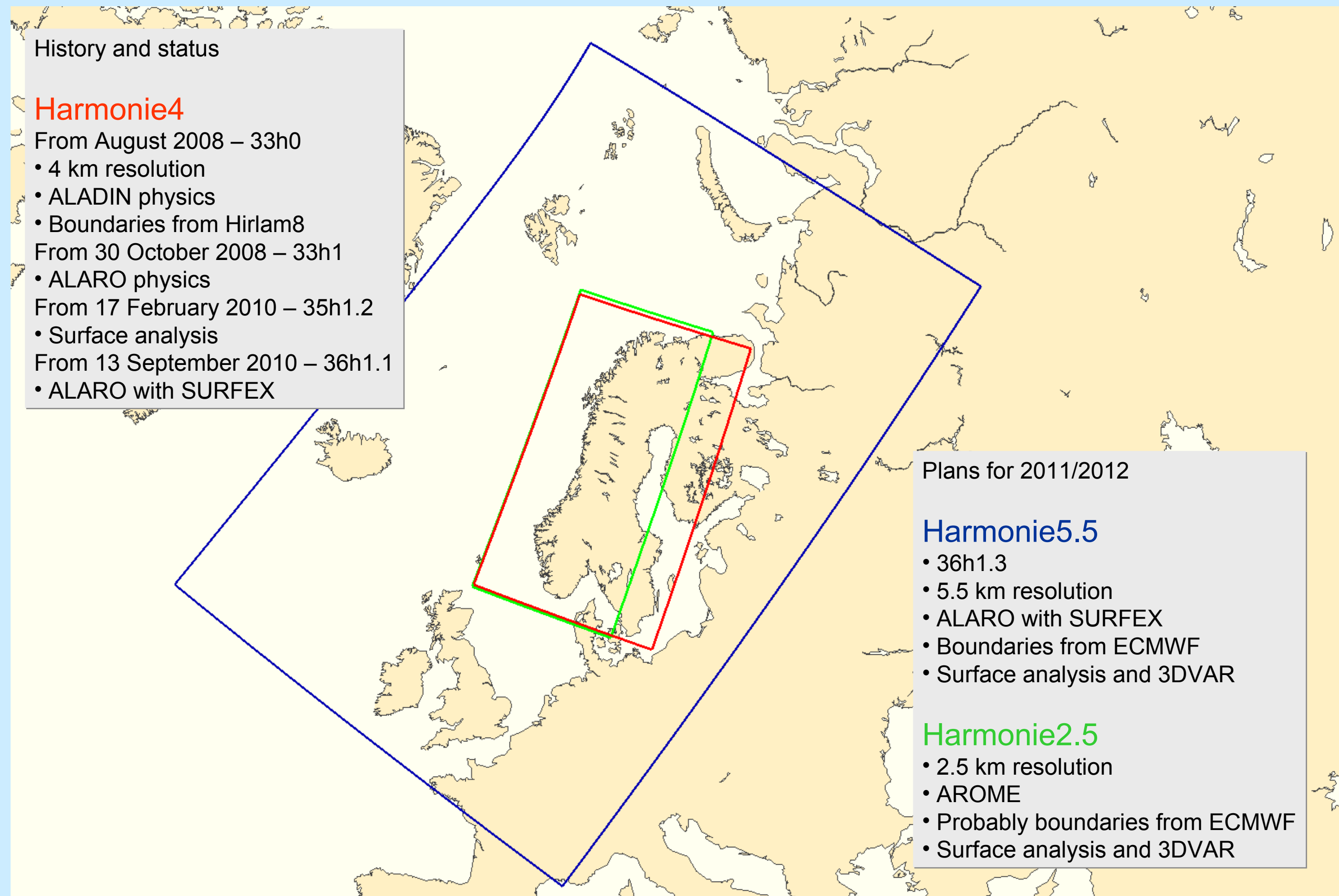
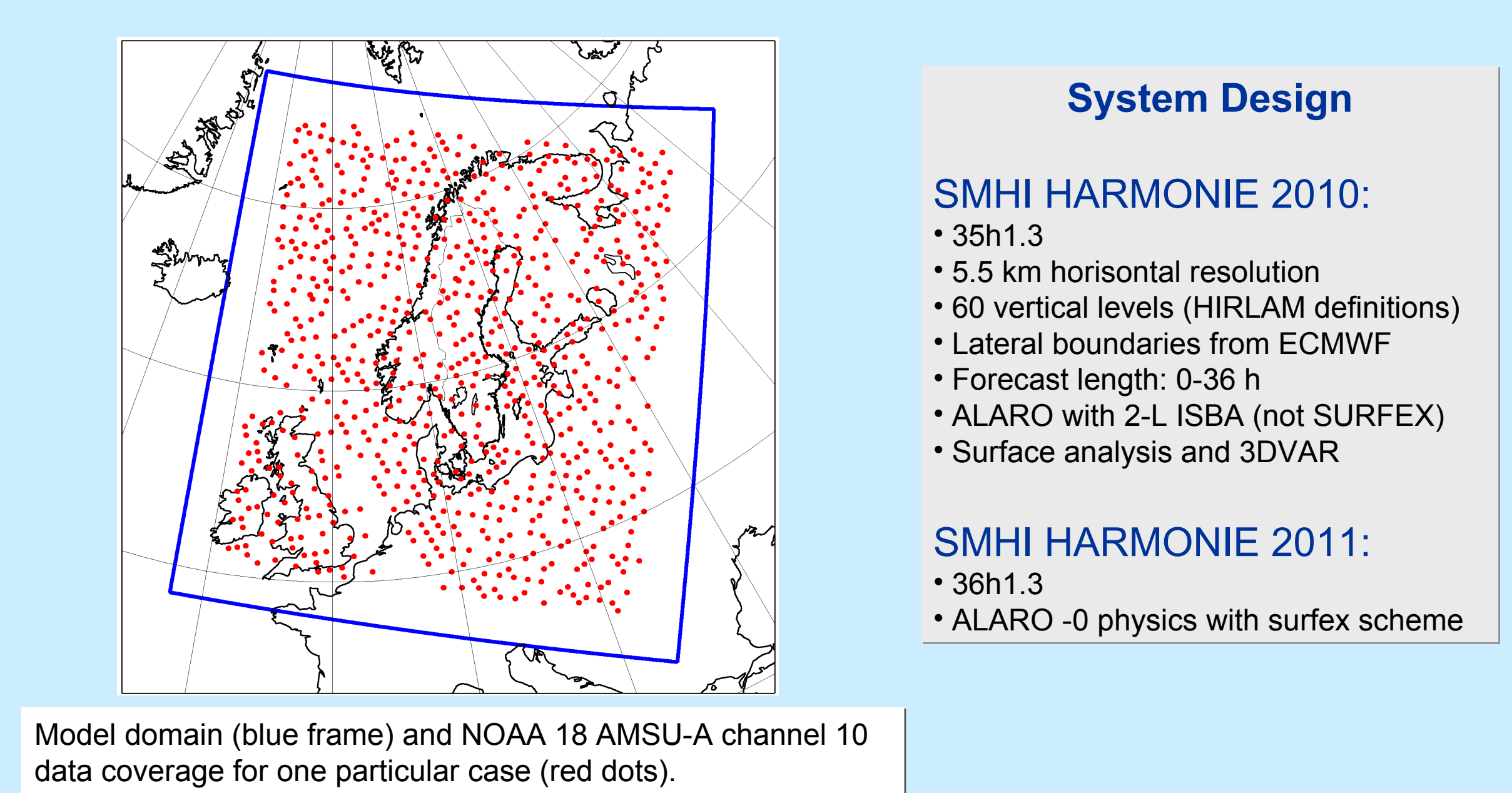


Ulf Andrae (SMHI), Trygve Aspelien (met.no), Lisa Bengtsson-Sedlar (SMHI), Mariken Homleid (met.no), Magnus Lindskog (SMHI) and Ole Vignes (met.no)

Daily ALARO runs in Norway



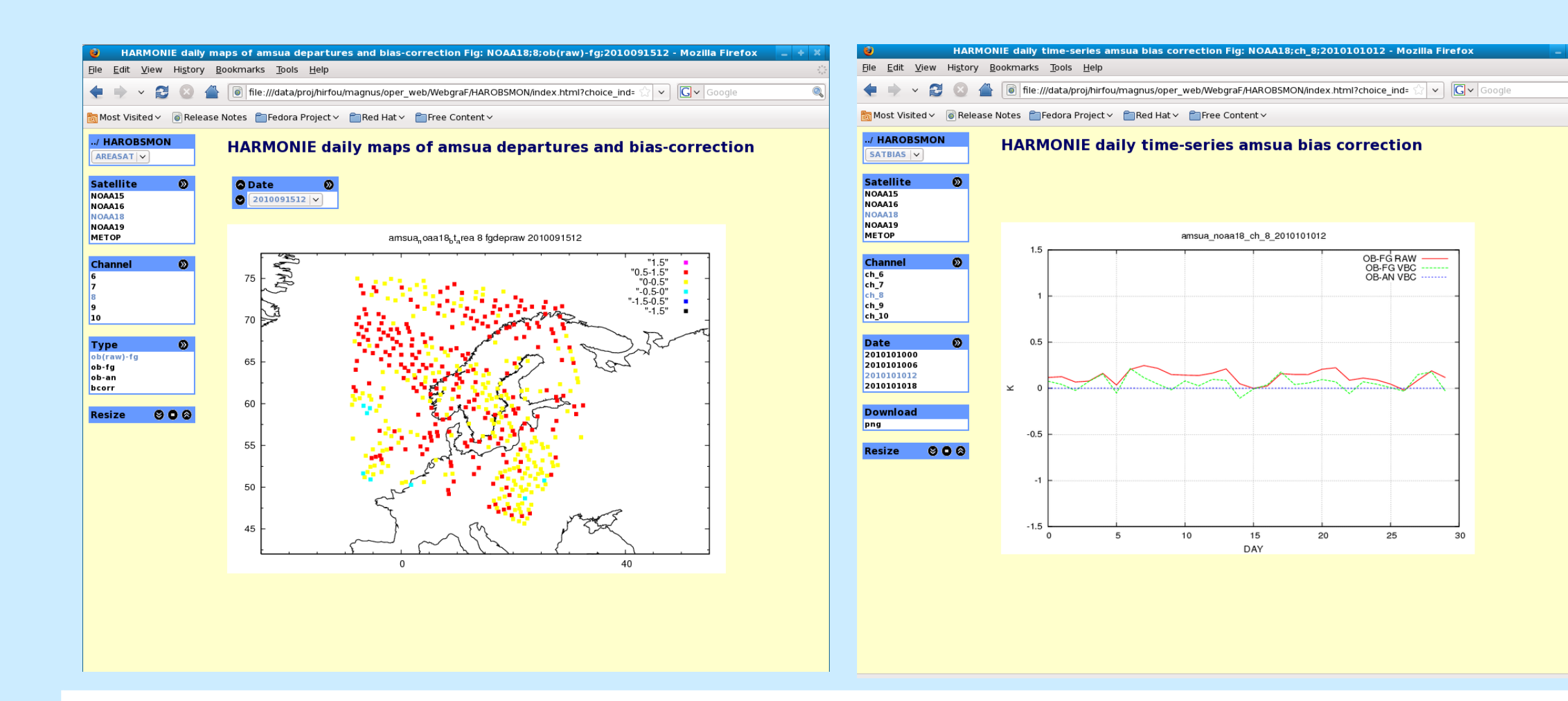
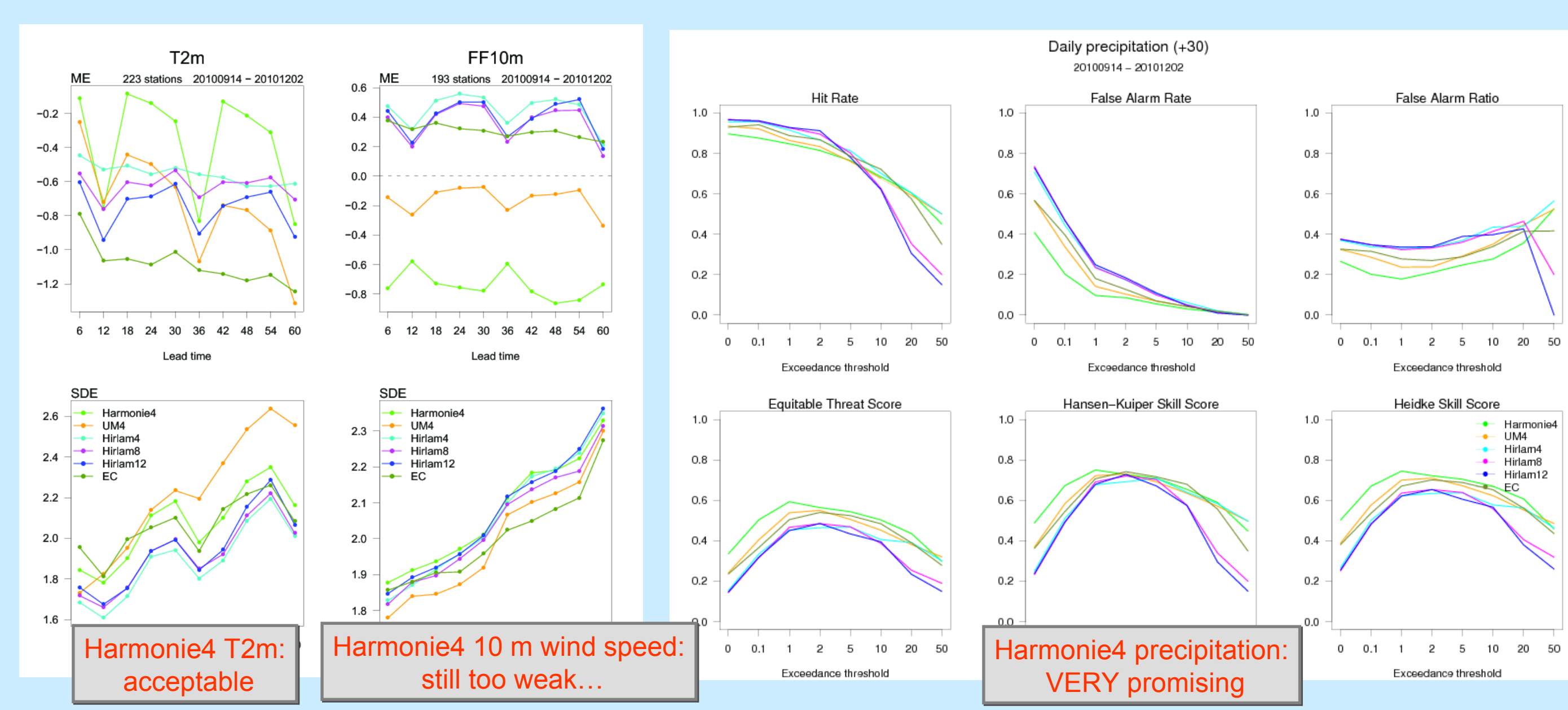
Daily ALARO runs in Sweden



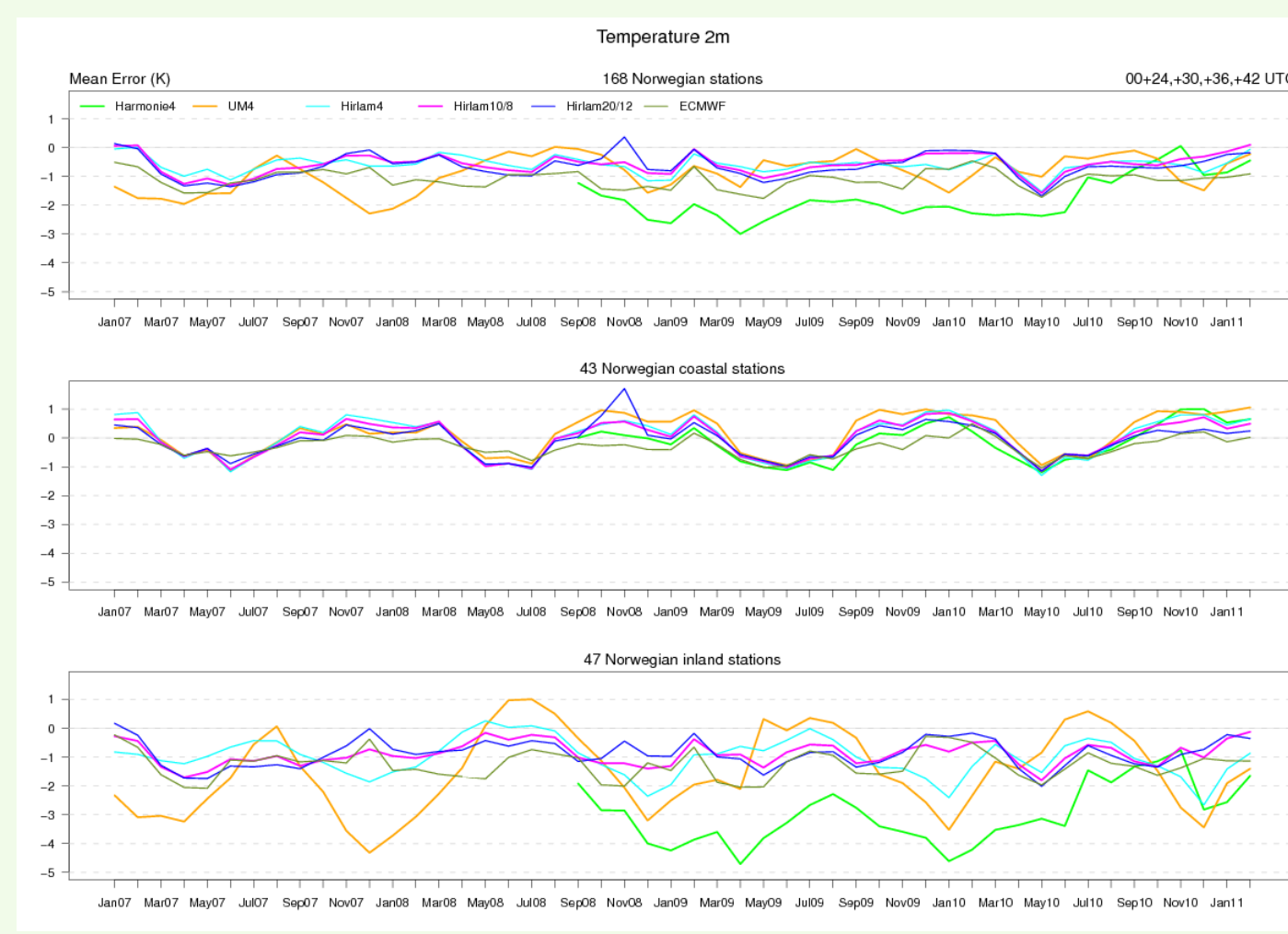
**SMHI HARMONIE 3DVAR**

- 6 h data assimilation cycle.
- Background error statistics from differences of downscaled forecasts. These are downscaled from an ECMWF data assimilation ensemble experiment.
- Conventional types of observations and ATOVS AMSU-A channels 6-10.
- Variational Bias Correction.
- Monitoring System for satellite data to be introduced to HARMONIE system.
- No observations closer to lateral boundary than 250 kms are assimilated.
- Future plans include assimilation of ATOVS AMSU-AMHS, radar radial winds, and GPS ZTD.

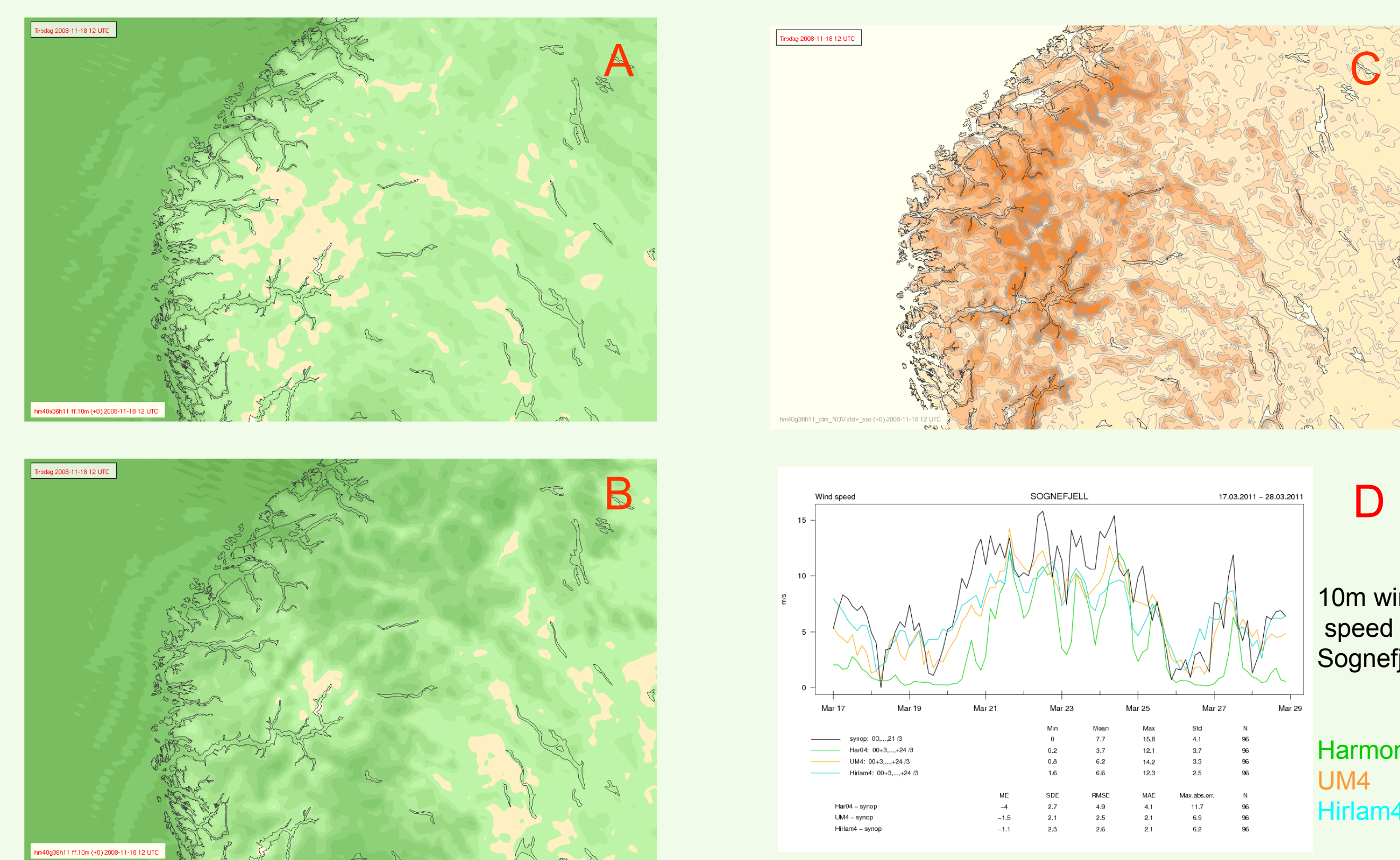
Summary verification of Harmonie4, UM4, Hirlam4/8/12 and ECMWF at Norwegian synop stations Autumn 2010



Experiences over Norway with Harmonie4 - 36h1.1



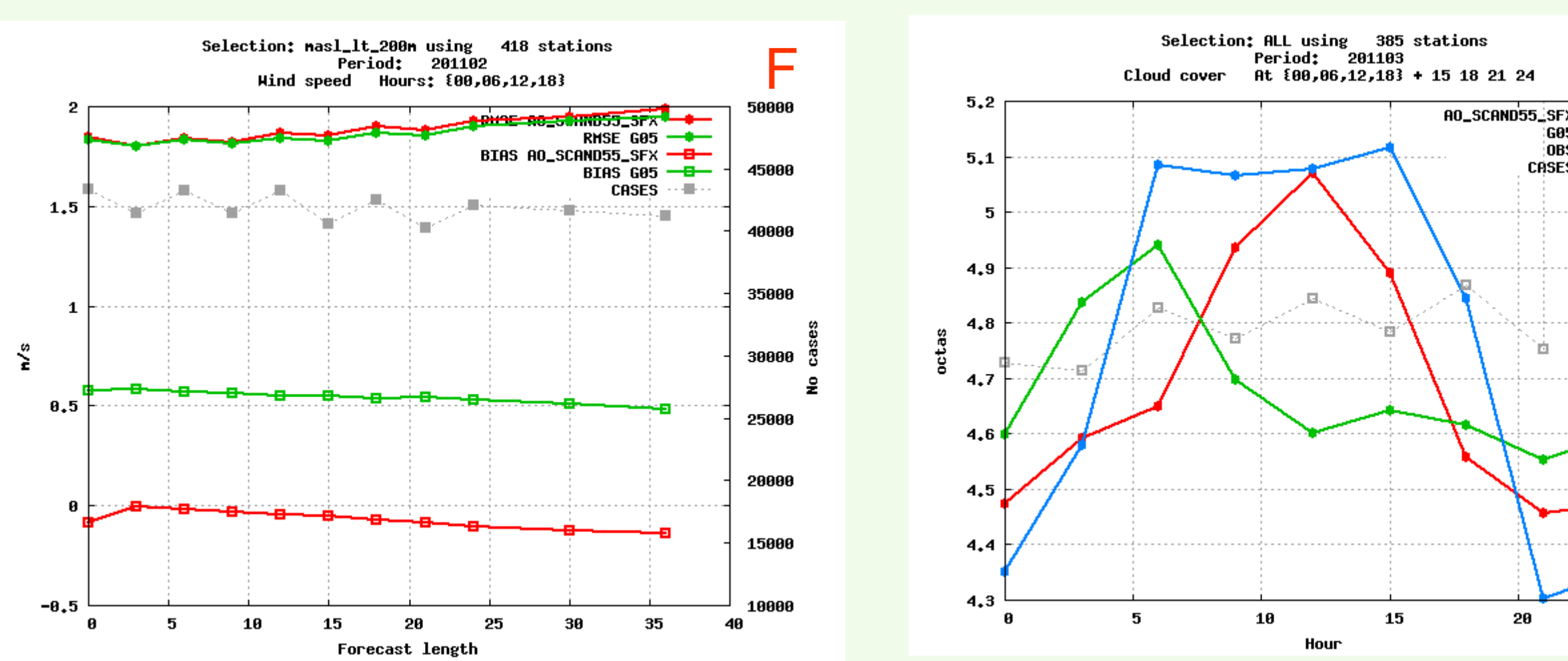
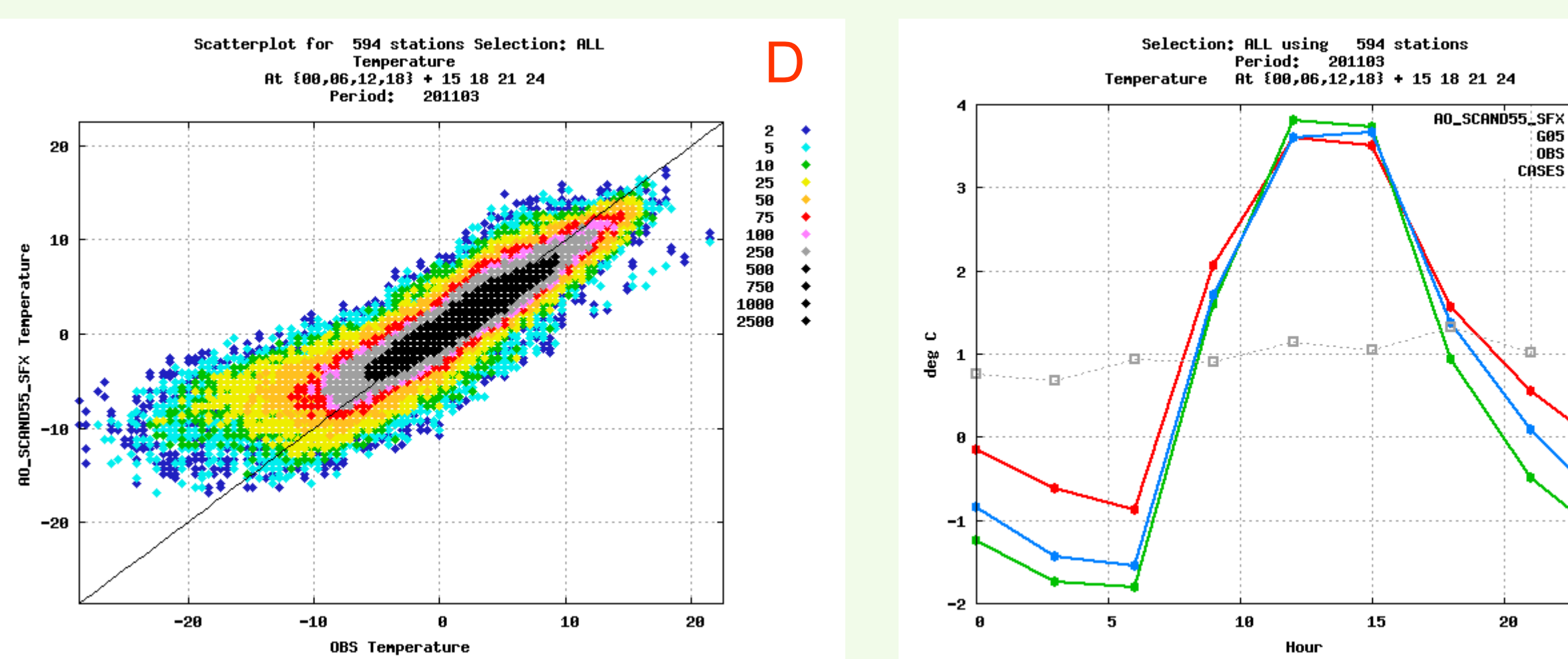
- Previous versions of Harmonie had large and systematic errors related to the physics, e.g.:
  - very low surface temperatures in winter
  - too low wind speed over land
- 36h1.1 with SURFEX from Seep 2010 shows significant improvements which can be related to
  - tiling (nature/sea/lake/town)
  - canopy module (multilayer surface scheme)
  - increased wind speed (from A to B) with reduced drag as a function of st.dev. of Small Scale Orography (C), but still too low (D)
  - mean orography instead of envelope



2011 experiences at SMHI with 36h1.3

- ALARO still has problems predicting the low temperatures (D) The daily T2M cycle shows good performance during daytime (D). Recent sensitivity tests indicates that a better surface assimilation may help.
- Very good wind speed over low land (F), still underestimation over high land (not shown)
- Better daily cycle for clouds (G) and better precipitation (not shown)
- Comparison against radio sondes shows similar performance for ALARO and HIRLAM

Red: ALARO 5.5km, Green: HIRLAM 5.5km, blue observations



Future work

- Improved treatment of snow and lakes
- Implement and evaluate EKF for surface assimilation
- Improved observation usage
- Look into reasons for poor 10 meter wind scores in high terrain
- SMHI and met.no plans for a joint operational NWP suite on the 2-5km scale in 2014. Integration and preparations starts during autumn 2011.

References

Le Moigne, P., 2009: SURFEX OFF-LINE Scientific Documentation and User's Guide, available at <http://www.cnrm.meteo.fr/surfex>

Taillefer, F., 2002: CANARI – Technical Documentation – Based on ARPEGE cycle CY25T1 (AL25T1 for ALADIN), available at <http://www.cnrm.meteo.fr/aladin/>