Results from CrIS/ATMS Obtained Using an "AIRS Version-6 Like" Retrieval Algorithm

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Joel Susskind NASA Goddard Space Flight Center Code 610 Earth Sciences Division Greenbelt, MD 20771 **Joel.Susskind@nasa.gov**

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Louis Kouvaris Louis.C.Kouvaris@nasa.gov

Lena Iredell Lena.Iredell@nasa.gov

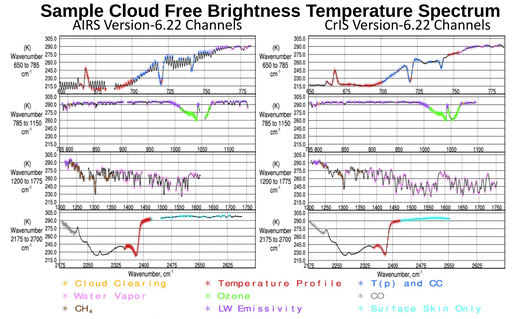
John Blaisdell John.Blaisdell@nasa.gov

For questions or comments during AGU poster session call: Joel Susskind (240) 793-6398

Background

The AIRS Science Team Version 6 retrieval algorithm is currently producing very high quality level-3 Climate Data Records (CDRs) from AIRS that will be critical for understanding climate processes. CDRs are gridded level-3 products which include all cases passing AIRS Climate Quality Control (QC). AIRS is predicted to last through at least 2020. CrIS/ATMS is the only scheduled sounder follow-on to AIRS/AMSU. The objective of this research is to generate a long term CrIS/ATMS level-3 data set that is consistent with that of AIRS/AMSU. The AIRS Science Team has made significant improvements to AIRS Version-6 and plans to reprocess all AIRS data with AIRS Version-7 in the relatively near future. The current version is called AIRS Version-6.22, which we adapted to also run with CrIS/ATMS. Version-6.22 generates improved temperature, water vapor, and ozone retrievals as compared to Version-6. AIRS Version-6.22 and CrIS Version-6.22 both run now at JPL. JPL plans to generate, in the relatively near future, many months in common of AIRS Version-6.22 and CrIS 6.22 data products, or possibly products using further improved versions of each retrieval system. We will evaluate the results by comparison of monthly mean AIRS and CrIS products, and more significantly, their inter-annual differences and anomaly time series. August 2014 was processed at JPL using both systems, the AIRS data using AIRS Science Team computers, and CrIS data by the JPL SIPS team.

Sample Cloud Free Brightness Temperature Spectrum



Sample AIRS and CrIS brightness temperatures computed for a cloud free scene. The AIRS and CrIS channels we use in different steps in the retrieval process are indicated in the figures by different colored stars. AIRS is sampled twice as densely as CrIS and extends further at the high frequency end.

CrIS/ATMS Neural-Net Coefficients

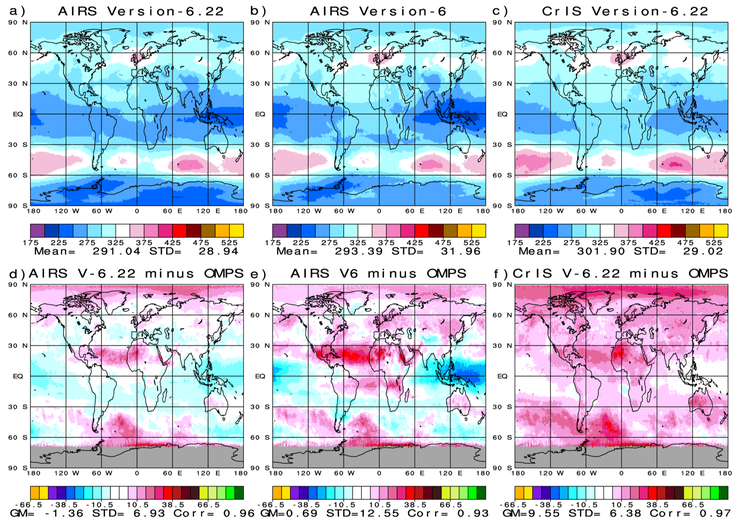
As in AIRS Version-6, Version-6.22 uses Neural-Net methodology to generate the first guesses for $T(p)$, $q(p)$, and T_{surf} for each AIRS/AMSU or CrIS/ATMS Field of Regard (FOR). The CrIS/ATMS Neural-Net coefficients were trained by Bill Blackwell and co-workers at Lincoln Labs using data on select time periods early in the mission. These coefficients are then used for all time periods. 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 produced a biased first guess after this change in calibration. They will need retraining. Bill Blackwell has indicated that he will generate new CrIS/ATMS Neural-Net coefficients trained on radiances using the newest CrIS/ATMS calibration procedures when they are finalized. In the meantime, we are using and evaluating results using the old Neural-Net coefficients.

Summary

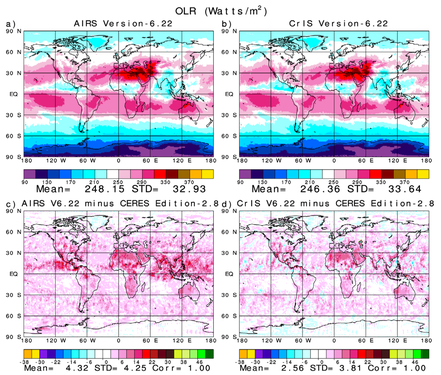
AIRS and CrIS Version-6.22 $O_3(p)$ and $q(p)$ products are both superior to those of AIRS Version-6. Monthly mean August 2014 Version-6.22 AIRS and CrIS products agree reasonably well with OMPS, CERES, and with each other. JPL plans to process AIRS and CrIS for many months and compare interannual differences. Updates to the calibration of both CrIS and ATMS are still being finalized. We are also working with JPL to develop a joint AIRS/CrIS level-1 to level-3 processing system using a still to be finalized Version-7 retrieval algorithm. The NASA Goddard DISC will eventually use this system to reprocess all AIRS and recalibrated CrIS/ATMS.

Monthly Mean Products for August 2014

Cross Comparison of AIRS, CrIS, and other NPP Instruments



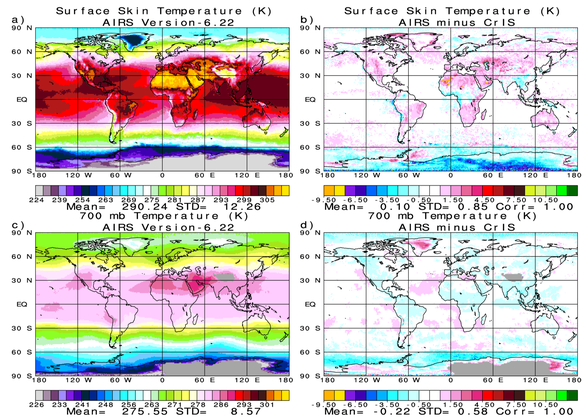
The AIRS Version-6.22 monthly mean field of total ozone agrees much better with OMPS than does AIRS Version-6 in terms of spatial standard deviation and correlation. CrIS total ozone has similar standard deviation and correlation with OMPS as AIRS, but is biased high. We are continuing to improve details of the ozone retrieval algorithm and QC procedures.

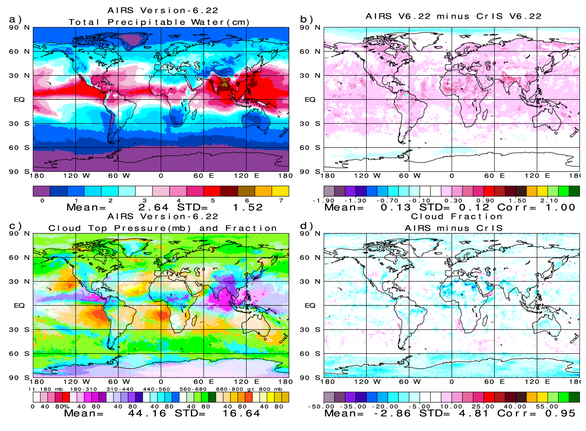


AIRS OLR monthly mean data has been previously shown to match CERES Edition-2.8 very closely in time and space. CrIS OLR matches CERES even better for this month than AIRS.

Comparison of AIRS Version-6.22 with CrIS Version-6.22

AIRS and CrIS surface skin temperature and 700 mb temperature fields match very well, especially over ocean. Currently CrIS skin temperatures are somewhat lower than those of AIRS over land, which leads to corresponding higher 700 mb temperature over land for CRIS.



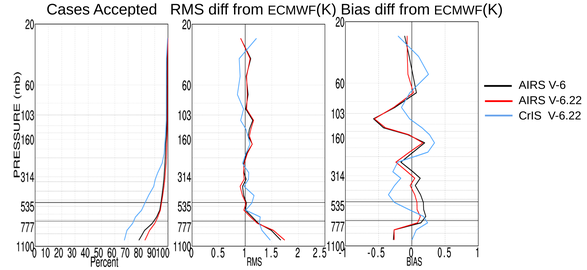


AIRS and CrIS total precipitable water and cloud products also match well with each other though AIRS has somewhat more total precipitable water than CrIS in the tropics. We are investigating the causes of the relatively small differences between the AIRS and CrIS results.

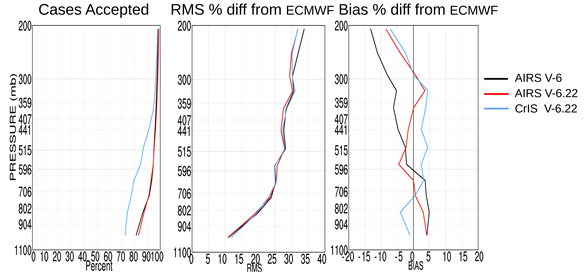
Single Day Global Comparisons

Results passing Climate QC are shown for the single day, 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. This day also occurs after the major upgrade in ATMS calibration procedures.

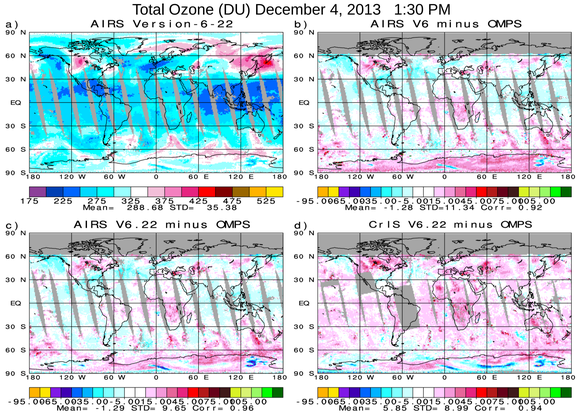
Comparison of AIRS Version-6 AIRS Version-6.22, and CrIS Version-6.22 Yields and Accuracies



CrIS V-6.22 temperature profile results with Climate QC are good, but has a lower yield and larger errors than AIRS V-6.22. This is possibly indicative of poorer performance in cloudier scenes than AIRS. AIRS V-6.22 has a slightly higher yield than AIRS V-6 with comparable accuracy.



AIRS and CrIS Version-6.22 water vapor profile results are both superior to those of AIRS Version-6, especially with regard to bias and RMS errors in the upper troposphere.



AIRS total O_3 V6.22 agrees much better with OMPS than AIRS V6 with regard to both STD and spatial correlation. OMPS provides no data in polar winter. CrIS V6.22 statistics are comparable to AIRS V6.22 but CrIS is biased high compared to AIRS and OMPS.