Eight Year Climatologies from Observational (AIRS) and Model (MERRA) data

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Abstract
We examine climatologies derived from eight years of temperature, water vapor, cloud, and trace gas observations made by the Atmospheric Infrared Sounder (AIRS) instrument flying on the Aqua satellite and compare them to similar climatologies constructed with data from a global assimilation model, the Modern Era Retrospective-Analysis for Research and Applications (MERRA). We use the AIRS climatologies to examine anomalies and trends in the AIRS data record. Since sampling can be an issue for infrared satellites in low earth orbit, we also use the MERRA data to examine the AIRS sampling biases. By sampling the MERRA data at the AIRS space-time locations both with and without the AIRS quality control we estimate the sampling bias of the AIRS climatology and the atmospheric conditions where AIRS has a lower sampling rate. While the AIRS temperature and water vapor sampling biases are small at low latitudes, they can be more than a few degrees in temperature or 10 percent in water vapor at higher latitudes. The largest sampling biases are over desert. The AIRS and MERRA data are available from the Goddard Earth Sciences Data and Information Services Center (GES DISC). The AIRS climatologies we used are available for analysis with the GIOVANNI data exploration tool. (see, http://disc.gsfc.nasa.gov)

Eight Year Climatologies from AIRS
We show the 8 year climatologies from AIRS examined in this study for the Ascending (daytime) parts of the AIRS orbit for the month of March.

OLR Trends
The OLR in the tropical western pacific has shown both positive and negative trends over the course of the AIRS mission. Susskind et al. (A43B-002) have used AIRS observations to show that this can be explained by changes in water vapor and clouds.

Temperature at 500 mbar
Although there is not much of a trend in the Temperature at 500 mbar there is a decreasing trend in the yield around Antarctica may be due to changes in sea ice.

Surface Air Temperature
The Surface Air Temperature shows similar changes in yield as those seen at 500 mbar.

Surface Skin Temperature
The Surface Skin Temperature shows larger trends in the daytime than at night. The temperature and yield trends around Antarctica may be due to changes in sea ice.

TotH2OVap
The total water vapor anomaly trend is strongly anticorrelated with changes in the OLR.

H2OVapMMR at 500 mbar
The Water Vapor Trends at 500 mbar are similar to those seen for the total water vapor.

Relative Humidity
The Relative Humidity trends at 500 mbar are similar to those seen in the mixing ratio.

Effective Cloud Fraction
The Effective Cloud Fraction does not show significant trends.

Cloud Top Pressure
The cloud top pressure resembles the changes in OLR seen in the tropical western pacific.

Conclusions
•The AIRS data can explain the OLR trends by changes in water vapor and clouds
•Analysis of AIRS and MERRA data suggest there are small sampling biases but they are small and do not explain the observed trends.
•The AIRS climatologies shown here are available for analysis in Giovanni.