AMV research activities and progress at ECMWF

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Introduction

There has been a long-standing gap in the spatial coverage of AMVs between the geostationary and polar orbiting satellites. The past two years have been rich in new satellites and products which provided the opportunity to close the gap with the use of Metop data [1]. Analysis of the single and dual Metop products using first guess departures and results from assimilation experiments are discussed.

Improving the height assignment and better understanding the associated errors is also an ongoing challenge. Recently, Meteosat-10 AMVs have been distributed with alternative height estimates derived using Optimal Cloud Analysis (OCA). Preliminary results are presented which compare the new technique with the current operational method.

In addition to new data, more relaxed blacklisting was implemented on 4th Feb 2016 which added AMVs from the Meteosat-10 infrared channel in mid-latitudes from 460-700hPa and increased the allowed zenith angle of geostationary satellites from 60° to 64°.

For further details on recent progress at ECMWF see also poster 5: "Comparison of AMV height assignment bias estimates from model best-fit pressure and lidar corrections" and talk: "Assessment of AMVs from Himawari-8 and VIIRS".

Current data use

Assimilated: Dual Metop A/B*, Single Metop A/B*, GOES-13, GOES-15, Met-7, Met-10, AQUA, NOAA-15, NOAA-18, NOAA-19, Himawari-8*

Monitored: FY-2E, FY-2G*, INSAT-3D*, COMS-1*, SNPP*, TERRA

* New in operational system since Jan 2015

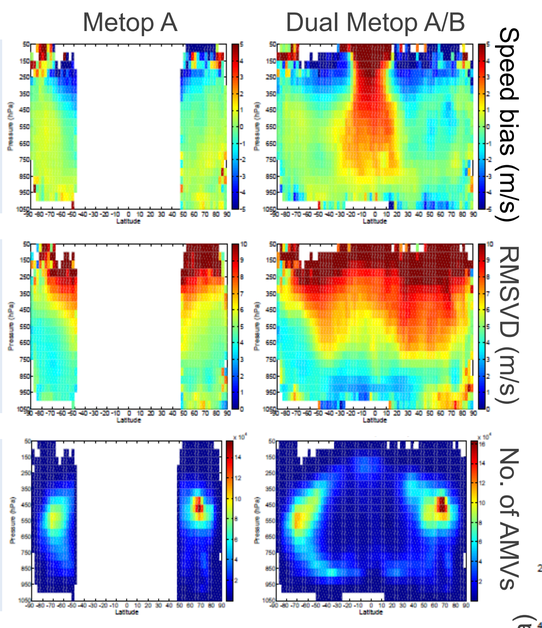
Introducing Metop AMVs

Single product: derives AMVs from 2 consecutive images from the same Metop satellite (~100 mins between images) ➡ polar product

Dual product: derives AMVs from 2 consecutive images on different Metop satellites (~50 mins apart) ➡ global product

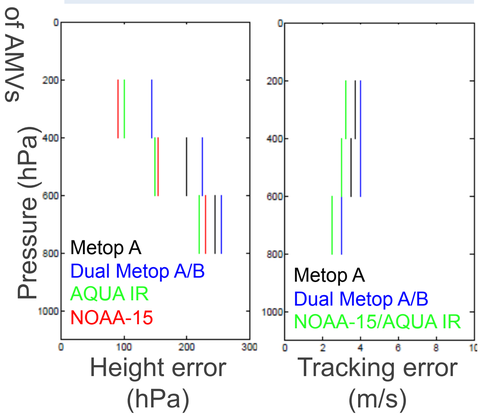
The quality of the single Metop winds has improved significantly in recent years, including reduction of the speed bias and RMSVD at mid and low levels. Use of Metop AMVs provides better resilience for the polar data and availability of the dual product gives the chance to achieve global coverage as well.

Observed – Background statistics



For both products, RMSVD decreases slightly as value of forecast independent quality indicator increases ➡ standard threshold (QI>60) used for quality control

Tracking and height errors larger for Metop products and largest for dual Metop



Assimilation experiments

Two configurations tested over 6 months (1st Jan – 30th June 2015):

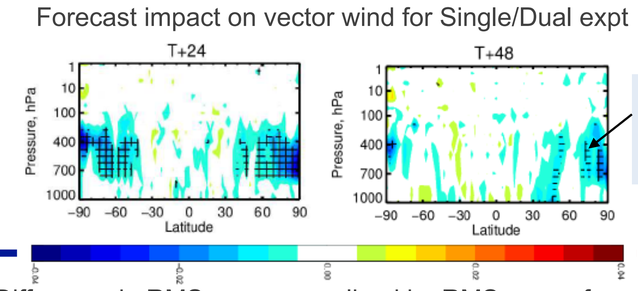
1. Single product only (latitude > 50N/S)
2. Single product (latitude > 60N/S) and dual product (40N(S) < latitude < 60N(S))

The control used the full operational observation set at that time and standard blacklisting was applied to the Metop AMVs.

- Significant increase in total number of AMVs assimilated, particularly at mid-levels (up to 200%)
- Impact on mean wind analysis and fit of other observations to the model background mostly neutral
  ➡ Metop AMVs already in good agreement with observing network

Forecast impact on vector wind for Single/Dual expt

Similar results for both experiments



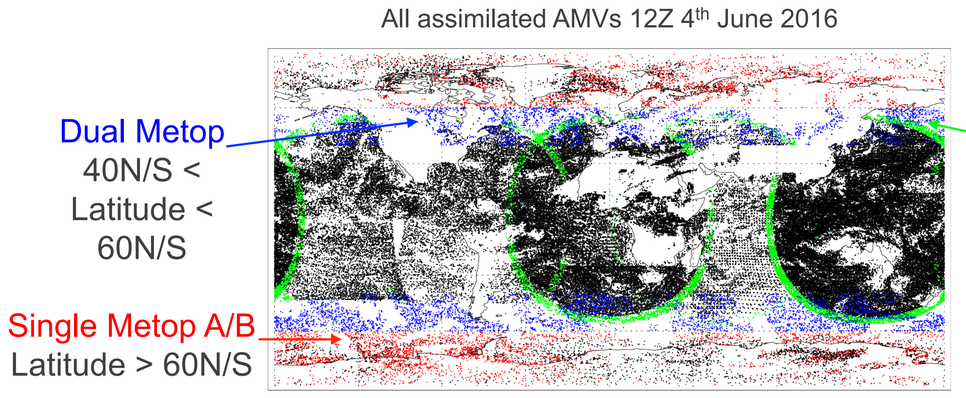
RMS error reduction in verification against analysis

Difference in RMS error normalised by RMS error of control

Combination of single and dual product selected for final configuration implemented in operations on 4th Feb 2016

Closing the gap

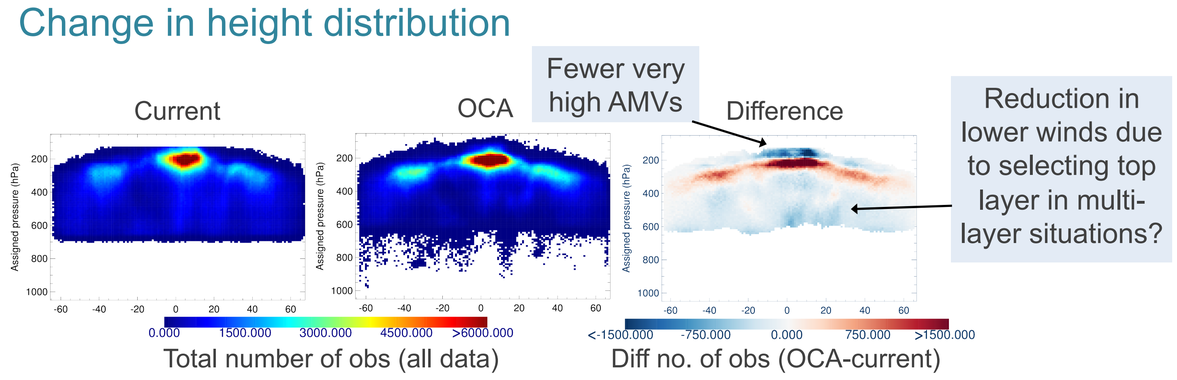
All assimilated AMVs 12Z 4th June 2016



Optimal Cloud Analysis

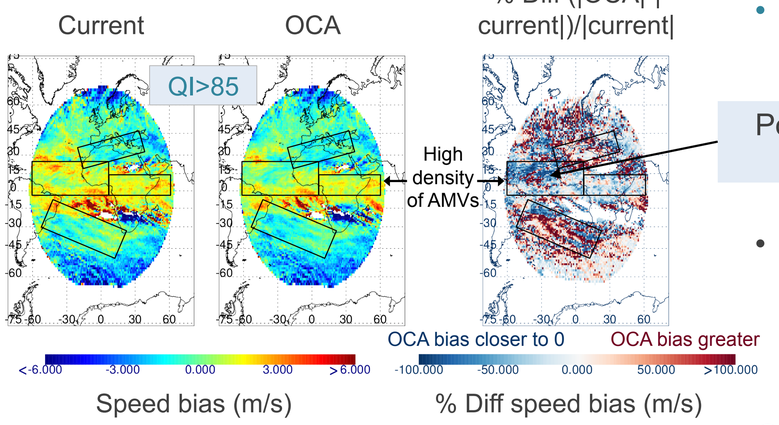
Meteosat-10 AMVs are provided with an alternative height assignment derived using OCA. This uses an optimal estimation method that extracts the cloud top height [2]. A key feature is the ability to process two-layer cloud situations. First guess departure statistics for 27th April – 26th May 2016 were analysed. Examples shown below use cloudy water vapour AMVs at 7.35μm.

Change in height distribution



High OCA AMVs concentrated into thinner pressure band

Data quality



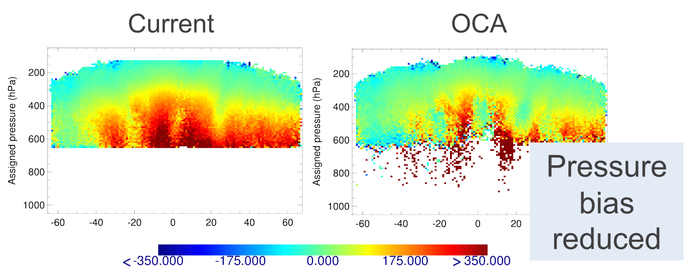
- RMSVD reduced especially around 300-500hPa.

Positive impact on speed bias for high level jet

- Mean speed of OCA AMVs mostly reduced apart from band roughly following increase in AMV number where speeds are higher.

➡ Generally reducing speed bias

- OCA statistics show many areas of improvement when compared to the wind field from the model background.
- Next step: assimilation experiments to test longer term forecast impacts and effects on other observations



Pressure bias reduced

References

[1] Salonen, K. and N. Bormann, 2016: "Atmospheric Motion Vector observations in the ECMWF system: Fifth year report", *EUMETSAT/ECMWF Fellowship Programme Research Report No. 41*

[2] Optimal Cloud Analysis: Product Guide, April 2016, EUMETSAT product guide, *EUM/TSS/MAN/14/770106, v2A e-signed*

Katie Lean is funded by the EUMETSAT Fellowship Programme