Retrieving sea surface wind speed through GNSS-R signal using one-step and two-steps geophysical model function

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Global Navigation Satellite System Reflectometry (GNSS-R) is a satellite receiving GNSS transmitted signal reflected from land or ocean surface. The reflected signal modulated by the wind-driven sea surface roughness, represented by the mean square slope (MSS), can be used to retrieve wind speed. In practice, one of the ways to retrieve wind speed from GNSS-R signal is using geophysical model function (GMF). The procedure to retrieve wind speed contains two parts, Level 1 and Level 2 algorithms. Level 1 calibration aims to transfer digital power in Watts on DDM to normalized bistatic radar cross section (NBRCS) in meters and compute DDM observables (DDMO) based on NBRCS. Level 2 is to build the GMF base on DDM observables from Level 1 result and reference physical variables and retrieve U_{10} from the GMF of DDMO. We built DDMO-U_{10}GMF and DDMO-MSS-ψ_0GMF. For DDMO-ψ_0GMF, ASCAT, ECMWF, SFMR, and WSRA datasets will be used as reference wind speed. For two-step GMF, satellite retrieved results SMOS, ECMWF ERA5 MSS, and direct sea surface measurements, ~40,000 sea truth data from miniature buoys deployed in 2021 by NCU, were used as reference MSS data. Based on the modification and correction of the algorithm, error analysis for each module has been conducted. In the L1 performance test, the computed DDM observable, DDMA, is 90% correlated with the published CYNGSS DDMA. The root-mean-squared error of wind speed retrieved from L2, decreased from ~4.0 m/s to ~1.8 m/s for low wind conditions (3~10 m/s). In this presentation, the latest performance assessment of the L1 calibration system, and the wind speed retrieving results from the two kinds of GMF will be shown.

Keywords:GNSS-R, wind speed retrieval, geophysical model function, miniature wave bouy, mean square slope