Analysis of CrIS/ATMS Data Using an AIRS Science Team Version 6 – Like Retrieval Algorithm

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Background

CrIS/ATMS is flying on NPP and is scheduled to fly on JPSS-1

CrIS/ATMS has roughly equivalent capabilities to AIRS/AMSU

The AIRS Science Team Version 6 retrieval algorithm is currently producing very high quality level-3 Climate Data Records (CDR's) that will be critical for understanding climate processes

AIRS CDRs should eventually cover the period September 2002 through at least 2020

CrIS/ATMS is the only scheduled follow on to AIRS AMSU

I have been asked by Ramesh Kakar if CrIS/ATMS can be counted on to adequately continue the AIRS/AMSU CDRs beyond 2020, or is something better needed?

This research is being done to answer that question

A minimum requirement to obtain a yes answer is that CrIS/ATMS be analyzed using an AIRS Version 6 – like algorithm

NOAA is currently generating CrIS/ATMS products using 2 algorithms: IDPS and NUCAPS

The IDPS Algorithm

- IDPS products are generated using improved versions of the heritage NGAS retrieval algorithm
- IDPS generates surface skin temperature (T_s), temperature profile T(p), moisture profile q(p), and pressure profile
- IDPS does not have a product dependent QC flag
- IDPS has no requirement for, and does not generate, Level 3 products
- There is no plan for reprocessing CrIS/ATMS as the IDPS algorithm improves
- The current version is IDPS Mx 6.7, which became operational March 2013
- Mx 7.0 is expected to be better and become operational in June
- We have been able to read and evaluate IDPS Mx 6.7 level-2 products and also generate level-3 products using the IDPS QC flag: IR and MW retrievals both converge

NOAA Unique CrIS/ATMS Processing System (NUCAPS)

The NUCAPS retrieval algorithm was developed by Chris Barnet and co-workers at NOAA/NESDIS/STAR

NUCAPS is based on AIRS Science Team retrieval algorithms and produces all products AIRS does

Possible limitations in NUCAPS with regard to generation of optimal CDRs

- NUCAPS is a hybrid AIRS Version-4/Version-5 algorithm
  - Channels used and QC methodology are not up to date with AIRS Version-6
- NUCAPS does not use a Neural-Net guess
- NUCAPS does not generate a level-3 product
- Current NUCAPS products are only stored at NOAA for the latest 2-week period

SRT Plans Using NUCAPS

We have not yet successfully processed NUCAPS

When able to, we plan to evaluate level-2 products and generate level-3 products from NUCAPS

We will compare monthly mean level-3 products of NUCAPS and IDPS with those of AIRS Version-6 as well as with our own Version-6 like CrIS/ATMS retrievals

SRT Research Using CrIS/ATMS

Approach

- Use as closely as possible the AIRS Version-6 retrieval methodology to analyze CrIS/ATMS data
- "Validate" monthly mean CrIS/ATMS products by comparison with AIRS products

Status of AIRS Version-6

AIRS Version-6 is running at JPL and SRT

We have not yet obtained CrIS/ATMS Neural-Net coefficients for CrIS/ATMS from Bill Blackwell

We plan to optimize and run Version-6 like CRIS/ATMS retrievals when we get these coefficients

AIRS Version-5.56

- SRT AIRS Version-5.56 is otherwise like AIRS Version-6 but uses a regression start-up with coefficients provided by NOAA many years ago – the performance of these coefficients is degrading

Status of SRT Research Using CrIS/ATMS

SRT AIRS Version-5.56 has been adapted to run with CrIS/ATMS data: called CrIS/ATMS Version-5.54

CrIS/ATMS Version-5.54 does not allow for CrIS FOV dependent NEΔN this is sub-optimal

We use the mean IFOV NEΔN given by NGAS TVAC4, November 2011

We have generated CrIS and ATMS tuning and regression coefficients using observations on July 10, 2012 and September 14, 2012

We have been testing retrievals for April 1, 2013

Results have been compared with AIRS Version-5.56 and AIRS Version-6

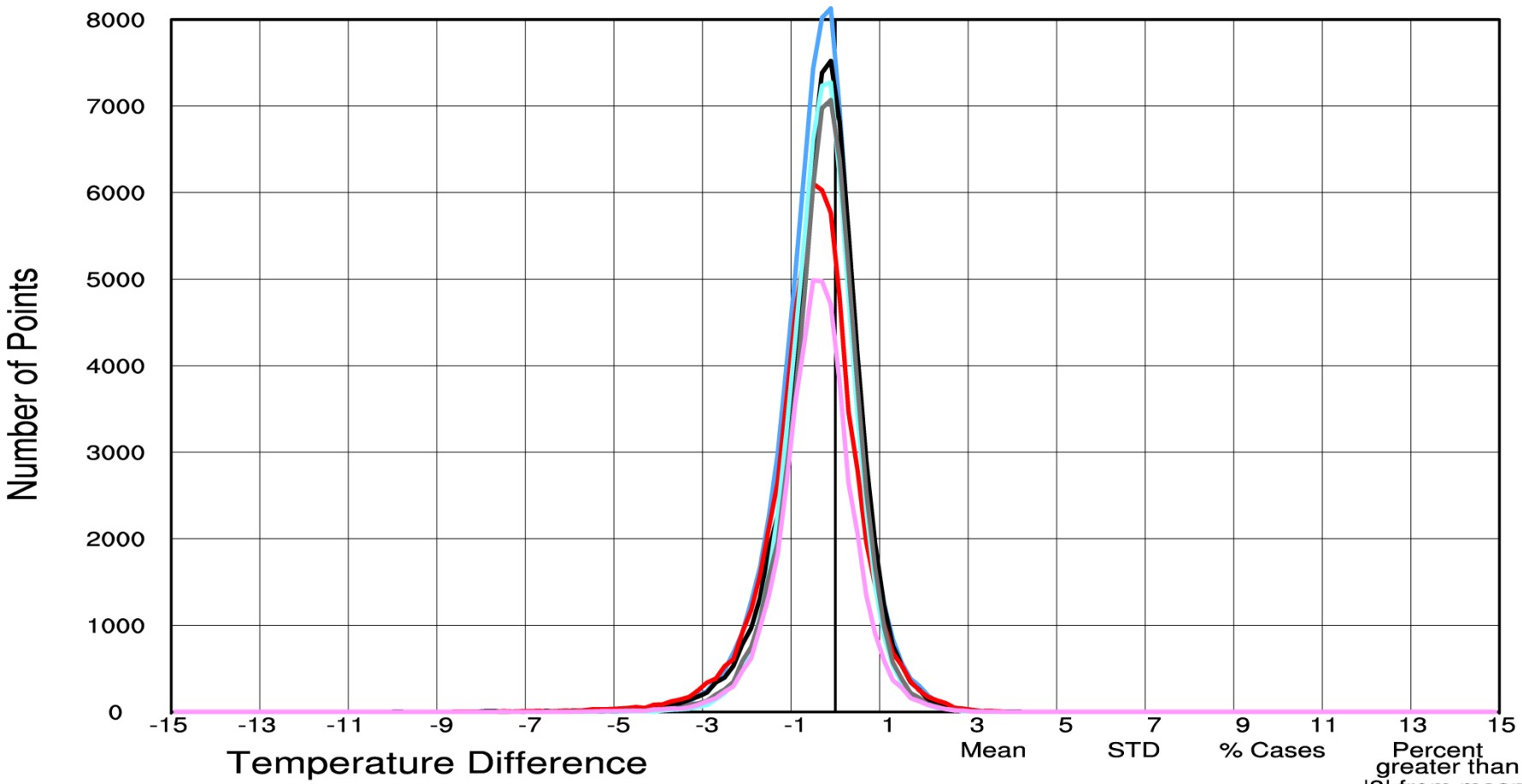
Comparisons Shown

Surface skin temperature T_s, temperature profile T(p), water vapor profile q(p)

- First comparisons show AIRS/AMSU Version-6, AIRS/AMSU Version-5.56, and CrIS/ATMS Version-5.54
  - Results are shown using both tight Data Assimilation QC and looser Climate QC thresholds
  - Achieving AIRS/AMSU Version-6 quality results is the goal for CrIS/ATMS

- Second comparisons show AIRS/AMSU Version-6, CrIS/ATMS Version-5.54, and IDPS CrIS/ATMS
  - SRT results shown use climate QC
    - The purpose of the study is for generation of climate data sets
  - Level-2 and level-3 IDPS results both use IDPS QC flag

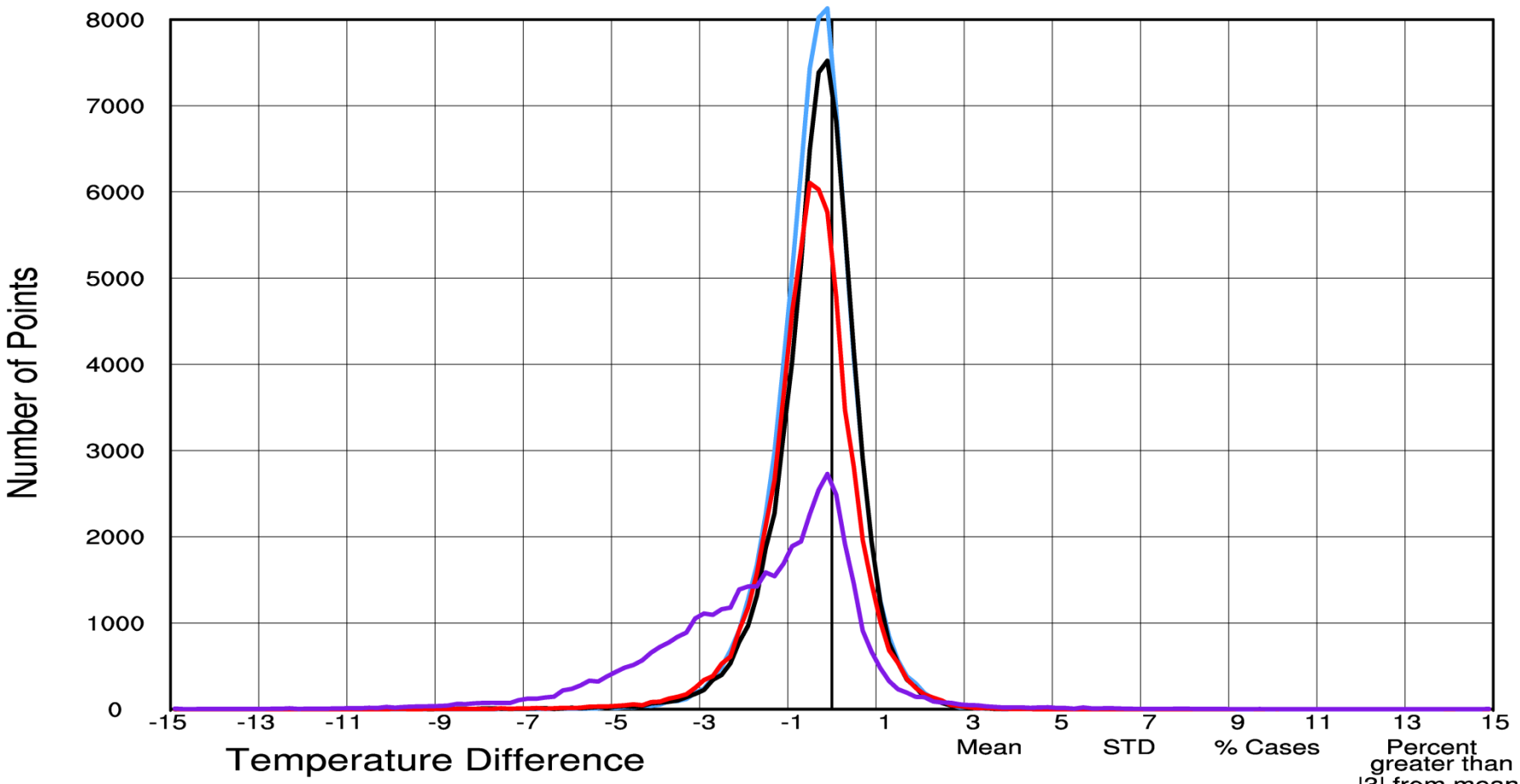
Surface Skin Temperature Difference From ECMWF
April 1, 2013 Daytime and Nighttime combined
50 N to 50 S Non-Frozen Ocean



			Mean	STD	% Cases	Percent greater than |3| from mean
V6	AIRS	Climate QC	-0.17	0.90	58.40	1.06
V5.56	AIRS	Climate QC	-0.14	0.95	52.58	1.50
V5.54	CrIS	Climate QC	-0.28	1.01	48.32	2.17
V6	AIRS	Data Assimilation QC	-0.13	0.77	47.65	0.35
V5.56	AIRS	Data Assimilation QC	-0.11	0.83	46.69	0.78
V5.54	CrIS	Data Assimilation QC	-0.22	0.83	34.95	0.83

CrIS results are reasonable but poorer than AIRS V5.56. AIRS V6 is the best.

Surface Skin Temperature Difference From ECMWF
April 1, 2013 Daytime and Nighttime combined
50 N to 50 S Non-Frozen Ocean



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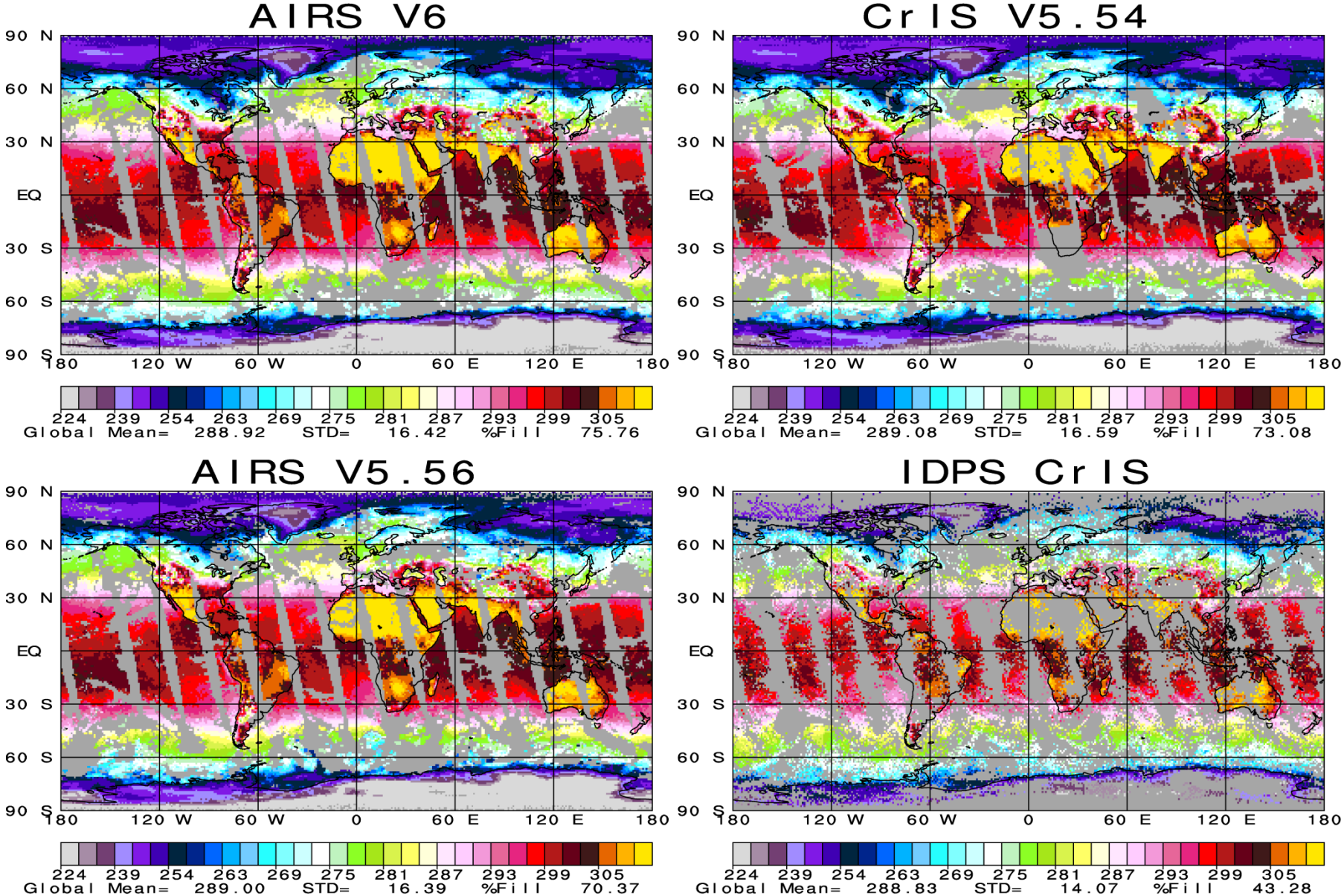
v5.54	CrIS	Climate QC	-0.28	1.01	48.32	2.17
IDPS	CrIS	IDPS QC	-1.33	2.00	34.90	23.65

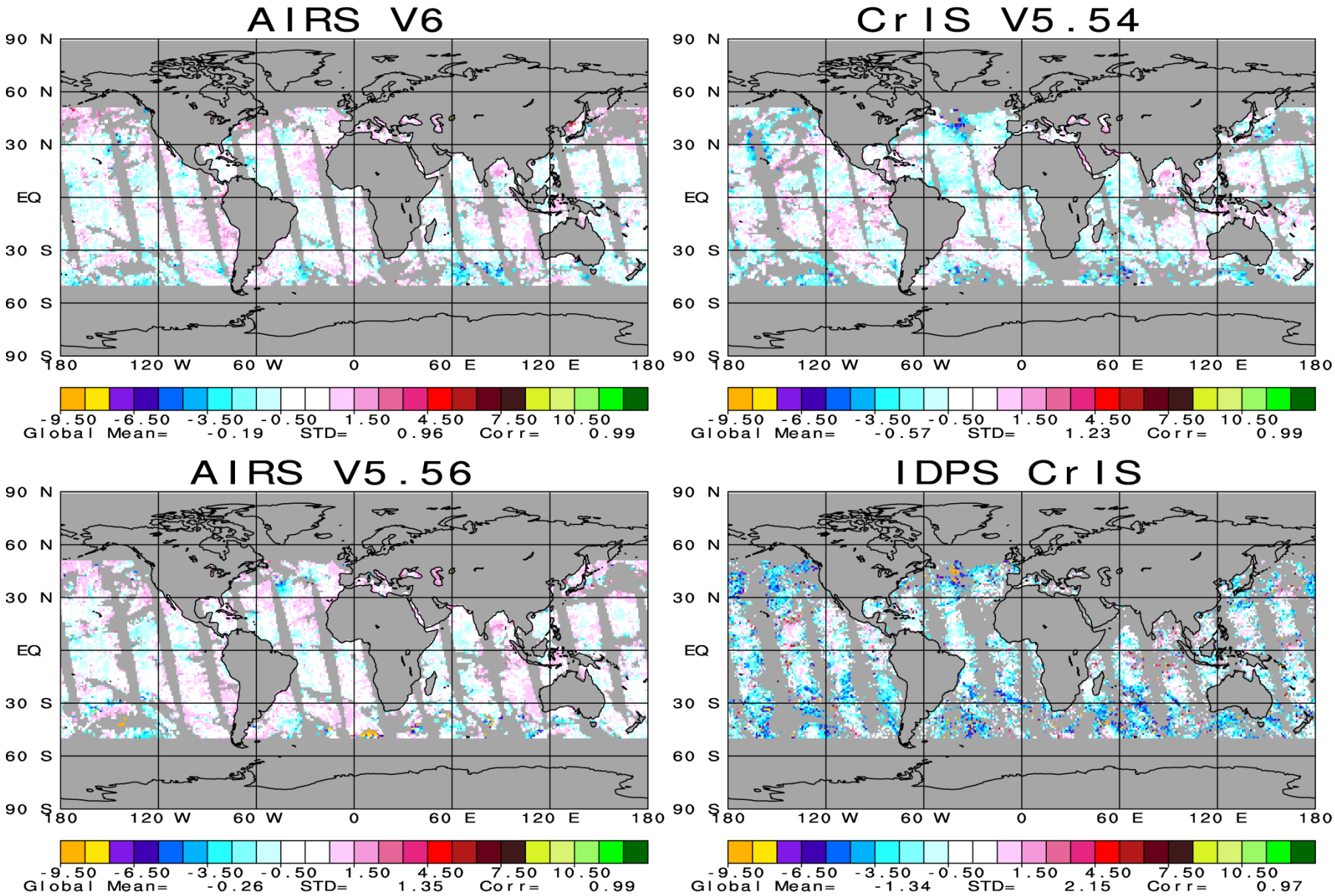
IDPS results are very poor.

April 1, 2013 Surface Skin Temperature (°K) 1:30 PM



IDPS coverage is poor- especially over hot and cold land.

April 1, 2013 Surface Skin Temperature (°K) 1:30 PM Difference from ECMWF



CrIS retrievals are biased cold – especially IDPS.

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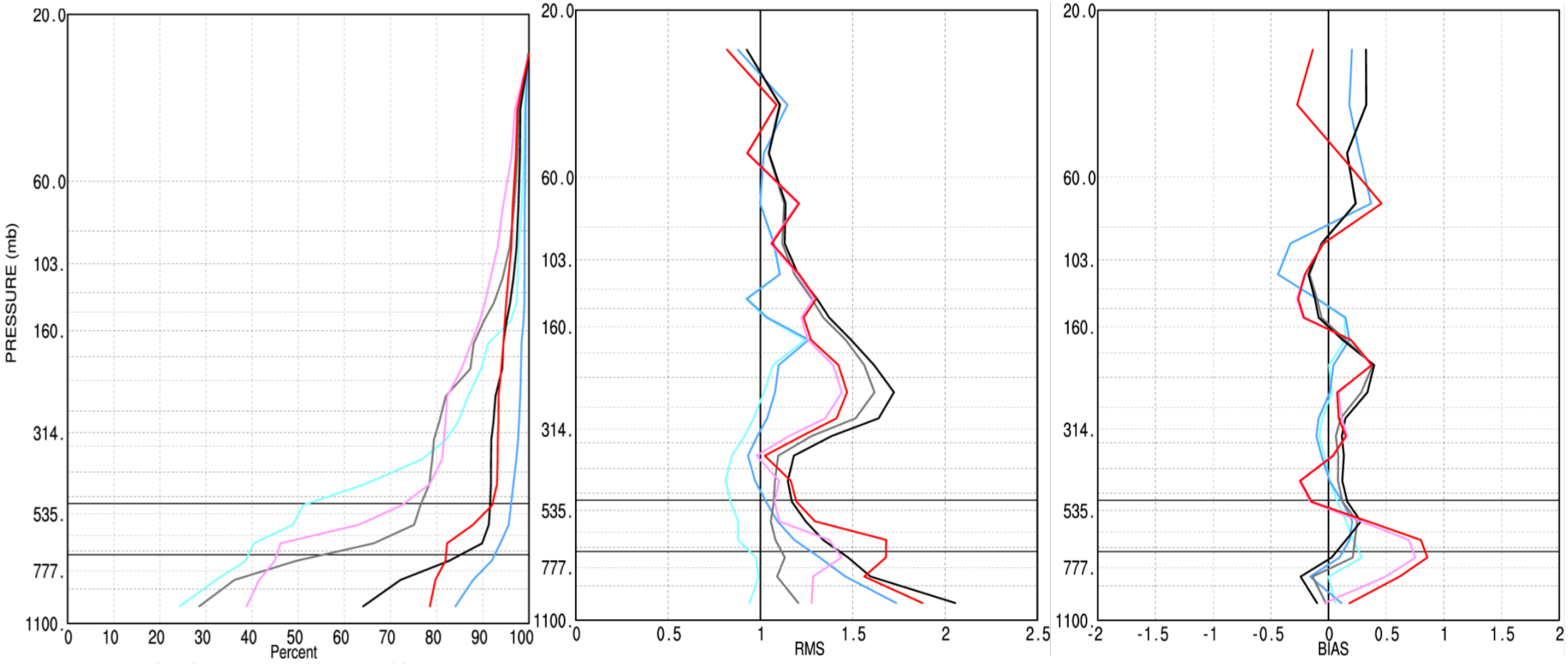
Global Temperature Profile April 1, 2013

Percent of All Cases Accepted

1 km Layer Mean RMS (°K) Difference from ECMWF

1 km Layer Mean Bias (°K) Difference from ECMWF



V6 AIRS/AMSU Data Assimilation QC
V6 AIRS/AMSU Climate QC
V5.56 AIRS/AMSU Data Assimilation QC
V5.56 AIRS/AMSU Climate QC
V5.54 CrIS/ATMS Data Assimilation QC
V5.54 CrIS/ATMS Climate QC

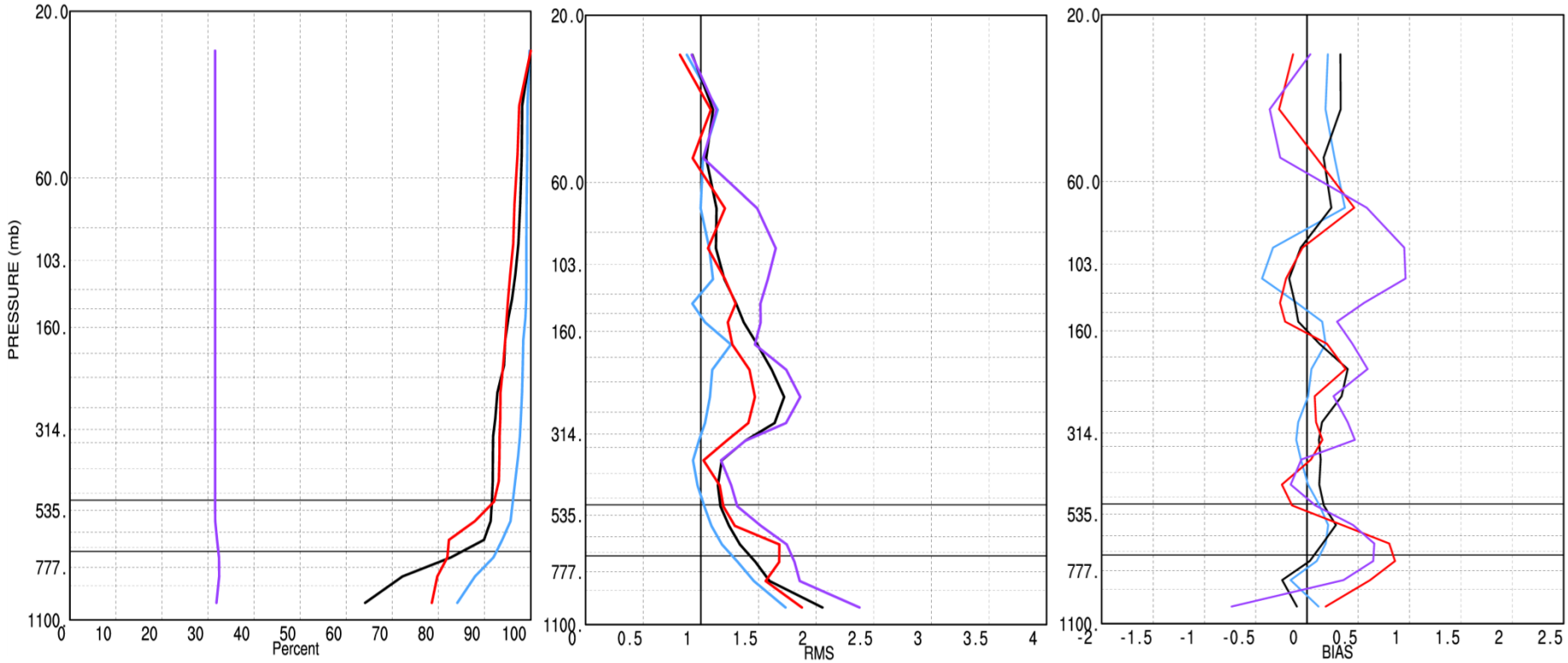
CrIS T(p) results are roughly comparable to AIRS V5.56; AIRS V6 is much better.

Global Temperature Profile April 1, 2013

Percent of All Cases Accepted

1 km Layer Mean RMS (°K) Difference from ECMWF

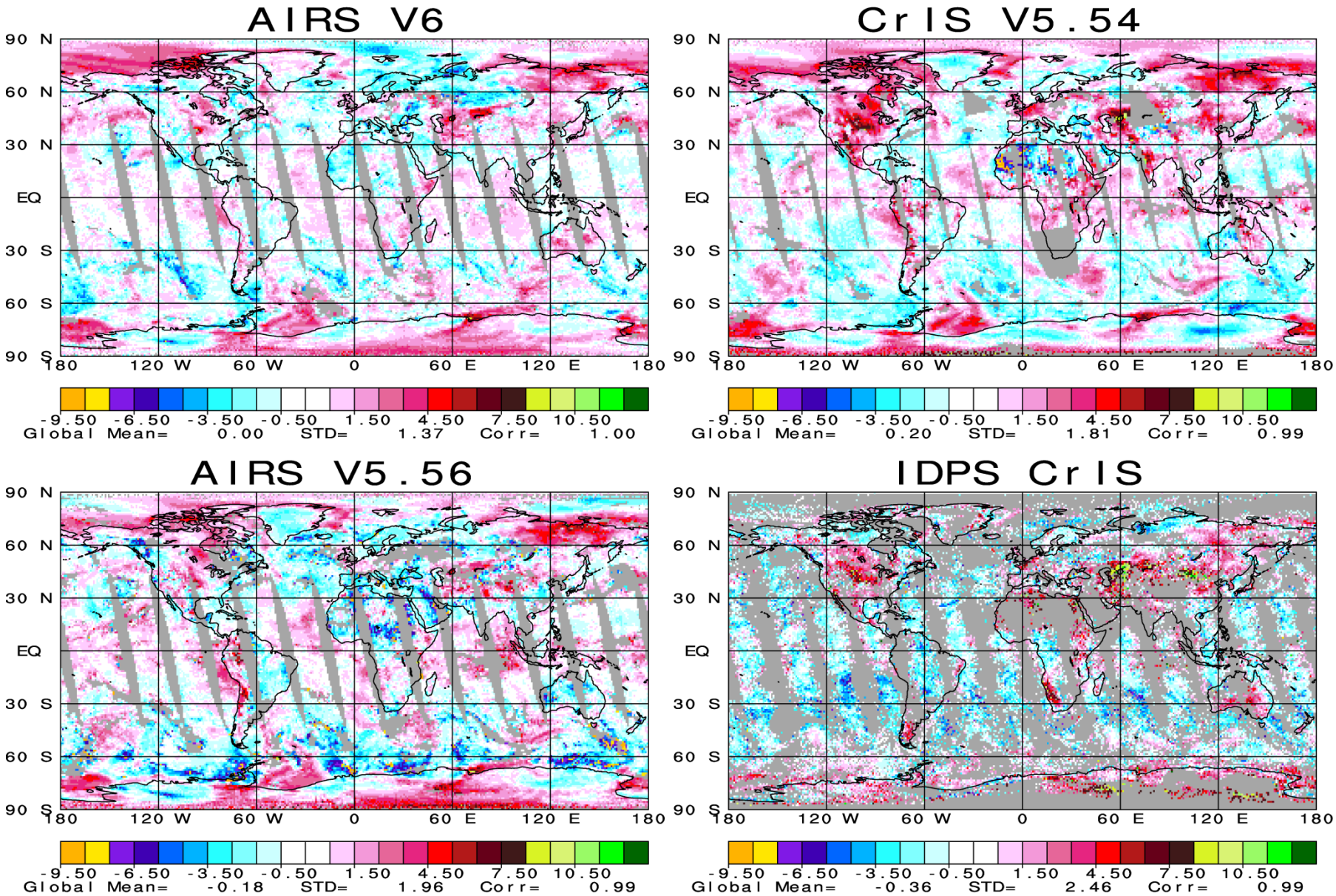
1 km Layer Mean Bias (°K) Difference from ECMWF



V6 AIRS/AMSU Climate QC
V5.56 AIRS/AMSU Climate QC
V5.54 CrIS/ATMS Climate QC
IDPS CrIS/ATMS IDPS QC

IDPS results have poorest quality and very low yield.

April 1, 2013 Boundary Layer Temperature (°K) 1:30 PM Difference from ECMWF



CrIS V5.54 is comparable to AIRS V5.56 and poorer than AIRS V6. IDPS is very poor.

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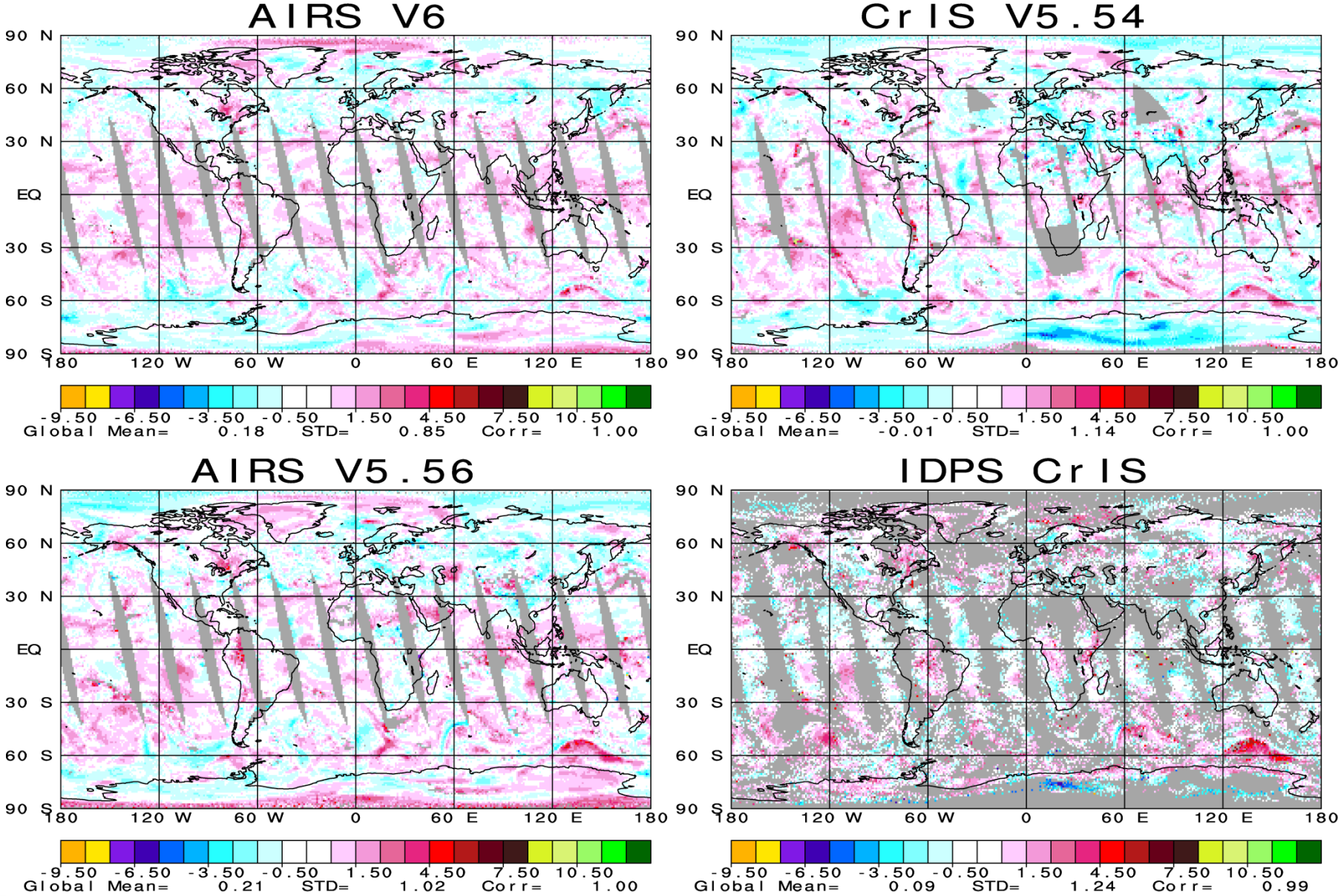
April 1, 2013 500 mb Temperature (°K) 1:30 PM Difference from ECMWF



IDPS accuracy is reasonable but coverage is poor.

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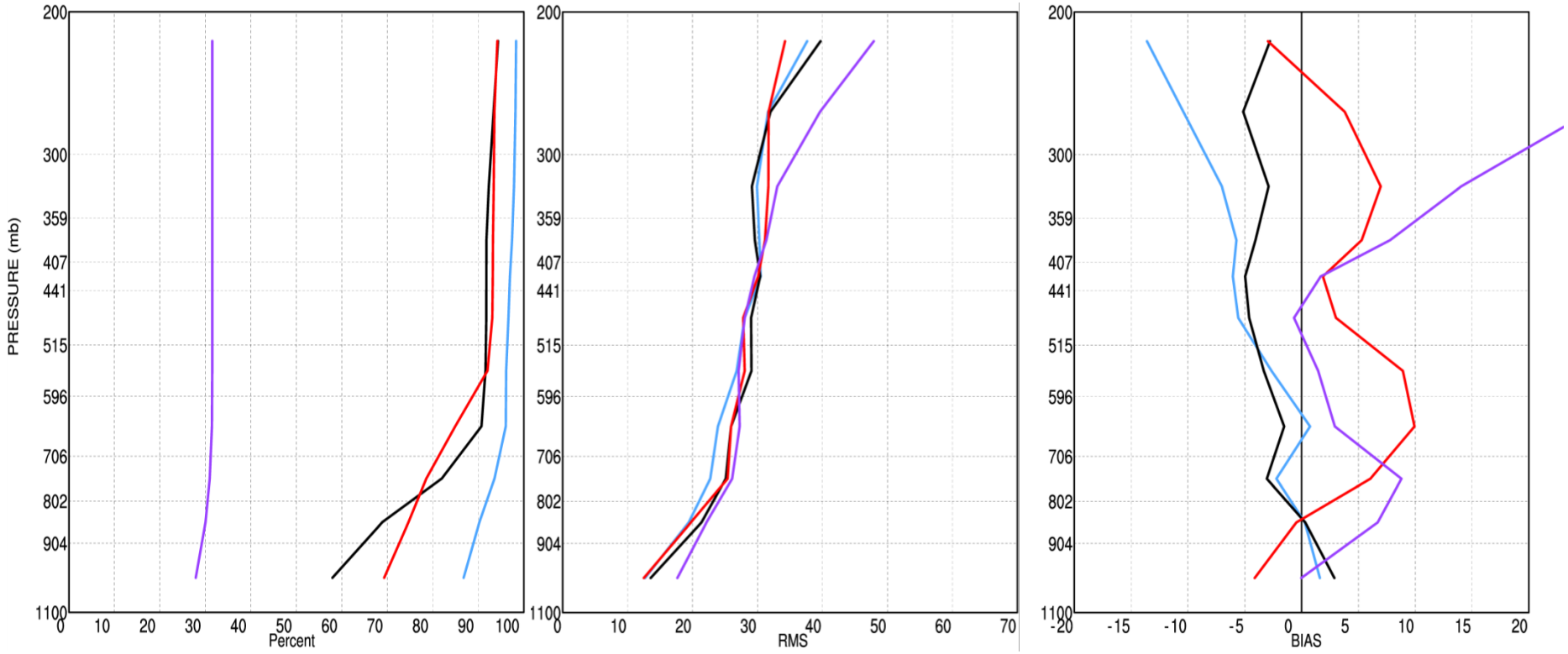
Global Water Vapor April 1, 2013

Percent Yield

1 km Layer Mean
Precipitable Water RMS
% Difference from ECMWF

1 km Layer Mean
Precipitable Water Bias
% Difference from ECMWF



V6 AIRS/AMSU Climate QC
V5.56 AIRS/AMSU Climate QC
V5.54 CrIS/ATMS Climate QC
IDPS CrIS/ATMS IDPS QC

IDPS results are again poorest with very low yield.

Summary and Plans

- IDPS Mx 6.7 is currently performing very poorly and is not a satisfactory follow-on to AIRS Version-6
- We will begin to generate monthly mean NUCAPS level-3 products and compare with AIRS Version-6 when we are capable to do it

SRT V5.54 CrIS/ATMS retrievals are currently of significantly poorer quality than Version-6 AIRS/AMSU

This is not a fair comparison because V5.54 does not use a

Neural-Net guess

V5.54 CrIS/ATMS T(p) and q(p) is only slightly poorer than AIRS/AMSU V5.56

We hope to begin testing CrIS/ATMS Version-6 shortly after obtaining CrIS/ATMS Neural-Net coefficients

GOAL

Once Version-6 CrIS/ATMS is optimized, we hope to generate monthly mean level-3 products for a number of months and compare with AIRS Version-6, NUCAPS, and IDPS

Hopefully, CrIS/ATMS Version-6 processing for a few months can be done in collaboration with Sounder PEATE or Goddard DISC