Surface Modelling and Assimilation at MET Norway: Status and Plans

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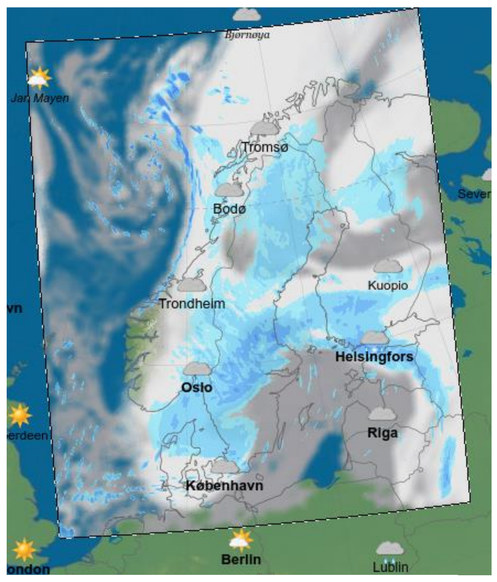
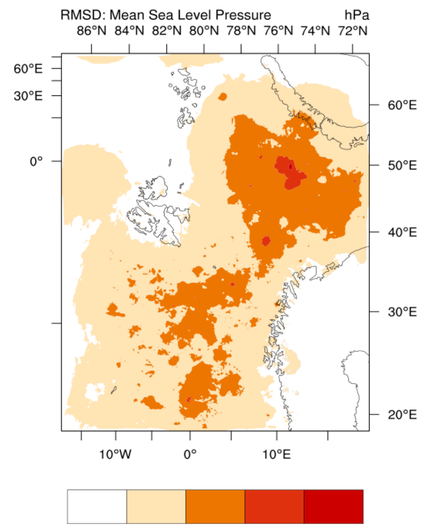
Meteorologisk institutt
150 år





Impact of ASCAT assimilation on Mean Sea Level Pressure over AROME-Arctic domain

AROME-MetCoOp

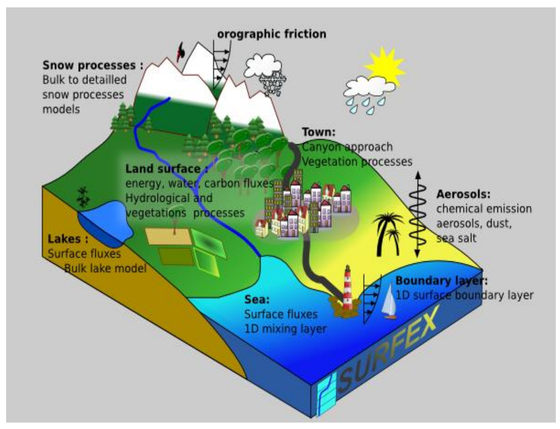
- Operational cooperation between SMHI and MET Norway
- Using Norwegian and Swedish HPC facilities
- Base for official forecast on yr.no

- Harmonie cycle 38h1.2
- AROME physical parametrization
- 2.5 km/65 levels/10 hPa top
- domain with 750x960 gridpoints (see left)
- hourly boundaries from ECMWF
- forecast length 66 hours

- ECOCLIMAP-2
- Surface assimilation (t2m, rh2m, snow)
- 3DVAR (conventional, ATOVS, GNSS, radar reflectivity)
- 3-hourly cycling
- SURFEX for surface modelling
- Simple Ice Scheme (SICE) for sea ice parameterization

AROME-Arctic

- Under operational implementation
- 750x960 gridpoints (see left)
- Same setup as AROME-MetCoOp except for:
  - Assimilation of ASCAT
  - No radar assimilation



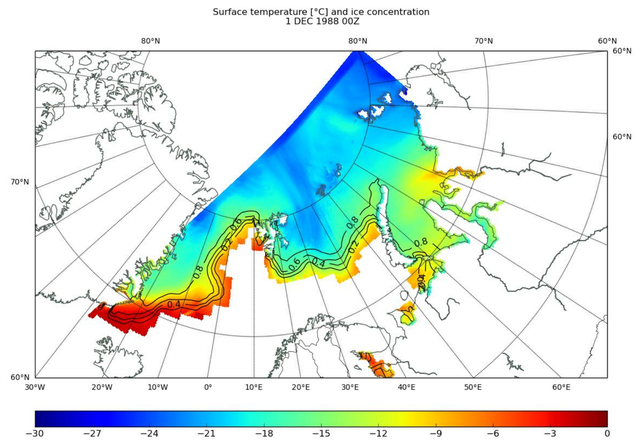
SURFEX

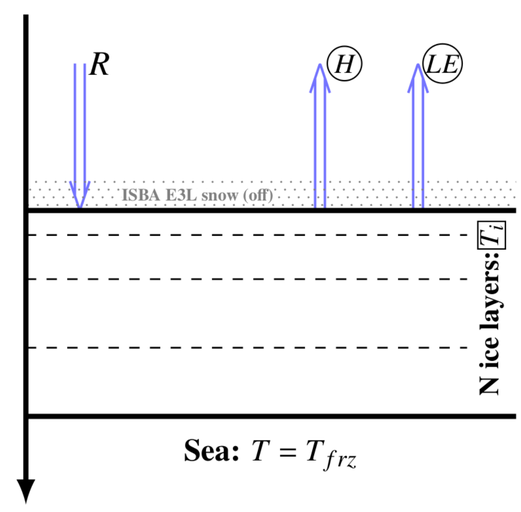
SURFEX (Surface Externalisée) is a surface modelling platform developed by Météo-France, composed of various physical models for natural land surface, urbanized areas, lakes and oceans. It also simulates chemistry and aerosols surface processes and can be used for assimilation of surface and near surface variables.

SURFEX has its own initialization procedures and can be used in stand alone mode and coupled to an atmospheric model.

SURFEX in AROME

- Soil scheme: ISBA force restore with 3 layers for hydrology (CISBA=3-L)
- Snow scheme: D95 - Douville et. al 1995 (CSNOW=D95)
- Number of patches: NPATCH=1
- Surface boundary multi layer scheme over vegetation (LISBA_CANOPY=T)
- Canopy drag: LCANOPY_DRAG=T, XCDRAG=0.01





Simple Ice Scheme (SICE)

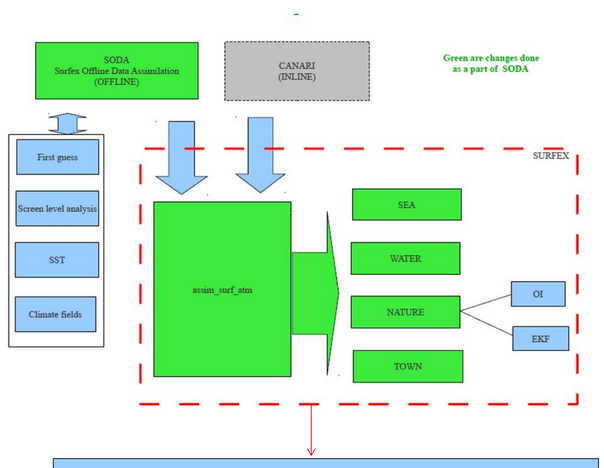
- Simple Ice Scheme developed to fix lack of sea ice parameterization in SURFEX 7
- Ice thickness remains constant during model run
- Arbitrary number of layers (3 <= N < 99)
- Fixed ice salinity
- ISBA explicit 3-layer snow scheme can be used for snow on ice parameterization
- Prognostic state of ice temperature for each layer is obtained through solution of heat diffusion equation
- No temperature analysis, scheme starts from previous forecast or ECMWF Sea Ice Surface Temperature data

Surface assimilation

1) Screen level analysis (T2m/RH2m/SWE) is performed in the program CANARI (Optimum Interpolation), The result is a 2-dimensional field for the model domain for the three mentioned variables.
2) The surface variables in SURFEX are updated based on the increments in step 1. This update can be done in two ways in the same framework:
   a.) Directly from CANARI (inline)
   b.) By the program SODA (offline)

The procedure is illustrated in the flowchart.

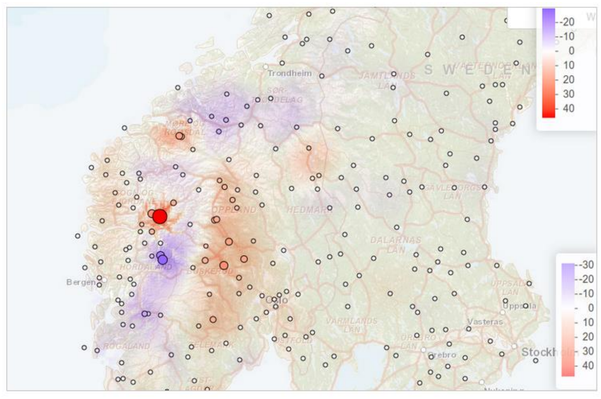
MetCoOp uses the inline option which is more efficient for operational use.



Update of SURFEX Variables

- Sea: Using SST from ECWMF (UK OSTIA)
- Inland water: Using soil temperature in common land/lake point, extrapolating these onto the lakes
- Nature: Update of soil temperature/ moisture/ ice based on empirical relations to screen level increments from CANARI. Snow is updated from CANARI SWE analysis. Experiments with a dynamically adjusting EKF method
- Town: Update road temperature based on the T2m increment from CANARI

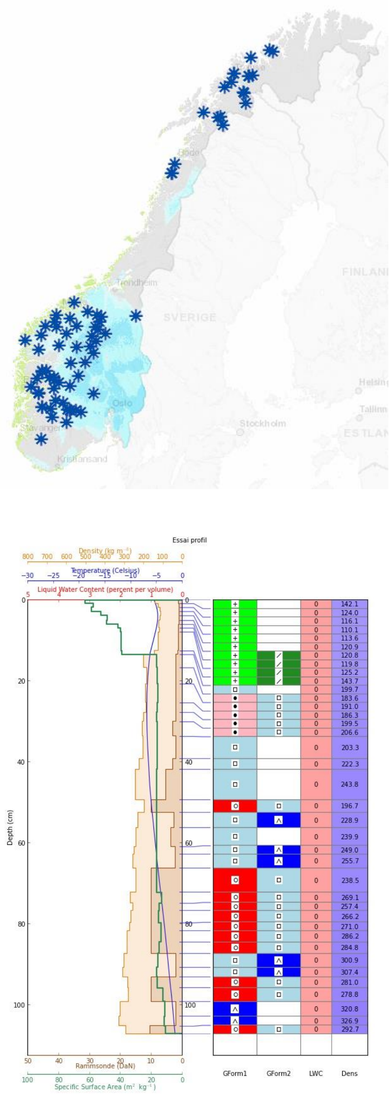
SWE Increments

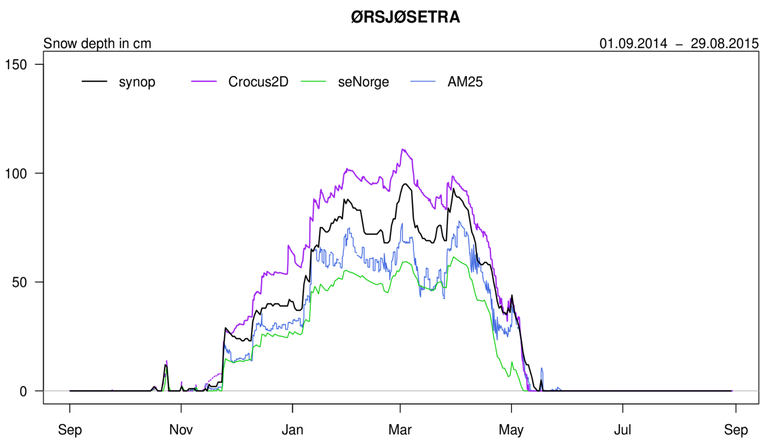


Offline SURFEX / ISBA-Crocus for snow modelling

- Running operationally in 1D & 2D
- Forcing data: Combination of observations from weather stations and AROME forecasts
- Used in snow avalanche service of NVE and MET
- Great potential in areas lacking observations, particularly high mountains

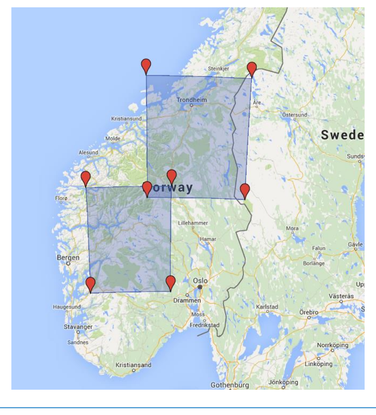
FORCING data for SURFEX
Temperature
Precipitation
Wind speed and dir.
Relative air humidity
Surface air pressure
Incoming long-wave radiation
Incoming short-wave radiation





SNOWHOW:

- SNOWHOW: Better SNOW models for prediction of natural hazards and HydropOWer applications
- NVE, MET Norway and SINTEF
- Part of the project is a model intercomparison study between snowmodels of different physical detail (including SURFEX/Crocus), for 2 domains (shown on right) and at least 2 winters
- Forcing data: gridded observations of temperature and precipitation + Arome forecasts



Ongoing and planned experiments

- Experiments with two patches:
  a) bare soil and low vegetation and b) forest
  This requires changes in the surface analysis. The surface boundary multi layer scheme will have to be switched off (and the results of this have to be evaluated)

- 3-layers snow scheme and ISBA -DIF
  - experiments will be performed with cy40 of Harmonie and SURFEX 8-version of ISBA
  - adapt Optimum Interpolation (OI) surface analysis to be able to evaluate potential improvements of more realistic schemes
  - evaluate replacement of OI by Extended Kalman Filter for surface analysis

- Assimilation of SMOS (Soil Moisture and Ocean Salinity) soil moisture observations using SURFEX V8 in Arome-MetCoOp for two case studies (floods May 2013 and drought January-March 2014), as part of the SMOS-PRODEX project with NILU

- Experiments with perturbations to vegetation fraction, leaf area index, thermal coefficient , roughness length (momentum), albedo, surface temperature, soil moisture, snow, sea surface fluxes and the ratio of roughness lengths of heat and momentum in MEPS (MetCoOp Ensemble Prediction System)