Bias correction of satellite data at Météo-France

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Contribution from

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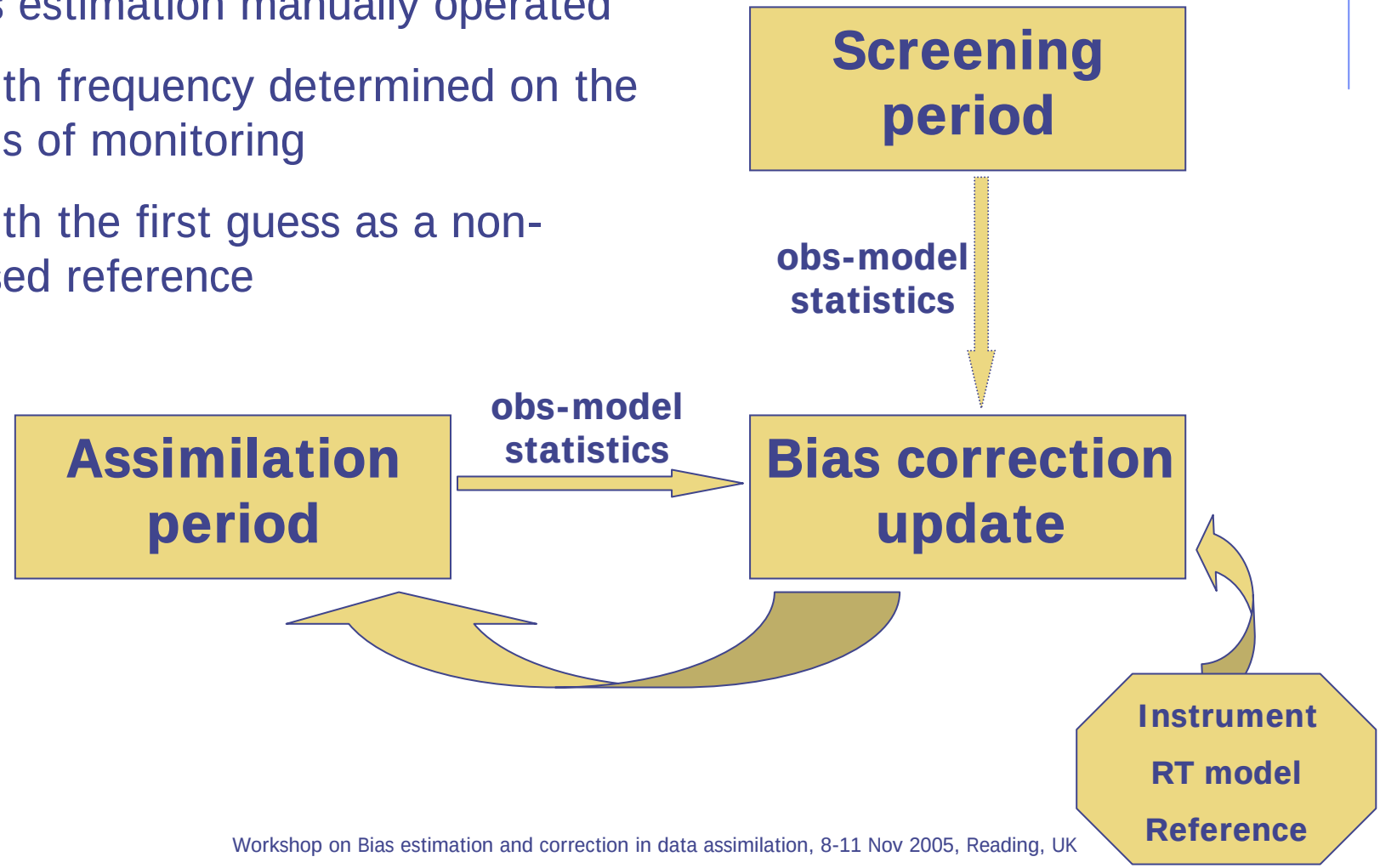
8-11 Nov 2005, Reading, UK

METEO FRANCE

Introduction

Bias estimation manually operated

- with frequency determined on the basis of monitoring
- with the first guess as a non-biased reference



Overview of Bias Correction at Météo-France

	Instrument	ARPEGE (global)	ALADIN (LAM)	No. of predictors	Scan correction	Period [days]	Update [/year]
❶	AMSUA/B, MHS & HIRS	oper	oper	4 (model)	✓	30	1-4 times
	SSM/I	test	test	4 (model)	✓	30	1-4 times
❷	AIRS	test	test	0		7	1-4 times
	QuikSCAT	oper	pre-oper	2 (obs)			
❸	SEVIRI	test	oper	4 (model)		21	> 4 times
❹	Ground-based GPS	test	test	0		10	running average

AMSUA/B, MHS, HIRS and SSM/I (Harris and Kelly, 2001)

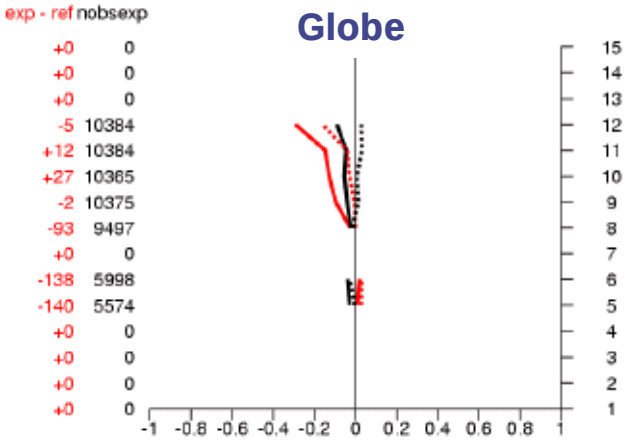
	AMSUA	AMSUB MHS	HIRS	SSM/I
Predictors	1000-300 hPa thickness 200-50 hPa thickness surface temperature total column water vapour			surface pressure surface temperature total column water vapour surface wind speed
↳	Global air-mass correction			
Scanning angles	30 from 30	30 from 90	18 from 56	13 from 64
↳	Latitudinally dependent scan correction (10° latitude bands)			

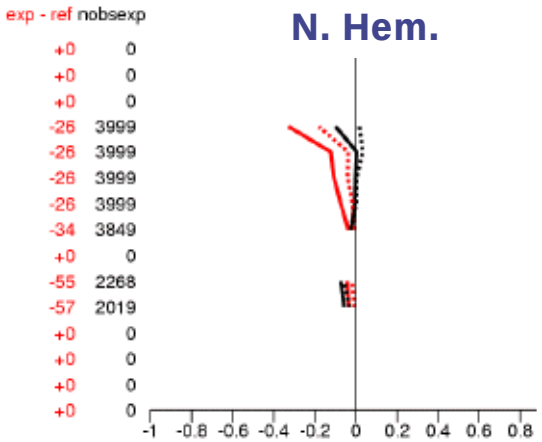
Global correction for “local” application...

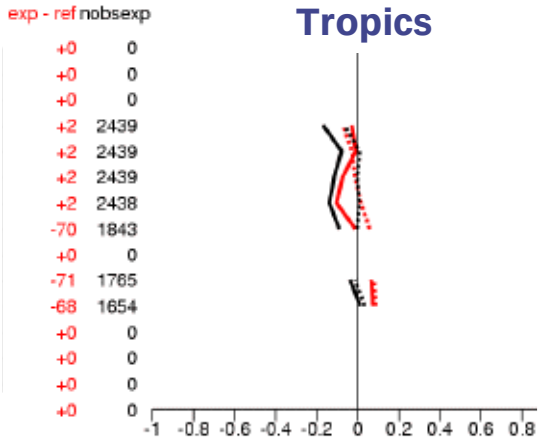
exp:70YQ obstat / ref: DBLE 2005100400-2005100418(06)
TOVS-1C AQUA AMSU-A Tb
used Tb AQUA AMSU-A

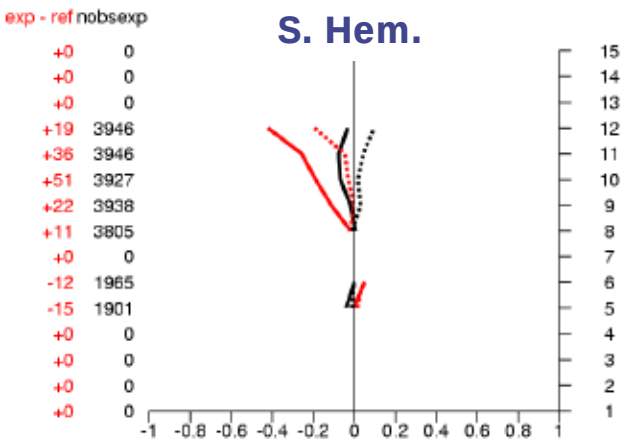
background departure o-b(ref)
background departure o-b
analysis departure o-a(ref)
analysis departure o-a

Reference + updated bias correction









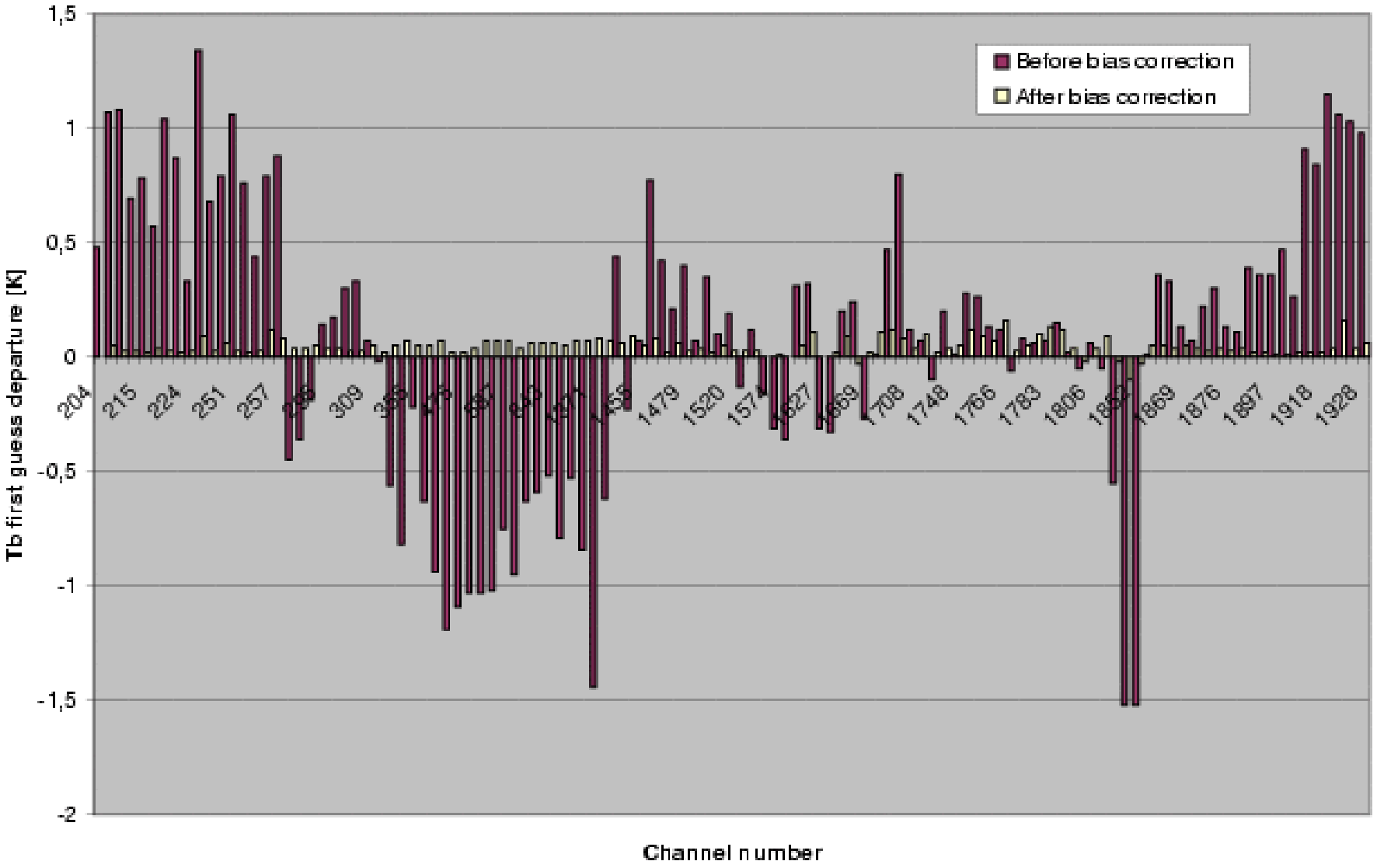
AMSUA, AMSUB, MHS, HIRS

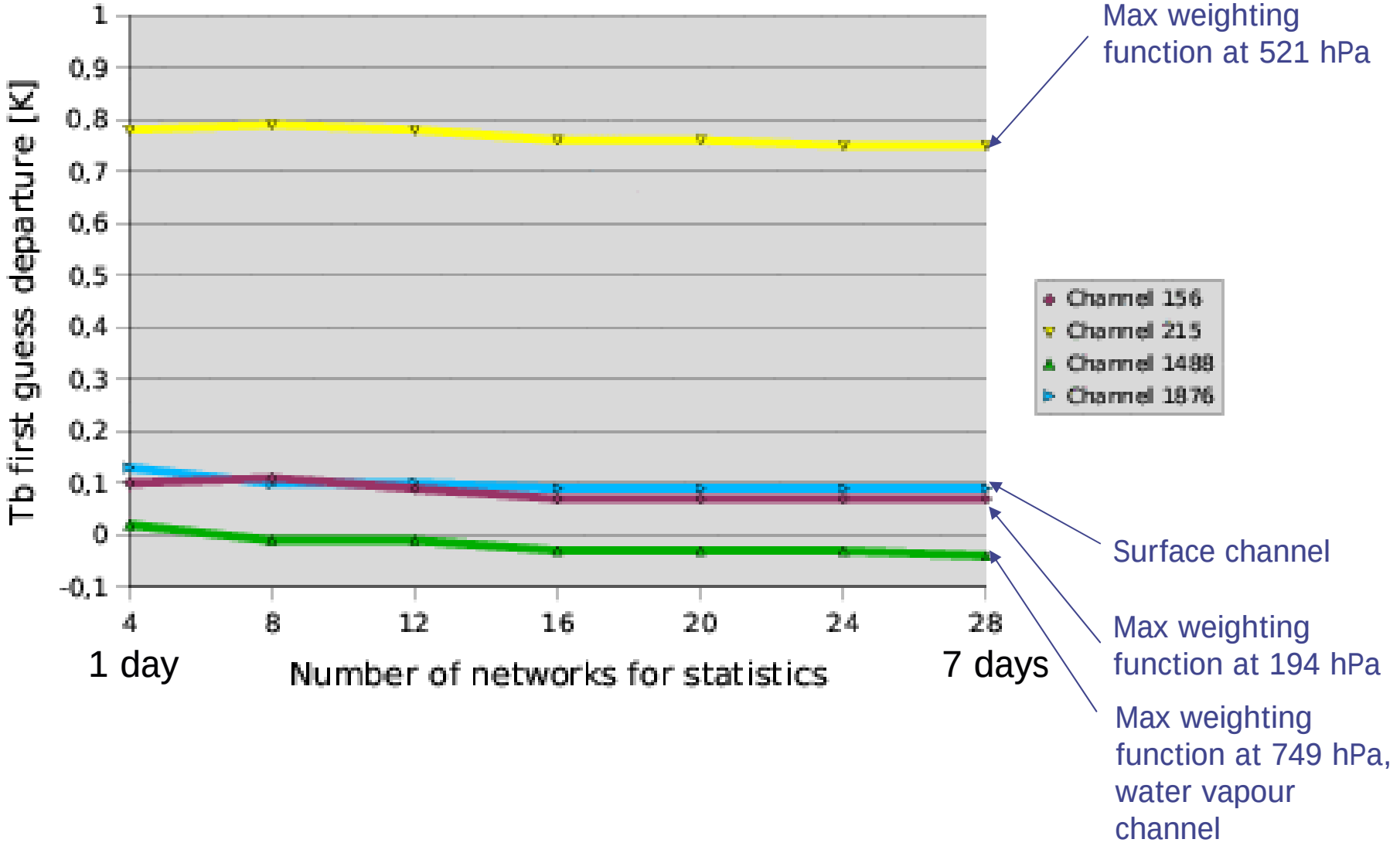
- Global Model ARPEGE
  - Bias correction from global approach for NESDIS disseminated data as well as for locally received EARS data
- Limited Area Model ALADIN
  - Same bias correction as in ARPEGE
  - See presentation by R. Randriamampianina
- Land/sea specific bias correction
  - Assimilation of AMSUA and AMSUB (SSM/I ?) surface sensitive channels over land (Karbou et al., submitted to QJRMS) is expected to benefit from it

AIRS

- 64 channels: neural network bias correction (T. Auligné)
  - Predictors: Ts, viewing angle, first guess Tb, latitude
  - Learning process on 56 analyses (2 weeks)
- More channels: flat bias correction as a first step
  - 103 channels
  - Learning period (shorter): ~ 1 week (no scan correction)

Flat bias correction – 21 Jan 2005 00/06/12/18 UTC - active data

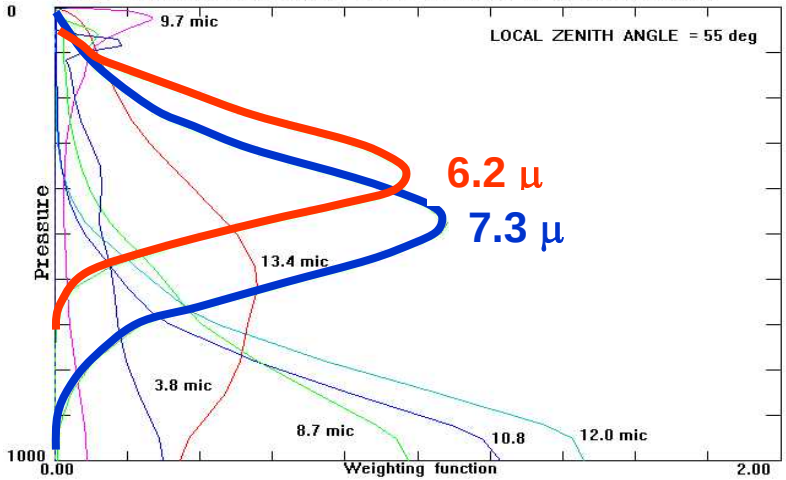



Tb first guess departure [K]
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
-0,1
4
8
12
16
20
24
28
1 day
Number of networks for statistics
7 days
Channel 156
Channel 215
Channel 1488
Channel 1876
Max weighting function at 521 hPa
Surface channel
Max weighting function at 194 hPa
Max weighting function at 749 hPa, water vapour channel

SEVIRI

- VIS and IR imager on board Meteosat 8
- Operational in ALADIN-France 3DVar since 25 July 2005
- Cloud classification (CMS, Lannion, France, SAF/NWC) for channel selection
  - IR channels 8.7μm, 10.8μm and 12μm only in clear air over sea
  - WV channels 6.2μm and 7.3μm kept above low-level clouds
- Use of 1 pixel over 5 (~25 km horiz. resol. over France)
- Thinning within 70 km^2 boxes

Mean weighting functions for mid-latitudes

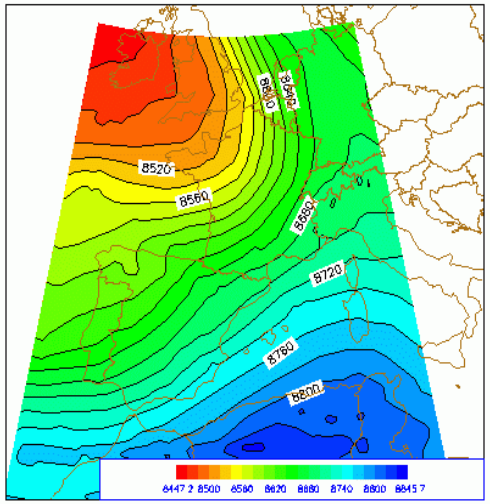


Bias correction of SEVIRI data

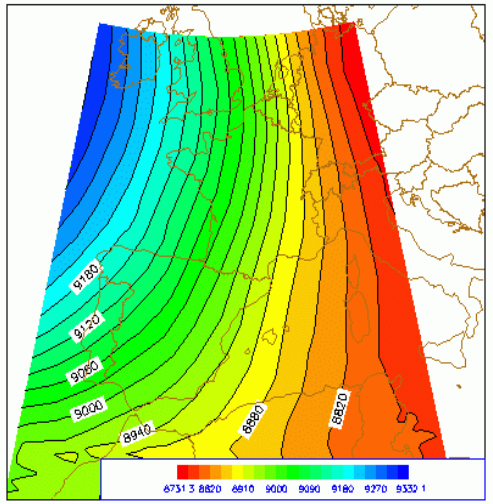
Air-mass dependent bias correction (Harris & Kelly, 2001)

- multiple linear regressions with 4 predictors
- no correction on angle
- regression computed
  - in clear air for WV channels
  - in clear air over sea for IR channels

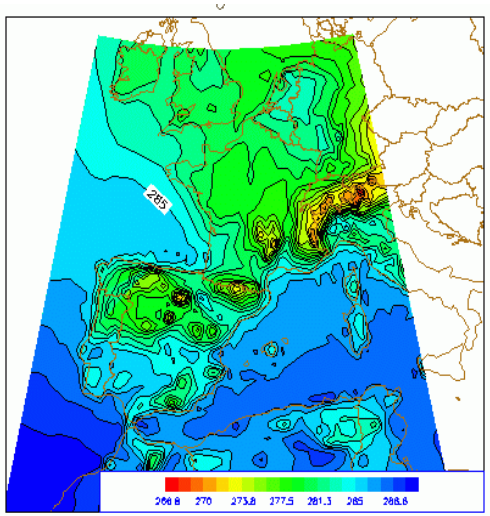
1000-300 hPa Thickness



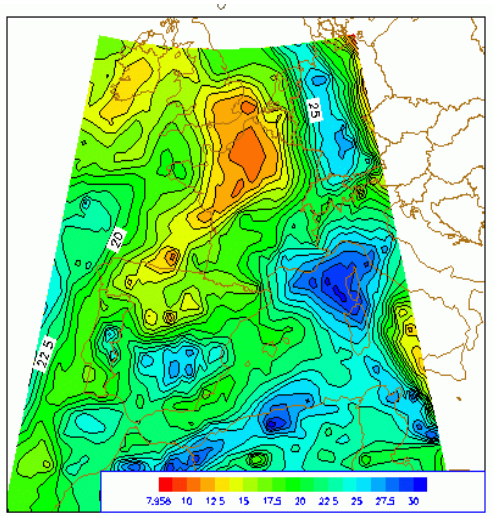
200-50 hPa Thickness



Surface Temperature



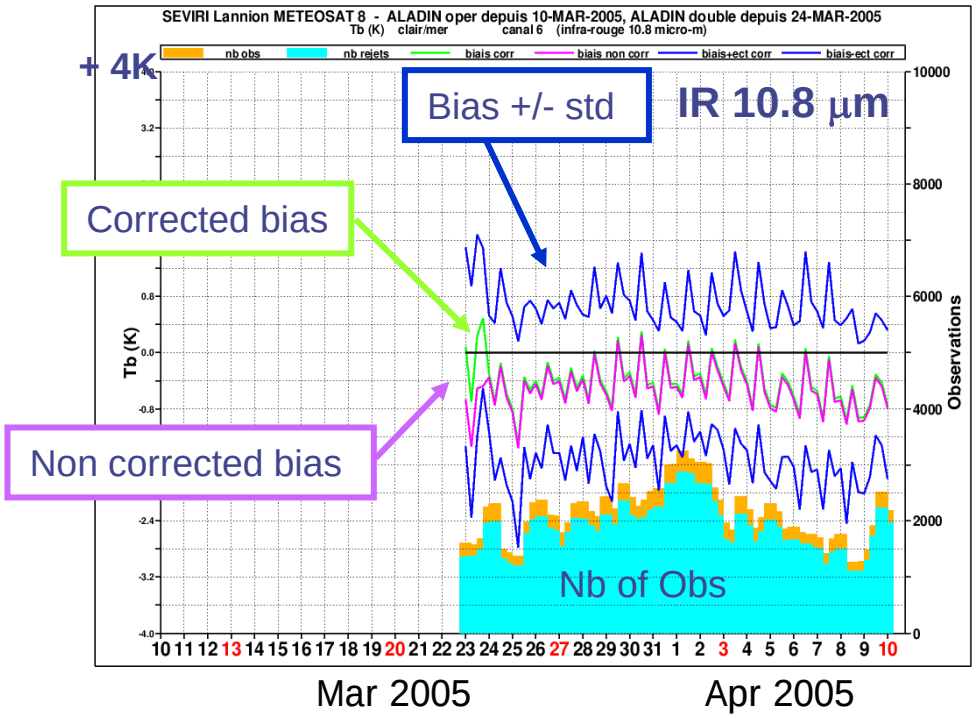
Total Column Water Vapour

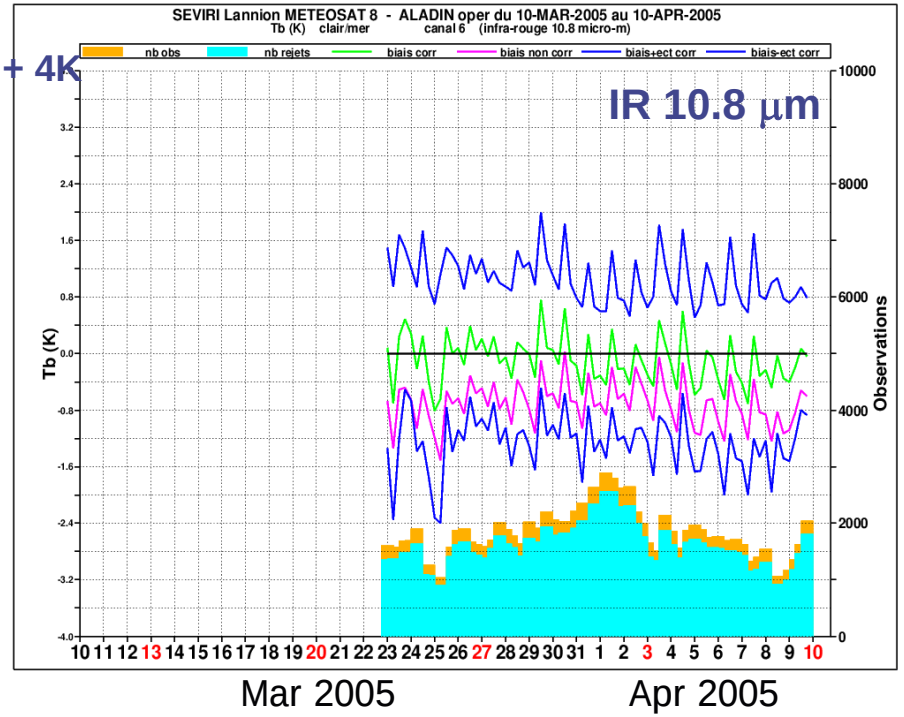


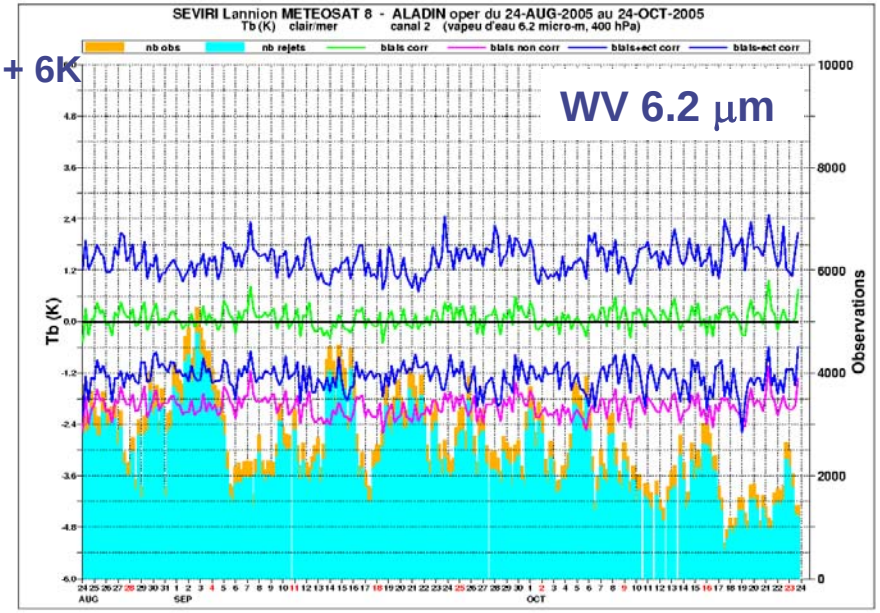
Robustness of the bias correction

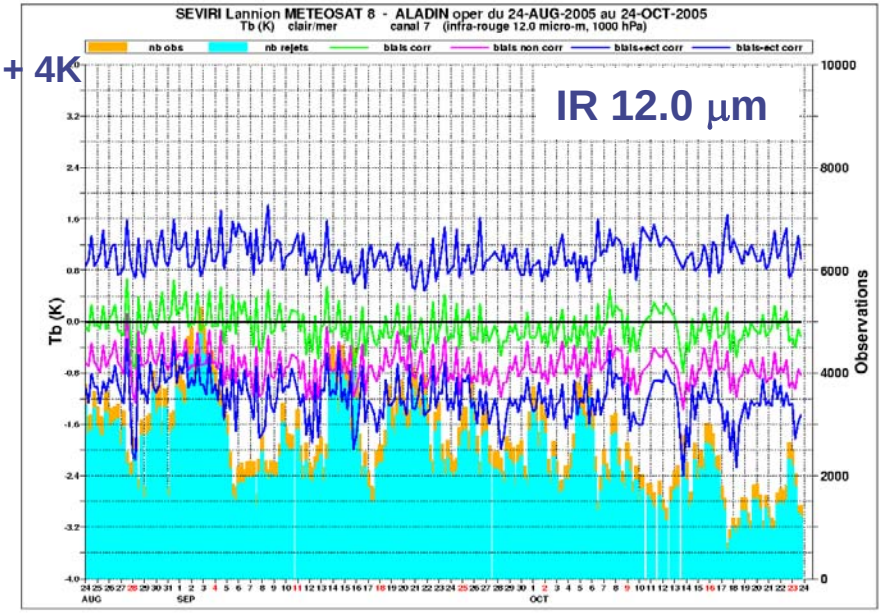
Flat bias tuned on the July 2004 period

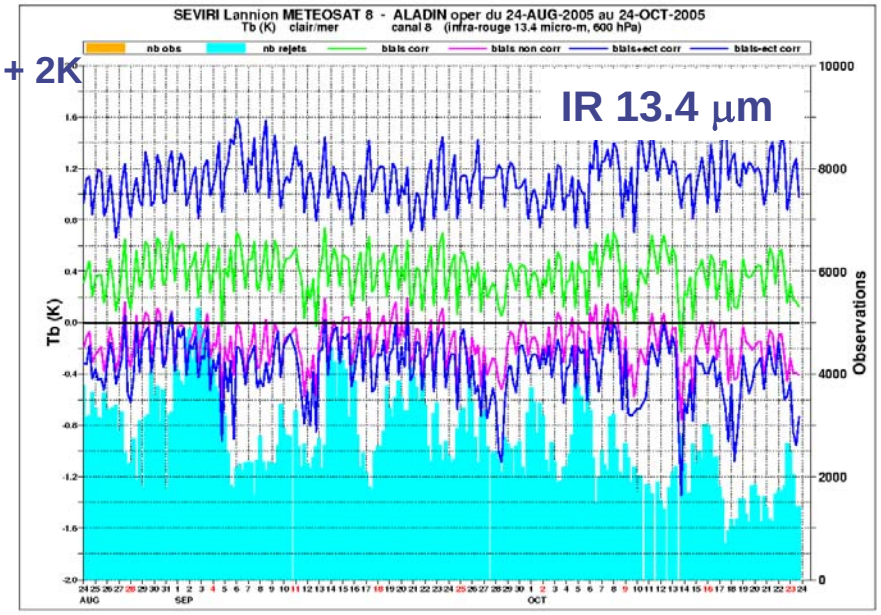
Biases computed using *Harris and Kelly* (2001) method











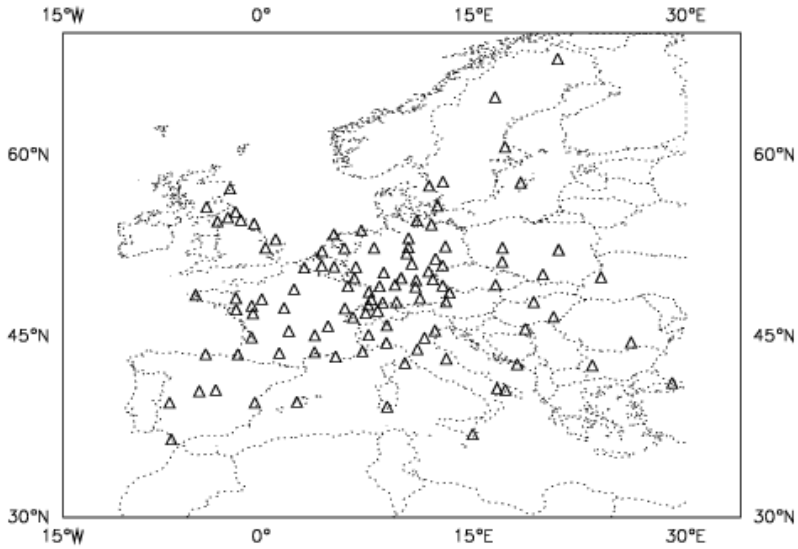
- Because of persistent 0.4 K bias, IR 13.4 μm channel blacklisted
  - Sensitive to tropospheric T
  - Revision of predictors ?
- If computed with weighted Planck functions + corresponding RT coefficients (provided by CMS, Lannion, France) compatible with RTTOV8
  - Bias slightly reduced but not enough to prevent from blacklisting. Still under investigation

SEVIRI

- Limited Area Model (ALADIN)
  - Because of limited area sampling, bias correction coefficients need to be often revised (at least 4 times/year – 3 week period)
- Global Model (ARPEGE)
  - EUMETSAT clear sky radiances (CSR) (40 km horizontal resolution) to be soon introduced, bias correction with 3 predictors (no Ts)

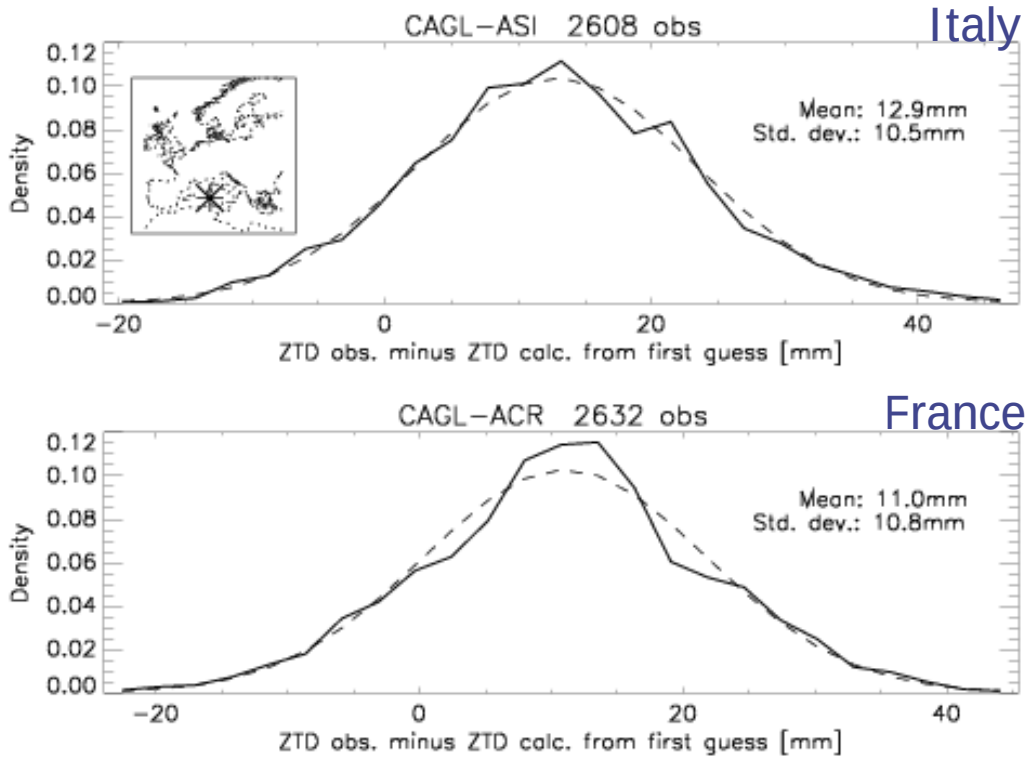
GPS

- ZTD (Zenith Total Delay) data collected by various European networks of ground-based GPS stations made available in near-real time since 2004
  (TOUGH project)



Poli et al, submitted to MWR

Distribution of ZTD departure



Station of Cagliari, Sardinia,
2 processing centres

- Bias correction using the first guess as a non-biased reference
- Bias correction for each couple (centre, station)

Bias correction (centre, station) estimation / application

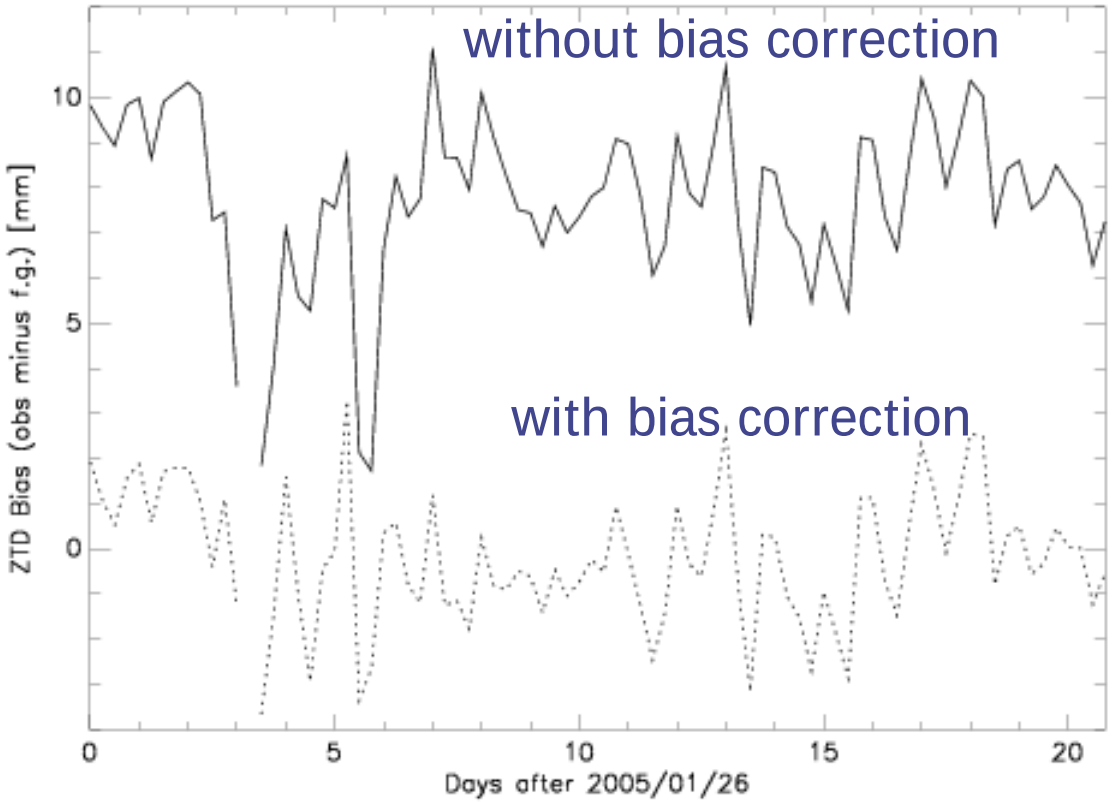
			Learning period 17 - 26 Jan 2005					Screening with bias correction 27 Jan – 16 Feb 2005				
			Bias (obs-first guess) [mm]					Bias (obs-first guess) [mm]				
	CEN	DT	no	min	mean	std	max	no	min	mean	std	max
Switz.	LPT	5	37	3.8	13.5	5.1	25.6	36	-11.5	3.4	4.1	10.7
France	ACR	15	43	-3.3	6.4	4.8	20.5	43	-3.3	0.5	2.1	5.4
UK	MET	15	64	-91.7	0.2	23.5	26.0	58	-3.2	-0.3	1.2	2.6
Germ.	GFZ	30	82	-14.4	10.1	4.8	24.7	82	-14.4	-0.9	2.2	3.5

averaging time period [min]

processing centre

Reduced bias and std thanks to a bias specific to each station

Average over all the stations



Good performance of the bias correction,
even 3 weeks after the date the biases were calculated

Bias correction update

- Limited observation network
- Operational configuration

  - Bias calculated from a running average of “obs minus first guess” differences on a time period extending before the analysis time
  - No predictor as it would require a longer history

Outlook

- Running average for bias correcting GPS data
- Revision of bias correction for QuikSCAT (positive bias in the ITCZ)
- Land / sea distinction for AMSU data ?
  - Model error on Ts (1 K over sea, 5 K over land)
  - Diurnal cycle