MetCoOp status and plans

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Current MEPS setup, operational since March 23, 2021

Forecast model aspects

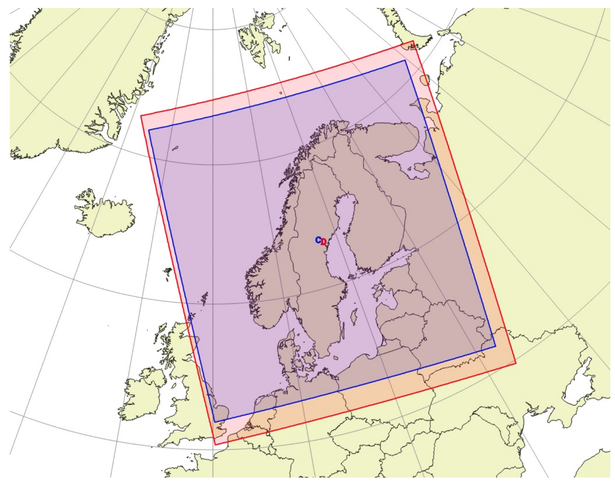
- Based on harmonie-43h2.1.1 using HARMONIE-AROME
- Domain is 960x1080 points, 2.5km grid spacing, linear grid, 65 levels. 75s timestep.
- Explicit treatment of open land and forest
- FLAKE freshwater model
- Ocean ice model SICE
- Some local modifications to vegetation roughness (fake trees, XRIMAX).

Assimilation aspects

- All members run their own 3D-VAR every 3h, with large scale mixing with the coupling model's first boundary file. Perturbed members use perturbed observations.
- Observations used are: conventional observations, AMSU A/B, MHS, IASI, ASCAT, RADAR, GNSS, Mode-S EHS.
- Cutoff 1 hour 15 min
- EDA derived structure functions
- All members run surface assimilation every 3h using T2M, RH2M, SNOW, ECMWF+NEMO SST/ice.

Ensemble system aspects

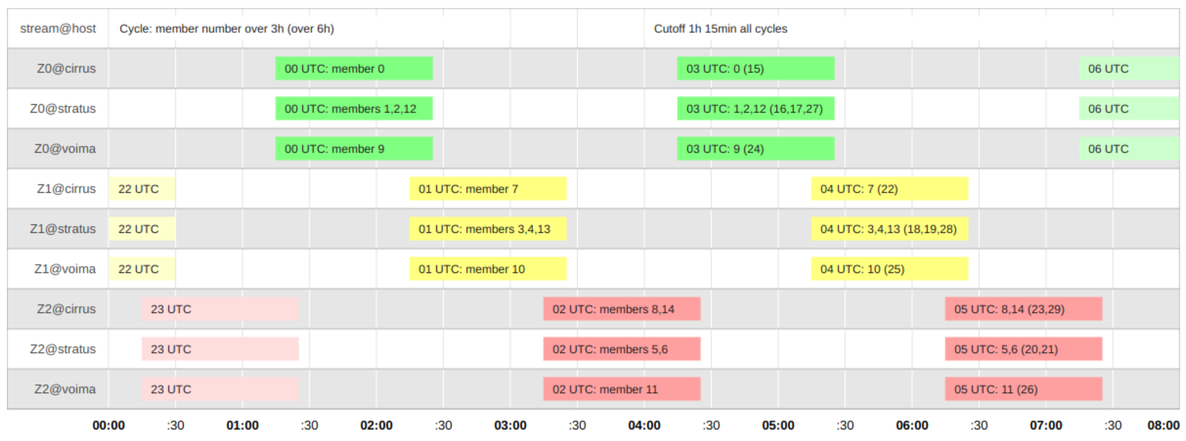
- MEPS currently consists of 15 members over 3 hours (30 members / 6h).
- The members are distributed over three HPCs where one member on each site serves as a (perturbed) backup for the control in case of failures.
- Control and perturbed members all run up to +66h every 3h.
- Initial and boundary perturbations come from the ECMWF EPS system, perturbed members are in alternating cycles nested in odd and even IFSENS members (1-28).
- Random perturbations of surface variables are applied to all non-control members.

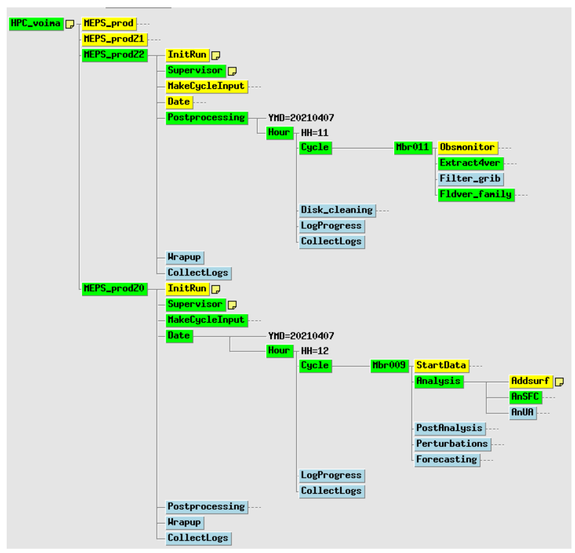


In red: current domain "D" introduced with the move to hourly production of ensemble members on February 4, 2020, see below. Previous domain "C" in blue.

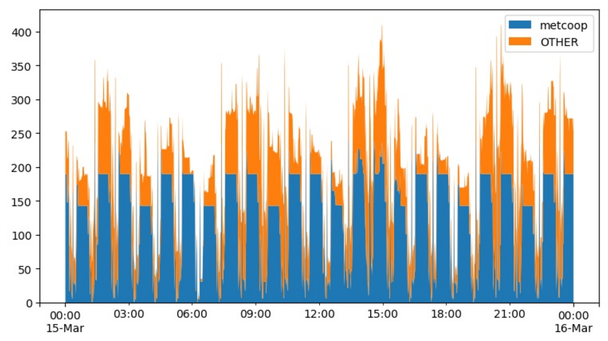
Hourly, distributed production of ensemble members, since February 4, 2020

A major upgrade to the MEPS system went operational on February 4th, 2020. Then, instead of computing all ensemble members at the same time (10 members every 6 hours), we went to a more continuous schedule, where 5 new members are produced each hour on the clock, distributed over 3 different HPCs, as shown in the figure below. This has essentially tripled the number of members, as we now produce 30 members over a 6 hour period. Members run a 3-hourly cycle, in three "streams" Z0, Z1 and Z2, where the number is the offset relative to the "main" hours 0,3,…,21 UTC.





The 3 different streams each have their own suite in ecFlow. This allows members to use more than 1 hour on the clock, as they can coexist with those in a different stream (on the same HPC).



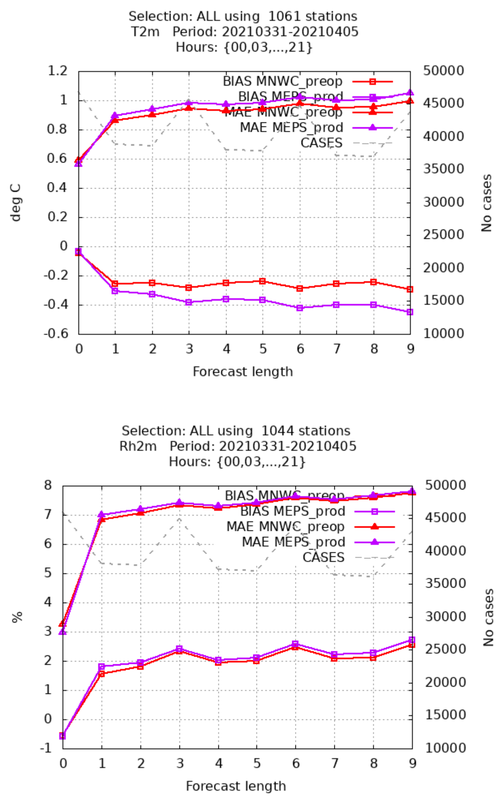
The new run schedule has lead to a much better utilization of each HPC. Here an example from the largest HPC stratus, which shows that MetCoOp's usage is quite even throughout the day. The machine is shared with national production in both Norway and Sweden, also with Swedish armed forces, all of these are shown as "OTHER".

Nowcasting in MetCoOp

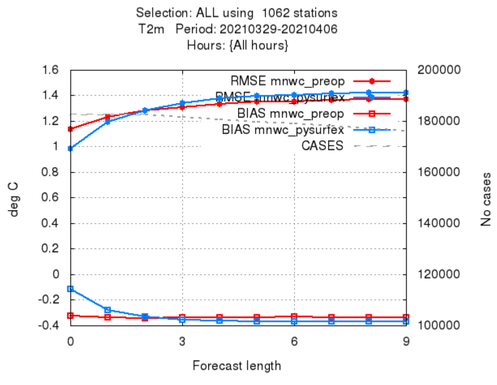
MetCoOp has been running a pre-operational nowcasting suite since April 2018. New forecasts to +9 hours are launched every hour, with a cutoff of 25 minutes for the assimilation, and available around 20 minutes after cutoff. We use a rapid refresh approach with first guess from the MEPS control, running on the same domain and same resolution. This suite was also upgraded to harmonie-43h2.1.1 on March 23, 2021. It differs from MEPS in a few respects:

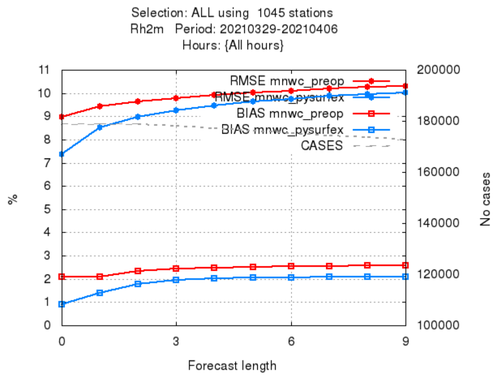
- MSG-NWCSAF cloud information is ingested at the start of the forecast to improve the convection initialization. In cycle 43 a somewhat "softer" approach is used, but still gives a "shock" to the initial state. Use of IAU to reduce this shock is currently looked into.
- SYNOP T2m and RH2m are assimilated not only in the surface assimilation, but also in 3D-VAR. Some recent scores against MEPS on the right.

Assimilation of AMV, MODE-S EHS and radar winds is in the plan.



After the switch to cycle 43 a second pre-operational nowcasting suite has been added. In this suite, the surface assimilation is no longer using Canari, but a new set of tools TITAN, gridPP and pysurfex. The main purpose of this is to enable assimilation of crowd-sourced data from e.g. Netatmo, giving around 50000 extra observation stations every cycle. Some very preliminary scores for T2m and RH2m below, compared against the main nowcasting suite.





Short and longer term plans

As HIRLAM RCR centre MetCoOp will take part in the testing and evaluation of harmonie-43h2.2. This includes:

- Technical and meteorological evaluation of various new or modified physics options related to fog, open cell convection, radiation, etc.
- Explore the performance of 4DVAR with respect to the current 3DVAR scheme and it's operational feasibility. This will probably include running 4DVAR in one of the pre-operational suites.

Other selected activities from the MetCoOp work plan:

- Investigate the potential of observation types not yet assimilated, e.g., radar radial winds, AMV, ATMS, CrIS, T2m/RH2m in upper air assimilation.
- Generate background error statistics for the current "D" domain instead of extrapolating old statistics from a previous, smaller area. Continue this exercise by also generating B-statistics for 90 levels in the vertical. See also oral presentations by Ulf Andrae and Ole Vignes regarding B-statistics generation and usage.
- Perform tests with increased vertical resolution (90 levels), in combination with running forecasts in single precision in order to make if affordable.
- Introduce model uncertainty in the ensemble system via SPP (stochastically perturbed parameters). This is at present mostly a HIRLAM activity.
- Replace the current observation pre-processing system by SAPP.
- Ensemble calibration: extend the current T2m calibration to other parameters like precipitation and gust.

Extension of MetCoOp

An MoU has been signed aiming at including Estonia, Latvia and Lithuania in the cooperation by 2022. Estonia hosted the working meeting in Tallinn, May 27-29, 2019 and officially entered the cooperation from Jan 1, 2020. Latvia are currently participating in the weekly video meetings as observers.