Update on AMV Activities at ECWMF and Assessment of New AMV Products

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LEO-GEO AMVs

In the past there has been a gap in AMV coverage between AMVs derived from geostationary and polar imagers. At ECMWF, extending the use of geostationary AMVs to higher zenith angles, and using the EUMETSAT Dual-Metop product, have helped to reduce that coverage gap. The LEO-GEO AMVs from CIMSS / University of Wisconsin have been successfully used at other NWP centres [2]

An assessment of the O-Bs shows that they are generally very small, both in terms of the difference in wind speeds (Figure 4) and the difference between assigned pressure and model best-fit pressure (Figure 5).

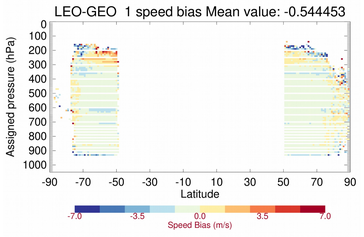
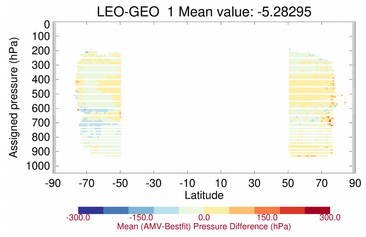


Figure 4: (left) Mean LEOGEO-model wind speed difference, 1st Nov 2020–14th Dec 2020

Figure 5: (right) Mean LEOGEO-model assigned-minus-bestfit pressure difference, 1st Nov 2020–14th Dec 2020
+ve indicates:
AMV pressure higher than bestfit pressure
AMV at lower altitude than bestfit pressure



Assimilation experiments are currently underway using the LEO-GEO AMVs for the dates 1st June–31st August 2020, and 15th November–15th February 2021. To err on the side of caution, we used the same quality control as other US polars, including a blacklist of data with pressures greater than 700 hPa, or greater than 400 hPa over land.

Ideally, we would not use a LEOGEO AMV where another AMV is already available. This is to avoid the situation where the same feature is tracked but given different height assignments in LEOGEO and another AMV product, which would mean the same information would be used twice in the model. To prevent this, the thinning scheme was adjusted so it only uses LEOGEO AMVs where there are no other AMVs in the same thinning box. Furthermore, we only use LEO-GEO at latitudes 55-65 North/South.

Satellites Added and Removed since 14th Winds Workshop

Replacement of GOES-17 with GOES-15

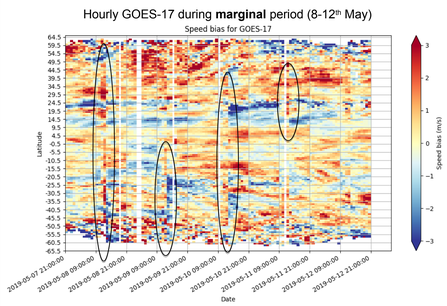


Figure 6: Hovmöller plot of GOES-17 speed bias.

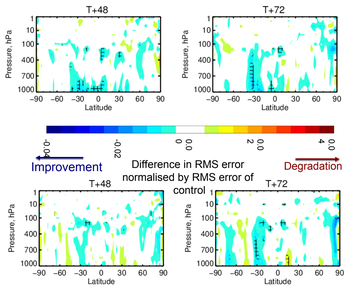


Figure 7: Impact on wind vector RMS error. Top row: GOES-17 excluding 9-17Z, versus no GOES-W baseline.
Bottom row: GOES-15 versus no GOES-W baseline.

An instrument problem on GOES-17means that periodically GOES-17 AMVs can be unusable or of marginal use during the hours from 9-17Z. During the period of normal operation, GOES-17 O-Bs generally agreed well with GOES-16. But during marginal periods, there were still some abrupt changes in O-B speed bias (Figure 7).

3 assimilation experiments were run with GOES-17 AMVs:

1. Never use 9-17Z
2. Exclude 9-17Z during worst-affected periods
3. Always allow use during 9-17Z due to low data volume at higher risk periods

Experiment 1 gave the best results, with greater positive impact than GOES-15 versus a no GOES-W baseline (Figure 6)

GOES-17 AMVs went operational at ECMWF in December 2019 [3]. We could consider revisiting the marginal periods if the AMV derivation was adjusted to account for them.

Other satellite changes

GOES-16 added 22nd May 2018
Metop-C (single product) added 25th June 2019
Metop-C (within dual product) added Jan 2019
NOAA-20 added 13th May 2020

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Dual Sentinel-3 Prototype AMVs Assessment

A month's worth of Dual-Sentinel A/B AMVs, covering 4th August–5th September 2020, were provided by EUMETSAT. They are derived in a similar way to the Dual-Metop AMV product, which showed a positive impact on ECMWF forecasts [1].

The distribution pattern of Dual-Sentinel AMVs is similar to the Dual-Metop AMVs (Figure 1). The overall amount of data is reduced due to the smaller swath width of SLSTR compared to AVHRR. Dual-Sentinel AMVs are only available in the tropics for A-B image pairs; there is not enough overlap in B-A image pairs. There are lots of Sentinel AMVs assigned heights near the surface with pressures of around 950–1000 hPa. There is also a sharp change in the number density at 600 hPa.

The Dual-Sentinel O-Bs (Figure 2) look similar to Dual-Metop. Both show a positive bias in the tropics which has been linked to the viewing geometry in the past. In the extratropics the Dual-Sentinel O-Bs are slightly higher than the Dual-Metop O-Bs. B-A Sentinel O-Bs are just slightly larger than A-B Sentinel AMVs which may be due to the difference in image interval.

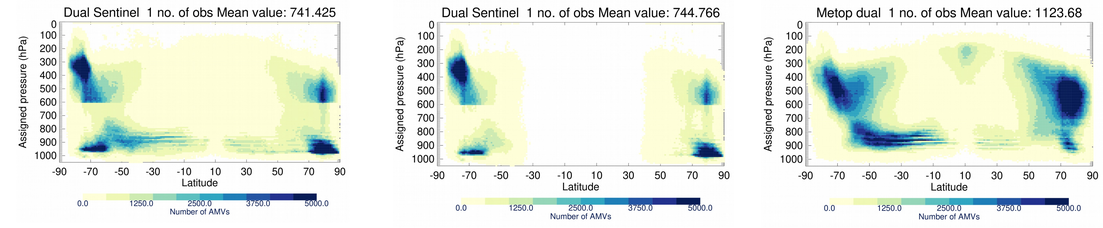

Figure 1: Data distribution.

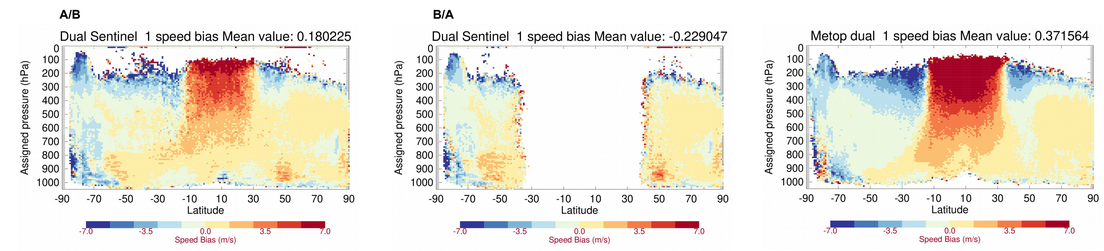

Figure 2: Mean AMV-model speed difference.

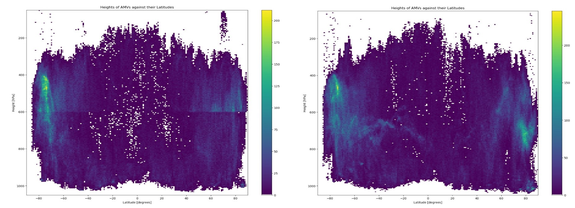

Figure 3: Height distribution of old (top) and new (bottom) Sentinel AMV products (thanks to Kévin Barbieux of EUMETSAT for this plot).

- Very low-height winds known to be due to issues with available cloud masks for SLSTR. Not a problem for an experiment as will be screened out by our quality control.
- Abrupt change in number distribution at 600 hPa removed in newer version (Figure 3).
- Hoping to do an assimilation experiment given longer period of data or continuous stream.

References

[1] Atmospheric Motion Vector observations in the ECMWF system: Second year report, EUMETSAT/ECMWF Fellowship Programme Research Report No. 28, K. Salonen and N. Bormann, 2012.

[2] Options for filling the LEO-GEO AMV Coverage Gap, NWP SAF Technical Report 30, F. Warrick, 2015.

[3] Replacement of GOES-15 with GOES-17 AMVs, EUMETSAT/ECMWF Fellowship Programme Research Report No. 54, K. Lean, N.Bormann, 2020.