Assessment of the sea surface wind and current retrieval from ALOS-2 and Sentinel-1 SAR data over coastal areas

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Synthetic aperture radar (SAR) has become an essential component in ocean remote sensing due to its high sensitivity to sea surface dynamics and its high spatial resolution. The ALOS-2 SAR data are underutilized for ocean surface wind and current retrieval. Although the primary goals of the ALOS-2 mission are focused on land applications, the extension of the satellite scenes over the coastal areas offers an opportunity for ocean applications. The underutilization of ALOS-2 data is mainly due to the fact that at low radar frequencies, e.g. L-band, the sensitivity of the radar scattering coefficient to wind speed and the sensitivity of the Doppler frequency shift to sea surface velocity is lower than at higher frequencies, e.g. C- and X-band. This is also due to the fact that most of ALOS-2 images are acquired in HH or HV polarization while the VV polarization is often preferred in ocean applications due the higher signal to noise ratio.

The wind speed is retrieved from Sentinel-1 and ALOS-2 using the existing empirical C- and L-band geophysical model functions. For Sentinel-1, the Doppler frequency shift provided in the OCN product is used. For ALOS-2, the Doppler frequency shift is estimated from the single look complex data using the pulse-pair processing method. The estimated Doppler shift converted to the surface radial velocity and the velocity is calibrated using land as a reference. The estimated L-band Doppler shift and surface velocity is compared to the C-band Doppler shift provided in the Sentinel-1 OCN product. Due the difference in the local time of ascending node (about 6 hours at the equator) of the two satellites, a direct pixel-by-pixel comparison is not possible, i.e. the wind and surface current can not be assumed to be constant during such a large time difference. Thus, the retrieved wind from each sensor is compared separately to model data and in-situ observations.

In this paper, the quality of the wind speed retrieved from the L-band SAR (ALOS-2) in coastal areas is assessed and compared to the C-band SAR (Sentinel-1). In addition, the feasibility of the surface current retrieval from the L-band Doppler frequency shift is investigated and also compared to Sentinel-1. Examples will be shown and discussed. This opens an opportunity for synergy between L-band and C-band SAR missions to increase the spatial and temporal coverage, which is one of the main limitations of SAR application in ocean remote sensing.