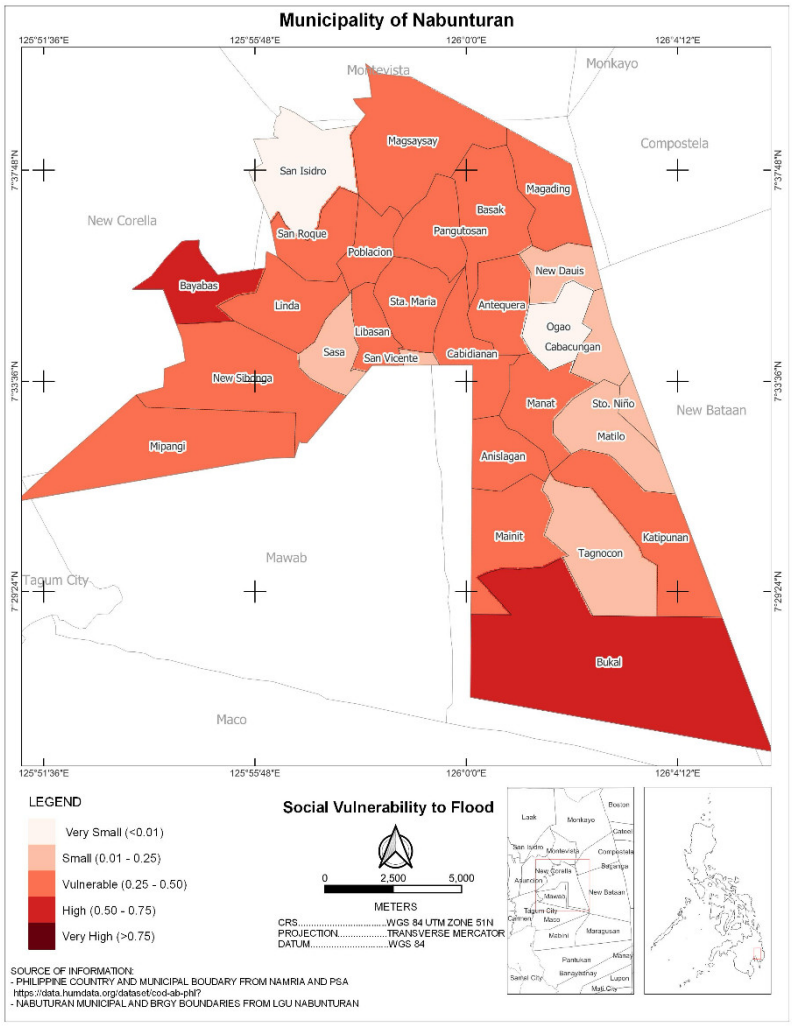


Figure 2 Social Flood Vulnerability Index Map of Nabunturan, Davao de Oro.

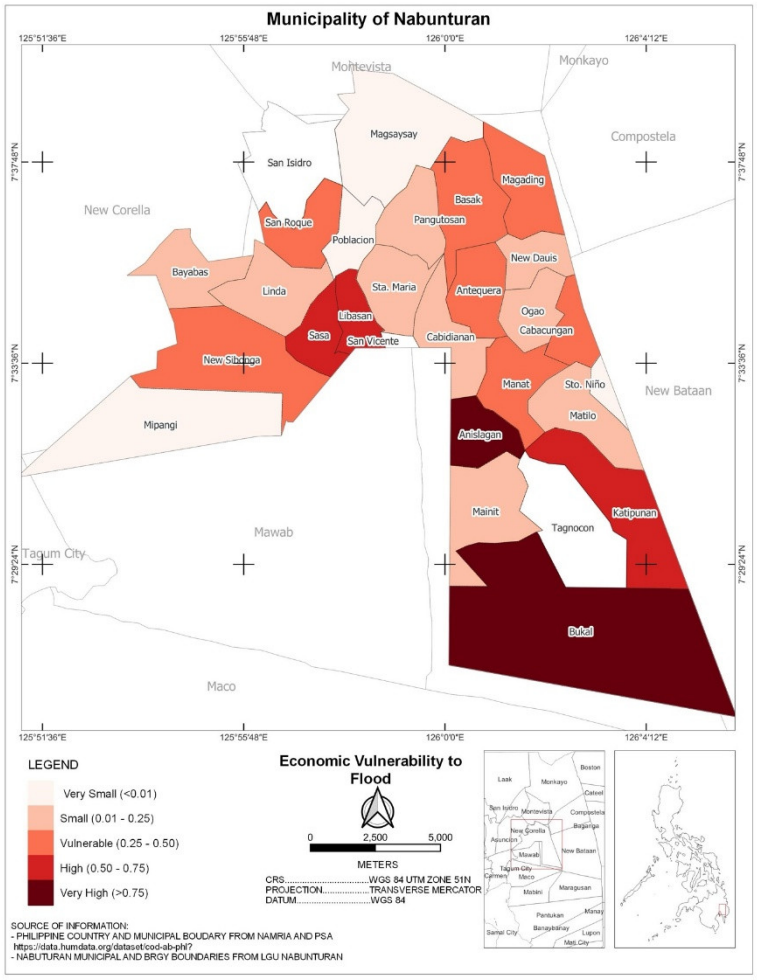


Figure 3 Economic Flood Vulnerability Index Map of Nabunturan, Davao de Oro.

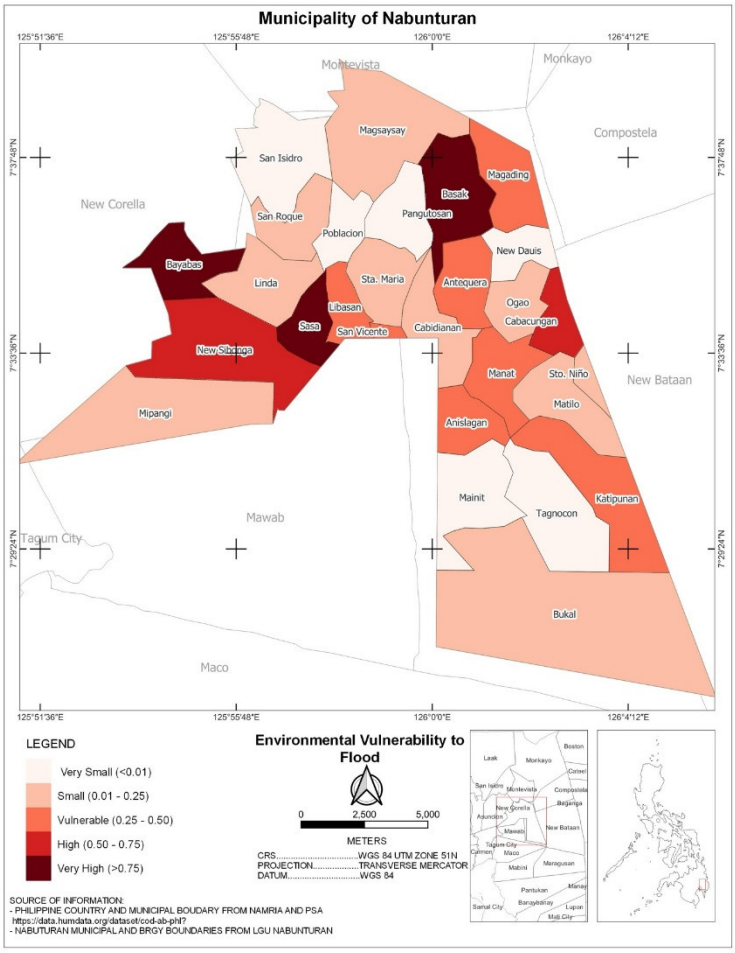


Figure 4 The Environmental FVI Map of Nabunturan, Davao de Oro.

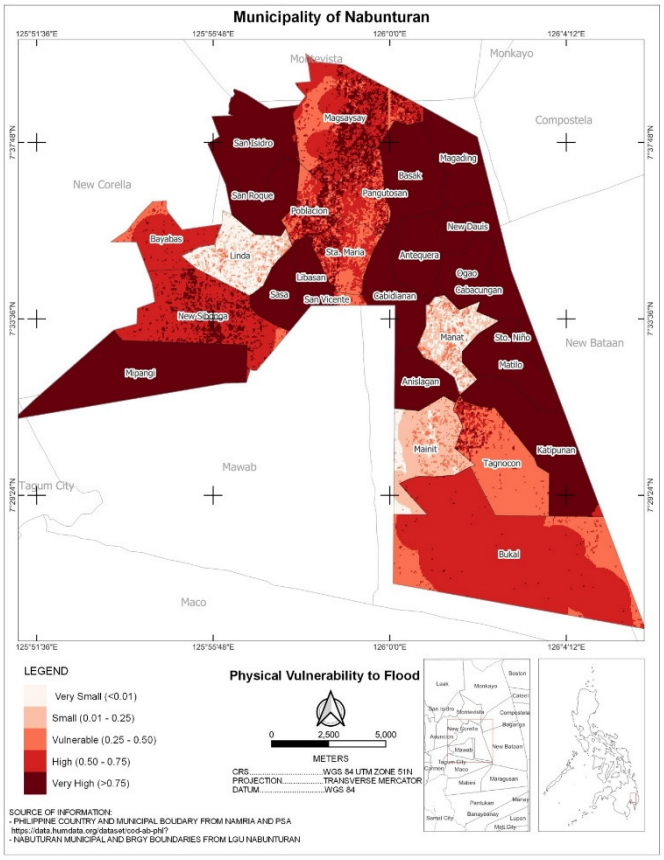


Figure 5 Physical Flood Vulnerability Index Map of Nabunturan, Davao de Oro

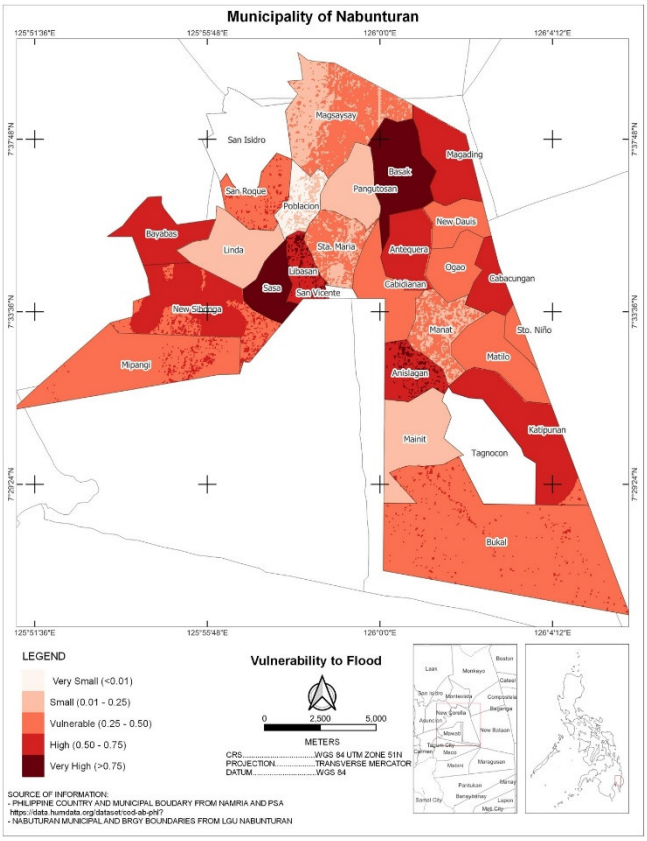


Figure 6 Total Flood Vulnerability Index Values of Nabunturan, Davao de Oro

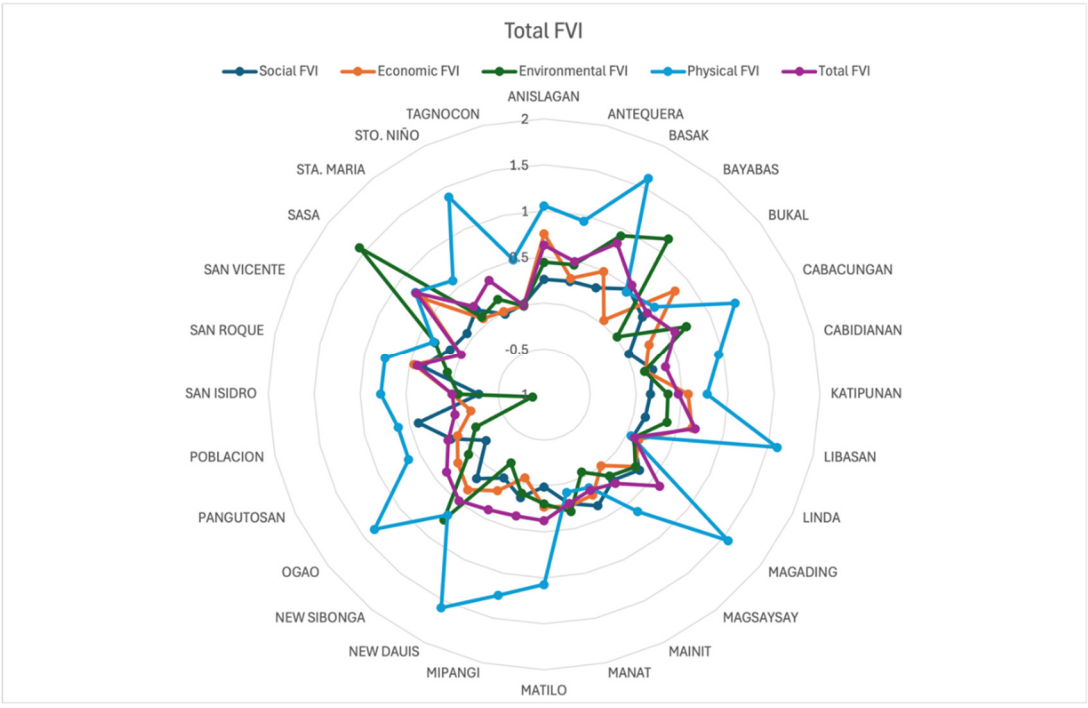


Figure 7 Total Flood Vulnerability Index Map of Nabunturan, Davao de Oro.

COMBINATION TREATMENT PROCESSES OF CHITIN PRODUCTION WASTEWATER CONTAINING HIGH SALINITY FROM SHRIMP SCRAPS

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ABSTRACT

This study aims to evaluate the treatment efficiency of chitin production wastewater, characterized by high organic content, nutrients, salinity, and minerals, using a combination of preliminary sedimentation, coagulation, and a biofilm-based biological process. Coagulation was performed using by-product chitosan, polyaluminum chloride (PAC), and polyacrylamide (PAM), with by-product chitosan offering a cost-effective and environmentally friendly alternative. The preliminary sedimentation step achieved over 80% turbidity and 93% total suspended solids (TSS) removal at pH 4 within 30 minutes. Under optimal coagulation conditions (chitosan dose of 77.5 mg/L, pH 8.3, crude protein/calcium ratio of 4.95), the removal efficiencies were 23% for total COD (tCOD), 32% for soluble COD (sCOD), 25% for TKN and NH_4^+–N, 90% for total phosphorus (TP), 84% for TSS, 29% for Ca^{2+}, and 25% for crude protein. Coagulation residue contained up to 55 mg/g crude protein, which may be reused as animal feed or fertilizer. The biological treatment employed anaerobic-anoxic-aerobic bioreactors with Stick-bed Biofix and Swim-bed Biofringe as biomass carriers. Organic removal remained high (95 ± 2%, 5.78 ± 1.10 kg COD/m^3/d) even under salinity stress. However, nitrogen removal declined from 0.45 ± 0.17 to 0.24 ± 0.10 kg N/m^3/d at 18,000 mg/L salinity. Phosphorus removal ranged from 0.032–0.057 kg P/m^3/d and decreased 1.5 times above 10,000 mg/L salinity. Additionally, the system removed approximately 50% of calcium ions, contributing to salinity reduction.

Keywords: *Chitin production wastewater, Chitosan, Coagulation, Stick-bed Biofix, Swim-bed Biofringe, High salinity.*

Acknowledgement: *This research was supported in part with a scholarship from the Vietnamese government (Project 911) and by a grant from the Ministry of Science and Technology.*

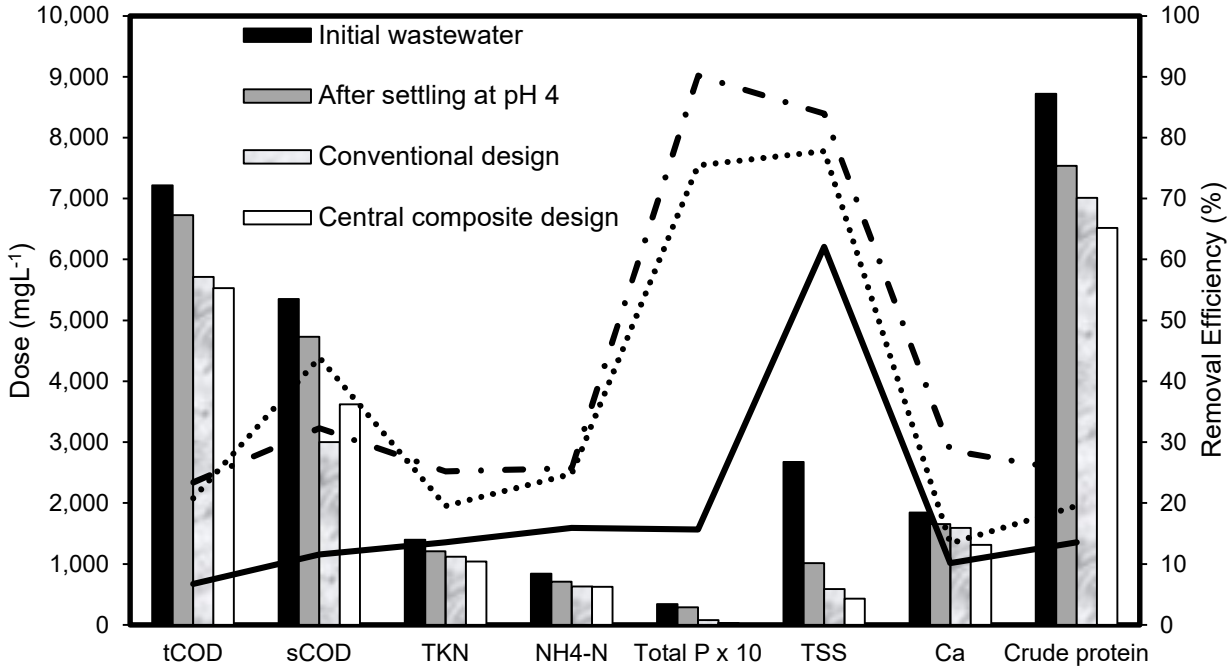


Figure 1. Changes of characteristics of wastewater after preliminary sedimentation and coagulation at optimum experimental conditions (left axis) and removal efficiencies (right axis).

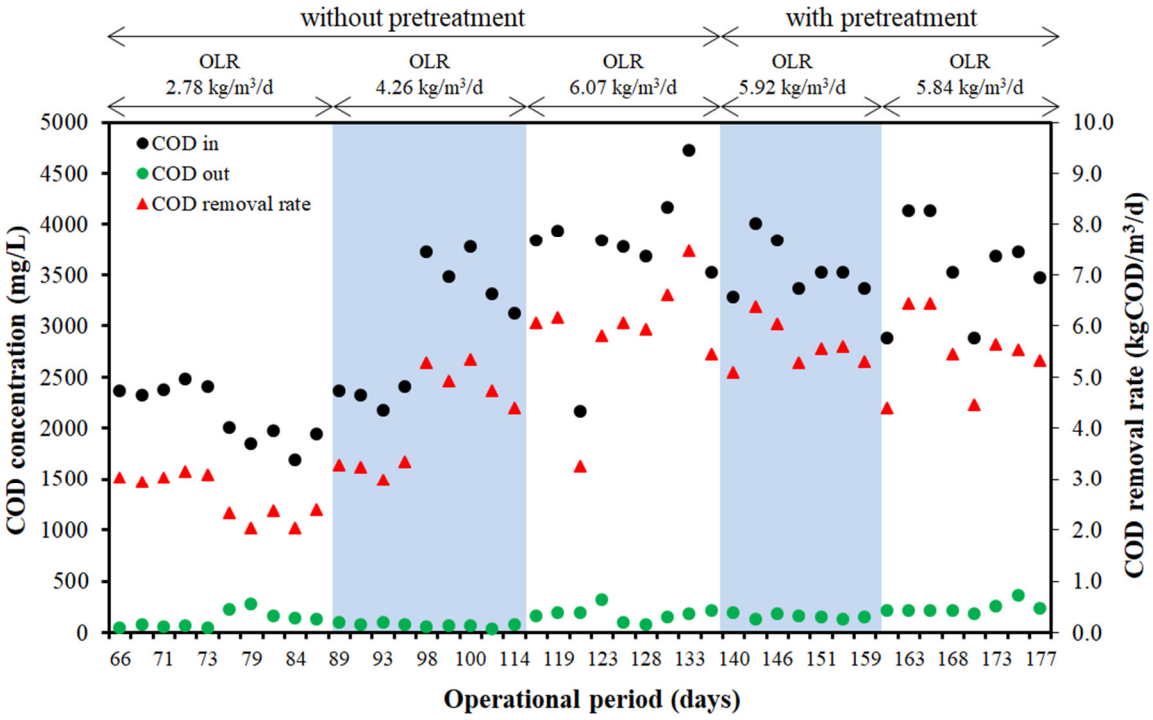


Figure 2. Variation of COD concentration of the combined system at different operational conditions.

THE ROBUST ROLE OF PETROPHYSICAL RELATIONSHIPS IN QUANTIFYING SALINITY IN HETEROGENEOUS COASTAL AQUIFERS

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ABSTRACT

Visualization for Geophysical characterization of saltwater intrusion using Electrical Resistivity Tomography (ERT) is often limited by complexity in lithological sequences of heterogeneous aquifers, where low resistivity can signify the presence of high salinity or clay-rich lithology. Resolving this challenge is validated by developing petrophysical relationships. In this study, we present an integrated workflow combining laboratory particle size distribution (PSD) and spectral induced polarization (SIP) on the borehole samples co-located with the field ERT, time-domain IP (TDIP) investigation in complicated coastal aquifers in the Luy River Catchment. Laboratory scale approach revealed formation factors (F) and surface conductivity of the different lithological classifications vary from 4.0 to 8.9 for coarse-grained sand and clay-bearing sediment mixtures, while normalized chargeability above 1.0 $mS.m^{-1}$ indicates the presence of clay. By using IP to map lithology heretofore and applying the corresponding petrophysical model to ERT data hereafter, the effects of clay and salinity are independently decoupled, even in co-occurrence conditions. The resulting salinity distribution was validated against direct sampling and logging data, demonstrating a significant improvement in accuracy over conventional interpretation. Our work proves that a well-constrained petrophysical framework is not merely a refinement but an essential prerequisite for quantitatively assessing saltwater intrusion, preventing the gross overestimation of contamination that arises when these fundamental relationships are ignored.

Keywords: *Petrophysical Relationship, Induced Polarization (IP), ERT, salinity.*

Acknowledgement: *This research was supported by VLIR-UOS and the Belgian development cooperation (Grant VN2019TEA494A103) and by the Special Research Fund (BOF), Ghent University, through Ph.D. scholarships to the first author. We thank the VIGMR staff for field and grain-size analysis support, and the Urban & Environmental Engineering Laboratory, Liège University, for assistance with SIP measurements.*

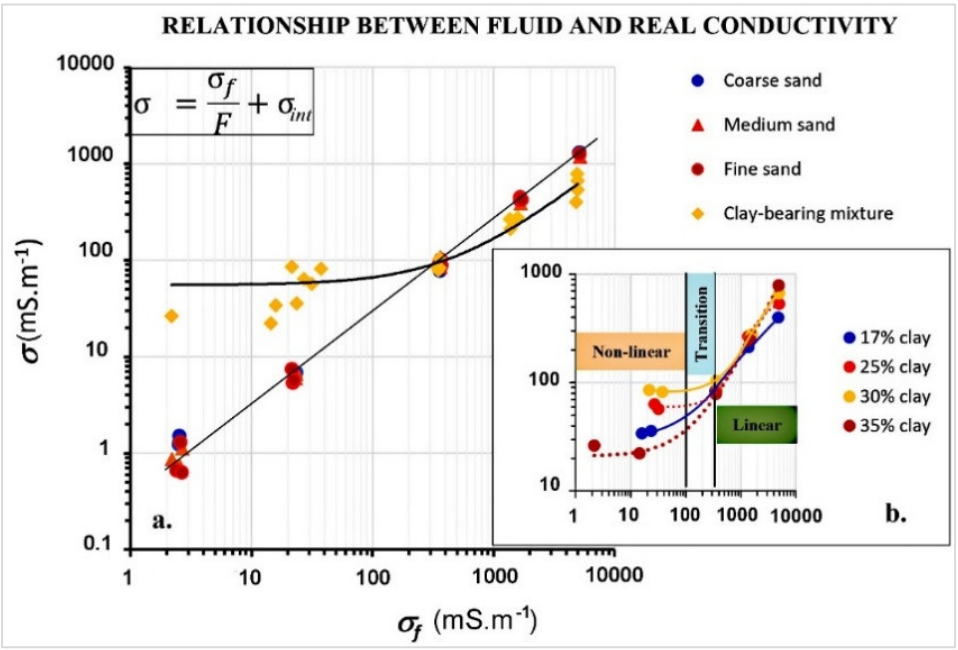
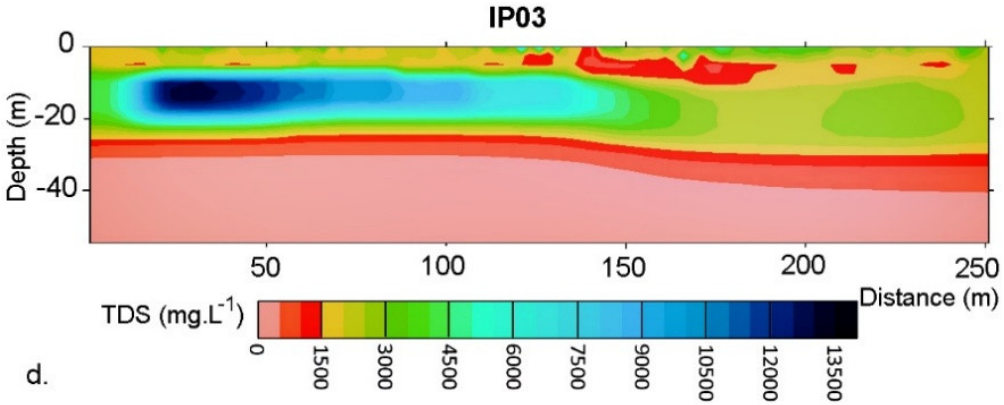


Figure 1. Log-log plot of the pore fluid conductivity versus the real conductivity. (a). A straight line represents the clean sand category (including coarse-, medium- and fine particles) and a curve refers to the clay-bearing mixture. (b). The generally detailed trends between σ and σ_f of four clay-bearing samples indicate linear relationships at higher salinity and non-linear relationships at lower salinity.

a)



b)

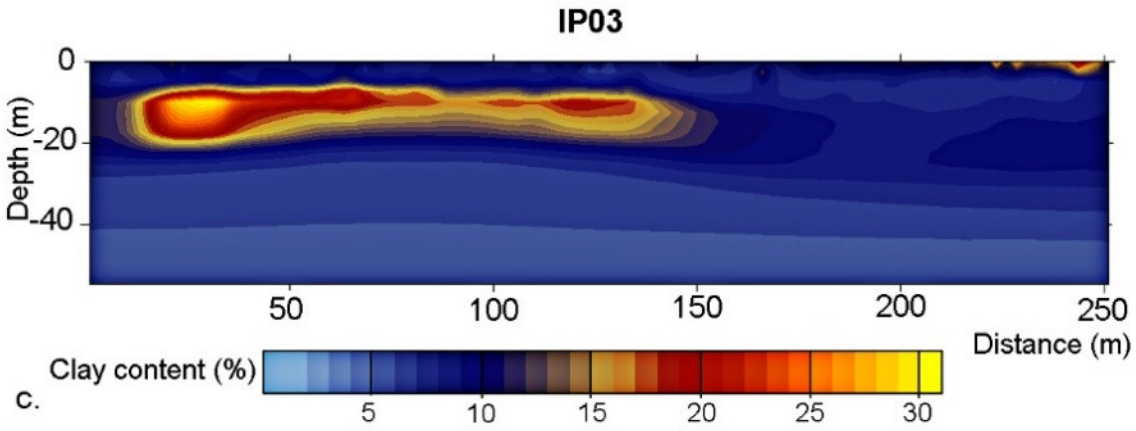


Figure 2. Mapping for distributions of clay minerals percentage (a) and salinity (b).

WATER QUALITY DYNAMICS OF BASAI WETLAND: SEASONAL ANALYSIS OF HEAVY METALS AND PHYSICOCHEMICAL PARAMETERS

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ABSTRACT

Wetlands are vital ecosystems that offer various ecological services, including groundwater recharge, nutrient cycling, supporting biodiversity, and climate regulation. The Basai Wetland, located in Gurugram, Haryana, functions as an essential natural habitat but is highly impacted by urbanization and human activities. This study aims to assess the water quality of Basai Wetland through seasonal (summer and winter) analysis of key physicochemical parameters and selected heavy metals from 2021 to 2023.

The physicochemical assessment included pH, total dissolved solids (TDS), electrical conductivity (EC), alkalinity, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), phosphate, and total nitrogen (TN). The results revealed a moderately alkaline pH (7.41–7.53), indicating a stable aquatic environment. TDS and EC values were significantly higher in summer (1734.8 mg/L and 3468.7 µS/cm in 2021), reflecting increased evaporation and solute concentration, whereas lower values were recorded in winter, suggesting dilution due to seasonal inflows. Alkalinity ranged from 721.3 to 1810 mg/L, signifying a strong buffering capacity of the wetland water. DO levels were consistently low (3.20–4.21 mg/L), pointing to oxygen stress and organic loading. BOD values were high (9.01–11.38 mg/L), indicating substantial microbial activity and organic pollution, while COD ranged between 147.46 and 196.55 mg/L, confirming the prevalence of oxidizable organic matter. Nutrient analysis showed elevated phosphate levels in summer (8.42 mg/L in 2021), whereas winter exhibited reduced concentrations (4.19–4.88 mg/L in 2022-2023), reflecting seasonal nutrient dynamics. Total Nitrogen ranged between 7.22–10.51 mg/L, suggesting eutrophic conditions that could support algal growth.

Heavy metal concentrations (Fe, Mn, Zn, Cr, Cu) were also quantified. Iron levels were highest during summer (1.35 mg/L in 2022) and declined in winter (0.34 mg/L in 2023), highlighting seasonal variation linked to hydrological conditions. Manganese and zinc followed a similar trend, with elevated concentrations in summers compared to winters. Chromium levels ranged between 0.08–0.15 mg/L, with higher summer values, while copper remained the lowest among all metals (0.011–0.037 mg/L), yet detectable across all samples. The observed concentrations of some heavy metals exceeded permissible limits for surface water, posing ecological risks to aquatic biota and potentially impacting human health through bioaccumulation in the food web.

Overall, the study underscored that Basai Wetland exhibits signs of organic pollution, eutrophication, and heavy metal contamination, particularly during summer months when concentration effects were prominent. These findings highlights the urgent need for continuous monitoring, strict regulation of untreated wastewater inflows, and integrated conservation measures to safeguard the ecological integrity

of Basai Wetland. Such scientific insights are crucial for policymakers and stakeholders to develop sustainable wetland management strategies in rapidly urbanizing regions, such as Gurugram.

Keywords: *Basai wetland, Heavy metals, nutrients, urbanization, eutrophication*

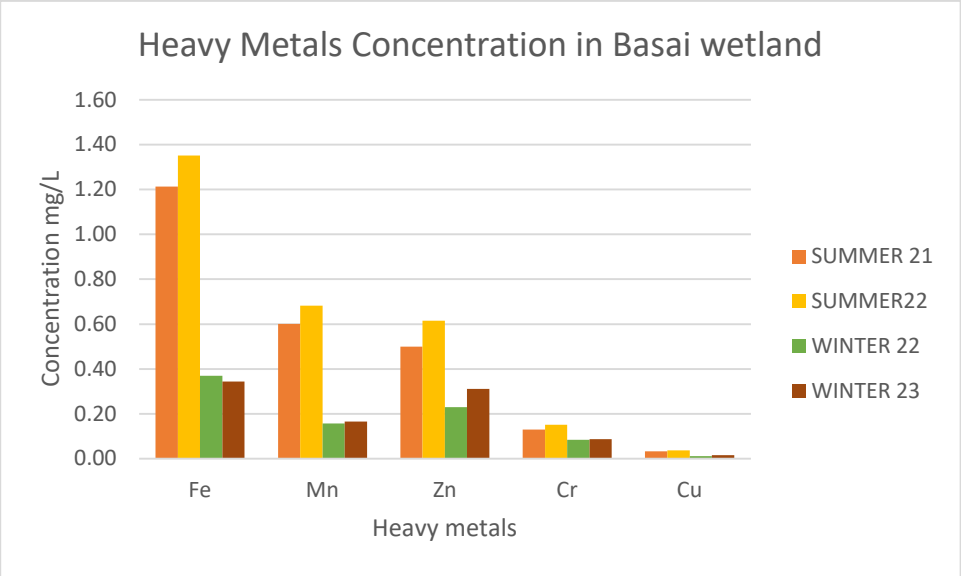


Figure: Seasonal Variation of Heavy Metal Concentrations in Basai Wetland

SURROGATE MODEL DEVELOPMENT FOR GROUNDWATER MULTISPECIES CONTAMINANT TRANSPORT USING MACHINE LEARNING

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ABSTRACT

Groundwater contamination by multi-species contaminants poses a significant environmental challenge that necessitates the use of accurate simulation tools to support risk assessment and remediation planning. Although widely applied, traditional numerical and analytical models often incur high computational costs, particularly in real-time or large-scale simulation scenarios. This study presents a surrogate model based on artificial neural networks (ANNs) to accelerate the simulation of multi-species transport and degradation processes in groundwater systems. High-fidelity training datasets were generated using finite-difference and analytical reactive transport simulations under a wide range of environmental and geochemical conditions. Validation results demonstrate that the ANN model can accurately reproduce the spatiotemporal concentration distributions of both parent compounds and degradation products, while reducing computational time by more than 50-fold compared to conventional methods. These findings highlight the potential of ANN-based surrogates as efficient, accurate, and cost-effective tools for assessing and managing groundwater pollution.

Keywords: *multispecies reactive contaminant transport; surrogate model; machine learning; artificial neural network (ANN); finite difference (FD).*

APPLICATION OF REMOTE SENSING AND MACHINE LEARNING FOR MONITORING SALTWATER INTRUSION IN RIVER BRANCHES OF THE LOWER VIETNAMESE MEKONG DELTA, VIETNAM

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ABSTRACT

As the world's third-largest delta, the Vietnamese Mekong Delta (VMD) has a critical role in global food security. However, climate variability, particularly saltwater intrusion, has increasingly disrupted the balance between human and ecological systems in the region, severely affecting both agriculture and local livelihoods. This study integrates two machine learning techniques with Sentinel-2 remote sensing imagery to map saltwater intrusion across the coastal areas of the VMD. A total of 639 Sentinel-2 scenes (2015–2025) and salinity records from 40 hydrological stations were employed. The 30 input variables consisted of 12 spectral bands, nine remote sensing indices (related to water, vegetation, and light), and nine salinity indices, which were used in this study with measured salinity data. The Pearson Correlation method was applied to identify the most influential predictors for model training. Using 1,157 training samples, two machine learning models—Support Vector Regression (SVR) and Random Forest Regression (RFR)—were developed. Model validation with 496 independent samples demonstrated that RFR outperformed SVR, achieving high accuracy (R^2 = 0.85), with MAE, RMSE, NSE, and PBIAS values of 2.88, 3.65, 0.84, and 3.51%, respectively. The mapping results reveal a clear upward trend in saltwater intrusion, with the most expansion occurring between 2020 and 2024.

Keywords: *Salinity intrusion, Lower Vietnamese Mekong Delta, Sentinel-2, Machine learning.*

Acknowledgement: *This research is funded by the Vietnam National Foundation for Science and Technology Development (NAFOSTED) under grant number 105.08-2023.40.*

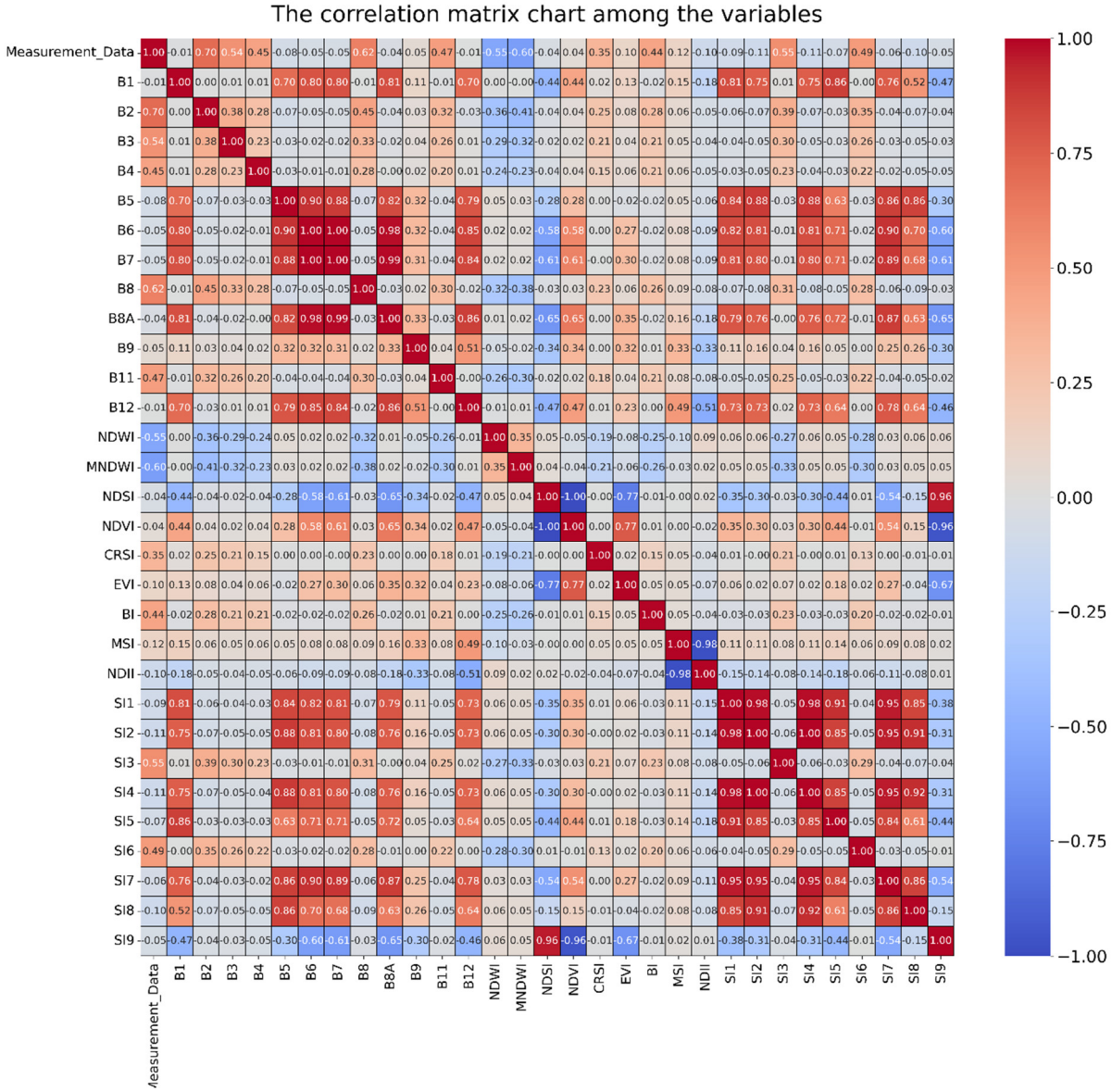


Figure 1. The correlation matrix chart among the variables.

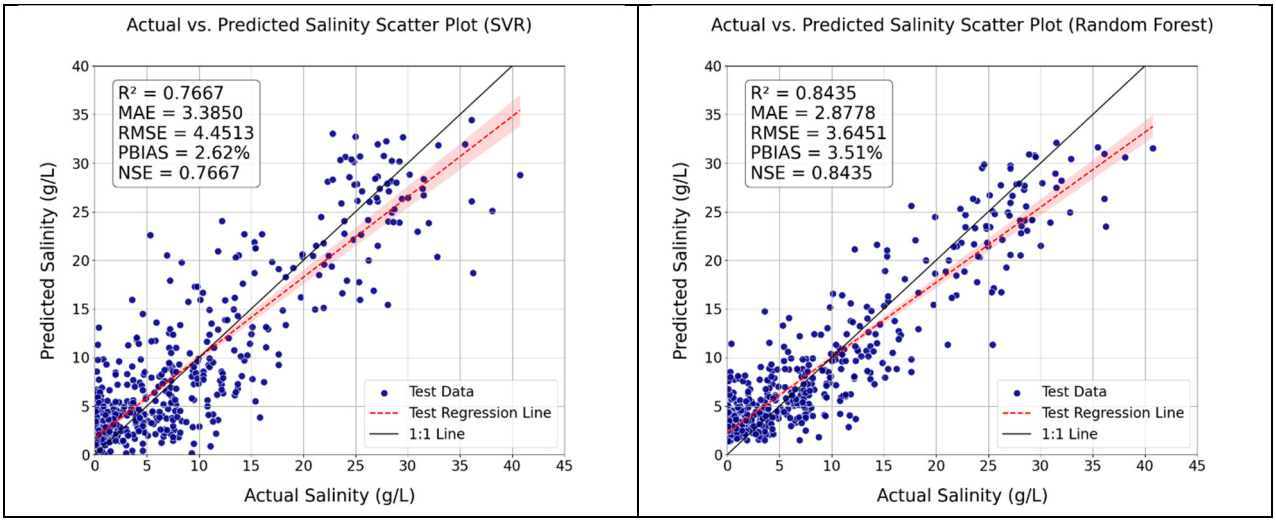


Figure 2. Relation of the measured and predicted salinity (test set) by (a) Support Vector Regression (SVR) and (b) Random Forest Regression (RFR).

CLIMATE CHANGE, FLOODING, AND AGRICULTURAL VULNERABILITY: PREDICTING ECONOMIC LOSSES OF RICE PRODUCTION IN THE NORTH CENTRAL VIETNAM

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ABSTRACT

In Asia, flood damage to agriculture is a great concern in many countries since large populations live in rural areas and mainly rely upon agriculture. Estimating flood damage to crops is important for post-flood relief and recovery planning as well as for long-term adaptation and mitigation actions in the agricultural sector; however, this is a challenging task due to the complex interaction between flooding processes and crop systems, especially when climate change is considered.

In this study, a GIS/modelling based method was applied to estimate the economic loss of rice production due to climate-change-reinforced floods. The method included: (1) using the GEV distribution and GCMs to project climate-change-reinforced extreme precipitation; (2) establishing maps of inundation depth and inundation duration of extreme precipitation-generated floods from the results of flood model simulations; and (3) calculating economic loss of rice production using GIS methods coupled with stage-damage functions.

The highly agricultural Ca River Basin in north-central Vietnam, which is home to more than 4 million people, was selected for this case study. The results reveal that under the medium-high greenhouse gas concentration scenario RCP6.0, in the future period 2061-2080, the intensity of 10-year extreme precipitation would increase approximately 12% (compared to the baseline period of 1986-2005), leading inundation to rise 0.6 m and last 0.5 days longer. As a result, the inundation of rice cultivation areas is expected to expand by 27% and the economic loss of rice production is expected to increase by 32%.

The method used in this study is a powerful tool for flood damage prediction under climate change impacts. It is expected to help with better decision-making regarding the prevention of flood damage to agriculture.

Keywords: *Agricultural damage, Climate change, emission scenario, flood inundation, GCM*

Acknowledgement: *This study was supported by the Japan Society for the Promotion of Science (JSPS)*

LEVEE DETECTION FROM HIGH-RESOLUTION DIGITAL ELEVATION MODELS FOR GLOBAL RIVER MODELING APPLICATIONS

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ABSTRACT

The flooding of rivers can be both a blessing and a problem for society. As global climate change progresses, global river models are emerging as a promising tool for hazard mapping, assisting disaster mitigation. Such models rely on accurate information of flood protection measures (for example, levees) to give reliable prediction of inundation extents. However, existing levee databases have limited spatial coverage. In this study, we propose a globally applicable method to detect levees from high-resolution LiDAR Digital Elevation Models (DEMs). Utilizing the Google Earth Engine platform, levees were identified by characteristic morphological parameters such as relative elevation and curvature. An image-processing algorithm was then applied to produce continuous levee lines from detected levee fragments. Verification results indicated adequate detection performance. The method also successfully detected unrecorded natural and artificial levees. Nevertheless, detecting levees with a narrow crest remains challenging. Across five countries (United States, Japan, Norway, Spain, and New Zealand), we detected 49 000 km of levee, 27 000 km of which protect cities and farmland. The method has high application potential as the availability of high-resolution DEM expands globally. Preliminary results of simulating past flood events using the CaMa-Flood model indicate that by inputting levee locations, simulated inundation extents were greatly reduced, coming much closer to observed extents. Moreover, the improvement is greater when levees are more accurately detected.

Keywords: *levee, digital elevation models, global river modeling, Google Earth Engine, CaMa-Flood*

Acknowledgement: *This work was supported by the JST FOREST Program (SOHATSU) (JPMJFR215P) and NEDO project (JP21500379).*

SOLAR RADIATION MODIFICATION: POTENTIAL IMPACTS OVER THE GLOBAL SOUT

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ABSTRACT

Solar radiation modification (SRM) is a controversial proposal for reducing some of the impacts of climate change by reflecting a small fraction of sunlight away from the Earth. SRM is a possible means to reduce the impacts of climate change. The decision to use it or reject it could be one of the biggest decisions humanity will face. This issue matters most to climate-vulnerable regions in the Global South. For over a decade, the Degrees Initiative has led the world in building the capacity of developing countries to evaluate solar radiation modification (SRM). The Degrees Initiative does this through outreach events that bring new people to the conversation, supporting and funding research that builds expertise and an evidence base, and activities that build an international community of experts.

This presentation highlights the research funded by the Degrees Initiative (through the Degrees Modelling Fund and the Socio-Political Fund), from nearly 40 projects conducted across over more than 20 countries of the Global South. Together, these projects are creating a global community of SRM experts with strong southern representation, transforming the environment in which decisions about SRM will be made by ensuring informed and confident representation from climate-vulnerable countries.

Keywords: *Solar radiation modification, impact assessment, climate change, Degrees Initiative.*

ASSESSING THE IMPACT OF CLIMATE CHANGE ON THE HYDROLOGY OF THE SETI GANDAKI RIVER BASIN

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ABSTRACT

The most important natural resource is water, which controls the ecosystem and promotes socioeconomic growth. Significant differences in water availability result from the water cycle's strong influence on human activity, land use changes, and regional climate variations, despite renewable natural resources. The Hindu Kush Himalaya (HKH) region, often referred to as the "water tower of Asia," plays a vital role in sustaining the water needs of billions in Asia through its network of glaciers and rivers. However, the hydrology of the area is being significantly impacted by climate change, endangering water security due to temperature changes, altered precipitation patterns, and glacier melting. Managing these resources in the face of environmental change requires an understanding of the hydrological processes occurring within river basins and watersheds, especially in the HKH. Thus, this study investigates the impacts of climate change on the hydrology of the Seti Gandaki River Basin (SGRB) by employing a Glacio-Hydrological Day Model (GDM). GDM is particularly effective for regions with limited data and simulates hydrological processes like snowmelt, ice melt, baseflow, and rainfall contributions to river discharge. Historical climate trends and future projections based on the CMIP6 Shared Socioeconomic Pathways (SSP2-4.5 and SSP5-8.5) are analyzed to assess the basin's response to rising temperatures and shifts in precipitation patterns. The model's performance, measured by Nash-Sutcliffe Efficiency (NSE), volume difference, and coefficient of determination, was robust during both the calibration and validation phases. Snowmelt and baseflow were identified as the dominant contributors to river discharge, with snowmelt peaking in spring and ice melting intensifying in late summer. Rainfall played a lesser role but remained critical during the monsoon season. Projected future discharge indicates an increasing trend under SSP5-8.5, with far-future rises of up to 7.36 m^3/s/year, while SSP2-4.5 initially shows a positive trend but declines in the far future to -5.85 m^3/s/year in ACCESS ESM1.5. By the end of the 21st century, the SSP5-8.5 scenario, characterized by higher emissions, predicts substantial increases in river discharge driven by accelerated glacier melting. The findings underscore the critical influence of climate change on the SGRB's hydrology. The projected rise in temperature will likely increase snow and glaciers' melt, exacerbating discharge variability. This presents both opportunities and challenges for water resource management, particularly in hydropower generation and flood risk mitigation. However, the long-term sustainability of water availability could be threatened as glacier reserves deplete, leading to potential water shortages.

Keywords: *Discharge, Glaciohydrological Degree Day Model, Climate Change, Seti Gandaki River Basin, Nepal*

ADVANCING DECISION SUPPORT SYSTEMS AND INTEGRATED WATER RESOURCES MANAGEMENT FOR CLIMATE ADAPTATION IN NORTHERN AND NORTH CENTRAL OF VIET NAM

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ABSTRACT

Northern, North Central of Viet Nam and adjacent regions are among the most climate-vulnerable areas in Southeast Asia, facing intensifying hydro-meteorological hazards such as typhoons, flash floods, droughts, and saline intrusion. Rapid shifts in seasonal rainfall, off-season storm events, and prolonged droughts driven by climate change are amplifying risks to agriculture, water resources, energy security, and livelihoods. These hazards frequently cause cascading impacts across multiple sectors, including infrastructure, education, and food security, and highlight the increasing complexity of disaster risk management in the region. Despite advances in hydro-meteorological monitoring, disaster risk governance remains hindered by fragmented institutional mandates, insufficient cross-sector coordination, and outdated operational frameworks. Current early warning systems are largely response-oriented, providing limited integration of impact-based forecasting, community engagement, or adaptive water resource management. Reservoir operations are conducted with static rules that cannot adequately accommodate climate variability, while data sharing across agencies and transboundary basins remains restricted. These gaps reduce the effectiveness of preparedness and leave vulnerable populations exposed to escalating disaster risks. A transformative shift toward integrated, multi-sectoral disaster risk management is critically needed. Priorities include strengthening coordination among water resources, agriculture, hydropower, transport, and health sectors; enhancing the reliability and dissemination of early warning information; and developing decision support systems (DSS) capable of synthesizing real-time data, predictive modeling, and scenario-based planning. Such systems would enable anticipatory and evidence-based decision-making, optimize reservoir operations, and balance competing water demands while protecting downstream communities and ecosystems. Pilot implementation of an integrated DSS in the Vu Gia–Thu Bon Basin offers a practical opportunity to test real-time data integration, cross-sector decision-making, and climate-adaptive reservoir management under complex but manageable governance conditions. Lessons from this basin can inform scaled deployment across Northern and North Central of Viet Nam, where multi-provincial coordination and higher disaster exposure present greater challenges. Strategic investment in climate adaptation and resilience through biodiversity conservation, watershed restoration, sustainable agriculture, and decentralized renewable energy systems will further reduce vulnerability and promote inclusive green development. Aligning such interventions with international financing frameworks, including GEF STAR allocations, provides an opportunity to catalyze system-level change and support long-term resilience.

By advancing multi-sectoral coordination, institutionalizing DSS platforms, and integrating climate risk into development planning, Northern and North Central of Viet Nam can transition from reactive disaster response to proactive resilience-building. This shift is essential to safeguarding human lives, sustaining livelihoods, and protecting ecosystems in the face of intensifying climate and environmental pressures.

Keywords: *decision support systems (DSS), Northern and North Central of Vietnam, disaster risk management, integrated water resources management.*

PER- AND POLY-FLUOROALKYL (PFAS) POLLUTION IN GROUNDWATER IN THE URBANIZED AREA: A CASE STUDY FROM BINH DUONG PROVINCE, VIETNAM

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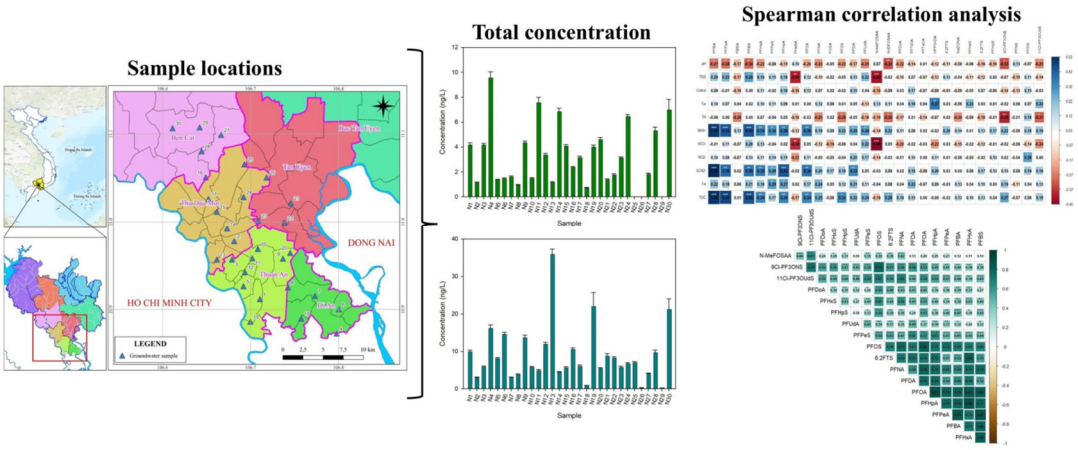
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ABSTRACT

Per- and poly-fluoroalkyl substances (PFAS) can be released into the environment at each stage, causing soil, surface water, and groundwater pollution, raising widespread concern due to potential negative impacts on human health. Groundwater, similar to surface water, is also a vulnerable source threatened by chemical and biological contamination. However, studies evaluating PFAS in groundwater in Vietnam are minimal. Therefore, this study examined 29 PFAS compounds, including major PFAS and their alternatives, in groundwater from residential areas and industrial zones in Binh Duong Province, which is experiencing ongoing urbanization, and the environmental status indicates a continuous decline, particularly in water quality. The study aimed to investigate the composition and concentration of PFAS in groundwater samples and assess seasonal variations in PFAS pollution levels between the rainy and dry seasons by liquid chromatography-tandem mass spectrometry (LC/MS-MS). The results showed that 60 groundwater samples collected in Binh Duong province in both the rainy and dry seasons mostly detected the presence of PFAS compounds. In particular, the dry season showed much higher PFAS concentrations than the rainy season, with the highest total concentrations of 35.93 ng/L and 9.57 ng/L, respectively. The detection frequency and contribution ratio of each PFAS compound were also evaluated with common compounds, including two main groups, PFCA and PFSA, and a substance belonging to the fluorotelomer sulfonate group, which was 6:2 FTS. The short-chain PFCAs, especially PFBA and PFPeA, were the dominant compounds, and long-chain PFSA compounds had lower concentrations in groundwater samples. In addition, environmental parameters including TOC, NH^{4+}, TDS, and SO_4^{2+} also exhibited strong correlations with PFAS levels, reflecting influences from domestic and industrial sources. These findings illustrate the spatio-temporal variability of PFAS pollution, emphasizing the need for focused monitoring and mitigation efforts in urbanizing areas like Binh Duong Province to protect groundwater resources.

Keywords: *Per-/polyfluoroalkyl compounds; Groundwater; Environmental parameters; Short-chain; Long-chain; Urbanization.*

Acknowledgement: *The present study was sponsored by the Ministry of Education and Training (MOET) under grant number B2023-VGU-05.*


Sample locations
Total concentration
Spearman correlation analysis
HO CHI MINH CITY
DONG NAI
LEGEND
Groundwater sample
Concentration (ng/L)
Sample

DEVELOPMENT OF AN EXTREME RAINFALL AND FLOOD ANALYSIS METHOD INTEGRATING METEOROLOGICAL AND HYDROLOGICAL MODELS: A CASE STUDY OF THE DA RIVER BASIN

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ABSTRACT

In the recent decades, under the impact of climate change and rapid social-economic development, rainfall and flooding in the Da River Basin (DRB) have become increasingly severe and extreme. Heavy rainfall events have occurred not only during the major rainy season but also during before or after rainy season, have triggered abnormal flood events. Previous studies have mainly focused on analyzing flood frequency or assessing reservoir operation efficiency. Such approaches are no longer adequate in the context of increasing extreme events, while reservoir operation procedures have not been timely adjusted, thereby heightening the risk of "compound floods" downstream. Therefore, this study proposes an extreme flood estimation approach using the integrated hydro-meteorology model (WEHY–WRF). The probable maximum precipitation (PMP) was determined by adjusting the initial and boundary conditions for the 50 largest flood-producing rainfall events during 1994–2021. Meteorological simulation results, as well as boundary data (topography, land use/cover, soil) were used as inputs for the WEHY model to simulate probable maximum flood (PMF) events in the DRB. The results show that most historical flood events were simulated with peak discharge errors smaller than the allowable thresholds, and the simulated hydrographs has high correlation compare to observations. This method not only successfully simulates historical flood events but also enables allows extreme flood simulations under various initial conditions. The study also reveals that not all large rainfall events necessarily lead to major floods in the basin, as the spatial distribution of rainfall and hillslope runoff differs. It can thus be concluded that maximum rainfall may not always be the primary driver of extreme floods. The influences of topography, soil moisture, and land use/cover must also be considered in the hydrological flow process.

Keywords: *Hydro-meteorology model (WEHY-WRF), Probable Maximum Precipitation (PMP), Probable Maximum Flood (PMF)*

ASSESSING THE IMPACTS OF CLIMATE CHANGES ON HYDROLOGICAL REGIME AT THE BA RIVER BASIN USING CMIP6 DATA

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ABSTRACT

Climate change has become one of the most pressing global issues, significantly affecting hydrological regimes in many river basins. The Ba River Basin, the largest river system in Central Vietnam, is particularly vulnerable due to its tropical monsoon climate and its critical role in agriculture, hydropower, and domestic water supply. Seasonal floods during the rainy season and water scarcity in the dry season make the basin highly sensitive to hydrologic extremes. Therefore, understanding how climate change may alter streamflow and hydrologic patterns in this basin is essential for sustainable water resource management.

This study aims to simulate streamflow in the Ba River Basin using the Soil and Water Assessment Tool (SWAT) and to assess changes in hydrologic extremes under different climate scenarios. Input data included a digital elevation model (DEM), land use and soil maps, as well as long-term hydro-meteorological records. The SWAT model was calibrated and validated using the SUFI-2 algorithm in SWAT-CUP, with observed streamflow data from 1990–2010. Model performance was evaluated using statistical indicators such as the Nash–Sutcliffe Efficiency (NSE), coefficient of determination (R^2), and Percent Bias (PBIAS), ensuring the reliability of hydrological simulations.

Future climate conditions were represented by downscaled and bias-corrected CMIP6-VN (10km) projections under two pathways: SSP245 (intermediate stabilization) and SSP585 (high emissions). Streamflow simulations were conducted for the mid-century (2041–2070) and late-century (2071–2100) periods, compared against a historical baseline (1980–2010). The findings highlight that climate change will likely exacerbate both floods and droughts in the Ba River Basin. The outcomes provide critical scientific evidence for designing integrated water resource management strategies, optimizing reservoir operations, and improving disaster preparedness. This study underscores the importance of incorporating climate projections into water resources planning to support climate change adaptation and sustainable development in Central Vietnam.

Keywords: *SWAT, Ba River Basin, hydrology, climate change, climate scenarios.*

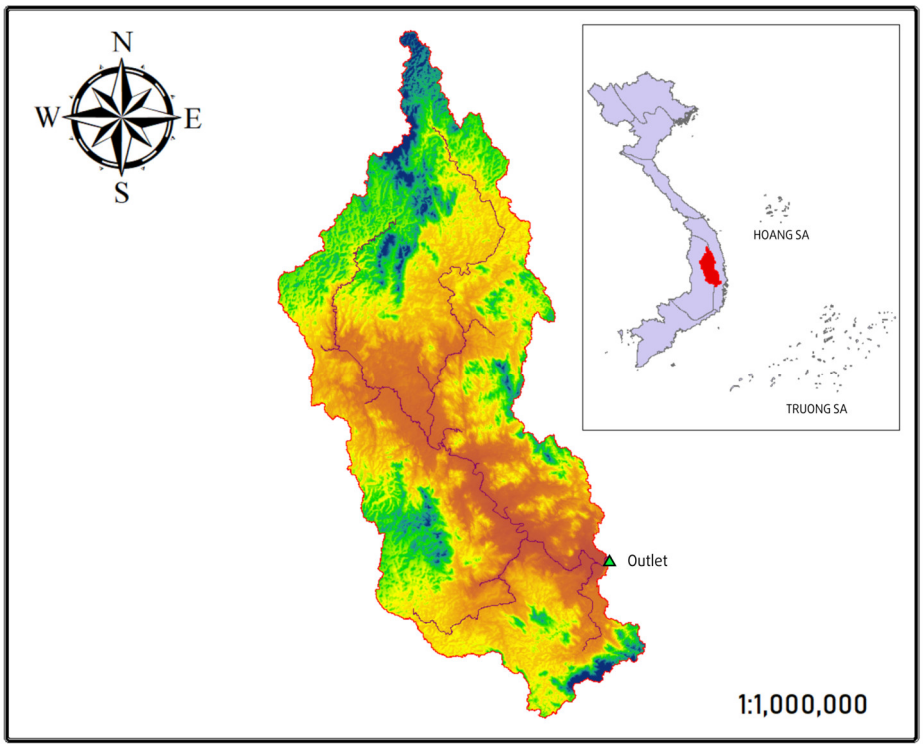


Figure 1. Map of Ba River basin and CungSon outlet station

SHORT-TERM INFLOW FORECASTING BASED ON THE COUPLED MODEL (WRF – WEHY) FOR HYDROPOWER RESERVOIR OPERATION: A CASE STUDY IN THE DA RIVER BASIN

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ABSTRACT

Hydropower represents a vital component in Vietnam's energy system, serving not only as a major source of electricity but also as important functions in downstream flood regulation and water supply for agricultural, industrial, and domestic demands. However, accurately forecasting reservoir inflows, particularly during flood seasons, remains a significant challenge due to the highly nonlinear, spatially heterogeneous, and temporally variable nature of hydro-meteorological processes. These uncertainties greatly affect the reliability of reservoir operation and decision-making for water and energy management.

This study develops an integrated short-term inflow forecasting framework by coupling the Weather Research and Forecasting (WRF) model with the physically based, fully distributed Watershed Environmental Hydrology (WEHY) model. The WEHY model, as an open-source and fully distributed system, enables flexible calibration and direct rainfall–runoff transformation at the watershed scale. In addition, its capability to dynamically update model parameters and state variables at each computational time step allows for a more realistic representation of evolving watershed conditions, thereby improving the accuracy of streamflow predictions, including flood peak magnitude, timing, and overall hydrograph response.

The proposed WRF–WEHY framework was applied to the Da River basin, with a focus on three key hydropower reservoirs: Lai Chau, Son La, and Hoa Binh. Model evaluation indicates that the coupled system provides significant improvements in short-term inflow forecasting compared with conventional empirical or lumped approaches, especially in reproducing flood peaks and overall hydrograph dynamics. The results demonstrate the potential of the WRF–WEHY framework to enhance hydropower reservoir operation, mitigate downstream flood risks, optimize power generation, and ensure water supply security during dry seasons. Owing to its flexibility and scalability, the approach can be extended to other river basins in Vietnam, providing a robust and transferable tool for sustainable water resources management and integrated hydropower operations.

Keywords: *Flood forecasting; WRF–WEHY; Hydropower Reservoir Operation;*

CAN THE CAPACITY AND OPERATION RULES OF MULTIPURPOSE RESERVOIRS IN BA RIVER BASIN COPE WITH FUTURE FLOOD EVENTS?

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ABSTRACT

Multipurpose reservoir systems play a crucial role in flood control, particularly in Vietnam. However, most reservoir systems are designed based on fixed flood frequency analysis and often face operational challenges during extreme rainfall events. In recent years, reservoirs in northern and central Vietnam have demonstrated limited flood mitigation capacity, with several facilities operating under high alert conditions due to elevated dam failure risks. With climate change expected to increase the frequency and intensity of extreme precipitation, this study evaluates whether the current capacity and operational protocols of multipurpose reservoirs in Vietnam's Ba River Basin remain adequate under future climate conditions. We analyze future flood resilience using CMIP6 climate change scenarios and simulations from the Geoengineering Large Ensemble (GLENS) project, which models climate outcomes under Solar Radiation Management (SRM) technology deployment. This comprehensive range of climate scenarios enables thorough assessment of projected changes in precipitation patterns and extreme rainfall frequency. The findings provide insights for reservoir management and infrastructure development while highlighting the importance of climate change mitigation strategies, including the potential role of solar radiation management technologies.

Keywords: *reservoir operation, climate change, flood, CMIP6, GLENS.*

Acknowledgement: *This work was supported by the Degrees Modeling Fund under the Grant Agreement No. RGA-DMF-VNM-01-25-00).*

ASSESSING THE IMPACT OF STRATOSPHERIC AEROSOL INJECTION ON EXTREME PRECIPITATION IN LAM DONG PROVINCE USING DOWNSCALED CLIMATE PROJECTIONS

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ABSTRACT

Human-induced climate change is intensifying extreme precipitation events, posing significant risks to infrastructure, and socio-economic conditions across multiple regions. Recent studies have focused on geoengineering approaches like Stratospheric Aerosol Injection (SAI) to mitigate the effects of human-induced climate change. However, the impacts of SAI on extreme precipitation, remain highly uncertain, especially over Global Southeast Asia region (such as Vietnam) as most SRM research has been conducted in developed countries. This study examines the potential impact of SAI on extreme precipitation at the local scale, utilizing Lam Dong Province as the testbed. It compares future climate projections influenced by SAI activities (generated by the Geoengineering Large Ensemble Project; GLENS) with those projected under the high-emission scenario SSP5-8.5, which is available through the Coupled Model Intercomparison Project Phase 6 (CMIP6). Both GLENS and CMIP6 data are statistically downscaled and bias-corrected to better capture local climate variability. Standard international indices of extremes (endorsed by the Expert Team on Climate Change Detection and Indices – ETCCDI) were then calculated and compared to highlight the differences in extreme indices projected under the two scenarios (i.e., with and without SAI). The findings offer insights into both the potential benefits and the possible risks of SRM: while it may contribute to mitigating climate change impacts, it also entails new uncertainties and challenges for climate disaster management.

Keywords: *Climate Change, CMIP6, Extreme Precipitation, Stratospheric Aerosol Injection, GLENS experiment.*

Acknowledgement: *This work was supported by the Degrees Modeling Fund under the Grant Agreement No. RGA-DMF-VNM-01-25-00).*

SESSION

VI

REMOTE SENSING AND APPLICATIONS

BLUE SPACE AND URBAN HEAT MITIGATION: ASSESSING COOLING EFFECT OF POND SYSTEM

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ABSTRACT

Greener urban development has become a critical strategy for city managers seeking to mitigate the challenges of rapid urbanization and climate change. Among nature-based solutions, the integration of blue spaces, particularly ponds, has gained increasing recognition for their role in regulating microclimates and alleviating urban heat island effects. This study investigates the inherent properties of pond systems, with particular attention to morphological characteristics and environmental variables that influence pond surface temperature (PST). Furthermore, it evaluates the cooling performance of ponds in terms of both spatial extent and intensity.

To achieve this, land surface temperature data were derived from Landsat-8 imagery, while land use and land cover types were extracted from Sentinel-2 data. A total of 709 ponds were analyzed. The results indicate that pond perimeter exerts the strongest influence on PST (β = -0.857), while pond area (β = 0.259) and shape ratio (β = 0.296) exert moderate effects. In addition, mean elevation demonstrates a cooling influence on PST (β = -0.214). Using polynomial regression and the first-turning-point method, two key cooling indicators of pond systems were identified: a maximum cooling extent of 140 m and a cooling intensity of 2.70 ^{0}C.

These findings highlight the significant role of pond morphology and environmental context in shaping their thermal regulation capacity. By clarifying how ponds contribute to local cooling, the study provides empirical evidence to support urban climate adaptation strategies. The insights gained are particularly relevant for urban planning and blue space design, offering practical guidance for optimizing pond systems to counteract the thermal impacts of urbanization and enhance climate resilience.

Keywords: *Blue spaces, cooling effect, land surface temperature, urban heat island, urban planning*

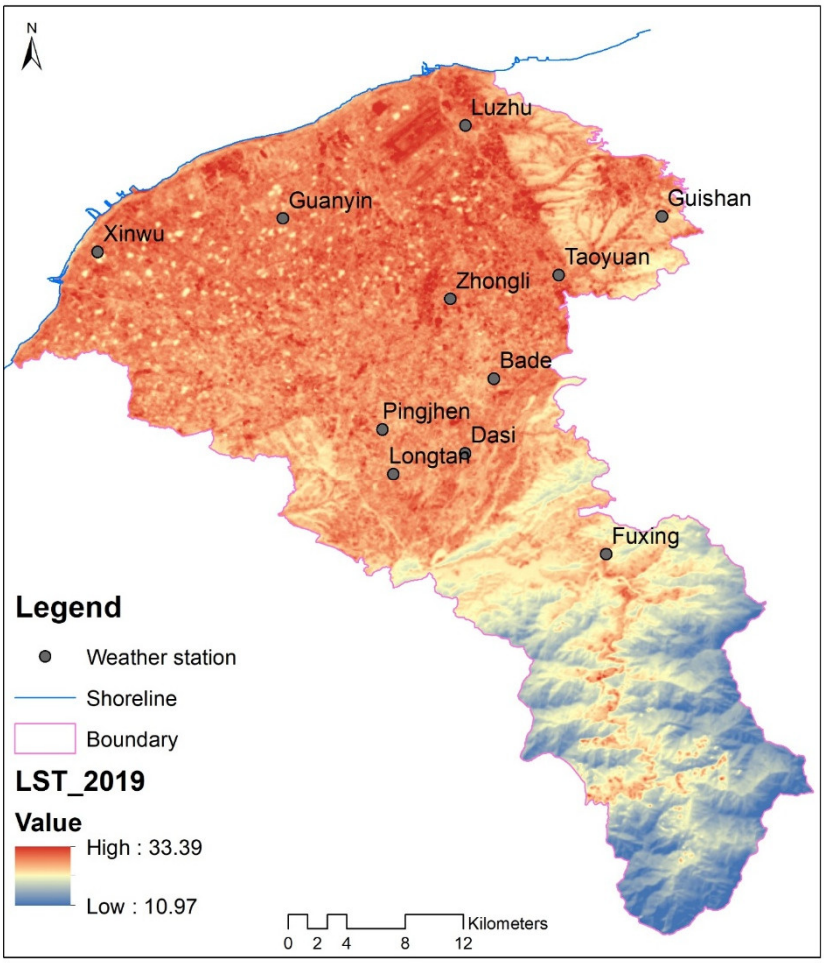


Figure 1. Study site and its land surface temperature.

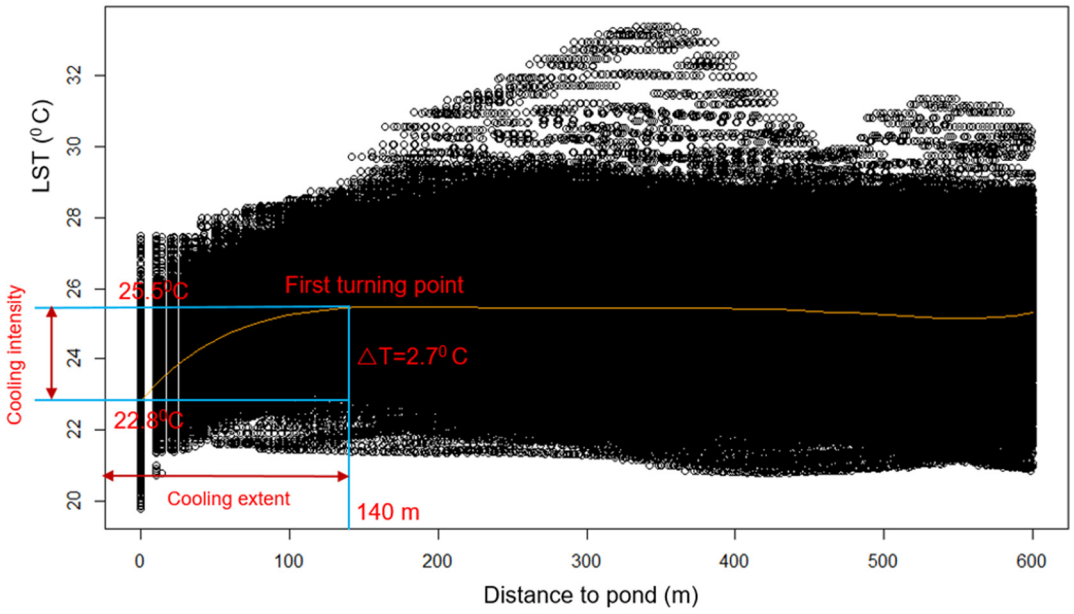


Figure 2. Cooling indicators of pond systems identified through polynomial regression.

URBANIZATION, VEGETATION, AND SOIL CARBON NEXUS: REMOTE SENSING AND GROUND-BASED INSIGHTS FROM SOUTH DELHI, INDIA

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ABSTRACT

Urbanization is rapidly transforming landscapes and ecological processes in metropolitan regions. In South Delhi, India, the interaction of expanding infrastructure, vegetation loss, and rising land surface temperature (LST) directly affects soil functions, particularly the storage of soil organic carbon (SOC). This study integrates high-resolution remote sensing with extensive ground validation to analyze the relationships between vegetation, urban expansion, thermal regimes, and SOC distribution. Satellite-derived indices Normalized Difference Vegetation Index (NDVI), Normalized Difference Built-up Index (NDBI), and LST were extracted from multispectral and thermal remote sensing data to map vegetation dynamics, urbanization intensity, and thermal variations. Concurrently, field-based soil sampling was conducted across agricultural lands, forests, scrublands, settlements, and wastelands to measure SOC content and validate satellite-based assessments.

The integrated analysis revealed significant spatial variations in SOC that closely mirrored vegetation cover and urban development. NDVI showed a strong positive correlation with SOC ($r = 0.67$, $p < 0.001$), confirming that dense vegetation enhances soil carbon storage. Conversely, NDBI ($r = -0.54$, $p < 0.001$) and LST ($r = -0.65$, $p < 0.001$) exhibited negative correlations with SOC, highlighting the adverse effects of urban growth and elevated temperatures on soil health. Regression analyses and correlation heatmaps further substantiated these trends, illustrating that urbanization and surface heating reduce SOC, while vegetation supports higher SOC levels. Ground validation confirmed the reliability of remote sensing in capturing SOC dynamics, with field observations aligning with satellite-derived relationships. SOC concentrations were lowest in urbanized and barren zones, whereas forested and vegetated areas acted as carbon sinks, moderating local temperature anomalies. These findings highlight the dual role of vegetation in maintaining soil health and mitigating the effects of urban heat islands.

The implications are twofold. First, remote sensing provides a robust, spatially detailed framework for monitoring urban ecological processes, which is vital for identifying land degradation risks and developing adaptive strategies. Second, the study highlights the importance of urban greening, forest protection, and sustainable land management in enhancing carbon sequestration and resilience against climate stresses. Policies promoting vegetation conservation and climate-aware urban development will be crucial to reducing SOC losses in rapidly growing urban areas.

In conclusion, this research offers a comprehensive framework that integrates satellite-based indices with ground validation for effective monitoring of urban soil and land systems in South Delhi. The approach is broadly applicable to other metropolitan areas facing the dual challenges of urban growth and climate resilience, thereby supporting informed policy and sustainable urban planning.

Keywords: *Remote Sensing, Land Surface Temperature, Soil Organic Carbon, Urbanization, Vegetation Assessment*

Acknowledgement: *I gratefully acknowledge the guidance of my supervisor,* **Dr. Tuisem Shimrah**, *and the support of the* **University School of Environment Management, Guru Gobind Singh Indraprastha University, New Delhi**, *in carrying out this research.*

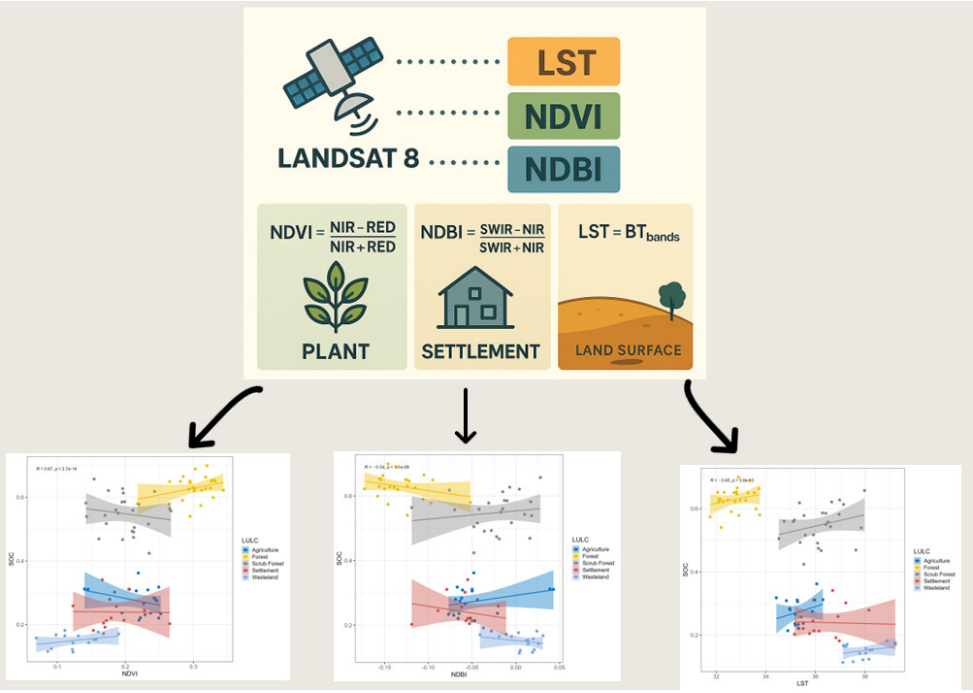


Figure: Remote sensing indices (NDVI, NDBI, LST) and their relationship with SOC across land cover types in South Delhi, India.

MACHINE LEARNING MODELS FOR FLOOD SUSCEPTIBILITY MAPPING: CASE STUDY IN DANANG CITY

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ABSTRACT

This study presents a method for flood susceptibility mapping in Hoa Vang District, Da Nang city, by integrating Geographic Information System (GIS), remote sensing data, and machine learning models. Eight individual algorithms including boosting models like CatBoost and XGB, and traditional models like Random Forest along with three novel ensemble models (BEG, TER, BER) were used to analyze 17 risk factors. The results indicated that elevation, soil type, slope, precipitation, NDVI, and NDBI were the most influential factors. All models demonstrated high performance (ROC_AUC > 0.95), with boosting models showing superior results (ROC_AUC > 0.97). Notably, the novel ensemble model, BoostingEnsembleRandom (BER), achieved excellent performance with an ROC_AUC of 0.998, demonstrating its outstanding potential for identifying flood-prone areas for proactive disaster management and mitigation.

Keywords: *Boosting, ensemble model, flood machine learning, Hoa Vang, susceptibility.*

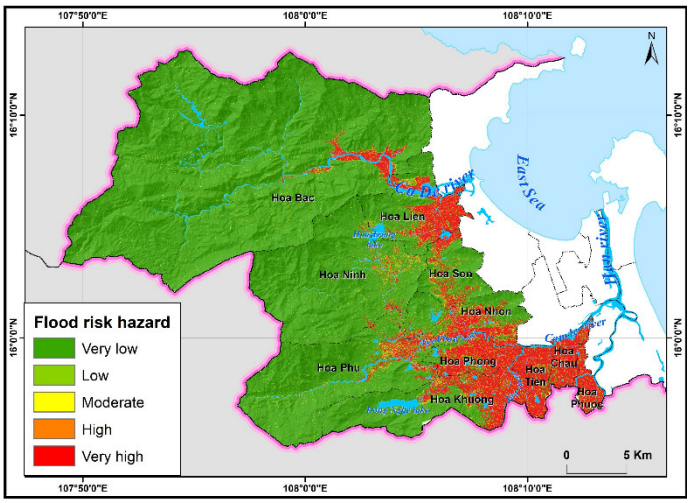


Figure 1. Flood susceptibility maps for the Hoa Vang District

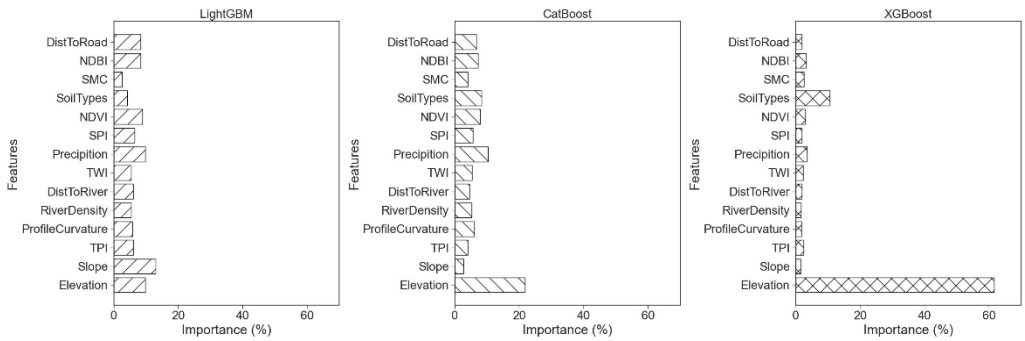


Figure 2. The importance of flood conditioning factors of each single ML model

ANALYSIS OF BLUE CARBON POTENTIAL IN MANGROVE ECOSYSTEMS OF BULU HADIK VILLAGE, SIMEULUE ISLAND, INDONESIA USING THE MANGROVE VEGETATION INDEX ALGORITHM

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ABSTRACT

Blue carbon refers to the carbon captured and stored by coastal ecosystems, including mangrove forests, seagrass beds, and salt marshes. These ecosystems play a strategic role in reducing the impacts of global climate change due to their ability to absorb large amounts of carbon and store it over long periods of time. Mangrove forests, in particular, are recognized as one of the most effective natural carbon sinks, not only through their aboveground and belowground biomass but also through the accumulation of carbon in their sediments. This study aims to measure and analyze the potential blue carbon storage in the mangrove forest ecosystem of Bulu Hadik Village, Simeulue Island, Indonesia, using a remote sensing approach through the Mangrove Vegetation Index (MVI) algorithm. In this study, Landsat 8 imagery was analyzed with QGIS and ENVI to map mangrove cover in Bulu Hadik Village, Simeulue Island, and to calculate its area, biomass, and blue carbon storage. Findings indicate that mangroves in this area cover about 220,303 ha, with an estimated biomass of 2,203,030 tons. The stored carbon was calculated at roughly 991,363 tons of C, equivalent to 3,639,000 tons of CO_2. The mangrove ecosystem in Bulu Hadik Village is threatened by coastal erosion and human activity, limiting its ecological functions. Despite this, it has strong carbon sequestration potential, especially when future growth and annual uptake are considered. These findings stress the urgent need for sustainable mangrove management to support climate change mitigation.

Keywords: *Mangrove Ecosystem, Blue Carbon, Climate Change, Simeulue Island*

OBJECT-BASED MACHINE LEARNING CLASSIFICATION FOR PLASTIC GREENHOUSES INDENTIFICATION USING PLANETSCOPE IMAGES: A CASE STUDY IN DA LAT, VIETNAM

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ABSTRACT

The integration of object-based image analysis (OBIA) and machine learning classifiers has significantly enhanced the efficiency and accuracy of land use land cover (LULC) classification. This study utilized OBIA and six machine learning (ML) algorithms including Random Forest (RF), Extreme Gradient Boosting (XGBoost), Artificial Neural Network (ANN), Support Vector Machine (SVM), K-Nearest Neighbors (KNN), and Naïve Bayes (NB) to classify land cover (LC) in Da Lat, Vietnam with PlanetScope imagery in 2025. The LC classes consisted of Plastic Greenhouse, bare land, built-up land, vegetation, and water bodies. Statistical analysis to quantitatively compare the performance of the ML models were conducted using ArcGIS and tidymodels in the R Studio. Performance metrics were divided into two main groups: hard predictions (overall accuracy, precision, recall, F1-score, kappa) and soft predictions (ROC-AUC and mean log loss). Based on the statistical distribution of metrics from 50 iterations for each ML model and values from the testing dataset, XGBoost showed the best classification results across both metric groups. Its F1-score and Kappa were 0.84 ± 0.0067 and 0.84 ± 0.0045 (mean ± 1.96 SE), while ROC-AUC and mean log loss were 0.98 ± 0.0012 and 0.33 ± 0.0093, respectively. In contrast, ANN obtained an F1-score and Kappa of 0.88 ± 0.0052 and 0.86 ± 0.0031 (mean ± 1.96 SE, but the ROC-AUC and mean log loss were 0.98 ± 0.0012 and 1.04 ± 0.0016, respectively. The results indicated that, for hard predictions, ANN had the highest accuracy. But when considering soft predictions, its mean log loss showed the model's prediction confidence was lower than that of XGBoost. The optimal model in this study was XGBoost, which was applied to classify the whole study area. The study demonstrated OBIA and ML classifiers have significant potential for generating LULC maps and detecting Plastic Greenhouses using high-resolution imagery like PlanetScope. However, comparing performance of classification models requires a comprehensive approach with multiple metrics to ensure accuracy, stability, and reliability of the models.

Keywords: *OBIA, Machine Learning Classifiers, PlanetScope, Plastic Greenhouse.*

VEGETATION INVESTIGATION USING UAV IMAGERY IN VIETNAM

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ABSTRACT

Vegetation, a key component of the Earth's surface, plays a vital role in ecological processes and human development. Satellite imagery has been widely used to monitor vegetation quality and quantity; however, this approach is often constrained by limited spatial resolution and atmospheric interference. Unmanned aerial vehicles (UAVs), equipped with flexible sensor systems and capable of operating below cloud level, provide imagery with centimeter-level resolution and represent a powerful tool for vegetation monitoring. This study demonstrates UAV applications in Vietnam for three purposes: (1) quantifying mangrove changes, (2) estimating nutrient content in rice leaves, and (3) predicting the productivity of fresh tea. Multitemporal UAV RGB imagery with 7 cm resolution over mangrove forests revealed that tidal flat deposition and erosion had minimal effects on mangrove growth. For nutrient monitoring, multispectral UAV images with 2 cm resolution acquired at three rice growth stages enabled estimation of potassium concentration in leaves, highlighting temporal variations during crop development (**Figure 1**). In the third application, UAV-based hyperspectral imagery (3 cm resolution, 122 spectral bands) was combined with multiple machine learning algorithms to predict tea bud height, weight, and bud count. Models tested included linear regressions and their regularized variants (Ridge, Lasso), ensemble methods (Random Forests), Bayesian regressors, and boosting algorithms (XGBoost, CatBoost), with performance evaluated using cross-validated R^2 and MSE. Results show that: the XGBoost model achieved the best performance for tea height prediction (MSE = 121.36, R^2 = 0.14); the CatBoost model performed best for weight estimation (MSE = 232.6, R^2 = 0.45); and Bayesian regressors yielded the highest accuracy for bud count (MSE = 583.2, R^2 = 0.54) (**Figure 2**). These findings demonstrate the potential of integrating UAV-based imaging with advanced machine learning for precision agriculture. The successful use of UAVs with diverse imaging sensors highlights their promise as an emerging remote sensing approach for investigating various aspects of vegetation.

Keywords: *UAV hyperspectral image, UAV RGB, UAV multispectral, vegetation monitoring, nutrient investigation.*

Acknowledgement: *The study is supported by the project "Application UAV imagery and machine learning for estimating fresh tea productivity", project code VAST08.03/25-26 funded by Vietnam Academy of Science and Technology.*

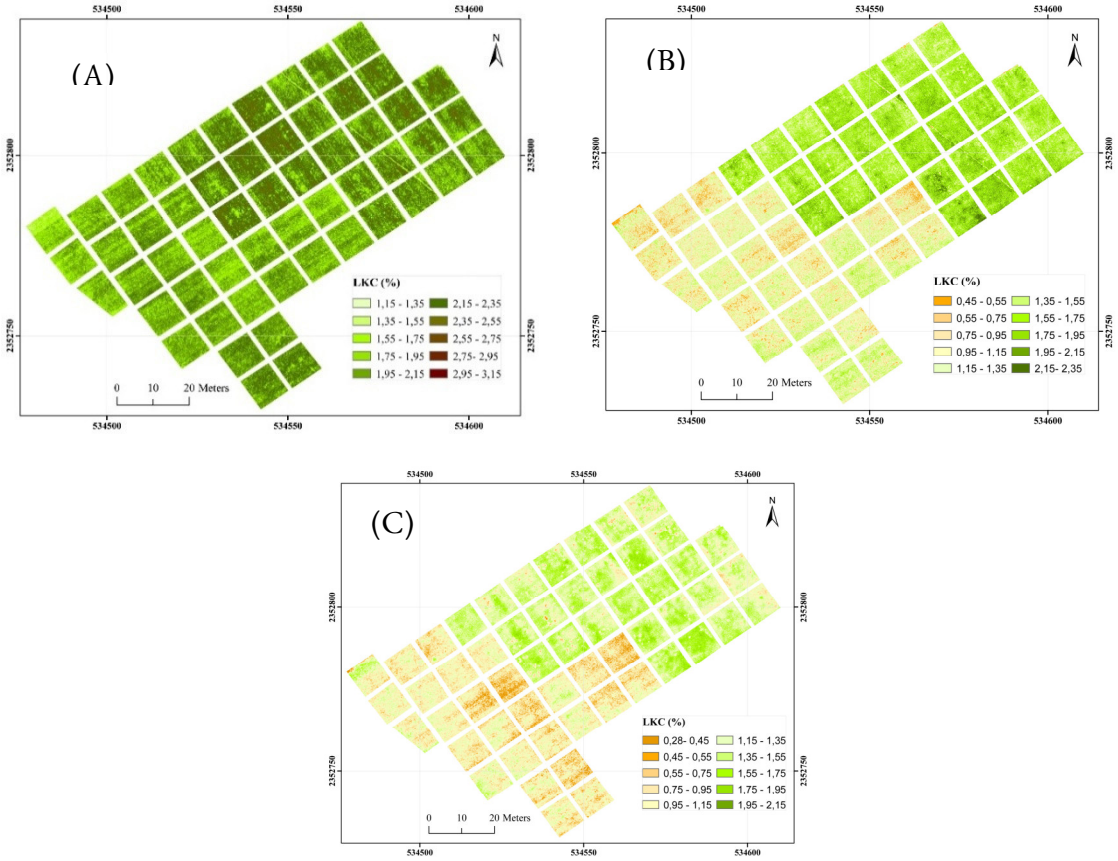


Figure 1. Potassium concentration in rice leaves estimated from UAV multispectral images at (A) panicle stage, (B) milk stage, and (C) mature stage

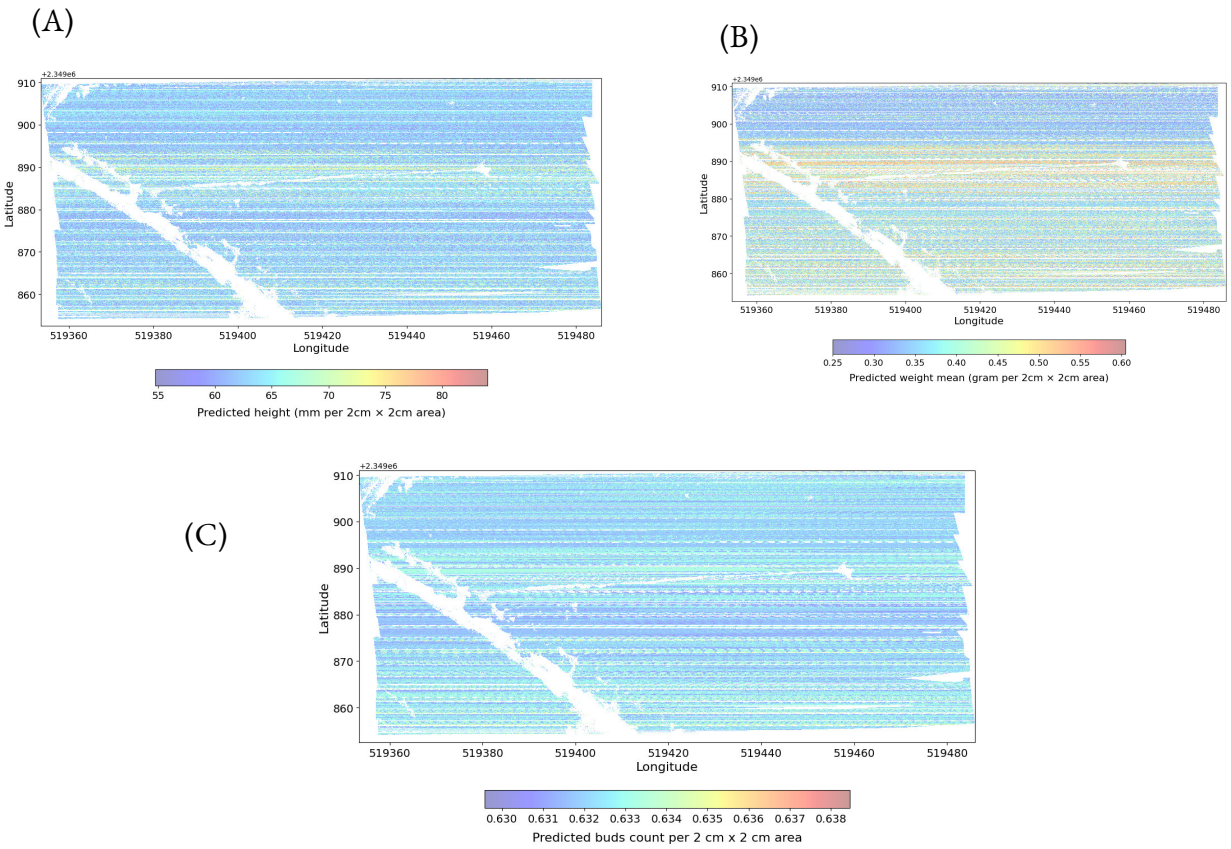


Figure 2. (A) Tea height, (B) weight, and (C) bud count of fresh tea estimated from UAV hyperspectral images.

↖ AGENDA ↖ SESSION VI

NDWI-BASED MONITORING OF RIVERBANK DYNAMICS AND COMMUNITY EXPOSURE IN PHU THO PROVINCE, NORTHERN VIETNAM

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ABSTRACT

Riverbank landslides represent a serious yet frequently overlooked hazard, posing threats to infrastructure, farmland, and communities in regions undergoing rapid development. As extreme weather events intensify, these hazards have emerged as both a non-traditional security issue and a central concern for disaster risk reduction (DRR), carrying broad implications for climate resilience and sustainable development. This research investigates the spatiotemporal changes of the Chay and Lo river in Phu Tho province, northern Vietnam, with particular attention to the consequences of typhoon Yagi in 2024. Multi-temporal Landsat data were analyzed using the Normalized Difference Water Index (NDWI) and its temporal variation (ΔNDWI) to capture long-term erosion dynamics and short-term riverbed expansion induced by the typhoon. The results indicate notable narrowing of the Chay river, including an eastward channel migration of nearly 100 m, and severe erosion near the Song Lo bridge, where the channel widened by roughly 90m between 2023 and 2024. Human exposure was further evaluated by integrating the Global Google–Microsoft Open Buildings Dataset with hazard zone mapping. Along the Chay River, 670 buildings with approximately 533 residents are located within a 60m hazard zone, while 1259 buildings and about 1008 residents fall inside a 90m zone. These findings demonstrate the potential of open-access geospatial datasets to strengthen DRR, enhance infrastructure resilience, and inform adaptive urban planning in Vietnam and beyond.

Keywords: *landslide, non-traditional security, NDWI, building footprint, disaster risk reduction*.

INTEGRATION OF UNMANNED AERIAL VEHICLES (UAVS) FOR RIVERBANK EROSION ASSESSMENT: A CASE STUDY IN MỸ XƯƠNG AREA, ĐỒNG THÁP PROVINCE

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ABSTRACT

Riverbank erosion monitoring in tropical deltaic environments faces significant challenges due to limitations in spatial resolution and temporal coverage of traditional satellite-based approaches. This study proposes the integration of Unmanned Aerial Vehicles (UAVs) with satellite imagery to enhance riverbank erosion assessment along the My Xuong Area, Dong Thap Province in Vietnam's Mekong Delta. The research addresses critical gaps in current monitoring capabilities by developing a systematic UAV-based framework that provides high-resolution spatial data (1–5 cm) to complement existing satellite imagery (10–30 m resolution).

The methodology encompasses multi-temporal UAV surveys conducted during pre-flood, flood peak, and post-flood phases, employing high-resolution optical sensors and Structure-from-Motion photogrammetry for orthomosaic generation. Shoreline positions are automatically extracted and subsequently processed within the Digital Shoreline Analysis System (DSAS) to quantify spatiotemporal dynamics. To provide broader spatial context, UAV-derived shorelines are compared with satellite-based products, thereby underscoring the superior accuracy and resolution achievable through UAV observations.

The study aims to establish standardized protocols for UAV-based erosion monitoring and investagation specifically adapted to tropical deltaic conditions, where dynamic sediment transport and complex hydrological processes pose unique challenges. Expected outcomes include validated data fusion methodologies, quantified accuracy assessments, and enhanced understanding of fine-scale erosional processes.

This research contributes to advancing precision monitoring techniques essential for sustainable river management and erosion hazard mitigation in the Mekong Delta region. The developed framework will provide valuable tools for environmental managers and researchers addressing riverbank erosion in similar deltaic environments globally. The integration of UAV technology represents a significant advancement in monitoring capabilities, enabling more timely and accurate assessment of riverbank stability for informed decision-making in river management practices.

Keywords: *UAV, riverbank erosion, remote sensing, Mekong Delta, photogrammetry, change detection*

Acknowledgement: *The authors gratefully acknowledge the academic support and research environment provided by the Vietnamese-German University (VGU).*

PERFORMANCE ASSESSMENT AND RANDOM FOREST-BASED MERGING OF SATELLITE PRECIPITATION PRODUCTS FOR HYDROLOGICAL APPLICATIONS IN THE BA RIVER BASIN

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ABSTRACT

Reliable rainfall data is one of the biggest challenges for hydrological modeling in regions where ground monitoring networks are sparse. In the Ba River Basin, floods, droughts, and the operation of several major reservoirs all depend heavily on accurate precipitation information. While satellite-based precipitation products (SPPs) such as CMORPH, CHIRPS, GSMaP, and IMERG provide continuous coverage, their performance can vary greatly across space, time, and storm intensity. This study sets out to evaluate how well these datasets capture rainfall in the Ba Basin and to explore whether combining them with ground observations could lead to a more reliable product. Daily ground station data were used as the benchmark for assessing the mentioned SPPs over 20 years (2004 – 2023). We relied on standard statistical metrics, including Root Mean Square Error (RMSE) and Kling-Gupta Efficiency (KGE) to quantify accuracy. The best-performing products were then blended and integrated with ground measurements using a Random Forest model to capture spatial rainfall variability more effectively. The improved dataset was tested not only against independent station data but also as input to a semi-distributed hydrological model (SWAT) of the basin, with a particular focus on the key reservoirs in the region. The results showed clear differences between the SPPs, with CHIRPS and CMORPH performing slightly better than GSMaP and IMERG. By integrating ground-truth data into the satellite-based set through Random Forest, we were able to reduce RMSE and improve KGE values by up to 0.2 compared to the best single product. These improvements were reflected in the hydrological simulations as well: the corrected dataset provided a closer match to observed reservoir inflow (with highest NSE~0.86 on daily flow and monthly flow at An Khe reservoir, along with improvement at other locations), especially during flood peaks. This study demonstrates the potential of combining multiple satellite precipitation products with ground observations through machine learning to improve rainfall estimation in data-scarce basins. The merged dataset not only enhances statistical performance but also significantly strengthens hydrological model outputs, offering practical benefits for hydrological analysis and water resources planning.

Keywords: *Satellite precipitation products, Random Forest, Merging techniques, Hydrological modeling, Ba river basin*

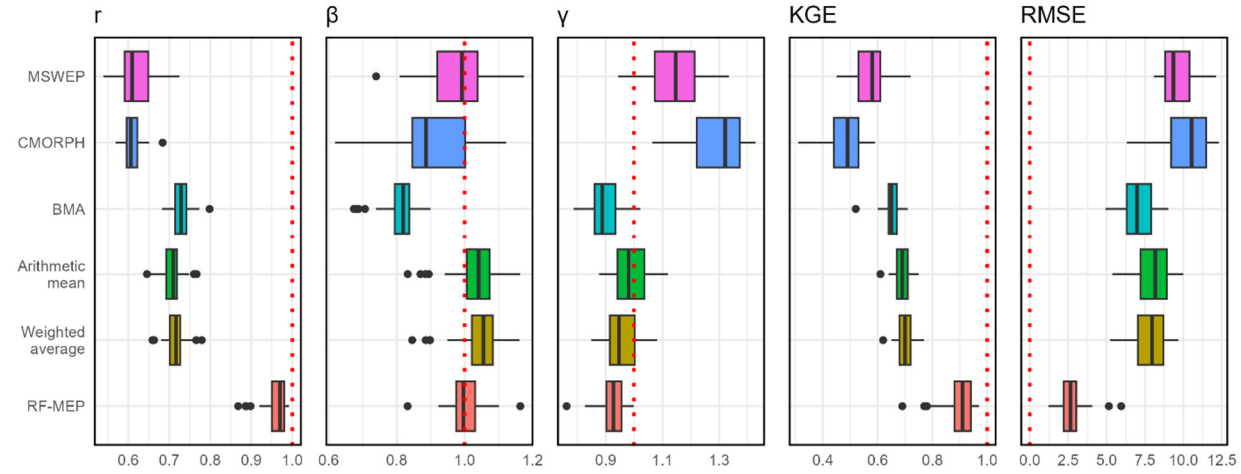


Figure 1. Comparing Random Forest (RFMEP) product to other merging procedures (MSWEP, Weighted Average, Bayesian Model Average) and a top-performing single product (CMORPH)

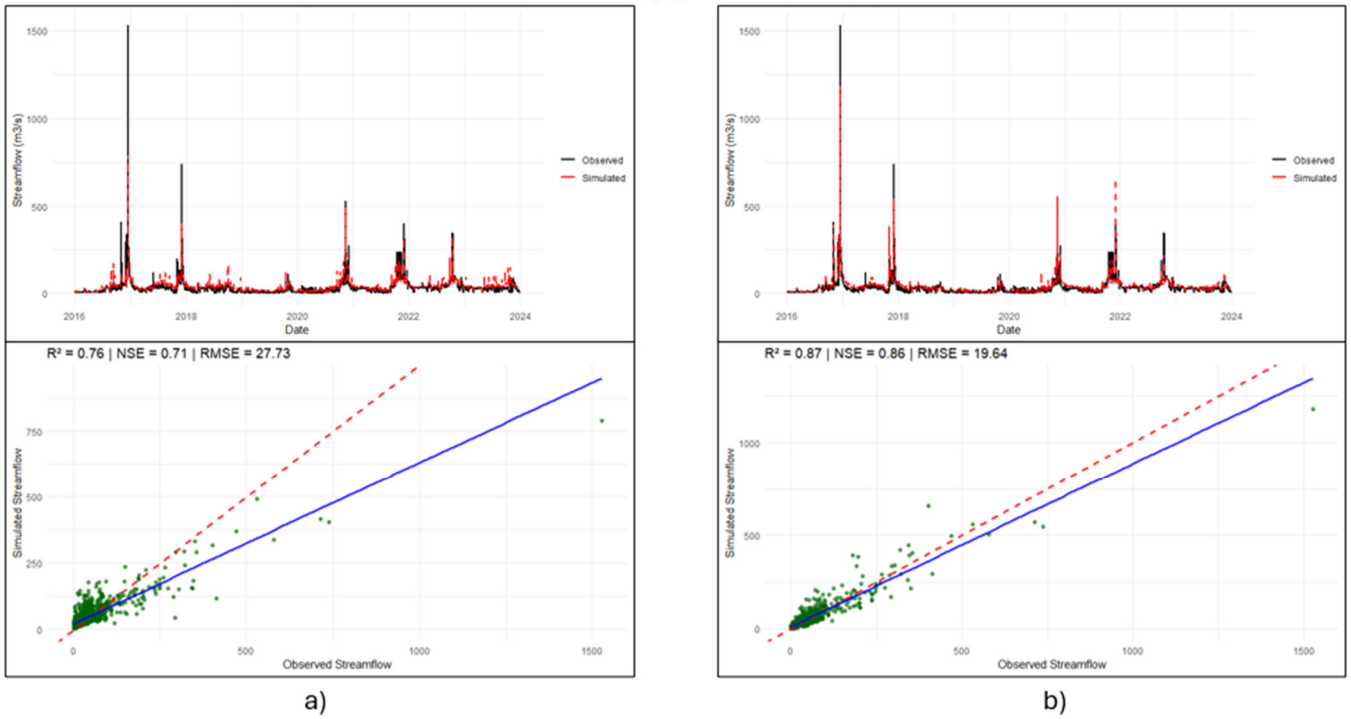


Figure 2. Improvement in daily streamflow simulation (An Khe reservoir inflow) from using CMORPH (a) to the new merged product (b)

COMPARATIVE EVALUATION OF AHP AND ADVANCED MACHINE LEARNING MODELS FOR DELINEATING GROUNDWATER POTENTIAL ZONES IN SOUTHERN REGION OF DELHI, INDIA

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ABSTRACT

Over the past few decades, groundwater has emerged as a critical resource due to rising demands driven by unregulated population growth, industrialization, and urbanization. The situation is projected to worsen with continued unsustainable usage and dynamic LULC pattern of the Southern region of Delhi creates adverse effects on groundwater resources leads to interruption of recharge process. Therefore, the novel objective of this study was to identify groundwater potential zones (GWPZs) by comparing machine learning techniques with an AHP-MCDM model utilising specific conditioning factors. In the first phase, 155 wells were identified and rest of data have been gathered from the secondary sources and the past literature reviews. Data have been split into 70% and 30% for model training and validation. Then in next step, 13 conditioning factors including, Geology, Geomorphology, Land Use/Land Cover, Lineament density, Drainage density, Rainfall, Soil, Slope, Roughness, Topographic Wetness Index, Topographic Position Index, and Curvature have been utilized to examined the relationship between these conditioning factors and groundwater occurrences. In the subsequent stages, the training dataset was used to performing the XGBoost, MLPNN, RF and Deep learning models, and factor weights were computed using Analytical Hierarchy method. The performance of five models was validated and compared using AUC-ROC curve and confusion matrix. All five models performed well overall in identifying the artificial GWPZs. However, the machine learning approaches outperform the conventional AHP MCDM models in terms of predictive ability, with the greatest AUC values and correlation values. These maps of groundwater potential can be used by engineers and planners to efficiently manage water resources sustainably.

Keywords: *Groundwater Potential Zone (GWPZ), Extreme Gradient Boosting (XGBoost), Random Forest (RF), Multi-Layer Perceptron Neural Network (MLPNN), Deep Learning (DL)*

Acknowledgement: *The authors would like to express gratitude to the Dean, University School of Environment Management, GGSIPU for providing the research infrastructure throughout this study.*

HIGH ACCURACY TEA CROP PRODUCTIVITY ESTIMATION USING UAV MULTISPECTRAL DATA

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ABSTRACT

Accurate and timely estimation of crop yield is essential to facilitate precision agriculture, optimize resource allocation, and enhance the sustainability of agricultural systems. In tea cultivation, an economically important crop in many tropical and subtropical regions, non-destructive yield prediction methods need more development. This study aimed to establish a reliable tea yield estimation model using high-resolution data obtained from unmanned aerial vehicles (UAVs) equipped with both RGB and multispectral sensors. Field experiments were conducted in Te Le commune, Phu Tho province, Vietnam, in which UAV images were collected at two time points: before and after harvest. The images were processed to extract a range of features, including vegetation indices (VIs) reflecting canopy greenness and biomass, surface roughness indices designed to capture canopy structural variation, and texture feature indices (TFIs) derived from spatial heterogeneity in reflectance patterns. A novel method for extracting the surface roughness index was tested to increase sensitivity to canopy morphology; however, this method yielded suboptimal results and was not retained in the final model. Three regression modeling techniques—multiple linear regression, stepwise regression, and Lasso regression—were deployed to assess the relationships between image-derived variables and fresh tea yield. Among them, Lasso regression showed the highest performance, achieving a high coefficient of determination (R^2 = 0.862) and a low mean square error (MSE = 20,494.55 g/m^2) (**Figure 2**), indicating a strong predictive ability. These findings highlight the potential of UAV-based remote sensing technology as an effective and scalable tool for yield estimation of perennial crops such as tea. By integrating multispectral and RGB data with advanced regression algorithms, the method provides a cost-effective, non-invasive solution for monitoring crop yield variability in the field. These techniques can play an important role in supporting the decision-making process for tea producers, agronomists, and policy makers towards sustainable and data-driven agricultural management.

Keywords: *Remote Sensing, UAV multispectral image, Precision agriculture, Tea productivities,*

Acknowledgement: *The study is supported by the project "Application UAV imagery and machine learning for estimating fresh tea productivity", project code VAST08.03/25-26 funded by Vietnam Academy of Science and Technology.*

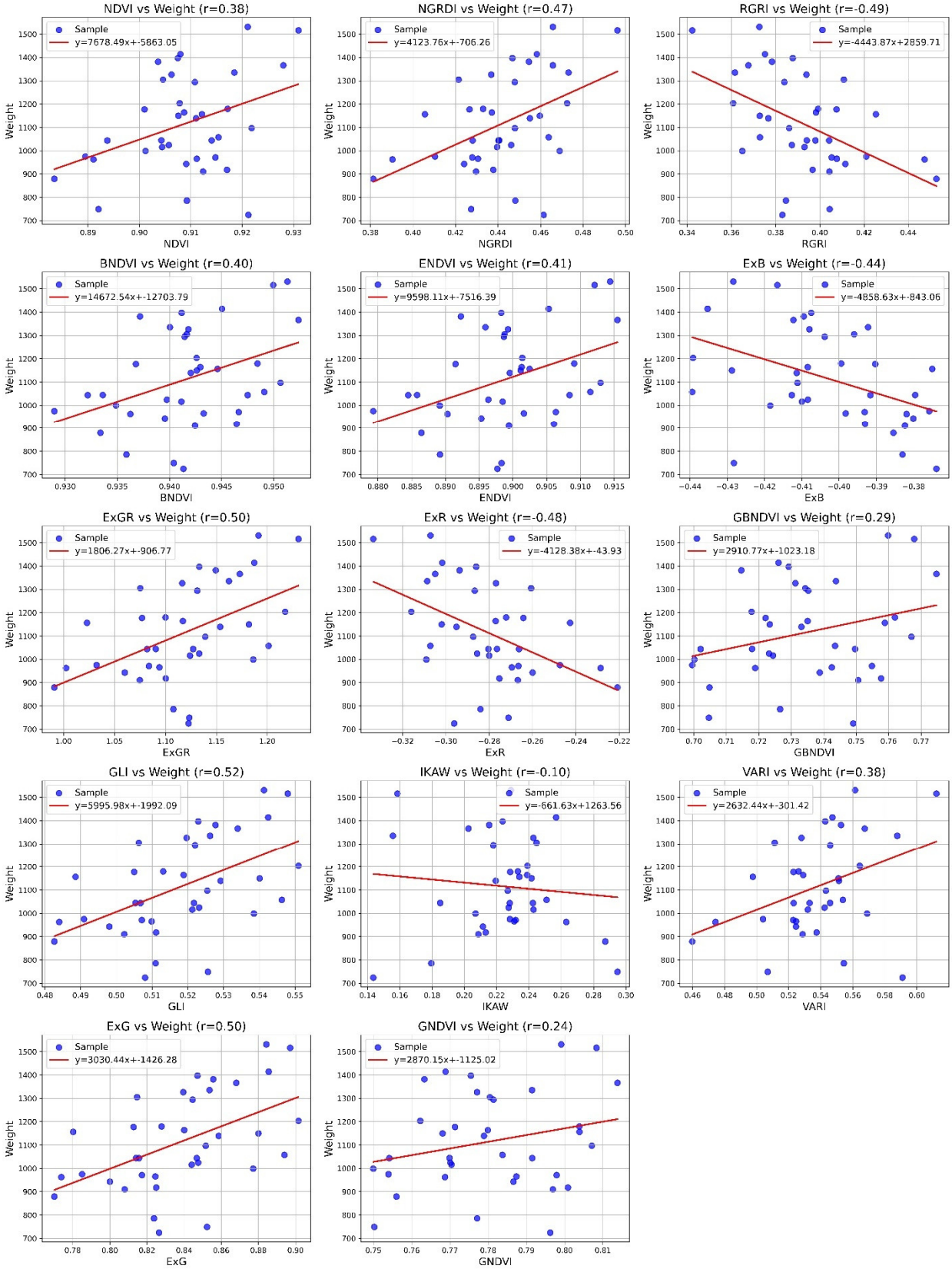


Figure 1. Linear Relationships Between Vegetation Indices and Fresh Tea Yield

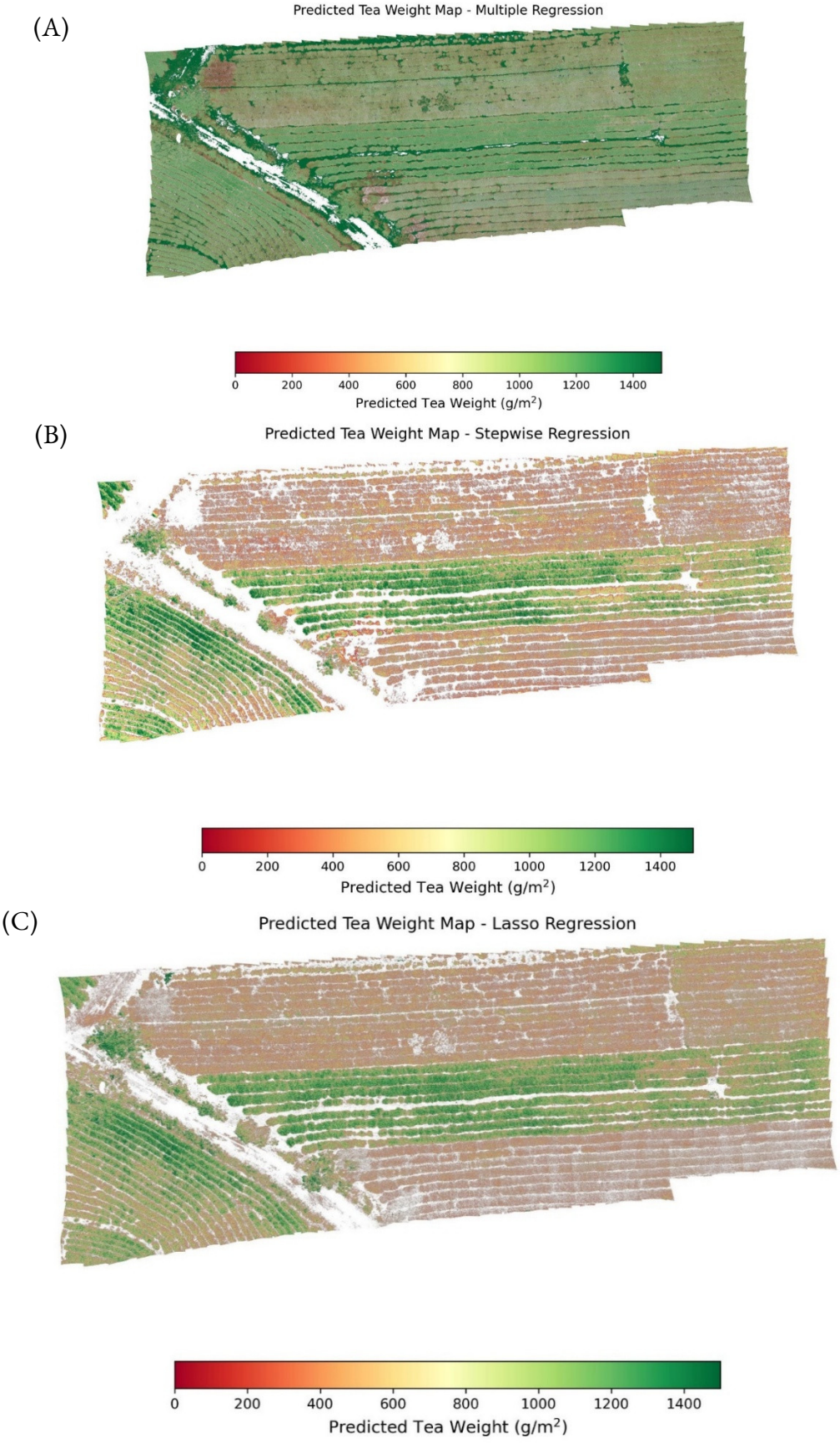


Figure 2. (A)Multiple regression, (B)Stepwise regression, (C)Lasso Regression predicted tea weight map using multispectral data from UAV

SESSION VII

EMERGING TECHNOLOGIES & INTERDISCIPLINARY TOPICS

TOWARDS AN INTEGRATED FISHERIES INFORMATION SYSTEM: BRIDGING MONITORING AND ECOSYSTEM-BASED MANAGEMENT

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ABSTRACT

The sustainable management of aquatic biodiversity and fisheries resources requires a paradigm shift from fragmented monitoring systems to integrated, science-based decision-making frameworks. This abstract presents the concept and development of an Integrated Fisheries Information System (IFIS), designed to unify traditional Monitoring, Control, and Surveillance (MCS) functions with advanced ecosystem and fisheries management tools. Conventional Fisheries Monitoring Centers (FMCs) focus primarily on vessel tracking, gear identification, and compliance verification. While effective for enforcement, these systems often lack ecological context and predictive capabilities. The proposed IFIS addresses this gap by incorporating oceanographic data, ecological modeling, and artificial intelligence (AI) to support both operational control and strategic resource management. At the core of the IFIS is a dual approach: mechanistic modeling and data-driven analytics. Mechanistic models, such as SEAPODYM (Spatial Ecosystem And Population Dynamics Model), simulate the dynamics of marine food webs -- from phytoplankton to top predators -- based on environmental drivers like temperature, oxygen, and currents. These models provide spatially explicit insights into the distribution and vulnerability of fish stocks, enabling scenario-based planning and long-term sustainability assessments. In parallel, machine learning algorithms are used to generate probabilistic maps of species occurrence and fishing activity. These models are trained on historical catch data and co-located oceanographic variables, offering flexible and rapid forecasting tools. Though less interpretable than mechanistic models, they are highly adaptable and efficient, especially in data-rich contexts. A key innovation of the IFIS is its application of trajectometry, the automatic analysis of vessel movement patterns, to detect fishing gear types and activities, even in the absence of reliable declarations. This method has been successfully adapted to small-scale fisheries (SSF), which represent a significant portion of global catches but are often under-monitored. Using AI, the system identifies harbor locations, classifies gear types, and detects fishing events with high accuracy, enhancing traceability and control.

The IFIS also integrates predictive tools to identify potential IUU (Illegal, Unreported, and Unregulated) fishing hotspots. By combining AIS data, oceanographic conditions, and behavioral analysis, the system generates weekly forecasts of areas likely to host fishing activity, supporting targeted inspections and proactive enforcement. Designed as a modular and scalable platform, the IFIS offers intuitive dashboards, real-time alerts, and contextualized maps for FMC operators. It facilitates data exchange across agencies and supports both national and regional fisheries governance. By bridging operational monitoring with ecological intelligence, the IFIS empowers decision-makers to balance enforcement with conservation, ensuring the resilience of marine ecosystems and the communities that depend on them.

This integrated approach marks a significant advancement in fisheries management, aligning technological innovation with ecological sustainability. IFIS is not just a tool for control it is a strategic asset for biodiversity protection, resource optimization, and inclusive governance.

Keywords: monitoring, control, surveillance, management, fisheries

MACHINE LEARNING-ENHANCED BIOASSAY FOR ACCURATE IDENTIFICATION OF SALINITY INTERFERENCE IN FRESHWATER TOXICITY ASSESSMENT

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ABSTRACT

Salinity-induced interference present a significant challenge in freshwater ecotoxicity assessments, as it can artificially inflate toxicity results and complicate the differentiation between chemical-induced toxicity and salinity-induced physiological stress. This interference poses practical difficulties for environmental regulators, potentially leading to misclassification of wastewater toxicity and inefficient environmental management decisions. We developed a bioassay-informed machine learning (ML) framework that detects and classifies interference using toxicity unit (TU) data from Daphnia magna, Lemna minor, and the salinity-tolerant macroalga Ulva australis. TU profiles highlighted Ulva as a reliable reference species for distinguishing true toxicity from salinity-induced physiological stress. Three ML models were evaluated, with Random Forest showing the strongest performance and selected for further development. A five-variable ready-to-use model maintained perfect classification accuracy with a higher AUC (0.889) than the full-feature model (0.867), offering a simplified and field-efficient alternative. SHAP analysis identified DO, Cu, Zn, Cr, and pH as key predictors. This bioassay-informed machine learning (ML) framework specifically designed to proactively detect and accurately quantify salinity-induced interference, offers a practical and scalable tool suitable for routine field monitoring and enhancing regulatory decision-making effectiveness.

Keywords: *Salinity interference; Bioassay; Random Forest; Ulva australis; Machine learning.*

Acknowledgement: *This work was supported by Ghent University Special Research Fund (BOF23/PDO/065).*

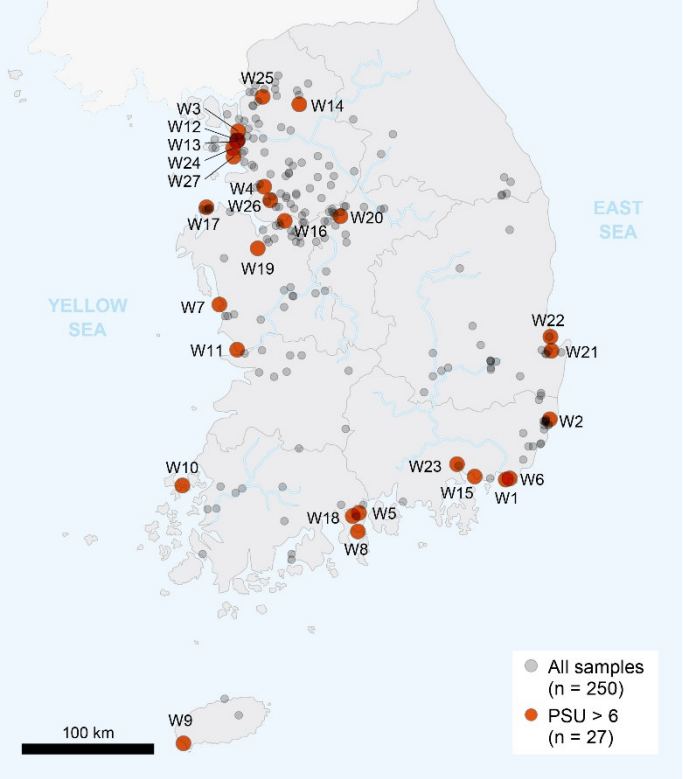
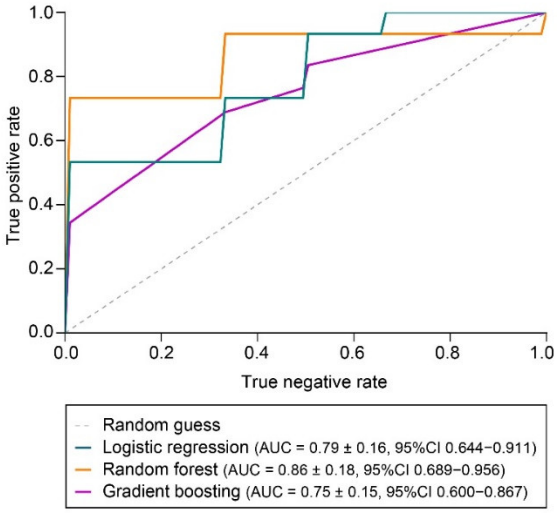
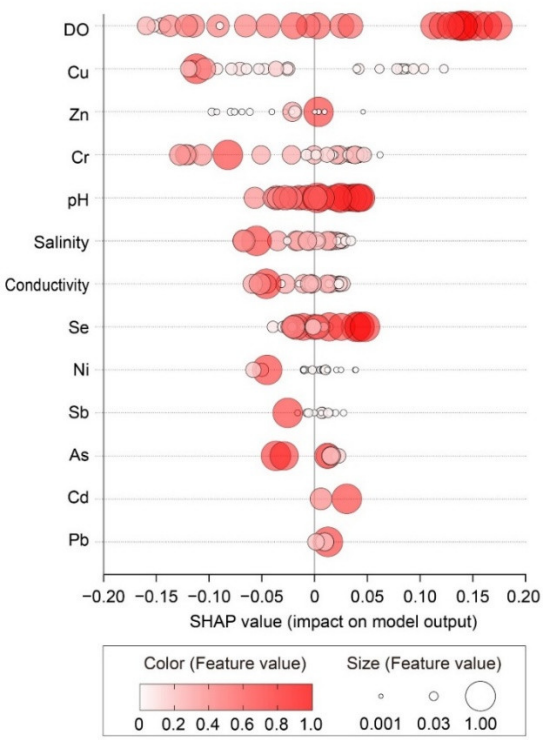


Figure 1. Geographic distribution of wastewater sampling sites across South Korea. Gray markers indicate all collected samples (n = 250), while red-highlighted sites represent samples with elevated salinity (PSU > 6; n = 27). These high-salinity samples were used to develop and validate the salinity interference classification models.



(a)



(b)

Figure 2. (a) Receiver operating characteristic (ROC) curves comparing the classification performance of three machine learning models; (b) SHAP summary plot showing the relative contribution of 13 physicochemical variables to the prediction of salinity-induced interference by the Random Forest.

A LABORATORY STUDY EFFECT OF BIOTIC AND ABIOTIC FACTORS ON CESIUM UPTAKE AND EXCRETION IN ASIAN GREEN MUSSELS *(PERNA VIRIDIS)*

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ABSTRACT

This study examines the effects of biotic and abiotic factors on cesium (Cs) uptake and excretion in Asian green mussels (*Perna viridis*) to improve the accuracy of marine radiological monitoring method. Field observations of radioactive cesium isotopes (^{134}Cs and ^{137}Cs) are often influenced by environmental variability, limiting the reliability of bioaccumulation models. To address this, controlled laboratory experiments were conducted to evaluate the influence of abiotic factors (Cs concentration, temperature, salinity, pH) and biotic factors (condition index, shell length, weight) on Cs accumulation and organ-specific distribution. Results showed that Cs uptake increased with Cs concentration in seawater and temperature but decreased with higher salinity and pH. Among biotic factor variables, shell length and condition index strongly correlated with Cs concentration, smaller mussels with higher condition index exhibiting greater accumulation, whereas weight had no significant effect. Excretion experiments revealed a two-phase clearance pattern: rapid elimination within the first three days followed by slower clearance, with over 90% excreted by day 11 and near-complete clearance by day 70. These findings highlight the combined influence of physiological and environmental factors on Cs bioaccumulation and provide essential parameters for refining predictive models, thereby enhancing the use of *P. viridis* as a bioindicator of radioactive contamination in marine environment and interpreting field monitoring data.

Keywords: *bivalve, Asian green mussel, cesium uptake, cesium excretion, bioindicator, biomonitoring*

Funding

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SOURCE IDENTIFICATION AND QUANTIFICATION OF POTENTIAL TOXIC ELEMENTS IN URBAN ROAD DUST BY POSITIVE MATRIX FACTORIZATION WITH INTEGRATED CORRELATION AND CLUSTER ANALYSES

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ABSTRACT

Urban road dust is a significant environmental medium that accumulates potential toxic elements (PTEs), posing both ecological and human health risks. Identifying and quantifying their sources is therefore essential for effective management in rapidly urbanizing cities. This study employed the Positive Matrix Factorization (PMF) receptor model, integrated with correlation and cluster analyses, to apportion the sources of PTEs in road dust collected from Da Nang City, Vietnam.

A total of 80 PMF model runs were performed with factor numbers ranging from three to seven. Model robustness was evaluated using bootstrap resampling (100 runs per solution) and rotational analysis (Fpeak). Diagnostic indices confirmed high reliability, with signal-to-noise ratios above 4.98, 100% convergence rates, and strong correlations between observed and predicted concentrations (r^2 = 0.88-0.95). Bootstrap mapping consistently exceeded 80%, demonstrating model stability. The optimal solution identified three factors, explaining 44.75%, 25.19%, and 30.06% of total PTE concentrations, respectively. The three source profiles showed distinct differences. Factor 1, dominated by Sb, As, Pb, and Zn, was linked to traffic emissions, including brake and tire wear, lubricants, and road paint. Elevated levels of Sb (67%) and Pb (46%) were concentrated along high-traffic corridors. Factor 2, enriched in Cd, Cr, and Zn, reflected industrial and commercial activities such as fossil fuel combustion, steel processing, metal plating, waste burning, and tobacco use. Factor 3, characterized by Al, Fe, and Mn, represented natural inputs from crustal materials and rock weathering. These findings were corroborated by a Spearman correlation ($r > 0.6$ among co-emitted metals) and hierarchical cluster analysis, which differentiated between anthropogenic and natural contributions. Overall, anthropogenic activities accounted for approximately 70% of PTE inputs, while natural sources contributed 30%.

This integrated receptor modeling approach provides a robust basis for source-oriented pollution control, highlighting traffic and industrial emissions as priority targets for mitigation in Vietnam's urban environments.

Keywords: *Road dust, Potential toxic elements (PTEs), Positive Matrix Factorization (PMF), Source apportionment, Urban pollution*

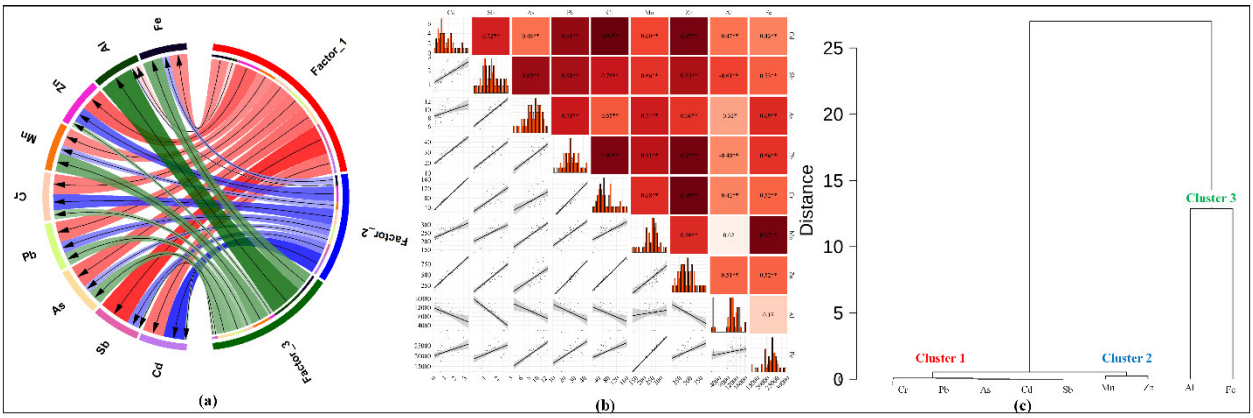


Figure 1. Source identification of PTEs in road dust: (a) PMF results; (b) correlation analysis; (c) cluster analysis.

FORMATION OF ANAEROBIC DIGESTION INHIBITORS DURING THERMAL HYDROLYSIS OF PRIMARY AND WASTE ACTIVATED SLUDGE MIXTURES

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ABSTRACT

This study investigated the formation of anaerobic digestion inhibitors during thermal hydrolysis of a mixed sludge (55% primary sludge, 45% waste activated sludge). Pre-treatment was carried out at 145, 160, 175, and 190 °C for 5 to 30 min prior to anaerobic digestion. The objective was to identify the optimal pre-treatment condition that enhances biogas yield while minimizing the formation of inhibitory compounds such as ammonia and volatile fatty acids (VFAs), particularly propionic acid.

Among the tested conditions, THP at 145 °C for 30 min resulted in the highest biogas yield of 389 ± 6 mL/g VS_added. This performance was strongly associated with the elevated concentration of acetic acid (1.32×10^3 mg/L) generated under this condition. As acetic acid is the primary precursor for methane production during methanogenesis, its accumulation corresponded well with the enhanced biogas output. A similarly high acetic acid level (1.18×10^3 mg/L) was also observed at 145 °C for 20 min, though the yield was slightly lower.

Importantly, THP at 145 °C for 30 min also maintained propionic acid at a low concentration (0.58×10^3 mg/L), below the inhibitory threshold of 0.5 g/L (Mamimin et al., 2017). In contrast, treatments at higher temperatures (e.g., 175–190 °C) led to propionic acid levels ranging from 0.68 to 0.76×10^3 mg/L. These elevated concentrations are known to suppress methanogenic activity, explaining the reduction in biogas yield despite higher sludge solubilisation. For instance, although THP at 190 °C for 10 min resulted in the highest solubilisation degree (SD%), the associated increase in propionic acid likely contributed to a significant inhibition of methanogenesis.

Additionally, free ammonia (NH_3-N) levels remained unchanged after treatment at 145 °C. This is attributed to the temperature-specific solubilisation behavior of sludge components. At temperatures below 150 °C, solubilisation primarily targets carbohydrate-rich exopolymers in the sludge matrix, rather than protein-rich intracellular content (Bougrier et al., 2008). Therefore, THP at 145 °C does not induce cell lysis or protein degradation, avoiding the release of ammonia. Conversely, higher temperatures cause more extensive cell disruption, leading to protein solubilisation and increased NH_3-N concentrations, which can further inhibit methanogenesis.

Overall, the findings demonstrate that moderate THP conditions, specifically 145 °C for 30 min, strike an effective balance between enhancing biodegradability and minimizing the formation of inhibitory

compounds. This condition improves acetic acid availability without elevating propionic acid or ammonia to inhibitory levels, making it the most suitable pre-treatment setting for maximizing biogas production from mixed sludge in anaerobic digestion.

Keywords: *Thermal hydrolysis; Anaerobic digestion; Hydrothermal processing; Sludge pre-treatment; Inhibitor.*

Acknowledgement: *The authors would like to thank Watercare New Zealand for providing samples and Mr Raymond Hoffmann and Dr Matthew Sidford (Department of Chemical & Materials Engineering, the University of Auckland) for technical assistance and helping with the chemical analyses.*

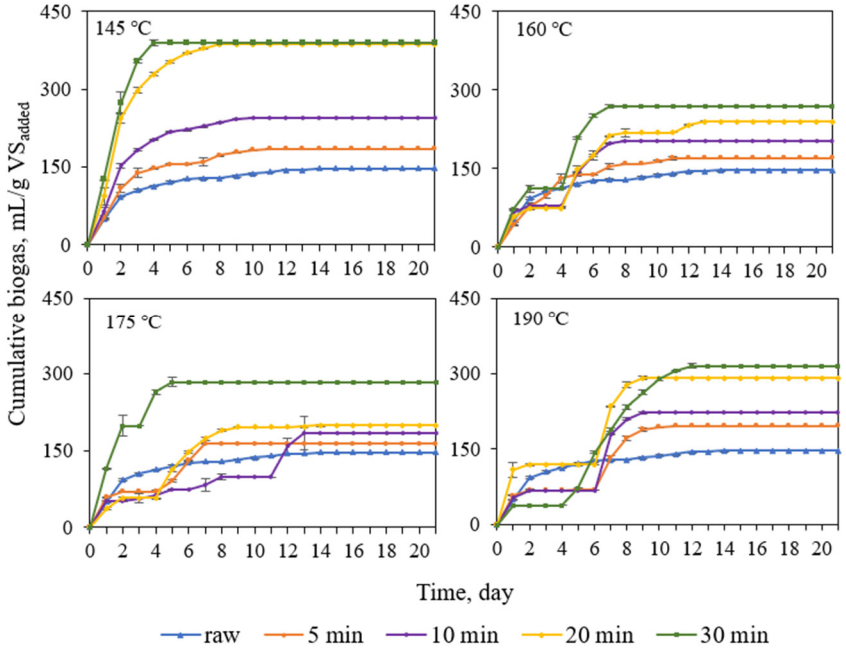


Figure 1. Cumulative biogas yield of sewage sludge with different THP pre-treatment conditions

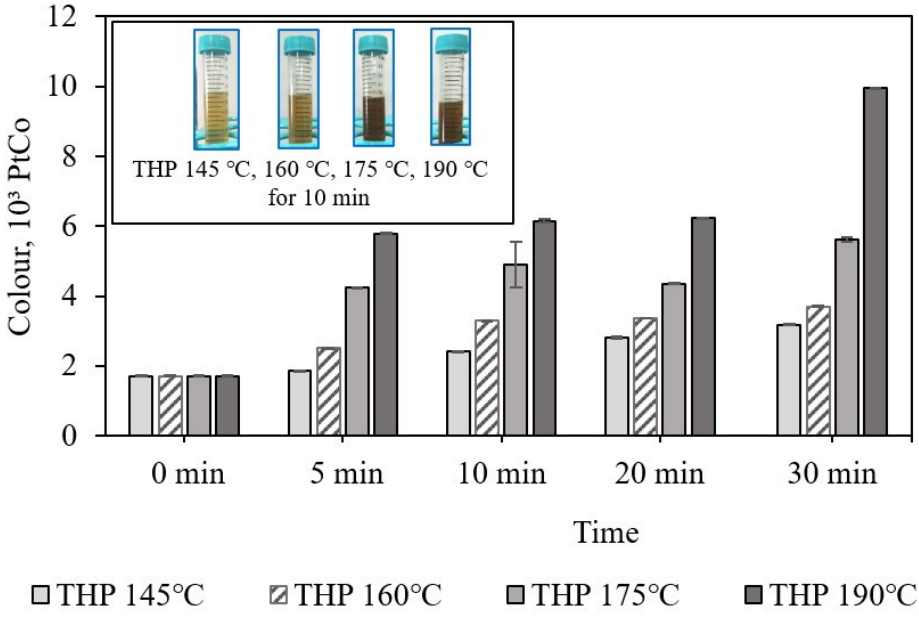


Figure 2. Changes in sewage sludge colour after THP pretreatment

BLUE ECONOMY AND THE LAW: LEGAL CHALLENGES FOR THE SUSTAINABLE MARINE BIODIVERSITY AND USE OF AQUATIC RESOURCE IN ASEAN

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ABSTRACT

The emergence of the "Blue Economy" as a paradigm for ocean-based development presents both a unique opportunity and a challenge for biodiversity conservation across the globe including the ASEAN region. While the Blue Economy emphasizes inclusive growth, livelihood security, and maritime innovation, its practical implementation often risks and undermining the ecological balance of fragile aquatic ecosystems due to unregulated exploitation, legal fragmentation, and institutional weaknesses.

ASEAN, as a regional association composed of ten maritime and riverine states, is the home to some of the world's most biodiverse aquatic systems, including the Coral Triangle, Mekong Basin, and Andaman Sea. However, pressures from overfishing, coastal tourism, aquaculture expansion, deep-sea mining, and transboundary pollution have intensified threats to marine and freshwater biodiversity. These pressures are aggravated by inadequate legal harmonisation, gaps in enforcement, and limited regional cooperation on biodiversity governance. The absence of a binding ASEAN legal framework for marine biodiversity protection creates inconsistencies across national regimes, and while many ASEAN countries are parties to the United Nations Convention on the Law of the Sea (UNCLOS), the Convention on Biological Diversity (CBD), and the 1995 Fish Stocks Agreement, their domestic implementation remains uneven and often uncoordinated with economic development policies.

This paper critically examines the legal and policy dimensions of sustainable aquatic resource use within the ASEAN context, where nations are increasingly aligning development agendas with marine economic growth. This paper evaluates the legal regimes across ASEAN states, assessing how their national laws on fisheries, environmental protection, and marine spatial planning interact with Blue Economy strategies. It further investigates the role of regional instruments like the ASEAN Charter, ASEAN Socio-Cultural Community Blueprint, and regional fisheries bodies, questioning whether they provide a normative basis for sustainable aquatic resource use or merely aspirational policy frameworks.

In light of the post-2020 Global Biodiversity Framework and increasing investment in ocean-based industries, the paper argues for a legally binding ASEAN convention on marine biodiversity, enhanced environmental safeguards in Blue Economy projects, and integrated marine governance involving coastal communities, indigenous knowledge systems, and scientific assessments. Through doctrinal legal analysis and comparative environmental law methodology, the study aims to contribute to the design of robust legal tools that reconcile biodiversity protection with economic imperatives in Southeast Asia's rapidly evolving maritime landscape.

Keywords: *Blue Economy, Biodiversity, ASEAN, Marine Law, Sustainable Development, Aquatic Resources, Environmental Governance, UNCLOS, CBD.*

VALUE CHAIN ANALYSIS OF MEDICINAL PLANTS IN GEOPARKS: LIVELIHOODS OF ETHNIC MINORITIES BASED ON NON-TIMBER FOREST PRODUCTS (NTFPS) IN VIETNAM

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ABSTRACT

Non-timber forest products (NTFPs) support the livelihoods and economic activi ties of households and communities in both rural and urban areas worldwide. This study applies the value chain analysis (VCA) approach to Jiaogulan (Gynostemma pentaphyllum), a local NTFP in the Cao Bang Geopark, Vietnam. A semi-structured questionnaire was used to survey 106 stakeholders involved in different stages of the Jiaogulan value chain, including agricultural experts (extension officers and farmer association representatives), harvesters, traders, primary processors, secondary processors, distributors, and consumers. The findings present a comprehensive mapping of the Jiaogulan value chain, illustrating the flow of the product from harvest to end consumer and quantifying the added value at each stage of the process. The study highlights the value captured by households involved in the primary market channels and assesses how this added value contributes to household income levels. The distribution of economic benefits across different actors within the value chain is also examined, identifying potential inefficiencies and disparities that need to be addressed to improve equity and economic outcomes for marginalized groups. Recommendations are made to strengthen production and cooperation among Jiaogulan value chain actors through technical training, infrastructure investment, e-commerce development, and policy support for international standards and medici nal value chains to enhance product quality, market access, and sustainable develop ment in Cao Bang Geopark.

Keywords: *Non-timber forest products (NTFPs); value chain analysis (VCA); medicinal plants; Jiaogulan; Cao Bang Geopark; Vietnam*

Acknowledgments: *The authors would like to thank the households, the district and commune authorities who were most collaborative in the execution of the field investigation, and in providing discussion opportunities on the results.*

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TOTAL ECONOMIC VALUE ASSESSMENT OF THE DONG VAN KARST PLATEAU UNESCO GLOBAL GEOPARK

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ABSTRACT

Vietnam currently has four UNESCO Global Geoparks, distributed across diverse geomorphological and cultural regions: the Dong Van Karst Plateau UNESCO Global Geopark, Non Nuoc Cao Bang UNESCO Global Geopark , Dak Nong UNESCO Global Geopark, and Lang Son UNESCO Global Geopark. Among these, the Dong Van Karst Plateau Global Geopark not only possesses outstanding geological, biodiversity, and cultural heritage values but also holds great potential for ecotourism development, community education, and sustainable livelihoods. Previous studies have often focused mainly on geological and natural aspects, while treating cultural dimensions separately, lacking an integrated framework to quantify the Total Economic Value (TEV). This study aims to assess the TEV of the geopark by analyzing the relative contributions of three systems: natural, cultural, and settlement. The Total Economic Value approach was employed to evaluate criteria including direct use value, cultural value, option value, and non-use value, structured within a three-system matrix. The results reveal that cultural value accounts for the largest share at 48.27%, followed by natural value at 39.98%, and settlement value at 11.75%. Accordingly, cultural value is identified as the most decisive factor in positioning Dong Van as a global destination for tourism and promotion; natural value provides the foundational condition; while settlement value enhances the distinctiveness of the geopark. This paper proposes a multidimensional approach to reasonably quantify the TEV of geoparks, thereby providing scientific evidence to support investment policy, effective resource management, and strengthening community engagement in the conservation and sustainable development of UNESCO Global Geoparks in Vietnam.

Keywords: *Total Economic Value (TEV); Dong Van Karst Plateau UNESCO Global Geopark; Natural–Cultural–Settlement systems.*

TECH MEETS ECOLOGY: LEVERAGING AI FOR ENVIRONMENTAL JUSTICE AND ACCOUNTABILITY IN INDIA

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ABSTRACT

The protection of the environment is a fundamental component of safeguarding human rights in India. The right to live in a pollution-free environment is enshrined under Article 21 of the Constitution of India[1] and reinforced by international human rights frameworks worldwide.

In recent years, Artificial Intelligence (AI) has emerged as a transformative force in advancing environmental justice. By leveraging data analytics, predictive modeling, and real-time monitoring, AI systems are increasingly capable of identifying pollution sources, quantifying environmental damage, and supporting the enforcement of accountability mechanisms such as the Polluter Pays Principle.[2] This principle, which mandates that polluters bear the cost of environmental harm, finds renewed strength through AI-driven transparency and precision.

The present paper explores the evolving role of AI in environmental governance in India, particularly from 2005 to 2024, highlighting empirical instances where AI technologies have supported regulatory bodies and civil society in detecting violations,[3] assessing ecological impact,[4] and recommending penalties. The contributions of institutions such as the National Green Tribunal (NGT) are amplified through AI-enabled tools that enhance decision-making and enforcement capabilities.

Researchers express deep concern over the escalating levels of pollution that continue to degrade India's natural environment. This study underscores the urgent need to integrate AI more robustly into environmental policy and judicial processes, ensuring that the Polluter Pays Principle is not only invoked but effectively implemented. By doing so, AI can serve as a powerful deterrent against environmental violations and help restore ecological balance with greater speed and accuracy.

Keywords: *Artificial Intelligence (AI), Environment, Human Rights, Polluter Pays Principle, Sustainable development, National Green Tribunal (NGT)*

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[1] Article 21 of the Constitution of India guarantees the right to life and personal liberty, which has been judicially interpreted to include the right to a clean and healthy environment. This interpretation forms the constitutional foundation for environmental protection in India.

[2] The Polluter Pays Principle, recognized in international environmental law and adopted by Indian regulatory frameworks, asserts that those responsible for pollution should bear the costs of managing it. AI technologies enhance the enforcement of this principle by enabling precise identification, monitoring, and quantification of environmental harm.

[3] In India, AI-driven platforms have been deployed to track stubble burning incidents in Punjab and Haryana using satellite data, helping reduce seasonal air pollution in Delhi and surrounding regions. These systems support timely intervention by authorities and enhance public awareness

[4] AI technologies such as remote sensing, satellite imagery analysis, and predictive modeling are increasingly used to monitor air and water quality, detect illegal deforestation, and assess biodiversity loss. These tools enable real-time data collection and analysis, improving the responsiveness of environmental governance systems

FIRST INVESTIGATION OF AIRBORNE MICROPLASTICS IN HANOI, VIETNAM

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ABSTRACT

Exposure to microplastics (MPs) in the environment, especially airborne MPs, has been increasingly linked to harmful effects on human health. This study examines suspended atmospheric microplastics (SAMPs) in Hanoi, Vietnam, one of the world's most polluted cities, to assess the physicochemical properties of total suspended particles (TSP) and SAMPs while comparing their distribution between urban and rural areas. TSP samples were collected simultaneously at both sites using high-volume air samplers (Tisch Model TE-5170X), and their morphology was analyzed using field emission scanning electron microscopy (FE-SEM). Micro-FTIR spectroscopy was employed to determine SAMPs' density, size, shape, and polymer composition. Results revealed significantly higher TSP concentrations in urban areas (163.1 ± 61.6 μg/m^3) than in suburban regions (117 ± 68.8 μg/m^3), with peak levels during the dry season. Inhalable particles dominated the samples, accounting for 70% (PM_{10}) and 50% ($PM_{2.5}$) of the total. SAMPs were predominantly fibrous and fragmented (80 - 90%), with blue, red, brown, and transparent being the most common colors. Thirty different polymer types were identified, with PET and Nylon being the most abundant. These findings underscore a critical environmental and public health challenge, highlighting the urgent need for further research on microplastic pollution and its mitigation strategies.

Keywords: *Microplastic, Atmospheric pollution, Polymer, Vietnam.*

Acknowledgement: *This research is funded by Vietnam National Foundation for Science and Technology Development (NAFOSTED) under grant number 105.08-2023.28.*

TRADITIONAL KNOWLEDGE IN HEALTHCARE SYSTEM AND BIODIVERSITY CONSERVATION IN TRIBAL COMMUNITIES OF NORTHEAST INDIA

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ABSTRACT

Traditional knowledge is the shared wisdom, skills, and beliefs that Indigenous and local communities have built over many generations of living close to nature. This knowledge shows how people care for forests and fields, grow crops in harmony with the land, and treat illnesses with herbal remedies. These are used to maintain health and treat illnesses, whether or not they are scientifically explained. In many parts of the world, traditional medicine remains an essential part of public healthcare systems, supported by the cultural identity and lived experiences of communities. The diverse and dynamic knowledge of tribal communities, especially from the culturally and ecologically distinct Northeast, is rarely reflected in such databases. Bridging this knowledge into mainstream scientific discourse requires thoughtful engagement, respectful documentation, and legal tools that acknowledge the collective and living nature of traditional knowledge. India has a large rural population, with 64 percent of its citizens living in rural areas. Many of these communities continue to depend on traditional medicine. Recognizing its importance, the Government of India established the Traditional Knowledge Digital Library (TKDL) in 2001 to protect and document the knowledge systems of Indian communities, including over 1,200 medical formulations. Northeast India hosts a variety of indigenous communities whose cultural practices and ecological wisdom shape their daily lives. Among these groups, the Tangkhul tribe in Manipur has preserved a vibrant tradition of herbal medicine, spiritual rituals, and environmental care. This community draws on native plants to treat common illnesses like respiratory infections and chronic conditions such as digestive disorders. Documenting traditional knowledge poses several challenges, much of the knowledge is passed orally and lacks formal written records. The lack of systematic documentation not only hampers preservation efforts but also limits the ability to validate and integrate traditional practices into broader health systems. This study employed a qualitative, field-based approach combining ethnobotanical documentation with participatory observation. Eight Tangkhul villages were selected based on their strong retention of traditional healing practices and local biodiversity. A total of 51 medicinal plant species representing 21 families were recorded, with Zingiberaceae, Asteraceae, and Lamiaceae being the most commonly cited, each comprising 14% of the identified species.

The findings highlight several key insights. First, the traditional knowledge held by the Tangkhul people is not only medically effective in many cases but also culturally embedded and ecologically adaptive. The continued use of species such as *Curcuma longa*, *Aloe vera*, and *Paris polyphylla* demonstrates both the therapeutic breadth and botanical specificity of their practices. Second, ethnopharmacological evidence aligns with many of the tribe's traditional applications, offering an important bridge between indigenous knowledge and modern biomedical science.. The research points to an urgent need for integrative strategies such as Community-led conservation, inclusion in People's Biodiversity Registers, and ethical benefit-sharing models must be prioritized.

Keywords: *Traditional Knowledge, Healthcare, Biodiversity, Tangkhul, Northeast India*

PROBABILISTIC HEALTH RISK ASSESSMENT OF HOUSEHOLD EXPOSURE TO PAHS FROM AIR-CONDITIONER FILTER DUST IN HO CHI MINH CITY

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ABSTRACT

Indoor exposure to polycyclic aromatic hydrocarbons (PAHs) is an emerging concern in urban environments, particularly through overlooked sources such as air-conditioner filter dust. This study conducted a probabilistic health risk assessment of household exposure to PAHs from air-conditioner filter dust in Ho Chi Minh City. A total of 67 dust samples were collected between November 2024 and April 2025 and analyzed using high-performance liquid chromatography with fluorescence detection. Exposure behaviors and demographics were obtained through face-to-face interviews with 146 participants. Health risks were quantified following the four-step United States Environmental Protection Agency (US EPA) framework across three exposure pathways (inhalation, ingestion, dermal contact) for adults and children. A Monte Carlo simulation (10,000 iterations) was employed to estimate Hazard Quotient (HQ) and Incremental Lifetime Cancer Risk (ILCR), considering both measured concentrations and BaP-equivalent toxicity (BaPeq). Fourteen PAH compounds were detected in filter dust. Dermal contact was identified as the dominant pathway, with mean HQ values exceeding the acceptable threshold (>1) for all routes except inhalation. The average ILCR was 5.11E-03 for adults and 7.92E-03 for children, both well above the US EPA's recommended limit of 1.00E-03. Sensitivity analysis revealed that exposure duration and body weight were the main contributors to adult risk, while PAH concentrations were the major determinants for children. Overall, the results highlight air-conditioner filter dust as a significant yet under-recognized source of household PAH exposure. Regular cleaning and maintenance of air-conditioning systems are recommended to reduce associated health risks.

Keywords: *PAHs; Indoor air pollution; Health risk assessment; Household exposure; Air-conditioner filter dust; Environmental health; Vietnam; Ho Chi Minh City.*

AGRICULTURAL WASTE-DERIVED BIOCHAR IMPROVES NITROGEN REMOVAL AND MITIGATES FOULING IN MEMBRANE BIOREACTOR TREATING BRACKISH AQUACULTURE WASTEWATER

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ABSTRACT

Nitrogen removal pathways were examined in a hybrid membrane bioreactor (MBR) treating brackish shrimp aquaculture wastewater at salinities of 0 and 5 ppt. A biochar-MBR (BC-MBR) incorporating rice husk biochar (RHB) was compared with a control MBR (C-MBR). At 0 ppt, the BC-MBR achieved higher DOC, NH_4^+, and TN removals (98.6%, 97.5%, and 90.7%, respectively) than the C-MBR (97.3%, 95.5%, and 70.8%, respectively) due to biochar adsorption and sustained carbon released as an additional substrate for enhancing denitrification. At 5 ppt, the BC-MBR maintained stable removals of 95.8% DOC, 93.8% NH_4^+, and 86.9% TN, whereas the C-MBR declined markedly to 93.5%, 89.2%, and 65.5%, respectively. Short-cut nitrification–denitrification was identified as the dominant pathway for nitrogen removal in the BC-MBR, with nitrite rising to 1.03 mg/L at 5 ppt, from undetectable levels at 0 ppt. Biochar also acted as a carbon framework that facilitated the formation of larger and better-settling sludge flocs under saline conditions. The bulk sludge properties (EPS, SMP, MLSS, MLVSS) were also significantly altered in BC-MBR, mitigating fouling and supporting stable operation. Therefore, biochar addition enhanced treatment performance and alleviated salinity impacts, highlighting its potential for treating brackish aquaculture wastewater under higher salinity conditions.

Keywords: *Rice husk biochar, MBR, Nitrogen removal, Brackish shrimp aquaculture wastewater, Short-cut nitrification–denitrification*

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CARBON EXCHANGE DYNAMICS AND RESOURCE USE EFFICIENCY OF CAT TIEN TROPICAL FOREST: 10 YEARS OF EDDY COVARIANCE FLUX TOWER OBSERVATIONS

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ABSTRACT

Energy fluxes and material cycles serve as critical links in the interactions between the geosphere, biosphere, and atmosphere, forming the core of ecosystem ecology research. This study aims to elucidate the decadal variability of carbon fluxes and explore changes in the resource use efficiency of the Cat Tien tropical forest ecosystem in Vietnam using the big-leaf model. The results reveal distinct patterns in air temperature (Tair), relative humidity (RH), radiation, and vapor pressure deficit (VPD). Diurnal cycles of net ecosystem exchange (NEE), gross primary productivity (GPP), and ecosystem respiration (Reco) exhibit seasonal variations, with higher amplitudes recorded from April to October. The primary finding indicates that the Cat Tien tropical forest functions as a carbon sink, with an average annual net carbon uptake of -0.47 ± 0.11 kgC m^{-2} yr^{-1}. The mean gross primary productivity (GPP) over 10 years is 3.73 ± 0.35 kgC m^{-2} yr^{-1}. Carbon exchange dynamics display clear seasonal patterns: the warm and humid rainy season optimizes carbon transformation processes, with NEE values 1.3 to 5.2 times higher than those in the dry season within the same year. However, at the end of the dry season (March and April), the forest tends to shift from a carbon sink to a carbon source, exhibiting negative carbon use efficiency (CUE) values. A notable finding is the high drought resilience of the Cat Tien tropical forest, evidenced by the absence of clear damage during the strong 2016 El Niño event and its rapid recovery as a carbon sink following the onset of the rainy season. The average annual water use efficiency (WUE) is approximately 3 $gCkg^{-1}H_2O$. These findings provide direct empirical evidence of the carbon sequestration potential of humid tropical forests in Vietnam, underscoring their critical role in mitigating climate change and achieving carbon neutrality goals.

Keywords: *Cat Tien tropical forest, eddy covariance technique, net ecosystem exchange (NEE), big-leaf model, carbon neutrality.*

Acknowledgement: *The authors acknowledge the leaders and staff of the Joint Vietnam-Russia Tropical Science and Technology Research Centre for providing the opportunity to conduct this research and for their invaluable assistance. We also extend our gratitude to the administration of Cat Tien National Park for facilitating our field work.*

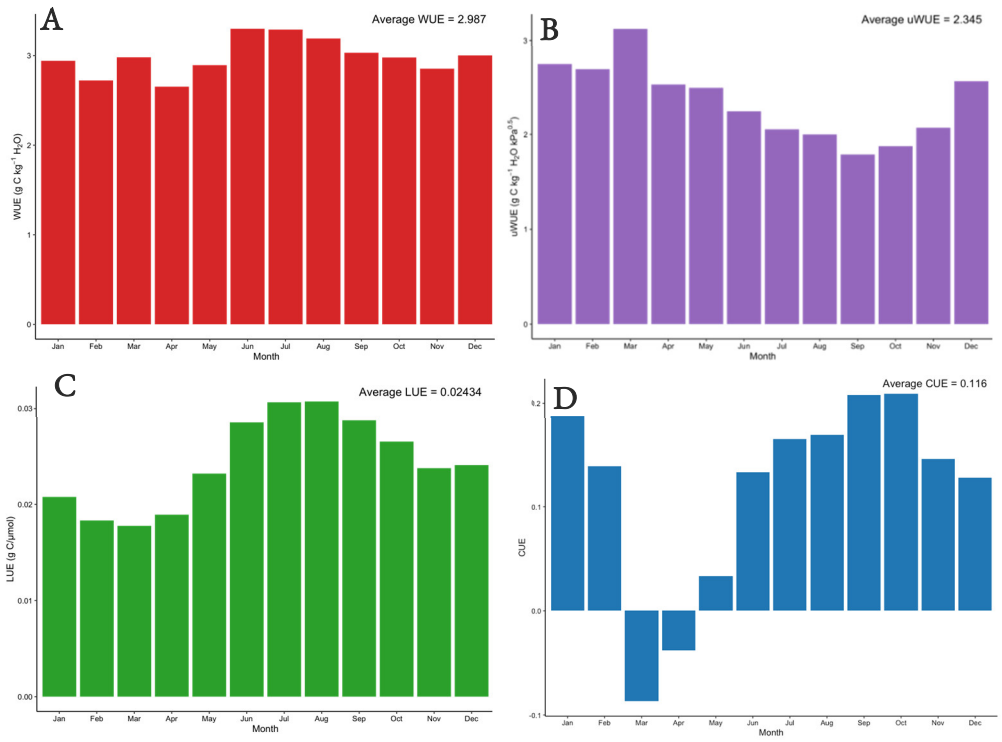


Figure 1.
Time series of daily environmental parameters measured at the NCT Flux Station over the period 2012–2021. The panels show: (A) Air temperature at 50 m (T50m, °C), (B) Net radiation (Rn, W m^{-2}), (C) Relative humidity (RH, %), (D) Vapor pressure deficit (VPD, hPa), (E) Precipitation (mm), and (F) Photosynthetic photon flux density (PPFD, µmol m^{-2} s^{-1}). Data are presented as mean values (solid lines) with the 95% confidence interval (shaded areas, between the 2.5th and 97.5th percentiles).

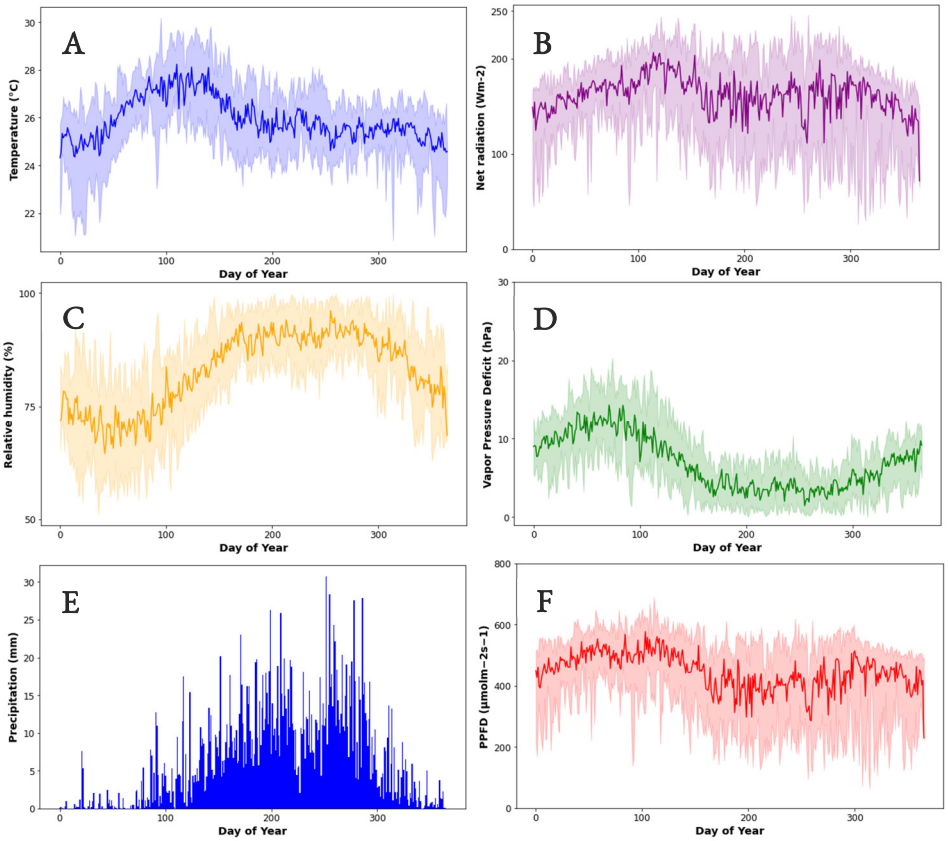


Figure 2.
Time series of monthly averaged ecosystem resource use efficiencies. (A) Water Use Efficiency (WUE). (B) Underlying Water Use Efficiency (uWUE), which describes the tight coupling of carbon and water cycles by incorporating the nonlinear influence of vapor pressure deficit. (C) Light Use Efficiency (LUE), defined as the amount of Gross Primary Production (GPP) per unit of incoming photosynthetically active radiation. (D) Carbon Use Efficiency (CUE), calculated as the ratio of Net Ecosystem Production (NEP) to GPP. Data are presented as means (solid lines) with shaded areas representing the 95% confidence intervals.

SESSION VIII

NATURAL RADIOACTIVITY IN THE ENVIRONMENT

MANAGEMENT OF NORM WASTE FROM RARE EARTHS MINING AND PROCESSING IN VIETNAM: A POTENTIAL GOVERNANCE PATHWAY

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ABSTRACT

Naturally Occurring Radioactive Material (NORM) waste can be generated from many industrial activities, including mining of minerals such as uranium, thorium, phosphate and mineral sands, extraction of rare earth elements, and production of oil and gas. In Vietnam, the main activities that produce NORM waste include mining and processing uranium, thorium, rare earth, and titanium ores. Among such minerals, rare earths deserve attention due to their unique chemical, nuclear and magnetic properties, which makes them essential in daily life and the global energy transition, given their applications in tablets and smartphones, electronics, wind turbines, high-capacity rechargeable batteries, and electric vehicles, etc. Despite the existence of data variability, Vietnam has been ranked as the top countries for significant rare earths reserves, with the historic and recent estimates of 22 and 3.5 million metric tons, respectively. However, rare earths mining in the country has been at a small scale, previously occurring in the presently inoperative Yen Phu mine, with the estimated rare earth oxides to be more than 23,500 tons. Rare earths have also been recovered as by-products of titanium mining in coastal placer deposits, which are contained in monazite and xenotime with high levels of radioactivity. While lacking a comprehensive rare earth processing facility, Vietnam has a rare earth concentrate beneficiation plant in Yen Bai province, which annually generates thousands of tons of xenotime concentrate and the associated NORM waste. Then in order to prepare for rare earths mining and processing at a larger commercial scale, safe and effective management of NORM waste is a critical issue, while Vietnam currently lacks a comprehensive legal and regulatory framework. This research aims to provide recommendations for the safe and effective governance of NORM waste from rare earths mining and processing in Vietnam, which is achieved through the review of rare earths mining and processing practices in Vietnam and Australia, a global leader in rare earth production with rich deposits; and comparison of the related laws, regulations, policies and standards, etc. in Vietnam, Australia, France and the UK. Although no rare earths mining has been initiated in the UK and France, of which the latter is developing Europe's first large-scale rare earth separation facility, these two countries are known to have robust NORM waste governing systems. Some legal and regulatory aspects that can be applied to Vietnam include NORM waste discharge and disposal strategies, land use planning for NORM waste storage and disposal facilities, treatment and disposal routes for NORM waste, transboundary movement of NORM waste, and capacity building for government agencies responsible for NORM waste management.

Keywords: *Naturally Occurring Radioactive Material, NORM, NORM waste management, legal framework, regulatory framework.*

RADIOLOGICAL ASSESSMENT FROM EXTERNAL EXPOSURE: A CASE STUDY AT TIN SMELTER IN BANGKA, INDONESIA

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ABSTRACT

The tin smelter in Bangka is one of the Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) sources, which contains primordial radioactive materials. It is essential to estimate the annual effective dose from external and internal exposures for the workers who have a high probability of being exposed to radiation. This study focuses on external exposure at each stage of the smelter process. To assess their radiation exposure, direct measurements were carried out using a survey meter at two smelters. Then, sampling was conducted at the smelting process area to identify the radionuclide and chemical composition. The results of the highest ambient dose equivalent rate in smelters A and B were 3,150 and 331 nSv h^{-1}, respectively, in the slag storage area. The results of radionuclide measurements for Uranium-238 and Thorium-232 showed that existing exposure materials have radioactivity levels exceeding the recommended thresholds greater than 1 Bq g^{-1}, present at both smelters in the slag storage area, and in the raw materials area at Smelter B. The calculations of the highest annual effective dose were found in smelters A and B, which were 3.93 and 0.41 mSv y^{-1} in the slag storage area, respectively. However, these effective doses are still below the threshold of 20 mSv y^{-1}; Workers in this area need to apply radiation protection to prevent significant chronic radiation exposure.

Keywords: *TENORM, smelters, annual effective dose.*

Acknowledgement: *JICA (Japan International Cooperation Agency) D2306549.*

DETERMINATION OF ^{210}PO IN FOODSTUFFS CONSUMED AT A FORMER TIN MINING AREA IN THAILAND

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ABSTRACT

Naturally Occurring Radioactive Materials (NORM) in former mining areas pose potential internal radiation exposure risks to local populations. One of the primary ways that NORM might enter the human body is through dietary consumption. Therefore, it is important to estimate the intake of radionuclides like Polonium-210 (^{210}Po), which is of particular interest due to its potential health impact. This study aimed to determine the activity concentrations of ^{210}Po in various foodstuffs consumed by residents in a former tin mining area in Kanchanaburi, Thailand, to assess potential internal exposure pathways. Food samples representing typical dietary intake of residents (rice, meat, seafood/fish, vegetables and fruit) were collected directly from local agricultural sources in E-Tong Village, located within the former mining area, and supplemented with purchases from local markets. Samples were prepared before analysis as for domestic use, including cleaning, separation of edible portions, and freeze-drying for at least 48 hours. Dried samples were then milled and sieved to achieve homogenization. In this study, five grams of dry weight of each dried sample was spiked with ^{209}Po as a tracer. Radiochemical analysis involved dissolving a sample with concentrated nitric acid and hydrogen peroxide, precipitating iron hydroxide, and spontaneously deposition polonium onto silver discs in a heated solution containing hydroxylamine hydrochloride, sodium citrate, and ascorbic acid. Activity concentration of ^{210}Po was carried out using an alpha spectrometry system. Rice samples showed activity concentrations ranging from 0.20 ± 0.04 Bq/kg to 0.23 ± 0.06 Bq/kg. Vegetable samples exhibited a range from < 0.29 ± 0.13 Bq/kg (Cabbage) up to 1.50 ± 0.11 Bq/kg (Bok choy). Among the meats, they showed a range from 0.20 ± 0.08 Bq/kg (Chicken) to 3.99 ± 0.23 Bq/kg (Wild boar), while seafood had much higher levels, shrimp: 10.96 ± 0.44 Bq/kg, squid: 175.57 ± 5.29 Bq/kg. Marine fish (Harpadon nehereus) had 4.66 ± 0.21 Bq/kg, and freshwater red tilapia 0.71 ± 0.08 Bq/kg. Fruit samples (Banana, Pumpkin, Pomelo) showed lower concentrations range from < 0.13 ± 0.06 Bq/kg (Pomelo) to 0.31 ± 0.08 Bq/kg (Pumpkin). This study provides crucial data on ^{210}Po activity concentrations in various foodstuffs consumed by residents

in a former tin mining area in Thailand. The results indicate that seafood, particularly squid and shrimp, contains significantly higher levels of ^{210}Po compared to other food categories. The ^{210}Po levels in seafood from this study, particularly squid and shrimp, are significantly elevated, consistent with natural bioaccumulation observed in other marine organisms globally, such as Korean shellfish (19.1–206 Bq/kg) (1) and South African marine fish (2.21–8.08 Bq/kg) (2). In addition, concentrations of ^{210}Po in vegetable and rice (grains) fall within ranges observed in studies from areas directly influenced by mining activities in South Africa (2). The annual effective dose due to ingestion of ^{210}Po in each food sample varied from < 0.02 to 5.3 mSv, the maximum being due to the consumption of squid. Further research is needed to evaluate the total dietary intake of other radionuclides and associated health risks for the residents.

Keywords: *^{210}Po in foodstuffs, former tin mining, internal radiation dose*

Acknowledgement: *We extend our sincere gratitude to the Environmental Protection Agency, Ireland for providing the silver discs essential for our research. We also deeply appreciate the support from the Department of Nuclear Engineering, Faculty of Engineering, Chulalongkorn University and the Office of Atoms for Peace, Thailand for granting us access to their instruments for this study.*

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CALIBRATION OF PASSIVE RADON PROGENY MONITORS USING CR-39 DETECTORS: EVALUATION OF CONVERSION FACTORS IN INDOOR AND CONTROLLED ENVIRONMENTS

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ABSTRACT

Inhalation of radon is recognized as the second-leading cause of lung cancer worldwide after tobacco smoking, with most of the health risk attributed to its short-lived radioactive progeny[1)]. To assess this risk more accurately, direct measurement of radon progeny concentration, commonly referred to as the Equilibrium Equivalent Radon Concentration (EERC), is crucial. In response to this need, a passive-type radon/thoron progeny monitor using CR-39 solid-state nuclear track detectors is being developed at Hirosaki University, Japan[2)].

These passive progeny monitors operate with an energy discrimination capability that utilizes three detection channels: RnPI and RnPII for radon progenies, and TnP for thoron progenies. Each channel is sensitive to alpha particles of specific energies, enabling more precise estimation of the Potential Alpha Energy Concentration (PAEC) from the decay of radon and thoron progeny.

This study focuses on the calibration of the passive radon progeny monitor by determining the conversion factors (CFI and CFII), which are used to convert CR-39 track densities into PAEC values. Calibration was conducted in both a controlled radon exposure chamber and various indoor environments, including a hot spring facility and a residential dwelling in Japan. Track densities corresponding to alpha emissions from ^{218}Po and ^{214}Po were measured using the RnPI and RnPII channels, respectively. These were compared to PAEC values of 6.0 MeV for ^{218}Po and 7.7 MeV for ^{214}Po measured with a portable environmental radiation monitoring instrument.

The resulting conversion factors showed considerable variation across environments. CFI values ranged from 2.3×10^7 to 24×10^7 tracks mm^{-2} per J m^{-3} day, while CFII values ranged from 0.6×10^6 to 17×10^6 tracks mm^{-2} per J m^{-3} day. This difference of approximately one order of magnitude is attributed to the influence of the unattached fraction of radon progeny, particularly ^{218}Po. Due to its small size and higher deposition rate, ^{218}Po is more likely to reach and be recorded by the detector surface, resulting in higher CFI values.

These findings underscore the significance of environmental factors such as the unattached fraction, equilibrium factor, and aerosol characteristics in determining calibration accuracy. However, current

field data on these parameters remain sparse. Further studies are needed to better quantify these variables and to support the development of reliable calibration protocols.

This research contributes important calibration data for passive progeny monitors and reinforces the need for integrated environmental monitoring to improve assessment of radon-related health risks.

Keywords: *Radon progeny, passive progeny monitor, CR-39 detector, conversion factor, PAEC*

Acknowledgement: *This work was supported by JSPS KAKENHI Grant Number JP25K13522.*

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CHARACTERIZATION OF RADON LEVEL IN SOIL GAS IN CAM LOC MINE OF KHANH HOA PROVINCE, VIETNAM AND A DECLINE IN INDOOR RADON CONCENTRATIONS AFTER NONE- EXPLOITATION OF GRANITE.

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ABSTRACT

Radon concentrations in soil gas near Cam Loc granite mine area were analyzed from both geological and radiation protection perspectives. The area is characterized by the presence of granite and NE-SW faults that divide the area into two main geological formations such as granite in the northwest and unconsolidated sediments in the southeast.

Granite is one of igneous origin and typically has elevated levels of radionuclides which includes uranium and its progeny. The exploitation of granite in area with high radiation content needs to assessed for radiation doses from radon. The study was carried on two field trips, including in 2013 when the mine was being exploited on a small scale with 36 sites of soil gas and 37 sites of indoor radon. The results of this field study indicate that the radon variations in soil gas were from 0 to 39.1 ± 1.91 kBq/m^3 and a fluctuation of indoor radon levels from 24 ± 24 Bq/m^3 to 413± 31 Bq/m^3, which were exceeded from 1to 4 times on the Vietnam and US-EPA standards (TCVN 13521:2022; EPA, 2023). The second field trip in 2025 was conducted after the cessation of production at the Cam Loc mine. During this trip, indoor radon concentrations ranged from 0 to 45.1 ± 147 Bq/m, all of which remained below the maximum allowable concentrations specified in Vietnamese standards (TCVN 7889:2008) and U.S. EPA guidelines.

The observed decrease in indoor radon concentrations demonstrates the effectiveness of sustainable mineral resource management and exploitation practices in achieving both economic and public health benefits.

Keywords: *Radon indoor, soil gas, granite mine, Khanh Hoa*

NATIONWIDE SURVEY OF ENVIRONMENTAL RADIOACTIVITY IN INDONESIA

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ABSTRACT

Indonesia is an archipelagic country with diverse geological formations and is recognized as a major mining country worldwide. In this situation, Indonesia has the potential for radiation exposure, especially from Naturally Occurring Radioactive Materials (NORM). This research aims to estimate baseline data for environmental radioactivity in Indonesia, including the ambient dose equivalent rate and radioactivity in soil. The nationwide surveys were conducted in 2004-2024. This study employed systematic random sampling with a total sample of 4,413 sampling points across 32 of 38 provinces. We used a NaI (Tl) survey meter for measuring the ambient dose equivalent rate and an HPGe detector for determining radioactivity in soil samples. The activity concentration and GPS location are used to make a map concentration using MapInfo Software v.10.5. In the result, the total annual arithmetic (AM), for 226Ra, 232Th, and 40K radioactivity in soils was 76 ± 4 Bq/kg, 136 ± 6 B/kg, 184 ± 10, and 8 to 2751, respectively. Several areas in Indonesia, such as Mamuju, are included in the High Natural Radiation Area. These data are useful in national development plans as the basis for health policy analysis due to the presence of radioactivity in Indonesia. Furthermore, this data will be Indonesia's contribution to the international world through the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).

Keywords: *Radioecology, NORM, radioactivity*

TOWARDS AN ADEQUATE CHARACTERISATION OF NORM

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ABSTRACT

Over the past years, much interest of the NORM community in Europe has been devoted to rather formal questions of implementing the Euratom Basic Safety Standards within national legislations. However, it appears that a thorough qualitative and quantitative understanding of the properties of naturally occurring radioactive materials (NORM) deserves more attention. Rather than formal subtleties of new regulations, an adequate understanding of the physical and chemical properties of NORM raw materials, products and wastes is what practitioners should be more concerned with. Radiological characterisation of NORM is of fundamental importance for (1) decision with respect to exemption levels, regulatory control, clearance etc., (2) process design and optimisation of planned or existing industrial operations, often in conjunction with radiation safety assessments, and, not least, (3) scientific purposes.

No matter how precise subsequent laboratory analyses may be, sampling is the key to right or wrong characterisation. Adequate sampling, in turn, strongly depends on a thorough understanding of the origin and genesis of materials and the physical and chemical processes that lead to the formation of NORM, and the ability to anticipate radiological properties of the NORM in question and to adapt both sampling strategy and plan accordingly. This includes methods to critically assess potential outliers, and an appreciation of the merits of linear versus iterative sampling strategies.

Innumerable studies on country-wide, site-, industry- and operations-based characterisation of NORM have been published, albeit often with missing or unclear descriptions of how samples have been taken and, consequently, how representative the results actually are. In addition, misleading interpretation of results may lead to unnecessary complication of industrial processes and unjustified risk perceptions among the public, as the recent example of polymetallic nodules from the deep sea has shown.

This contribution attempts to illuminate some aspects of sampling and characterisation from a practitioner's perspective. However, these aspects are also relevant for lawmakers and regulators.

Keywords: *Natural Radioactivity, Residues, Sampling, Characterisation*

Acknowledgement: *This contribution is partly funded by the German Federal Ministry for Higher Education and Research under grant no. 033R276D.*

REMEDIATION OF URANIUM LEGACY SITES IN UZBEKISTAN

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ABSTRACT

Between the 1950s and 1995, Uzbekistan served as a key uranium supplier for the former Soviet Union, with extraction activities concentrated at the Yangiabad and Charkesar sites, located 80 km and 140 km east of Tashkent, respectively. The cessation of mining operations left extensive environmental legacies, including approximately 3.7 million m^3 of waste rock, multiple open shafts and adits, remnants of a former ore sorting facility, and widespread physical and radiological degradation. Unsecured mine openings, eroding waste dumps, and contaminated surface and groundwater present substantial risks to local communities and ecosystems.

A comprehensive feasibility study, funded by the European Commission (EuropeAid/133660/C/SER/UZ), was conducted to assess the current condition of these sites and to develop a remediation strategy in line with international best practices. The study included detailed site characterization, environmental sampling (soil, water, air), radiological assessments, and long-term radon monitoring. Calculated annual effective doses from the use of contaminated mine water reached up to 17 mSv, significantly exceeding internationally recommended exposure limits.

All identified legacy features were subjected to a semi-quantitative risk analysis, incorporating geotechnical and radiological criteria. Based on the outcome, each site component was classified into one of three risk categories, guiding the selection of appropriate remediation measures. These included the sealing of shafts with engineered concrete caps, closure of adits using either backfilled masonry structures or deep concrete plugs with integrated drainage, stabilization and partial relocation of waste rock piles, and demolition of contaminated structures. An environmental impact assessment was conducted to evaluate potential adverse effects during remediation, such as dust generation, worker exposure, and contaminant transport. A site-specific monitoring program was designed, including airborne radioactivity measurements, dosimetry, noise and dust surveillance, and vehicle contamination control.

The remediation concept is technically feasible, environmentally sound, and aligned with both national regulatory frameworks and international guidelines. The detailed design documentation was submitted to Uzbek authorities for review and got the approval for the construction.

The remediation works were funded and supported by the European Bank for Reconstruction and Development (EBRD). The implementation of the works had been done from April 2023 to August 2025. All envisaged remediation goals and the planned schedule were met. The radioactive and geotechnical risks from the uranium mining legacies in Yangiabad and Charkesar were reduced substantially. Moreover, the capabilities of local authorities were strengthened through training programs dealing with radioactivity in the environment.

Keywords: *Radiological assessment, Uzbekistan, remediation*

Acknowledgement: *European Bank for Reconstruction and Development, European Commission*



Figure 1. Bunker with radioactive material in Yangiabad



Figure 2. Adit with outflow of contaminated water

MANAGEMENT AND REUSE OF NORM WASTES IN VIETNAM: A CASE OF TITANIUM MINING AND PROCESSING.

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ABSTRACT

Naturally Occurring Radioactive Materials (NORM) arise from geological formations containing uranium, thorium, and radium series isotopes, which can become concentrated during mining and mineral processing activities. In Vietnam, titanium-bearing mineral sands constitute one of the largest sources of NORM-containing residues, particularly in coastal provinces such as Binh Thuan and Ninh Thuan. This paper provides an overview of the current status of NORM management in Vietnam, reviews relevant legislation, presents monitoring data from selected mining and processing industries, and discusses management practices together with potential pathways for beneficial reuse of residues from titanium processing. The findings highlight not only environmental and radiological challenges but also opportunities to advance circular economy approaches in the mineral sector.

Keywords: *NORM, reuse of NORM residues, titanium mining and procesing, waste management, circular economy, Vietnam.*

SPECIAL SESSION

IX ATMOSPHERIC SCIENCES AND REGIONAL CLIMATE

WAYS TO IMPROVE SUB-SEASONAL TO SEASONAL WEATHER FORECASTING FOR VIETNAM TO STRENGTHEN EARLY WARNING

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ABSTRACT

Droughts, often in combination with heat waves, are climate hazards that increasingly affect Vietnam. For the drought hazard, term "flash drought" has been coined for droughts characterized by rapid onset and intensification, often occurring within a few weeks ~~or even days~~. The atmospheric and oceanic drivers of these "(flash) Drought-Heat Compound" (DHC) events are poorly known for Vietnam. In the upcoming joint Vietnamese-German research project DHCDAI ("*Development of a Prediction and Early Warning System for Drought-Heatwave Compound Hazards in Key Cities and Agricultural Sub-Regions of Vietnam by Merging Dynamical Model and Artificial Intelligence approaches")* run by HUS (the REMOCLIC team lead by Prof. T. Phan-Van) and KIT (the Tropical Meteorology team led by Prof. A. H. Fink), not only will these drivers studied, but also the practical predictability of these DHC events at sub-seasonal to seasonal lead times will be assessed by merging dynamical model and artificial intelligence approaches. The forecast regions in Vietnam are three metropolitan areas, viz. the Hanoi, Ho-Chi-Minh-city, and Buôn Ma Thuột areas.

To achieve improved early warnings of DHCs, appropriate indices for DHC events will be tested to define them, and additional oceanic and atmospheric subseasonal to seasonal drivers of DHC events will be identified. The predictability of DHC events at subseasonal (up to 1.5 months) will be studied for the target regions. On the German side, novel and free ensemble (re-)forecast from the European Centre For Medium-Range Weather Forecasts (ECMWF) will be used. Their forecast skill will be quantified improved using latest AI-based postprocessing methods to correct mis-calibrations. The Vietnamese partner will utilize own downscaled predictions up to two months from regional climate models forced by operationally available, global predictions. These forecasts will also be calibrated by AI-based calibrations. The two forecast approaches will then be merged and operationalized in the Northern Delta and Midland Regional Hydro-Meteorological Center (NDMRC) in a co-design approach. The project will thus improve operational early warning on DHC events in Vietnam using novel forecasts and AI-approaches. These novel forecast approaches to improve and strengthen sub-seasonal early warning procedure will be presented in the talk. In the context, the project will benefit from more than a decade of joint research between the HUS REMOCLIC and KIT teams from which highlights will also be shown in the presentation.

Keywords: *Compound Drought-heat event, heat and drought indices, subseasonal prediction, AI-based forecast correction, early warning,*

SENSITIVITY OF CCAM CLIMATE SIMULATIONS TO ASPECTS OF CUMULUS PARAMETERIZATION

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ABSTRACT

Fine resolution climate simulations have been carried out at CSIRO using the global, variable-resolution Conformal Cubic Atmospheric Model (CCAM), for the CORDEX-SEA project. The methodology involves running global 100 km simulations from 1960 to 2070, driven by the sea-ice and bias-corrected SSTs of two CMIP6 CGCMs: ACCESS-CM2 and GFDL-CM4. The historical period is covered, followed by the evolving SSP370 scenario for greenhouse gas emissions. The simulations are then downscaled from 100 km to 25 km resolution over the Southeast Asia domain.

After making a variety of improvements to the cumulus parameterization scheme, two further simulations have now been carried out, also downscaling ACCESS-CM2 and GFDL-CM4. The new runs better represent present-day rainfall. Improvements in rainfall extremes are also found. The projected future climate changes over southeast Asia will also be compared to those from the previous simulations.

Keywords: *Downscaling, variable-resolution.*

HYDRO-METEOROLOGICAL FORECASTING FOR WATER MANAGEMENT AND DISASTER RISK REDUCTION

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ABSTRACT

Climate change is intensifying, making natural disasters more frequent and unpredictable. In this context, advanced Meteorological and Hydrological forecasting technologies are essential for Natural Disaster risk reduction and sustainable Water Resource management. Methods/tools such as numerical weather prediction models, artificial intelligence (AI), remote sensing, automated observation systems... are increasingly applied to enhance early warning capacity, improve forecast accuracy, and support timely responses to tropical cyclone, floods, and droughts. For disaster preparedness, integrating real-time data from automated observation stations with numerical models enables the development of real-time early warning systems. These systems allow local authorities and communities to take proactive measures and reduce vulnerability. At the same time, studies on climate variability and extreme weather events provide critical scientific evidence for national/regional planning, particularly in high-risk areas (central coast, mountainous areas). Such efforts strengthen preparedness, reduce potential damages, and foster resilient development. In term of Water Resource management, advanced Meteorological and Hydrological forecasting technologies and big data analytics offer new opportunities to optimize water use. Decision Support Systems (DSS) based on hydrological simulations and forecasts of streamflow, water demand, and water quality allow policymakers to design more efficient allocation strategies. Improved data sharing and cross-sector interoperability also enhance integrated water resource management at the river basin scale, which is increasingly important under rapid socio-economic development and climate change. Effective hydrological forecasting relies heavily on meteorological prediction. Therefore, we are developing coupled meteorological–hydrological forecasting products that integrate advanced methods such as numerical model, AI, machine learning (ML), and big data analytics. In particular, seasonal forecasting, has been applied in constructing water resource scenarios. These products are designed to support the Department of Water Resources Management (DWRM) and the Vietnam Disaster and Dyke Management Authority (VDDMA) under the Ministry of Agriculture and Environment (MAE). They provide inputs for water resources management, such as water resource scenarios, annual water resources bulletins ... and proactive disaster response guidance. This presentation highlights the importance of meteorological forecasting and introduces several advanced techniques, including nowcasting (1-6 hour), short-term forecast (1-5 day) and seasonal forecast (1-6 month). These technologies have already been applied in practice and demonstrate significant potential for improving early warning systems, as well as enhancing efficient water resource management through DSS. Finally, the presentation emphasizes that meteorological forecasting plays a vital role not only in reducing disaster risks but also in ensuring sustainable and effective water resource management, thereby contributing to climate resilience and sustainable development.

Keywords: *Hydro-meteorological forecasting, water resources management, disaster risk reduction, seasonal forecast.*

IMPLICATION OF BIAS-CORRECTION ON THE PROJECTED CHANGES OF RAINFALL EXTREMES OVER SOUTHEAST ASIA

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ABSTRACT

Bias-correction (or bias-adjustment) has become a standard procedure for using General Circulation Models (GCMs) and Regional Climate Models (RCMs) rainfall data in hydrological impact modelling. This is because raw climate model simulations often contain systematic biases due to incomplete physical representations and coarse spatial resolutions. When combined with spatial disaggregation, bias-correction methods also serve as empirical-statistical downscaling tools for local-scale assessment. However, conventional cross-validation techniques cannot assess the validity of bias correction under future climate conditions, and studies typically rely on a single algorithm. This raises critical questions – i) How do different bias-correction algorithms affect projected changes in rainfall characteristics? ii) what is the magnitude of the associated uncertainty? To address these questions, we analysed projected changes in rainfall extremes over Southeast Asia regions using the multi-model simulations (multi-GCMs/multi-RCMs) from the CORDEX-SEA CMIP6 downscaling experiments. We examine four indices representing key extreme rainfall characteristics i.e i) total precipitation (PRCTOT), ii) maximum daily rainfall (RX1DAY), iii) the frequency of heavy rain days (R20mm), and iv) consecutive dry days (CDD). The performance of three common bias-correction algorithms i.e Linear Scaling (LS), Quantile Mapping (QM), and Quantile Delta Mapping (QDM) is evaluated. Our results indicate that while all algorithms produce consistent and satisfactory results during historical baseline periods under cross-validation, they generate markedly different projections for future rainfall extremes. Furthermore, the algorithms can substantially dampen or amplify the raw climate change signals simulated by the CORDEX-SEA downscaled projections. Consequently, the choice of bias-correction algorithm introduces significant uncertainty into climate impact assessments related to rainfall extremes, a factor often overlooked. Our analysis reveals that over Southeast Asia, the uncertainty associated to bias-correction choice for total precipitation (PRCTOT) is 40–70% of the uncertainty associated with the Shared Socioeconomic Pathways (SSPs). For extreme rainfall intensity (i.e RX1DAY), this uncertainty is even larger, reaching 70–120% of the SSP-driven uncertainty. The relative contribution of bias-correction uncertainty to the total projection uncertainty exhibits substantial spatial variation across the region (**Figure 1**).

Keywords: *Bias-corrections, extreme rainfall indices, CORDEX-SEA, downscaling, climate projections*

Acknowledgement: *This study is funded by the Malaysian Ministry of Higher Education's LRGS Grant (LRGS/1/2020/UKM-UKM/01/6/1).*

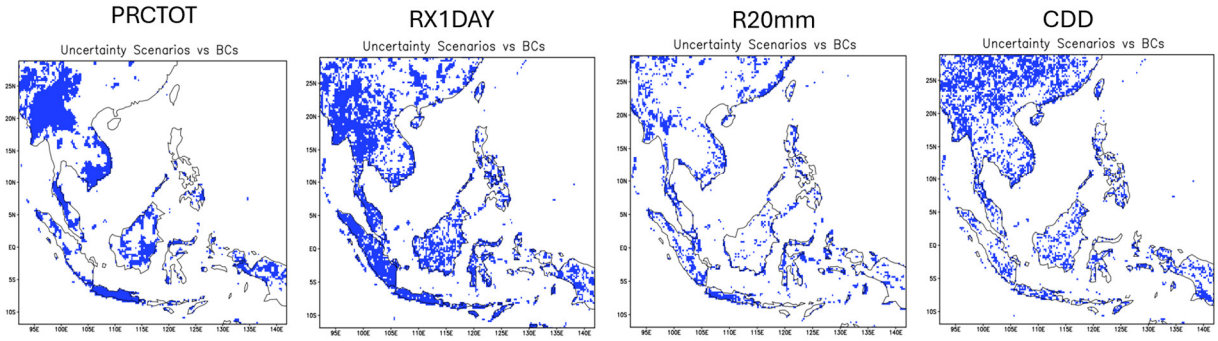


Figure 1. Regions (blue shades) where the bias-correction uncertainties are larger than that associated with the SSPs.

PERFORMANCE EVALUATION OF REGCM5 IN LONG-TERM SIMULATION OF IMPACTS OF RAPID URBANIZATION ON VIETNAM'S HIGH-URBANIZED AREAS AT CONVECTION PERMITTING SCALE

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ABSTRACT

The upcoming national climate change and sea level rise scenarios in Vietnam require detailed information on urbanization, particularly at Hanoi and Ho Chi Minh City, the two most urbanized areas. This study thus investigate the capability of the latest convection-permitting (CP) RegCM5 model to simulate the impacts of urbanization in these cities. It represents the first attempt in Vietnam to employ RegCM at the CP scale for simulations with a horizontal grid spacing of 2 km, driven by ERA5 reanalysis and incorporating annually updated urban data from 2000 to 2020. Unlike previous studies that utilized low-resolution simulations without updated urban information, the addition of MOLOCH dynamics into this latest RegCM5 allows us to complete all simulations stably with significantly shorter execution times, making it feasible for long-term projection. The results highlight three key findings. First, the simulations at 2 km significantly outperform those at 10 km, suggesting the advantage of using CP resolution. In some cases, the 2 km simulations even surpass VnGC, a well-known gridded observation dataset for the country, in comparison to station observations. Secondly, with updated urban information, our results produce more realistic temporal evolution of impacts of urbanization, particularly more pronounced during the late afternoon, around 16:00 local solar time (LST), until midnight, around 01:00 LST. Lastly, it was found that in both cities, urban heat island (UHI) effect is also stronger during late afternoon to midnight hours and tends to be further amplified by increases in background temperature, with the magnitude of the UHI in Hanoi generally being higher than in Ho Chi Minh City. This study underscores the necessity of such a CP scaled modeling approach with updated urban extension, which provides insights and reliable references for policymakers and planners to develop sustainable strategies, particularly in offering valuable information for sectors such as air quality assessment, flood risk management, and public health analysis.

Keywords: *Convection Permitting, RegCM5, Urban modeling.*

Acknowledgement: *This work is supported by the Vietnam Academy of Science and Technology (VAST) grant number THTETN.03/23-24*

ASSESSING FUTURE HEAT STRESS IN VIETNAM USING PHYSICALLY-BASED WET-BULB GLOBE TEMPERATURE AND HIGH-RESOLUTION DOWNSCALED PROJECTIONS

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ABSTRACT

The wet-bulb globe temperature (WBGT) is a widely applied index for assessing heat stress, yet many climate change studies rely on simplified WBGT estimates that introduce substantial biases. In this study, we combine high-resolution downscaled climate projections with a physically based WBGT model to provide a robust assessment of future heat stress across Vietnam and its seven sub-climatic regions. Projections are evaluated for the near future (2021–2040), mid-future (2041–2060), and far future (2081–2100) relative to a baseline (1995–2014) under three Shared Socioeconomic Pathways (SSP1-2.6, SSP2-4.5, SSP5-8.5), as well as across global warming levels (1.5°C, 2°C, 3°C and 4°C above pre-industrial). Long-term trends over the entire study period are also analyzed. Results reveal a marked intensification of heat stress across Vietnam with substantial increases in both the WBGT values and the number of days exceeding health-relevant thresholds. Particularly concerning are the Red River and Mekong River Deltas—Vietnam's most densely populated and agriculturally vital subregions—where the number of days requiring 75% rest per hour for daytime outdoor work (daily maximum WBGT >32°C) could reach 240–270 per year under SSP5-8.5 in the far future and at 3–4°C of global warming. Nighttime heat stress is also projected to intensify, reducing recovery potential and exacerbating chronic health risks. The severity of future heat stress scales with radiative forcing and global warming, with the most extreme outcomes projected under SSP5-8.5 and high GWLs, underscoring the urgent need to limit warming. Simplified WBGT methods are shown to significantly overestimate exceedances in much of Vietnam, creating risks of misleading assessments and ineffective adaptation planning. These findings emphasize the critical importance of accurate WBGT modeling and high-resolution climate data for reliable assessment of future heat stress and for informing effective risk management and adaptation strategies in Vietnam.

Keywords: *heat stress; Wet-Bulb Globe Temperature; climate change; CORDEX-SEA; Vietnam.*

Acknowledgement: *This study is conducted as part of the Vietnam Academy of Science and Technology (VAST) under Grant THTETN.01/25-26, and by the 2nd phase of the GEMMES Vietnam project funded by the French Development Agency (AFD) through Facility 2050. The downscaled CMIP6 data were obtained from the SEACLID/CORDEX-SEA project funded by the Asia Pacific Network for Global Change Research (CRRP2023-658 08MY-Cruz) and by the Vietnam National Foundation for Science and Technology Development (NAFOSTED) under Grant 105.06-2021.14.*

↖ AGENDA ↖ SESSION IX

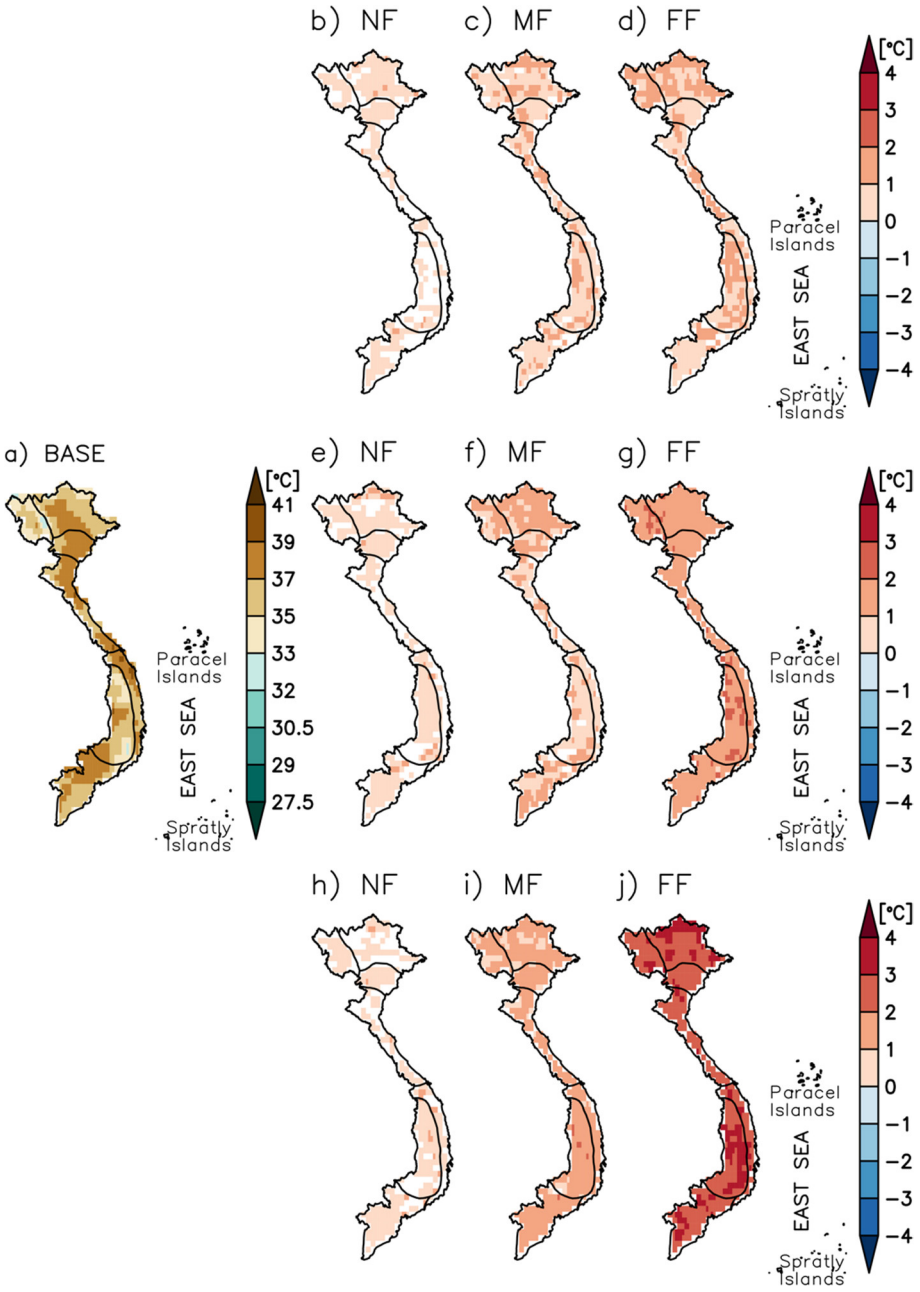


Figure 1. **(a)** The spatial distribution of climatological annual maximum $WBGT_x$ ($WBGT_{x,x}$) over Vietnam during the baseline period (1995–2014) and its projected changes for the **(b)**, **(e)**, **(h)** near future (NF; 2021–2040); **(c)**, **(f)**, **(i)** mid-future (MF; 2041–2060); and **(d)**, **(g)**, **(j)** far future (FF; 2081–2100) under three Shared Socioeconomic Pathways **(top)** SSP1-2.6, **(middle)** SSP2-4.5, and **(bottom)** SSP5-8.5. Only significant differences (p-value<0.05) are plotted.

EXTENDED-RANGE PREDICTION OF MONSOON ONSET OVER VIETNAM USING ECMWF-S2S DATA AND CLUSTER ANALYSIS

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ABSTRACT

Extended-range prediction of monsoon onset is essential for supporting decision-making in Vietnam. However, determining the exact onset remains challenging, as rainfall during the transitional period is influenced by multiple weather systems and there is still no universally accepted objective index for defining monsoon onset in the country. To address this challenge, this study employs a pattern-based approach using both Self-Organizing Maps (SOMs) and *k*-means clustering to classify large-scale atmospheric circulation patterns derived from ERA5 reanalysis data. The atmospheric variables analyzed include 850 hPa winds and geopotential height. The resulting daily weather patterns were grouped into six distinct clusters. Each cluster's composite characteristics were examined to determine whether they reflect typical summer monsoon conditions. Clusters identified as "monsoon patterns" were used as indicators of monsoon onset, and the onset date for each year was defined as the first persistent occurrence of one of these patterns. Based on this classification, the onset of the summer monsoon over Vietnam was found to typically occur around May 9, characterized by a marked increase in rainfall and the establishment of low-level monsoon westerlies. Building upon this foundation, the ECMWF Subseasonal-to-Seasonal (S2S) forecast system was then used to predict the same finite set of weather-pattern clusters, providing an alternative to traditional monsoon onset indices. The evaluation of the ECMWF-S2S model revealed that it possesses strong predictive skill in identifying the correct weather pattern clusters, particularly during the first 10 days of lead time, with accuracy levels exceeding 85%. Notably, the model continued to outperform the climatological mean up to a lead time of approximately 17 days, suggesting that pattern-based forecasts offer a promising avenue for extended-range prediction of monsoon onset in this region. Furthermore, 70% of the forecasts achieved a mean absolute error (MAE) within 5 days, and more than 85% were within a 10-day MAE

Keywords: *onsoon onset, self-organizing maps, k-mean, monsoon index, extended range forecast, ECMWF-S2S*

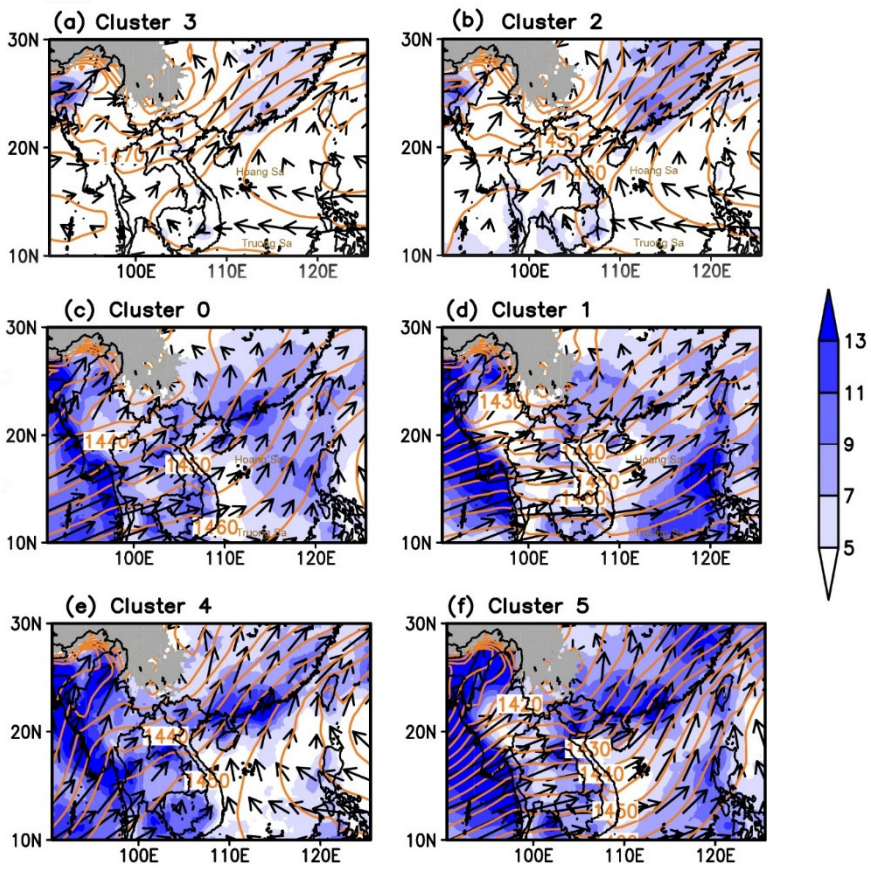


Figure 1. Mean patterns of 850 hPa wind, geopotential height and total precipitation in each SOMs node

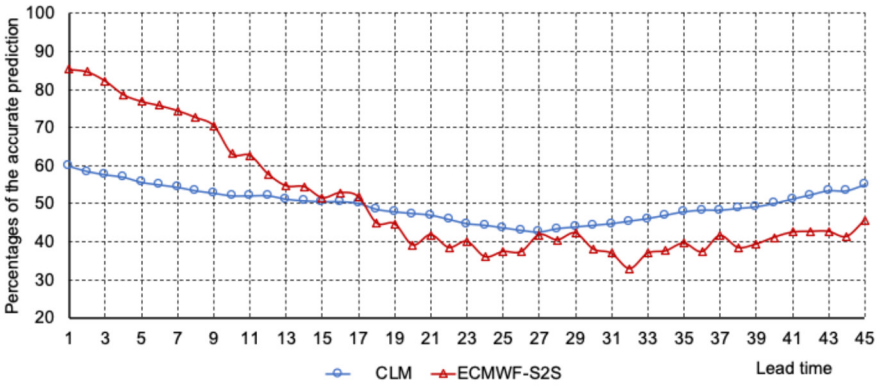


Figure 2. Percentages of the accurate prediction of the predefined categorical weather pattern by the ECMWF-S2S (orange line) and climatological mean (blue line)

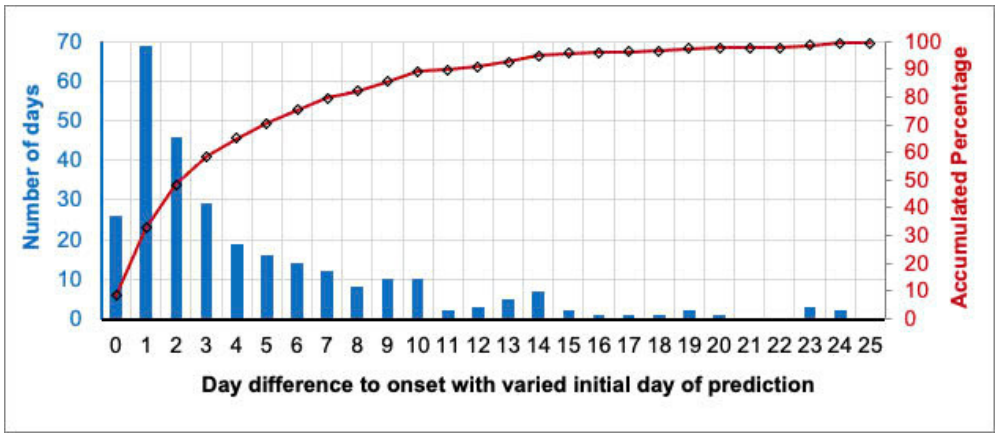


Figure 3. Absolute mean error of prediction the onset date with varied initial days by the ECMWF-S2S and cluster analysis

INCREASING COMPOUND HEAT AND PRECIPITATION EXTREMES AND POPULATION EXPOSURE IN A WARMING VIETNAM

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ABSTRACT

Compound heat and precipitation extremes (CHPEs) can lead to severe and widespread impacts due to their combined effects. This study investigates future changes in CHPEs across seven climatic regions of Vietnam using the high-resolution CMIP6-VN dataset (~10 km) and future population projections. Extreme events are identified using the 95th percentile of historical data (1980–2014), with a compound event defined when at least three consecutive days of extreme temperature coincide with an extreme precipitation within a 7-day window. The results show that (1) In the future, the changes in CHPE events vary by Shared Socioeconomic Pathway (SSP) scenarios. Under SSP1-2.6, most regions exhibit a slight, statistically insignificant increase in CHPEs, while SSP5-8.5 exhibits the most pronounced rise, with some areas experiencing up to 15 events per year by the end of the 21st century. Although precipitation hazard days remain relatively stable, the number of days with extreme temperatures increases substantially, indicating that future CHPEs will be primarily driven by rising temperatures. (2) Seasonal distributions of CHPEs shift, with a marked increase toward the later months of the year. Under SSP5-8.5, the number of CHPEs rises sharply, particularly in northern regions, where events are projected to occur more than once per month from May to September. (3) Regarding the corresponding number of people exposed to CHPEs, although the population is projected to decline after peaking around mid-century, exposure to CHPEs increases significantly under warmer scenarios. Quantifying the contributions of climate change and population change to future population exposure shows that, while population change has a notable influence in some regions during the early to mid-century, climate change is the dominant driver across all regions and scenarios.

IMPACTS OF RAPID URBANIZATION ON CLOUD ACTIVITY IN GREATER HO CHI MINH OVER THE PAST 30 YEARS

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ABSTRACT

The impacts of urban areas on precipitation and cloud activity have been extensively examined in mid-latitude megacities. However, changes in cloud activity associated with urban expansion have not been investigated at all. This study evaluates the influence of rapid urbanization on cloud activity in Greater Ho Chi Minh (GHCM) over the 30-year period from 1995 to 2024. Long-term geostationary Himawari satellite visible imagery was used to define the difference in cloud frequency between urban and rural areas as the Urban Cloud Island Intensity (UCII), and to compare conditions before and after urbanization.

The analysis indicates that over the past three decades, GHCM experienced both an expansion of high cloud-frequency regions and a distinct increase in cloud frequency over the urban core. This enhancement was particularly pronounced during the rainy season from May to October. The UCII increased from approximately 8% in 1995–2000 to 13% in 2020–2024, representing an average rise of 5%. In the urban core, the increase exceeded 10%. In addition, newly urbanized areas converted from farmland also exhibited enhanced cloud activity, particularly in the eastern GHCM (e.g., Thủ Đức City and Biên Hòa), where notable increases have been observed since 2015.

The intensification of UCII is attributed to stronger Urban Heat Island (UHI) effects, which enhanced thermal convection within urban areas and reinforced UHI-induced circulation between urban and rural regions. The strengthening of the UHI is likely driven primary by the horizontal expansion of urban land but also by increased anthropogenic heat emissions associated with large-scale urbanization.

Keywords: *Greater Ho Chi Minh City Metropolitan Area, Urbanization, Urban Cloud Island, Cloud Activity, Urban Heat Island*

Acknowledgement:

This research was supported by JSPS KAKENHI Grant Number JP24K07130.

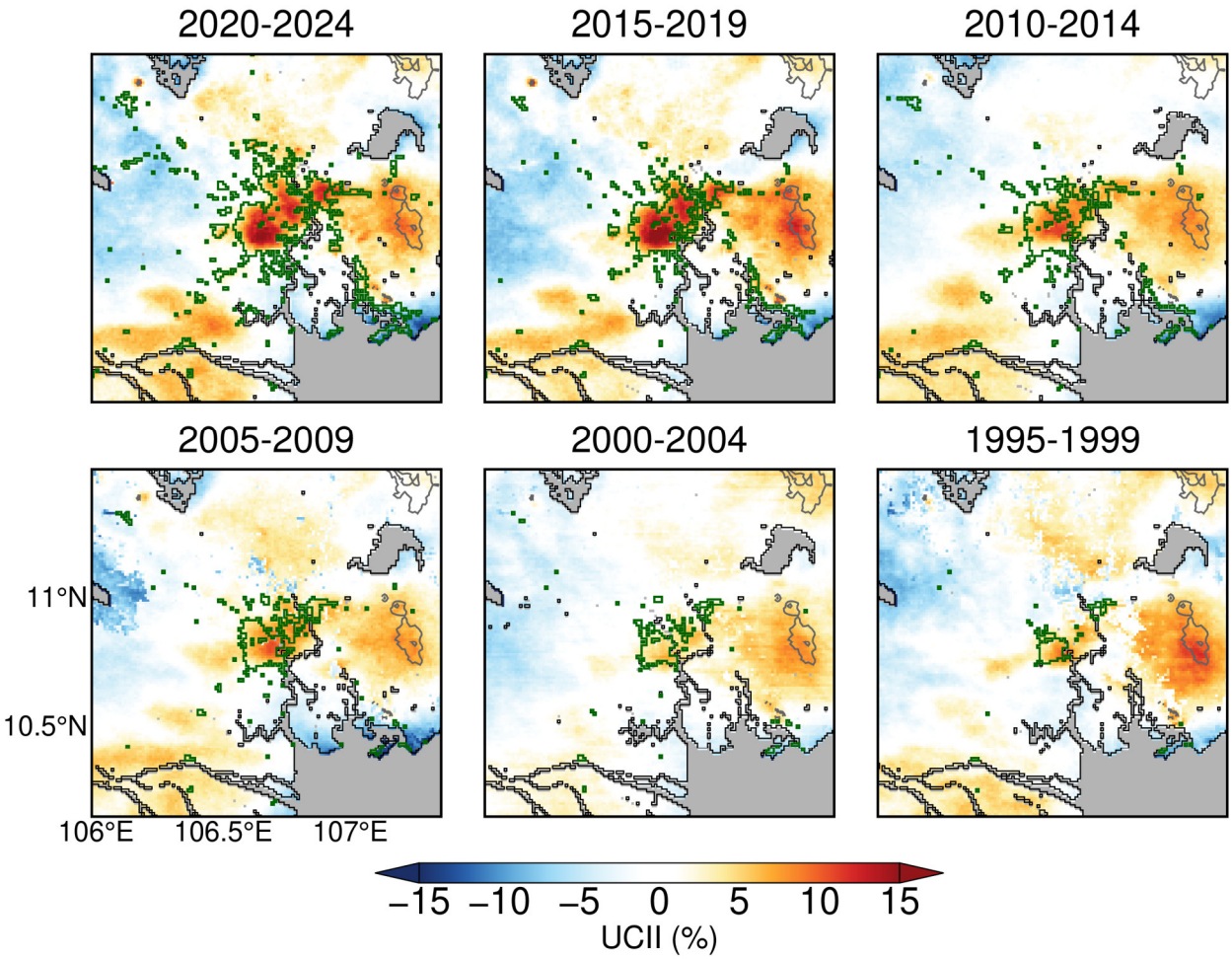


Figure 1 Temporal evolution of Urban Cloud Island Intensity ($CF - CF_{rural}$) from 1995 to 2024. The figure shows the 5-year average during the rainy season. Gray areas indicate water bodies. Black lines represent coastlines, gray lines indicate contour lines at 100 m intervals, and green lines show urban areas for each period.

INTRASEASONAL TO INTERANNUAL VARIABILITY OF THE SOUTH VIETNAM UPWELLING AND THE ROLES OF WIND, TIDES, RIVERS AND CHAOTIC VARIABILITY : A REVIEW

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ABSTRACT

The South Vietnam upwelling (SVU) occurs in summer under the influence of the southwest monsoon. It is a key process in the East Vietnam Sea circulation, influencing the formation of ocean water masses and triggering the biological productivity, hence the fishing resources, as well as affecting the local climate and precipitations. Several studies based on field observations, satellite data or numerical tools have shown the influence of wind; however the associated mechanisms need to be identified more precisely. Moreover, these studies have suggested that other factors could also be involved in the functioning and variability of the SVU, including tides, freshwater released by rivers but also the ocean intrinsic variability (OIV), which is associated with the chaotic behavior of the ocean.

In this presentation, we will summarize the results of our team's efforts to better identify the different areas of upwelling development along the Vietnamese coast, quantify the intraseasonal to interannual variability of the upwelling and understand the associated mechanisms. To this end, we implemented a high-resolution (1 km at the coast) version of the SYMPHONIE regional ocean model and ran both multi-annual simulations over the period 2009-2018 and ensembles of bi-annual simulations over the period 2017-2018 (see *To-Duy et al. 2022, Herrrmann et al. 2023, 2024*). We demonstrated that the upwelling occurs in four distinct areas, associated with different underlying processes (see **Figure 1**). Upwelling along the Southern Vietnamese coast (SVU) is induced by the convergence of northern cyclonic and southern anticyclonic gyres (induced by the summer monsoon winds), which characterize the large-scale summer circulation in the area. Its variability is therefore mainly related to the monsoon intensity, with a strong influence of ENSO at the interannual scale. Upwelling along the Northern Vietnamese coast (NCU) can only develop under conditions of weak large-scale circulation and is mainly induced by sub-mesoscale coastal structures, with a strong impact of chaotic variability. Upwelling offshore the Vietnamese coast (OFU) is primarily caused by the interactions between summer wind stress and mesoscale eddies exhibiting strong chaotic behavior, and is consequently influenced by both monsoon wind intensity and OIV. Finally, we revealed for the first time that upwelling also develops off the Mekong delta, with minimal OIV impact. This upwelling is actually induced by the convergence and divergence of surface large-scale currents induced by wind and topography. It is moreover strongly enhanced by tides, through the direct impact of tidally induced vertical mixing, as well as indirectly through the enhancement of surface currents convergence and divergence.

Keywords: *South Vietnam Upwelling, Southwest summer monsoon, Ocean Intrinsic variability, Tides, ENSO*

Acknowledgement: *This work was supported by Institute of Research for Sustainable development (IRD), CALMIP HPC resources, CNES/TOSCA (MONSUN and SEASTERS projects) and the French Embassy in Vietnam.*

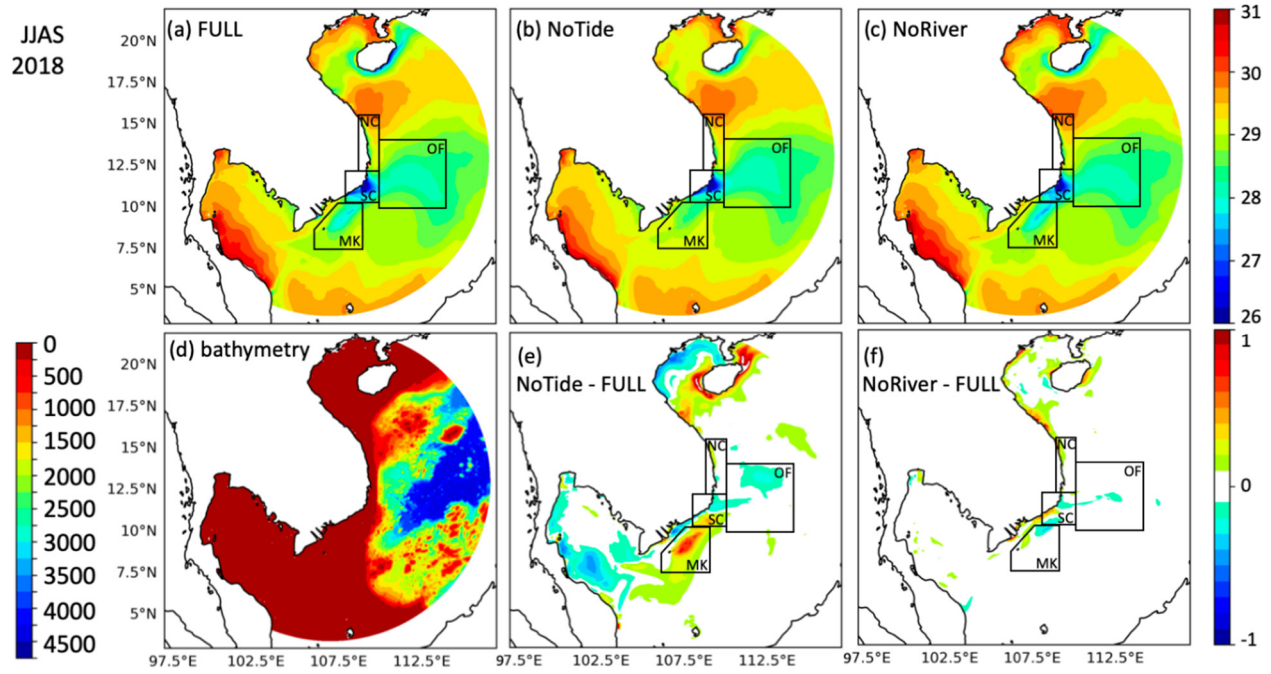


Figure 1. Ensemble average summer SST in June–September 2018 from three 10-simulations ensembles performed with the SYMPHONIE ocean model over the period 2017-2018 : a reference ensemble with all forcings (FULL: river discharges, atmospheric, tides and lateral forcing, a) and two sensitivity ensembles respectively without tides (NoTide, b) and without river discharges (NoRiver, d), and difference between the sensitivity and the reference ensemble (e,f). The upwelling areas (OFU, NCU, SCU and MKU) are indicated as well as the bathymetry of the numerical domain [m, d]. From *Herrmann et al. 2024*

SEA4C: SOUTHEAST ASIA 4-KM CLIMATE DATASET: HISTORICAL REANALYSIS AND FUTURE PROJECTION

Fei Chen, Zhenning Li, Tianyuan Ma, Jimmy Fung, Alexis Lau, Xiaoming Shi, Eun Soon Im, Wanliang Zhang, Yeer Cao, Jerasorn Santisirisomboon, Faye Abigail Cruz, Ju Neng Liew, Thanh Ngo-Duc

ABSTRACT

High-resolution gridded climate data are critical for understanding historical and future climate variability, as well as for providing stakeholders and policymakers with actionable insights. In this study, we employ a 4-km convection-permitting Weather Research and Forecasting (WRF) model to generate a 50-year reanalysis dataset and future climate projections for the data-scarce Southeast Asia (SEA) region. Given the increasing vulnerability of densely populated coastal megacities in SEA to extreme weather and climate events, we enhanced model performance by optimizing the spectral nudging method and utilizing urban canopy models, ensuring refined representation of local and regional climate processes. We evaluate the performance of this fine-scale reanalysis in capturing key climatic phenomena, including tropical cyclones, extreme heat and heavy precipitation events in urban areas, as well as water cycle dynamics and drought conditions. The results demonstrate the dataset's capability to provide detailed insights into extreme weather dynamics and their implications for urban risk management and climate adaptation strategies in Southeast Asia.

SEASONAL FORECASTING FOR NORTHEAST BRAZIL WITH A SIMPLE GCM

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ABSTRACT

A simple GCM known as DREAM (Dynamical Research Empirical Atmospheric Model) is used to perform historical forecasts for rainfall in northeastern Brazil for the years 1982–2020. The model is forced by empirically derived source terms and includes basic parameterisations to simulate vertical diffusion, convection and condensation. Details of the model will be presented and the model can be made available to interested persons for idealised climate studies and potentially for operational forecasts. **Figure 1** shows the global precipitation climatology of the model.

In this study ensemble forecasts with 38 members are initiated on 1st January using persisted tropical sea surface temperature anomalies (SSTAs). Rainfall forecast performance is evaluated for the February–April (FMA) rainy season. The model reproduces the climatological precipitation in the specified Nordeste region with a mainly dry bias as the model rainfall maximum is displaced in the the northwest. Hindcasts for interannual rainfall anomalies correlate with observed values (r=0.46) but model variance is somewhat weaker than observed, as shown in fig. 2.

A further set of forecast experiments with SSTAs restricted to the three major ocean basins reveals that most of the forecast skill can be attributed to the Pacific, despite the model's greater sensitivity to Atlantic SSTAs. The sum of results from the three ocean basins is close to the full hindcast result.

Finally, a set of 128 forecast runs with idealised SSTAs placed regularly within the tropics is carried out to calibrate the response of modelled rainfall to remote influences. An influence function is diagnosed in the form of a tropical distribution of northeastern Brazil rainfall in mm/ day per unit SSTA. It is strongly concentrated in the tropical Atlantic, with dry/wet conditions resulting from positive SSTAs in the northern/southern tropical Atlantic, in keeping with the observed covariance.

Keywords: *Seasonal Rainfall Forecast GCM SSTA.*

Acknowledgement: *This study was financed by IRD during the sabbatical stay of N. Hall in Fortaleza, Brasil.*

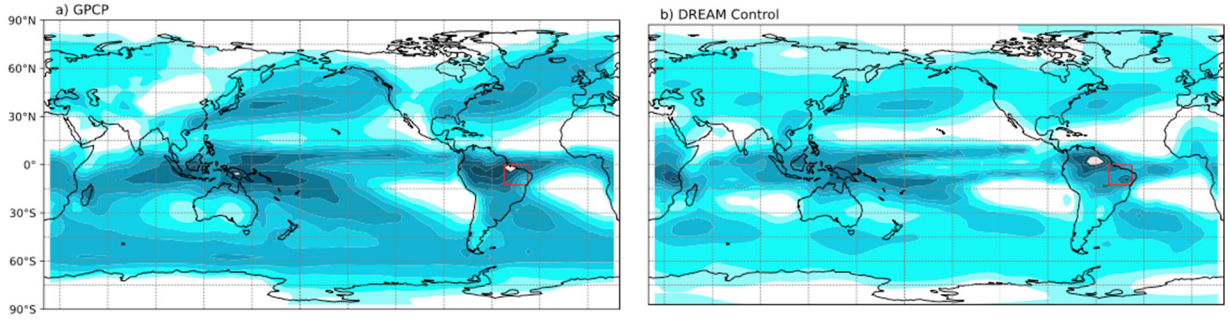


Figure 1. DREAM precipitation for FMA climatology compared to GPCP observations

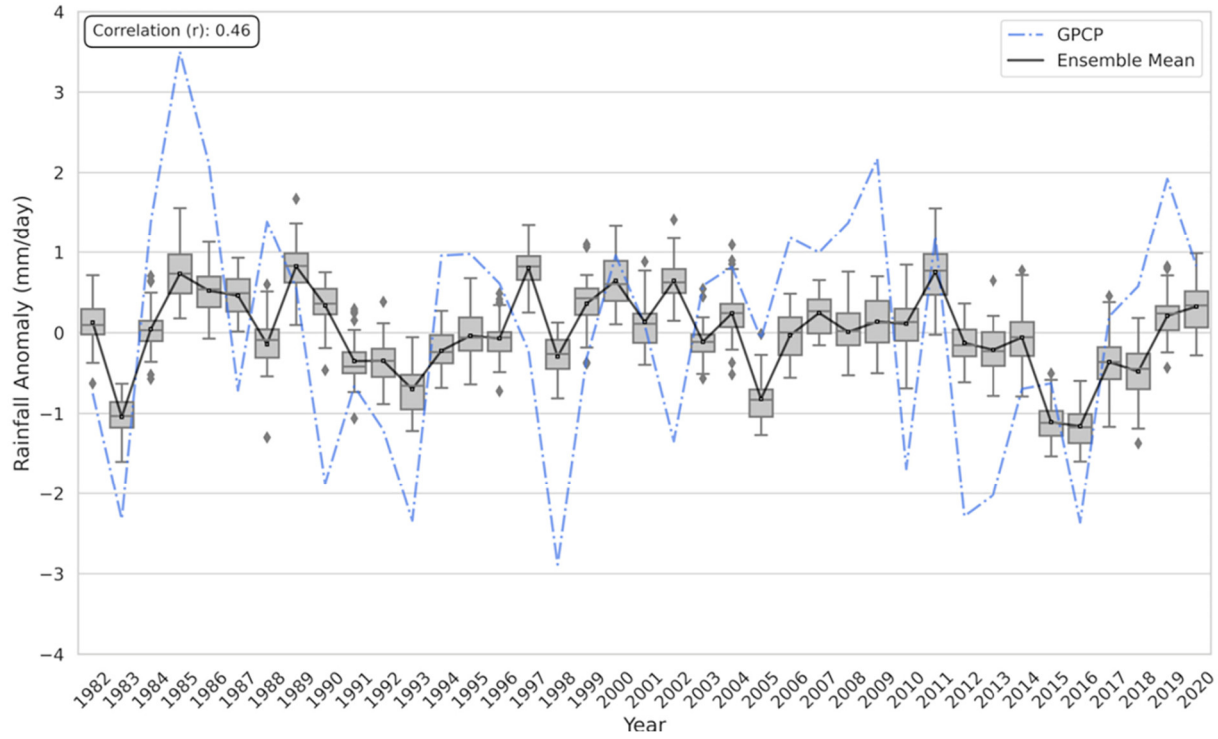


Figure 2. Ensemble hindcast timeseries for Nordeste rainfall

WARM TROPICAL SOUTH ATLANTIC IN 2023-24 AND IMPACTS ON SOUTH AMERICAN RAINFALL

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ABSTRACT

From 2023 to early 2024, the tropical Atlantic experienced widespread warming, driven by distinct regional factors and resulting in significant climatic impacts over South America. Sea surface temperature anomalies (SSTAs) remained high in the tropical North Atlantic from spring 2023 until early 2024, peaking in June 2023 and February 2024 (Fig. 1). In contrast, the tropical South Atlantic underwent a rapid transition from negative to positive SSTAs in late 2023, with peak in November–December. By early 2024, these anomalies had spread across the basin, making this period one of the warmest on record.

Atmospheric anomalies in November 2023 played a central role in the warming of the South Atlantic. A sea level pressure dipole, with negative anomalies north of 50°S and positive anomalies to the south, altered wind and heat flux patterns. Combined with shallow mixed-layer depth, weak zonal surface winds led to reduced turbulent heat loss, allowing the ocean to accumulate more heat. In the equatorial Atlantic, SST increases were mainly associated with horizontal advection from the north and downwelling Kelvin waves driven by westerly wind anomalies. Cooling episodes in January 2024 were tied to intensified local winds and turbulent mixing. This was followed by rapid warming in February, as winds weakened and surface net heat flux increased. These results emphasize that distinct physical mechanisms controlled the late 2023 warming in the tropical south Atlantic.

The warm tropical South Atlantic had a significant impact on rainfall across South America. From November to December 2023, a dipole pattern emerged, characterized by above-average rainfall in southern Brazil and dry conditions in central and eastern regions. From February to March 2024, the presence of exceptionally warm southern equatorial Atlantic waters (>29°C) was associated with increased rainfall in Northeastern Brazil, while El Niño conditions suppressed rainfall in the Amazon basin (Fig. 2). Simple GCM experiments confirmed that warming in the tropical South Atlantic substantially enhanced precipitation over Northeastern Brazil.

Keywords: *Warming, Tropical Atlantic, Northeast Brazil, Rainfall, GCM.*

Acknowledgement: *This study was financed by IRD.*

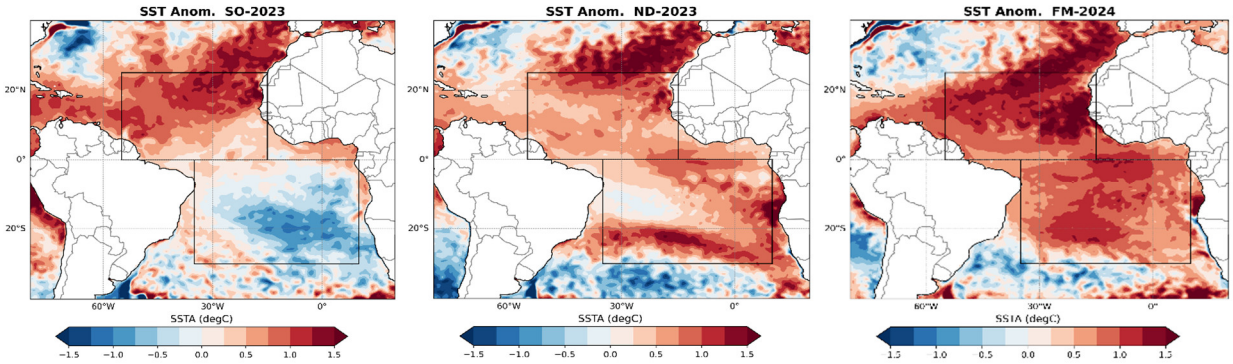


Figure 1. (a) September-October, (b) November-December 2023 and (c) February-March 2024 SST anomalies in the Atlantic. The anomalies are detrended by removing the long-term trend of the area-averaged tropical Atlantic SST anomalies (30°N-30°S).

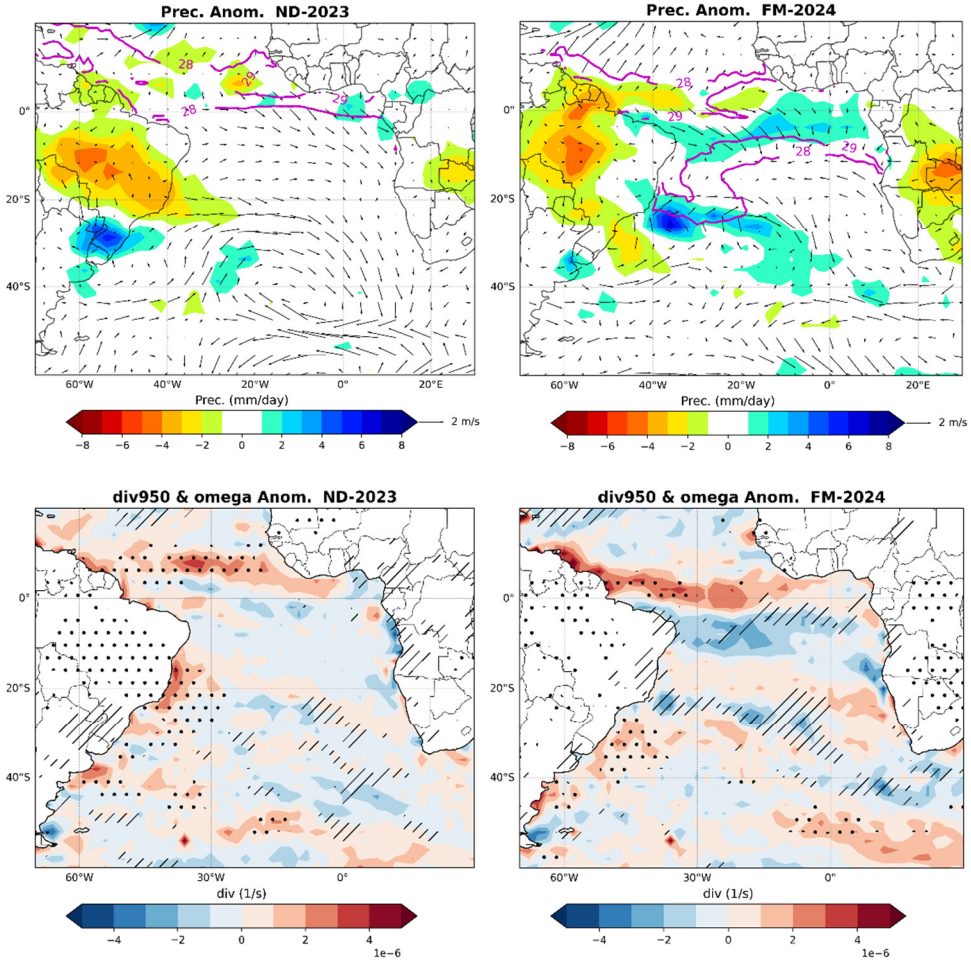


Figure 2. Left panels: Precipitation anomalies (shaded, mm/day, from GPCP) and surface wind anomalies (vectors, m/s, from ERA5) along with the monthly observed SST (magenta contour, °C, from OISST) for (top left) November-December 2023, (top right) February-March 2024. **Right panels**: 950 hPa wind divergence anomalies (shaded, 10^{-6}/s, from ERA5) and vertical velocity anomalies (dots for positive values > 0.01 Pa/s, hatching bars for negative values < -0.01 Pa/s, from ERA5) for (bottom left) November-December 2023, (bottom right) February-March 2024.

A GLOBAL FIRST-ORDER ESTIMATE OF THE IMPACT OF ANTHROPOGENIC HEAT ON URBAN AIR TEMPERATURE

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ABSTRACT

In cities, anthropogenic heat is a strong point source, causing higher air temperature and worsening heat-related health risks. While the impact of anthropogenic heat has been researched for decades, a method that can estimate the temperature rise due to an increase in anthropogenic heat flux for any city globally has yet to be proposed. In this study, we propose a global first-order estimate of the temperature rise by combining similarity theory and numerical simulations using WRF model. We found that under mean atmospheric conditions, the impact of anthropogenic heat on urban air temperature is mainly controlled by planetary boundary layer height, wind speed, and urban surface area. Moreover, anthropogenic heat behaves similarly to a passive scalar in general, possibly due to its short residence time in urban areas. Nevertheless, radiation, a key factor differentiating anthropogenic heat from a passive scalar, may have an important role in dispersing the extra heat, particularly at low wind speeds. Applying the model to the world's 626 cities with populations of at least one million, we found that urban air temperature rise due to anthropogenic heat is small under mean atmospheric conditions. However, given the right conditions that can delay the dissipation of anthropogenic heat to just two hours, about half of the cities may experience a temperature rise larger than 0.3 K in the 2050s.

Keywords: *anthropogenic heat, urban climate, WRF model, similarity theory.*

Acknowledgement: *This study was supported by JSPS KAKENHI Grant JP21H04573, JP21K14249, JP24K22982, and 25K00040.*

SIMULATING CITY SCALE HEAT AND RAINFALL CLIMATOLOGY IN GREATER KUALA LUMPUR USING HRLDAS LSP-DS AND REGCM4-NH

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ABSTRACT

Made up of 10 municipalities, centering around Kuala Lumpur, the Greater Kuala Lumpur (GKL) with an area around 2800 km^2 wide, is the most important location in Malaysia. This is because about 30% of Malaysia's population are concentrated here, and its economic activities contribute to more than 50% of the Malaysia GDP. While this area is relatively sheltered from enormous natural disasters that frequent other megacities in other parts of Southeast Asia, it is plagued with rain and heat related climate hazards. Thus, this study aims to study if the High Resolution Land Data Assimilation System (HRLDAS) Land-Surface-Physics-based downscaling (LSP-DS) approach could provide ultra-high-resolution heat-related climate information for GKL, and identify the capability of RegCM4-NH in simulating rainfall climatology at the scale applicable for GKL. In the same time, HRLDAS LSP-DS is also used to investigate how the GKL heat climatology would respond to the change of its land use land cover (LULC). All these are done in the hope that reliable high resolution city scale climate change information can be provided via these tools to relevant stakeholders in GKL, supplying them with reliable scientific information to aid their efforts in adapting and mitigating GKL away from the potential adverse impacts of climate change. Validated against all station-based observations available, results indicate that at a resolution of 500 m, HRLDAS LSP-DS could provide realistic added value to the temperature and relative humidity climatology in GKL simulated from 2000 – 2020. However, it tends to underestimate the GKL's temperature, especially its maximum temperature (~3°C cooler), and overestimated its sub-urban's relative humidity (~6% higher). Nevertheless, HRLDAS LSP-DS demonstrated its capability by being able to simulate the temperature cooler and relative humidity higher over GKL's highly urbanized area when changing its year 2018 LULC to that of 2000, a typical climate response to be expected when de-urbanizing the highly urbanized area. As for the RegCM4-NH simulation, results indicates that at 5 km resolution, the model could already correctly replicate the signature higher temperature, higher rainfall and lower relative humidity of a highly urbanized area in GKL. At 2 km resolution, the rainfall simulated by RegCM has a smaller bias when compared against the stations' observation. Thus, it is believed that while with some biases in persisted in their simulations, HRLDAS LSP-DS and RegCM4-NH, are capable of providing city scale climate information needed by GKL.

Keywords: *City Scale Climate, HRLDAS, RegCM, Greater Kuala Lumpur.*

Acknowledgement: *This research is funded by the Asia-Pacific Network for Global Change Research under the project Climatic hazard assessment to enhance resilience against climate extremes for Southeast Asian megacities (CARE for SEA megacities) (CRRP2023-08MY-Cruz).*

URBAN IMPACTS ON PRECIPITATION IN THE GREATER HO CHI MINH CITY METROPOLITAN AREA, VIETNAM

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ABSTRACT

Urban impacts on precipitation have been extensively studied in mid-latitude developed countries. However, despite the recent rapid urban development, such studies focusing on Southeast Asian cities remains limited. This study evaluated urban impacts on precipitation in GHCM by multi-case numerical simulations using the Weather Research and Forecasting model (WRF) for 217 precipitation events during the rainy seasons (May–October) from 2013 to 2022. We conducted each simulation with and without 2020 urban land use (URB and NO_URB), and under two different initial and boundary conditions to enhance the robustness of the results.

Results show that daily precipitation over the central urban area was up to 25% higher in URB than in NO_URB, with statistical significance ($p < 0.05$), especially between 15:00 and 23:00 LT. A unique characteristic, unlike in mid-latitude cities, is longer duration of urban-induced precipitation increase. URB also exhibited higher sensible heat flux, temperature, mixing layer height, and lower surface pressure than those of NO_URB. These thermodynamic changes caused greater CAPE and smaller CIN than those of NO_URB, indicating intensified atmospheric instability due to urbanization. In addition, horizontal water vapor convergence was stronger in URB than in NO_URB. This strong convergence was due not to sea breeze modification, but to urban-induced weakened boundary-layer winds associated with the monsoon. This represents another unique characteristic, distinct from those in many other cities. These results indicate that the urban area strengthened atmospheric instability and horizontal water vapor convergence, resulting in greater precipitation than the non-urban case.

Keywords:

Greater Ho Chi Minh City Metropolitan Area, urbanization, precipitation, atmospheric instability, water vapor convergence

Acknowledgement:

This research was supported by JSPS KAKENHI Grant Number JP24K07130.

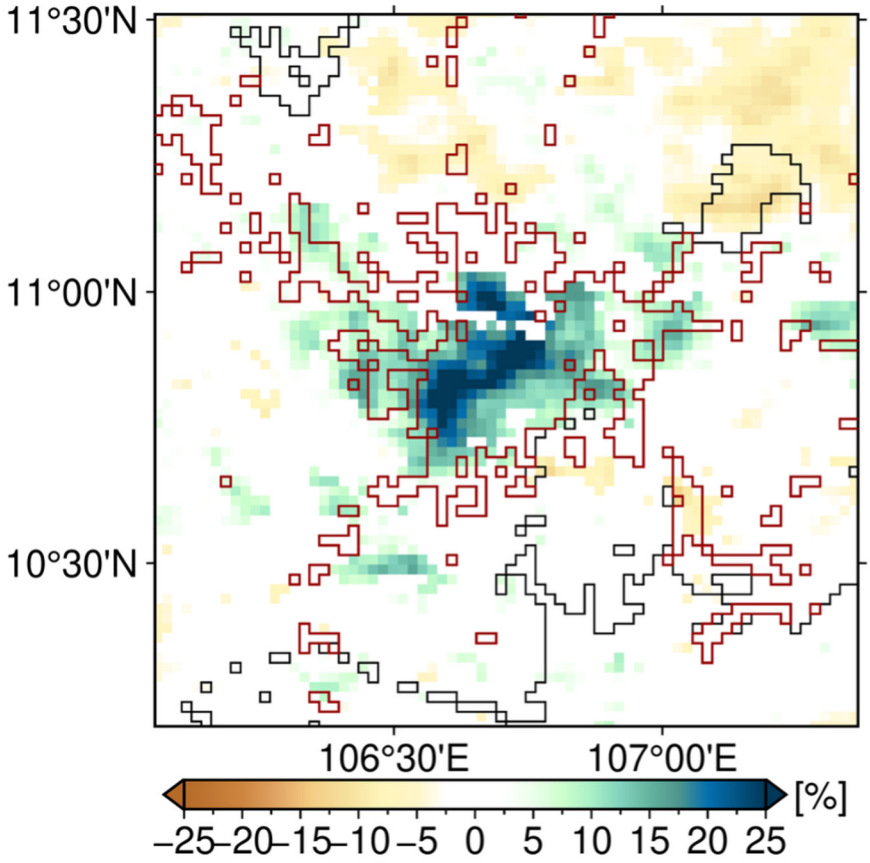


Figure 1 Percentage difference of the URB from the NOURB ((URB – NOURB) / NOURB) based on the average (composite) of the precipitation results from 434 numerical simulations. The shaded areas in the figure are statistically significant at $p < 0.05$. The black lines indicate coastlines, and the red lines indicate urban areas.

UNVEILING THE FIRST TWO YEARS ATMOSPHERIC BULK DEPOSITION OF MERCURY IN CENTRAL URBAN MEGACITY SOUTHERN VIETNAM: FLUXES, INFLUENCING FACTORS AND WASHOUT EFFECT

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ABSTRACT

Atmospheric deposition is a critical process in the global mercury (Hg) cycle, particularly in tropical regions with intense rainfall. However, observational data of Hg deposition remains scarce, particularly across the tropical Southeast Asia region, limiting our understanding of its regional variability and controlling factors. This study presents two years (April 2023–March 2025) of bulk Hg deposition (wet + dry) measurements in Ho Chi Minh City (HCMC), a tropical urban megacity in southern Vietnam. Weekly bulk rainfall samples were collected and the THg concentration ranged from 1.87 to 47.1 ng L^{-1}, with the volume-weighted mean (VWM) THg concentration of 14.5 ng L^{-1}. The annual Hg deposition flux was estimated to be 27.6 μg m^{-2} yr^{-1}, indicating substantial atmospheric Hg input to HCMC. Seasonal variations were evident, with significantly higher THg concentrations observed during the dry season (December–April). In contrast, deposition fluxes peaked during the wet season (May–November), driven by enhanced rainfall amount despite lower concentrations. Principal component analysis (PCA) revealed that THg in rainwater originates from multiple sources, dominated by anthropogenic combustion, vehicular emissions, and influenced by meteorological conditions. Event-based sampling allowed detailed investigation of atmospheric scavenging processes. A marked decline in THg concentrations within the first 5-10 minutes of rainfall demonstrated the importance of below-cloud scavenging (i.e. washout effect). This phase was typically followed by a relatively stable concentration period, during which differences among events suggested varying in-cloud scavenging efficiencies. The estimated rainfall depth required for full washout efficiency was 6–7 mm. Our study provides critical insights for validating atmospheric Hg models and supports the development of Hg emission mitigation strategies in rapidly urbanizing tropical regions.

Keywords: *Mercury, bulk deposition, PCA, washout effect, source apportionment.*

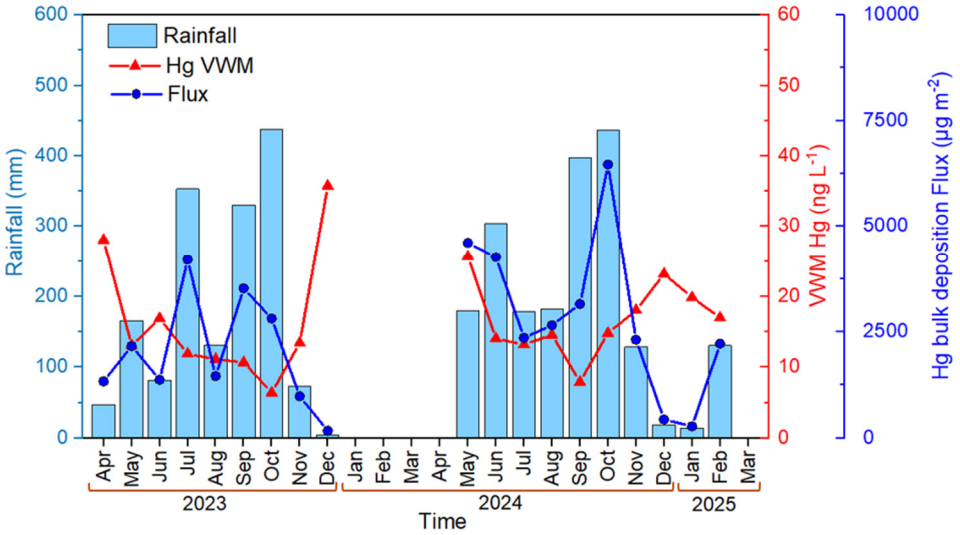


Figure 1. Seasonal variation of THg concentrations, deposition, and rainfall in Ho Chi Minh City during the study period

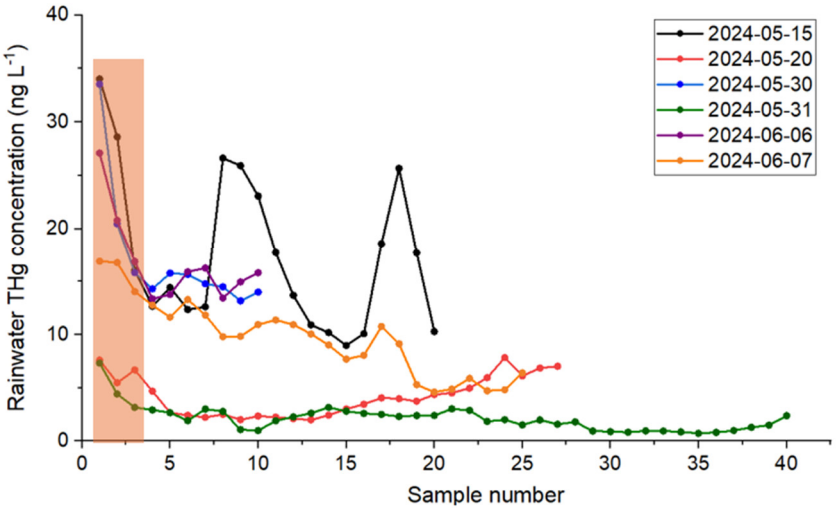


Figure 2. Evolution of THg during rainfall events, illustrating the influence of the washout effect

HOSPITAL-BASED STUDY ON HEALTH EFFECTS OF AMBIENT $PM_{2.5}$ EXPOSURE IN URBAN AREAS OF HO CHI MINH CITY, 2019–2021

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ABSTRACT

Ambient fine particulate matter ($PM_{2.5}$) remains a pressing environmental health challenge in Ho Chi Minh City, Vietnam, where concentrations frequently exceed the national air quality guidelines. This study investigated the short-term effects of $PM_{2.5}$ exposure on cardiorespiratory morbidity and mortality using a hospital-based, retrospective case-crossover design. Both unidirectional and symmetric bidirectional referent strategies were employed to improve analytical robustness. From 2019 to 2021, $PM_{2.5}$ concentrations were continuously monitored across four urban districts with calibrated low-cost sensors, while health outcome data—comprising emergency visits, hospital admissions, and mortality from cardiorespiratory diseases—were retrieved from three hospitals in the study area. Each case was matched with four referent days according to a predefined temporal selection scheme. Associations between $PM_{2.5}$ exposure and health risks were quantified using logistic regression models without meteorological adjustment and generalized linear mixed models with adjustment for meteorological covariates. Among 2,457 cardiorespiratory cases, the most pronounced effects were observed at lag0, where a 10 $\mu g/m^3$ increase in $PM_{2.5}$ corresponded to a 6% elevation in risk (odds ratio: 1.06; 95% confidence interval: 1.01–1.10). Stratified analyses revealed age- and sex-specific susceptibility, with heightened cardiovascular risks in individuals under 35 years, increased respiratory vulnerability among women, and greater cardiovascular sensitivity in men. These findings provide robust epidemiological evidence of the adverse health effects of $PM_{2.5}$ in rapidly urbanizing environments and underscore the urgent need for strengthened air quality management policies in Vietnam.

Keywords: *air pollution; cardiovascular; respiratory; case-crossover; health effect.*

APPLICATION OF MICROBIAL TECHNOLOGY FOR MITIGATING AIR POLLUTION AND ODOR IN POULTRY PRODUCTION FACILITIES

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ABSTRACT

This study aimed to evaluate the effectiveness of applying biotechnologies in odor control and air pollution mitigation in poultry farms, thereby proposing suitable environmental management solutions for chicken production systems. A pilot experiment was designed with three treatments: GC1, the application of microbial products to supplement bedding and treat solid waste; GC2, the combined use of microbial products in bedding and odor-control spraying; and a control treatment (ĐC): Use the product that the owner of the poultry farming facility is applying. Concentrations of NH_3, H_2S, CH_4, and VOCs were monitored both inside and outside the poultry houses at 7, 14, 21, and 28 days after treatment and before treatment. Results demonstrated that microbial-based odor control significantly improved air quality, particularly with reductions in NH_3 and H_2S concentrations (over 60% reduction inside and more than 40% outside). The highest efficiency was observed in GC2 for H_2S inside the poultry house, reaching up to 75%. However, H_2S reduction outside the house remained insufficient, suggesting the need for odor-control spraying at ventilation points. Methane (CH_4) reduction was moderate (~50% inside and outside), while VOC reduction was the lowest (10–30%). Overall, odor mitigation was consistently more effective inside than outside the poultry houses. Among treatments, GC2 exhibited the greatest overall efficiency, highlighting the potential of combining microbial technology in bedding with odor-control spraying. These findings suggest that the routine application of microbial products as bio-bedding and odor-control agents could not only reduce odor emissions and pathogen spread but also improve environmental quality and contribute to the long-term health and well-being of farmers, thereby supporting sustainable and biosecure poultry farming.

Keywords: *Poultry house; Microbial Technology; Odor pollution; Odor treatment.*

ATMOSPHERIC SIZE-RESOLVED TRACE ELEMENTS IN URBAN AND INDUSTRIAL AREAS IN SOUTHERN VIETNAM: POTENTIAL SOURCE, RESPIRATORY DEPOSITION AND HEALTH RISK

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ABSTRACT

Size-fractionated particulate matter (PM) analysis plays an important role in air pollution research because of the health impacts of different particle sizes. To characterize the mass concentration, size distribution, temporal distribution, and sources of 20 elements (Mg, Al, K, Ca, Fe, Ti, V, Cr, Mn, Co, Ni, Cu, Zn, As, Se, Sr, Cd, Sb, Ba, and Pb) in $PM_{<0.5}$, $PM_{0.5-1}$, $PM_{1-2.5}$, $PM_{2.5-10}$, and $PM_{>10}$, a long-term monitoring was conducted at an urban and an industrial site in Southern Vietnam. Size-fractionated 120 samples were collected monthly from September 2023 to August 2024. A 5-day sampling scheme was employed using a nanosampler, and elements were analyzed using inductively coupled plasma-mass spectrometry (ICP-MS). A comparative analysis with other studies indicates that the levels observed in urban and industrial regions of Vietnam are 1.42 to 75 times lower than those reported in China, while being 1.17 to 4.02 times higher than levels recorded in European countries like Spain and Italy. Seasonal variation was evident, with metal concentrations during the dry season being 1.5 to 2.8 times higher than in the wet season across all particle size ranges, especially pronounced in the fine particle fraction PM1. At both sites, crustal elements like Al, Fe, Sr, Ti, and Ba exhibited more than 70% of their total mass in the coarse particulate matter fraction ($PM_{>2.5}$). In contrast, anthropogenic elements such as Pb, Zn, As, Cd, Sb, and Se showed a significantly higher contribution in the accumulation mode, with over 66% of their mass found in $PM_{<2.5}$. Additionally, elements such as Ca, Cr, Mg, Mn, Co, and Ni displayed broader size distributions, ranging from 14% (Ni) to 36% (Mg), with peaks observed in $PM_{2.5-10}$, indicating their dispersion across multiple size fractions. Deposition modeling showed that crustal elements such as Ti, Al, and Fe were predominantly retained in the head region (up to 77%) due to their larger aerodynamic sizes. In contrast, anthropogenic elements like Sb, Cd, and V exhibited higher deposition in the tracheobronchial and alveolar regions (7-13%), indicating greater potential for deep lung penetration and associated health risks. Children in the industrial area faced significantly higher health risks, with HI and TCR values (1.52 and 2.45×10^{-3}, respectively) greatly exceeding those in the urban area (0.83 and 8.83×10^{-4}), indicating both non-carcinogenic and carcinogenic risks above safe thresholds. Pb, Ni, and Cr were the major contributors to cancer risk, with Pb showing the highest TCR in children, emphasizing the urgent need for targeted pollution control in industrial environments to protect vulnerable populations. This study offers valuable insights into the distribution and temporal patterns of metals across various particle sizes, as well as helping to bridge knowledge gaps and enhance the current understanding of air pollution in Southeast Asia.

Keywords: *Size-fractionated, elements, Southern Vietnam, respiratory deposition, health risk assessment.*

REVEALING THE DISCREPANCY IN POTENTIAL DRIVING FACTORS OF PARTICULATE-BOUND MERCURY BETWEEN URBAN AND SUBURBAN SITES IN A SOUTHEAST ASIAN MEGACITY USING GENERALIZED ADDITIVE MODEL

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ABSTRACT

Particulate-bound mercury (PBM) plays a critical role in atmospheric mercury (Hg) cycling, yet its complex spatiotemporal variability and potential driving factors remain insufficiently understood, particularly in the Southeast Asia (SEA) region. This study reported year-round (May 2022 to April 2023) data of PBM at an urban (Nguyen Van Cu: 59.81 ± 29.15 pg m^{-3}) and a suburban site (Can Gio: 26.4 ± 9.59 pg m^{-3}) in southern Vietnam. Distinct seasonal trends were observed at both sites, with elevated PBM concentrations in the dry season (November-February), likely driven by changes in source origin and transport paths of air masses. Lower PBM concentrations in the wet season (July-September) may result from enhanced removal by wet deposition, whereas limited rainfall in the dry season reduces this effect, leading to higher concentrations. We employed Generalized Additive Models (GAM), which effectively captured nonlinear relationships between PBM and meteorological-chemical covariates. GAMs explained 87.7% of PBM variance in the urban area and 41.6% in the suburban area, indicating better model performance in urban vs suburban areas. In the urban area, metals (i.e. Cr, Sr, Pb, and V) were the dominant contributors (36.7%), suggesting influence from industrial and traffic-related sources. In contrast, PBM at the suburban site was mainly modulated by temperature (60.8%), Zn (21.3%), and planetary boundary layer height (17.9%), pointing to the significance of atmospheric processes over local emissions. Our findings highlight the utility of GAM in resolving complex PBM-environment interactions and indicate its potential for advancing source attribution and informing targeted mercury mitigation strategies.

Keywords: *Particulate-bound mercury (PBM), Generalized Additive Models (GAM), Southeast Asia, Source attribution.*

Acknowledgement: *This research is funded by University of Science, VNU-HCM under grant number T2024-121.*

METAL CONTENTS IN CASSIA FISTULA LEAVES: THE FIRST PRELIMINARY STUDY FROM A SOUTHERN VIETNAM MEGACITY

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ABSTRACT

Plant bioaccumulation is a critical process for understanding the pathways through which heavy metals may impact human health. However, research in this area remains limited in tropical regions, particularly within megacities such as Ho Chi Minh City (HCMC). This study assessed the levels and spatial distribution of 10 metals (Al, Cr, Fe, Ni, Cu, Zn, As, Cd, Hg, Pb) in the deciduous species Golden Shower Tree (Cassia fistula). Leaf samples were collected along seven routes in both urban and suburban areas of HCMC to examine the influence of anthropogenic activities and plant physiology on metal accumulation. In mature leaves, metal concentrations follow the order Fe > Al > Cu > Zn > Ni > Pb > Cr > Cd > As > Hg, with Fe showing the highest mean value (84.30 ± 17.94 mg kg^{-1}) and Hg the lowest (0.028 ± 0.008 mg kg^{-1}). Temporal trends across leaf age reveal two distinct patterns: Group 1 elements (Fe, Al, Cd, Cr, As, Pb, Hg) exhibit increasing accumulation with leaf aging, whereas Group 2 elements (Zn, Cu, Ni) reach peak levels in young or mature leaves before declining at the later stage. Hg concentrations rise from young leaves (0.006 ± 0.003 mg kg^{-1}) to mature ones (0.028 ± 0.008 mg kg^{-1}), reaching the highest levels in old leaves (0.038 ± 0.003 mg kg^{-1}). Spatial distribution indicates elevated Hg concentrations in residential areas (e.g., Trung Son and Nam Long), while sites with heavy traffic (e.g., Hoang Sa Street, Ly Thai To Street) exhibit higher levels of Pb, Zn, and Cr. These findings provide a foundation for future studies on metal bioaccumulation in urban plants in HCMC and confirm Cassia fistula as a promising bioindicator species.

Keywords: *Cassia fistula, Mercury, Metals, Residential areas, Ho Chi Minh City.*

Acknowledgement: *We thank the National Foundation for Science and Technology Development (NAFOSTED) for financial support under Grant105.08-2024.13.*

NUMERICAL HAIL FORECAST IN NORTHWEST VIETNAM: A CASE STUDY

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ABSTRACT

Hail is a severe weather phenomenon that occurs with relatively high frequency in Northwest Vietnam. In recent years, hail-related damages have shown an increasing trend, underscoring the necessity for further investigation. This study examines hail size forecasting for the hailstorm event of 21 March 2021 affecting Lai Chau, Dien Bien, and Son La provinces, based on simulations with the Weather Research and Forecasting (WRF) model. The hail forecast product of the model consists of three storm surrogates and three diagnostics for predicting hailstone size. A comparison with the Maximum Estimated Size of Hail (MESH), derived from weather radar data, shows that the model's forecast variables are able to capture the spatial occurrence of hail events. However, the forecast skill exhibits substantial differences among microphysics (MP) schemes when evaluating the large-hail category (hailstone size >25 mm), particularly for the storm surrogates. The findings indicate that variations in the particle size distribution (PSD) of hydrometeors across MP schemes result in significant differences in the forecasted hail size. Moreover, beyond altering cloud-phase characteristics, the MP schemes also feed back on the dynamical intensity of thunderstorms, leading to considerable differences in forecasts of large hail-producing storms.

Keywords: *Hail, WRF, Microphysic*

IDENTIFYING THE UNIQUE CHARACTERISTICS OF TROPICAL STORM KETSANA (2009) RELATIVE TO OTHER LANDFALLING TROPICAL CYCLONES OVER LUZON

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ABSTRACT

On September 26, 2009, Tropical Storm (TS) Ketsana made landfall near Baler, Luzon, in the Philippines and maintained a westward track as it traversed through the central regions of Luzon. The distribution of rainfall had been disproportionate, such that areas south and far from the tropical cyclone (TC) track had experienced the greatest rainfall. Widespread flooding occurred in the affected provinces, devastating 4.06 million people and destroying billions of pesos worth of infrastructure and agriculture. The significance of the TC event prompted the researcher to determine what makes this TC unique compared to previous landfalling TCs in the same region. TS Ketsana (2009) ranks among the weakest Luzon-landfalling TCs during the September-November (SON) season, recording a 10-minute sustained wind speed of only 40 knots, which places it below the 10th percentile. Analysis showed that its intensity metrics, including 30-kt TC radius, were below average compared to other landfalling TCs in Luzon. It was found that TS Ketsana maintained its intensity even after landfall, whereas the composite of the SON landfalling TCs over Luzon showed a declining trend after landfall. An analysis of the translational speed of TS Ketsana showed greater values than those of the composite of the SON landfalling TCs over Luzon. Moreover, the accumulated cyclone energy (ACE) of TS Ketsana was nearly half the average SON ACE of landfalling TCs in Luzon, placing it near the 20th percentile. Further analysis of the environmental conditions where TS Ketsana formed, intensified, and made landfall is necessary, since its intrinsic characteristics did not exhibit extreme values. Examination of the Madden-Julian Oscillation (MJO) phase space diagram revealed that TS Ketsana occurred when the MJO was active and transitioning over the Maritime Continent and western North Pacific. This could have provided additional moisture and contributed to the heavy rainfall during this event

Keywords: *TS Ketsana, Ondoy, Philippines, Extreme Rainfall, Flood*

Acknowledgement: *Martein Angela dela Cruz was supported by the scholarship and financial aid program of the Department of Science and Technology-Science Education Institute and the Office of Admission and Aid of the Ateneo de Manila University. L.M.P. Olaguera and J.R.T. Villarin were supported by the High-definition Clean Energy, Climate, and Weather Forecasts for the Philippines project of the Manila Observatory.*

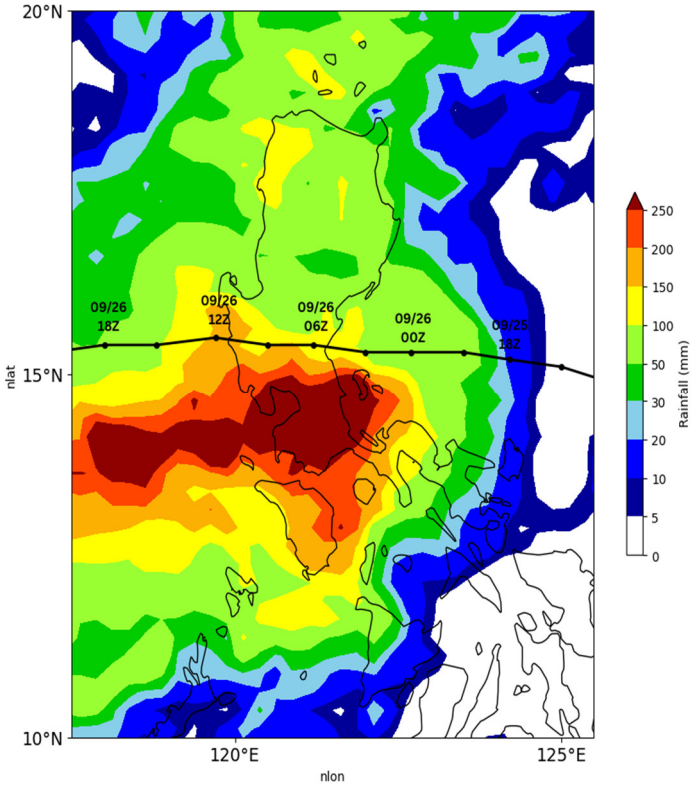


Figure 1. Spatial distribution of 24-hour accumulated rainfall associated with TS Ketsana (2009) from 12 hours before landfall to 12 hours after landfall (−12 LF to +12 LF), derived from the TRMM 3B42 3-hourly dataset. Rainfall intensity is shaded (mm) with warm colors indicating heavier precipitation. The cyclone track is overlaid in black with 6-hourly positions marked by dots from the IBTrACS dataset using 3-hourly data.

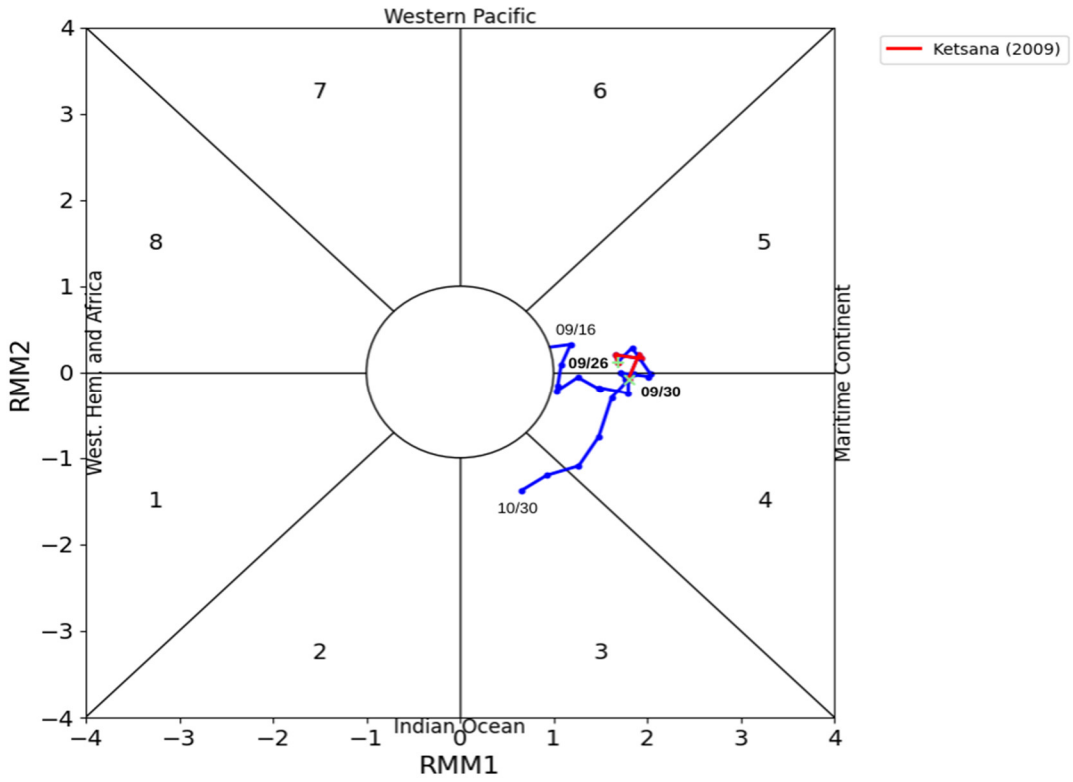


Figure 2. Phase diagram of the Madden-Julian Oscillation (MJO) from 10 days prior to the genesis of TS Ketsana until 10 days after its dissipation. The period corresponding to TS Ketsana's lifetime is highlighted in red.

HEATWAVES' VARIATION IN SOUTHEAST ASIA IN THE PERIOD OF 1983-2014

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ABSTRACT

The objective of this study is to investigate several characteristics of heatwaves over the Southeast Asia in the historical period of 32 years (1983-2014). To do this, we apply the data from observation (CHIRTS) and modelling taken from 5 models: CanESM5, CNRM-ESM2-1, NóEM2-MM, EC-Earth3-Veg, MIROC-ESM2L and MPI-ESM1-2-HR. The initial results show that there are some differences in each of characteristics of heatwave between observation and modeling and there was a significant increase in the characteristics when using both kind of data sources.

Keywords: *heatwave, Southeast Asia, observed data, modelled data*

SPATIOTEMPORAL TRENDS IN HOT DAYS IN THE NORTH CENTRAL AND CENTRAL COASTAL REGIONS OF VIETNAM (2010-2024).

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ABSTRACT

Heat waves are one of the most critical climate extremes, exerting substantial impacts on public health, agricultural production, and socio-economic development in Vietnam. The North Central and Central Coastal regions are particularly vulnerable due to their complex topography and severe climatic conditions. Using meteorological observation data from 2010–2024, this study analyzes the spatial distribution and temporal trends of hot days. The results show a significant upward increase in the number of hot days in this region, with Ha Tinh Province experiencing the largest increase. These findings provide a critical scientific basis for developing climate change adaptation strategies and enhancing heat risk management in Central Vietnam.

Keywords: *hot days, trend, impact, climate change.*

Acknowledgements

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FUTURE WARMING EFFECTS ON EXTREME RAINFALL IN METRO MANILA USING A PSEUDO GLOBAL WARMING APPROACH

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ABSTRACT

Tropical Cyclone (TC) Ketsana, locally known in the Philippines as "Ondoy", caused extreme rainfall that led to widespread flooding in Metro Manila, resulting in numerous casualties and significant damages. In this study, we determine the effects of future warming on the extreme rainfall associated with Ketsana using the Advanced Research Weather Research and Forecasting (WRF-ARW, Skamarock et al, 2019) model and a pseudo-global warming (PGW) approach. Simulations were performed for September 24-27, 2009 using three nested domains with resolutions of 25 km, 5 km and 1 km. The innermost domain was centered on Metro Manila. A control (CTL) experiment with physics schemes based on Cruz and Narisma (2016) and boundary forcing from NCEP FNL (Final) Operational Global Analysis (available from https://rda.ucar.edu/datasets/d083002) was first simulated. Then, PGW experiments were performed with PGW deltas added to the CTL initial and lateral boundary conditions. The PGW deltas were derived from a set of CORDEX Southeast Asia downscaled CMIP6 models, specifically, by getting the difference between the SSP 3-7.0 future period (2041-206) and the baseline period (1995-2014). Results of the CTL simulation showed that the model underestimated the 24-hr rainfall amount over Metro Manila, which may be due to the northerly TC track of the model relative to the Joint Typhoon Warning Center (JTWC) best track data. In addition, analysis of the PGW experiments reveal that rainfall intensity and spatial distribution and TC track are sensitive to PGW deltas being added. This suggests that a thorough assessment of PGW deltas and corresponding effects is necessary for improved assessment of extreme events with the PGW approach.

Keywords: *Extreme Rainfall, Tropical Cyclones, WRF ARW, Pseudo Global Warming, CORDEX SEA.*

Acknowledgement:

This is to acknowledge the Climatic hazard Assessment to enhance Resilience against climate Extremes for Southeast Asian megacities (CARE for SEA megacities) CRRP2023-08MY-Cruz funded by Asia Pacific Network for Global Change Research (APN) and the High-definition Clean Energy, Climate and Weather Forecasts for the Philippines (ECW) project.

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CHANGES IN TEMPERATURE AND RAINFALL EXTREMES IN VIETNAM UNDER PROGRESSIVE GLOBAL WARMING LEVELS FROM 1.5°C TO 4°C

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ABSTRACT

This study analyzes projected climate extremes in Vietnam using 33 statistically downscaled CMIP6 models (CMIP6-VN database) across global warming levels (GWLs) from 1.5°C to 4°C, revealing significant regional variations in temperature and precipitation patterns. Temperature analyses demonstrate substantial warming trends compared to the baseline period 1995–2014: maximum temperatures are projected to increase by 1.5°C at 2°C GWL and 2.2°C at 3°C GWL on average at the national scale, with northern regions experiencing more pronounced effects. The annual percentage of warm days (TX90p) could dramatically increase from 25.5 % at 2°C GWL to 57.5% at 4°C GWL. Southern regions, particularly the Mekong Delta and Southeast, face the most severe heat impacts. At 4°C GWL, these areas may experience many hot days (daily maximum temperature TX ≥ 35ºC), potentially reaching 220 days per year. Precipitation projections show high uncertainty, due to large inter-model spread, with moderate intensity increases ranging from 3.3% to 7.8% across GWLs. The North Central Region is expected to experience the largest precipitation increases. Notably, the annual maximum number of consecutive dry days (CDD) is projected to increase across regions, with the southern areas experiencing the longest durations (up to 86 days) and the most substantial increases (up to 11.6 days at 4°C GWL) among all sub-climatic regions. The study emphasizes the urgent need for flexible, targeted adaptation strategies to mitigate potential impacts on health, agriculture, water resources, and economic productivity, highlighting the critical importance of reducing greenhouse gas emissions.

Keywords: *Global warming level; Vietnam; temperature extremes; precipitation extremes; climate change*

Acknowledgement: *This study is supported by the GEMMES Vietnam project Phase 2, launched by the French Development Agency (AFD) through Facility 2050, and the Vietnam National Foundation for Science and Technology Development (NAFOSTED) under Grant 105.06-2021.14.*

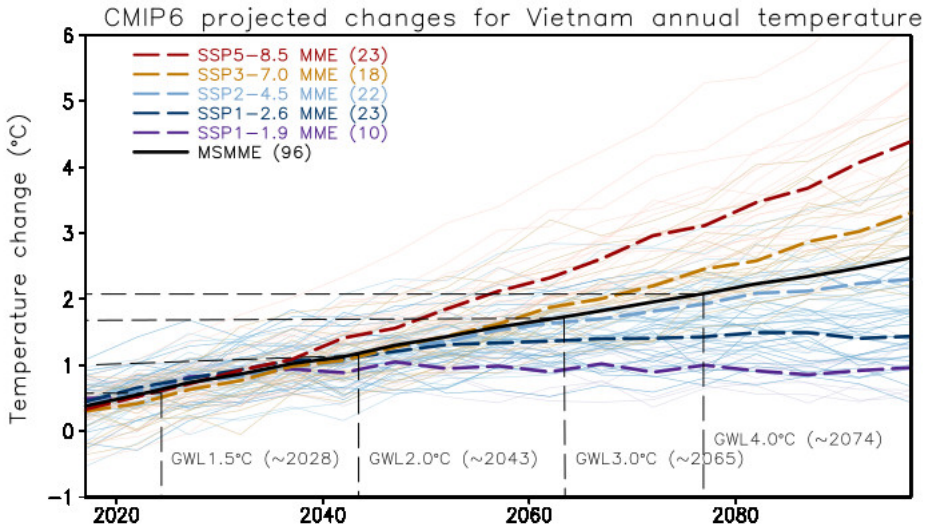


Figure 1. Projected mean near-surface temperature changes in Vietnam relative to the 1995–2014 baseline under scenarios SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.5 for 2015–2099. Thin solid lines show individual model projections, bold dashed lines indicate the MME mean for each scenario for 5-year moving averages, and the thick black line represents the MSMME mean. The number of model simulations per scenario is given in brackets. Dashed black lines mark the timing when the MSMME global temperature crosses each GWL relative to pre-industrial levels, with corresponding Vietnam warming levels relative to the baseline, according to the MSMME of CMIP6 simulations.

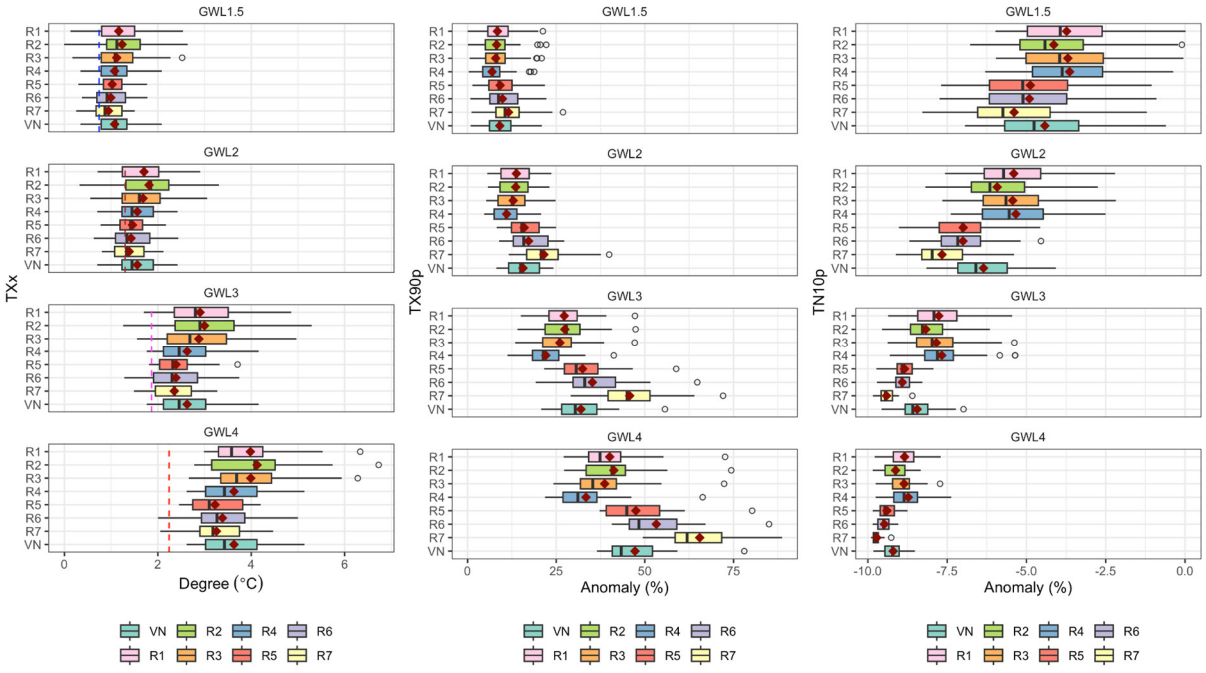


Figure 2. Projected changes of TXx (left), TX90p (middle), and TN10p (right) over Vietnam and its seven sub-climatic regions, relative to the 1995–2014 baseline period, under GWLs 1.5°C, 2°C, 3°C and 4°C. Boxplots visualize the distribution of changes projected by the CMIP6-VN models, with boxes presenting the interquartile range (IQR), vertical bands showing the median, and whiskers extending to the most extreme data points within 1.5 times the IQR from the boxes. Any outlier models beyond 3 times the IQR are shown as individual white dots. The multi-model ensemble (MME) mean change is highlighted by red dots. For TXx plots, vertical dashed lines denote the warming levels over Vietnam relative to the baseline period, corresponding to GWLs of 1.5°C (blue), 2°C (brown), 3°C (pink), and 4°C (red).

FIRST INSIGHTS INTO COMPOUND DROUGHT–HEATWAVE EVENTS IN VIETNAM: HISTORICAL CHARACTERISTICS AND ENSO LINKAGES

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ABSTRACT

Droughts and heatwaves both are natural extreme climate events occurring in most parts of the world and resulted in a lot of negative impacts, but the compound of them may lead to much more serious damages. In order to have first insights into compound drought–heatwave events in Vietnam, across seven climatic sub-regions (R1–R7), we examine the drought and heatwave compound (DHC), some of their characteristics and the relationships with large-scale drivers during 1981–2016, based on the data from CHIRPS and CHIRTS-daily, with the calculation up on SPEI (for drought) and Tx (for heatwave). The analysis reveals a marked intensification of DHC characteristics since the mid-1990s, along with a shift in regional hotspots. The results show that DHC have become more frequent and prolonged, particularly in central and northern regions (R1-R4), with frequency (FRQ) values exceeding 4.0 events/year and max duration (Dx) surpassing 10 days in many locations. Severity has also increased substantially, with max severity (Svx) reaching above 22°C in some areas during the 2013-2016 period. Notably, Southern regions (R6-R7) exhibit fewer DHC events but longer durations during the early dry season (Jan-March), indicating regionally distinct DHC regimes. Intra-annual analyses further suggest that DHC events are clustering in critical months, such as May-June in the North and January-March in the South, potentially compounding impacts on agriculture and water resources. These findings point to an evolving pattern of compound drought-heatwave hazards under climate variability and change, call for efforts on assessing the impact of compound extremes, predicting them, improving early warning capabilities, since then contributing to mitigation and adaptation strategies of compound extreme events.

NOVEL AND DISAPPEARING CLIMATES UNDER DIFFERENT GLOBAL WARMING LEVELS

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ABSTRACT

The research illustrates the global distribution of climate novelty and climate disappearance under various emissions scenarios: SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5, based on temperature (tas), precipitation (pr), and their combined effects (both), under different global warming levesl (GWLs). Results indicate that a proportion of the globe will experience novel climates, particularly in both and tas patterns (22 - 35% of land area), whereas precipitation-related novelty almost does not affect the land surface. Similarly, some areas are projected to lose their historical climatic analogs, with temperature and both-driven disappearance (25 - 33%). These spatially explicit patterns show the magnitude of projected climate regime shifts, emphasizing the heightened risks of climatic instability and challenges for ecosystems and human adaptation in the future.

Keywords: *climate analog, novel climate, disappearing climate, global emissions scenarios, global warming level*

TWO CENTURIES OF REGIONAL CLIMATE EXTREMES: INSIGHTS VIA MULTI-SCALE DYNAMICAL DOWNSCALING

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ABSTRACT

The NOAA-CIRES-DOE 20th-Century Reanalysis Version 3 (20CRv3) provides a century-long record of global atmospheric variability, yet its coarse resolution constraints its applicability for regional hazard assessment. Here we introduce a dynamical downscaling framework that exploits 20CRv3 as boundary forcing for the WRF model, designed to enhance the representation of extremes at regional scales. A continuous 200-year integration at 25-km resolution establishes a dynamically consistent regional climate backbone over Southeast Asia (SEA), while nested convection-permitting 4-km domains are employed to further downscale selected extreme events. Collectively, these simulations yield two complementary datasets: a long-term regional climate archive and high-resolution event reconstructions. This strategy is applied to analyse tropical cyclones impacting Southeast Asia (SEA), a hazard prone to misrepresentation owing to the insufficient resolve of vertical dynamics and weak representation of vorticity. The nested simulations explicitly capture tropical cyclone structure, rainfall distribution, and landfall intensity, processes that are underrepresented in 20CRv3 alone. By applying this framework, we demonstrate how dynamical downscaling of a long-term reanalysis can yield added value in advancing historical perspectives on tropical cyclone risks. The resulting multi-scale dataset offers a novel resource for historical climate assessment and warrants further application in regional hazard analyses.

Keywords: *Reanalysis (20CRv3), Dynamical Downscaling, Historical climate, Southeast Asia, Tropical cyclones*

A HYBRID APPROACH FOR SEASONAL RAINFALL FORECASTING ACROSS VIETNAM USING CONVOLUTIONAL NEURAL NETWORKS AND DYNAMICAL DOWNSCALING

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ABSTRACT

Forecasting seasonal rainfall is challenging but has important socio-economic implications. In Vietnam, despite encouraging results from previous studies, practical application remains difficult. This is because forecast accuracy remains low when studies only evaluate and use the products of global or regional models, or correct forecasts using simplistic traditional statistical methods. Modern statistical models using artificial intelligence show great potential to improve seasonal rainfall forecasting. This study aims to build a highly accurate forecasting tool for rainfall from May to October in seven climatic regions of Vietnam using a hybrid approach that combines convolutional neural networks (CNNs) and the dynamic downscaling product of the climate Weather Research and Forecasting model (clWRF). Three CNN models were developed for lead times of 1, 3, and 5 months. To train the models, the study used monthly data from 1983 to 2011 (29 years), including 5 meteorological variables from clWRF forecasts and total monthly rainfall observations. The forecasts from the CNN models were then evaluated against observations using the dataset for 2012-2020 (9 years). The results showed that the distribution of rainfall forecasted using CNN models closely agreed with the observations. In addition, the performance of the CNN models was supported by low Relative Mean Absolute Error (mostly below 30% for the regional average and 50% at each grid point), along with reasonably high spatial correlations with observed patterns (0.4-0.8). These results outperforme the forecasts produced by the clWRF model, with Added Value mostly positive, ranging from 0.2 to 0.8. This study contributes to enhancing the practical application of seasonal rainfall forecast information.

Keywords: *Seasonal rainfall forecast; CNN, Vietnam*

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