A Novel Approach for Evaluation of Hydrodynamic Model by Integrating Performance for Multiple Variables

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November 23, 2022

Abstract

Large-scale river hydrodynamic model act as fundamental tool for many scientific applications related to water cycle, biogeochemistry, and carbon cycle. Even though process representation in the physically based hydrodynamic models has improved significantly in recent times, due to many error sources the uncertainty reduction and evaluation remains a key issue. Previously most of the research focused on the evaluation of hydrodynamic model considering single variable only i.e., discharge due limitations related to models and data availability. The recent advances in hydrodynamic modelling and remote sensing helped to overcome limitation. Some recent studies performed calibration and validation considering multiple variables but were unable to integrate them into a single evaluation score due to different spatial and temporal dimension of variables and thus make it hard to judge the overall performance. Here, we have evaluated the performance of Catchment-based Macroscale Floodplain (CaMa-Flood) hydrodynamic model over Amazon basin considering multiple variables i.e., discharge (Q), water surface elevation (WSE) and flooded area (FA) for a topography data multi-error removed improved terrain (MERIT) DEM. We proposed an evaluation method and introduced a metric "overall basin skill score" (OSK) to integrate the performances due to multiple (three here) variables considering their spatial distribution via a sub-basin approach and provide the evaluation on a scale of 0 to 1. The integrated method showed the robustness in the method and able to detect the best river channel depth parameter set with maximum OSK of 0.57, whereas the evaluation using single variable proved inadequate due to different sensitivity of variables and maximum metric score were obtained for many parameters sets. The proposed method enables a balanced evaluation of different variables and proved useful to integrated multivariable model evaluation with reducing the chances of getting the right results due to wrong reasons. Preprint related to this work: https://doi.org/10.1002/essoar.10506596.1

A NOVEL APPROACH FOR EVALUATION OF HYDRODYNAMIC MODEL BY INTEGRATING PERFORMANCE FOR MULTIPLE VARIABLES

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Dec 16, 2021

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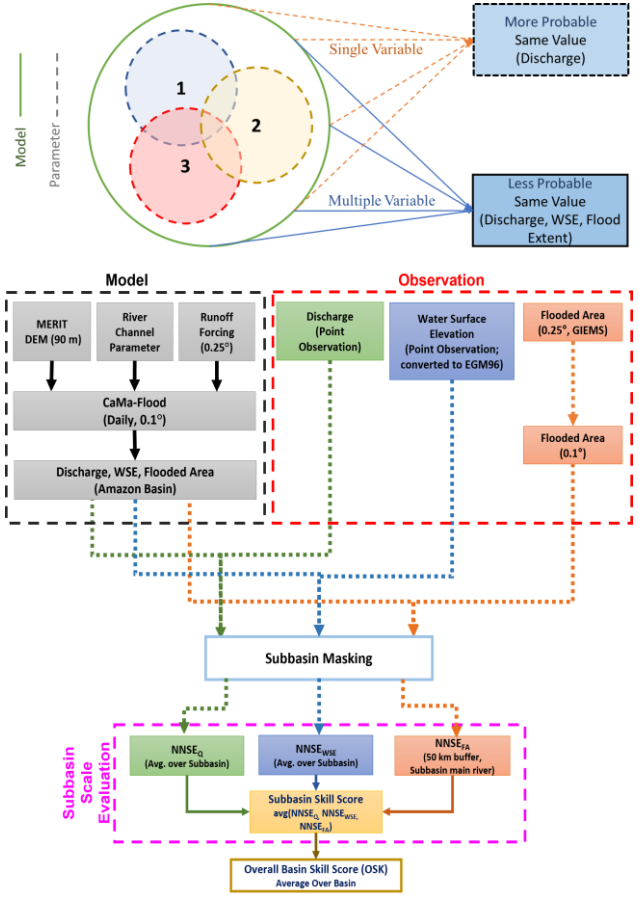
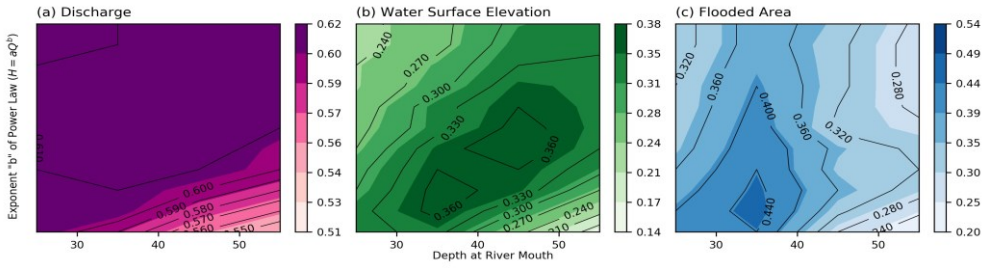
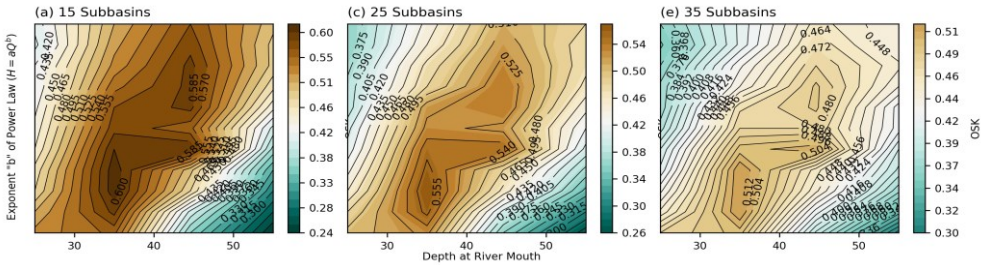
A NOVEL APPROACH FOR EVALUATION OF HYDRODYNAMIC MODEL BY INTEGRATING PERFORMANCE FOR MULTIPLE VARIABLES



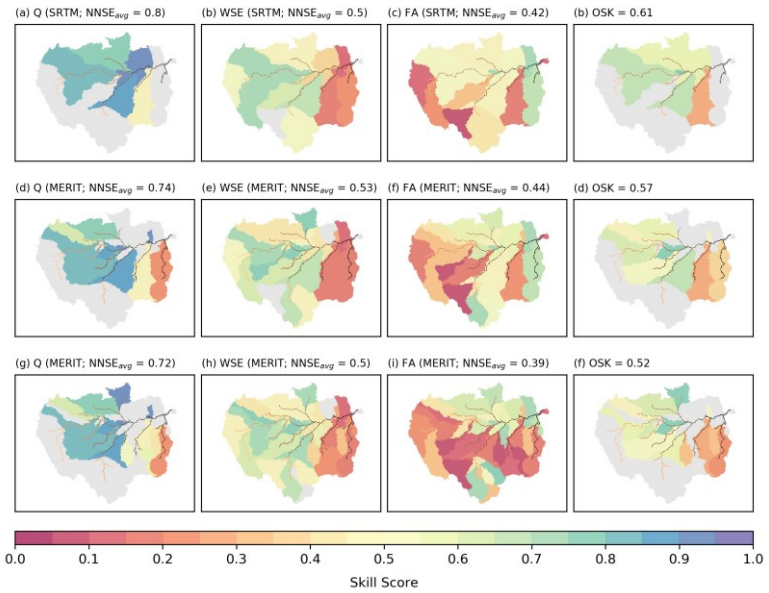
Performance Contour – Single variable



Performance Contour – Multivariable Integrated



$$OSK = \frac{1}{K}\sum_{i=1}^{K}\left(W_Q \times \frac{1}{m}\sum_{j=1}^{m} NNSE_{Q,i,j} + W_{WSE} \times \frac{1}{n}\sum_{j=1}^{n} NNSE_{WSE,i,j} + W_{FA} \times NNSE_{FA,i}\right)$$



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