1D-Var assimilation of ATOVS radiances at CNMCA

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6th COSMO General Meeting – Milano 22-24 September 2004

Outline

- Motivation for the ATOVS assimilation project
- Current status of the project
- Scientific and technical issues
- Future plans

- ATOVS (Advanced TIROS Operational Vertical Sounder) is a good example of the next generation of hyperspectral sounders
- Satellite soundings provide wealth of information on data sparse areas
- Satellite data are currently available in near real time (EARS)

- The aim of the EUMETSAT ATOVS Retransmission Service (EARS) is to provide sounder instrument data from the National Oceanic and Atmospheric Administration (NOAA) polar orbiting satellites with a timeliness suited to the needs of European operational short range regional numerical weather prediction models.

Station Name	Country	Operated by
Bedford		
Gander	Canada	MSC/CMC
Edmonton		
Gilmore Creek (Alaska)		
Monterey	USA	NOAA
Wallops		
Maspalomas	Spain	INTA/INSA
Kangerlussuaq	Greenland	DMI
Tromsø	Norway	TSS
Athens	Greece	HNMS

Table 3 HRPT Station Details

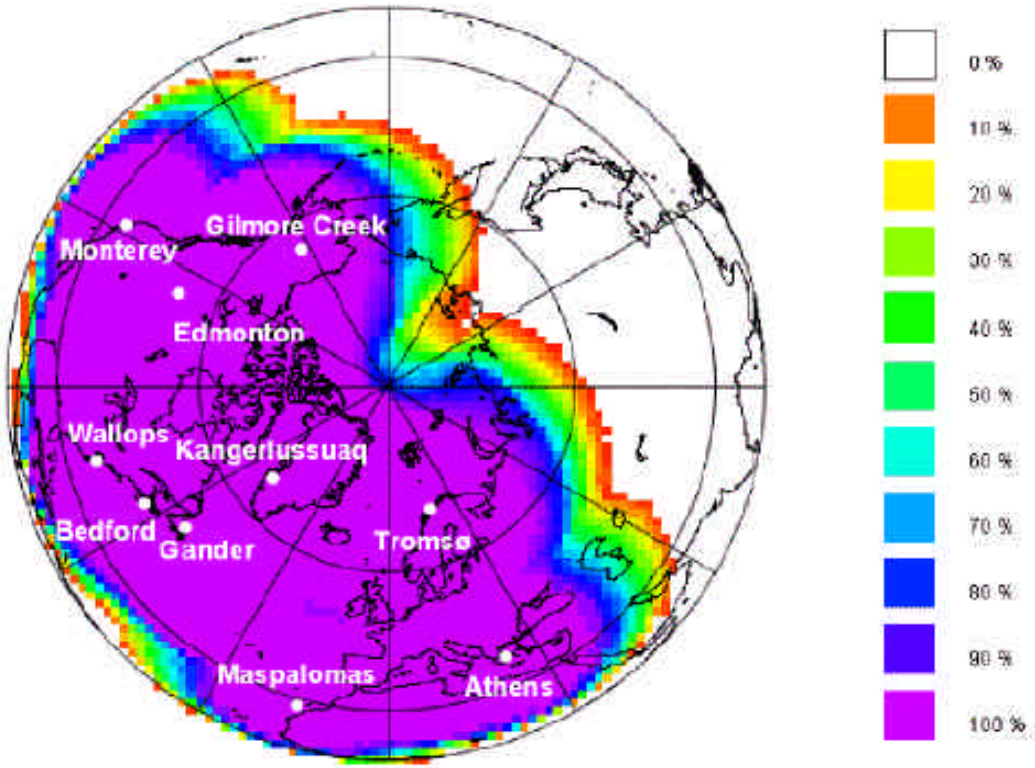
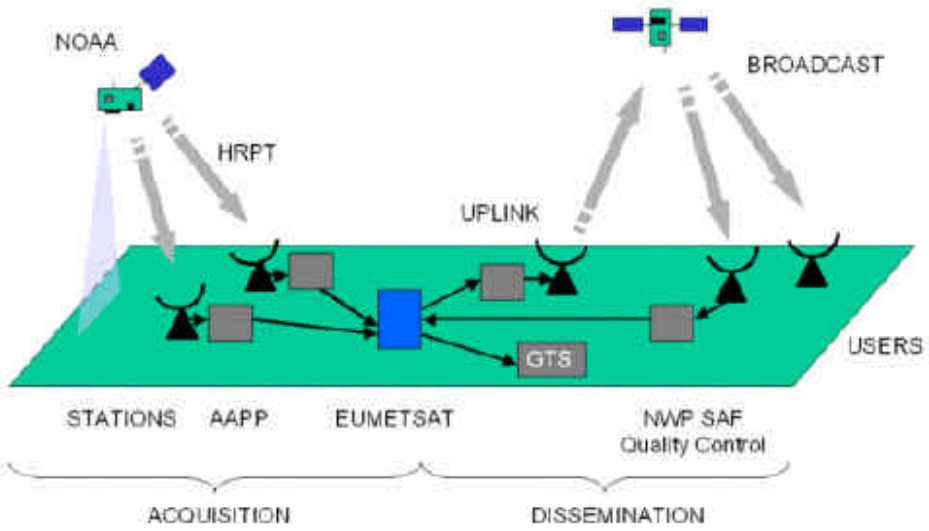


Figure 4 HRPT Station Locations and Geographical Coverage



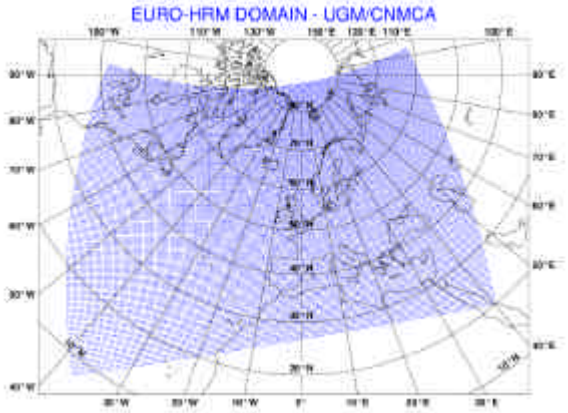
Summary of EUMETSAT ATOVS Retransmission Service	
Objective	To provide the European Meteorological Community with ATOVS data covering data-sparse areas.
Timeliness	30 minutes from time of measurement
Instruments	AMSU-A, AMSU-B, HIRS/3, AVHRR for local cloud information. AVHRR full resolution data will not be distributed.
Processing Level of Retransmitted Products	• AMSU-A - AAPP level 1a and 1c on AMSU-A grid. • AMSU-B - AAPP level 1a and 1c on AMSU-B grid. • HIRS/3 - AAPP level 1a and 1c on HIRS/3 grid. • Cloud information - Modified AAPP level 1d containing only AVHRR derived cloud information on HIRS/3 grid.
Satellites	All operational NOAA satellites.

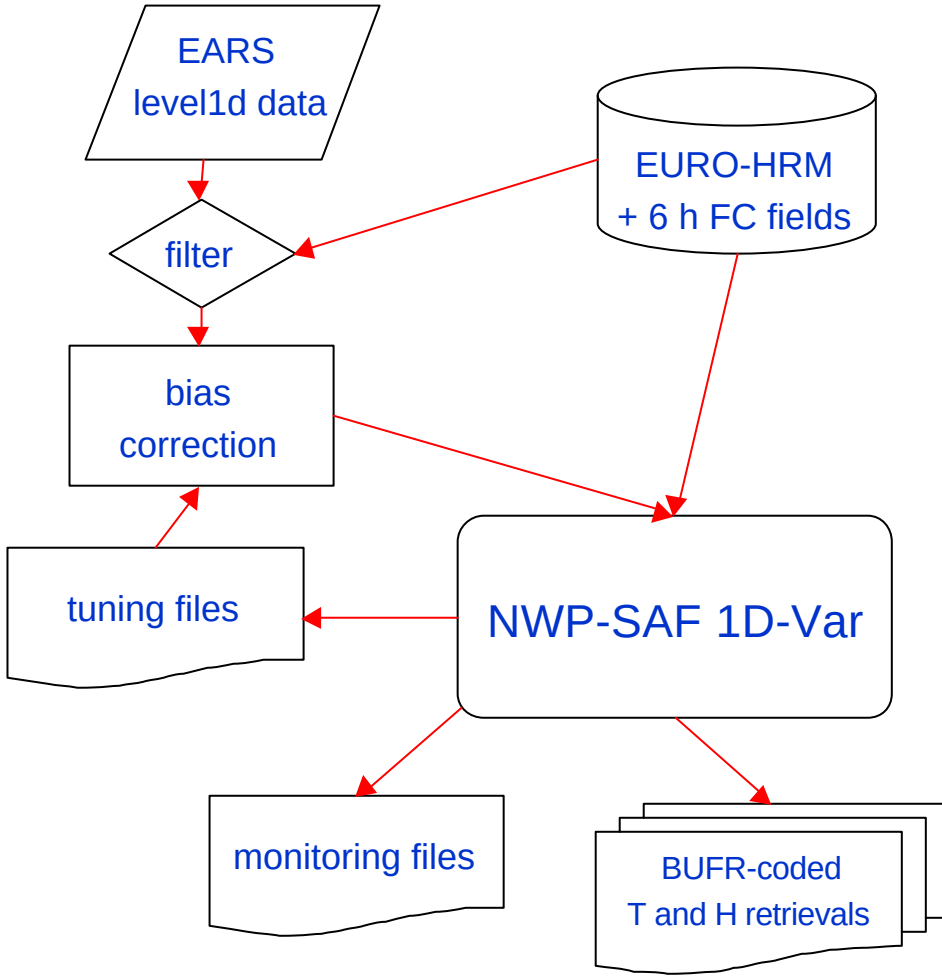
Current status

- The Italian Air Force Weather Service has recently started operational production of BUFR-coded Temperature and Humidity profiles from interactive 1DVAR retrievals for use in the CNMCA Data Assimilation Cycle.
- Forecast fields (+6h) from the CNMCA Regional NWP Model (EURO_HRM) and Level1d ATOVS products from EARS are fed into the IASI_1DVar package from the EUMETSAT NWP SAF to produce the retrievals.
- The impact of the ATOVS retrievals on the analysis and forecast fields is currently being evaluated.

ATOVS 1D-Var at CNMCA

- While the retrieval step is commonly used as a preliminary quality control check for radiances before direct ingestion in variational objective analysis algorithms, it is also a simple and computationally cheap way of exploiting the ATOVS data.



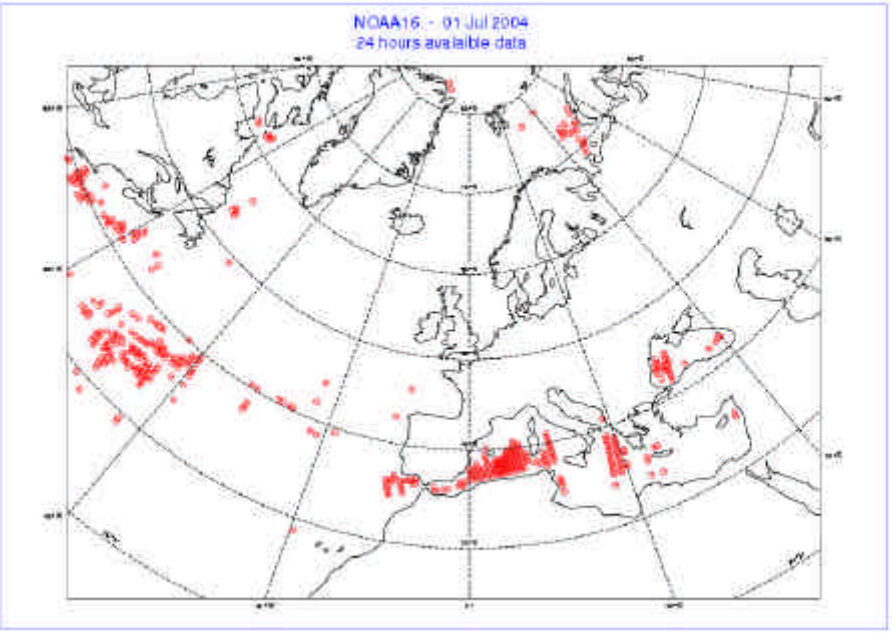


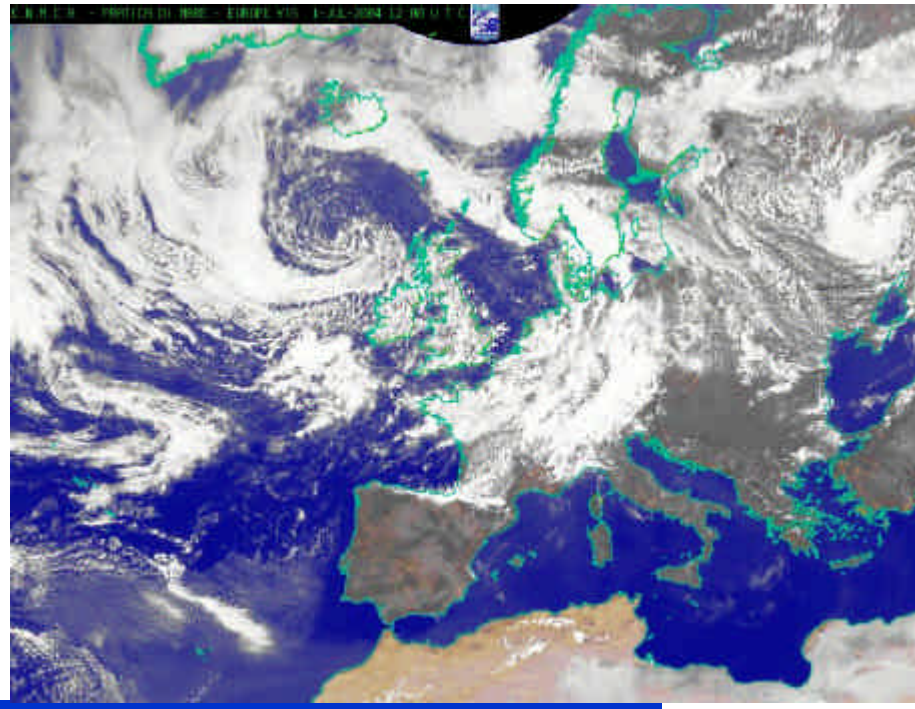
- 1D-Var interactive retrieval of Temperature and Humidity profiles
- 1DVAR package of the NWP SAF: stand-alone 1D-Var retrieval system for nadir-sounding passive instruments
- Solution of the same equation of the linear 3D-PSAS algorithm, plus outer loop (Newtonian iteration) to account for weak nonlinearities:

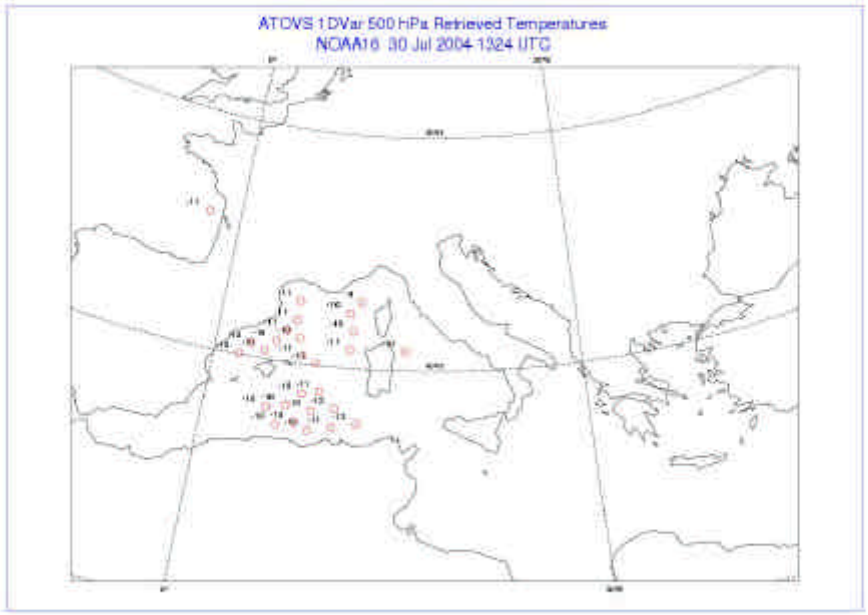
$$\boldsymbol{x}_{n+1} - \boldsymbol{x}_b = \boldsymbol{P}_b \boldsymbol{H}_n^T (\boldsymbol{H}_n \boldsymbol{P}_b \boldsymbol{H}_n^T + \boldsymbol{R})^{-1}[\boldsymbol{y} - H(x_n) - \boldsymbol{H}_n(\boldsymbol{x}_b - \boldsymbol{x}_n)]$$

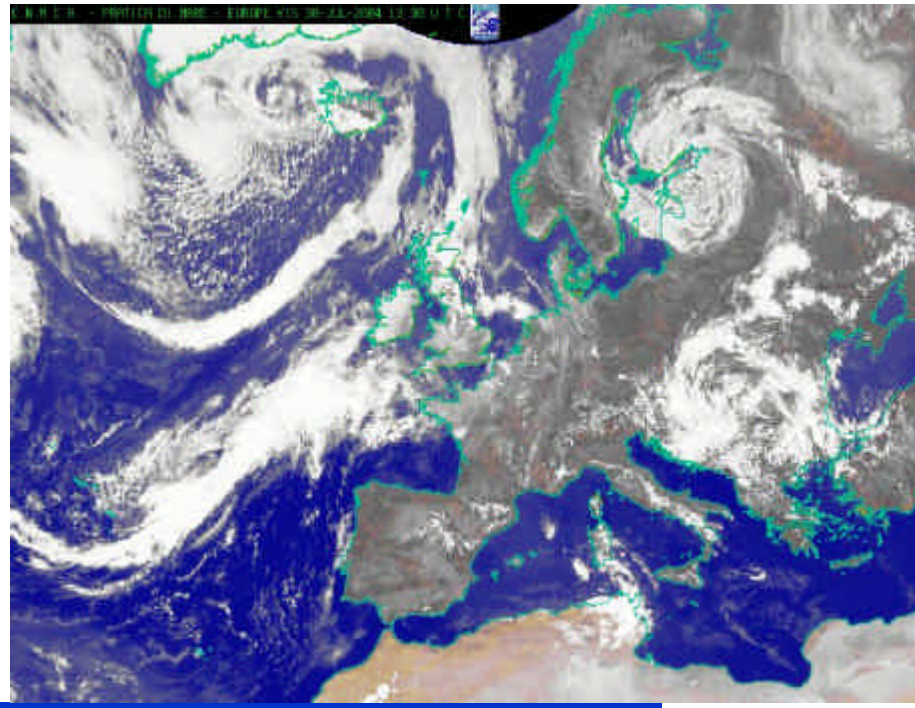
- Observation operator *H* and its jacobian from RTTOV package version 7

- Implementation of the 1DVAR package on HP alpha and PC32 linux platforms
- Interface to EARS level1d ATOVS observations and HRM model fields
- Extrapolation of Temperatures above 10hPa (HRM model top) and ozone columns from climatological dataset
- Dinamically adjusted, scan and air mass dependent (AMSU-A channels 4 and 9 as air mass predictors) bias correction model based on Eyre (1992)
- Only clear fovs (now based on AVHRR/3 mask included in level1d product) over the sea


NOAA16 - 01 Jul 2004
24 hours available data



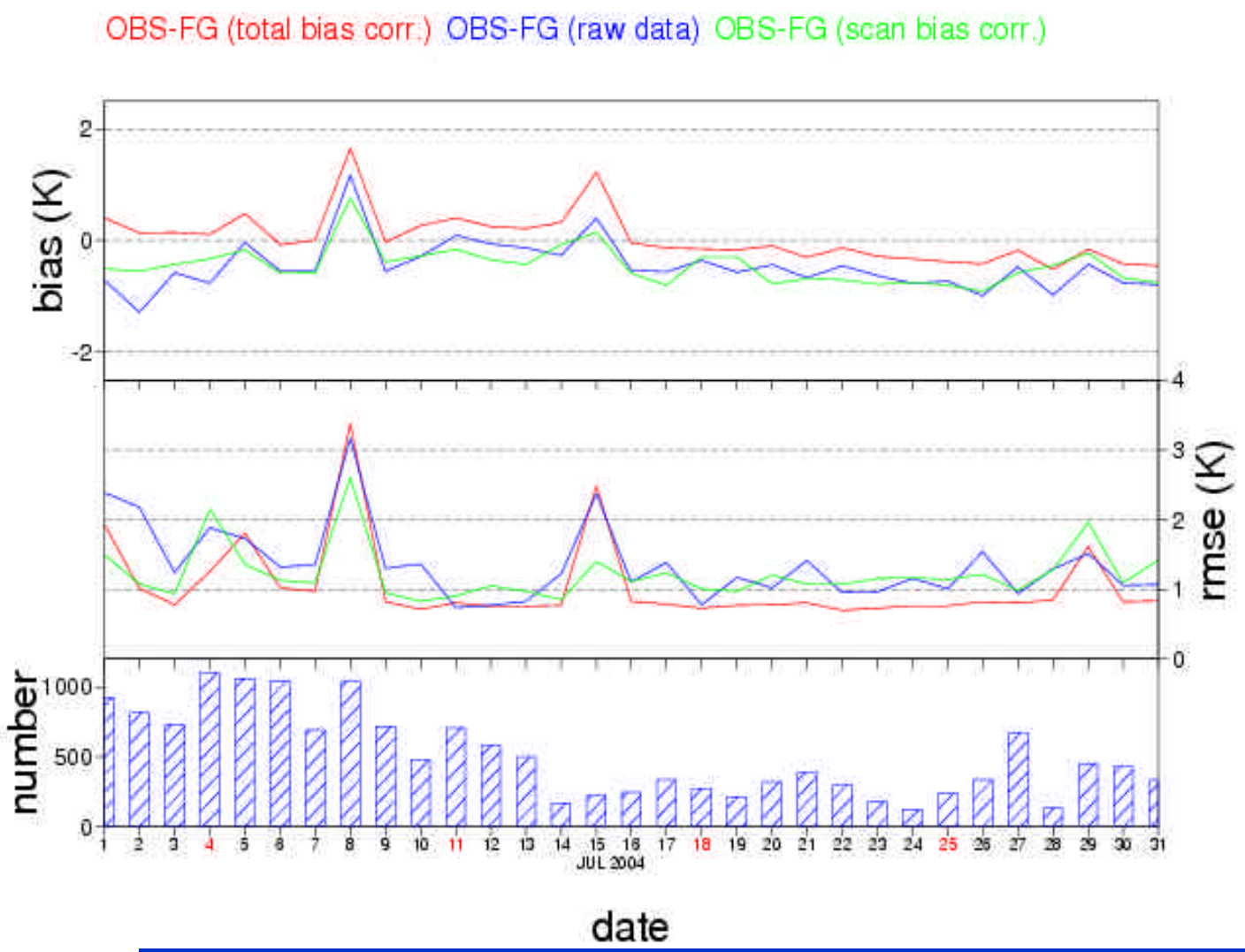

ATOVS 1DVar 500 hPa Retrieved Temperatures
NOAA16 30 Jul 2004 1324 UTC



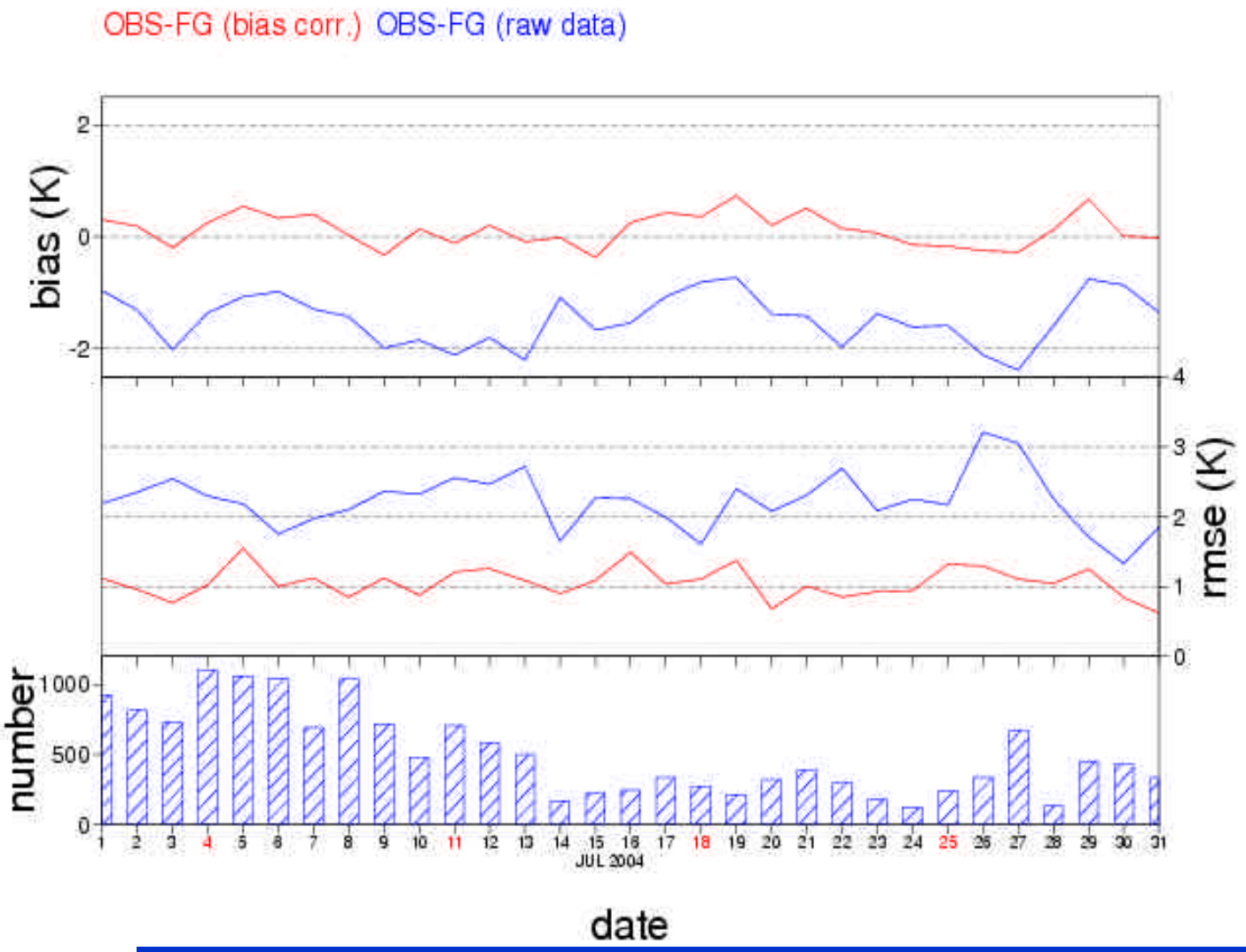
- Tuning of bias correction software: continuous test of the scheme and monitor of the performance.

- Collecting statistics of retrieved profiles versus colocated (≤200Km) radiosondes, to evaluate in a simple way the "information content" introduced into the analysis

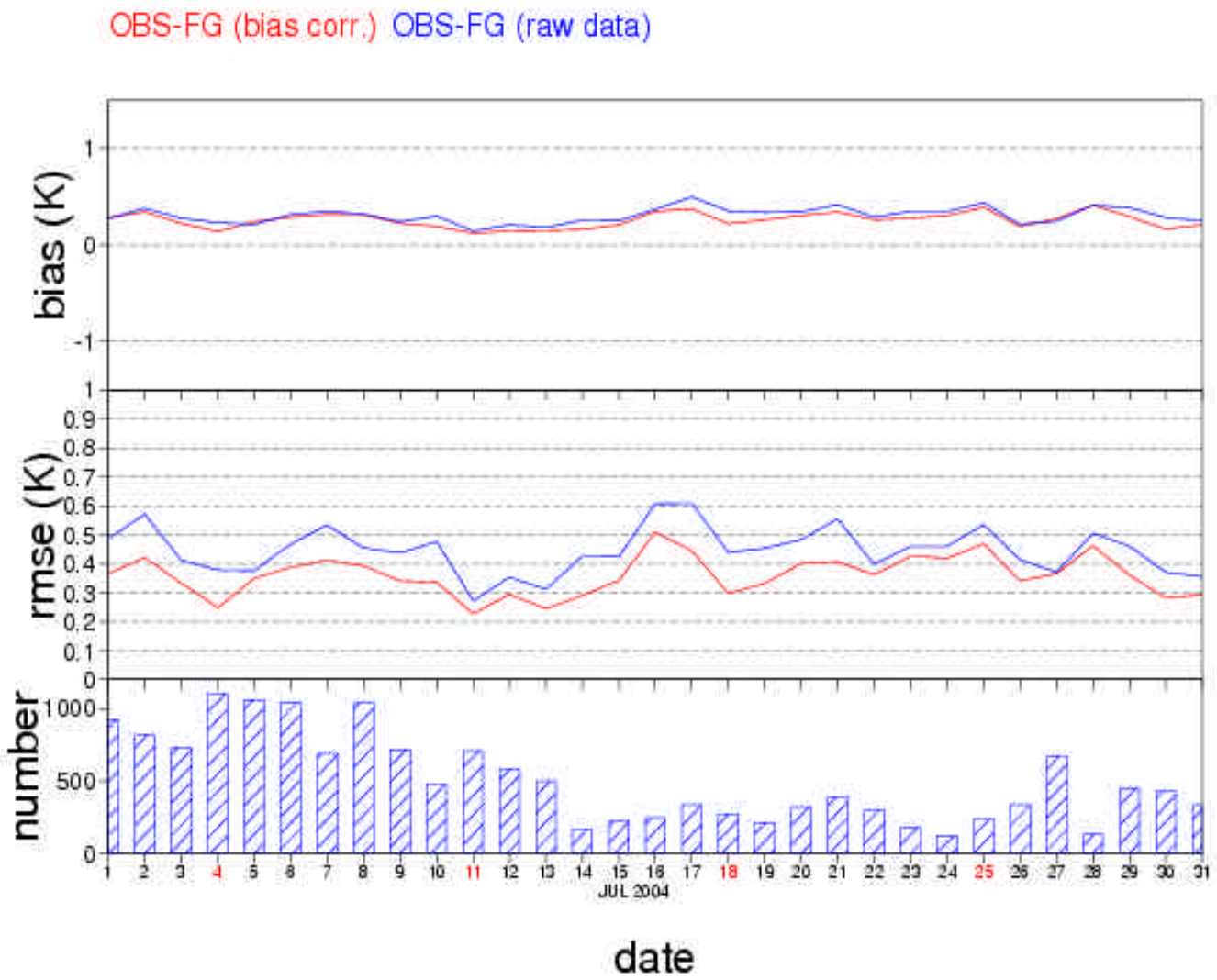
BT Statistics for NOAA16 HIRS channel 2



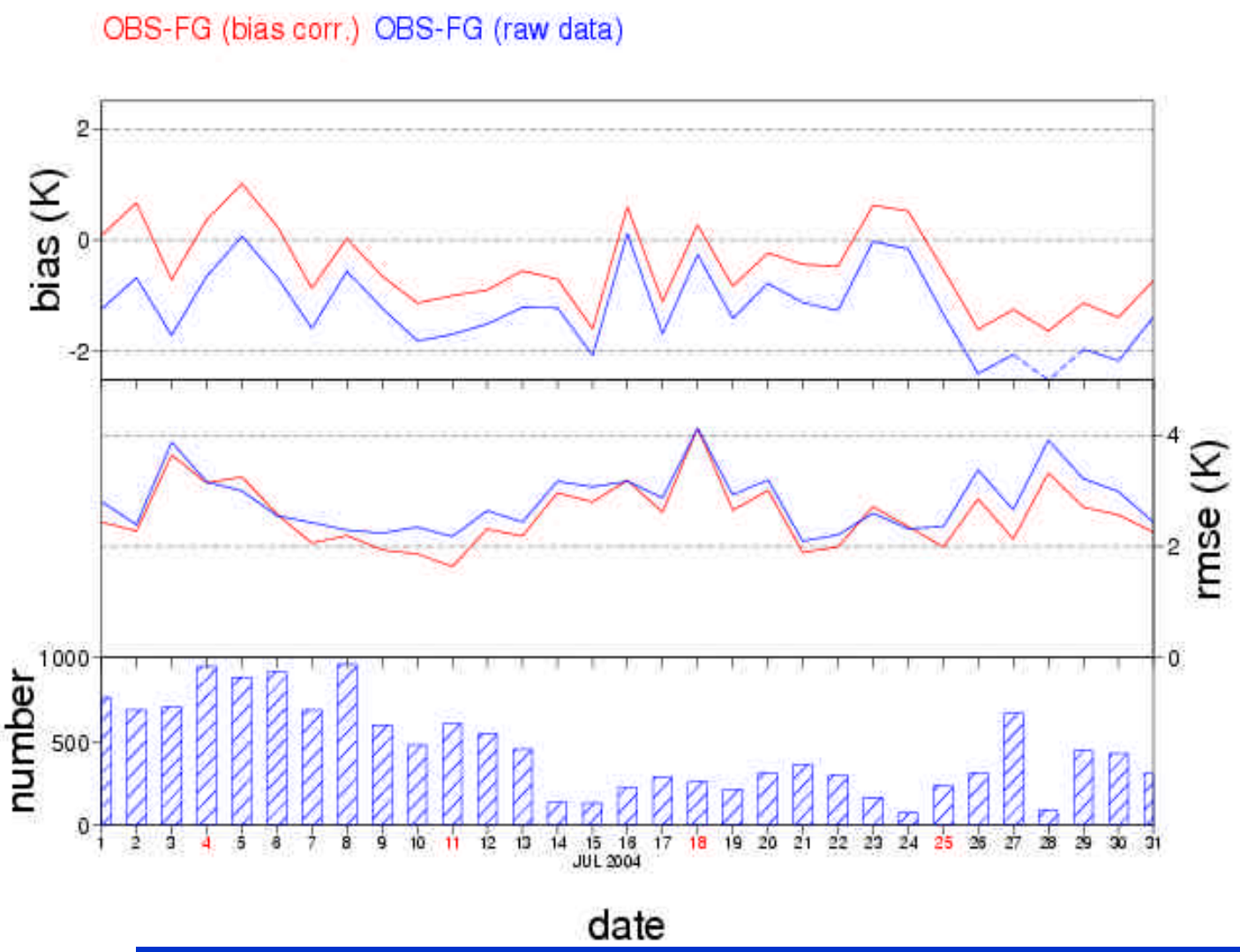
BT Statistics for noaa16 HIRS channel 13



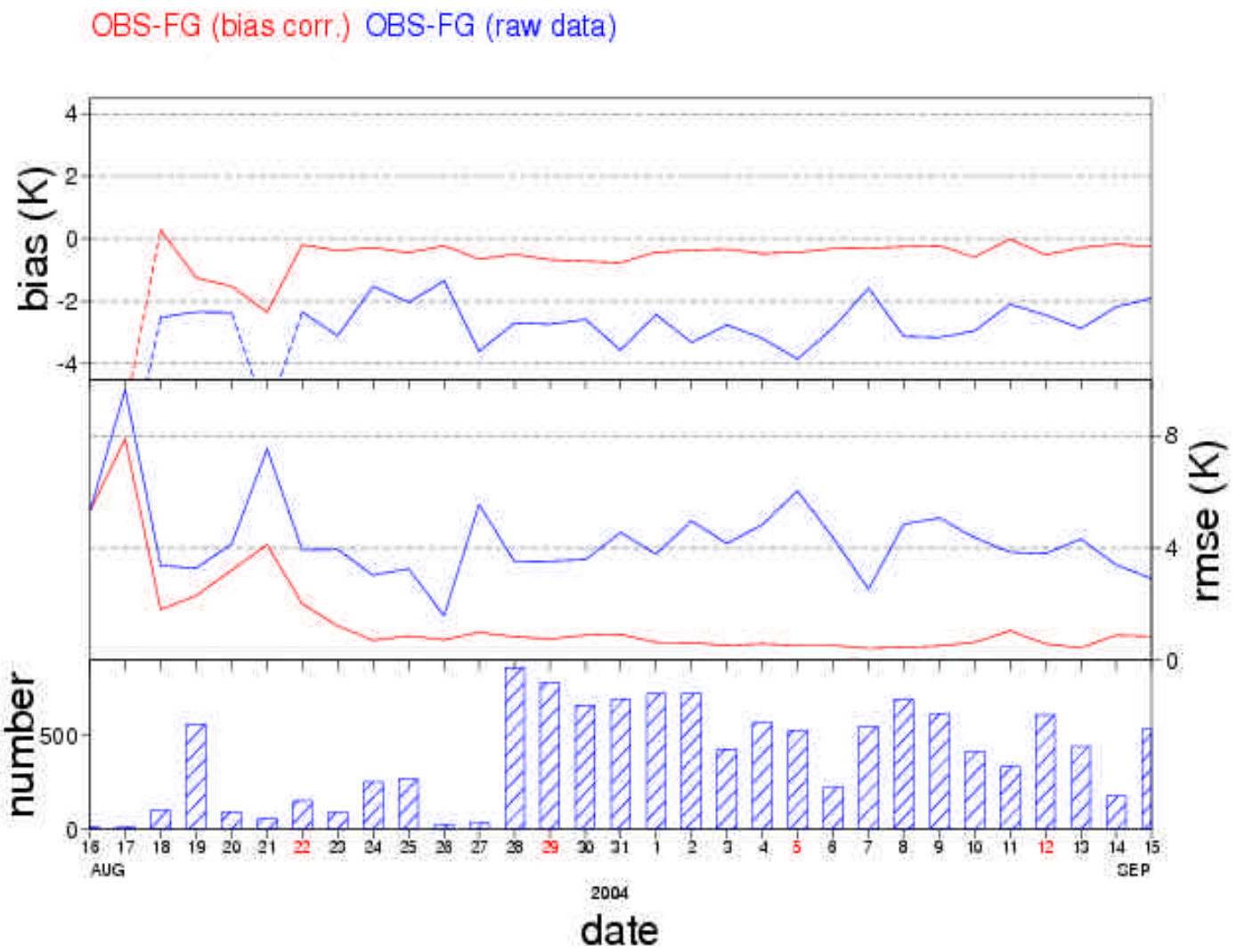
BT Statistics for NOAA16 AMSU-A channel 5



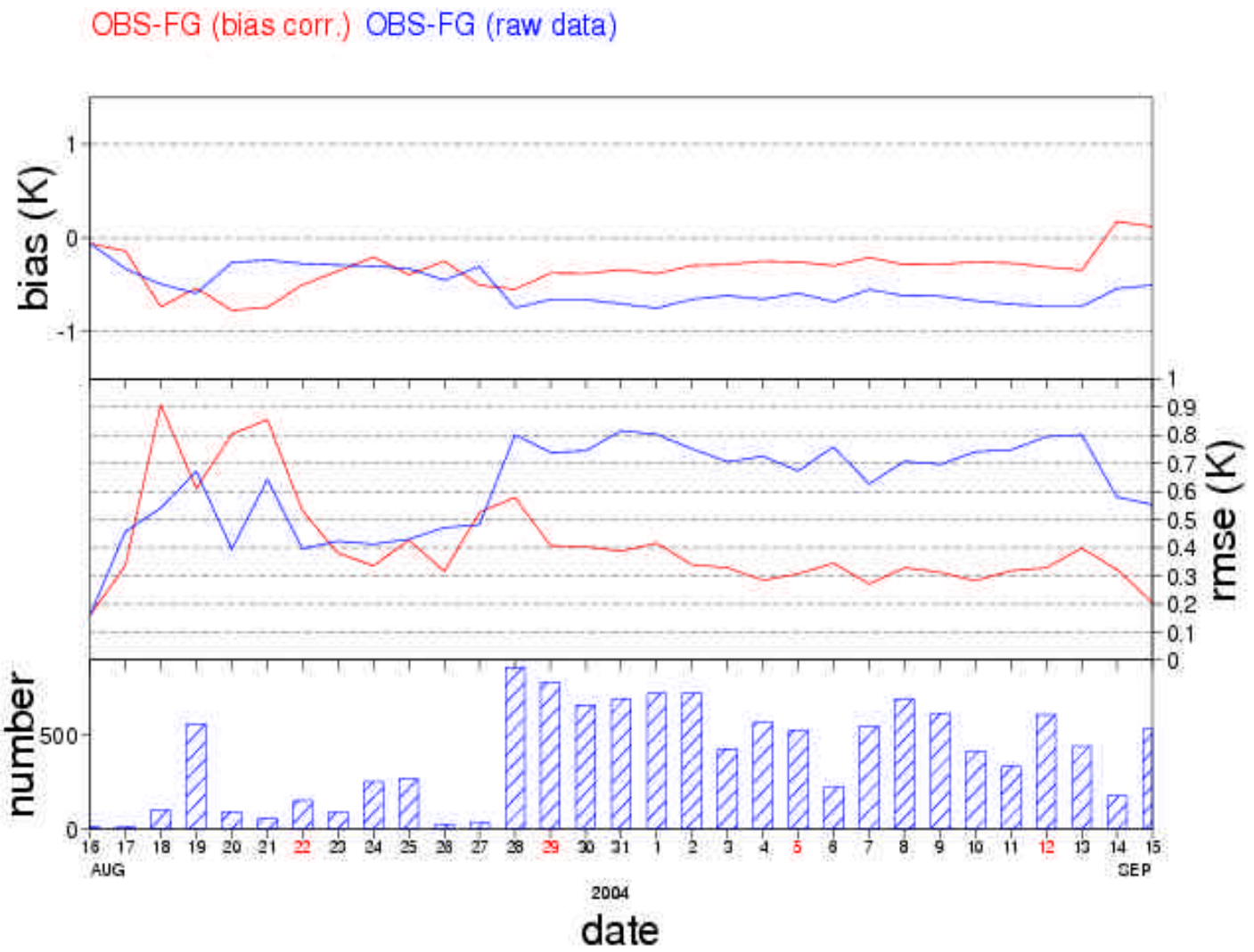
BT Statistics for noaa16 AMSU-B channel 4



BT Statistics for NOAA15 HIRS channel 4



BT Statistics for NOAA15 AMSU-A channel 6



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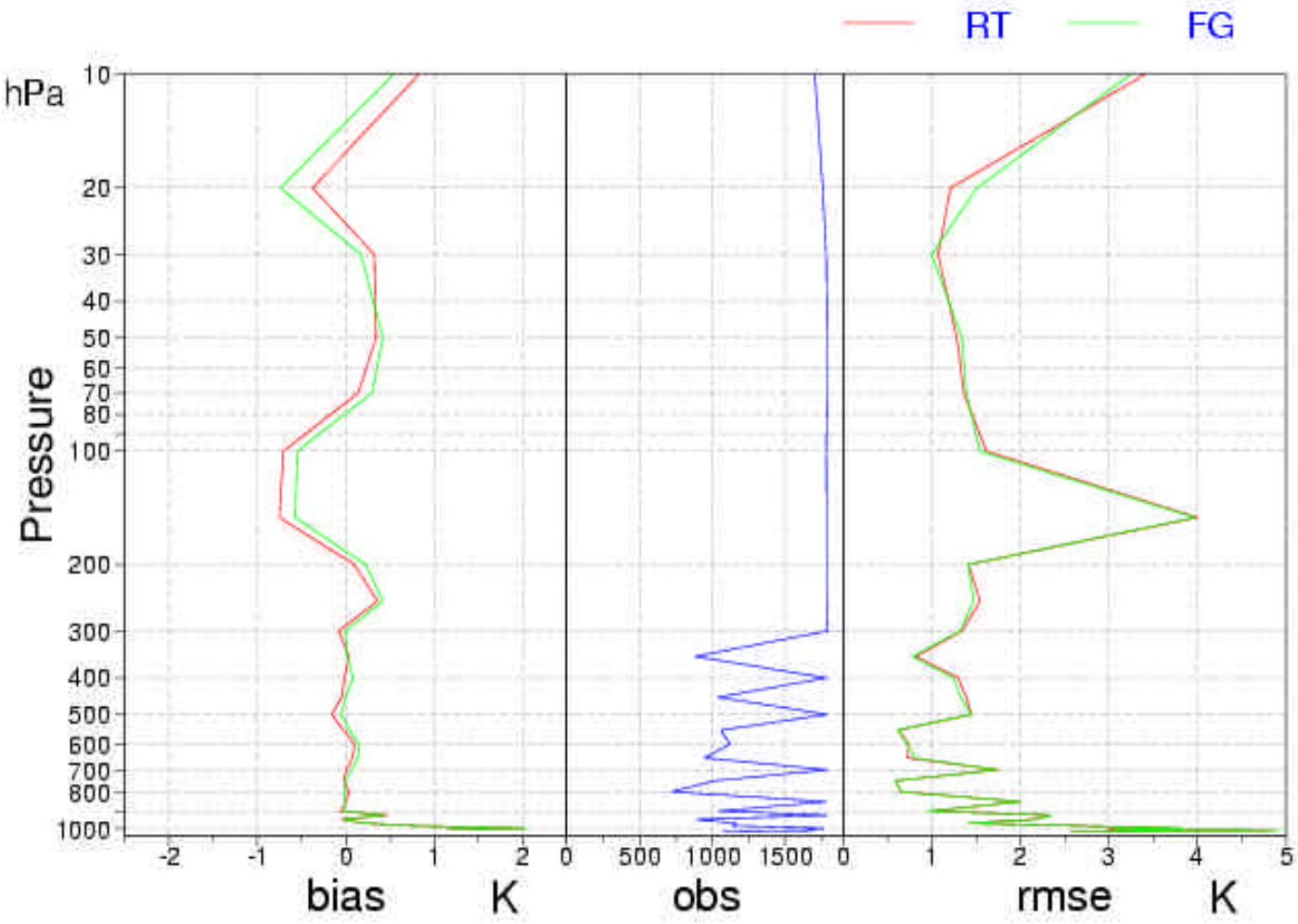
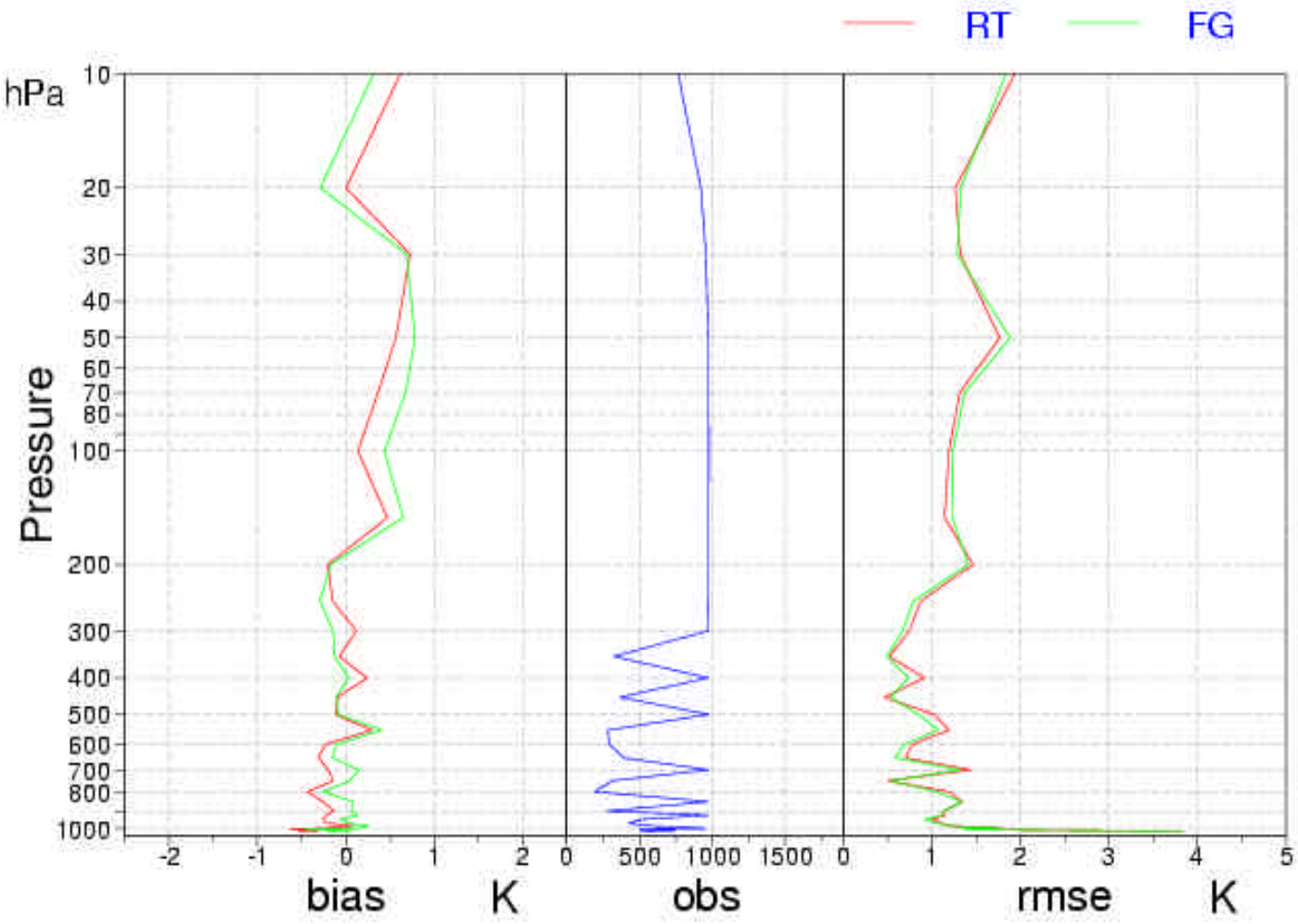
T retrievals from NOAA16 vs colocated radiosondes

July 2004 statistics



T retrievals from NOAA15 vs colocated radiosondes

16 Aug. – 15 Sep. 2004 statistics



Future plans

- Evaluation of the impact on the analysis and forecast fields
- Ways to properly take into account, in the assimilation of the retrieved profiles, the fact that correlated a priori information has been exploited in the retrieval process are being investigated.
- Filtering of a priori information from the retrieved profiles through averaging kernel techniques (Rodgers, 2000)

Thank you for your attention
Questions?