Paper ID: 46138
student

25th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Earth Observation Missions (4)

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HIGH WIND RETRIEVAL IN HURRICANES USING CYGNSS MEASUREMENTS

Abstract

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 CYGNSS mission is to study and model the inner core of hurricanes to accurately forecast its intensification. The previous scatterometer technologies were severely limited in their ability to measure surface winds inside a hurricane for two principle reasons. Firstly, the operating frequencies of majority of the current polar 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 very little affected by heavy precipitation. CYGNSS improves its temporal frequency by utilizing 8 micro satellites that are equally spaced around an 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 the Delay and Doppler space called the Delay-Doppler Map (DDM). This allows CYGNSS to make 32 surface measurements per second. In this work, CYGNSS measurements are used to retrieve wind information for a young sea- limited fetch condition which can be 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. Ground truth inter comparisons are provided by 10 meter referenced winds obtained from near co-incident tracks of NOAAs P-3 hurricane hunter flights over the major 2017 Atlantic hurricanes.