

Ocean Wind Speed Measurement Using Wideband GNSS-R Signals

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ABSTRACT

The use of Global Navigation Satellite System-Reflectometry (GNSS-R) for remote sensing of ocean wind speeds has been explored for nearly two decades and has become an important passive remote sensing technique for verification of hurricane formation models. To obtain wind speed measurements, reflected GNSS signals are first cross-correlated with locally generated copies to construct delay-doppler maps (DDMs). Through statistical models, DDMs can provide information about the mean-square slope (MSS) of the ocean surface, which is related to wind speed. Previous studies have focused on legacy signals such as GPS L1. However, it is expected that the MSS relationship with ocean wind field can be better understood by using similar methods with wider bandwidth signals, such as the GPS L5 or Galileo E5 signals. For this research purpose, a prototype data collection system was developed to handle the necessary data sampling speeds for the L5 and E5 signals. This system used a Universal Software Radio Peripheral X300 device configured to sample at 100 MHz. A receiver was designed to generate DDMs with the L5 signal through zero-padded FFT techniques for cross-correlations. Lab tests showed that the resulting DDMs have the proper sinc function behavior with respect to doppler frequency and triangle function behavior to time delay. For future field experiments, data will be obtained by mounting the prototype system to the National Oceanic and Atmospheric Administration (NOAA) Hurricane Hunter aircraft during the 2017 hurricane season, and wind speed retrieval will be performed by analyzing the DDMs generated by the receiver.

KEYWORDS

GNSS Remote Sensing, Ocean Wind Speed, Reflectometry in High Winds