



ASSIMILATION OF ATOVS RETRIEVALS AND AMSU-A RADIANCES AT THE ITALIAN WEATHER SERVICE: CURRENT STATUS AND PERSPECTIVES

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ITSC, Maratea 4-10 October 2006



Overview

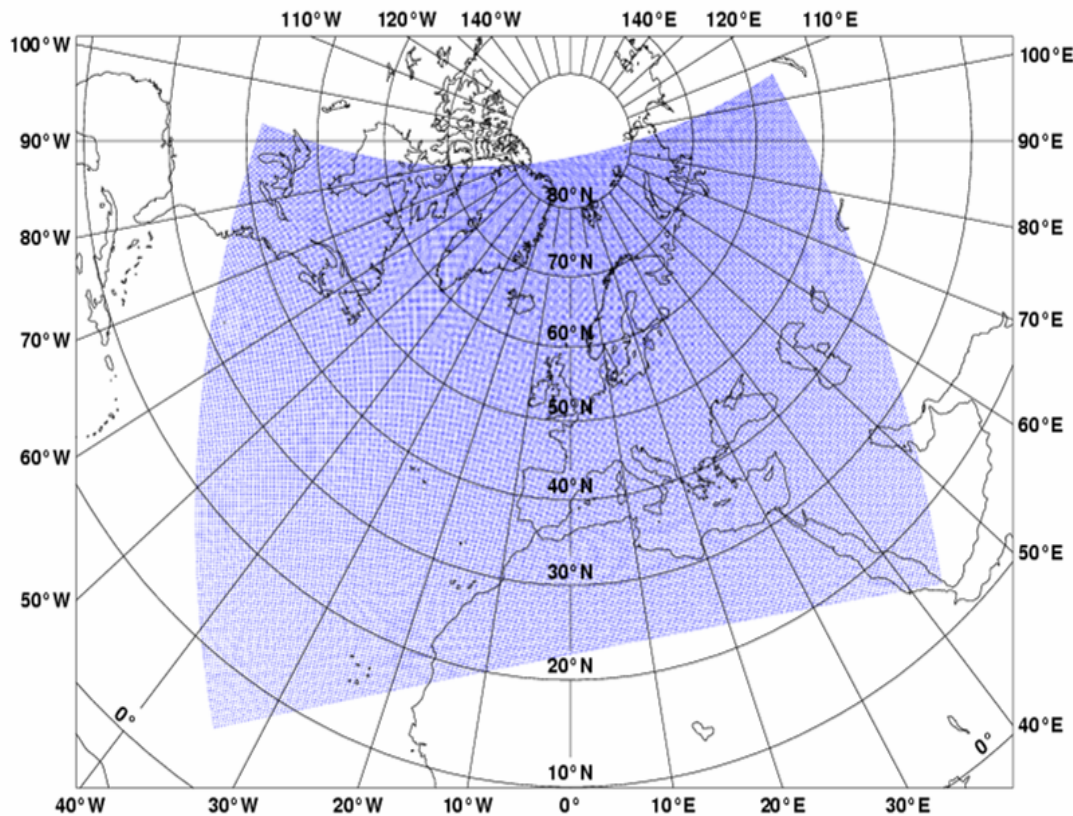
- Short description of the NWP system at CNMCA
- 2005-2006 developments
- 1D-Var retrievals
- Direct assimilation of AMSU-A radiances
- Impact studies on the CNMCA NWP system
- Conclusions and future plans



CNMCA NWP System



EURO-HRM DOMAIN - UGM/CNMCA



Domain size	385 x 257
Grid spacing	0.25 Deg (~28 km)
Number of layers	40
Time step	150 sec
Forecast range	72 hrs
Initial time of model run	00/12 UTC
L.B.C.	IFS
L.B.C. update frequency	3 hrs
Initial state	CNMCA 3D-PSAS
Initialization	NMI
External analysis	None
Status	Operational
Hardware	IBM P690 (ECMWF)
N° of processors used	32 (Model), 90 (Analysis)

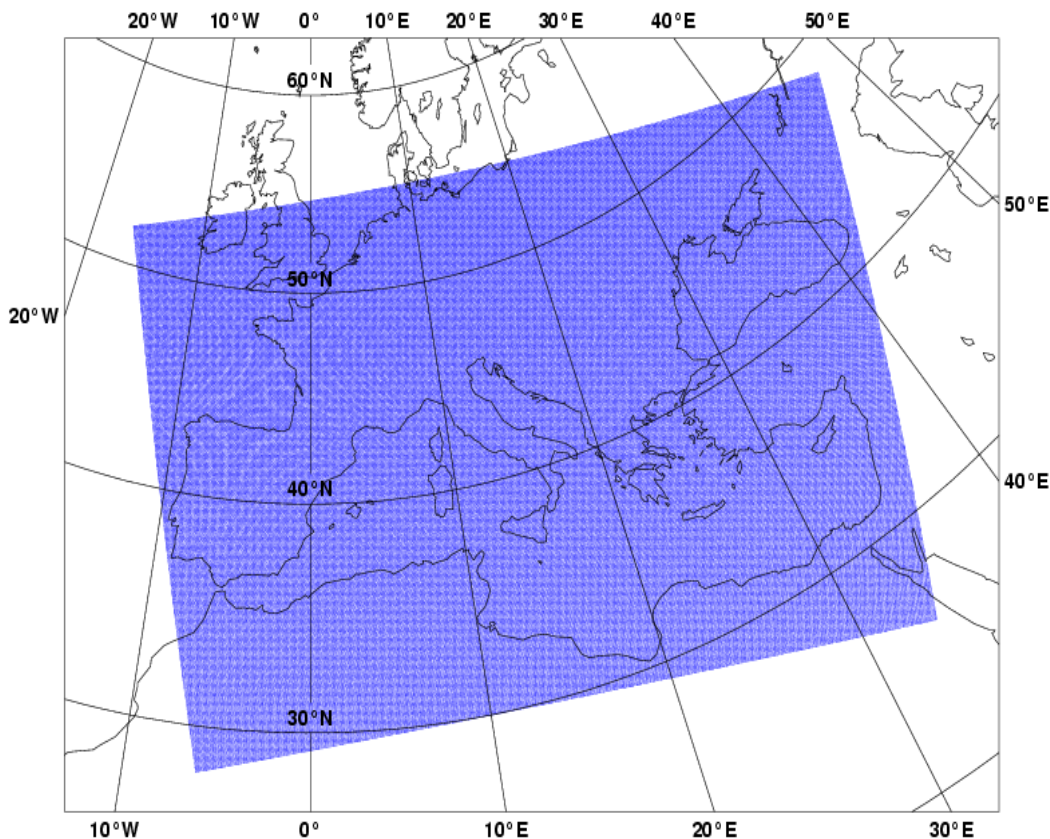
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CNMCA NWP System



LM-EURO DOMAIN - UGM/CNMCA



Domain size	641 x 401
Grid spacing	0.0625 (7 km)
Number of layers	40
Time step	40 s
Forecast range	48 hrs
Initial time of model run	00 UTC
Lateral bound. condit.	IFS
L.B.C. update frequency	3 hrs
Initial state	Interpolated 3D-PSAS
Initialization	None
External analysis	T,u,v, PseudoRH, SP
Special features	Filtered topography
Status	Operational
Hardware	IBM P690 (ECMWF)
N° of processors	120

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Data Assimilation System

- Intermittent (6h) data assimilation cycle with IFS boundary conditions
- Objective analysis algorithm:
 - 3D-Var “PSAS” scheme in (T,u,v) and *pseudo-RH* on 30 pressure levels and a 2D-Var version in p_s
 - parallel (MPI) minimization algorithm of the cost function:
$$J = \frac{1}{2}[\mathbf{y} - H(\mathbf{x})]^T \mathbf{R}^{-1}[\mathbf{y} - H(\mathbf{x})] + \frac{1}{2}[\mathbf{x}_b - \mathbf{x}]^T \mathbf{P}_b^{-1}[\mathbf{x}_b - \mathbf{x}]$$
- Observations:
 - synoptic: TEMP, PILOT, SYNOP, SHIP, BUOY
 - a-synoptic: AMSUA rad., AMDAR-AIREP, MSG AMV, Wind Profilers, QUIKSCAT-ERS2 scatt. winds
- Prognostic model: HRM

More details in:

Bonavita and Torrisi, 2005: Meteor. and Atmospheric Physics Vol.88 No.1-2



2005-2006 Developments

- FG production as first step in assimilation cycle, in order to wait for the latest BC (instead of use of old BC)
- Assimilation of AMSU-A radiances over sea
 - implementation of radiative transfer model **RTTOV7**, direct radiance assimilation and radiance bias correction
 - upgrade of radiative transfer model **RTTOV7** to **RTTOV8.7**
 - introduction of AMSU-A rad. from **NOAA-18**
- Use of METEOSAT8 Atmospheric Motion Vectors (AMV)
 - error characterization
 - bias correction changed
 - switch from METEOSAT7 to METEOSAT8 AMV
- NMC evaluation of background error matrix



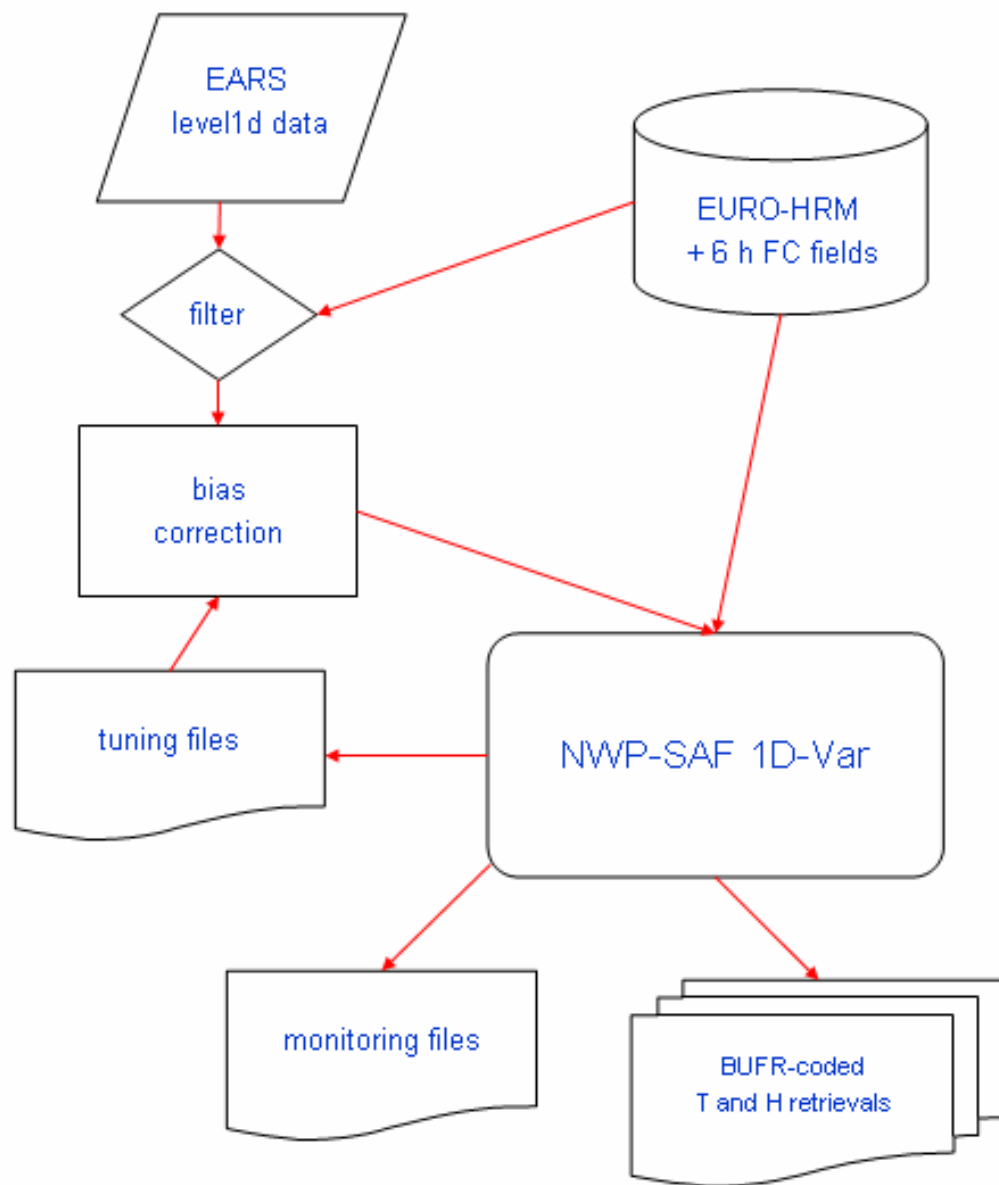
1D-Var retrievals - motivations

- Availability of near real time Obs through EARS program
- Availability of IASI 1D-VAR and RTTOV packages in the context of NWP SAF
- Need to gain experience in view of hyperspectral sounders' use in data assimilation



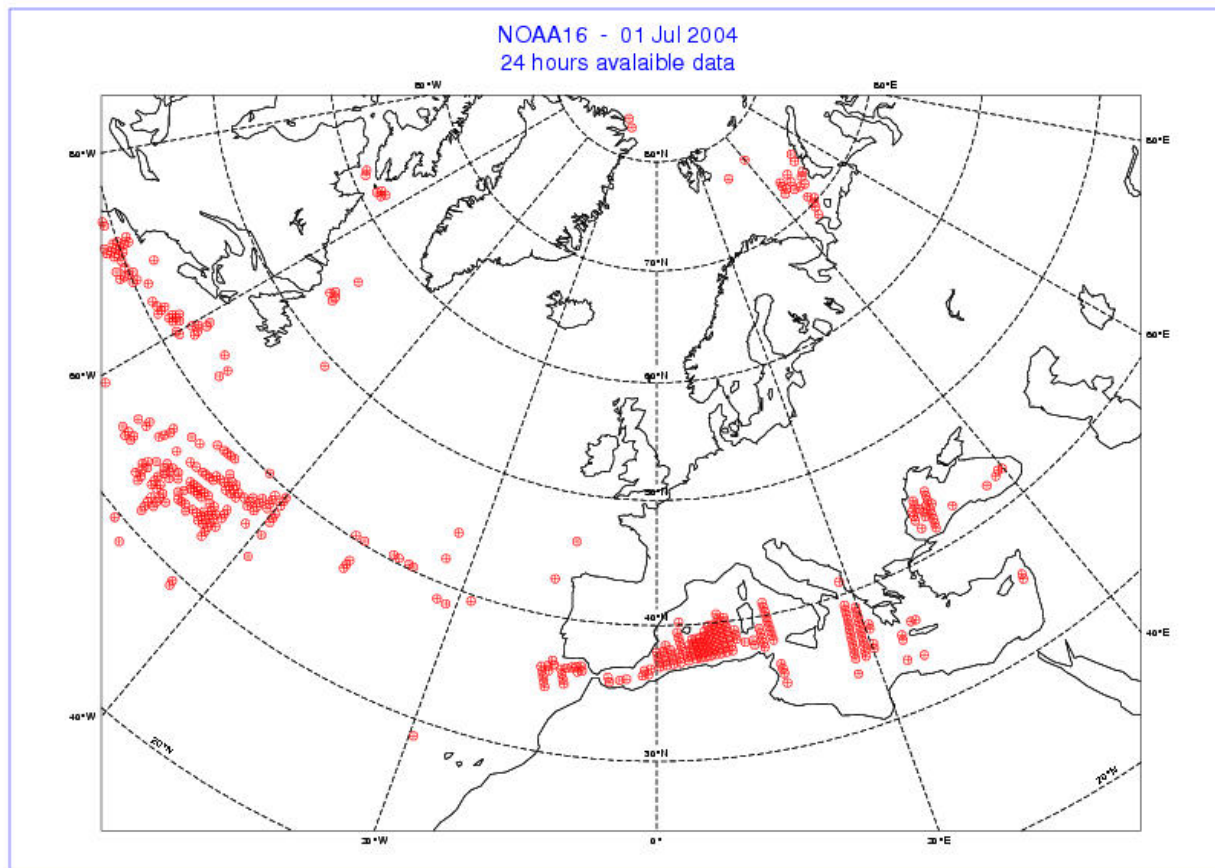
1D-Var retrievals

- Interactive retrievals (IASI 1D-Var package) from EURO-HRM t+6h forecast
- Combination of HIRS and AMSU-A/B channels
- Clear sea FOVs, using AVHRR cloud mask (Level1d product)
- Air mass dependent bias correction (Harris & Kelly, 2001)
- Retrievals thinned to 200 Km and used as pseudo-RAOB on standard levels





1D-Var retrievals



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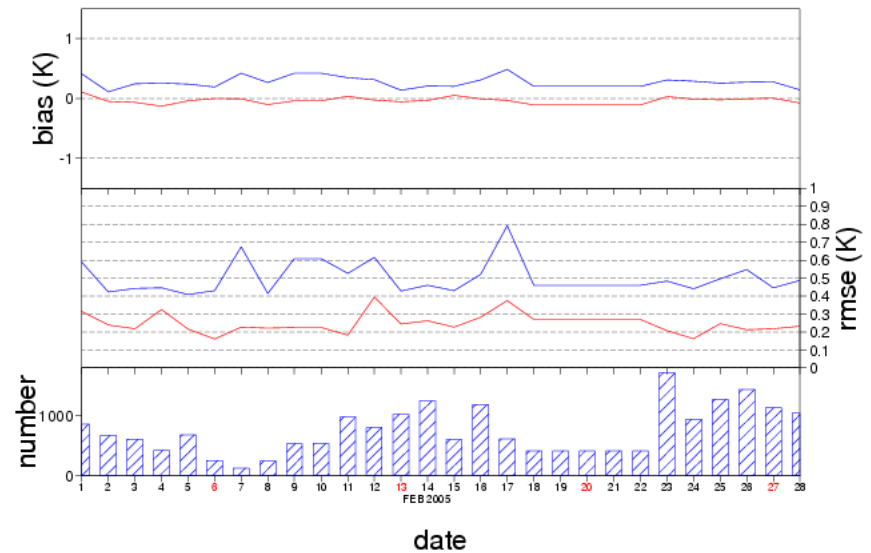
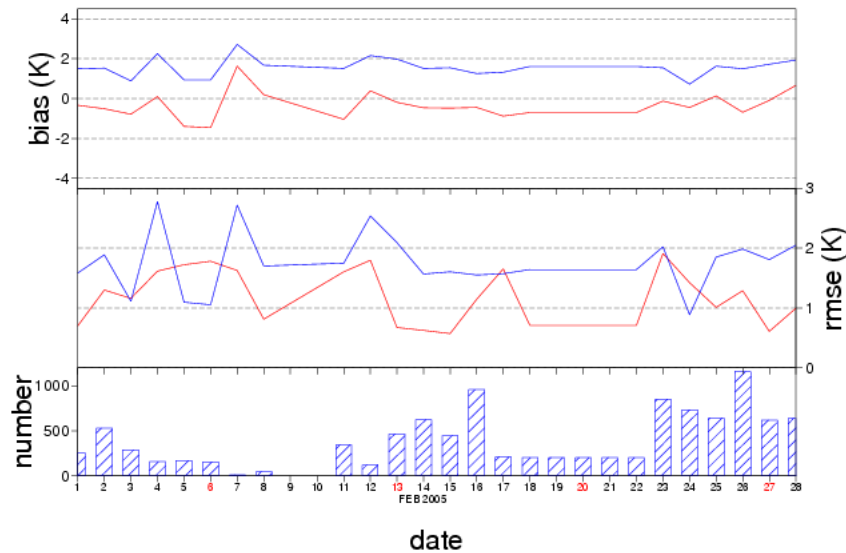
1D-Var retrievals

BT Statistics for NOAA15 HIRS channel 13

BT Statistics for NOAA15 AMSU-A channel 7

OBS-FG (bias corr.) OBS-FG (raw data)

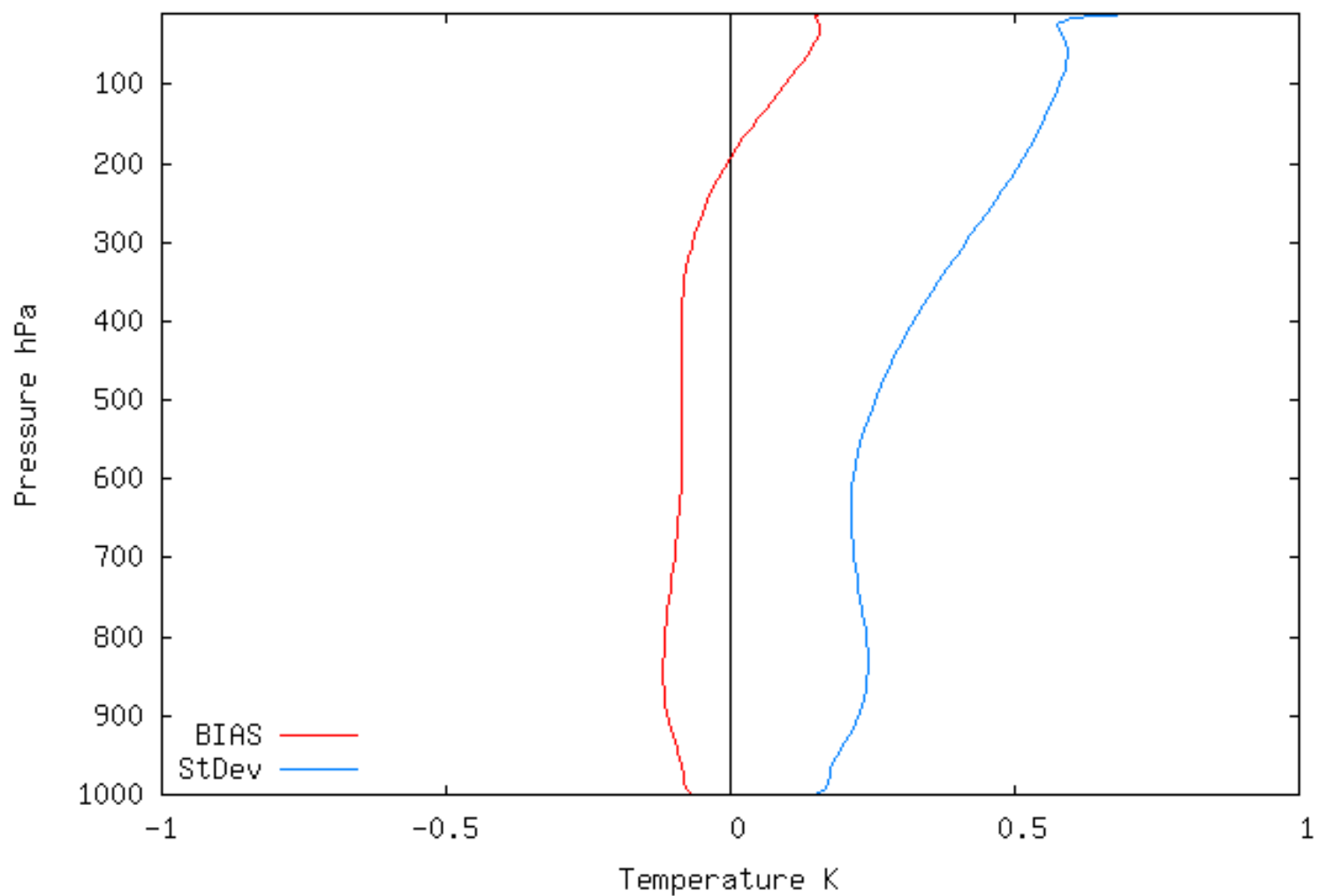
OBS-FG (bias corr.) OBS-FG (raw data)



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ATOVS TEMPERATURE Retrievals Observation Increments vs EUROHRM 00UTC run +6h FCST

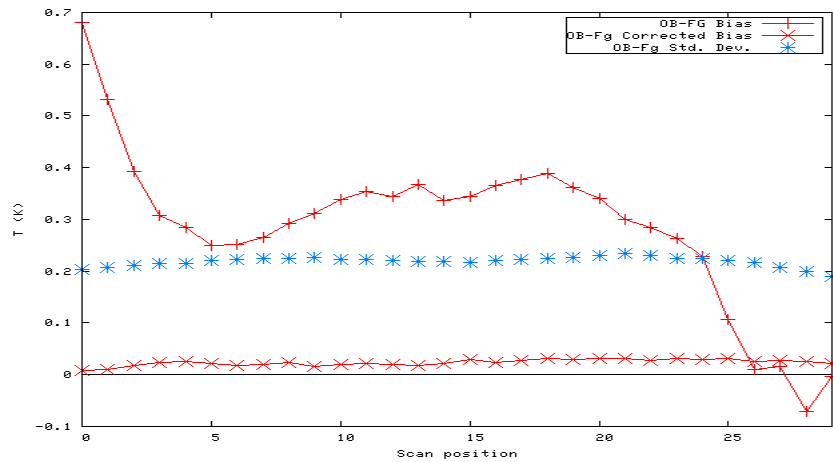




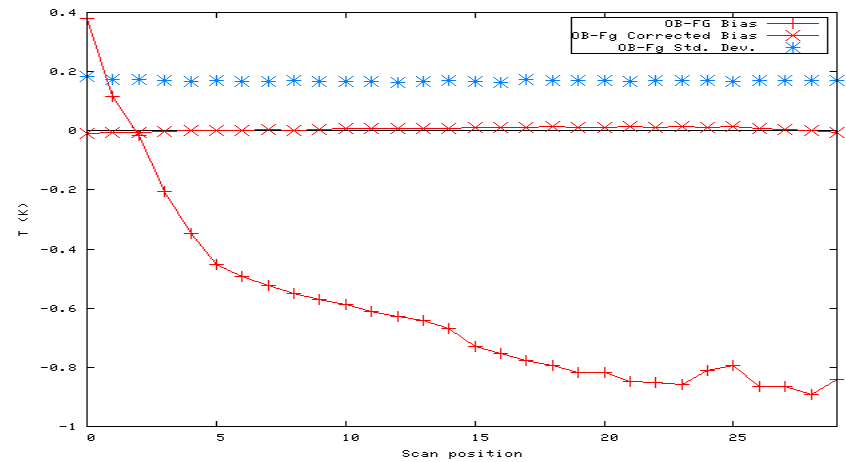
Assimilation of AMSU-A radiances

- Upgrade of radiative transfer model from RTTOV7.1 to RTTOV8.7 in forward and T.L. mode
- AMSU-A channels 5-10 over sea
- Rain contamination check: $|T_{\text{obs}} - T_{\text{fg}}|_{\text{ch4}} < 1.5\text{K}$ (Gerard,2003)
- Scan position dependent bias correction
- 200 km thinning
- Introduction of AMSU-A rad. from NOAA-18

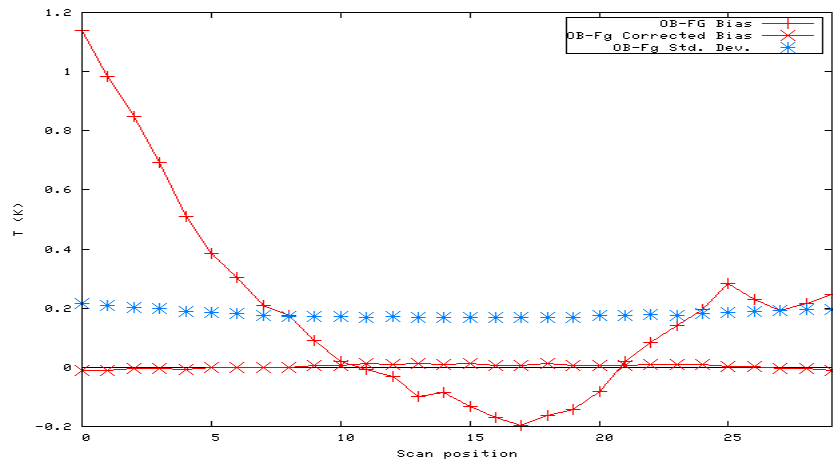
NOAA15 AMSUA Ch5



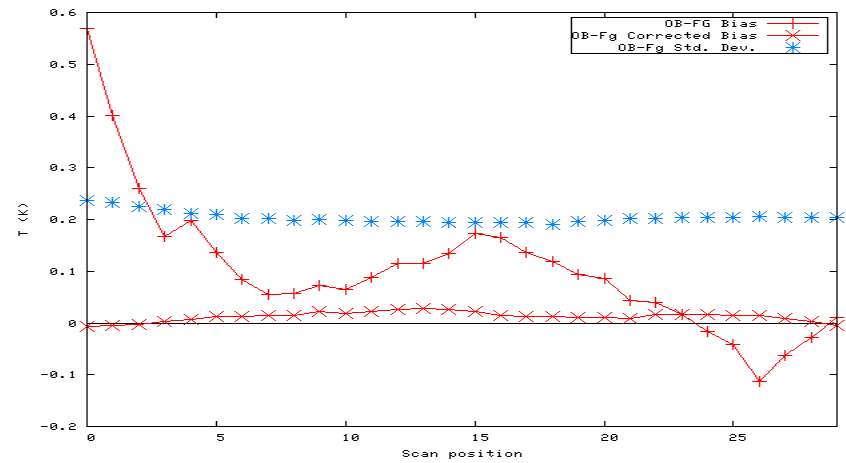
NOAA15 AMSUA Ch6



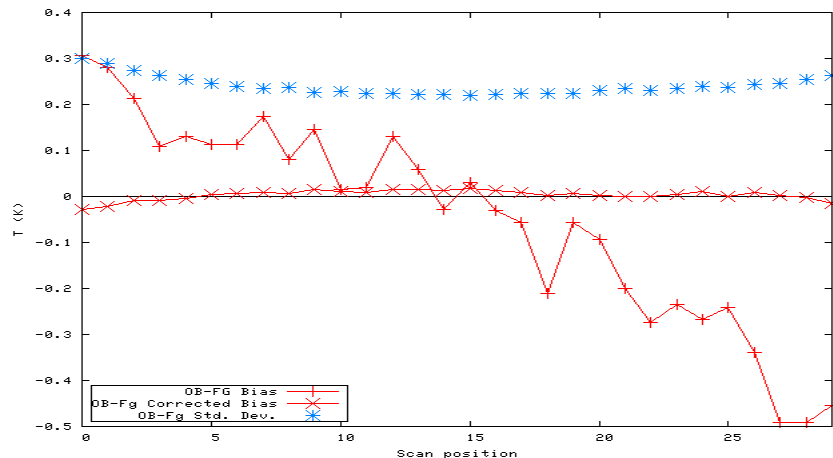
NOAA15 AMSUA Ch7



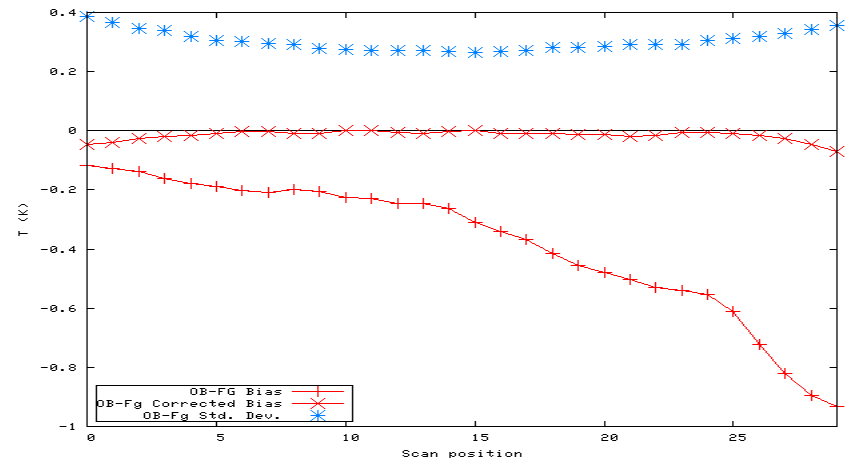
NOAA15 AMSUA Ch8

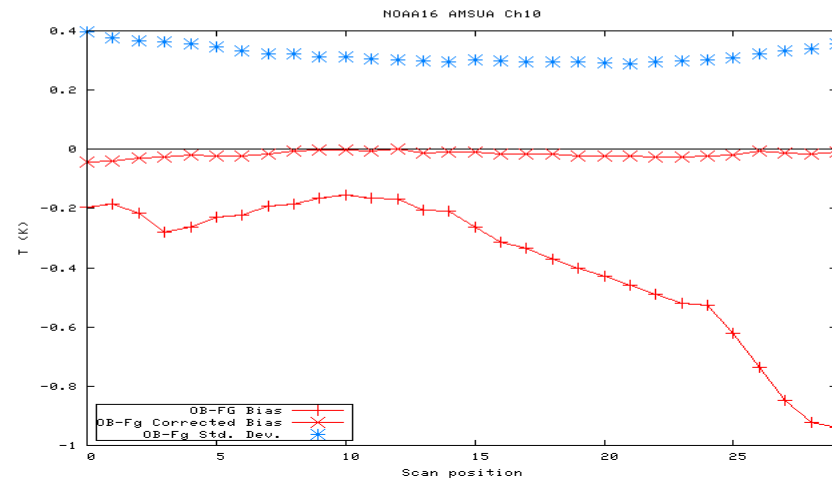
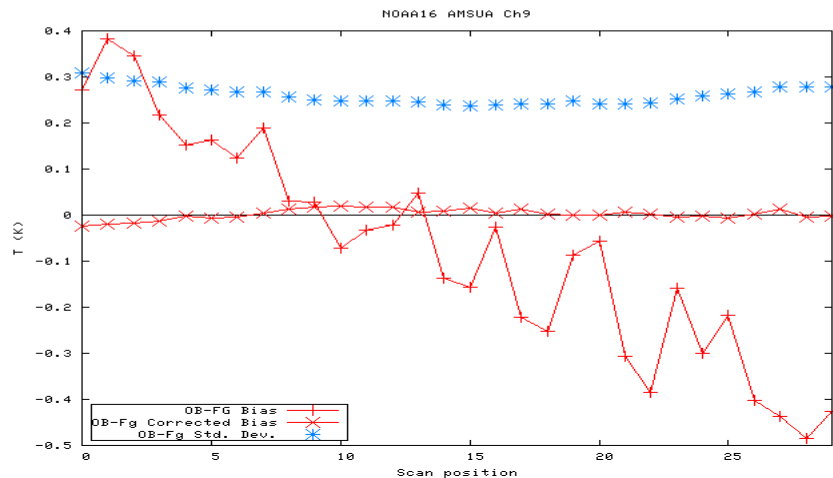
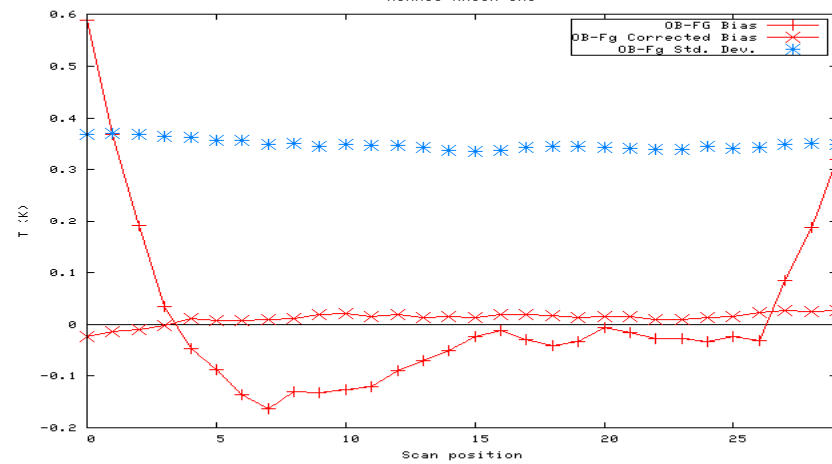
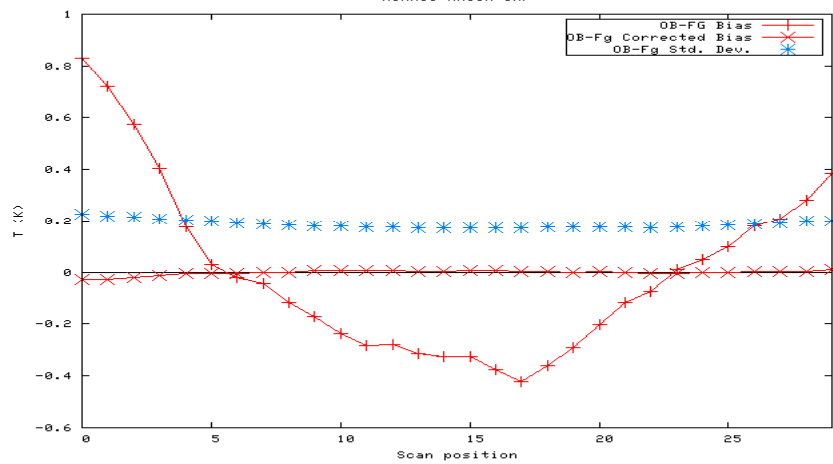
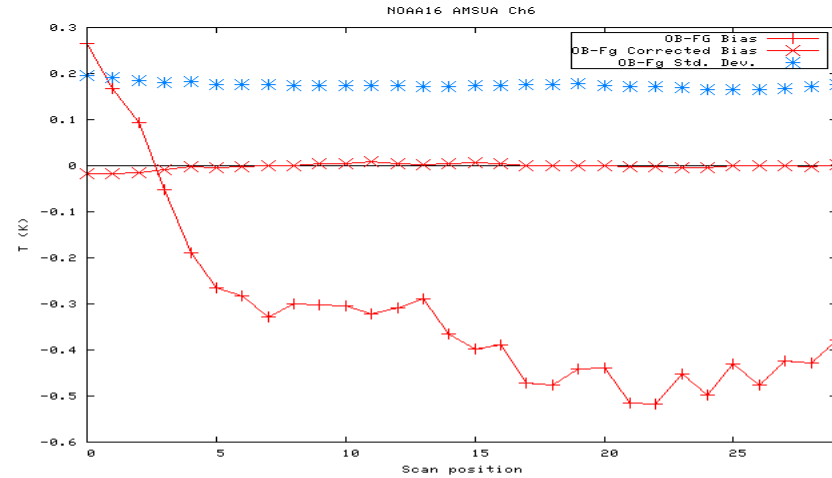
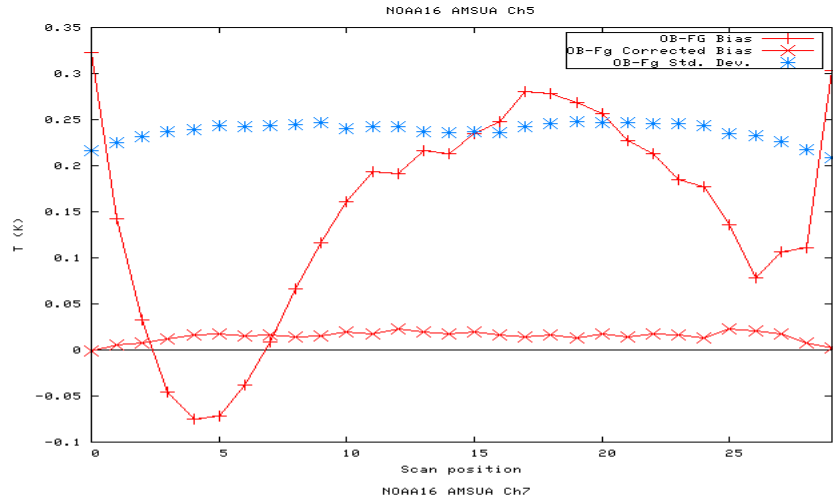


NOAA15 AMSUA Ch9



NOAA15 AMSUA Ch10



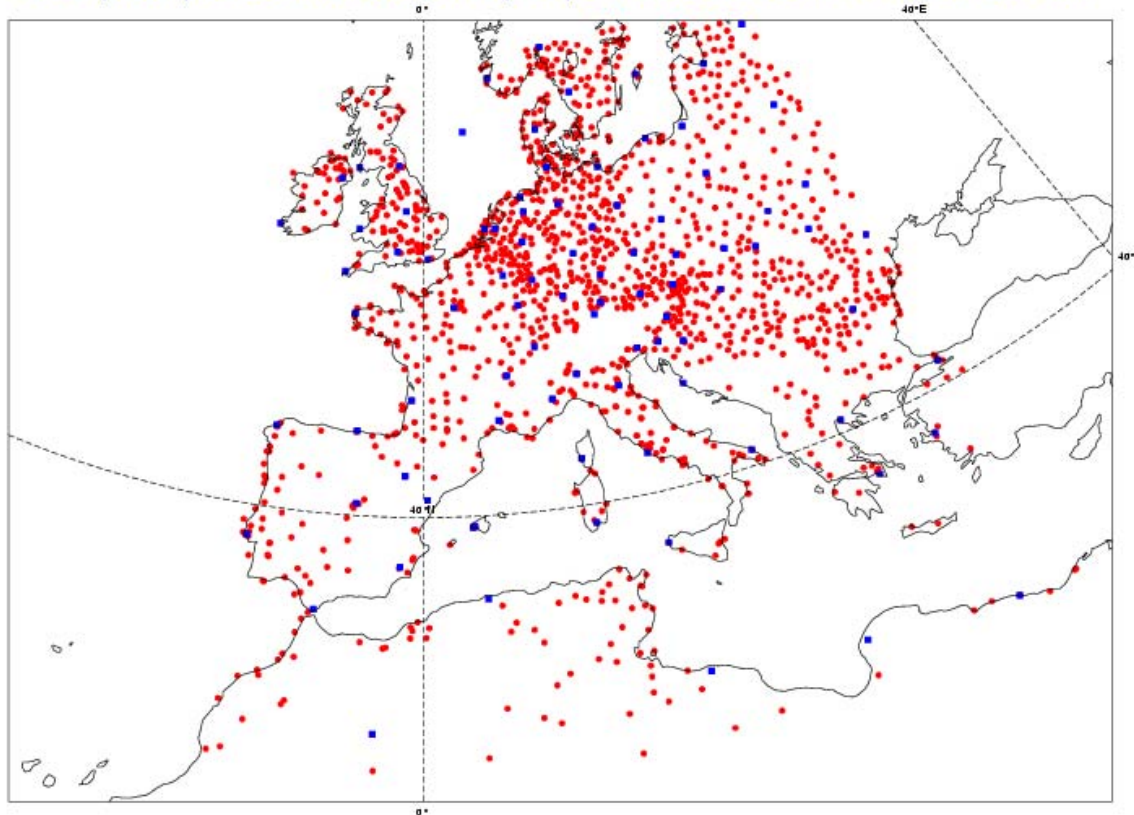




Impact studies: verification methodology

Comparison of forecasts produced from the analyzed fields with SYNOP and RAOB observations.

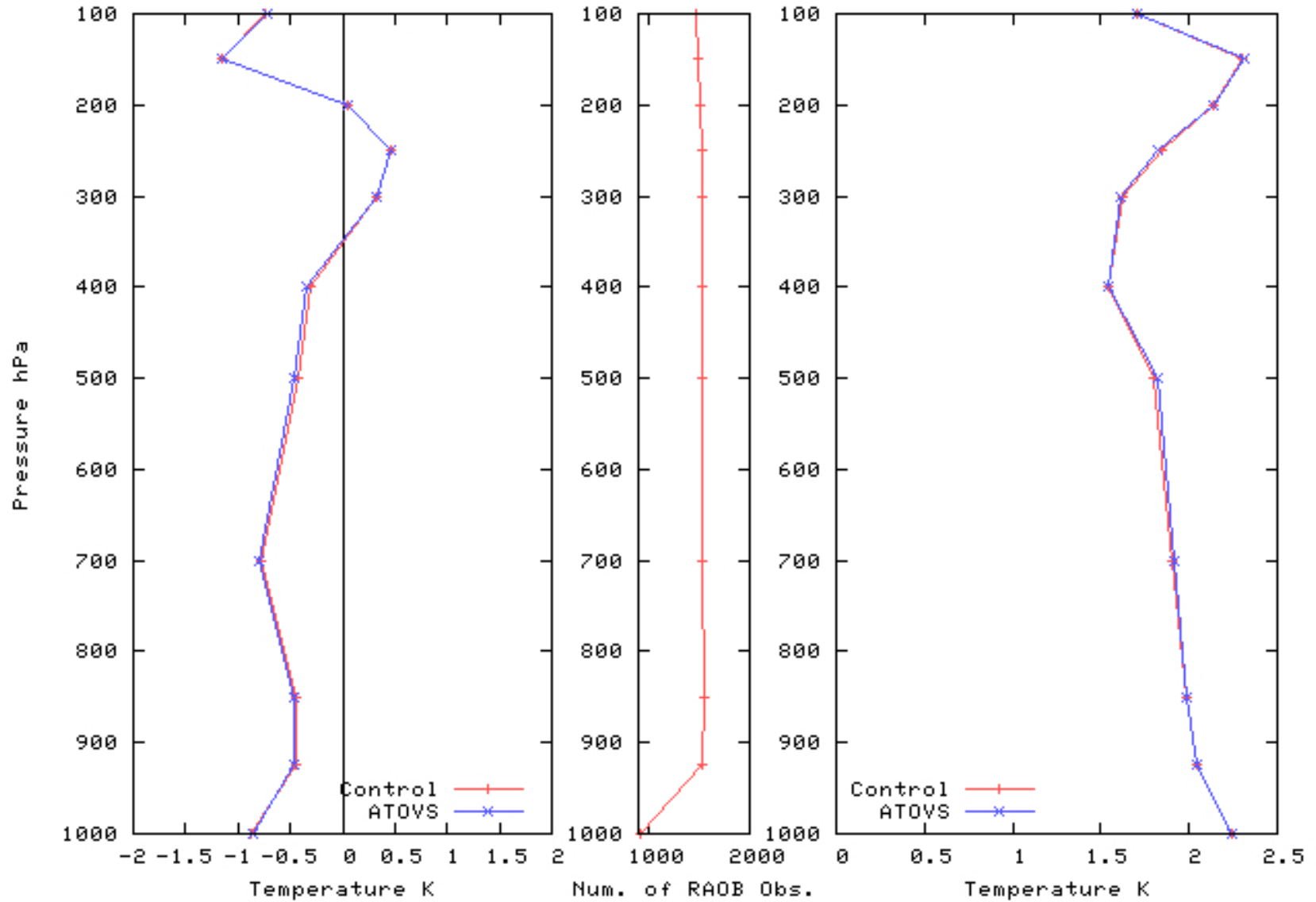
TEMP (BLUE)AND SYNOP LOWLAND (RED) STATIONS USED IN THE VERIFICATION





Impact studies: ATOVS 1D-Var

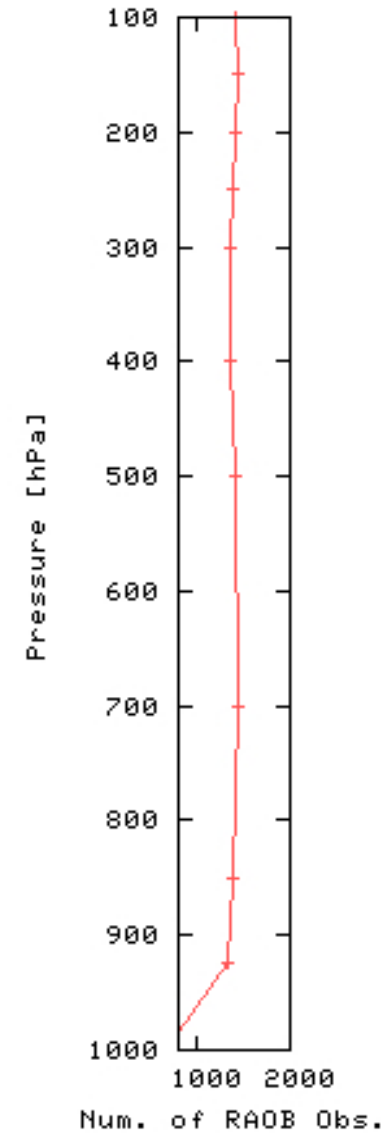
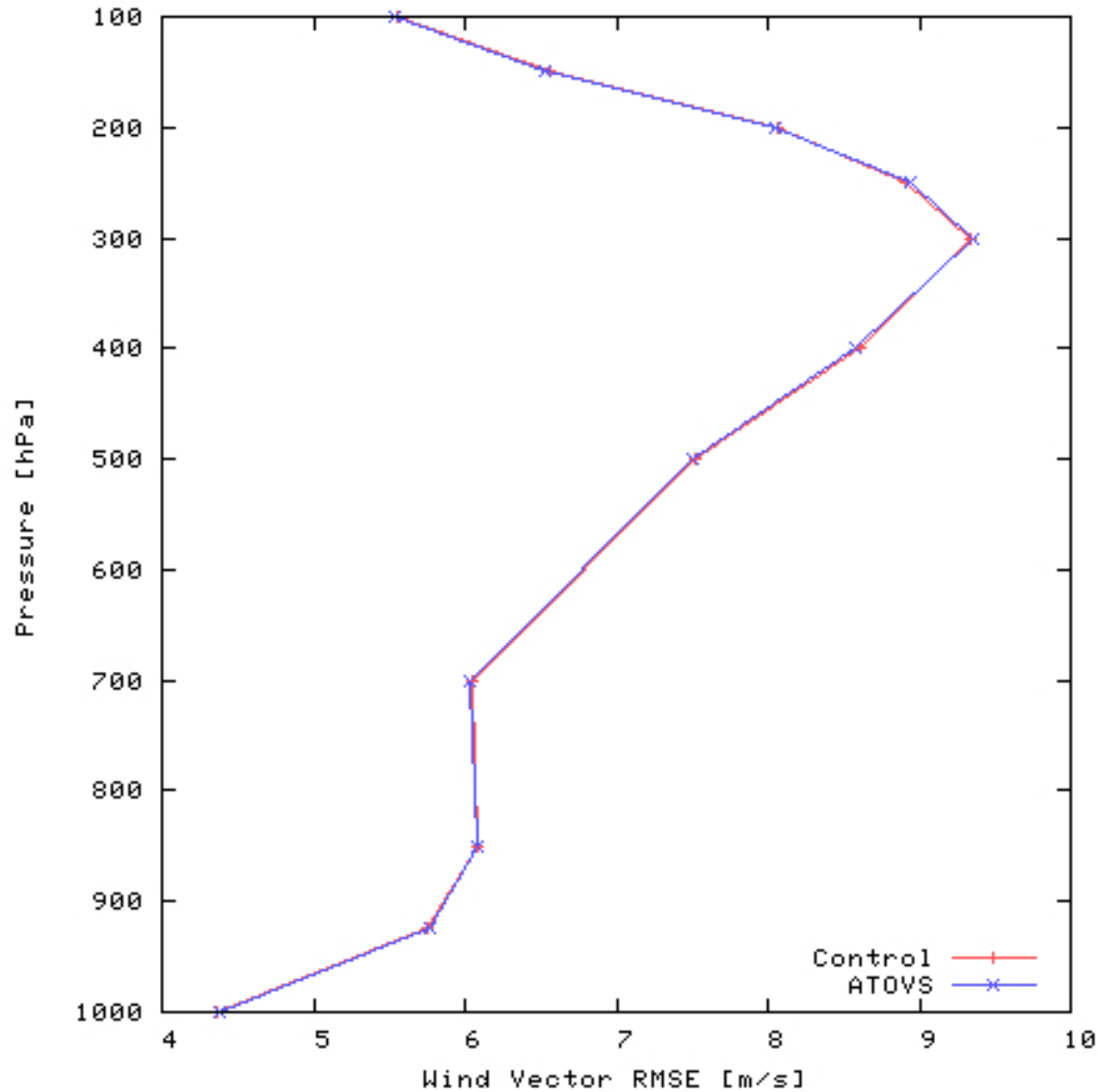
TEMPERATURE Verification: 15/12/2004 - 20/01/2005
EURO HRM 00UTC run +48h FCST





Impact studies: ATOVS 1D-Var

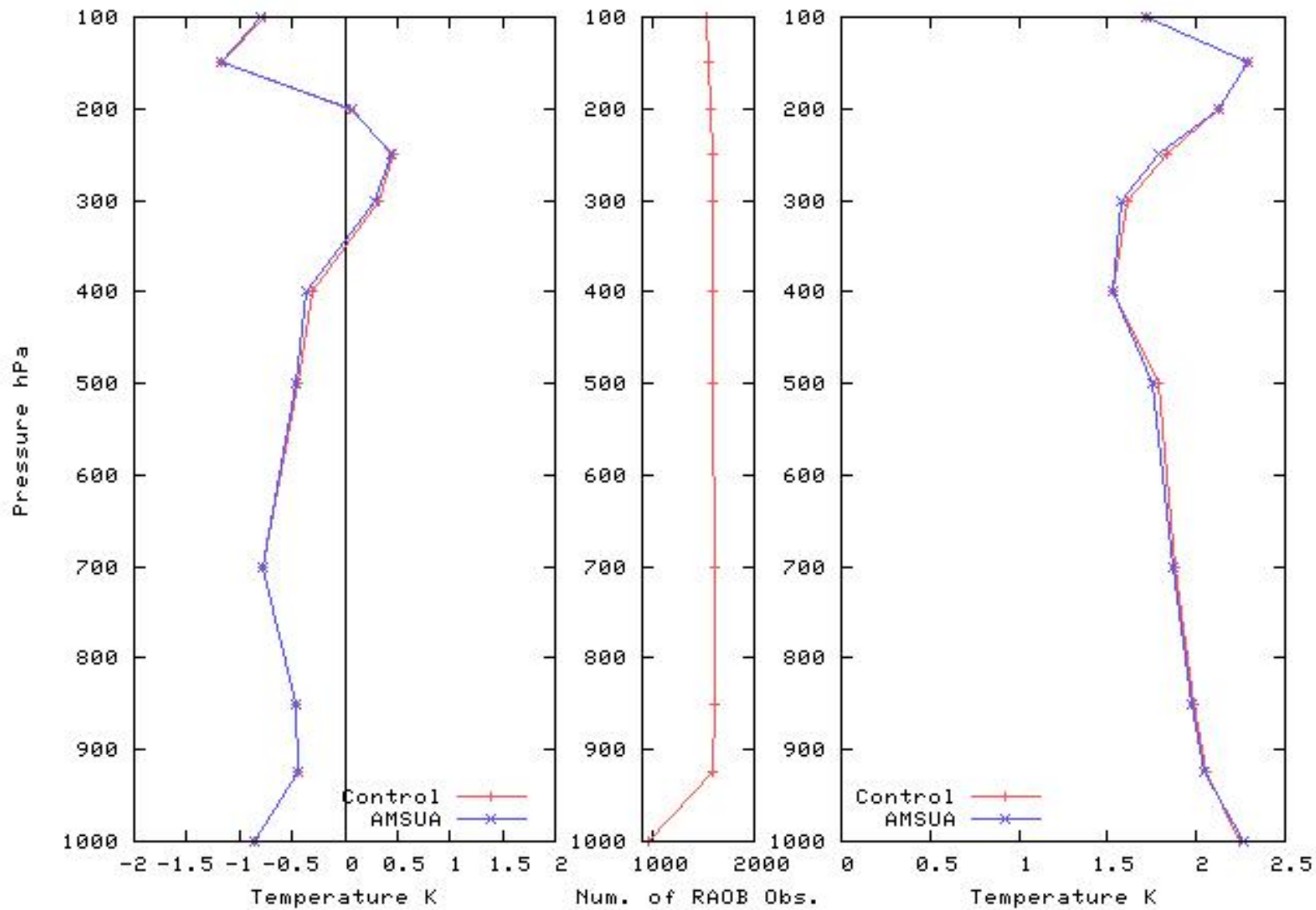
Wind Vector Verification: 15/12/2004 - 20/01/2005
EURO HRM 00UTC run +48h FCST





Impact studies: AMSU-A rad.

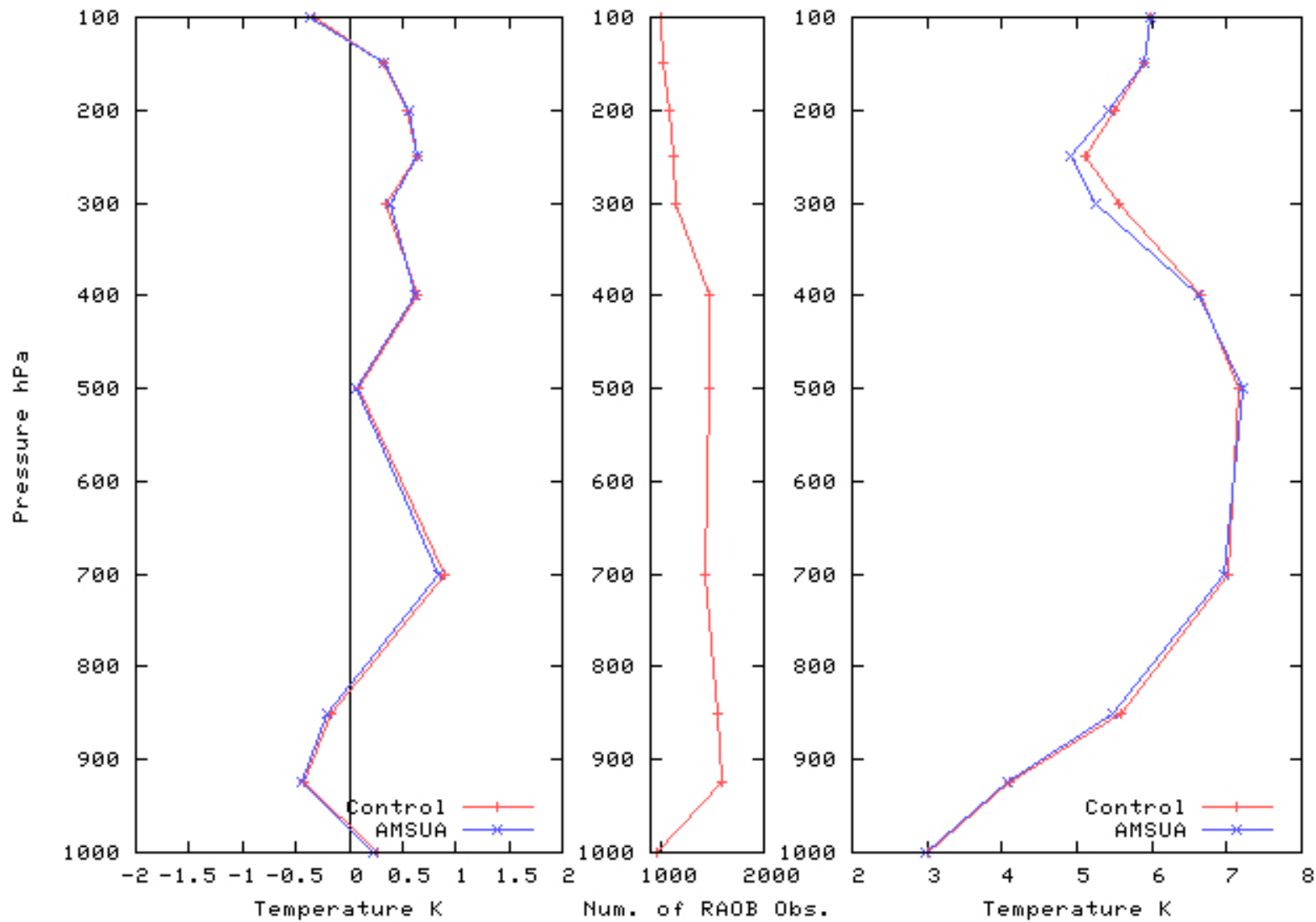
TEMPERATURE Verification: 15/12/2004 - 20/01/2005
EURO HRM 00UTC run +48h FCST





Impact studies: AMSU-A rad.

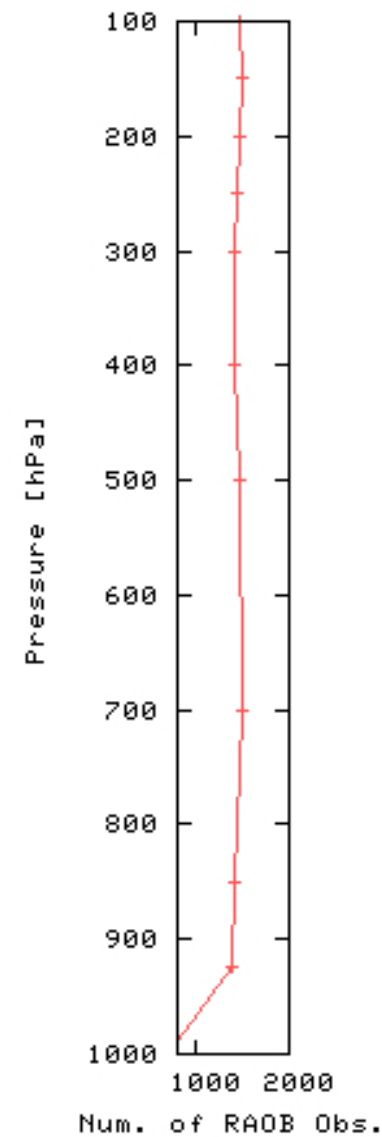
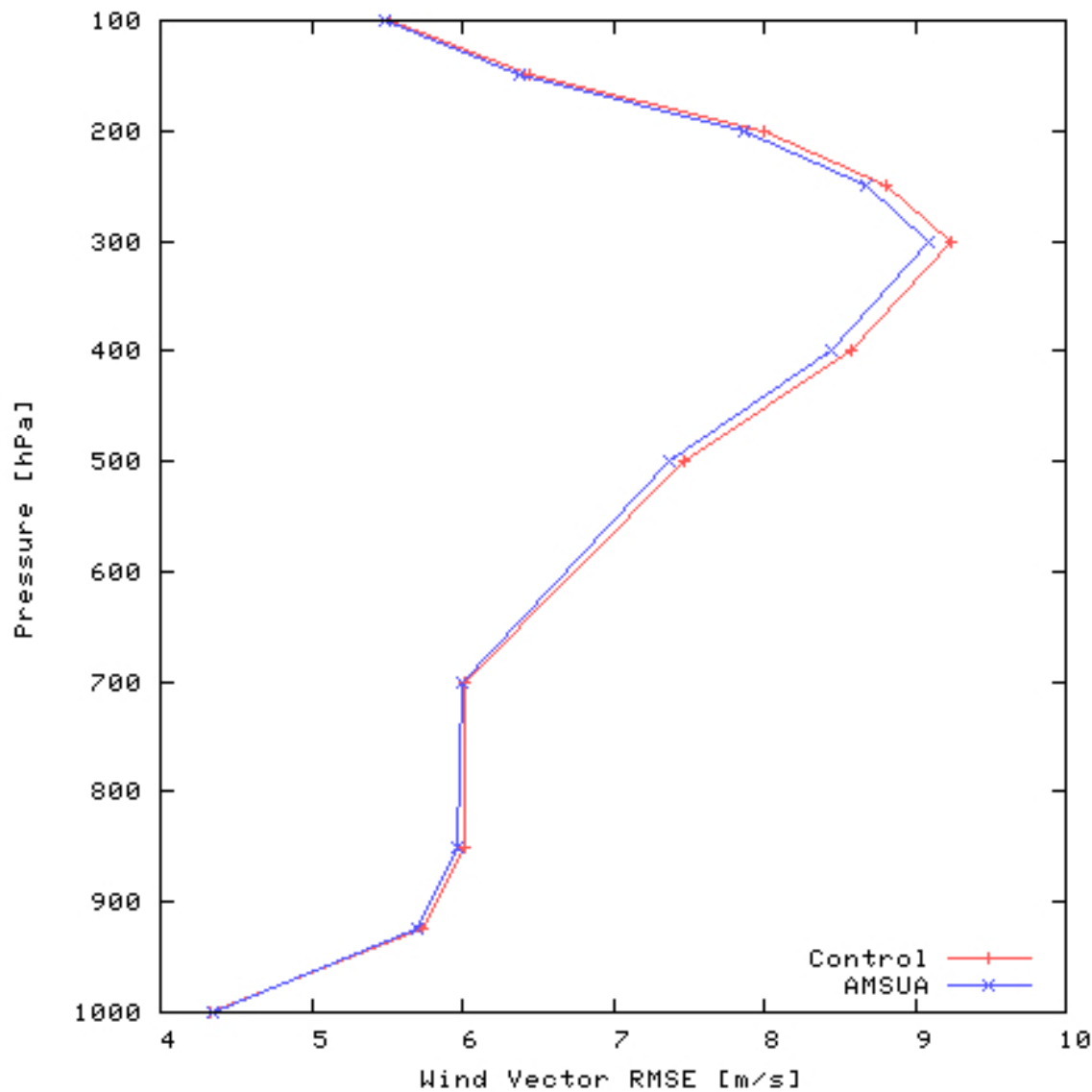
Dew Point Temp. Verification: 15/12/2004 - 20/01/2005
EURO HRM 00UTC run +48h FCST





Impact studies: AMSU-A rad.

Wind Vector Verification: 15/12/2004 - 20/01/2005
EURO HRM 00UTC run +48h FCST





Conclusions and future plans

- Retrievals' impact is overall neutral:
 1. not enough observations;
 2. still unresolved tropospheric cold bias

- AMSU-A radiance assimilation: slight positive impact especially in wind vector and humidity forecasts.



Conclusions and future plans

- Consolidate AMSU-A radiance assimilation results and extend their usage over land and sea ice
- Implement the module RTTOV_SCATT for radiances contaminated by rain
- 3D-PSAS is an “observation space” analysis, computational cost depends \sim quadratically on number of ingested obs

⇒

apply the retrieval technique to IASI data assimilation



Conclusions and future plans

- Bias correction has been the main hurdle towards operational use of ATOVS data;
much bigger problem with hyperspectral sounders



a core bias correction capability should be integrated in future versions of retrieval packages



Thank you!

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