8 GOES R Algorithm Working Group (AWG)

8.1 GOES R Algorithm Working Group: Proxy Data Set Development – Allen Huang, Jason Otkin and Tom Greenwald

Proposed Work

The main focus of this project is to provide state-of-the-art proxy data sets, models, software tools, and their associated documents and/or user guides in support of a broad range of GOES-R AWG application and development team activities. The accomplishments from this project will directly enable most of the AWG team members to use the common GOES-R datasets and software tools. This will allow the various AWG teams to concentrate on their own area of expertise and allow better sharing of results between groups. In addition, the refined and up-to-date databases will include: 1) global infrared surface emissivity, 2) ice and water cloud microphysical properties, 3) aerosol/dust microphysical properties, and 4) community models (such as NWP, infrared radiative transfer, and infrared emissivity models).

In addition, ABI-like datasets (for most ABI bands) will be generated from MODIS imagery. Some of the steps to simulate the spatial, geometric and radiometric features include: acquiring the MODIS hdf format images, selecting bands with similar central wavenumbers, de-striping the IR bands with an algorithm developed at CIMSS, averaging to appropriate ABI resolution, etc.

Summary of Accomplishments and Findings

Eight WRF model simulations (at 4 km grid spacing) of an intense extratropical cyclone over the North Atlantic Ocean were performed using different combinations of cloud microphysical and PBL parameterization schemes. Cloud data from each simulation was subsequently compared to MODIS-derived cloud information in order to assess the ability of the WRF model to realistically simulate the observed cloud features. Preliminary results are encouraging. Figure 8.1.1 directly below shows frequency distributions for the MODIS-derived and WRF-simulated cloud water paths. The table legend is organized from the simulation with the most sophisticated parameterization schemes (SEIF_ETA) to the least sophisticated schemes (PLIN_YSU). Overall, it is clear that the various WRF model simulations captured the observed cloud water path distribution very well. It is also evident that the most sophisticated schemes consistently outperformed the least sophisticated schemes.

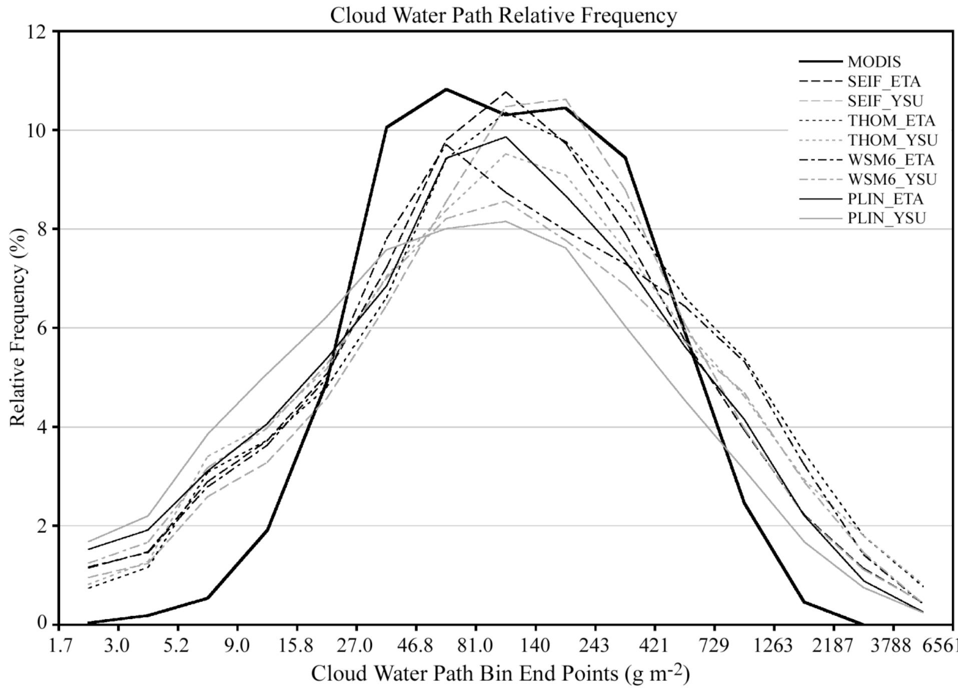

Figure 8.1.1: Plots of frequency distributions for the MODIS-derived and WRF-simulated cloud water paths.

Besides comparing the synthetic ABI radiances to observations we have also begun to examine the quality of the synthetic radiances by determining the errors in our 2-cloud-layer radiative transfer model (FIRTM2) due to multiple scattering, which is one of the dominant errors in our forward model system. We used the SOI RT model (developed here at UW-Madison) as the reference model in 32-stream mode with delta scaling. The SOI model and FIRTM2 were both given identical gas and cloud properties and calculations were performed for two different fixed zenith angles of 0^{o} and 55^{o} for a section of the WRF model domain for the North Atlantic case described above. The sub-domain consisted of 300x300 grid points and covered a wide range of cloud types (see figure directly below). Preliminary results show that bias errors in FIRTM2 for all cloud types and for a wide range of zenith angles were less than 0.4 K for all ABI channels considered here (8-16). RMS errors were less than 1 K (see figure below). The biggest errors occurred for cirrus (visible optical depth < 3.6) at the largest zenith angle, with bias errors of over 1 K and RMS errors of up to 1.5 K for the window channels (see figure below). These enhanced errors for cirrus are likely caused by the assumption of isotropic scattering in FIRTM2.

Other accomplishments included:

- Supplied the adjoint model for PLOD (predicts layer gas optical depths) to UW-Madison sounding team member Dr. Jun Li for testing purposes in his impact study of the retrieval of cloud and atmospheric properties.

- Began work on the adjoint model for the 2-cloud-layer model, FIRTM2, which is needed by the sounding group.

- Began work on the Users' Guide for the forward model code.

- Prepared for 1st dissimilation of proxy models and datasets for AWG members in the end of January 2007.

- Simulated the GIFTS and ABI channels 8-16 at geosynchronous orbit for the full disk (8 km grid spacing). Figure 8.1.2 shows examples of top-of-atmosphere radiances for two of the ABI channels that are similar to channels on current GOES imagers.

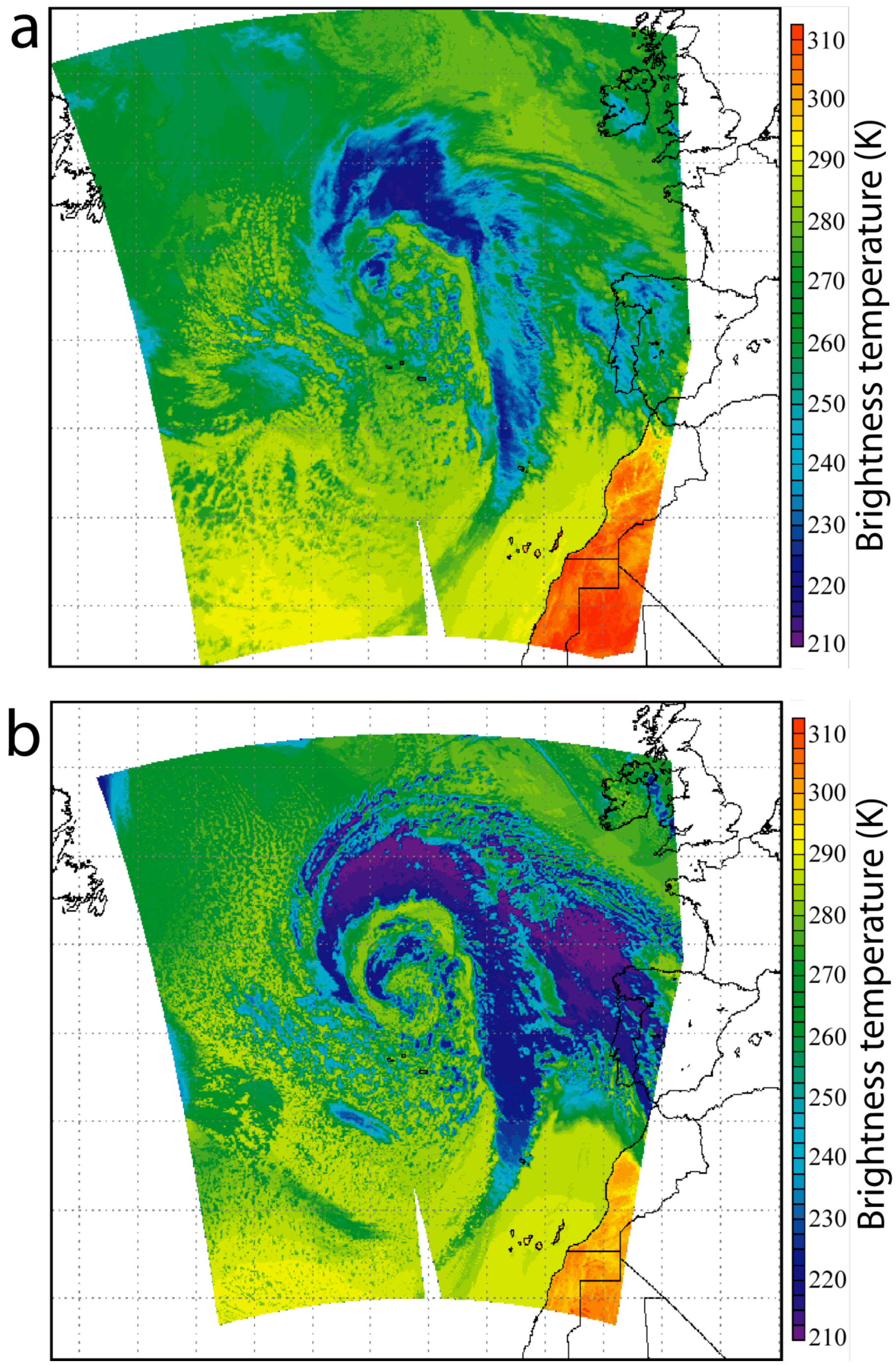

Figure 8.1.2: Composite of top-of-atmosphere brightness temperatures for MODIS band 29 (8.5 μm) (a) actually measured and (b) simulated. Overpass times were 1410 and 1550 UTC.

- The 5 km resolution global land surface IR emissivity databases were converted to netCDF and the size of the databases were greatly reduced by using instead emissivities at 10 spectral tie points. Obtaining surface emissivities between these tie points is done through linear interpolation.

- Successfully ported the forward radiative transfer model code onto our new 32-node 64-bit Opteron cluster using two different compilers in order to expand its portability to other systems. Examining the quality of the top-of-atmosphere radiance data files helped to uncover coding errors in the forward model code. Several improvements were made to the code as well as the addition of other input options.

Publications and conference reports

Greenwald, T., H.-L. Huang, D. Tobin, J. Otkin, E. Olson, M. Gunshor, and P. Yang, 2007: Evaluation of simulated GOES-R ABI and hyperspectral radiance measurements, Third Future National Operational Satellites Symposium, San Antonio, Texas, January14-18.