ILMATIETEEN LAITOS
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Exploitation of radar radial winds in HIRLAM 3D-Var

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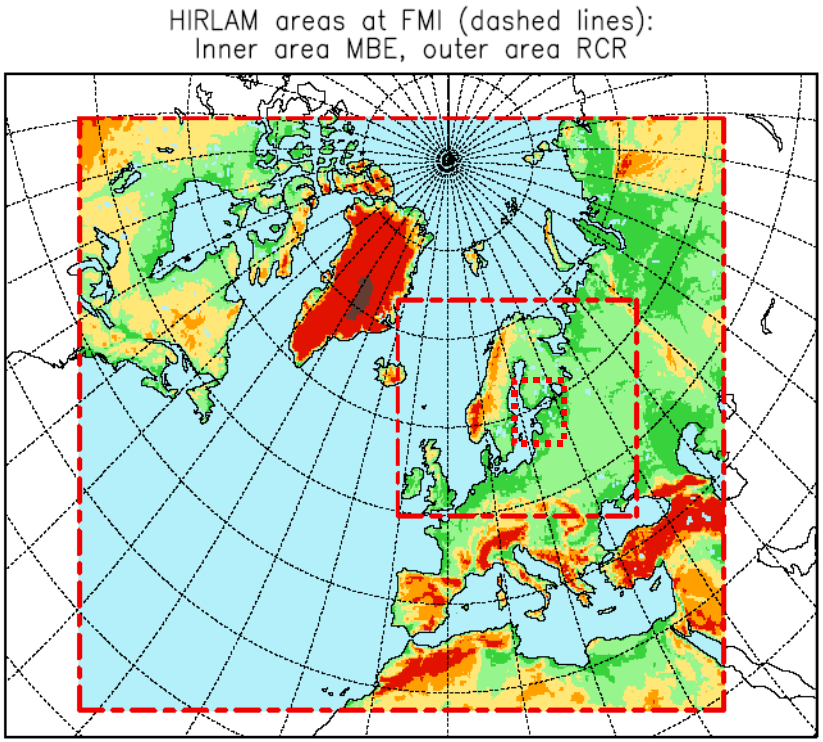
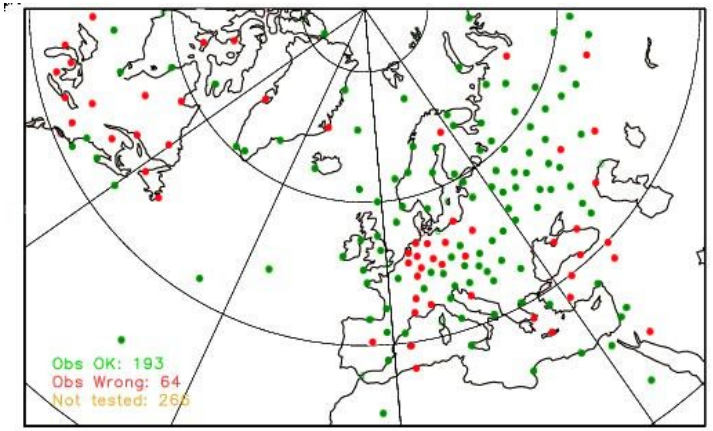
NetFAM – COST ES0702 Workshop

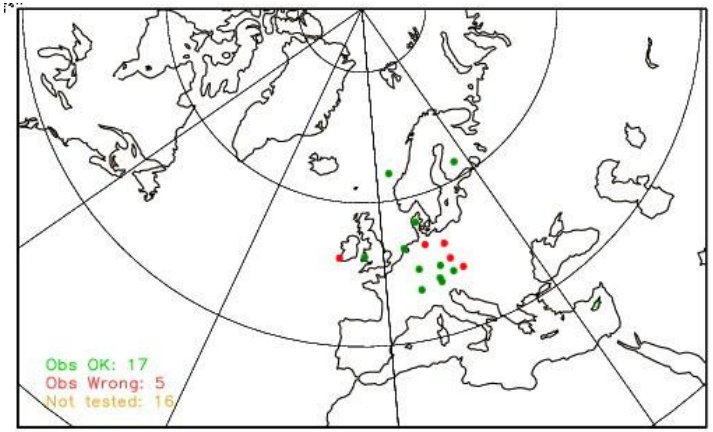
Motivation for the work

FMI model domains



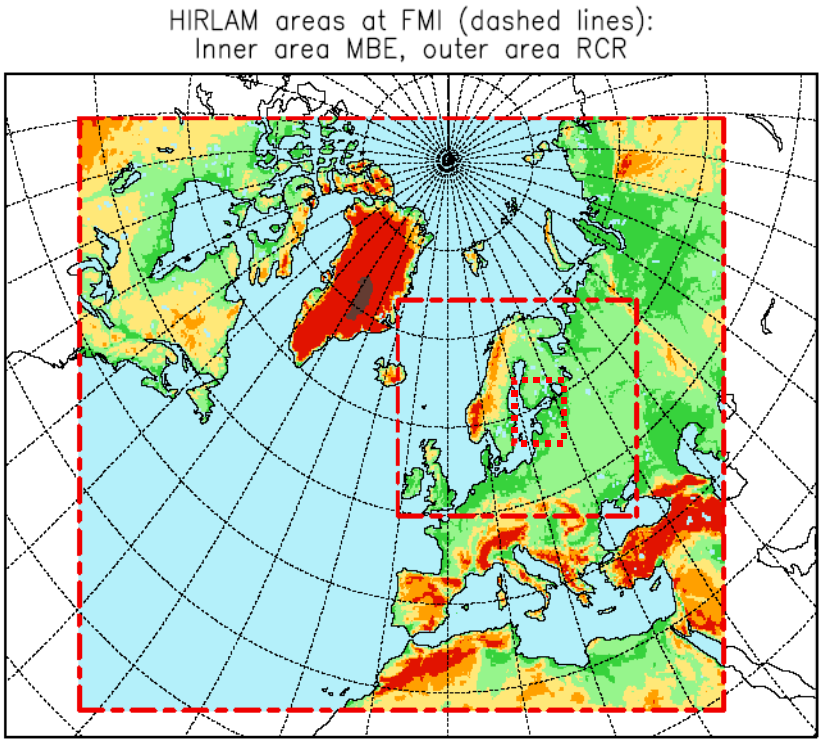
Radiosoundings 00, 06 UTC



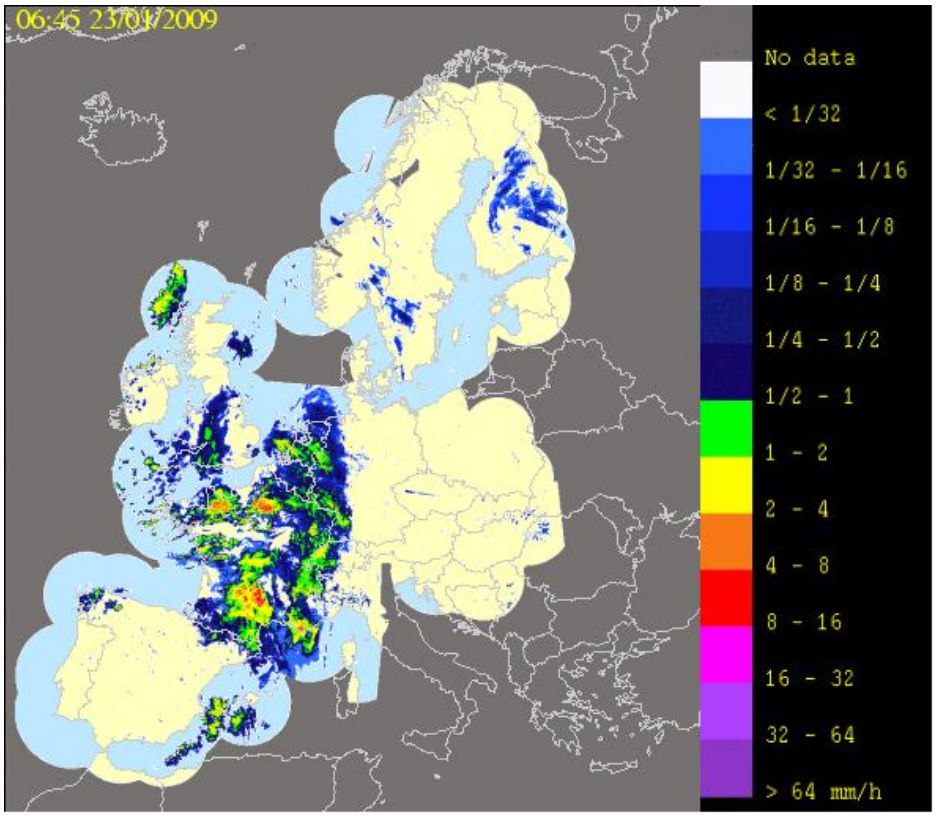


Motivation for the work

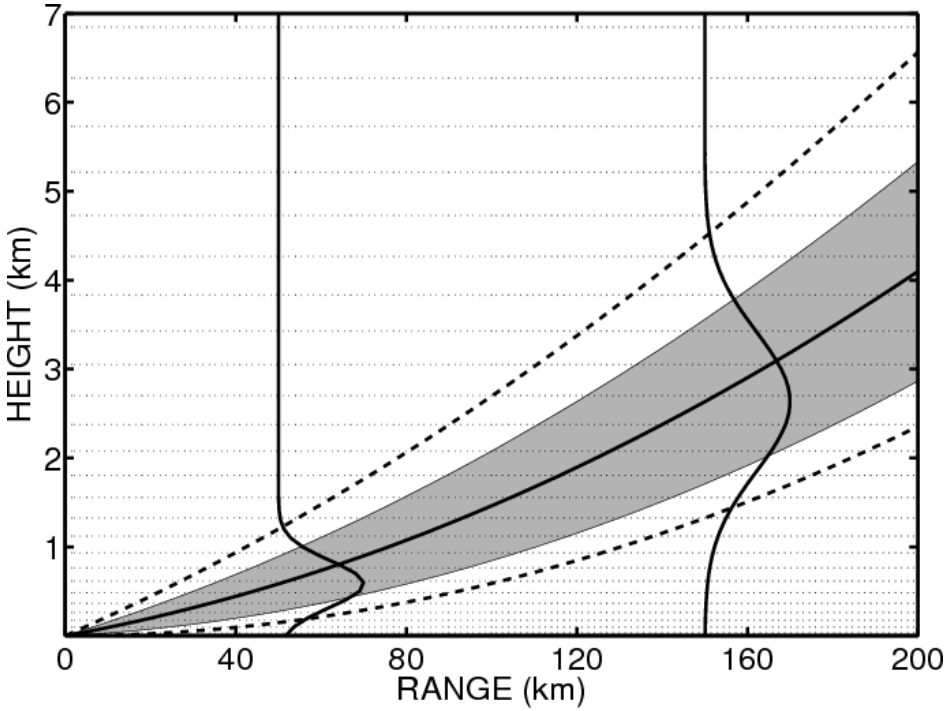
FMI model domains



European radar network



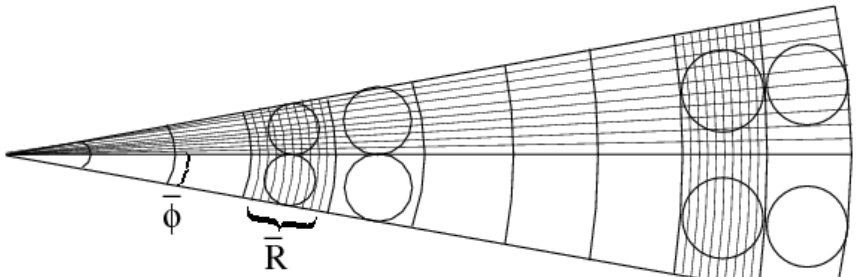
Modelling the radial wind observation

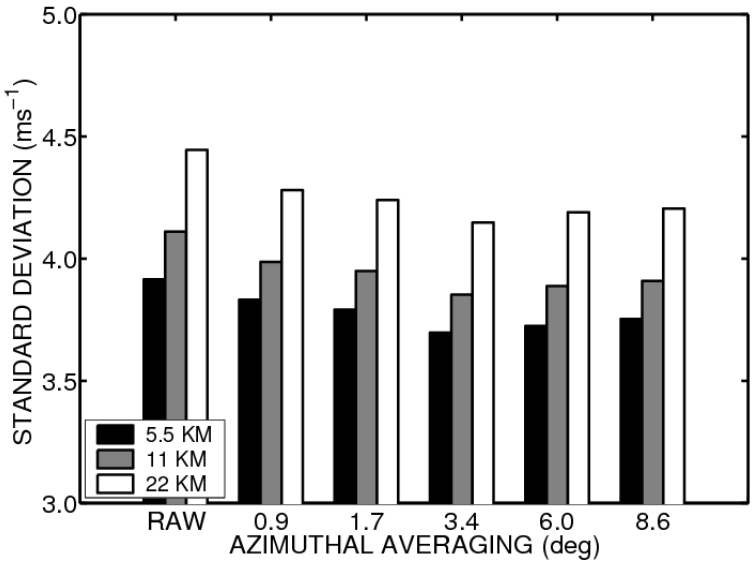


- Model variables: u and v.
- Interpolation of u and v to the observation location.
- Projection of u and v towards the radar and on the slated direction of the radar beam.
- Broadening of the radar beam.
- Bending of the radar beam path.

Spatial average, so called superobservation

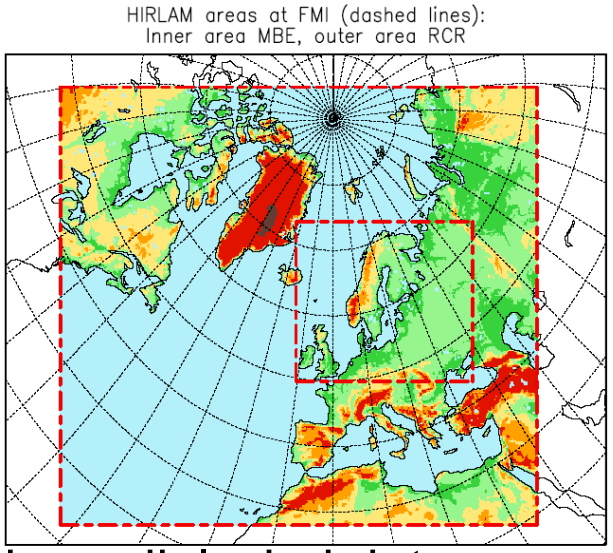
- Effective way to reduce the impact of random errors.
- HIRLAM strategy: choose optimal R and Φ.
- Possible drawback: increase in bias.





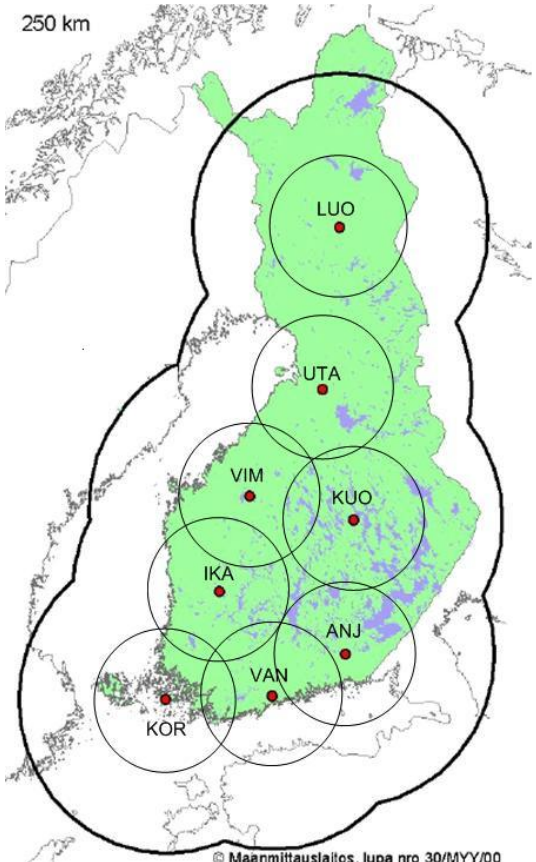
Impact studies with FMI radar data (1)

- HIRLAM version 7.1.4, analysis system 3D-Var.
  - 6 h cycling
  - 48 h forecasts
- Period: 1.-29. February 2008.
- Two experiments
  - CON: conventional observations
  - RAD: conventional observations + radar radial wind data.

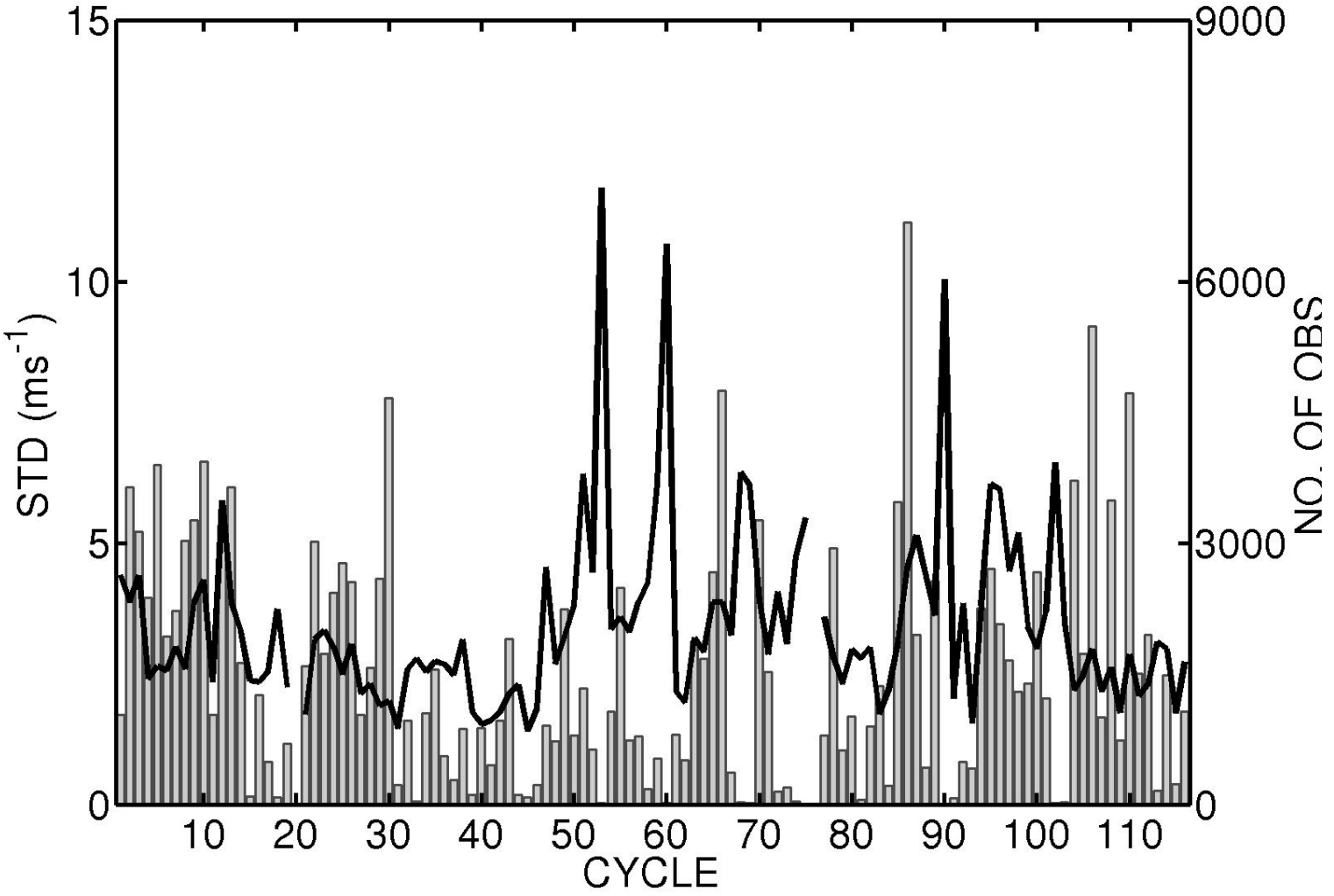


Impact studies with FMI radar data (2)

- Radar data from FMI radar network, 8 radars.
  - Velocity measurement task every 15 minutes
  - Range resolution 500 m
  - Azimuth resolution 1°
  - Maximum range 150km
  - Unambiguous velocity interval ± 36m/s
- Superobservations:
  - Range bin spacing 10 km
  - Azimuthal averaging 2°



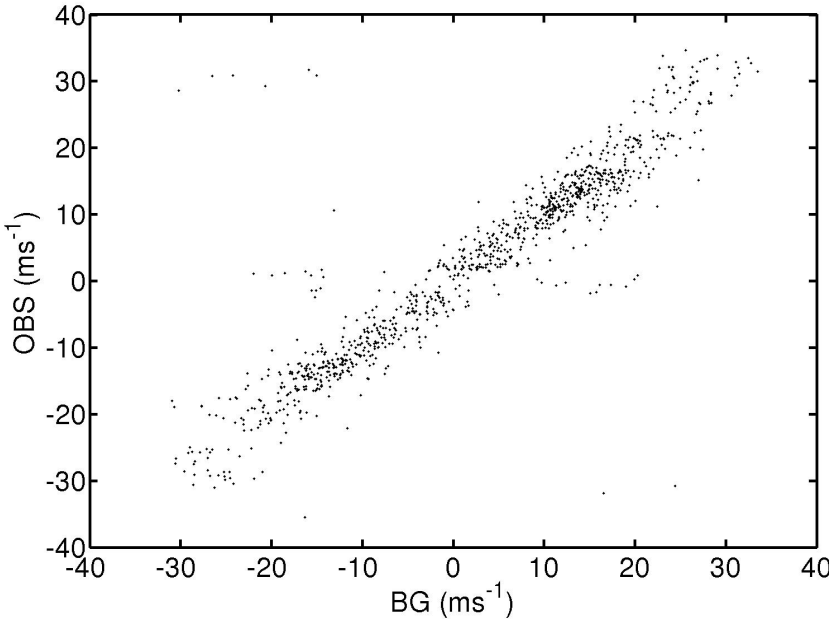
Radar data monitoring (1)

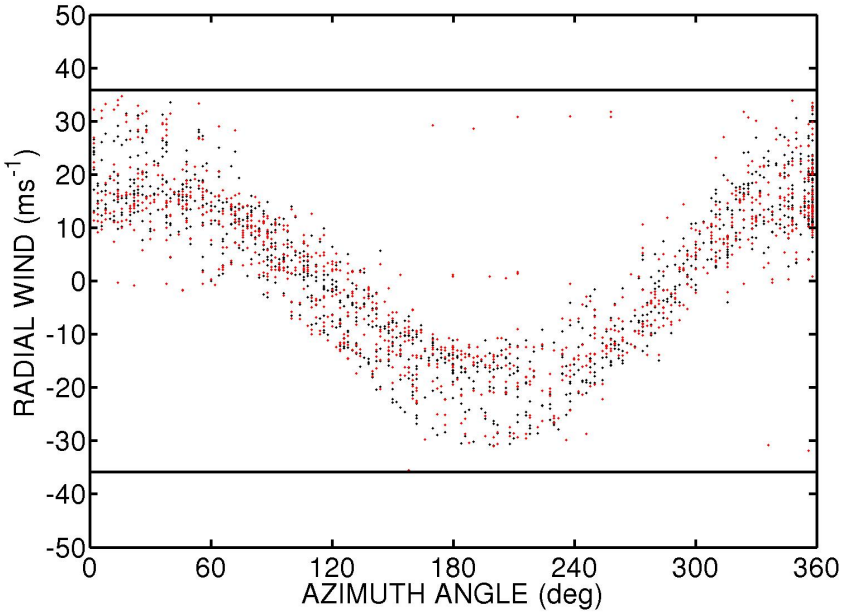


Radar data monitoring (2)

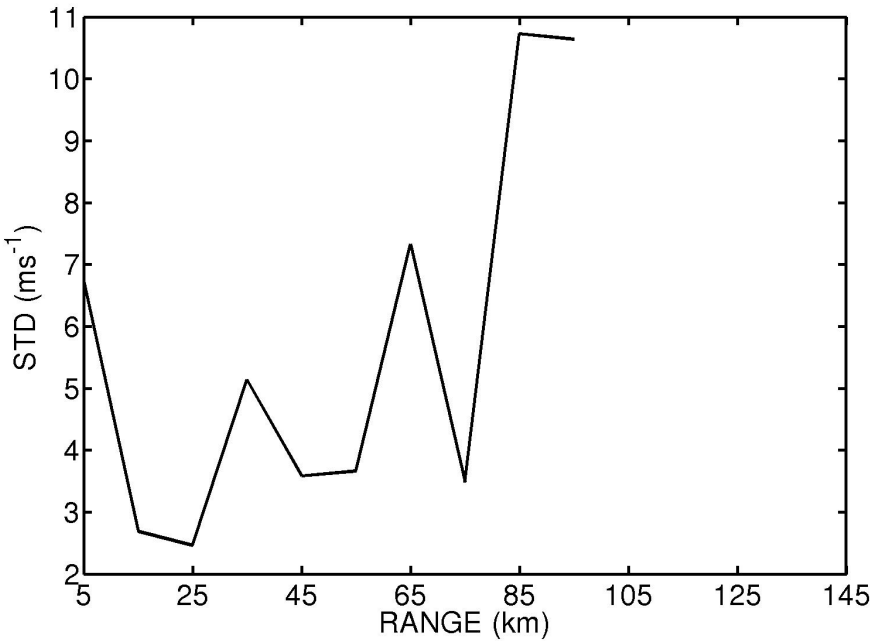
1st February 2008, 00 UTC

OBS
BG





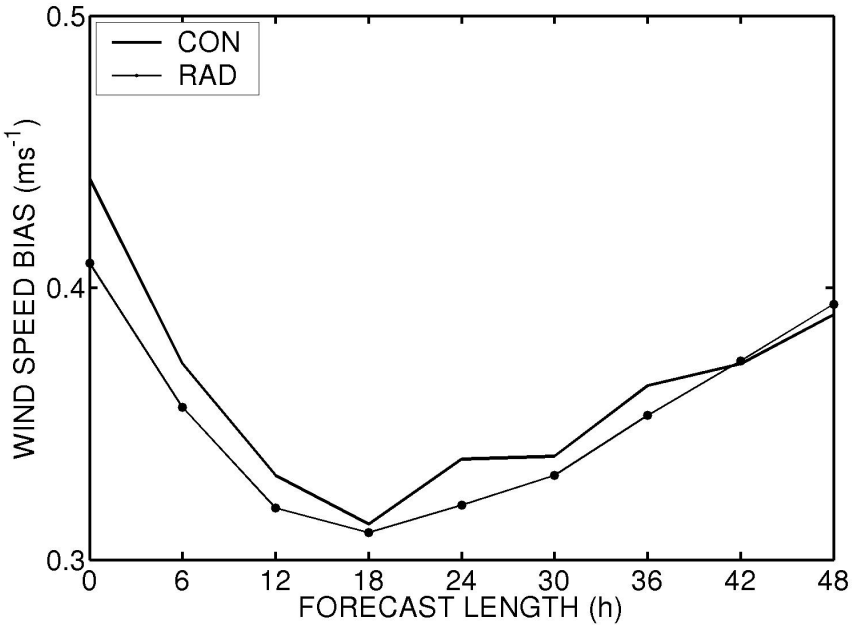
Radar data monitoring (3)

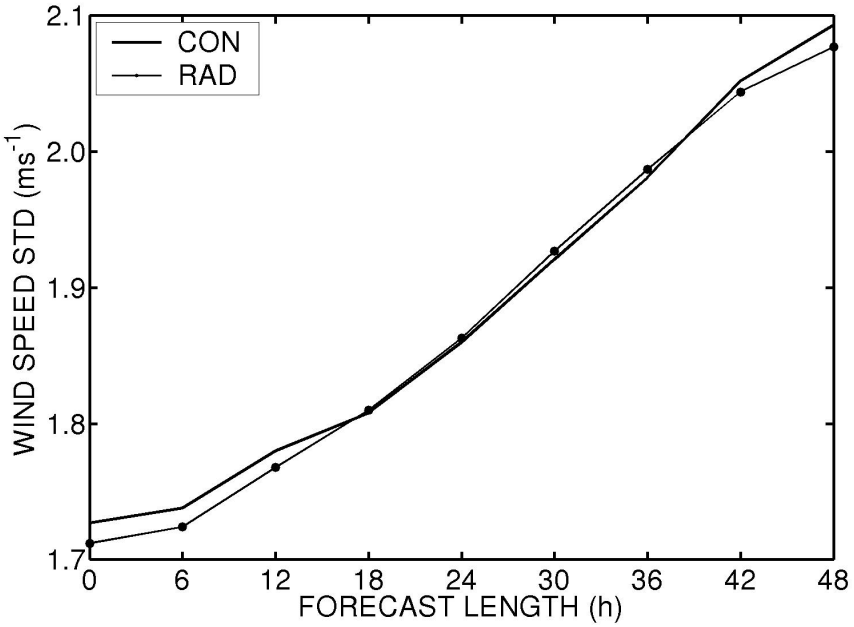


- In general the quality of the radial winds is good.
- In occasional cases unambiguous velocity interval is exceeded (typical for long ranges).
- In occasional cases filtering of ground clutter fails (typical for short ranges).

Verification against surface observations over Finland

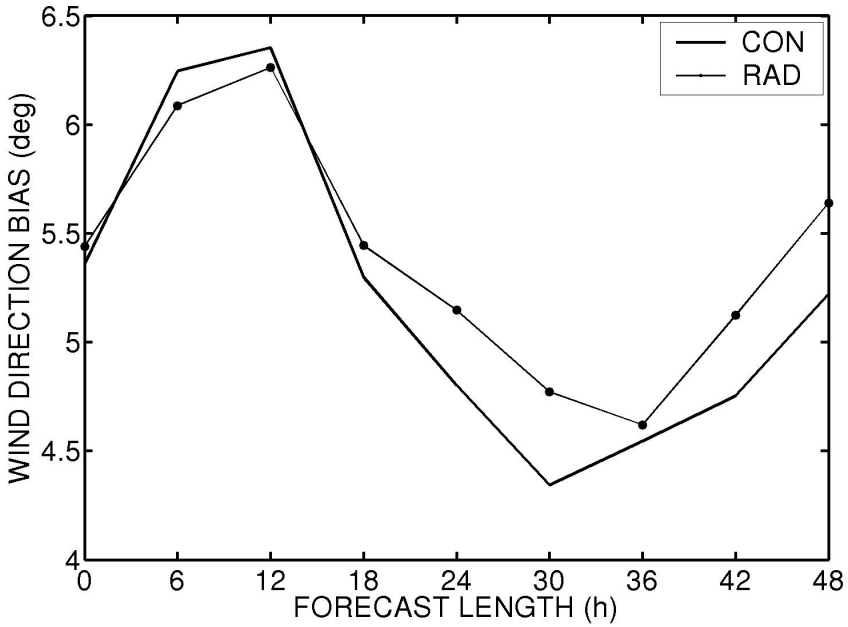
WIND SPEED

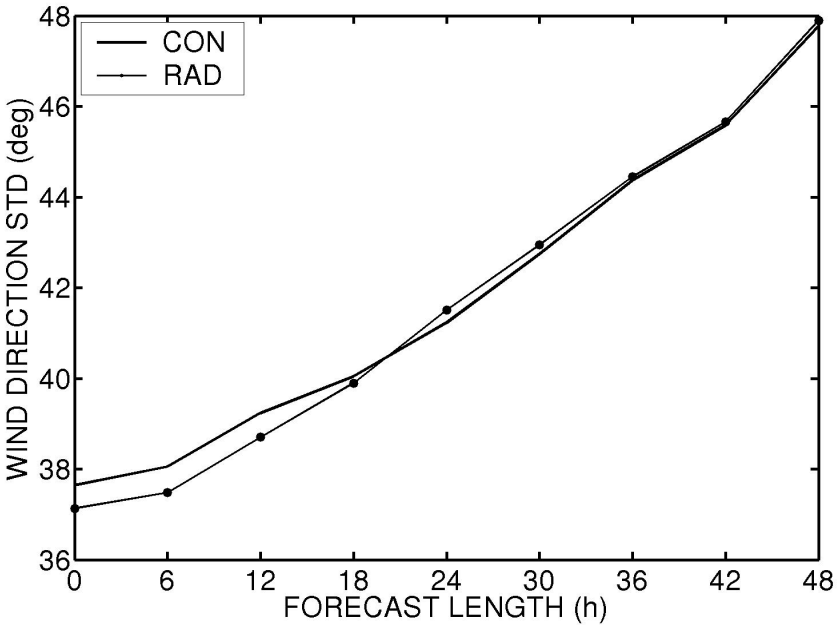




Verification against surface observations over Finland

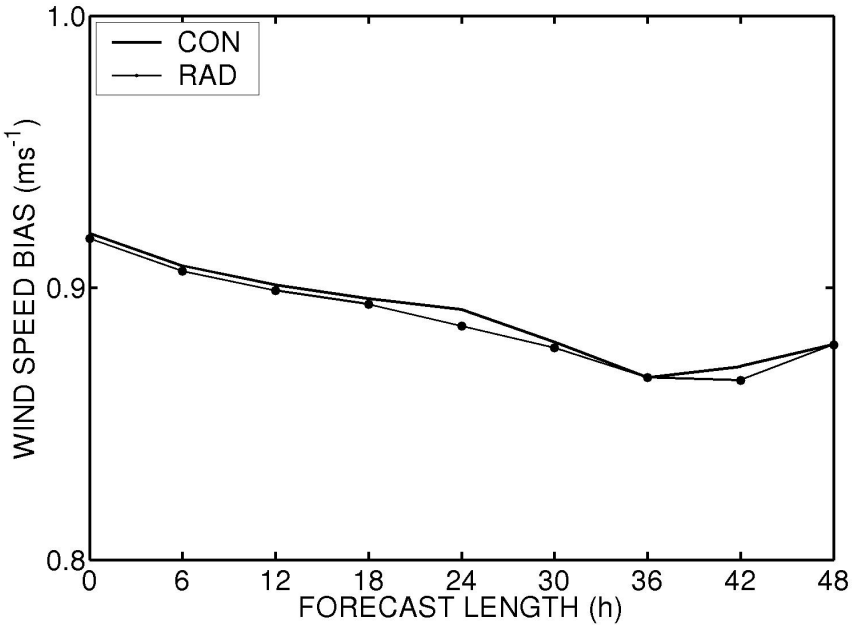
WIND DIRECTION

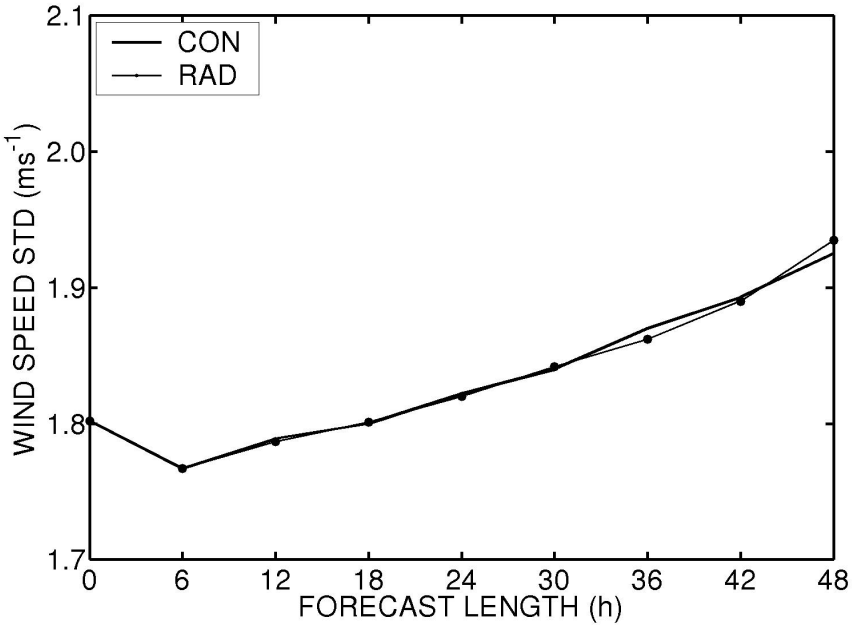




Verification against EWGLAM surface observations

WIND SPEED



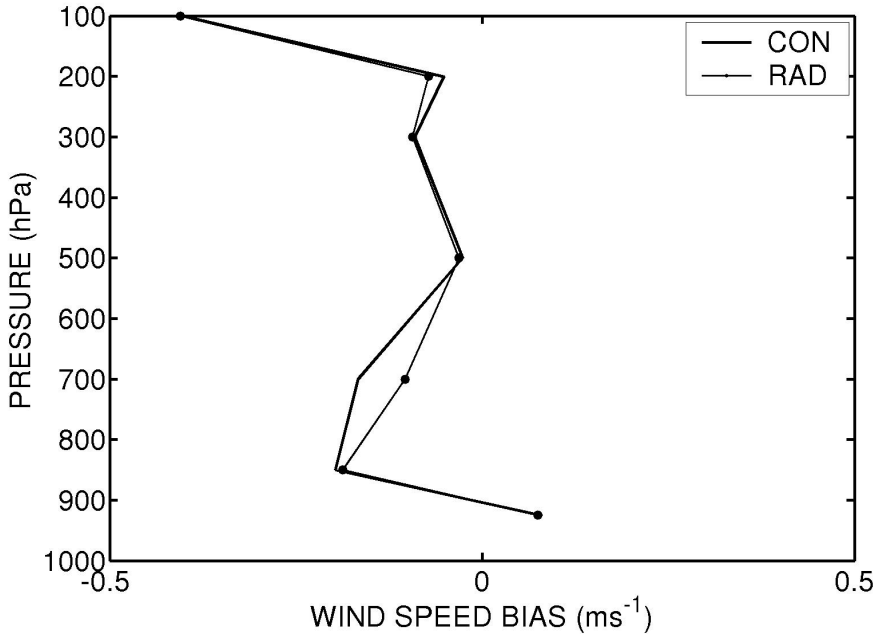


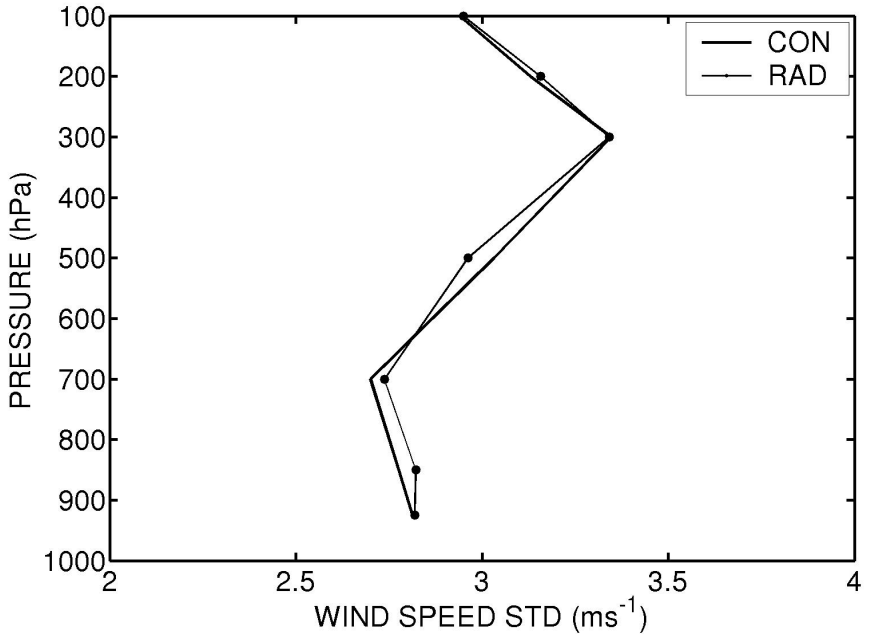
Summary of surface verification

- Verification over Finland
  - Positive impact on wind speed bias and std.
  - Positive impact on wind direction bias and std up to 18 h forecasts, negative impact for longer forecasts.
  - Impact on other verification parameters is rather neutral.
- Verification over EWGLAM stations
  - Small positive impact on wind speed bias and std.
  - Neutral impact on other verification parameters.

Verification against EWGLAM radiosoundings

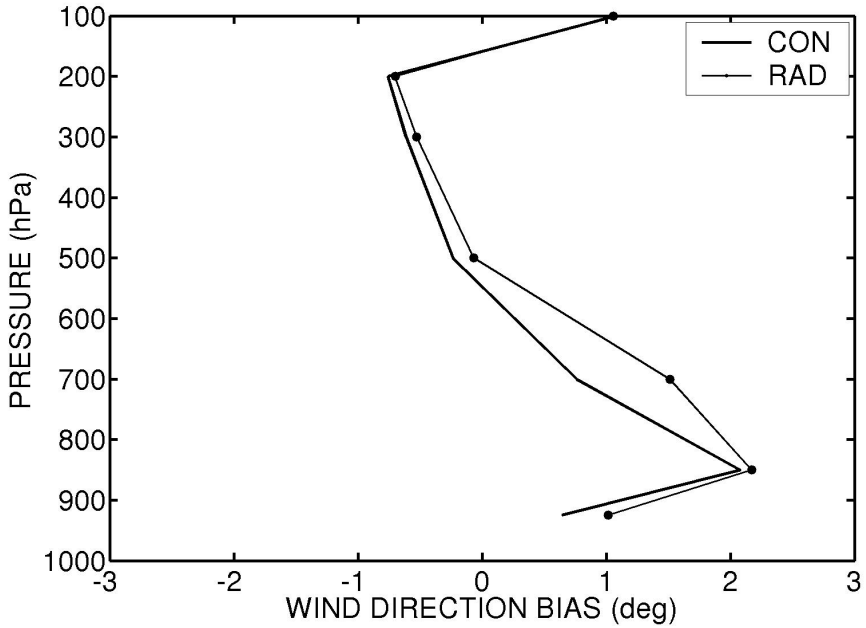
WIND SPEED, 12h forecast

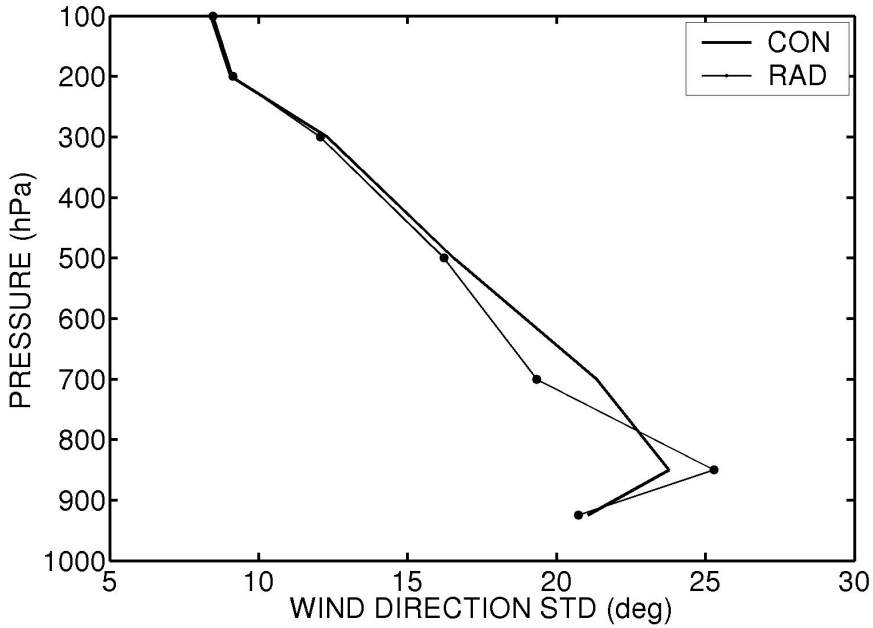




Verification against EWGLAM radiosoundings

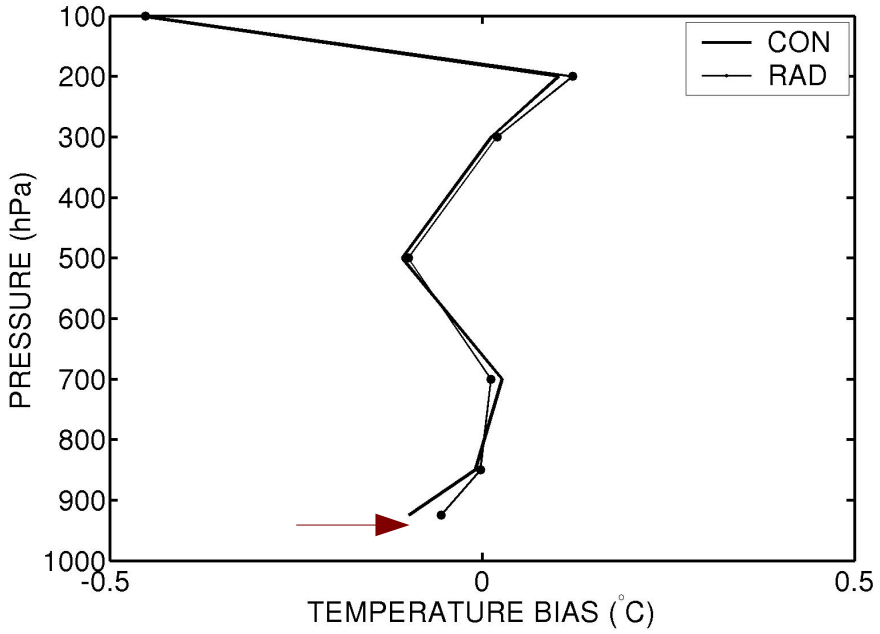
WIND DIRECTION, 12h forecast

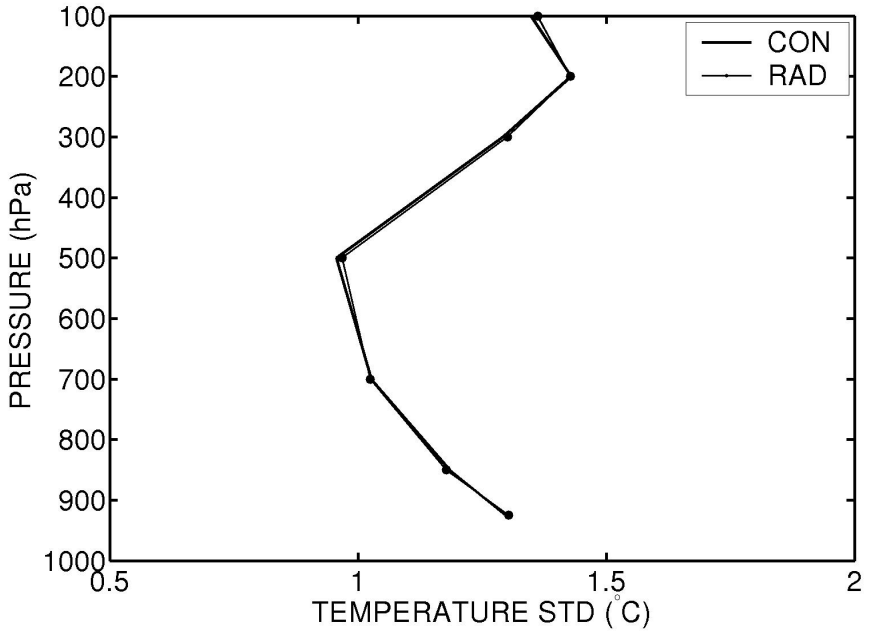




Verification against EWGLAM radiosoundings

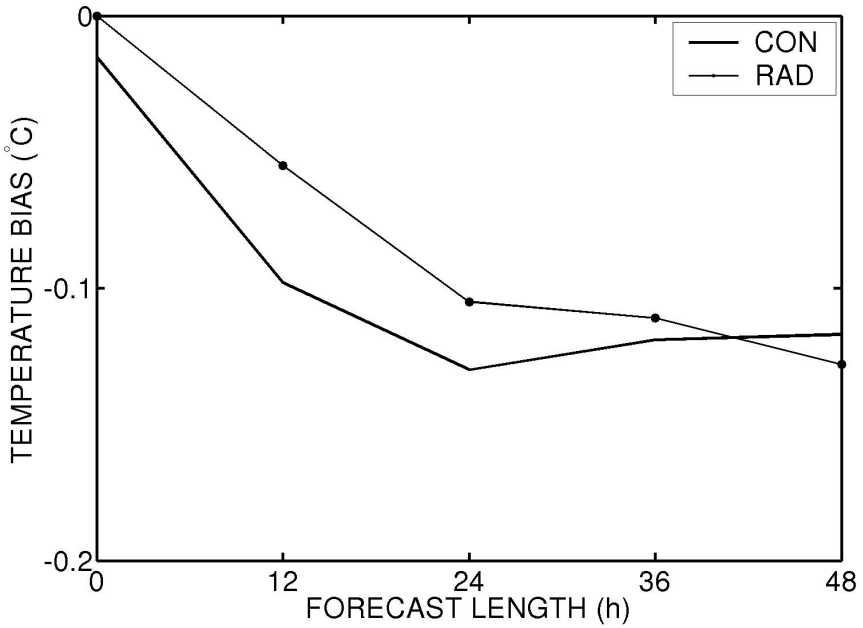
TEMPERATURE, 12h forecast

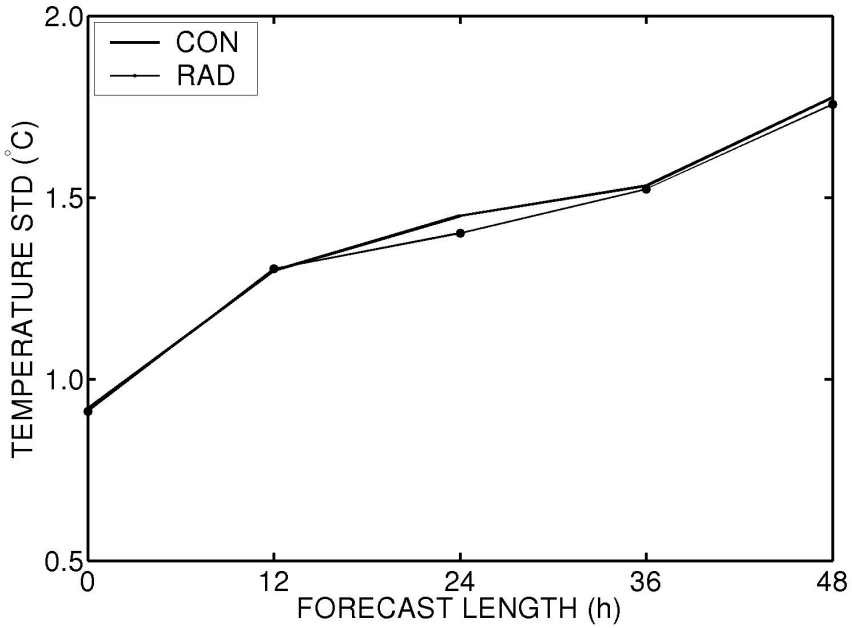




Verification against EWGLAM radiosoundings

925 hPa TEMPERATURE





Summary of radiosonde verification

- Positive impact on wind speed bias
  - up to 36h forecasts at 925 - 700 hPa levels.
- Varying impact on wind speed std
  - In 12 h fc wind speed std increases below 700 hPa and decreases above the height.
- Negative impact in wind direction bias BUT positive impact on std.
- Positive impact on temperature
  - up to 36h forecasts at 925 - 700 hPa levels.
- Other verification parameters show minor positive and minor negative impacts.

Conclusions

- HIRLAM 3D-Var is ready to exploit radar radial wind observations.
- FMI radar network has radial wind measurement task designed especially for data assimilation purposes.
- Data monitoring indicates that the quality of radial wind observations varies from day to day, in general it is relatively good.
- Impact studies show encouraging results.

Near future plans

- Repeat similar impact studies for July 2008.
- HIRLAM CIS studies with 4D-Var
  - 1.6.2007 – 15.7.2007
  - radar data from FMI and SMHI radar networks and possibly from the COPS measurement campaign.
- Operational monitoring of radial wind observations against HIRLAM MB71 runs
  - Optimization of the radial wind measurement task.
- Final goal: operational data assimilation of radar radial wind observations.