

Studies in HARMONIE 3D-Var with 3 hourly rapid update cycling

ALADIN/HIRLAM

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Outlook of the talk

- Harmonie-36h1.1 forecast system
- Experimental set-up
- Verification of analyses & forecasts
- 20th August 2009 rapid cycl. dev.
- RUC without sat. data for upper air
- Conclusions & outlook

Harmonie-36h1.1 forecasting syst.



SMHI pre-oper. model domain
Horizontal resolution: 5.5 km
Coupled 3 hourly with ECMWF fc
Vertical levels: 60. Top: 10 hPa
Surface DA: CANARI
Upper-air DA: ALADIN 3D-Var
Dynamics: ALADIN Hydrostatic
Physics: ALARO
Surface: Old surface scheme
Initialisation: IDFI

Experimental set-up

Two parallel exp. for **July & August 2009** and **January & Febr. 2010**:

- 6 h intermittent data assimilation cycle
- 3 h intermittent data assimilation cycle

Lateral boundary conditions from 6 to 9 h old ECMWF forecasts and observations from ECMWF MARS archive

Observation time window:

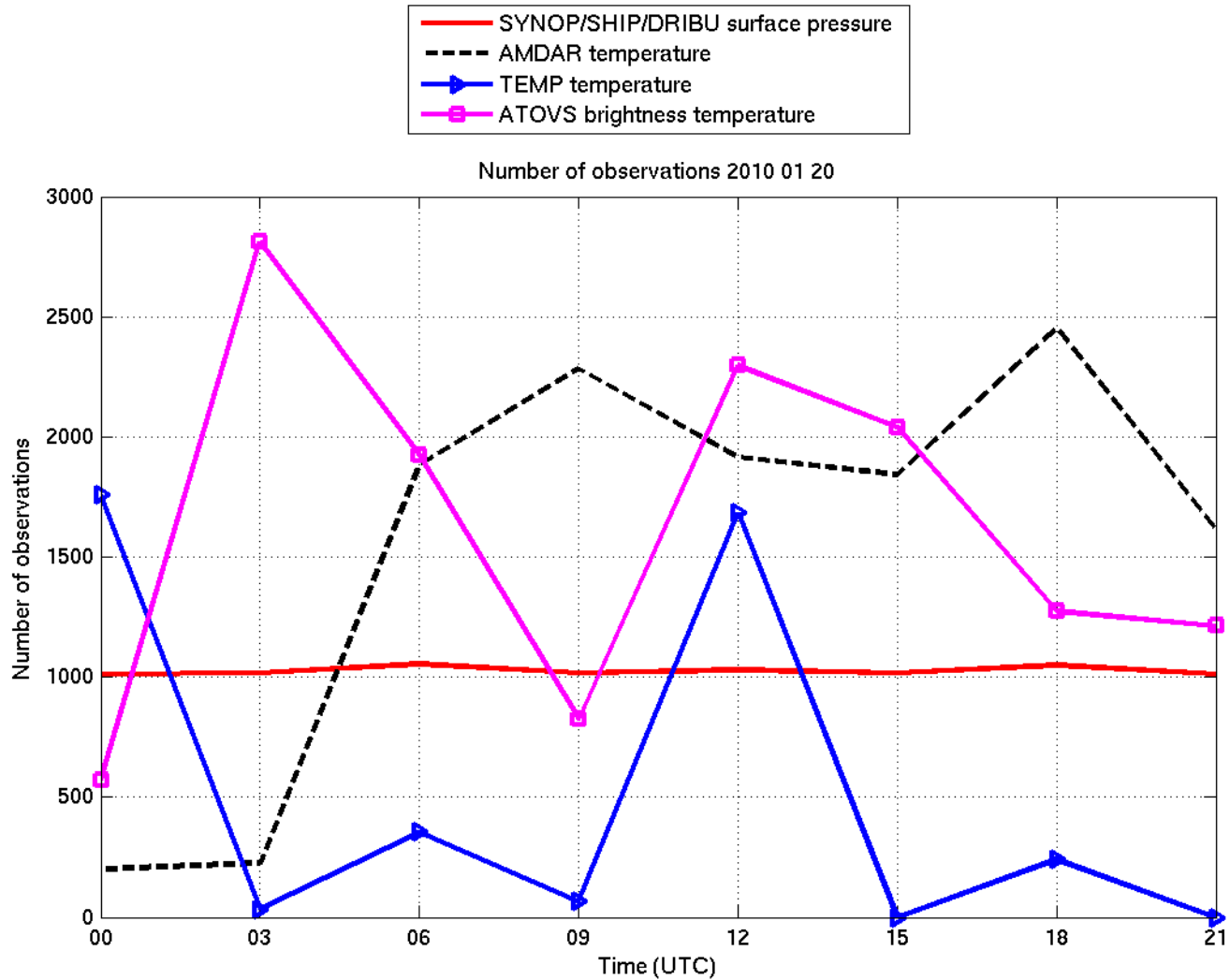
- HH +/- 3 h for 6 h intermittent DA cycle
- HH +/- 1.5 h for 3 h intermittent DA cycle
(no modifications of error statistics or IDFI settings

At 00 and 12 UTC 30 h forecasts were launched
applied when modifying from 6 h to 3 h cycle)

Utilized observations

- SYNOP/SHIP (Z, u_{10}, v_{10})
- DRIBU (Z)
- AIREP/AMDAR (u, v, T)
- TEMP (u, v, T, q)
- PILOT (u, v)
- ATOVS AMSUA (NOAA 15, NOAA 18 and METOP) (T_b ch 6-10 and VarBC)

Distribution of observations along the 3-hourly RUC for 2010 01 20

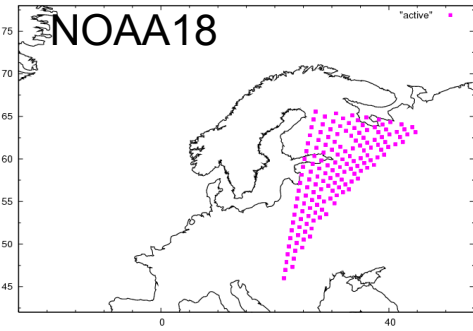


Satellite data important to obtain observations of upper-air state for all cycles when applying 3 h DA cycling

AMSU-A observation usage 2010-01-20 (RUC 3h)

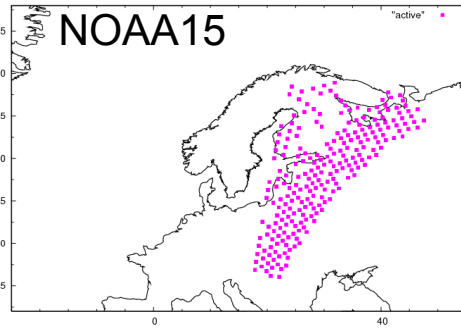
00 UTC

amsua_0aa18_j_20100120 00 UTC



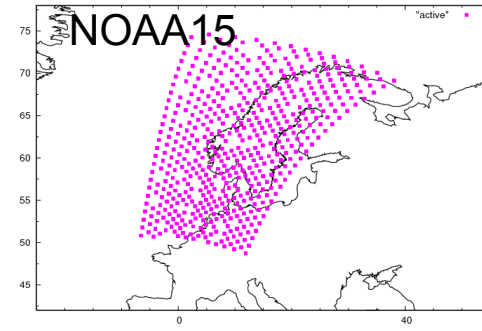
03 UTC

amsua_0aa15_j_20100120 03 UTC



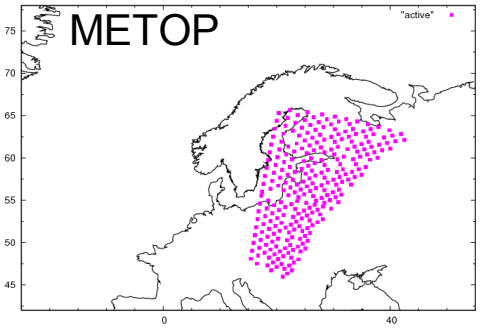
06 UTC

amsua_0aa15_j_20100120 06 UTC

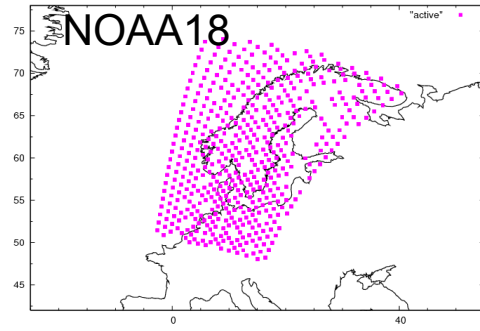


09 UTC

amsua_m_top_j_20100120 09 UTC

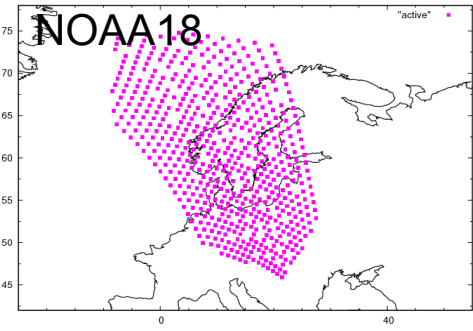


amsua_0aa18_j_20100120 03 UTC



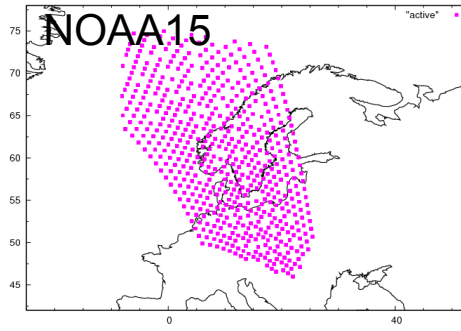
12 UTC

amsua_0aa18_j_20100120 12 UTC



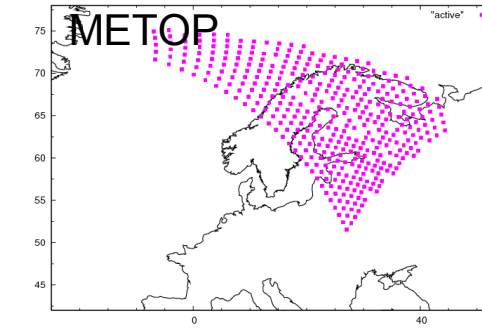
15 UTC

amsua_0aa15_j_20100120 15 UTC



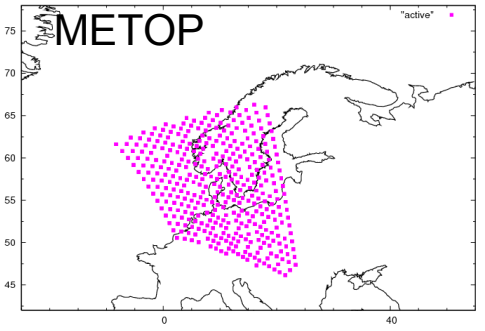
18 UTC

amsua_m_top_j_20100120 18 UTC



21 UTC

amsua_m_top_j_20100120 21 UTC

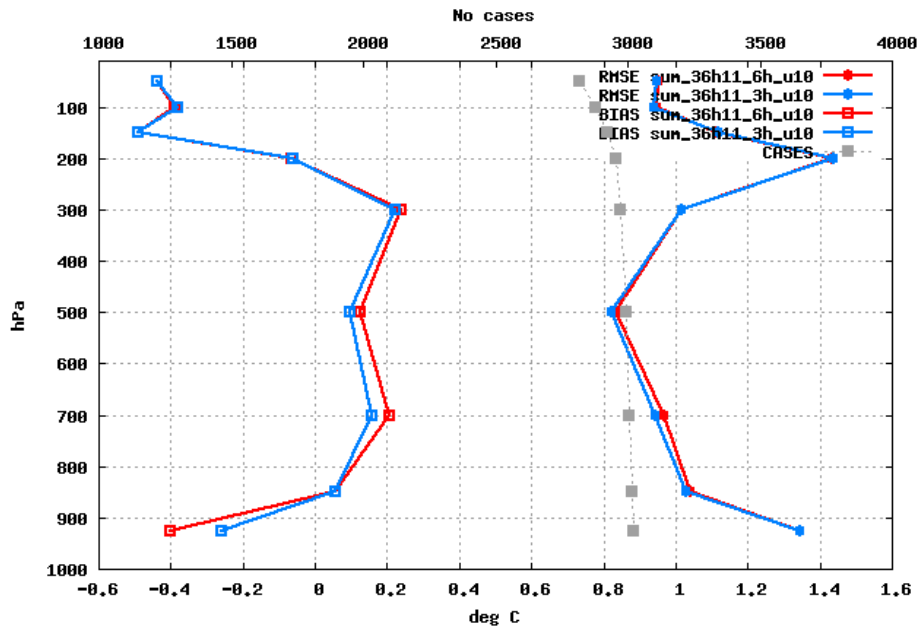


Verification of analyses and forecasts

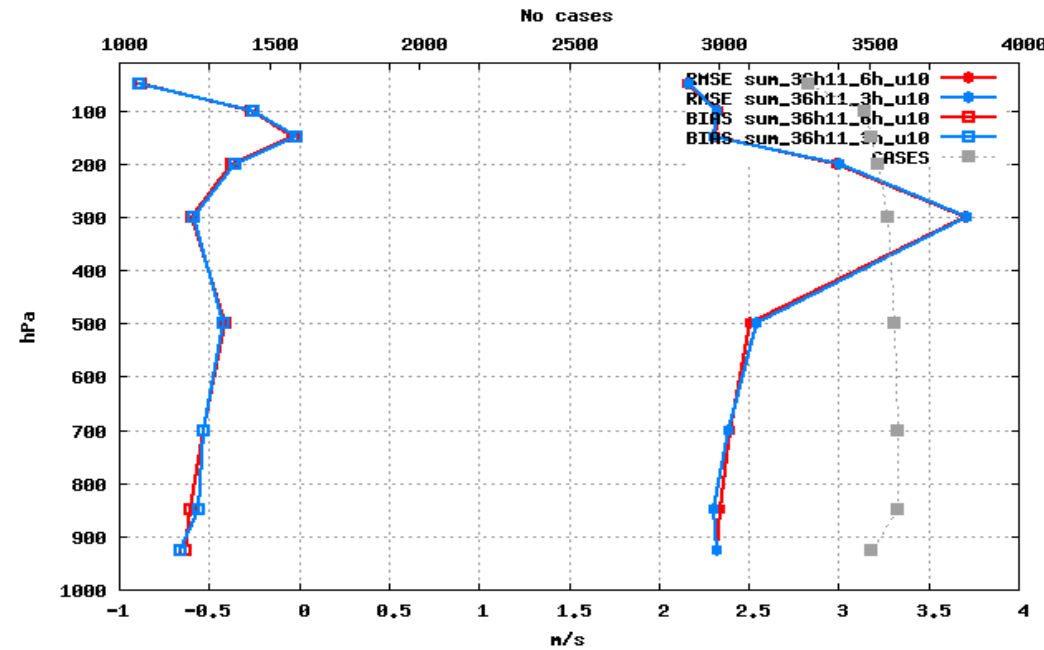
- Verification against radiosonde and SYNOP observations (no analysis verification)
- Bias (mean) and Root Mean Square verification scores.

Validation of RUC, summer 6h versus 3h

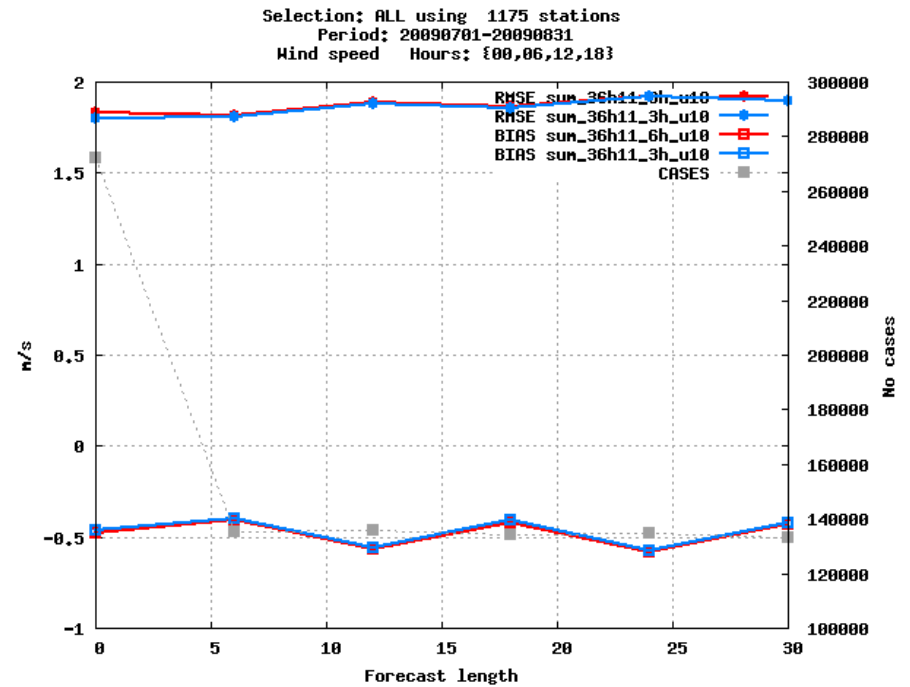
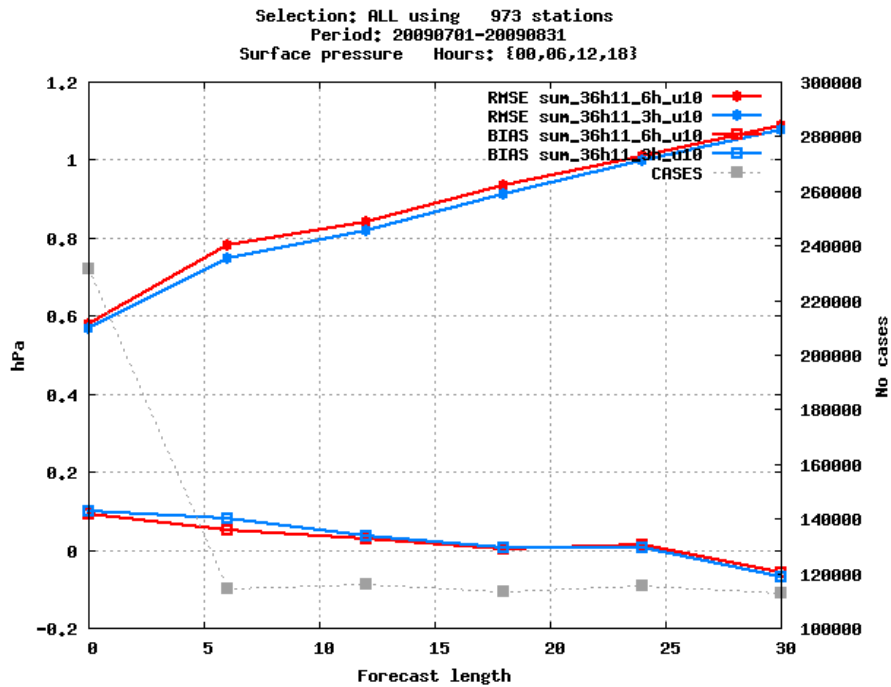
59 stations Selection: ALL
 Temperature Period: 20090701-20090831
 Statistics at 12 UTC At {00,12} + 12



65 stations Selection: ALL
 Wind speed Period: 20090701-20090831
 Statistics at 00 UTC At {00,12} + 12

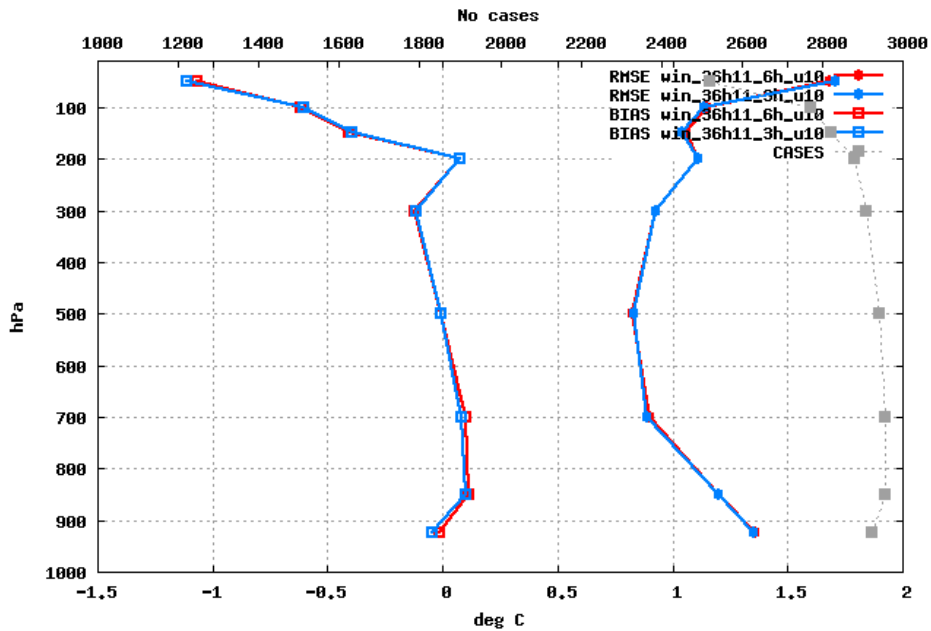


Validation of RUC, summer 6h versus 3h

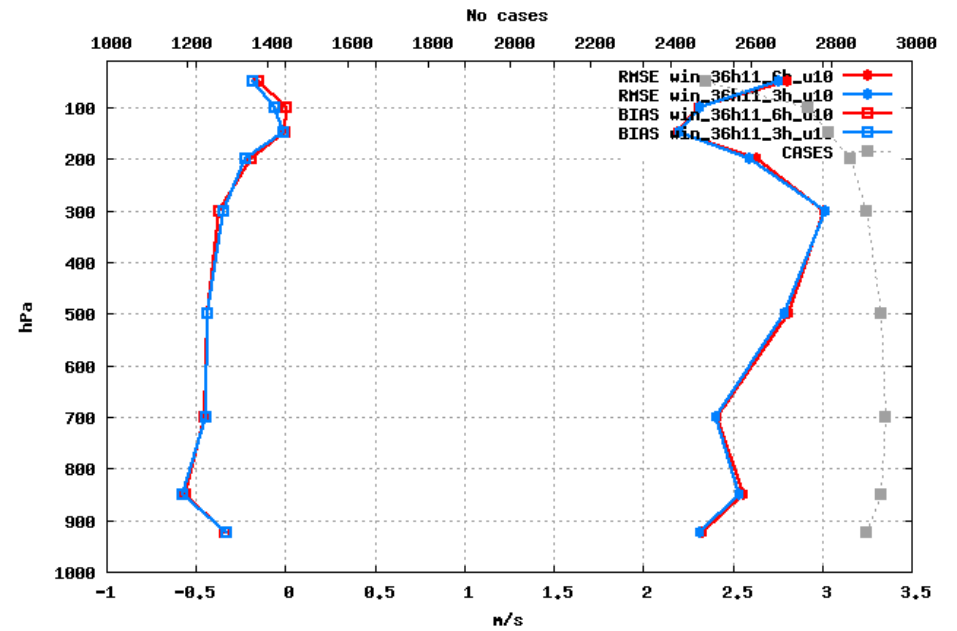


Validation of RUC, winter 6h versus 3h

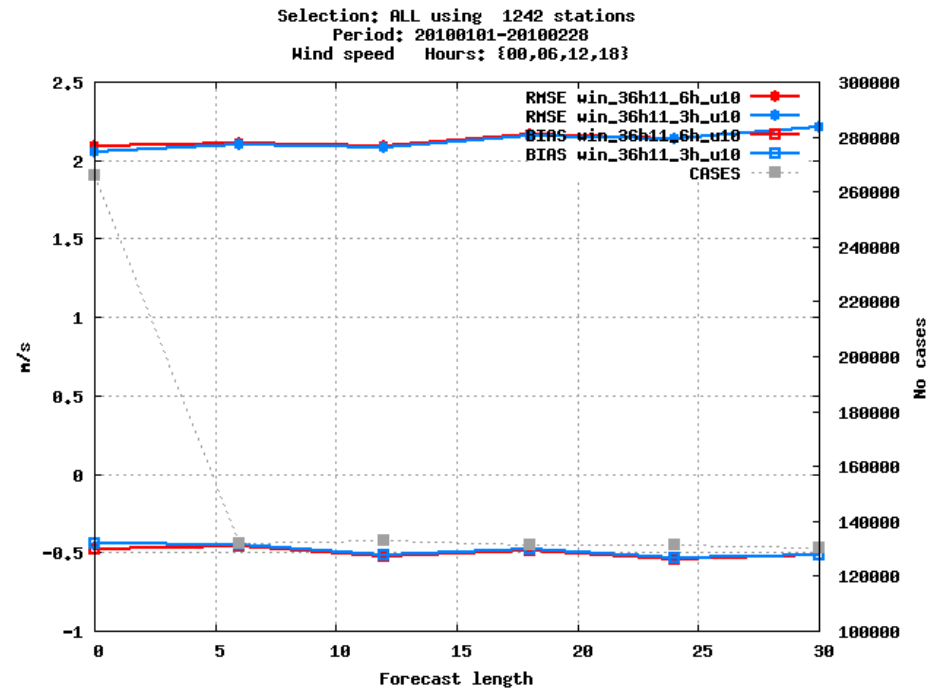
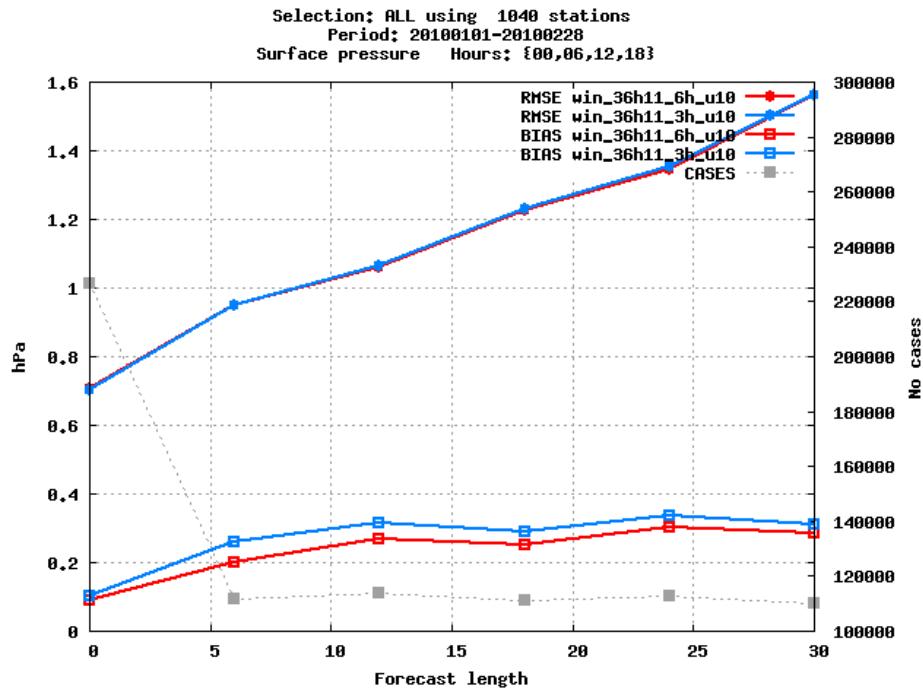
60 stations Selection: ALL
 Temperature Period: 20100101-20100228
 Statistics at 12 UTC At {00,12} + 12



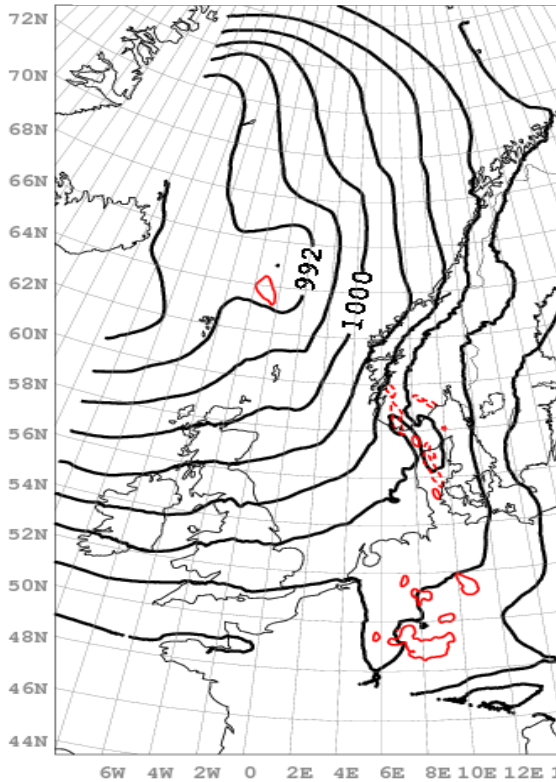
60 stations Selection: ALL
 Wind speed Period: 20100101-20100228
 Statistics at 12 UTC At {00,12} + 12



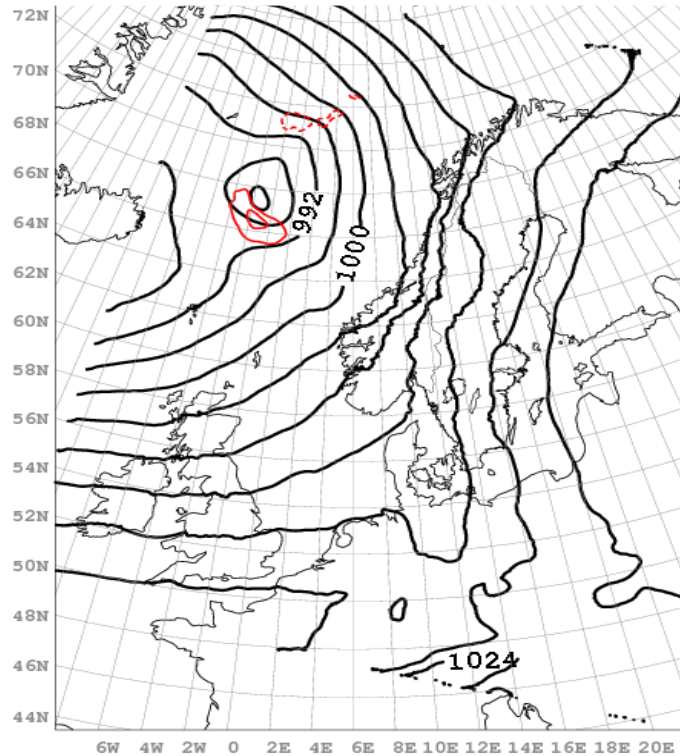
Validation of RUC, winter 6h versus 3h



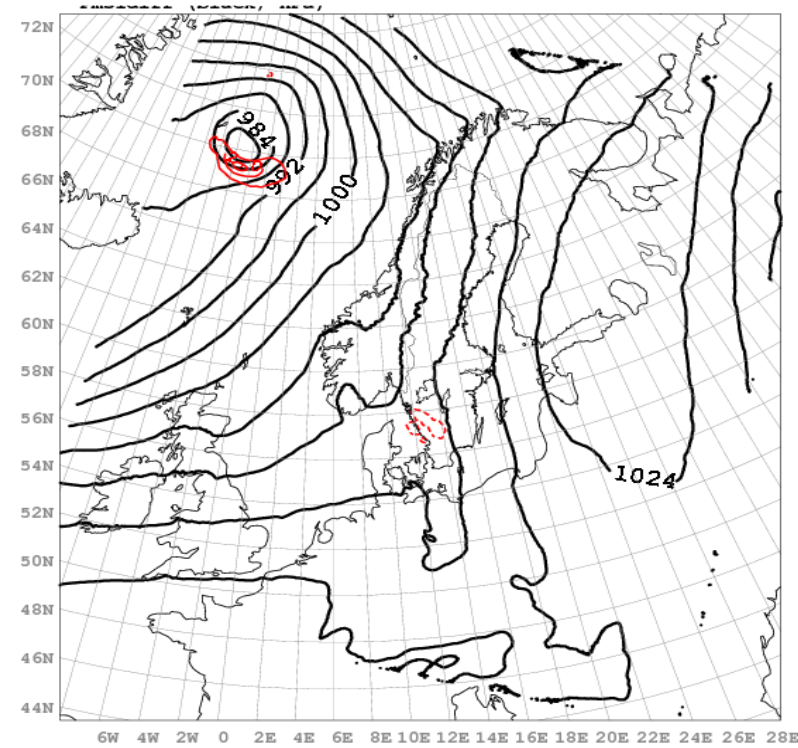
20 Aug 2009 12 UTC
sum6h mslpfc (black, hPa)
sum6h-sum3h psdiff (red, conint 1 hPa)



+6 h

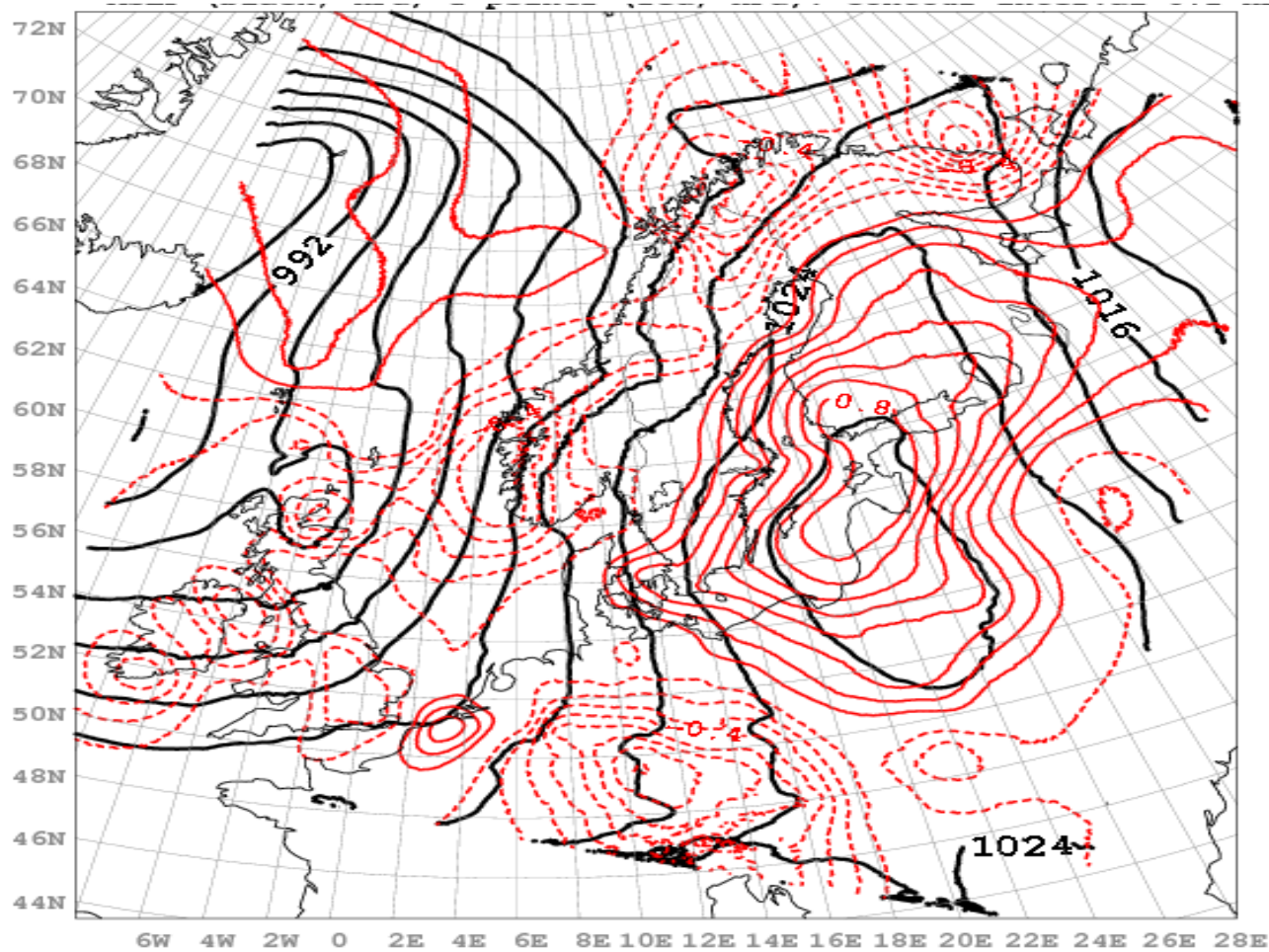


+12 h

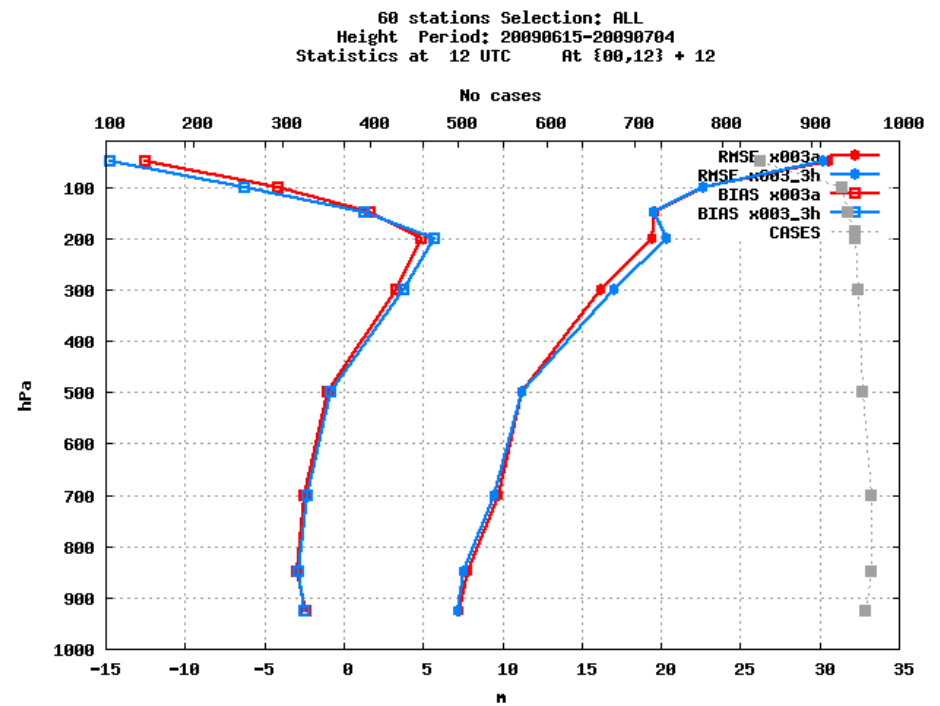
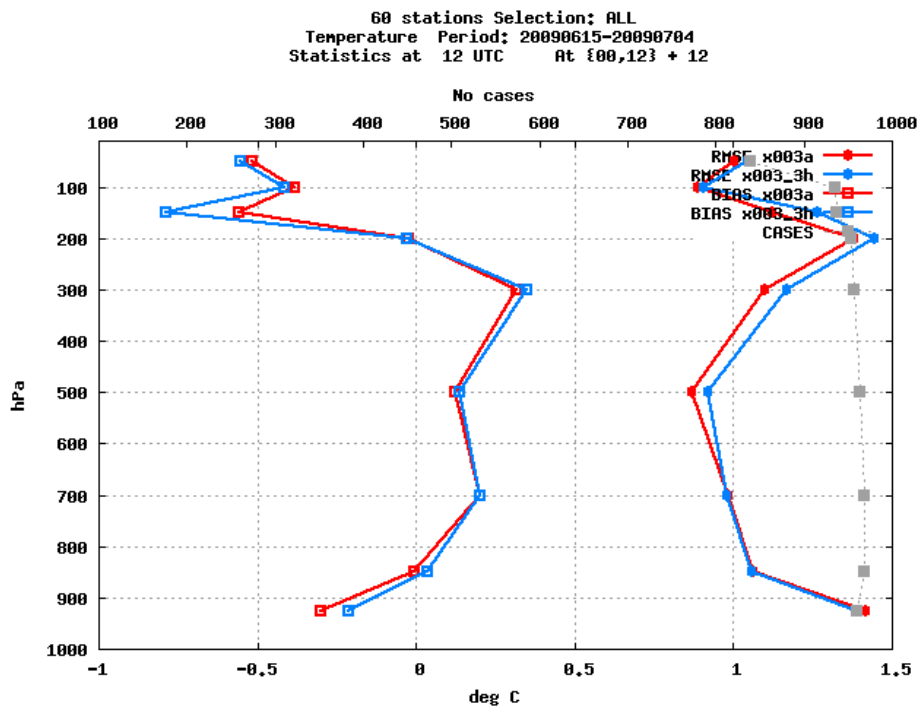


+18 h

20 August 2009 09 UTC (RUC 3h)
sum3h mslpfc(black,hPa)
3h analysis incr.(red,conint 0.1hPa)



RUC without sat. data for upper air 6h versus 3h



x003a Control with 6 h analysis and boundary
 x003_3h Control+Rh2+T2 with 3 h analysis and boundary

Conclusions and Plans

- HARMONIE 3D-Var system has been set up for use with a 3 h RUC and evaluated on one summer period and one winter period.
- First results were promising, especially for the summer period.
- Upper air data availability important
- Possibility of increased imbalances due to 1 and 3 h cycling will be studied.
- Future RUC experiments with AROME 2.5 km will also evaluate assimilation of, for instance, radar and GPS observations with 3 and 1 h RUC.