An Analysis of Maximum Hurricane Wind Retrievals Using Spaceborne GNSS-R Systems

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Monitoring the maximum wind speeds of tropical storms from space is of high interest due to the importance of this parameter in forecasting storm impact and evolution. While existing systems for remotely sensing ocean winds can provide some information on maximum winds, their performance may be limited by the impact of rain attenuation or by infrequent temporal sampling. The Cyclone Global Navigation Satellite System (CYGNSS, launch December 2016) is well suited to address these challenges. CYGNSS's constellation of eight satellites receives the reflections from Earth's surface of signals produced by GPS satellite transmitters, thereby forming a bistatic radar geometry. The frequent revisit provided by CYGNSS measurements of ocean wind speeds provides new opportunities for observing and forecasting storm properties. CYGNSS's L-band frequency also is unaffected by rain attenuation, making observations of winds in the central core of storms possible.

CYGNSS's fundamental measurement is the delay-Doppler map (DDM), which maps specularly reflected power from Earth's surface as a function of delay and Doppler offsets from the specular point. CYGNSS specular points form "tracks" on the surface as the transmit and receive satellites orbit, so that measurements in differing portions of a storm are obtained as a function of time. Of particular interest are estimates of storm maximum winds and radius that may be obtainable from a time series of DDM measurements.

This presentation will report a method to estimate these parameters from a "track" of CYGNSS measurements. The retrieval approach is based on the matching of observations to a synthetic dataset created for a similar track through a synthetic storm having maximum wind speeds and radius as the fundamental parameters. The retrieval approach focuses on the use of the DDM "shape" rather than "amplitude" in the matching process, therefore bypassing uncertainties associated with CYGNSS absolute power calibration. Studies of the potential performance of this method will be reported as well as initial use of the method with CYGNSS measurements.