Data Quality, Operational Assimilation and Impact of MetOp-B IASI

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Data quality

- The fit of MetOp-A and MetOp-B IASI observations to simulated observations, modelled from the Met Office forecast background fields using RTTOV-9, have been compared.
- Data was collected for the period 1-15 June 2013.
- The observations were processed through the Met Office's Observation Processing System (OPS).
- The same bias correction (derived using MetOp-A data from the period 17 May – 11 June) was applied to both MetOp-A and MetOp-B data.
- Statistics are shown for cloud-free observations over the sea, where cloud free means that the fitted cloud fraction is less than 5%.
- Only the 314 channels received via EUMETCast are shown.
- Figure 1 compares the mean bias corrected observed minus background brightness temperatures (O-B) for MetOp-A and MetOp-B IASI.
- Figures 2 compares the standard deviation of O-B.
- Figures 3 shows histograms of O-B for 6 selected channels.

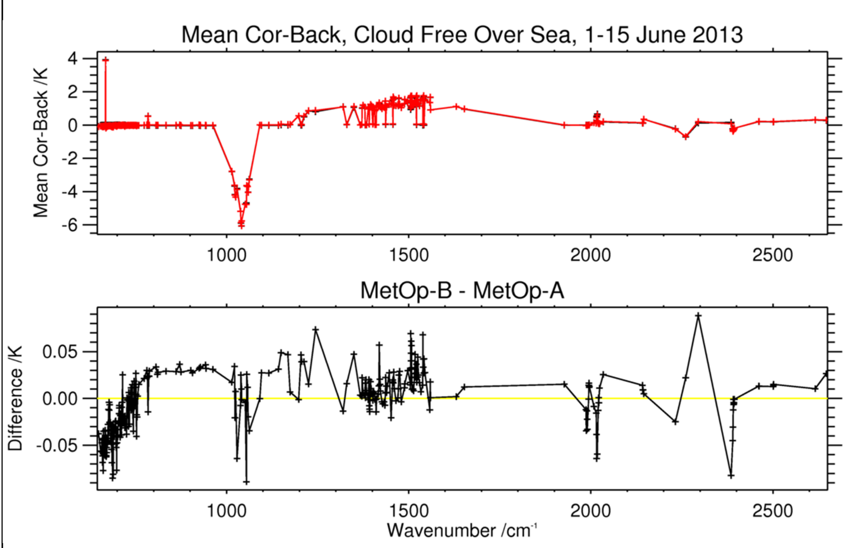

Figure 1: The mean bias corrected observed minus forecast background brightness temperatures for cloud-free observations over the sea for MetOp-A IASI (black) and MetOp-B IASI (red). The two lines very nearly overlap so only MetOp-B is visible. The lower plot shows the difference between MetOp-B and MetOp-A.

- From the upper plot there are strong residual biases for the Q-branch (662.75 cm^{-1}), the ozone channels (1014.50–1062.50 cm^{-1}) and also for many of the water vapour sensitive channels (around 1500 cm^{-1}).
- From the lower plot the difference in the bias of MetOp-A IASI and MetOp-B IASI is typically less than 0.05K.

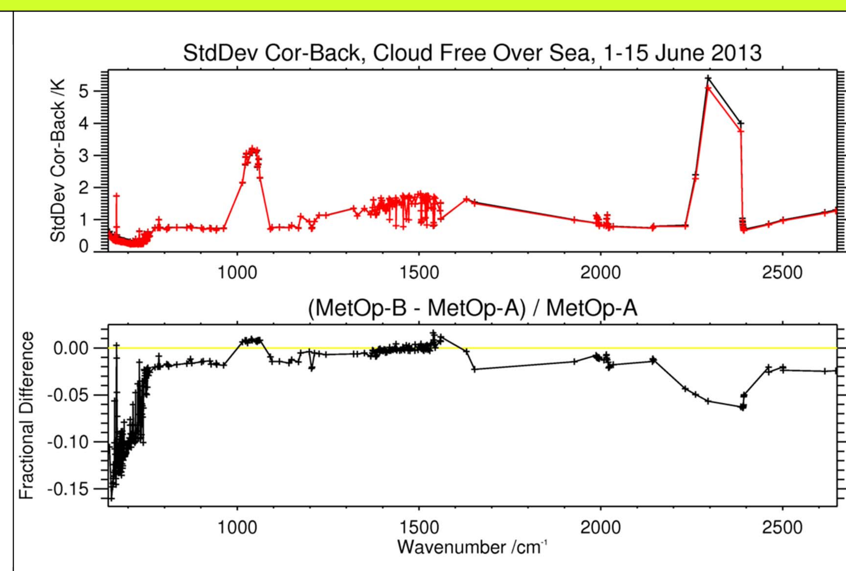

Figure 2: The standard deviation of bias corrected observed minus forecast background brightness temperatures for cloud-free observations over the sea for MetOp-A IASI (black) and MetOp-B IASI (red). The fractional difference is shown in the lower plot.

- The standard deviations of the lowest frequency channels are 10-15% lower for MetOp-B than for MetOp-A. Some of the high frequency channels also have a lower standard deviation.
- These high and low frequency channels are well modelled and it is likely that this difference is due to a lower instrument noise at these frequencies.

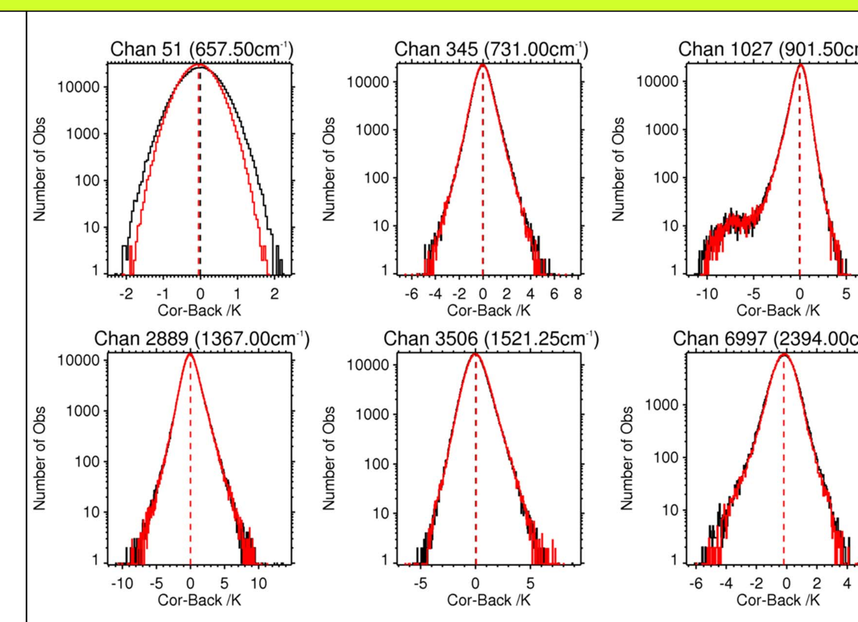

Figure 3: Histograms of bias corrected observed minus forecast background brightness temperatures for 6 IASI channels. The channels are a long-wavelength stratospheric temperature channel, a mid-tropospheric temperature channel, a window channel, low peaking and high peaking water vapour channels and a short-wavelength window channel. MetOp-A data is plotted in black and MetOp-B in red.

- There is a cold tail on the 901.50cm-1 window channel histogram, but it is a logarithmic scale and the tail is present for both MetOp-A and MetOp-B.

Operational Assimilation

- MetOp-B IASI observations have been operationally assimilated at the Met Office since 19 February 2013.
- The channel selection and observation errors used for MetOp-B IASI are the same as those for MetOp-A IASI.
- The data is currently thinned to 154km in the tropics and 125km in the extra-tropics.
- MetOp-A was given priority in the data thinning as MetOp-B was still in the calibration and validation phase when operational assimilation began.
- Assimilating MetOp-B IASI increases the number of IASI observations assimilated by around 20%.
- Data coverage is improved and the system will be more robust to any interruptions of the data flow.

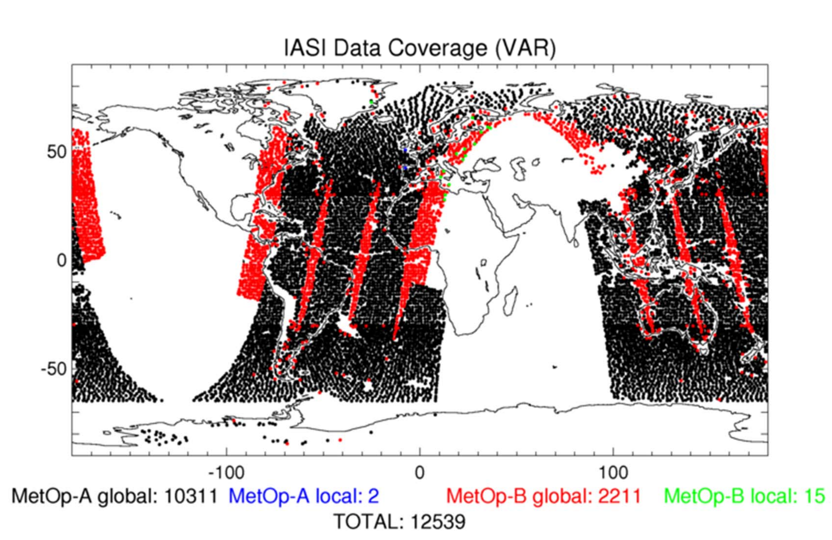

Figure 4: The distribution of IASI observations passed to VAR for a typical 6 hour data assimilation time window. MetOp-A observations are shown in black and MetOp-B observations in red. Locally received MetOp-A and MetOp-B IASI data are shown in blue and green respectively. Locally received observations have the lowest priority in the data thinning.

Assimilation experiments

- Observing system experiments have been run for two time periods:
  - 1 February – 25 March 2013
  - 1 July – 15 August 2013
- MetOp-B IASI was in the calibration and validation phase for the first time period and so there are a number of data outages.
- The impact of adding MetOp-B IASI to a full system that includes MetOp-A IASI and other MetOp-B instruments was tested for both time periods, see figure 5.

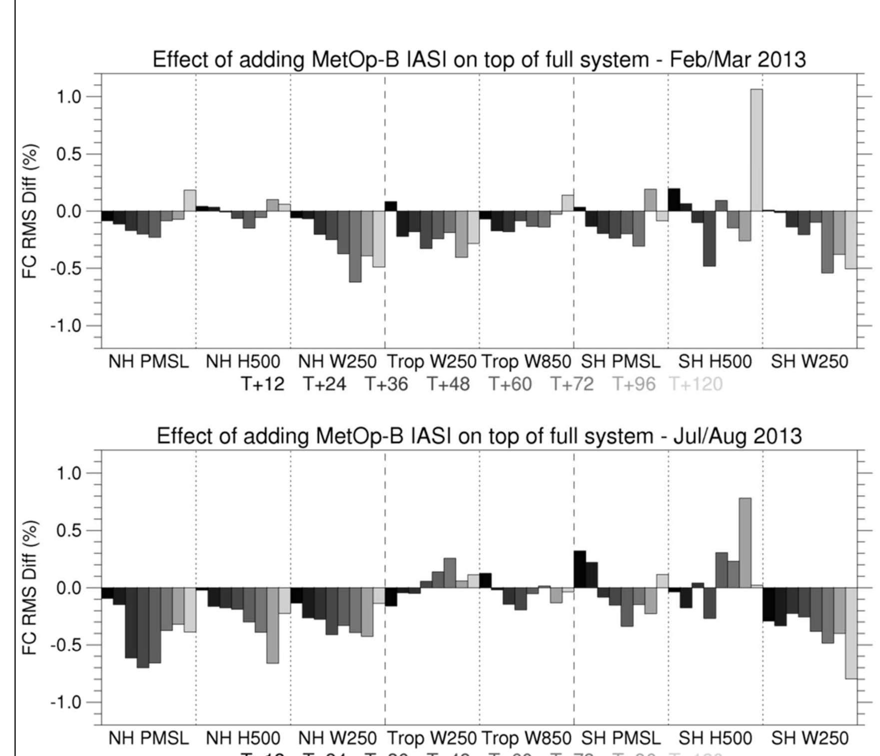

Figure 5: The percentage change of the root mean square (R.M.S.) difference between forecast and observations for the forecast fields used in the calculation of the NWP index.

- The observations used in this comparison are radiosondes, AMDAR measurements and satellite winds.
- A skill score is calculated by normalising the forecast R.M.S. error against the persistence R.M.S. error.
- These skill scores are combined with different weights to form a single index representing the total impact of the change.
- The change in the NWP index was +0.13 for the February/March OSE and +0.22 for the July/August experiment.
- Further discussion of the first season results may be found in Cameron (2013).

Forecast sensitivity to observations

- Statistics of the sensitivity of the forecast to observations were collected for the period 23 March – 25 April 2013.
- The method is described in Lorenc and Marriott (2013).
- Figure 6 shows the impact of each observation type for a moist energy norm.
- The impact of MetOp-B IASI is about 20% of that of MetOp-A IASI, consistent with the ratio of the numbers of observations assimilated.

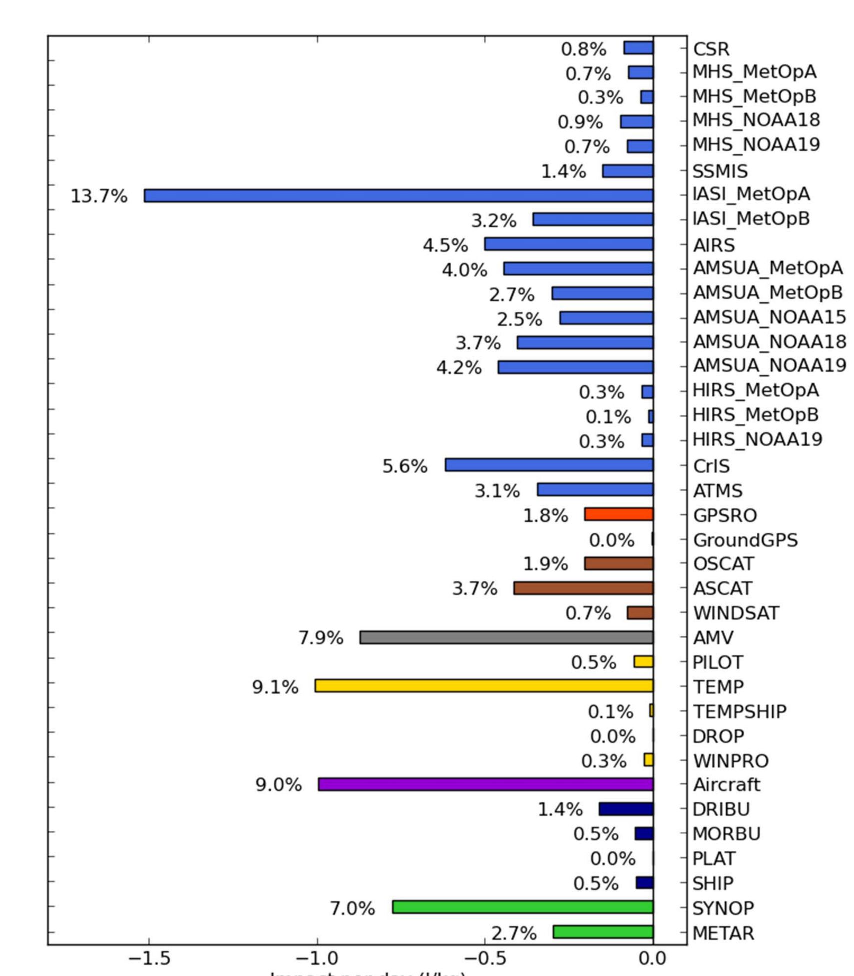

Figure 6: The mean impact per day of different observation types as derived from a forecast sensitivity experiment.

Changes to the data thinning

- A number of assimilation experiments have been run for the February/March and July/August time periods.
- The baseline experiment is the full observing system including MetOp-B IASI.
- Experiments were run dropping MetOp-B IASI data, and dropping both MetOp-A and MetOp-B IASI data.
- Experiments were run reducing the thinning in the extra-tropics from 125 km to 100, 80 and 60 km. The temporal thinning was also reduced from 6 hours to 3 hours.
- An experiment was run for the Feb/Mar period where MetOp-A and MetOp-B data were thinned independantly.
- An experiment was run for the Jul/Aug period at 80km thinning where no preference was given to MetOp-B or MetOp-A data.

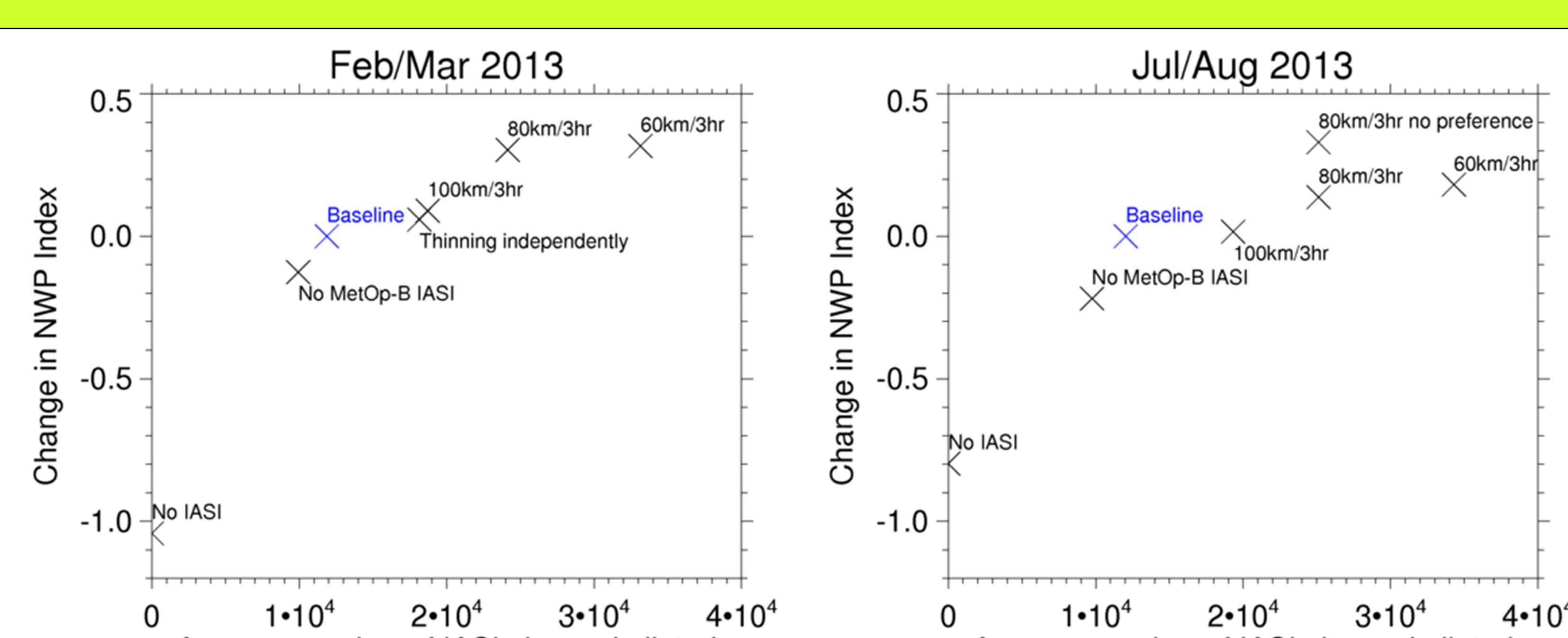

Figure 7: The change in the NWP index (forecast impact) versus the number of IASI observations assimilated for various experiments. All experiments are at an analysis resolution of N216.

- It is planned to switch to using 80km thinning in the extra-tropics and 3 hours temporally. This change is scheduled for May 2014.
- No preference will be given to MetOp-A or MetOp-B data.
- The number of IASI observations assimilated will approximately double.
- The resolution of the analysis will increase from N216 to N320. Further assimilation experiments will be required to test the impact of IASI at this resolution.

References

Cameron, J. R. N., Cotton, J. and Marriott, R. T. (2013)
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http://www.metoffice.gov.uk/media/pdf/n/9/FRTR579.pdf

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