Evaluation and Assimilation of ATMS and CrIS at NCEP

Andrew Collard[1], John Derber[2],

Yangrong Ling[1], Jim Jung[3], Yanqiu Zhu[1],

Li Bi[1], Emily Liu[4], Kristen Bathmann[1]

[1]IMSG@NOAA/NCEP/EMC [2]Retired
[3]Univ. of Wisconsin [4]SRG@NOAA/NCEP/EMC

Introduction

- Assimilation Configuration
- Data Quality
- Impact on Analysis
- Impact on Forecasts
- Summary and Next Steps

Assimilation Configuration

Assimilation Configuration

- For testing purposes, experiments were run at reduced resolution using the operational 4DEns-Var Hybrid GSI.

- Deterministic model resolution is T670 (operations is T1574).

- EnKF and analysis resolution is T254 (T574)

- The default (box-car ISRF) CRTM radiative transfer coefficients for ATMS are being used in this implementation.

  - Testing with coefficients using the measured ISRF is underway.

- After testing implementation was both in the operational global GFS and the pre-operational FV3-GFS parallel.
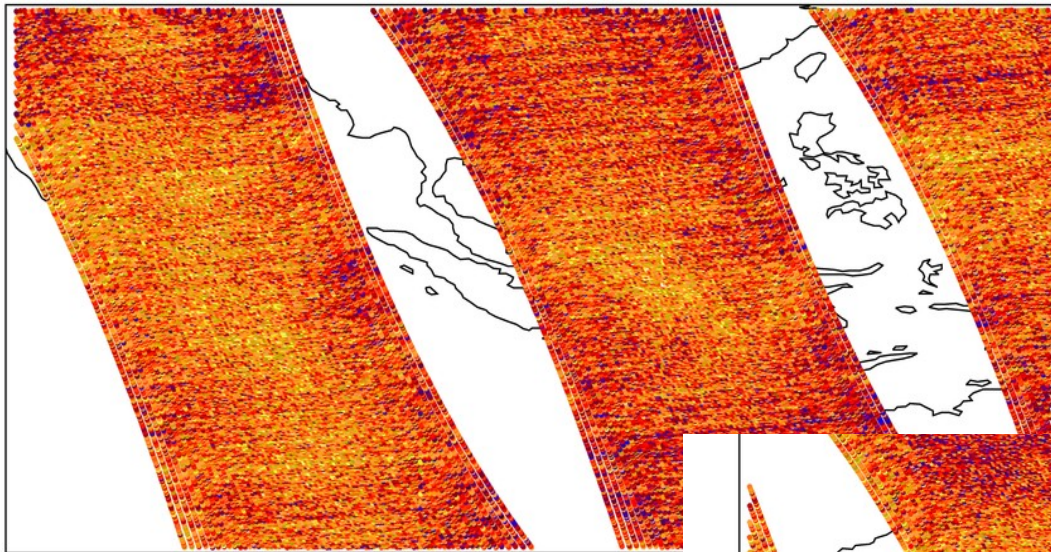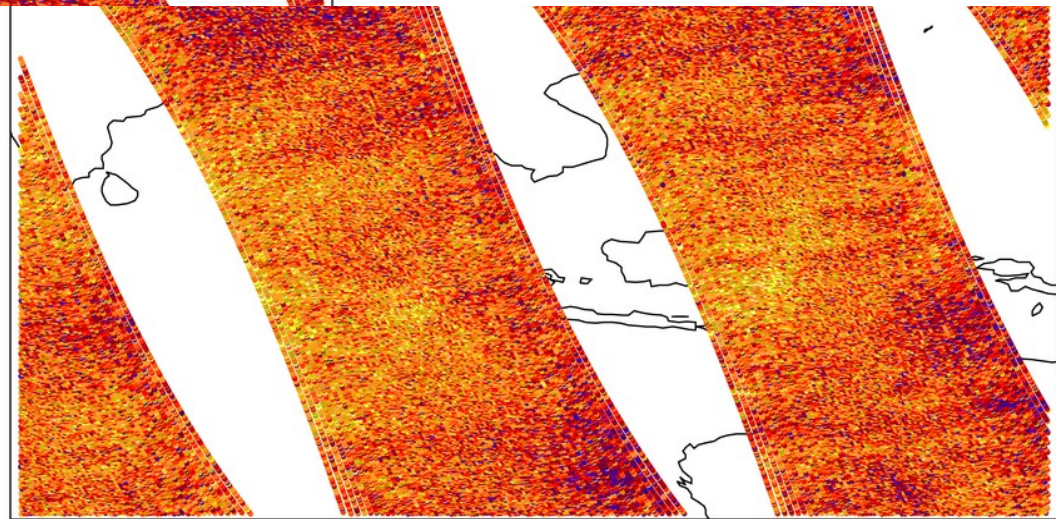
ATMS
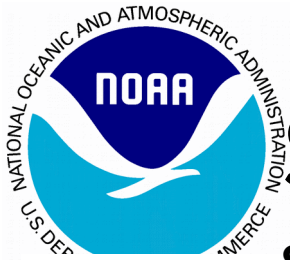
Striping Seems to be better

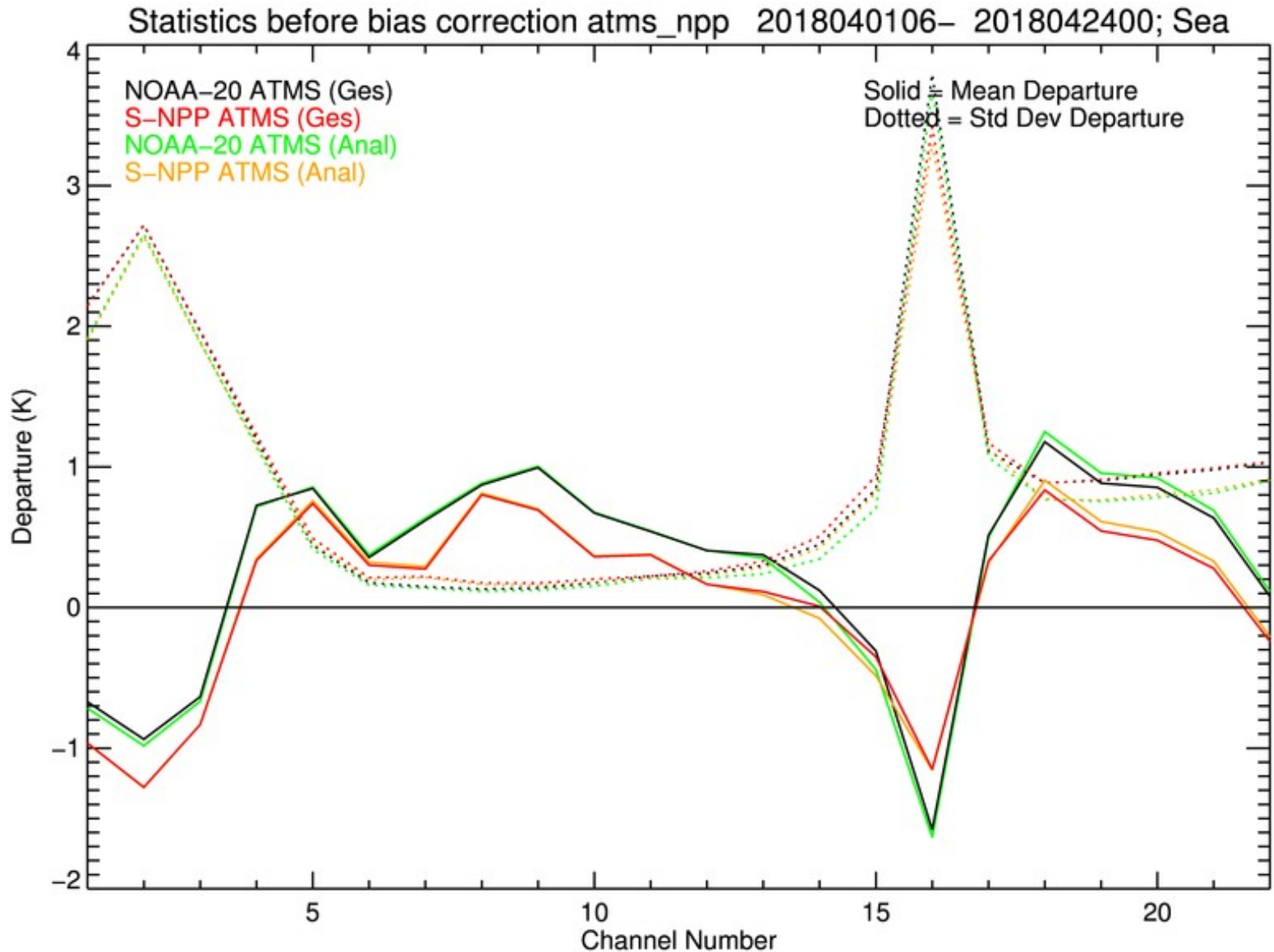**S-NPP Channel 10**
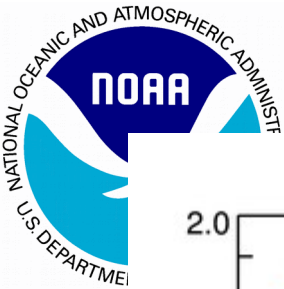

NOAA-20 Channel 10
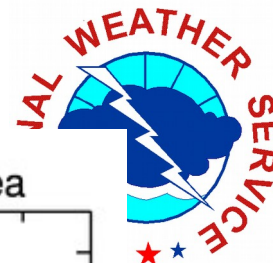
Spatial Averaging / Re-Mapping

- 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.
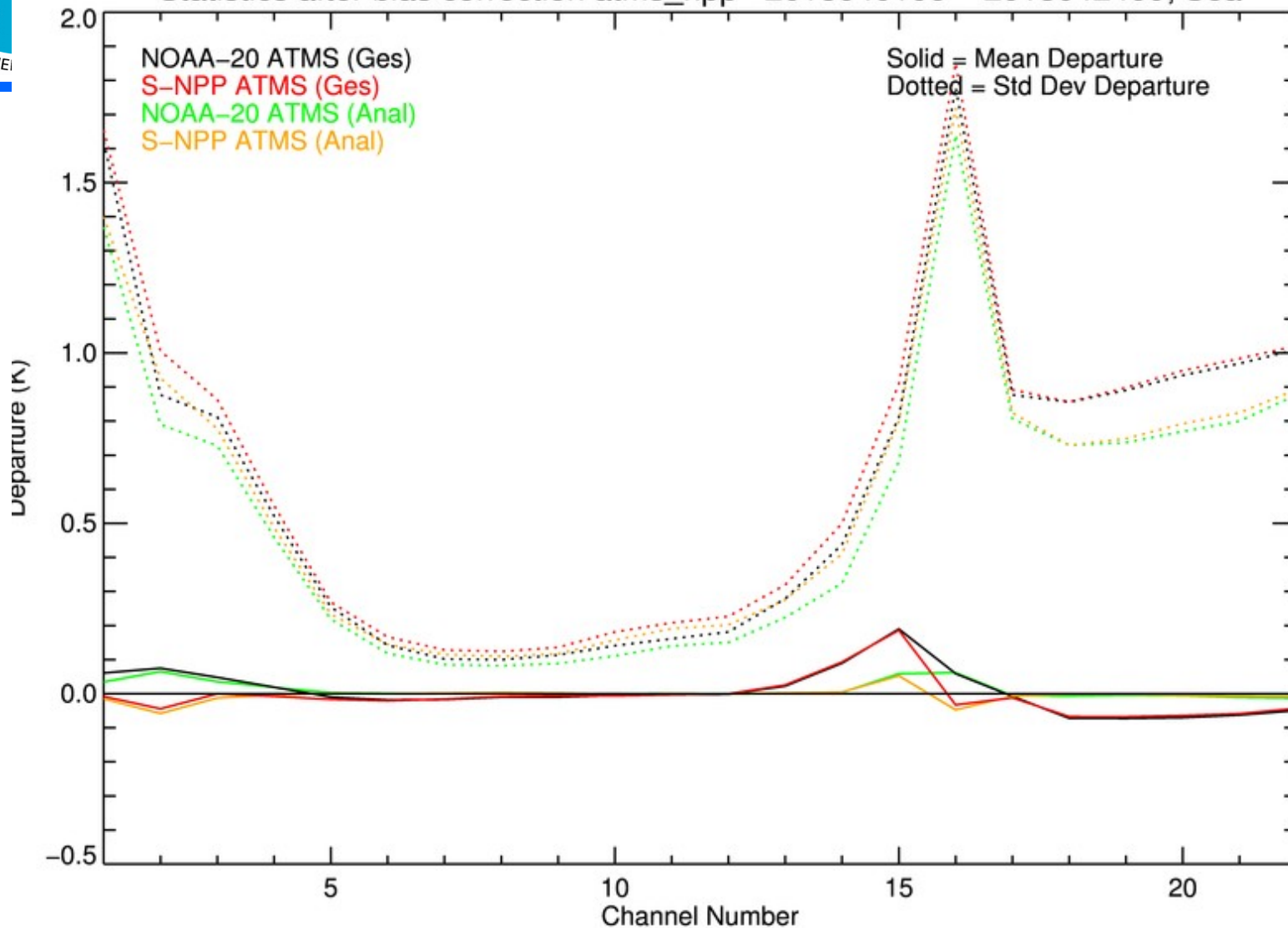
Uncorrected Departure Stats

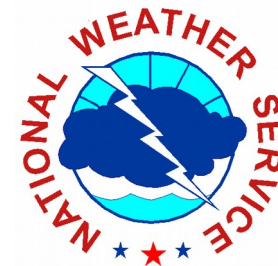Statistics before bias correction atms_npp   2018040106– 2018042400; Sea

NOAA–20 ATMS (Ges)
S–NPP ATMS (Ges)
NOAA–20 ATMS (Anal)
S–NPP ATMS (Anal)

Solid = Mean Departure
Dotted = Std Dev Departure

Bias-corrected Departure Stats

Statistics after bias correction atms_npp   2018040106– 2018042400; Sea

NOAA–20 ATMS (Ges)
S–NPP ATMS (Ges)
NOAA–20 ATMS (Anal)
S–NPP ATMS (Anal)

Solid = Mean Departure
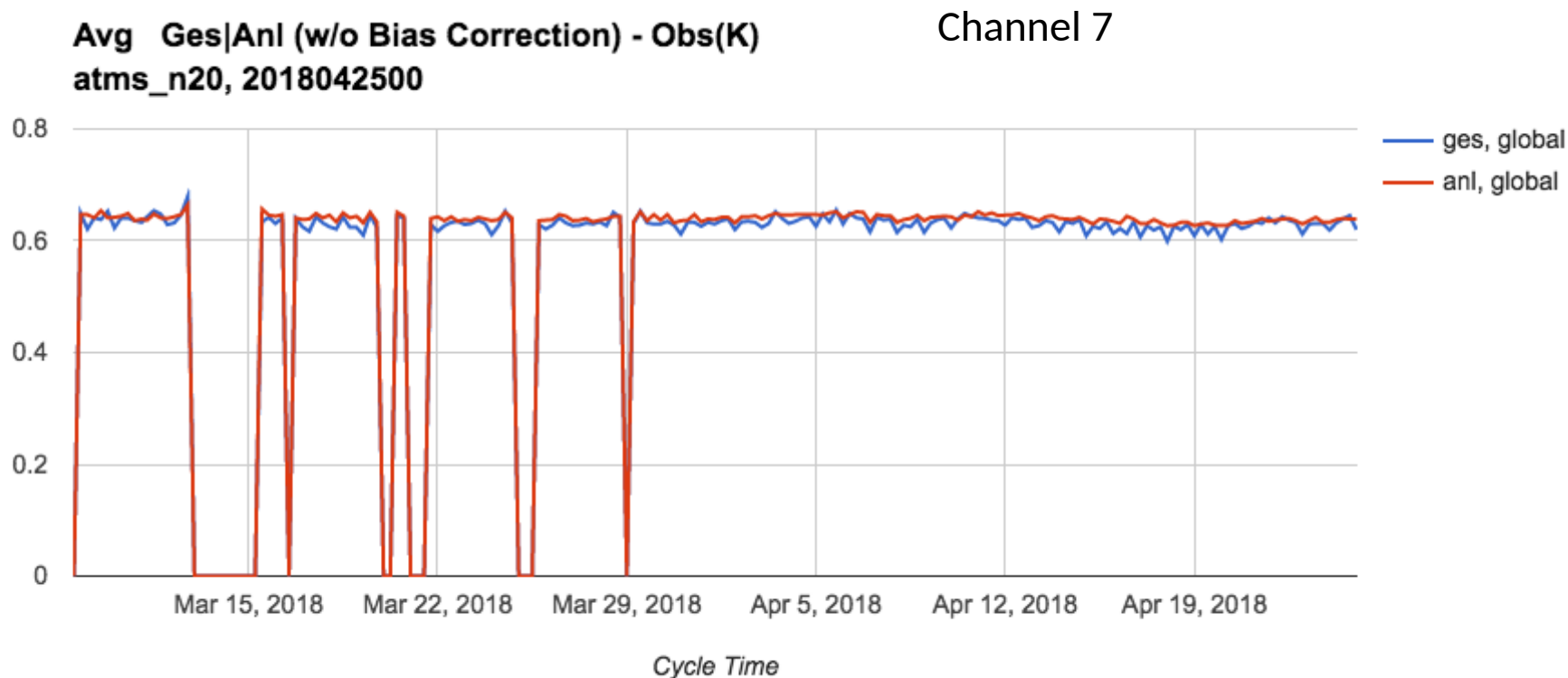Dotted = Std Dev Departure

Monitoring Instrument Performance in the GSI

Our evaluation experiments start on 3rd March 2018.

Since that date observed-calculated statistics appear to be stable

Channel 7

Observation Errors

ATMS Channel	AMSU-A/MHS NOAA-19 Obs Error (K)	ATMS Obs Error (K)
1	2.50	5.00
2	2.00	5.00
3[†]	2.00	5.00
4		3.00
5[†]	0.55	0.55
6	0.30	0.40
7	0.23	0.40
8[†]	0.23	0.40
9	*0.25	0.40
10	0.25	0.40
11	0.35	0.45
12	0.40	0.45
13	0.55	0.55
14	0.80	0.80
15	*3.00	*3.00
16-22	2.50	2.50

[†]ATMS and AMSU-A have different polarizations.

*Channel not used

Temperature Analysis Increments

Analysis

RMS of GDAS Analysis Increments, Temp (K)
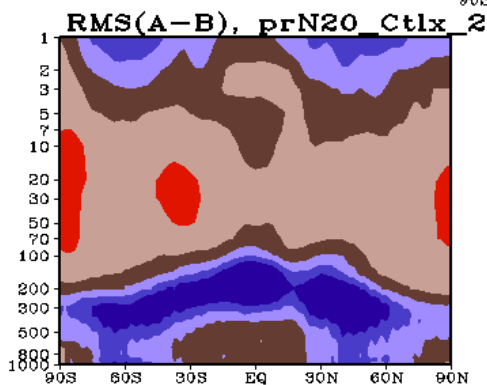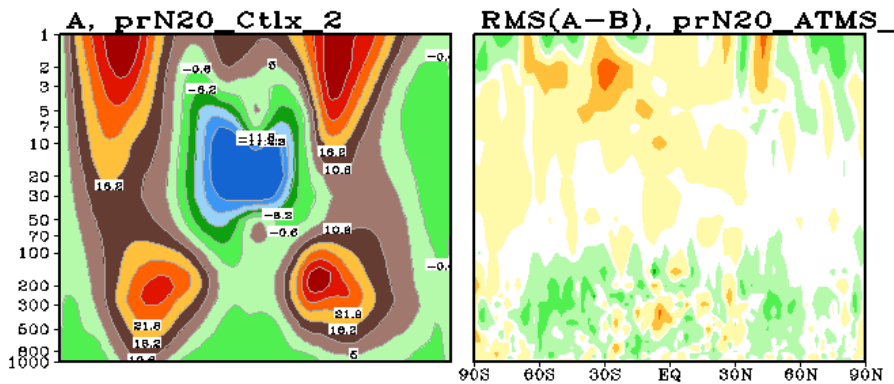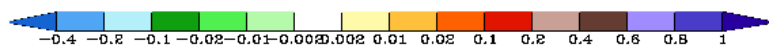[00 06 12 18] Cycles, 00Z14Mar2018 ~ 18Z06Apr2018

A, prN20_Ctlx_2

RMS(A−B), prN20_ATMS_2−

RMS(A−B), prN20_Ctlx_2

Difference in RMS Analysis Increment (experiment - control)

RMS Analysis Increment (control)

Wind Analysis Increments

U-Wind

V-Wind

Relative Humidity Analysis Increments

RMS of GDAS Analysis Increments, RH (%)
[00 06 12 18] Cycles, 00Z14Mar2018 ~ 18Z06Apr2018

Analysis

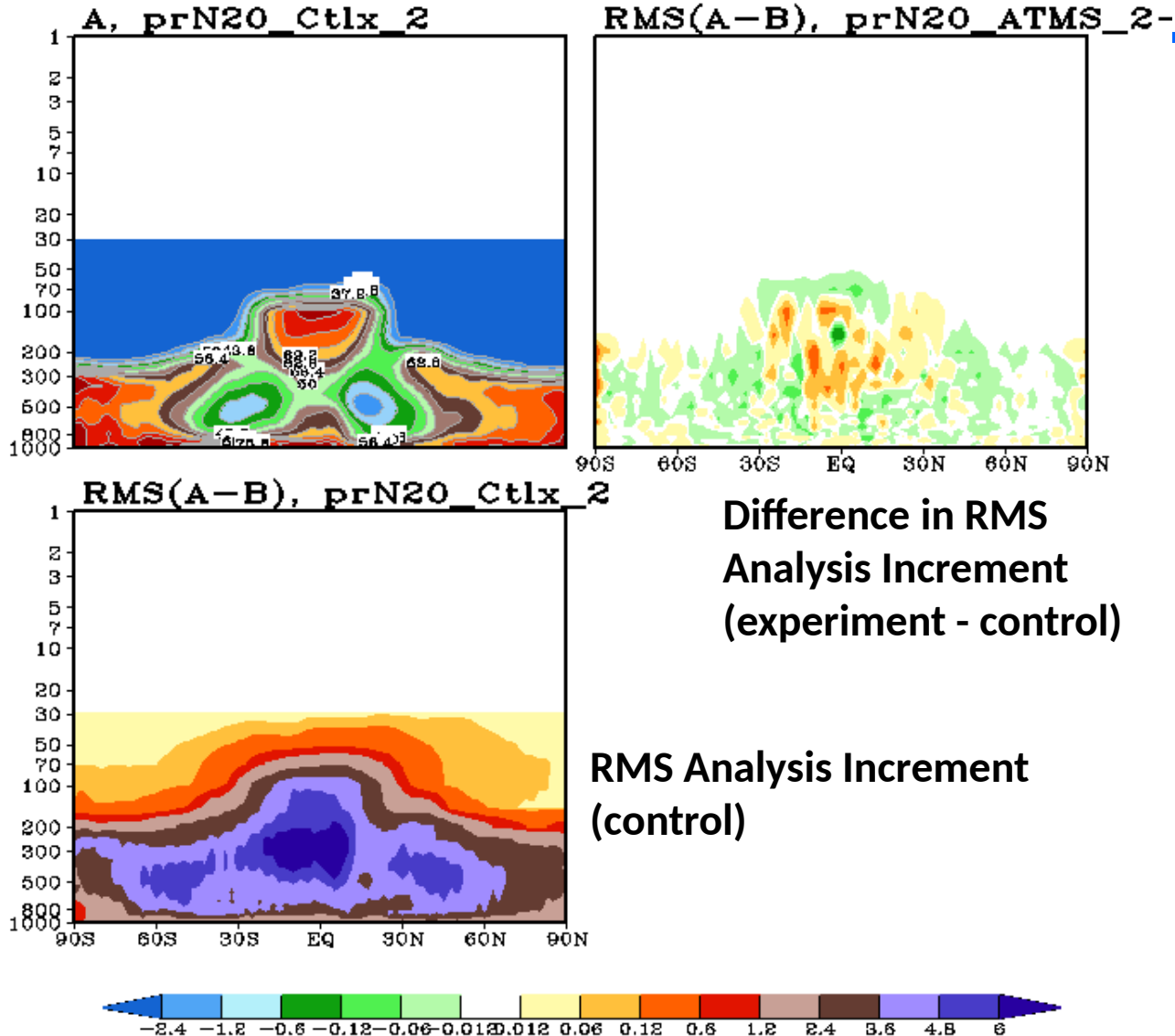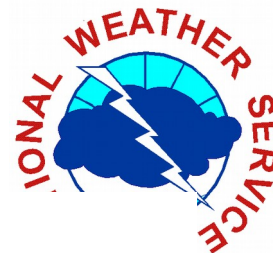**Difference in RMS Analysis Increment (experiment - control)**

RMS Analysis Increment (control)

Background and Analysis Fit to Sondes

Temperature

Guess
Analysis

Solid=Control
Dotted=Control
         +ATMS_N20

LH Curves=Bias
RH Curves=RMS

North   TEMPERATURE   South

Tropics   North America

prN20_Ctlx_2 solid   prN20_ATMS_2 dptteN20_Ctlx_2 solid   prN20_ATMS_2 dotted

Anl for 00z   Ges for 00z   00z14mar2018 – 00z06apr2018
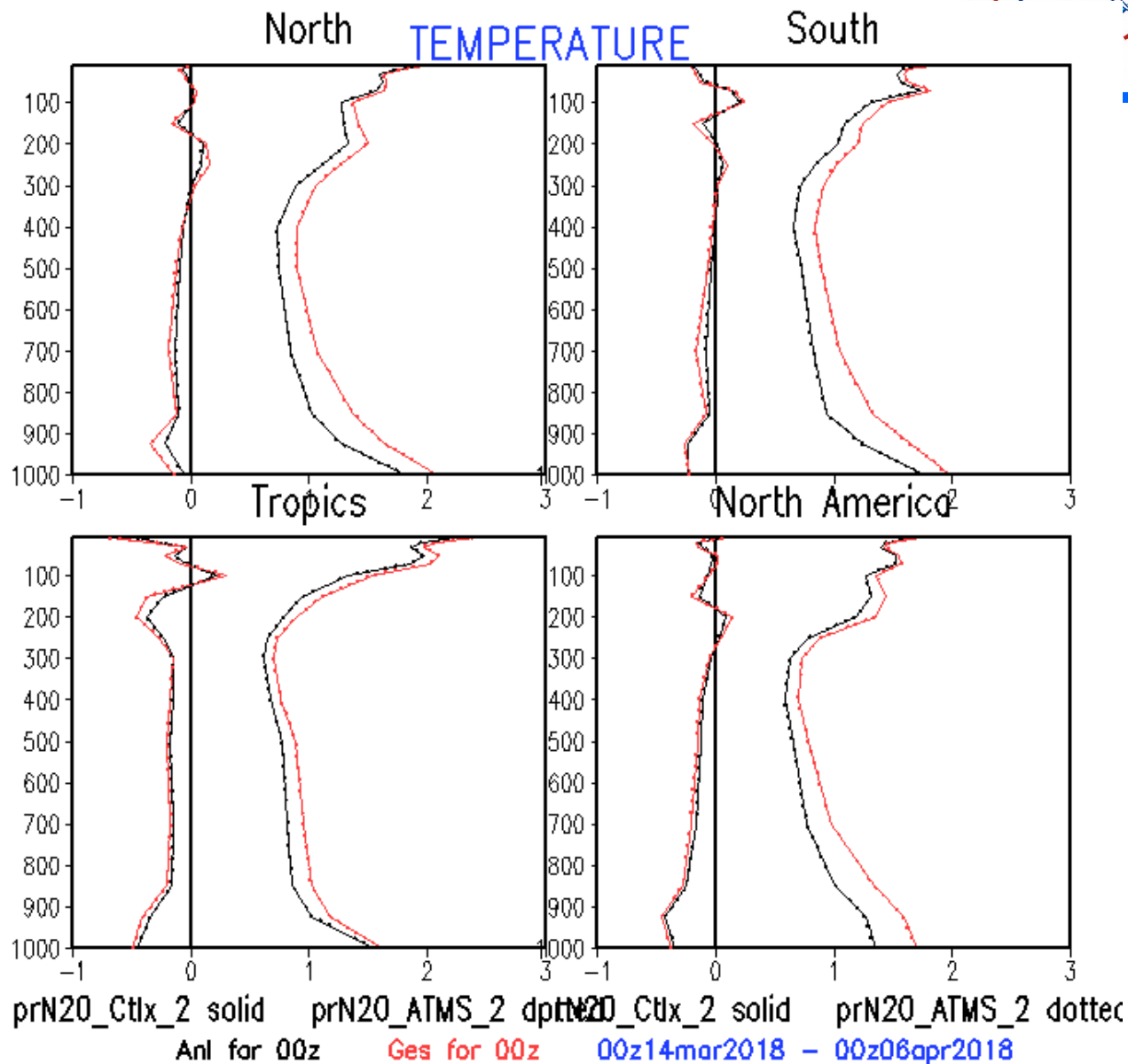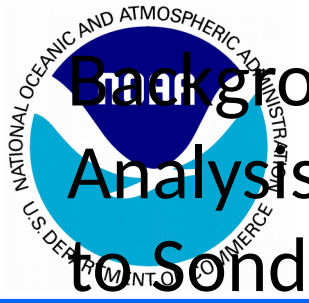
Background and Analysis Fit to Sondes

Specific Humidity

Guess
Analysis

Solid=Control
Dotted=Control
**   +ATMS_N20**

LH Curves=Bias
RH Curves=RMS
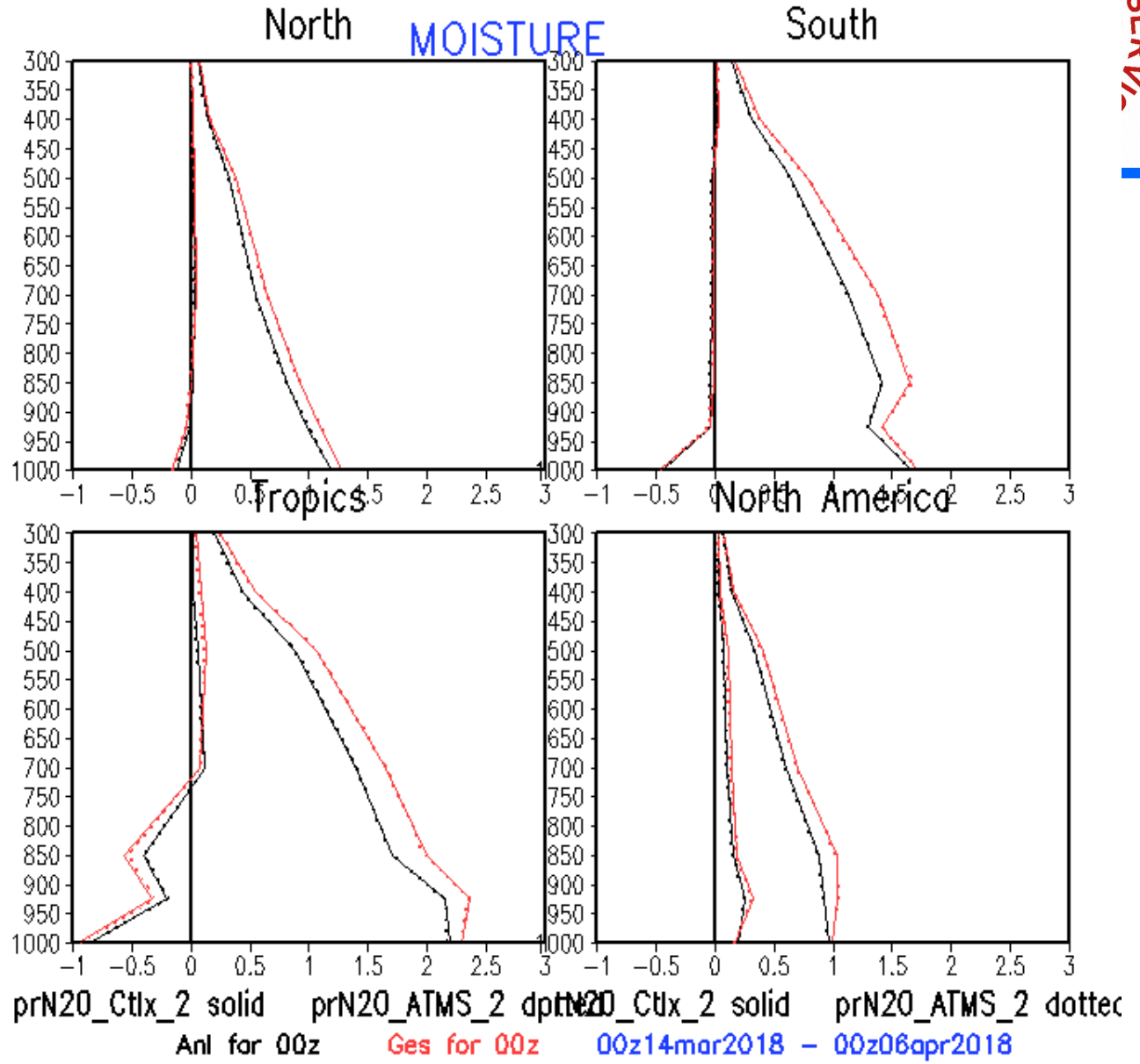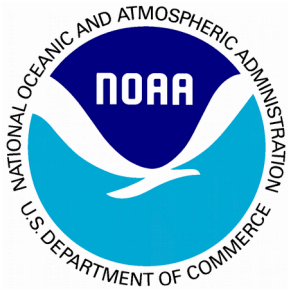
Background and Analysis Fit to Sondes
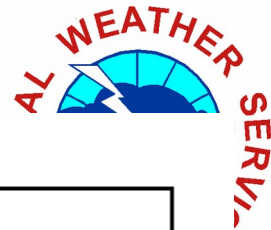
Vector Wind

Guess
Analysis

Solid=Control
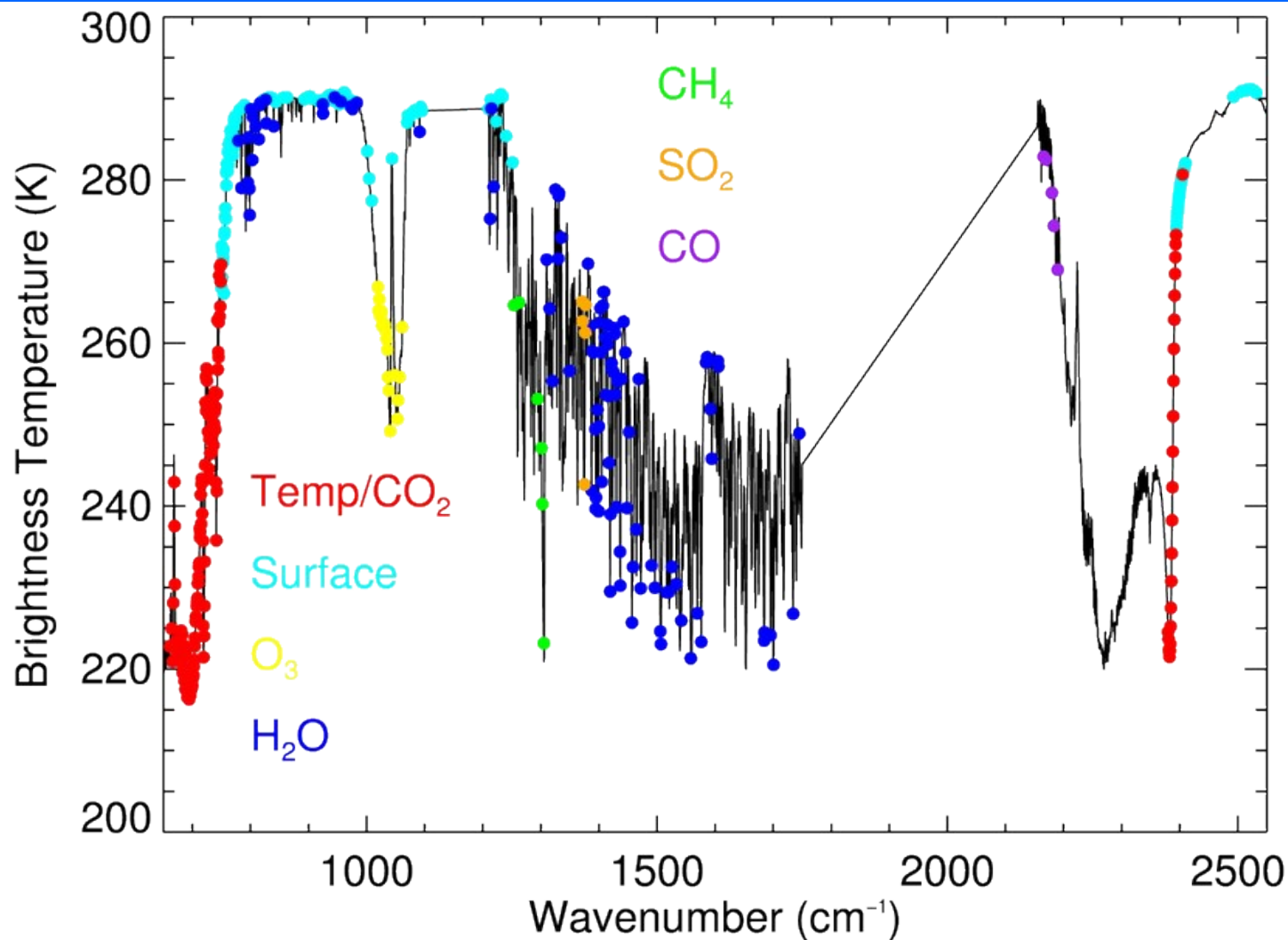**Dotted=Control**
      +ATMS_N20

LH Curves=Bias
RH Curves=RMS
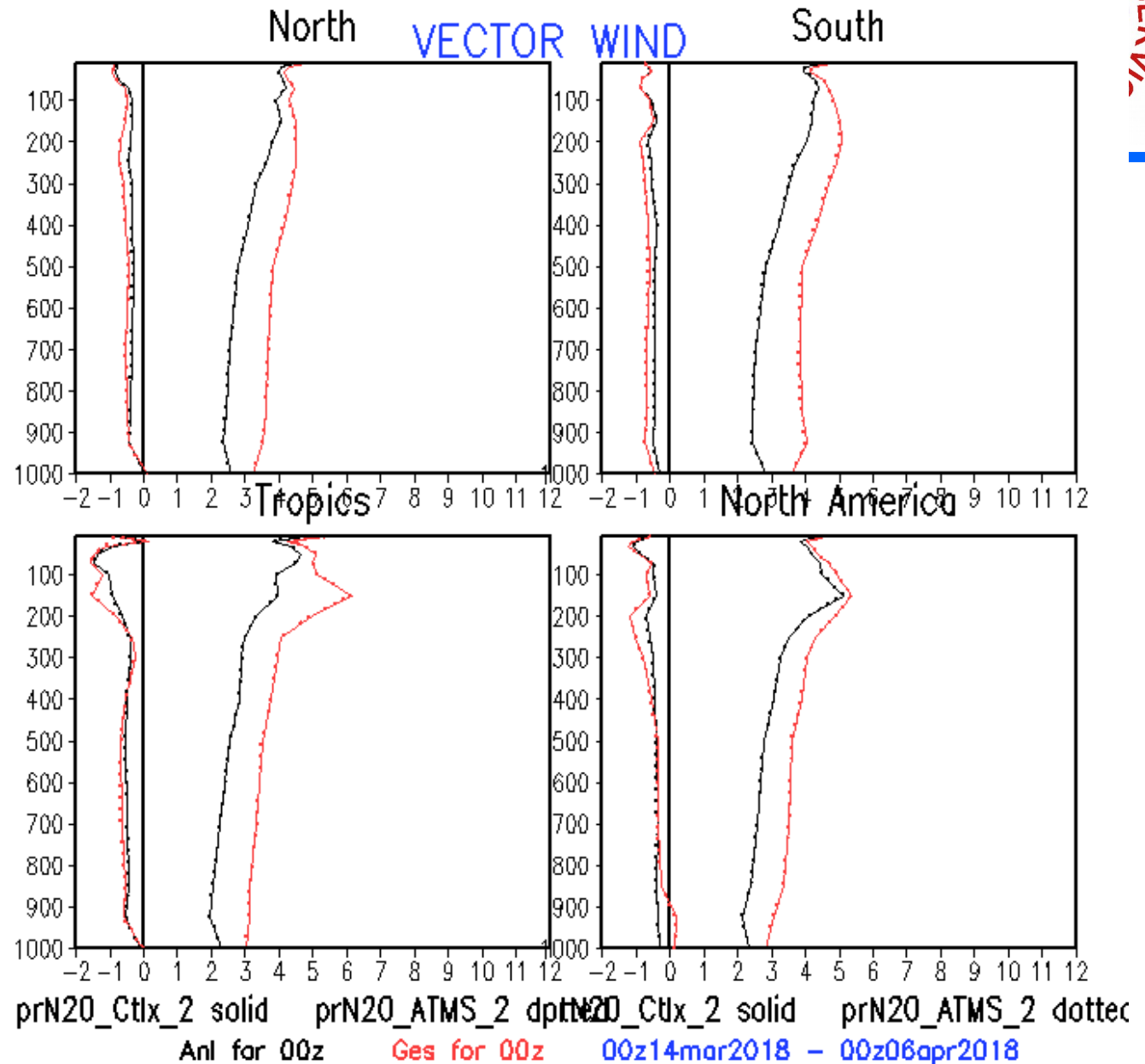
CrIS

CrIS FSR 431
Channel Selection

Uncorrected Departure Stats

Statistics before bias correction cris-fsr_npp 2018080612– 2018081306; Sea

NOAA–20 CrIS (Ges)
S–NPP CrIS (Ges)
NOAA–20 CrIS (Anal)
S–NPP CrIS (Anal)

Solid = Mean Departure
Dotted = Std Dev Departure

Bias-corrected Departure Stats

Statistics after bias correction cris-fsr_npp 2018080612– 2018081306; Sea
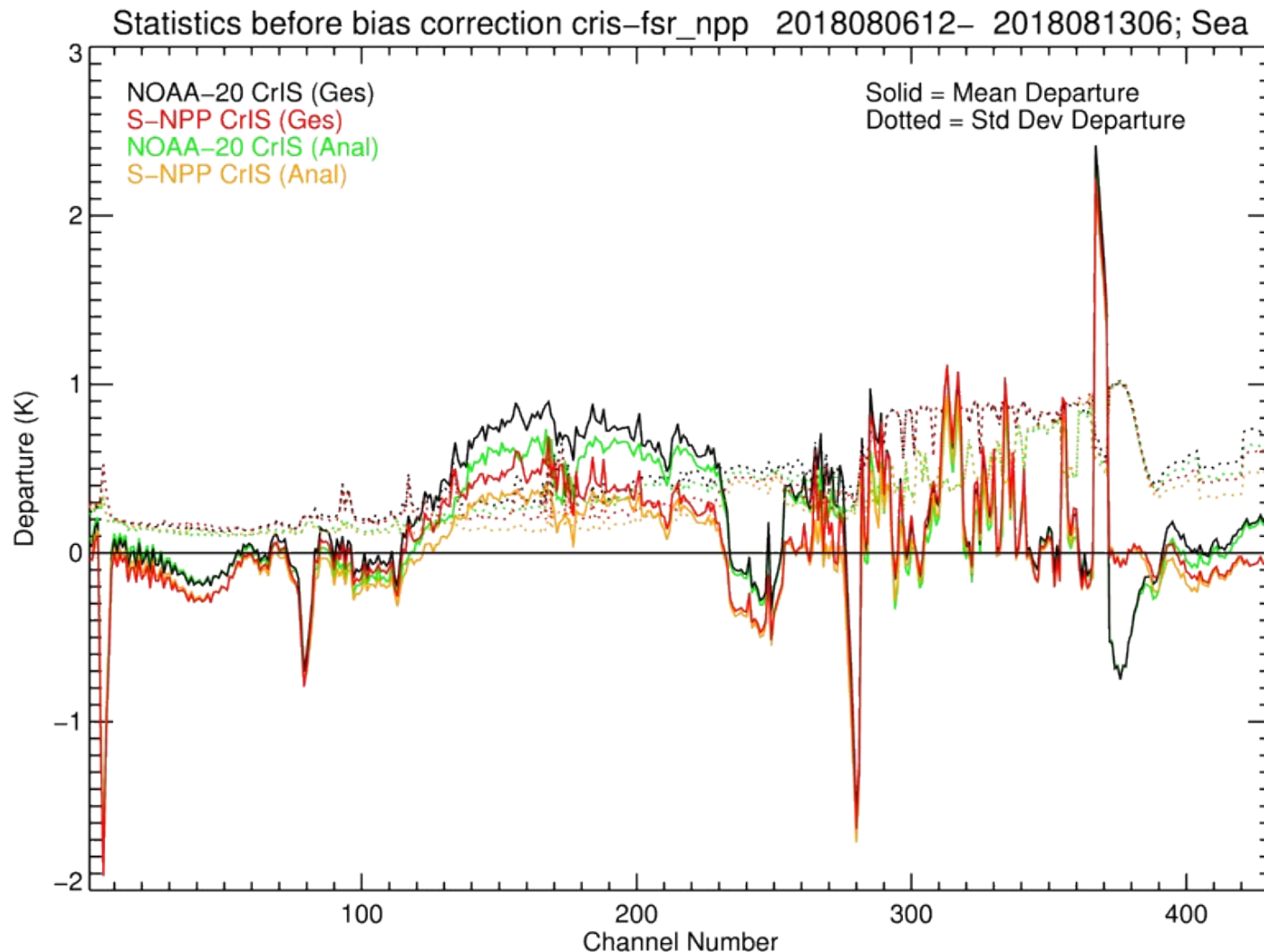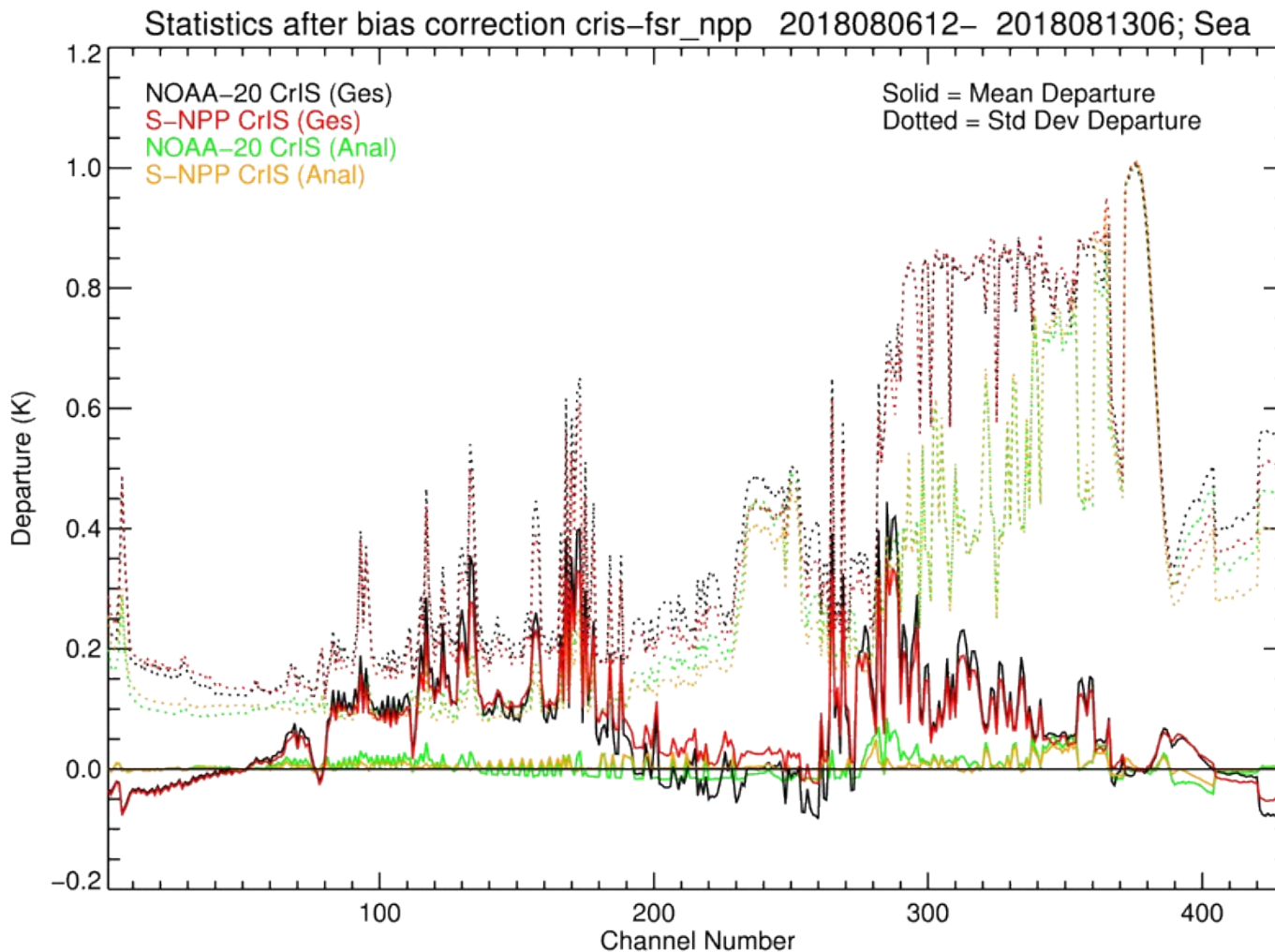
Changes to observation errors and channel usage in FV3
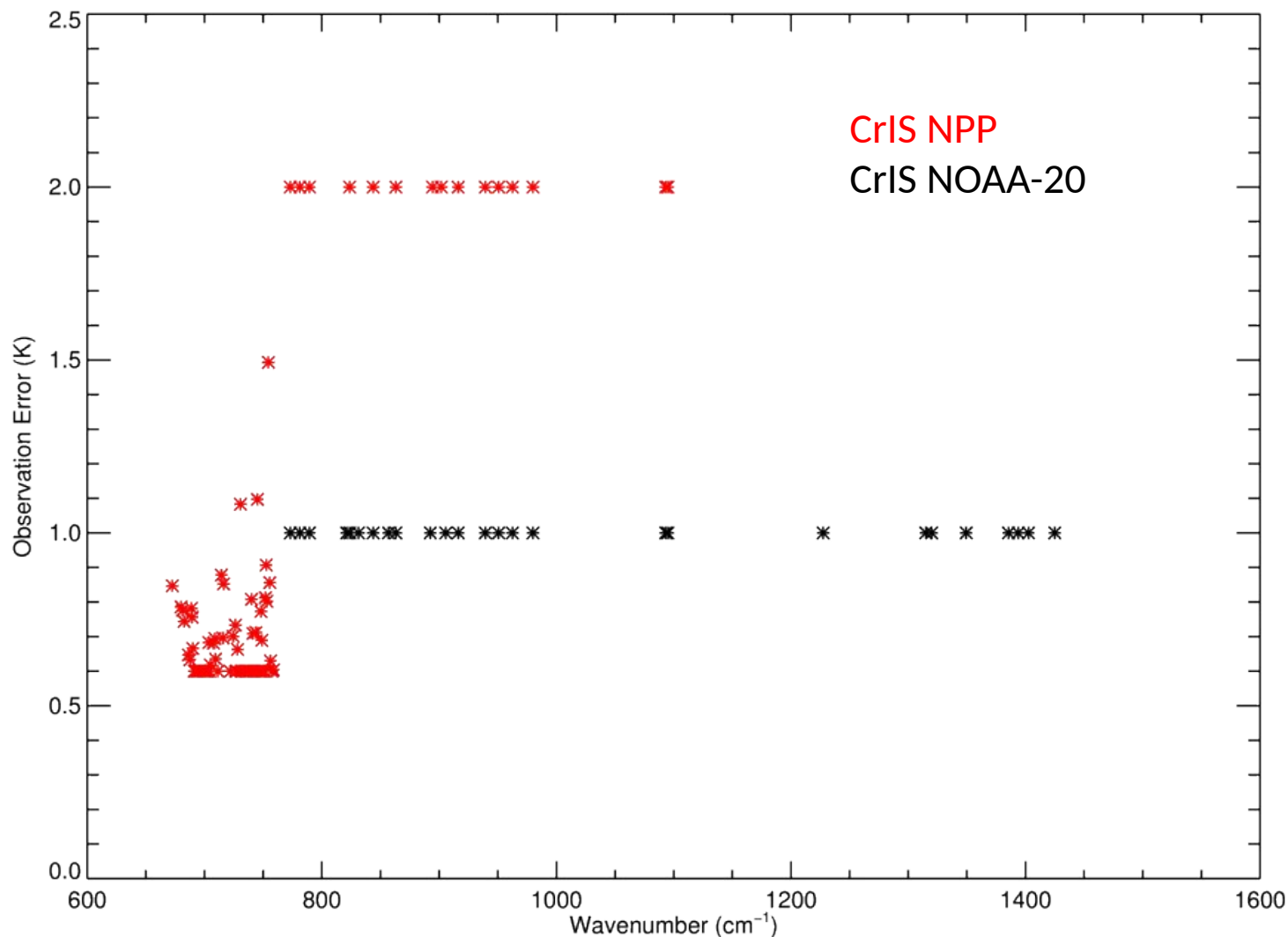
Forecast Impacts

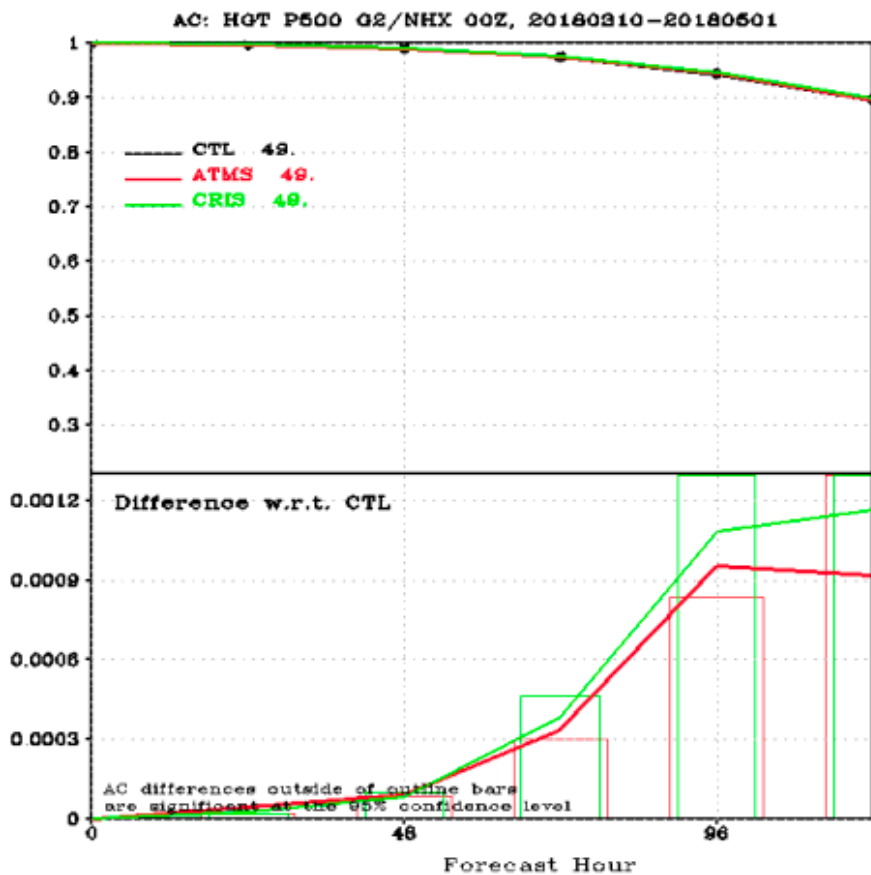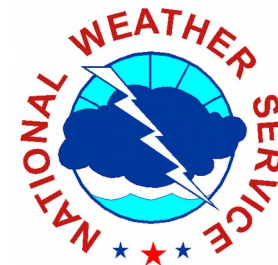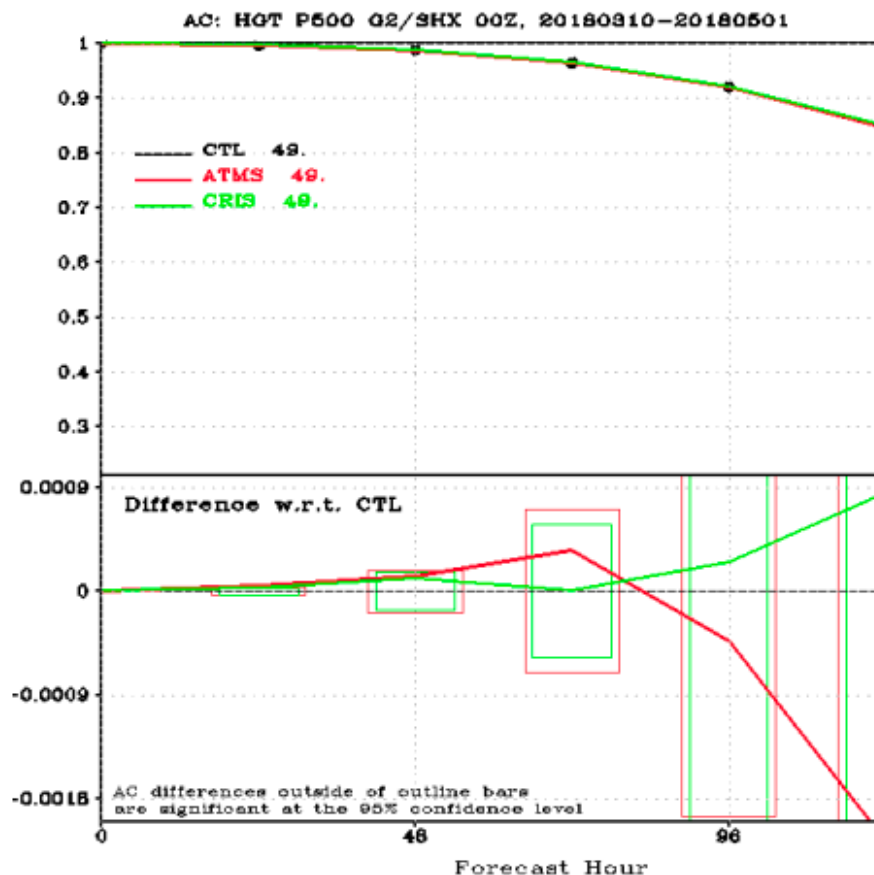# 500hPa Geopotential Height Anomaly Correlation Scores

NOAA-20 Improves

NOAA-20 Degrades

Tropical Vector Wind RMS Error Scores

WIND: RMSE
P850 G2/TRO 00Z, 20180310–20180501 Mean

WIND: RMSE
P200 G2/TRO 00Z, 20180310–20180501 Mean

200hPa

Difference w.r.t. CTL

rms differences outside of outline bars are significant at the 95% confidence level

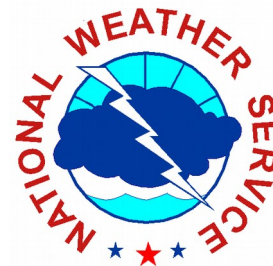Forecast Hour
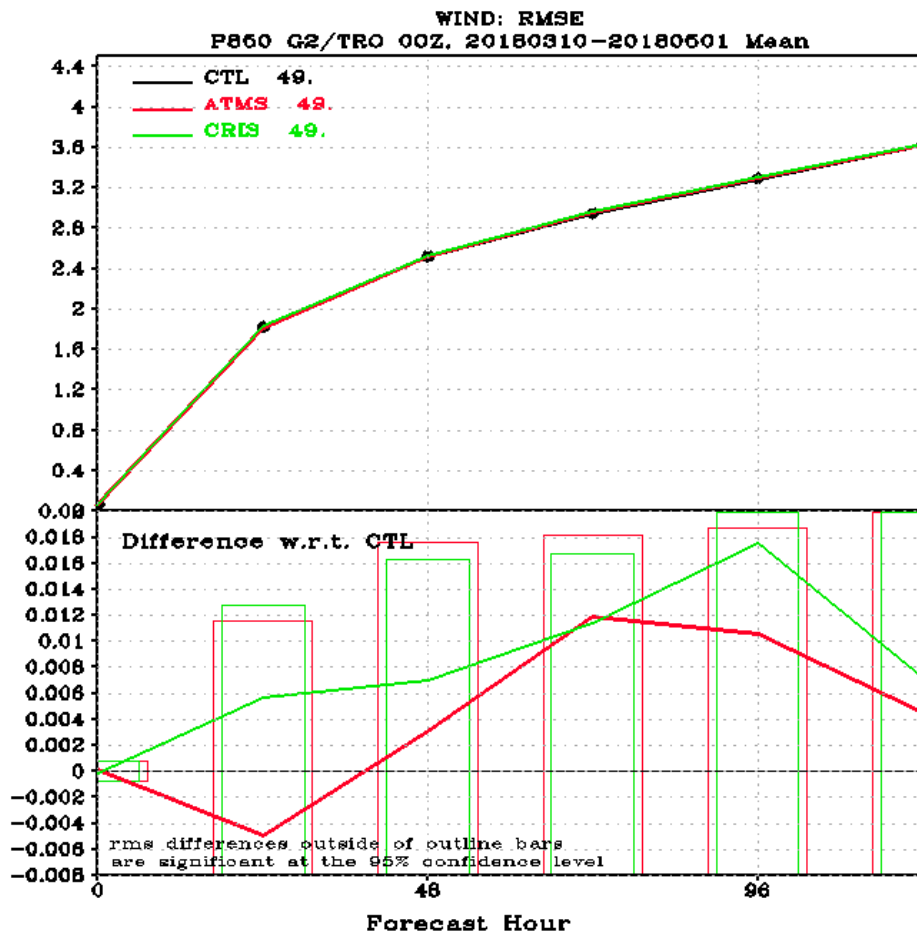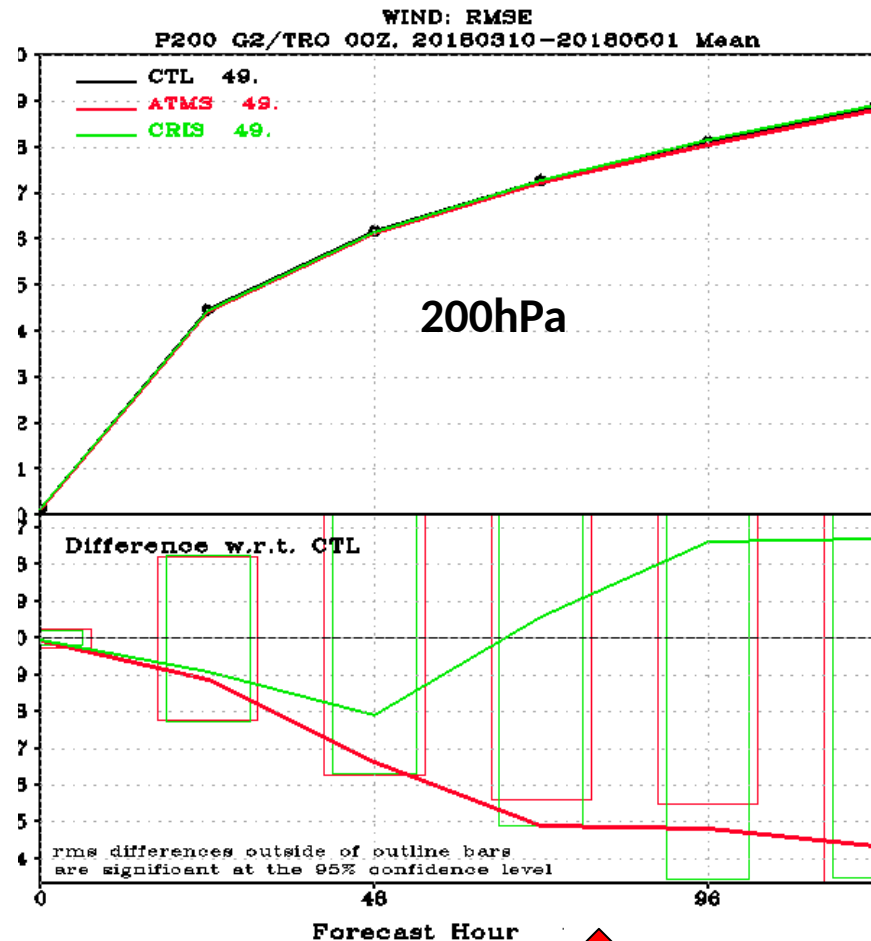
NOAA-20 Improves

NOAA-20 Degrades

ATMS Summary and steps forward

- The initial quality of the ATMS data from NOAA-20 is comparable with/slightly improved relative to that from NPP.

- Small bias differences are removed through bias correction.

- Striping appears to be less of an issue compared to S-NPP.

- In assimilation experiments, analysis increments and fit-to-observations appear reasonable.

- Forecast impacts are neutral to slightly positive.

- For operational implementations, there are two configurations:
  - The current configuration (clear sky) was put into the global operational system on 30th May 2018
  - **Cloudy radiance assimilation** (affecting channels 1-6 and 16-22) is implemented in the FV3-Beta GFS to be run in parallel with the operational system

CrIS Summary and steps forward

- The initial quality of the CrIS data from NOAA-20 is comparable or slightly better that from NPP.

- In assimilation experiments, analysis increments and fit-to-observations appear reasonable.

- Forecast impacts are mostly neutral.

- For operational implementations, there are two configurations:
  - The current configuration was put into the global operational system on 30th May 2018
  - The FV3-Beta GFS being run in parallel with the operational system has slightly more aggressive observation errors.

- Future work includes the introduction of cloudy radiances and correlated observation errors.