SMHI NWP modelling – operations, development and research 2014/5

Main Operational runs

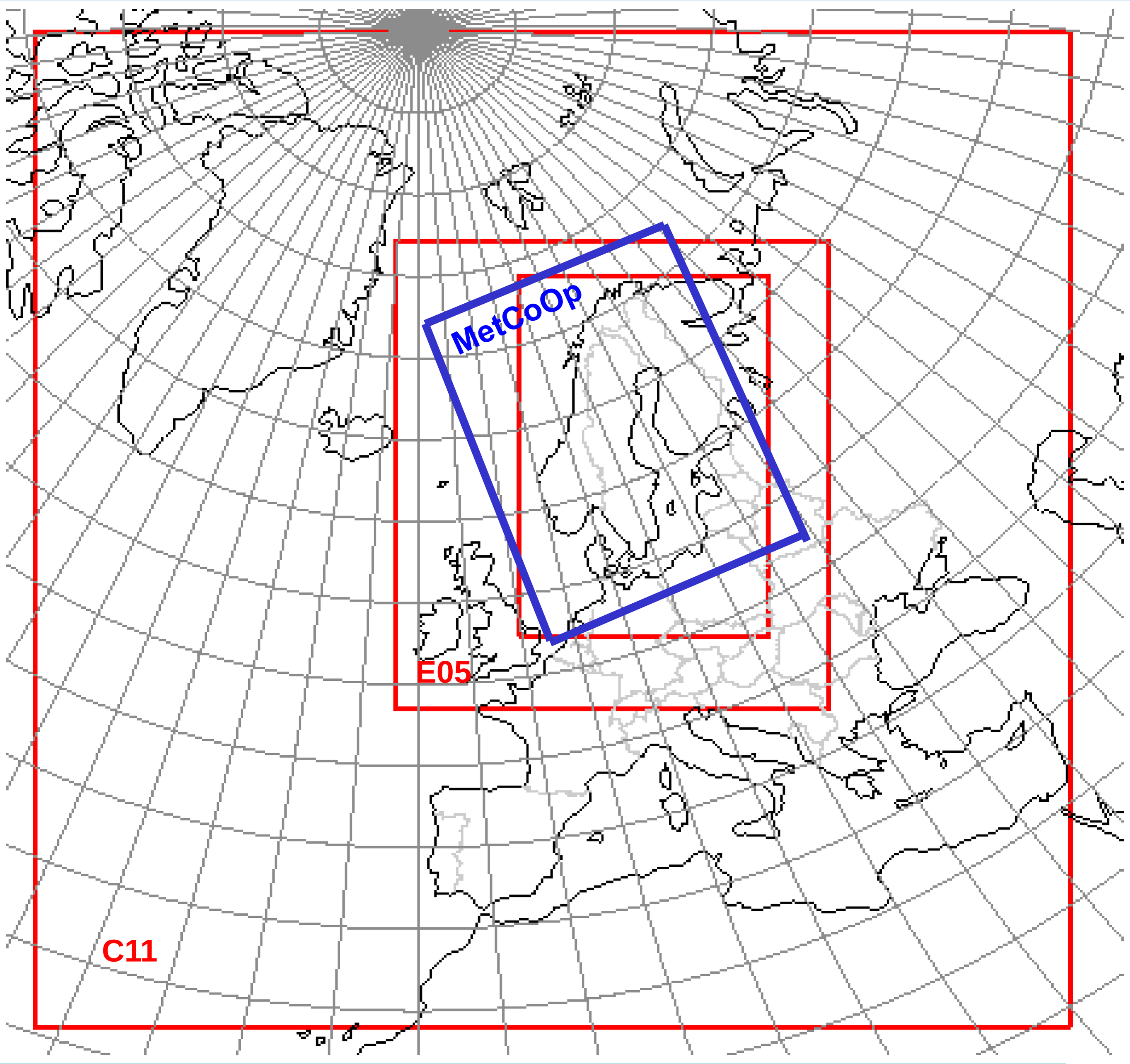
4 analyses and forecasts per day. 00, 06, 12, 18

HARMONIE Arome, 2.5km –
3D-VAR 3h-RUC +60h
HARMONIE-RCR for cy38h1

HIRLAM C 11km –
4D-VAR 2 loop LSMIX +60 h
2 hours data cut-off

HIRLAM E 5 km –
3D-VAR no LSMIX+48 hours
1 hour 20 min data cut-off

1 hourly ECMWF boundaries
ECMWF GTS -> BUFR obs preprocessing
SYNOP,SHIP,TEMP,PILOT,
BUOY,AIREP,AMDAR
BUFR AMDAR
ATOVS AMSU-A radiances – EARS
Radar reflectivities and winds passive in HARMONIE



Name	Model	gridpoints	levels	timestep	Assimilation	Boundaries
C11	Hirlam 7.1.2	606x606	60	300 s	4D-Var	ECMWF
E05	Hirlam 7.3	506x574	65	150 s	3D-Var	HIRLAM
MetCoOp AM25	HARMONIE y38h1.1	750x960	65	60 s	3D-Var 3h-RUC	ECMWF

MetCoOp - A joint Swedish-Norwegian NWP production

HarmonEPS status in MetCoOp
- Cycle 40.
- AROME-MetCoOp domain @2.5 km
- AROME and ALARO control run + 8 AROME members.
- Lead times: control runs: +66hr, members: +36hr.
- Perturbations: IC and LBC from SLAF (or ECMWF-ENS),
- perturbations of physics
- Cut-off: 1hr 15min. Delivery: 2hr 15min.
- Cycling, members: 6 hourly, control runs: 3 hourly.
- Experiment for this test period is running now on Frost and
- Vilje. Evaluate this test period.
- Good stability and quality before distributed. First impression important.
- Daily test runs autumn 2015, operational runs 2016.

New HPC resource at SMHI: Frost
- 5,984 core cluster, Intel Xeon E5-2640v3 processors at 2.6 GHz
- Delivered by ClusterVision

HARMONIE-Climate – Combining NWP and climate modelling

First HARMONIE-Climate training was held on September 2015. Now we can run AROME and ALARO in multi-year climate mode within the HARMONIE system. I.e. downscaling of boundary conditions without data assimilation. This offers a new HARMONIE-tool for model development and sensitivity studies. More information can be found here: https://hirlam.org/trac/wiki/HarmonieClimate

Stochastic parameterization of cumulus convection in a meso-scale ensemble prediction system.

Lisa Bengtsson, Heiner Körnich (SMHI)

A stochastic parameterization for deep convection, based on cellular automata, has been evaluated in the high resolution (2.5 km) ensemble prediction system HarmonEPS. It was studied whether such a stochastic parameterization, whilst implemented in a deterministic forecast model, can have an impact on the performance of the uncertainty estimates given by an ensemble prediction system. Various feedback mechanisms in the parameterization were studied with respect to ensemble spread and skill, both in sub-grid and resolved precipitation fields. It was found that the stochastic parameterization in general improves the model skill, by reducing a positive bias in precipitation. This reduction in bias however led to a reduction in ensemble spread of precipitation. Overall, scores that measures the accuracy and reliability of probabilistic predictions indicate that the net impact (improved skill, degraded spread) of the ensemble prediction system is improved with the stochastic parameterization.

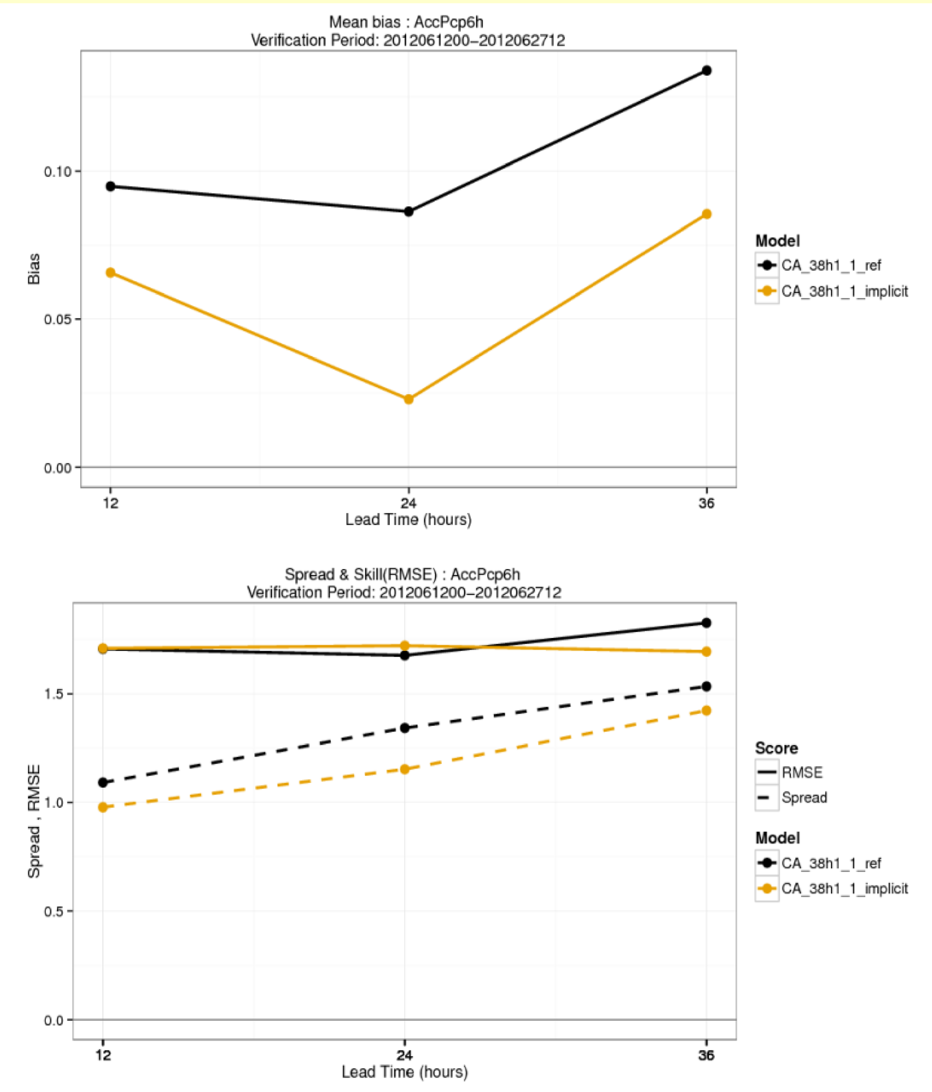
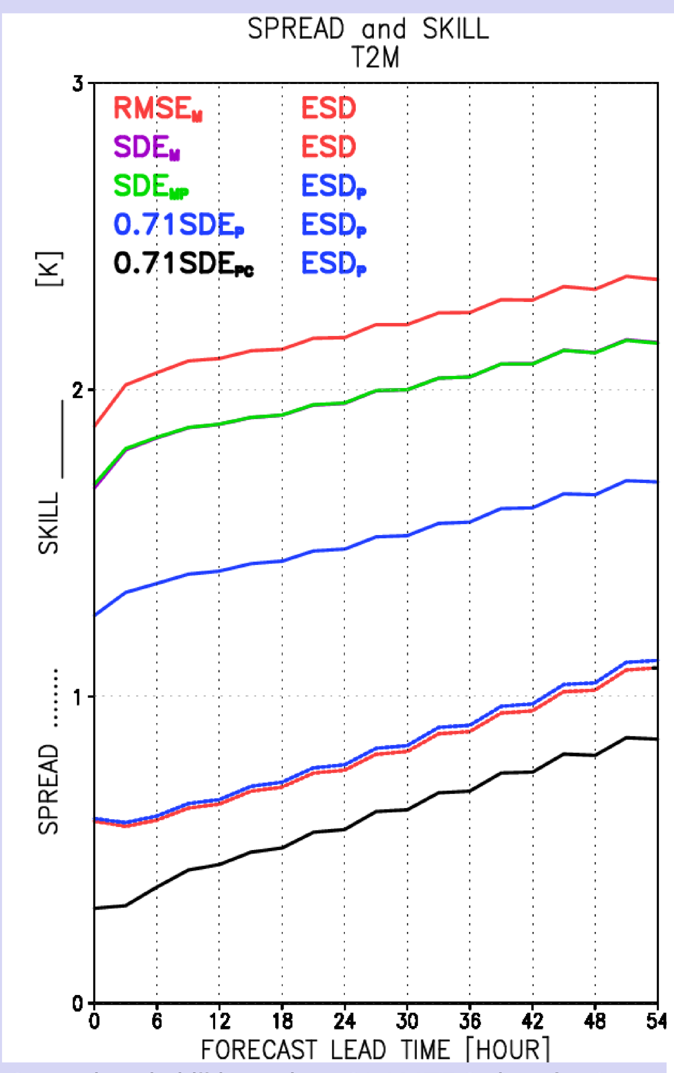


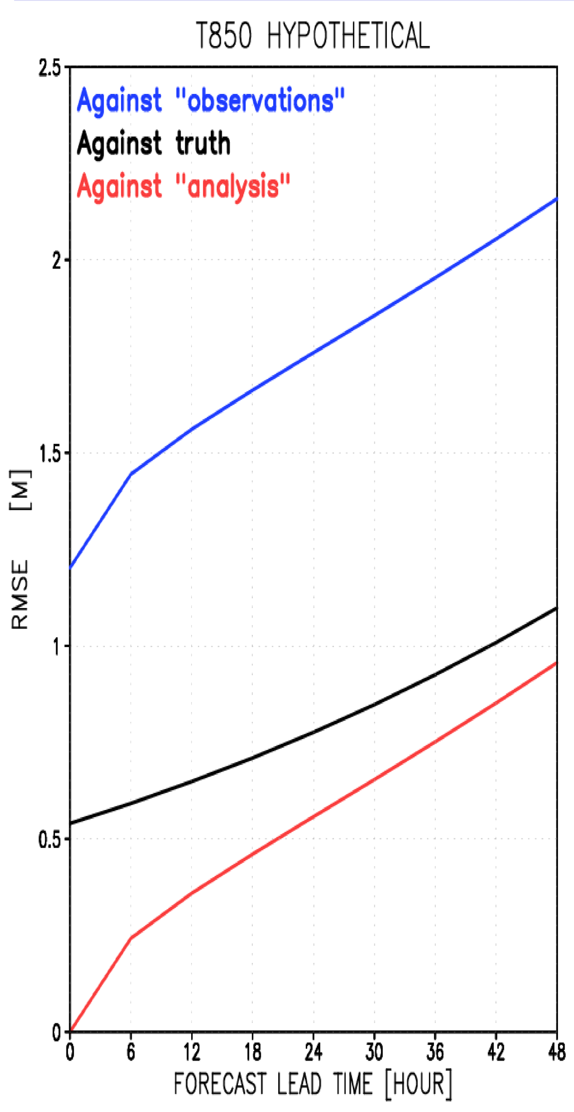
Figure 1: Mean Bias and Spread-Skill for the reference experiment in black, and the CA-implicit experiment in orange

UUI Spread Skill relationship

Åke Johansson (SMHI)



Spread and skill based on GLAMEPS data for 2m-temperature. Root mean square error $RMSE_M$ of ensemble mean, standard deviation error SDE_M of ensemble mean, standard deviation error SDE_{MP} of ensemble mean based on perturbed members only, standard deviation error SDE_P of perturbed members, and the latter for Desroziers-corrected errors SDE_{PC}. Ensemble spread with all members ESD and with perturbed members only ESD_P



Given a hypothetical true error evolution (black) for 850hPa-temperature RMSE, verification statistics against observations (blue) and analysis (red) are derived based on Desroziers et al. (2005).

Problem: The commonly used spread-skill relationship often show an apparent under-dispersion for ensemble forecasting systems.

Method: To use consistent statistical methods for the spread-skill relationship, i.e. **U**-Statistics on members that are **U**-unbiased and statistically **I**dentical. Furthermore, the observation error is taken into account in the verification following Desroziers et al. (2005).

Results:
The **UUI** spread-skill relationship with the corrected verification demonstrates that the EPS is actually slightly over-dispersive instead of severly under-dispersive. The corrections result from:

1) Mean skill of perturbed members are calculated instead of skill of ensemble mean
2) Removal of bias in skill estimates
3) Use of only perturbed members
4) Corrected verification against observations

Reference: Johansson, Å., 2015:…

Advances with Radar assimilation

Martin Ridal

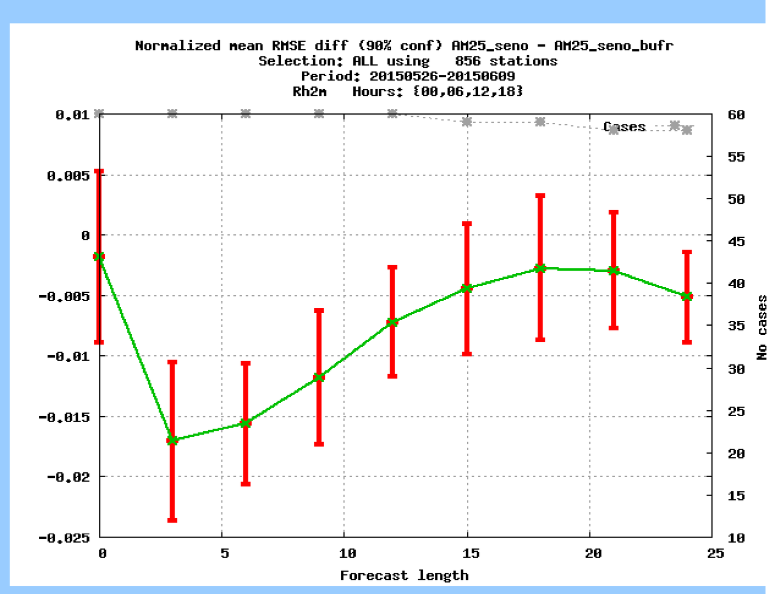
Radar data is used operationally since 16 June 2015

Pre-processing is important together with quality control.

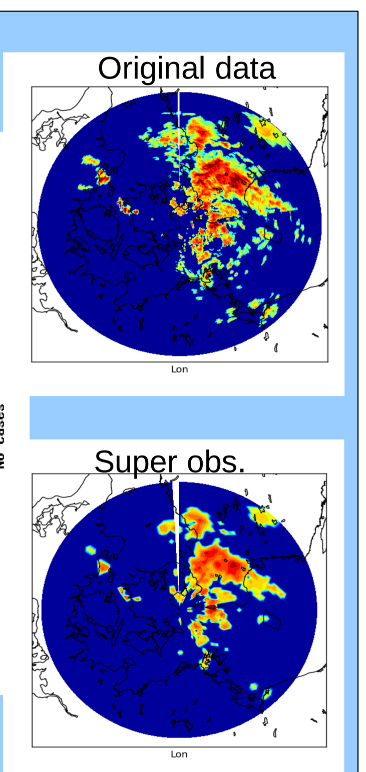
The figures show a comparison between two ways of doing data reduction, "blind" thinning and creation of super observations using OPERA data.

Together with the super observations an elevation check is made to avoid overlapping elevations.

Super observations (SO): Only good quality observations are included. At least 30% of the SO need to be rainy or else it will be a dry observation



Difference in forecast RMSE for blind thinning vs super-obbing.



Tests with new turbulence scheme HARATU

Karl-Ivar Ivarsson (SMHI), Wim de Rooy (KNMI)

The effect of the modifications of the turbulence scheme in AROME as in the RAMCO scheme may be summarized as:

- The turbulent vertical mixing seems to increase, reducing the over-prediction of fog and of the lowest clouds.
- The positive bias of MSLP in winter is reduced, and so is also the negative bias of temperature between 850 and 925 hPa.
- The 10m wind are generally better predicted with RACMO
- More mixed result for cloudiness,precipitation and T2m temperature

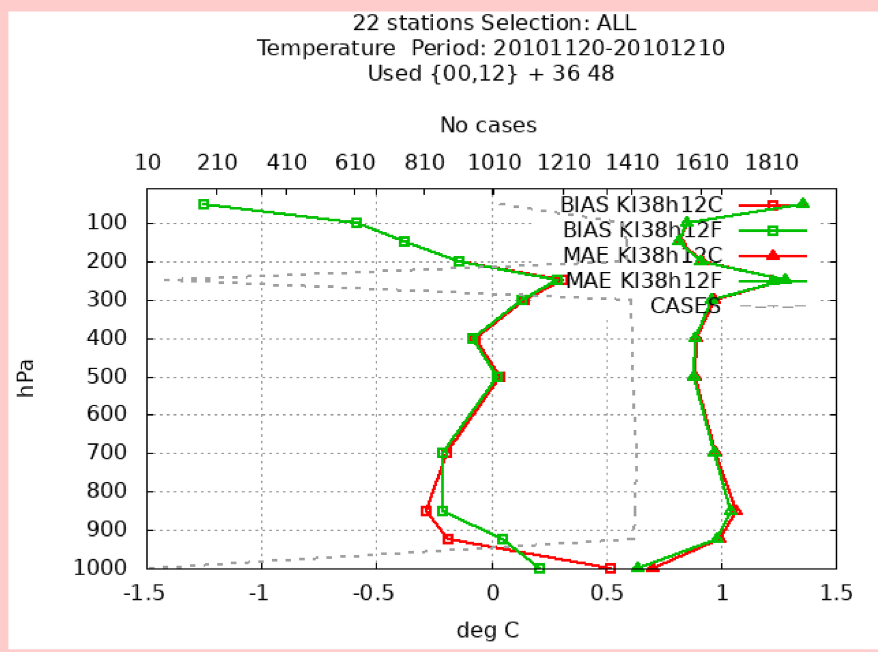


Figure:Verification of the temperature for different pressure-level heights for a cold winter period. (November 20 to December 10, 2010) Red is **without the HARATU** modifications and green is **with HARATU** changes (Mean error and mean absolute error)
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Data Assimilation of IASI radiances

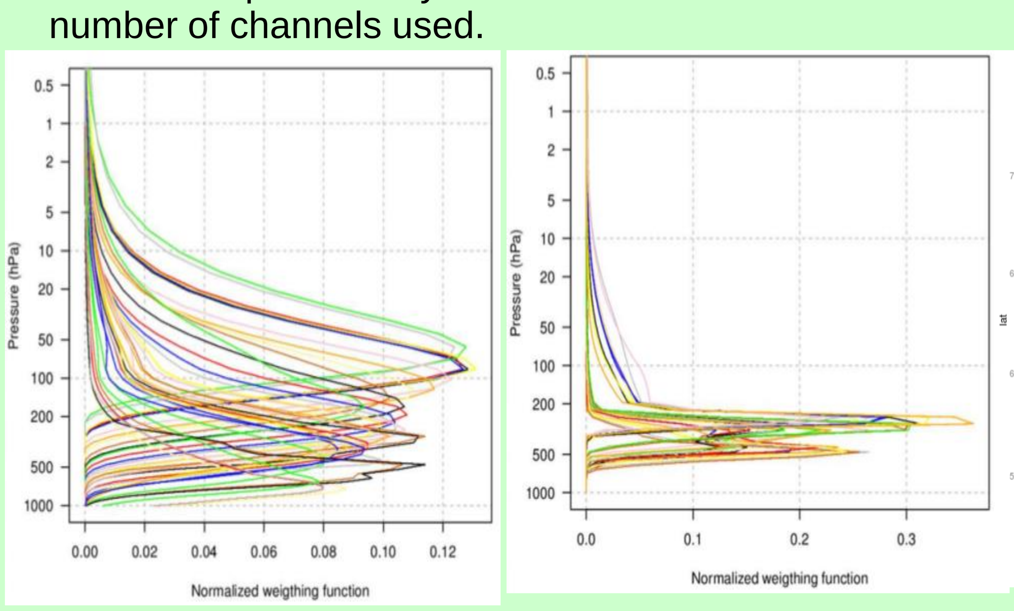
Magnus Lindskog (SMHI),
Roger Randriamampianina (MET)

Aim: IASI radiances do have potential to improve the quality of NWP forecasts, and there is a huge amount of data.

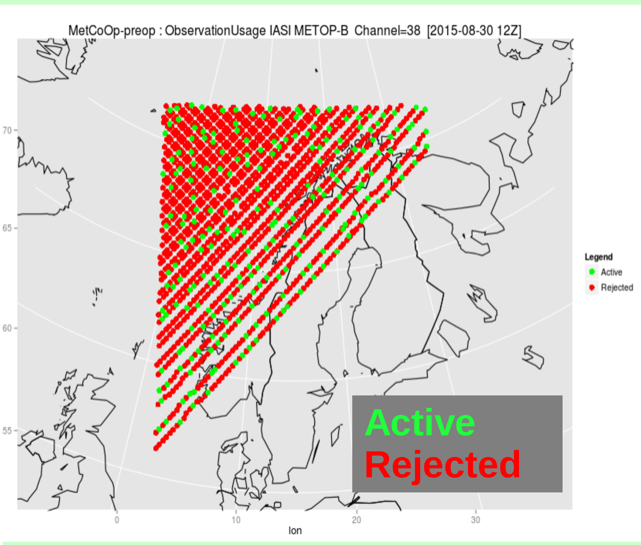
Future plans include introducing IASI radiances operationally and increase the number of channels used.

Results: IASI radiances are currently assimilated in preoperational mode with encouraging results.

Quality control, bias correction and observation monitoring are crucial.



Weighting functions for the 55 (outof 8000) channels used (left temperature sensitive, right humidity sensitive)



Example of data usage for one particular case and channel

European regional reanalysis project UERRA

Per Undén, Esbjörn Olsson, Martin Ridal, Ulf Andae, Per Dahlgren (SMHI)

Status of SMHI contribution:
- Assessed EURO4M with hydrological model
- Finished 2006-2010 with two physics packages: ALARO and ALADIN
- Verification shows better scores for ALADIN, so it will be used as production model for 1960 to 2010.

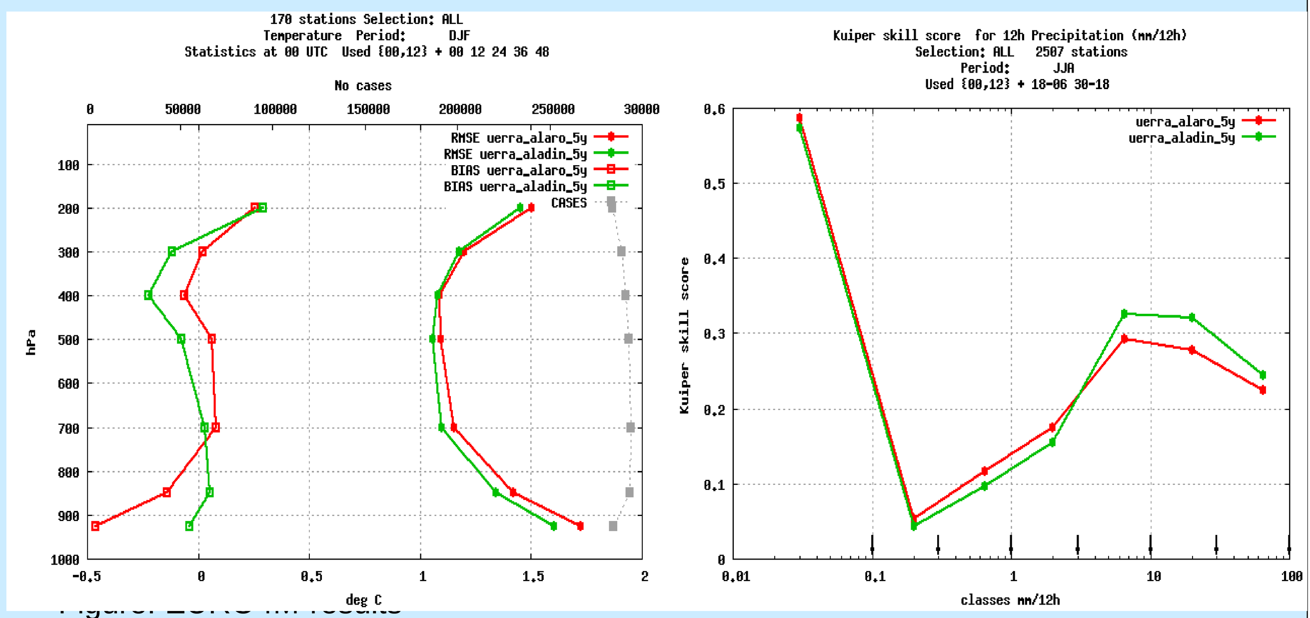


Figure: UERRA verification for UERRA 2006 – 2010 for ALADIN and ALARO. Left RMSE and bias for T2m during DJF. Right: Kuiper skill score for 12h-precipitation during JJA.