Asia Water Forum 2022
8–11 August 2022 • Online

Focus Area: Climate change and water-related risks

Session Title:Technologies for climate resilience

Schedule: 11 August 2022 (Thu), 9:00 a.m. - 10:30 a.m. (GMT+08)

Space-Based Technologies to Enhance Water Security Monitoring in Viet Nam

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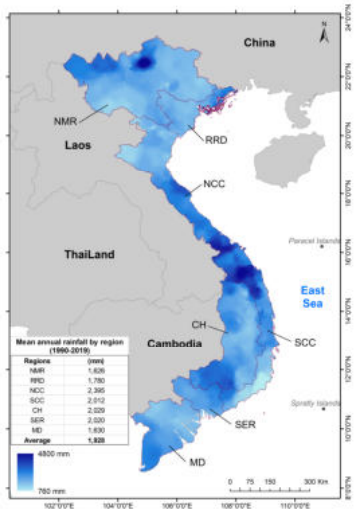
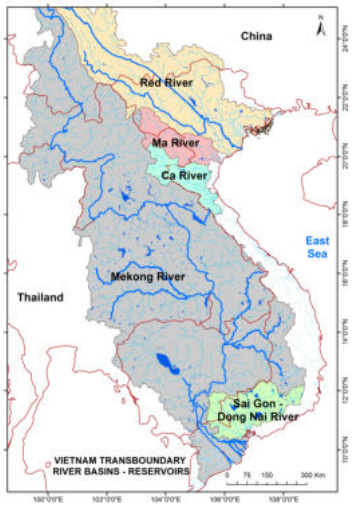
Outline

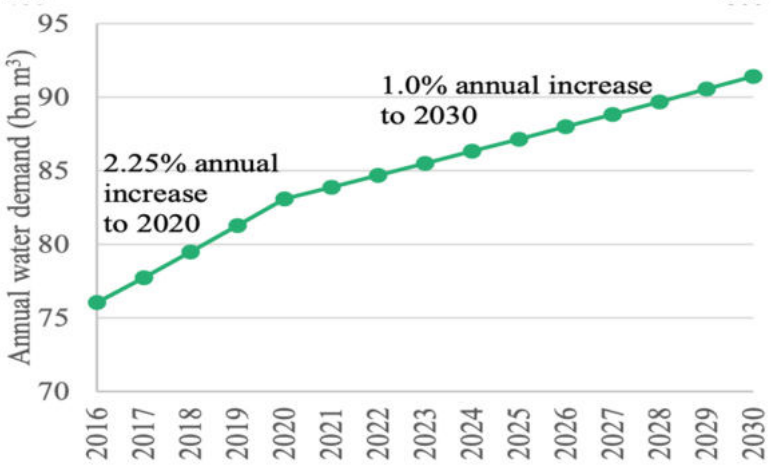
1) Background
2) Space-borne data
3) Water availability monitoring
4) Drought monitoring
5) Water security assessment
6) Conclusions

Background

- Viet Nam is endowed with abundant annual rainfall (1920mm on average).
- However, the country faces water security challenges:
  - A high reliance on transboundary flows.
  - An uneven distribution of water resources across the country.
  - Agriculture uses over 80% of all available surface water, but with low productivity.
  - High economic growth rate and expanding populations cause additional demands for water.
  - Water pollution is a major problem in many river systems.
  - Most at risk from water related disasters including floods, droughts, typhoons and saline intrusion. Climate change will impact all of these.
- Water security has become a focal point of attention for the Government of Viet Nam.



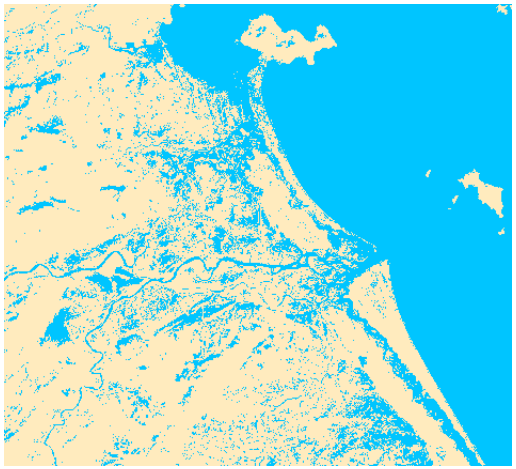




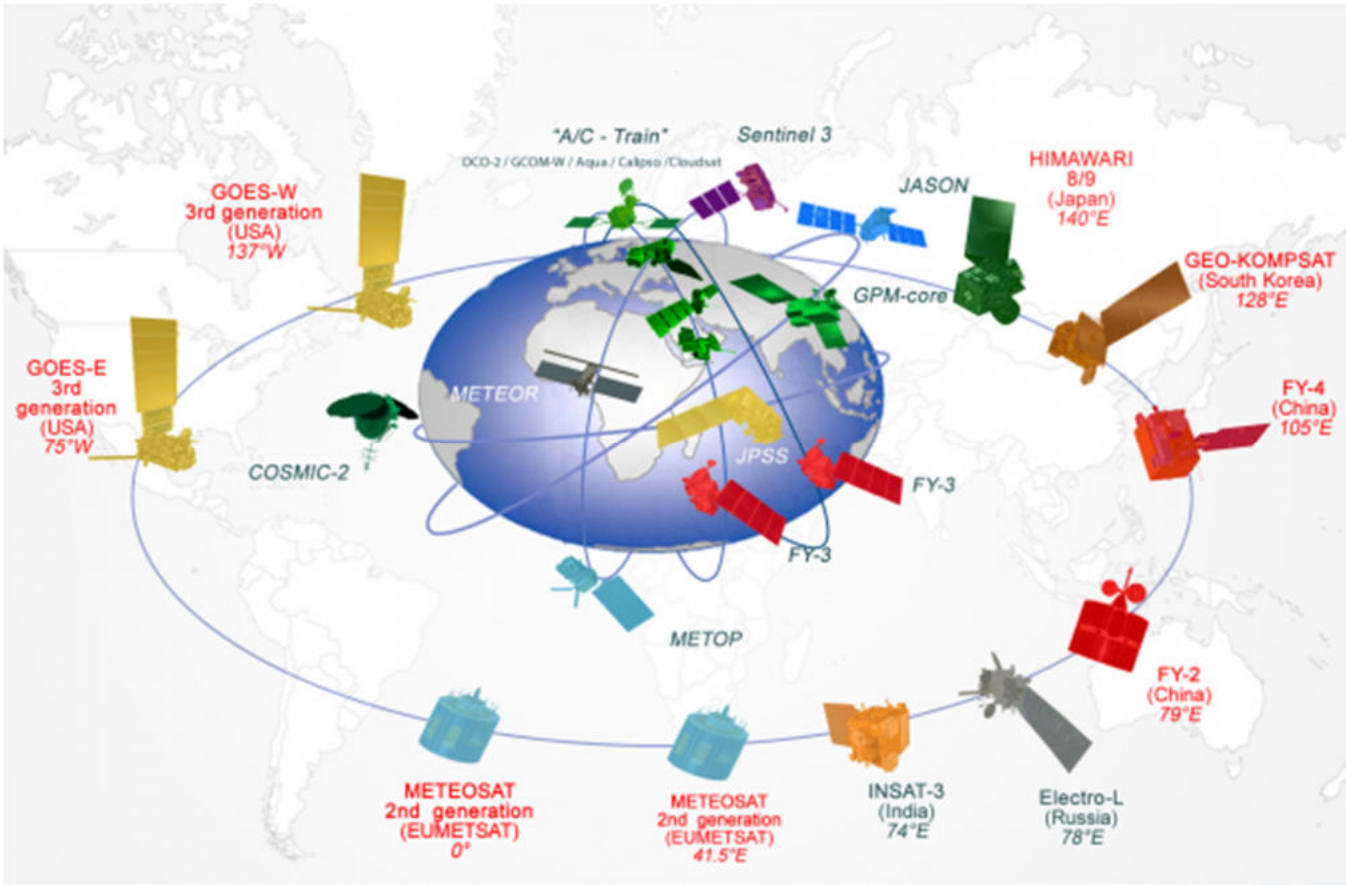
(Source: WB 2017)

Space-borne data

- Weather and climate
- Land cover
- Topography
- Environment
- Disaster



Capture of flood inundation
In Vu Gia-Thu Bon river basin



(Source: WMO)

Water availability monitoring

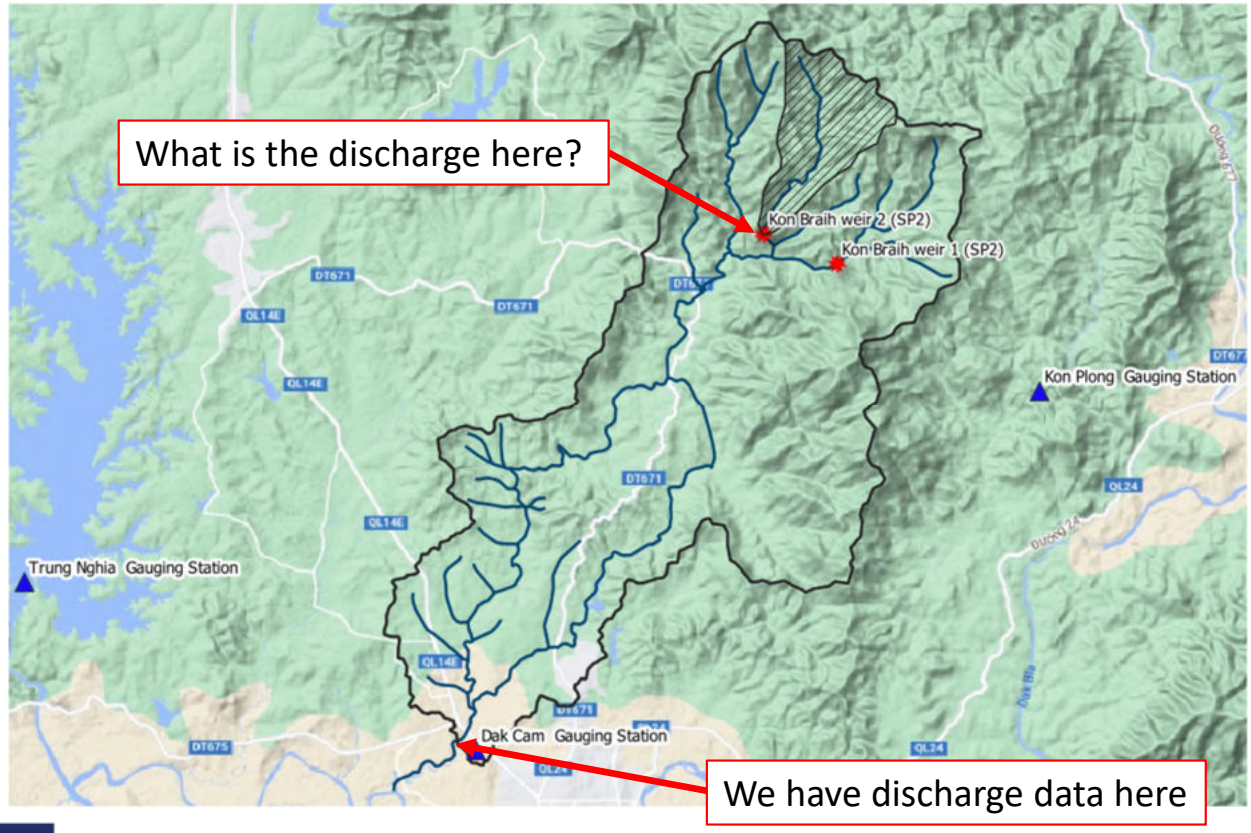
- Key challenges:
  - Very little historical and monitoring meteorological data available.
  - Intermittent historical stream flow data available, but very few gauging stations to represent large river basins.
  - Modelling streamflow is a solution, but not possible to achieve a satisfactory calibration with the available data.
  - In many cases, model does not contribute to a better understanding of basin water balance.
- Alternative approach to estimate the basin water balance:

$$\text{Precipitation} = Evapotranspiration + Runoff + \Delta\, Storage$$

$$Long\ term\ \Delta\, Storage \approx 0$$

$$\therefore\ \text{Precipitation} = Evapotranspiration + Runoff$$

Water availability monitoring



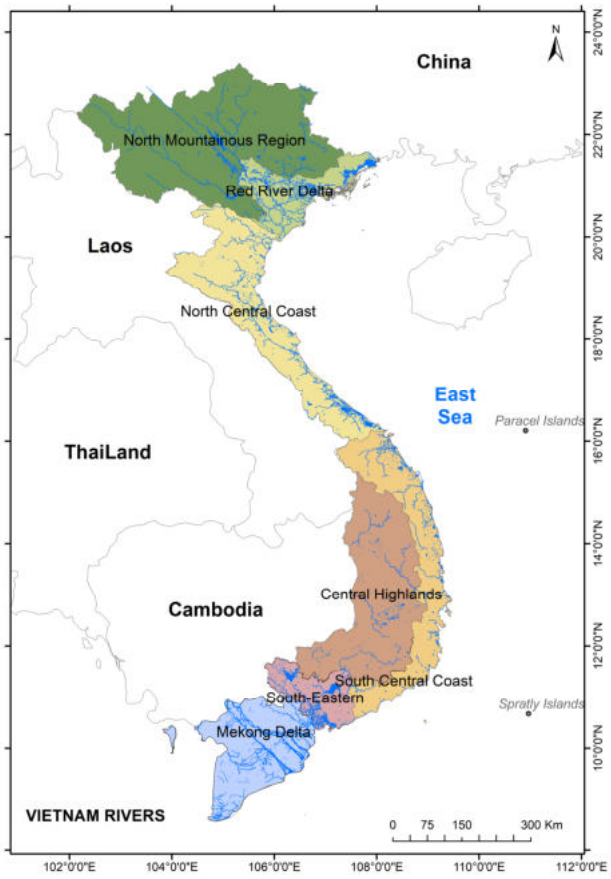
A river basin in Central Highland of Vietnam

Methodology to estimate basin runoff

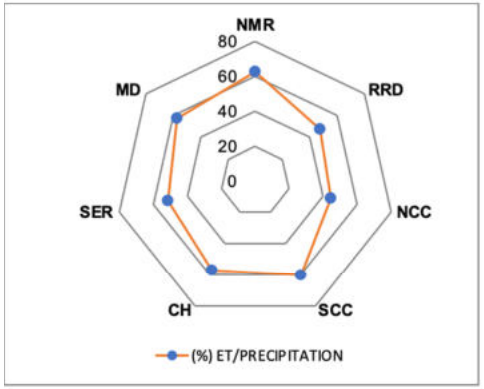
$$Q_{SB} = \frac{(P_{SB} - ET_{SB})}{(P_B - ET_B)} * Q_B$$

$Q_{SB} = Sub - basin\ Runoff$
$P_{SB} = Sub - basin\ Precipitation$
$ET_{SB} = Sub - basin\ ET\ (Actual)$
$P_B = Basin\ Precipitation$
$ET_B = Basin\ ET\ (Actual)$
$Q_B = Basin\ Runoff$

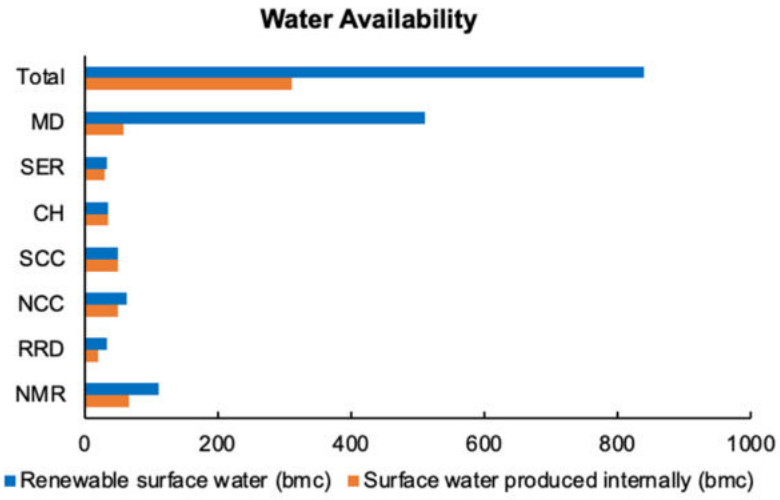
Water availability monitoring

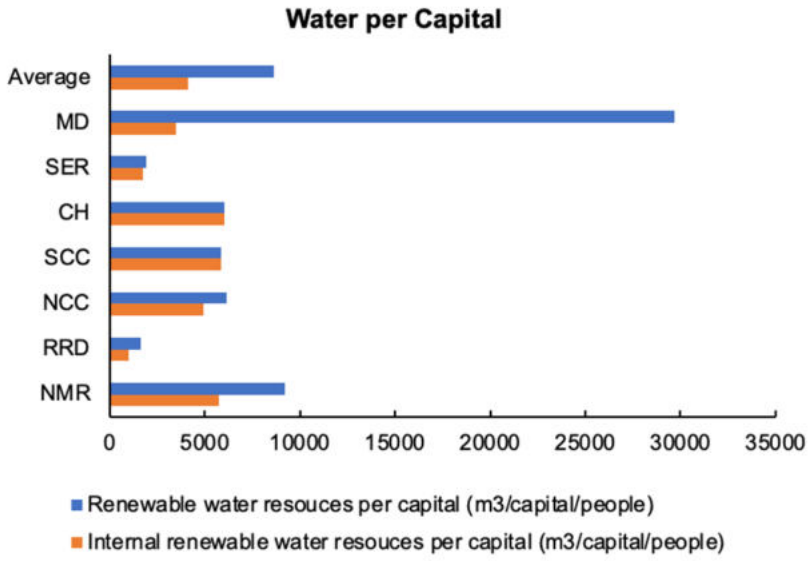


Proportion of ET over Precipitation by region



(Derive from:
- GPM Level 3 IMERG (10km)
- ET MODIS MOD16 500m)





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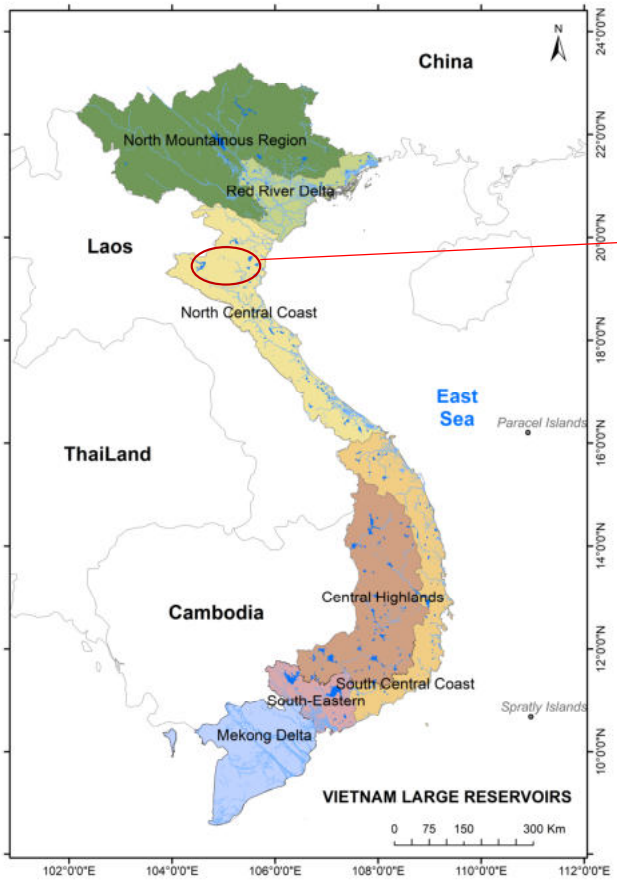
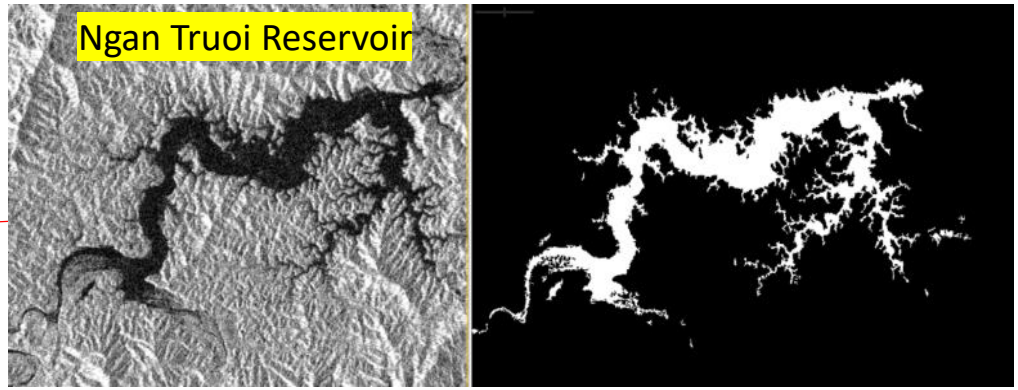
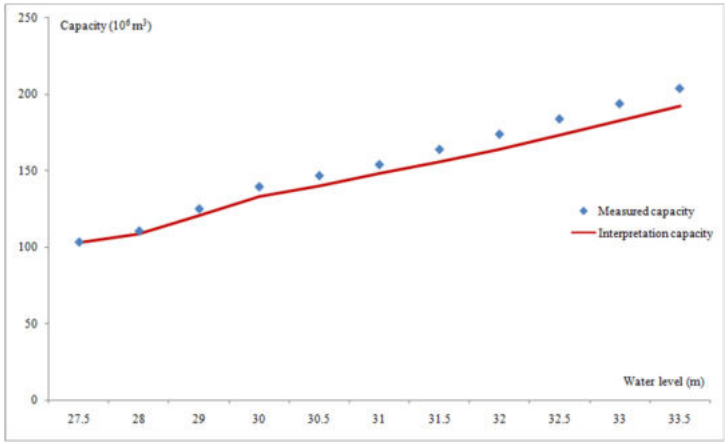
Reservoir volume detection



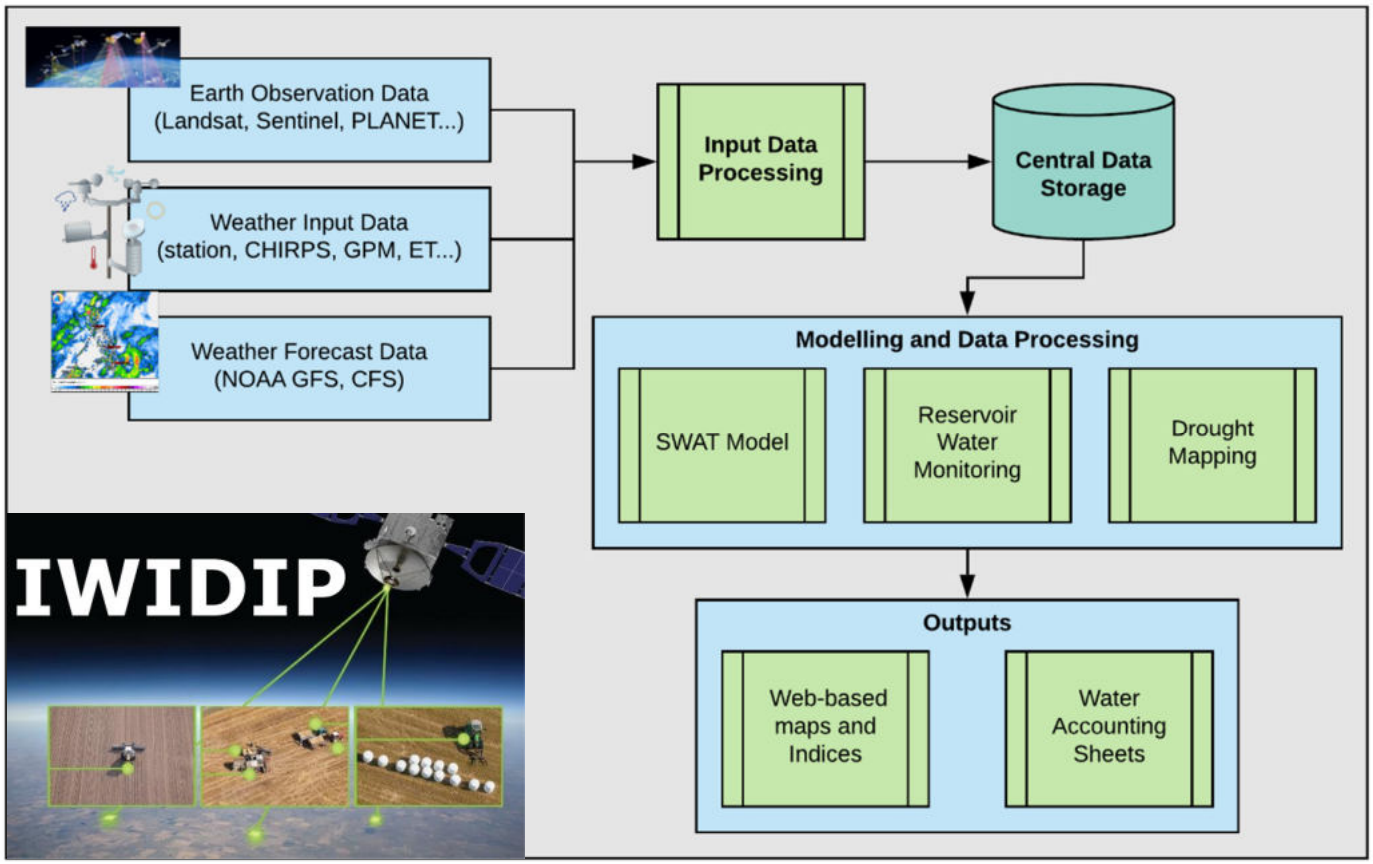


Sentinel-1 satellite imagery (10m)



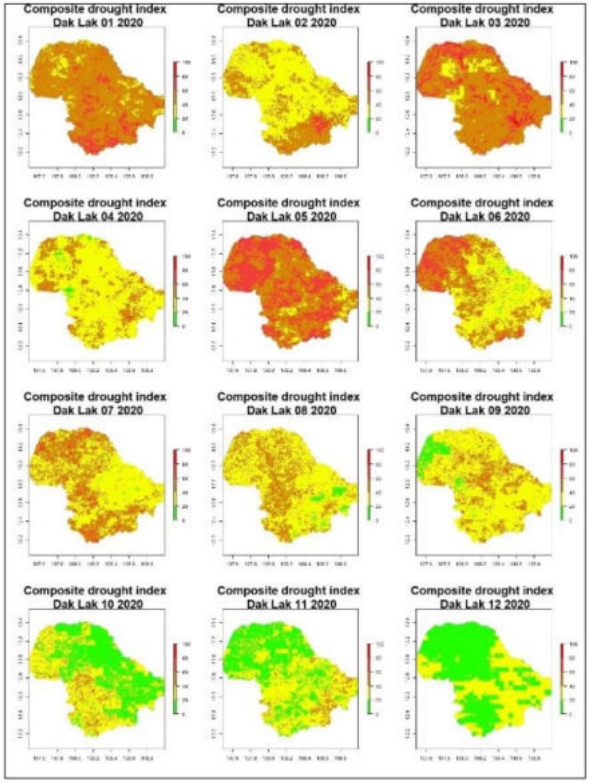
Volume vs water level

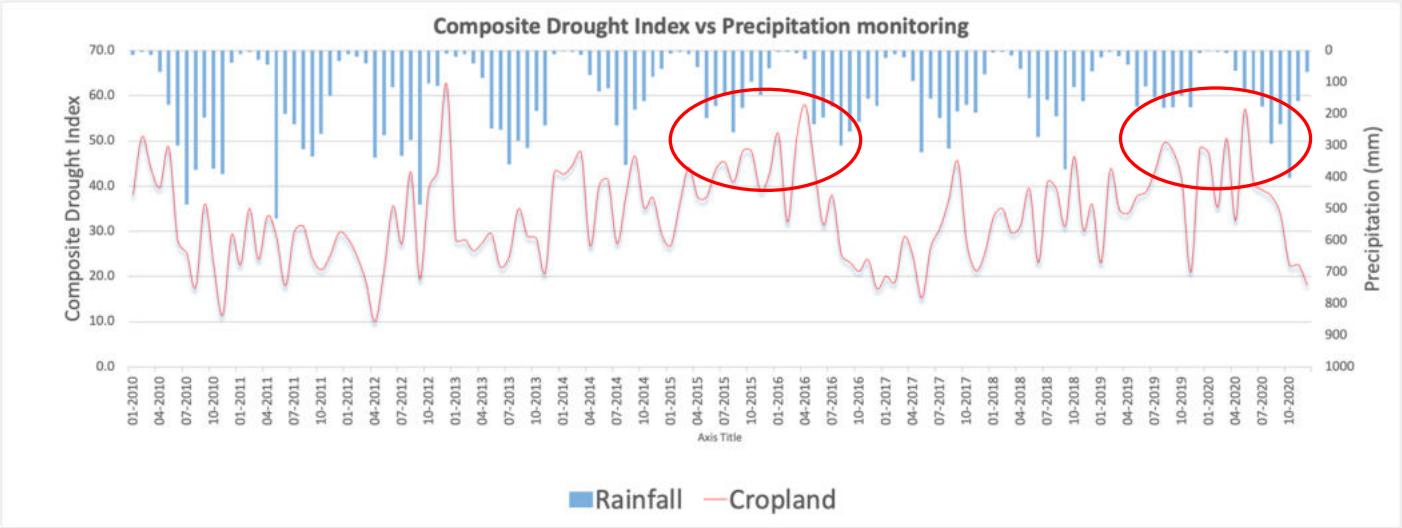
Drought monitoring



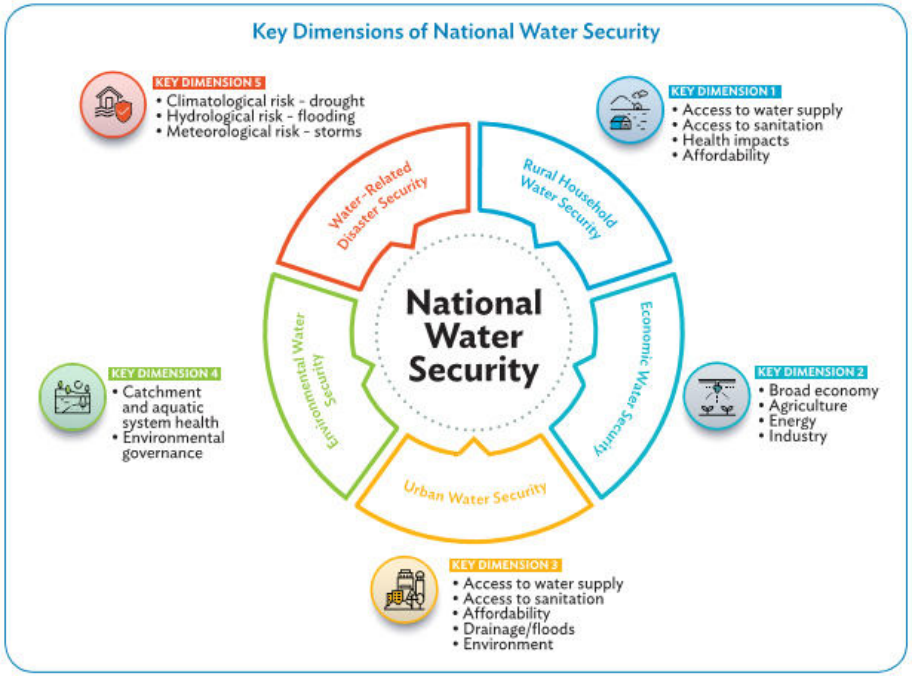
(IWIDIP: Integrated Water Infrastructure and Drought Information Portal)

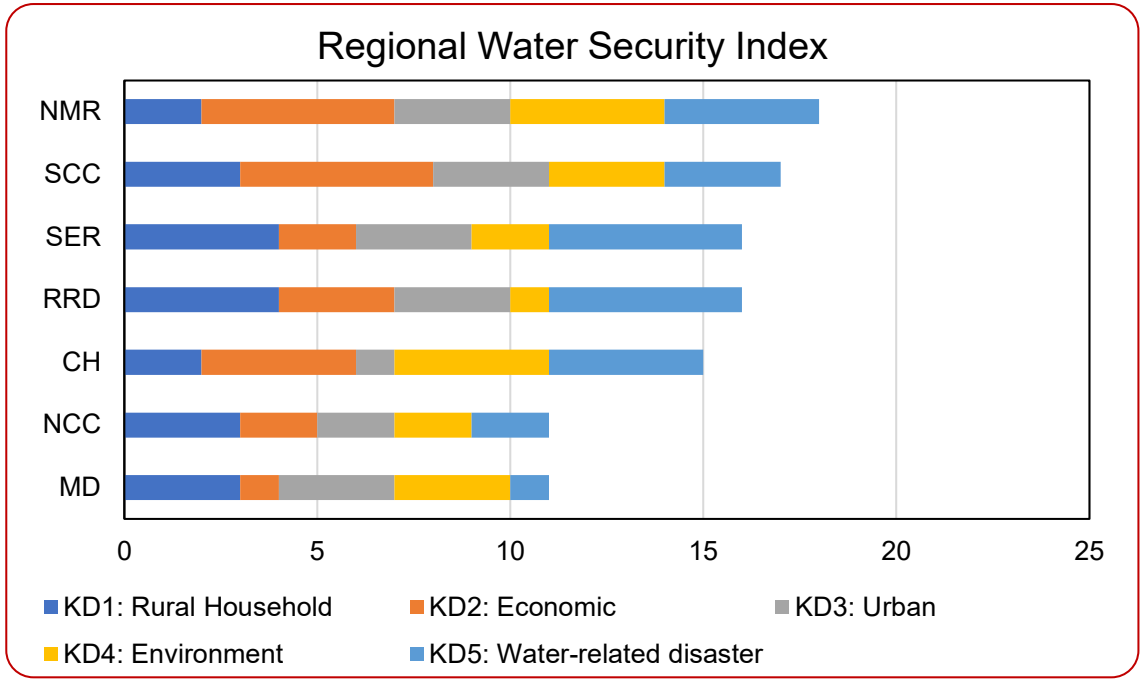
Drought monitoring (examined for Dak Lak province in Central Highland)





Water security assessment over different climate regions of Viet Nam





Framework for Measuring Water Security (ADB 2020)

Conclusions

- Space-born data shows enhanced resolution, temporal sampling, spatial coverage, and reliability.
- Google Earth Engine emerges as a robust platform to process vast amounts of satellite imagery.
- New approach for estimating the basin water balance is very promising, overcome the unavailability of hydro-meteorological data.
- Renewable water resources and storage in reservoirs were reasonably estimated using high-resolution satellite images.
- Drought monitoring was well examined and validated in the south-central and central highland regions of Vietnam.