



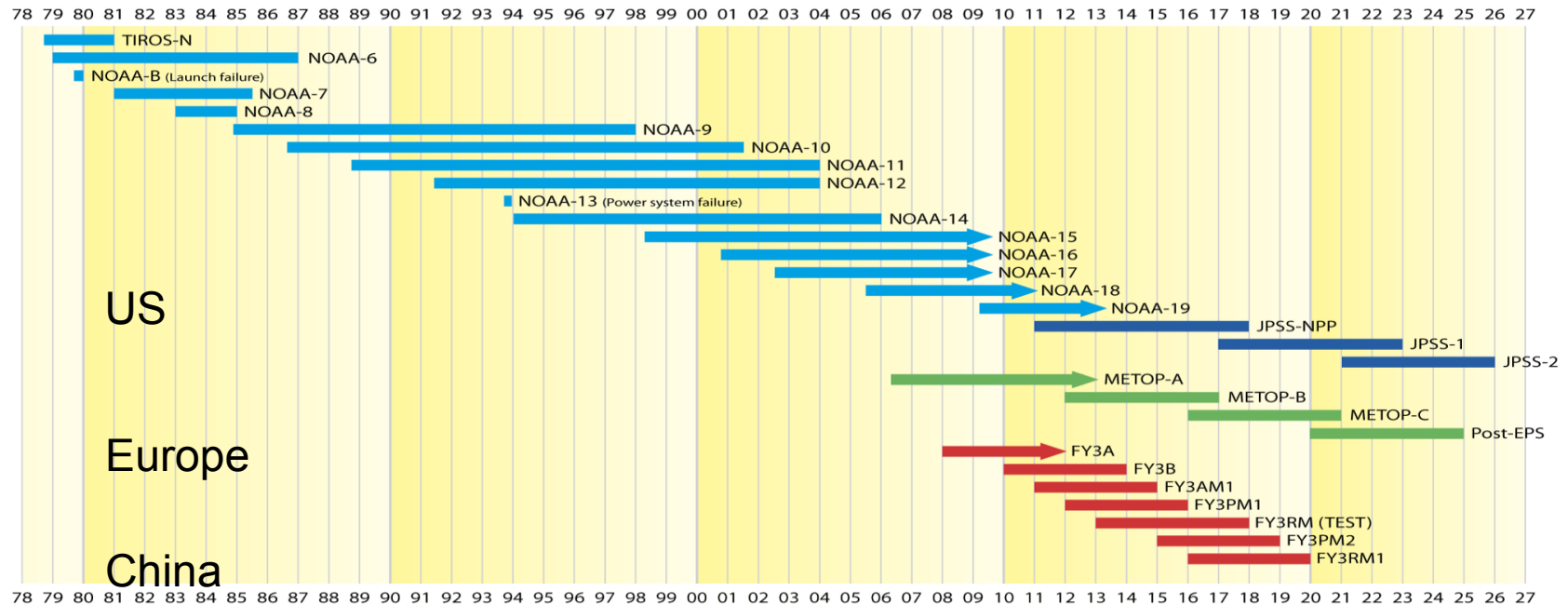
# Experience with using feedback information at CMA National Satellite Meteorological Center, from numerical weather prediction feedback



Qifeng Lu



# Operational Sounding Satellites



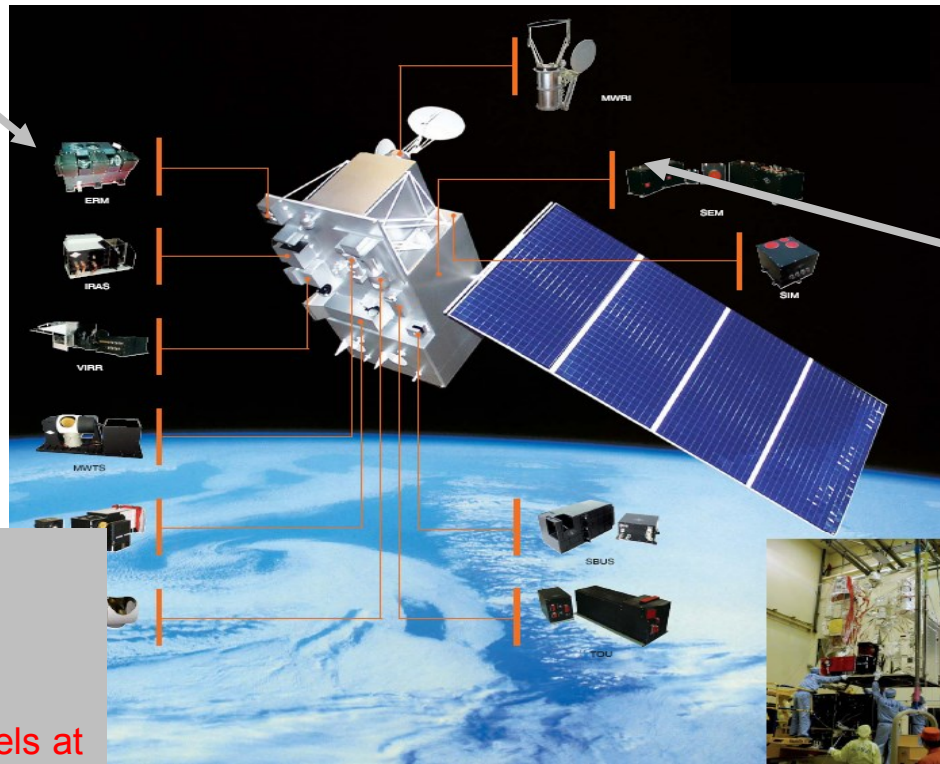
- Microwave sounding data provides information on temperature and humidity which has been widely used in :
  - Operational NWP data assimilation systems and;
  - Climate research – to determine long term trends in atmospheric state
- The US has launched a series of polar satellites, dating back to 1978;
- Europe began to contribute in 2006 (MetOp-A)
- China began to contribute in 2008 (FY-3A)

# 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 (MWS)  
5 channel (~MHS)  
**15 channels with channels at  
118 GHz**

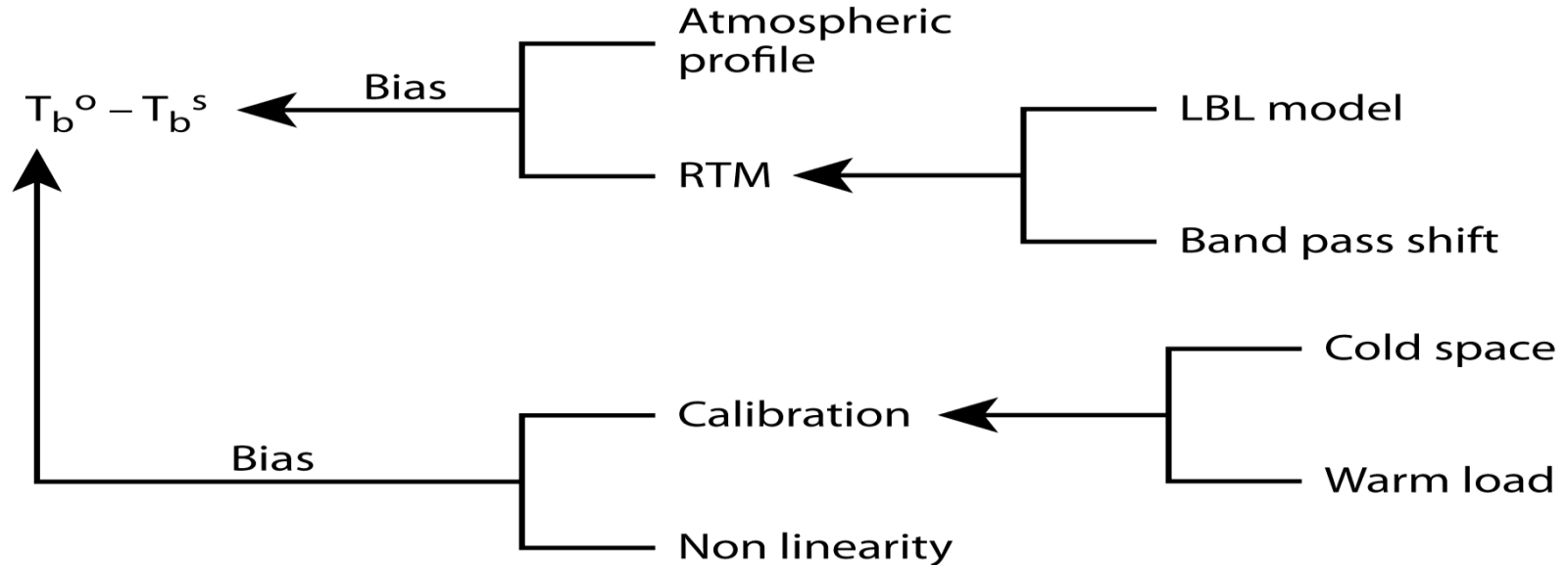


Microwave  
Radiation Imager  
10 channels  
(~AMSR-E)

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

# Characterize the instrument

## Schematic of error terms



**Derivation:** from instrument parameters pre-launch; specific experiment after launch; from GCISCS; from NWP community

**The derivations have to be agreed well and they are stable**

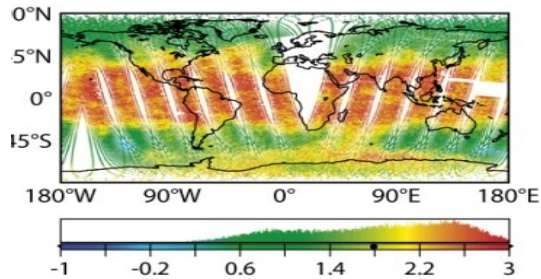
# **Data Quality Assessment at: General Approach**

- Approach involves a comparison of observations (OBS) with simulated observations based on short range (up to T+9 hour) forecast fields ('First Guess', FG) and radiative transfer modelling → 'FG departures'
- FG is 'proxy' for truth → 'FG departures' ( $\text{OBS} - \text{FG}$ ) indicate error in the measurements or RT modelling
- High accuracy of the NWP fields results from the large & diverse range of observations assimilated (MW sounders, Advanced IR sounders, GPSRO, radiosondes ... etc)
- Able to detect biases at  $\sim 0.1\text{K}$  level for temperature sounders (MWTS and IRAS), sensitivity slightly lower for MW humidity sounders & imagers ( $\sim 0.5\text{K}$ )
- Similar work ongoing at NOAA/NCEP, JMA, and UK Met Office

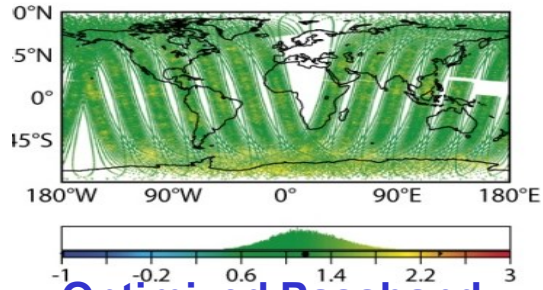
# Characterize the MWTS

## The OMB comparison between FY-3A/MWTS and MetOp/AMSU-A

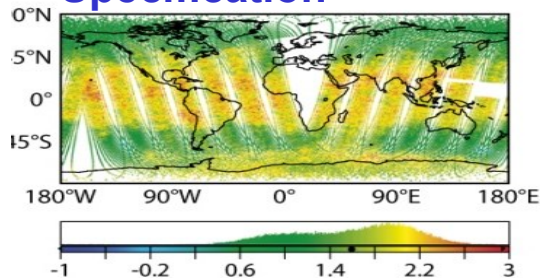
MWTS Channel 4



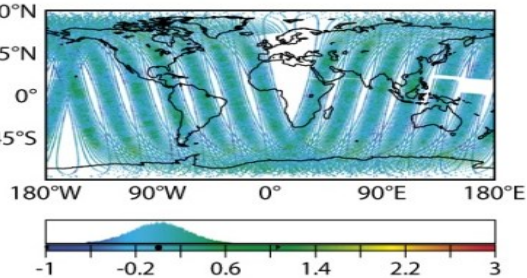
Specification



Optimized Passband

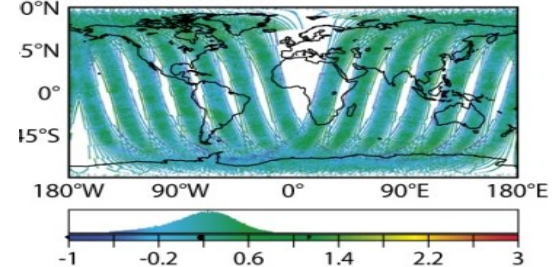


PreLaunch Measurement



Optimization+NonLinearity Correction

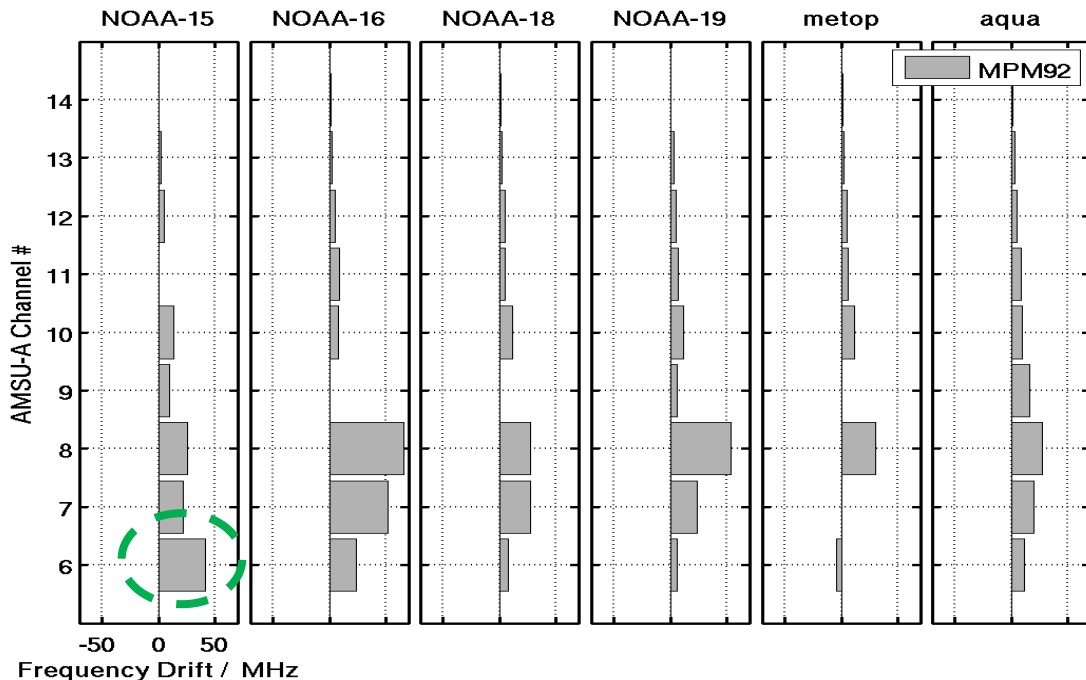
AMSU-A Channel 9



MetOp AMSU-A

# Preliminary passband frequency shift analysis for AMSU-A: Frequency Drifts

## Characterize the MSUs/AMSUAs



- Small shifts diagnosed for Chs 9-14:

- single phase locked loop oscillator, expect very high (< 1MHz) stability

- Very large shifts diagnosed for chs 5-8

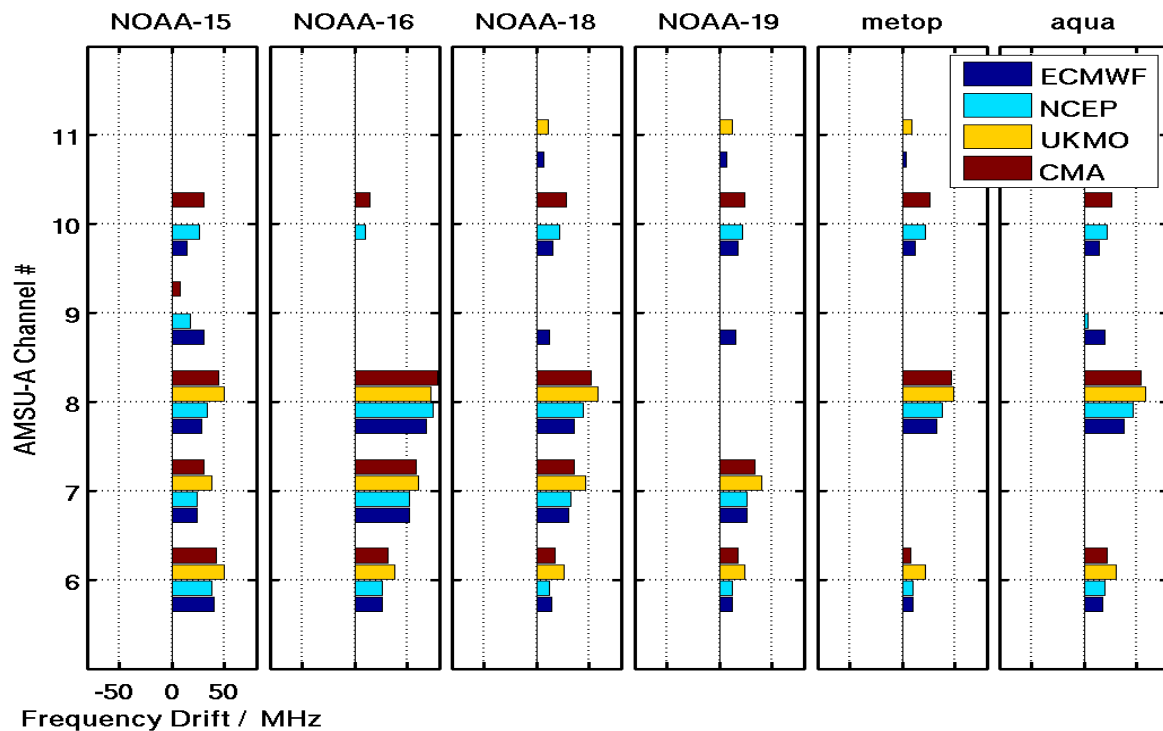
- Ch 5 drift estimates less reliable

- All shifts positive: consistent with passband shifts to higher optical depths (spectroscopy ? - difficult to explain small drifts for Ch9 and above though)

- Data screened to avoid aliasing of strong cross scan biases into passband (fovs 10-20 only)

- Shift for NOAA-15 Ch6 (42MHz) is reasonable
- agreement with Zou (2011) of 36MHz.



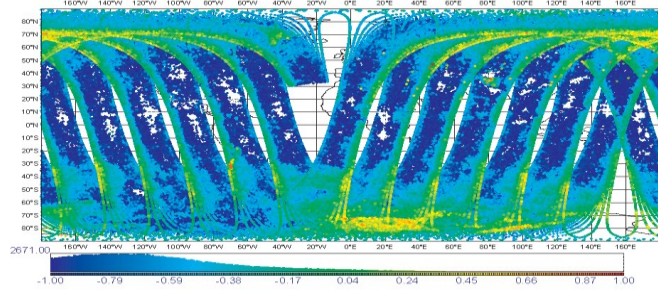


**Similar results obtained  
From 4 NWP models  
(ECMWF, UKMO, NCEP,  
CMA)**

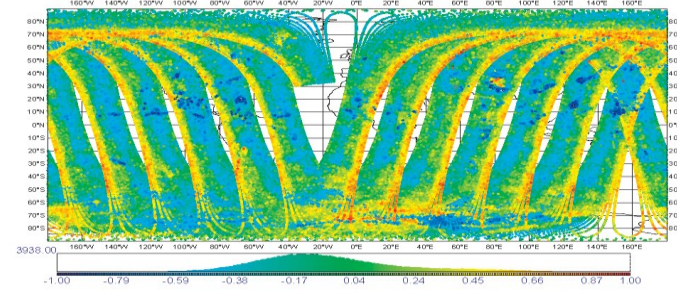


# Characterize the MSUs/AMSUAs

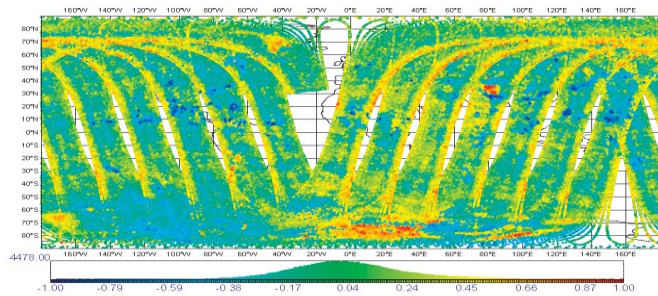
## Analysed Frequency Shifts for AMSU-A (Channel 6)



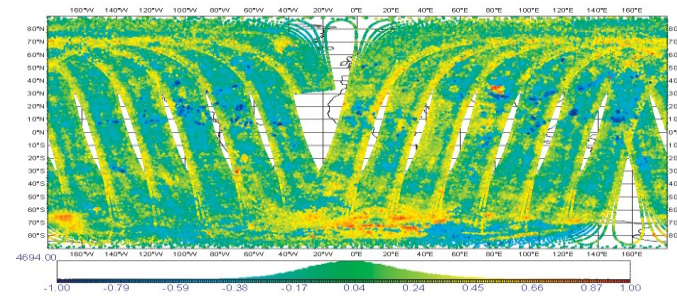
(a) Nominal passband centre, pre-VarBC



(b) New passband centre, pre-VarBC

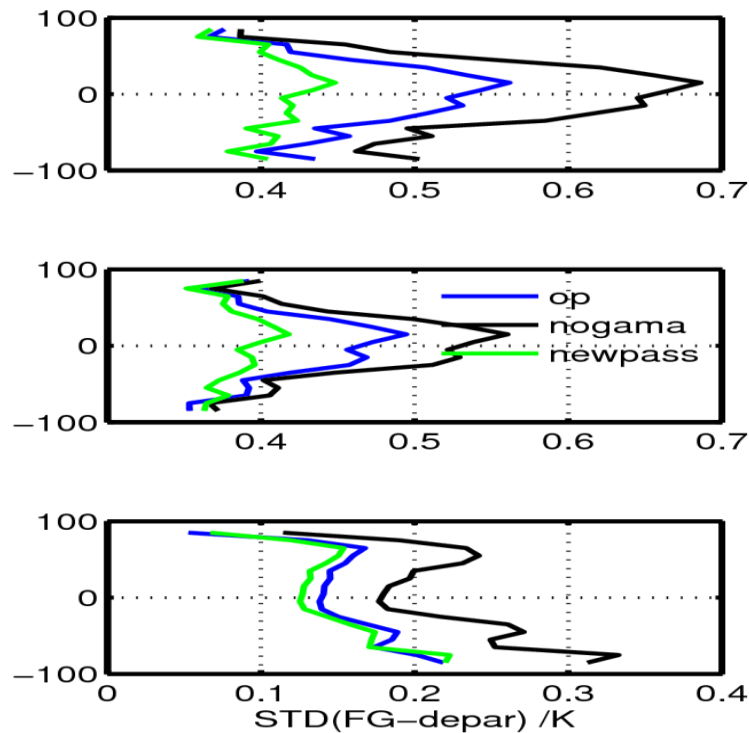
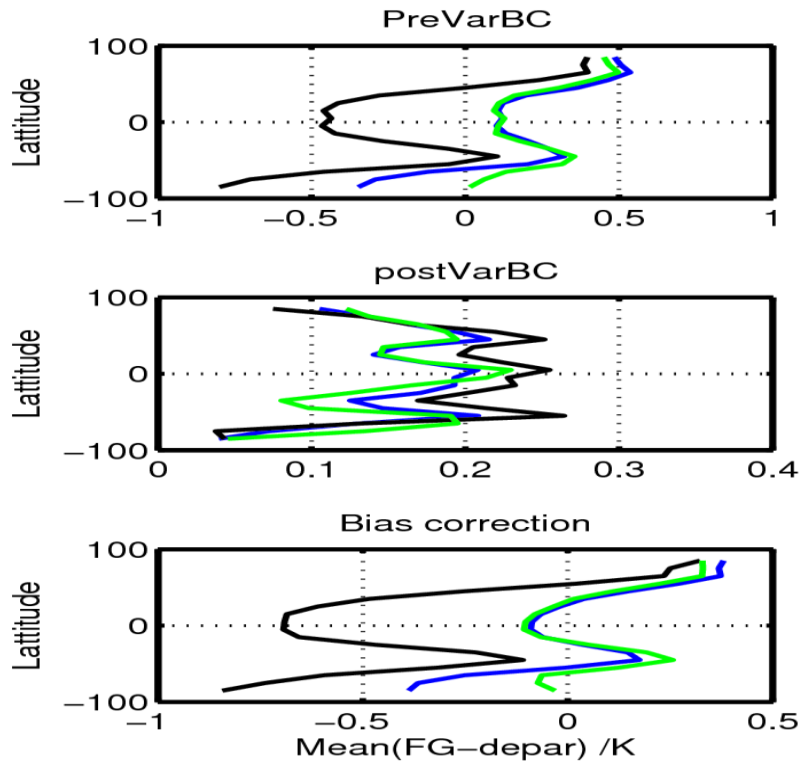


(c) Nominal passband centre, post-VarBC

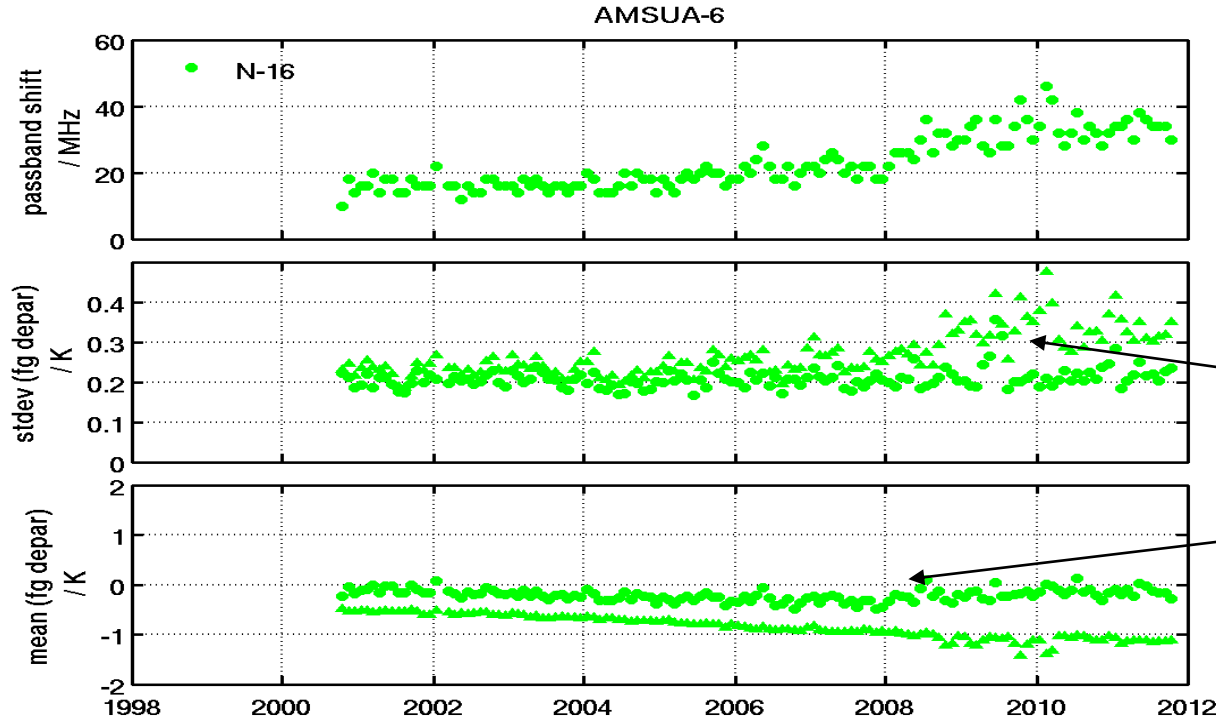


(d) New passband centre, post-VarBC

# NOAA16 AMSUA CH8 at 55.5 GHz



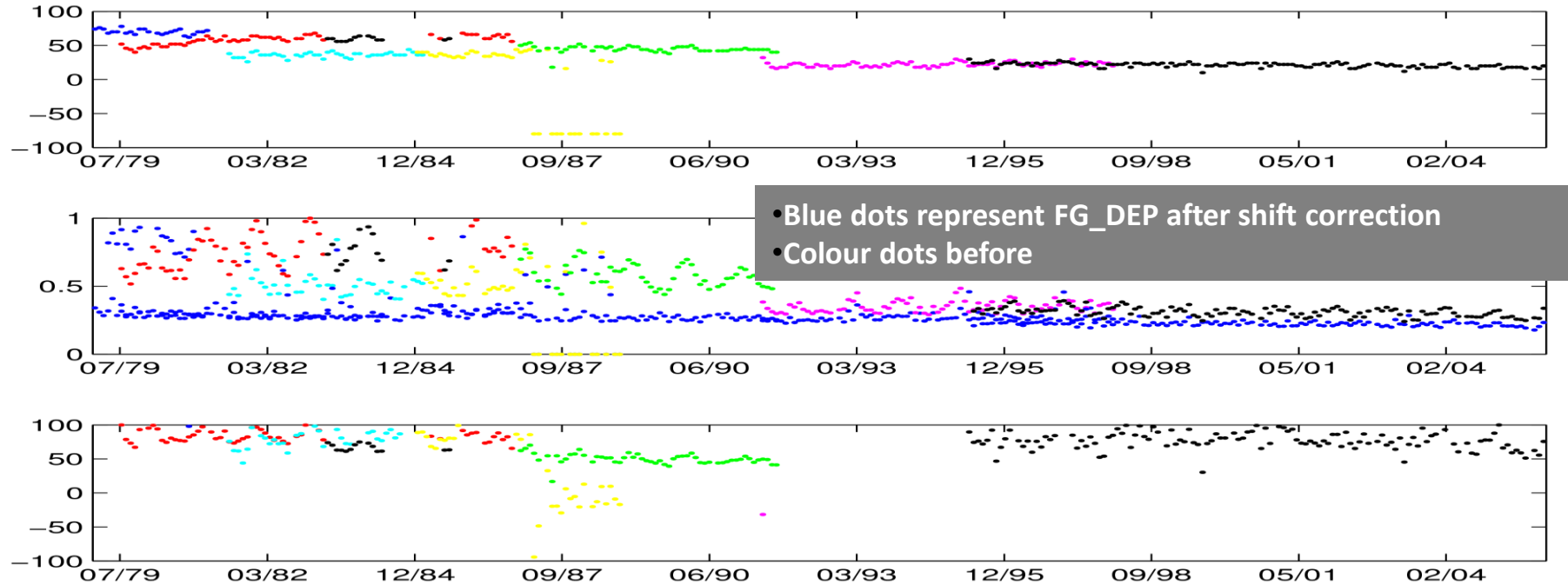
# Analysed Frequency Shifts for AMSU-A: Time Dependence (Channel 6)



Triangles – old PB  
Circles – new PB

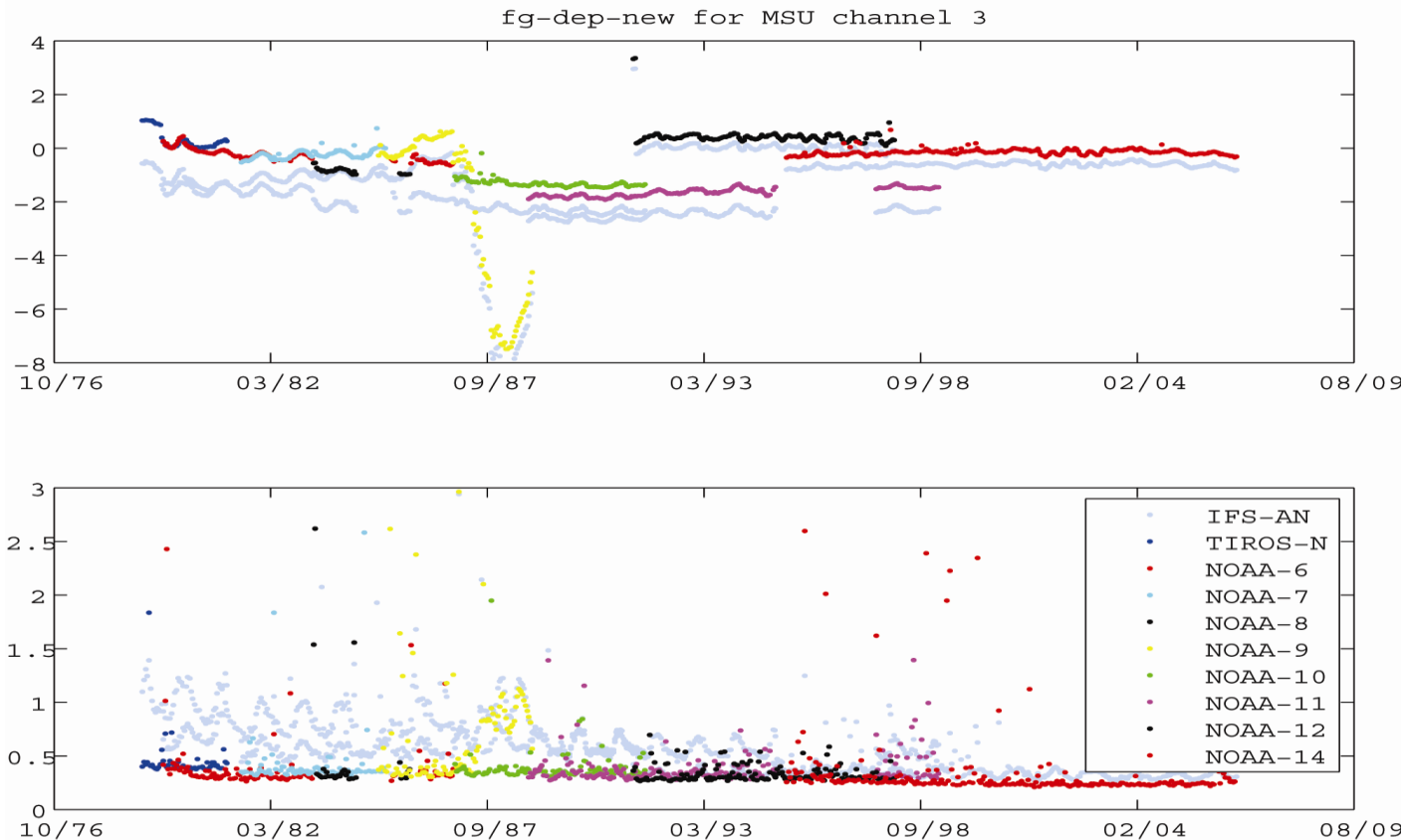
Mean bias  
improved by new  
PB estimate

# MSU CH3 (54.96 GHz): NOAA-6 to NOAA-14



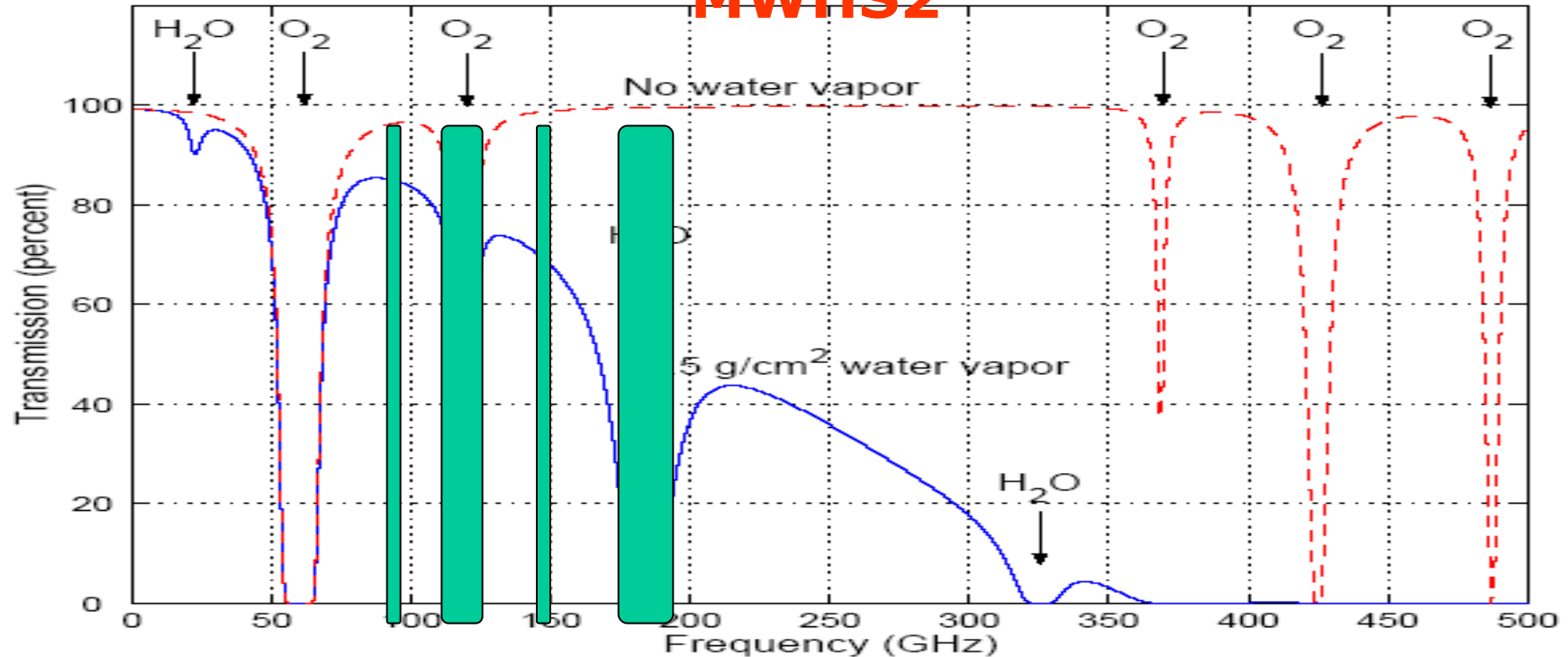
- **LbL modelling based on ERA-Interim fields**
- **1 cycle per month: 1979 -2011**

# Potential use in the operational ECMWF reanalysis

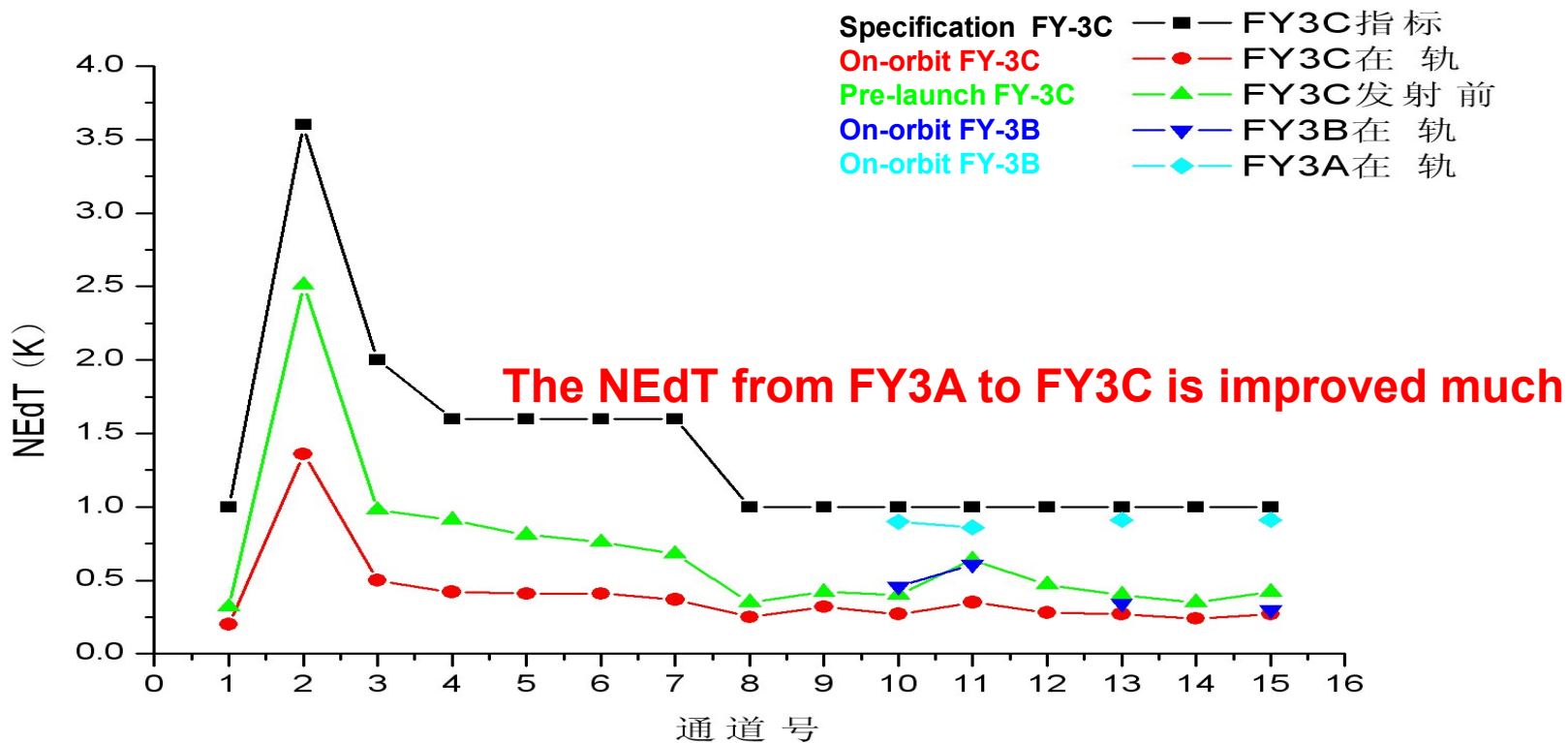


# Atmospheric Transmission at Microwave Wavelengths

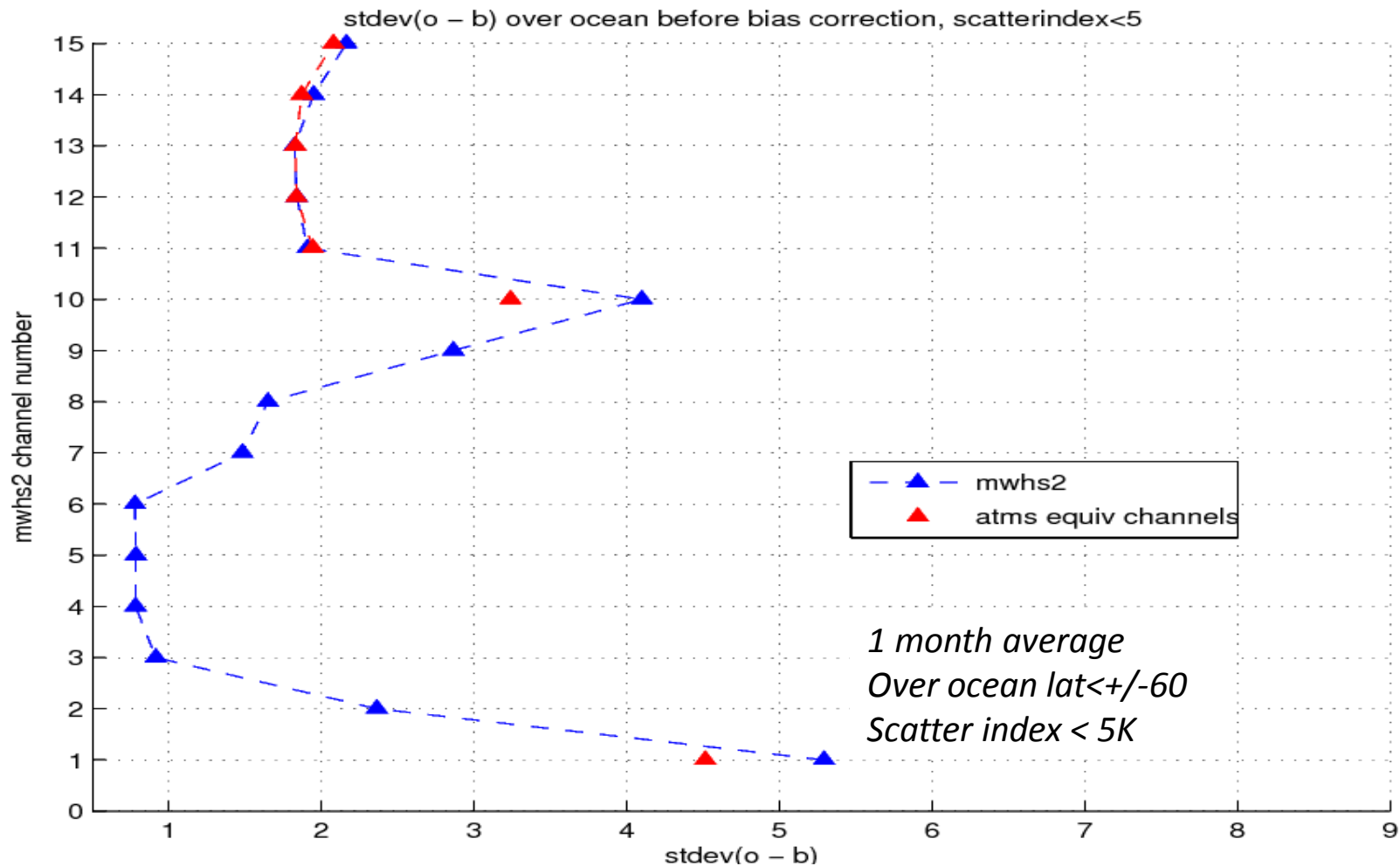
**MWHS2**



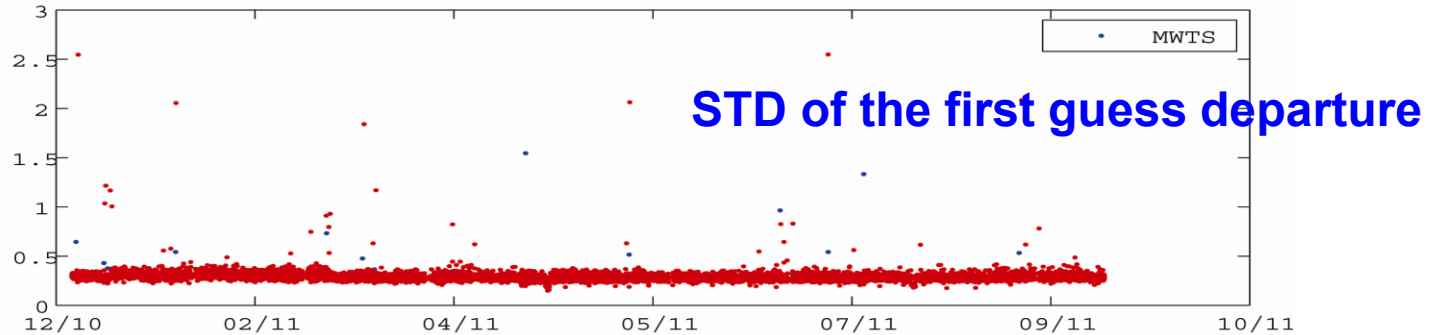
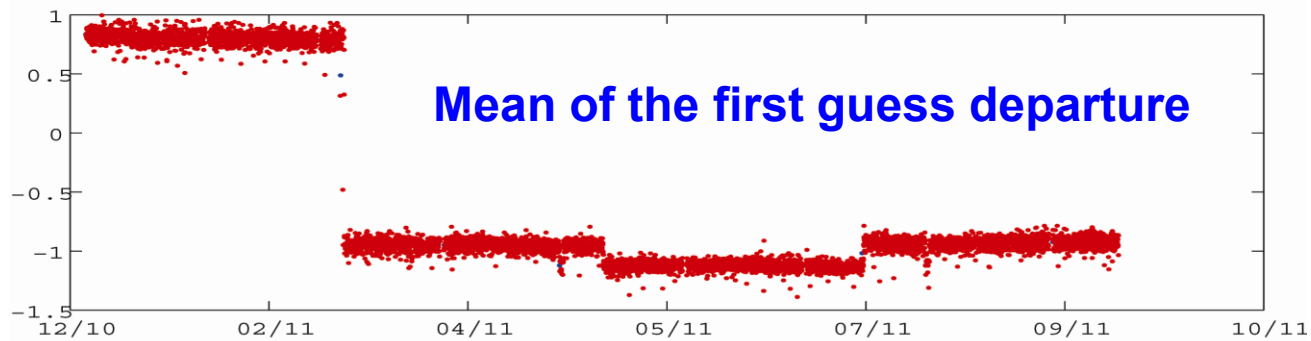
**The frequency dependence of atmospheric absorption allows different altitudes to be sensed by spacing channels along different absorption lines.**







# Statistics time series of first guess departure from FY-3B MWTS-CH3

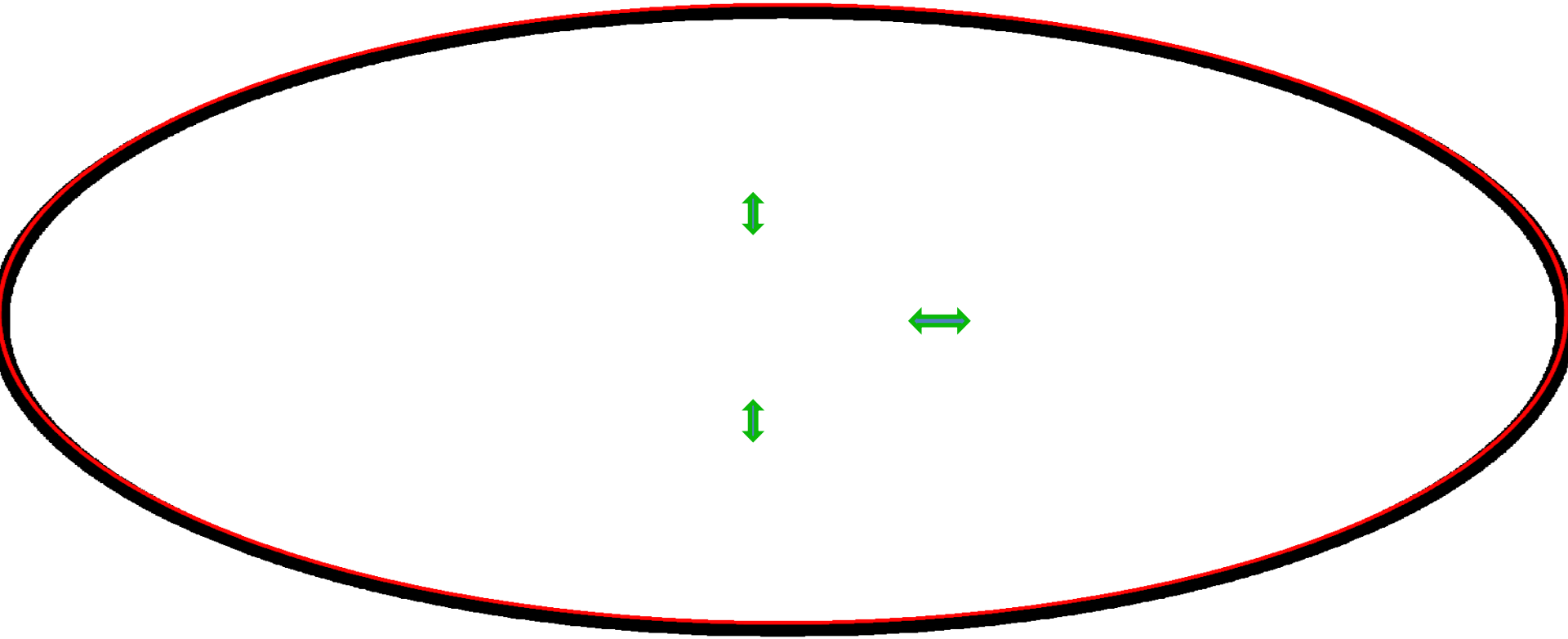


**We don't expect the spike for operation!**

# **Monitoring FY-3 sounders**

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

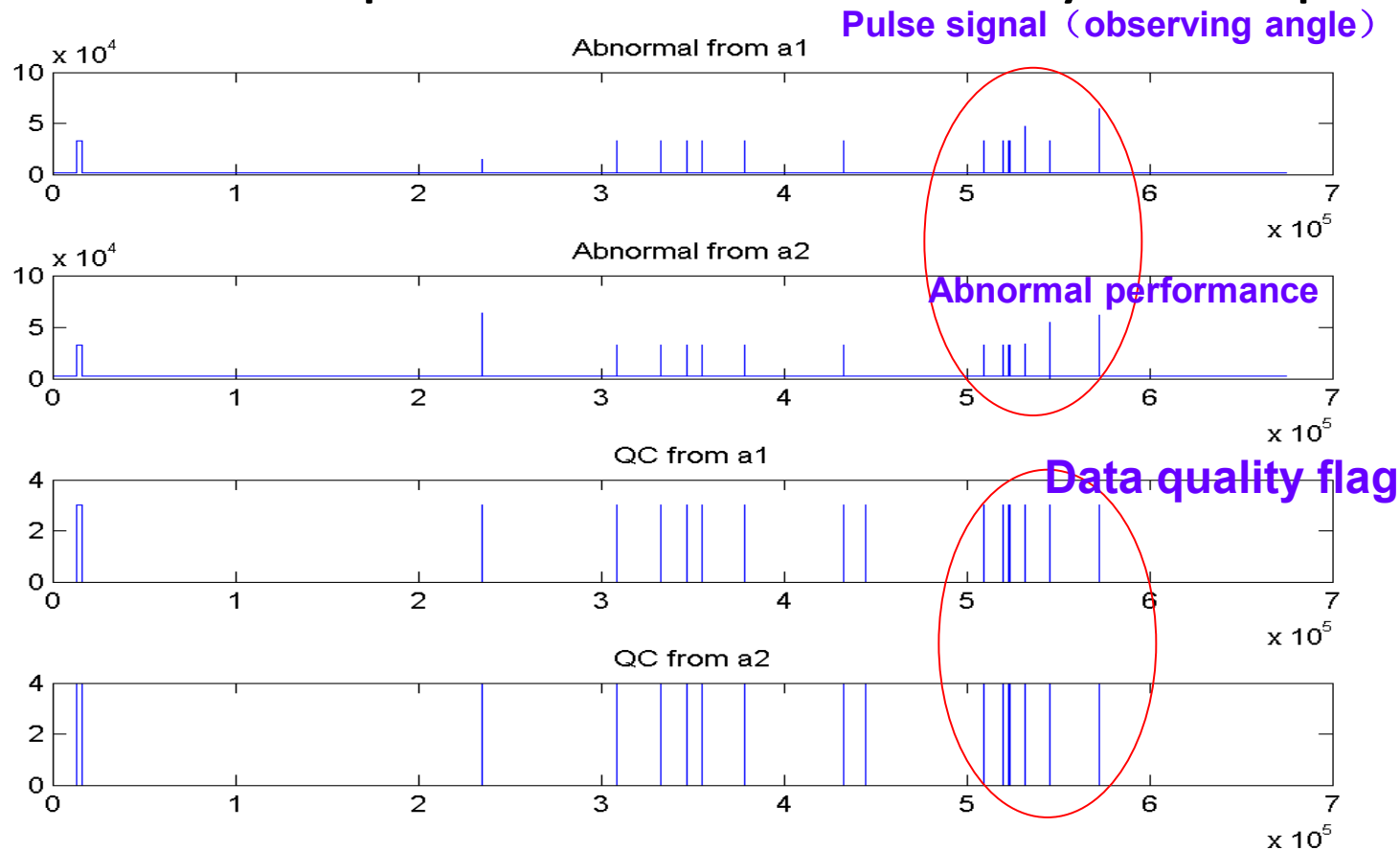
**Closer collaborations among NWP user, agency and manufacturer**  
--improve the misunderstanding and fill the gap from requirements



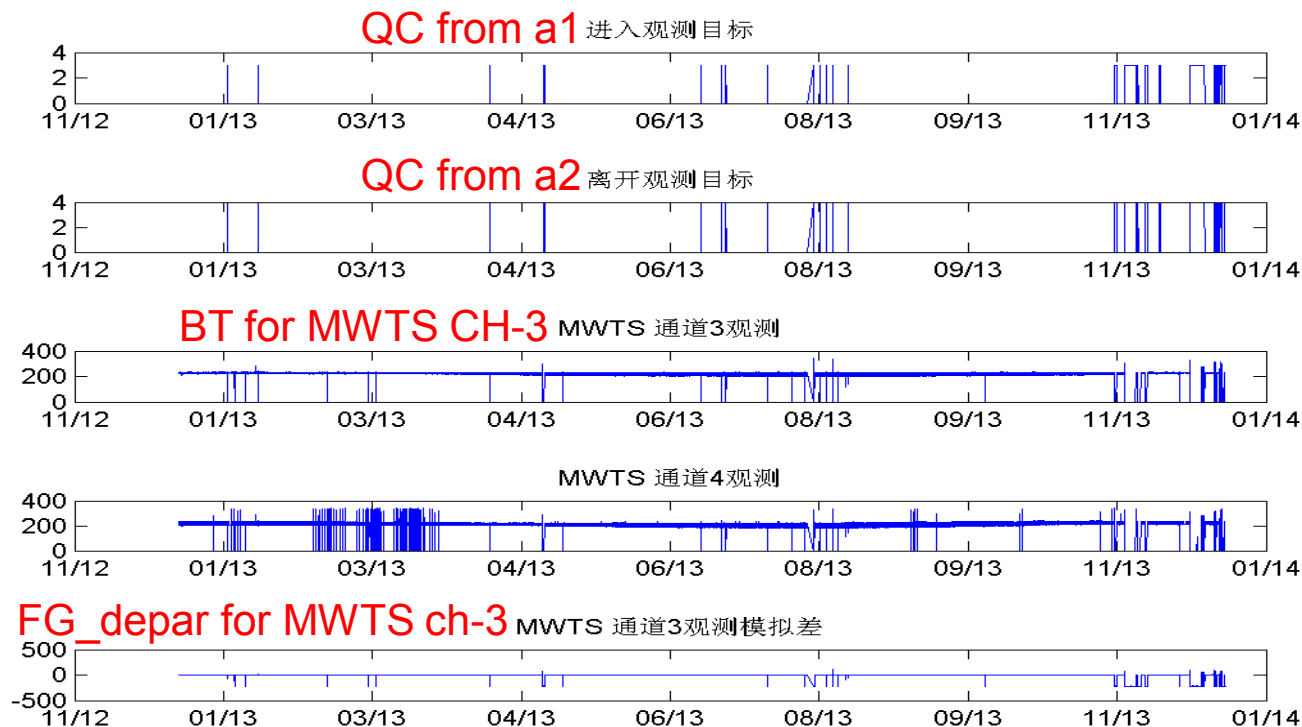
# Parameters indicating the data quality

- 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

# Abnormal instrument performance on-orbit can identify the data quality



# Abnormal instrument performance on-orbit can identify the data quality





**FY-3 data quality monitoring, bias diagnosis and correction system will be ready soon to support the operational assimilation through early anomaly warning**

Satellite

FY3C

Instrument

MWTS

Type

Global

Channel

Channel 1

Time

Latest

Submit

# Website interface

当前位置：首页 > 监测 > 监测参数

风云三号

风云二号

NOAA

FY-3C

FY-3B

FY-3A

## 仪器选择

GNOS >> VIRR >> IRAS >> MWTS MWHS >>  
MERSI >> SBUS >> TOU >> MWRI >> ERM >>  
SIM >> SEM >>

## 监测参数

### 质量信息

文件数

扫描线数

地理信息

时间码信息

### 遥测数据

### 科学数据

## 卫星介绍

## 仪器介绍

## 监测参数

### 亮温(OBSBTS)

- 一自然天内预处理系统生产的整轨文件个数

## 时间选择

☐ 最近3天 ☐ 最近一周 ☐ 最近一个月

通道：CHN01

测温点：全部

开始日期：2014-07-30

结束日期：2014-08-01

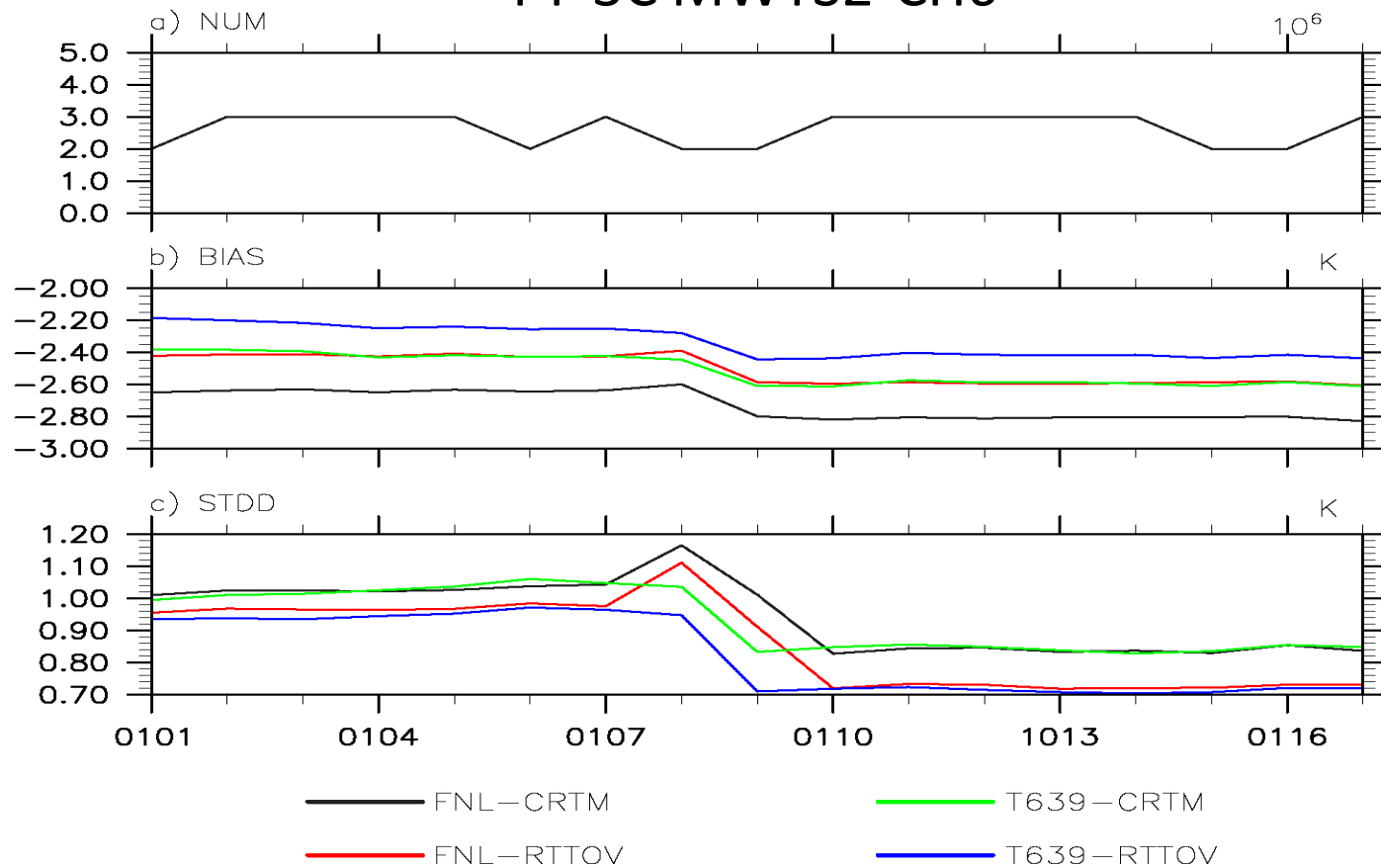
区域：全球

图的类型：空间分布

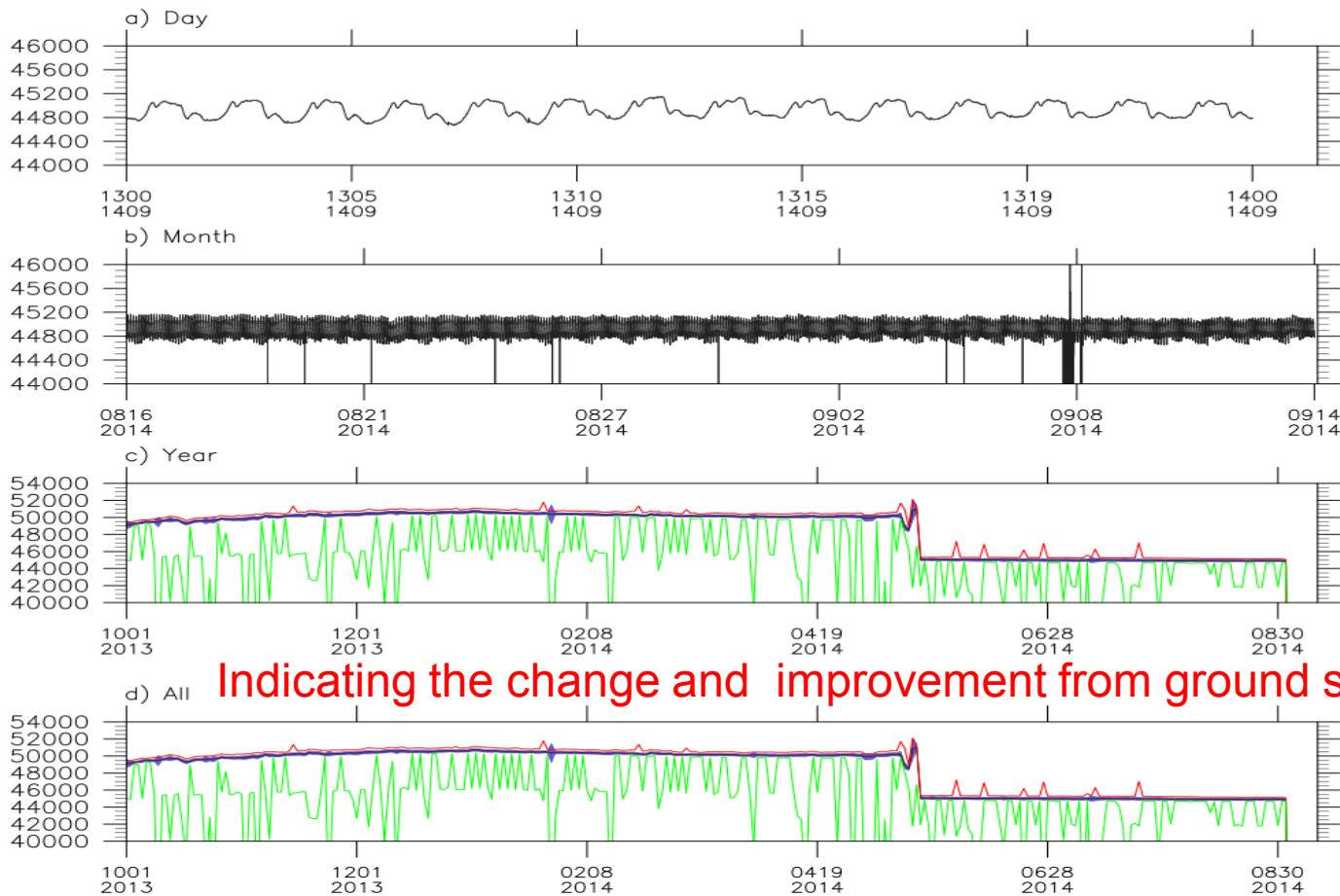
搜索



# FY-3C MWTS2-CH6



FY3C\_MWTS\_20140913\_0057\_TO\_20140914\_1600\_12H\_CH07\_HOT\_CN1



# Feedback-- NWP user, agency and manufacturer

- Data format: HDF and ODB(Oracle), ODB2 from ECMWF
- Satellite observations and feedback: plots and data

→ Identification by satellite

FY3A/B/C; FY-2 and FY-4; NOAA/MetOp

→ Identification by instrument

MWTS; MWHS, MWRI and IRAS, GNOS, AMSUA

→ Identification by data

Geometry; instrument, fg-depar metadata; quality flag; telemetry

NWP user: good data; agency and manufacturer: bad data

# Summary

- 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.