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IPU Science for Peace Parliamentary Meeting

Water security and insecurity: Rebuilding peaceful coexistence with science
September 11-13, 2023

Planet of water: Earth Observation Programmes as a tool to monitor water

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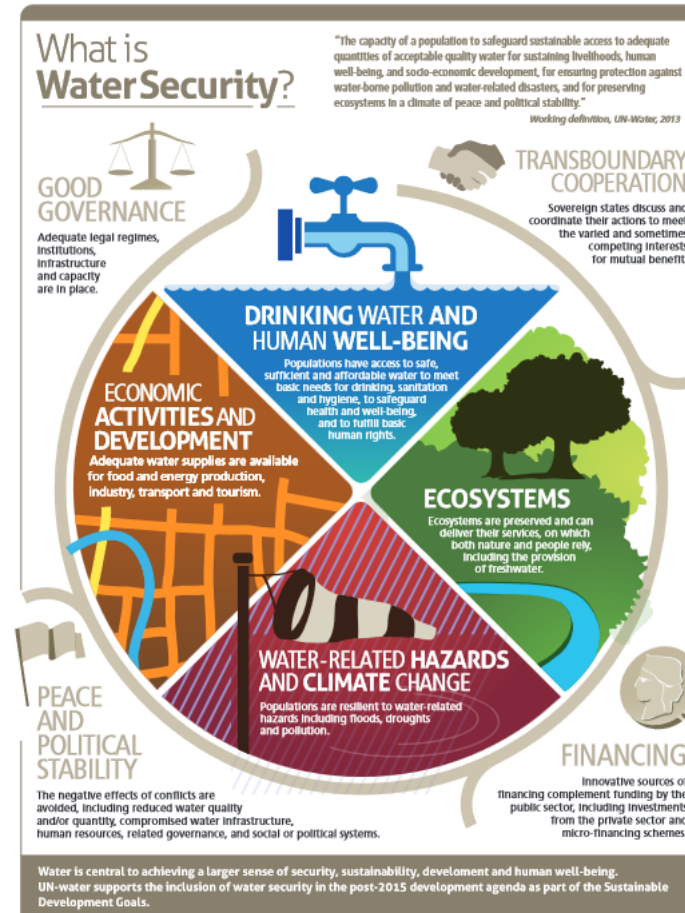


What is water security ?

UN-Water definition describes **water security** as:

The capacity of a population to safeguard sustainable access to water of ***adequate quantities*** of and ***acceptable quality*** for

- sustaining livelihoods, human well-being, and socio-economic development,
- ensuring protection against water-borne pollution and water-related disasters, and for
- preserving ecosystems in a climate of peace and political stability'



Water insecurity is often the main cause of food insecurity and in some cases, a cause of transboundary issues

Threats to Water Security

- Climate change: extreme events, drought, floods, precipitation patterns, sea level rise
- Population growth: increase in water demand
- Land use change: industrial expansion, agricultural practices, deforestation, leading to stress on hydrologic systems, overuse of water, and pollution
- Water inequity between social communities, unregulated upstream use, inadequate infrastructure

Why we need data for maintaining Water Security ?

Planning: Data and models support the scoping and evaluation of options, risk assessment and the assessment of benefits of infrastructure development under different management scenarios. Planning is needed for risk reduction, market development, effective management of water resources, and reducing the impacts of short-term extreme events and long-term environmental trends.

Evaluation: Information enables governments to assess proposals for increasing water security and to select those worth funding.

Management: Information supporting operational decisions is needed on different time scales by basin managers to ensure that quality water continues to be available under every threat and contingency.

Monitoring: Data for analysis to determine if government policies and regulations are achieving the goals set for water security if specific controls need to be put in place.

Enforcement: Data for use by governments, insurance companies and others to evaluate where regulations and standards have been violated and where penalties should be levied or claims need to be denied.

What data we need that could be provided by EO ?

- **Precipitation:** to determine drought and flood potential,
- **Surface water extent:** to monitor water networks, flood and drought
- **Soil moisture :** to determine the water in the soil for plant growth,
- **Ground water:** to determine location of groundwater aquifers and their rates of recharge or depletion,
- **Reservoir and lake storages:** to calculate storage volumes-availability for irrigation, hydropower,
- **Water quality:** suspended matters, pollution..

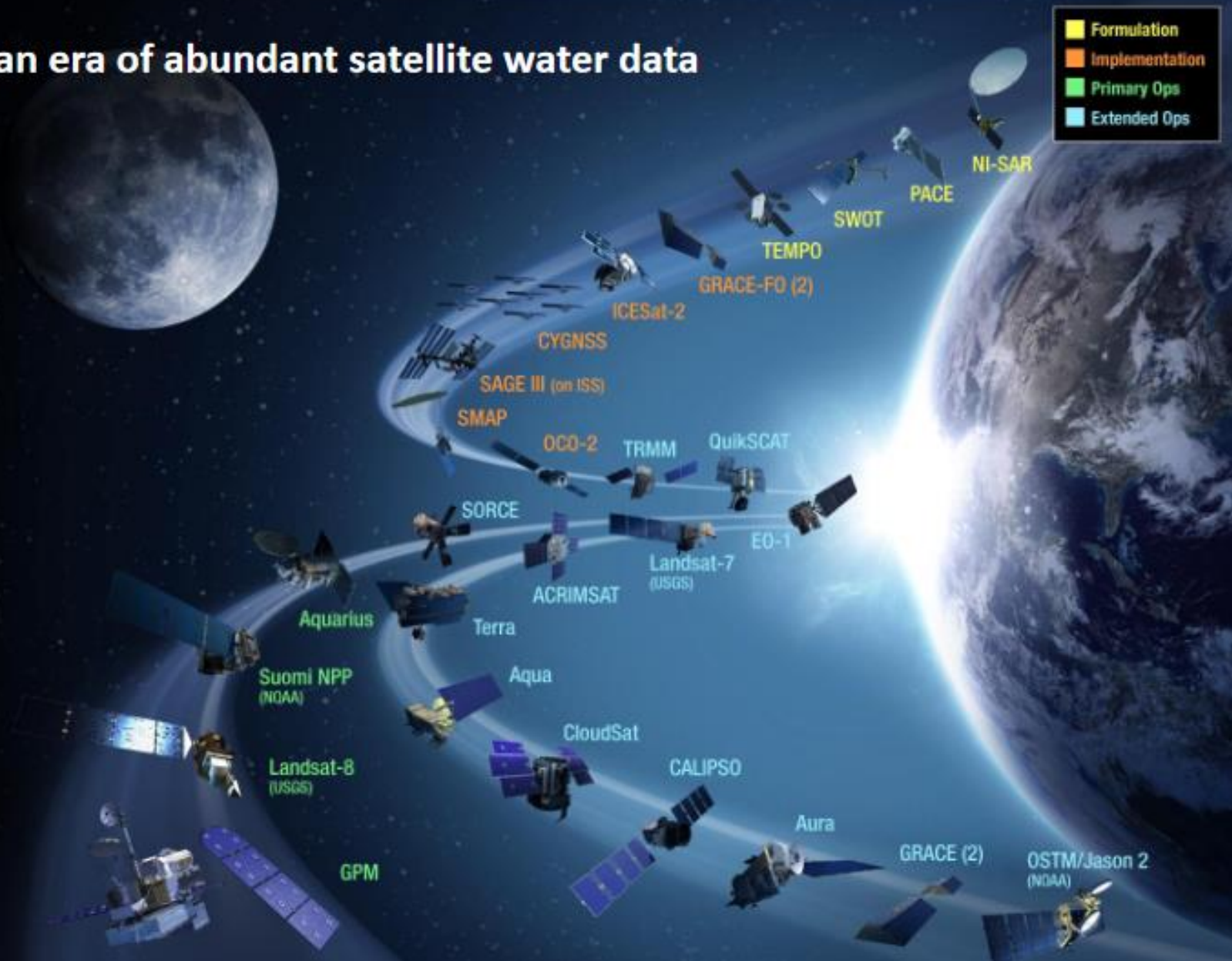
Water security monitoring strategy requires satellite Earth Observation data

- Satellite data provide impartial global coverage with standardized data
- Not limited by national boundaries so they are useful for informing international and transboundary water issues
- Satellite data are useful where in-situ data are not available or sparse
- Satellite data production is in many cases funded by developed countries, for global use

Challenges in using satellite data

- Data provided by satellites must be transformed into adequate information to help decision makers, to observe changes, to understand threats to water security, whether from climate change or human pressures,
- Operational applications rely on long-term sustainability of satellite platforms (research satellites are to demonstrate their use) ,
- Need to make the data open and at no cost,
- Algorithms to provide reliable water information need to be adapted to the local (regional) conditions.
Many water information are of global scale, not sufficient for supporting local planning, management decisions,
- Lack of knowledge by Water Security users on the use of Earth Observation

We live in an era of abundant satellite water data

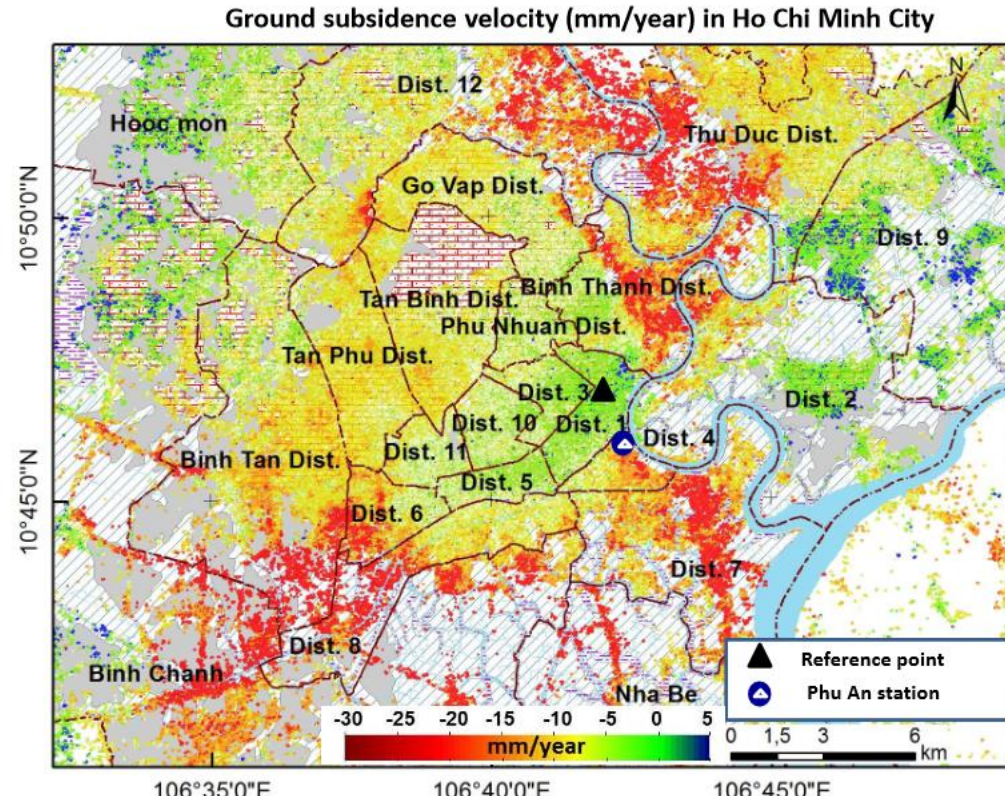


(Courtesy of NASA)

(SAR missions)

Illustrations of EO used to monitor the impacts of water extraction on land subsidence

Ground subsidence detected by Radar Interferometry



Mapping Ground Subsidence Phenomena in Ho Chi Minh City through the Radar Interferometry Technique Using ALOS PALSAR Data

Dinh Ho Tong Minh ^{1,*}, Le Van Trung ² and Thuy Le Toan ³
Remote Sens. 2015, 7, 8543-8562

Causes: urban expansion increases water extraction (through silty loam soil)

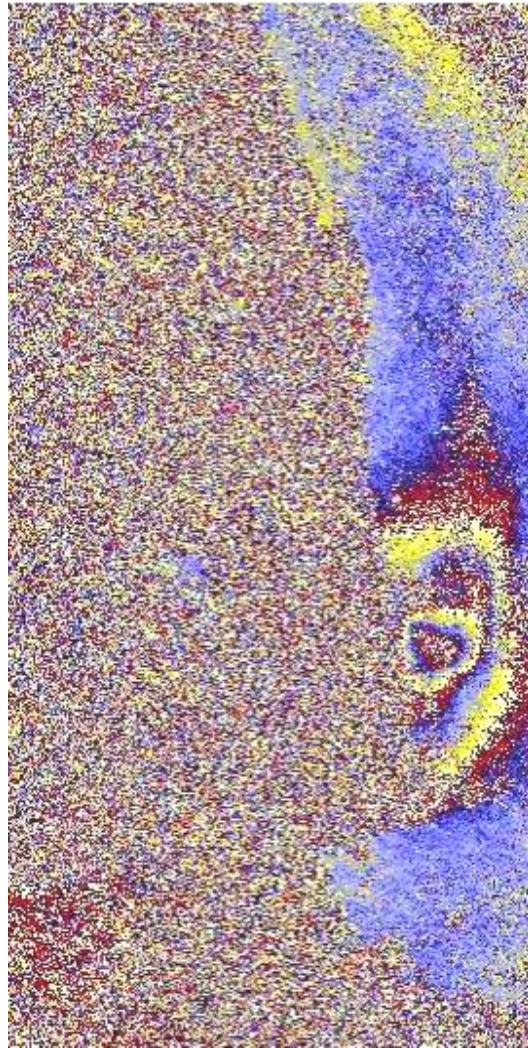
Impact: combined with the effect of SLR, flooding during rainy season



Subsidence caused by groundwater extraction: possible source of transboundary conflict



ERS intensity image



Interferogramme

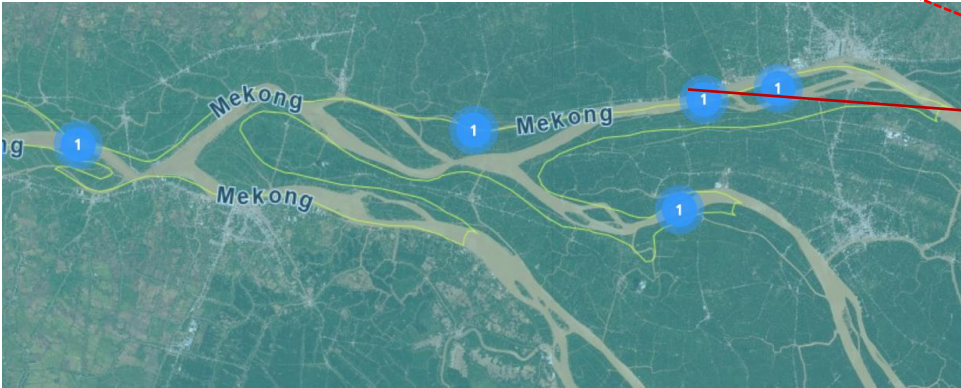
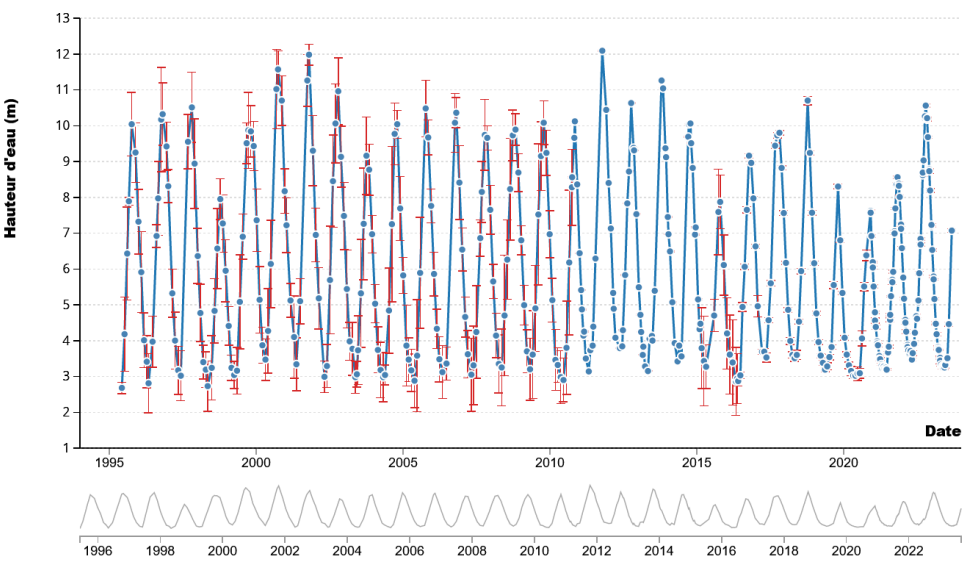
ERS Interferometry

Mesa, USA/ Mexico border

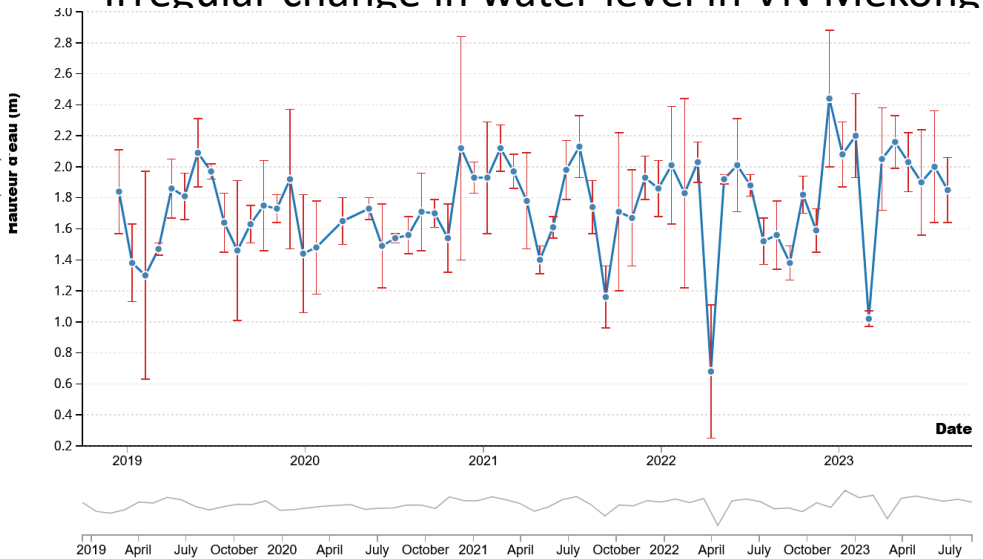
Interferogram processed from two ERS images, acquired at two years interval. The fringes characterize the ground subsidence : subsidence of about 6 cm (2 fringes) which covers 17km x 8km.

Upstream hydropower dams contribute to the change in hydrological system of the Mekong

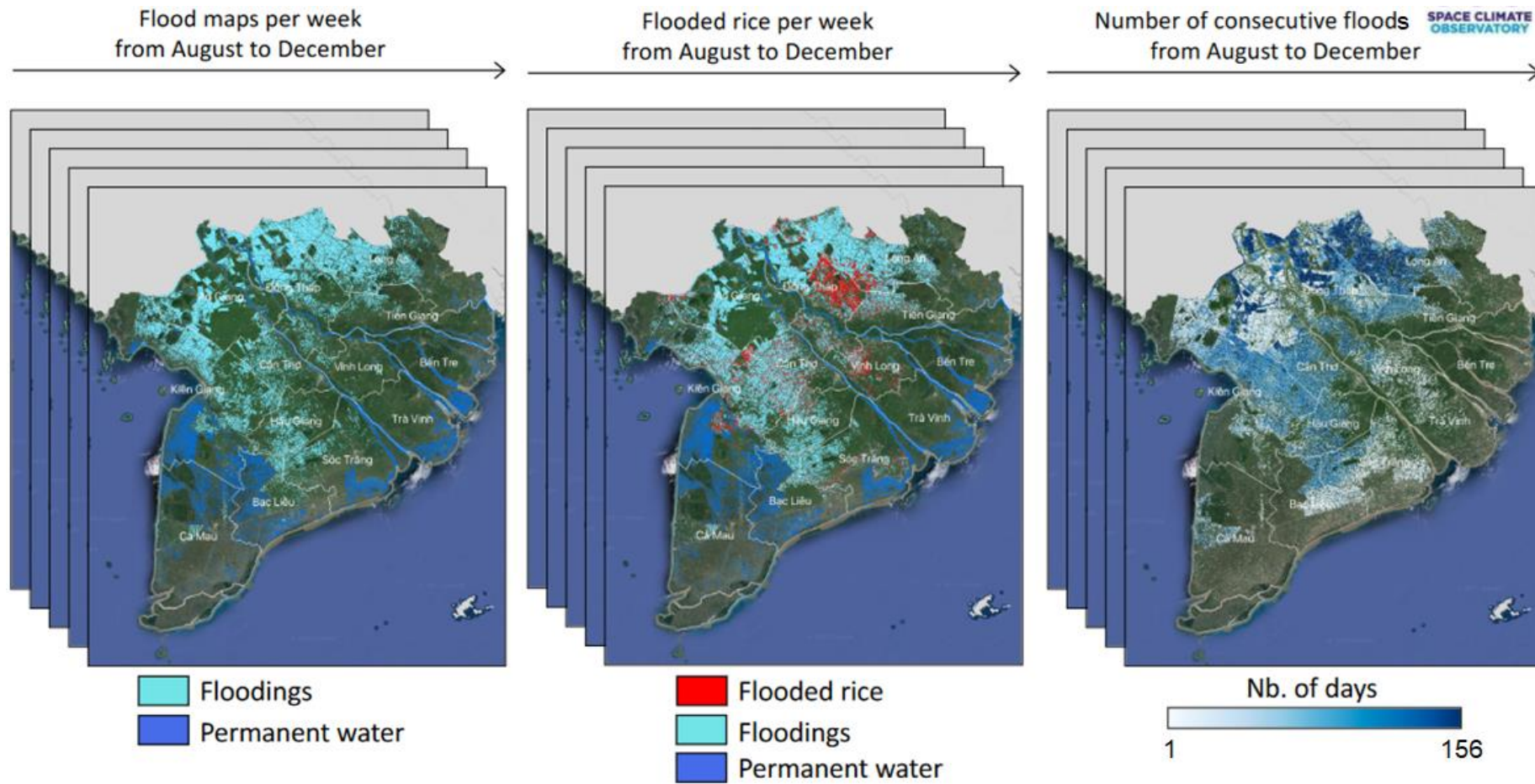
Diminution of water volume in the last 10 years Tonle Sap lake



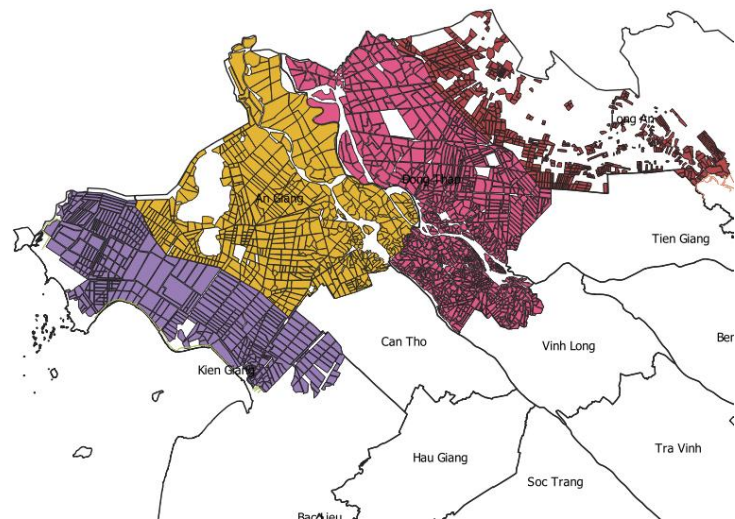
Irregular change in water level in VN Mekong



Water extent monitored using Sentinel-1



In high flood zone, high dykes systems protect rice fields from flooding



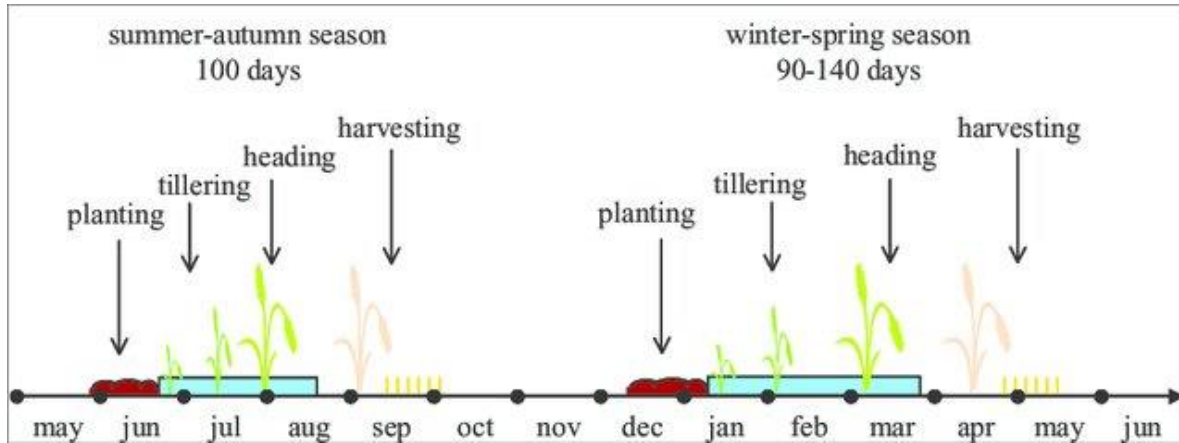
dyke rings have been built



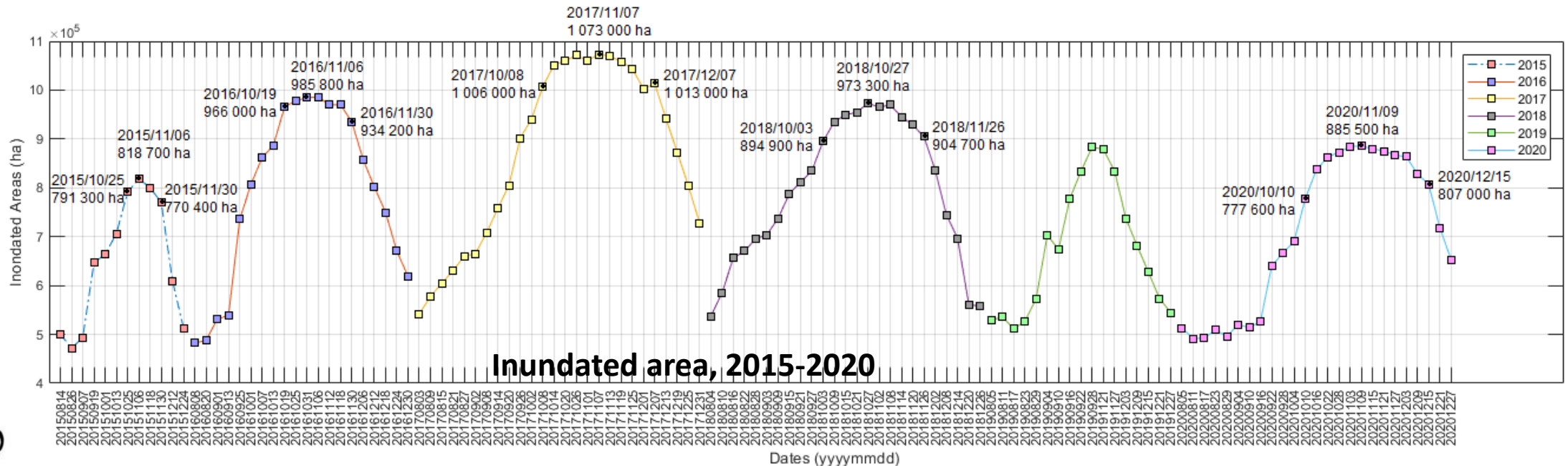
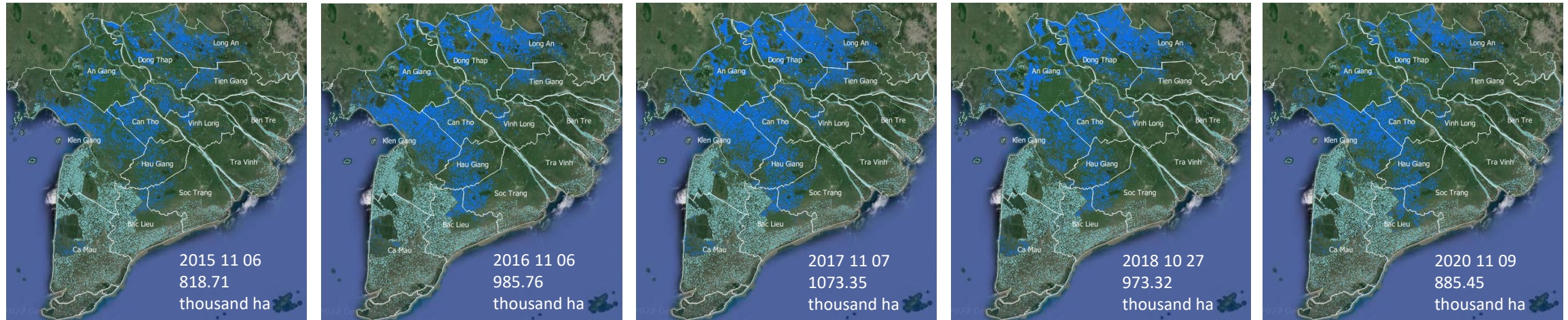
Flooded area (blue), 7 Nov 2017

Downstream, the rice crop calendar traditionally avoided flood season.

Flood Season

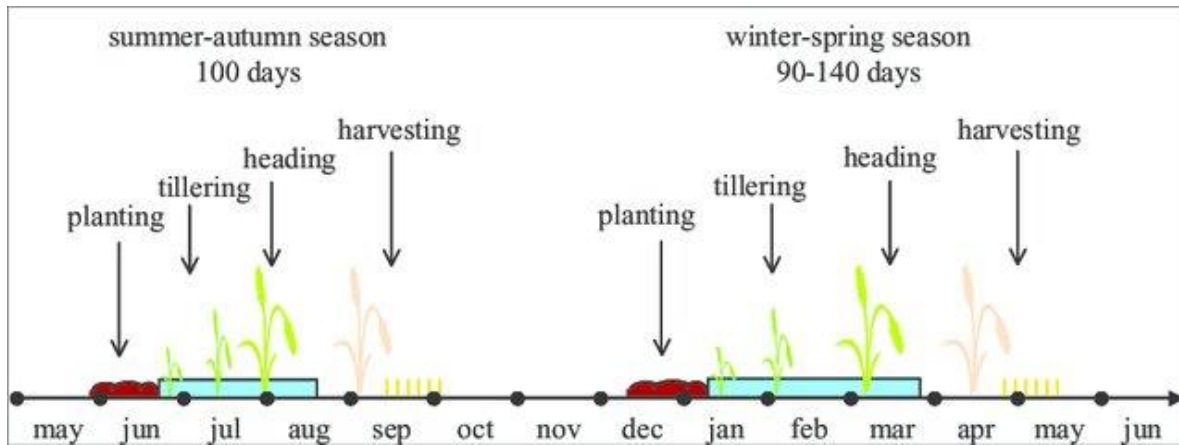


However, flood extent and timing observed to have significant interannual change



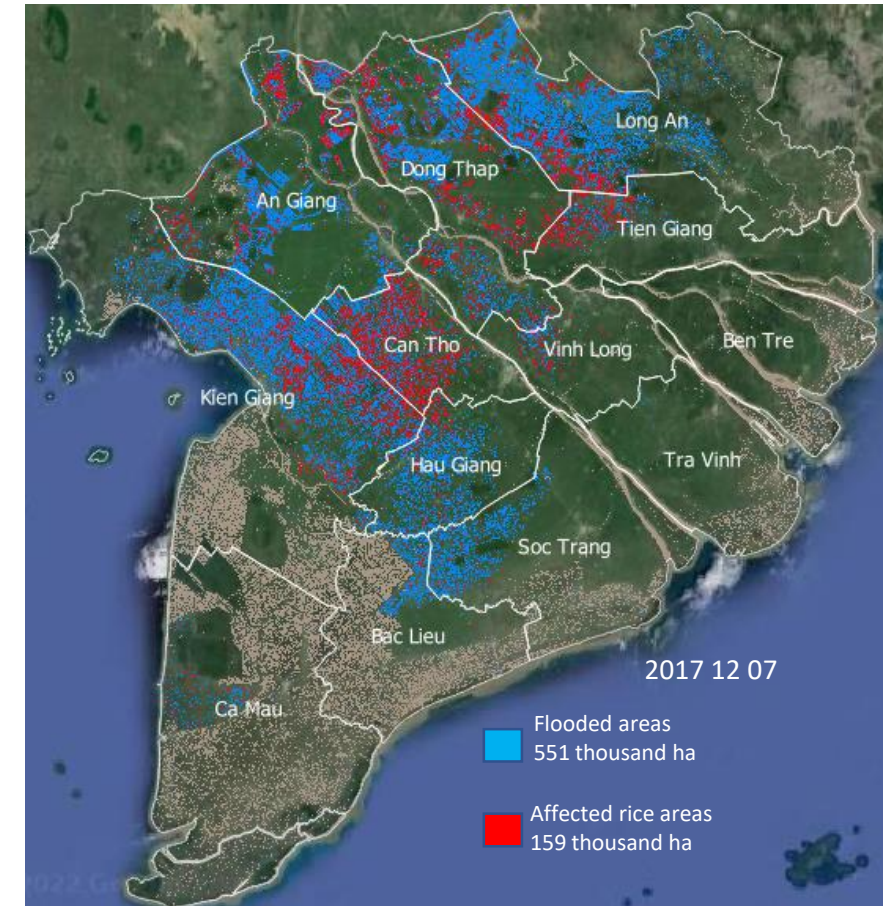
**Downstream, the rice crop calendar traditionally avoided flood season.
But earlier or longer lasting, or higher flood can damage rice crop**

Flood Season



To raise high dykes in the dwnstream region ?

Example in 2017



EO information help identifying possible mitigation and adaptation measures

Risk Type	Impact on rice agriculture	Mitigation measures	Adaptation measures
Flood extent and timing variability	Summer-Autumn rice before harvest in semi-dike regions 	-Availability of timely information from upstream dams - Rotating annually flood season rice with flooding in high dike upper regions	Advance the Summer-Autumn rice season in semi-dikes regions

.. To conclude

- Space agencies are providing huge amount of useful data for supporting water security,
- The derived information can be used not only for short term emergency operations, but also in an integrated system combining satellite, in-situ data and models to understand the threats, and to simulate scenarios,
- The satellite data are the most effective for monitoring, analysing the threats of water security, when used to response to the specific needs expressed by countries or regions, in particular for transboundary issues
- Countries should be able to use EO data in their strategies and actions to achieve SDG6 water security targets.

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Thuy Le Toan, IPU Science for Peace, Quy Nhon 11-9-2023