Assimilation of CrIS and ATMS in the NCEP Global Model

Andrew Collard[1], John Derber[2], Russ Treadon[2], Daryl Kleist[2]

[1] IMSG at NOAA/NCEP/EMC [2] NOAA/NCEP/EMC

Content

- Introduction
- Spatial Averaging
- Comparison with Forecast Model
- Assimilation Configuration
- The future
- Final Remarks

Current ATMS Status

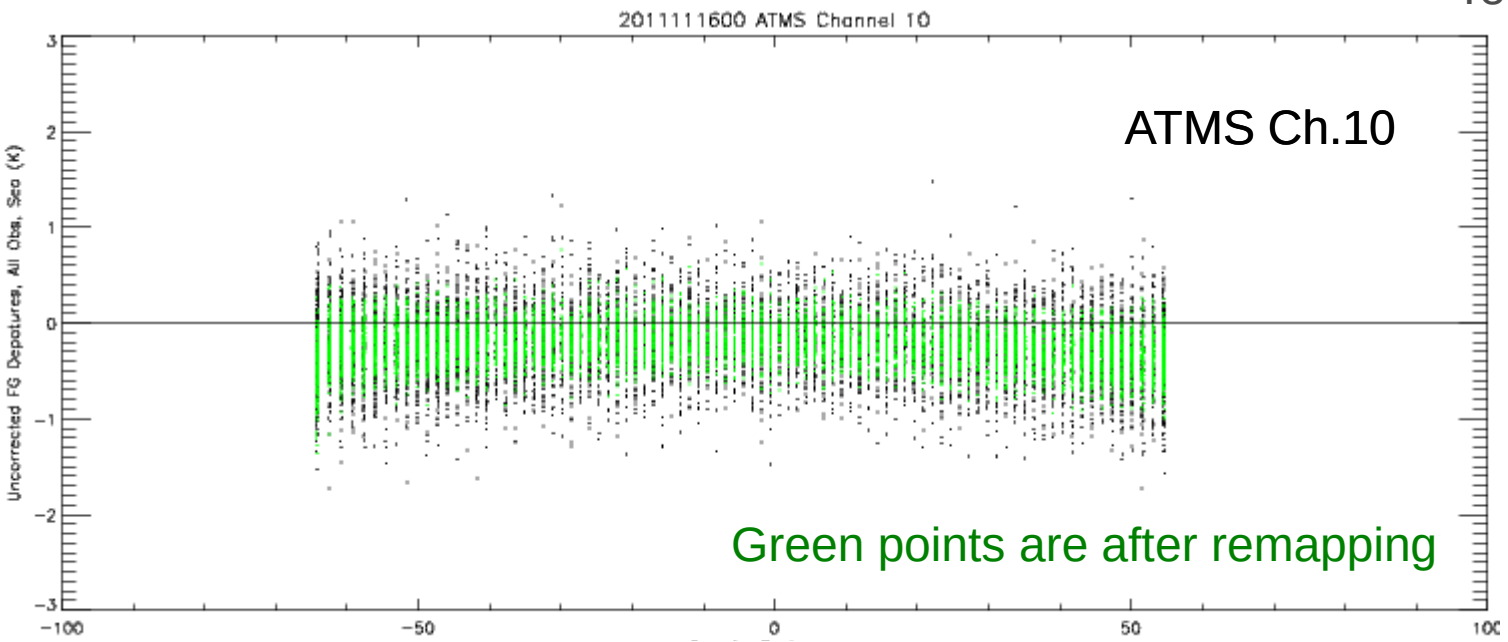
- We are routinely receiving ATMS data as BUFR
- We are using the antenna temperatures contained in these files (following our use of AMSU-A/MHS radiances)
- The AAPP spatial averaging software is being used to re-map ATMS observations to a common FOV.
- The assimilation of ATMS is performed analogously to AMSU-A
- ATMS has been operationally assimilated at NCEP since 22nd May 2012.
- The forecast impact is statistically neutral.

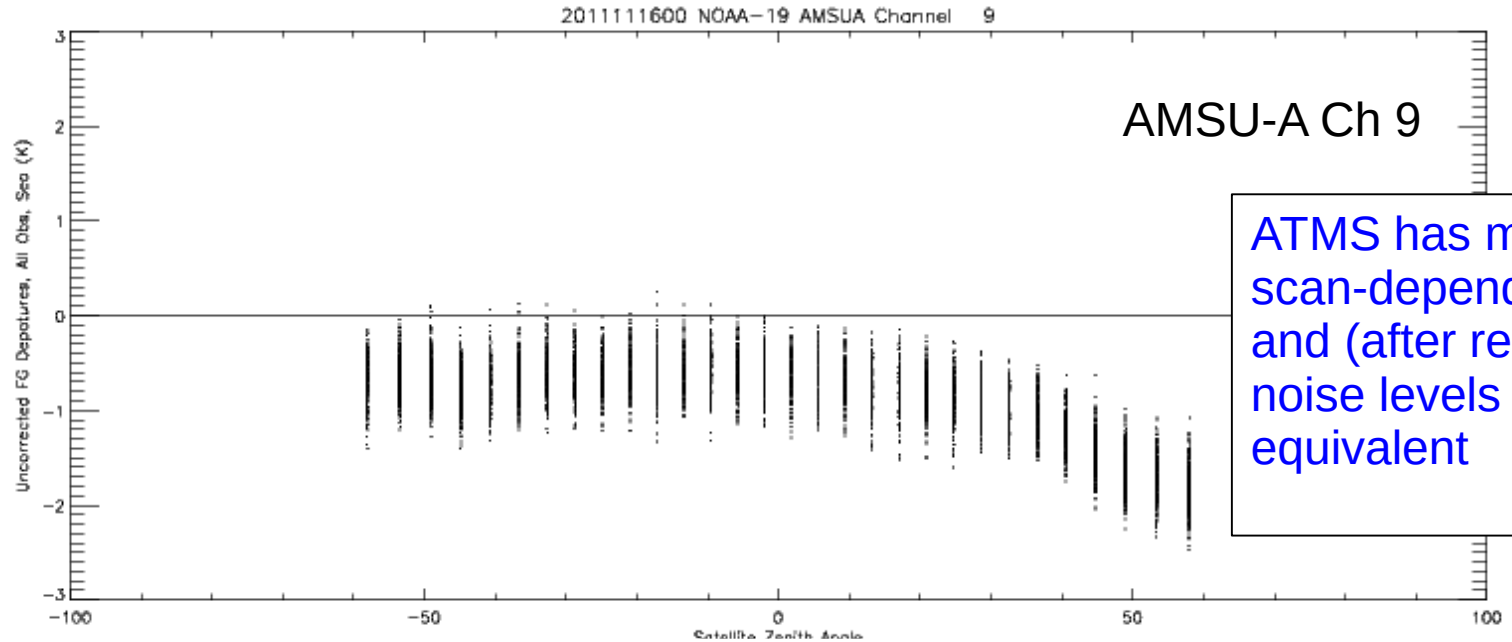
Spatial Averaging / Re-Mapping

- We use the AAPP FFT-based remapping code (described by Nigel Atkinson) to re-map (and in the process spatially average) the AMSU-A like ATMS channels to a common field of view (3.3°).
- This is to reduce the noise on the temperature sounding channels and also to allow the 5.2° FOV channels 1 and 2 to be consistent with the other AMSU-A like channels (as these are used for cloud-detection).
- Special attention has to be paid to missing and bad data as this will affect surrounding points in the re-mapped product.
- Similarly, we did not want to assimilate observations within 5 scan-positions/scan-lines of each other and they will not be independent.

AMSU-A vs ATMS Stats

Antenna Temperatures



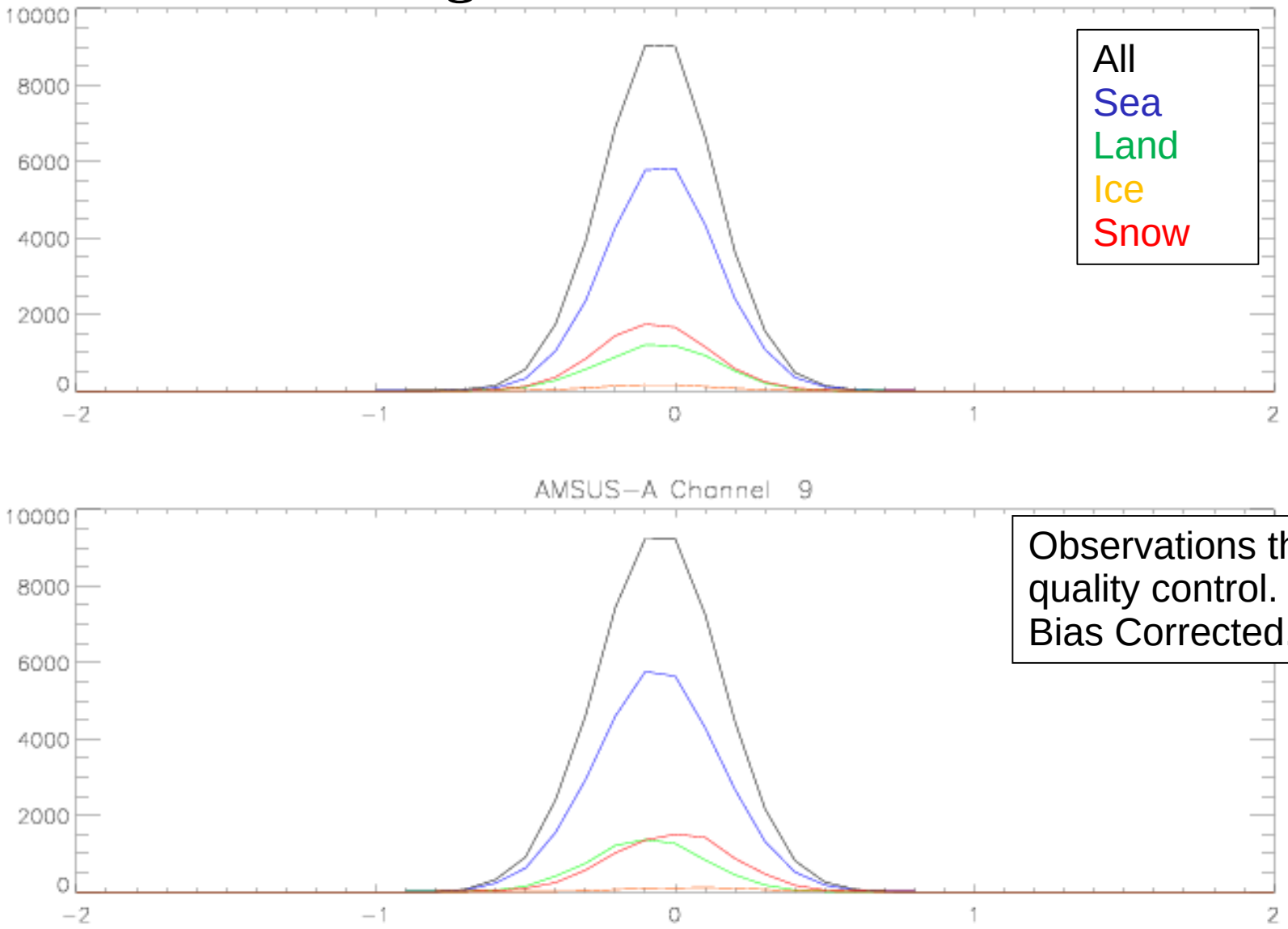


ATMS has much better scan-dependent bias and (after re-mapping) noise levels are equivalent

Uncorrected First Guess Departure; All Obs over Sea (K)

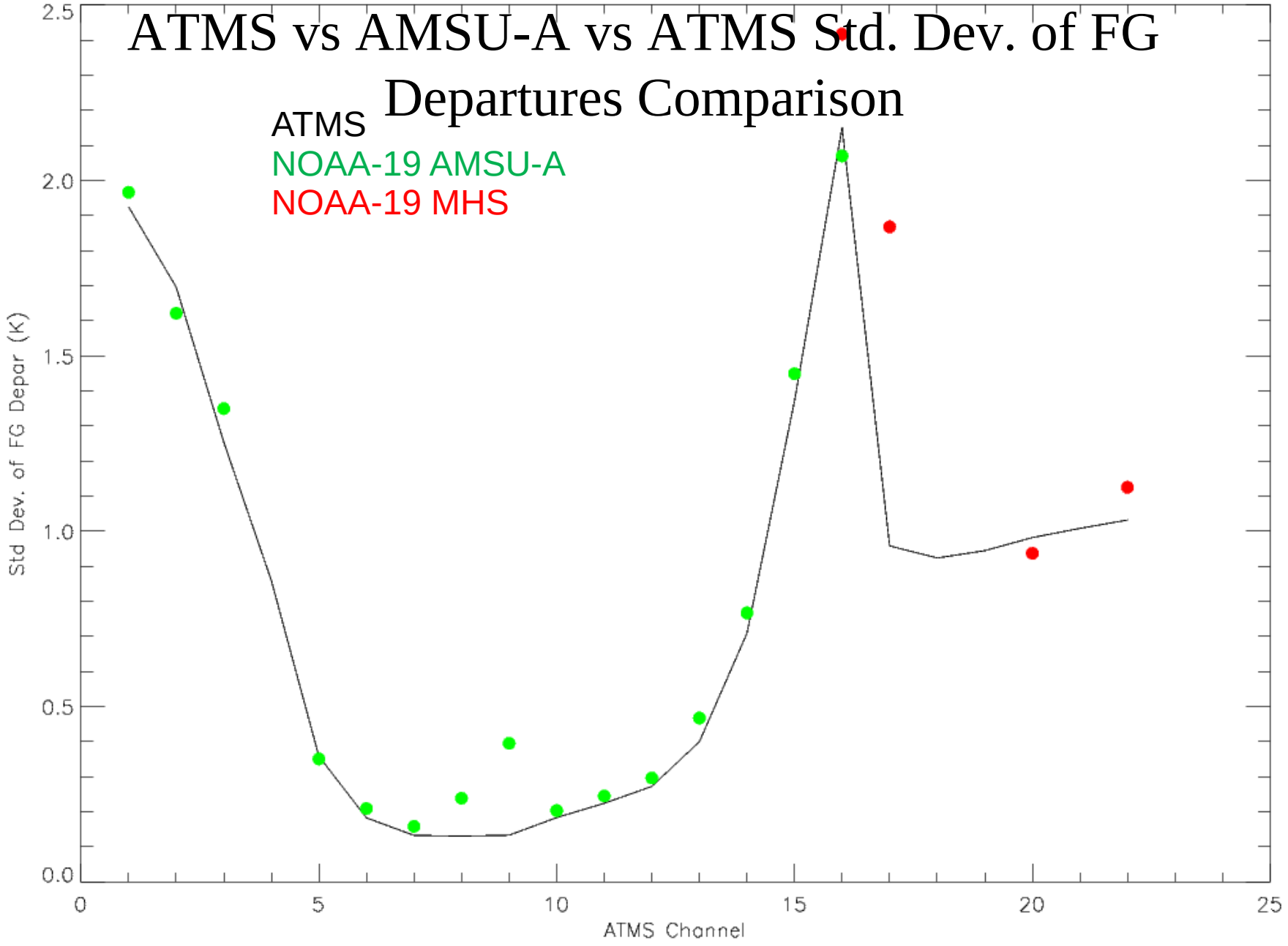
Satellite Zenith Angle (degrees)

Histogram ATMS Ch. 10

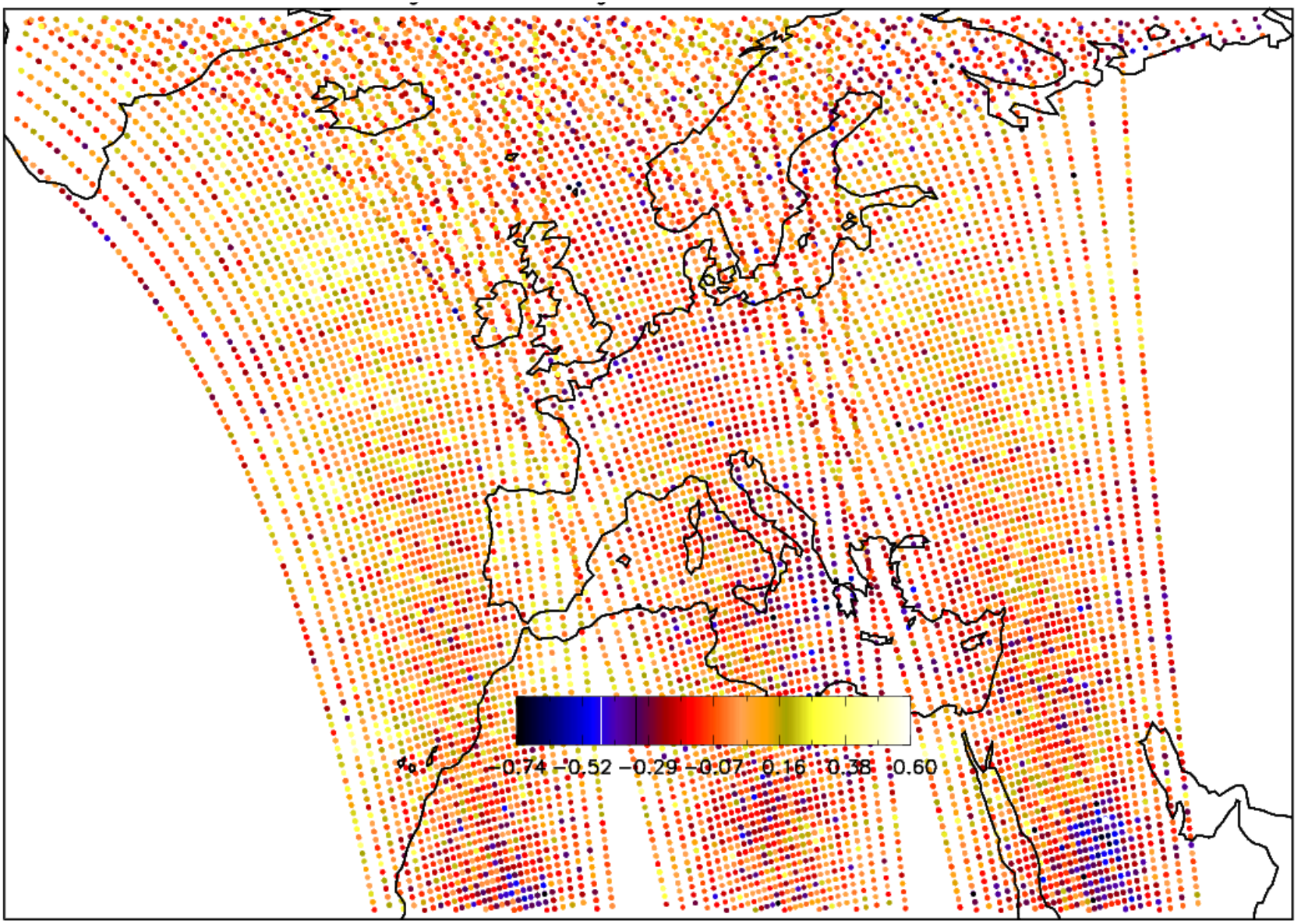


Observations that pass quality control.
Bias Corrected.

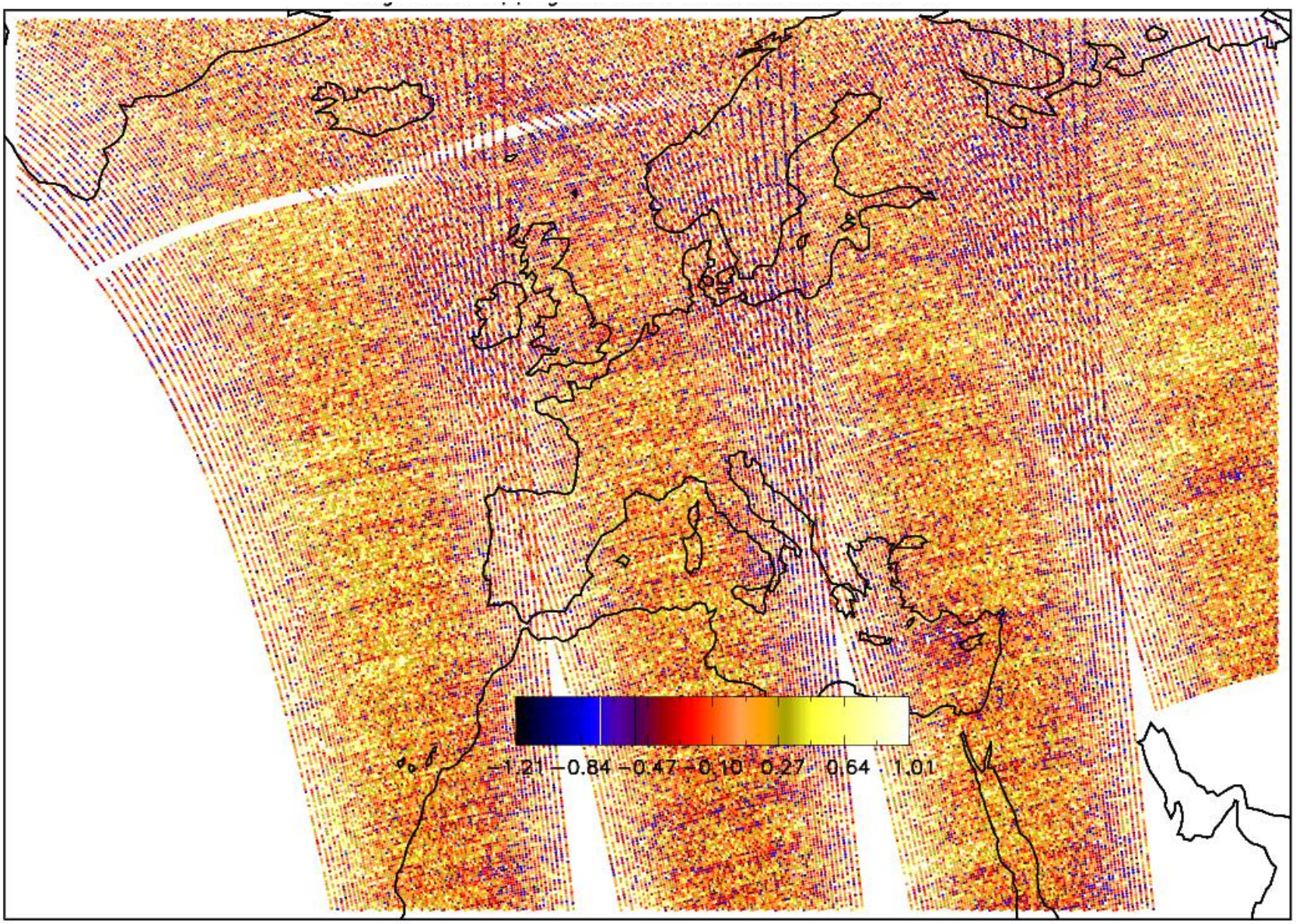
ATMS vs AMSU-A vs ATMS Std. Dev. of FG Departures Comparison



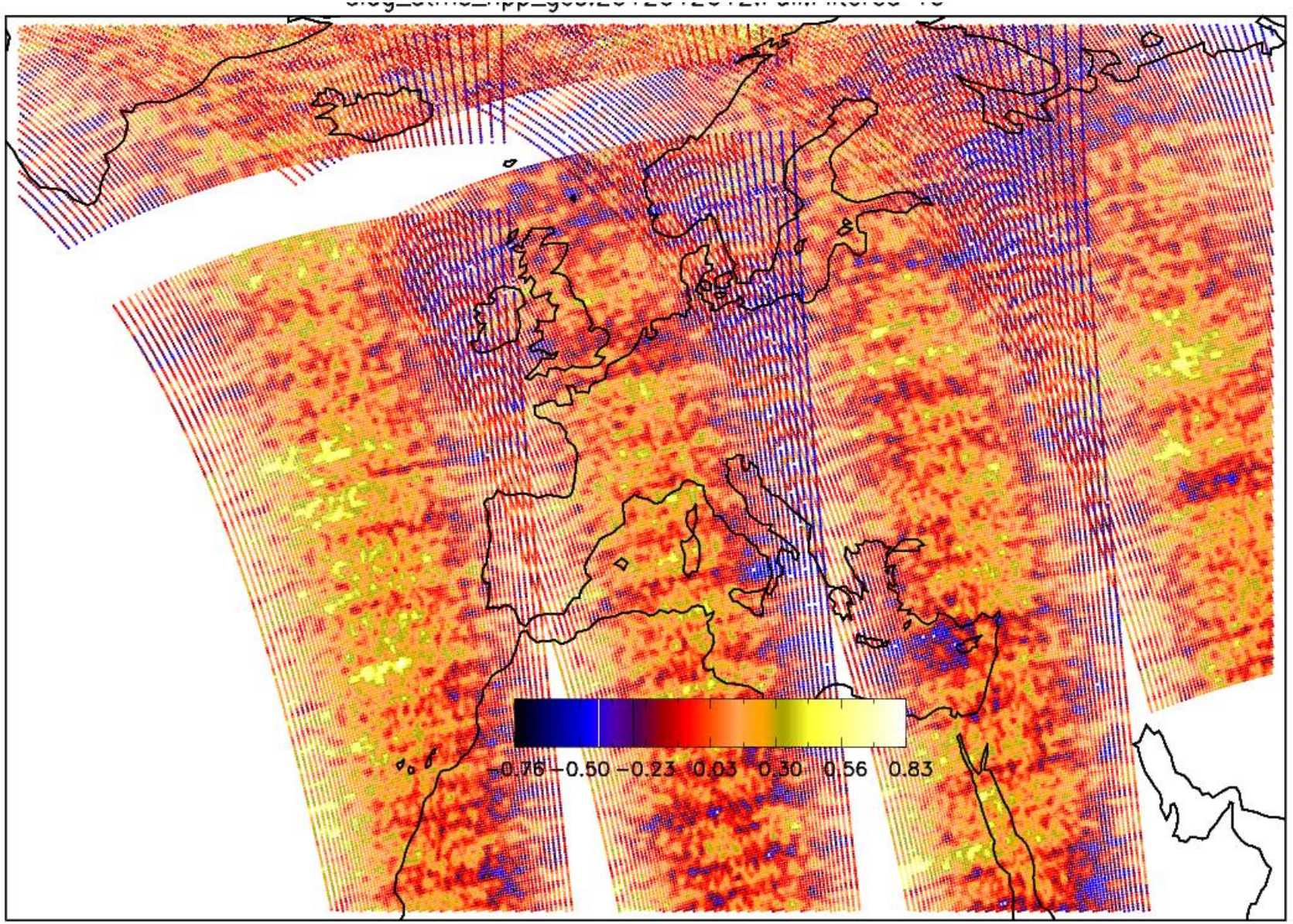
AMSU-A Ch 9 First-Guess Departures



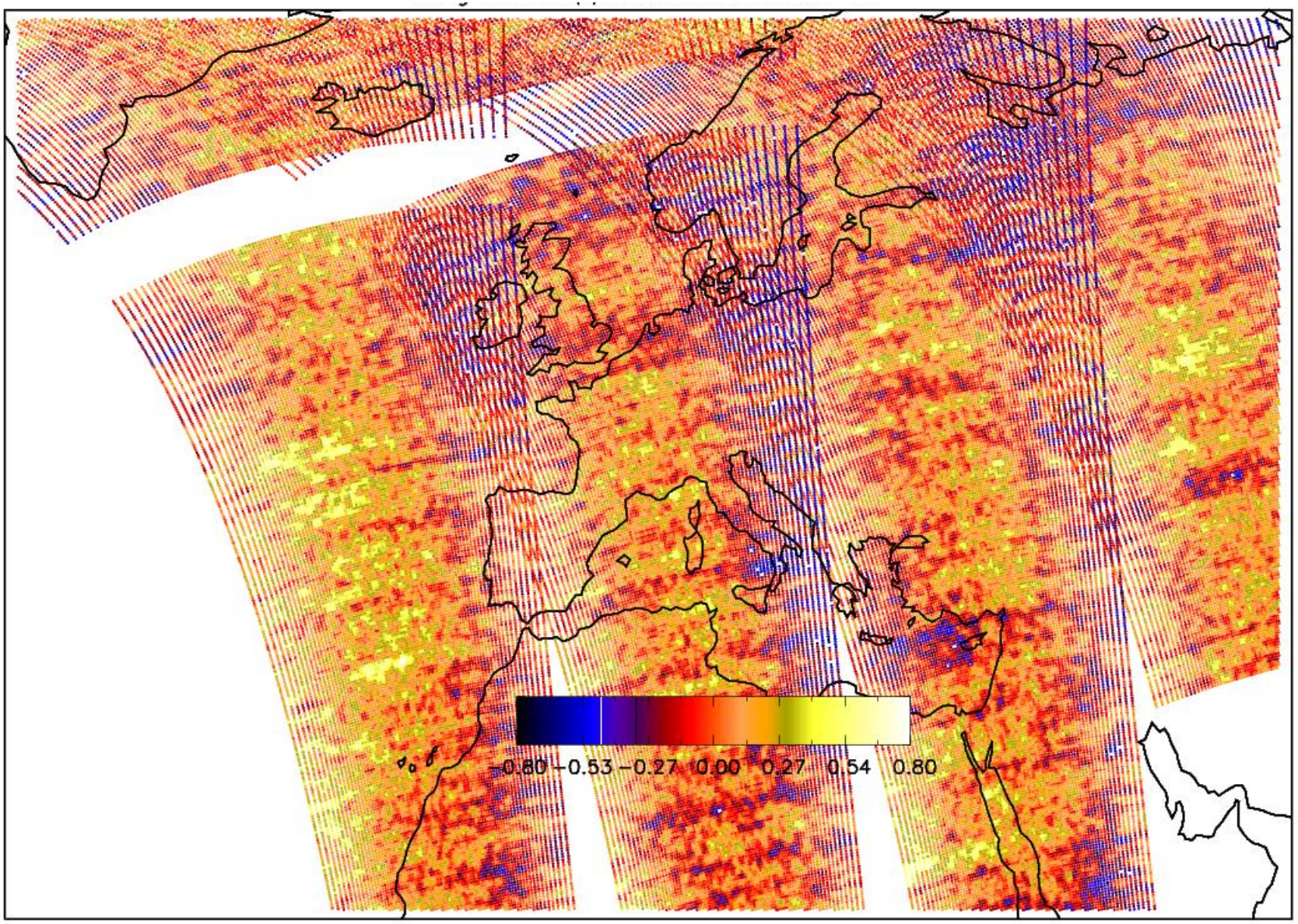
Unfiltered ATMS Ch 10 First-Guess Departures



Filtered ATMS Ch 10 First-Guess Departures



Filtered ATMS Ch 10 (3x3) First-Guess Departures



Assimilation Configuration

- The assimilation configuration follows AMSU-A/MHS as closely as possible but with some differences:
  - Assumed observation errors differ slightly. See next slide
  - Data are not assimilated over snow and ice
    - … as the empirical model used in CRTM has not been developed for ATMS.
  - Only data every 5th scan position and 5th scan line may be assimilated
    - … as spatial averaging introduces spatially correlated observation errors

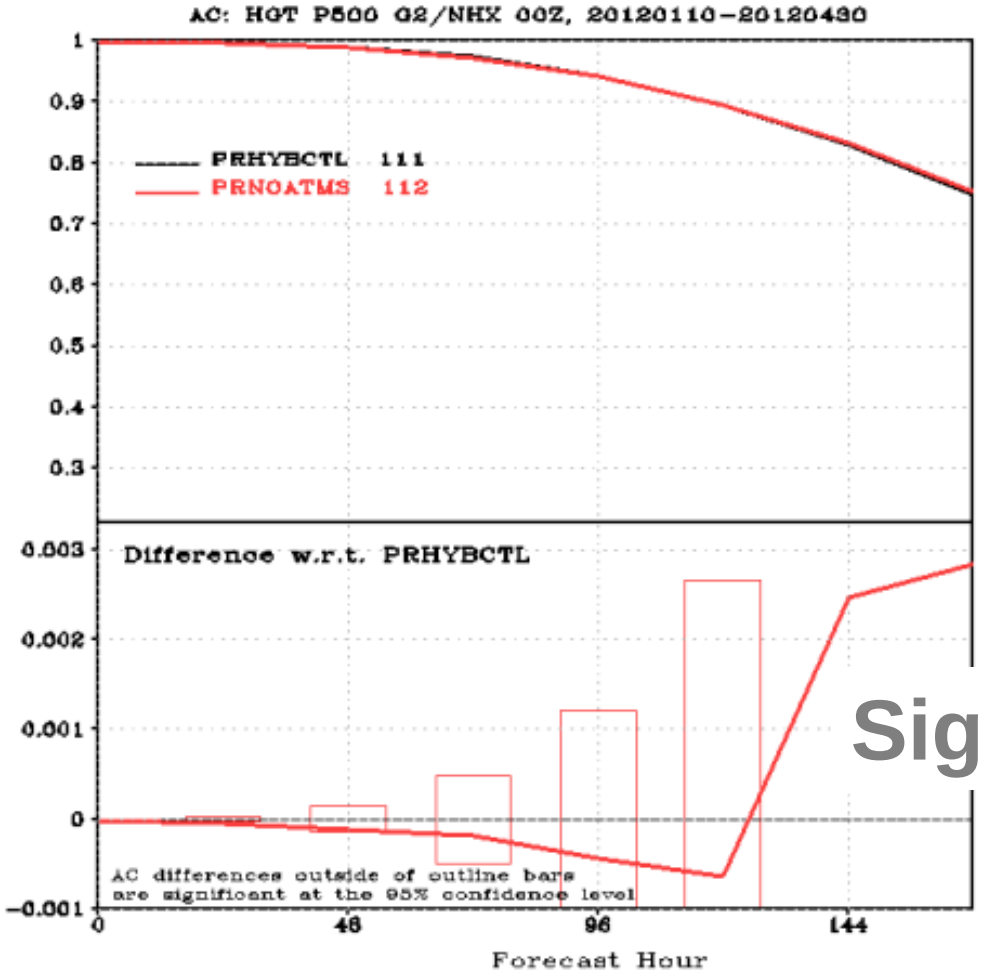
Observation Errors

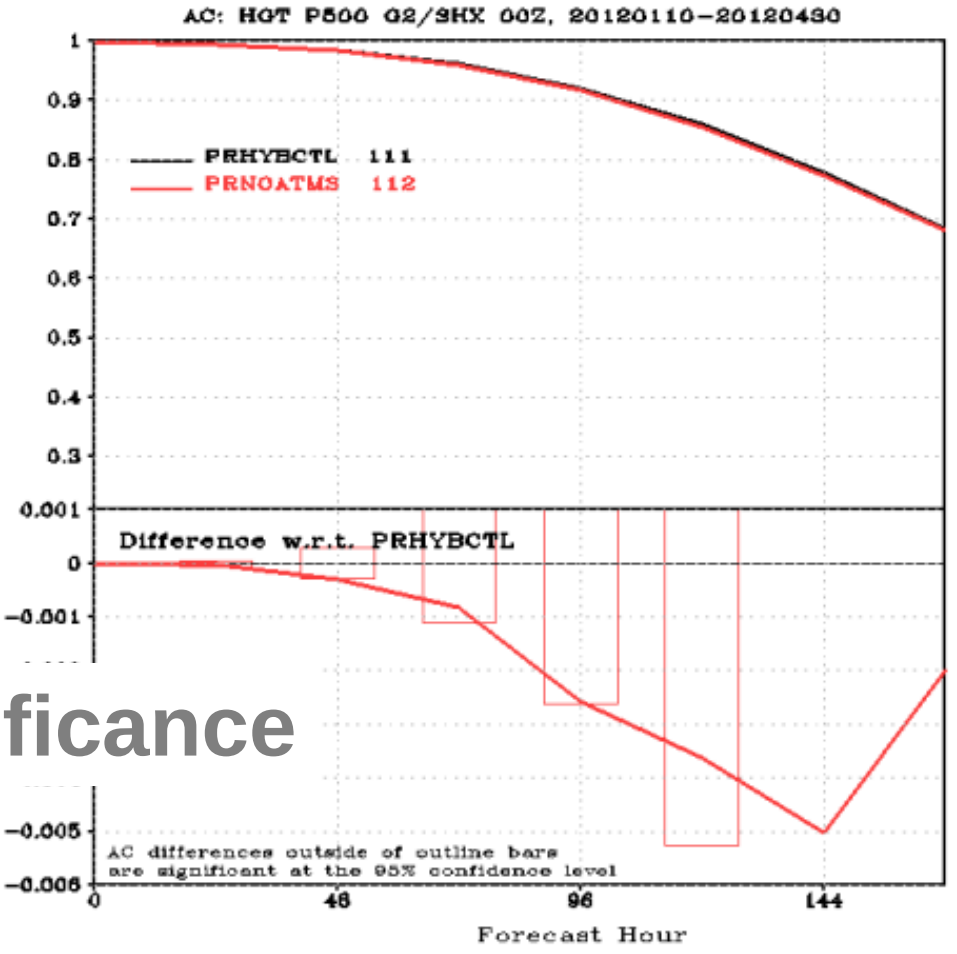
ATMS Channel	AMSU-A N-19 Obs Error (K)	ATMS Obs Error (K)	
1	2.50	5.00	Surface
2	2.00	5.00	Surface
3†	2.00	5.00	Surface
4		3.00	
5†	0.55	0.55	
6	0.30	0.30	
7	0.23	0.30	Minimization
8†	0.23	0.30	Minimization
9	*0.25	0.30	Minimization
10	0.25	0.30	
11	0.35	0.35	
12	0.40	0.40	
13	0.55	0.55	
14	0.80	0.80	
15	*3.00	*3.00	

†ATMS and AMSU-A have different polarizations.

*Channel not used

Statistically Neutral Forecast Impact





Significance

ATMS Improves forecast

ATMS Degrades forecast

The Future

- It was recently discovered (by Lin-Lin) that we are not acting on the lunar intrusion flag and other QC is not catching all instances where this is set. We will look into using this flag in future implementations.
- We are also looking at 1DVar-based quality control to estimate cloud and surface emissivity properties.
- For all the microwave sounders we are working towards the assimilation of cloudy radiances. Most work has so far been done with AMSU-A, but we will evaluate ATMS (including the MHS-like channels) in the near future.

Conclusions

- ATMS observations appear to be generally of good quality.
- In particular the bias characteristics seem much better than for AMSU-A
- However, there is striping visible in the upper troposphere sounding channels that is introducing some spatially correlated error.
- Using the AAPP re-mapping tool, AMSU-A like noise performance can be obtained.
- Forecast impact is mostly neutral.