CrIS/ATMS Retrievals Using the Latest AIRS/AMSU Retrieval Methodology

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AIRS Science Team Meeting

Pasadena, California

April 22, 2015

SRT CrIS/ATMS Research

This research is being done under the NPP Science Team Proposal: Analysis of CrIS/ATMS Using an AIRS Version 6-like Retrieval Algorithm

Objective:

Generate a long term CrIS/ATMS level-3 data set that is consistent with that of AIRS/AMSU.

Approach:

Adapt the currently operational AIRS Science Team Version-6 Retrieval Algorithm, or an improved version of it, for use with CrIS/ATMS data.

Metric:

Generate monthly mean level-3 CrIS/ATMS climate data sets and evaluate the results by comparison of monthly mean AIRS/AMSU and CrIS/ATMS products, and more significantly, their inter-annual differences and, eventually, anomaly time series. The goal is consistency between the AIRS/AMSU and CrIS/ATMS climate data sets.

CrIS/ATMS Neural-Net Coefficients

Like AIRS Version-6, neural-net methodology is used to generate the first guess $T^o(p)$, $q^o(p)$, *and* T^o_{surf} for each CrIS/ATMS FOR. The neural-net coefficients were trained by Bill Blackwell and co-workers at Lincoln Labs using data on select time periods. These coefficients are then used on all time periods. The CrIS neural-net coefficients were trained using CrIS/ATMS observations early in the mission. CrIS and ATMS calibration procedures were modified in November 2013. The quality of CrIS/ATMS retrievals improved after this change, even though the neural-net coefficients began to produce a biased first guess. They will need retraining.

Bill Blackwell has indicated that he will generate new CrIS/ATMS neural-net coefficients trained on radiances using the new calibration procedures. In the meantime, we are using and evaluating results using the old neural-net coefficients.

CrIS/ATMS Version-6.19 Retrieval Results

We call the SRT CrIS/ATMS retrieval system as of April 2015 Version-6.19. Version-6.19 is analogous to AIRS/AMSU Version-6.19 that John Blaisdell has run at JPL for select time periods.

AIRS/AMSU Version-6.19, has significantly improved water vapor and ozone products compared to AIRS/AMSU Version-6.

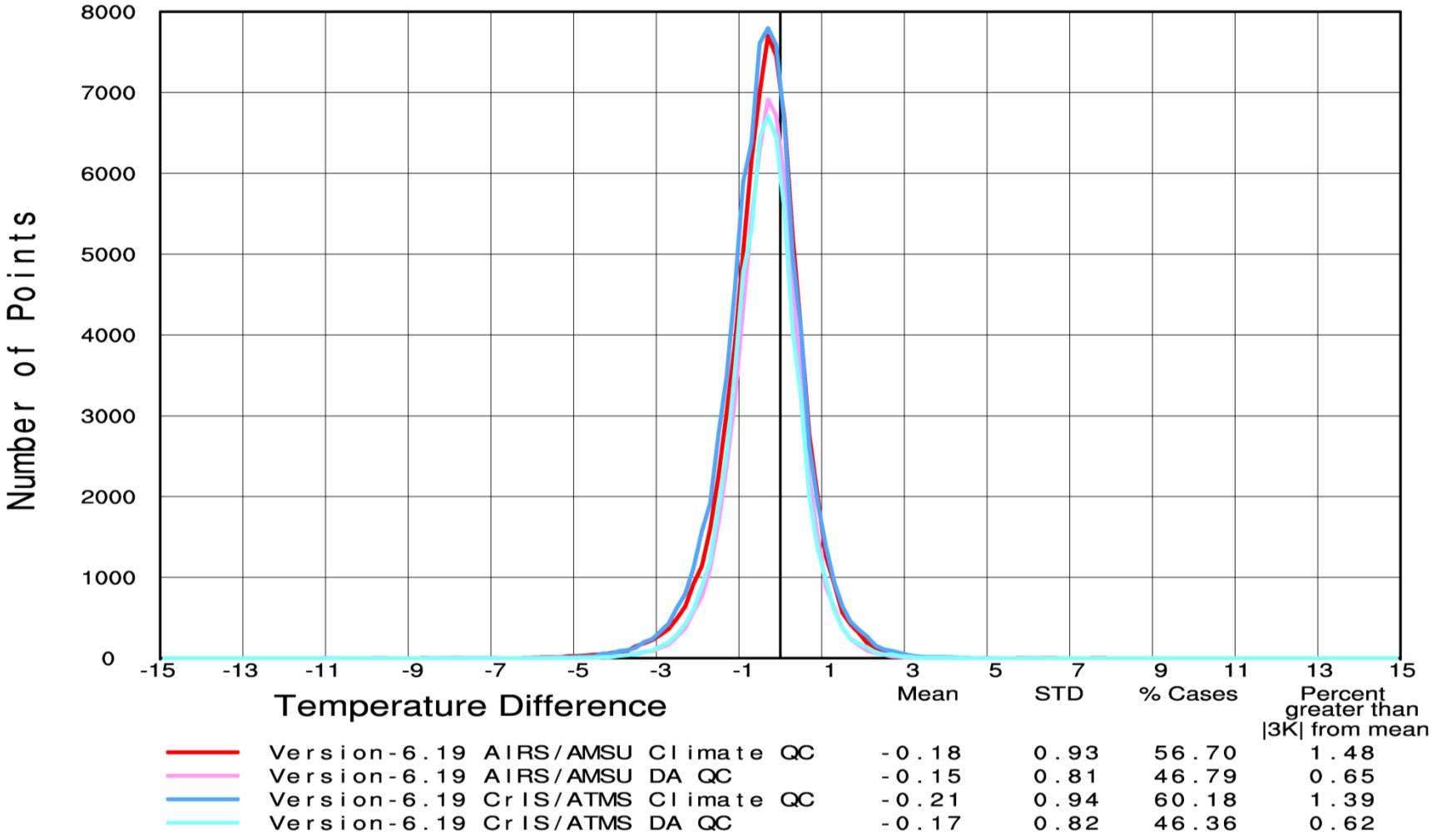
AIRS/AMSU and CrIS/ATMS Version-6.19 results are shown for December 4, 2013. EOS Aqua and NPP orbits overlap closely on this day. This is important for comparison purposes to minimize time-of-day sampling differences.

QC'd level-2 results are shown in terms of yields, RMS errors, and biases compared to ECMWF.

More importantly, AIRS/AMSU and CrIS/ATMS level-3 gridded fields are shown and compared.

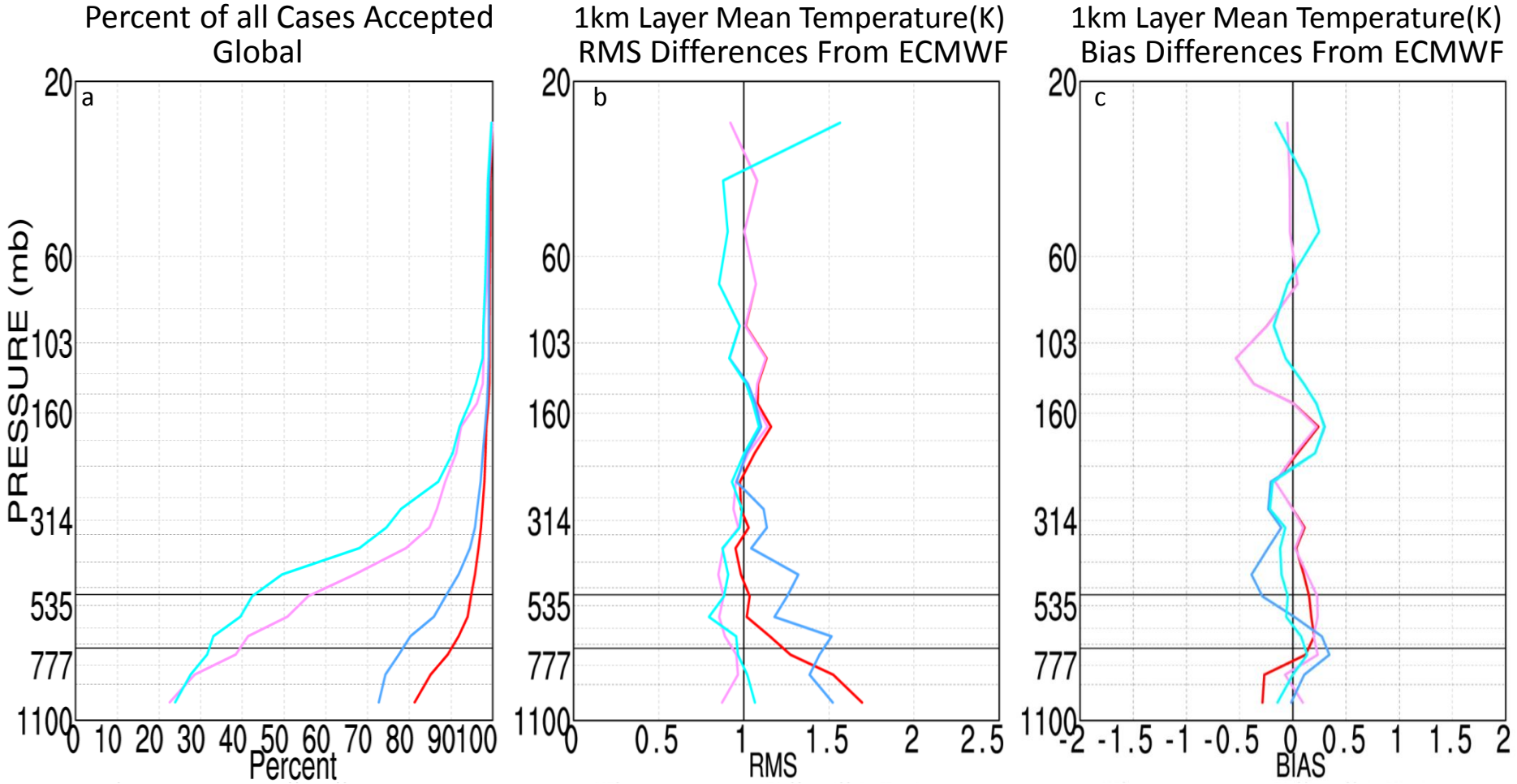
Spatial coverage of level-3 products is at least as important as accuracy.

Surface Skin Temperature Difference
December 4, 2013 Daytime and Nighttime combined
50 N to 50 S Non-Frozen Ocean



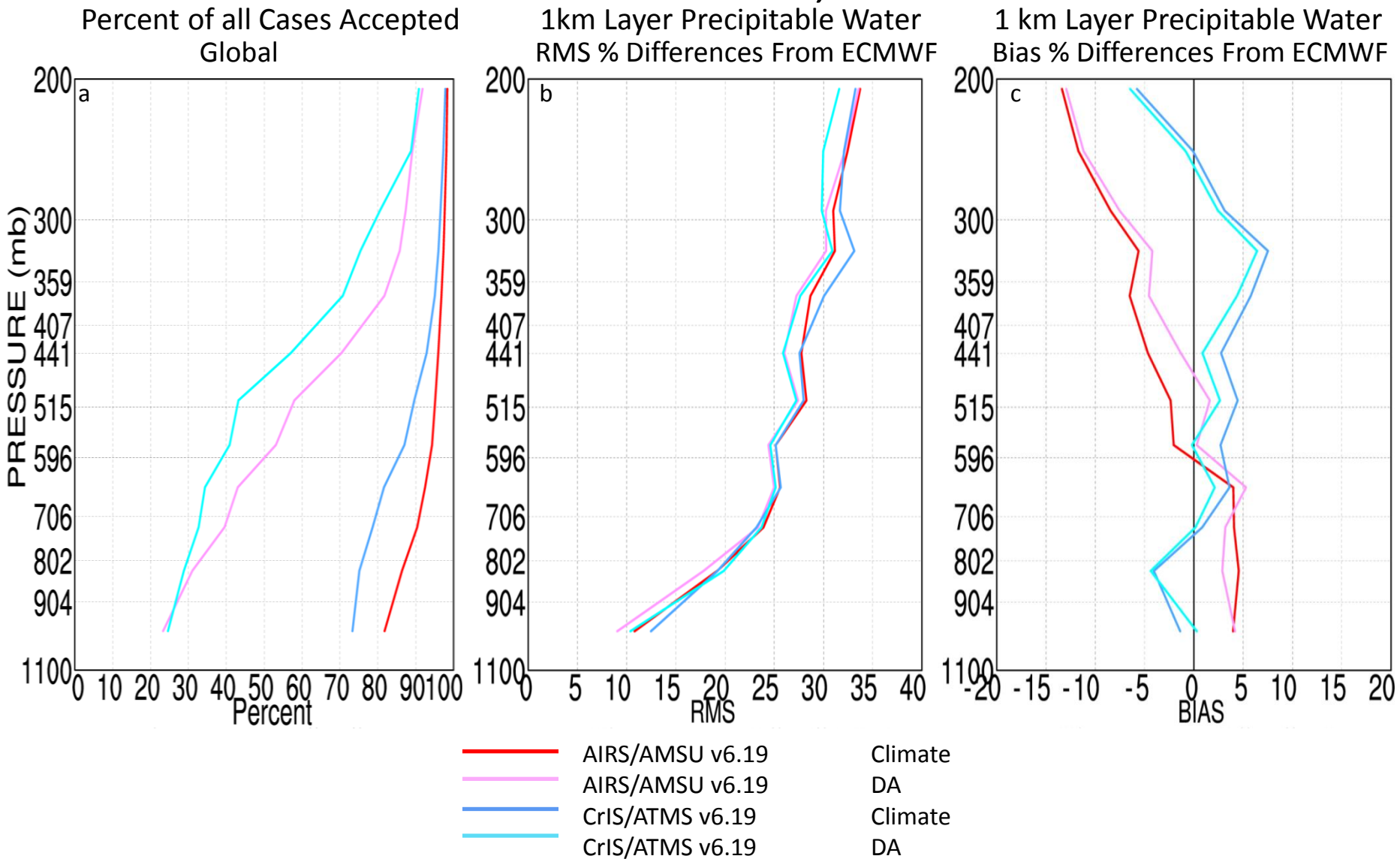
CrIS/ATMS and AIRS/AMSU Sea Surface Temperatures are of comparable quality

December 4, 2013



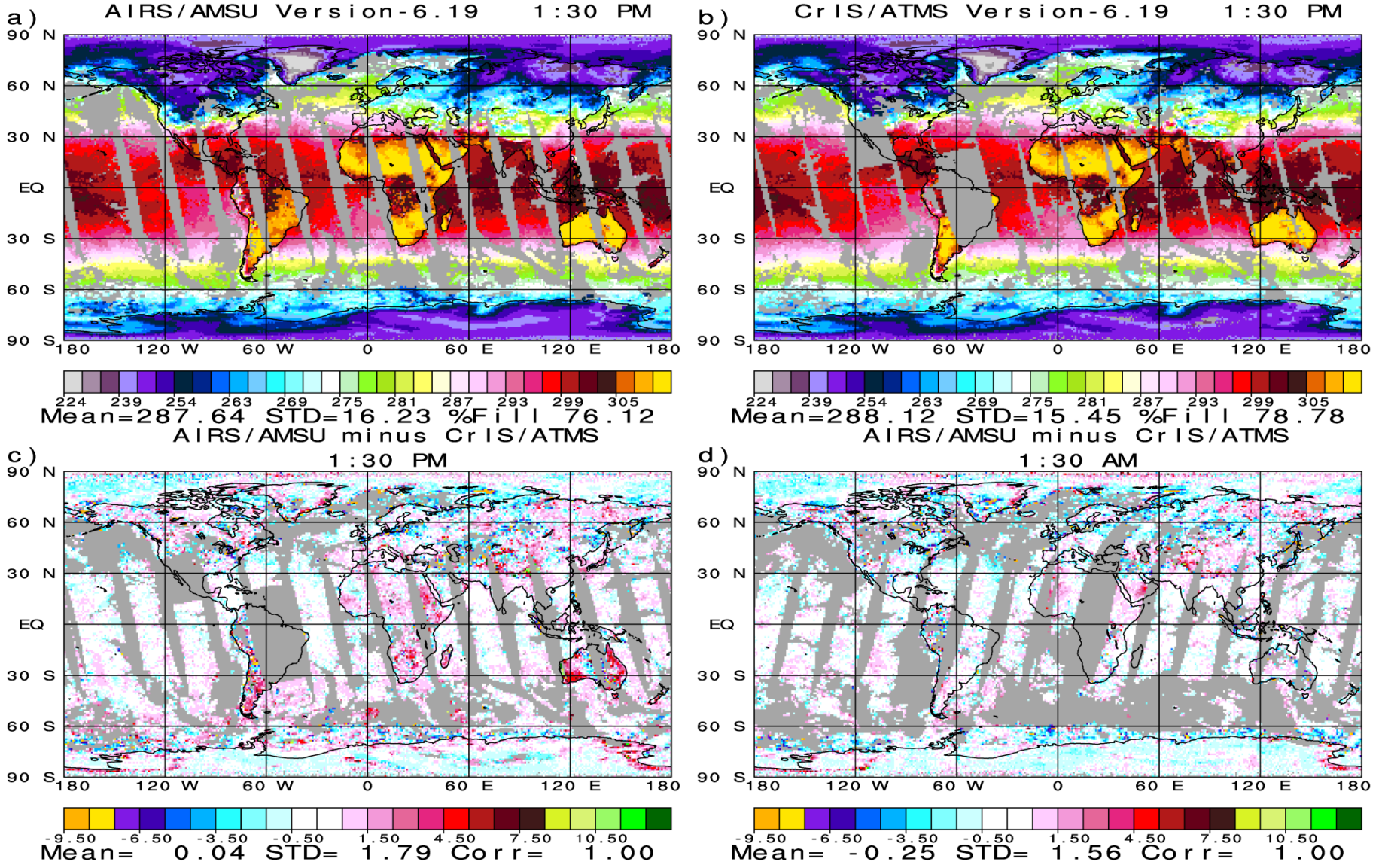
CrIS/ATMS *T(p)* retrievals are of comparable accuracy with AIRS/AMSU, with a slightly lower yield. Results should improve with new neural-net guess coefficients

December 4, 2013



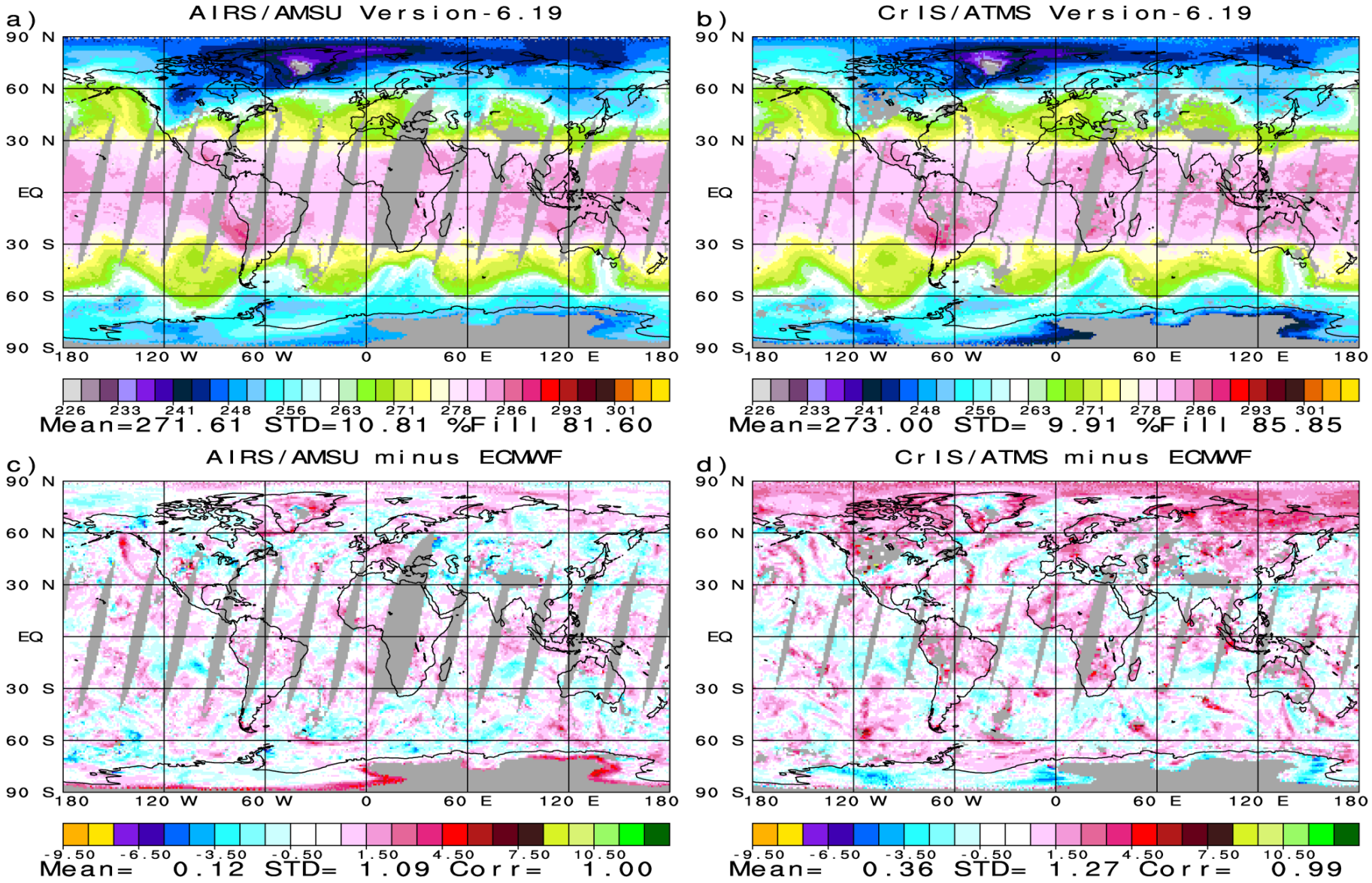
AIRS/AMSU *q(p)* retrievals are somewhat more accurate than CrIS/ATMS in the lower troposphere where CrIS retrievals have a dry bias compared to ECMWF.

Surface Skin Temperature (K)
December 4, 2013



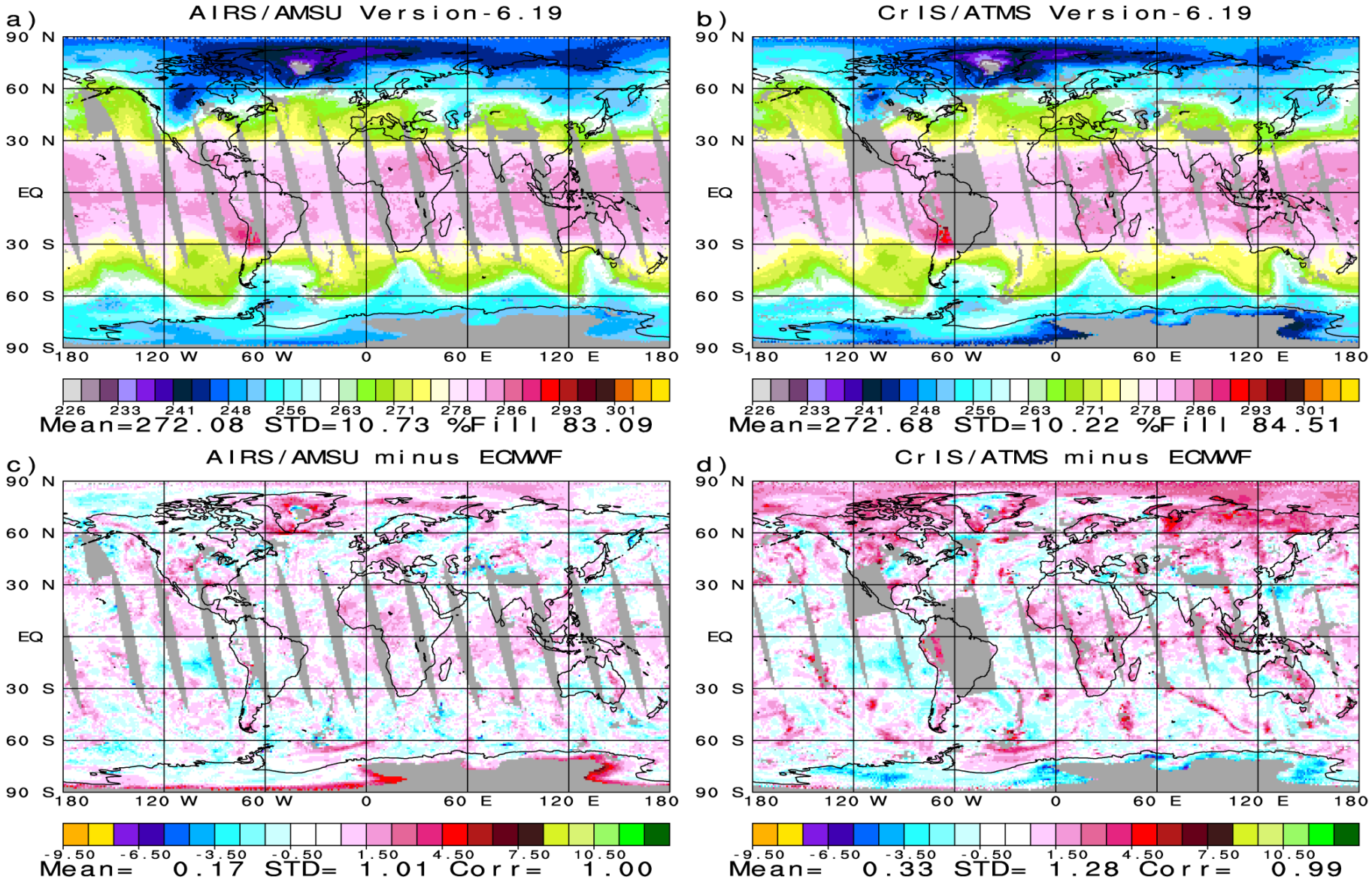
AIRS/AMSU and CrIS/ATMS results agree extremely well over ocean. Agreement is poorer over land during the day. This might be a result of time-of-day sampling differences.

700 mb Temperature (K)
December 4, 2013 1:30 AM



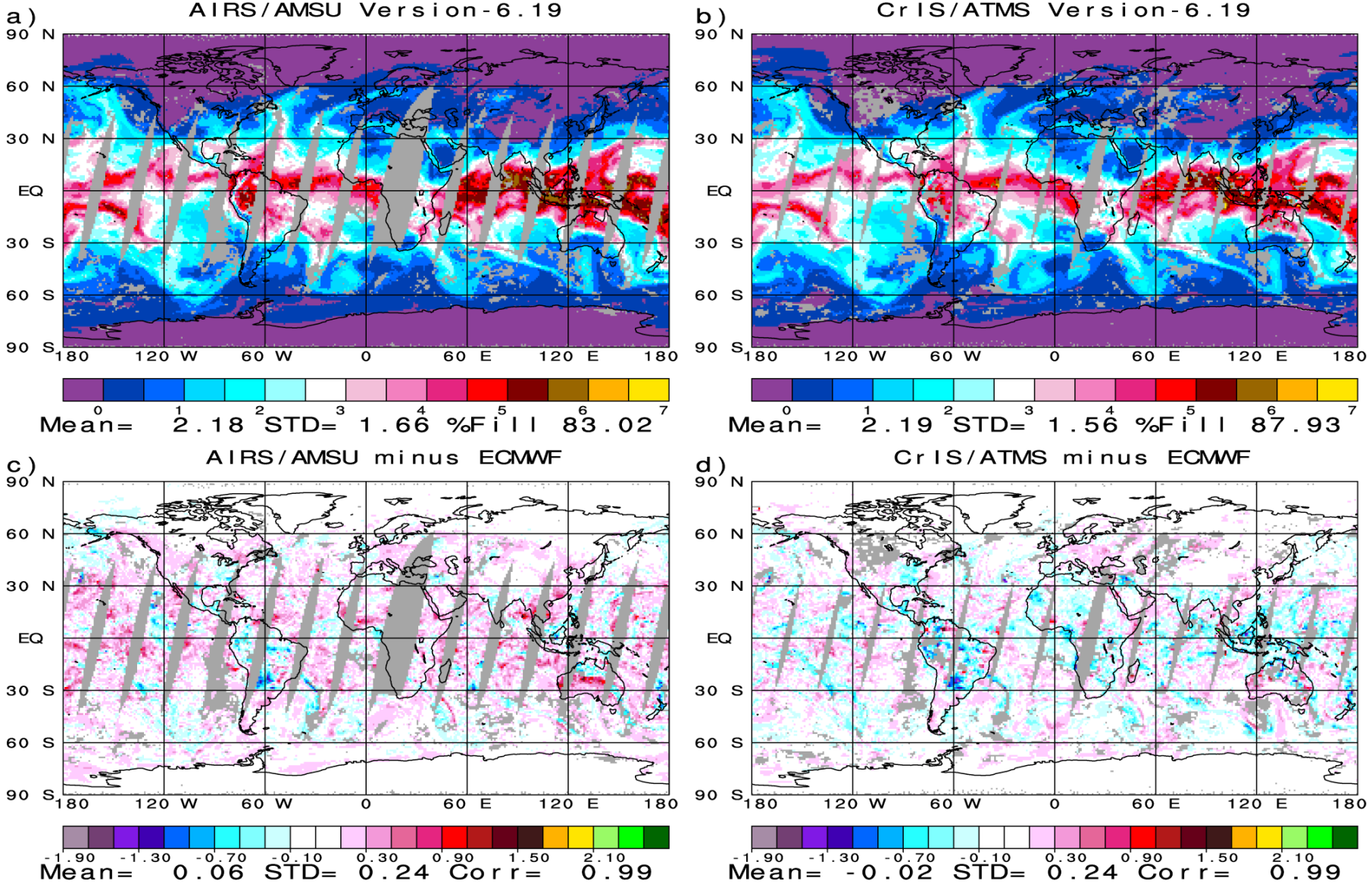
AIRS/AMSU and CrIS/ATMS agree reasonably well with ECMWF at 1:30 AM, but CrIS/ATMS results are biased slightly high, especially in cloudy regions.

700 mb Temperature (K)
December 4, 2013 1:30 PM



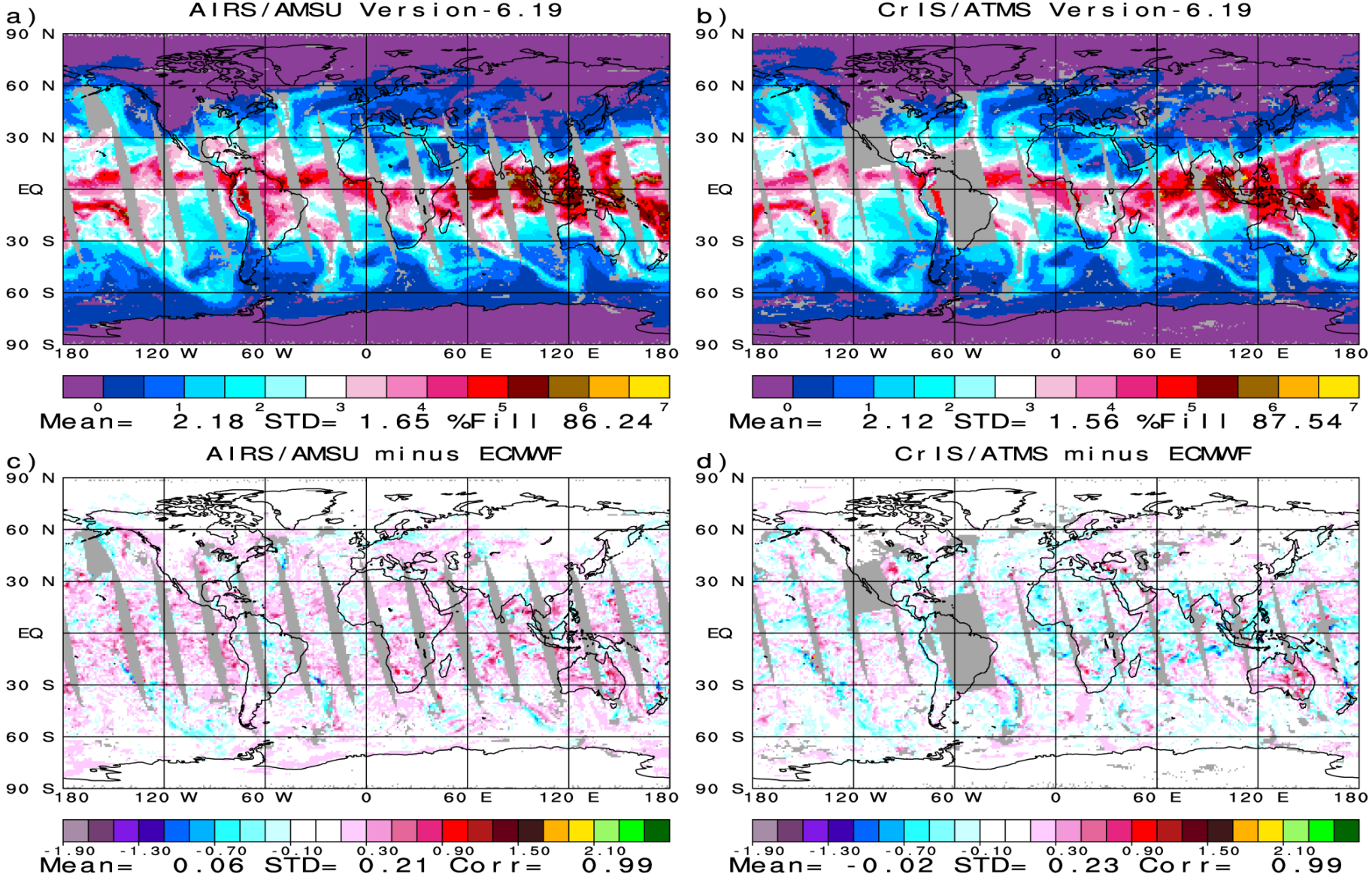
AIRS/AMSU and CrIS/ATMS also agree reasonably at 1:30 PM.

Total Precipitable Water (cm)
December 4, 2013 1:30 AM



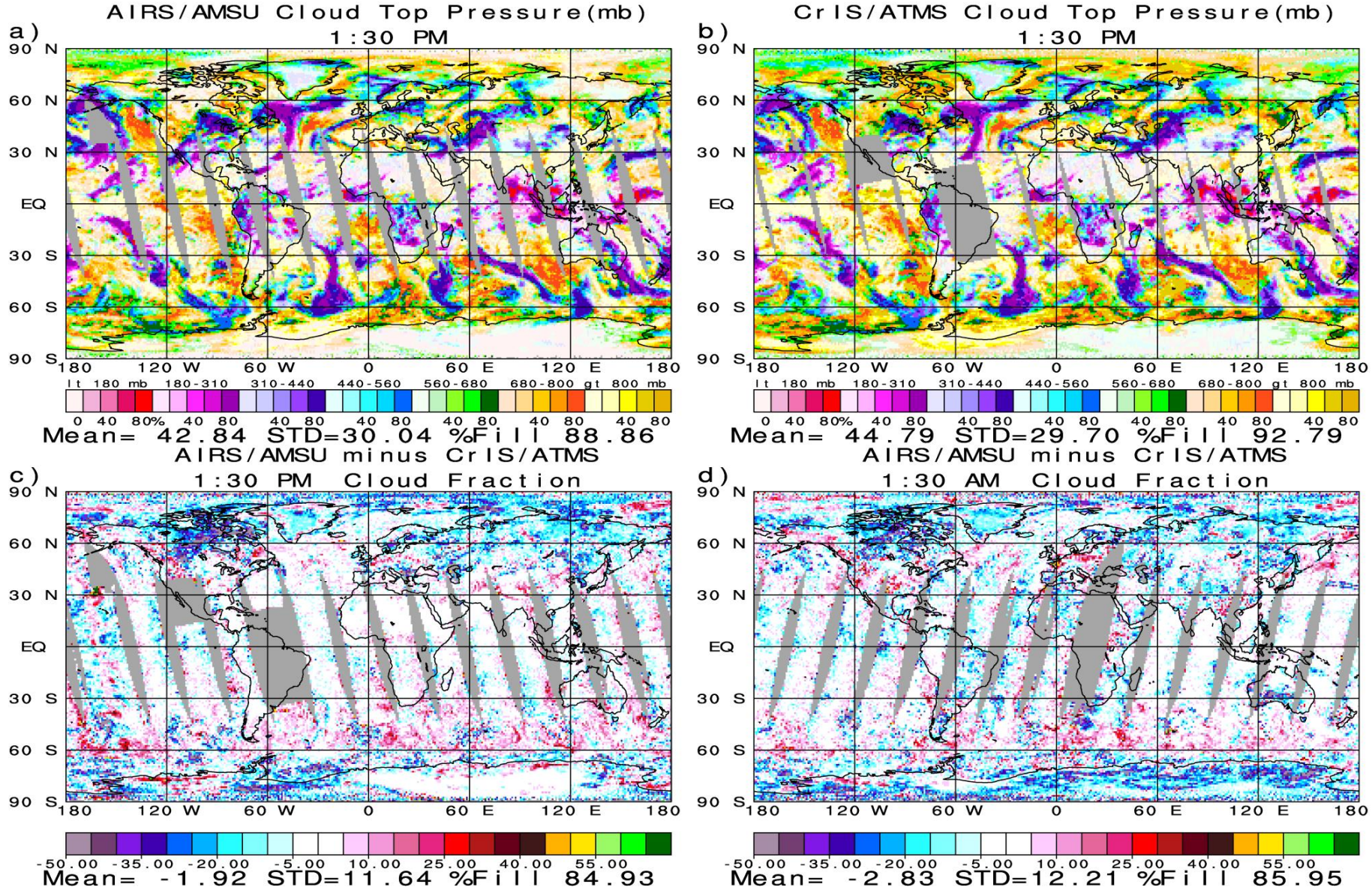
AIRS/AMSU and CrIS/ATMS W_{TOT} agree well with ECMWF and with each other at 1:30 AM.
CrIS/ATMS retrievals are biased low compared to ECMWF in areas of high clouds.

Total Precipitable Water (cm)
December 4, 2013 1:30 PM



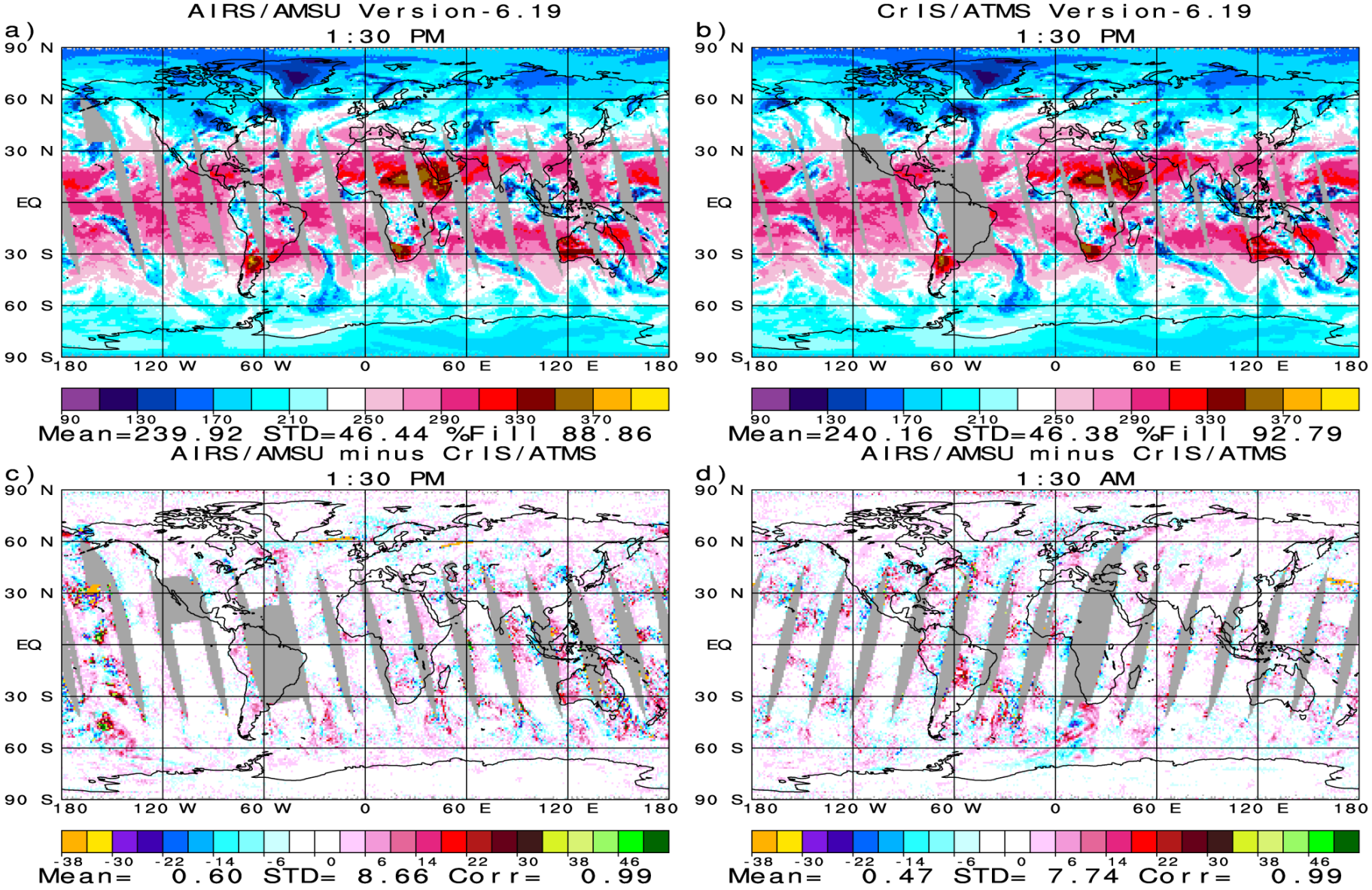
AIRS/AMSU and CrIS/ATMS W_{TOT} likewise agree well with ECMWF and with each other at 1:30 PM.

Cloud Parameters
December 4, 2013

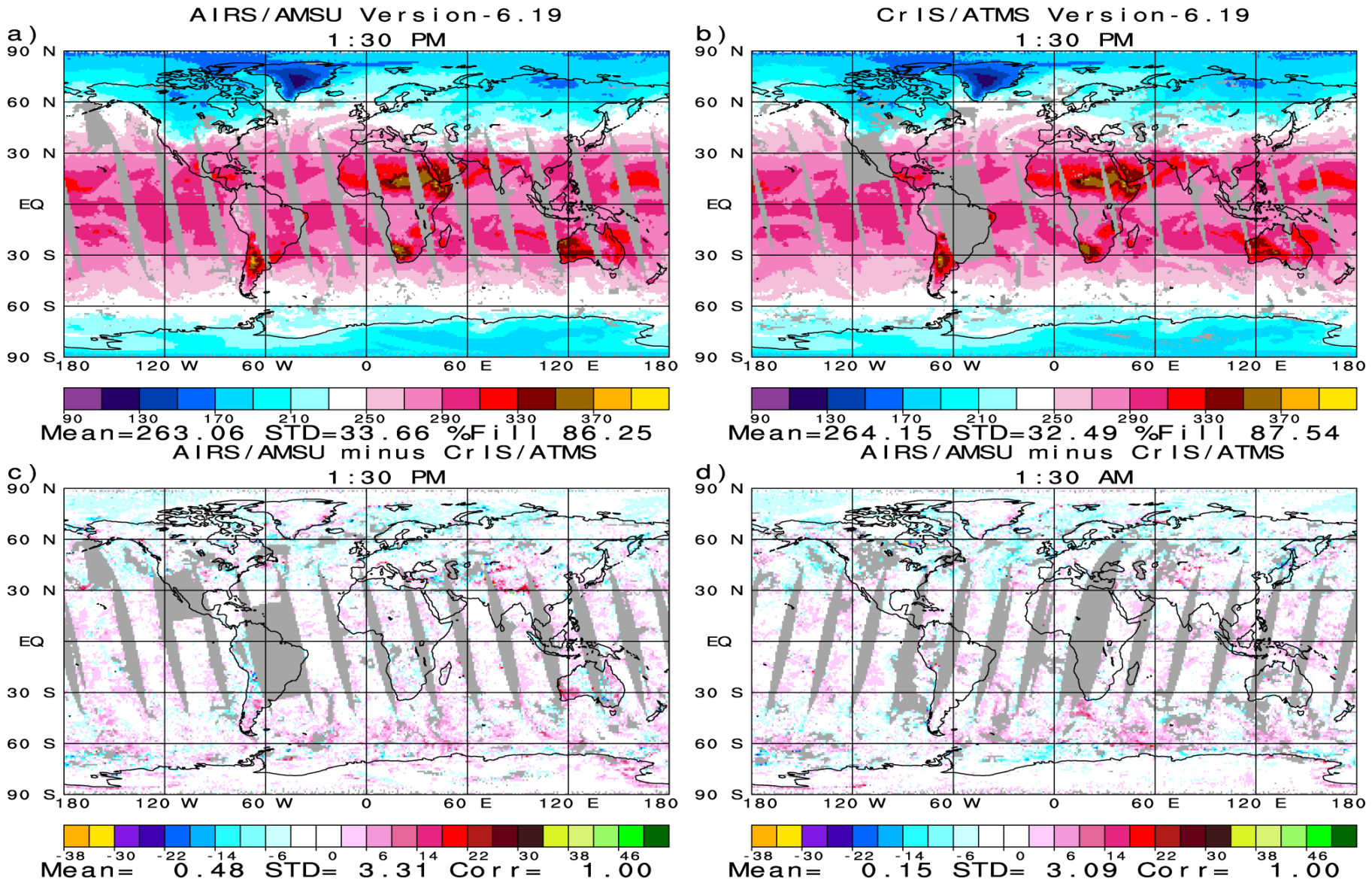


AIRS/AMSU and CrIS/ATMS retrieved cloud parameters agree very well with each other at both 1:30 PM and 1:30 AM.

Outgoing Longwave Radiation (Watts/m^2)
December 4, 2013

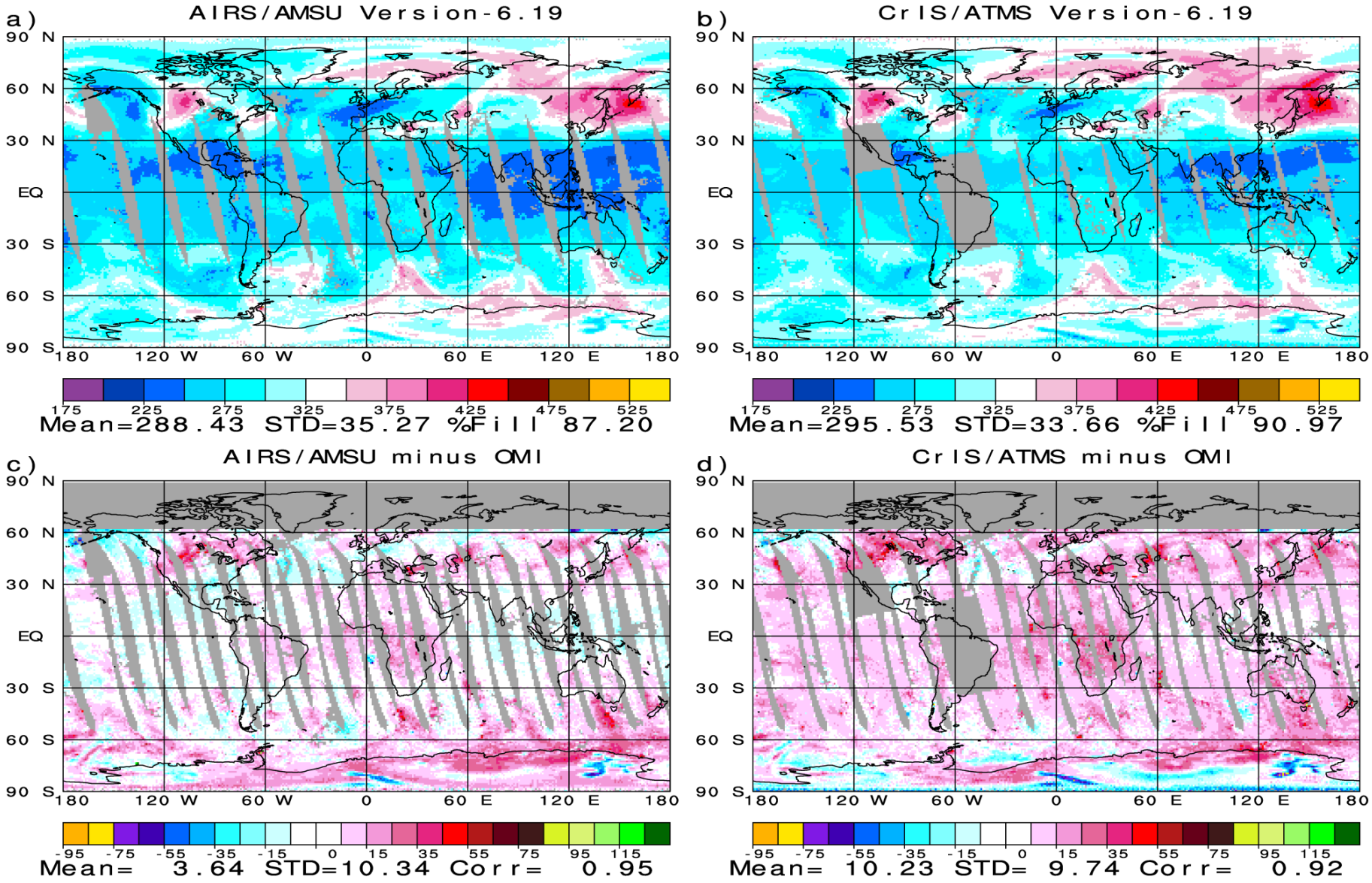


AIRS/AMSU and CrIS/ATMS OLR agree extremely well with each other. Some differences (e.g. left side of plot c) appear to be due to averaging neighboring days within a gridbox.



AIRS/AMSU and CrIS/ATMS Clear Sky OLR agree almost perfectly with each other.

Total Ozone (DU)
December 4, 2013 1:30 PM



AIRS/AMSU and CrIS/ATMS Total O_3 agree well with each other and with OMI. CrIS/ATMS Total O_3 is biased high compared to AIRS/AMSU and OMI.

Summary and Plans

- Most CrIS/ATMS Version-6.19 products match AIRS/AMSU Version-6.19 products very well in terms of yield and accuracy: temperature profiles, water vapor profiles, total ozone burden, land and ocean skin temperature, cloud heights and amounts, OLR, clear sky OLR.
- CrIS/ATMS and AIRS/AMSU total column CO and CH_4 do not match well at this time. This is not our priority now but we will look into it later.
- We have implemented AIRS/AMSU Version-6.19 at JPL. We are now porting CrIS/ATMS Version-6.19 to the Sounder SIPS for parallel testing and comparison of results with AIRS/AMSU Version-6.19 on daily, monthly, and interannual difference time scales.