Progress in HARMONIE surface assimilation

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HARMONIE surface analysis

Updated variables
- Surface and deep soil temperature – Ts and Td
- Surface and deep soil water and ice – Ws, Wd, Is, Id
- Snow water equivalent – SWE . . . . . .
- Sea Surface Temperature (and Sea Ice Concentration)

In cycle 33–35: with CANARI (Taillefer, 2002)
- T2m and RH2m analyzed by Optimum Interpolation (OI)
- Ts, Td, Ws, Wd updated from T2m/Rh2m increments based on Giard and Bazile, 2000
- SWE analyzed by OI
- SST (and SIC) interpolated from ECMWF, which is based on OSTIA/OSISAF products

From cycle 36:
- T2m and RH2m analyzed by (OI) with CANARI as in previous cycles
- 3 options for updating Ts, Td, Ws and Wd from T2m/RH2m analysis increments:

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

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"
NOT YET IMPLEMENTED

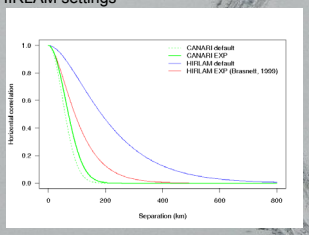
SURFEX (Le Moigne, 2009):
- 4 tiles; sea water, inland water, town and nature (12 patches)
- ISBA-2L/3L
- 3 snow schemes; D95, EBA and 3-L

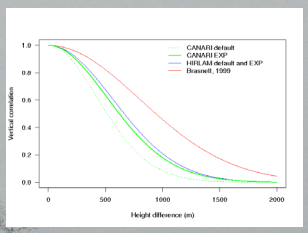
Snow analysis

Experiments with CANARI snow analysis in HARMONIE performed by L. Taseva, F. Taillefer,and M. Homleid, autumn 2009, with cycle 35h1.2

- introduced in CANARI and tested in ALADIN and ARPEGE in 2000/2001 (Gaytandjieva,2000/2001)
- the snow analysis as introduced in CANARI and HIRLAM are similar:
  - analysis method is OI
  - background error correlation includes a horizontal and a vertical term
  - use only synoptic observations which are supposed to have uncorrelated error

Setup of first experiments:
- no relaxation
- limits of quality control increased to include all available observations, default limits lead to rejection of most observations
- scales of **background error correlations** increased from 50 to **60 km** for the **horizontal** and from 0.05 to **0.06** for the **vertical** part, to be closer to experimental HIRLAM settings





- standard deviations of observation and background errors; use default value: 5 kg/m^2
- first guess is 6 h forecast, interpolated to observation position
- monthly mean values for snow density introduced in the experiment, replace the value 100 kg/m^3

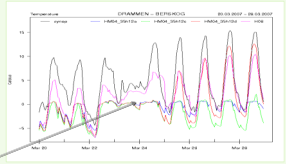
	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
kg/m^3	222	233	240	278	312	312	312	143	143	161	182	213

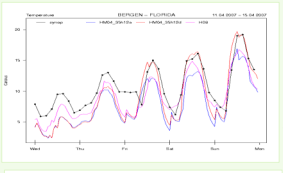
Photo Jan Erik Haugen

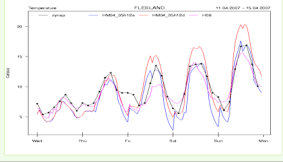
HARMONIE at met.no – experience, examples and experiments

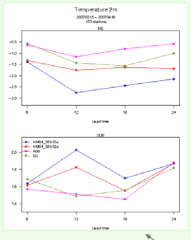
Daily runs at 00 and 12 UTC since august 2008
- boundaries and initial fields from Hirlam8
- 4 km resolution, 300 x 500 grid points
- ALARO physics, non hydrostatic dynamics

Diagnostics of T2m forecasts:
- Large errors related to snow
  - surface temperature never above 0°C with snow on ground
  - too high albedo gives too low temperatures
- In coastal regions
  - good performance over sea where Land Sea Mask (LSM) = 0
  - large errors at stations with unrealistic LSM
  - tiles are needed to give realistic temperatures in coastal regions









Daily runs at 00, 06, 12 and 18 UTC from February 2010
- CANARI: temperature, humidity and snow
- T0m from Hirlam8 where LSM < 0.5
- blending of analyzed surface fields and upper air fields from Hirlam8
- ALARO physics, non hydrostatic dynamics

Experiments
- HM04_35h12a – cy35h1.2 - reference version
  - with no assimilation
- HM04_35h12c
  - CANARI: temperature, humidity and snow
  - T0m from Hirlam8 where LSM < 0.5
  - blending of analyzed surface fields and upper air fields from boundaries (Hirlam8)
- HM04_35h12d
  - as HM04_35h12c, but
  - tuning to reduce albedo which is a function of snow, vegetation and LAI

Time periods
- Spring: 15 March – 15 April 2007
- Autumn: 3 – 31 August 2007

Summary results
- Positive impact with CANARI in spring, particularly T2m forecasts due to improved snow cover (less snow)
- Neutral impact in august

Coastal stations
- improved performance with CANARI at coastal stations where HM04 have more realistic LSM than Hirlam8
- best performance without CANARI where Hirlam8 LSM is more realistic

Next steps
- Check the performance of OI_MAIN and SURFEX in cycle 36
- Transformation of soil water with Soil Wetness Index
- Test within SURFEX/HARMONIE available snow schemes and the tuning of them, e.g. related to albedo, melting and fractional snow coverage
- Extended Kalman Filter
- Experiments with satellite data in soil water content and snow analysis

References

Gaytandjieva, L.., 2001: Snow analysis in ARPEGE/CANARI. Final report of the work in MF (June-July 2001), available at http://www.cnrm.meteo.fr/aladin/

Homleid, M., 2009: Report from working week on snow analysis in HARMONIE with CANARI at Météo-France, Toulouse, 19 – 23 October 2009, available at http://www.cnrm.meteo.fr/aladin/

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Mahfouf, J. F., K. Bergaoui, C. Draper, F. Bouyssel, F. Taillefer, and L. Taseva, 2009: A comparison of two off line soil analysis schemes for assimilation of screen level observations, JGR.

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