A Two-Scale Ocean Surface Emissivity Model Tuned to WindSat Polarimetric Emissivity Observations

Sang-Moo Lee*(1) and Albin J. Gasiewski(1)
(1) Center for Environmental Technology, Electrical, Computer, and Energy Engineering, University of Colorado, Boulder, Colorado, USA.

The goal of this study is to develop a full-Stokes vector model for ocean surface emissivity based on the two-scale approach applicable at arbitrary microwave frequencies, incidence, and azimuth angles. The model consists of six modules such as ocean dielectric constant, specular surface emission, ocean wave height spectrum, short-scale scattering, large-scale scattering, and whitecap modules. The results show that the calculated full-Stokes emissivities range in theoretically expected values and logically understandable variation with respect to incidence and azimuth angles.

The model is tuned against 4-year WindSat and SSM/I data provided by Meissner and Wentz (2012) for full-Stokes emissivity and in the first three azimuthal harmonics at 55.2^{o} of incidence angle for 1 m/s wind bins from 1 to 15 m/s. A total of six tuning parameters are selected, including the two-scale cut-off wavenumber, hydrodynamic modulation, and foam coverage. Manual tuning is performed for 0th harmonic coefficients and then automatic tuning based on the Newton method is done for 1st and 2nd harmonic coefficients in order to minimize chi-squared value. A chi-squared tuning criterion based on error statistics provided by Meissner (2020, private communication) is used. For the manual tuning case, the expected chi-squared is 225 and the minimum chi-squared we obtain is 277, indicating close to a good fit. For all harmonics, expected and obtained chi-squared values are 660 and 5422, respectively, which is unacceptable value. Further work on reducing chi-squared value is in progress. Application of the tuned model to ocean surface emissivity for T/q profiling purposes is considered.