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Assessing Remote Topographic Datasets: Comparing ASTER GDEM, SRTM and the Role of Icesat/GLAS Transect Data with Survey Control Points for Floodplain Modelling

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Topographic data plays a critical role in water resources modeling Raster-based DEMs are the basis for deriving topographic attributes used in hydraulic and hydrologic modeling such as slope, stream network, basins boundary and area. Accurate models of floodplain topography are essential for having accurate output of hydrologic models. The Shuttle Radar Topography Mission (SRTM) provides near-global topographic coverage of the Earth's surface with horizontal resolution of 1-3 arc seconds (30-90m) and with <=16 m absolute vertical height accuracy, <= 10 m relative vertical height accuracy and <=20 m absolute horizontal circular accuracy. The new Global Digital Elevation Model (GDEM) from optical stereo data acquired by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) was recently released with the resolution of 1 arc second and a nominal vertical accuracy of 7-14 m. The ICESat/GLAS (Ice, Cloud, and land Elevation Satellite/Geoscience Laser Altimeter System) satellite collects globally-distributed surface topographic data in transects approximately 80 km apart at an accuracy of 2.4-7.3 m horizontal error and 0.04-0.13 m vertical accuracy per degree of incidence angle.

We compared the ICESat GLA14 elevation products (Land/Canopy elevations) for the Laser 3a observation period and Release 31 and corresponding SRTM and ASTER GDEM at the location of 5000 ground survey control points from a 9x9degree (900x1000 km) area in Queensland, Australia. This area contains large and remote river basins, where these datasets provide an invaluable resource from which river floodplain inundation can be measured and modelled. We also used the ICESat satellite altimetry points to conduct further assessment of the ASTER GDEM and SRTM DEMs more widely over the study area. Our ICESat-control point, ICESat-DEM and DEM-DEM analysis shows that SRTM DEMs are more suited than ASTER GDEM data for large scale hydrologic studies in our basins, even with the lower spatial resolution. The ASTER GDEM shows inland water noises and other noises like straight lines which are caused by the methods that are used to produce them that affect replication of hydrological processes. Our study also demonstrated a potential for using survey datum to provide a reliable assessment of relative and absolute ground topographic accuracies which allowed us to correct absolute elevation errors through datum adjustment by analyzing the difference of the SRTM DEM and ICESat elevations, with corrections made to the DEM for hydrological modeling applications. The ICESat data also provides a higher-accuracy topographic dataset at locations of the transects that allowed us to validate floodplain models derived from SRTM.