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Insights on streamflow variability in the Lower Mekong River Basin using in-situ observations, modeling and NASA satellite observations

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The aim of this research is to advance the understanding of the streamflow variability of the Lower Mekong River Basin (LMRB) through the combination of modeling and satellite remote sensing. In this study, we utilized the Soil and Water Assessment Tool (SWAT) to examine the impacts associated with anticipated changes in the inflow from the Upper Mekong River. This work serves as a novel combination of remotely sensed satellite observations and a catchment scale model (SWAT). Two model sets were developed and assessed for this work. The first developed SWAT model enables the integration of satellite-based daily remote sensed precipitation (TRMM and GPM), air temperature (GLDAS), digital elevation model, soil information (HWSD), dam information layer, and land cover and land use data to drive SWAT model simulations over the Lower Mekong River Basin. The second SWAT model set developed was driven by in-situ climate observations as well as the above static layers. The SWAT models driven by remote sensing and in-situ climate data were calibrated and verified with observed runoff data at the watershed outlet as well as at multiple sites along the main stem of the Lower Mekong River. The SWAT model driven by remote sensing climate performed better in calibration and verification metrics as compared to the SWAT model driven by in-situ data. It is worth to mention here that the SWAT models' performance comparison was based on monthly flows output, so some amount of temporal and spatial aggregation may have masked individual event prediction or adds uncertainty. The Mekong regional in-situ climate data network is sparse and over short temporal periods as compared to the available satellite remote sensing data. Therefore, we adopt the SWAT model driven by satellite remote sensing climate data. Our work results suggest that the Lower Mekong River streamflow is highly variable and has a low predictability (Colwell index of 32%). We find that release of more water from the upstream Mekong during rainy season would affect flood duration in terms of more flooded days and higher frequency of downstream occurrence of floods. Our results also suggest that releasing more water from upstream Mekong during rainy season (for instance by 30%) would imply a further reduction in the Lower Mekong streamflow predictability (i.e. Colwell index reduces to 25%). This means our ability to predict floods/droughts at the Lower Mekong River would be affected to if there are any anticipated changes (i.e. increase/decrease) from upstream flow releases. Results from this work present a framework for improving the decision-making process and aid to the Lower Mekong River Basin to address challenges in hydrologic modeling. The coupled model framework presented is part of SERVIR, a joint capacity building venture between NASA and the U.S. Agency for International Development, providing state-of-the-art, satellite-based earth monitoring, imaging and mapping data, geospatial information, predictive models, and science applications to improve environmental decision-making among multiple developing nations.