High-resolution mapping of lake and floodplain topography from space

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Terrain elevation data are essential for land management, navigation, and earth science applications. Digital elevation models (DEMs) can be created for land as well as underwater surfaces, and remote sensing advancements have led to the increase in the availability of a range of DEMs over the land. However, the generation of underwater DEMs usually requires the shorelines delineation of the water body, and in regions with many lakes, such approach have high processing costs. Currently, there is no systematic mapping of lakes and channels bathymetry of large and complex wetlands using remote sensing data.

We present here the first high-resolution topographic mapping (30 m) of the central Amazon floodplain (~1100 km extension of the Amazon River) using a new method based on water surface elevations and a flood-frequency map derived from Landsat images. Validation using field bathymetric surveys presented a Root Mean Square Error (RMSE) of 1.30 m in floodplain elevations and Pearson's correlation coefficient of 0.73. These results indicate adequate spatial representation over a large complex floodplain geomorphology and important improvements relative to the SRTM (RMSE of 3.55 and Pearson's coefficient of 0.22). The method can be applied to temporarily flooded regions, with the advantage of not requiring lake delimitation. Finally, this method provides synergism with the forthcoming satellite SWOT mission for advancements in hydrological, ecological and geomorphological studies of floodplain as the projected increase in availability of surface water elevation data will enhance its applicability and yield unprecedented opportunities to create new datasets of floodplain DEMs and lakes storage volumes.