Comparative Results of AIRS/AMSU and CrIS/ATMS Retrievals Using a Scientifically Equivalent Retrieval Algorithm

Joel Susskind, Louis Kouvaris, and Lena Iredell
NASA GSFC
Earth Sciences Division - Atmospheres, Code 610AT

AIRS Science Team Meeting
Greenbelt, MD

September 14, 2016

Objective

The AIRS Science Team Version-6 retrieval algorithm is currently producing high quality level-3 Climate Data Records (CDRs) from AIRS/AMSU which are critical for understanding climate processes. The AIRS Science Team is finalizing an improved Version-7 retrieval algorithm to reprocess all old and future AIRS data. AIRS CDRs should eventually cover the period September 2002 through at least 2020.

CrIS/ATMS is the only scheduled follow on to AIRS/AMSU. The objective of this research is to prepare for generation of long term CrIS/ATMS CDRs using a retrieval algorithm that is scientifically equivalent to AIRS/AMSU Version-7.

Success Metric

Agreement of AIRS/AMSU and CrIS/ATMS level-3 monthly mean fields with each other, and even more importantly, agreement of interannual differences of monthly mean fields.

The results I show today are meant to be a demonstration of how well we are currently doing with regard to meeting this goal.

Background

At the last Science Team meeting, I presented results comparing AIRS/AMSU and CrIS/ATMS retrievals using SRT Version-6.22. The CrIS/ATMS level-1b data we used was generated by the IDPS. The ATMS level-1b data we used was brightness temperatures, T_B, resampled to the CrIS footprints. We are now using CrIS/ATMS level-1 data generated by U. Wisc/JPL. The new ATMS level1-b data is in the form of antenna temperatures, T_A.

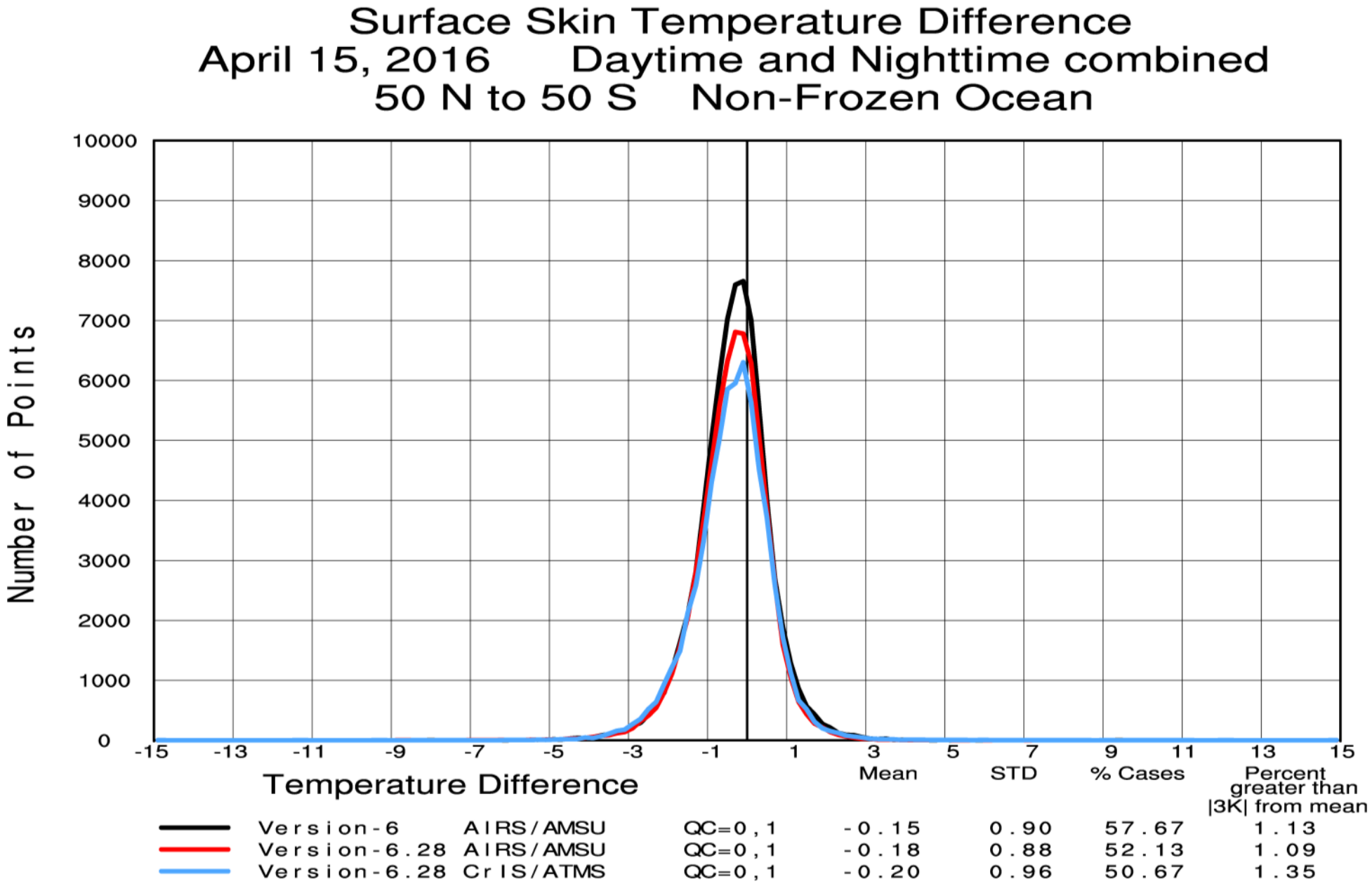
We continue to make improvements to our retrieval methodology. The latest scientific version we used for both AIRS/AMSU and CrIS/ATMS is called SRT Version-6.28. Accuracy of both AIRS/AMSU and CrIS/ATMS monthly mean results, as well as their agreement, should improve further as we approach optimized Version-7 retrievals for both instrumental suites.

Comparison of AIRS Version-6, AIRS Verison-6.28, and CrIS Version-6.28 Results

The first set of results are for April 15, 2016. EOS Aqua and NPP orbits overlap closely on this day. This is important for comparison purposes to minimize time-of-day sampling differences.

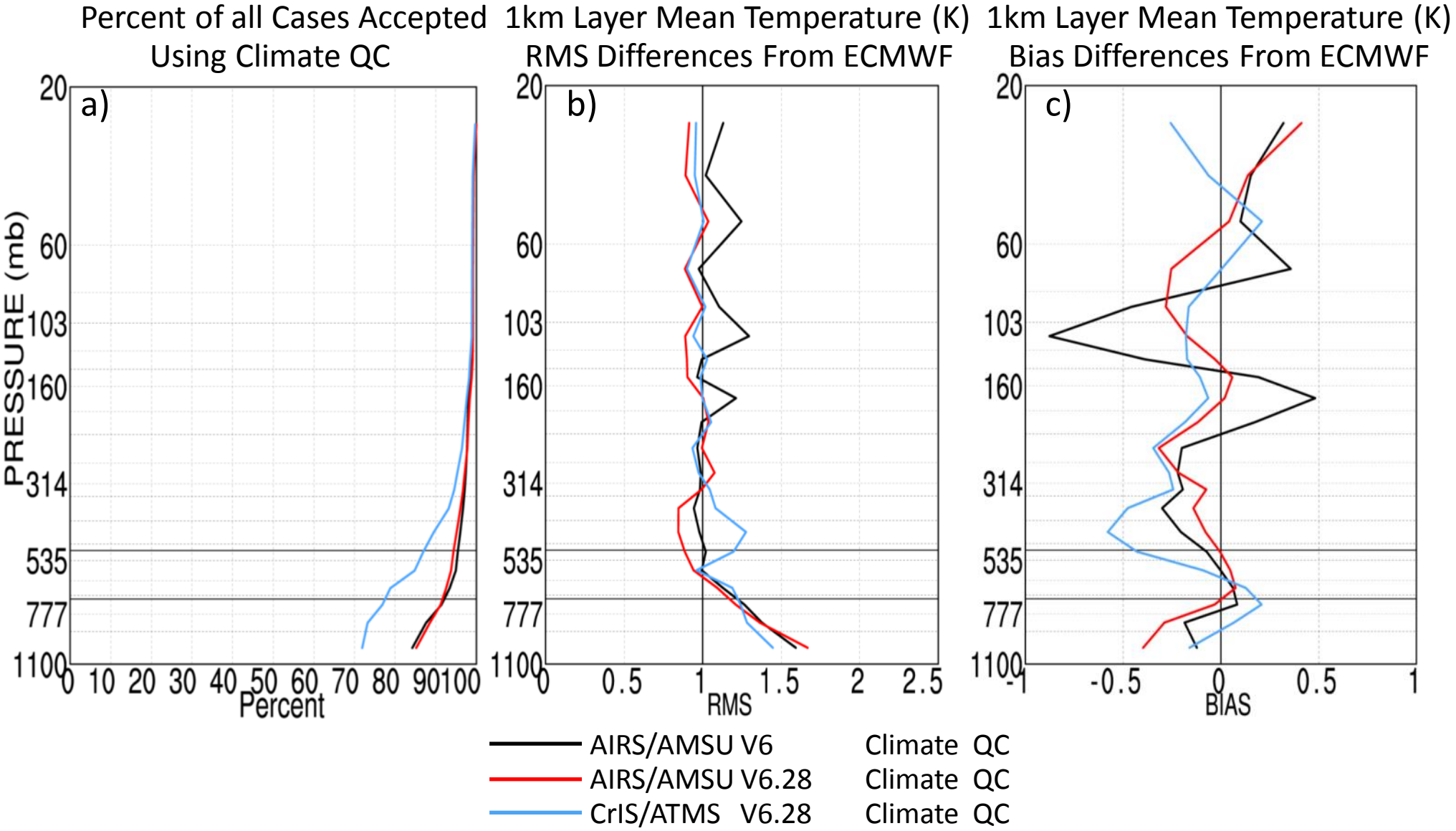
We show Climate QC'd level-2 results for all retrievals in terms of yields, RMS errors, and biases compared to ECMWF for *T(p)*, *q(p),* and ocean surface skin temperature T_s. We also show agreement of sample AIRS/AMSU and CrIS/ATMS single day level-3 products.

More significantly we also show AIRS Version-6, AIRS Version-6.28, and CrIS/ATMS Version-6.28 level-3 gridded fields for August 2014 and compare them to measures of truth. AIRS and CrIS results using Version-6.28 are both significantly improved compared to Version-6 for ozone products. In addition, we compare monthly mean level-3 fields of other select products of Version-6.28 AIRS and CrIS to demonstrate the level of agreement with each other at this time.



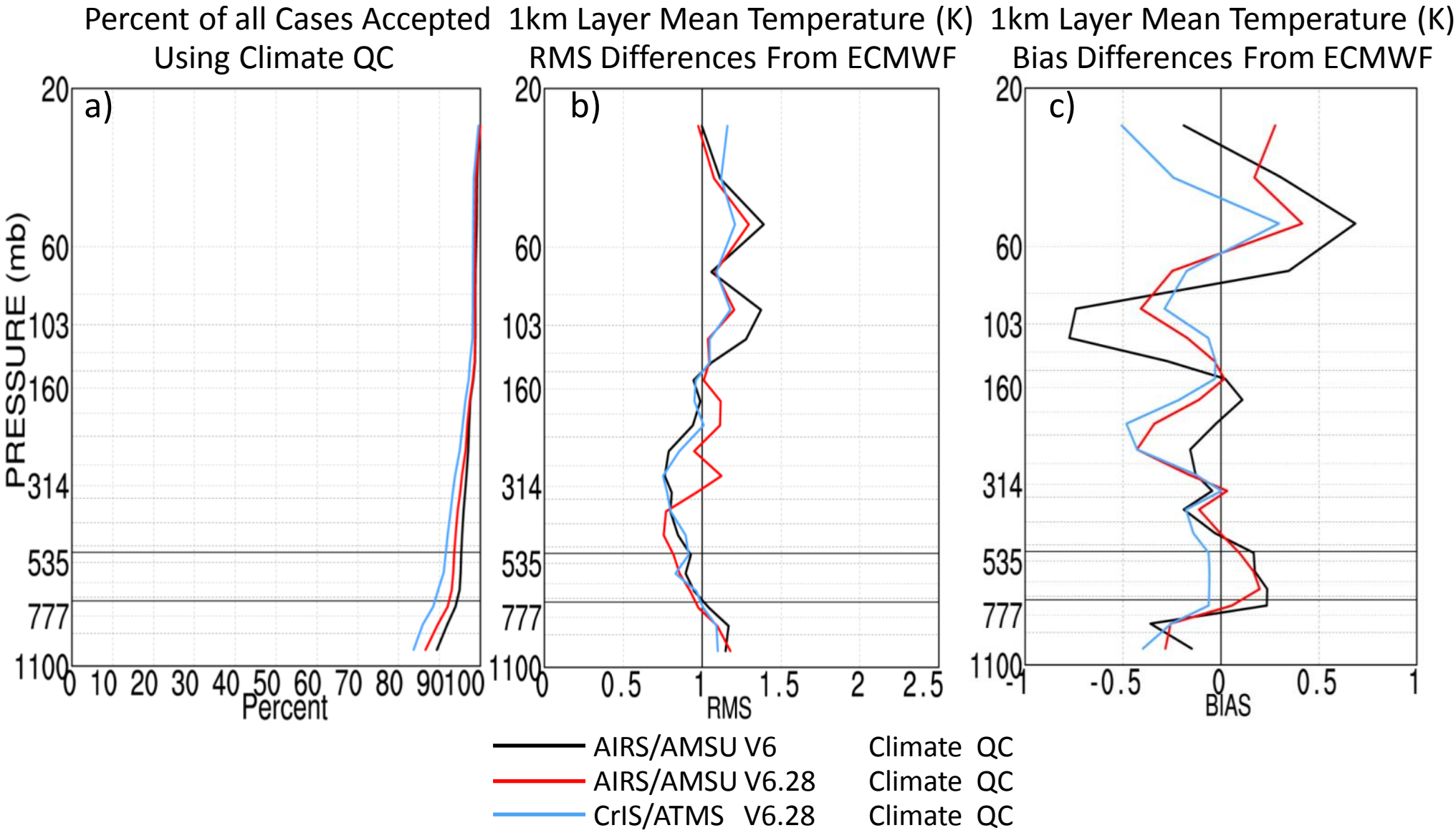
Counts of QC'd values as a function of errors of AIRS Version-6, AIRS Version-6.28 and CrIS Version-6.28 sea surface temperatures using Climate (QC=0,1) QC thresholds. All three sets of results are excellent. CrIS SW spectral coverage truncated at 2550 cm^{-1} does not degrade ocean SST significantly.

April 15, 2016 Global Statistics



AIRS V6.28 and CrIS V6.28 1 km layer mean temperatures are both more accurate than AIRS V6 overall. CrIS V6.28 results with Climate QC has a lower yield, and somewhat larger errors, than AIRS V6.28, with a spurious positive bias at 700 mb and a negative bias at 500 mb.

April 15, 2016 50°N to 50°S Ocean



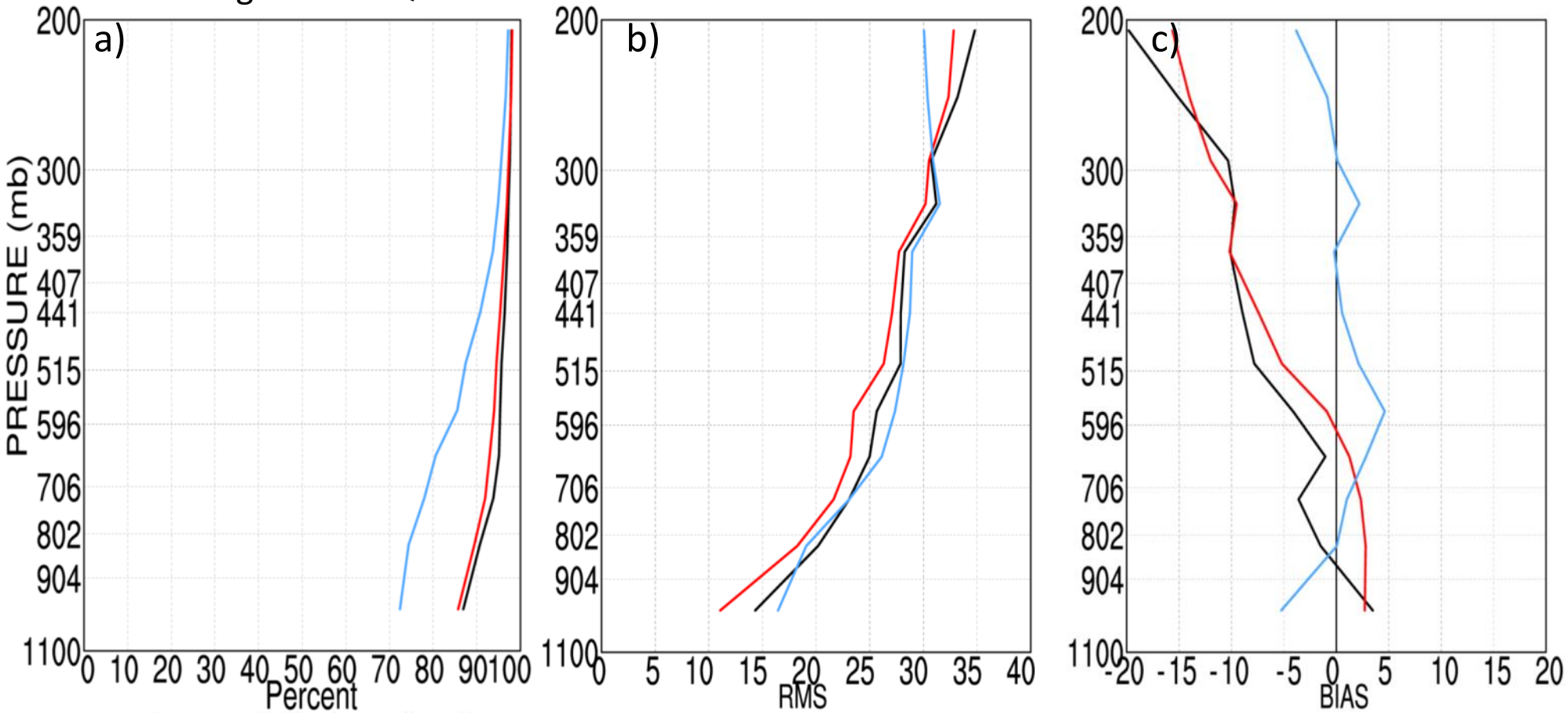
CrIS/ATMS statistics for *T(p)* are similar to those of AIRS/AMSU over mid-latitude ocean using Climate QC thresholds. Degradation of CrIS/ATMS retrievals compared to AIRS/AMSU occurs primarily over land.

April 15, 2016 Global Statistics

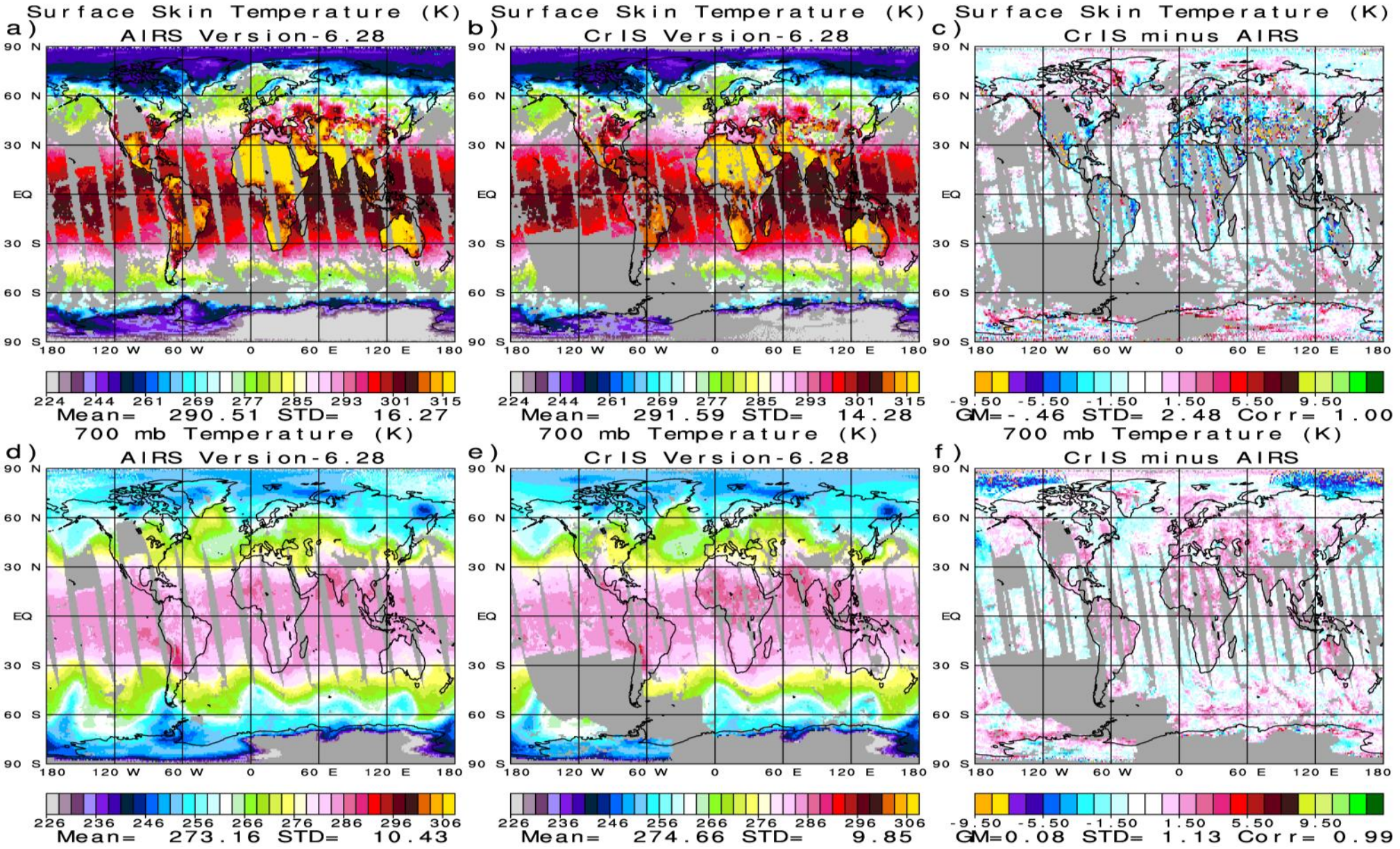
Percent of all Cases Accepted Using Climate QC

1km Layer Precipitable Water RMS % Differences From ECMWF

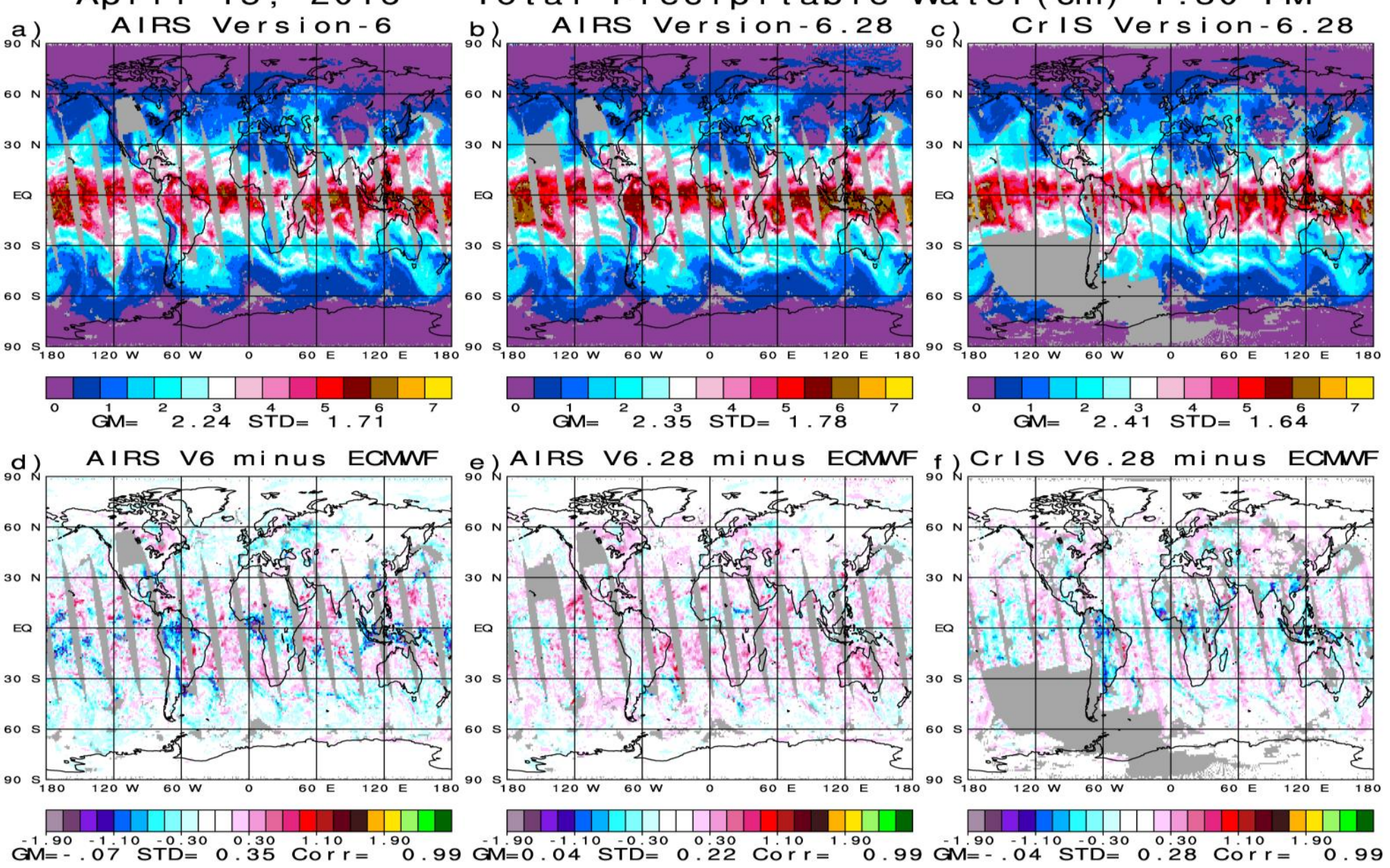
1km Layer Precipitable Water Bias % Differences From ECMWF



AIRS V6.28 1 km layer precipitable water results are superior to those of AIRS V6 with regard to both RMS errors and biases. The AIRS V6.28 dry bias above 500 mb has been alleviated by subsequent research. Global CrIS V-6.28 water vapor retrievals have comparable RMS errors to those of AIRS V6, but with a smaller yield.



AIRS and CrIS retrieved values of surface skin temperature and 700 mb temperature for ascending orbits on April 15, 2016 agree very well over the tropical oceans. There are some differences over land, especially at high latitudes. Cooler CrIS land skin temperatures result in spuriously warmer 700 mb temperatures over land.

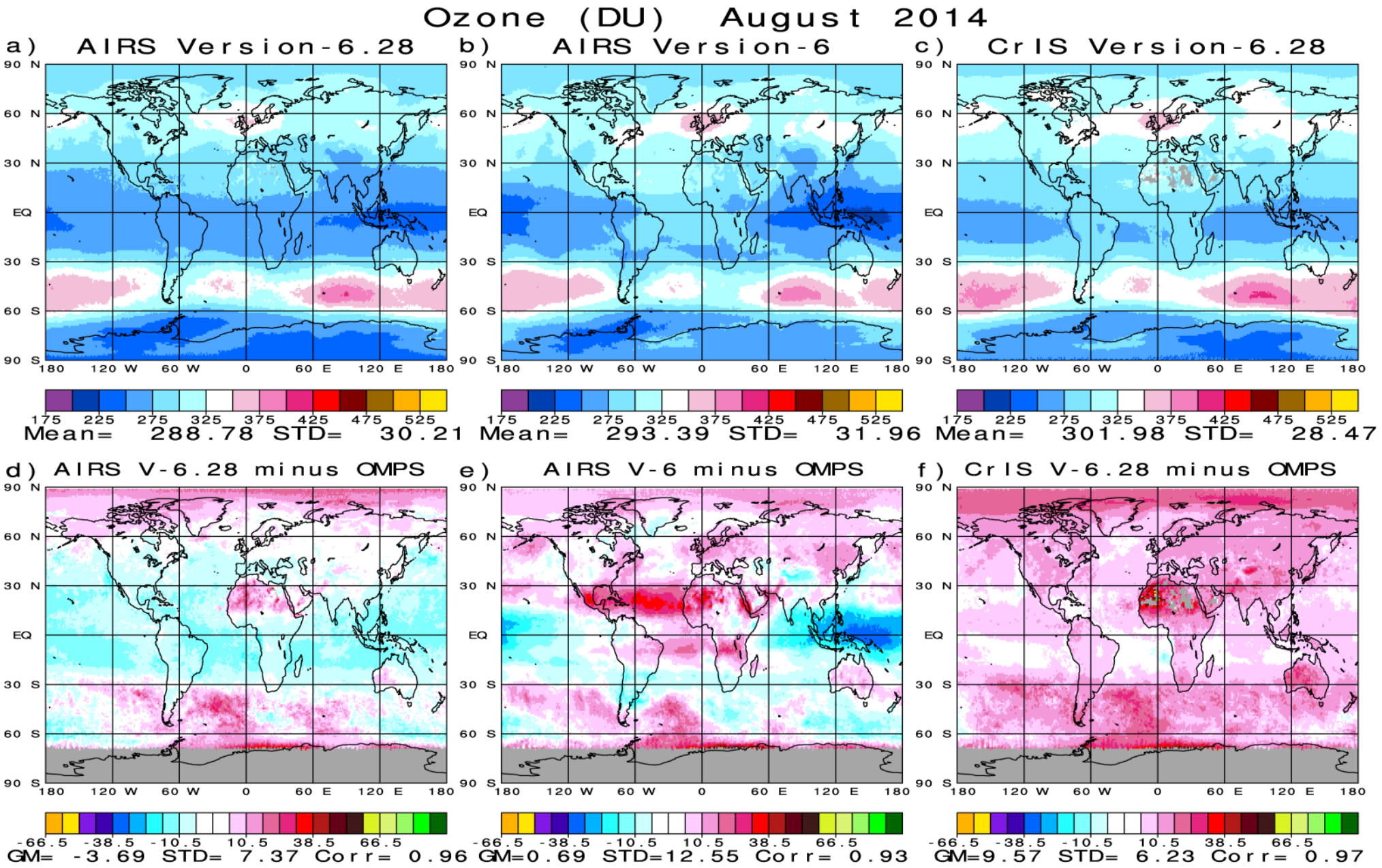


AIRS V6.28 W_{tot} is much more accurate than AIRS V6, especially in areas of high cloud cover. CrIS V6.28 W_{tot} has intermediate accuracy.

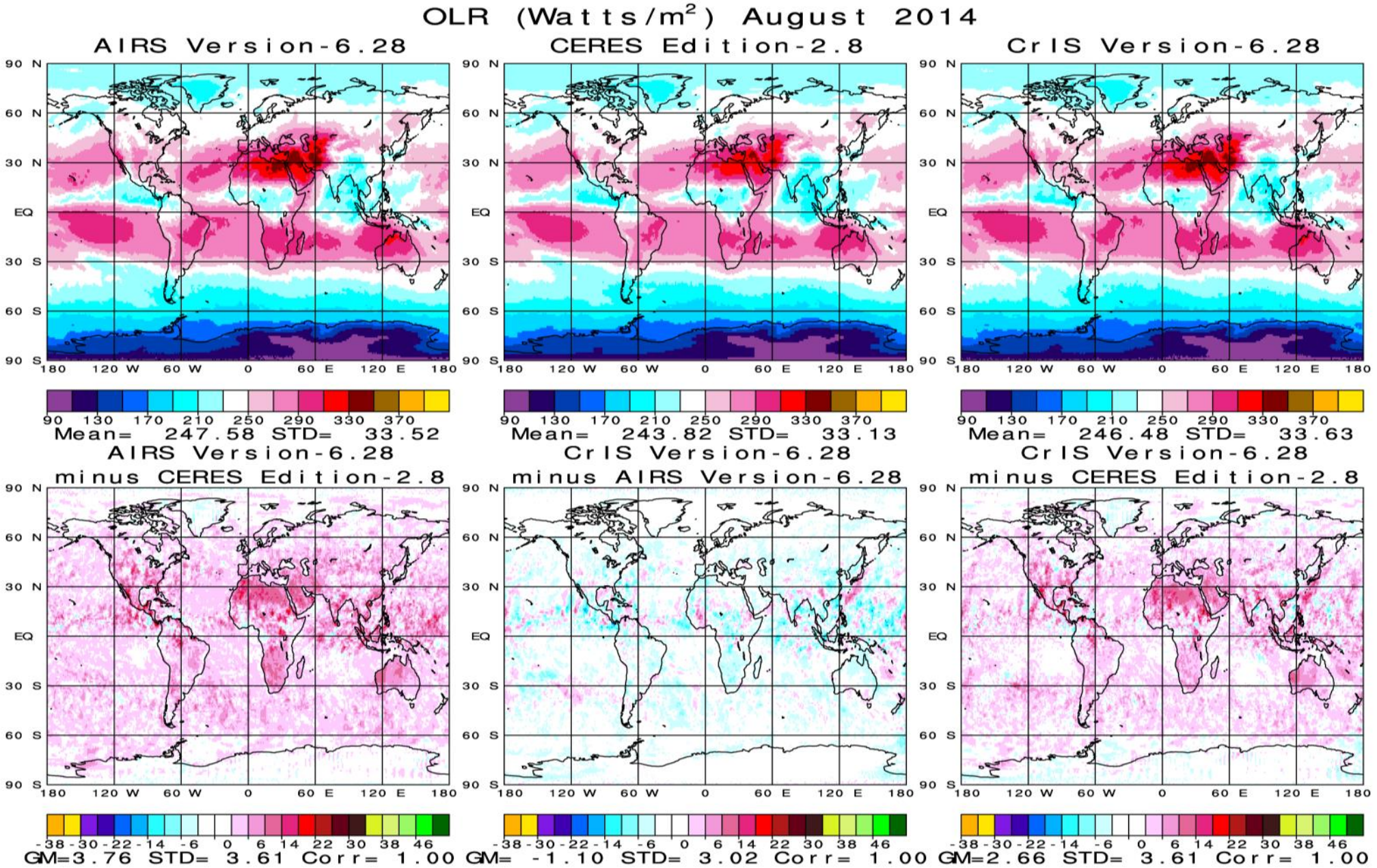
Monthly Mean Products

Version-6.28 now runs for AIRS/AMSU at the AIRS Team Leader Science Computing Facility (TLSCF) and for CrIS/ATMS at the Sounder SIPS. JPL has generated Version-6.28 AIRS/AMSU and CrIS/ATMS retrievals for August 2014.

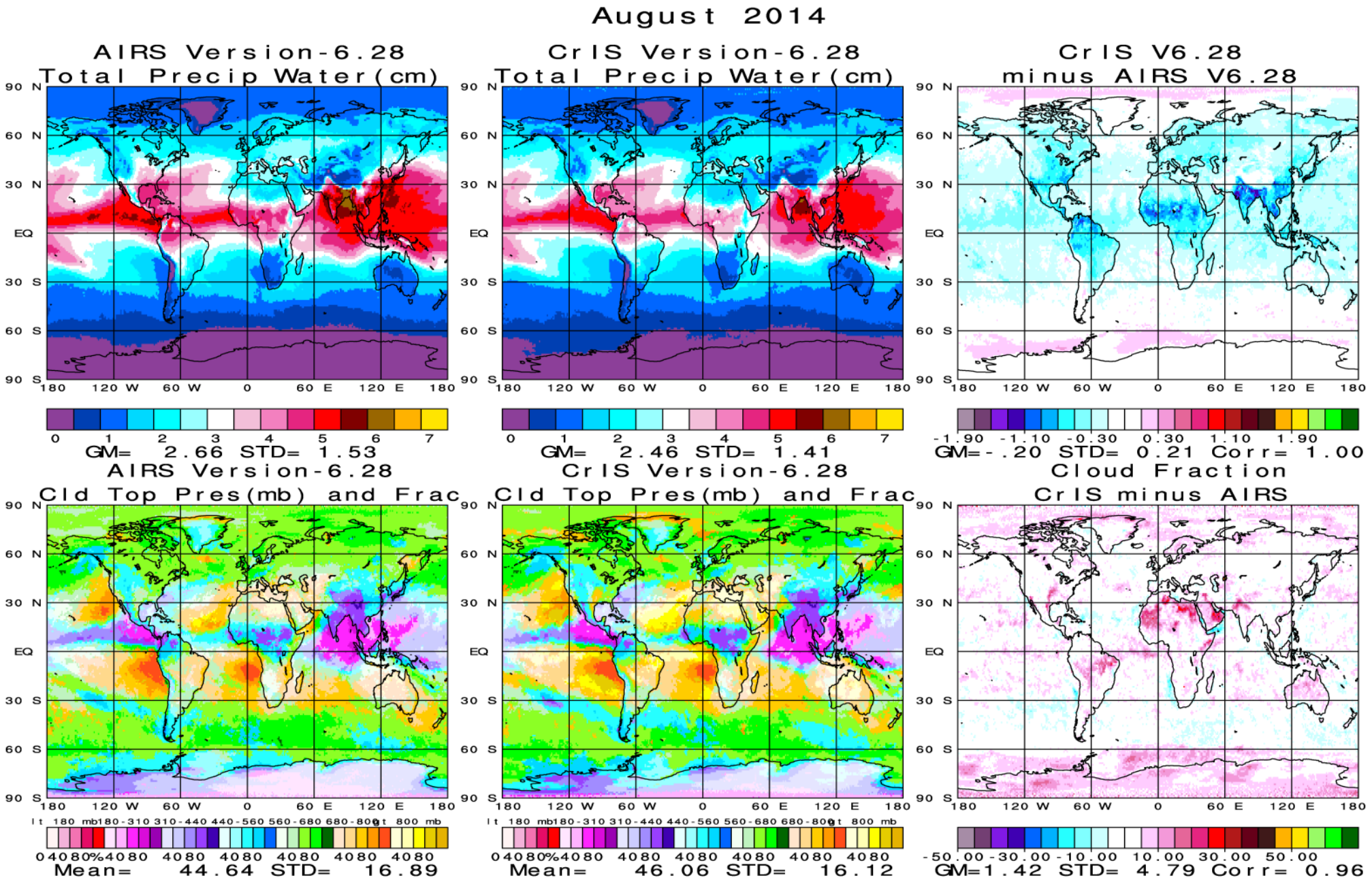
The next viewgraphs compare Version-6.28 AIRS/AMSU and CrIS/ATMS August 2014 monthly mean products with other measures of truth, as well as with each other.



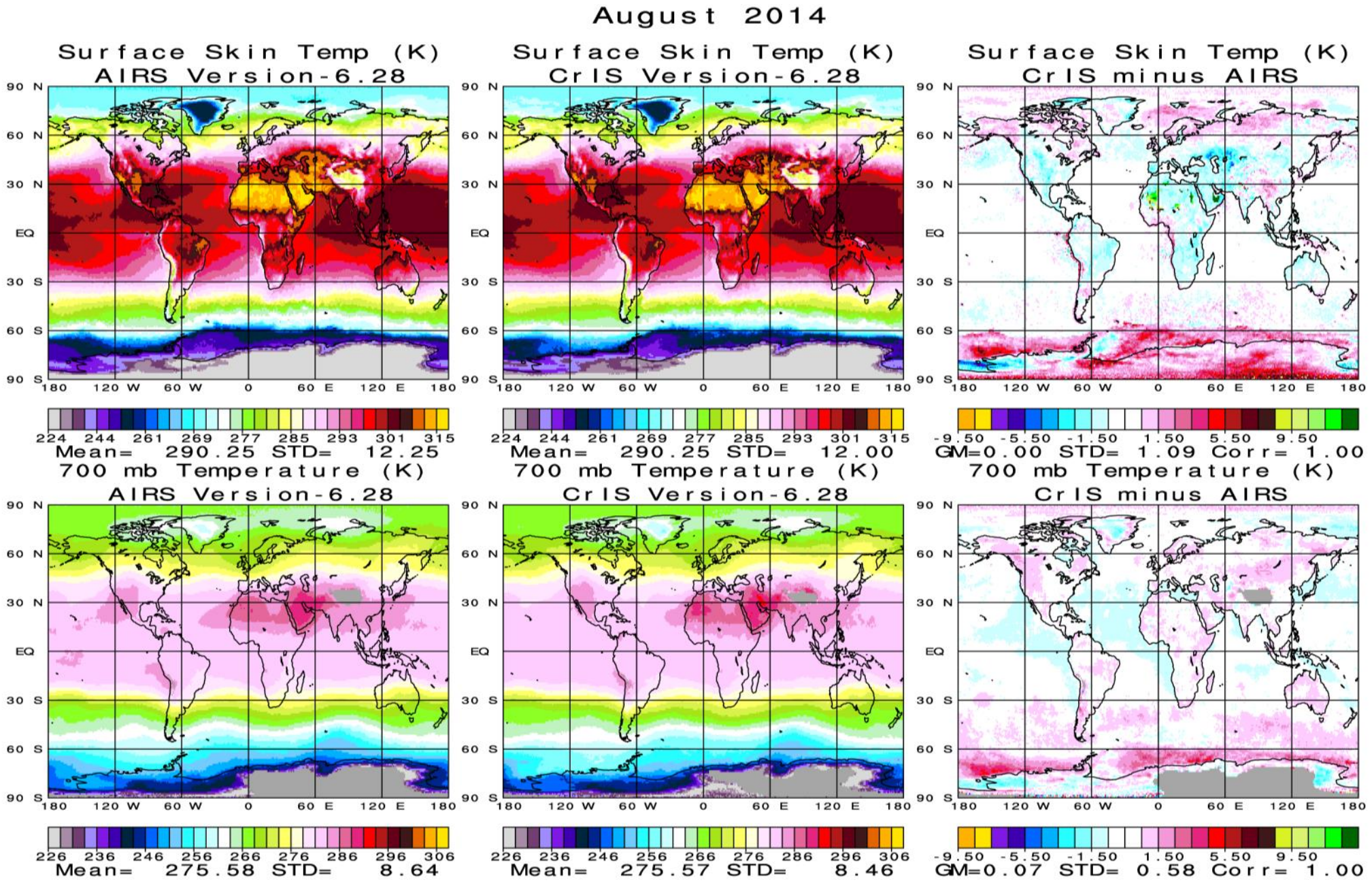
AIRS Version-6.28 monthly mean total O_3 agrees much better with OMPS than Version-6, especially in the tropics. CrIS Version-6.28 total O_3 has comparable spatial standard deviation and correlation with OMPS as AIRS Version-6.28, but is biased high.



Version-6.28 AIRS and CrIS monthly mean OLR agree well with each other and with CERES Edition-2.8. CrIS OLR agrees better with CERES in areas containing high clouds.
AIRS OLR is an extremely important climate parameter because it validates CERES and explains which geophysical parameters are contributing to OLR variability and trends.



Version-6.28 AIRS and CrIS monthly mean cloud parameters agree well with each other. CrIS total precipitable water is considerably lower than AIRS in the tropics however. This is consistent with what was found for April 15, 2016.



Monthly mean Version-6.28 AIRS and CrIS surface skin and atmospheric temperatures agree well with each other over ocean. Agreement is poorer over land and ice.

Summary and Future Plans

Version-6.28 AIRS/AMSU and CrIS/ATMS retrievals were both run at JPL for August 2014 . The CrIS/ATMS retrievals were run at the Sounder SIPS and the AIRS/AMSU retrievals were run at the AIRS TLSCF. Select August 2014 monthly mean products agreed very well with each other. This is a requirement for CrIS/ATMS products to be used to continue the AIRS/AMSU CDRs. We are working with JPL to enable end-to-end processing of AIRS/AMSU and CrIS/ATMS to both be run at the Sounder SIPS, using a common program with appropriate switches for CrIS and AIRS.

Our research plans are to first finalize our contribution to AIRS Version-7 and later apply and optimize those improvements for CrIS/ATMS. Our latest retrieval methodology (see my talk tomorrow) is called SRT Version-6.33, which has considerably improved AIRS products compared to Version-6.28. We are currently optimizing Version-6.33 retrieval methodology for use with CrIS/ATMS.

Our desire, if possible, is for AIRS/AMSU Version-7 to go into production roughly 6 months from now, and CrIS/ATMS Version-7 sometime after that.


NASA