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Insights on Streamflow Variability in the Lower Mekong River Basin Using In-situ Observations, Modeling, and NASA Satellite Observations

Ibrahim N. Mohammed♠•*, John Bolten♠, Raghavan Srinivasan♦, Venkat Lakshmi♣

*Ibrahim.mohammed@nasa.gov

ResearcherID: H-7798-2013

♠Hydrological Sciences Laboratory, NASA Goddard Space Flight Center, Mail Code 617.0, Greenbelt, Maryland, 20771, USA
•Science Applications International Corporation, 12010 Sunset Hills Road, Reston, Virginia, 20190, USA
♦Texas A&M University, Department of Ecosystem Science and Management, College Station, Texas 77843, USA
♣University of South Carolina, Department of Earth and Ocean Sciences, Columbia, South Carolina 29208, USA

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1 HIGHLIGHTS

- Remote sensing data advances the understanding of the Lower Mekong streamflow variability.
- Lower Mekong water variability implications are immense in response to Upper Mekong water resources management.
- Lower Mekong streamflow is highly variable with a low predictability (Colwell index of 32%).
- The principal value of the Colwell index used in this work is assessing the uncertainty of the Lower Mekong environment due to the Upper Mekong water resources management.

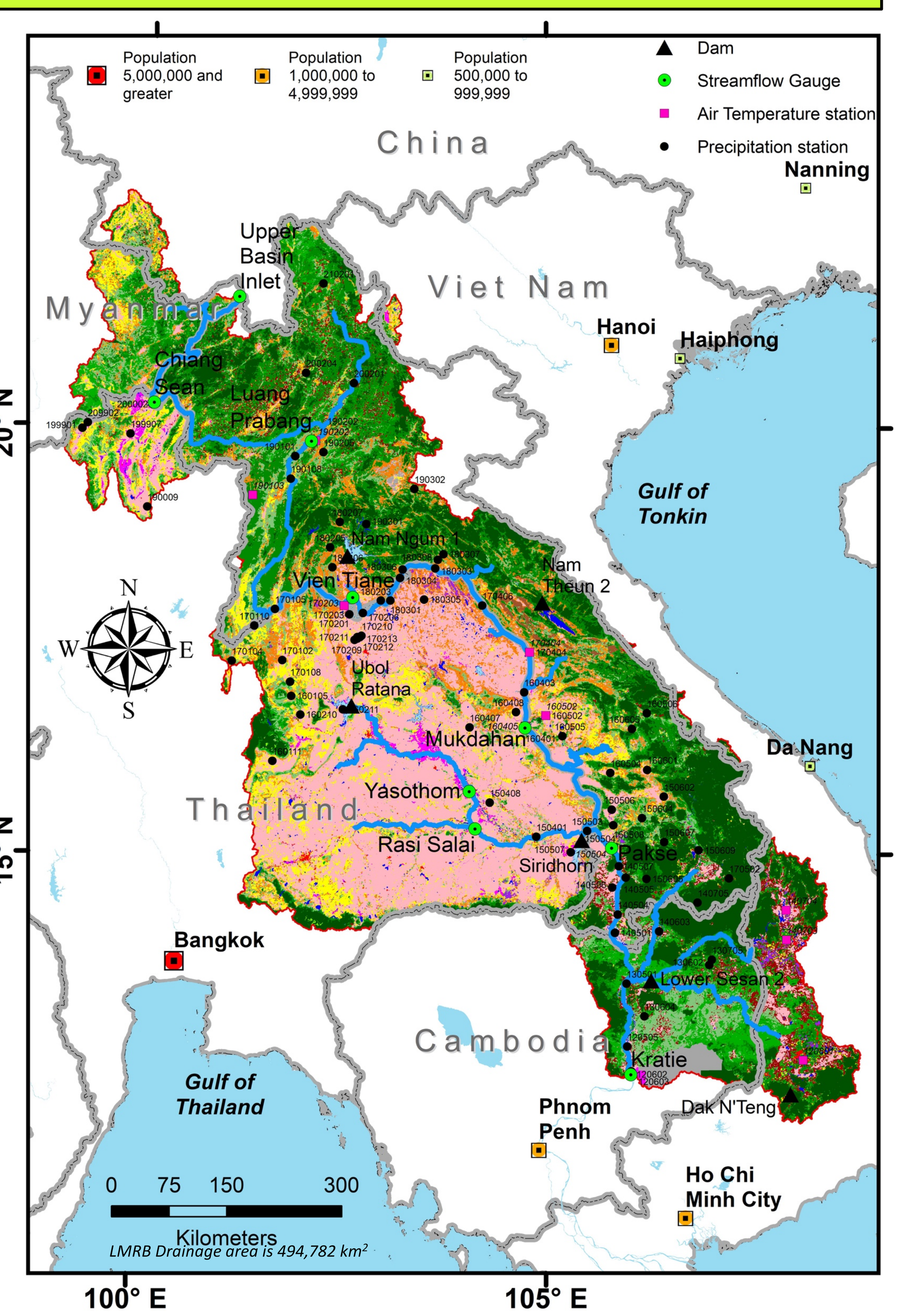
2 OBJECTIVES

The main objective of this work is the better understanding of the hydrological cycle of the Lower Mekong River Basin (LMRB), and the floodplain management over the basin. We explore the streamflow variability of the Lower Mekong River by examining the impacts associated with changes in the Upper Mekong River Basin (UMRB) inflow. The UMRB inflow to the Lower Mekong changes are generally due to reservoir construction for hydropower development.

3 METHODS

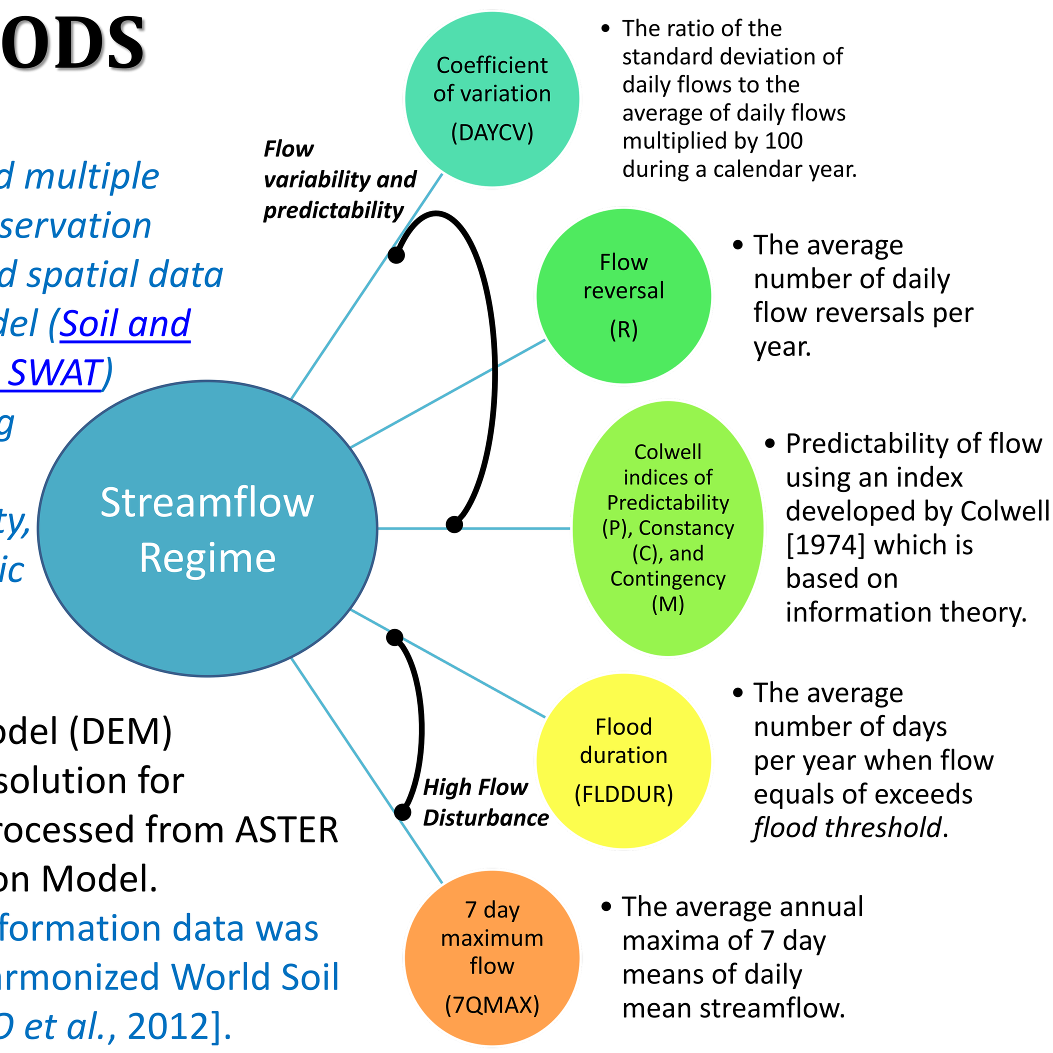
- The Mekong River originates in the high altitude of the Tibetan Plateau in China and flows south through five countries (**Myanmar, Lao PDR, Thailand, Cambodia, and Vietnam**) ending in a large delta before exiting to the South China Sea. The Mekong River Basin is divided into the Upper and the Lower basins. The Lower Mekong River Basin Model developed follows basin subareas presented by *Rossi et al.* [2009].

Sub-basin	Streamflow Gauge
SB1	Chiang Sean, Thailand
SB2	Luang Prabang, Laos (PDR)
SB3	Vien Tiane, Laos (PDR)
SB4	Mukdahan, Thailand
SB5	Pakse, Laos (PDR)
SB6	Kratie, Cambodia



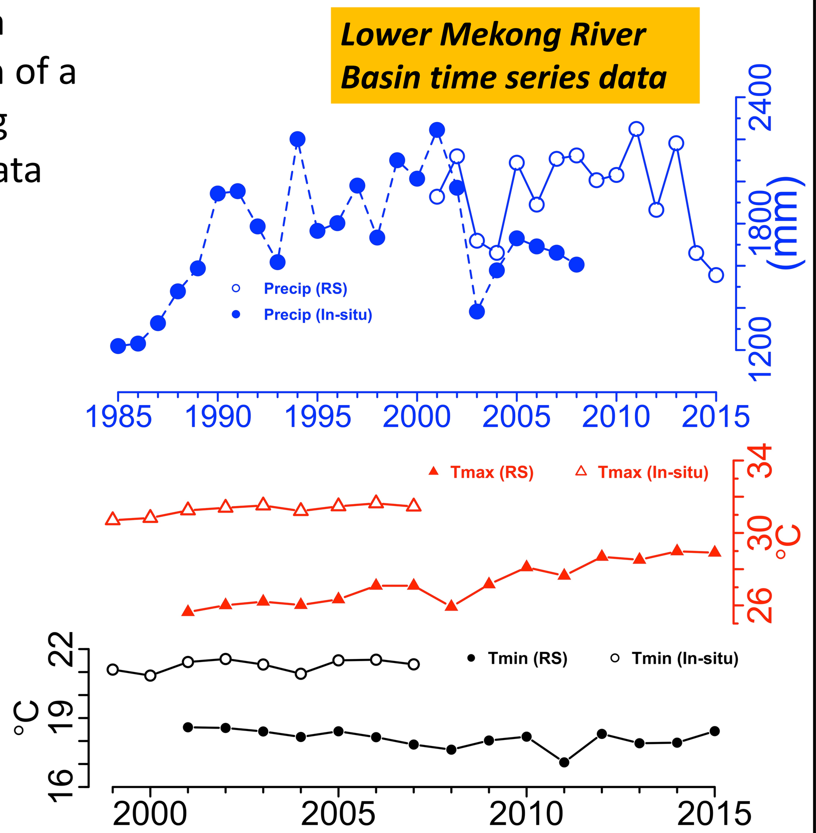
3 METHODS

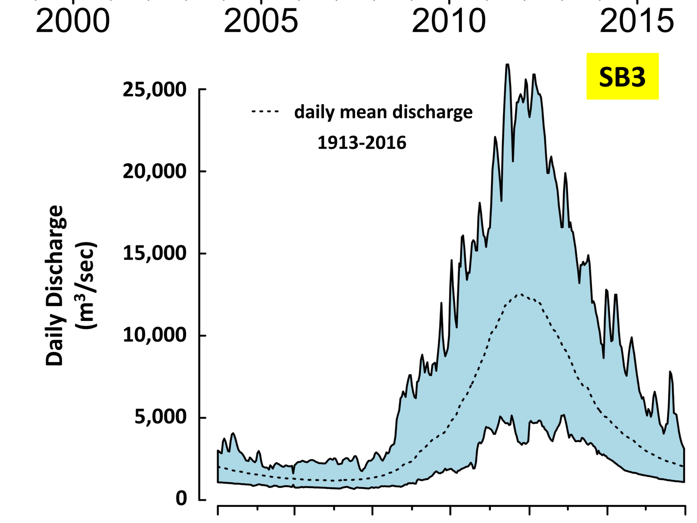
This work has integrated multiple satellite-based earth observation systems, in-situ data and spatial data with the hydrologic model ([Soil and Water Assessment Tool, SWAT]) employed in the Mekong River Basin region to explore water availability, based on both hydrologic flows and total water demands/use.



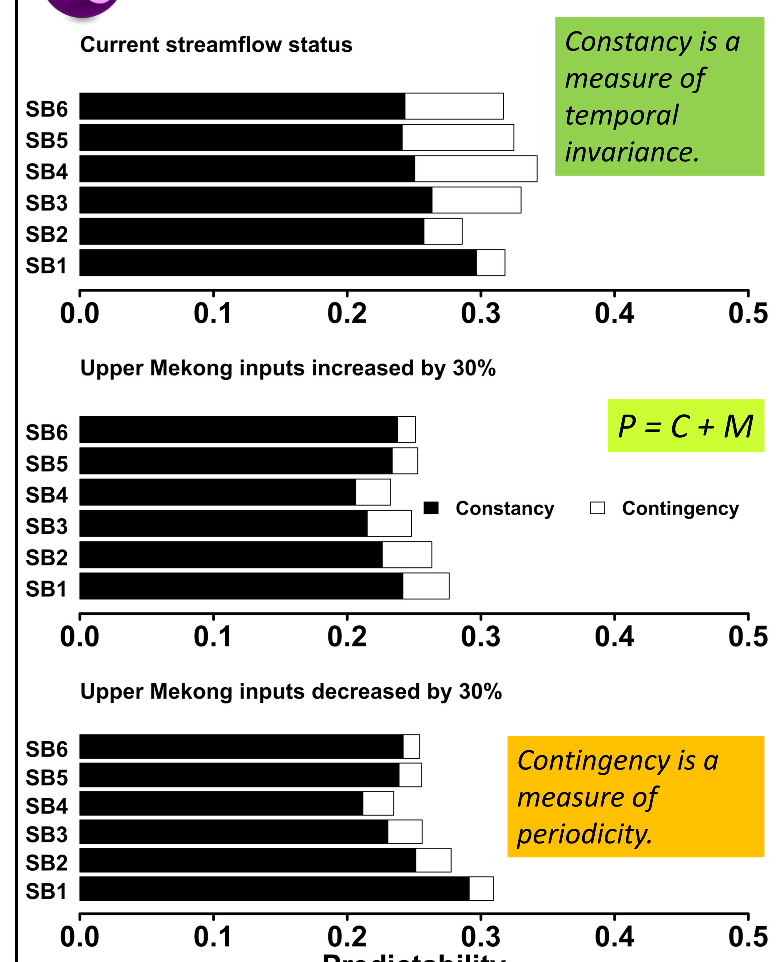
- A digital elevation model (DEM) with 1 arc-sec grid resolution for the study area was processed from ASTER Global Digital Elevation Model.
- The study area soil information data was obtained from the Harmonized World Soil Database, HWSD [*FAO et al.*, 2012].
- The Land Use Land Cover (LULC) data was developed at a spatial resolution of a 0.25 kilometer for the Lower Mekong Basin using 2010 MODIS and NDVI data [*Spruce et al.*, 2017].
- Daily cumulative precipitation data was used from the GPM and TRMM datasets.
- Minimum and maximum daily air temperature data was calculated from GLDAS air temperature records [*Rodell et al.*, 2004].
- Wind speed, relative humidity and solar radiation data was estimated using the global reanalysis weather data from the National Centers for Environmental Prediction (NCEP), and Climate Forecast System Reanalysis (CFSR).
- Daily in-situ precipitation, streamflow, and minimum and maximum air temperature data was retrieved from the MRC and ADPC repositories.
- Dam characteristics data was implemented from CGIAR Research Program on Water, Land and Ecosystems database [WLE, 2017].

Lower Mekong River Basin time series data

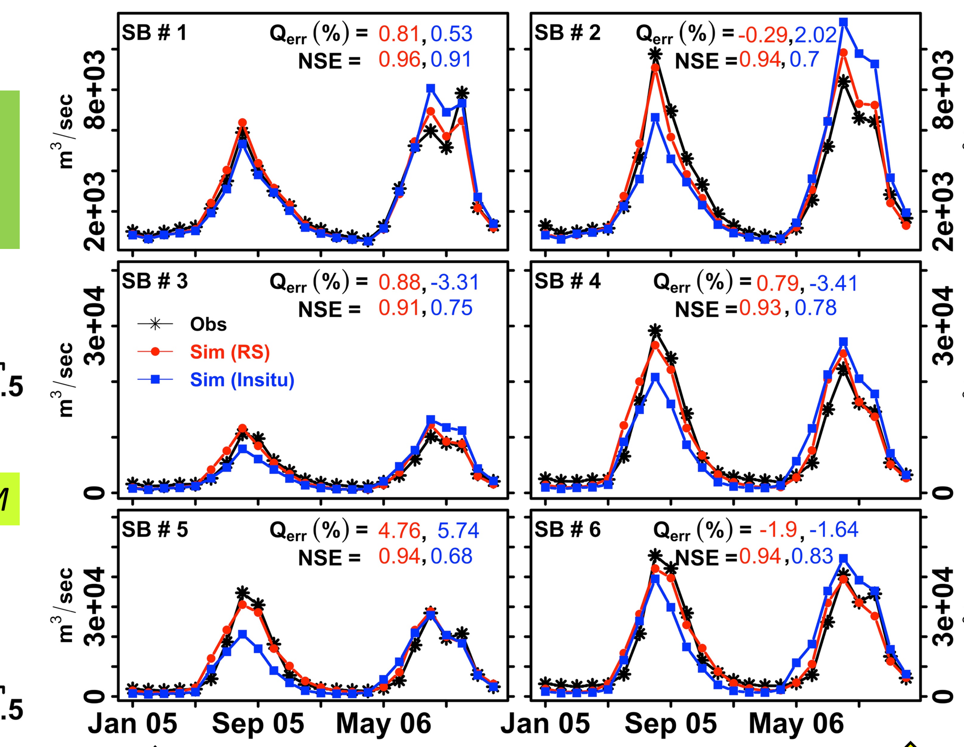




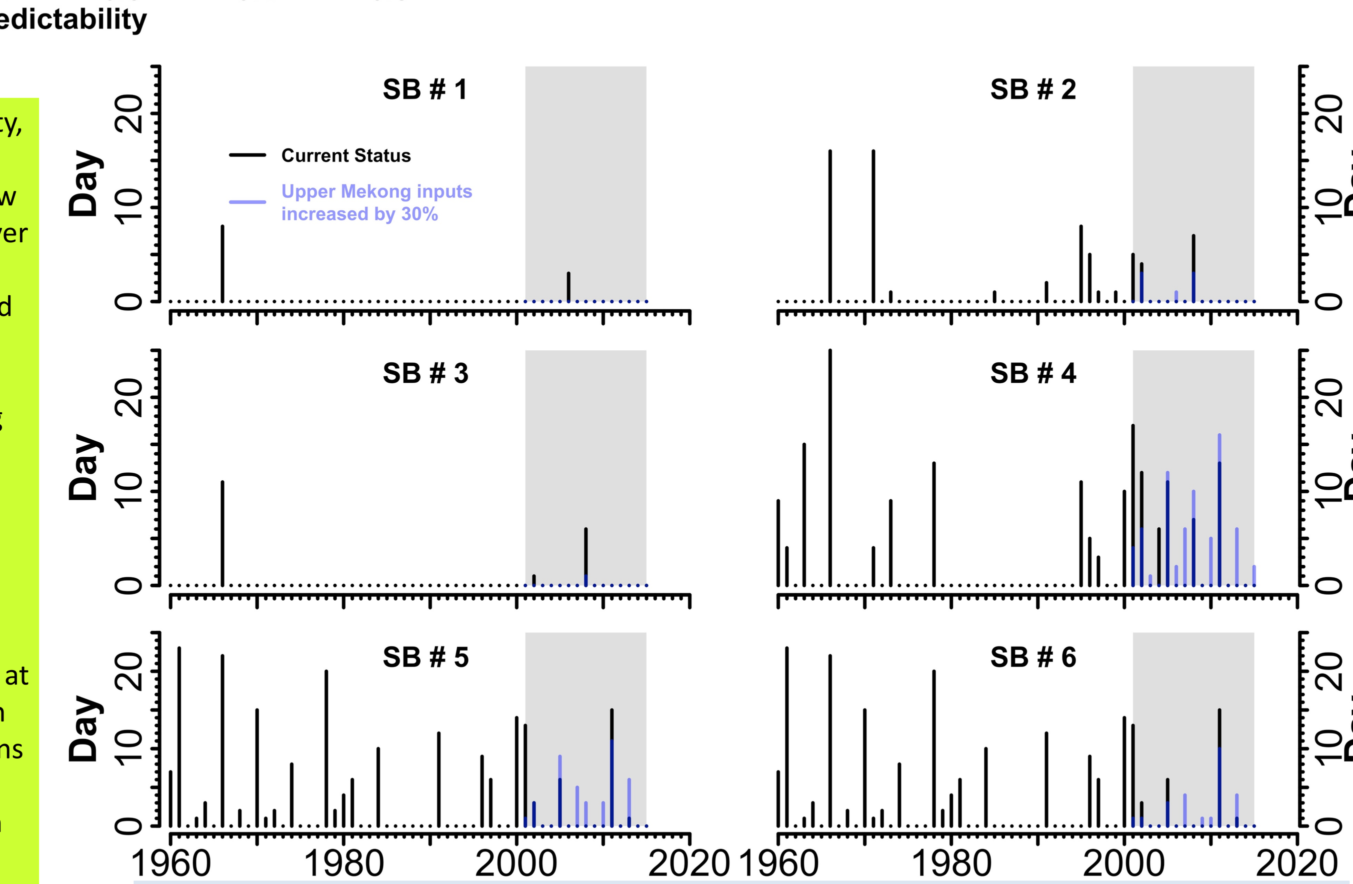
4 RESULTS



Colwell index Predictability, Constancy, and Contingency of streamflow for the Lower Mekong River Basin (2001–2015). The Constancy at the observed historical predictability is on average of 26%. This suggests that the Mekong River streamflow gauges predictability are due to high constancy of streamflow which varies little among months and years studied. Therefore, the streamflow discharge at the Lower Mekong (which never varies across seasons during years studied) is perfectly predictable with all the predictability deriving from the constancy component.



Monthly mean observed and simulated discharge in m^3/sec at six sub-basin watersheds in calibration of the SWAT model. PRECIPITATION, CN2, AWC, ESCO, GWHT, GW_DELAY, GWQMN, REVAPMN, GW_REVAP, and RCHRG_DP were found to be the needed parameters for calibration.



Flood duration analyses at the LMRB. 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%.

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