Study of SMAP High Resolution Data over Hurricanes using Empirical and Physics-based Modeling

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Spaceborne Synthetic Aperture Radar (SAR) systems have been playing an increasingly important role in global ocean surface observations since the SeaSat mission. Even though *in situ* measurements remain an important component of sea surface observations, they are unable to meet the spatial and temporal sampling requirements associated with many science needs. In contrast, remote sensing systems can provide increased temporal and spatial coverage albeit with lesser accuracy for some products. High resolution SAR imagery from missions such as ERS-1/2, EnviSat, RadarSat-1/2, and PALSAR has revealed a remarkable range of both direct and indirect observables that can be used to further understand the underlying oceanographic and atmospheric dynamics. This increased understanding is especially invaluable in coastal oceans due to its direct impact on daily human life.

L-band SAR systems have been of particular interest because the imagery is largely unaffected by rain and cloud conditions due to their greater penetration through hydrometeors (in contrast to C- and X-band instruments). In this paper, we assess the utility of high resolution (1 km, termed "L1C data") L-band backscattered normalized radar cross section (NRCS) products from NASA's Soil Moisture Active/Passive (SMAP) mission for sea surface observations. SMAP, which was launched on January 31st, 2015, provides soil moisture information over land surfaces. The SMAP L-band radar operated until July 7th, 2015, and provided HH, VV, and HV-polarized L1C data over coastal regions at a global revisit rate of 2-3 days during its time of operation.

We investigate the relationship between SMAP L-band L1C NRCS data and the sea surface wind vector (wind speed and direction) over hurricanes. Using matchups with other sources of wind information, it is possible to derive an empirical relationship between winds and the NRCS referred to as a geophysical model function (GMF). SMAP L1C derived GMFs will be studied and compared with other L-band GMFs proposed based on Aquarius, PALSAR and PALS data. Results will be shown from observations of three typhoons/hurricanes that ventured into near coastal regions in three different geographic regions: 1) tropical cyclone Quang between April 27th and 30th near Western Australia, 2) typhoon Noul between May 7th and 11th near the Philippines, and 3) hurricane Blanca between June 1st and 9th near the pacific coast of Mexico. Furthermore, physics-based modeling studies using the widely accepted two-scale model of sea clutter will be described to assess the model's ability to represent SMAP L1C observations. Plans for continued investigation into the use of L-band 1 km resolution radar measurements for the measurement of sea winds and other oceanographic pheonomena will also be discussed.