Experimentations at met.no with the SURFEX surface scheme under the HARMONIE forecasting system

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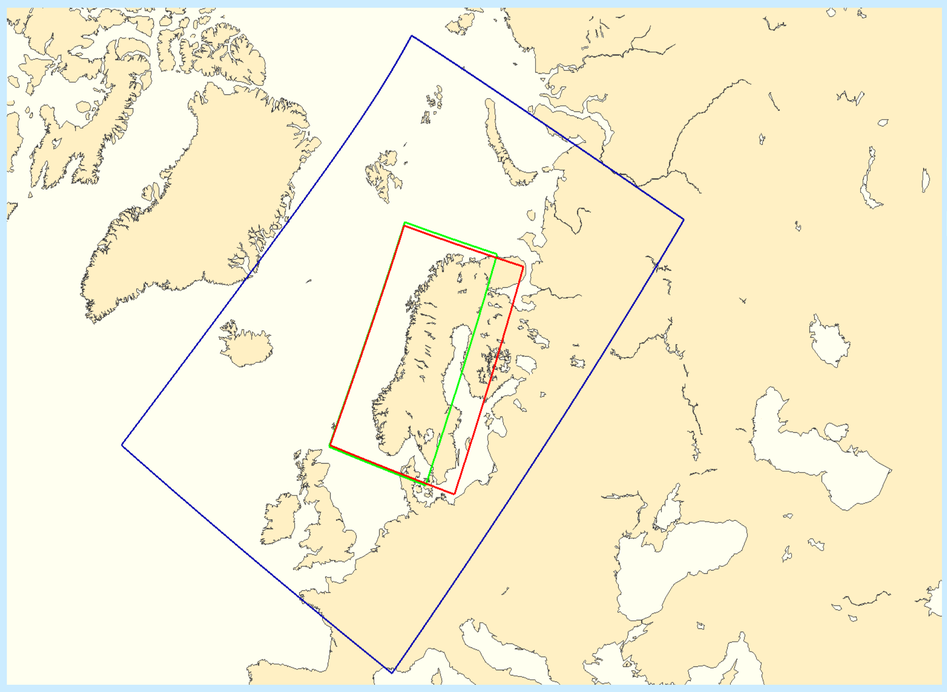
HARMONIE @ MET.NO



- **HM55**
  - 5.5 km resolution
  - Hydrostatic dynamics
  - ALARO physical parameterization
  - SURFEX external surface model
  - Surface assimilation
    - CANARI + OI_main for soil variables

*Daily runs since May 5'th 2011. A continuation of **HM04** but run on a larger domain and with hydrostatic dynamics.*

- **HM25**
  - 2.5 km resolution
  - Non-Hydrostatic dynamics
  - AROME physical parameterization
  - SURFEX external surface model
  - Surface assimilation
    - CANARI + OI_mail for soil variables

Daily runs since May 5'th 2011

HARMONIE Surface analysis

TO BE PHASED OUT

1)
As previous cycles
ANASURF=CANARI
SURFACE="old surface"

OPERATIONAL

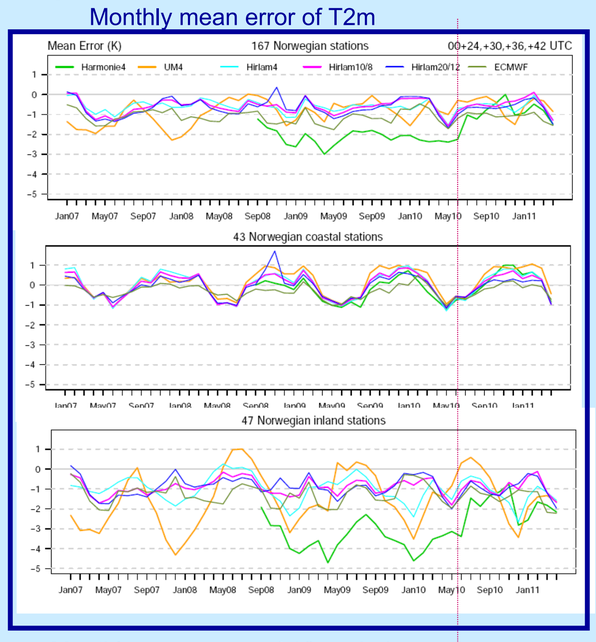
2)
OI with SURFEX
ANASURF=CANARI_OI_MAIN
SURFACE="surfex"

EXPERIMENTAL

3)
Extended Kalman Filter with SURFEX
(Mahfouf et al. 2009)
ANASURF=CANARI_EKF_SURFEX
SURFACE="surfex"

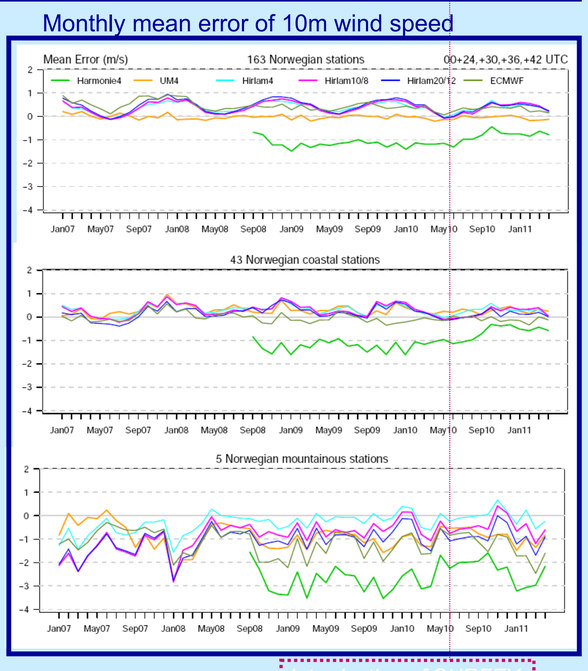
Experiences with HARMONIE at met.no

Monthly mean error of T2m



The ***HARMONIE*** runs with "old surface" scheme were not adapted well to Nordic conditions. The mountains gave a too strong damping of the wind in the lower part of the atmosphere, never above fresh breeze at 10m at the Norwegian mountains. Surface temperatures were also too low, particularly in spring and winter, partially coursed by too weak winds. The introduction of ***SURFEX*** gave significant improvements forecasting ***T2m***, which might be related to the tilting, the activation of canopy model and use of mean orography instead of the envelop orography. The performance of ***T2m*** forecasts in the inlands areas is not satisfactory yet . The ***10m wind speed*** is still heavily underestimated, in particular in the mountainous areas.
One can say that there is still a lot of place for improvements!!!

Monthly mean error of 10m wind speed



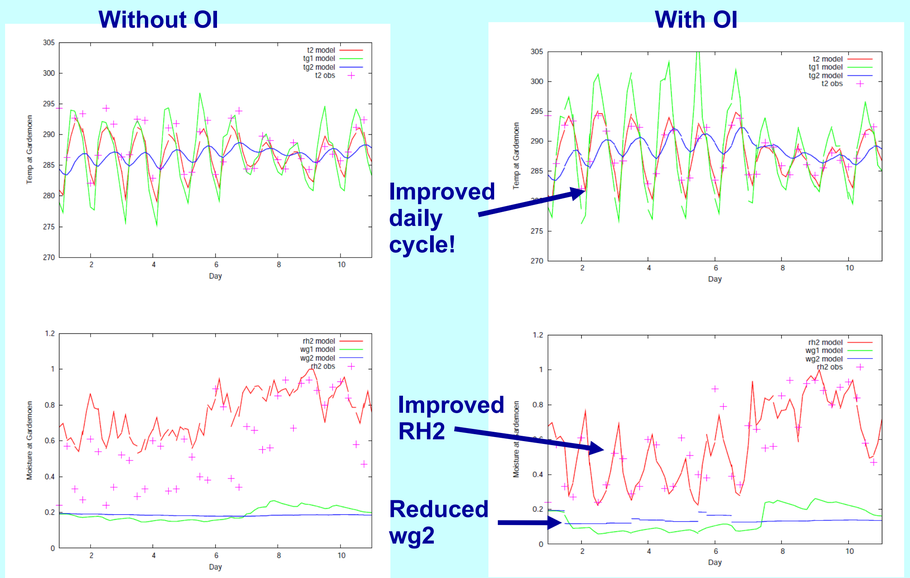
Introduction of SURFEX from June 2010

Ongoing work and short term plans:

- ✓Alternative treatment of ***the orographic drug*** implemented by Météo-France in operational AROME runs will be investigated;
- ✓***Extended Kalman Filter*** scheme ***for soil model data*** assimilation will be carefully evaluated on its performance in nordic conditions;
- ✓***Nordic challenges*** will be addressed:
  - ***EKF*** for snow in SURFEX
  - SWE product (***GLOBSNOW***) for snow DA into HARMONIE
  - ***SCE*** products for snow DA into HARMONIE
  - ***Flake*** and ***HIGHTSI***: sea-ice, modeling and DA

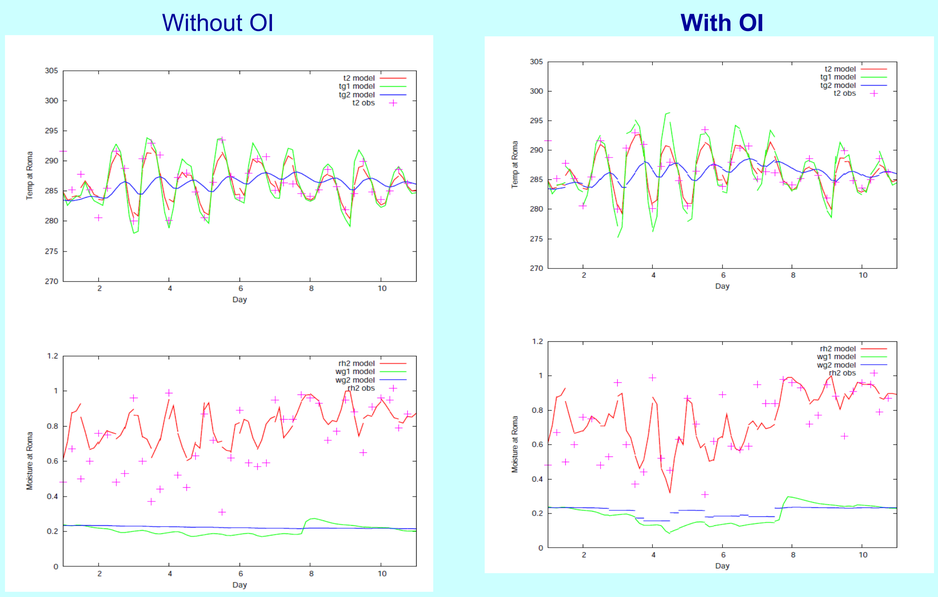
Impact of the soil data assimilation of the forecast quality of the upper air fields

Example of time-series in SYNOP stations - Gardermoen

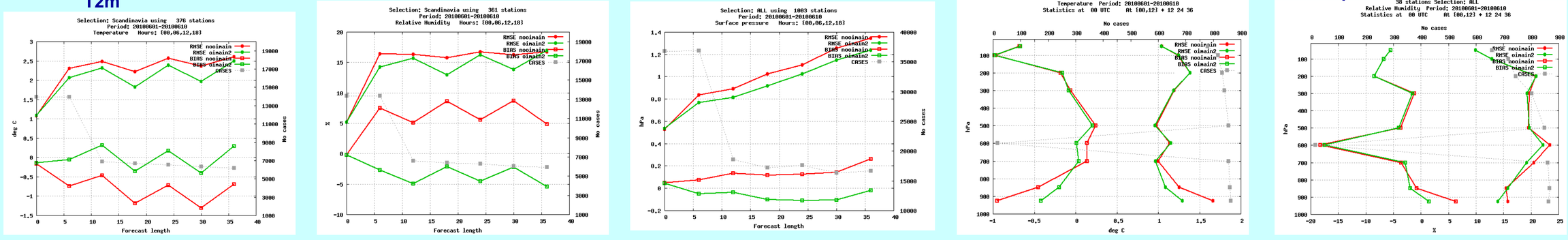


- HARMONIE-HS-ALARO-SURFEX
- 3D-VAR and OI_MAIN
- SMHI Scandinavia 5km domain, 60 levels
- 10 days in June 2010
- With and without OI for the soil variables
- *In order to be certain that the only difference was the assimilation of soil variables, the updating of soil variables was simply removed in the OI-MAIN code*

Roma (Gotland!)



Verification



Conclusion: The OI_main scheme with the statistically pre-calculated coefficients can be used as a reference in validating performance of the EKF soil data assimilation scheme ***To beat OI_main is not a simple task***!

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/

Homleid, M., 2011: HARMONIE surface data assimilation, HIRLAM Newsletters No. 58, September 2011, available at http://hirlam.org