MERIT Hydro: a new global hydrography map based on multiple satellite observations, and its application to model-satellite integration in global river hydrodynamic simulations

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High-resolution raster hydrography maps are a fundamental data source for many geoscience applications. Here we introduce MERIT Hydro, a new global flow direction map at 3sec resolution derived from the latest elevation data (MERIT DEM) and water body data sets (G1WBM, Global Surface Water Occurrence, and OpenStreetMap). We developed a new algorithm to extract river networks near automatically by separating actual inland basins from dummy depressions caused by the errors in input elevation data. After a minimum amount of hand editing, the constructed hydrography map shows good agreement with existing quality-controlled river network data sets in terms of flow accumulation area and river basin shape. MERIT Hydro improves on existing global hydrography data sets in terms of spatial coverage (between N90 and S60) and representation of small streams, mainly due to increased availability of high-quality baseline geospatial dataset. We then integrated the MERIT Hydro into the global river hydrodynamic model CaMa-Flood, to utilize the advantage of high-accuracy topography datasets for global river and floodplain simulations. The new CaMa-Flood simulation with MERIT Hydro showed better agreement to various satellite observations of surface waters, compared to the old simulation with SRTM and HydroSHEDS. Flooding of swamp forest was better represented with MERIT Hydro, due to the tree canopy bias removal in MERIT Hydro. Also, direct comparison of absolute water surface elevations between satellite altimetry and hydrodynamic models was first achieved, since absolute elevation bias (up to 10m in SRTM) was removed. Given that the uncertainty in the baseline topography data was largely reduced by the development of MERIT DEM, the direct comparison of surface water dynamics between model and satellite became meaningful. For example, we cannot attribute the error in simulated variables (water level, inundation extent, and discharge) to a specific cause (runoff, bathymetry) if baseline topography has large uncertainty. We introduce our latest activity on utilizing direct satellite-model comparison to estimate channel bathymetry in JpGU presentation.

