Assimilation of AIRS SFOV Retrieval Profiles in the Rapid Refresh Model System: Assimilation Modifications to Maximize Forecast Improvement

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NASA's Atmospheric Infrared Sounder (AIRS) has the ability to provide atmospheric temperature and water vapor information at higher resolution and accuracy than previous systems, which may be very beneficial for improving forecasts of high impact weather, cloud and precipitation systems. Accordingly, we are conducting a series of tests to evaluate the impact of assimilating AIRS single field-of-view (SFOV) retrieved temperature and water vapor profiles, which were created by the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin-Madison, into the NOAA Rapid Refresh (RAP) mesoscale model system. The RAP is a high frequency (1-hour) cycling assimilation and prediction system that will replace the Rapid Update Cycle (RUC) at the National Centers for Environmental Prediction (NCEP) in May 2012.

Prior to assimilation of the SFOV data, an assessment of the retrieval profiles was performed by comparing them with collocated radiosonde profiles. From this analysis, biases of the SFOV data relative to the radiosonde data were computed. Next, conventional observation denial experiments were completed to document the robustness of the assimilation system. Then a series of tests incorporating the SFOV data have been performed to examine the impact of the AIRS data on subsequent weather forecasts (as measured by upper-air and precipitation verification) were completed. A variety of different data thinning and observation error specification strategies were considered, yielding improved results compared to the initial SFOV assimilation experiment.

Recent work has focused on analysis of observation innovations (O-B) to further document the nature of systematic differences between the RAP background fields and the SFOV retrievals, especially for SFOV moisture data. Results indicate that SFOV moisture data are substantially drier than RR background fields in the lower half of the

atmosphere. Based on these results, a simple moisture bias correction scheme was developed and used in a SFOV moisture assimilation experiment, yielding substantially improved results. This improvement included significant reduction in the dry moisture bias (relative to rawinsonde verification), significant reduction in the moisture RMS error, and slight reduction in the temperature and wind RMS errors. Work is ongoing to evaluate systematic differences in SFOV temperature innovations, with a goal of developing a similar bias correction procedure for SFOV temperature observations.
In addition, several High Resolution Rapid Refresh (HRRR) runs initialized from the RAP retro runs with and without SFOV data will be performed to investigate the impact of AIRS data on the high-impact weather in a higher resolution numerical model system. At the workshop, a summary of this work will be shown, including quantitative verification of upper-air and precipitation fields, as well as case study plots.