

Operational use of Atmospheric Motion Vectors at ECMWF

Claire Delsol, Niels Bormann, Graeme Kelly,
Lueder von Bremen, Jean-Noël Thépaut and Peter Bauer

ECMWF, Reading, UK

Outline

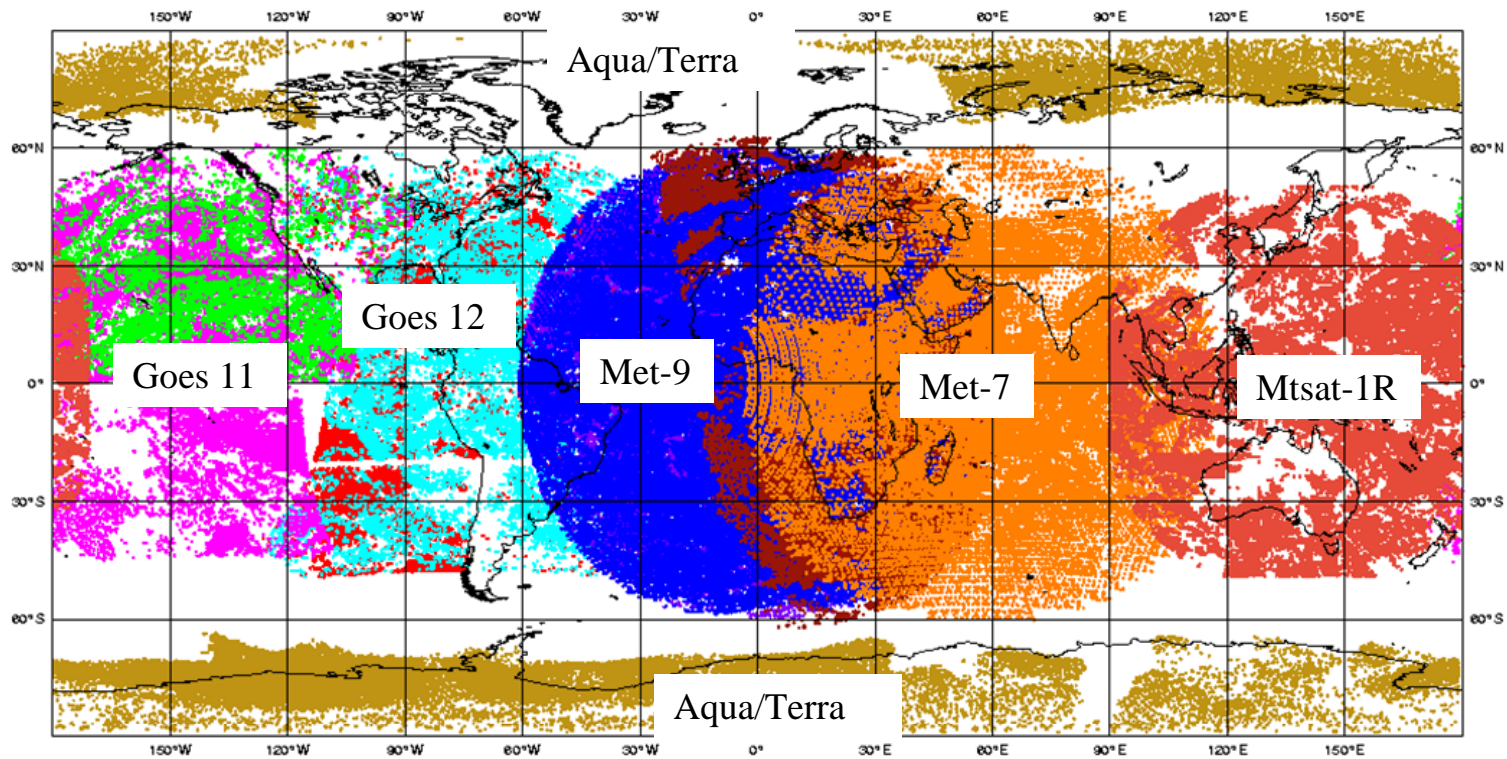
- 1) Overview of operationally assimilated AMVs**
- 2) AVHRR AMVs**
- 3) Direct-broadcast MODIS AMVs**
- 4) FY-2C AMVs**
- 5) MISR AMVs**

1) Overview of operationally assimilated AMVs

ECMWF Data Coverage (all obs DA) AMV

09April2008 06 UTC

Total number of obs = 374104



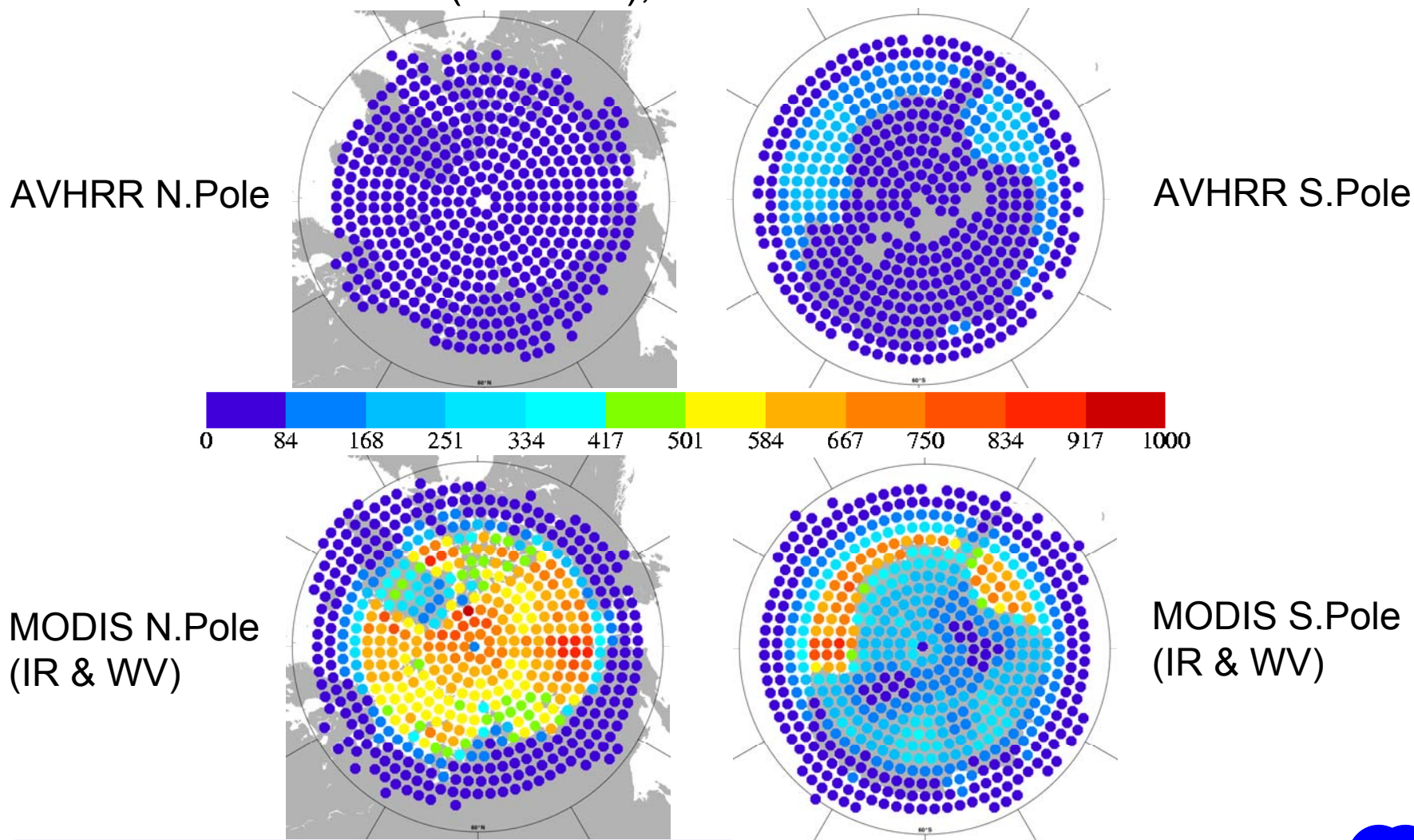
2) AVHRR AMVs

- **CIMSS-derived polar AMVs from AVHRR from NOAA-15, -16, -17, -18.**
- **No WV channel on AVHRR, so IR winds and height assignment only.**
- **Assimilation experiments:**
 - ◆ **12-hour 4DVAR**
 - ◆ **Resolution: T511L60 (~40 km, model), T159 (~125 km, analysis)**
 - ◆ **1 January 2007 – 14 February 2007 (45 forecasts)**

 - ◆ **Control: Conventional observations + NOAA-18 AMSU-A**
 - ◆ **AVHRR: As Control, but plus AVHRR winds**
 - AMVs used over land above 400 hPa, over sea/ice above 700 hPa.
 - ◆ **MODIS: As Control, but plus MODIS winds**
 - IR AMV usage as for AVHRR;
 - WV AMVs used over land above 400 hPa, over sea/ice above 550 hPa.

2) AVHRR AMVs: Coverage

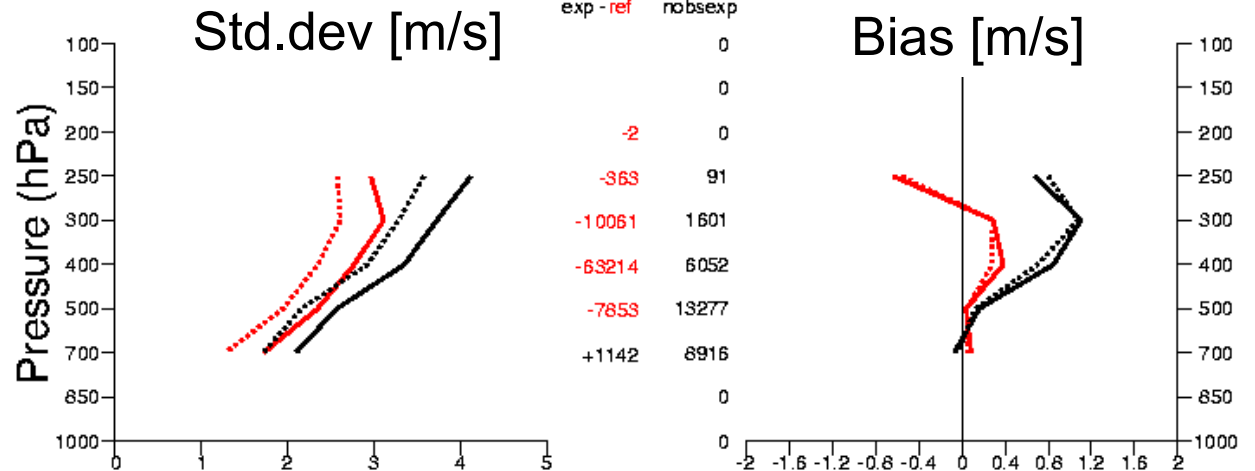
Number of used winds (all levels), 1 Jan – 14 Feb 2007:



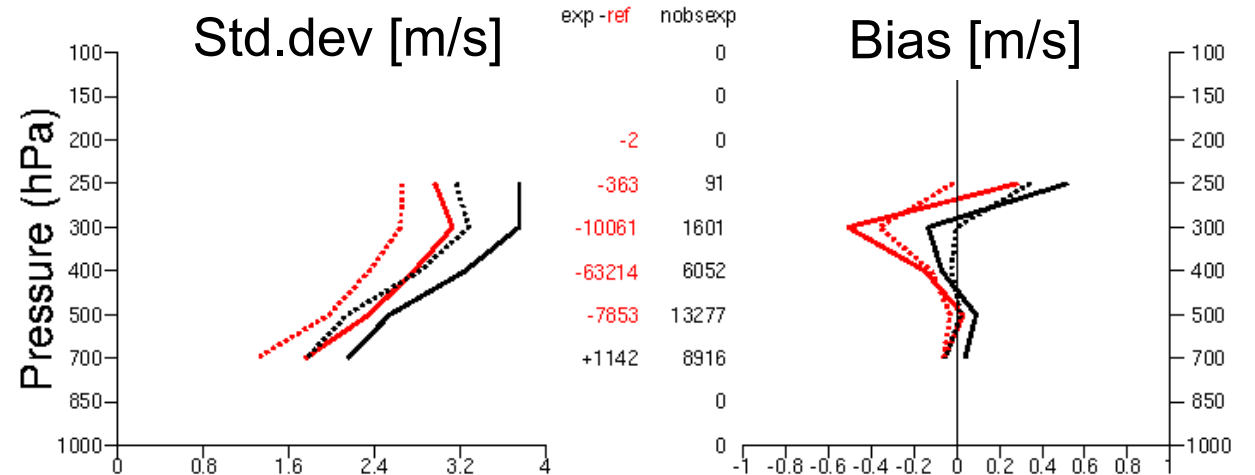
2) AVHRR AMVs U-component:

- Statistics for used AMVs over Antarctica for **AVHRR** and **MODIS (IR & WV)**.

- AVHRR** winds show larger departures and worse biases against the FG than **MODIS** winds.



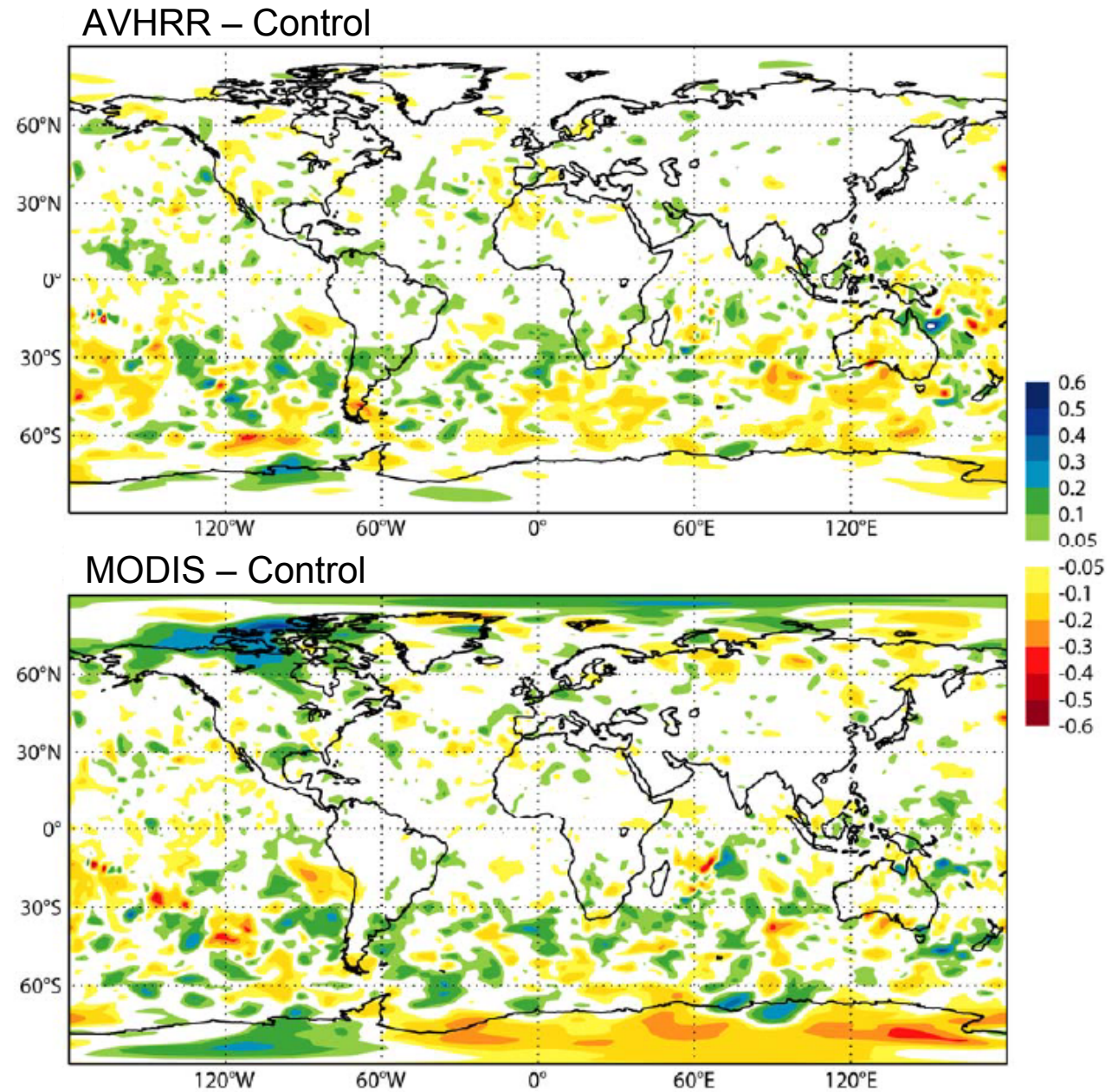
V-component:



— Obs-FG MODIS
— Obs-FG AVHRR
- - - Obs-AN MODIS
- - - Obs-AN AVHRR

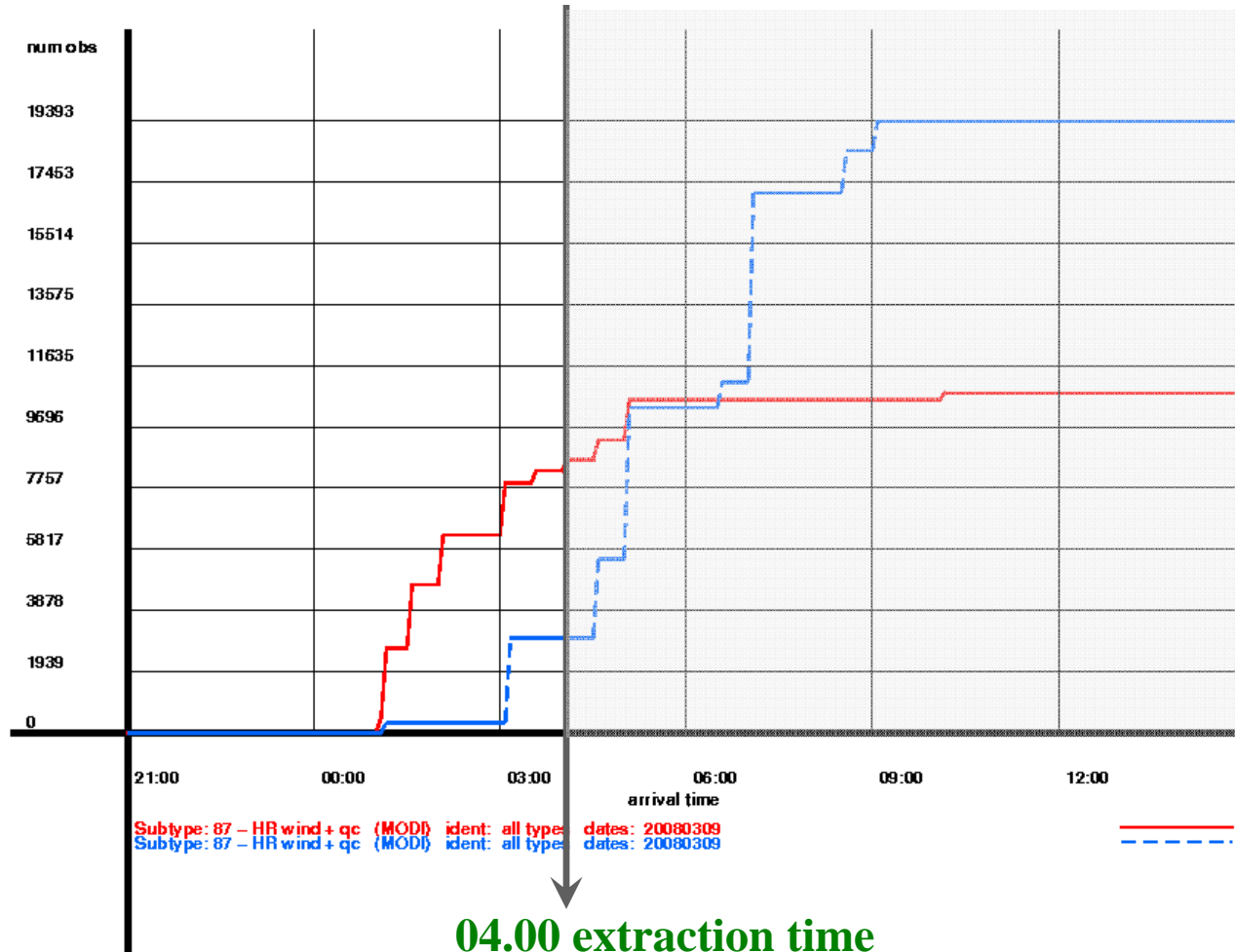
2) AVHRR AMVs

- Normalised differences in RMS of 48-hour forecast errors for the 500 hPa geopotential



3) Direct broadcast MODIS AMVs

Number of obs



00Z
cycle
20080309

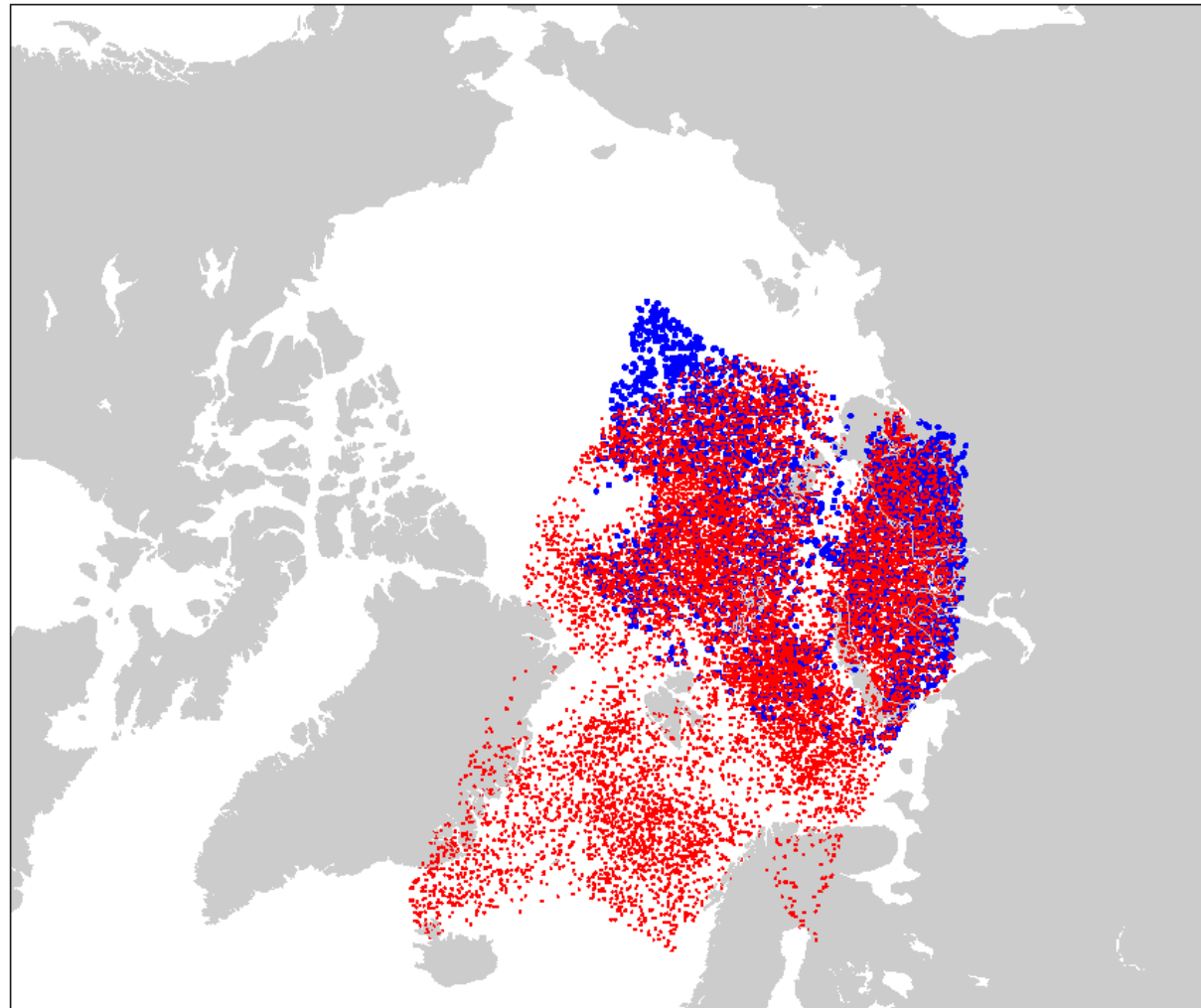
Red: db MODIS

Blue: NESDIS
MODIS

04.00 extraction time
for early delivery

3) Direct broadcast MODIS AMVs

NESDIS MODIS
winds and **direct
broadcast MODIS
winds** for 6-hour
cycle around 1 Dec
2007 12 Z with early
cut-off time.



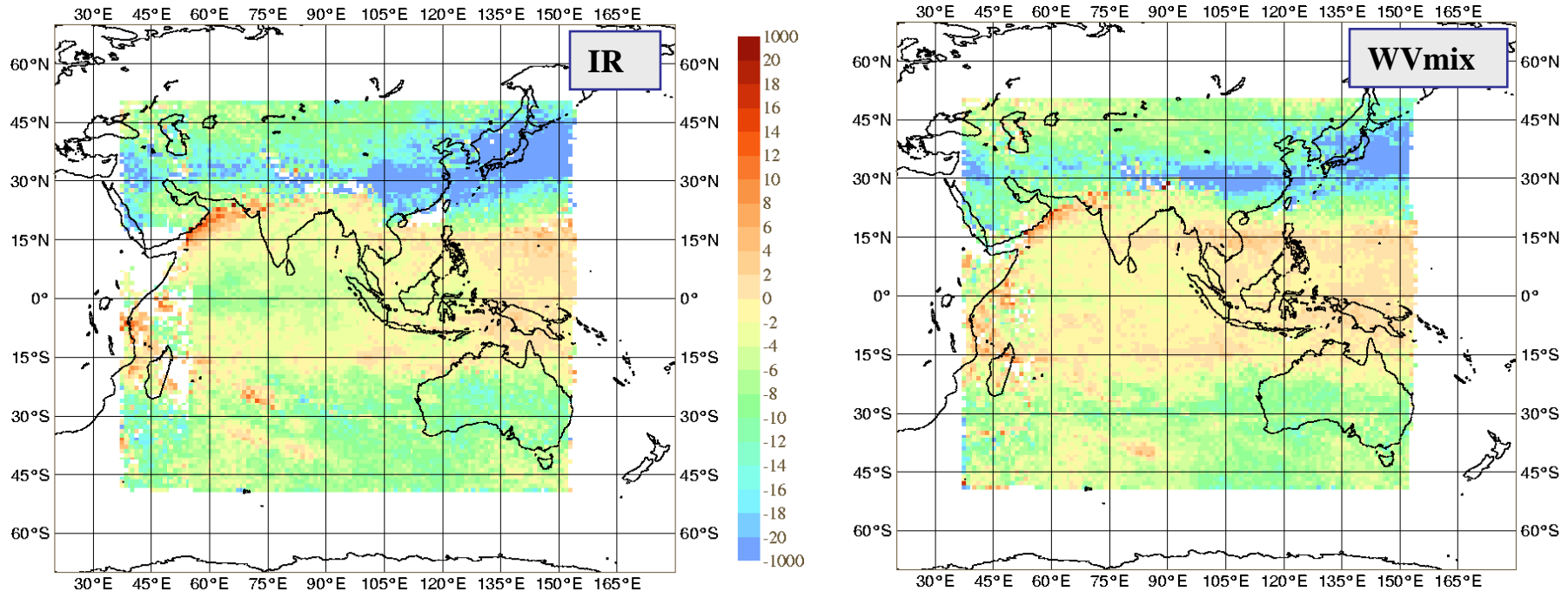
4) FY-2c AMVs

FY-2C (105° E) AMVs:

2 channels: IR and mixWV

QI 1 and QI 2

Passive monitoring expt: T159 L91 (IFS cycle 32r3) 1 month Dec 2007



Mean windspeed departures

<400hPa

QI 1 > 80

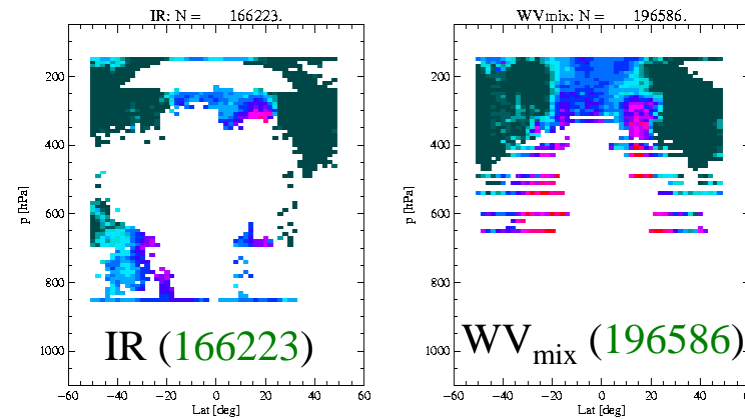
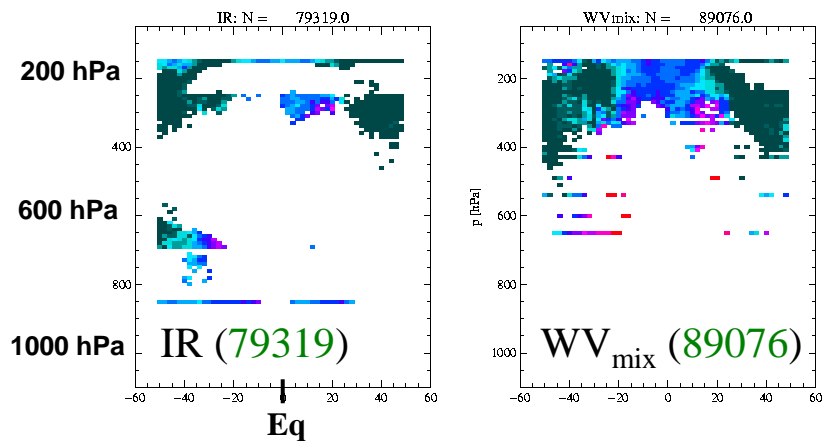
4) FY-2c AMVs

hPa ↑
Zonal mean
speed bias
lat →

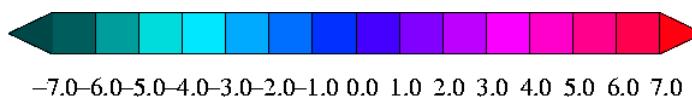
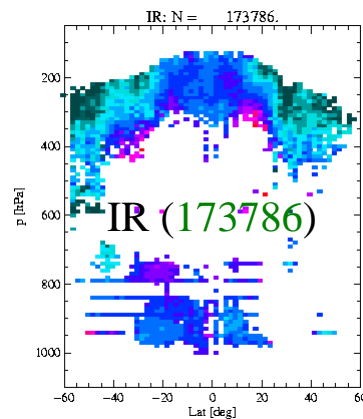
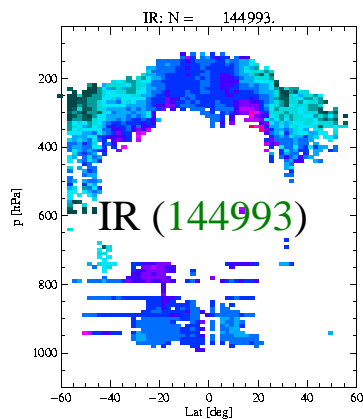
QI 1 > 80

QI 2 > 80

FY-2C



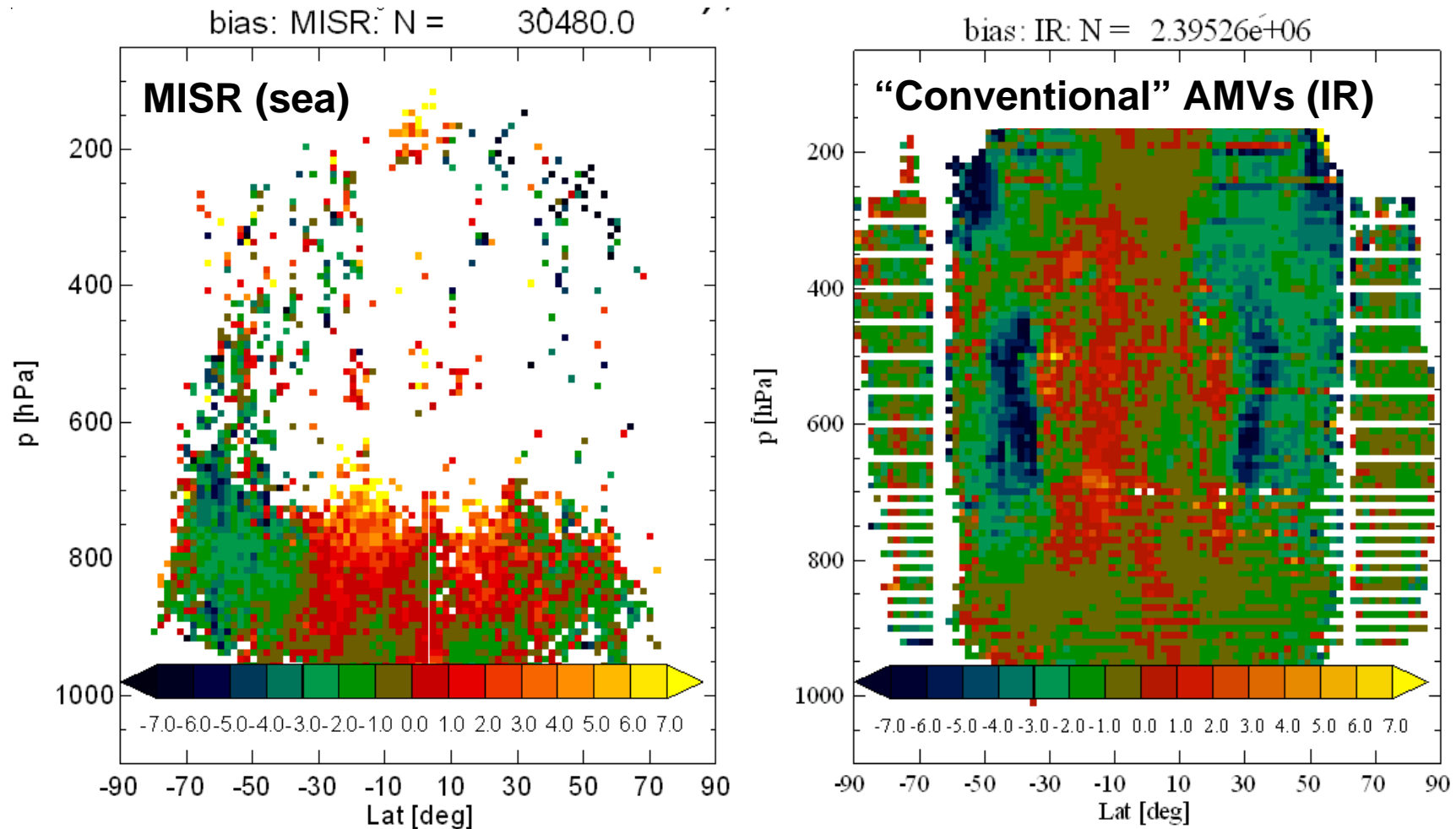
MET-7



5) MISR AMVs

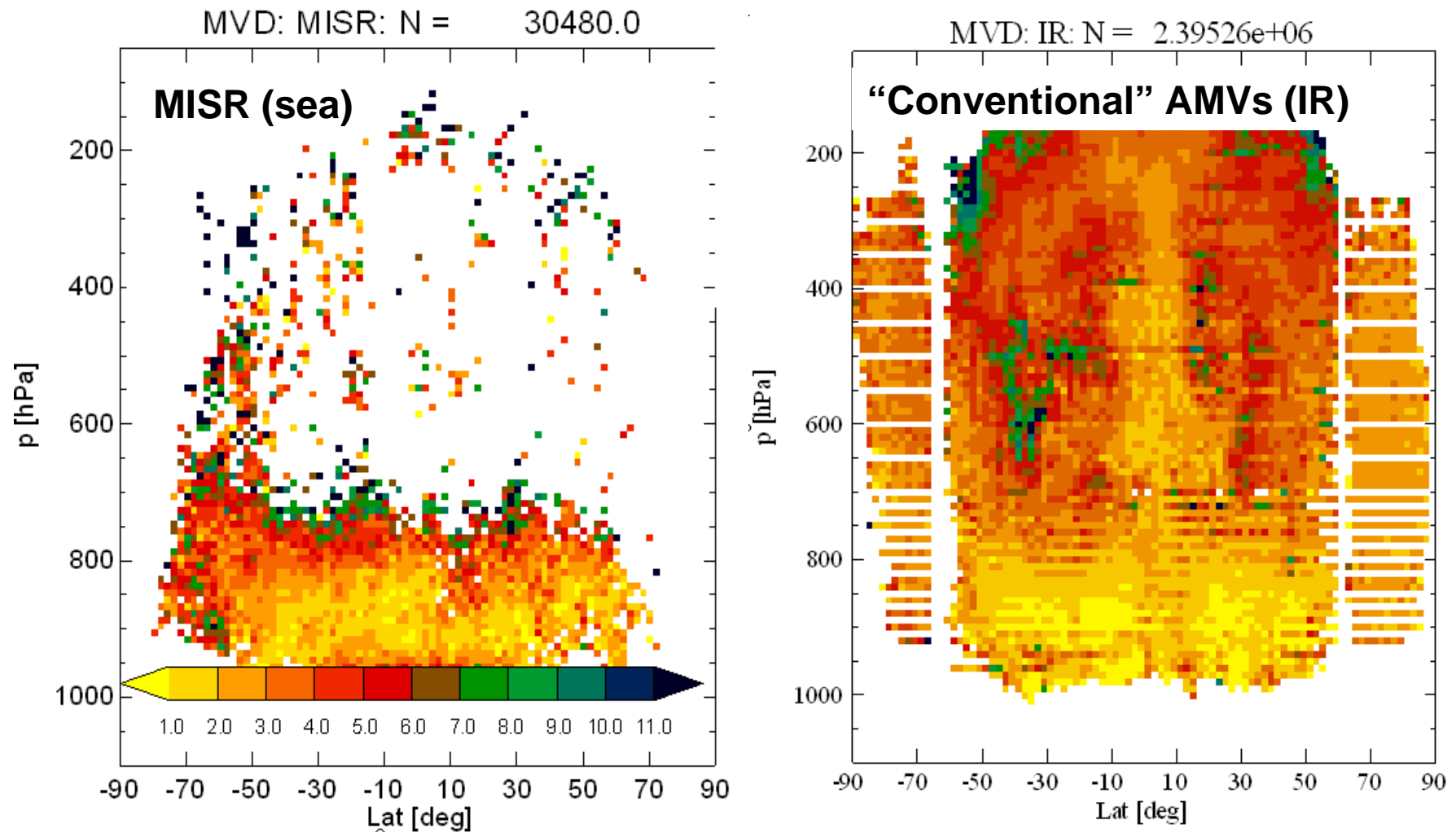
- Comparison of Terra-MISR AMVs against model FG for 6 days (24-29 Oct 2006). Data kindly provided by Roger Davies.
- MISR-winds are based on multi-angle VIS and near-IR images; use stereographic height assignment.
- Geometric heights for MISR winds were converted to pressure using the FG.
- Statistics are based on MISR winds labelled “good” and “very good”; no difference in monitoring statistics was noted between the two categories.
- Sample of MISR winds is relatively low (~30500 over 6 days).
- Statistics also compared against “conventional” AMVs from GOES11/12, MET5/8, MODIS (QI > 60).

5) MISR AMVs: Zonal mean speed bias against FG



Speed biases similar to “conventional” AMVs, despite theoretically better height assignment.

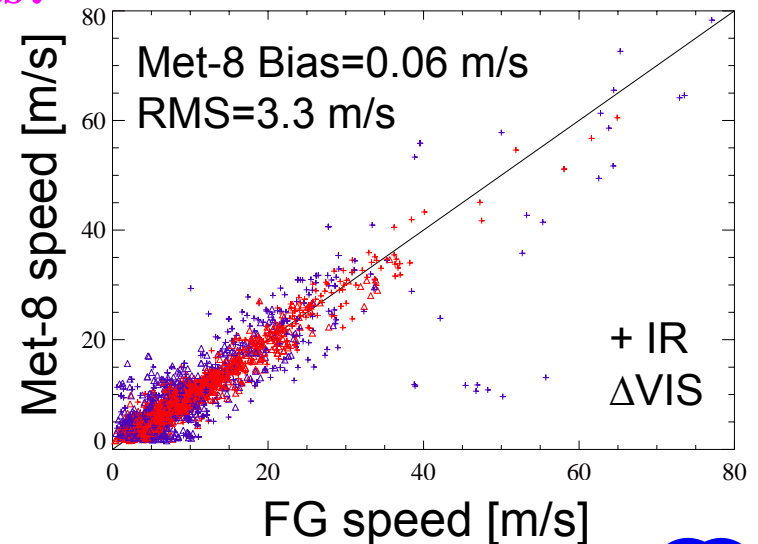
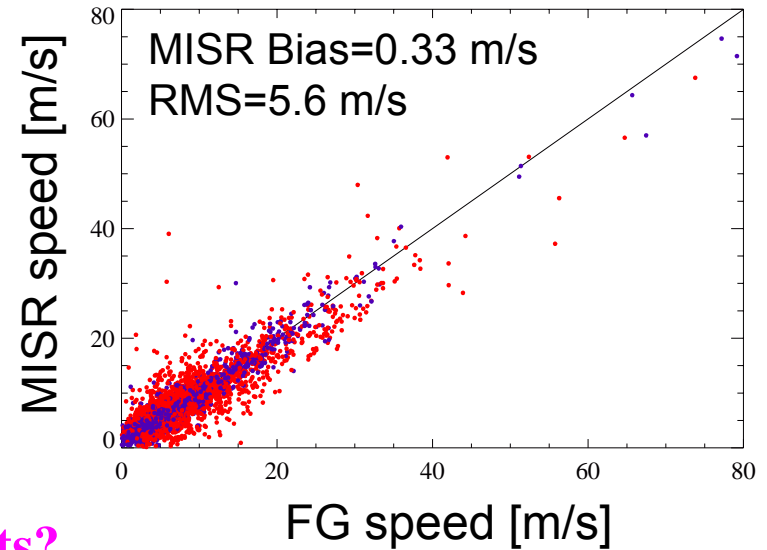
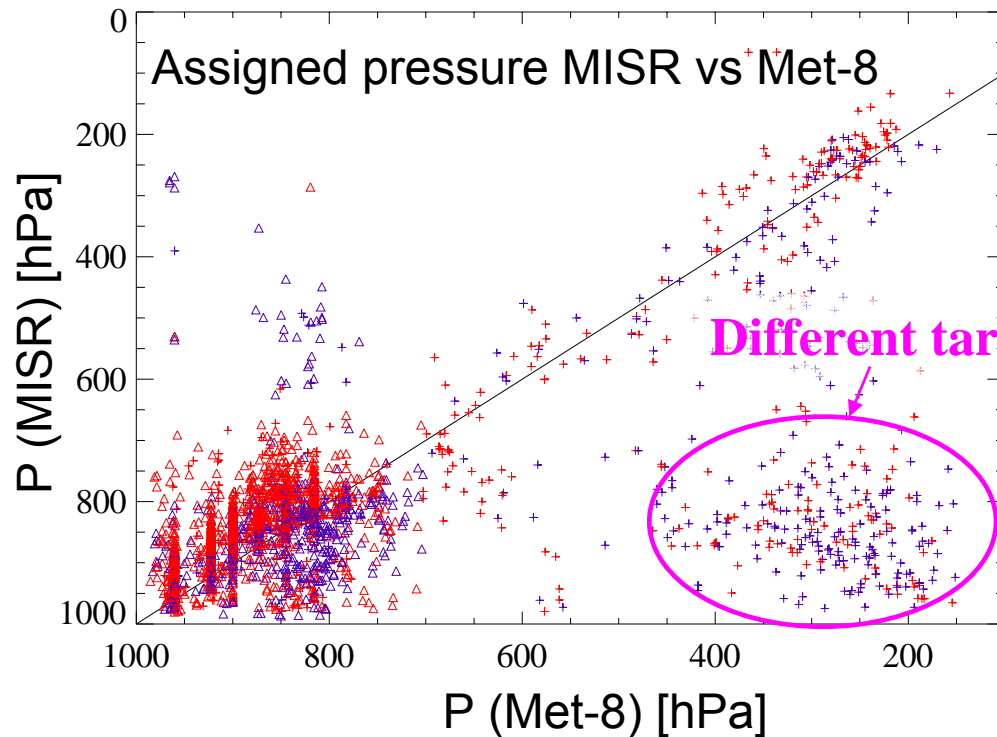
5) MISR AMVs: Zonal mean MVD against FG



MVD slightly larger compared to “conventional” AMVs.

5) MISR AMVs: Collocation with Met-8

Time difference < 15min
Horizontal difference < 50km



Red: Met-8 has lower vector difference to FG
Blue: MISR has lower vector difference to FG
+ - Met-8 IR; Δ - Met-8 VIS

Summary

- AVHRR AMVs show somewhat poorer monitoring statistics and coverage compared to MODIS AMVs, but encouraging forecast impact in a system with limited use of other satellite observations.
- Db MODIS AMVs have a more timely arrival time – better coverage for early delivery stream. Assimilation trial to be conducted shortly.
- FY-2C AMVs contain large biases – especially in the high level Extra-Tropics. Will be monitored passively in operations.
- MISR winds show a quality similar to “conventional” AMVs; speed biases are surprisingly similar, despite better height assignment for the MISR winds. However less data.

AMV denial experiment • 12 Dec 2007-12Jan 2008 • Neutral in Extra-tropics
 • Forecast impact in Tropics

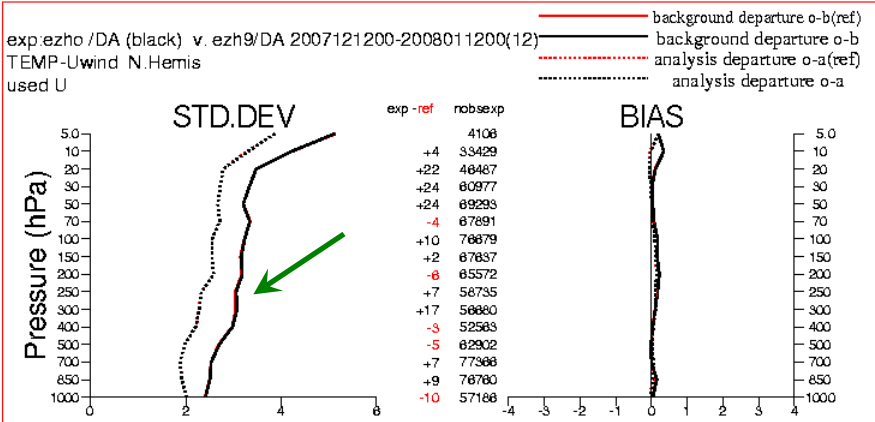
TROPICS	Verification against		
	Oper (32 cases)	Own analysis (22 cases)	Observations * (32 cases)
1000 hPa	+ve days 1-3	+ve day 4	+ve day 1-2
850 hPa	+ve days 1-3	very -ve days 1-3	Neutral
500 hPa	+ve days 1-3	very -ve days 1-3	Neutral
300 hPa	-ve days 4-5 (+ve day 1)	Neutral	+ve day5
200 hPa	-ve days 4-5	+ve day 1	Neutral
100 hPa	neutral	Neutral	Neutral

+ve = positive
including AMVs

* Selected radiosondes

Radiosondes

Expt (ezho) : no amvs Control (ezh9): amvs



Reduction in standard deviation

Slight increase in bias?

