The Signatures of Ocean Surface Currents on GNSS-Reflectometry Observations

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Abstract

The earth-reflected signals of global navigation satellite systems (GNSS) can be collected and processed in a technique known as GNSS reflectometry (GNSS-R). Several remote sensing applications currently use this relatively new method. The low instrumentation demands of this technique make it a perfect match for low-cost small satellites. With a constellation of eight microsatellites, the Cyclone GNSS (CYGNSS) mission collects GNSS-R observations on a global scale. We investigate these observations for possible signatures of ocean surface currents as a novel application of spaceborne GNSS-R. Our study shows that GNSS-R measurements of surface roughness are sufficiently sensitive to detect the interaction of surface currents with low wind speeds. The response of GNSS-R measurements to the presence of the currents depends on the wind conditions and is more prominent for wind speeds of about 2 to 6 m/s. For currents that are codirectional with or in the opposing direction of the wind, their interactions with wind leave different and discernible signatures in GNSS-R measurements. For example, the impact of a current with a velocity of 0.5 m/s can reach 1.0 dB for the GNSS-R Normalized Bistatic Radar Cross Section (NBRCS). We formulate the impact of ocean surface currents on GNSS-R NBRCS through a combined wind-current model. Based on our preliminary results, the model shows improved performance in describing the variations in the GNSS-R measurements in the presence of surface currents.