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Sea surface wind field by TerraSAR-X and Tandem-X data

Xiaoming Li and Susanne Lehner
Remote Sensing Technology Institute, German Aerospace Center (DLR), Germany (Xiao.Li@dlr.de)

A new Geophysical Model Function (GMF), denoted XMOD2, is developed to retrieve the sea surface wind field from X-band TerraSAR-X/Tandem-X (TS-X/TD-X) data. In contrary to the previous XMOD1, XMOD2 is based on a nonlinear GMF, and moreover it also depicts the difference between upwind and downwind of the sea surface backscatter. By exploiting 371 collocations, the retrieved TS-X/TD-X sea surface wind speed U_{10} by XMOD2 agrees well with *in situ* buoy measurements with a bias of 0.39 m/s, an RMSE of 1.52 m/s and a scatter index (SI) of 16.1%. To apply XMOD2 to TS-X/TD-X data acquired at HH polarization, we verify the X-band SAR Polarization Ratio (PR) models by comparing the retrieved sea surface wind speed to *in situ* buoy measurements as well. Based on 62 collocated pairs, it is found that by using the Elfouhaily type PR model and XMOD2 yields better U_{10} retrieval with a bias of -0.27 m/s, an RMSE of 2.06 m/s and a SI of 22.7% than using the X-PR model which yields a bias of -0.98 m, and RMSE of 2.30 m and a SI of 23.4%.

Several TerraSAR-X and TanDEM-X ScanSAR images are acquired in October, 2012 to track the Hurricane Sandy. Three of the images are acquired in the open sea, which are presented in this chapter to demonstrate observations of sea surface wind and wave extracted from X-band ScanSAR image with high spatial resolution of 17 m in the hurricane.

In the case of the TerraSAR-X image acquired on October 26, 2012, we analyze the peak wave direction and length of swell generated by Hurricane Sandy, as well as interaction of swell with the Abaco Island, Bahamas. In the other two cases, sea surface wind field derived from the TerraSAR-X and TanDEM-X acquired on October 27 and 28 are presented. The sea surface wind speed retrieved by the X-band Geophysical Model Function (GMF) XMOD2 using wind direction derived from SAR images and the NOAA Hurricane Research Division (HRD) wind analyses are both presented for comparisons. We also compare the retrieved sea surface wind speed with Stepped Frequency Microwave Radiometer (SFMR) to quantify effect of rainfall on X-band SAR images.