

Evaluating and Assimilating China's FY-3C MWHS-2 instrument in All-Sky conditions at ECMWF

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Outline

- Background: Microwave Humidity Sounders at ECMWF
- FY-3C MicroWave Humidity Sounder -2 (MWHS-2) Instrument
- Assessing Data Quality
- Assimilation Trials in the All-Sky framework
- Summary: Results and ongoing work

Background: Microwave Humidity Sounders at ECMWF

6 Instruments are assimilated operationally:

- 4 MHS instruments: MetOp-A, MetOp-B, NOAA-18, NOAA-19
- Suomi-NPP ATMS
- **FY-3B MWHS: Operationally assimilated from September 2014**

Keyi Chen, Poster 1p.02

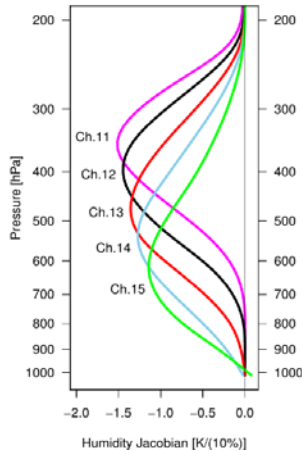
Clear-sky to All-sky:

- 4 MHS instruments moved to All-Sky assimilation in 2015

Alan Geer, et al, Tech Memo 741

FY-3C MWHS-2: Channels

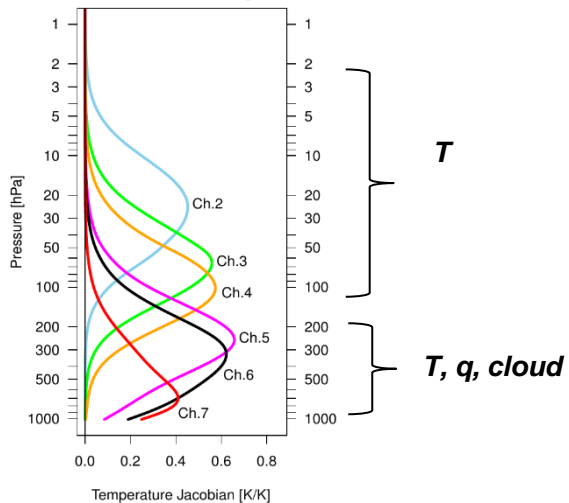
183 GHz humidity Jacobian



5 183 GHz Channels (channels 11 – 15):

- Same frequencies as **MHS** (3 channels), **ATMS** (5 channels)

118 GHz Temperature Jacobians



8 118 GHz Channels (channels 2 – 8):

- **Temperature** – Oxygen band
- **Humidity** – Water vapour continuum
- **Cloud sensitive** – scattering, emission/absorption
- Higher noise than instruments at 53 GHz (AMSU-A)

+ 2 window channels (89, 150 GHz, channels 1, 10)

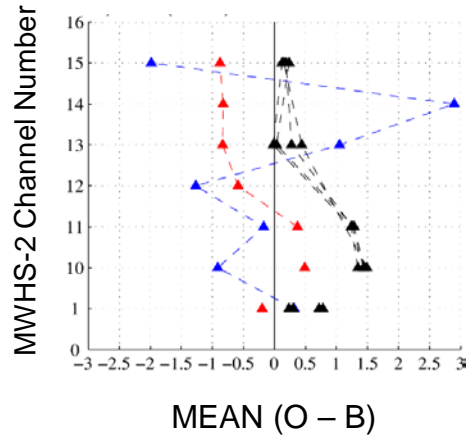
1. Assess Data Quality

- Compare Observations(O) to NWP model background (B)
- Compare O – B statistics to similar instruments

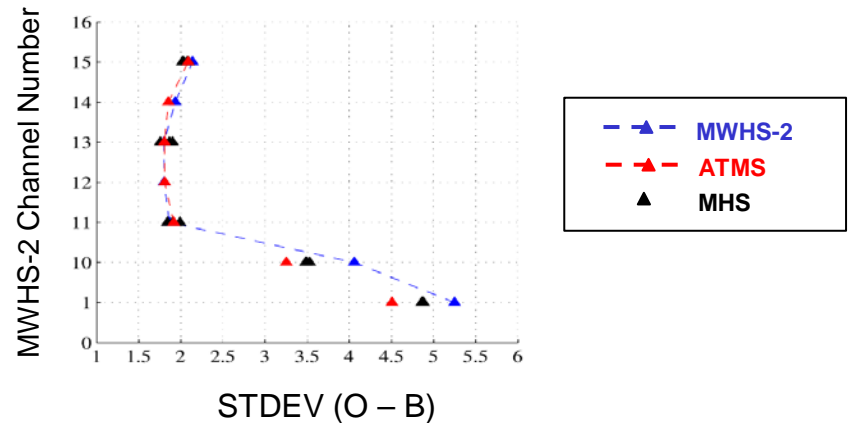
FY-3C MWHS-2 Data Quality

183 GHz: Compare background departure (O – B) statistics to ATMS and MHS:

MEAN(O – B) 1 month, ocean, cloud-filtered

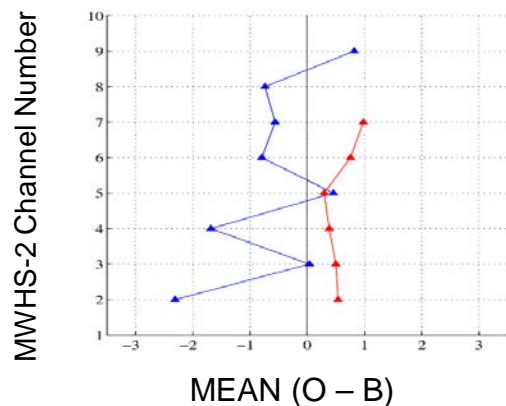


STDEV(O – B) 1 month, ocean, cloud-filtered

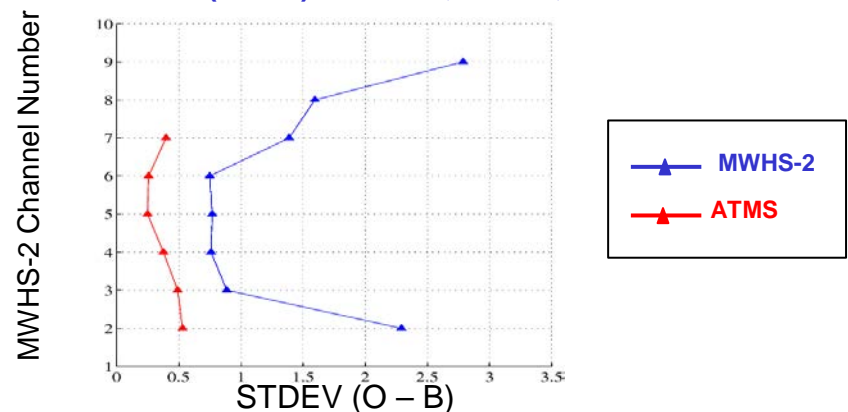


118 GHz: Compare background departure (O – B) statistics to ATMS (53 GHz):

MEAN(O – B) 1 month, ocean, cloud-filtered



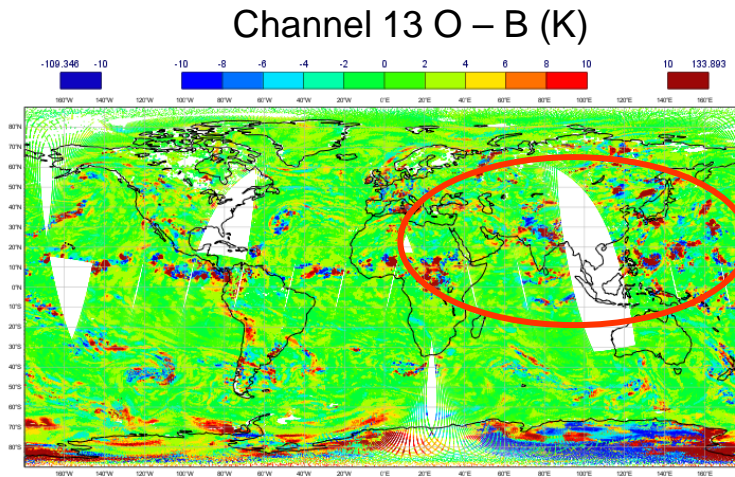
STDEV(O – B) 1 month, ocean, cloud-filtered



2. Assimilation Trials: All-sky Assimilation

MWHS-2: All-Sky assimilation

- Keep cloud-affected data
- Apply a radiative transfer forward model with cloud effects: RTTOV-SCATT



Cloud in background and observations

- Apply higher observation errors in cloudy regions

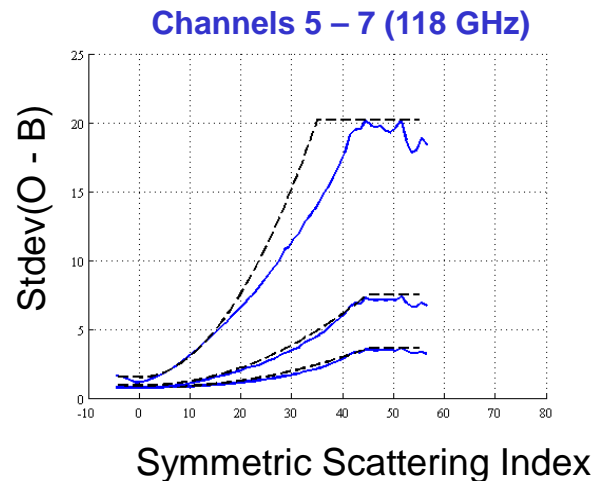
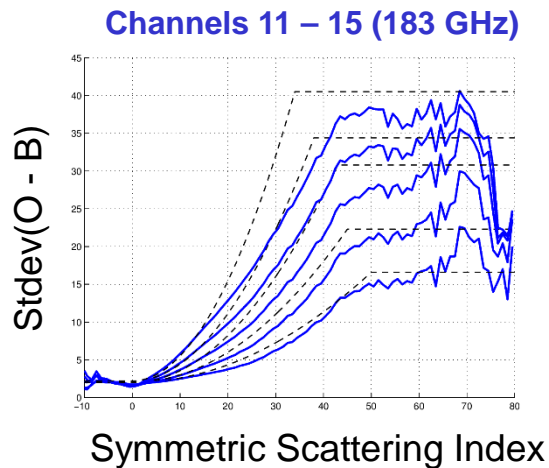
MWHS-2: MHS-like Observation Errors

Cloud Predictor: Use the symmetric scattering index calculated from window channel observations

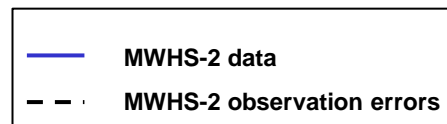
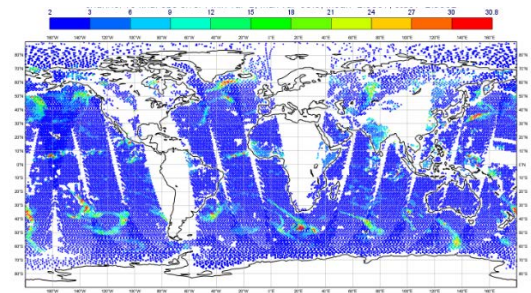
$$SI = (TB_{90GHz} - TB_{150GHz}) - (FG_{90GHz}^{clr} - FG_{150GHz}^{clr})$$

$$C_{sym} = (SI_{FG} + SI_{OB})/2$$

Use a quadratic Model (MHS-like):



Observation Error Map:



MWHS-2 Assimilation Trial Experiments

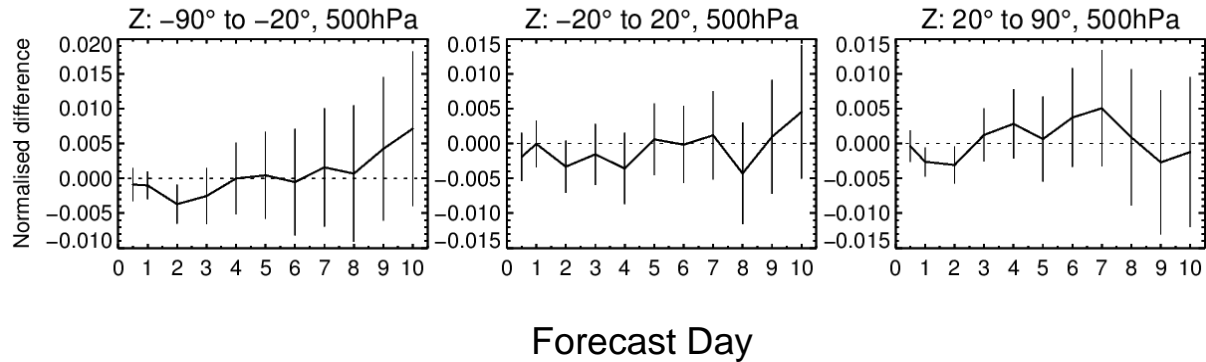
- Control Experiment
- Assimilate MWHS-2 183 GHz globally in all-sky (5 channels)
- Assimilate MWHS-2 118 GHz channels over ocean in all-sky (6 channels)

6 months experimentation, Resolution T511, or T639
(137 model levels), Cycles 41R1 or 42R1

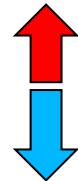
Results: All-sky assimilation of 183 GHz channels

Forecast Scores (41R1 T511 6 months):
June – November 2014

Z 500hPa



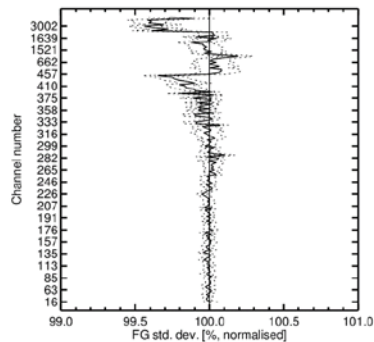
+ve values =
degradation



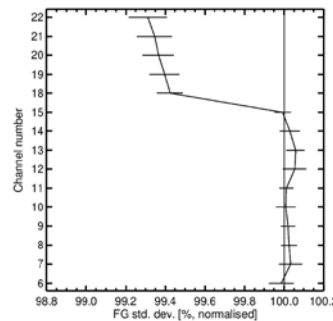
-ve values =
improvement

Fits to Other observations : Normalised STDEV(O – B)

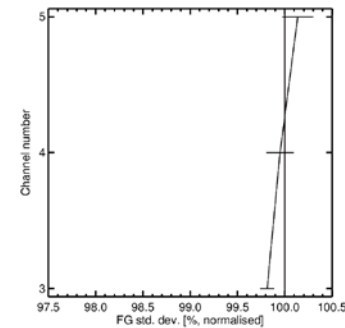
IASI Global



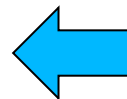
ATMS Global



MHS Global



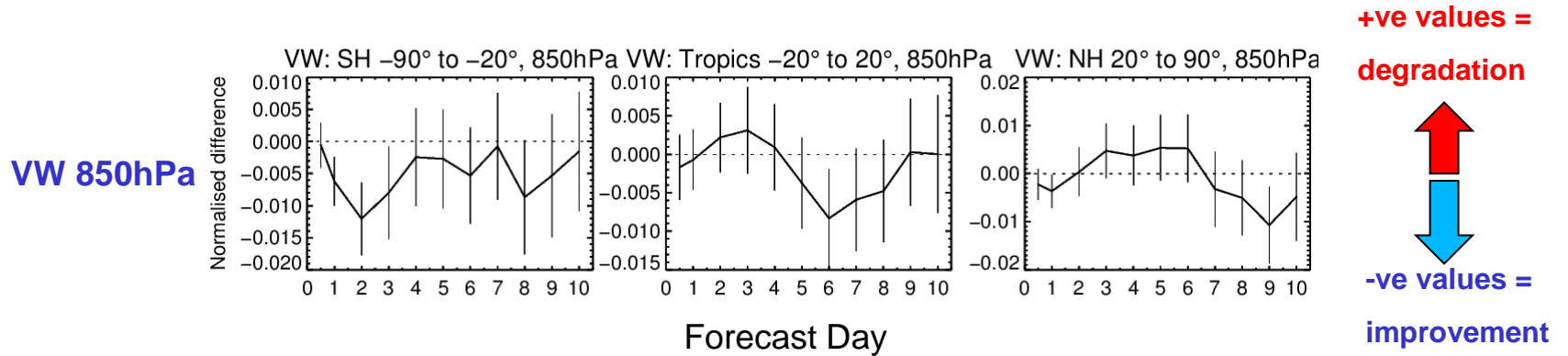
< 100% = improvement



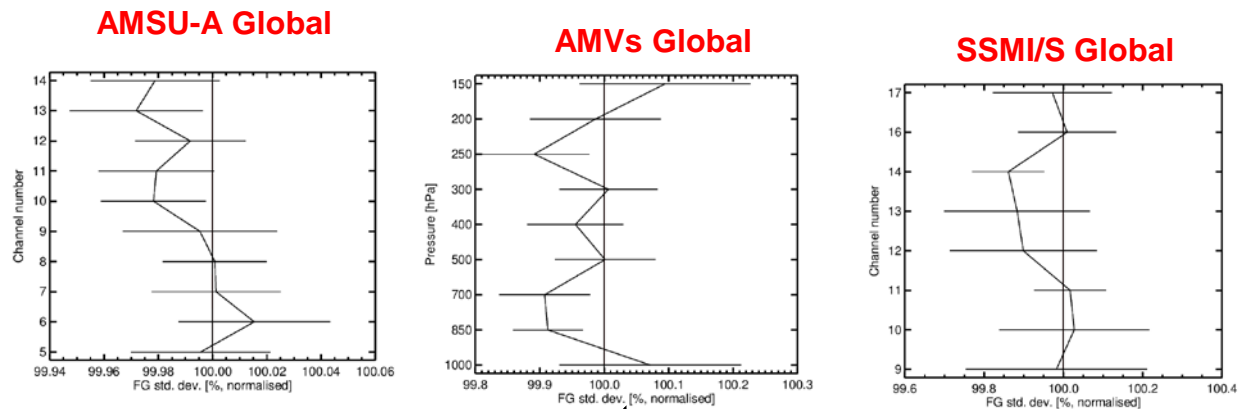
Results: All-sky assimilation of 118 GHz channels

Forecast Scores (42R1 T639 6 months):

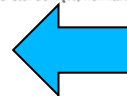
June – August 2014, December 2014 – February 2015



Fits to Other observations : Normalised STDEV(O – B)



< 100% = improvement



Summary

China's FY-3C MWHS-2:

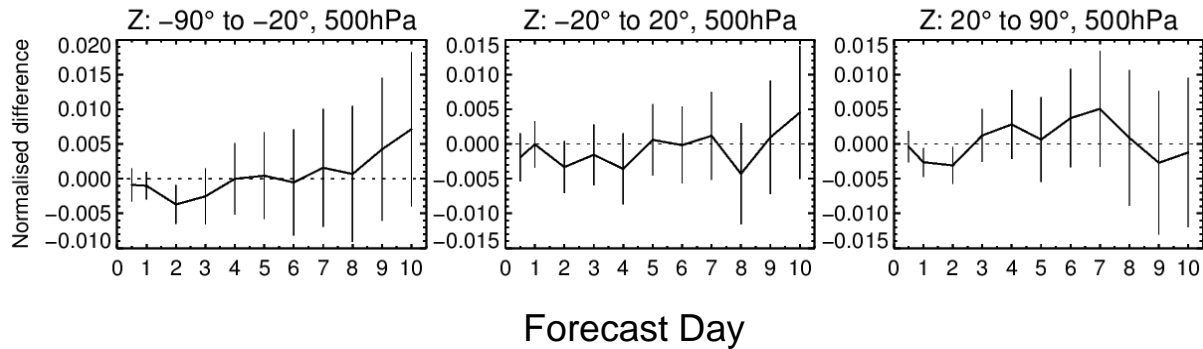
- MWHS-2 data quality looks good, similar to ATMS, MHS
- 183 GHz channels can be assimilated in all-sky with some benefits to short-range forecast accuracy
- 118 GHz channels assimilated in all-sky indicate some small improvements in short-range forecast accuracy
- Aim to activate MWHS-2 183 GHz channels
- Ongoing work to understand the 118 GHz channels

Extra Slides...

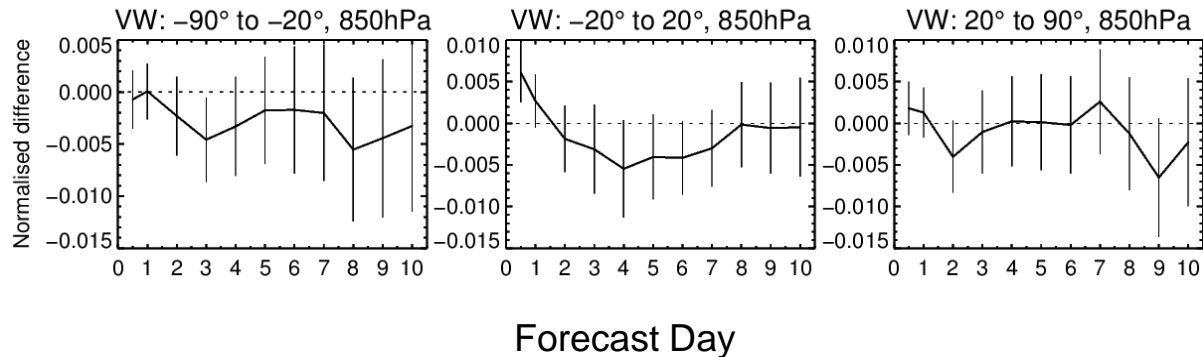
Results: All-sky assimilation of 183 GHz channels

Forecast Scores (41R1 T511 6 months):
June – November 2014

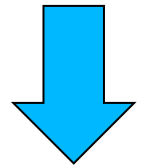
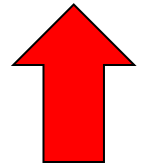
Z 500hPa



VW 850hPa



+ve values =
degradation

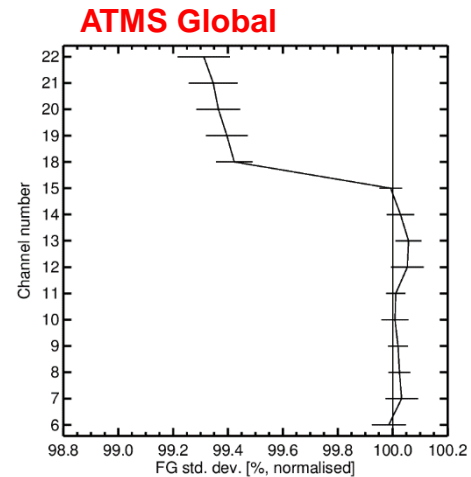
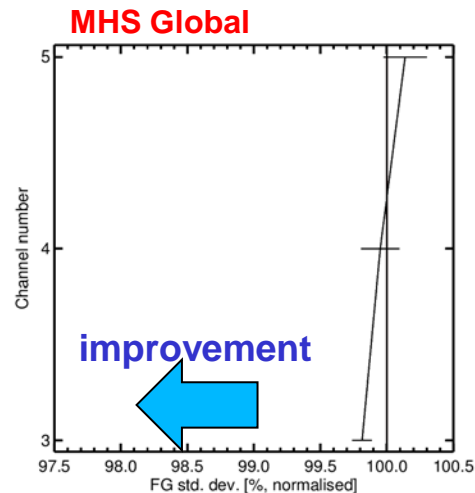
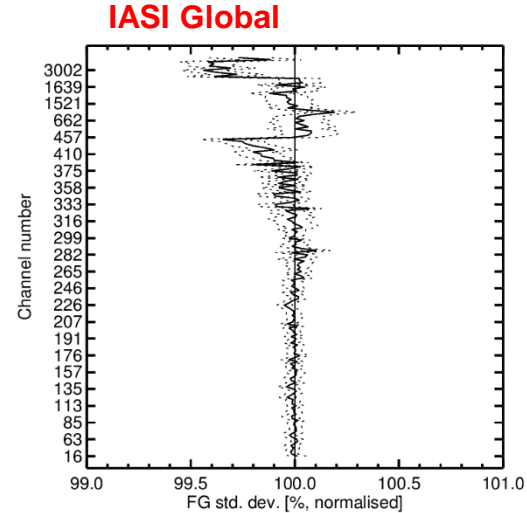
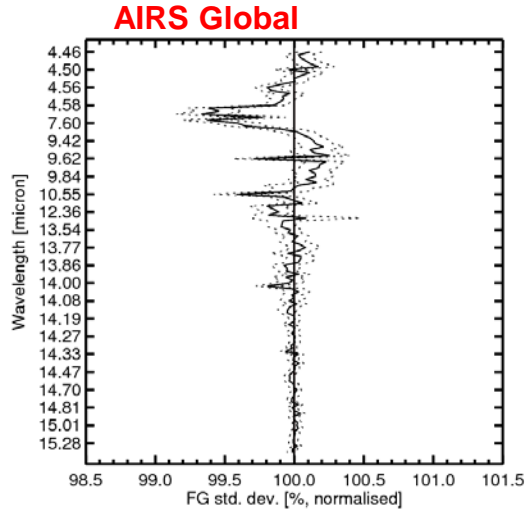


-ve values =
improvement

Results: All-sky assimilation of 183 GHz channels

Fits to other observations: Normalised STDEV(O - B)

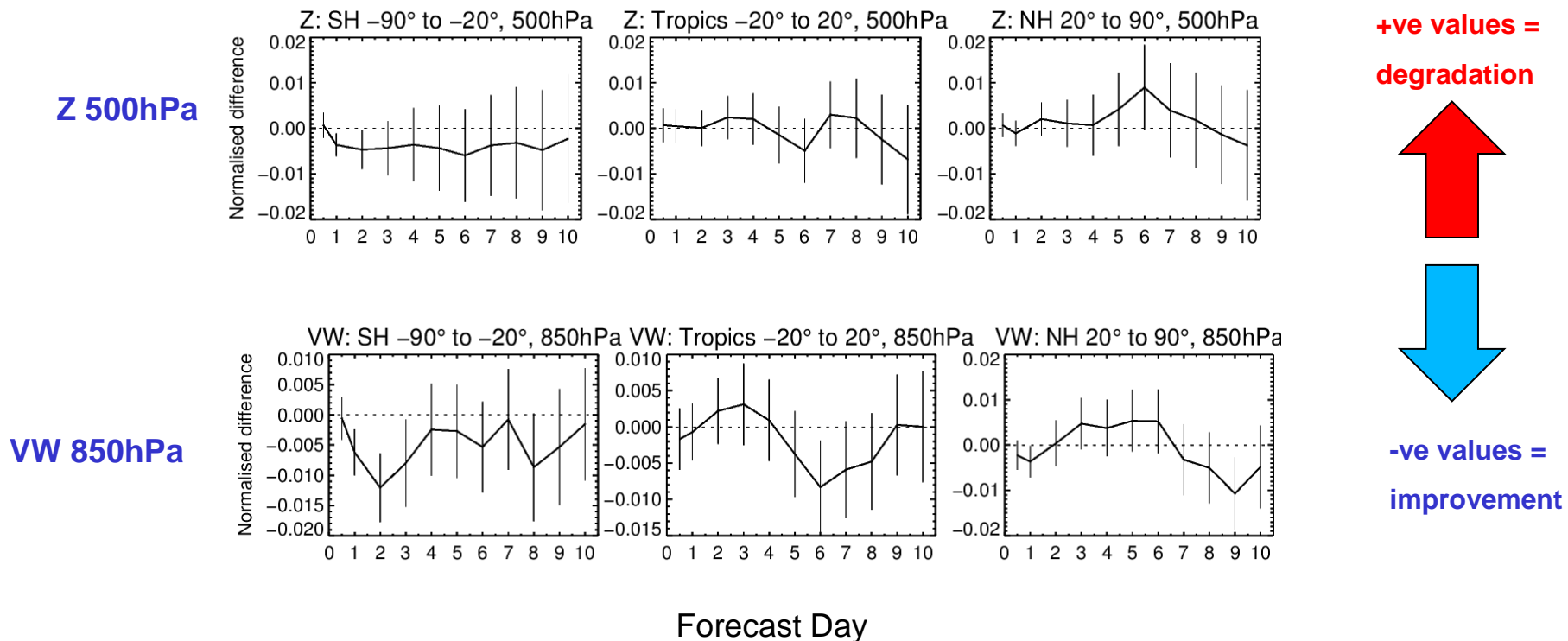
GLOBAL
6 months



Results: All-sky assimilation of 118 GHz channels

Forecast Scores (42R1 T639 6 months):

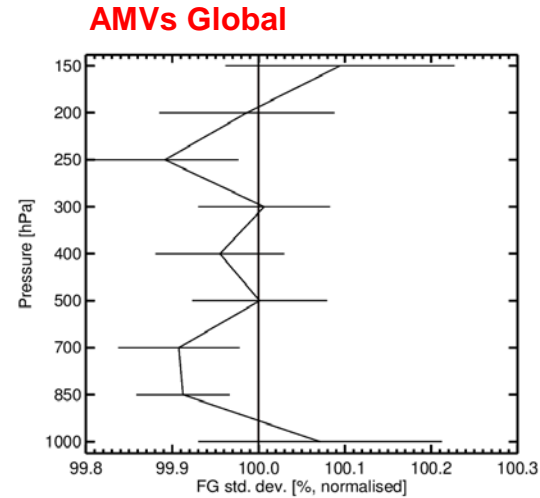
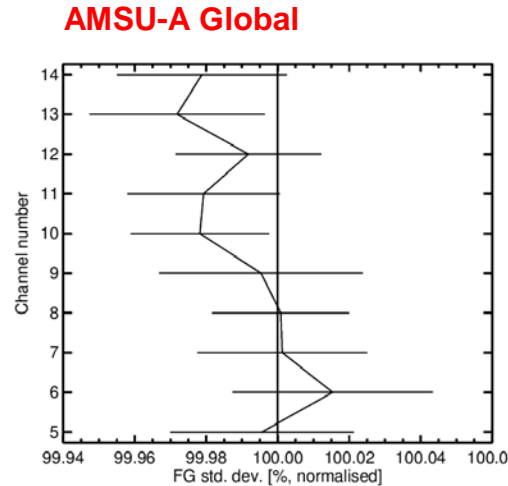
June – August 2014, December 2014 – February 2015



Results: All-sky assimilation of 118 GHz channels

Fits to other observations : Normalised STDEV(O – B)

Clear-sky Instruments
Temperature, wind...



All-sky Instruments
Cloud, humidity...

