The Impact of Community Radiative Transfer Model Microwave Sea Surface Emissivity Improvements on Forecast Skill

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Observation operators are needed in data assimilation systems to map forecast model space to observation space. In this regard, the accuracy of observation operators is important, because aliasing of forecast model errors and errors from the observation operator will serve to degrade analyses. For satellite-based radiance observations, the mapping to observation space requires application of a radiative transfer model that can perform sufficiently accurate satellite-based radiance simulations. Furthermore, the radiative transfer model must be sufficiently fast to satisfy time constraints imposed on operational data assimilation systems. As such, the Community Radiative Transfer Model (CRTM) is applied in the National Centers for Environmental Prediction (NCEP) Gridpoint Statistical Interpolation (GSI) data assimilation system.

A desirable feature that accompanies the latest CRTM, release 2.1.2, is a general improvement in the accuracy of sea surface field of view simulations for surface sensitive microwave channels. For example, when applied in the GSI, the variances and biases of first guess departures for AMSUA surface sensitive channels have in general been reduced relative to the application of a previous CRTM, release 2.0.5, over sea surfaces. This CRTM improvement is due to the replacement of an older Fast Microwave Emissivity Model (FASTEM), FASTEM-1, with a newer FASTEM, (FASTEM-5), in CRTM release 2.1.2. A particularly salient component of the FASTEM-5 Geometrical Optics (GO) theory is the accounting of interactions with small-scale sea surface waves [1]. This accounting of small-scale waves was absent in FASTEM-1. To estimate the forecast impact of this CRTM improvement, parallel experiments were performed using a 3dvar T254 configuration. The impact appears to be neutral for the Northern Hemisphere, but positive in both the tropics and Southern Hemisphere. In this work, we describe how reduction of model error aliasing in the GSI that can be attributed to application of the aforementioned CRTM improvements, might explain the positive forecast impact.

References

[1] Q. Liu, F. Weng and S. English. "An Improved Fast Microwave Water Emissivity Model", ***IEEE Transaction on Geoscience and Remote Sensing*****, vol. 49, no. 4, pp. 1238-1250, April 2011.**