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CYGNSS SMALL SATELLITE GNSS-R CONSTELLATION MISSION FOR OCEAN SCIENCE APPLICATION

Abstract

Abstract: In this work the CYGNSS (Cyclone Global Navigation Satellite System) bistatic radar cross-section measurements and their sensitivity to surface roughness is described in relation to ocean surface wind retrieval especially in hurricanes.

The CYclone Global Navigation Satellite System (CYGNSS) is the first of its kind GNSS-R complete orbital mission selected by NASA's earth venture program. The goal of the CYGNSS mission is to study and model the inner core of hurricanes to accurately forecast their intensification. Previous scatterometer technologies were limited in their ability to measure surface winds inside a hurricane for two principle reasons. Firstly, the operating frequencies of the majority of current orbiting scatterometers fail to penetrate into the inner core of hurricanes, which is characterized by heavy precipitation. Secondly, with individual satellites, their re-visit period is very large hence fail to capture sufficient data from rapidly evolving weather phenomena. CYGNSS overcomes these two inadequacies by improving the temporal frequency and by operating at a frequency less affected by heavy precipitation. CYGNSS works at the GPS L1 frequency, which is sensitive to wind speed yet is affected very little by heavy precipitation. CYGNSS improves its temporal sampling frequency by utilizing 8 micro satellites that are roughly equally spaced around an common orbit inclined at 35 degree to the equator, thereby providing a median re-visit period of around 3 hours and a mean re-visit period of 7 hours. The microsatellites carry a 4 channel bistatic radar receiver which maps the received signals into Delay and Doppler space to produce images of surface scattering called Delay-Doppler Maps (DDMs). This allows CYGNSS to make 32 surface measurements per second. In this work, CYGNSS measurements are used to retrieve wind information for young sea- limited fetch conditions which are observed inside hurricanes. Two observables that are sensitive to sea surface roughness - the Normalized Bistatic Radar Cross Section of the observation and the slope of the leading edge of the radar return pulse scattered by the surface - are extracted from the DDM measurements. Geophysical Model Functions (GMFs) for each observable are inverted to estimate the wind speed.