The MetCoOp EPS

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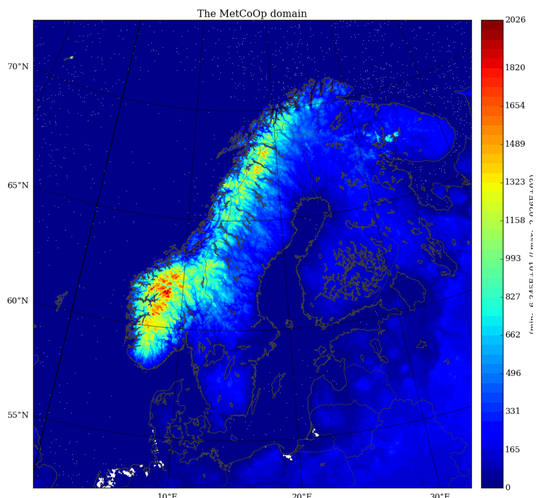
What is MetCoOp?

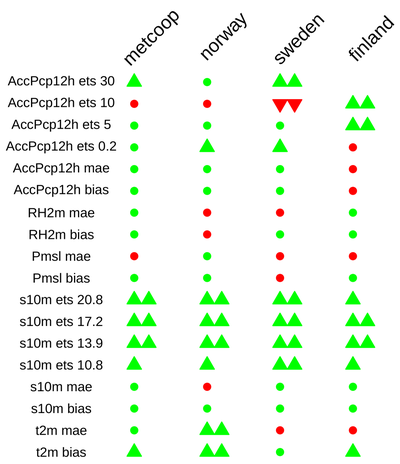
MetCoOp is the cooperation around NWP production between Sweden, Norway and Finland. MetCoOp has been running HARMONIE-AROME operationally since March 2014 and included the ensemble in November 2016. The shared tasks involves pre processing of observations and boundaries, the core production and the daily monitoring of the meteorological and technical performance. Post processing and product generation is handled by each institute.



The MEPS setup

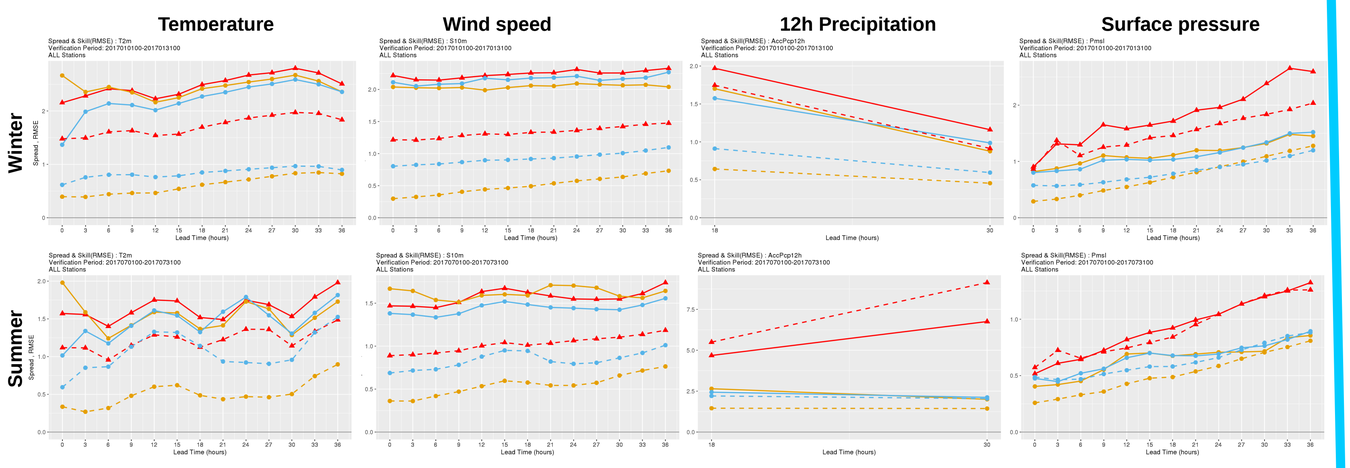
- Based on harmonie-40h1.1 using HARMONIE-AROME (Bengtsson et.al.,2017) with 900x960 points, 2.5km grid spacing, 65 levels
- Control member(s) run 3DVAR with large scale mixing every 3h. Observations used are: conventional observations, AMSU A/B, MHS, IASI, ASCAT, RADAR and GNSS
- All members runs surface assimilation every 6h with using T2M, RH2M, SNOW, ECMWF+NEMO (oceanographic model) SST/ice
- Control and perturbed members runs up to 66h and 54h respectively every 6h.
- MEPS currently consists of 1+9 members.
- The SLAF method (Garcia-Moya et.al. 2015) is used to produce initial and boundary perturbations from ECMWF deterministic forecasts using a lagging technique.
- Perturbations of surface variables is applied to all members and has been operational since June 2017.

Quality of HARMONIE 40h1.1



MEPS maintains the added value compared to ECMWF over areas of importance for MetCoOp. The scorecard for Jan/Feb 2017 shows better scores than ECMWF especially for wind. During the snow melting season the model is far to wet and cold close to the surface (not shown).

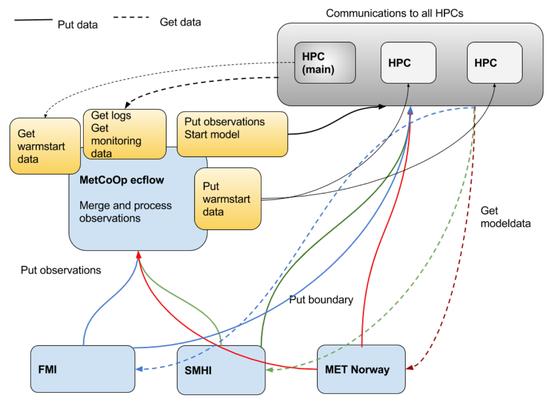
MEPS performance for the winter/summer of 2017



ECMWF (51) GLAMEPS (52) MEPS (10) ***(number of members)***

MEPS has been operational since mid November 2016. In the plots above we compare the spread and skill for MEPS with other ensemble systems available for the forecasters such as ECMWF ENS and GLAMEPS. Note that both ECMWF and GLAMEPS has more than 50 members whereas MEPS has 10. In general MEPS is comparable or better compare to the others. For T2M we see an increased spread during the summer thanks to the surface perturbation. For wind we also see a improved spread/skill ratio during summer both with respect to the winter period and compared to GLAMEPS which benefit from the multi model approach used.

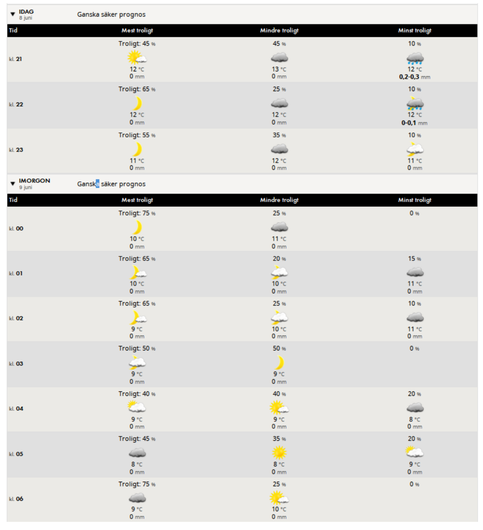
Controling a multi host EPS



Since September 2017 the MEPS members are produced on three different HPCs with identical copies of the system. The preprocessing and the supervision of the runs are done from servers located at SMHI. The control member serves as the deterministic input to downstream products, and member 1 and 2 are backup in case the control should fail. All members are available within an hour from the cutoff time.

	Control mrb Runs to +66h	Q-control Runs to +66h	Perturbed mbrs Runs to +54h
Alvin (MET)	0		5,6,9
Frost (SMHI)		1	3,4,7,8
Teho (FMI)		2	

Examples of operational usage



Even though most products are still based on the deterministic forecast the usage of MEPS is slowly increasing. Above we show two examples from MET and SMHI. To the left we see how forecasters in Norway communicate the possible trajectories for a polar low case to the public. To the right we see an example of how SMHI uses the ensemble for point forecasts available at smhi.se. The interface has been developed together with the public and gives a quick interpretation of the options and the level of uncertainty in the forecast.

For the future

The MEPS system has been operational since mid November 2016. Future work involves :

- Further investigation of perturbations of surface parameters and parameters important for clouds and turbulent processes.
- Revisiting the use of ECMWF ENS boundaries as a replacement of the current SLAF method. Combine it with clustering selection methods to find the most representative members
- Addressing near surface biases by a better representation of the surface through an introduction of a lake model and a more detailed description of vegetation properties.
- Procurement of a larger HPC systems in 2018 for MET/SMHI/FMI will allow options like an increased ensemble, larger domain, more advanced assimilation methods and model descriptions.

References:

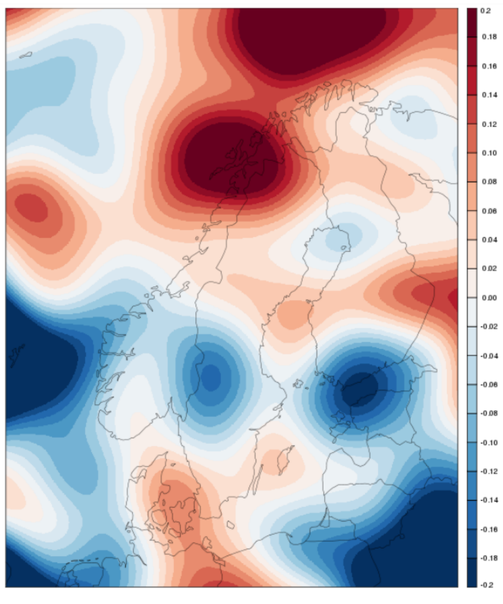
Bengtsson, L., and Coauthors, 2017: The HARMONIE-AROME model configuration in the ALADIN-HIRLAM NWP system. Mon. Wea. Rev., 145, 1919-1935, doi:10.1175/MWR-D-16-0417.1

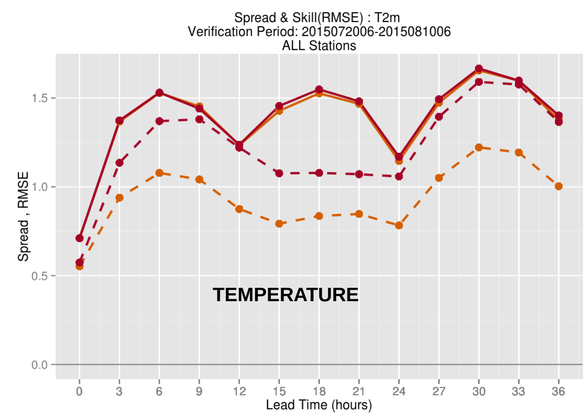
Bouttier F, Vie B, Nuissier O, Raynaud L. 2012. Impact of stochastic physics in a convection-permitting ensemble, Mon. Weather Rev. 140: 3706 – 3721

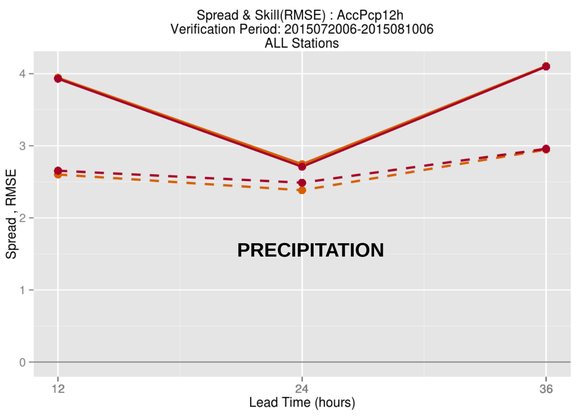
Garcia-Moya, J-A et.al, 2015 SLAF implementation in HarmonEPS: First results, ALADIN-HIRLAM ASW, http://www.umr-cnrm.fr/aladin/IMG/pdf/slaf.pdf

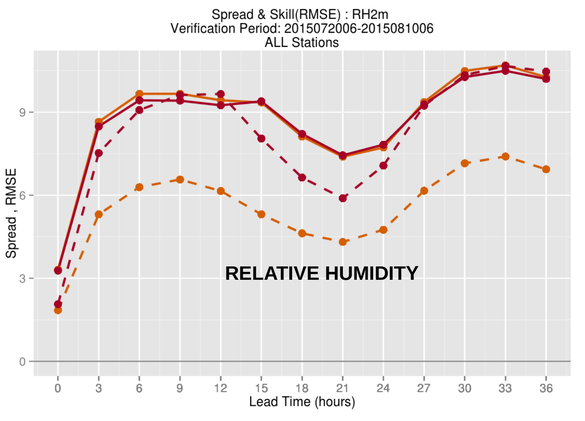
Improving the quality of the ensemble through surface perturbations

- An ensemble system should not only represent the uncertainty in the initial conditions but also the uncertainty in the model description and as in the case of MEPS the uncertainty in the forcing from the boundaries.
- Earlier the only perturbations utilized in MEPS were through ECMWF data for the initial and boundary conditions. Following Bouttier et. al. (2012) we have been working on including surface perturbations in the system.
- Before starting the forecast we perturb parameters like SST, soil temperature, soil water and surface albedo with a spatial scale and size as exemplified in the map below.
- These perturbations has a clear positive impact on the spread on especially near surface temperature and relative humidity. For other parameters, like precipitation, the impact is smaller.









WITH PERTURBATIONS
WITHOUT PERTURBATIONS