FY-3C evaluation overview: CMA, ECMWF and UKMO

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ECMWF, Met Office

Outline

- **General introduction**
- **Jointly evaluating FY-3C by CMA, ECMWF and UKMO**
- **Monitoring FY-3 sounders – Early warning system**
- **Summary**

The FY-3A/B/C Instrument Suite

Infrared Atmospheric Sounder (IRAS)
20 channels
(~HIRS/3)

Microwave Temperature Sounder (MWTS)
4 channel (~MSU)
13 channels

Microwave Humidity Sounder (MWHS)
5 channel (~MHS)
15channels with channels at 118 GHz

Microwave Radiation Imager
10 channels
(~AMSR-E)

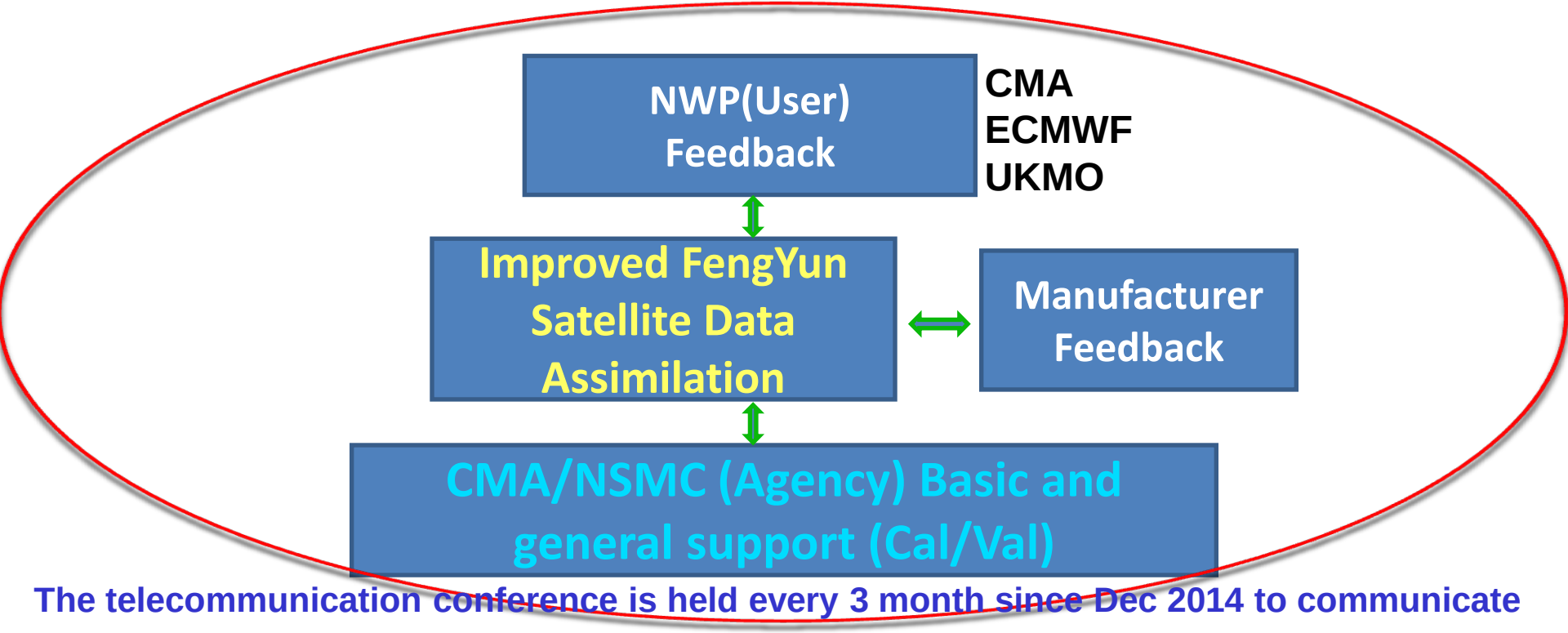
GNSS Radio-Occultation Sounder (GNOS)
(~GPS)

Jointly evaluating FY-3C by CMA, ECMWF and UKMO

Closer collaborations among NWP user, agency and manufacturer

--improve the misunderstanding and fill the gap from requirements

Share; early evaluation; preparation before launch

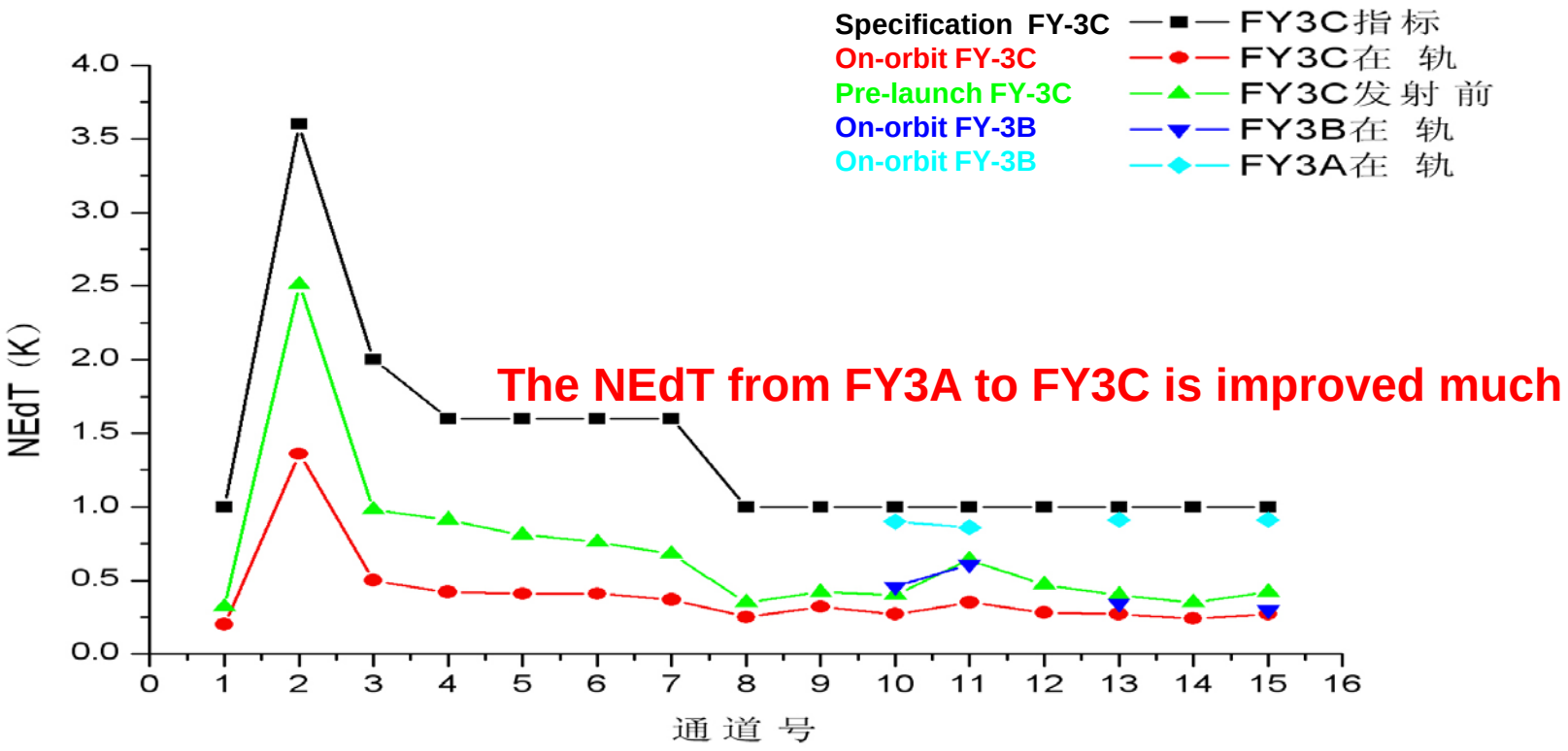


The telecommunication conference is held every 3 month since Dec 2014 to communicate the progress on evaluating, improving and assimilating FY-3C data in NWP models

Key points progressing the FY-3C evaluation

- **CMA, ECMWF and UKMO starts to work together;**
- **Scientists exchange: Katie's and Heather's visiting CMA/NSMC learnt useful understanding on the FY-3C instruments to prepare them in UKMO UM system and ECMWF IFS system; Nigel's visiting CMA/NSMC helps to exchange the understanding on the calibration; Stephen English's visiting agrees further cooperation**
- **FY-3 data quality monitoring, bias diagnose and correction system will be ready soon to support the operational assimilation through early abnormal warning;**
- **EUMETSAT started the trial dissemination of FY-3C: MWTS-2, MWHS-2, MWRI, IRAS, commencing on 18 September 2014**

MWHS2



The NEdT from FY3A to FY3C is improved much

Comparisons of MWHS2 OMB statistics from ECMWF and UKMO

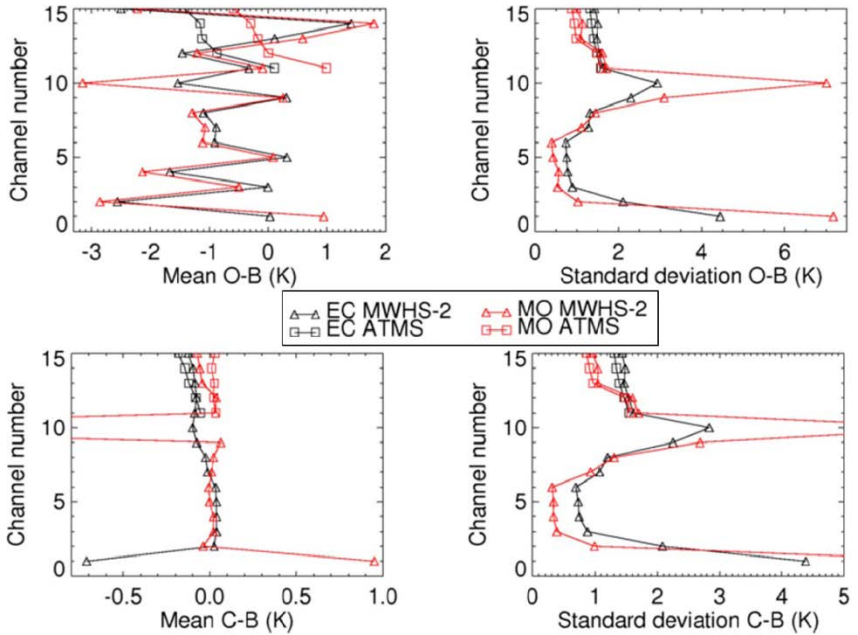
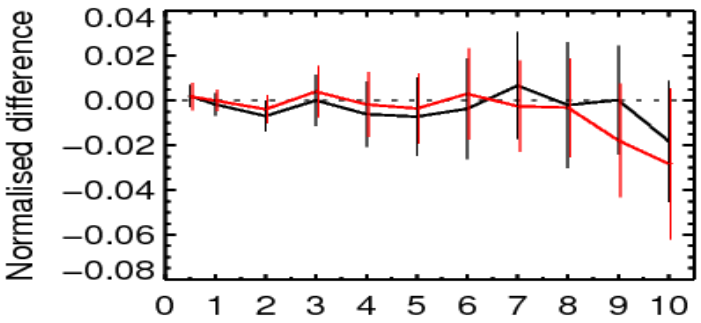


Figure 15: Top row: Bias (left) and standard deviation (right) of background departures before bias correction for MWHS-2 by channel from the ECMWF (black) and Met Office system (red). Triangles indicate values for MWHS-2 for the two systems. Also shown are statistics for ATMS channels that either have similar frequencies (for MWHS-2 channels 11-15). The statistics are based on cloud-free data over ocean at latitudes between +/- 60° from December 2014 (1 month averages). Note that there are significant differences in the treatment of the data in both systems, as outlined in the main text, including differences in the observation operator and cloud-screening. The Met Office statistics are for observations that are considered cloud-free, whereas the ECMWF statistics are based on data for which both the model and the observations are considered cloud-free. Bottom row: As the top row, but for statistics after bias correction.

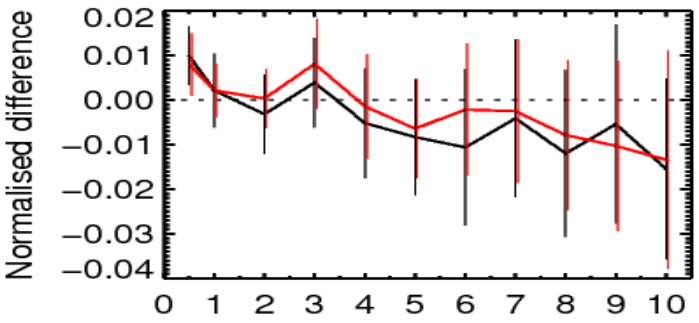
Assimilation Trials: 183 GHz channels from ECMWF

Neutral impact on medium-range forecast scores:

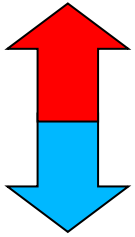
Geopotential height SHEM, 500hPa



Vector Wind SHEM, 500hPa



degradation



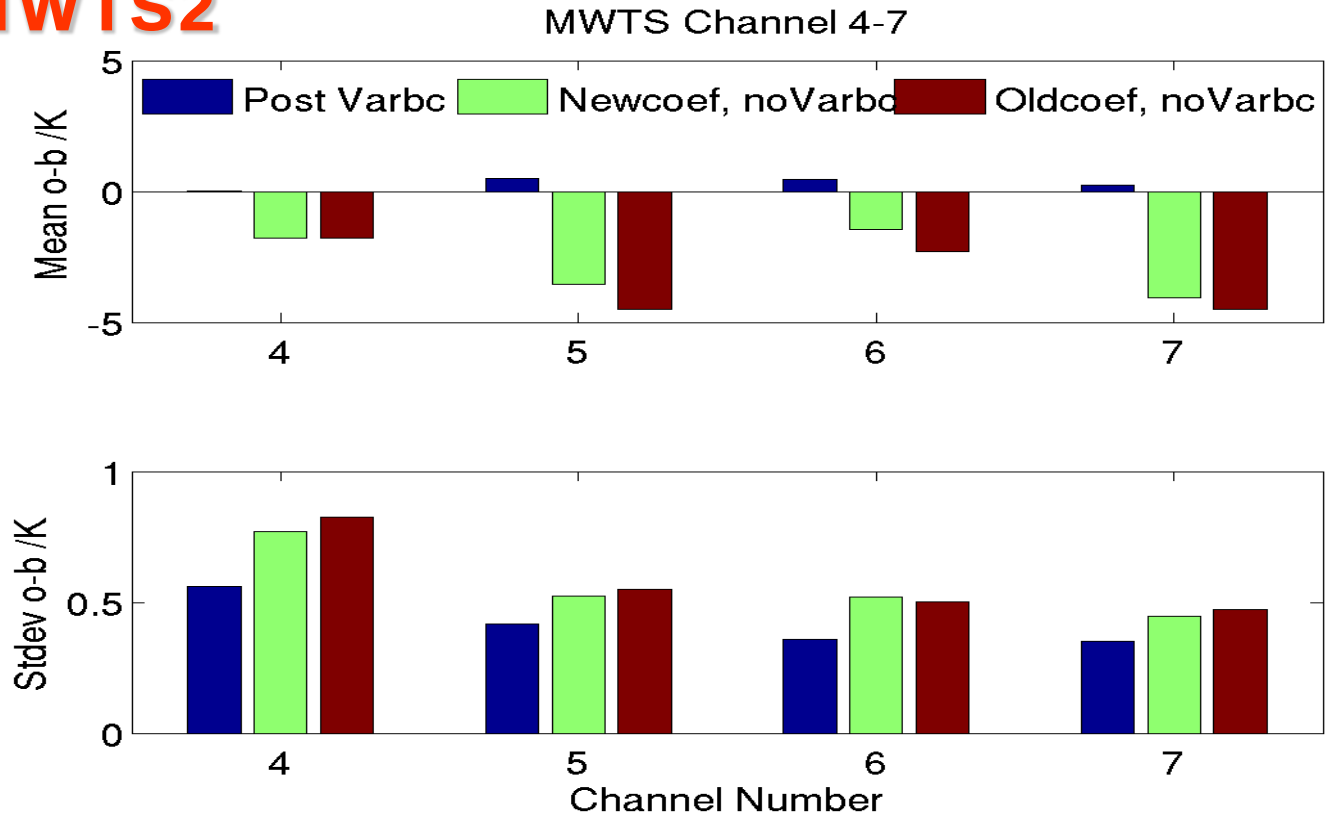
improvement

183 GHz over **ocean**

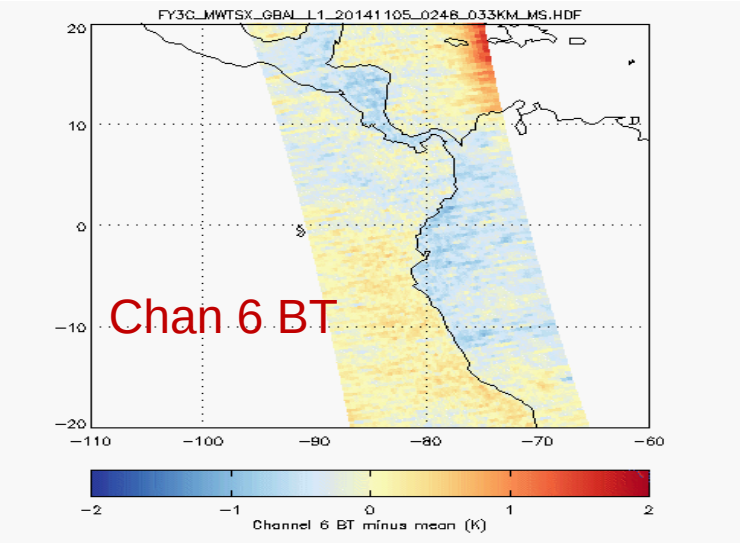
183 GHz over **ocean, land, sea-ice**

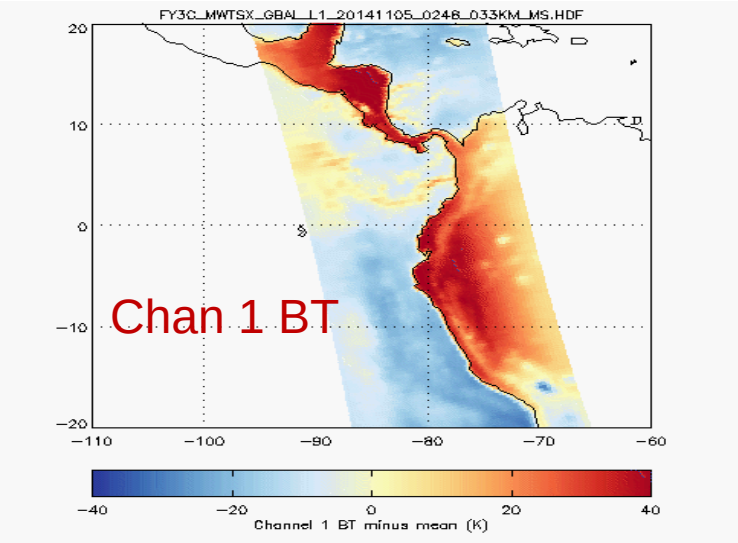
MWTS2: Optimize the passband to improve the OMB fit

MWTS2



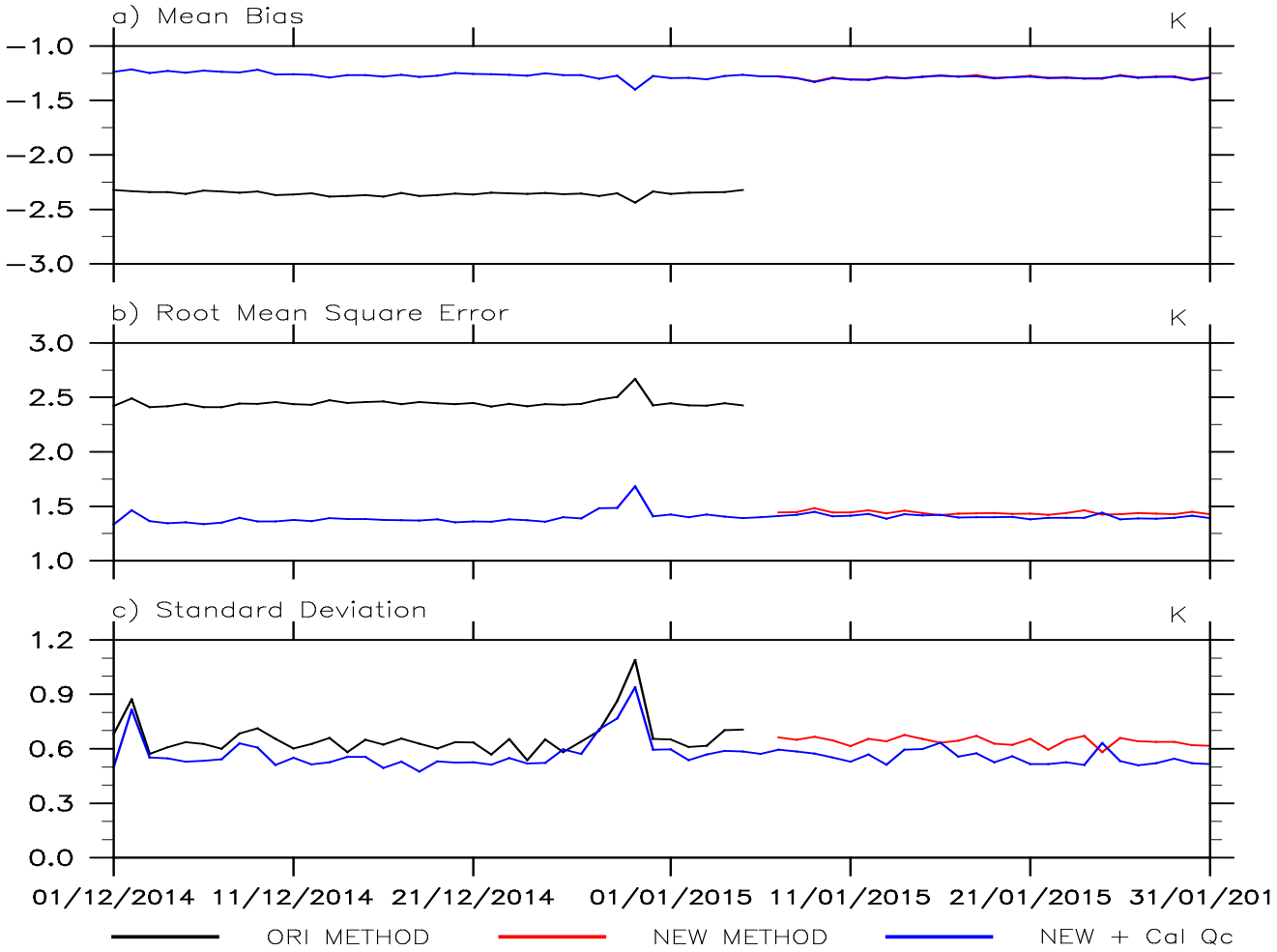
MWTS-2 Land/sea bias

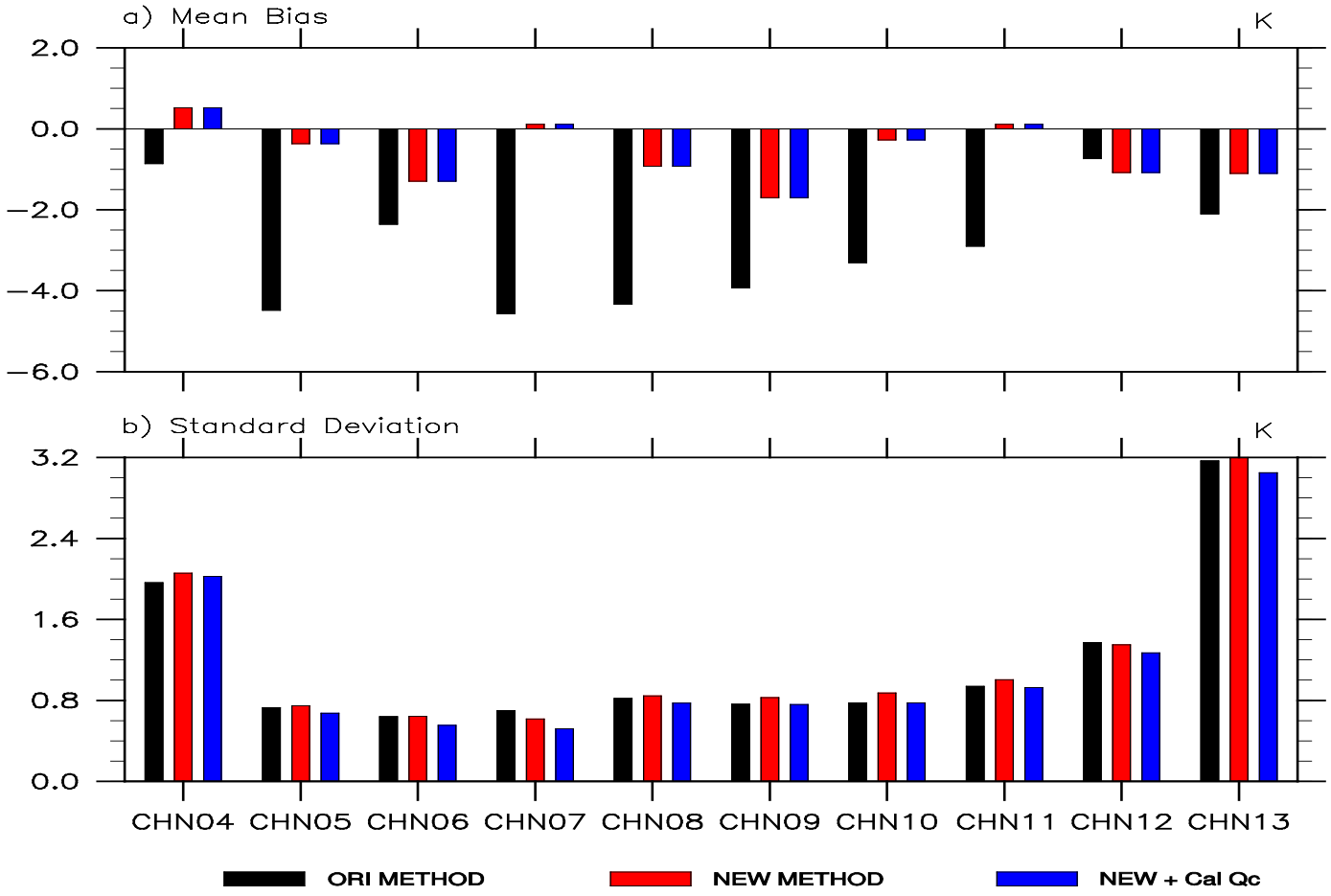




- Ch 5, 6, 7 and 8 display unphysical temp depressions over land
- These channels are not supposed to be surface sensitive
- Direct broadcast and global data affected
- *anti-correlation* with ch 1
- We formulated en empirical fix

CHN06


a) Mean Bias
K
−1.0
−1.5
−2.0
−2.5
−3.0
b) Root Mean Square Error
K
3.0
2.5
2.0
1.5
1.0
c) Standard Deviation
K
1.2
0.9
0.6
0.3
0.0
01/12/2014
11/12/2014
21/12/2014
01/01/2015
11/01/2015
21/01/2015
31/01/201
ORI METHOD
NEW METHOD
NEW + Cal Qc


a) Mean Bias
K
2.0
0.0
−2.0
−4.0
−6.0
b) Standard Deviation
K
3.2
2.4
1.6
0.8
0.0
CHN04
CHN05
CHN06
CHN07
CHN08
CHN09
CHN10
CHN11
CHN12
CHN13
ORI METHOD
NEW METHOD
NEW + Cal Qc

Impact experiment from GRAPES

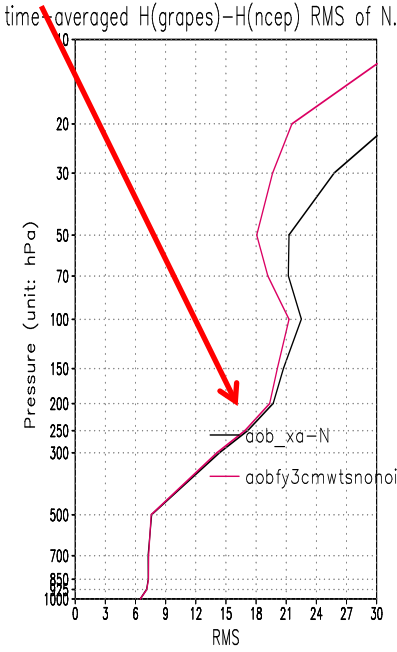
Positive impact when MWTS-2 data are added in Global GRAPES (20140701-20140720)

CTRL: Conventional (black lines)
TEST: CONV+FY-3C MWTS-2 (red lines)

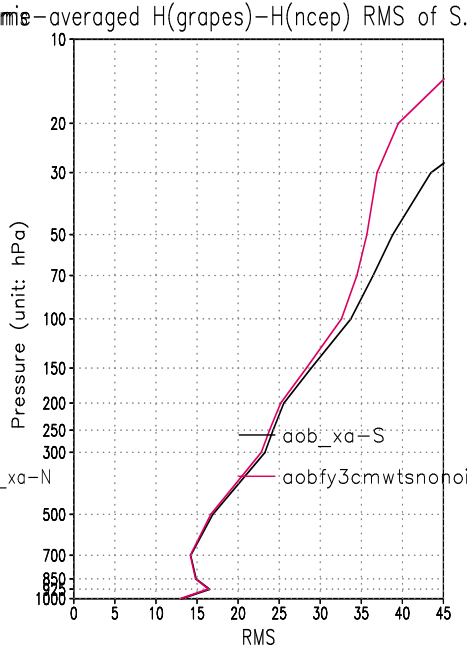
The RMS is decreased

Geopotential Height

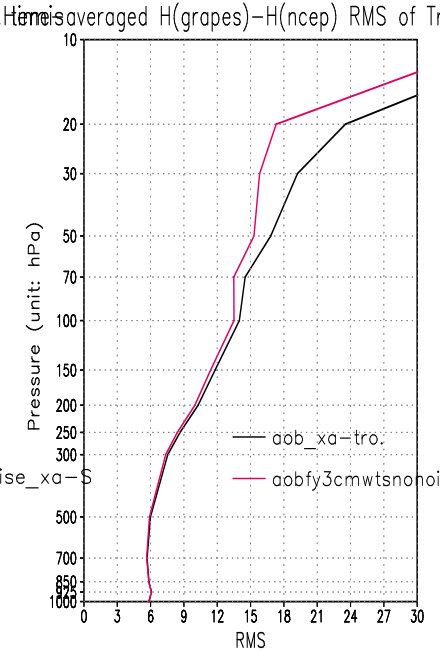
Northern Hemisphere



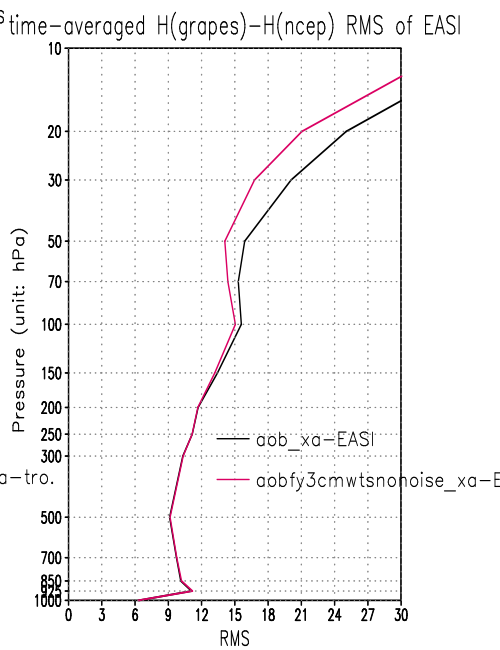
Southern Hemisphere



Tropic



East Asia

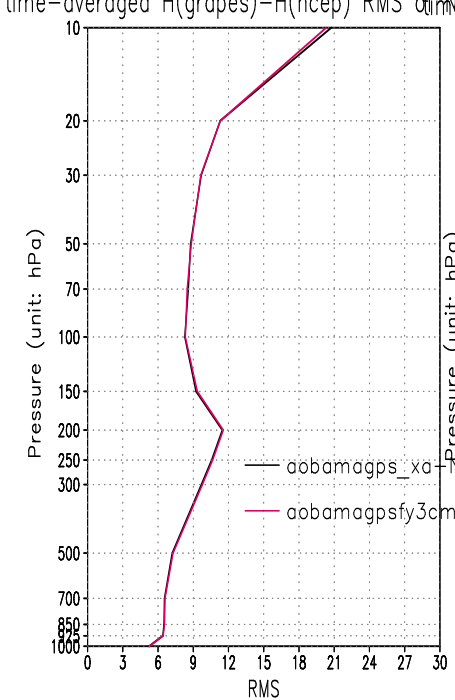


Neutral impact on the experiment when assimilating all observations (201407)

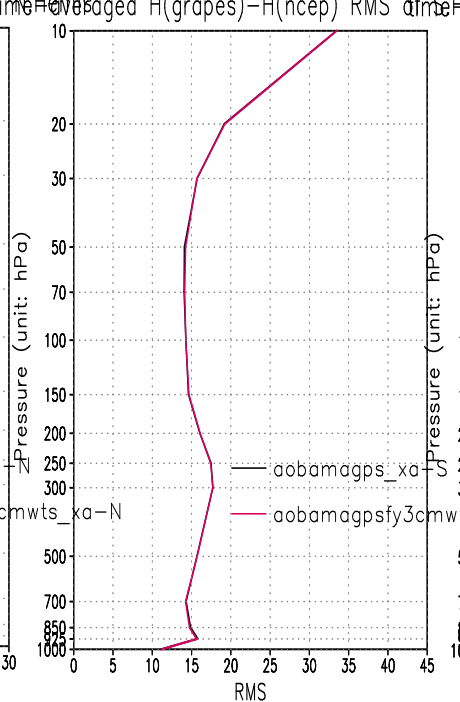
CTRL: Conventional data+NOAA-15/18/19, MetOp-A AMSU-A, GPS-RO (black line)
TEST: CONV+FY-3C MWTS-2 (red line)

Geopotential Height

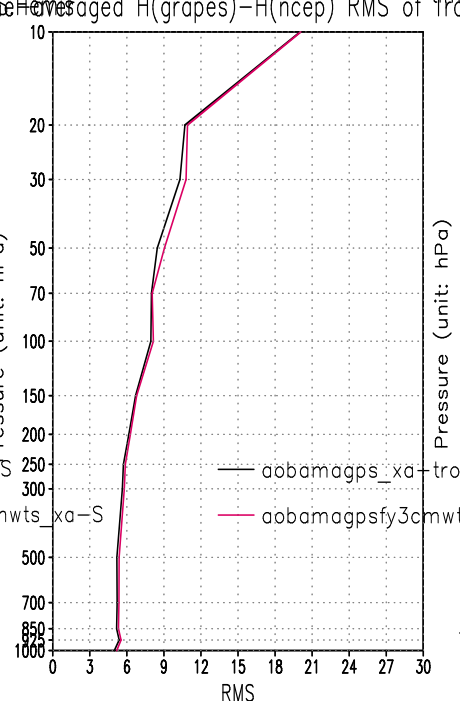
Northern Hemisphere



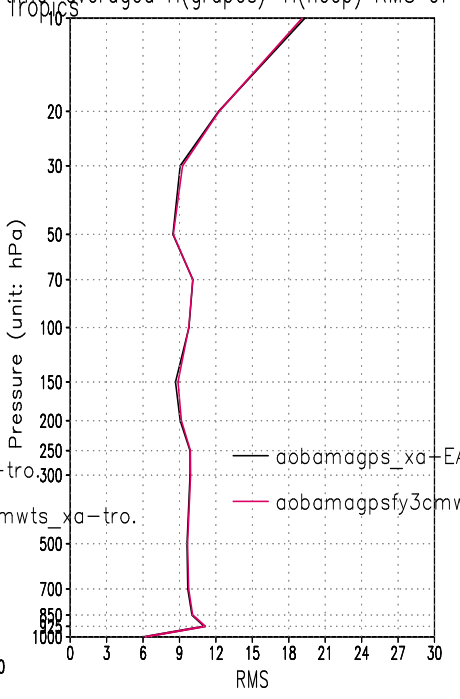
Southern Hemisphere



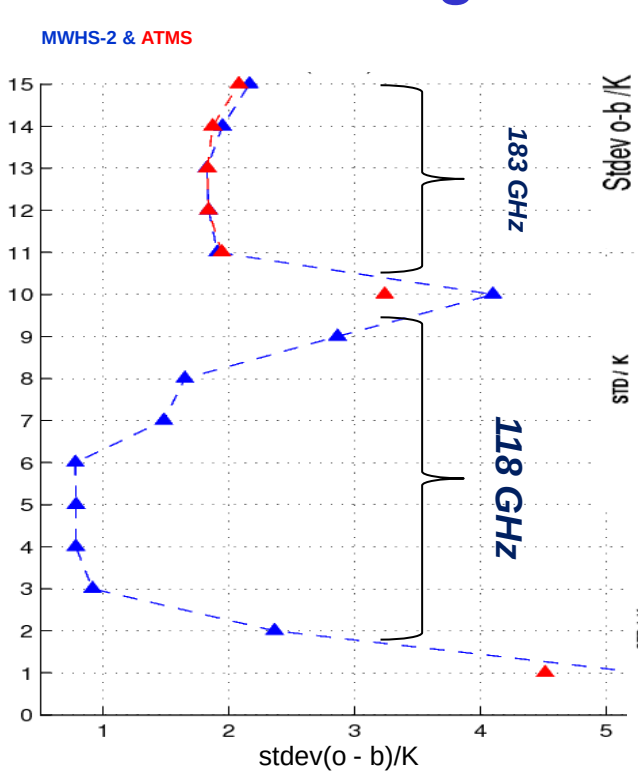
Tropic

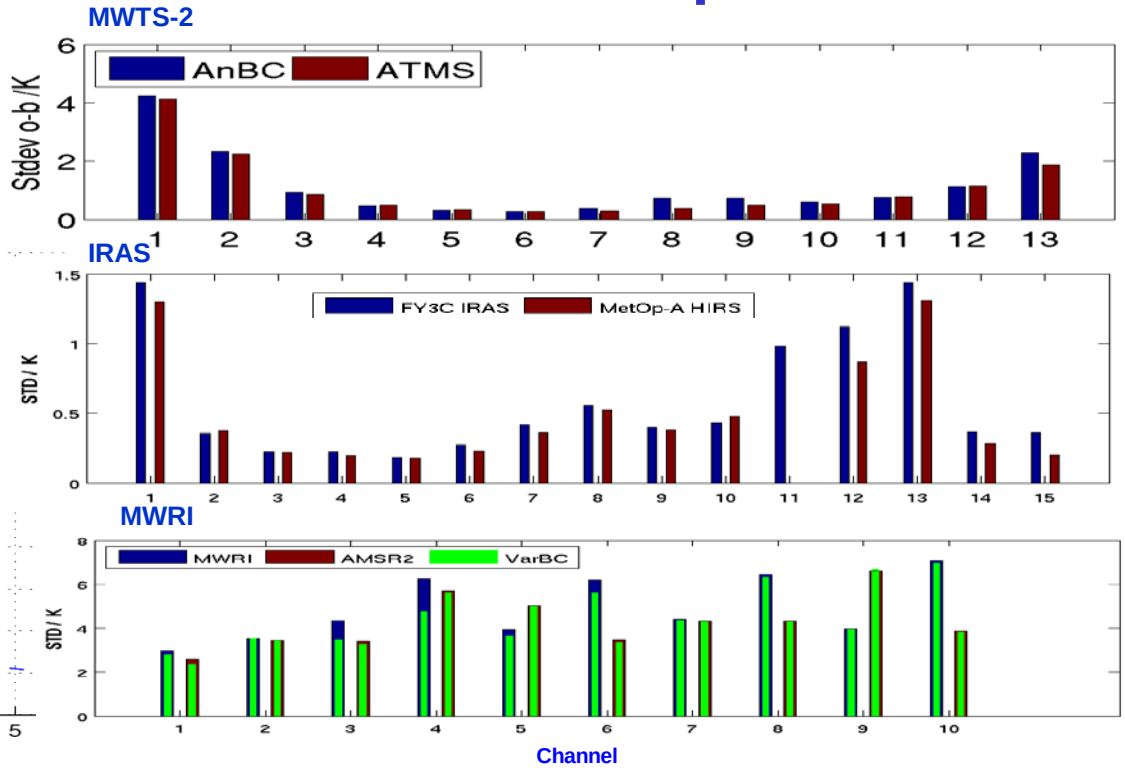


East Asis

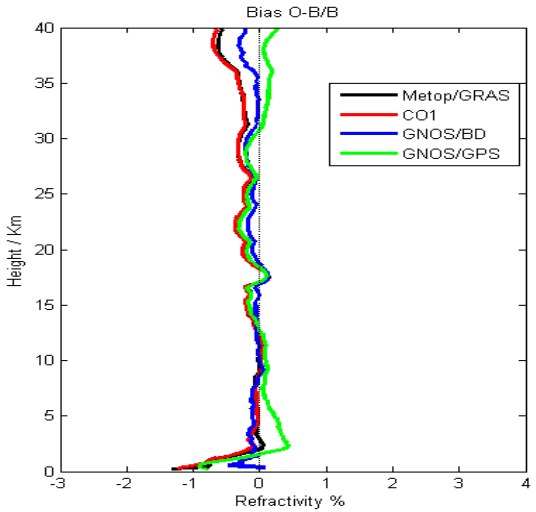


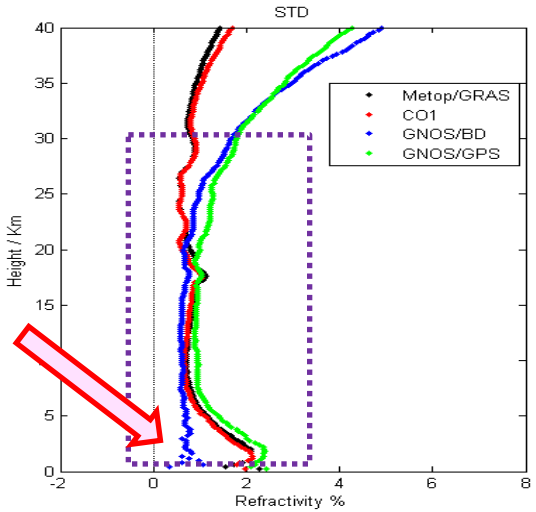
The comparable data quality of FY-3C sounding instruments to its counterparts





Error Sta. of Refractivity

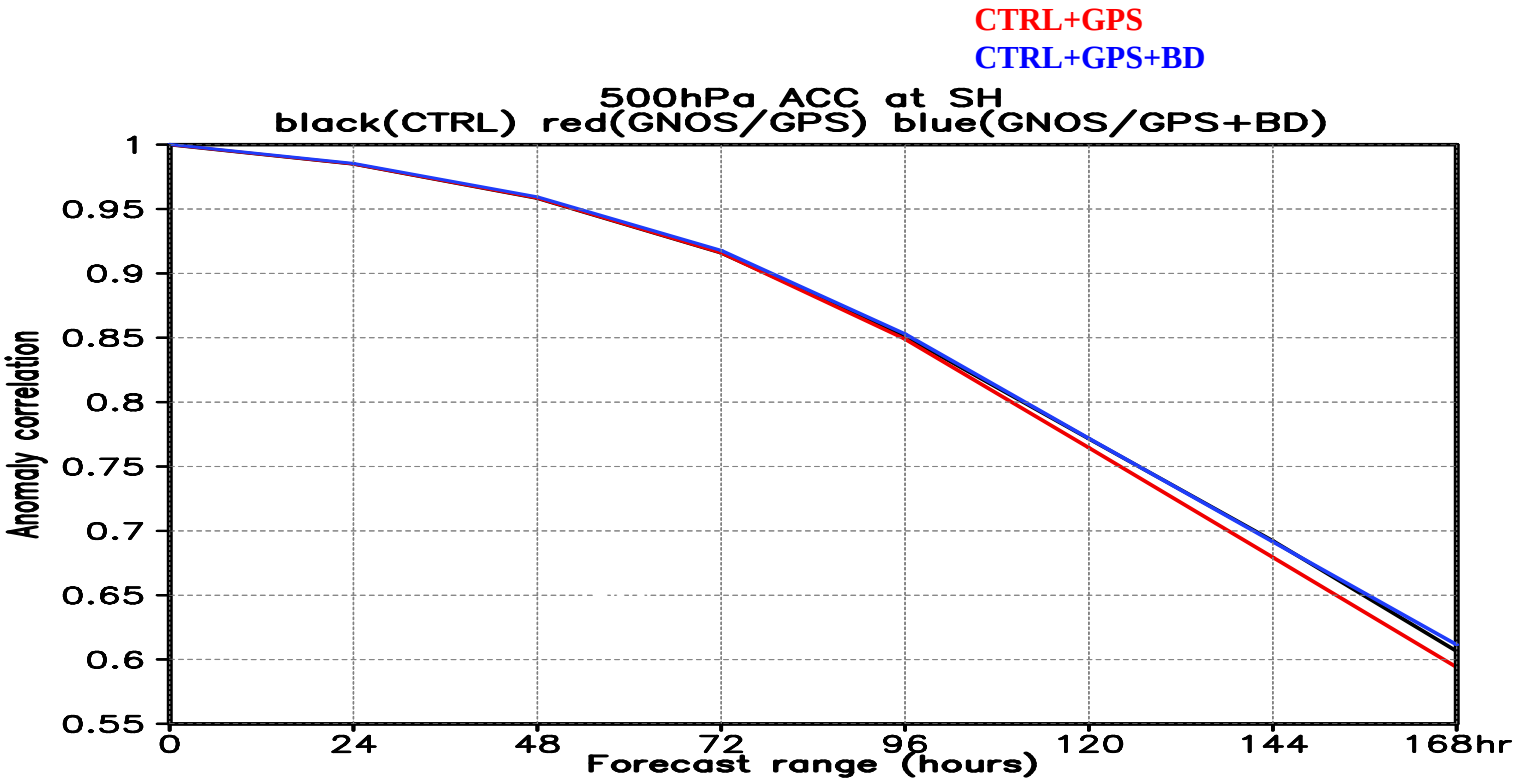




- Bias are consistent with each other
- STD shows small below 30 km
- Beidou shows least std below 5 km

ROs	0 – 40 km		5 – 30 km	
	Mean bias	Mean STD	Mean bias	Mean STD
GNOS/GPS	-0.01	1.66	-0.04	1.11
GNOS/BDS	-0.09	1.37	-0.07	0.81
Metop/GRAS	-0.21	0.91	-0.16	0.76
COSMIC	-0.23	0.90	-0.16	0.71

Impact Experiment of FY3C/GNOS RO Data from GRAPES



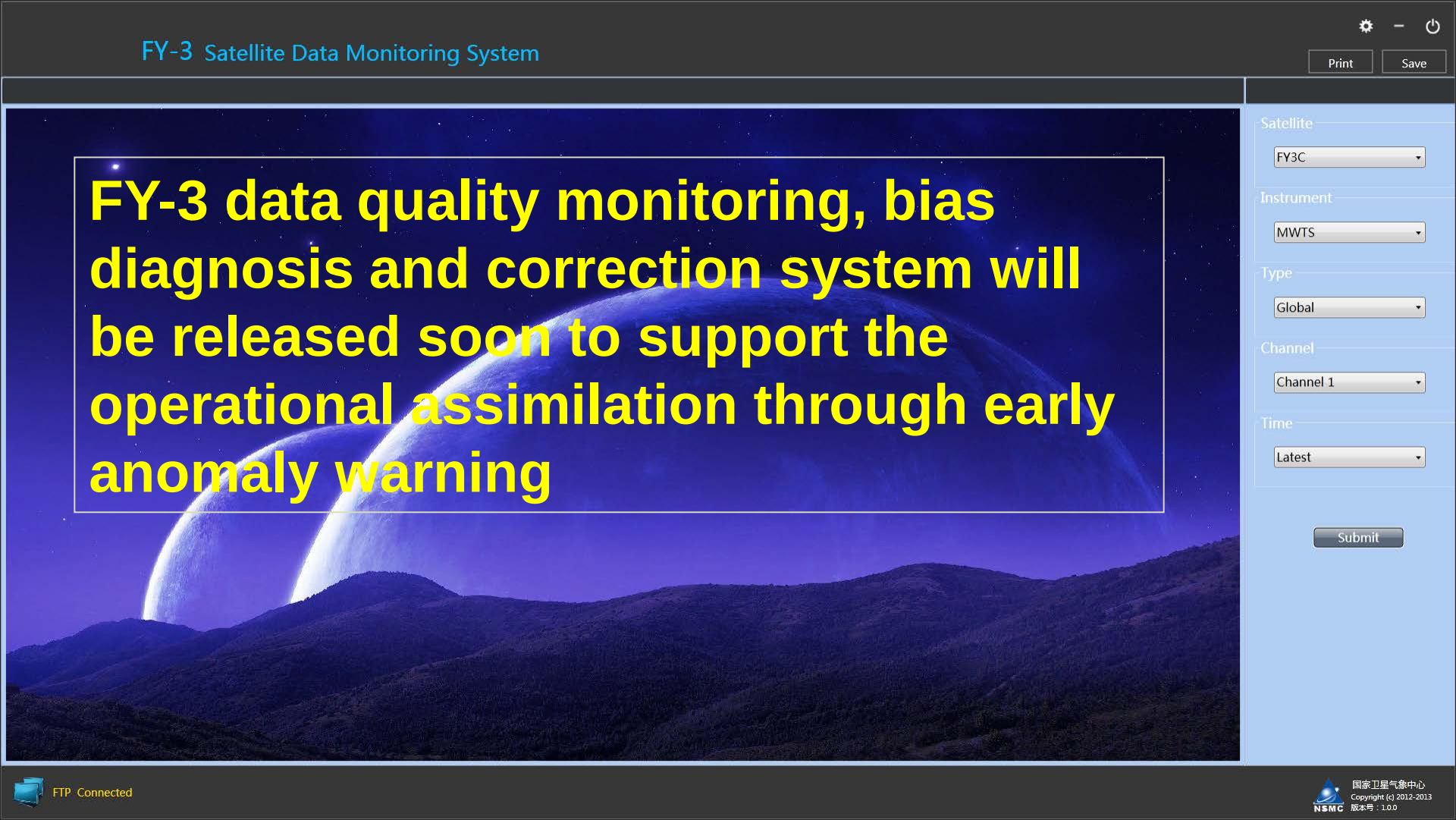
GNOS data have neutral (NH) and positive impacts (SH) on GRAPES analysis and forecast skill.

Monitoring FY-3 sounders

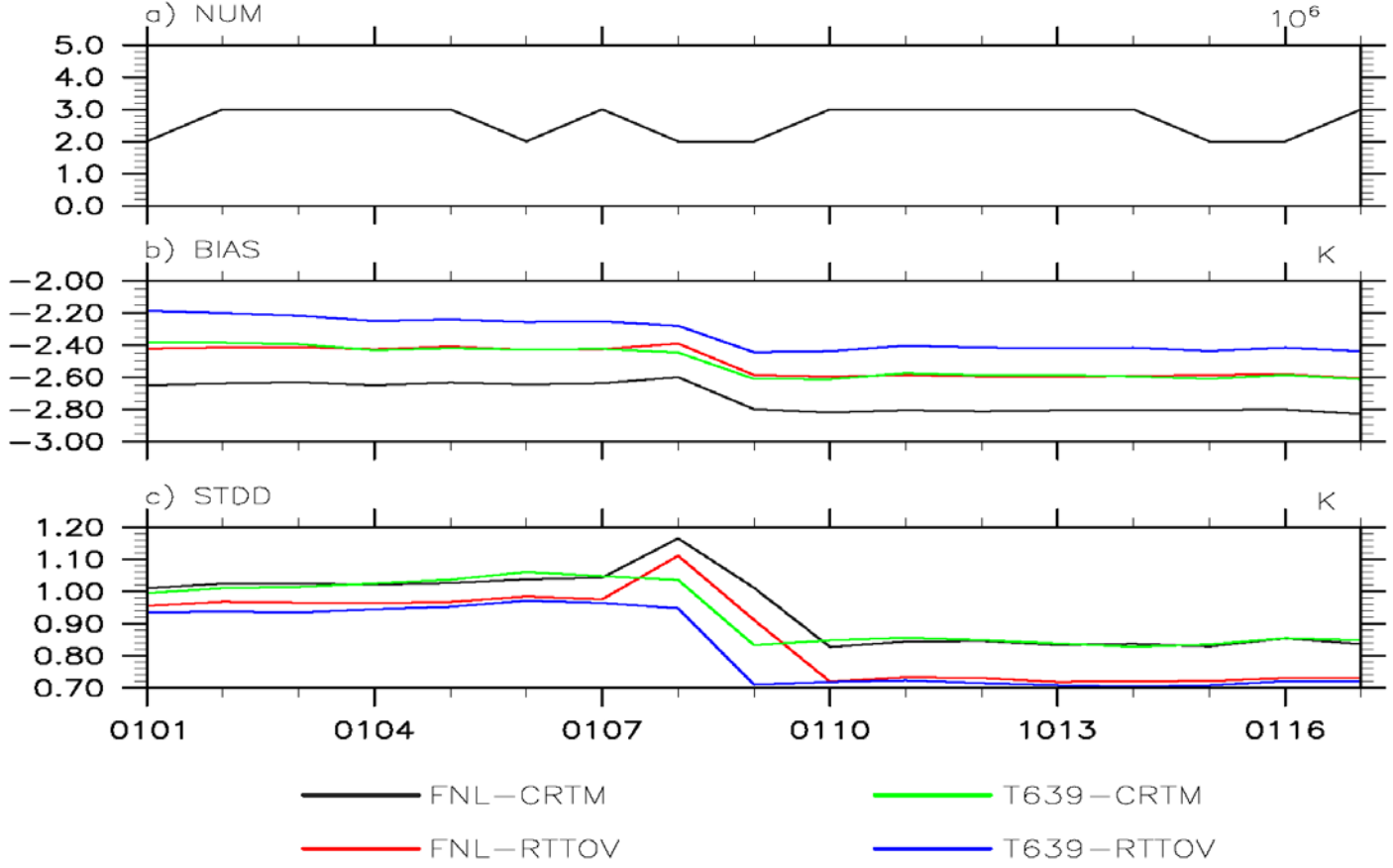
--Early warning system at CMA/NSMC for operational assimilation

Parameters indicating the data quality

- **Observing system: such as, frequency locker, Receiver;**
- **Temperature: such as, PRT, instrument temperature;**
- **Antenna: such as, cold space starting/end angle, warm load starting/end angel, earth scene starting/end angle;**
- **Auxiliary information: time, volt, gain**

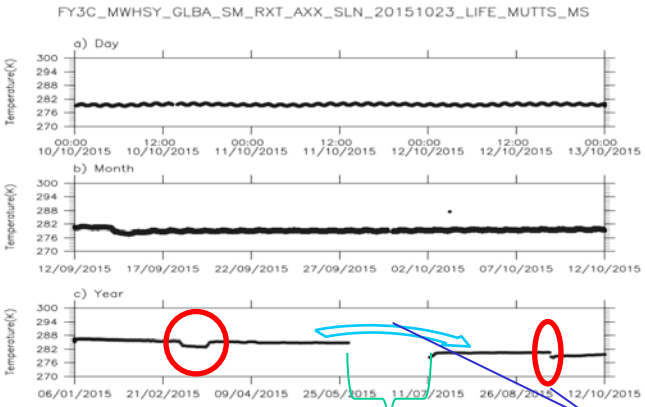

FY-3 Satellite Data Monitoring System
Print
Save
FY-3 data quality monitoring, bias diagnosis and correction system will be released soon to support the operational assimilation through early anomaly warning
Satellite
FY3C
Instrument
MWTS
Type
Global
Channel
Channel 1
Time
Latest
Submit
FTP Connected
NSMC
国家卫星气象中心
Copyright (c) 2012-2013
版本号：1.0.0

FY-3C MWTS2-CH6

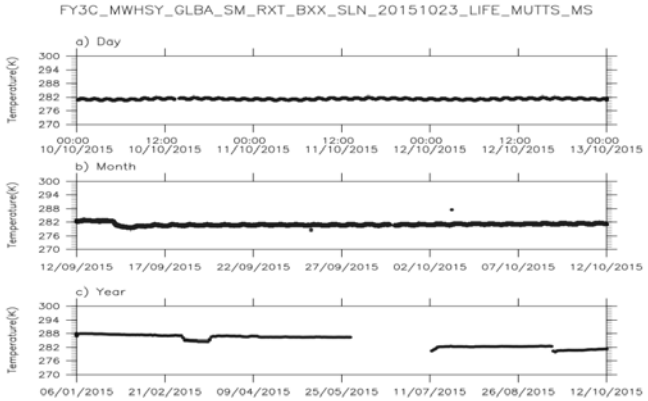


Instrument Temperature

89&118GHz



Fy3c Temporarily Out of Service



Based on FY-3 Satellite data monitoring system:

✓We found the MWHS instrument temperature and PRT temperature dropped from 2-19 March. MWHS(II) temperature was passively controlled, so the warm target can make heat exchange with satellite platform. During that time, MWTS was switched alternatively.

Some instrument reboot
（VIRR、MWRI、MWHS、GNOS、IRAS、TOU)

In the middle of September, CMA decided opening another four instruments on FY-3C, so there are ten instruments except MERSI, back to work again, as a result, the instrument working temperature changes

The plan and status of FY-3C in NWP

ECMWF			
	2013	2014	2015
FY-3B MWHS	Monitoring	Op DA	Op DA
FY-3C MWTS2		Evaluating	Evaluating (Now dead)
FY-3C MWHS2		Evaluating	Monitoring
FY-3C MWRI		Evaluating	Evaluating
FY-3C IRAS		Evaluating	Monitoring
FY-3C GNOS		Sample data	Sample data

UKMO			
	2013	2014	2015
FY-3B MWHS	Evaluating	Evaluating	Monitoring
FY-3C MWTS2		Evaluating	Evaluating (Now dead)
FY-3C MWHS2		Evaluating	Monitoring
FY-3C MWRI		Evaluating	
FY-3C IRAS			
FY-3C GNOS		Evaluating	Evaluating

CMA NWPC			
	2013	2014	2015
FY-3B MWHS	Evaluating	Evaluating	Evaluating
FY-3C MWTS2		Evaluating	Evaluating (Now dead)
FY-3C MWHS2		Evaluating	Evaluating
FY-3C MWRI		Evaluating	
FY-3C IRAS			
FY-3C GNOS		Evaluating	To be Op Da

Summary: opportunity and Challenge--- OSSE

FY-3 early-orbit satellite; FY-4 (high spectral ir, MW)

- **The early warning system from CMA/NSMC will contribute to the operational NWP centers;**
- **NWP users, CMA Agency and Manufacture work together on FY3C even closely;**
- **The feedback mechanism between the agency and NWP centres is contributing much to the improvement of data quality and assimilation;**
- **We are expecting through the closer collaborations among the three parties, the FY-3 data assimilation in NWP models will be advanced to a new stage.**