Parametrization of an Anisotropic Ocean Surface Emissivity Model Based on WindSat Polarimetric Brightness Observations

Dean F. Smith*[(1)], Albin J. Gasiewski[(1)], Srikumar Sandeep[(1)], and Bob L. Weber[(2)]
(1) Dept of ECEE, University of Colorado, Boulder, CO 80309 USA
(2) DeTect, Inc, Longmont, CO, 80501, USA

The goal of this research has been to develop a standardized fast full-Stokes ocean surface emissivity model with Jacobian for a wind-driven ocean surface applicable at arbitrary microwave frequencies, polarizations, and incidence angles. The model is based on the Ohio State University (OSU) two-scale code for surface emission developed by Johnson (2006, IEEE TGRS, 44, 560) as presented in our 2012 URSI talk. A total of five physical tuning parameters for the model were identified, including the spectral strength and the hydrodynamic modulation factor. The short wave part of the sea surface spectrum is also allowed to have an arbitrary ratio relative to the long wave part. The foam fraction is multiplied by a variable correction factor, and also modulated to allow an anisotropic foam fraction with more foam on the leeward side of a wave.

The model is being tuned against multi-year sequences of WindSat and Special Sensor Microwave/Imager (SSMI) data as analyzed by Meissner and Wentz (2012, IEEE TGRS, 50, 3004) for up to four Stokes brightnesses and in all angular harmonics up to two in twenty five wind bins from 0.5-25.5 m/s and of 1 m/s width. As a result there are 40 brightness data per wind bin, for a total of 1000 brightness data used to constrain the model. A chi-squared tuning criterion based on error standard deviations provided by Meissner (2011, private communication) is used. Previously, an automated conjugate gradient search based on the modified Powell's Method (1992, Press, Teukolsky, Vetterling, and Flannery, *Numerical Recipes in Fortran Second Edition*) was used to optimize the parameter set, but it only gives a local minimum. To insure a global minimum a genetic algorithm (1999, Vose, *The Simple Genetic Algorithm: Foundations and Theory)* is being implemented in Matlab.

There is no guarantee that the above parametrization is able to achieve the minimum chi-squared. To overcome this problem the model is being reparametrized in two ways. First, instead of using 12 wind-speed dependent parameters for each of the two foam correction factors, a 3 parameter polynomial fit in wind-speed is being used. Second, a quadratic frequency dependence of the foam emissivity is used to accommodate the anticipated frequency spectrum of foam. The results for several different reparametrizations will be presented and related to their implications for wideband ocean emissivity modeling.