## FY-3 Data Quality and Assimilation in NWP

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## Outline

• Initial FY-3A data quality assessment at ECMWF

- (OBS Modelled T<sub>B</sub>) for FY-3A & comparison with MetOp & Aqua
- Initial Assimilation Experiments
- Characterising the FY-3A MWTS
  - Passband Uncertainties & Non-linearity Effects
  - Assessment in the ECMWF Model & CMA Grapes Model
  - Improved Assimilation of MWTS
- Initial Assessment of FY-3B



### Initial Data Quality Assessment at ECMWF: 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' (OBS 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 ~0.1K level for temperature sounders (MWTS and IRAS), sensitivity slightly lower for MW humidity sounders & imagers (~0.5K)
- Similar work ongoing at NOAA/NCEP, UK Met Office and DWD



#### Initial Data Quality Assessment at ECMWF: Comparison of FY-3A with MetOp & Aqua



### Initial Data Quality Assessment at ECMWF: Assimilation Experiments





### **Characterising the FY-3A MWTS: Detecting and Correcting passband errors and Non-linearities**



First Guess Departures (K)

#### **Pre-launch measured passband**

#### **Optimised passband**

- from line-by-line modelling
- uncertainties of ~32-55 MHz detected and corrected

#### Non-linearity corrected

#### **AMSU-A** equivalent



#### **Characterising the FY-3A MWTS: Radiometer Non-linearity**





#### **Characterising the FY-3A MWTS:** Assessing corrections in the CMA-GRAPES model



## $\rightarrow$ the corrections, developed at ECMWF, improve the (OBS-GRAPES\_MODEL) fits.



#### **Characterising the FY-3A MWTS: Comparison with AMSU-A**



The passband and non-linearity corrections bring the data close to AMSU-A quality



### **Characterising the FY-3A MWTS: Comparison with AMSU-A**



### **MWTS OSEs Forecast Verification:** Z at 200, 500 and 700 hPa

Normalised differences in RMS Errors in Z, verified against own analysis 90% confidence intervals shown

## Small improvements in SH in going from:

original data

- → recalibrated (low weight)
- → recalibrated (high weight)

NH close to neutral with some benefit in recalibrated data



### Improvement due to MWTS data

**PRELAUNCH\_MWTS** (full system + original MWTS data)

HIOBSERR\_MWTS (Full system + optimised MWTS with low weight)

LOWOBSERR\_MWTS

(Full system + optimised MWTS with high weight)



#### **MWTS: current status**

# Ground system changes implemented at CMA, March 2011



## **Initial FY-3B Evaluation**



#### FY-3B MWTS FG Departure Channel 3: 54.072 GHz

 Correction of passband measurement bias and radiometer non-linearity has been implemented in pre-processing at **NSMC/CMA** 

 No significant problems with the MWTS-2 and -3 observations

 Cross scan bias is dominant & accounts for non-gaussian FG departures (corrected by variational bias correction scheme):

> After VarBC STDEV(O-FG) = 0.17 K





#### **FY-3B MWHS FG Departure**



#### Scan bias is improved compared with FY3A MWHS



#### FY-3B IRAS FG Departures: Comparison with NOAA & MetOp sensors



- orbital bias is improved relative to FY-3A IRAS
- occasional abnormal points evident



#### **FY-3B MWRI** vs **AMSR-E FG Departure statistics prior to VarBC**



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#### **Summary**

- FY-3A data has been evaluated at ECMWF through a comparison with simulated radiances & full assimilation experiments in which FY-3A data is introduced in the ECMWF system.
- > A detailed study of the FY-3A revealed, and corrected, biases in MWTS related to :
  - Uncertainties in the passband centre frequencies
  - Radiometer non-linearities
- These corrections bring the MWTS data close to the quality of equivalent AMSU-A data & in assimilation experiments this MWTS data delivers improvements in forecast accuracy.
- > Initial assessment of FY-3B suggests the data is comparable with its counterpart.
- The high values of NWP in Cal/Val of new satellite sensors has been clearly demonstrated – further improvements in FY-3A and FY-3B data are expected, and it is hoped NWP will again play a crucial role for FY-3C, .... FY-3G !

