Use of reprocessed AMVs in the ECMWF Interim Re-analysis

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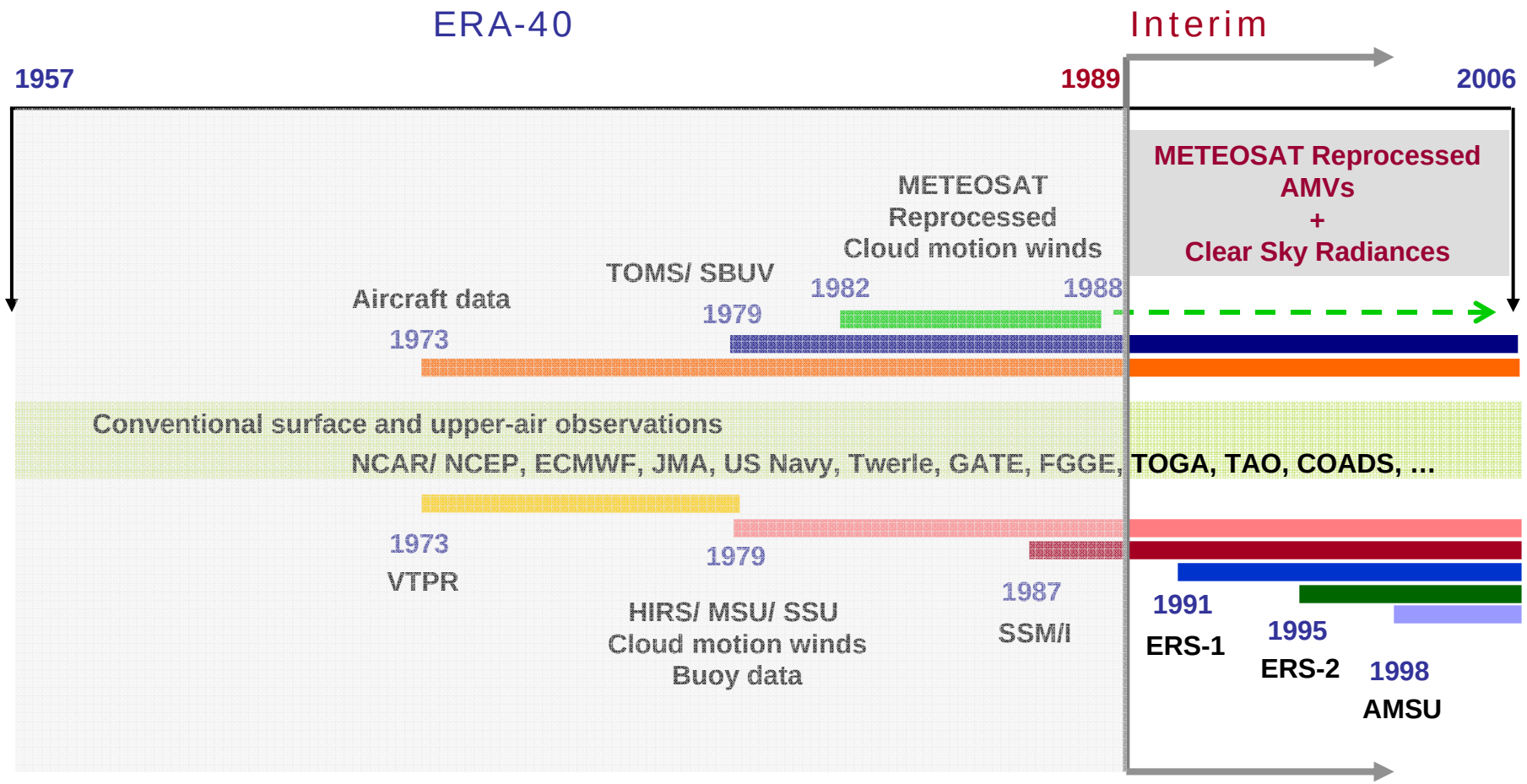
ECMWF

Talk Outline

- Introduction
- 1989 experiment (Met-3)
- 1995 experiment: XADC period (Met-3 and Met-5)
- Summary

Observing systems used in:



EUMETSAT have reprocessed the AMV product for the Interim project:

- improvements in derivation techniques
- fully automated use of IR, VIS, WV images (better approach for h.a.)
- use of QI (allows greater control on usage of data by NWP users)
- better spatial and temporal coverage (1 ½ hrly compared to 2-4 times a day).

AMV monitoring and impact Study I

Interim IFS configuration: CY31R2 T255 (T159) L60 (4DVAR 12hr window)
ECMWF Newsletter nº110

QC for new data: Updated blacklist + quality control same as current pre-MSG operational one except for tighter Tropics as a result of findings from previous ERA studies (Bormann, 2003) + thinning at 140km x 140km + use fg-dep QI 1

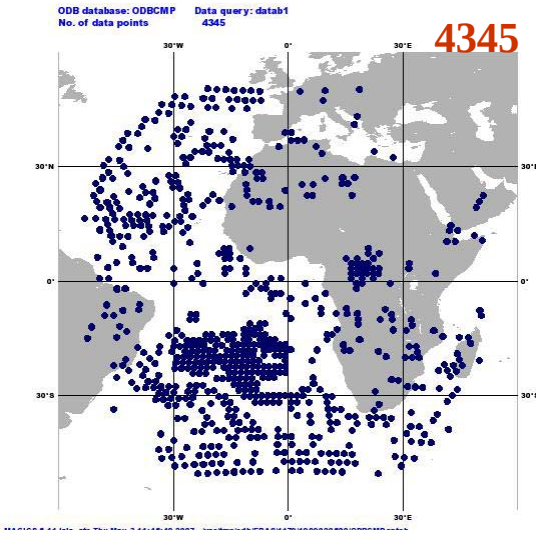
Data: reprocessed Meteosat-3 (centred on 0º) for 3 months: 4th Feb to 4th May 1989

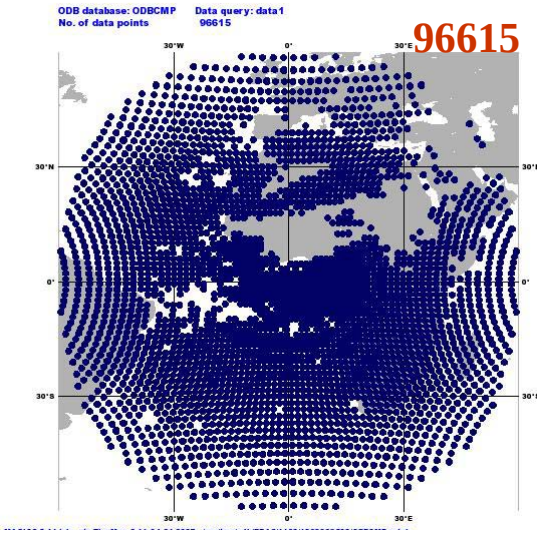
Sample of AMV coverage: 6th Feb 1989

old

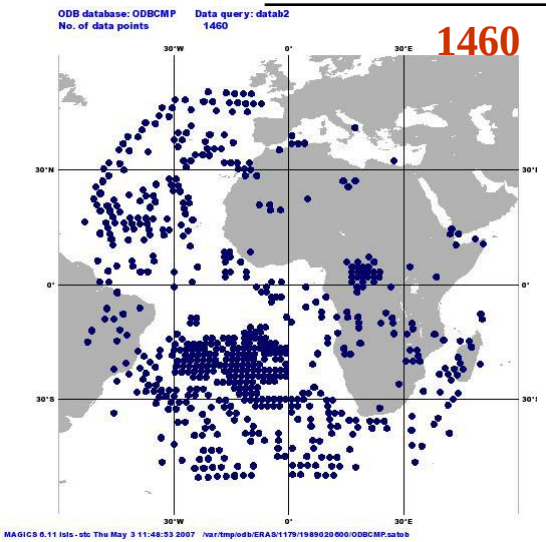
reprocessed

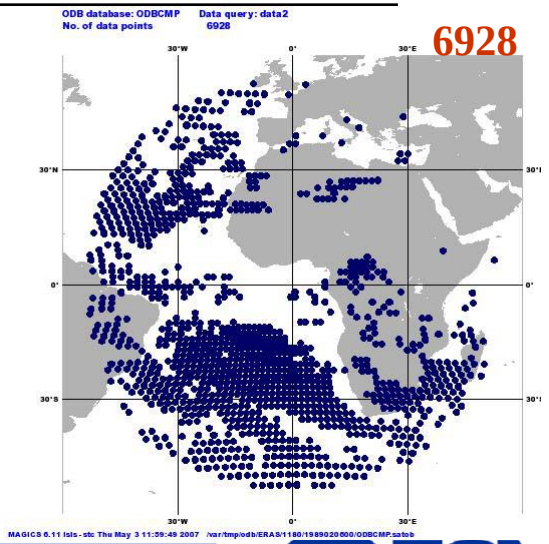
all





Used (after QC)

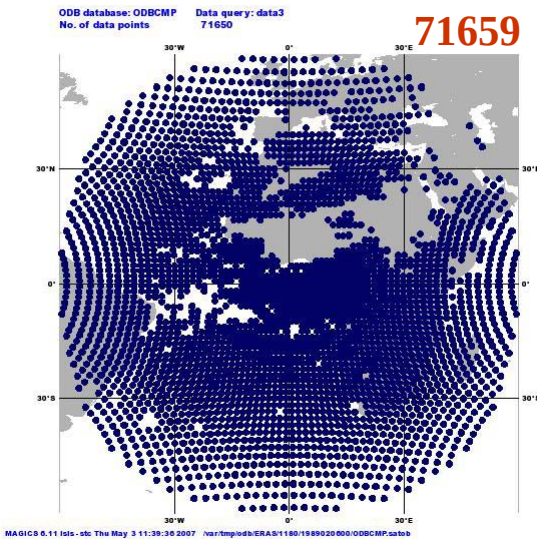


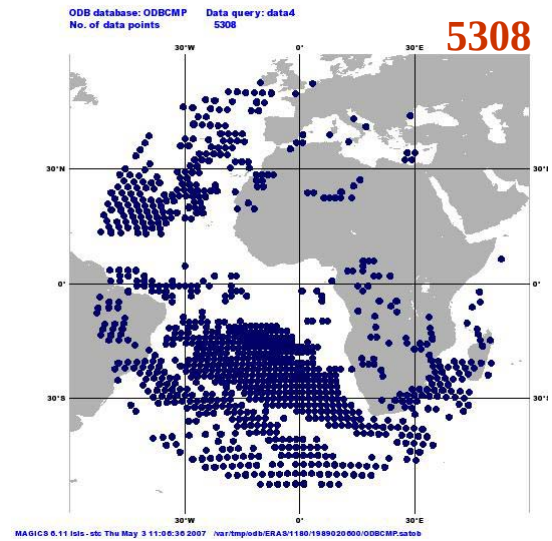


Reprocessed: all

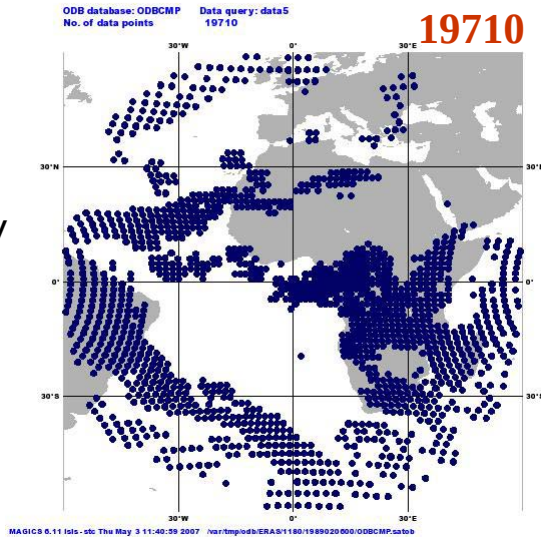
Reprocessed: used

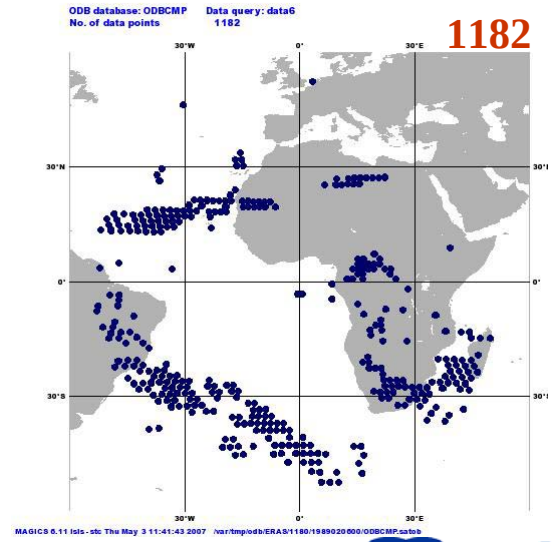
IR





Cloudy WV

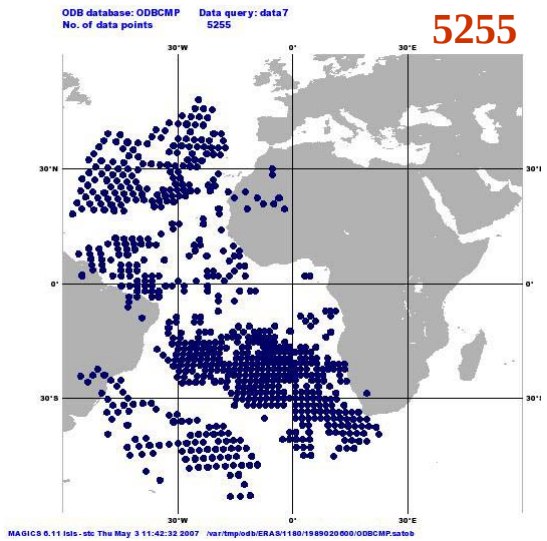


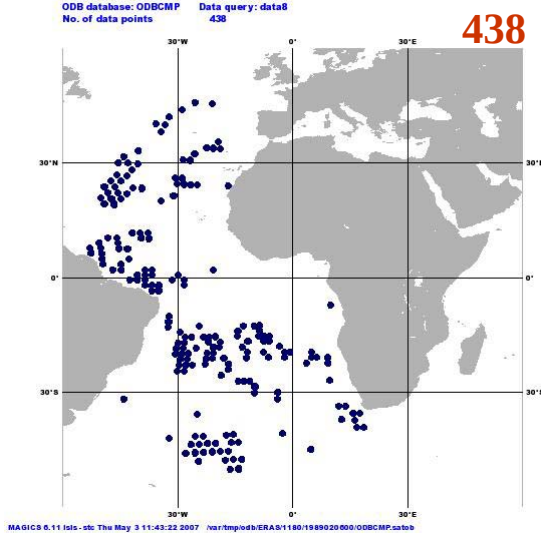


all

Used (after QC)

VIS



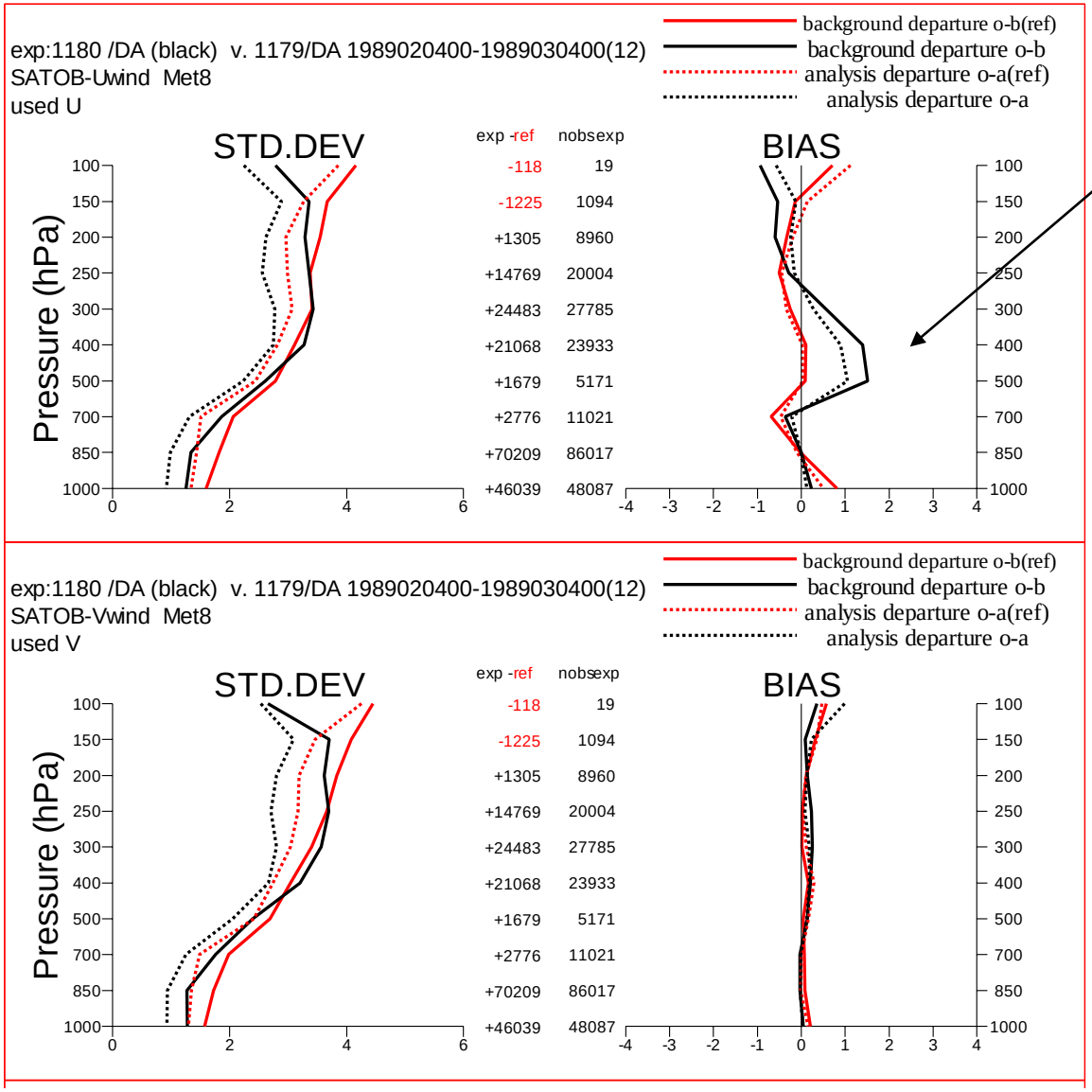


- increase in numbers at high levels (IR + WV contribution) + low levels (IR + VIS contribution)
- mid level constrained more by strict quality control.

Used U, V

Met 8 region

Statistics for used reprocessed amvs and used original amvs



Semi-transparency method applied irregularly to IR AMVs.

Bias worse at mid to high levels but standard deviation **better** + **large** increase in number of AMVs

Statistical significance (t-test) RMS Vector wind forecast error validated against ERA-40 analysis (90 cases)

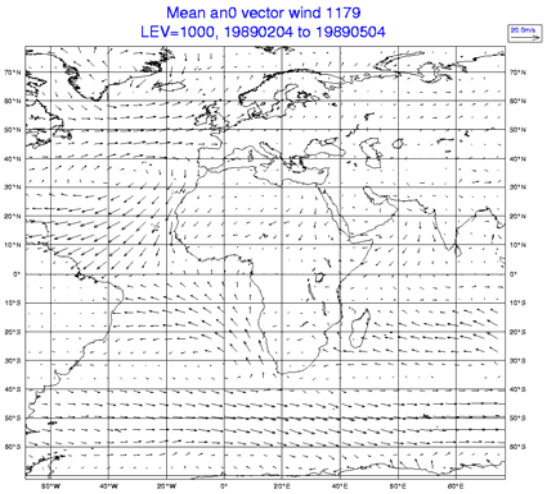
	Forecast Day	1000hPa	850hPa	500hPa	200hPa
NH Extra-trop	2				
	3	10%			
	5				
	7	10%			
Tropics	2	0.2%	0.1%		
	3	0.5%	0.1%		
	5	2%	1.0%		
	7	5%	10%		
SH Extra-Trop	2		10%	10%	
	3				
	5				
	7				
Europe	2			2%	10%
	3			10%	
	5		5%	10%	10%
	7	10%			

No entry means that there is not enough statistical significance

Improved scores in **black**
Degraded ones in **orange**.

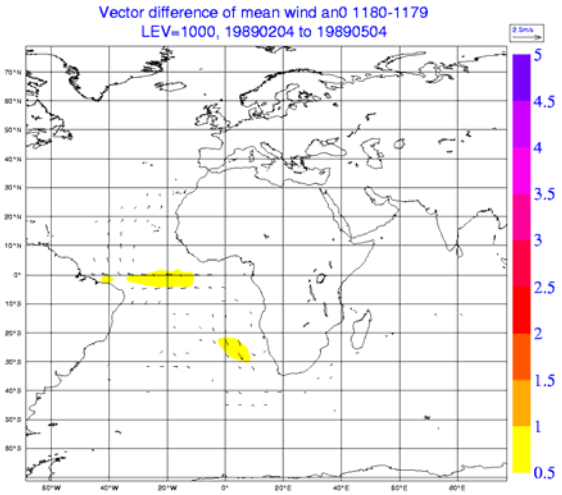
Mean wind analysis (control)

Vector difference of mean wind analysis between ctl and expt (new Met3)

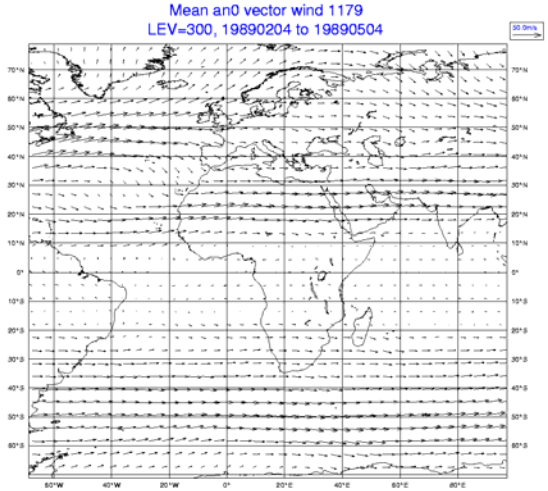


20m/s

1000hPa

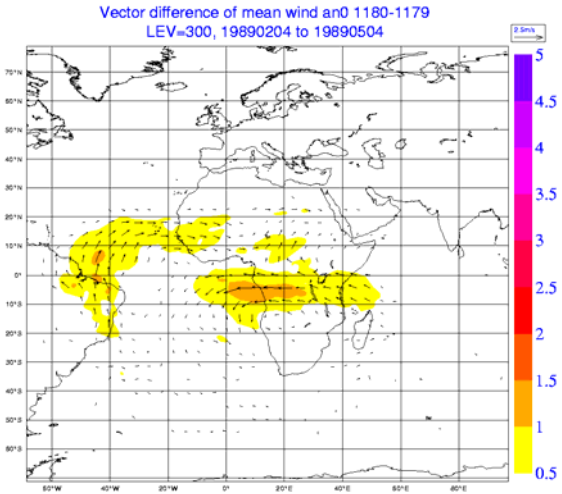


2.5m/s



50m/s

300hPa



2.5m/s

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AMV monitoring and impact study II: XADC period

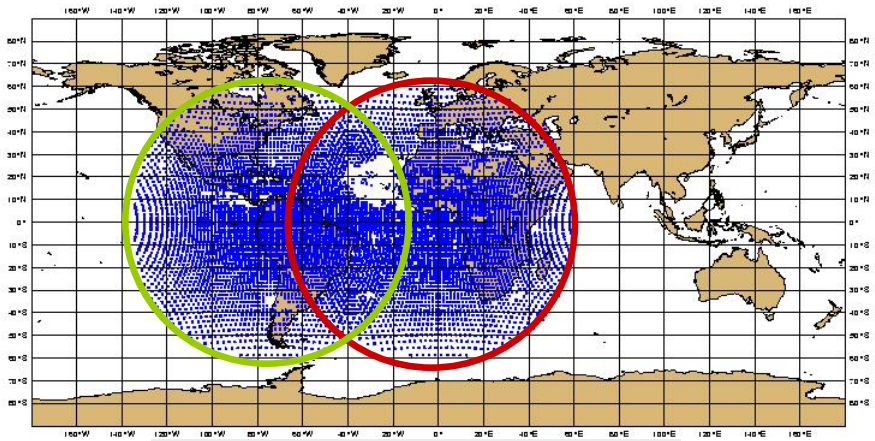
This corresponds to period when Meteosat-5 was operational at 0º and Meteosat-3 was leant to the US due to a faulty GOES satellite. Reprocessing of both datasets gives us an opportunity to look at the impact of having more reprocessed datasets simultaneously.

Interim IFS configuration: CY31R2 T255 (T159) L60 (4DVAR 12hr window)

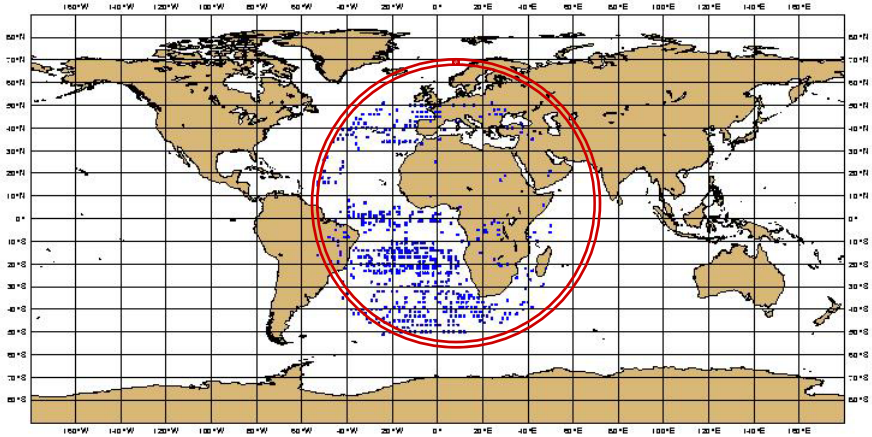
Data: reprocessed Meteosat-5 (0º) and Meteosat-3 (75º W) for 3 months: 1st Jan to 31st Mar 1995

QC: as for the 1989 experiment.

Example of coverage: 19950102



Reprocessed Met3 and Met5 (satid: 50 and 52)



Original Met5 (satid: 5)

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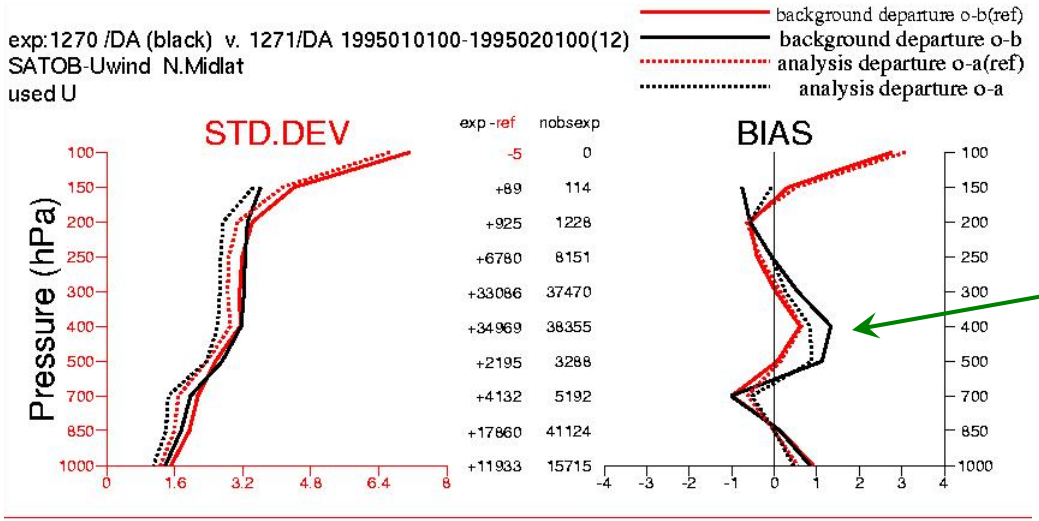
Met-5 and Met-3 Used U

Reprocessed AMVs:**black**

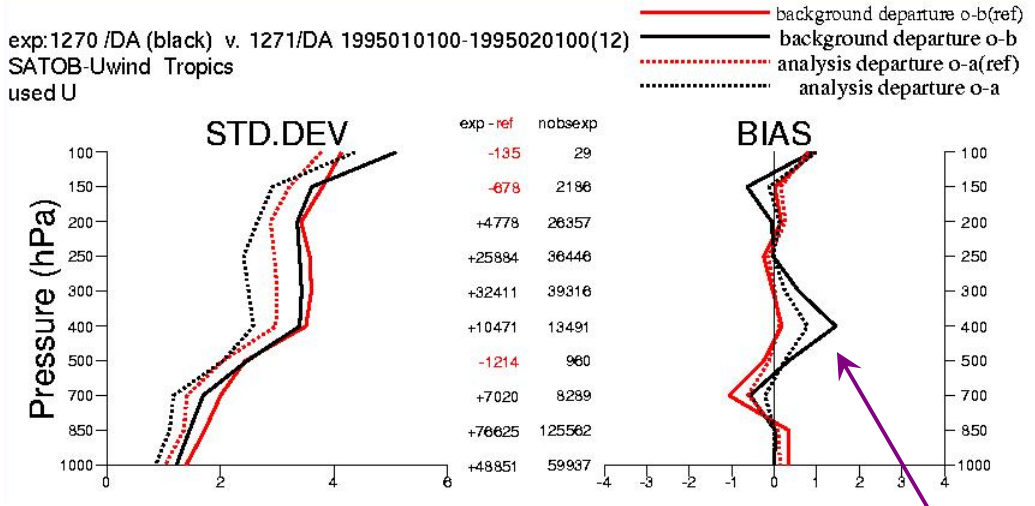
Old AMVs: **red**

Northern Extra-tropics



+ve bias still present in extra-tropics: semi-transparency correction method irregularity?

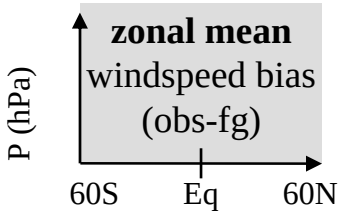
Tropics



Highlights large increase in data “used” in assimilation (note no Met3 in original operations)

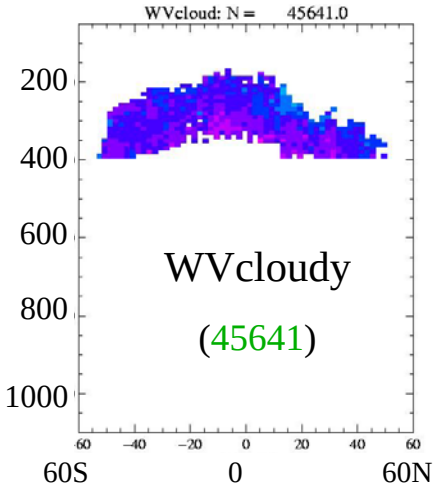
Expect bias/std to be different

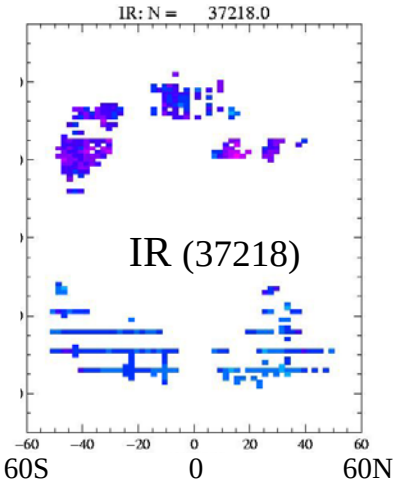
Large bias not as pronounced in 1989 experiment

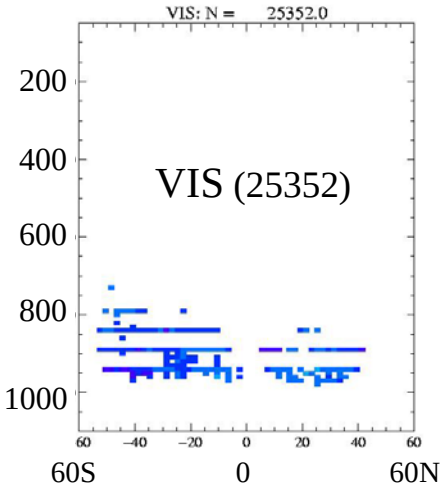


1-15 Jan 1995

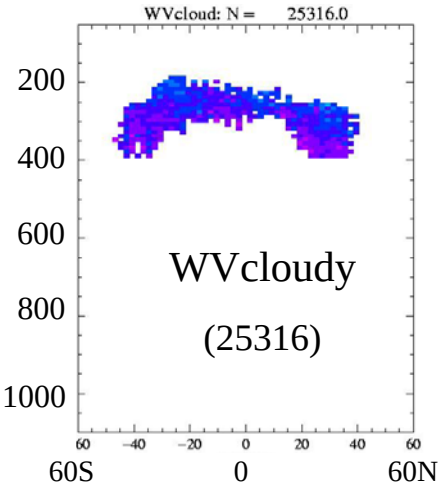
Met5 (used)

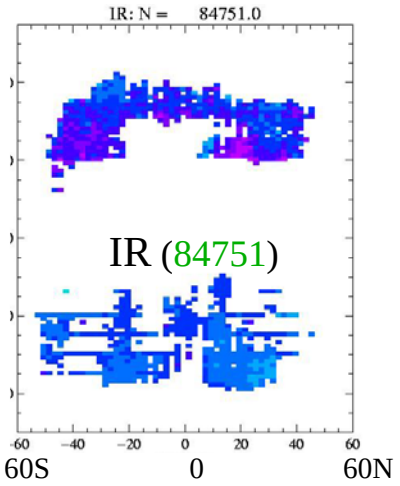


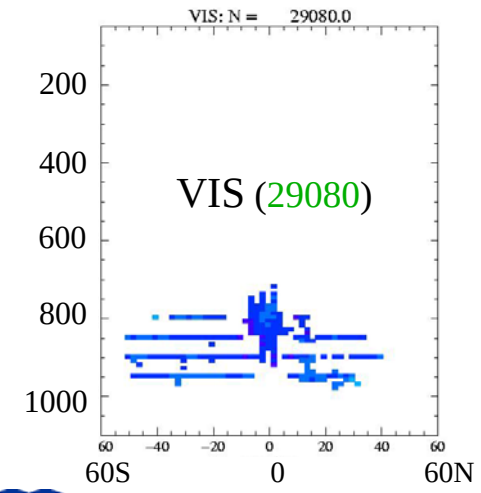


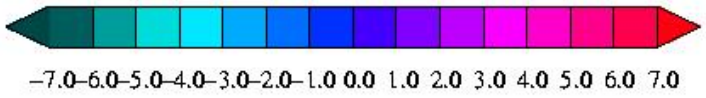


Met3 (used)









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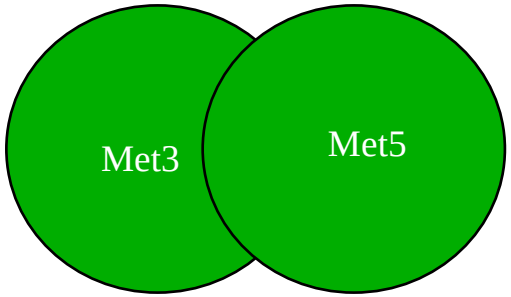
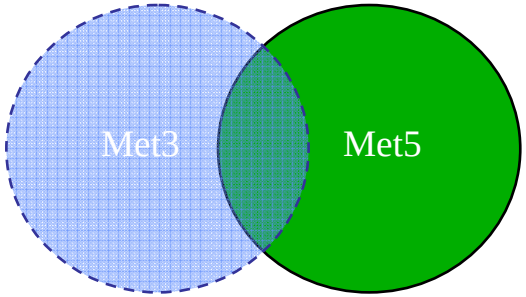
3 EXPERIMENTs

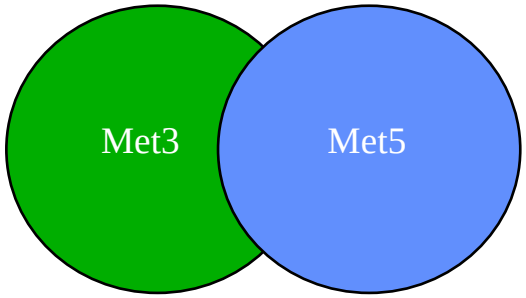
EXPT1



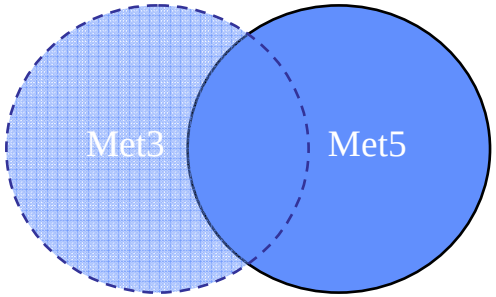
EXPT2

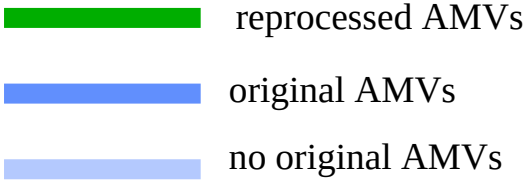


EXPT3



CTL: original operational set-up





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EXPT1

Statistical significance RMS Vector wind forecast error validated against ERA-40 analysis

	Forecast Day	2	3	4	5	6	7
1000hPa	NH	**0.5%**	**0.1%**	**10%**			**2%**
	SH						
	Trop			**10%**		**10%**	
850hPa	NH	**0.5%**	**1%**	**5%**		**5%**	**0.2%**
	SH						
	Trop		**5%**				
500hPa	NH	**10%**	**5%**			**5%**	**0.5%**
	SH	**5%**	**10%**				
	Trop		**2%**	**5%**	**5%**	**1%**	
200hPa	NH						**10%**
	SH	**10%**	**2%**	**5%**			
	Trop	**2%**	**0.2%**	**0.5%**			

VERY good scores except for Tropics!

Improved scores in **black**
Degraded ones in **orange**.
Smaller % = more significant impact

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EXPT2

Reprocessed Met-5 (no Met-3)

Statistical significance RMS Vector wind forecast error validated against ERA-40 analysis

	Forecast Day	2	3	4	5	6	7
1000hPa	NH		5%			5%	
	SH	2%	5%		10%		
	Trop		10%				
850hPa	NH						
	SH	2%	10%			10%	
	Trop		5%				
500hPa	NH					10%	
	SH	5%	1%	10%	10%		
	Trop	0.5%	0.1%	5%		5%	10%
200hPa	NH	2%	5%			10%	10%
	SH	10%	1%	2%	5%	10%	10%
	Trop	0.2%	2%	10%			

• NH extra-tr not as good • SH extra-tr particularly good at high levels •Tropics degraded

Improved scores in **black**
Degraded ones in **orange**.

EXPT 3

old Met-5
reprocessed Met-3

Statistical significance RMS Vector wind forecast error validated against ERA-40 analysis

	Forecast Day	2	3	4	5	6	7
1000hPa	NH	**1%**	**2%**				
	SH	**10%**					
	Trop						
850hPa	NH	**0.5%**	**5%**			**10%**	**2%**
	SH	**10%**					
	Trop	**2%**				**10%**	
500hPa	NH	**1%**	**5%**			**5%**	**0.5%**
	SH		**2%**	**10%**		**10%**	
	Trop						
200hPa	NH	**0.1%**	**1%**			**10%**	**5%**
	SH			**1%**	**10%**	**5%**	**10%**
	Trop	**1%**	**5%**				

• NH extra-tropics better • Tropics not as bad!

Improved scores in **black**
Degraded ones in **orange**.

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Negative impact in Tropics: WHY?

- Tropics difficult area to validate against other observations
- Subtropical jets area: sensitive (location + intensity)

- Tested blacklisting more strictly (remove the mid-to-high-level biases between 30ºS and 30ºN – up to 300hPa)
  - removes negative impact locally but the negative impact still present at the very high levels (ie. 200hPa)

Further Investigation:

- Difference between 1989 and 1995 experiments is in the observing system: ERS-1 scatterometer surface winds.
- Run experiment during the wet season for the ITCZ (more active season)

SUMMARY

Reprocessed winds were monitored as part of the Interim Re-analysis project. EUMETSAT's support for this has been of great value.

A first quality and impact study:

- Reprocessed Met-3 AMVs for Feb-April 1989
- Large increase in the amount of AMVs + improved std dev of departures BUT biases at mid-levels – semi-transparency correction method?
- Forecast impact: relatively neutral in extra-tropics and very positive in low-level Tropics.

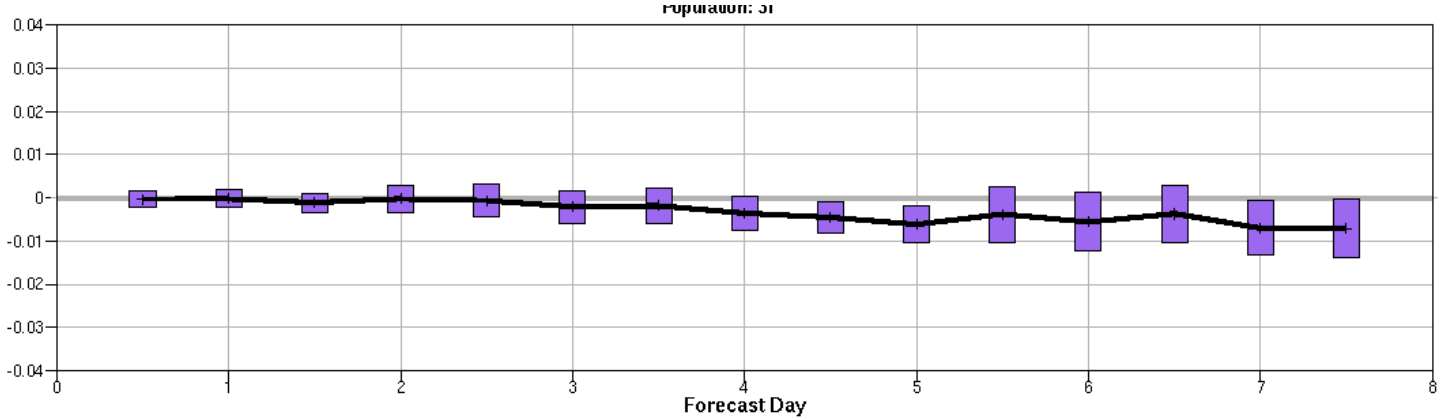
A second study:

- for XADC period (1995) – Met-3 (75ºW) and Met-5 (0º).
- Mid level bias still present.
- Very positive impact in Extra-Tropics but very negative in Tropics at high levels
- Blacklisting Tropics more strictly reduces the –ve impact locally but more –ve at 200hPa.

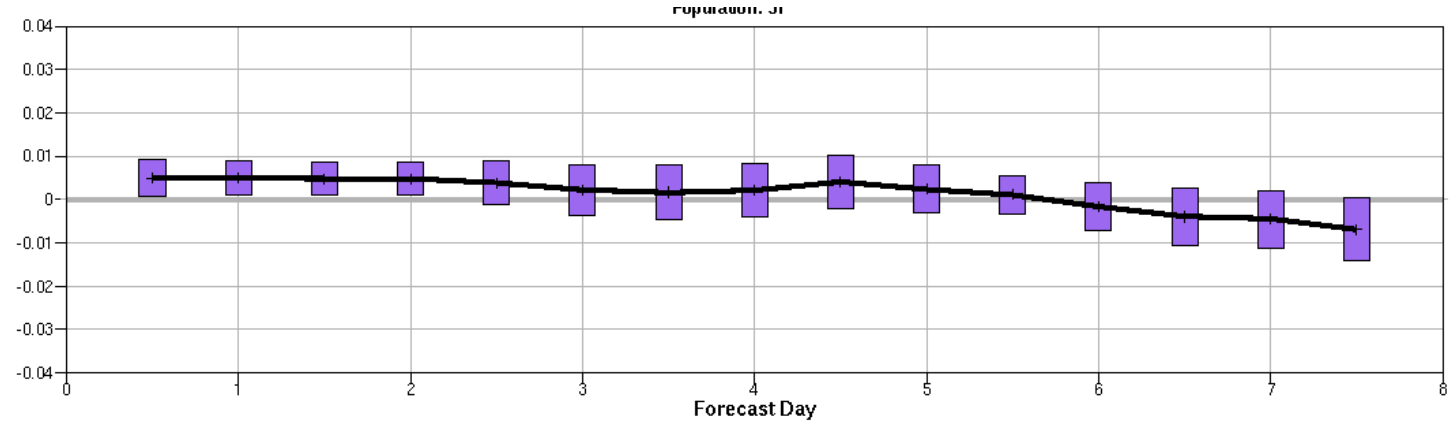
Areas to pursue: ITCZ wet season (July-Sept) + impact of the scatterometer data

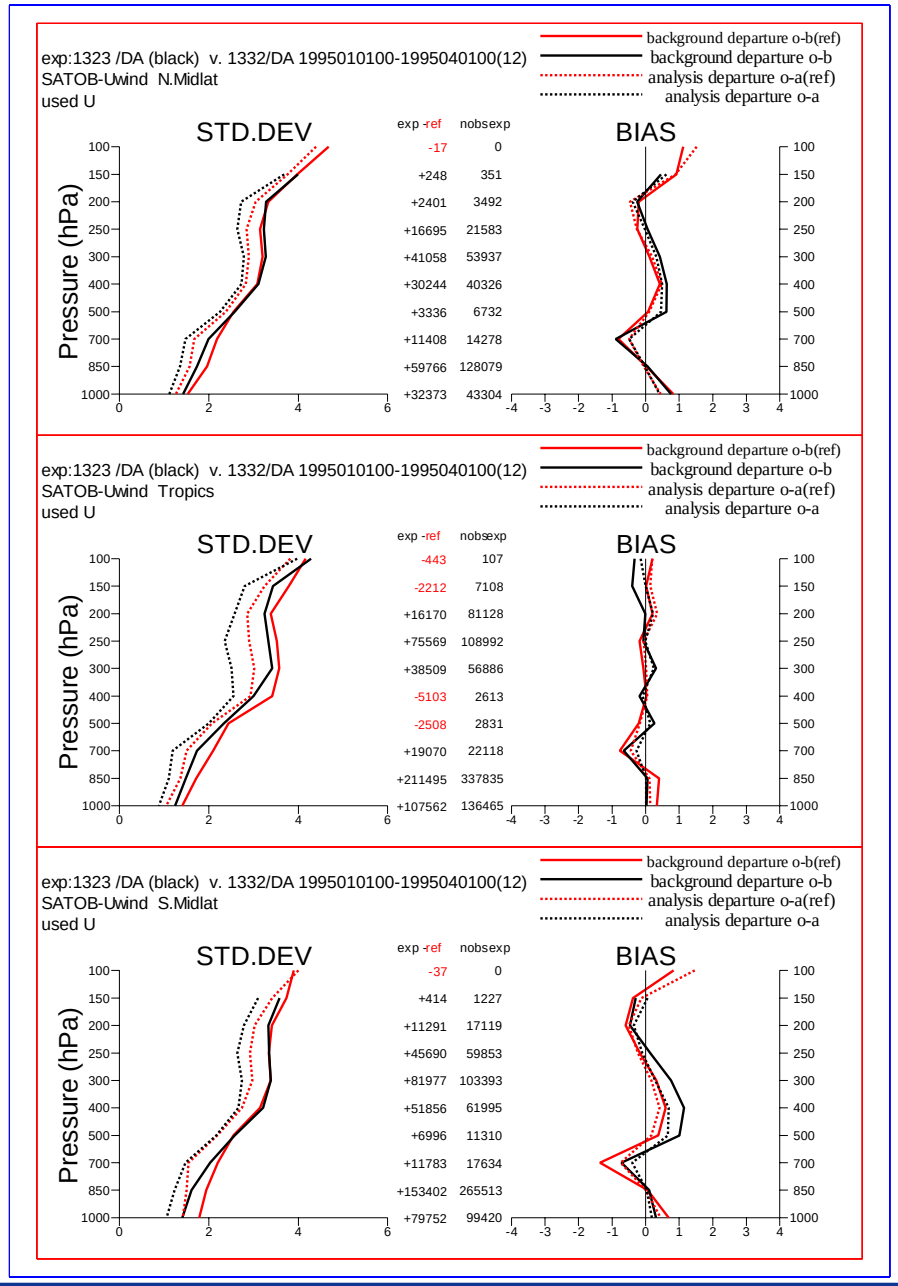
Scatterometer surface wind - Interim expt: 1992 (May)

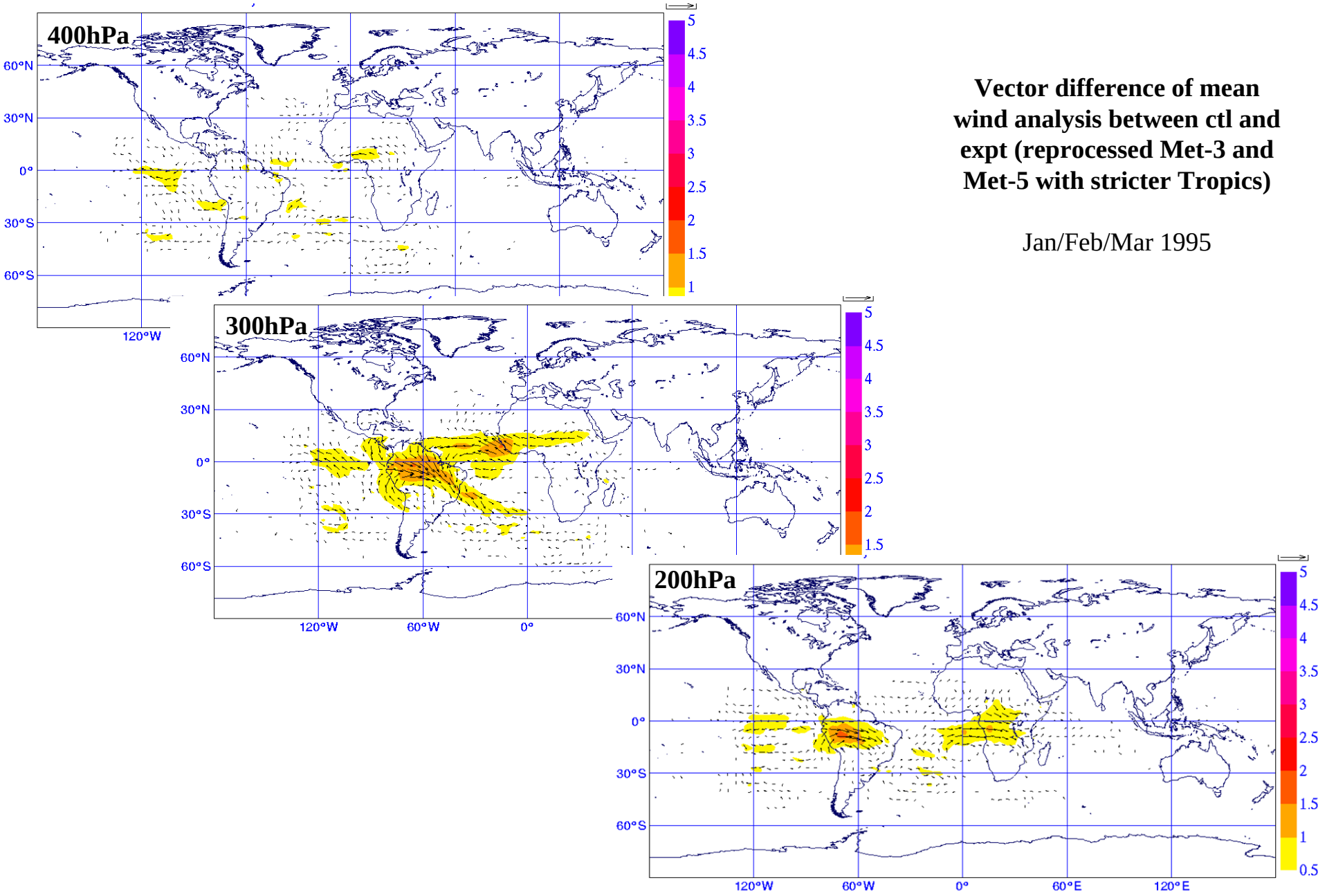
500hPa



200hPa




exp:1323 /DA (black) v. 1332/DA 1995010100-1995040100(12)
SATOB-Uwind N.Midlat
used U
background departure o-b(ref)
background departure o-b
analysis departure o-a(ref)
analysis departure o-a
STD.DEV
BIAS
exp -ref nobsexp
-17 0
+248 351
+2401 3492
+16695 21583
+41058 53937
+30244 40326
+3336 6732
+11408 14278
+59766 128079
+32373 43304
Pressure (hPa)
exp:1323 /DA (black) v. 1332/DA 1995010100-1995040100(12)
SATOB-Uwind Tropics
used U
STD.DEV
BIAS
exp -ref nobsexp
-443 107
-2212 7108
+16170 81128
+75569 108992
+38509 56886
-5103 2613
-2508 2831
+19070 22118
+211495 337835
+107562 136465
Pressure (hPa)
exp:1323 /DA (black) v. 1332/DA 1995010100-1995040100(12)
SATOB-Uwind S.Midlat
used U
STD.DEV
BIAS
exp -ref nobsexp
-37 0
+414 1227
+11291 17119
+45690 59853
+81977 103393
+51856 61995
+6996 11310
+11783 17634
+153402 265513
+79752 99420
Pressure (hPa)



Vector difference of mean wind analysis between ctl and expt (reprocessed Met-3 and Met-5 with stricter Tropics)

Jan/Feb/Mar 1995

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Stricter blacklist

Statistical significance RMS Vector wind forecast error validated against ERA-40 analysis

	Forecast Day	2	3	4	5	6	7
1000hPa	NH	**10%**					
	SH		**0.2%**	**1%**			
	Trop		**10%**	**10%**		**2%**	**10%**
850hPa	NH				**5%**		
	SH		**0.5%**	**1%**			
	Trop					**2%**	**2%**
500hPa	NH			**10%**	**2%**		
	SH	**0.2%**	**0.5%**	**10%**			
	Trop						**10%**
200hPa	NH			**10%**	**0.2%**	**5%**	
	SH	**1%**	**0.5%**	**0.2%**	**10%**		
	Trop	**0.1%**	**0.1%**	**0.2%**	**2%**		

Better in Tropics : -ve impact confined to higher levels

BUT –ve impact in >500hPa in NH

Improved scores in **black**

Degraded ones in **orange**.