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Advancement of Satellite-based Rainfall Applications for Hydrologic Modeling in Topographically Complex Regions

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Accuracy and reliability of hydrological modeling studies heavily depends on quality and availability of precipitation estimates. However hydrological studies in developing countries, especially over complex topography, are limited due to unavailability and scarcity of ground-based networks. In this study we evaluate three different satellite-based rainfall retrieval algorithms namely, Tropical Rainfall Measuring Mission Multi-satellite Precipitation Analysis (TMPA), NOAA/Climate Prediction Center Morphing Method (CMORPH) and EUMETSAT's Multi-Sensor Precipitation Estimate (MPE) over orographically complex Western Black Sea Basin in Turkey, using a relatively dense rain gauge network. Our results indicated that satellite-based products significantly underestimated the rainfall in regions characterized by orographic rainfall and overestimated the rainfall in the drier regions with seasonal dependency. Further, we devised a new bias adjustment algorithm for the satellite-based rainfall products based on the "physiographic similarity" concept. Our results showed that proposed bias adjustment algorithm is better suited to regions with complex topography and provided improved results compared to the baseline "inverse distance weighting" method. To evaluate the utility of satellite-based products in hydrologic modeling studies, we implemented the MIKE SHE-MIKE 11 integrated fully distributed physically based hydrological model in the study region driven by ground-based and satellite-based precipitation estimates. Model parameter estimation was performed using a constrained calibration approach guided by multiple "signature measures" to estimate model parameters in a hydrologically meaningful way rather than using the traditional "statistical" objective functions that largely mask valuable hydrologic information during calibration process. In this presentation we will provide a discussion of evaluation and bias correction of the satellite-based precipitation products and further provide an analysis of their utility in flood simulation over topographically complex regions.