Remote Sensing of Environment

Signature of the Agulhas Current in high resolution satellite derived wind fields

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Abstract

5 years of Systematic Envisat Advanced Synthetic Aperture Radar (ASAR) acquisitions and 8 years of observations from the Jason 2 altimeter are used to investigate the signature of the Agulhas Current on high resolution (between 1 and 5 km) satellite-derived winds. The satellite wind observations are analysed together with co-located ocean current, Sea Surface Temperature (SST) and significant wave height information. Satellite-derived winds cannot be considered current relative over the Agulhas Current. SAR and altimeter winds increase in magnitude over the Agulhas Current in all up-, down- and cross-current wind conditions, with contributions from both the ocean surface current and SST. When winds blow against the current, strong accelerations in satellite winds are observed at the Agulhas Current's inshore front, with the strongest winds observed 10 km offshore from the location of maximum SST gradient. The strong SST gradient appears to drive a thermal wind with a magnitude of about 1 m/s and which intensifies/abates the predominant alongfront winds at the Agulhas Current's northern wall. The SAR dataset shows abnormally high increases in wind speeds during up-current conditions in comparisons to the Jason-2 derived winds. We argue that these differences are caused by the inability of the CMOD_type algorithms to taken into account the wave field and provide accurate wind speed estimates in conditions where wave height exceed the expected value for a given wind speed. Our analysis suggests that wave-current interactions in regions of strong current shear produce enhanced sea surface roughness signatures and lead to artificially high estimates of SAR-derived wind speeds. There is future potential in using high resolution SAR imagery to map strong ocean current fronts and thus improve our ability to monitor ocean surface currents from space.