An Assessment of SSMIS Imager Data

Bill Bell, Alan Geer, Peter Bauer

ECMWF, Reading

Steve Swadley

NRL, Monterey

Outline

- Introduction
  - UPP SSMIS Data
  - All-sky assimilation of MW imager data
  - F16 & F17 coverage / first guess departures
- Assimilation Experiments
  - Configuration
  - Scores
  - Fits to other observations
- Ascending / Descending biases
- Summary

UPP / 'All-Sky' assimilation scheme

- **Unified Pre-Processor (UPP) for F16 / F17**
  - Reflector emission correction
  - Gain correction for intrusion affected scan lines
  - All channels remapped to 50GHz channels
  - No averaging

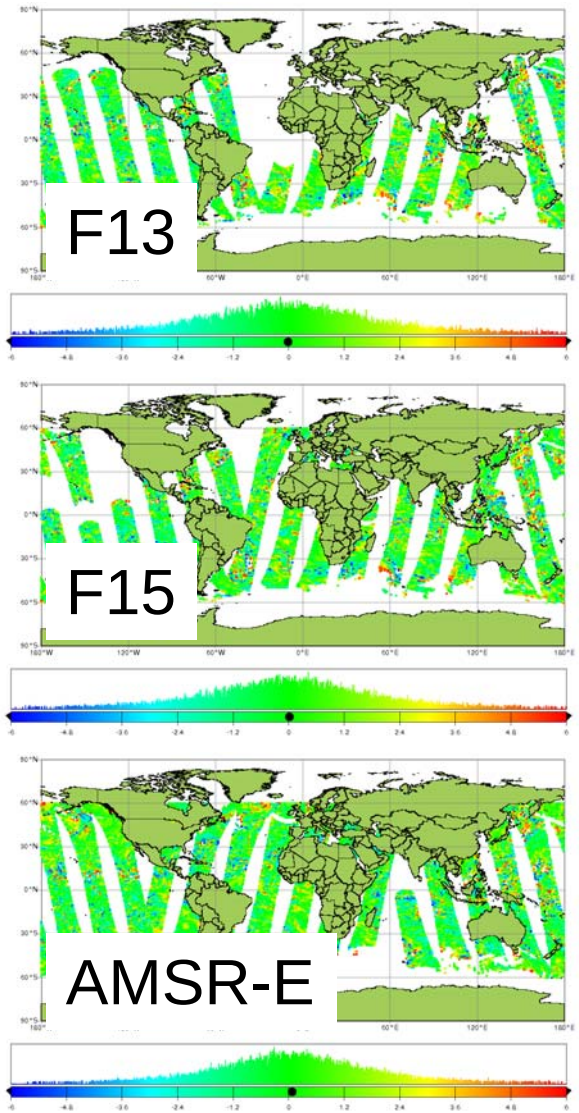
see : Steve Swadley presentation 3.1 / Anna Booton poster 7.36

- **'All-Sky' Assimilation of MW Imager Data**
  - Direct 4D-Var assimilation of all-sky radiances
  - Moist physics in inner loop and scattering RT model
  - Operator operates at model grid points
  - State dependent observation errors
  - Radiances super-obbed to match final inner loop resolution (T255)

see: Peter Bauer poster 7.33

ECMWF Tech Memos 618, 619, 620 by Alan Geer & Peter Bauer, April 2010

Coverage: SSMI, AMSR-E and SSMIS



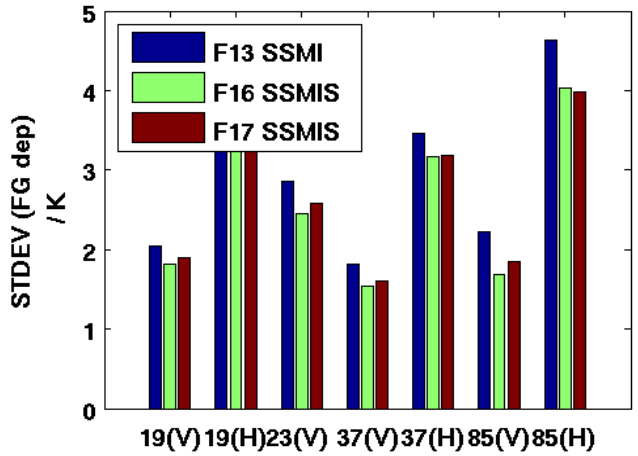
First Guess departures for 19 GHz (V pol) shown

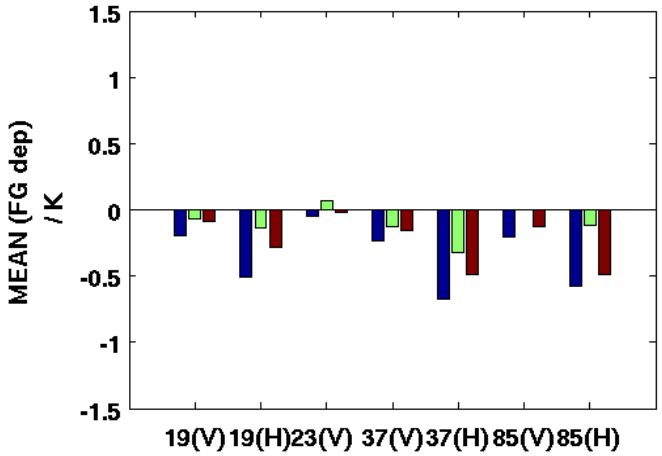
- Wider swath of SSMIS (1700km) compared to SSMI(1400 km) gives near complete coverage in a 12-hour assimilation window

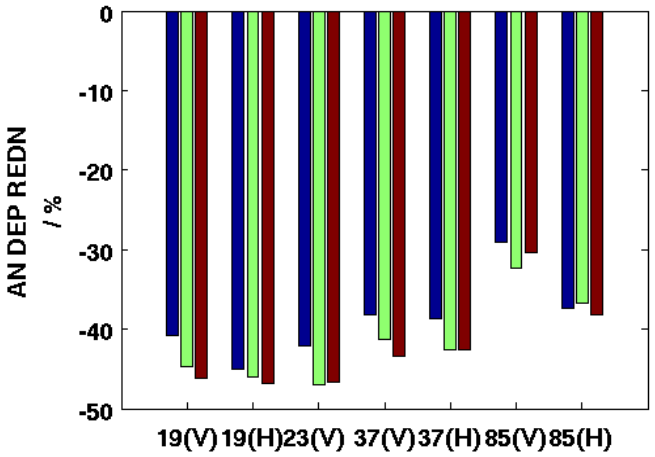
- No obvious problems from initial inspection of FG departures

ECMWF

First Guess Departures







- Based on clear-sky processing 20-30th August 2009.

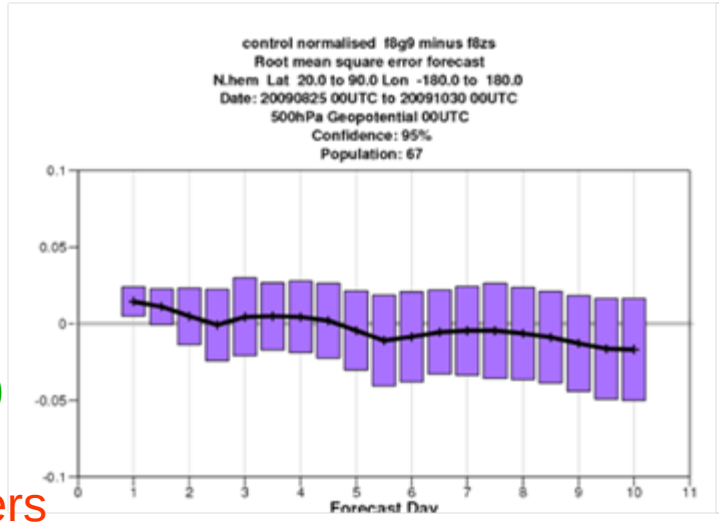
- F16 & F17 SSMIS data of similar quality to F13 in SSMI-like window channels.

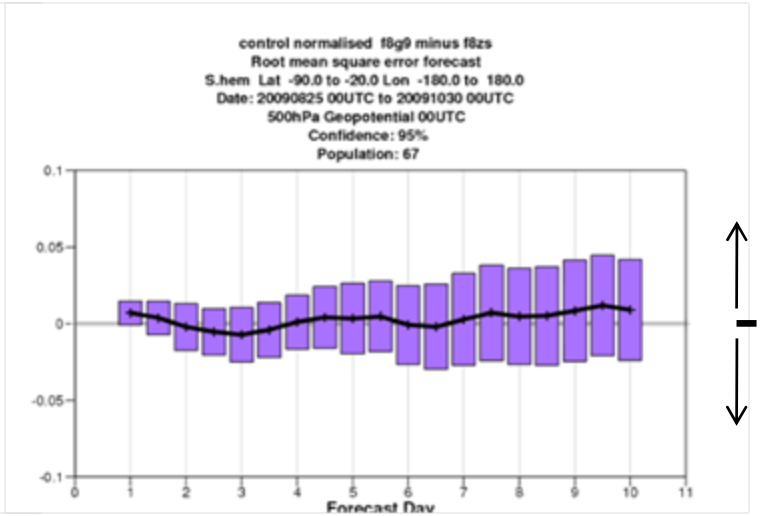
Assimilation Experiments

- T799 CY36R3
- 19th August – 30th October 2009
- Three Experiments (full observing systems):
  - No Imagers
  - All-Sky-New (includes F13 + F15 + AMSRE)
  - All-Sky-New+ UPP F16 & F17 SSMIS

Scores : Z500 RMSE

All-Sky (SSMI+ AMSR-E) against No imagers

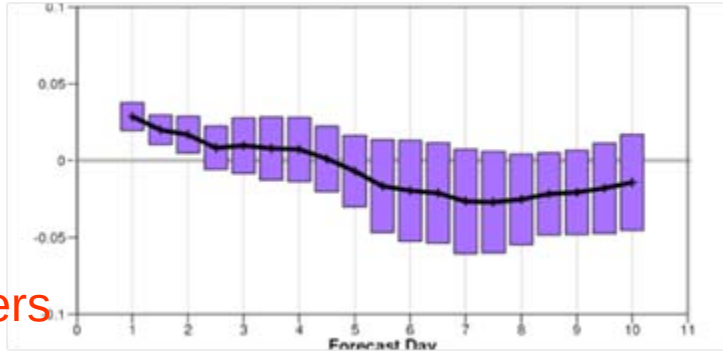


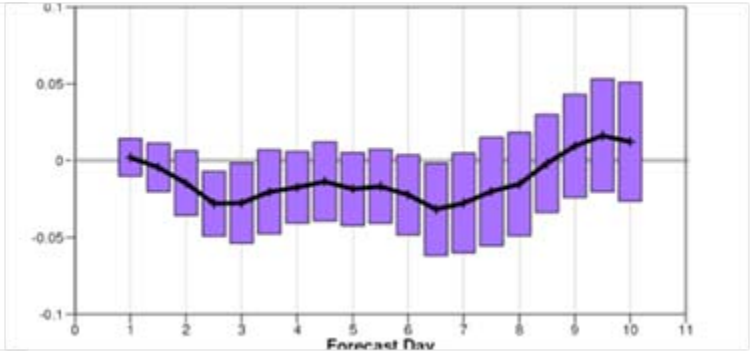


Imagers improve forecast

Imagers degrade forecast

All-Sky + SSMIS against No imagers



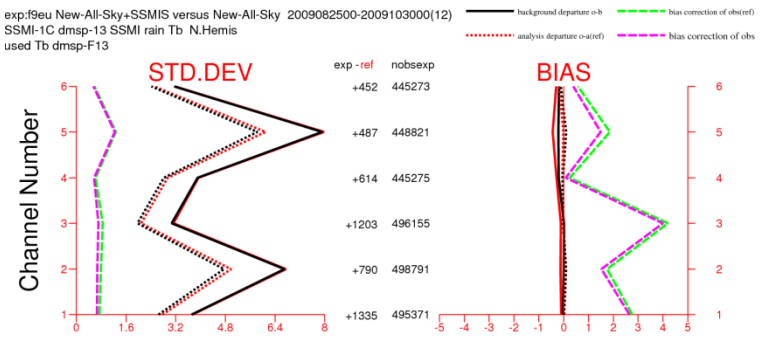


Northern Hemisphere Southern Hemisphere

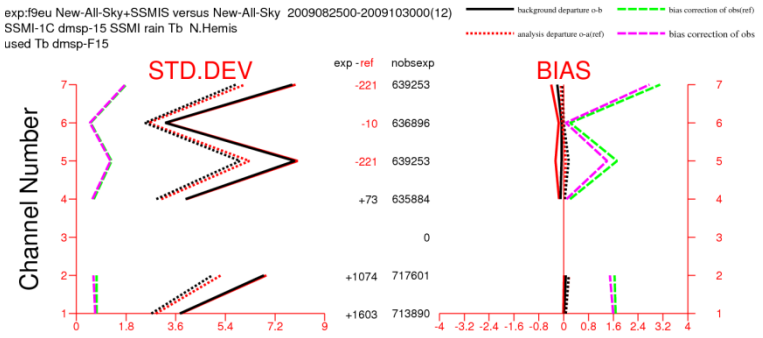
ECMWF

Improved FG fit to other MW Imagers

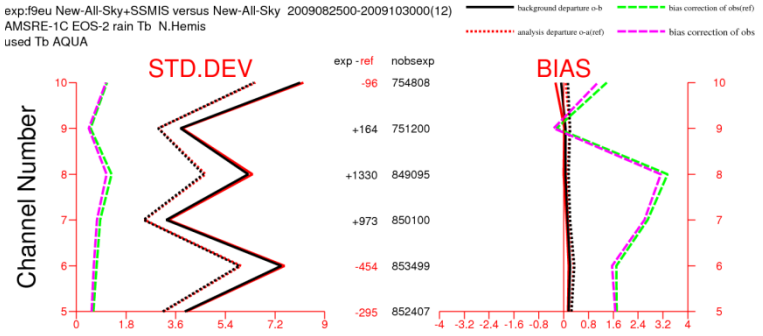
F13 SSMI



F15 SSMI



AMSR-E



(Northern Hemisphere)

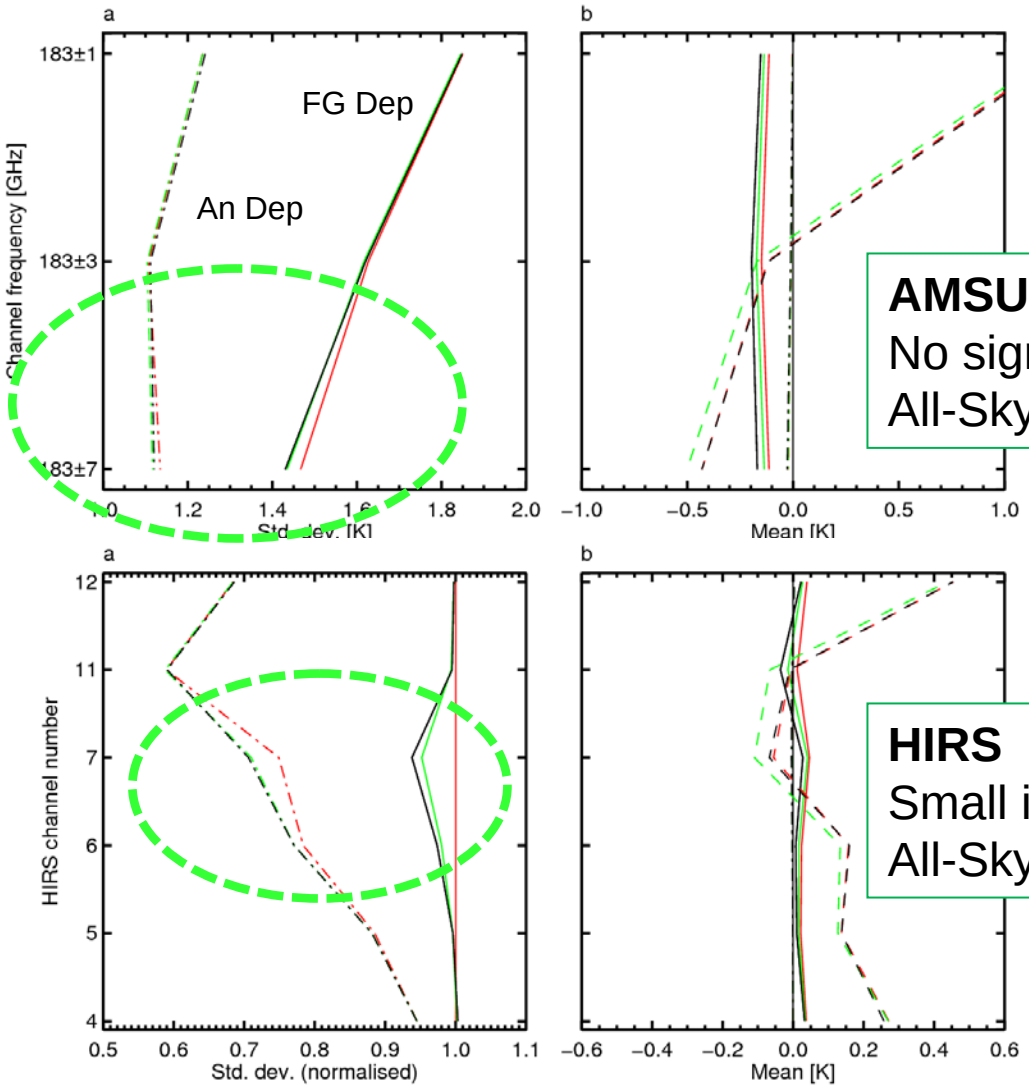
Orange line = ‘New All-Sky’ (includes SSMI & AMSR-E)

Black line = ‘New All Sky’ + SSMIS

(dotted = analysis departure solid = FG departure)

ECMWF

Improved FG fit to other observations



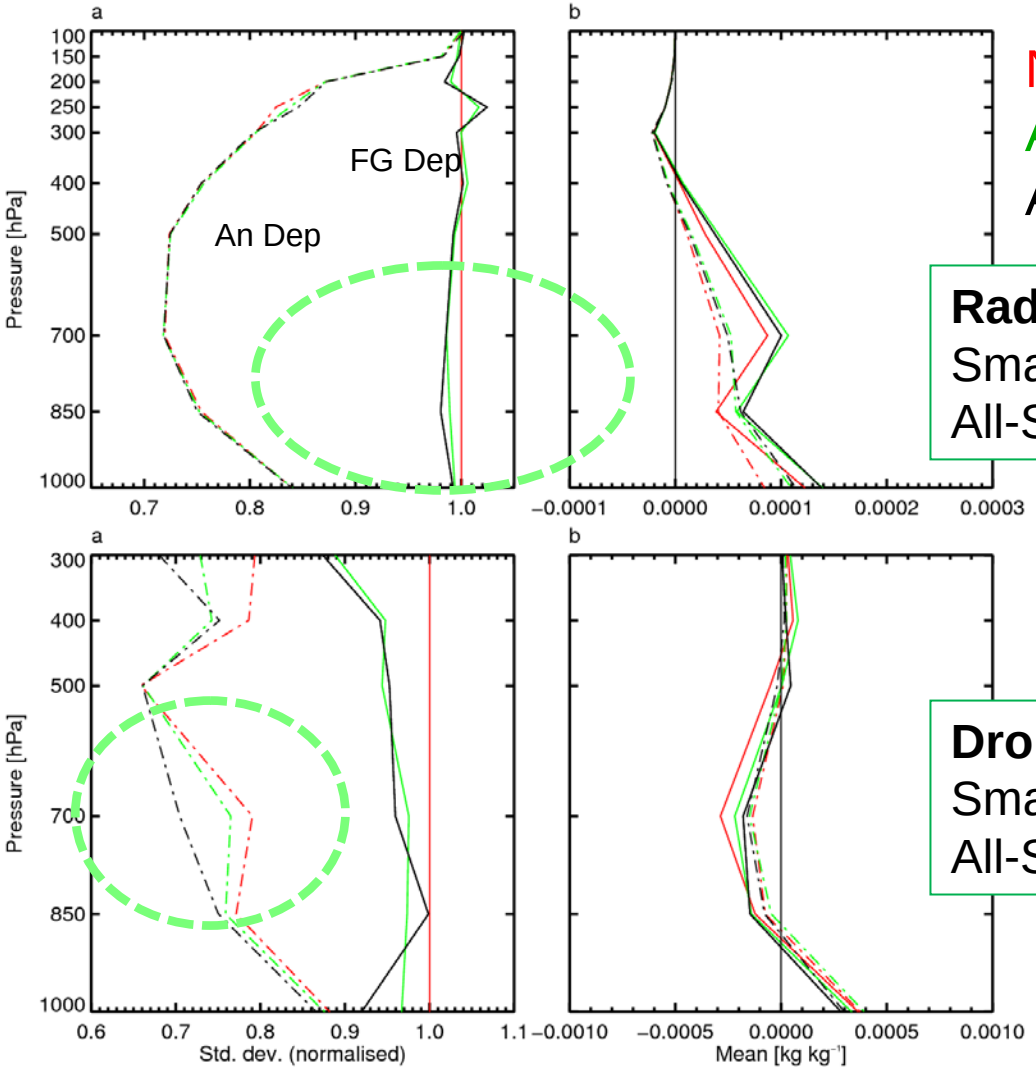
No imagers
All-Sky-New (SSMI + AMSRE)
All-Sky-New +SSMIS

AMSU-B / MHS
No significant improvement over
All-Sky-New (includes SSMI and AMSR-E)

HIRS
Small improvement over
All-Sky-New including SSMI and AMSR-E

ECMWF

Improved FG fit to other humidity sensitive observations



No imagers

All-Sky-New (SSMI + AMSRE)

All-Sky-New +SSMIS

Radiosondes

Small improvement over
All-Sky-New including SSMI and AMSR-E

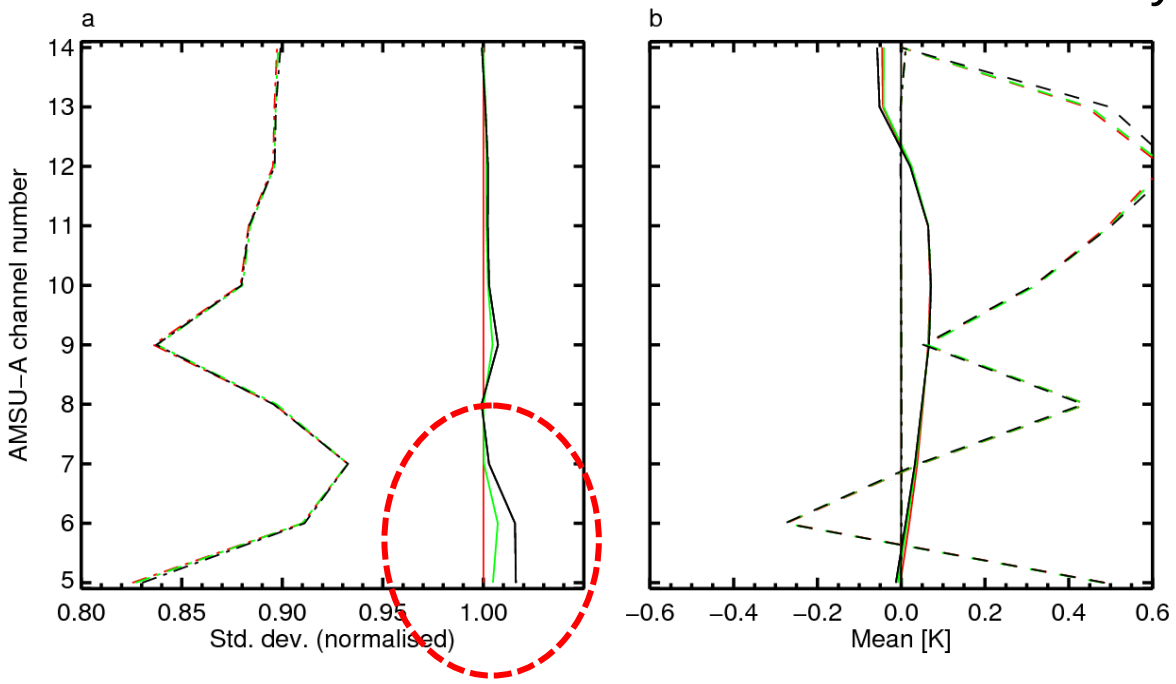
Drop sondes

Small improvement over
All-Sky-New including SSMI and AMSR-E

ECMWF

Degraded FG fit to AMSU-A

No imagers
All-Sky-New (SSMI + AMSRE)
All-Sky-New +SSMIS

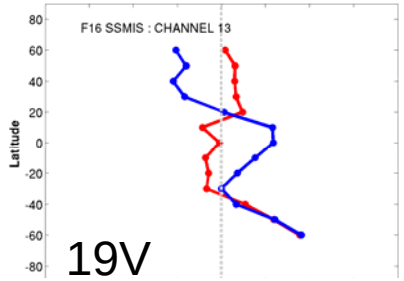


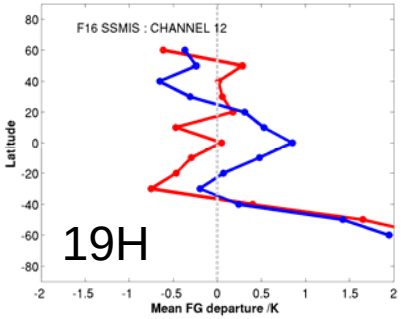
1.5 % degradation in FG fit to AMSU-A

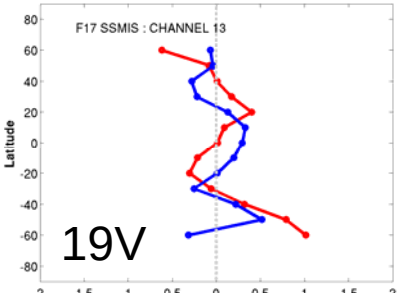
Ascending / Descending Biases

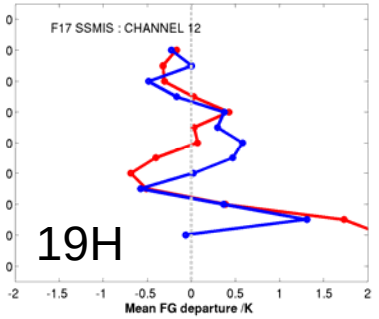
F16

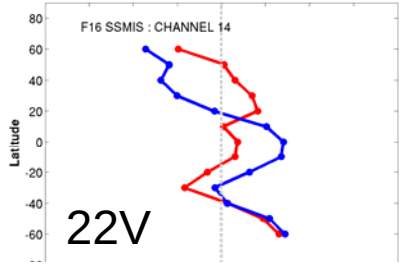
F17





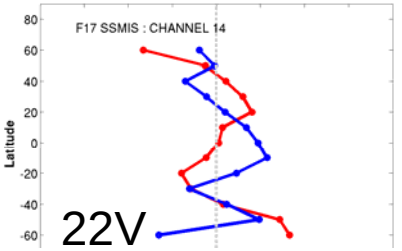


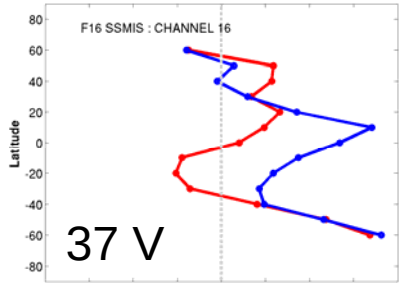


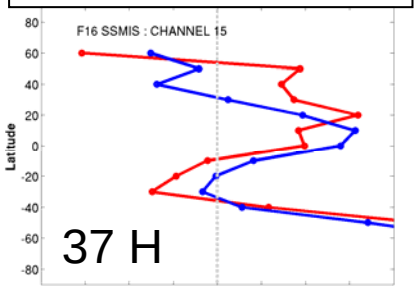


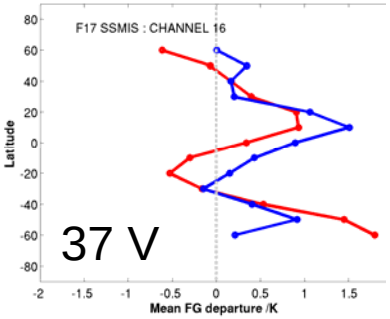
ASC / DESC

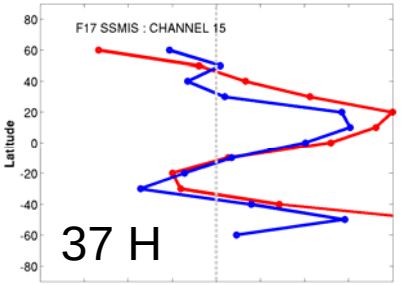
- Similar biases for SSMI & AMSR-E
- Model bias ?

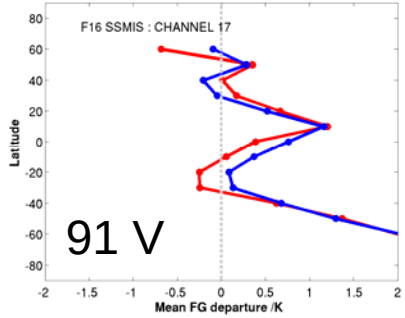


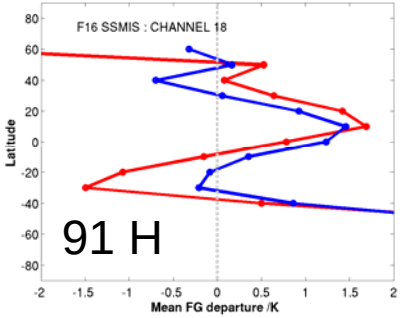


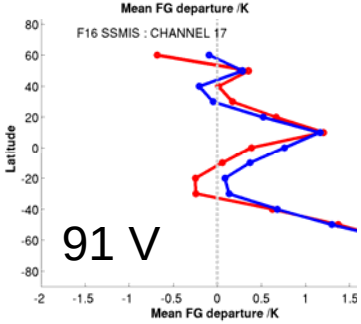


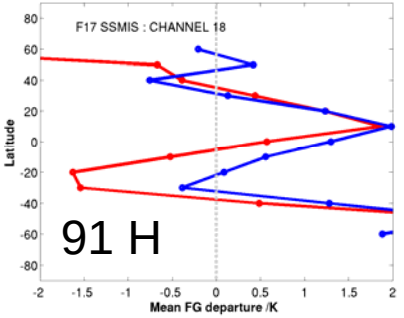










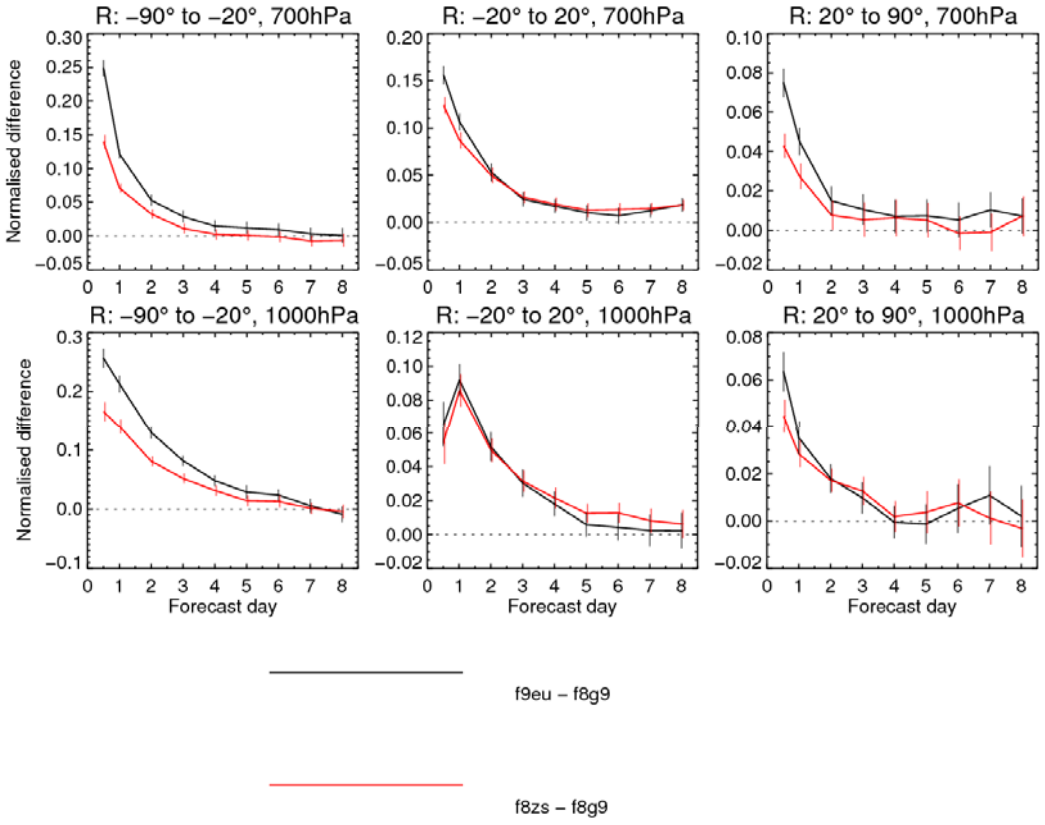


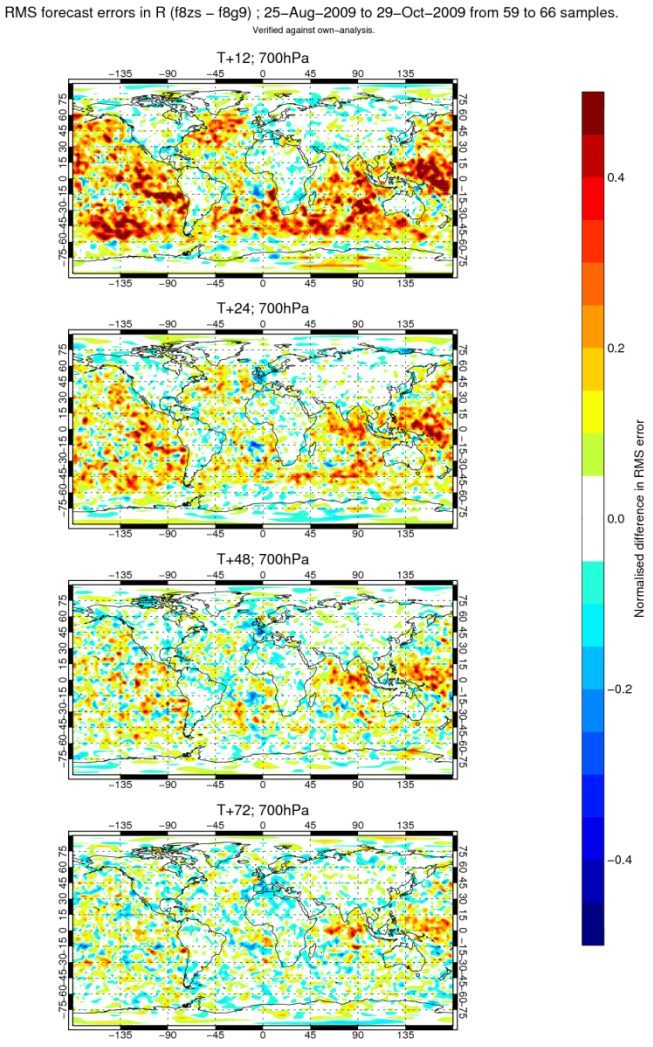
Summary and Plans

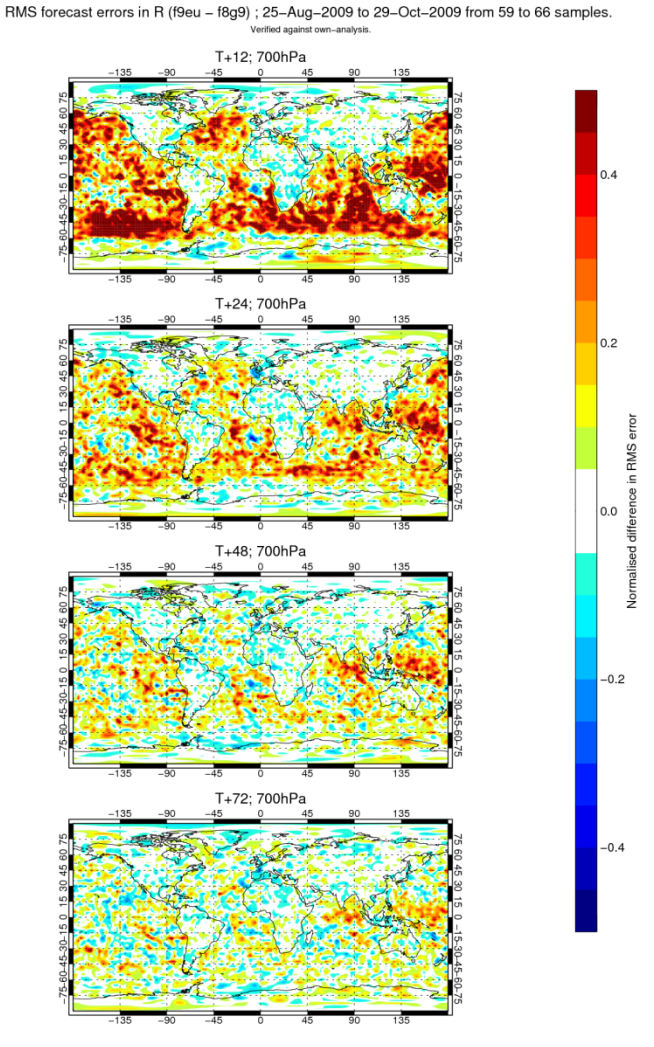
- **Operational stream of UPP SSMIS data for F16 and F17 established 19th August 2009. Plans are to monitor / assimilate, depending on further experiments, with upgrade to CY36R4 (summer 2010).**
- **No obvious signs of problems in FG departures. Data quality very similar to SSMI.**
- **Assimilation experiments show:**
  - **Neutral / mixed results on Z scores.**
  - **Improved fits to other observations (HIRS, Sondes & Drop Sondes), as for All-Sky SSMI+AMSR-E.**
  - **Degradation to AMSU-A ch 5 & 6 FG fits is a concern.**
- **Ascending / descending bias, also evident in SSMI/AMSR-E, is probably model related.**
- **SSMIS is set to become a key part of the ECMWF assimilation system.**

The End …

Thanks !


R: −90° to −20°, 700hPa
R: −20° to 20°, 700hPa
R: 20° to 90°, 700hPa
R: −90° to −20°, 1000hPa
R: −20° to 20°, 1000hPa
R: 20° to 90°, 1000hPa
Normalised difference
Normalised difference
Forecast day
Forecast day
Forecast day
f9eu – f8g9
f8zs – f8g9


RMS forecast errors in R (f8zs – f8g9) ; 25–Aug–2009 to 29–Oct–2009 from 59 to 66 samples.
Verified against own–analysis.
T+12; 700hPa
T+24; 700hPa
T+48; 700hPa
T+72; 700hPa
Normalised difference in RMS error
0.4
0.2
0.0
−0.2
−0.4


RMS forecast errors in R (f9eu – f8g9) ; 25–Aug–2009 to 29–Oct–2009 from 59 to 66 samples.
Verified against own–analysis.
T+12; 700hPa
T+24; 700hPa
T+48; 700hPa
T+72; 700hPa
Normalised difference in RMS error
0.4
0.2
0.0
−0.2
−0.4

International TOVS Study Conference, 17th, ITSC-17, Monterey, CA, 14-20 April 2010. Madison, WI, University of Wisconsin-Madison, Space Science and Engineering Center, Cooperative Institute for Meteorological Satellite Studies, 2011.