ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Towards the operational use of radar radial wind observations in HIRLAM

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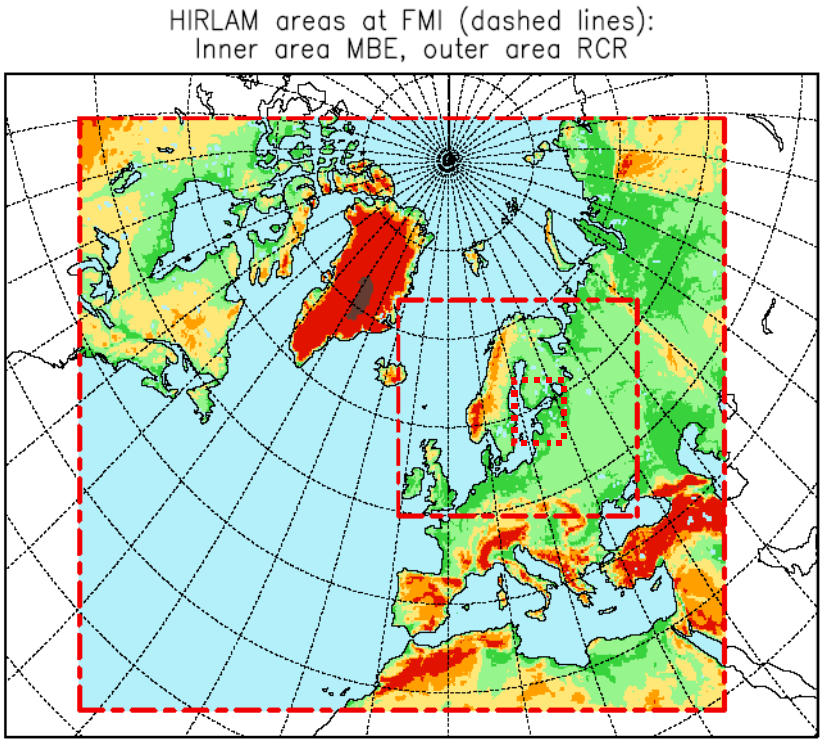
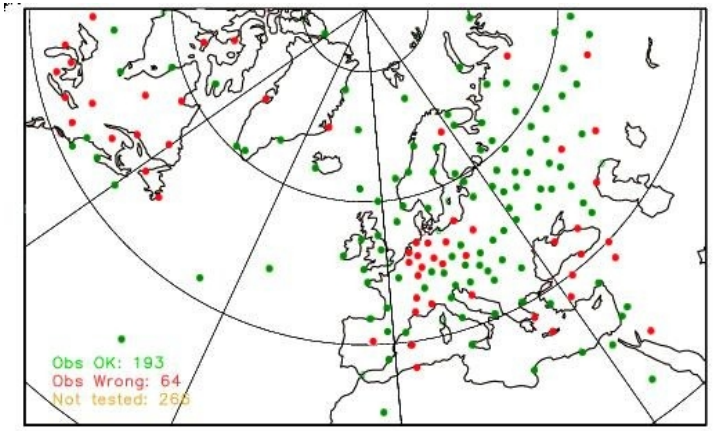
ALADIN/HIRLAM All-staff meeting

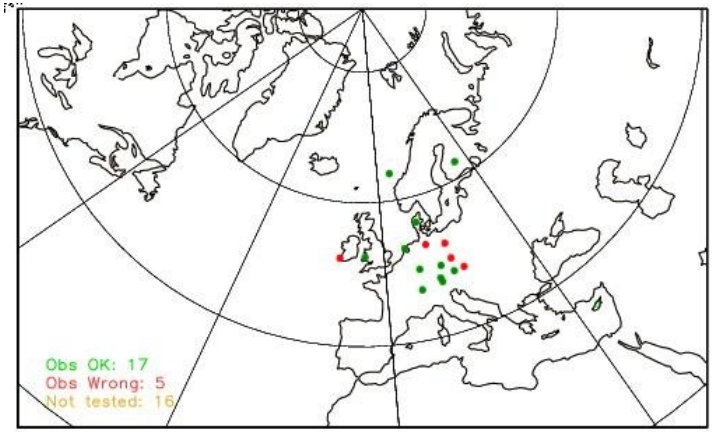
Motivation for the work

FMI model domains



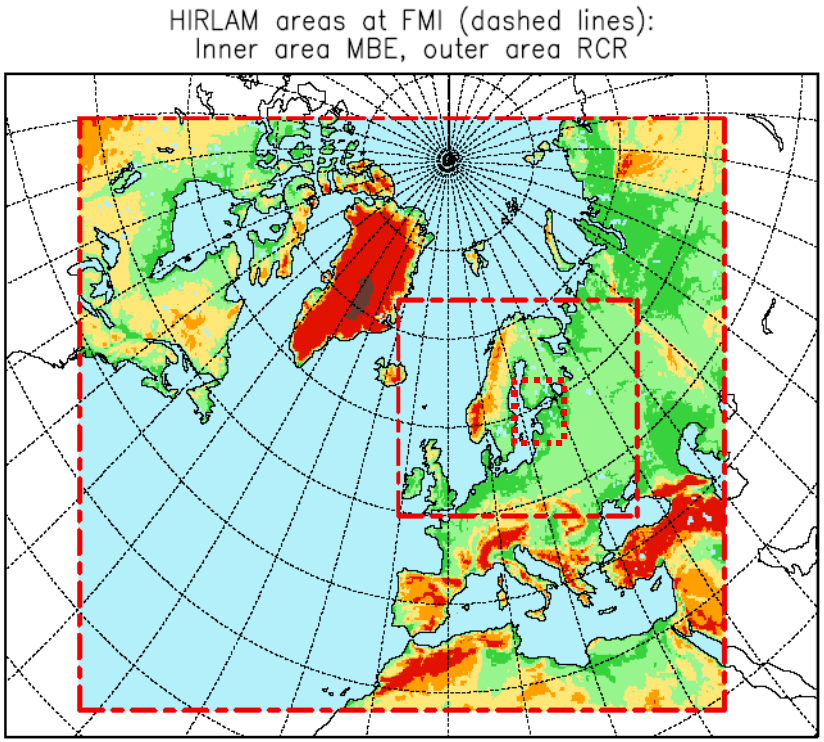
Radiosoundings 00, 06 UTC



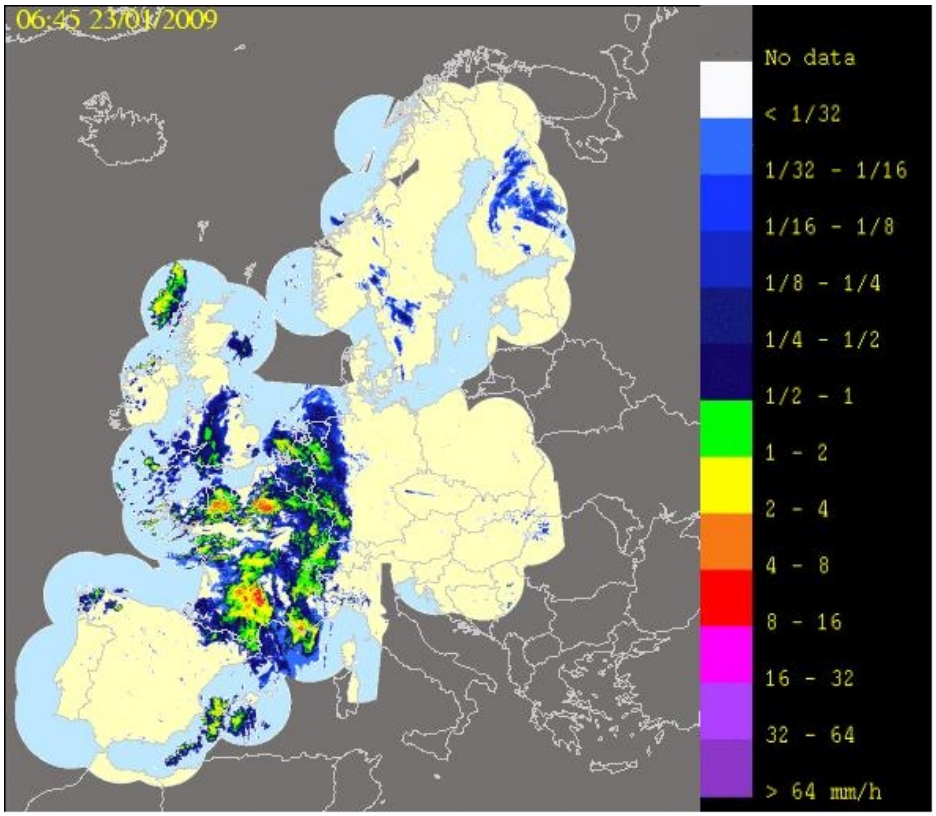


Motivation for the work

FMI model domains



European radar network

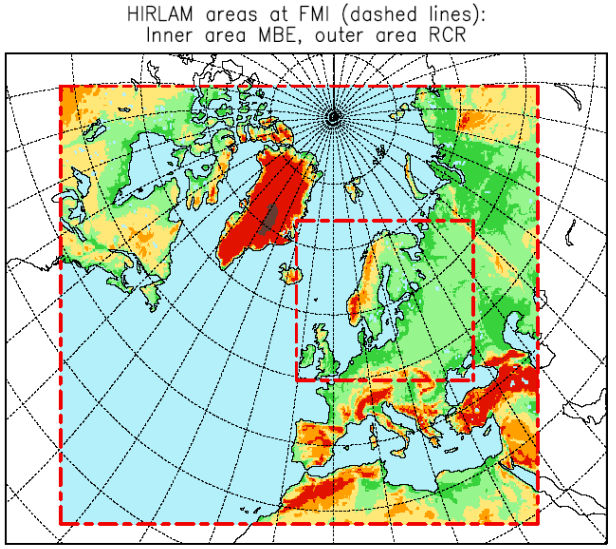


Towards the operational use of radial winds

- FMI radar network measurement tasks have been redesigned
  - Measurement task for radial wind data assimilation purposes.
- Accurate and computationally feasible observation operator is available in the HIRLAM reference system.
- HIRLAM strategy is to use super-observations, spatial averages, of the raw observations.
  - Superobservation processing is operational at FMI (since 5th March 2009).
- What is the impact?

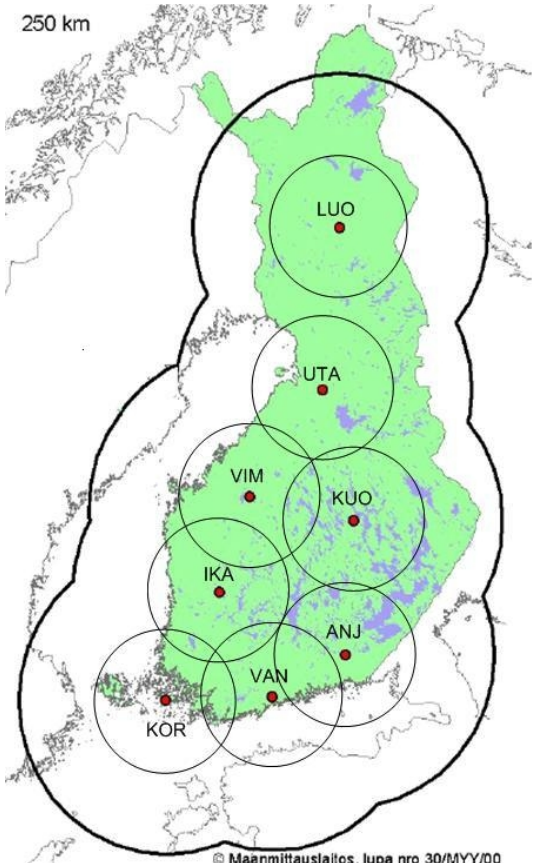
Impact studies with FMI radar data (1)

- HIRLAM version 7.1.4, analysis system 3D-Var.
  - 6 h cycling
  - 48 h forecasts
  - 7.5 km, 60 levels
- 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°



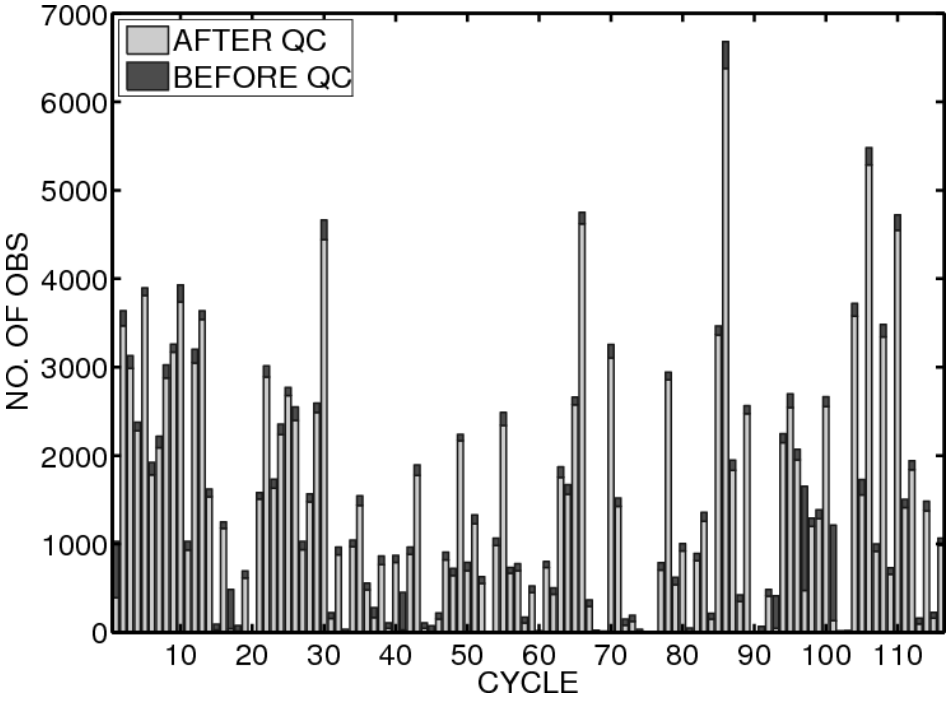
Quality control

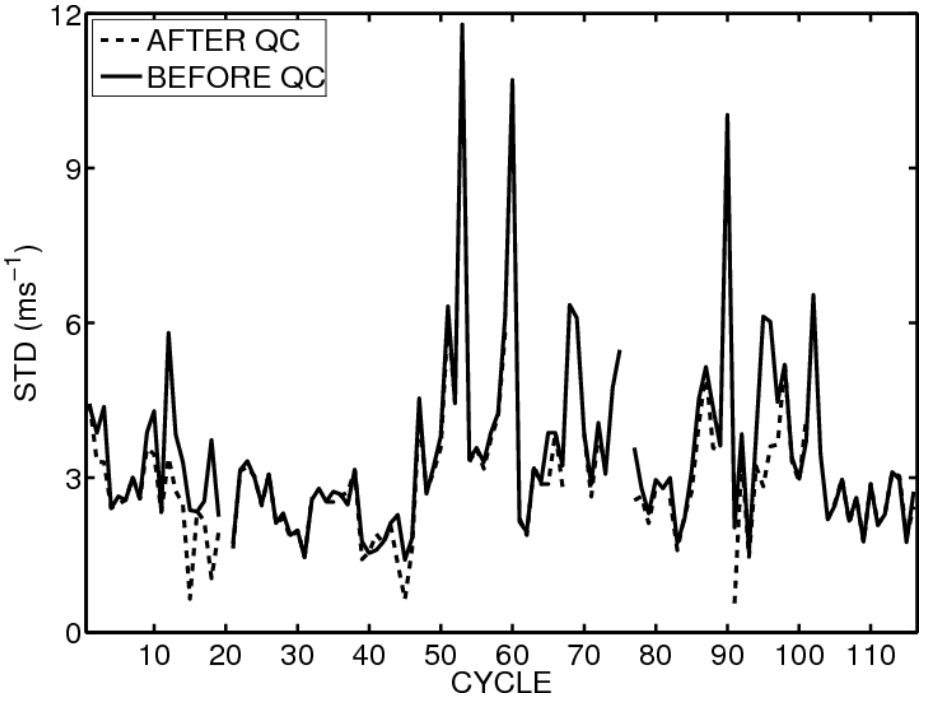
- Screening
  - Internal variability of an SO < 10 m^2s^{-2}
- BgQC
  - Observations are tested against model background, subjective rejection limit L=6.

$$\frac{(H[\mathbf{x_{b,i}}] - \mathbf{y_i})^2}{\sigma_{b,i}^2 + \sigma_{o,i}^2} \leq L,$$

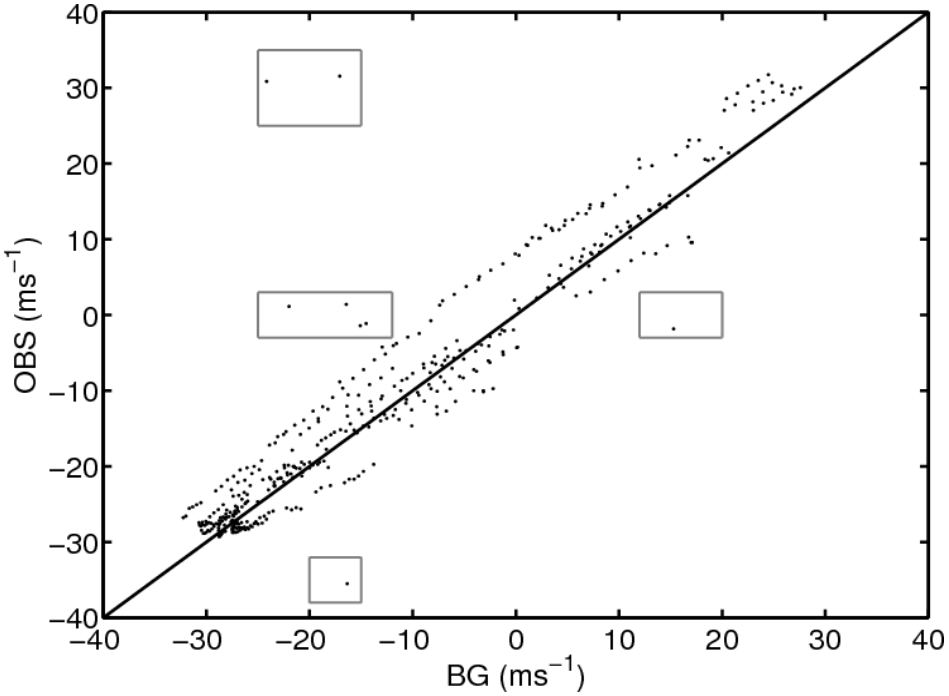
- VarQC
  - Accounts for the non-Gaussian observation errors.

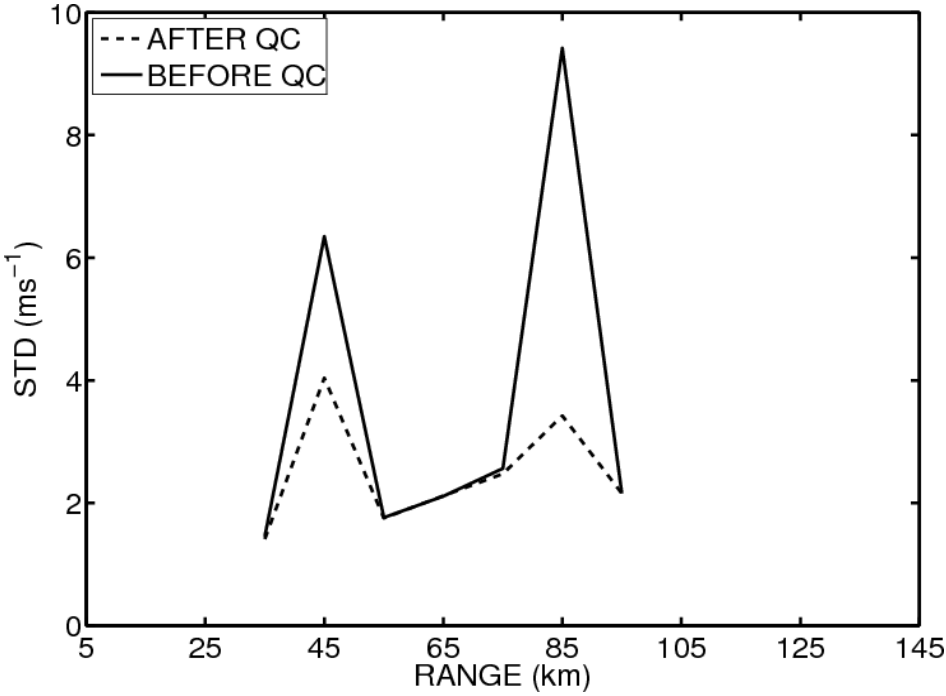
Radar data monitoring



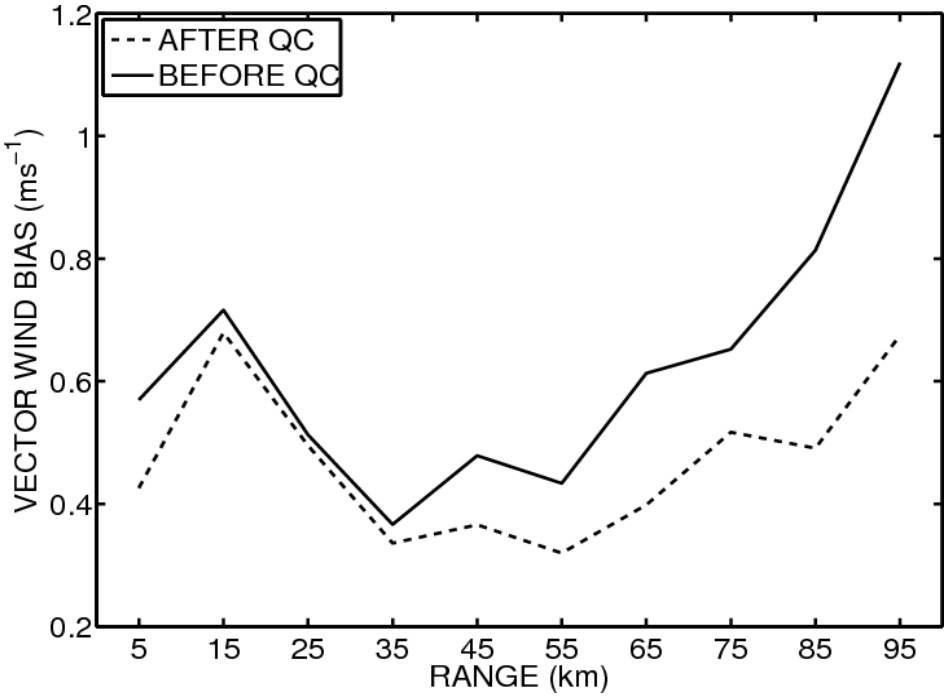


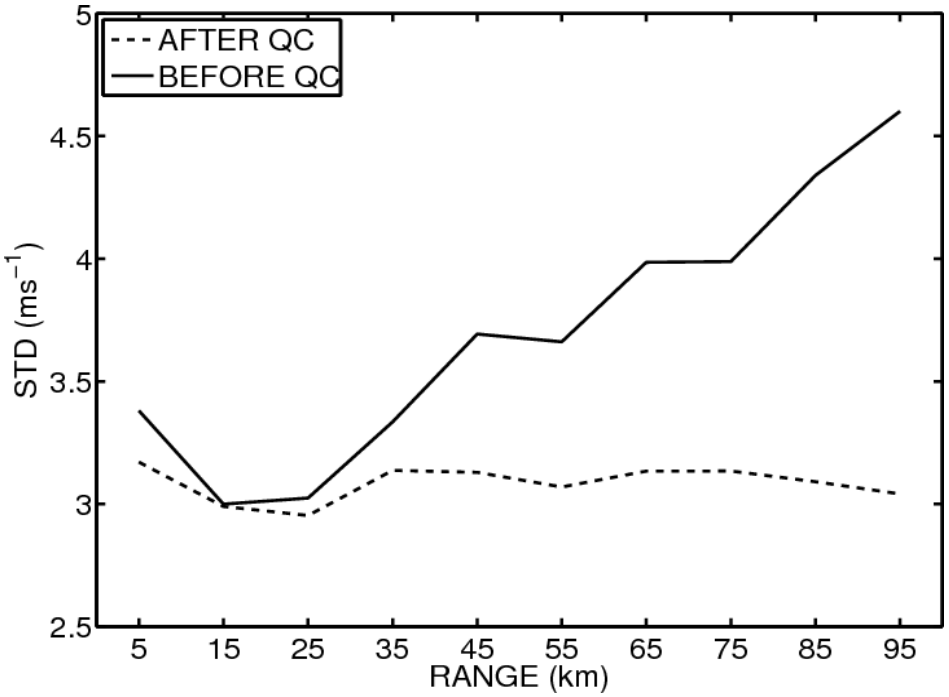
Cycle 14, 4th Feb 2008, 06 UTC





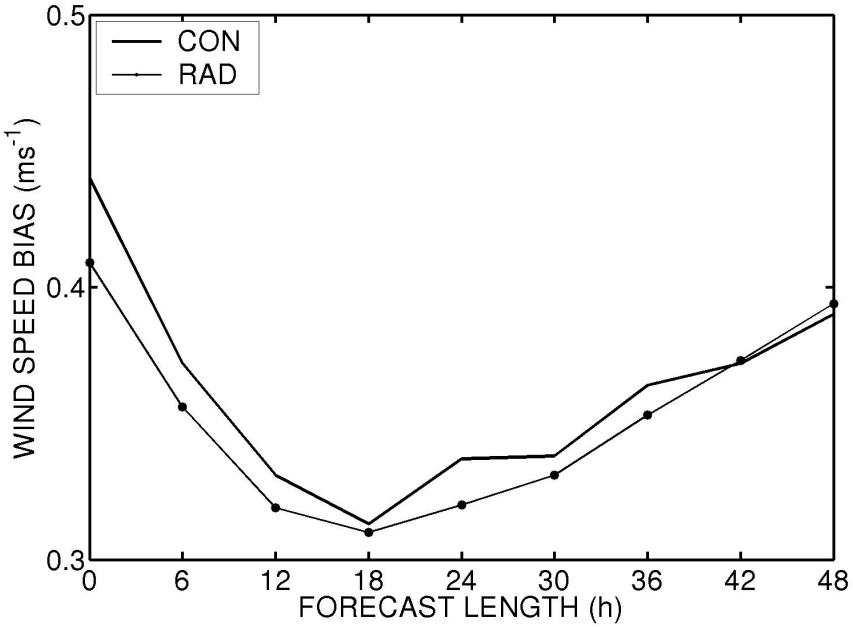
Monthly statistics

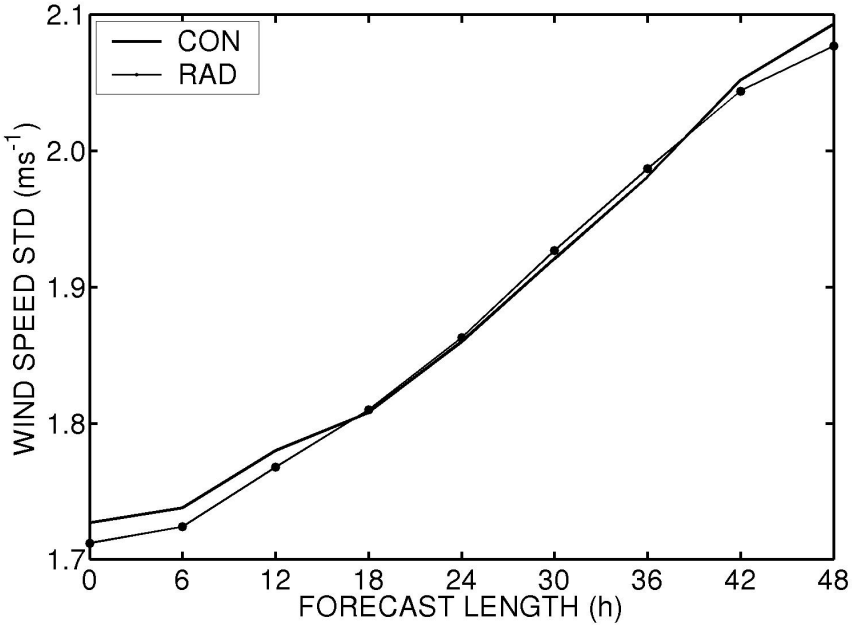




Verification against surface observations over Finland

WIND SPEED



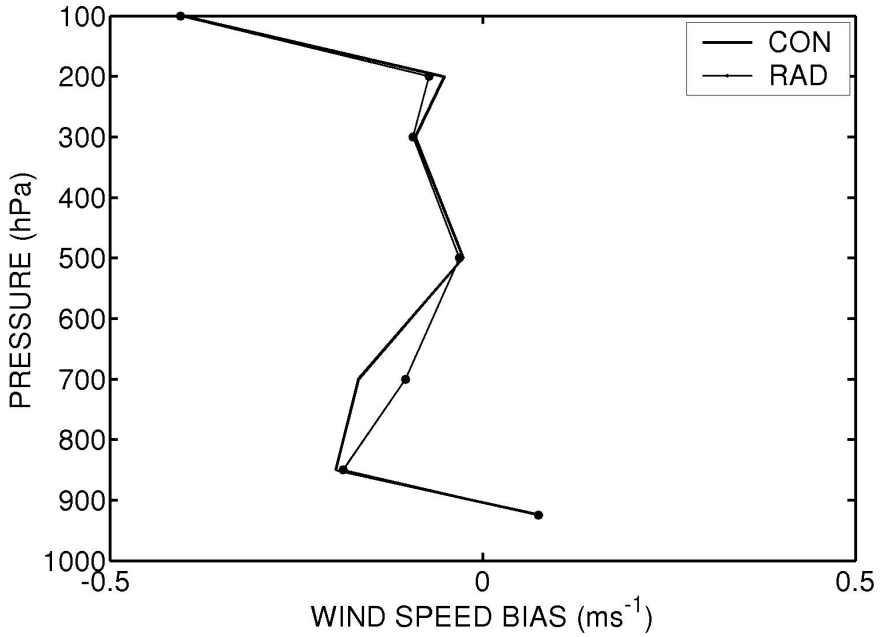


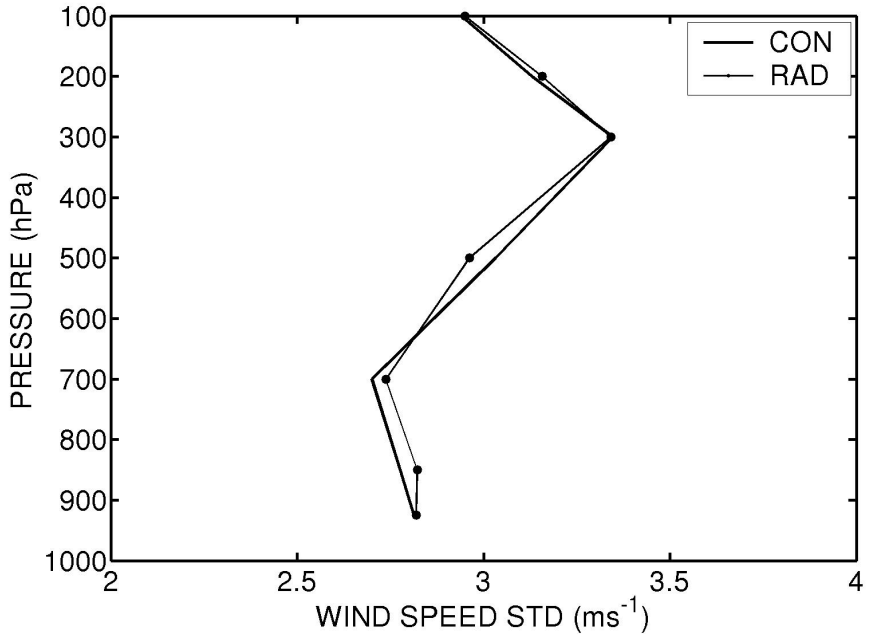
Summary of surface verification

- 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

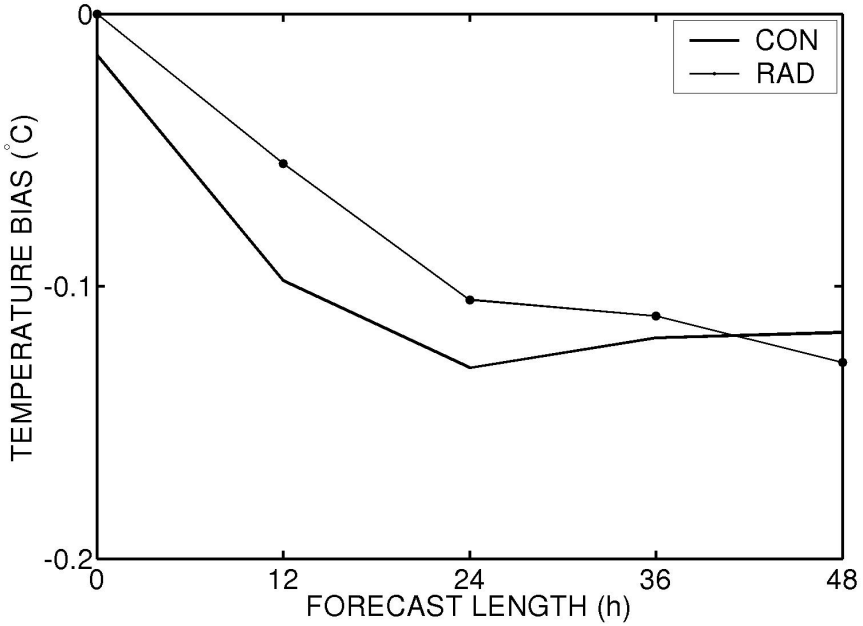
WIND SPEED, 12h forecast

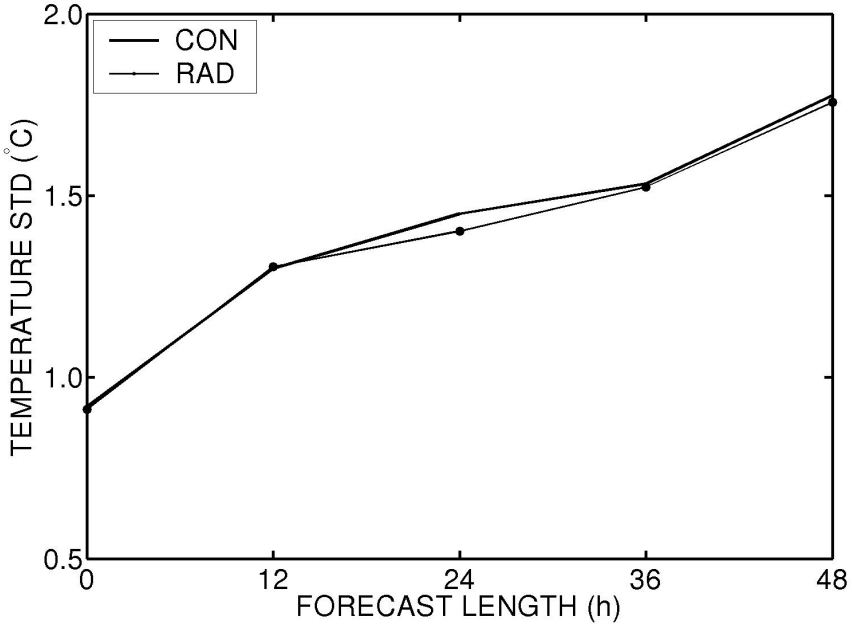




Verification against EWGLAM radiosoundings

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 neutral 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.
- Quality of the radial wind observations varies from day to day, in general it is relatively good.
- HIRLAM QC procedures effectively reject erroneous observations.
- Impact studies show encouraging results.

Ongoing work and near future plans

- Repeat similar impact studies for June 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.