Cal/Val and Assimilation of satellite data at ECMWF

Heather Lawrence, Reima Eresmaa, Niels Bormann, Peter Weston, Bruce Ingleby, Stephen English

Thanks to: Fabien Carminati, Bill Bell, Stuart Newman

UK Met Office
Using NWP short-range forecasts to evaluate satellite data

**MHS/MWHS-2/SAPHIR/MWHS**

**SYNOP**

**NWP Data Assimilation:**

- Optimal combination of many observations past and present
- High accuracy temperature and humidity analyses
ATMS operational change – March 2017

- Biases are now more different to AMSU-A
- But magnitude still similar
What are the forecast biases?

GRUAN processor from the GAIA-CLIM project

Met Office GRUAN Processor (F. Carminati):

\[ \text{GRUAN T, q} \xrightarrow{\text{GRUAN processor}} T_B^{\text{GRUAN}} \xrightarrow{\Delta T_B^{\text{GRUAN-NWP}}} \]

\[ \text{NWP T, q} \xrightarrow{\text{GRUAN processor}} T_B^{\text{NWP}} \]
Evaluating ATMS bias change

But….

Error bars should be increased for:
- Radiative transfer uncertainty
- Representivity
- Vertical interpolation uncertainty…
- Correlations?

Are the number of GRUAN sites enough?

Ongoing work…
Assimilation of CrIS and ATMS
Assimilating CrIS: Reima Eresmaa

1. New Observation Errors

- Assigned \( \sigma_0 \)
- Diagnosed \( \sigma_0 \)

2. Increased number of channels used (118 channels):

- Long-wave IR band: CO2, O3
- Mid-wave IR band: H2O
- Short-wave IR band: CO2
Assimilating CrIS: Reima Eresmaa

Future Plans:

- Start using a large number of tropospheric channels over land (to become operational in 2018 Q1)
- Assimilation of JPSS-1 CrIS
- Working on making the observation error situation-dependent e.g. intersatellite differences
CrIS monitoring: HCN event identified

CrIS channel 101

50 mK – 0.1 K change identified
Assimilating ATMS: Peter Weston

Improve the use of ATMS with Correlated observation errors:

- Improved short-range forecast
Summary

- NWP forecasts are very powerful for assessing new satellite data

- There is ongoing work to assess the uncertainties of NWP in the GAIA-CLIM project

- Improved use of CrIS and ATMS at ECMWF, especially accounting for observation error correlation

Future work: New data from JPSS-1

Keen for new data soon…:

- 2016 AMSU-A losses due to window channel failures:
  - 24 September: Aqua due to channel 1 & 2 failure
  - 17 Oct – 29 Nov: Metop-B due to channel 15 failure

Only 9 of 24 channels used…
Thank you for listening..
Extra slides
Evaluating biases in satellite data

Striping noise:

ATMS channel 10

(Data are successfully assimilated despite the striping)
43R3 FSOI

12-Jul-2017 to 8-Aug-2017

Observations per cycle in 43R3

Infrared T

Infrared WV

Microwave T

Microwave WV

AQUA AMSU Radiiances
NOAA 18 AMSU Radiiances
METOP-A AMSU Radiiances
NPP ATMS Radiances
NOAA 19 AMSU Radiiances
METOP-B AMSU Radiiances
NOAA 15 AMSU Radiances
FY-3B MWHS Radiiances
DMSP 18 SSMIS Radiances All-sky
SAPHIR All-sky
GCOM-W1 AMSR-2 Radiances All-sky
MHS NOAA 19 MHS Radiiances All-sky
GPM GMI Radiances All-sky
FY-3C MWHS2 Radiances All-sky
MHS METOP-A MHS Radiances All-sky
MHS METOP-B MHS Radiiances All-sky
MHS NOAA 18 MHS Radiances All-sky
NPP ATMS Radiances
DMSP 17 SSMIS Radiances All-sky
METOP-B IASI Radiances
METOP-A IASI Radiances
NPP CRIS Radiiances
AQUA AIRS Radiiances
GOES 13 GEOS Radiances
NPP CRIS Radiances
GOES 15 GEOS Radiances
METEOSAT 8 GEOS All-sky Radiances
AQUA AIRS Radiiances
METEOSAT 10 GEOS All-sky Radiances
METOP-B IASI Radiiances
METOP-A IASI Radiances
Himawari 8 GEOS radiiances