Validation of Suomi-NPP CrIMSS retrievals of temperature and water vapor using ARM site best estimates of atmospheric state

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Abstract

CrIMSS is the Crosstrack Infrared and Microwave Sounding Suite, which is comprised of the Cross-track Infrared Sounding (CrIS) and the Advanced Technology Microwave Sounder (ATMS) instruments. This suite of instruments is onboard the Suomi-NPP satellite which was launched in October 2011. In this effort, CrIMSS Environmental Data Records (EDRs), including atmospheric temperature and water vapor retrieved profiles, are validated against radiosondes launched coincident with the satellite overpasses of three Atmospheric Radiation Measurement (ARM) sites. These sites represent three different climatic regimes and include Lamont, Oklahoma in the US southern Great Plains (SGP), Barrow, Alaska on the North Slope of Alaska (NSA), and Manus, Papua New Guinea in the Tropical Western Pacific (TWP). Combined with other ARM data, an assessment of the radiosonde data quality is performed and post-processing corrections are applied producing an ‘ARM site best estimate’ product. Comparisons of the resulting sondes profiles and the satellite retrievals are made to determine the accuracy of the satellite products. Retrieval products include those from the CrIMSS IDPS EDR Algorithm, GDAS, and CSPP Dual Regression Model (here noted as CSPP HSRTV).

Conclusions

• The Phase1 sonde launch effort is complete and Phase2 is ongoing
• The ARM site best estimates (BE) of the atmospheric state were produced for Phase1 & 2
• Comparisons were made between ARM BEs of temperature and water vapor and NPP derived retrievals (CrIMSS, GDAS, and CSPP HSRTV)
• For Phase1, the ARM BE agrees well with the GDAS retrievals and differs with the CrIMSS retrievals. Note that this analysis uses the CrIMSS EDRs with MX Version 5.3 - 6.5 and did not follow the official 1km/2km layering methodology for NPP derived retrievals (CrIMSS, GDAS, and CSPP HSRTV)
• For Phase1, the ARM BE agrees well with the GDAS retrievals and differs with the CrIMSS retrievals.
• For Phase1, Comparisons of atmospheric state best estimate and NPP derived products
• For Phase2, Comparisons of atmospheric state best estimate and NPP derived products

Future Work

• Coordinated of the remaining Phase2 sondes launch schedule
• Incorporation of additional datastreams into ARM BE product
• Repeating analysis when CrIMSS EDR products are reprocessed

Methodology

1. Coordinate radiosonde launches at NSA, SGP, & TWP coincident with NPP overpasses

2. Produce best estimate (BE) of atmospheric state

• Sondes are interpolated onto common pressure grid
• ARM BEs are applied to sondes
• MWR PWV scaling applied to sondes
• Sondes are interpolated to overpass time

Primary ARM data products:

• sondewp: RS-82 balloon-borne sounding system: Version processed: http://dx.doi.org/10.5439/1046211
• radiosonde microwave radiometer: water-vapor and water-liquid, vapor along-the-path: http://dx.doi.org/10.5439/1046211
• sond2cr: Vaisala Ceilometer, cloud base heights, 5000 feet maximum range: http://dx.doi.org/10.5439/1046211

ARM Site Best Estimate Profiles

While the collection sites are limited in number, the BE profiles consist of highly accurate measurements of wide range of climatic conditions. This is critical for assessing the CrIMSS EDRs.

Comparisons of atmospheric state best estimate and NPP derived products

Sample Matchup: BE, CrIMSS, & GDAS

• ARM Best Estimate agrees well with GDAS, but differs significantly with the CrIMSS product especially near the surface.

• Mean variability in temperature (water vapor) that occurs within ~10 minutes.

• NSA: 0.4°F (0.1 g/kg) SGP: 0.0°F (0.0 g/kg)

Phase1 Best Estimate Temperature Comparisons with CrIMSS & GDAS

• The ARM Best Estimate differs greatly from the CrIMSS product and compares well with the GDAS product
• At NSA there is a large temperature bias, on the order of 3K, between the ARMBE and CrIMSS products near 800mb, while these biases are smaller at SGP

Phase 1 & 2 Best Estimate Comparisons with CSPP (100layer)

• The ARMBE product differs greatly with the CSPP product
• At NSA the large temperature bias that was present at 800mb with the CrIMSS comparison is gone
• At TWP there are large temperature biases, on the order of 3-4K near 250mb and 10mb
• Also at TWP there are large water vapor biases near the surface

References


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