Evaluation of GOES-12 Sounder single field of view and 3x3 retrievals of total precipitable water over the ARM SGP site

Sarah T. Bedka, Jun Li, Wayne F. Feltz, Anthony J. Schreiner, James P. Nelson III
Cooperative Institute for Meteorological Satellite Studies, University of Wisconsin-Madison

Introduction
Total Precipitable Water (TPW) is a very useful value for forecasters to determine atmospheric stability and the probability of convection and severe weather. The current GOES Sounder provides the capability to retrieve water vapor profiles and TPW hourly over CONUS at approximately 10 km resolution. Historically, at Cooperative Institute for Meteorological Satellite Studies (CIMSS), retrievals have been performed on 3x3 field of view (FOV) areas. However, the desire to improve product spatial resolution as well as assimilating derived water vapor into numerical models has led to single FOV (SFOV) retrievals. These SFOV retrievals may also provide insight into what differences may be observed with the future, increased-resolution GOES instruments, especially with respect to discriminating spatial gradients of water vapor.

The purpose of this study is to compare the retrievals of TPW from the GOES-12 Sounder with those retrieved from ground-based instruments such as the Microwave Radiometer (MWR), GPS, and rawinsonde. Both SFOV and 3x3 retrievals from 2005-2007 are included. Results are examined for the ARM-SGP central facility, as well as several boundary facilities.

ARM-SGP Site Details
The U.S. Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) program Southern Great Plains (SGP) site is centrally located in Lamont, OK. Rawinsonde launches are performed at this site regularly, and a MWR and GPS are located on-site. Water vapor profiles from these instruments are used to derive TPW. In addition to the central facility, MWR instruments are located at 4 boundary facilities (Hillsboro KS, Morris OK, Purcell OK, and Vici OK). No rawinsonde or GPS profiles are available from these sites.

Seasonal and Diurnal Trends
Hourly statistics of RMS/Bias suggest that the different retrievals have difficulties at different times of the day. The merged SFOV product has a higher RMS and bias in the early morning hours, while the Legacy SFOV product has a high RMS (but little bias) in the afternoon. The 3x3 FOV product shows the least improvement over the first guess in the afternoon.

• Higher errors are associated with summertime retrievals at all sites (Lamont is shown).
• All retrievals (SFOV and 3x3 FOV) show improvement over the first guess in the wintertime (DJF).
• None of the retrievals show improvement over the first guess in the summertime (JJA).
• Spring and fall show mixed results, with only the 3x3 retrievals providing a slight improvement over the first guess.

Conclusions
Results from this comparison show that the GOES-12 3x3 FOV retrievals show the most skill in retrieving TPW in agreement with the ARM-SGP MWR, GPS, and rawinsonde. However, over 2005-2007, the 3x3 FOV retrieval showed a lower RMS than the first guess for only 1 of the 3 sites examined. The 3x3 retrieval showed a lower RMS and Bias than all sites. The merger of the SFOV products at all sites and the SFOV retrieval product had a consistently higher Bias than any other product, which was most pronounced in the summer. This suggests that cloud contamination may be an issue for this algorithm. Collectively, over 2005-2007, neither retrieval showed improvement in accuracy over the first guess. However, an improvement was seen in the wintertime data only. One issue with SFOV retrievals is noise and time-continuity. Recently an improved GOES SFOV sounding algorithm (Li et al. 2007, GRL) has been implemented into the CIMSS merged processing, the improved sounding product will be evaluated using MWR and GPS data.

Acknowledgements and Web Links of Interest
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CIMSS GOES realtime product homepage: http://cimss.ssec.wisc.edu/goes/realtime/
CIMSS realtime ARM-SGP TPW comparison: http://ibors1.ssec.wisc.edu/~sarah/goes_lpw

Contact: Sarah T Bedka, sarah.bedka@ssec.wisc.edu