THE FRESHWATER HEALTH INDEX: NASA-CONSERVATION INTERNATIONAL PARTNERSHIP

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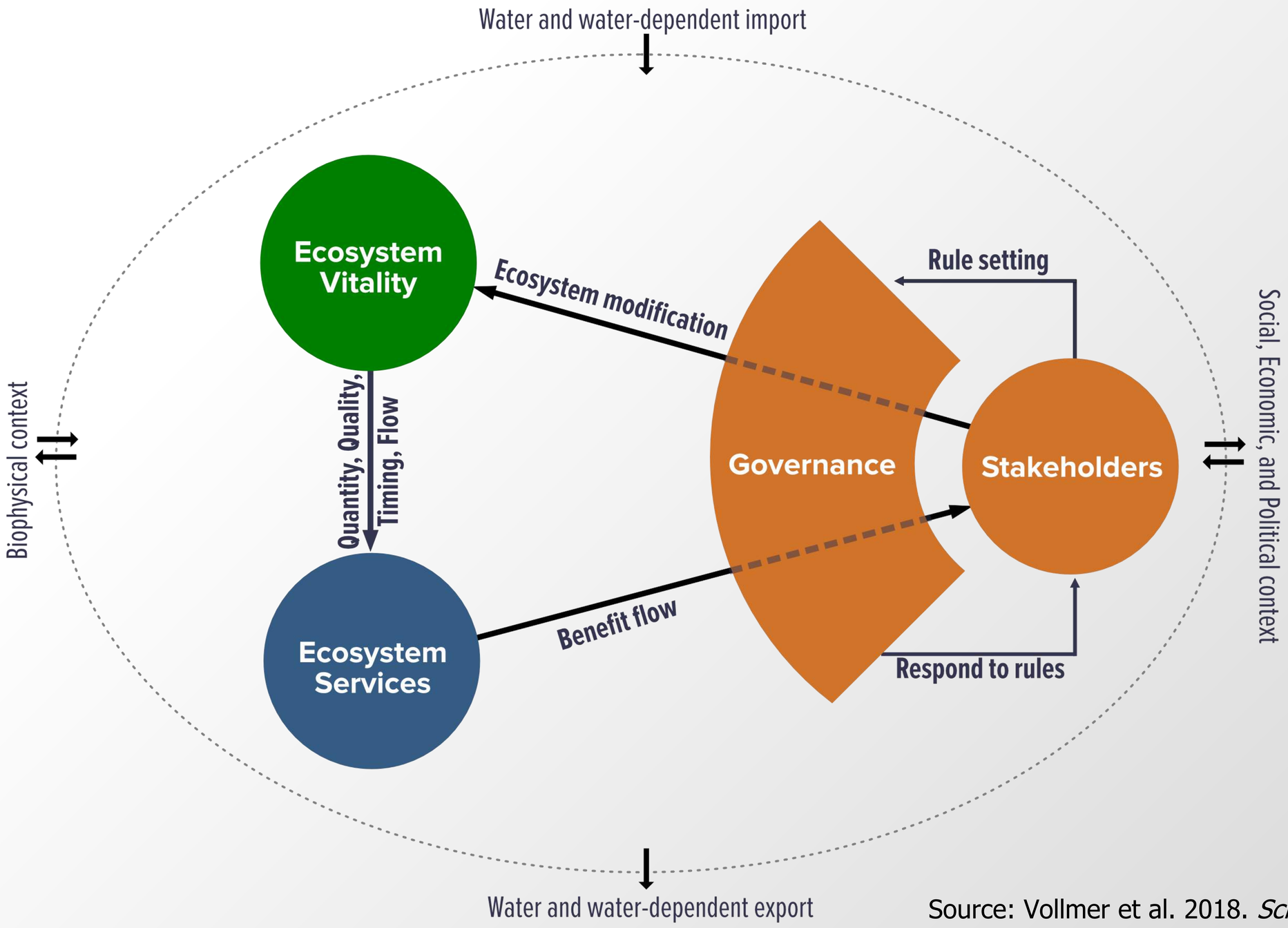
WHY DO WE NEED ANOTHER MONITORING TOOL?

- Thousands of unique indicators and hundreds of unique indices for assessing freshwater systems already exist.
- Applications range from ecological assessments of streams, to water "vulnerability" at national scale, to global corporate water risk assessments.
- But no approaches linked ecological integrity (health) to ecosystem service delivery, or adequately combined social with ecological indicators.

FRESHWATER HEALTH INDEX

Source: Vollmer et al., 2016. *Ambio* 45(7):765-780



FRESHWATER HEALTH INDEX

Source: Vollmer et al. 2018. *Science of the Total Environment* 627:304-313

INDICATORS OF FRESHWATER HEALTH

- Combination of remotely sensed, monitored, modeled and survey data
- Each indicator scaled from 0-100 for ease of interpretation
- Ecosystem Vitality and Ecosystem Services indicators can be modeled to assess scenarios

ECOSYSTEM VITALITY

Water Quantity
- Deviation from natural flow
- Groundwater storage depletion

Water Quality
- Suspended solids
- Total nitrogen
- Total phosphorus
- Other quality parameters of concern

Basin Condition
- Bank modification
- Flow connectivity
- Land cover naturalness

Biodiversity
- Species of concern
- Invasive & nuisance species

ECOSYSTEM SERVICES

Provisioning
- Water supply reliability
- Biomass for consumption

Regulation & Support
- Sediment regulation
- Water quality regulation
- Flood regulation
- Disease regulation

Cultural
- Conservation areas
- Recreation

GOVERNANCE & STAKEHOLDERS

Enabling Environment
- Water resources management
- Right to resource use
- Incentives & regulations
- Financial capacity
- Technical capacity

Stakeholder Engagement
- Information access
- Engagement in decision-making processes

Vision & Adaptive Governance
- Strategic planning & adaptive management
- Monitoring & learning mechanisms

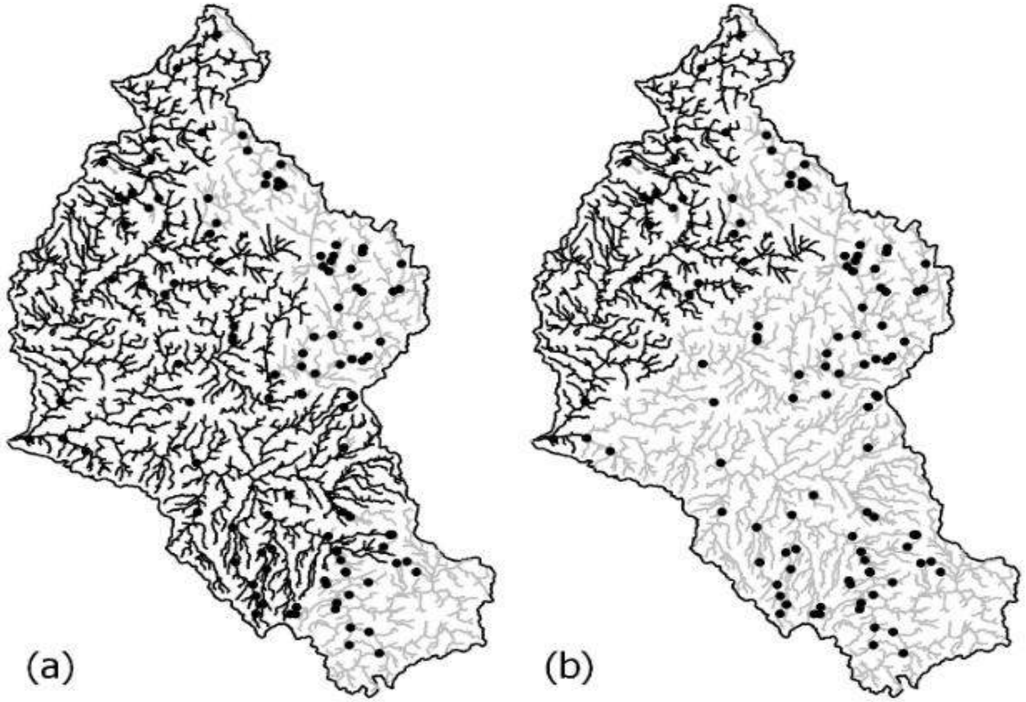
Effectiveness
- Enforcement & compliance
- Distribution of benefits
- Water-related conflict

SCENARIO ANALYSIS

- Future scenarios – for climate change, land-use change and dam development – are the most important way that we can influence decisions around investing in natural capital in a basin.

- Scenarios reveal areas that may be threatened in the future (e.g., where dams could impact fisheries) and where ecosystem restoration could have downstream benefits.

FLOW CONNECTIVITY AND DAM DEVELOPMENT



EXISTING

56

+LOWER SESAN

27

WHERE WE HAVE BEEN WORKING

FRESHWATER
HEALTH INDEX

FRESHWATER HEALTH INDEX TOOL

Link One Link Two Link Three Link Four

Results Explorer

Active Basin: Dongtiang 20181202

FHI SCORES

Ecosystem Vitality	75
Water Quantity	71
Water Quality	65
Basin Condition	57
Biodiversity	99
Ecosystem Services	62
Governance	85
Another One	55
Another One	59

BASIN CONDITION

Score 75

Export Results

HOME

Earth Science Partnership (NASA-CI)

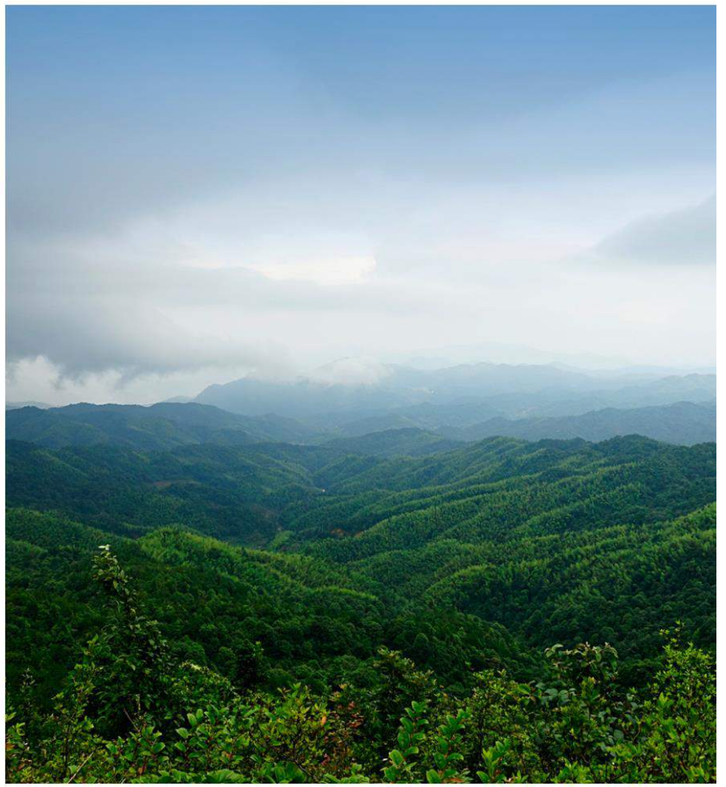
Opening new doors by leveraging our SERVIR Project with NASA – Conservation International Partnership

- The value of the CI FHI is highly dependent on the ability to accurately simulate **Ecosystem Vitality, Ecosystem Services,** and incorporating **Governance & Stakeholders**.

- NASA has worked to calibrate and validate a hydrological model leveraging the proper utilization of available in situ and satellite-based Earth observations.

- Our modeling capabilities and established data access and formatting tools are being utilized to provide a comprehensive picture of freshwater ecosystem health.

FRESHWATER HEALTH INDEX



CONSERVATION INTERNATIONAL

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Improved Hydrological Decision Support System for the Lower Mekong River Basin Using Satellite-Based Earth Observations

- The Soil Water Assessment Tool (SWAT) is considered one of the most widely used and trusted hydrologic models in the region
- However, the region suffers from insufficient gauge data
- We successfully demonstrated improved modeled streamflow form Soil Water Assessment Tool (SWAT) when applying satellite-based observations!

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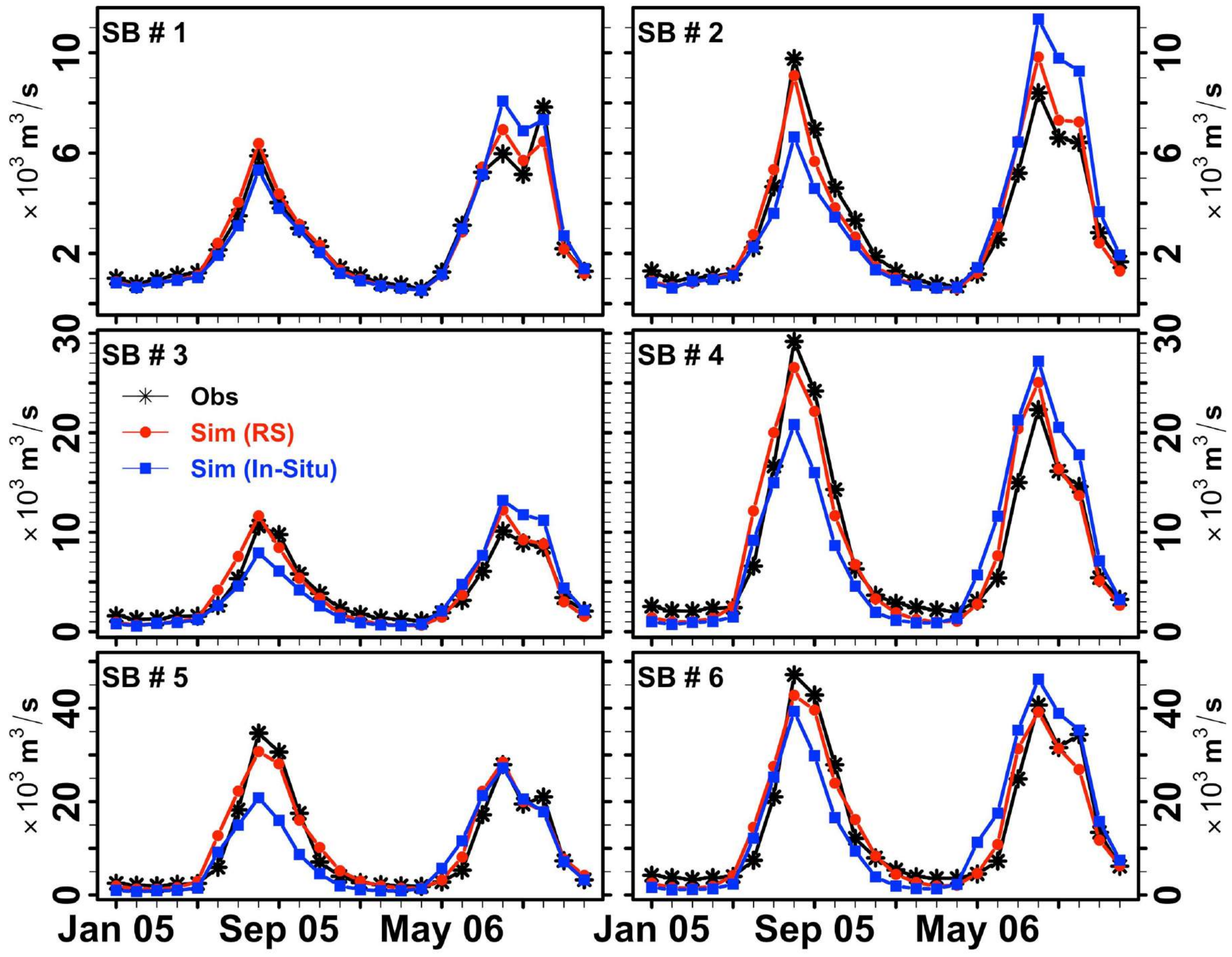
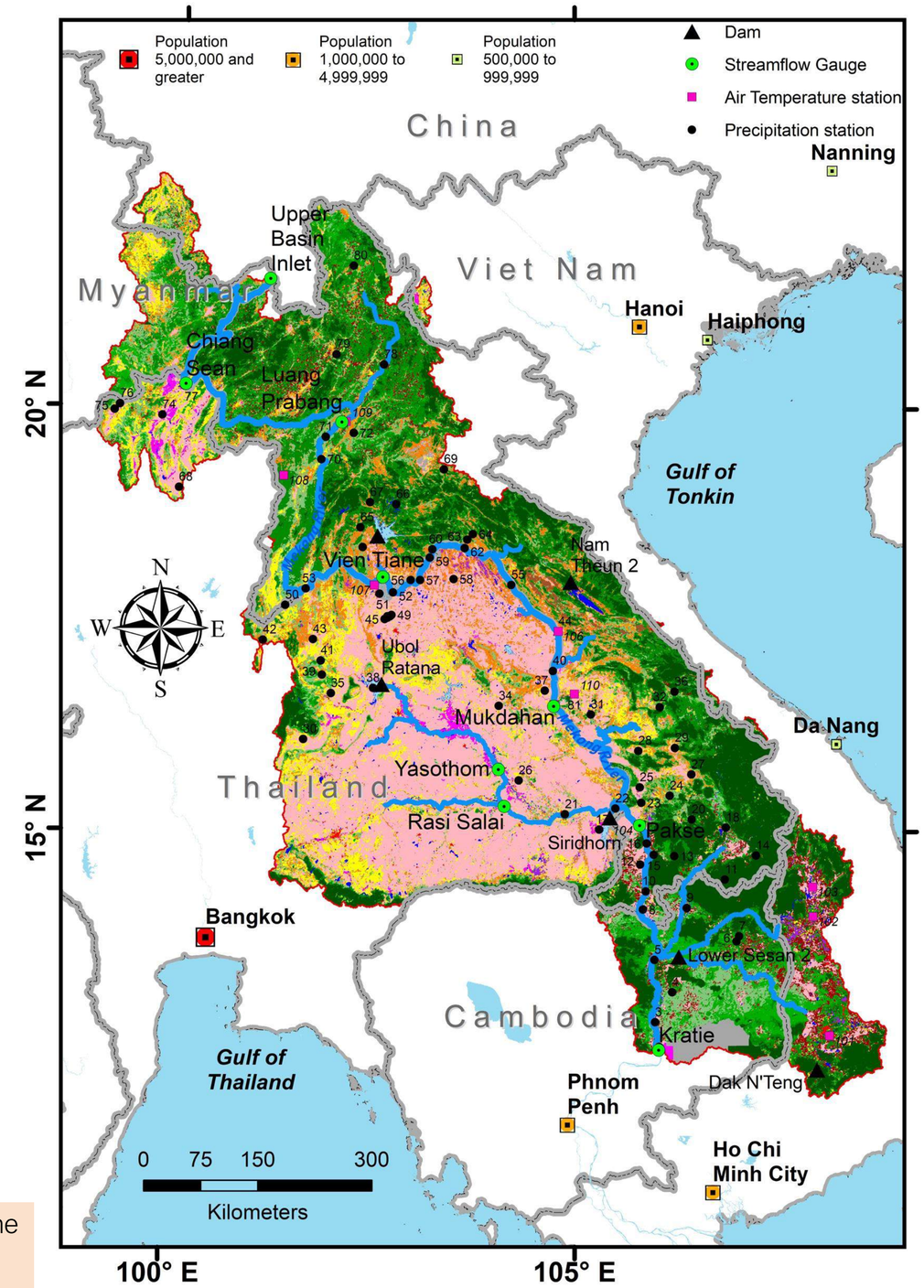
Mohammed, I. N., Bolten, J., Srinivasan, R., & Lakshmi, V. (2018). Improved Hydrological Decision Support System for the Lower Mekong River Basin Using Satellite-Based Earth Observations. *Remote Sensing, 10* (6), 885. http://dx.doi.org/10.3390/rs10060885

Remote Sensing and Gauge Driven SWAT models - Streamflow Comparison



Monthly mean observed and simulated discharge in m^3/s at six sub-basin watersheds in calibration of the LMRB model (TRMM).



Mohammed, I. N., Bolten, J., Srinivasan, R., & Lakshmi, V. (2018). Improved Hydrological Decision Support System for the Lower Mekong River Basin Using Satellite-Based Earth Observations. *Remote Sensing, 10* (6), 885. http://dx.doi.org/10.3390/rs10060885

How Can We Better Understand Lower Mekong River Basin Streamflow Variability?

- Upper Mekong River Basin inflow changes on the Lower Mekong River Basin are generally due to reservoir construction for hydropower development.
- But, to what degree?

Journal of Hydrology
Volume 564, September 2018, Pages 559-573

Research papers

Satellite observations and modeling to understand the Lower Mekong River Basin streamflow variability

Ibrahim Nourein Mohammed [a], John D. Bolten [b], Raghavan Srinivasan [c], Venkat Lakshmi [d]

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https://doi.org/10.1016/j.jhydrol.2018.07.030

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Highlights

- Multiple scenarios of Upper Mekong flow releases are examined.
- Hydrological modeling and generic remote sensing data processing tools are developed.
- Lower Mekong streamflow is highly variable with a low predictability (Colwell index of 32%).
- Implications for the management of Upper Mekong on the Lower Mekong are immense.
- Remote sensing data is useful in addressing Lower Mekong streamflow variability.

Recommended articles

Ground and satellite based observation datasets for...
Data in Brief, Volume 21, 2018, pp. 2020-2027
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Observed changes in flow regimes in the Mekong ...
Journal of Hydrology, Volume 551, 2017, pp. 217-232
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A MODIS-based automated flood monitoring syste...
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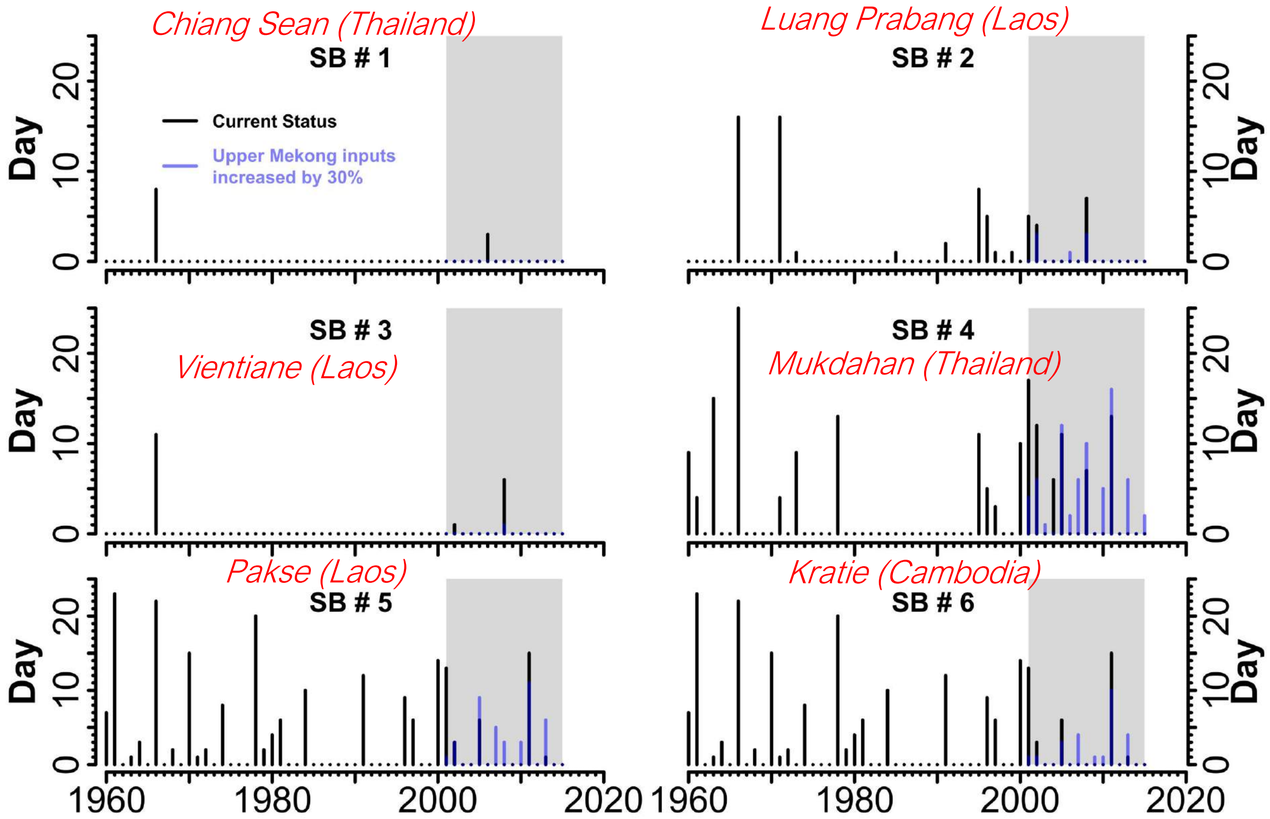
Mohammed, I.N., Bolten, J.D., Srinivasan, R., Lakshmi, V., 2018. Satellite observations and modeling to understand the Lower Mekong River Basin streamflow variability. J. Hydrol. 564, 559-573, https://doi.org/10.1016/j.jhydrol.2018.07.030

High Flow disturbance analysis for the Lower Mekong River Basin

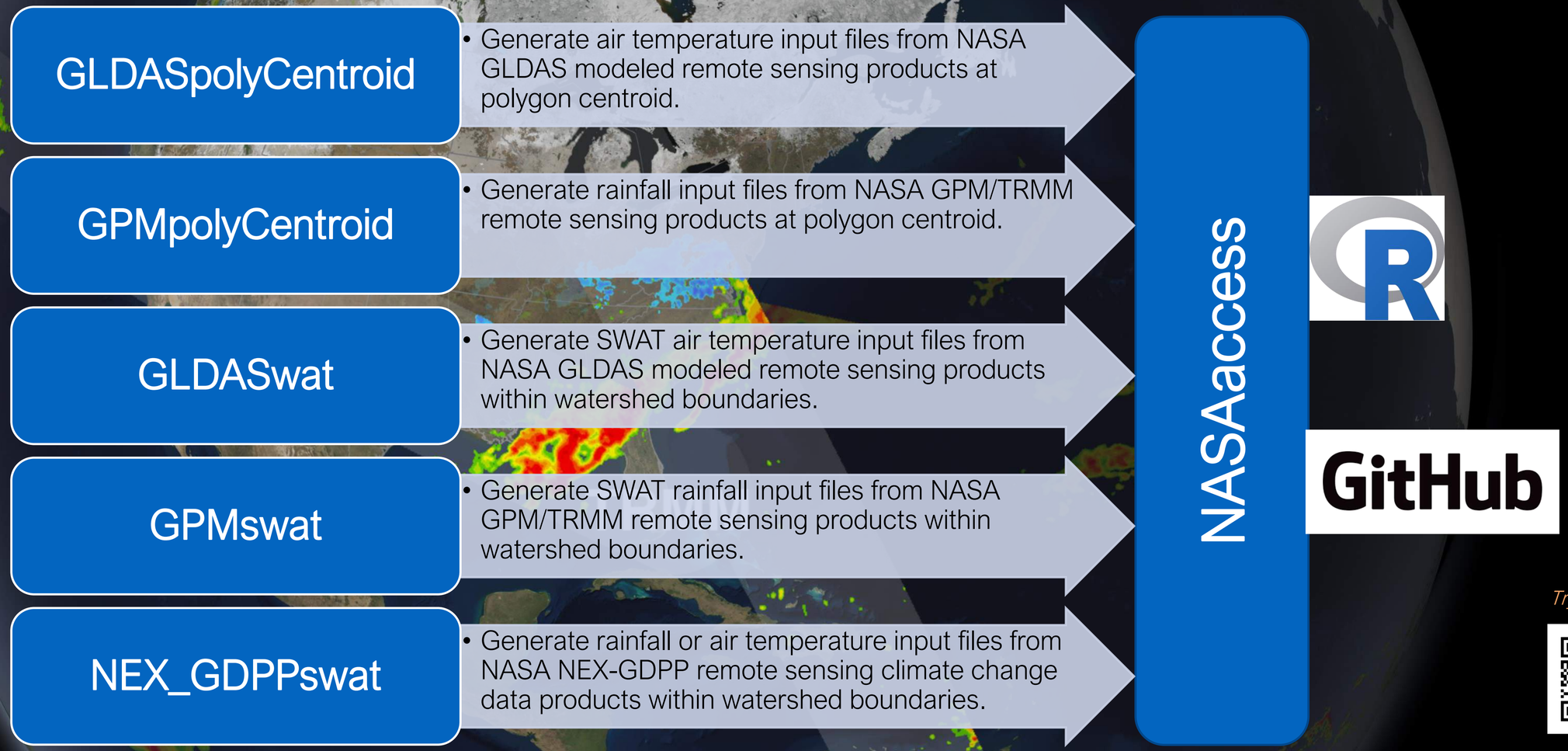
- Our work suggests that increased flow releases from the Upper Mekong River Basin would mean more flooded days as well as higher frequency of flood occurrences specially at Mukdahan (Thailand), Pakse (Laos), and Kratie (Cambodia).



Flood duration analyses. The flood duration in days are the number of days when discharge equals or exceeds a threshold discharge magnitude causing floods. Black bars give flood duration in days for the 1960–2015 time period calculated from observed discharges, and blue bars give flood duration calculated from simulated discharges with the UMRB inflow increased by 30%.

Mohammed, I.N., Bolten, J.D., Srinivasan, R., Lakshmi, V., 2018. Satellite observations and modeling to understand the Lower Mekong River Basin streamflow variability. J. Hydrol. 564, 559-573, https://doi.org/10.1016/j.jhydrol.2018.07.030

NASAaccess - Downloading and reformatting tool for NASA Earth observation data products



GitHub

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GPM

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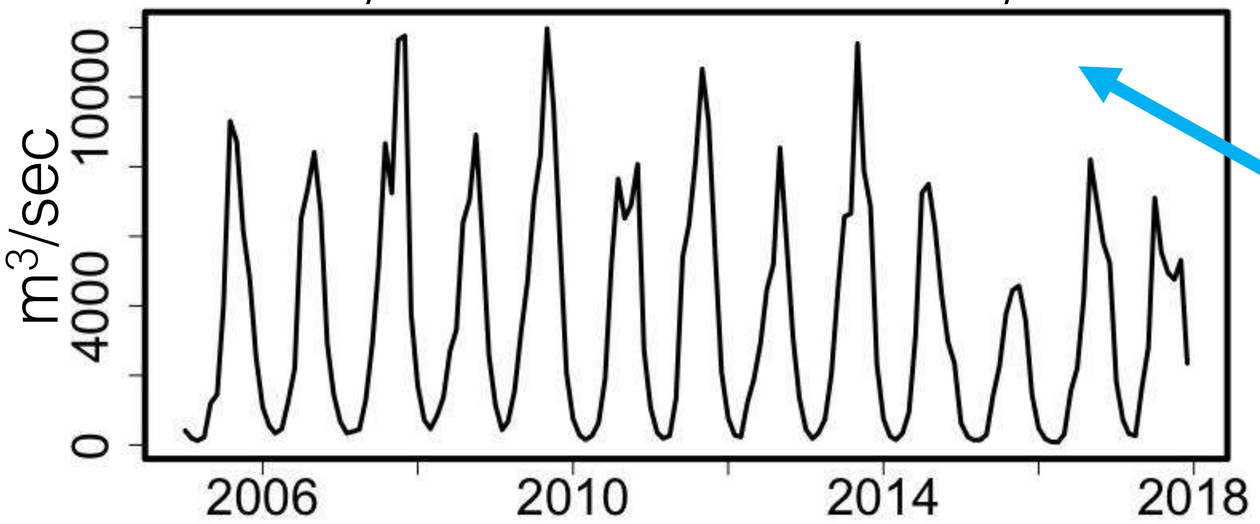
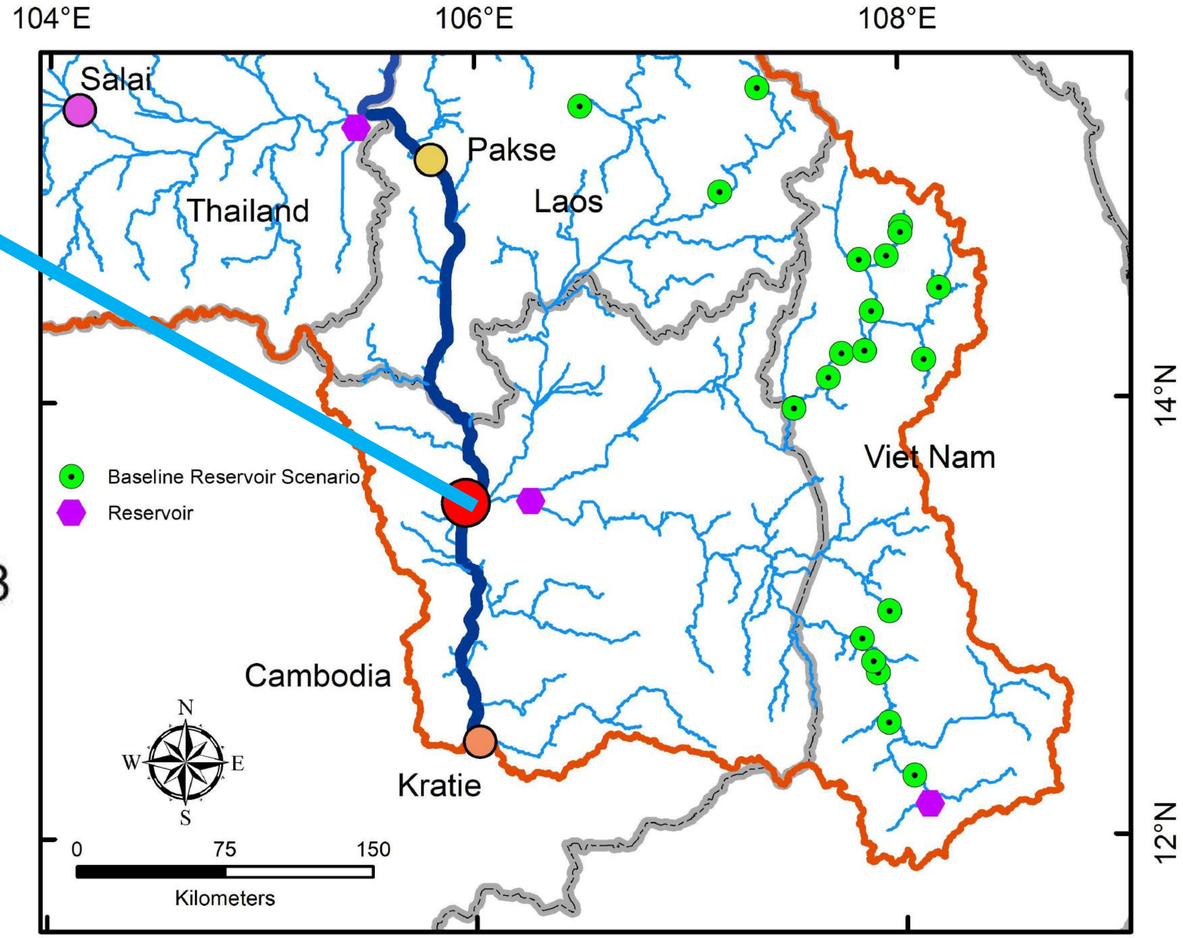
SAIC

On the flood's socioeconomic impacts at the Lower Mekong River Basin – On Going Work…

Enhancement quantification of the FHI components



Streamflow output from the Srepok, Sesan, and Sekong (3S) River Basins



After the completion of this work analysis it will be submitted to Nature Geosciences highlighting the NASA-CI partnership

THANK YOU!

FOR ADDITIONAL INFORMATION PLEASE
VISIT **FRESHWATERHEALTHINDEX.ORG**

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