8.3 GOES R Algorithm Working Group: Sounding Validation – Dave Tobin

Proposed Work
This work was proposed in March 2006 and does not reflect the more recent decision to exclude HES from the GOES-R payload. We planned to provide essential validation datasets and analysis in 2006 for assessing candidate HES temperature and water vapor sounding algorithms. The primary focus was to be on the production and use of highly accurate temperature and water vapor profiles from the Atmospheric Radiation Measurement (ARM) sites and from aircraft campaigns.

Even though the decision has been made to exclude HES from the GOES-R payload, achieving temperature and water vapor soundings with high accuracy and optimal vertical resolution remains a major goal of atmospheric scientists. High accuracy and vertical resolution are required for critical applications, such as nowcasting the onset of severe weather over the CONUS. Representative validation data and highly accurate analyses are required to assess the candidate sounding algorithms that will be investigated by the AWG. The ARM sites are perhaps the best sites in the world for providing atmospheric state, cloud, and radiation observations for this type of validation activity. Also, high spectral resolution infrared radiance observations collected by the Scanning-High resolution Interferometer Sounder (S-HIS) and the NPOESS Aircraft Sounder Testbed-Interferometer (NAST-I) from high altitude aircraft are useful for sounding algorithm assessment.

Our plan remains to produce and provide ARM site and aircraft based datasets for the AWG sounding algorithm validation, and to use the datasets to assess the algorithms. This requires assembly of validation data sets including best estimates of the surface, atmospheric temperature and water vapor profiles and cloud observations from an array of ARM site observations, and coincident satellite observations (AIRS, MODIS, and GOES). Supplemental aircraft datasets will include the S-HIS and/or NAST-I radiance observations and coincident validation data. During the first year we planned to:

- Coordinate dataset needs with Sounding AWG chair and members
- Assemble ARM and aircraft datasets
- Perform sounding algorithm validation analyses

This activity will be continued in future years as required to select, assess and refine AWG sounding algorithms.

Summary of Accomplishments and Findings
The proposed efforts regarding Sounding Algorithm Validation were proposed in March 2006 and therefore did not reflect the more recent decision to exclude HES from the GOES-R payload. The AWG strategy and necessary actions for producing and assessing GOES-R soundings in the no-HES framework is still uncertain. Therefore, efforts this year focused on the generic preparatory work of developing sounding validation datasets from ARM, with relatively little sounding validation work for the AWG.

ARM site atmospheric state best estimates have been produced to compile a sounding algorithm dataset. The effort is described in detail in Tobin et al., 2006. This AWG effort leverages heavily on support from EOS Aqua. In addition to datasets produced for the Southern Great Plains (SGP) and Tropical Western Pacific (TWP) ARM sites, datasets are now also assembled for the arctic North Slope of Alaska (NSA) site. Conditions for this site pose a difficult challenge for advanced sounding due to cloud conditions, cold and dry atmospheres, and a variety of surface types.

Drawing upon radiosondes launched at EOS Aqua ARM site overpass times, ensembles of validation profiles were compiled for each site during five "phases" of dedicated radiosonde launches spanning approximately four years. Additional phases are now being planned for CY2007. Figure 8.3.1 shows an assessment of AIRS team version 4 temperature and water vapor retrievals for one phase of dedicated soundings at the NSA site. The results reflect the difficulty in performing retrievals for the NSA site conditions characterized by low yields and RMS performance exceeding standard retrieval goals (1K/1km temperature and 20%/2km water vapor). These datasets are also used to assess other candidate retrieval algorithms, and soundings produced using a combined AIRS/MODIS algorithm are being assessed.

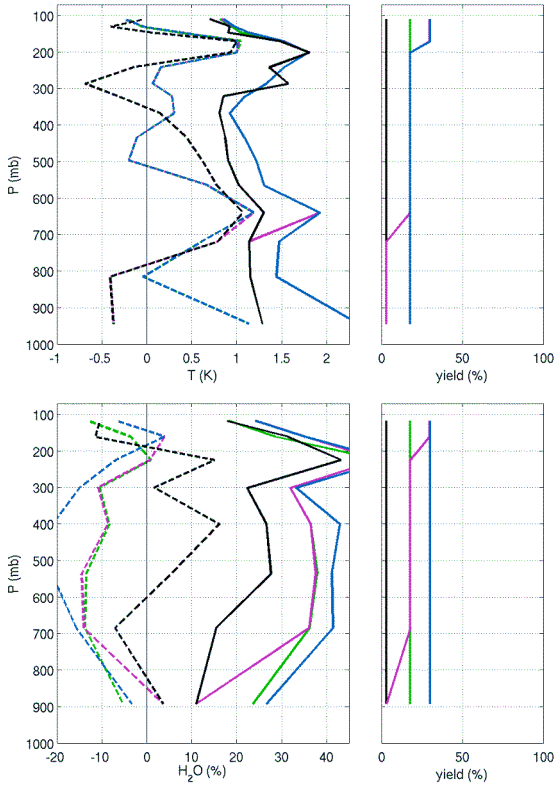

Figure 8.3.1: Validation of AIRS version 4 atmospheric profile retrievals using ARM NSA site profiles. Top left panel: 1 km layer temperature differences (AIRS-ARM); Top right panel: temperature retrieval yield; Bottom left panel: percent difference in 2 km layer water vapor amounts (100(AIRS-ARM)/ARM); Bottom right panel: water vapor retrieval yield. Each panel includes the bias (dashed curves) and RMSE (solid curves) for four selections of quality control flags (QC1, black; QC2, green; QC3, purple; QC4, blue) as discussed in Tobin et al. 2006. Water vapor statistics are computed with percent differences weighted by the ARM water vapor amounts.

Publications and Conference Reports

Tobin D. C., et al., (2006), Atmospheric Radiation Measurement site atmospheric state best estimates for Atmospheric Infrared Sounder temperature and water vapor retrieval validation, *J. Geophys. Res.*, 111, D09S14, 10.1029/2005JD006103.