

Combined Co- and Cross- Polarized SAR Measurements Under Extreme Wind Conditions

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During summer 2016, the European Space Agency (ESA) set up the Satellite Hurricane Observations Campaign, a campaign dedicated to hurricane observations with Sentinel-1 synthetic aperture radar (SAR) in both vertical-vertical (VV) and vertical-horizontal (VH) polarizations acquired in wide swath modes. More than 20 observations over hurricane eyes were acquired and tropical cyclones were captured at different development stages. This enables us to detail the sensitivity difference of VH and VV normalized radar cross section (NRCS) to the response of intense ocean surface winds. As found, the sensitivity of the VH-NRCS computed at 3-km resolution is reported to be more than 3.5 times larger than in VV. Taking opportunity of SAR high resolution, we also show that the decrease in resolution (up to 25 km) does not dramatically change the sensitivity difference between VV and VH polarizations. For wind speeds larger than 25 m/s, a new geophysical model function (MS1A) to interpret cross-polarized signal is proposed. Both channels are then combined to get ocean surface wind vectors. SAR winds are further compared at 40-km resolution against L-band soil moisture active and passive mission (SMAP) radiometer winds with co-locations less than 30 min. Overall excellent consistency is found between SMAP and this new SAR winds, opening perspectives for MetOp-SG SCA, the next-generation C-band scatterometer with co- and cross-polarization capability. Moreover, in situation of rain rate less than 20 mm/hr, a striking linear relationship is found between active C-Band cross-polarized NRCS and passive L-Band ocean surface roughness brightness temperature. As interpreted, this can correspond to a regime change of the air-sea interactions during extreme events.