AN IMPROVED WIDE BAND OCEAN EMISSIVITY RADIATIVE TRANSFER MODEL

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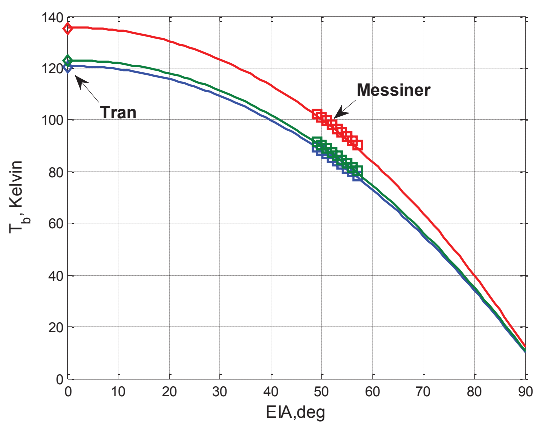
ABSTRACT

Ocean radiative transfer models (RTM's) find many applications in remote sensing, and as such, it is important that they can accurately predict brightness temperatures (T_b) over a wide range of electromagnetic wavelengths and environmental conditions. For the microwave spectrum (< 40 GHz), the major component of T_b comes from the surface emission; therefore precise knowledge of the surface emissivity is essential. While there are many ocean surface emissivity models that currently exist in the literature, most are limited in their range of applicability. This paper presents results of our research to develop a single and unified ocean surface emissivity model that has been validated using one year of independent WindSat radiometer observations over the frequency range of 6.8 – 37 GHz.

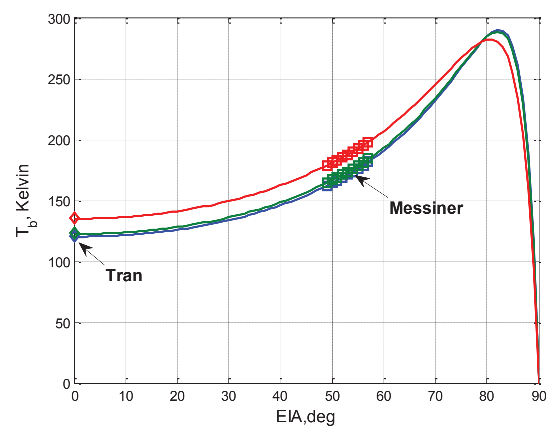
This model has adopted a physically based approach with coefficients, which are empirically tuned to measurements from satellites, aircrafts, and laboratory experiments available in the published literature. It combines these measurement sources and results from several state-of-the-art surface emissivity radiative transfer models (RTM) to converge to a unified model that is applicable over a wide range of earth incidence angles (*EIA*), ocean surface wind speeds (and wind directions), and operating frequencies. A unique contribution of this research has been the analysis of C-band (4 – 7 GHz) Stepped Frequency Microwave Radiometer (SFMR) measurements in hurricanes [1]. These data augmented by other satellite radiometer measurements have lead to the development of our model that provides accurate prediction of polarized microwave brightness temperature over a wide range of ocean wind speeds up to

category five hurricane force winds, frequencies from 1 GHz to 40 GHz, and earth incidence angles from nadir to > 60 degrees [2].

This paper will provide a description of our ocean surface emissivity model and will present comparisons with several independent surface emissivity models and recent high wind speed emissivity SFMR measurements in hurricanes. Figure 1 shows an example of surface emissivity (scaled to 300 Kelvin) for H-pol and V-pol for different frequencies with respect to incidence angle in comparison to Tran et al. and Messiner et al. emissivity models for the nominal ocean wind speed of 6 m/s.



(a)



(b)

Fig. 1 Brightness temperature for (a) H-pol and (b) V-pol for frequencies 18 (blue), 21 (green), and 37 GHz (red) with respect to incidence angles in comparison to Tran et al. (diamond) and Messiner et al. (squares).

Moreover, a satellite radiometric T_b validation will be presented using WindSat T_b observations and collocated Global Data Assimilation System (GDAS) provided by NOAA National Center for Environmental Prediction numerical model environmental parameters. These data validate our emissivity model over sea surface temperature and wind speed for a variety of atmospheric conditions during a one-year observation period. Results show that our emissivity model is capable of reproducing WindSat T_b observations within 1 Kelvin in the mean for the 6.8, 10.6, 18.7 and 37 GHz vertical and horizontal polarized channels.

REFERENCES

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[2] Salem Fawwaz El-Nimri, W. Linwood Jones, Eric Uhlhorn, Christopher Ruf , James Johnson, and Peter Black, "An Improved C-band Ocean Surface Emissivity Model at Hurricane-force Wind Speeds over a Wide Range of Earth Incidence Angles," *IEEE Geoscience and Remote Sensing Letters, 2009*.