Characterising AMV Errors Using the NWP SAF Monitoring

15th International Winds Workshop

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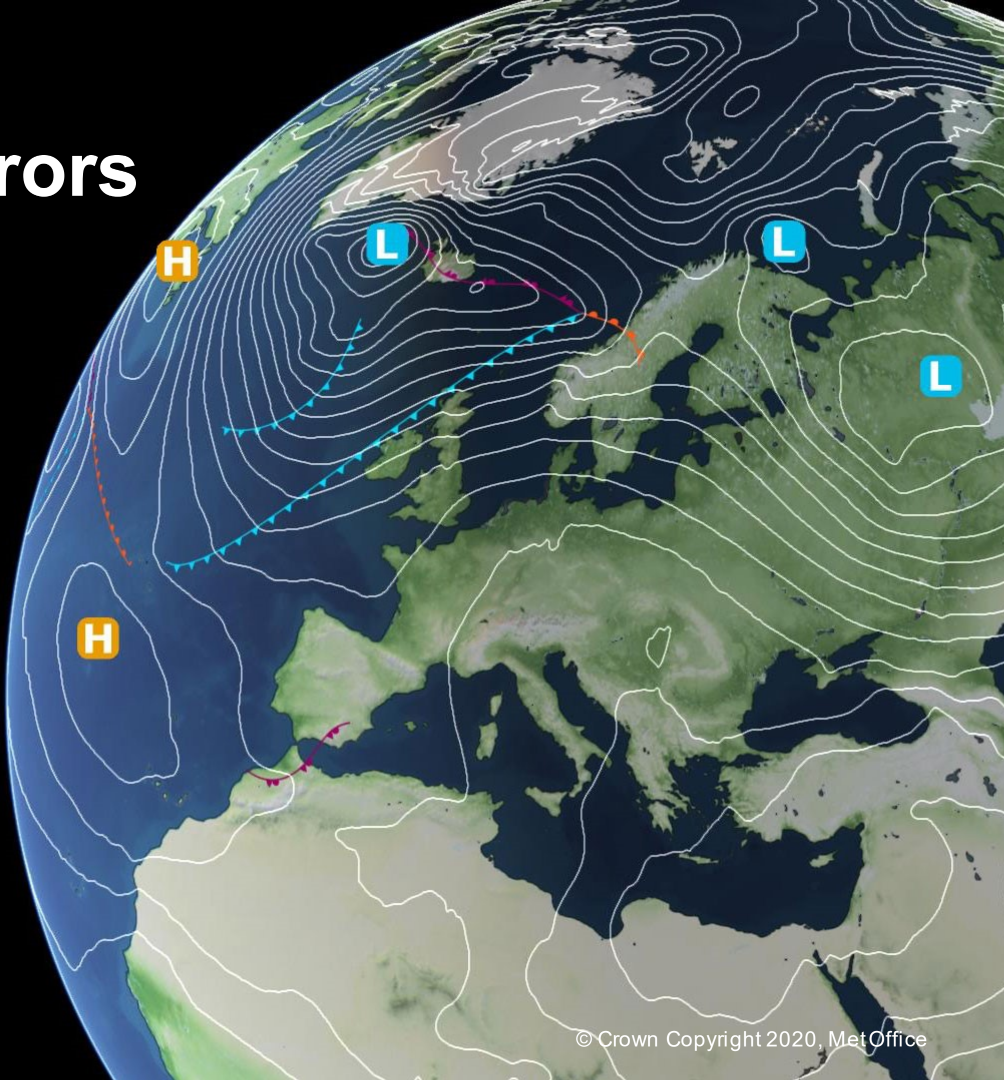

Met Office

EUMETSAT NWP SAF NUMERICAL WEATHER PREDICTION

NWP SAF AMV monitoring

Aim

Improve our understanding of AMV errors in order to enable improvements to the AMV derivation and their impact in NWP

Deliverables

- Monthly O-B monitoring (UKMO/ ECMWF)
- AMV-Lidar height collocations
- **Analysis reports**
- [Data use in NWP]

- Ahead of the IWW, a thorough evaluation of the AMV monitoring is documented in a series of analysis reports (AR)
- Reports identify features from the monitoring statistics and document how these evolve over time. Where possible attempts are made to diagnose the cause of the difference between the AMVs and the model.
- Latest report, AR9, published in Feb 2020

https://nwp-saf.eumetsat.int/site/monitoring/winds-quality-evaluation/amv/

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AMV data monitored (2021)

Geostationary AMVs	Producer	Channels
Meteosat-8/10/11	EUMETSAT	IR 10.8, WV 6.2, WV 7.3, VIS 0.8, HRVIS
Himawari-8	JMA	IR, WV 6.2, WV 6.7, WV 7.3, VIS
GOES-16/17	NOAA/NESDIS	IR, SWIR, WV, VIS
INSAT-3D/3DR	ISRO	IR, SWIR, WV, VIS
FY-2G	CMA	IR, WV
Leo AMVs		
Terra	NESDIS, DB	IR
Aqua	NESDIS, DB	IR, WV, CSWV
NOAA-15/18/19	CIMSS, DB	IR
Metop-A/B	CIMSS	IR
Metop-A/B/C	EUMETSAT	IR
Suomi NPP	NESDIS, DB	IR
NOAA-20	NESDIS	IR
Mixed AMVs		
LeoGeo	CIMSS	IR
Dual-Metop	EUMETSAT	IR
Stereo Motion Vectors		
Terra MISR	NASA-JPL	VIS

Additions since AR8
- GOES-16/17
- Meteosat-11
- NOAA-20
- INSAT-3DR

Archived
- GOES-13/15
- Meteosat-9

Pending
- GK-2A (BUFR)

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AR9 overview

New features identified	Updates on existing features	New addition
Feature 9.1: Orographic impacts Feature 9.2: Large vector differences near the South West African coast Feature 9.3: Differences between Met Office and ECMWF statistics for Himawari-8 Feature 9.4: EUMETSAT Metop low level AMVs in winter hemisphere Feature 9.5: Negative speed bias in tropics for GOES-16/17	Feature 5.2: MSG negative bias during Somali Jet Feature 8.1: Meteosat-8 (IODC) positive speed difference in the tropics Features closed: 2.7, 4.1, 5.1, 6.1, 5.3, 6.4, 7.4	"Status table" now documents the features that were active from AR8 and provides an update on their current status within the monitoring Saves looking back through all previous reports to get an overall picture

N.B. Features are referenced in the format X.Y, where X is the number of the analysis report where that feature was first described, and Y is the example number.

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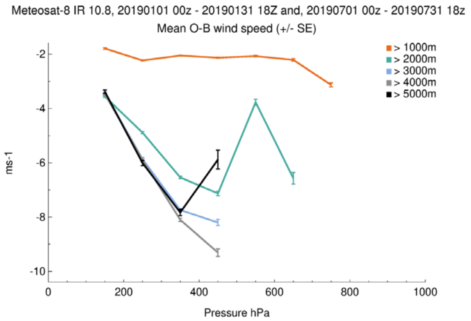
Status table example

Status of the active features identified in the AMV monitoring. Green shading denotes a new feature, blue denotes a feature than is fixed or considered closed. The AR column lists the analysis report numbers where that features is discussed. The AR9 column shows whether a feature is discussed further in this report.

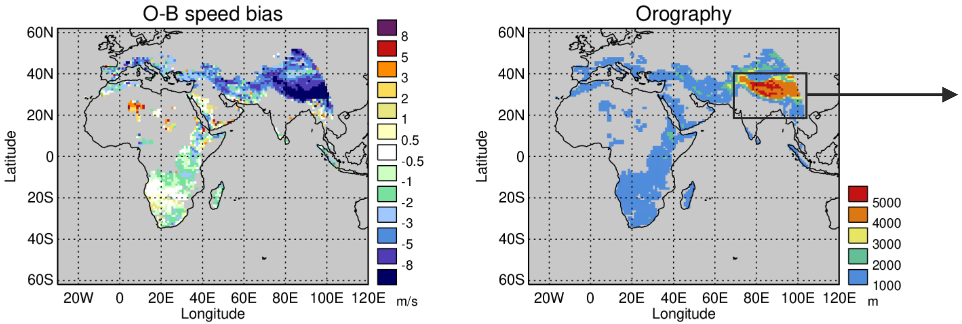
Ref. number	Feature name	AR	Status	AR9
Geostationary: low-level (below 700 hPa)				
2.3	GOES winter negative bias over NE America	2,3,6	Still present. Feature background: AR3 highlighted observations over land with a high height bias relative to the level of best-fit. This was linked to low level winds assigned to cloud base over sea, but not over land. AR6 showed a negative bias is also observed over N. Atlantic during cold air outbreaks which is linked to model forecast bias and difficulties in tracking the breakup of cloud along the SST front.	
2.6	MSG positive bias over N Africa	2,3,4,6	Still present. Feature background: A large positive wind speed bias is observed in the MSG IR and visible channels over North Africa and the Arabian Peninsula during winter. Although mainly over land, the bias does extend over the Atlantic to the west of Africa in January/February and moves northwards into the Mediterranean by May. AR4 linked the bias to large height assignment errors when tracking cirrus clouds, leading to very fast winds being assigned around 500 hPa too low. The feature closely matches the location of the sub-tropical jet stream. Investigated positive biases over Arabian Peninsula in July 2018 and July 2019. Case for 27 July 2018. IR channel shows AMVs are easterlies whereas background is west or north-westerlies. Observed pressures are typically 700-800 hPa, best-fit is 100-200 hPa. Imagery shows tracking thin cirrus moving from east to west. Appears to be a classic example of large height assignment error. Also noted lots of dust in the imagery but AMVs (600-700 hPa) for this appear to match the model well.	
2.7	Spuriously fast Meteosat and MTSAT winds	2,3,4,6,7	Closed. Satellites no longer active.	
4.1	Model differences in the Pacific	4,5	Closed. Models now more consistent.	
5.1	Patagonia negative bias	5	Closed. No longer present following the change from GOES-13 to GOES-16.	
5.2	MSG negative bias during Somali jet	5,6	Still present – see update. Feature background: SEVIRI AMVs from Meteosat-8 and Meteosat-10 show a large negative wind speed bias during July and August in the NW Indian Ocean, near the Gulf of Aden. This time period coincides with the strengthening of the Somali Low-Level Jet. Previous investigation has shown the bias is due to instances of height assignment error, with slow upper level vectors incorrectly assigned within the fast, low-level wind regime, and the influence of an island (Socotra) causing semi-stationary wave cloud formations within the jet.	Y

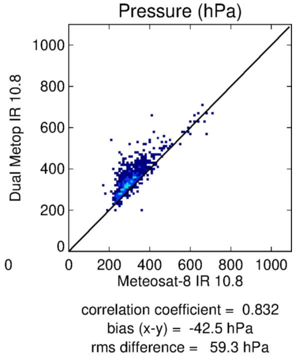
9.1 Orographic impacts

Met-8 vs Dual Metop



Met Office: Meteosat-8 IR 10.8 AllLev, January 2019





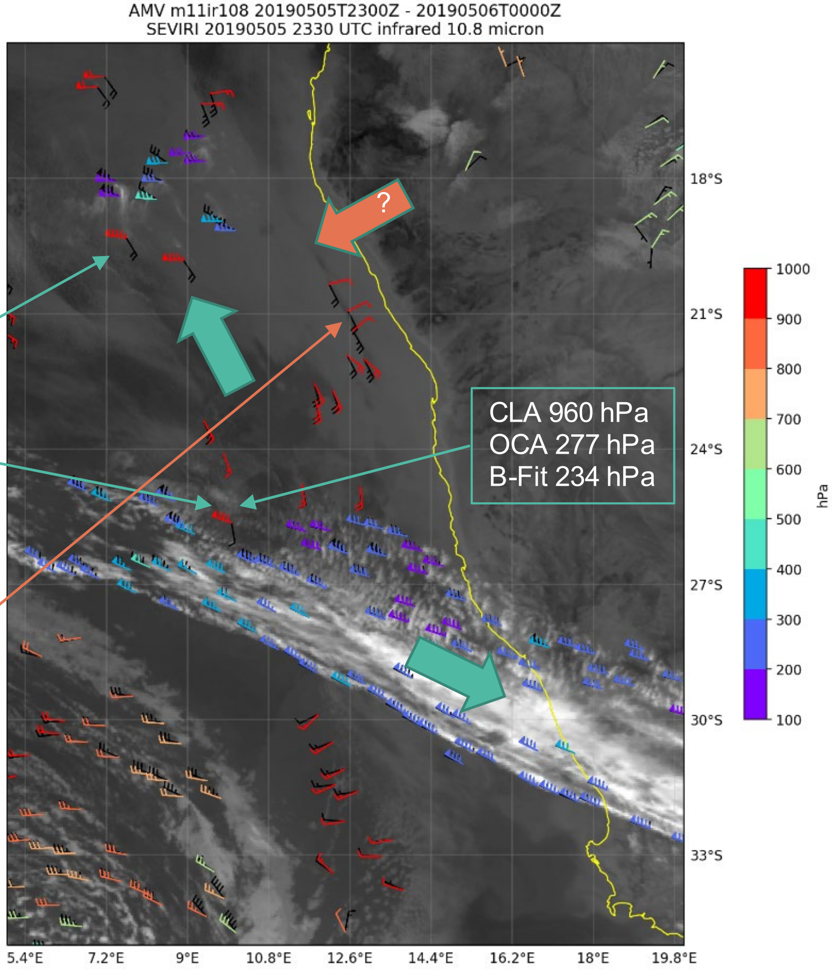
- Meteosat-8 shows the largest impact due to high land surfaces, mainly the Himalayan Plateau.
- Find a strong negative speed bias for most of the year, except in NH summer.
- In both summer and winter, there is a consistent 50 hPa height difference between Meteosat-8 and both Himawari and dual Metop in this area.
- This height bias has less of an impact in summer where the vertical wind shear is less.

9.2: Large vector differences near SW African coast

At least 2 causes identified

- Upper-level westerlies assigned to 960 hPa
- Calipso overpass shows this occurs in a multi-layer cloud scenario (common due to the prevalence of low cloud). AMVs assigned heights with OCA are often much improved in these situations

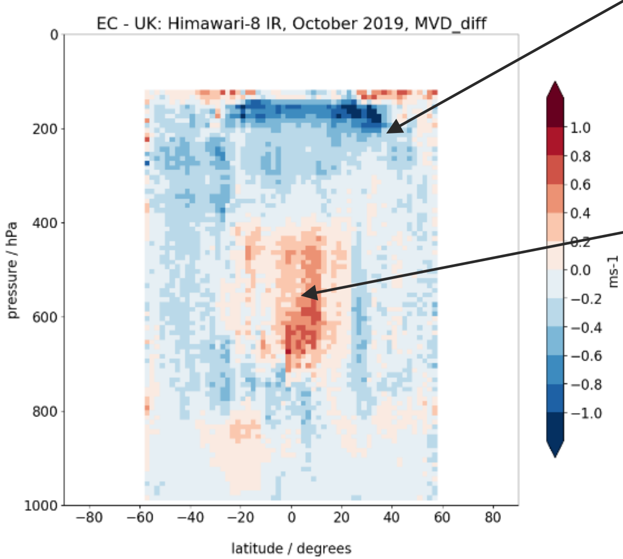
- Well-defined break in low cloud shows an apparent motion perpendicular to both the model and other nearby AMVs assigned to 960 hPa.
- Motion of rear edge of cloud is not representative of the local wind?
- Helpful to view animation:



https://nwpsaf.eu/monitoring/amv/animations/m11ir108_20190505T2100Z_20190506T2100Z.gif

9.3: Differences between Met Office and ECMWF statistics for Himawari-8

- Zonal statistics for Himawari-8 show noticeable differences between ECMWF and Met Office models
- At upper levels, particularly above 200 hPa height, MVD are consistently lower for ECMWF compared to the Met Office
- At mid-level in the tropics, MVD are consistently lower for the Met Office
- Differences in the way Himawari-8 winds are used in data assimilation
- Could also reflect wider NWP model uncertainties in this area.

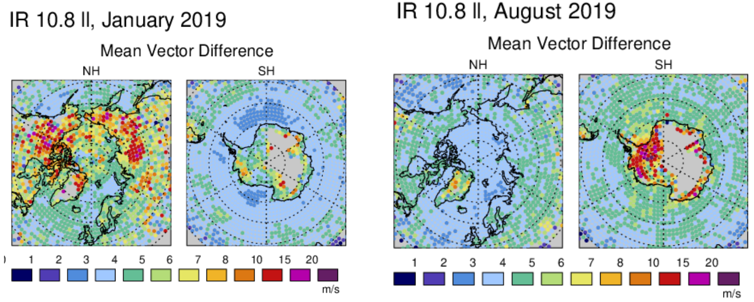


Blue - ECMWF lower MVD

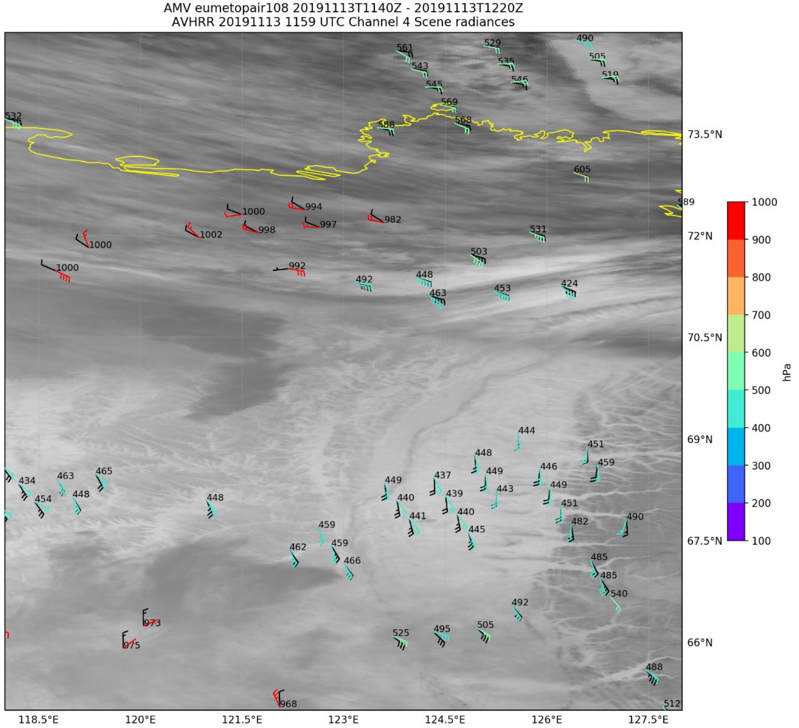
Red -Met Office lower MVD

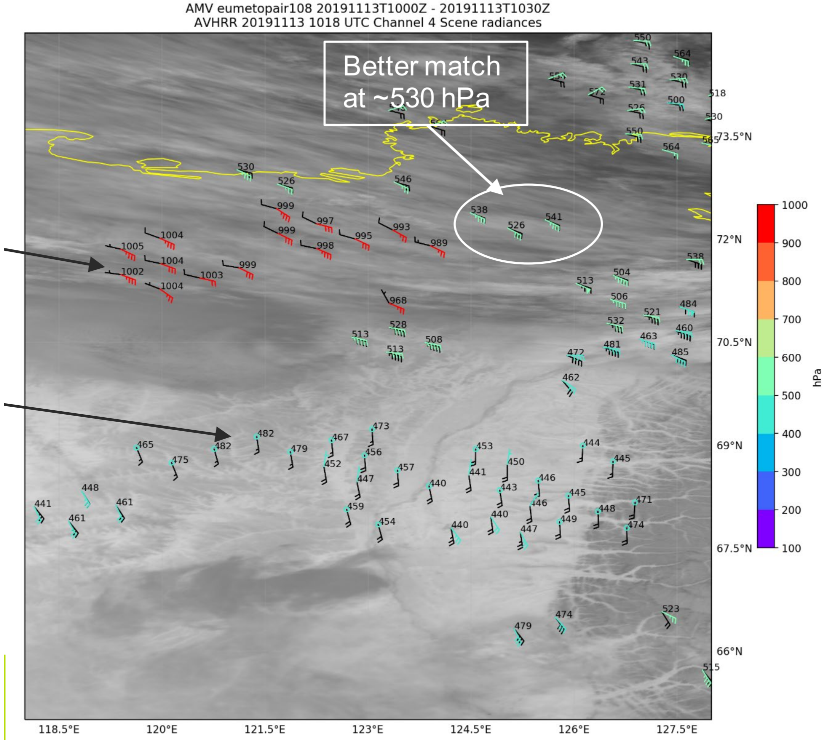
9.4: EUMETSAT Metop low level AMVs in winter hemisphere

Metop-B



- Spee seen level
- Case assig near
- AMVs identi to 40
- Track geo-r
- Next





Summary and plans

- The status of existing features identified in the monitoring has been updated to reflect changes in the past two years.
- Seven previously active features are now considered closed because the signal is no longer prominent, some of which are related to a change in satellite.
- Seeking feedback on reports (good and bad!).
- Any areas where data producers would like to collaborate on for next report to tackle ongoing issues?
- CDOP3: DWD preparing lidar-AMV height monitoring results for web display (Q2 2021)
- CDOP4 (March 2022-)
  - DWD model to be added to AMV (and Scatt) monthly monitoring
  - Adapting to new lidars (e.g. EarthCare) and inclusion of model best-fit pressure for triple height comparison (lidar/AMV/model)
  - New AMV data sets from EPS-SG/MTG, including hyperspectral winds from IRS