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Evaluation of Precipitation Resolution and Quantification Error Effects on Flood Modeling of Mid-Latitude Basins

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Precipitation products from satellite remote sensing and global reanalysis are the main data sources for flood forecasting and water resources management at global scale. However, these precipitation datasets have quantification uncertainties and resolutions that affect the accuracy of hydrologic simulations. This study assesses the resolution and precipitation error propagation effects on flood modeling for a range of basin scales (50 – 5,000 km2) based on multi-year (2002-2011) simulations of the Housatonic River Basin in Northeastern United States. The study is facilitated by the recently released NOAA/NSSL high-resolution (1km/5min) multi-sensor precipitation product (named MRMS, Multi-Radar/Multi-Sensor System), and a hyper-resolution distributed hydrologic model (Shen and Anagnostou, 2017) that strictly couples water and energy balances at the soil-vegetation-atmosphere-snow layer (named CREST-SVAS). The precipitation datasets evaluated in this study are the NCEP multi-sensor precipitation analysis (Stage IV) (available at 4km/hourly), the North-America Land Data Assimilation (NLDAS) reanalysis system precipitation dataset (available at ∼14-km/hourly) and the TRMM Multi-satellite Precipitation Analysis (3B42V7) (available at 25 km/3-hourly). The MRMS is used as the reference precipitation for the evaluation of the hydrologic simulation errors. Observed streamflows are used to evaluate the MRMS driven CREST-SVA flow simulation performance. The study presents error metrics for both moderate and extreme flood events over the study area. Error propagation will be investigated in terms of precipitation resolution aspects (25km-14km-4km-1km) and rainfall quantification errors using different flood event parameters (events' flood peak, volume and time-to-peak). Basin scale effects will be investigated by grouping error statistics to three different scales: 50-200 km2, 500-2000 km2 and the entire Housatonic watershed (∼5,000 km2). In addition, we will examine the effect of the different precipitation products on the evaluation of peak flows for different return periods (10, 25, 50 and 100 years).

Shen, X. and E.N. Anagnostou, 2017: A framework to improve hyper-resolution hydrological simulation in snow-affected regions, Journal of Hydrology, Vol. 552, Pages 1-12 (https://doi.org/10.1016/j.jhydrol.2017.05.048).