AMV MONITORING:

RESULTS FROM THE 4th NWP SAF ANALYSIS REPORT

James Cotton and Mary Forsythe, 10th International Winds Workshop, Tokyo, 23 February 2010

Contents

This presentation covers the following areas

- Introduction
- Updates since IWW9
- Examples from 4th Analysis Report
- Future developments
- Summary

Introduction

Introduction

Website

http://research.metoffice.gov.uk/research/interproj/nwpsaf/satwind_report/

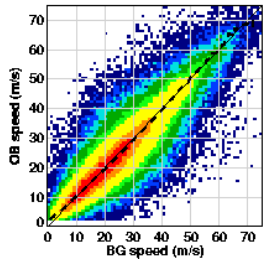
- Apologies for access problems with NWP SAF website - "www" replaced by "research“ please update your bookmarks as appropriate.

Aims

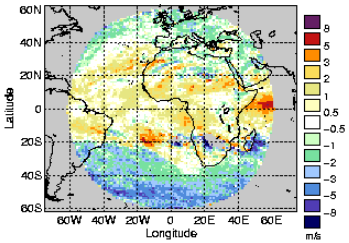
• Provision of rolling 3 year archive of monthly monitoring plots (Met Office and ECMWF)

• Production of biennial analysis reports – core is a maintenance of a record of features identified in the O-B monitoring

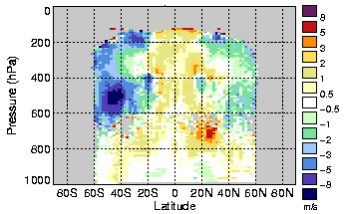
• Increase our understanding of the AMV errors and identification of improvements to AMV derivation and assimilation – enhance impact in NWP.



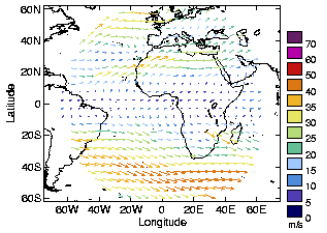
Speed bias density



Map



Zonal



Vector

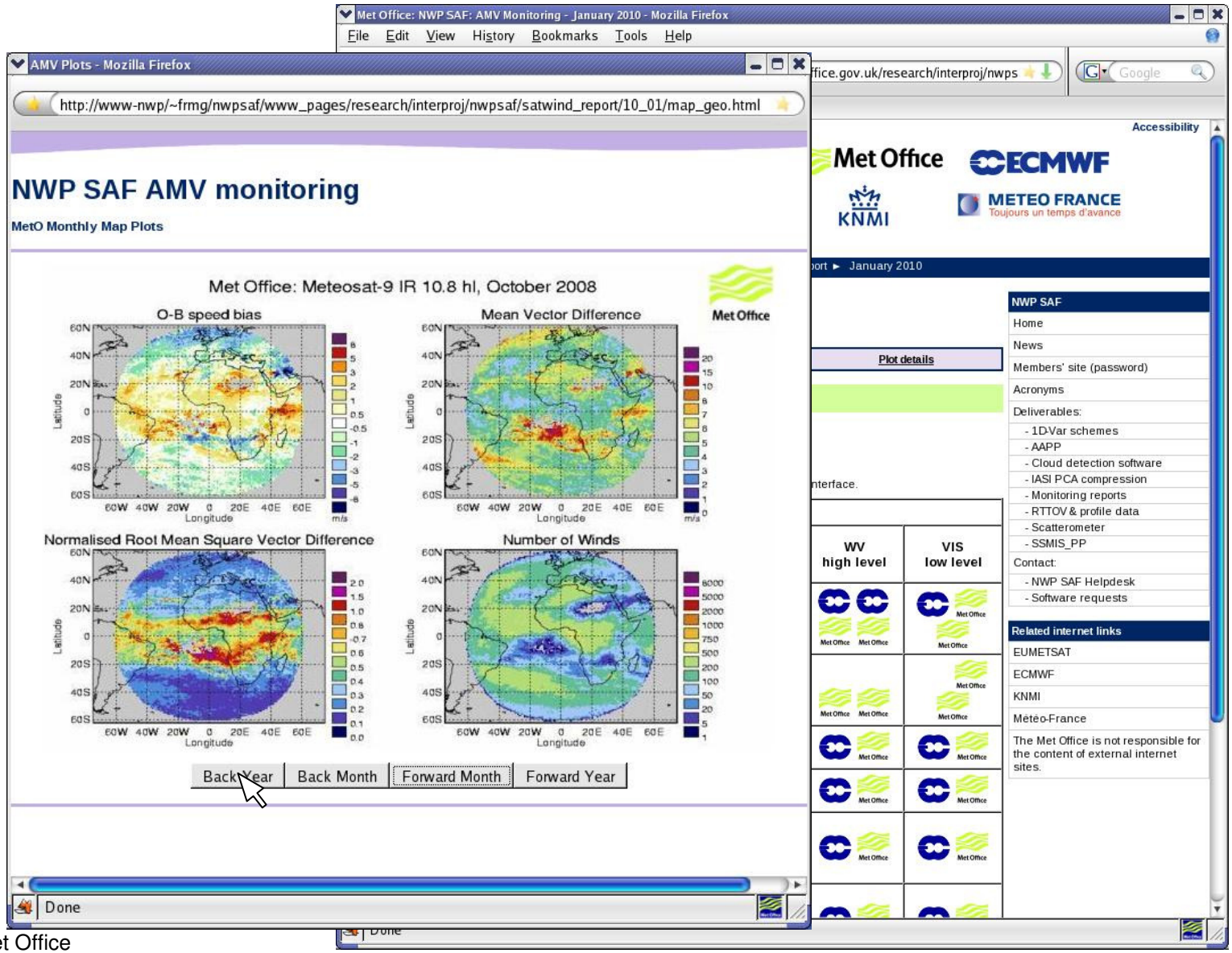
Updates since IWW9

Updates since IWW9

- Buttons to allow easy comparison of plots across different months and years
- New investigations section
- New data sets added including NOAA-19 AVHRR polar winds (assimilated UKMO since 16 Feb'10), MODIS/AVHRR winds from new direct broadcast stations and Meteosat-8 rapid scan winds
- Improved consistency of speed bias density plots between Met Office and ECMWF (colour scales, standard deviation calculation)

New Buttons

Useful tool for looking at seasonal patterns



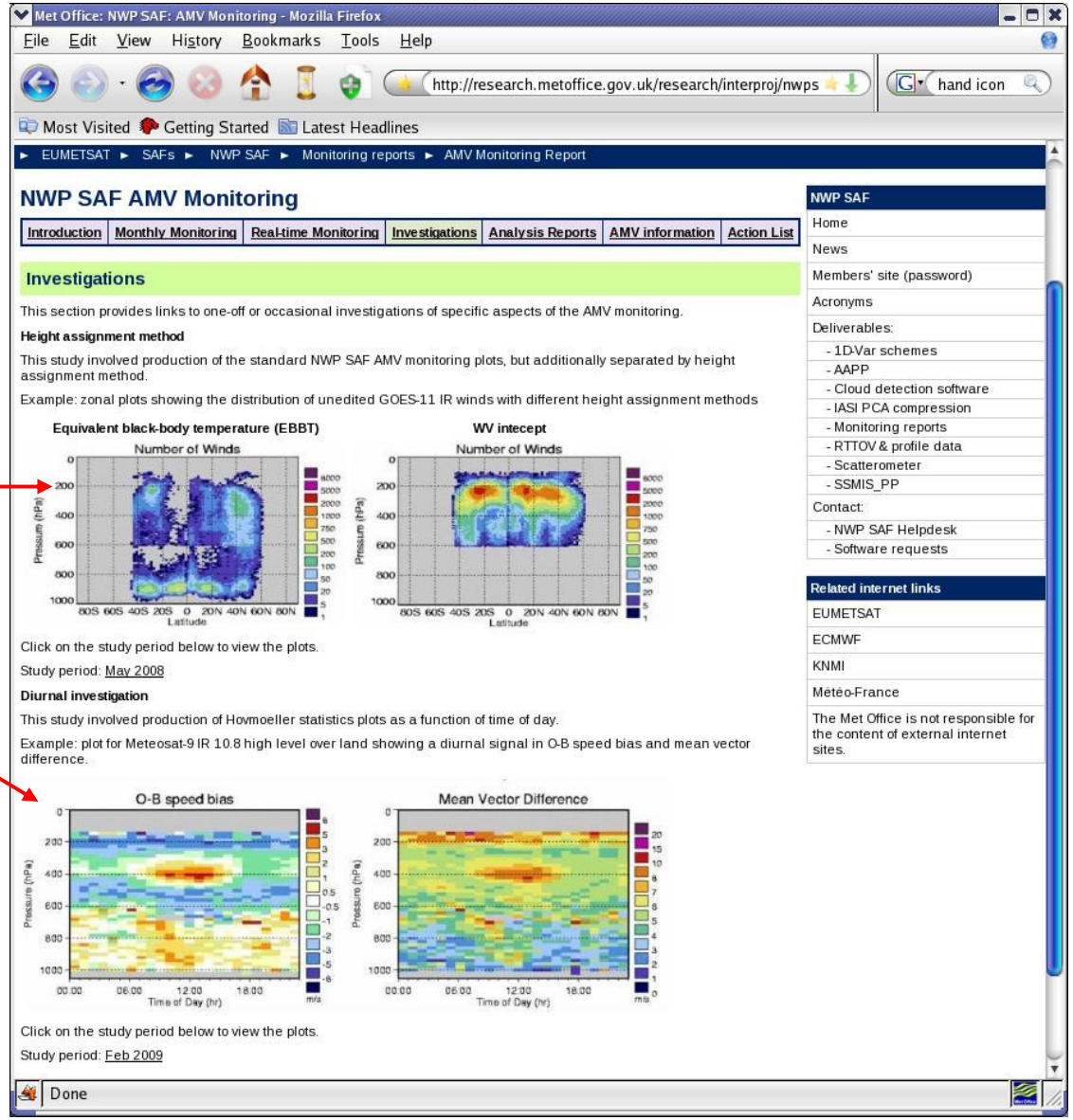
Investigations

One-off investigations of specific aspects of AMV monitoring

Two have been added:
O-B stats as function of

1) HA method

2) Time of Day

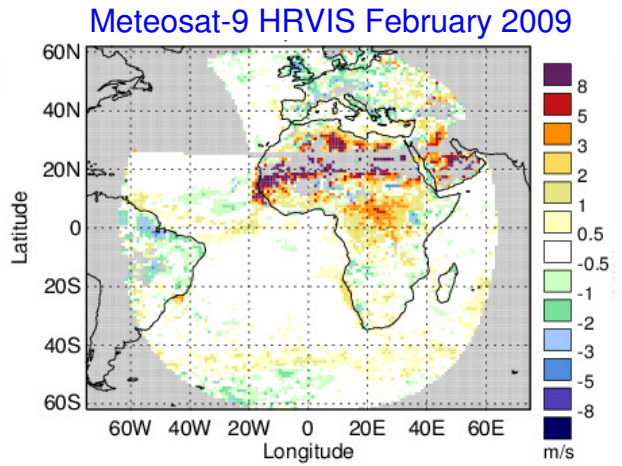


Examples

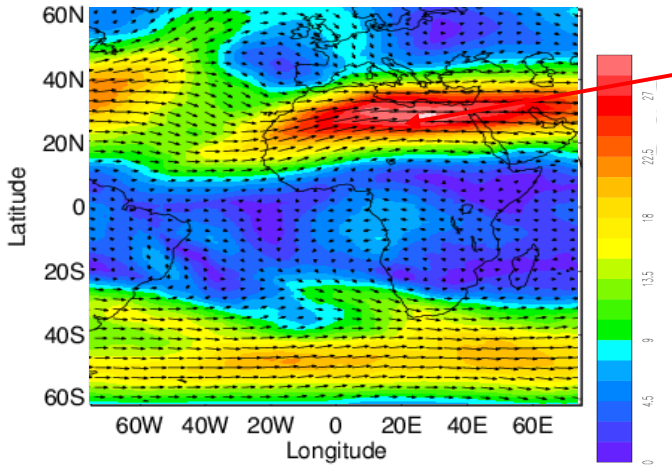
from 4th NWP SAF Analysis report J.Cotton & M.Forsythe, Jan 2010

Example 1

low level fast bias over Africa



O-B speed bias



Mean MetO 200 hPa analysis wind speed

- Low level fast bias observed in IR and visible channels over much of North Africa
- Present all year but location varies with seasons
- Peak in NH winter months around 10-30N over Sahara - but also extends north into Mediterranean during summer months

- Example of fast bias seen in high resolution visible, Feb 2009
- Vector plots show AMVs have very strong westerly component compared to model
- Peak in fast bias corresponds well with the location of high level sub-tropical jet as it crosses North Africa – also peaks in strength around February

Example 1

low level fast bias over Africa

Case study: 17 Feb 2009 (1200 UTC)

Band of fast speed bias exceeding 20m/s across Libya/Algeria for AMVs much faster than those nearby in the Mediterranean.

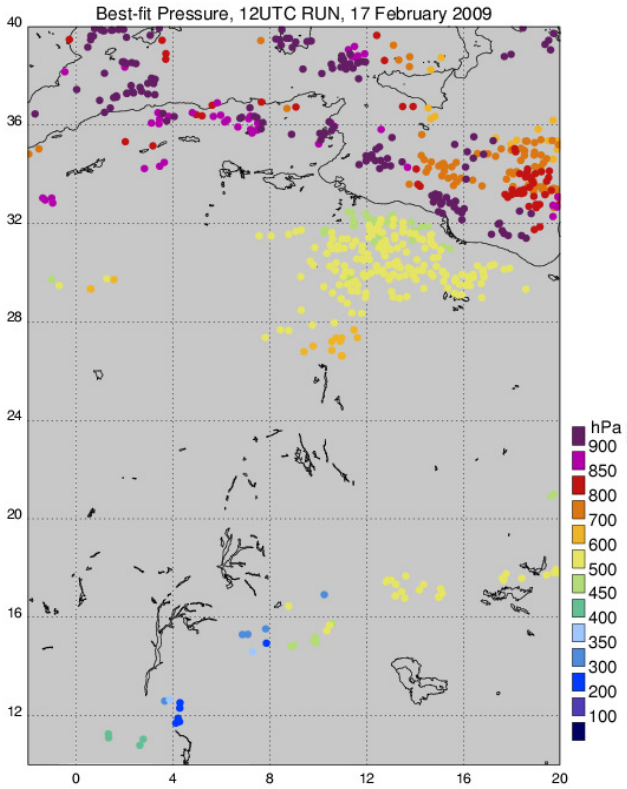
Large difference between observed and model best-fit pressures..

In worst case:

AMVs assigned below 900 hPa

whilst model best-fit pressure is around 500 hPa.

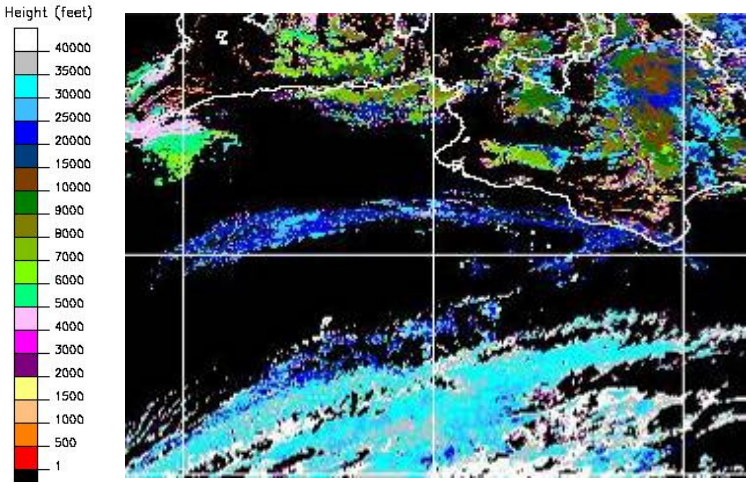
Meteosat-9 HRVIS February 17 2009



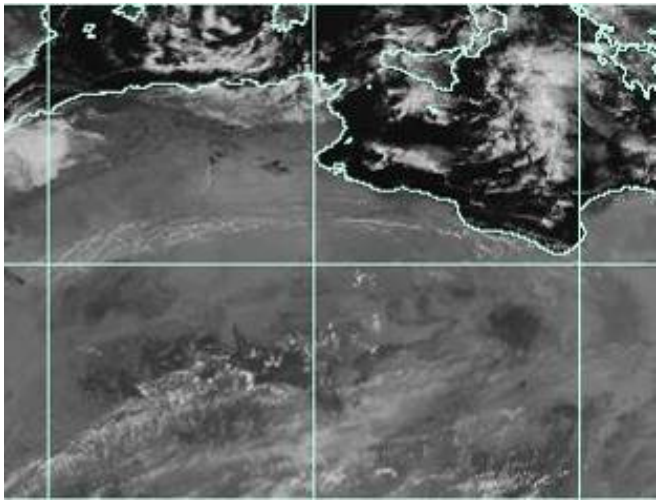
Example 1

low level fast bias over Africa

Case study: 17 Feb 2009 (1200 UTC)



Meteosat-9 visible imagery



Are AMVs being put too low? Yes, according to best-fit pressure and Met Office MSG cloud top height product (above). The cloud tops (shown in dark blue) of 20,000ft ~ 465 hPa agree well with model.

Why being assigned too low?

Imagery shows AMVs associated with a band of high semi-transparent cloud. Cloud base HA used here will tend to put these too low due to contributions from below the cloud.

CO2 slicing pressures (500-700 hPa) agree better but not used as cloud top temps warmer than 253 K threshold.

Example 1

low level fast bias over Africa

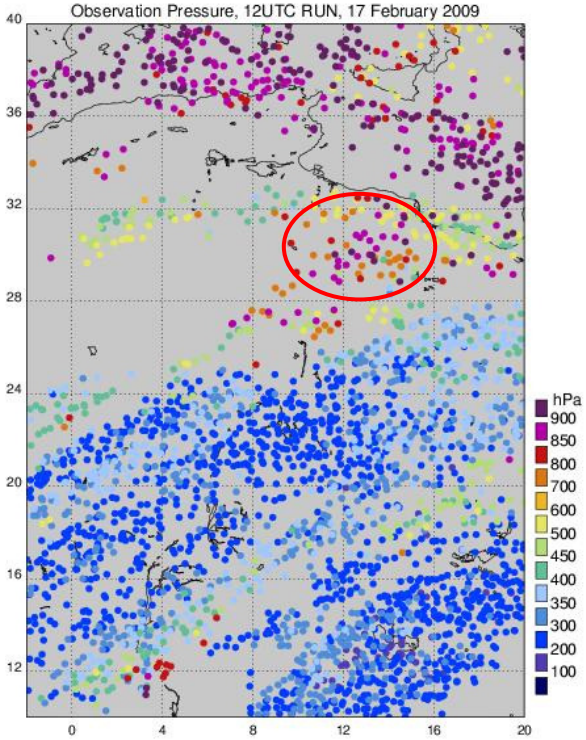
Case study: 17 Feb 2009 (1200 UTC)

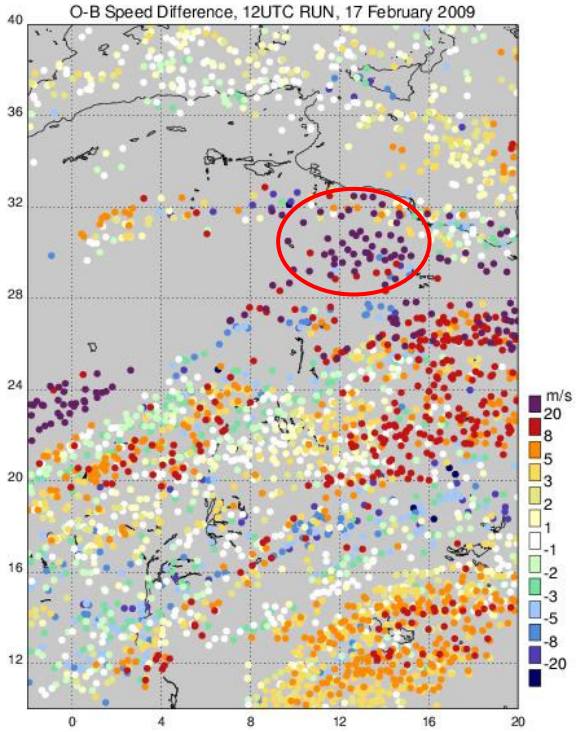
Meteosat-9 IR 10.8 February 17 2009

IR AMVs any better for this case?

- Generally assigned slightly higher at 400-700 hPa
- Still some low level winds with large fast bias

(obs- model best-fit press > 400 hPa)



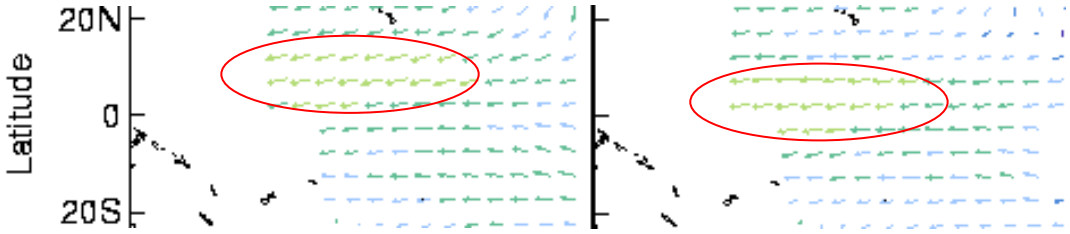


Example 2

low level slow bias in equatorial Pacific.

MetO and ECMWF plots usually **identical** but there is some variation..

GOES-11 visible and IR plots from both centres show fast bias near 15N. However, MetO plots also show slow bias around equator which is not present for ECMWF.

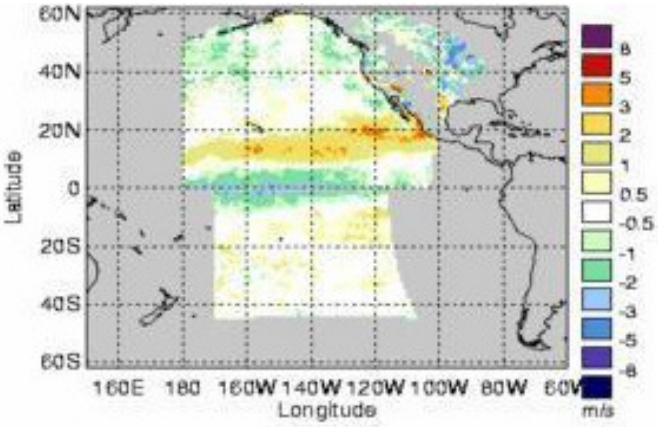


Observations Met Office model

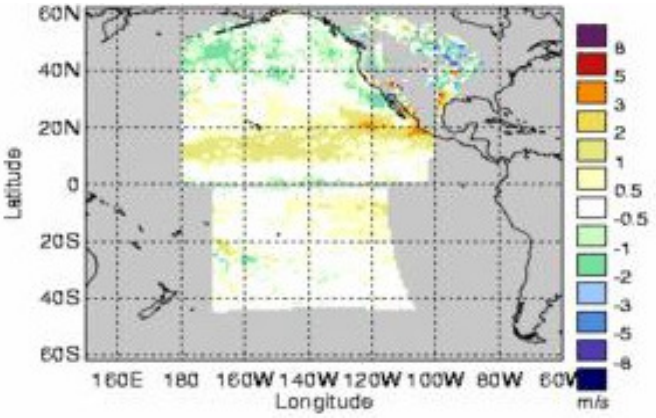
Met Office model has max equatorial wind located further south compared to AMVs resulting in paired fast and slow bias.

In this case, neutral ECMWF bias in tropics suggests bias may be in MetO model and not an issue with AMVs.

Met Office



ECMWF



GOES-11 VIS April 2009

Example 3

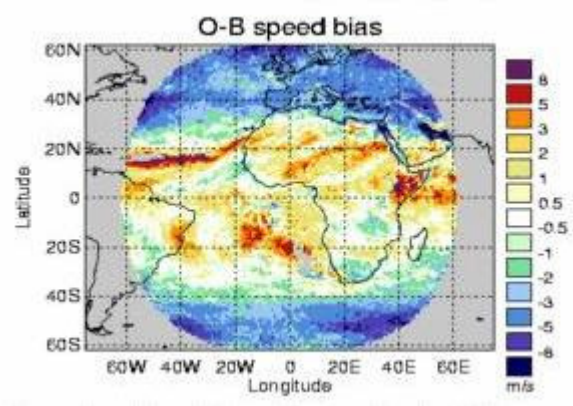
High level Jet region slow bias

Slow bias in Jet regions is frequently described problem. What we know so far:

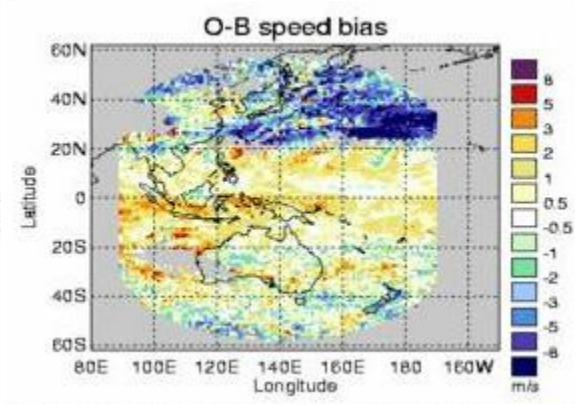
- Worse in winter months/hemisphere when Jets strongest
- Affects most satellite-channel combinations to some extent – worse for Meteosat-7 IR, WV and MTSAT-1R IR.

Recent examples taken from January 2010..

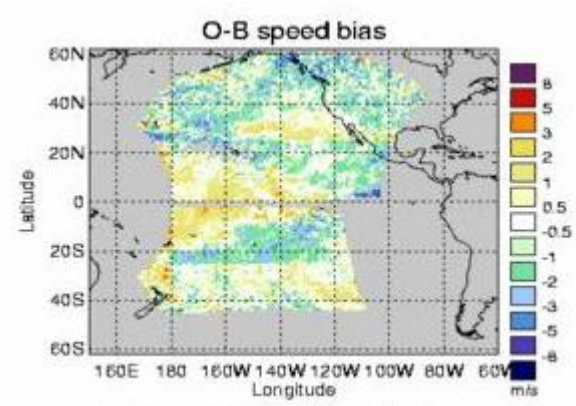
NB: bias is masked by autoeditor speed increase in edited product



Meteosat-9 IR 10.8



MTSAT-1R IR



GOES-11 WV

Can looking at case studies improve our understanding?

Example 3

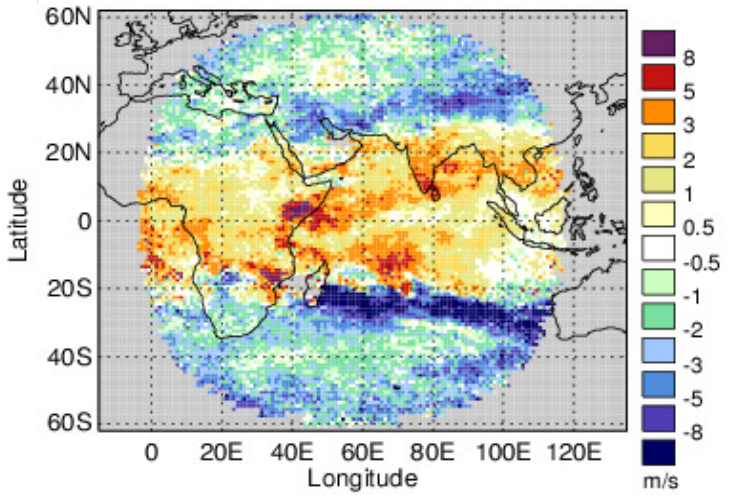
High level Jet region slow bias

Meteosat-7 WV Indian Ocean – large slow bias feature

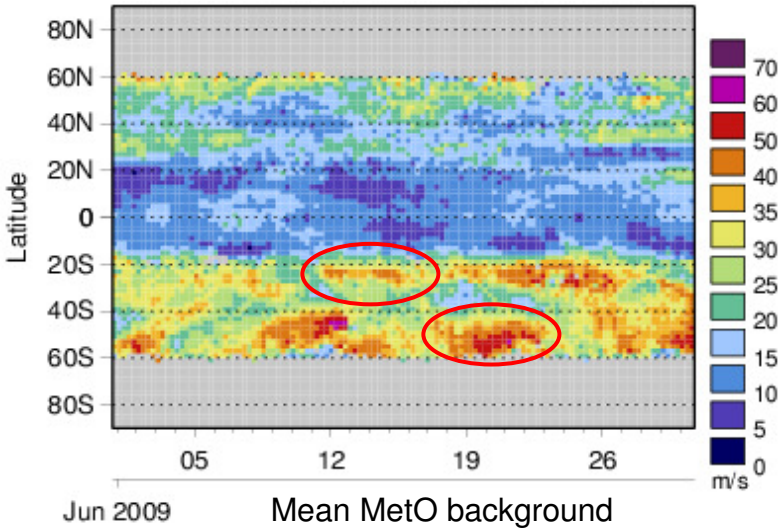
- Persist May-Sept (SH Winter)

Example for June 2009

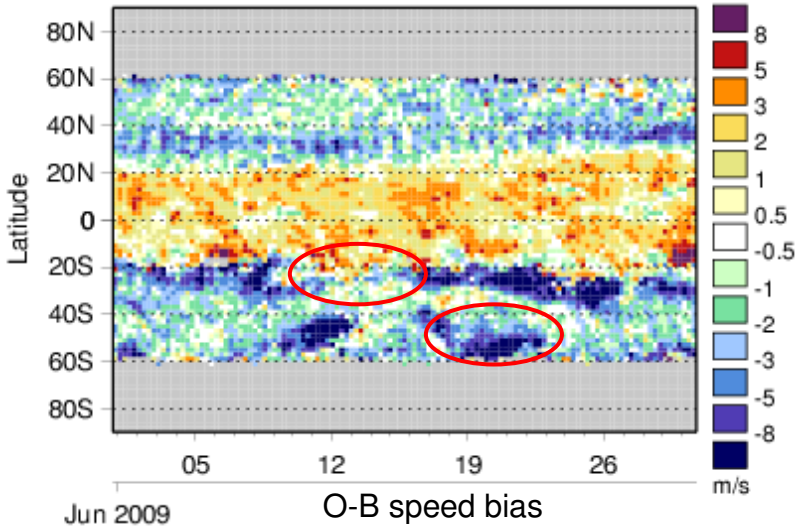
- Closely matches location of sub-tropical Jet around 20-30S
- Feature varies throughout June but not always coinciding with fastest wind speeds e.g.



O-B speed bias June 2009



Mean MetO background

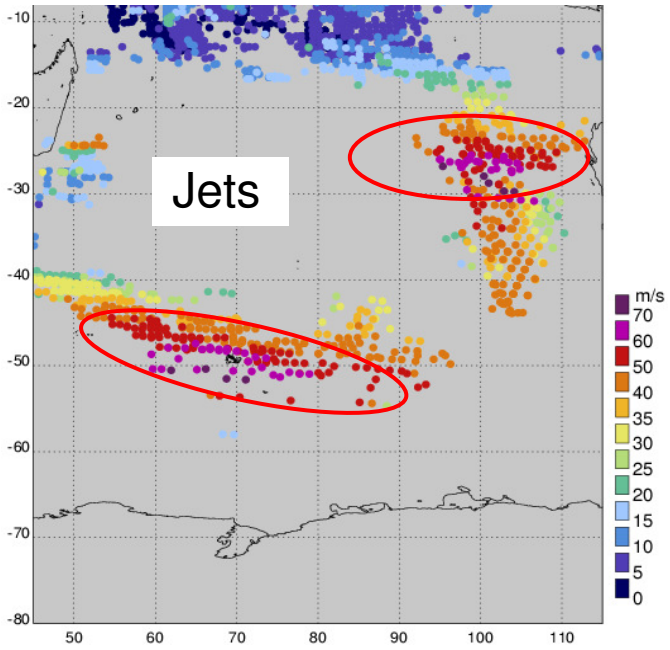


O-B speed bias

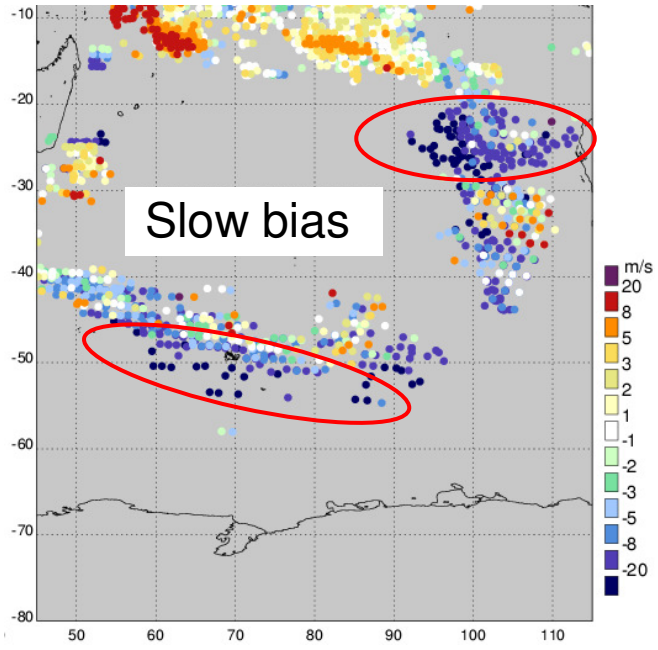
Example 3

High level Jet region slow bias

Case Study 1) 22 June 2009, 00UTC



MetO model background wind speed



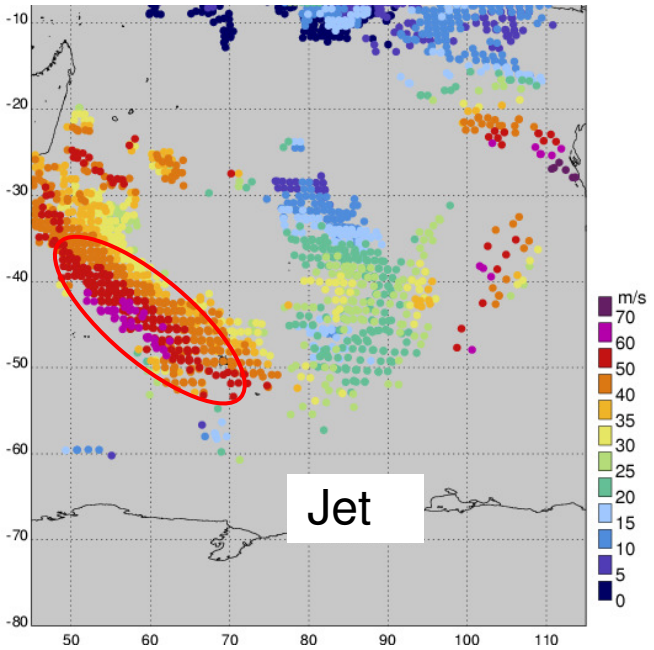
O-B speed bias

Both sub-tropical Jet and Polar Jet show fast model wind speeds (>70 m/s) for AMVs (WV) associated with large slow biases

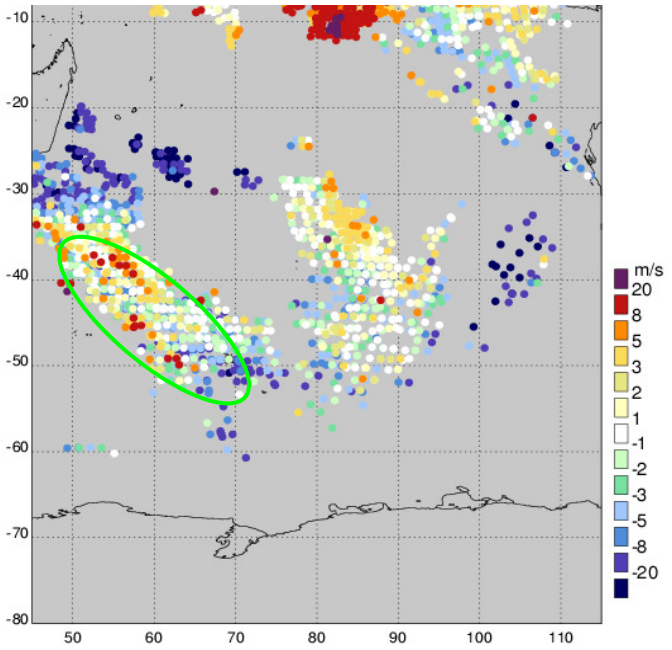
Example 3

High level Jet region slow bias

Case Study 2) 29 June 2009, 00UTC



MetO model background wind speed



O-B speed bias

Jet to SE Madagascar shows fast wind speeds, but AMVs in this case with neutral (or even slightly fast) bias.

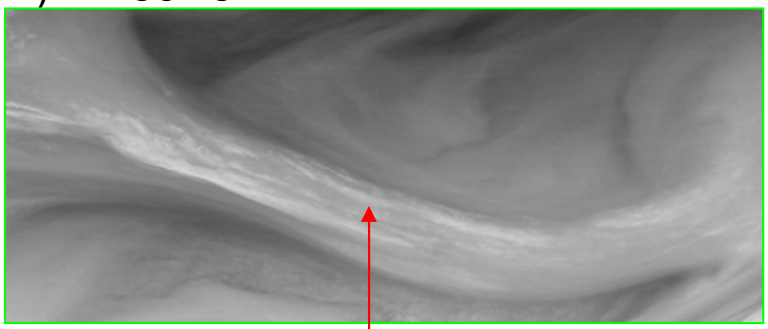
Why large slow biases associated with very fast winds in some cases and not others?

Example 3

High level Jet region slow bias

Looking at the WV imagery may help

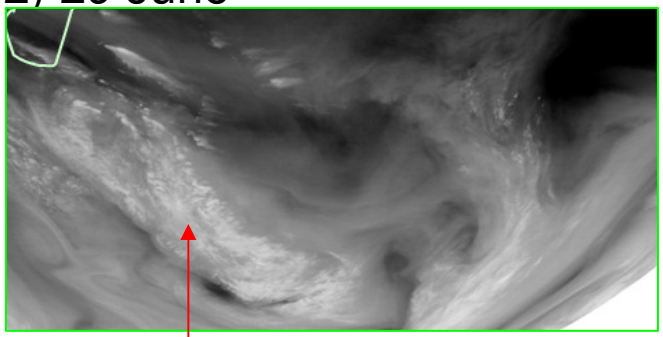
1) 22 June



Feature exhibiting large slow bias

- Narrow jet core
- Smooth linear features aligned parallel to direction of wind

2) 29 June



Feature with fairly neutral bias

- Much wider
- Less regular - more contrast details perpendicular to flow

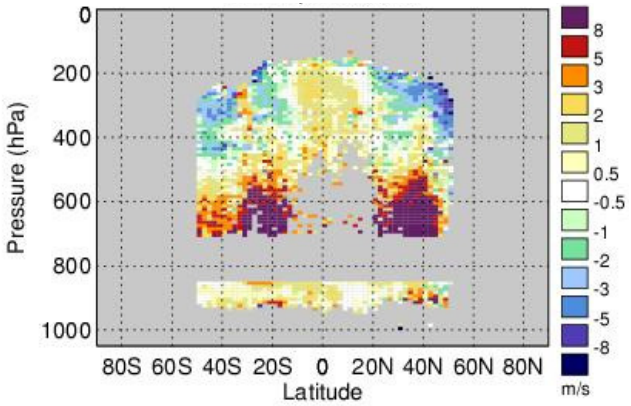
Model speeds are similarly fast in both instances but AMV speed is much less in case 1).

Differences in texture of the two features may be affecting success of tracking step (rather than a HA issue). Hard to be certain..

Example 4

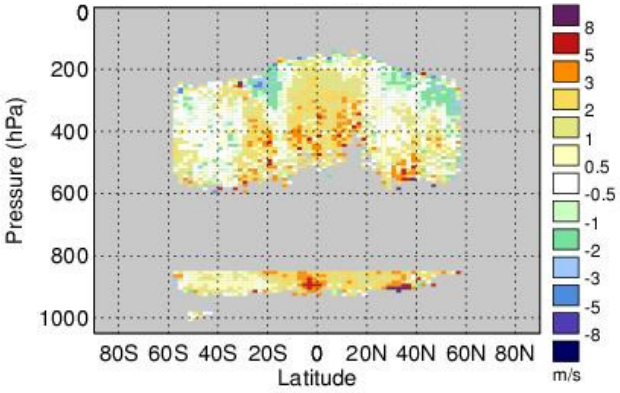
Features resolved

MTSAT-1R mid level fast bias



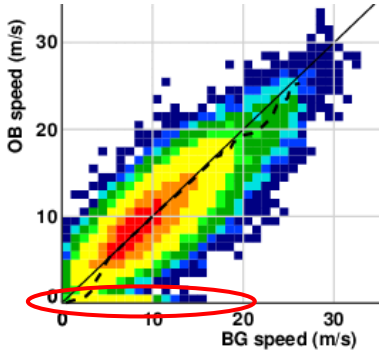
1-18 May 2009 (IR)

JMA derivation change 19 May – improved HA scheme



19-31 May 2009

NESDIS MODIS IR slow streak

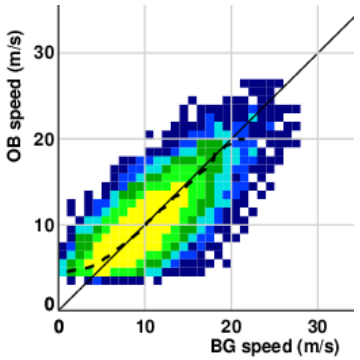


October 2009

e.g. Aqua IR NH low level

Caused by tracking of stationary surface features (navigation error)

27 October 2009 NOAA/NESDIS processing change remove winds < 4 m/s



November 2009

Future Developments

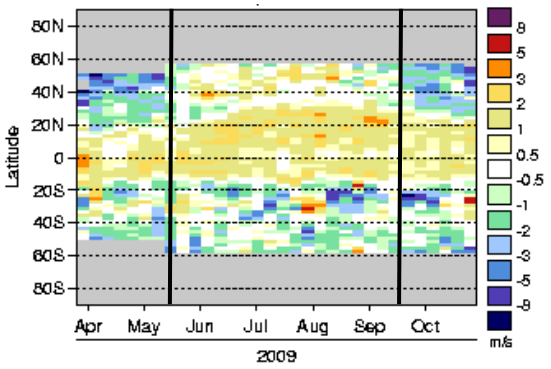
to NWP SAF AMV monitoring

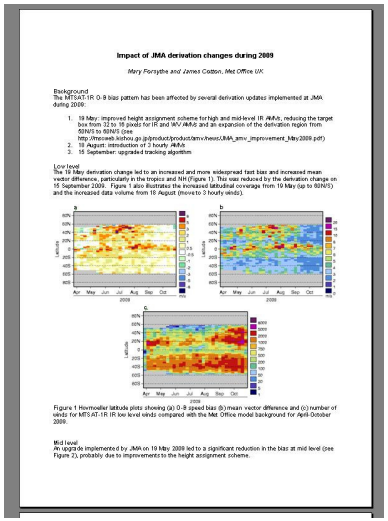
Future developments

- Routine production of Hovmoeller plots for monthly monitoring –proven useful for looking at temporal variability

- Participation from more NWP centres - low priority: Met Office and ECMWF plots similar but differences can occur

- Updates on significant AMV monitoring events e.g. several JMA derivation changes were made during production of 4th analysis report. Short summary document was produced outlining impact of the changes on O-B monitoring statistics (combined changes lead to an overall improvement in AMV quality and spatial/temporal coverage).





Summary

Summary

• NWP SAF AMV monitoring website holds a comprehensive record of monthly O-B statistics. Monitor 13 satellites, ~12000 plots every 2 years.

• Analysis reports produced every 2 years to tie in with International Winds Workshops.

⇒ Feedback on new data sets to NWP centres/providers e.g. NOAA-19

⇒ Record of features – better understand AMV errors. Often relate to difficulties in height assignment in multi-level cloud regions and exacerbated by high vertical wind shear.

• Improvements have resulted from this work. Plan to continue with this and expand on one-off investigations (rather than wait for biennial reports).

• Other options depend on user requirements.

Questions