EXTRACTION OF ABSOLUTE WATER LEVEL IN THE FLORIDA EVERGLADES USING TANDEM-X BISTATIC SCIENCE PHASE OBSERVATIONS WITH A LARGE PERPENDICULAR BASELINE

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Abstract: High spatial resolution maps of relative water level changes in wetlands environment have been successfully generated using spaceborne interferometric synthetic aperture radar (InSAR) techniques. However, the wetland InSAR application is often limited for hydrological monitoring, because it does not estimate absolute water levels continuously flowing water surfaces over time, when using a repeat-pass interferometric pair. TanDEM-X bistatic observations provide simultaneous phase measurements on water surfaces with a two-satellite constellation without temporal decorrelation. In this study, TanDEM-X bistatic science phase observations with very large baseline (> 1.3 km) geometric configuration were evaluated to extract absolute water levels of the Everglades wetland in south Florida, U.S.A. Thanks to the advantage of the large perpendicular baseline, spatial variation of water level surfaces with extremely low slope were estimated. We processed two datasets of TanDEM-X bistatic observations acquired on 26 and 31 August 2015. The perpendicular baseline is 1.43 km and 1.36 km and the height of ambiguity was calculated as 3.61 m and 3.90 m in each interferometric pair. The estimated absolute water level maps with 3.6 m and 7.4 m pixel spacing in range and azimuth directions (multilook factor of 4), respectively, show vast detailed variation of the water surface. Hourly water level measurement from stage stations provided by the Everglades Depth Estimation Network (EDEN) were obtained for verifying the estimated absolute water levels. Some of stage stations, which are located in low interferometric coherence areas such as dense vegetated and tree areas, were considered as outliers. The verification results show good agreement (code of determination > 0.75) between the TanDEM-X derived absolute water levels and stage station measurements. The root mean square error (RMSE) between the TanDEM-X results and stage records for the two datasets were 11.3 cm and 9.4 cm. Although, TanDEM-X bistatic observations have no temporal baseline, there are severe volume decorrelation over various types of trees due to its very large perpendicular baseline. The TanDEM-L mission with longer wavelength of radar signal will enable us to generate more coherent interferometric phase observations over wetlands and, consequently generate improved absolute water level maps.

Keywords: TanDEM-X, Wetland, Water level, Everglades, TanDEM-X science phase, Perpendicular baseline