Assessment and Trialling of New AMV Datasets in the Met Office Global Model since IWW13

Francis Warrick

GOES-16 AMVs

• The Met Office started storing and monitoring AMVs from GOES-16 in January 2018. Compared to GOES-13 AMVs from early 2017 the GOES-16 AMVs have larger biases in some areas, smaller in others.

• Assimilation trials of the GOES-16 AMVs were carried out using the Met Office global model, and were compared to a control which used no GOES-East AMVs. Quality control was kept the same as GOES-13, including height error profiles and the blacklist of low level infra-red AMVs over northern hemisphere land.

• The first trial used only the infra-red GOES-16 AMVs. The GOES-16 AMVs have greater coverage than GOES-13 and now reach as far as the West African coast. In the low-level (below 700hPa) infra-red AMVs a similar fast bias is seen in the GOES-16 and the Meteosat Second Generation (MSG) data. Consequently the same blacklisting used for MSG in this area was used for GOES-16 (Figure 1B). An additional blacklist was added for all infra-red AMVs above 250 hPa due to a negative O-B speed bias of many AMVs at those heights (Figure 1C).

• Results from the first trial are shown in Figure 1A, given as percentage difference in forecast errors. While the impact is mostly neutral in the tropics and northern hemisphere, the southern hemisphere shows some improvement against all three truths. Forecast fit-to-observations was improved for AMVs and radiances.

• A second trial added GOES-16 cloudy water vapour 6.2 micron AMVs on top of the first trial. Blacklisting was also tightened up to avoid fast biases in the extra-tropics (Figure 1C). The hope was that the various quality control steps would find the better AMVs of the two channels in the priority.

• Verification from the second trial is shown in Figure 1D. The improvement in the southern hemisphere is similar to the IR-only trial. Northern hemisphere performance was generally better. However, winds at 250 hPa show a negative impact in the tropics and northern hemisphere. For this reason it was decided to err on the side of caution and only make the infra-red GOES-16 AMVs operational initially, in April or May 2018.

FIGURE 1A *(right): Trial results for GOES-16 infra-red AMVs versus a no GOES-East baseline. Verification is against observations, Met Office analyses, ECMWF analyses (from left).*

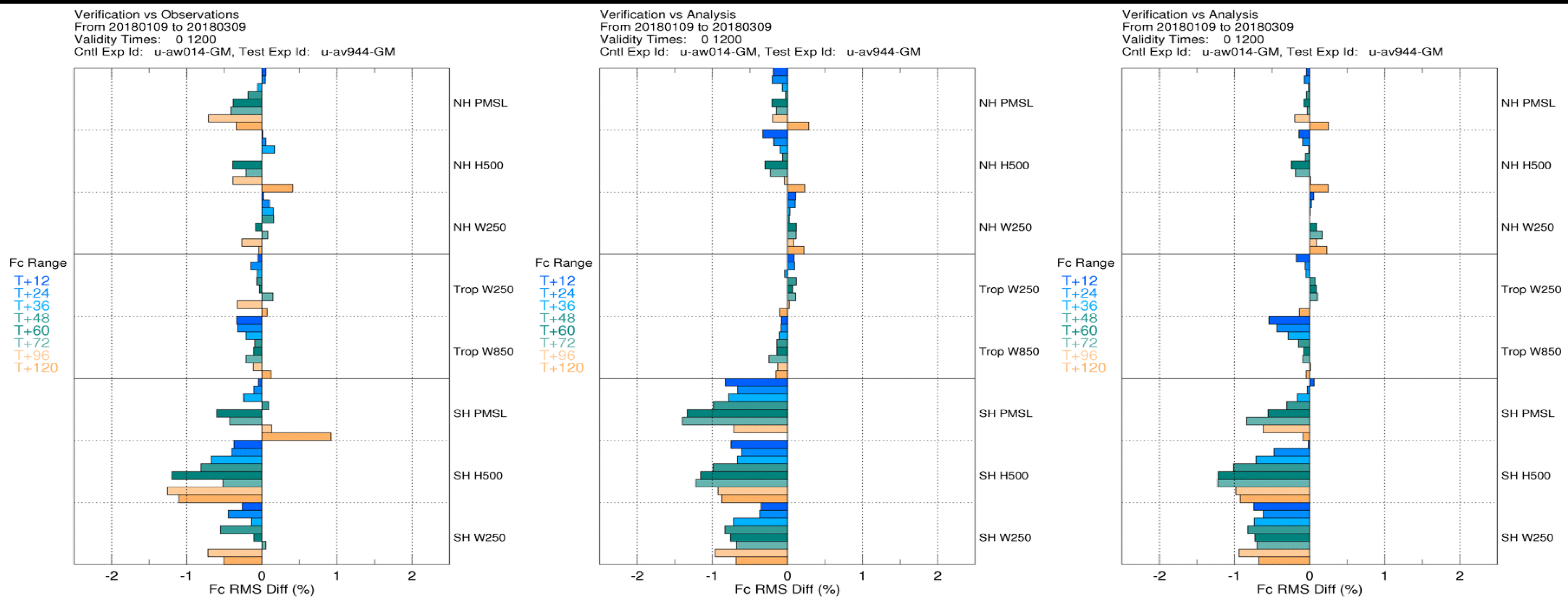
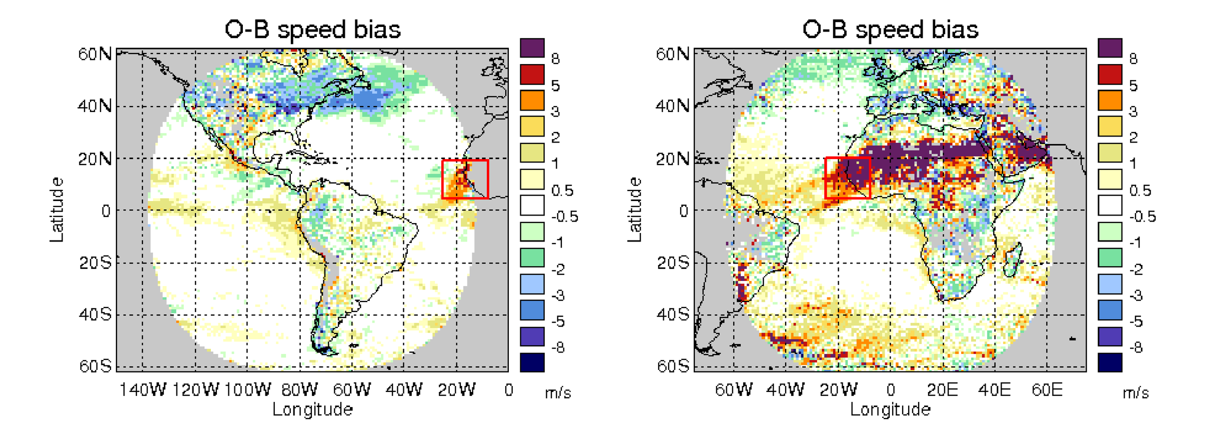


FIGURE 1B *(below): Map of infra-red AMVs from GOES-16 (left) and Meteosat-10 (right), February 2018, below 700 hPa. Red box shows location of spatial blacklisting.*



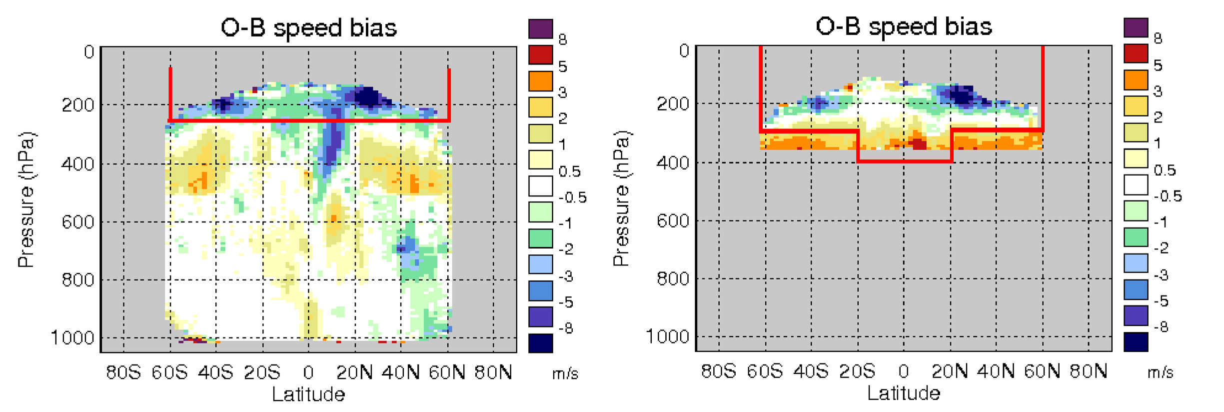
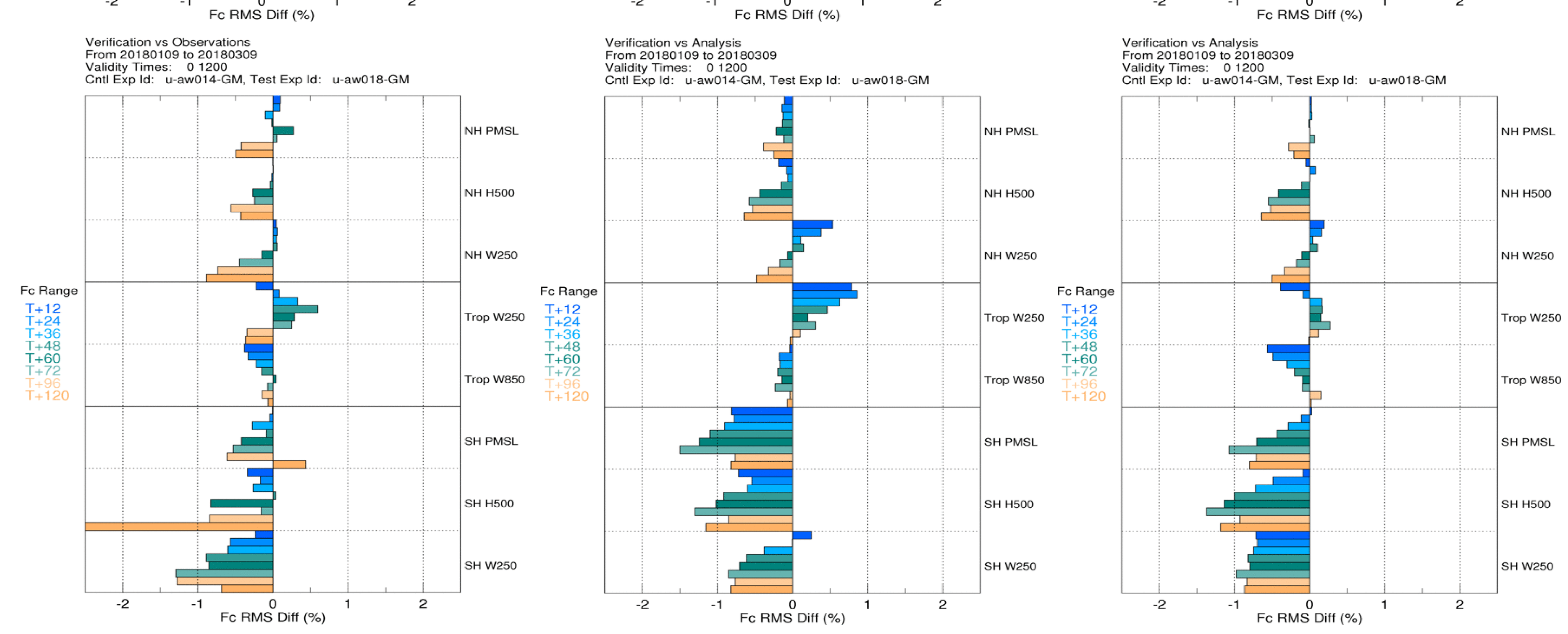


FIGURE 1C *(above): GOES-16 infra-red (left) and water vapour 6.2 micron AMVs, February 2018. AMVs blacklisted above red line (infra-red) and below (water vapour).*

FIGURE 1D *(right): Trial results for GOES-16 infra-red and water vapour 6.2 AMVs versus a no GOES-East baseline. Verification is against observations, Met Office analyses, ECMWF analyses (from left).*



Nested Tracking versus NESDIS Heritage Algorithm: Comparison Using GOES-13 and GOES-15 AMVs

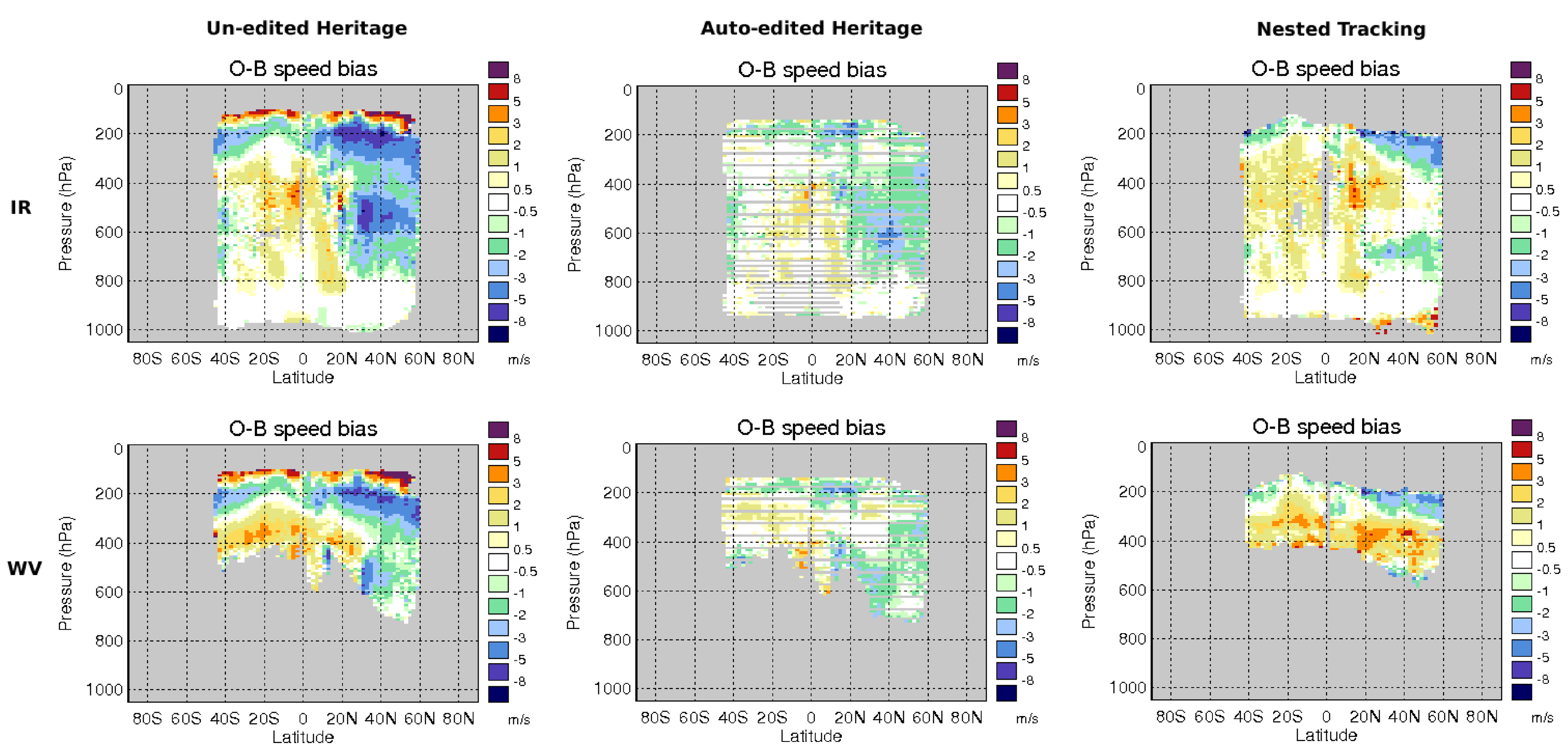


FIGURE 2A: *O-B speed bias of GOES-15 infra-red (top row) and cloudy water vapour (bottom row) AMVs, February 2017.*

• Test data was produced by NESDIS using the nested tracking algorithm, designed for GOES-16 onwards, on GOES-13 and GOES-15 imagery, allowing direct comparison of the new algorithm to the heritage algorithm. The auto-editor (Figure 2B) is no longer used in the heritage algorithm.

• O-Bs for the nested tracking AMVs are compared with those of the heritage algorithm with and without auto-editor in Figure 2B. Generally in the test dataset the nested tracking AMV quality was in between that of the auto-edited and un-edited heritage algorithm

• The nested tracking AMVs were trialled in the Met Office global model. Verification is shown in Figure 2C. The nested tracking AMVs have a worse impact than the auto-edited heritage AMVs but a better impact than the unedited heritage AMVs. Verifying the nested tracking AMVs against a no-GOES control (not shown) gives slightly positive impact except against own analyses in the tropics.

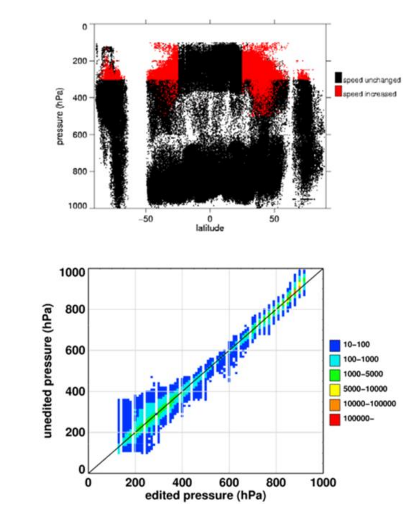
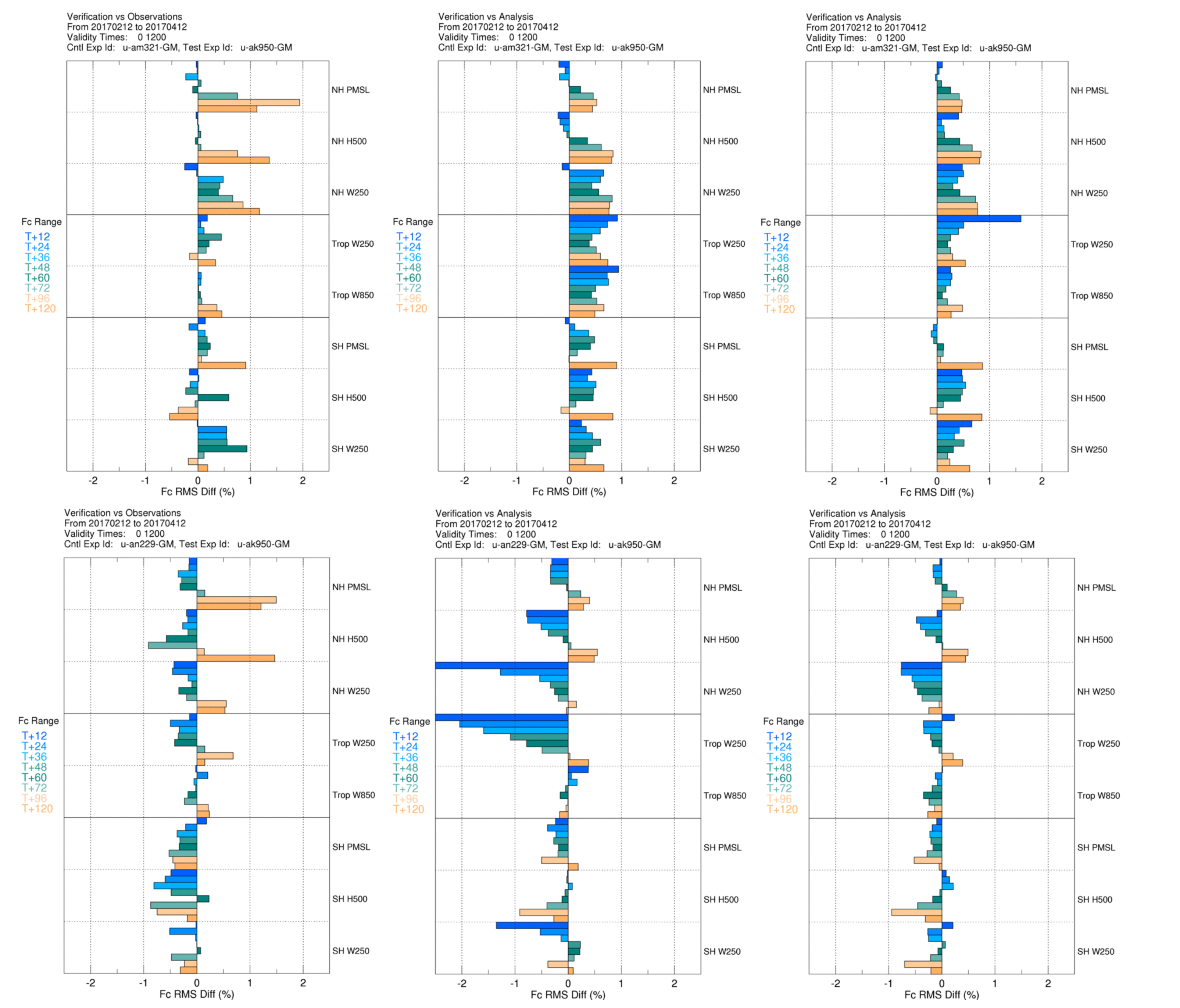


FIGURE 2B *(above): Top plot shows in red the GOES AMVs which have had their speed changed by the auto-editor. Lower plot compares pressures of edited and unedited GOES AMVs. Plots are from the 3rd NWP SAF Analysis Report (Forsythe et al).*

FIGURE 2C *(right): Forecast impact of assimilating the nested tracking GOES-13 and GOES-15 AMVs verified against observations (left column), Met Office analyses (middle column) and ECMWF analyses (right column). Top row uses auto-edited heritage GOES AMVs as control, bottom row uses un-edited GOES AMVs as control.*



Impact of OCA heights on MSG AMVs

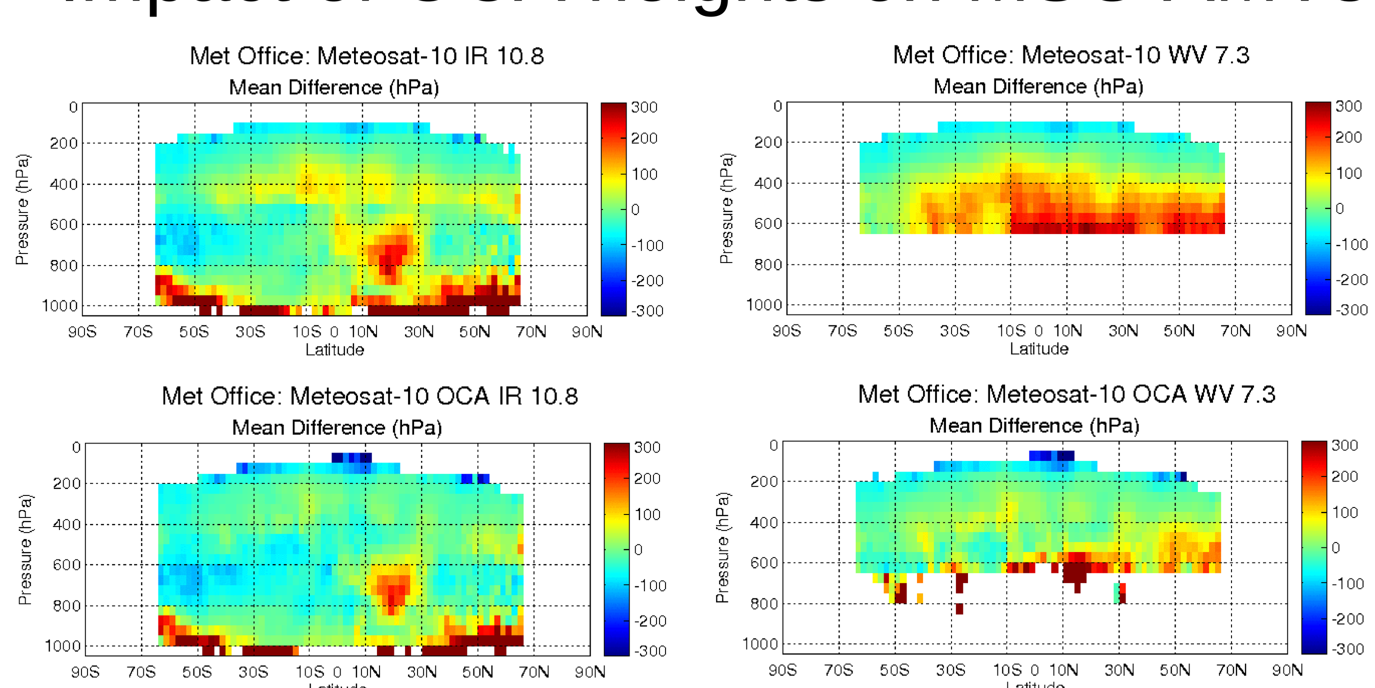
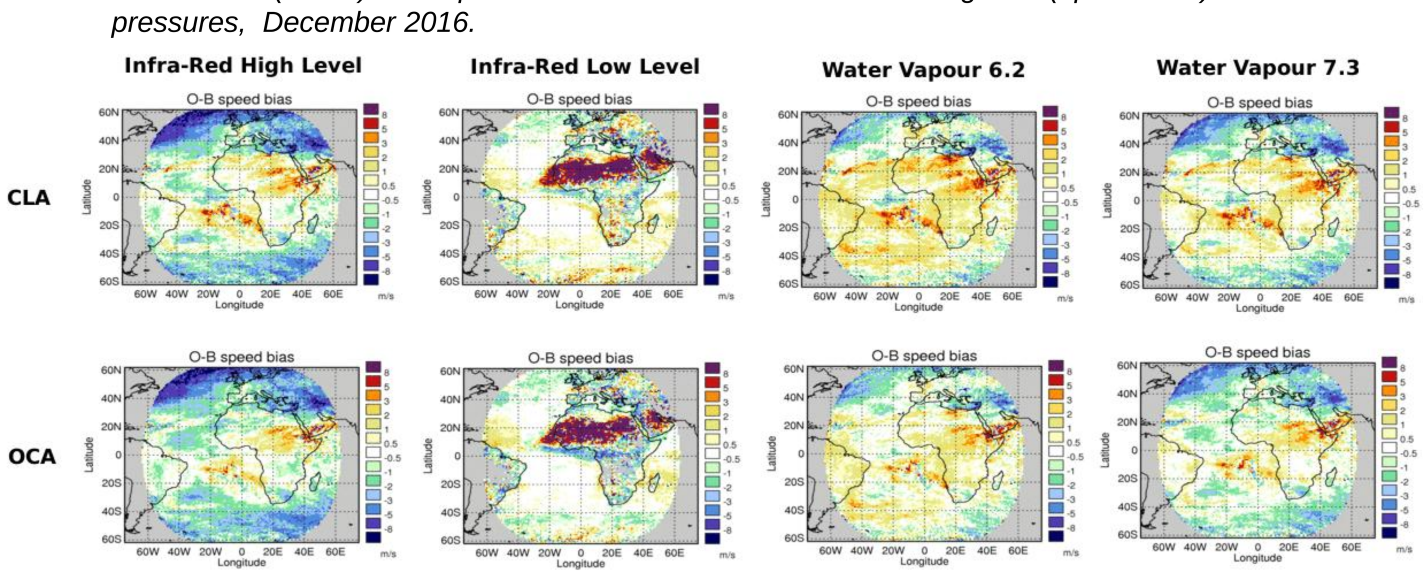


FIGURE 3A *(above): difference between AMV pressures and their model best-fit pressures, May 2017. Top row is CLA operational pressures, bottom row is the OCA pressures.*

FIGURE 3B *(below): O-B speed biases of Meteosat-10 AMVs using CLA (operational) and OCA pressures, December 2016.*



• Alternative AMV height assignments using the OCA cloud product were made available by EUMETSAT for Meteosat-10 and Meteosat-8. OCA can identify two-layer cloud situations so the AMV pressure can be assigned to the upper layer.

• Figure 3A shows differences between AMV pressures and their best-fit pressures (BFPs - height at which O-B speed difference is minimised), both for the operational heights (CLA) and the OCA heights. A positive number means the AMV altitude is lower than its BFP. OCA heights generally show smaller BFP differences than CLA heights at high level AMV, larger at low level.

• The effect on O-Bs of OCA heights is shown in Figure 3B. The high-level (above 400 hPa) infra-red AMVs show only small differences in the tropics, reducing some fast biases and increasing some slow biases. The low-level (below 700 hPa) infra-red AMVs show a more severe slow bias in the Gulf of Guinea. The water vapour AMVs show the most improvement from the OCA heights, reducing the fast bias seen in the tropics, especially for the 6.2 micron channel.

• A trial was run to assess the impact of using OCA heights instead of CLA heights. Figure 3C shows the results were generally poor for the OCA trial. The map of forecast impact shown in Figure 3D suggests height assignments of low-level AMVs may have caused the negative forecast impact. One caveat with the results is that the AMVs had their quality indicator values set based on their CLA heights, not their OCA heights.

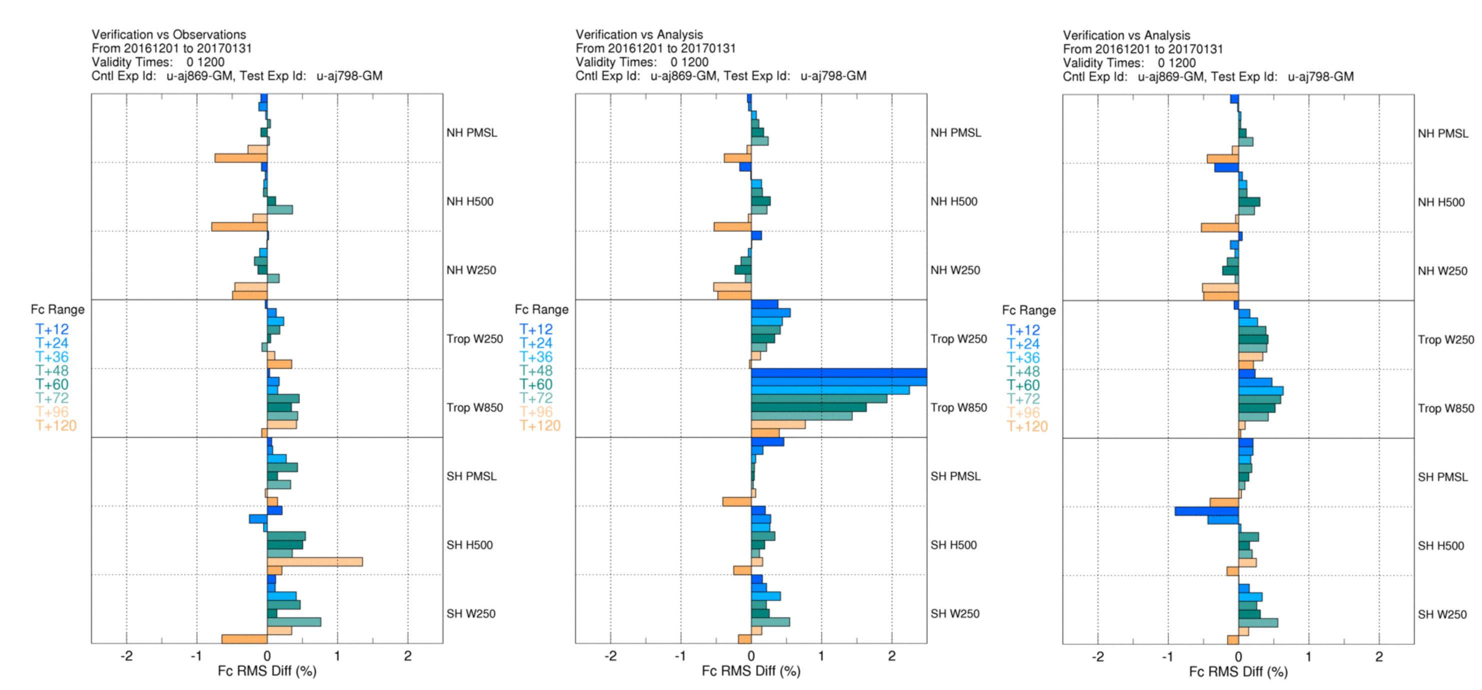
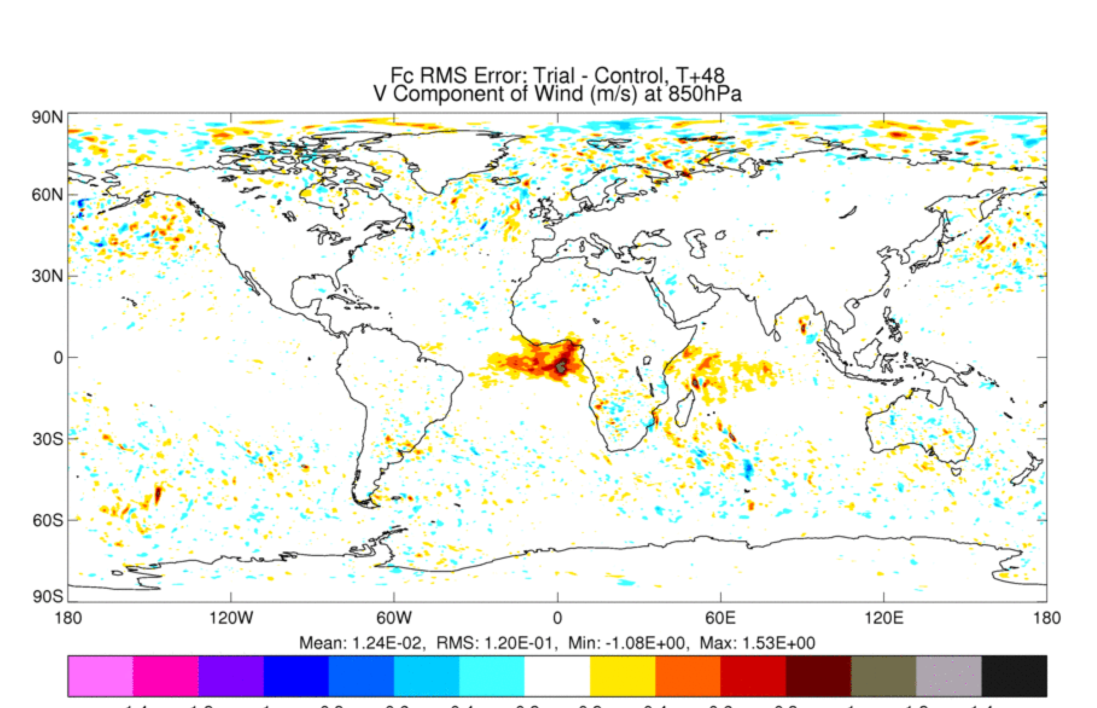


FIGURE 3C *(above): Forecast impact of using OCA heights for MSG AMVs, versus observations (left), Met Office analyses (centre) and ECMWF analyses (right).*

FIGURE 3D *(right): Difference in root-mean-square error of wind v-components at 850 hPa for forecasts using OCA heights (trial) versus CLA heights (control).*



Met Office FitzRoy Road, Exeter, Devon, EX1 3PB United Kingdom
Tel: +44 1392 884427 Email: francis.warrick@metoffice.gov.uk