AMV Monitoring

Results from the 3rd NWP SAF Analysis

Mary Forsythe and Roger Saunders, 9th International Winds Workshop, Annapolis, U.S.A., 15 April 2008

Introduction

Web link:

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

Primary aim:

- to provide monthly monitoring plots and biennial analysis reports with the aim of improving AMVs and their treatment in NWP models.

Contents

This presentation covers the following areas

- Changes since 8IWW
- Examples from the 3rd analysis report
- Recommendations
- Future developments to the NWP SAF AMV monitoring
- Summary

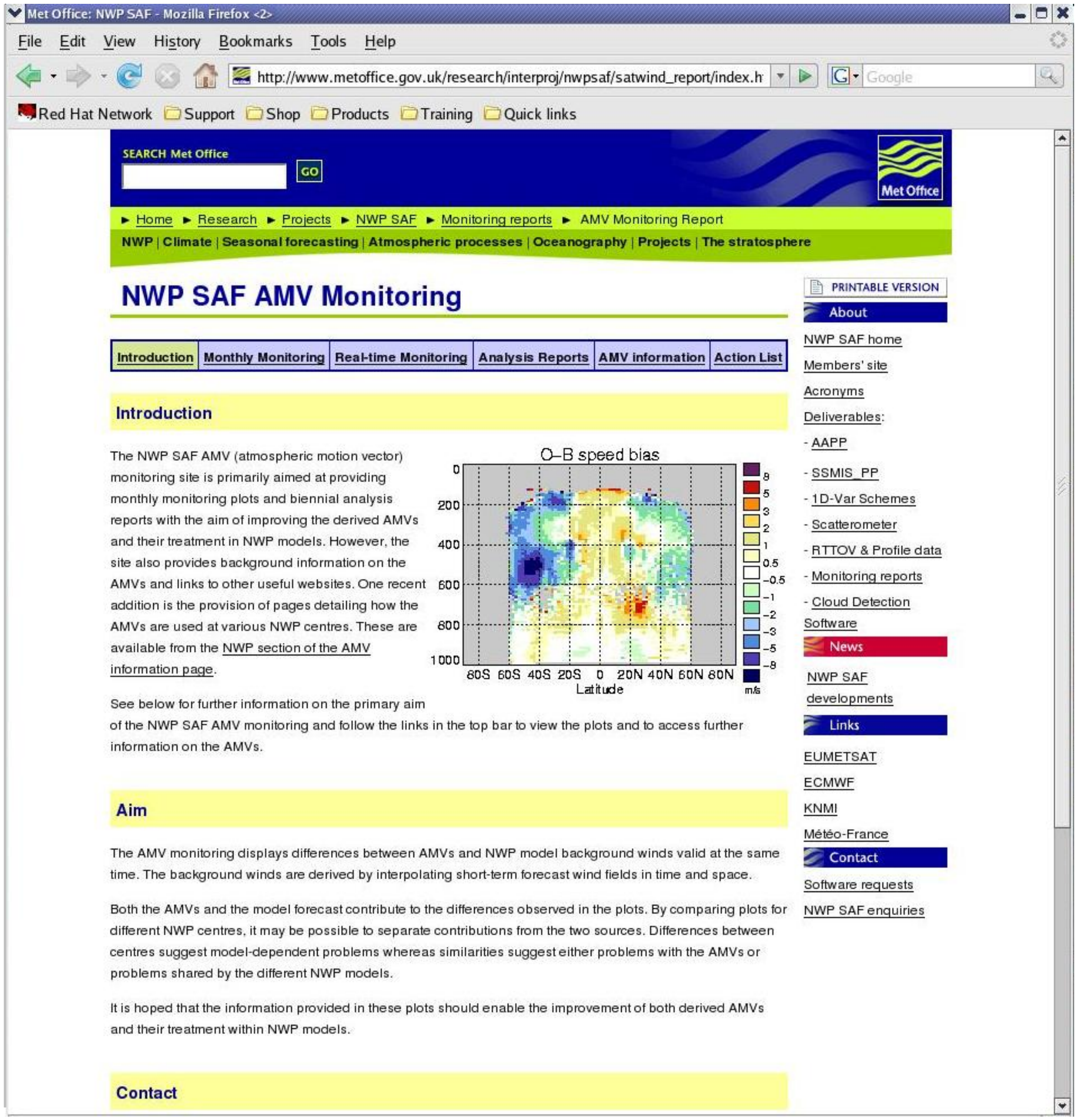
Changes

To the NWP SAF AMV monitoring since 8IWW

Changes

- Site layout updated
- Added information on NWP AMV usage from more centres (requested at 8IWW)
- Reduced inconsistencies between ECMWF and Met Office plots
- Moved to forecast-independent QI for pre-filtering
- Colour scales updated and expanded
- Added new datasets including:
  - unedited GOES and MODIS winds (requested at 8IWW)
  - NOAA 15-18 AVHRR polar winds
  - MODIS direct broadcast polar winds

New layout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http://www.metoffice.gov.uk/research/interproj/nwpsaf/satwind_report/index.h

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NWP SAF AMV Monitoring

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Introduction

The NWP SAF AMV (atmospheric motion vector) monitoring site is primarily aimed at providing monthly monitoring plots and biennial analysis reports with the aim of improving the derived AMVs and their treatment in NWP models. However, the site also provides background information on the AMVs and links to other useful websites. One recent addition is the provision of pages detailing how the AMVs are used at various NWP centres. These are available from the NWP section of the AMV information page.

See below for further information on the primary aim of the NWP SAF AMV monitoring and follow the links in the top bar to view the plots and to access further information on the AMVs.

Aim

The AMV monitoring displays differences between AMVs and NWP model background winds valid at the same time. The background winds are derived by interpolating short-term forecast wind fields in time and space.

Both the AMVs and the model forecast contribute to the differences observed in the plots. By comparing plots for different NWP centres, it may be possible to separate contributions from the two sources. Differences between centres suggest model-dependent problems whereas similarities suggest either problems with the AMVs or problems shared by the different NWP models.

It is hoped that the information provided in these plots should enable the improvement of both derived AMVs and their treatment within NWP models.

Contact

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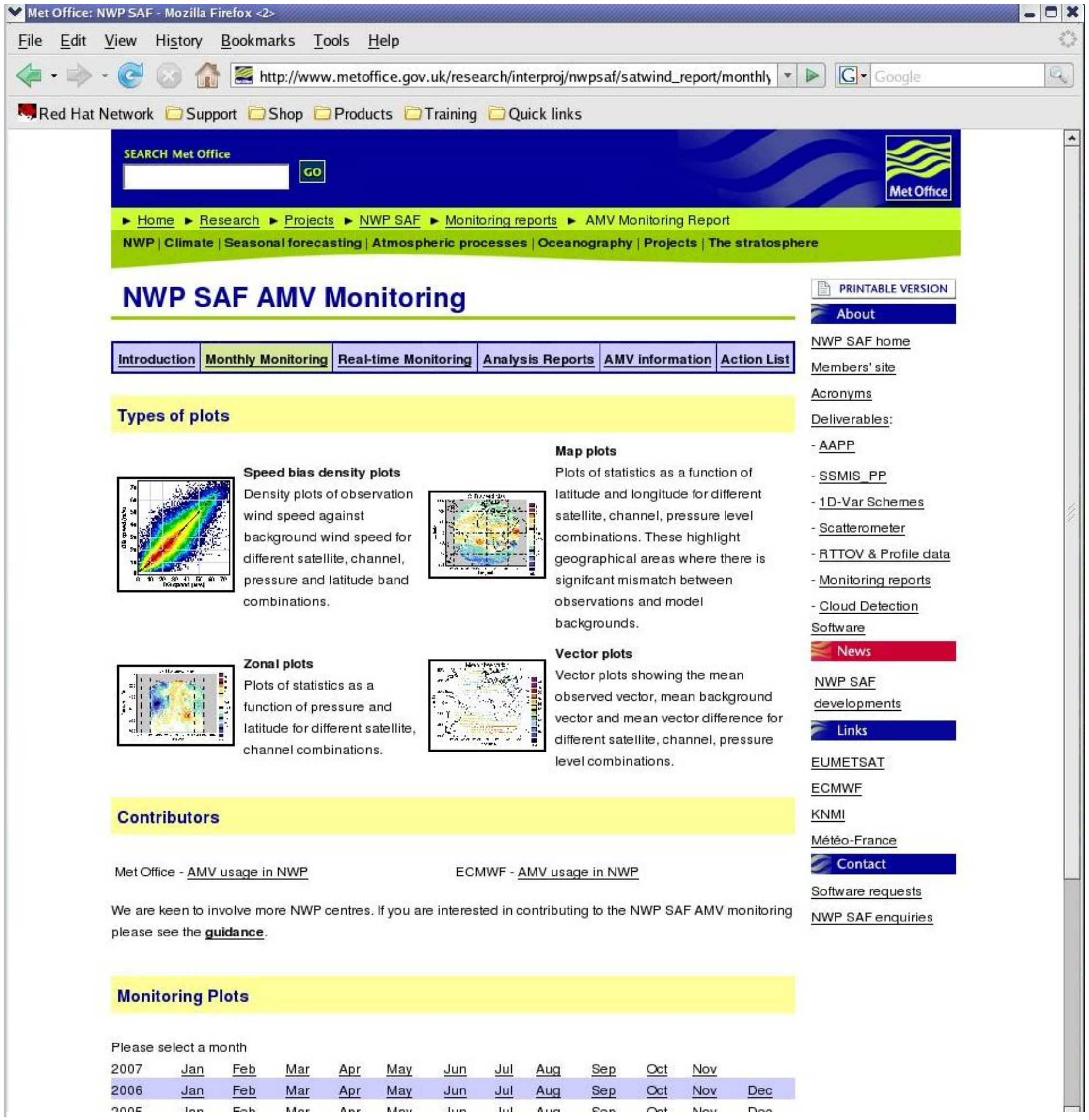
New layout



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Types of plots
Speed bias density plots
Density plots of observation wind speed against background wind speed for different satellite, channel, pressure and latitude band combinations.
Map plots
Plots of statistics as a function of latitude and longitude for different satellite, channel, pressure level combinations. These highlight geographical areas where there is signifcant mismatch between observations and model backgrounds.
Zonal plots
Plots of statistics as a function of pressure and latitude for different satellite, channel combinations.
Vector plots
Vector plots showing the mean observed vector, mean background vector and mean vector difference for different satellite, channel, pressure level combinations.
Contributors
Met Office - AMV usage in NWP
ECMWF - AMV usage in NWP
We are keen to involve more NWP centres. If you are interested in contributing to the NWP SAF AMV monitoring please see the guidance.
Monitoring Plots
Please select a month
2007 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov
2006 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
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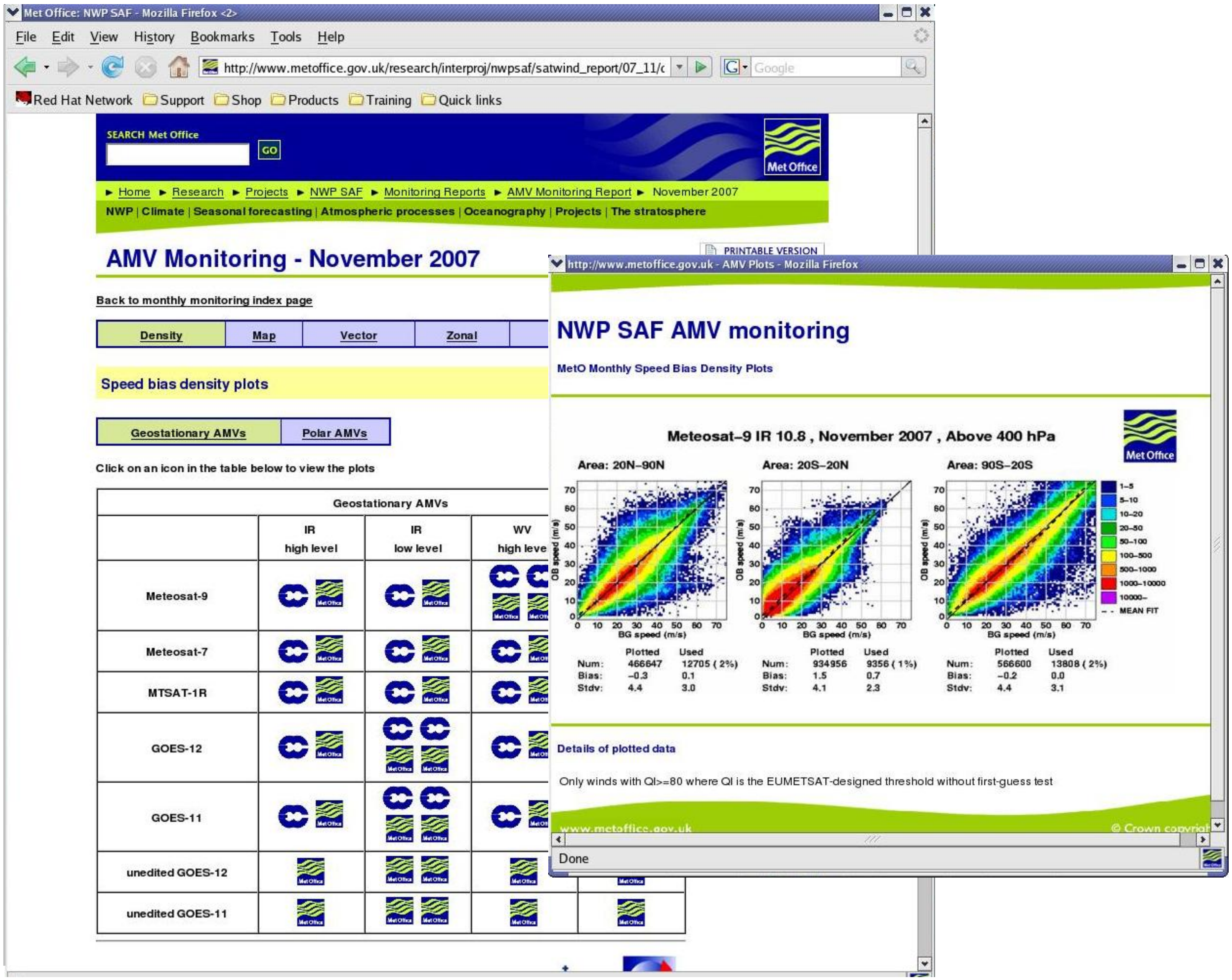
New layout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AMV Monitoring - November 2007
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Density
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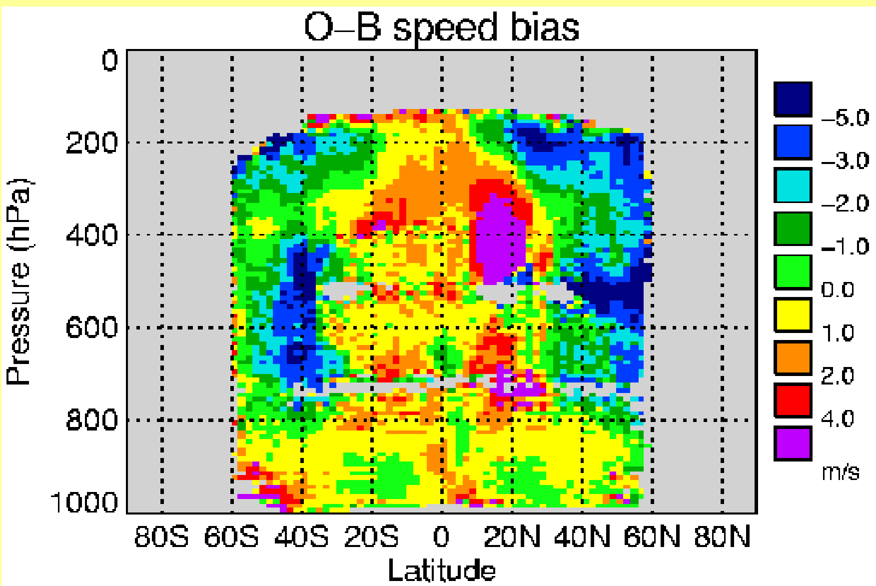
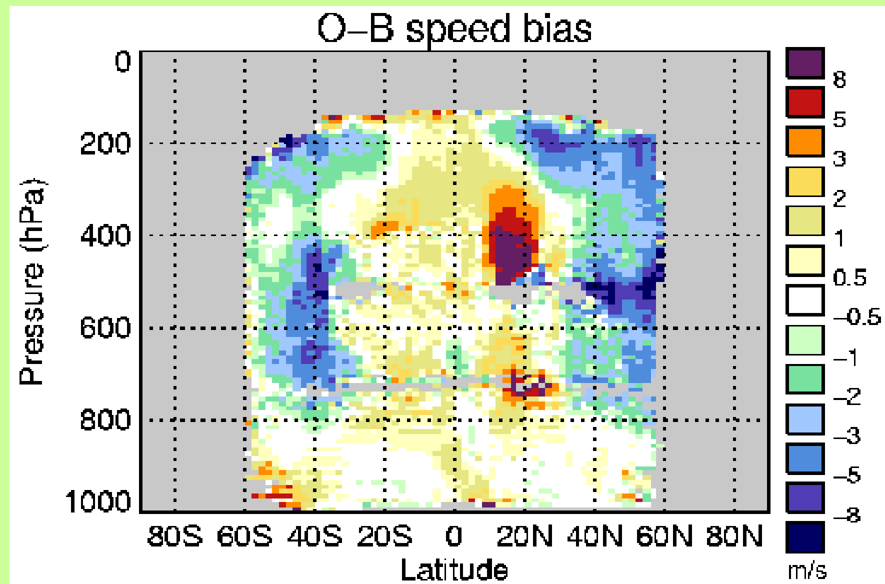
Speed bias density plots
Geostationary AMVs
Polar AMVs
Click on an icon in the table below to view the plots
Geostationary AMVs
IR high level
IR low level
WV high level
Meteosat-9
Meteosat-7
MTSAT-1R
GOES-12
GOES-11
unedited GOES-12
unedited GOES-11
http://www.metoffice.gov.uk - AMV Plots - Mozilla Firefox
NWP SAF AMV monitoring
MetO Monthly Speed Bias Density Plots
Meteosat–9 IR 10.8 , November 2007 , Above 400 hPa
Area: 20N–90N
Area: 20S–20N
Area: 90S–20S
OB speed (m/s)
BG speed (m/s)
1–5
5–10
10–20
20–50
50–100
100–500
500–1000
1000–10000
10000–
MEAN FIT
Plotted Used
Num: 466647 12705 (2%)
Bias: –0.3 0.1
Stdv: 4.4 3.0
Num: 934956 9356 (1%)
Bias: 1.5 0.7
Stdv: 4.1 2.3
Num: 566600 13808 (2%)
Bias: –0.2 0.0
Stdv: 4.4 3.1
Details of plotted data
Only winds with QI>=80 where QI is the EUMETSAT-designed threshold without first-guess test
www.metoffice.gov.uk
Done

New Colour Scales

OLD



NEW



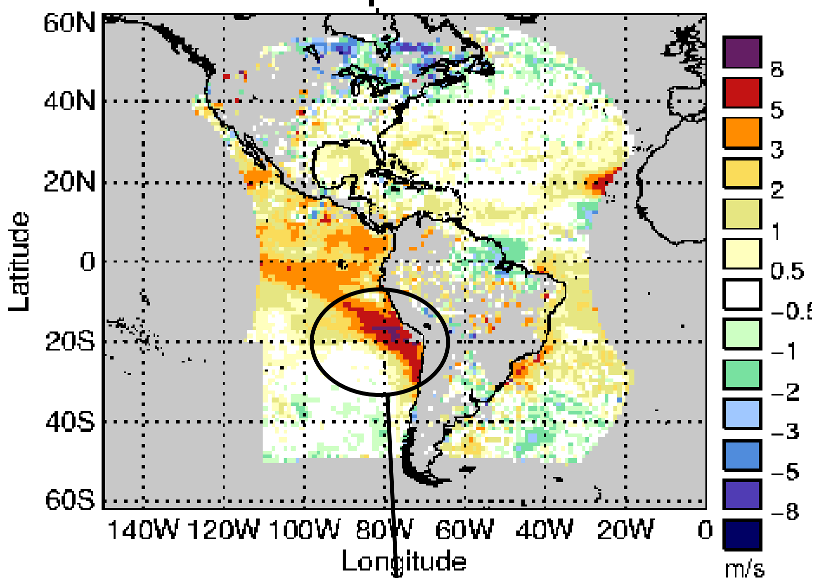
Examples

From the 3rd analysis of the NWP SAF AMV monitoring

3rd analysis – example 1

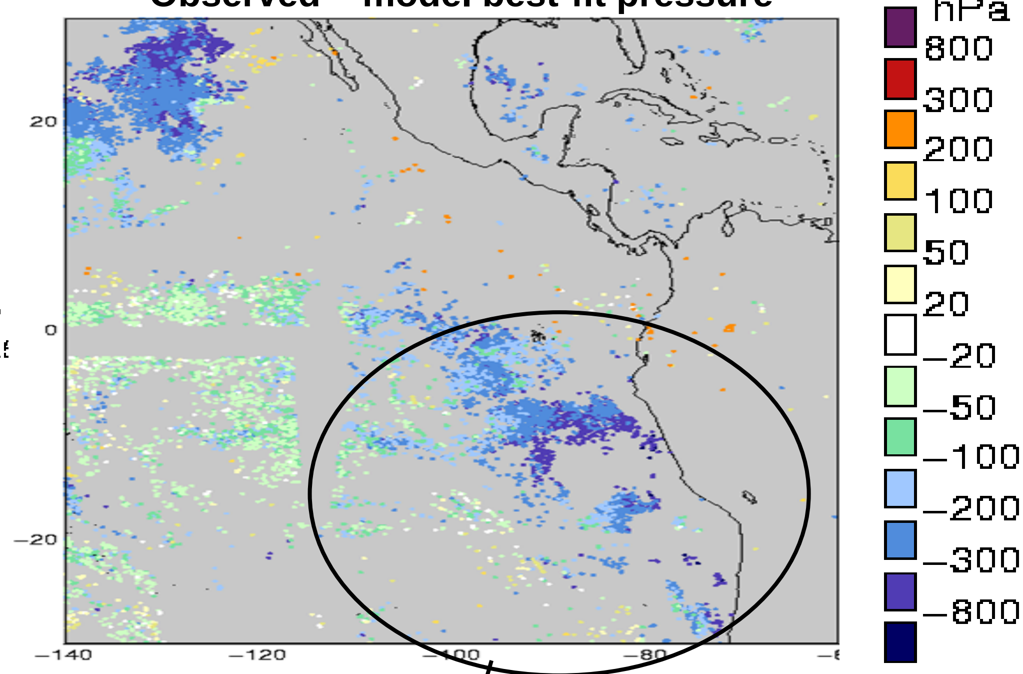
GOES fast bias at low level in inversion regions

Unedited GOES-12 VIS, October 2007
O-B speed bias



Large fast speed bias (> 5 m/s)

Unedited GOES VIS, 3rd July 2007
Observed – model best-fit pressure

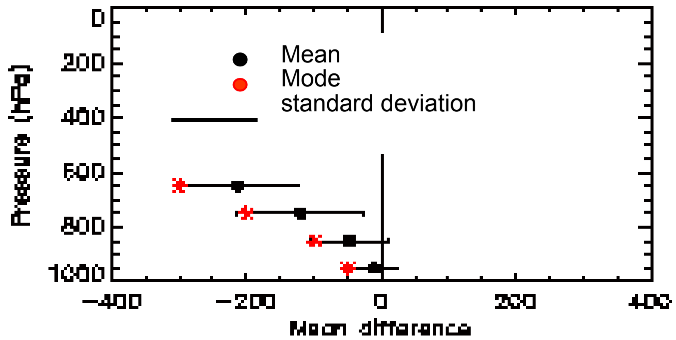


These areas are associated with a high height bias in the model best-fit pressure statistics. Best-fit pressure below 900 hPa, in agreement with Calipso cloud heights.

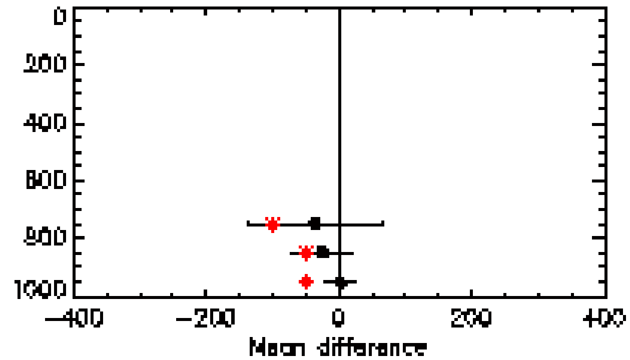
3rd analysis – example 1

GOES fast bias at low level in inversion regions

Unedited GOES-11 VIS, Mar-Apr 2007
Mean observed – model best-fit pressure



Meteosat-9 VIS 0.8, Mar-Apr 2007
Mean observed – model best-fit pressure



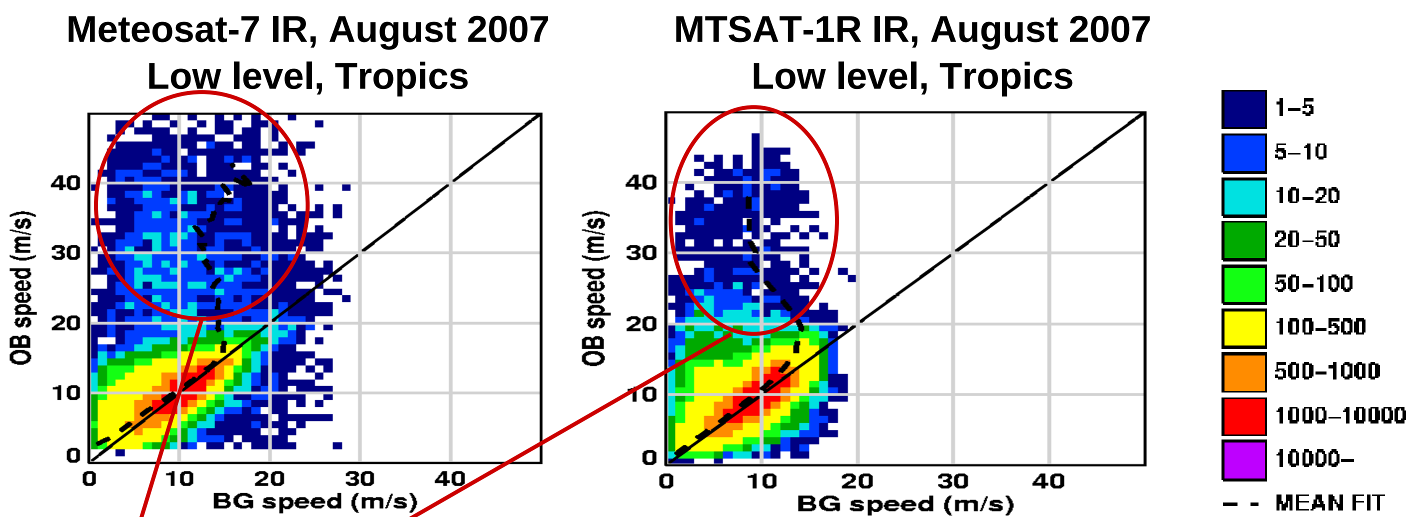
EUMETSAT wind heights are less biased (inversion correction applied).

Recommend:

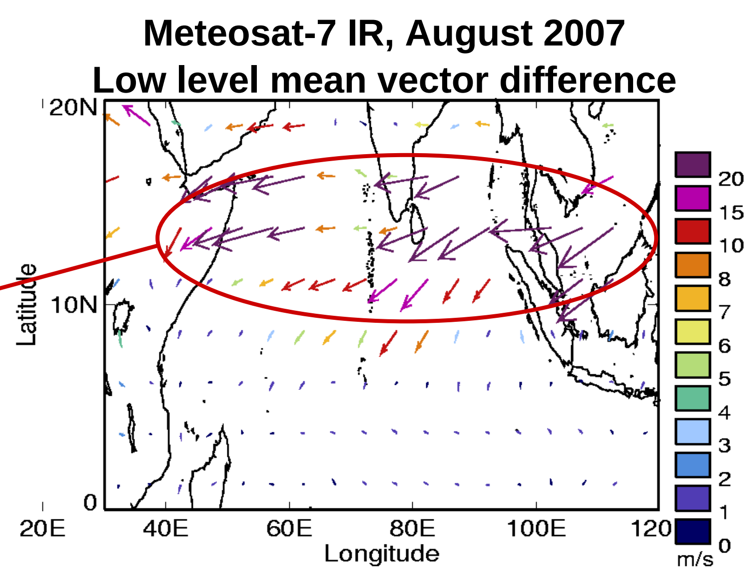
Relook at height assignment in inversion regions

3rd analysis – example 2

Spuriously fast low level Meteosat and MTSAT-1R winds



Large number of spuriously fast winds

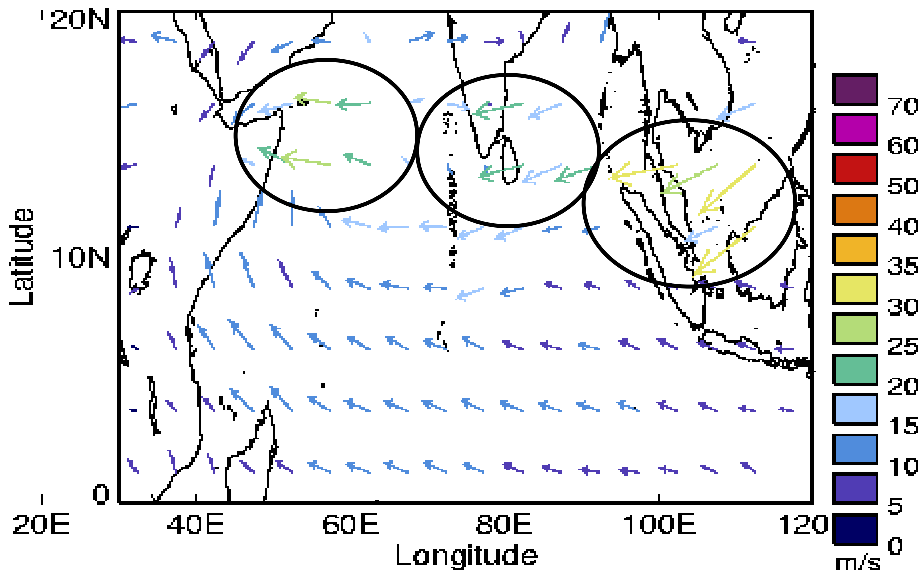


Leads to large mean vector differences localised in some regions

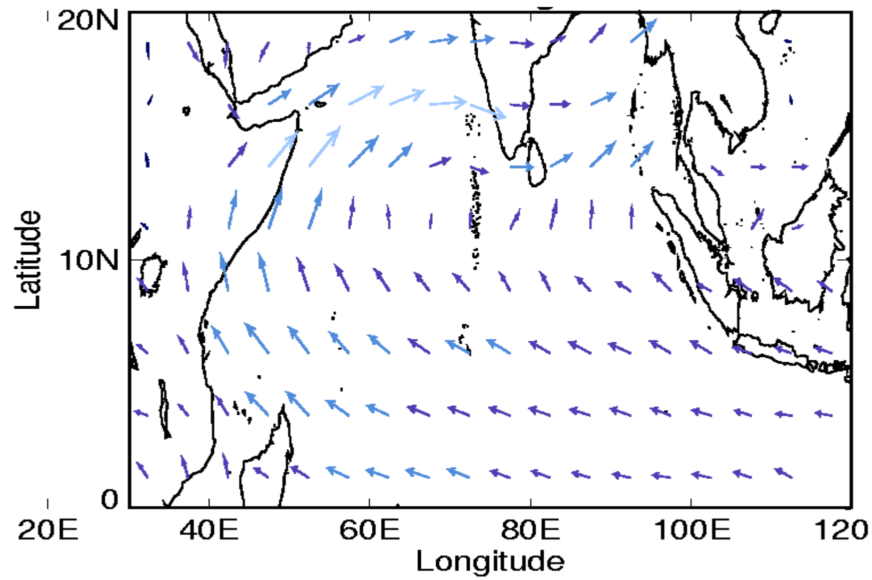
3rd analysis – example 2

Spuriously fast low level Meteosat and MTSAT-1R winds

Mean observed vector, Met-7 IR, Aug 07
Low level, below 700 hPa



Mean background vector
Low level, below 700 hPa

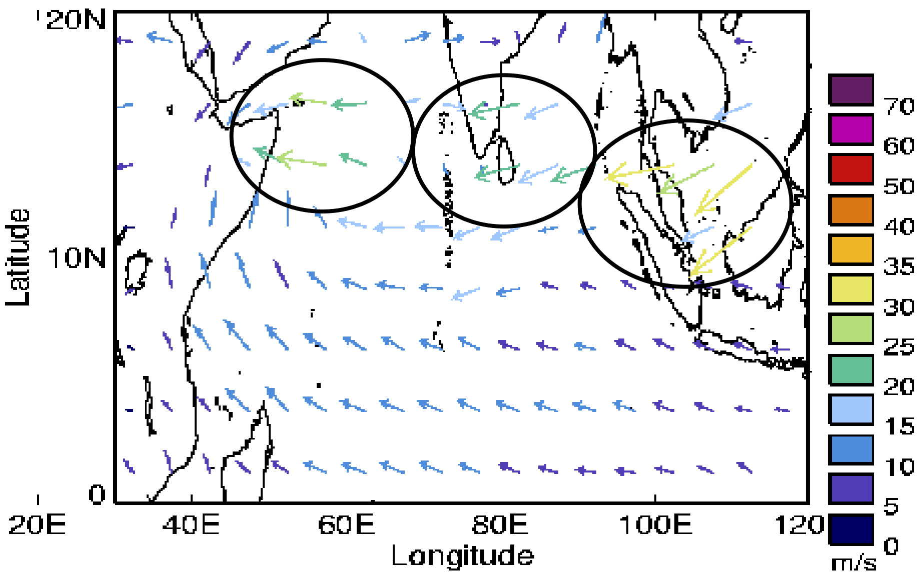


3rd analysis – example 2

Spuriously fast low level Meteosat and MTSAT-1R winds

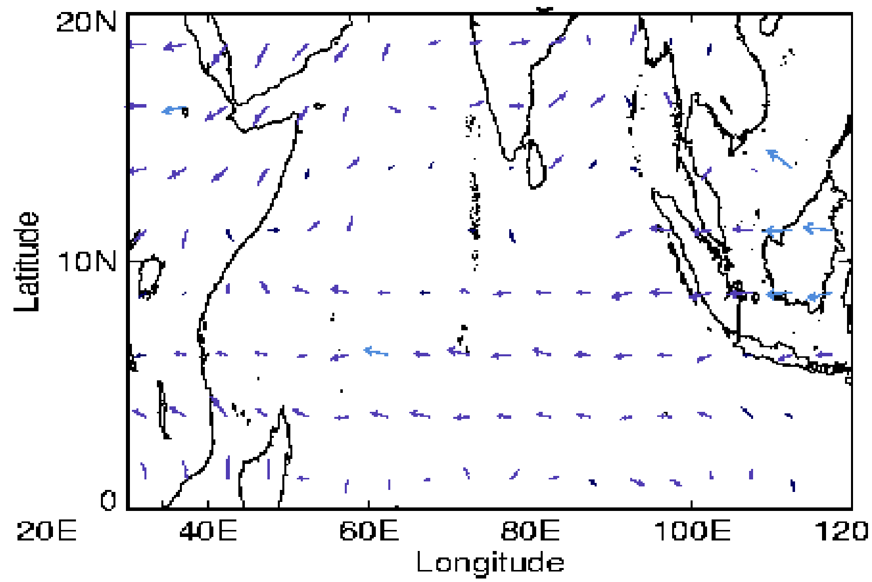
Mean observed vector, Met-7 IR, Aug 07

Low level, below 700 hPa



Mean background vector

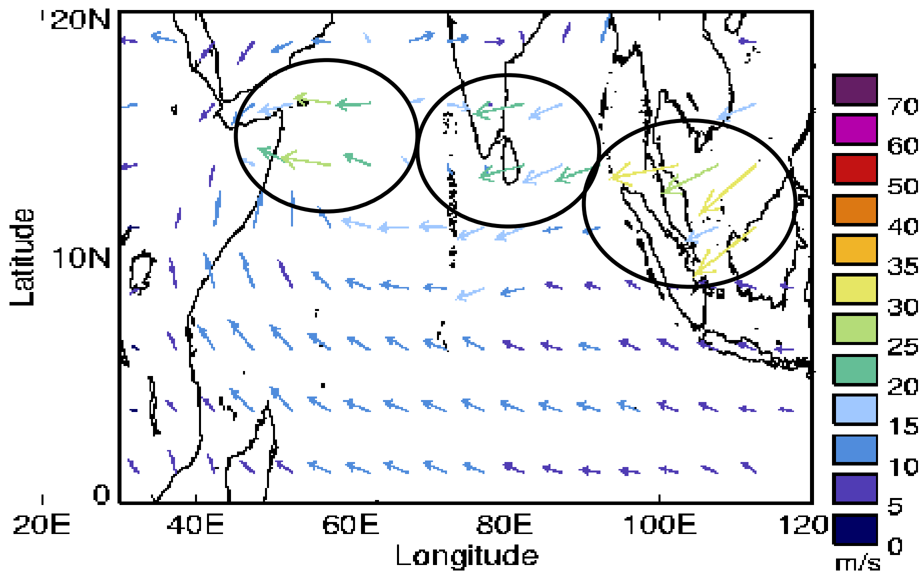
Mid level, 400-700 hPa



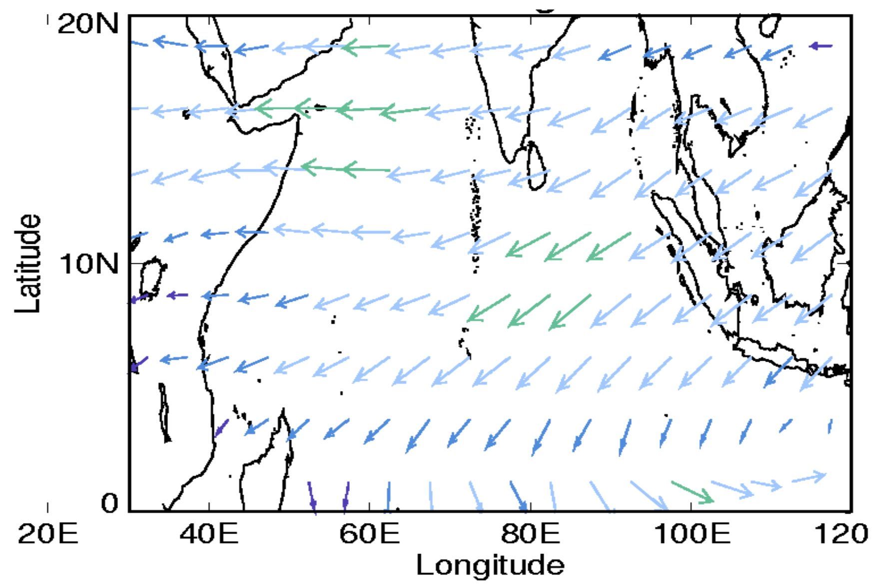
3rd analysis – example 2

Spuriously fast low level Meteosat and MTSAT-1R winds

Mean observed vector, Met-7 IR, Aug 07
Low level, below 700 hPa



Mean background vector
High level, above 400 hPa



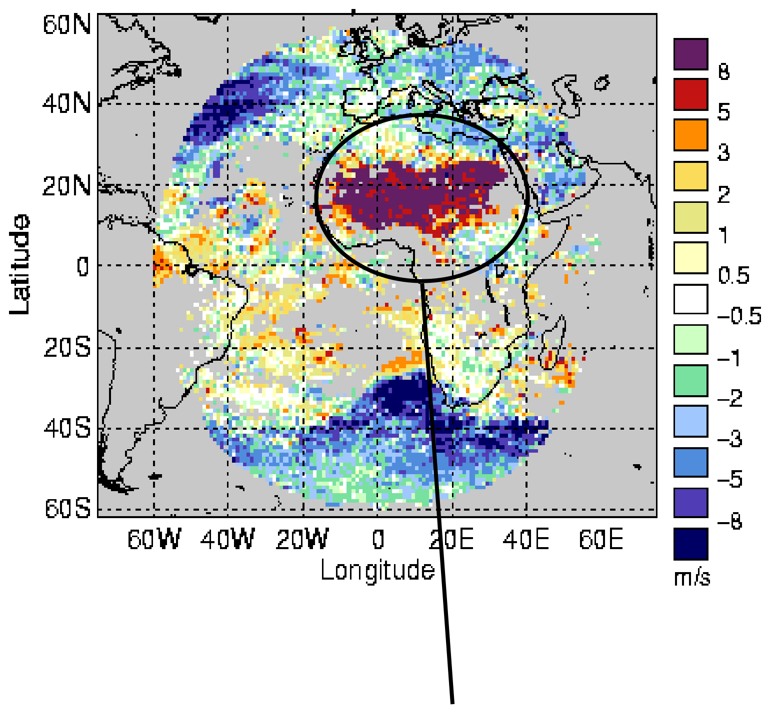
Conclude: Some high level AMVs put much too low (by 500 hPa or more) – probably multi-level cloud cases - tracking high cloud, heights based on low cloud

***Recommend:** research into improving match between tracking and height assignment (e.g. Régis Borde's and Ryo Oyama's talks)*

3rd analysis – example 3

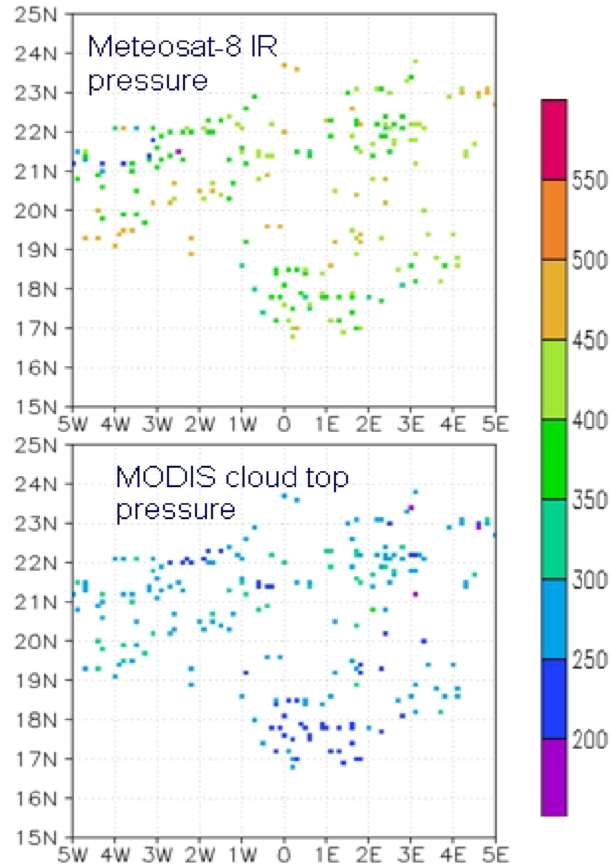
Sahara mid level fast bias revisited

Meteosat-8 IR 10.8, Nov 05
Mid level O-B speed bias



Fast speed bias (> 8 m/s) during winter months

2100-0300 7-8 Dec 05

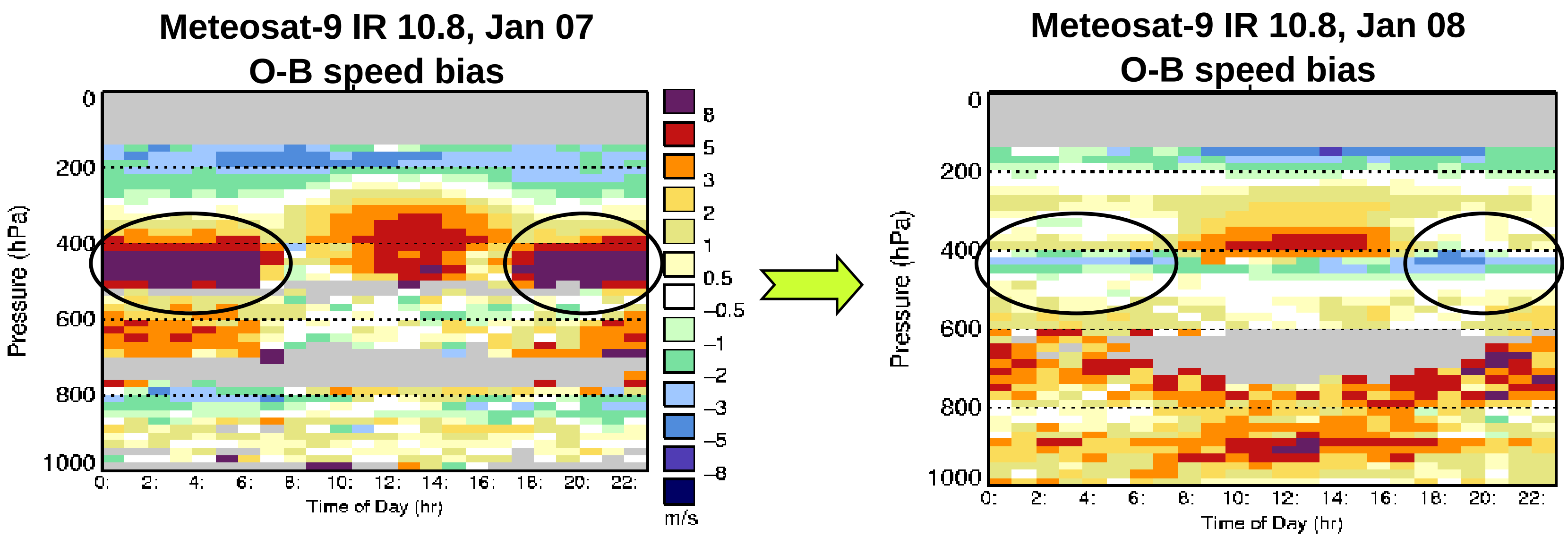


Linked to high level AMVs being assigned to mid level

3rd analysis – example 3

Sahara mid level fast bias revisited

EUMETSAT implemented a derivation update on 22nd March 2007, which has reduced the mid level fast bias.



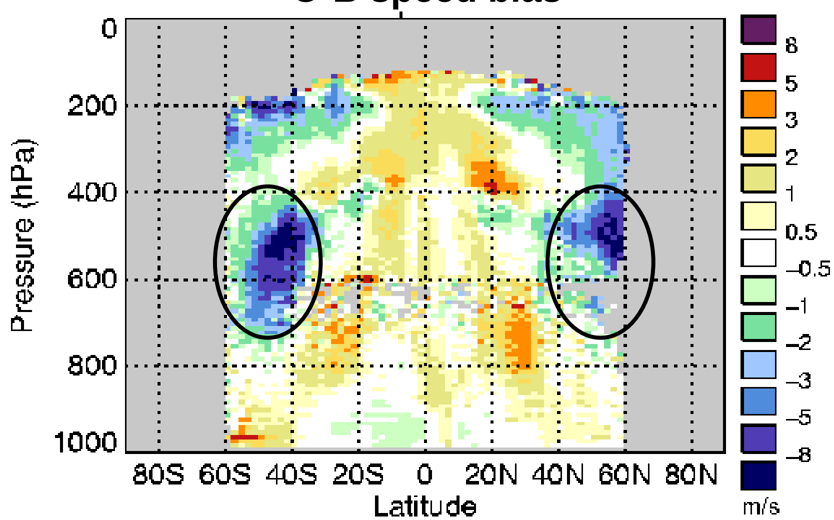
Most impact is seen during the night-time when a low level inversion is present (it was the handling of multiple height assignment solutions in these situations that was partly responsible).

Still some fast bias above 400 hPa during daytime and fast bias at low levels is worse.

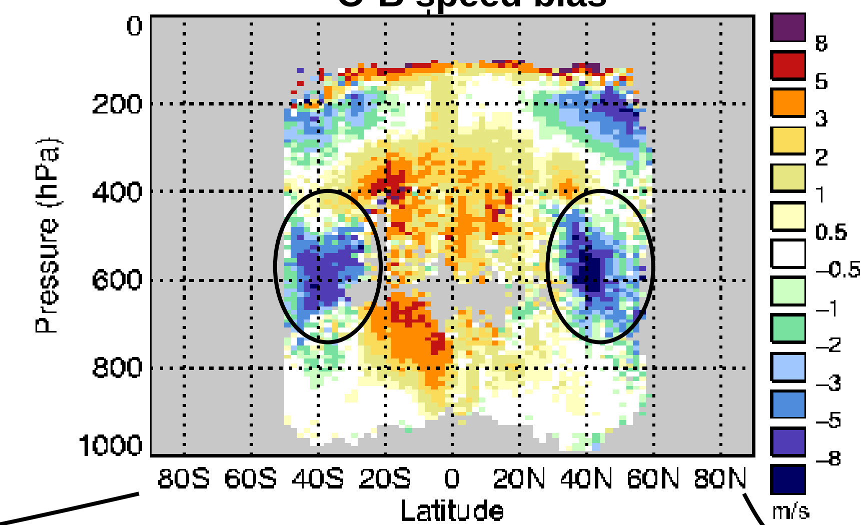
3rd analysis – example 4

Slow bias at mid level in the extratropics

Meteosat-9 IR 10.8, Oct 07
O-B speed bias

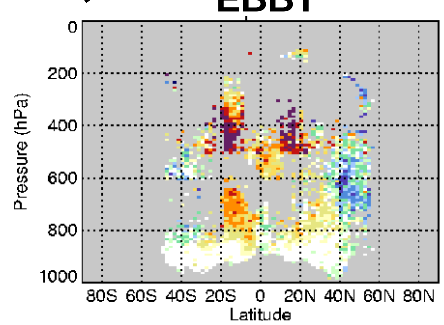


Unedited GOES-12 IR, Oct 07
O-B speed bias

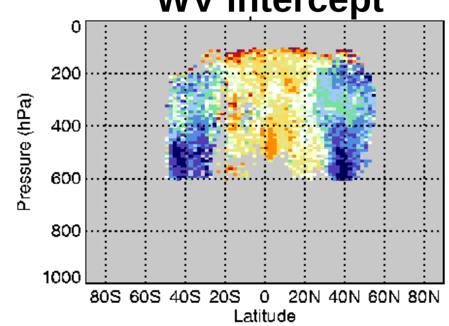


Slow bias linked to WV intercept and CO_2 slicing height assignment methods

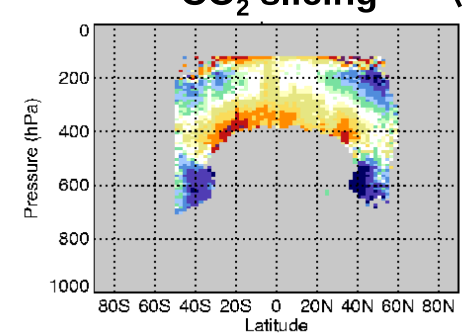
EBBT



WV intercept



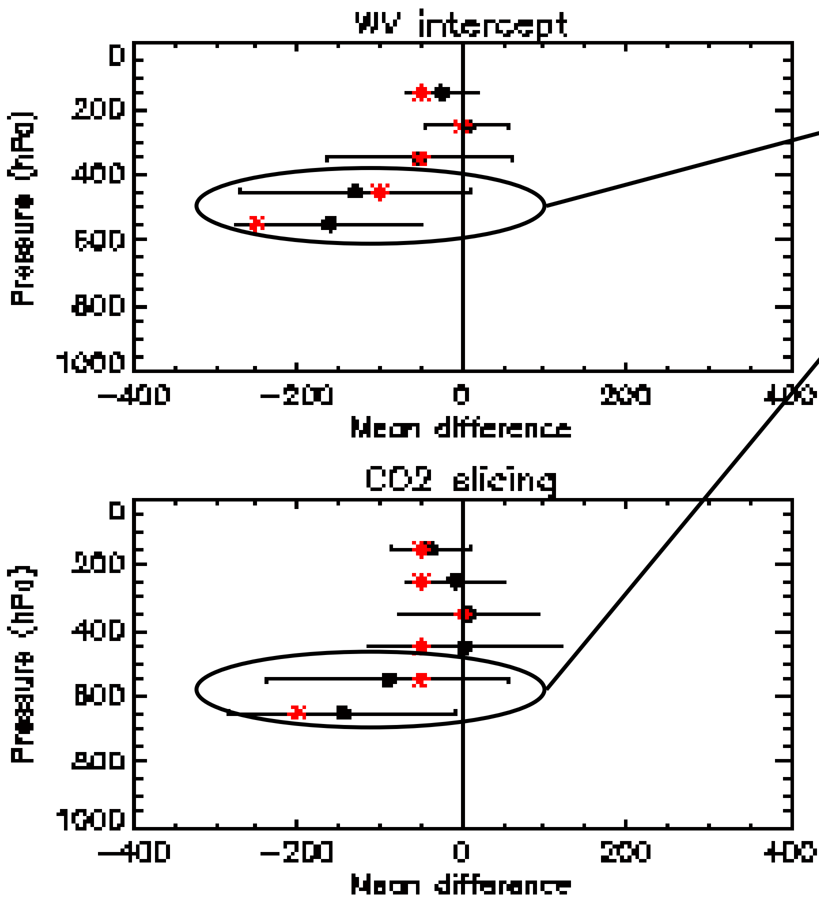
CO_2 slicing



3rd analysis – example 4

Slow bias at mid level in the extratropics

Unedited GOES-12 IR, Mar-Apr 2007
Mean observed – model best-fit pressure



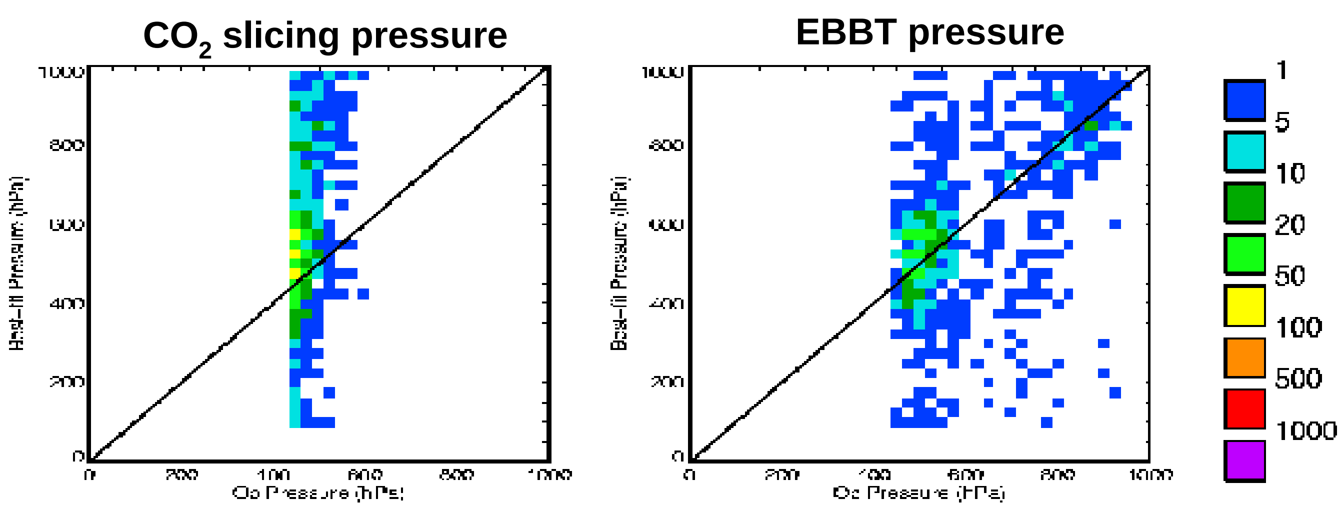
High height bias relative to model best-fit pressure

3rd analysis – example 4

Slow bias at mid level in the extratropics

Are the EBBT heights any better in these cases?

Density plots comparing model best-fit pressure to observed pressure for 3 days of Meteosat-9 IR 10.8 winds below 450 hPa where the CO_2 slicing method was used.



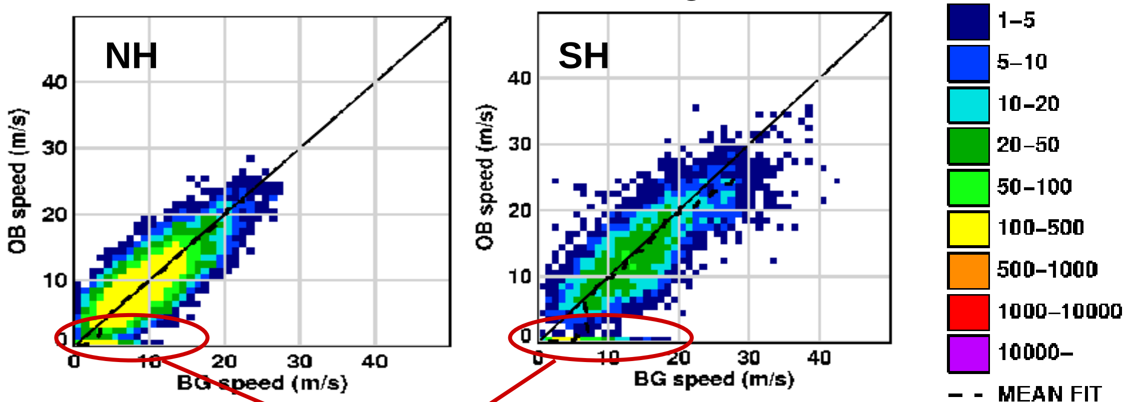
Conclude: while not perfect the EBBT heights are better in this 3 day case study.

Recommend: *include additional pressure thresholds for applying WV intercept and CO_2 slicing techniques.*

3rd analysis – example 5

NESDIS MODIS IR slow streak

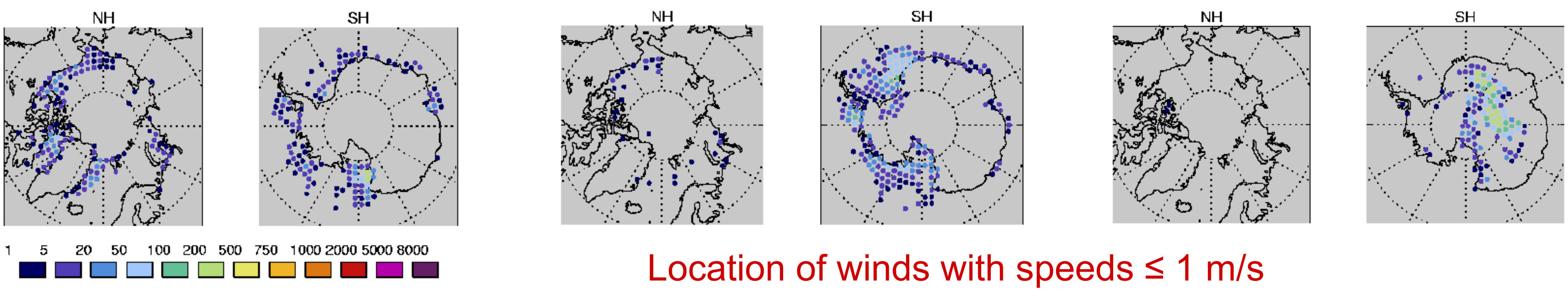
NESDIS Terra IR low level for August 2007



Only seen for NESDIS IR polar winds

Large number of winds with speeds ≤ 1 m/s

Low level, below 700 hPa **Mid level, 400-700 hPa** **High level, above 400 hPa**

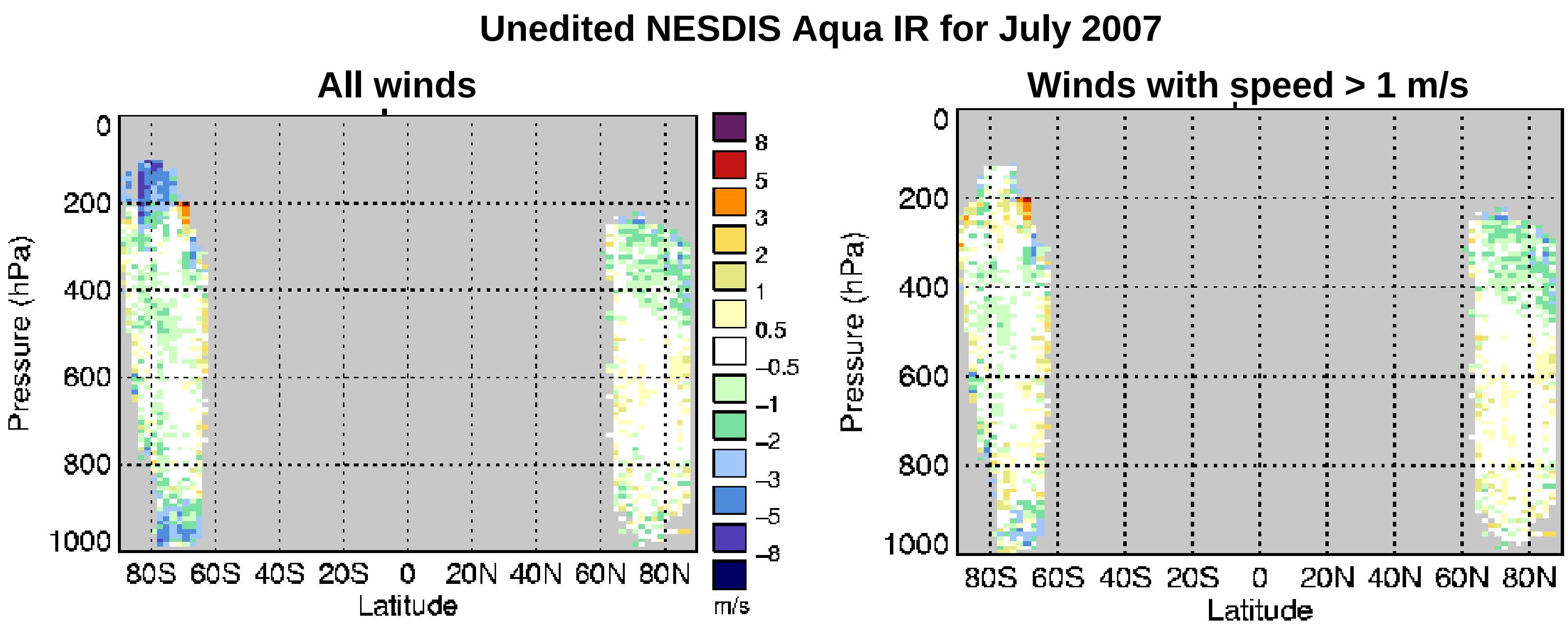


Location of winds with speeds ≤ 1 m/s

3rd analysis – example 5

NESDIS MODIS IR slow streak

If remove these spurious slow winds….



Slow speed bias above 200 hPa is removed and slow speed bias at low level is reduced.

Recommend: remove winds with speeds ≤ 1 m/s from dataset

Recommendations

From the 3rd analysis of the NWP SAF AMV monitoring

Where to go from here?

Three areas to address in order to optimise the contribution of AMVs to forecast skill. The second and third items are inter-linked and require the producers and users to work together.

1. Improve AMV quality through developments to the derivation and height assignment.
2. Improve the AMV assimilation.
3. Develop extra quality and representiveness information using data available during the derivation.

With limited resources at any one centre it is important for the AMV community to discuss and prioritise the development options and to work together on achieving them.

Where to go from here?

Ref	Action	Details	Centre(s)
6.1	Document methods	Document the main steps in the AMV derivation and height assignment so differences can be easily identified.	All producers
6.2	Compare methods	Production of AMVs from each other's imagery to directly compare different derivation schemes (Iliana Genkova's talk)	All producers
6.3	Carry out simulated imagery studies	Analysis of AMVs derived from simulated imagery (Peter Bauer's talk)	ECMWF and producers
6.4	Develop vector and height errors	To consider each step in the derivation and assess the possible sources of error. What information can be used to develop vector and height errors?	All producers
6.5	Improve height assignment	General improvements and investigations into a better link between the pixels that dominate in the tracking and the pixels used for height assignment (Régis Borde's and Ryo Oyama's talks)	All producers
6.6	AMVs as a representation of the local wind field	The AMVs do not always represent the local wind field. In some situations the cloud is not moving passively with the wind field. Are the AMVs still useful in these areas and can they be identified? Also scale of interest. Should higher resolution NWP models use AMVs generated using smaller target sizes and shorter time intervals?	All producers

Where to go from here?

Ref	Action	Details	Centre(s)
6.7	AMVs as a layer	Is it important to represent the AMVs as a layer wind in the assimilation and if so what layer thickness should be used? Is there information available from the derivation step to help with this? – see also Chris Velden and Kris Bedka's talk.	All
6.8	Carry out height assignment investigations	Comparisons to other cloud top pressure information (e.g. A-Train, MODIS cloud top pressure etc.) and further best-fit pressure investigations (e.g. work shown here and Geneviève Sèze's talk)	All
6.9	Improve AMV assimilation	e.g. use of more model independent data, development of individual observation errors and modifications to the observation operator to treat the AMVs as layer observations. Share experiences with other NWP centres.	All users
6.10	Identify where AMVs are most important	Run AMV data denial experiments to get a feel for where the AMVs have most to offer and where they can be more problematic. Feed back findings to producers and other users.	All users
6.11	Maintain list of known problems	Users to work with the producers to collect a list of known problem areas. Currently addressed through the NWP SAF AMV analysis reports.	All

Future developments

To the NWP SAF AMV monitoring

The future

Planned activities

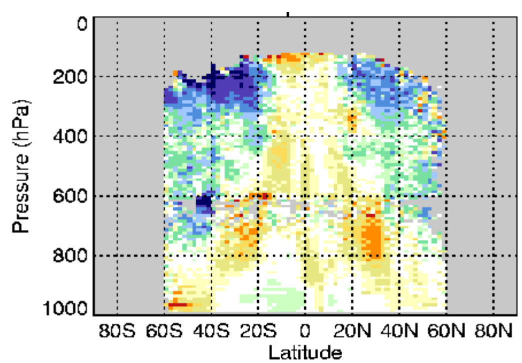
1. Continue to produce analysis reports every 2 years to coincide with the IWWGs.
2. Add new datasets to the monitoring as soon as is practically possible to provide users and producers with early feedback. The FY-2C winds are a candidate for the future.
3. Improve the existing plots where deficiencies are identified.
4. Extend the number of NWP centres contributing to the monitoring (dependent on provision of statistics from more centres).
5. Maintain the information on AMV usage at NWP centres.

The future

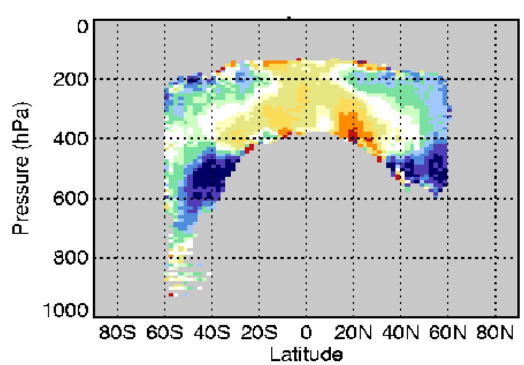
Possible activities #1

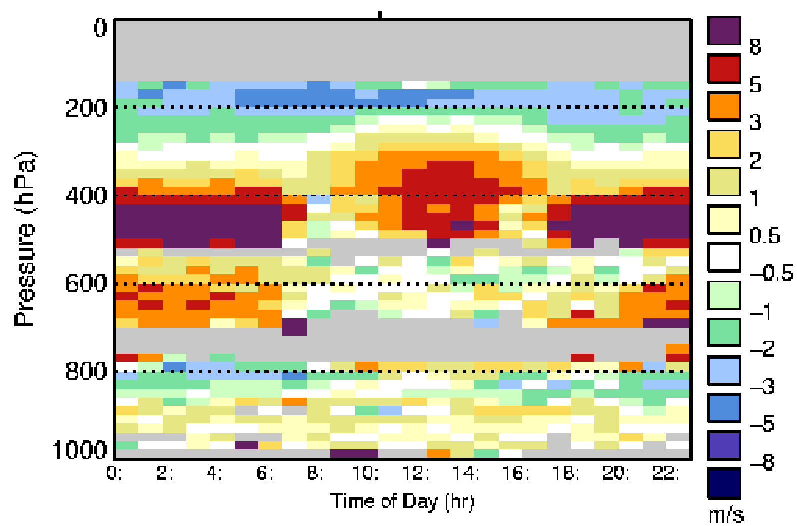
1. Provision of real-time monitoring.
2. Provision of additional plots on a one-off or occasional basis to investigate specific aspects of the AMV data e.g. map and zonal plots filtered by height assignment method and Hovmoeller plots as a function of time of day.

EBBT



CO_2 slicing

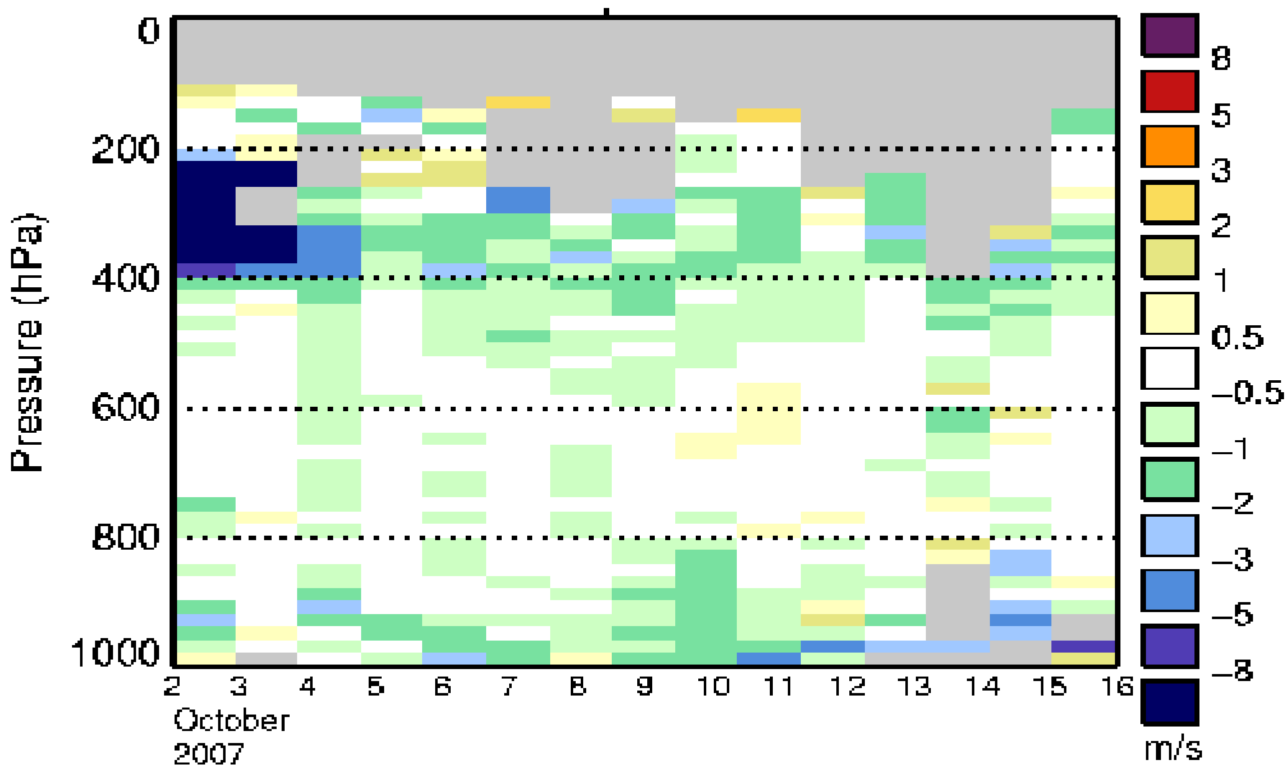




The future

Possible activities #2

3. Provision of extra monthly plots e.g. Hovmoeller plots. These can be used to investigate temporal variability in the bias characteristics.



Summary

Summary

1. There has been significant development since 8IWWG including an update to the site layout, the provision of more NWP usage pages and plot improvements.
2. The third analysis was released in February 2008 and for the first time includes a section on new observation types.
3. The core of the analysis reports is the maintenance of a record of features identified in the O-B monitoring. In some cases investigations have highlighted possible causes and solutions.
4. AMV quality is improving, but there is more work to be done. Producers and users should work together to identify and prioritise improvements.
5. Future NWP SAF AMV development options are being considered and user feedback is welcomed.

Questions and answers