An Analysis of CYGNSS Reflections over Land

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The CYGNSS (Cyclone Global Navigation Satellite System) was launched on December 15, 2016 and comprises of a constellation of eight satellites receiving GPS signals reflected from Earth's surface. The near specular forward scattering measured by CYGNSS is cross correlated with a local copy of GPS C/A-code to form a delay-Doppler map (DDM). Delay diversity arises due to the varied paths scattered signals take while Doppler frequency shifts arise due to the relative motion between transmitter, receiver, and specular point. The primary scientific mission of CYGNSS is to measure incoherent scattering from the ocean's surface and to utilize these measurements for ocean wind speed retrieval. Wind speed retrievals are based on the relationship between ocean surface roughness (which impacts incoherent forward scatter) and ocean surface wind speed using empirically developed descriptions of this process.

Extensive evidence from CYGNSS land datasets suggests that the observed forward scattering is also sensitive to land surface properties, offering an opportunity to examine CYGNSS land surface returns and their correlation with land surface properties. Variations with soil moisture and composition, vegetation cover, and surface roughness are all to be expected, significantly increasing the complexity of forward models and any associated land surface parameter retrieval algorithms.

This presentation will describe initial analyses of CYGNSS land observations and their relationships to surface roughness, soil moisture content, and vegetation cover. Particular emphasis will be placed on investigating the presence of both coherent and incoherent scattering effects, and the differing dependence of these scattering behaviors on land surface and GNSS-R system properties. A time series retrieval approach will also be proposed to attempt to resolve ambiguities between differing land surface characteristics. The implications of the study for the future development of land surface products from CYGNSS observations will also be discussed.