High Resolution Ocean Winds Retrieved from TerraSAR-X

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Abstract: The possibility for retrieving wind fields from C-band synthetic aperture radar (SAR) data is well developed and validated and is currently used to produce operational wind maps. With the X-band SAR aboard the German TerraSAR-X and the L-band SAR aboard the Japanese ALOS, two additional frequencies have become available. It is quite possible that quantitative characterization of differences in SAR imagery of a particular ocean process collected at different radar frequencies can yield significant improvements in the extraction of geophysical parameters. At present several international research groups are addressing multi-frequency and multi-polarization SAR retrieval techniques. One of the major limitations in this research is the lack of a reliable Geophysical Model Function (GMF) that relates the X- and L-band backscatter of the ocean surface to the local surface wind vector.

We report here the development of a GMF for X-band, which was utilized to retrieve ocean surface wind speeds from TerraSAR-X data. Therefore, a simple, physics-based X-band GMF was constructed that utilizes wind-dependent models of the ocean surface roughness spectrum. Furthermore, an empirical X-band GMF was developed that is based on the interpolation of the standardized Ku-band and C-band GMFs, which are operationally used for wind retrieval from today's scatterometers (QuikSCAT and ASCAT). Wind directions are retrieved from wind induced streaks visible in the SAR image. The orientations of the streaks are retrieved by the Local Gradient Method used for C-band images, which was adjusted to the needs of TerraSAR-X data. For validation of the X-band SAR wind retrieval algorithm several TerraSAR-X retrieved wind fields were compared to results from a high resolution numerical weather prediction model.