

A Consortium for COnvection-scale modelling
Research and Development

ACCORD Overview of Surface activities

Patrick Samuelsson, 2023-09-26,
45th EWGLAM and 30th SRNWP Meeting in Reykjavik, Iceland

Overview outline

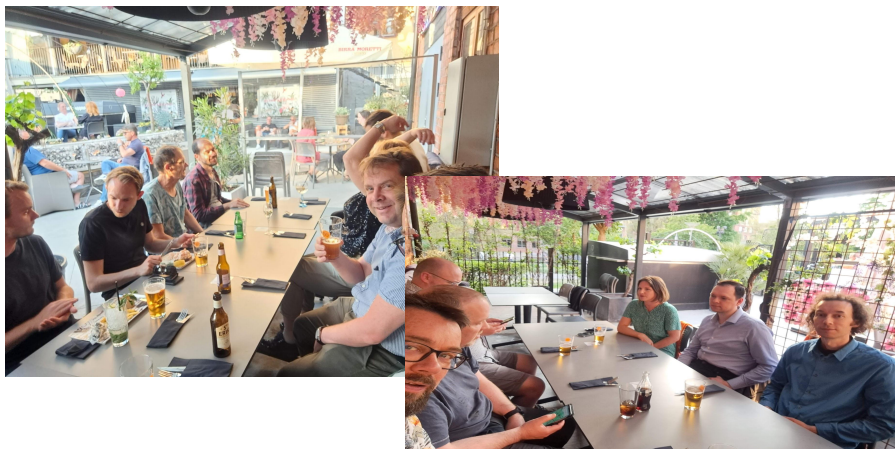
ACCORD surface overview covers activities at ACCORD level and in sub-organisations Météo-France, HIRLAM and LACE. This year though, the LACE surface activities will be presented separately by the LACE project manager Martina Tudor.

Outline

- **Coordination and working weeks**
- **Surface physiography**
- **Surface processes**
- **Surface Data Assimilation**

ACCORD Surface Work Meetings

Working weeks and monthly meetings are important events to share progress among colleagues.



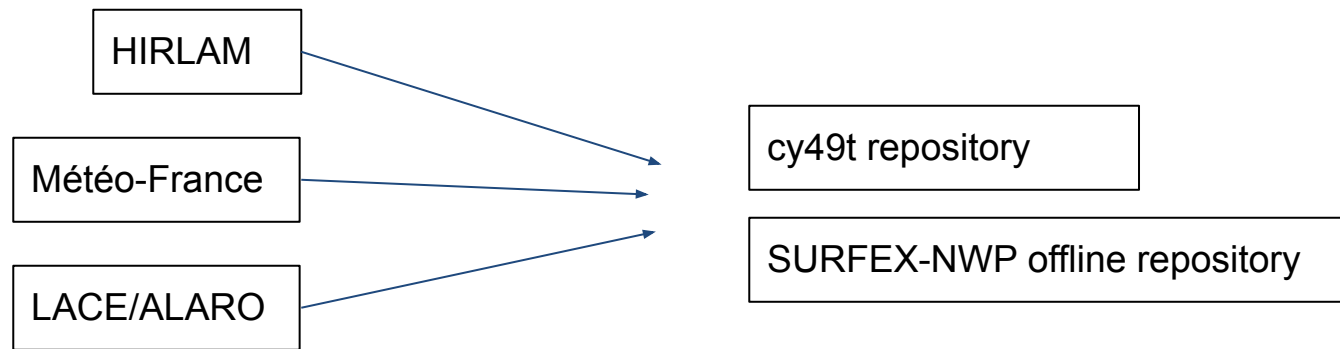
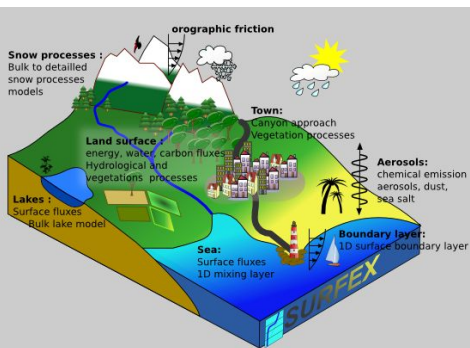
ACCORD Surface Working week in May 2023 at SMHI, Norrköping, Sweden. 19 participants at site and 15 by remote connection.



Online-only autumn Surface Working Week in November 2022. 15-30 participants attending seven different sessions. **Next event is November 20-24 2023.**

How ACCORD surface researchers join in common code

SURFEXv8.1 code from different sub-consortia in ACCORD is now, for the first time, being merged into a common SURFEX code for NWP:

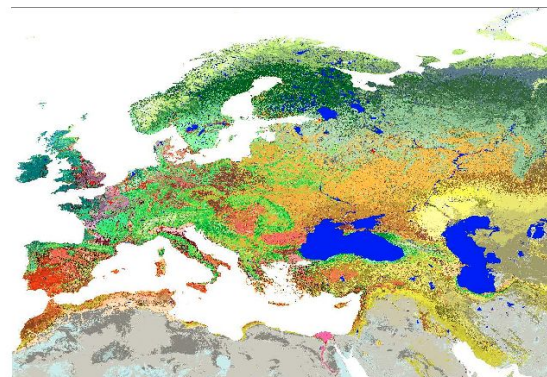


This common SURFEX-NPW code will of course be beneficial for cooperation and development among ACCORD R&D colleagues.

Land cover in ACCORD

Operationally based on ECOCLIMAP 1st (1 km) and 2nd (ESA-CCI land cover 300 m) generations. Work on alternative land-cover databases are ongoing for a couple of reasons:

- To overcome the issues with ESA-CCI land cover as already reported (e.g. too homogeneous and not representative).
- The need for even higher resolution O(50-100 m).



Thomas
Rieutord

Geoffrey
Bessardon

Ekaterina
Kurzeneva

Sandro
Oswald

Working week on ML in physiography, last October at FMI, Helsinki. A plan was developed for how to produce a **high resolution ML-based physiography map over Europe** to complement ECOCLIMAP. Based on WorldCover10 map by ESA, ECOSG, thematic maps (e.g. water, trees, grassland, ...), sentinel data, auxiliary info. Agreed resolution and projection: **60m, UTM projection**

More physiography and its processing

For the soil we have now increased interest in **SoilGrids** (global gridded soil information) published by

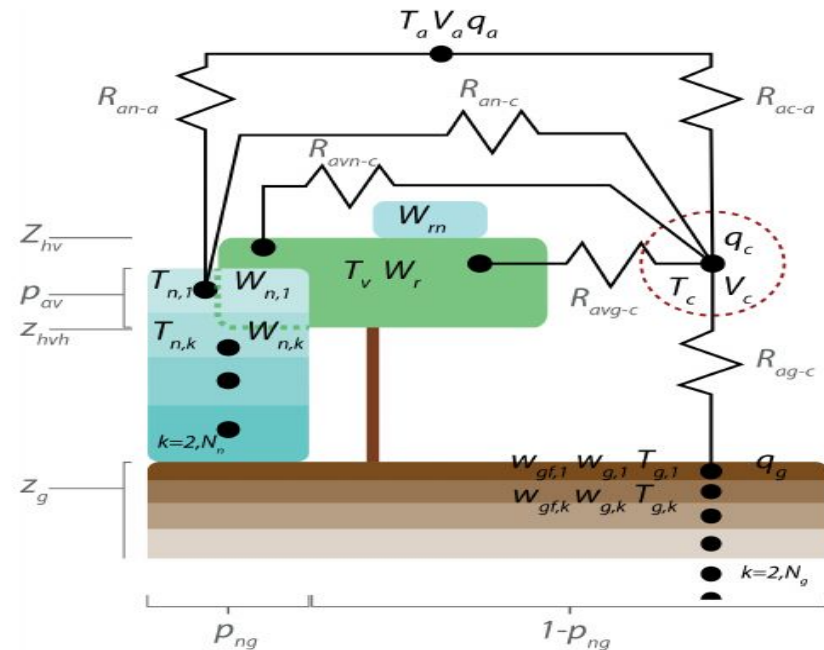


SoilGrids provides content of e.g. sand, silt, clay and soil organic carbon at 250 m global resolution. SURFEX can now also utilize its vertical discretization (6 levels).

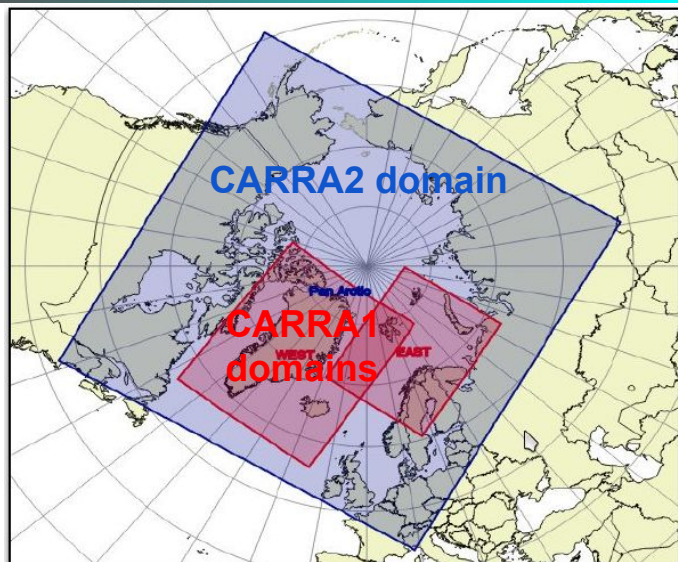
During the last year the processing of physiography data has been given much attention by ACCORD members. Bigger domains (grid points) and need for faster processing has initiated work on increased efficiency of processing (the SURFEX PGD step) and alternative formats of databases (PGD input), especially with respect to land cover (ECOCLIMAP).

SURFEX multi-layer land processes for NWP

- ❑ All ACCORD operational NWP systems are still running the 2-3 layers Force-Restore soil scheme together with the 1-layer D95 snow scheme.
- ❑ But we see more and more setups where the multi-layer surface physics options enter, i.e. the combination of the [14-layer diffusion soil scheme](#), the [12-layer explicit snow scheme](#) and the [explicit canopy \(Multi-Energy Balance\)](#).
- ❑ Apart from evaluation of the multi-layer surface physics over a few operational ACCORD domains we also apply this setup in a couple of projects...



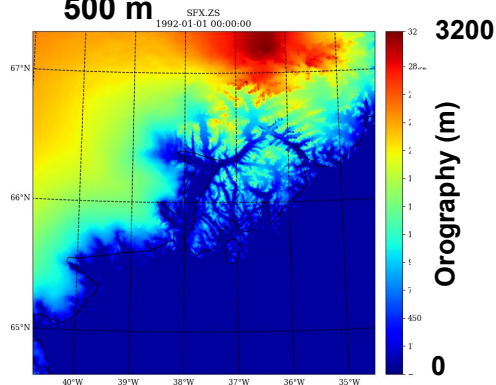
SURFEX multi-layer land processes for NWP



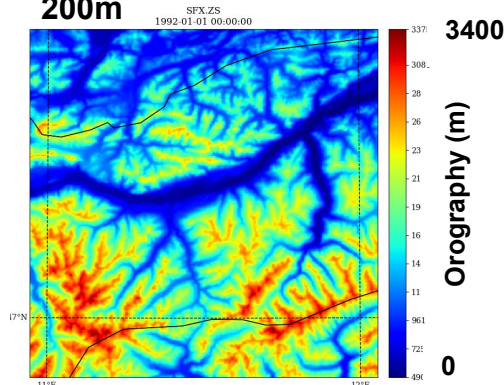
For the [CARRA2 pan-Arctic reanalysis project](#) the multi-layer surface setup is used. One motivation for this is that sparse near-surface observational data (for assimilation) asks for better description of physical processes.

The agreed surface for [Destination Earth On-Demand Extremes Digital Twin](#) setups is the multi-layer physics. Two of the test domains are:

Tasiilaq, Greenland,
500 m



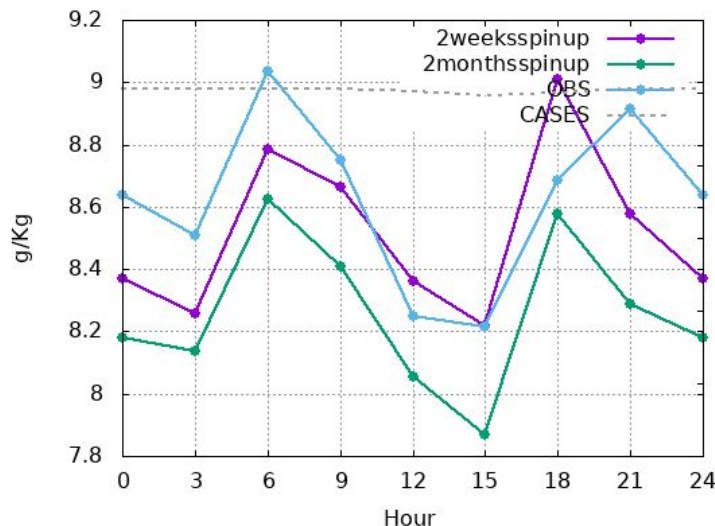
Innsbruck, the Alps,
200m



SURFEX multi-layer land processes for NWP

As usual, when moving towards new process descriptions in NWP setups, we struggle with some identified biases that we need to deal with. For example, currently the multi-layer physics setup, in combination with SEKF surface assimilation, suffers from dry near-surface conditions during summer.

Validation of the Q2m diurnal cycle against 23 SYNOP stations over northern Germany in July 2022:



- An **experiment with 2 weeks sinup** shows a dry bias compared to **observations**.
- A **longer spinup experiment, 2 months**, gives even drier conditions!?!
- Hmhm, could it be so that the standard setup dries out the soil via bare-soil evaporation...
- A sensitivity experiment with increased vegetation cover for crops (~60% → 95%) is on its way...

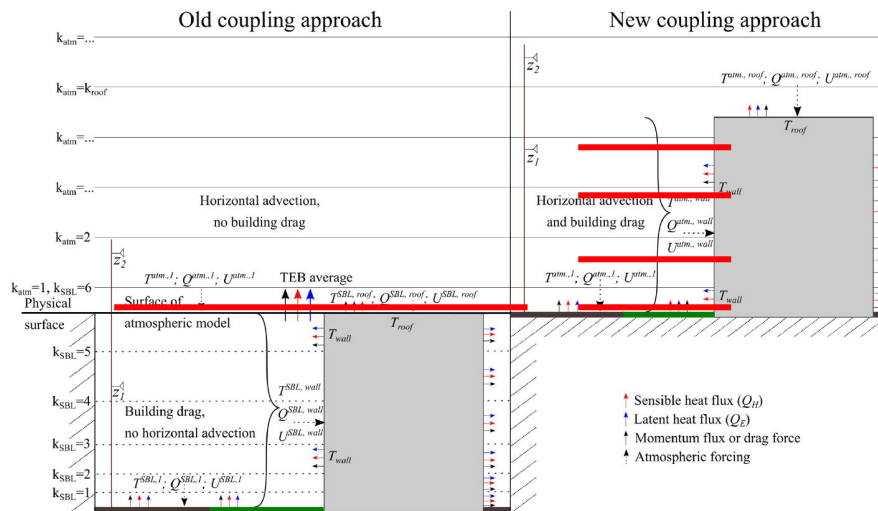
All experiments use ECMWF highres IFS for initial conditions. I.e. TESSEL layers for the soil.

SURFEX Town-Energy Balance

Multi-layer coupling between SURFEX-TEB and atmospheric levels have already been developed in Meso-NH for urban high-rise cities.

This development does now continue in the AROME NWP system by Belgian and Dutch colleagues:

Today the ACCORD NWP atmosphere and surface (SURFEX) have a strict interface **at the lowest atmospheric model level** where state variables and fluxes are interchanged.



In the new coupling approach urban buildings interact with **a number of the lowest atmospheric model levels** depending on their height.

Surface data assimilation

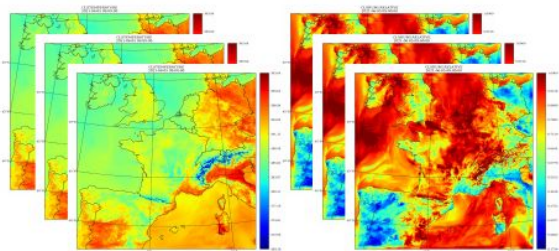
All ACCORD operational NWP systems, except one, are still running the OI analysis and OI soil assimilation scheme.

Hungary is running SEKF for the soil.

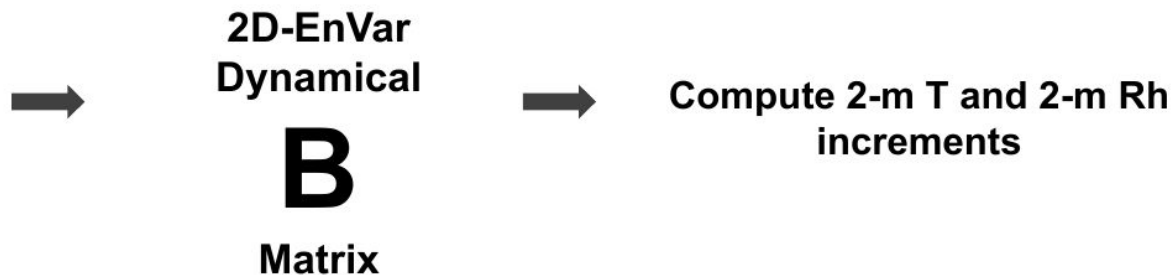
But we have development activities in e.g. 2D-EnVAR and EnKF...

Ensemble approach for surface analysis in AROME-France

- 1) Implement a **2D-Variational approach** to replace the 2D-OI surface analysis (constant B-matrix)
- 2) Use AROME-France EDA to implement a **2D-Ensemble Variational** surface scheme



2-m T and 2-m Rh fields
EDA AROME 50 members



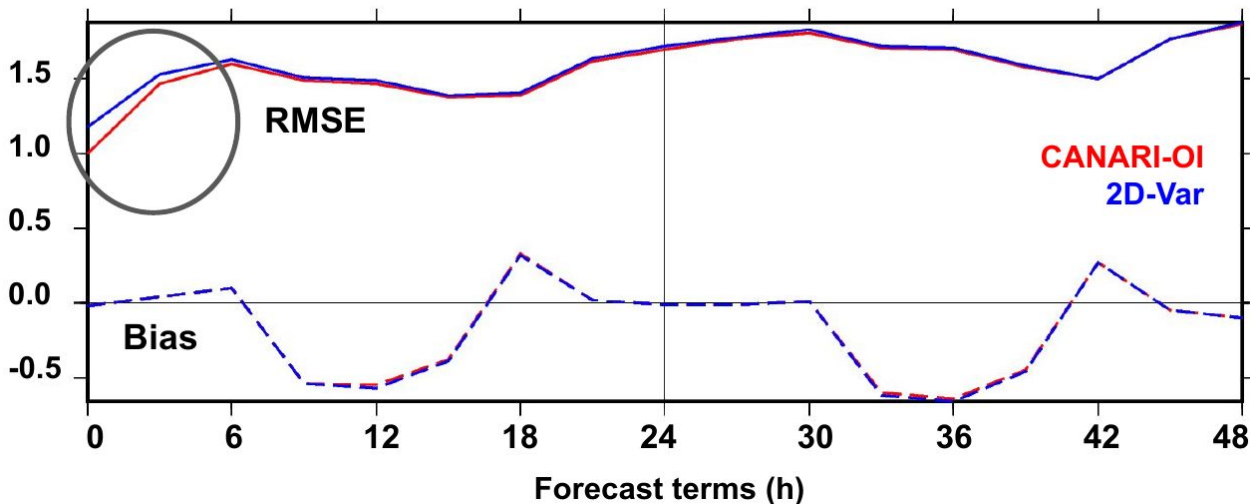
Sophie Marimbordes, Camille Birman, Nadia Fourrié, Etienne Arbogast, Jean-François Mahfouf

Ensemble approach for surface analysis in AROME-France

Forecast Bias and RMSE over 2 months using surface station observations : 7/ 09/ 2021 - 5/ 11/ 2021

2-m temperature over FRANCE

Temperature (K)



Between 0 - 6 h :
slight degradation
for 2D-Var

CANARI-OI and
2D-Var **similar**

**2D-Var : robust
results**

**2D-EnVar
gives similar
results**

Sophie Marimbordes, Camille Birman, Nadia Fourri , Etienne Arbogast, Jean-Fran ois Mahfouf

EnKF assimilation of Sentinel-1 backscatter



Soil moisture retrievals from Sentinel-1 are provided over Norway and assimilation of backscatter (VV and VH polarisation) is evaluated in an HARMONIE-AROME NWP setup

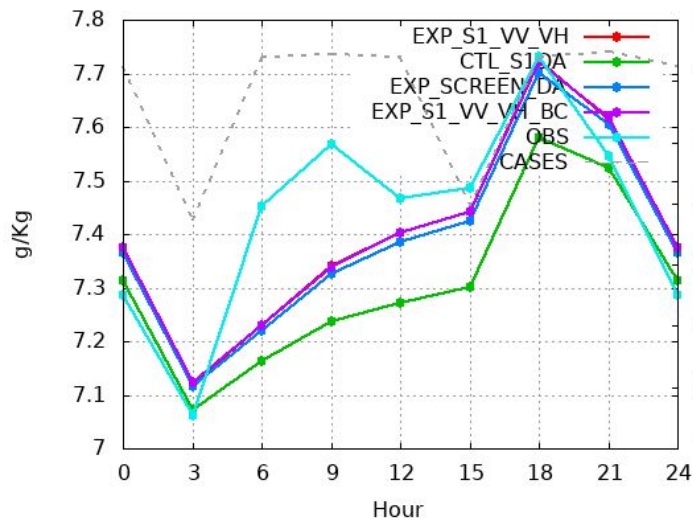
The applied observation operator is a machine-learning based K-nearest neighbors model.

- **Experiment setup is based on MetNorway AROME-Arctic with EnKF implementation, with multi-layer surface physics, pySurfex and 3D-VAR (Conv obs + AMSU-A, MHS, IASI, Scat.)**
- **Small domain over southern Norway**
- **Time-period 1st August 2021 - 1st September 2021**

Jostein Blyverket, Åsmund Bakketun, Trygve Aspelien at MET-Norway

EnKF assimilation of Sentinel-1 backscatter

Q2m mean diurnal cycle Aug 5-31 2021
(validation against 94 SYNOP stations)



- Observed Q2m
- SEKF assimilation of SYNOP observations
- EnKF assimilation of SYNOP observations
- EnKF assimilation of SYNOP observations and backscatter

EnKF assimilation gives better Q2m diurnal cycle than EKF (reason not yet understood). Very slight improvement with backscatter on top of SYNOP.

Jostein Blyverket, Åsmund Bakketun, Trygve Aspelien at MET-Norway

Agenda of Parallel session on surface aspects

Wednesday 08:45 - 10:30 UTC

- **Patrick Samuelsson and Sandro Oswald: “Status of the C-SRNWP project on ESA-CCI land cover”**
- **Jan-Peter Schulz**, P. Mercogliano, M. Adinolfi, C. Aprea, F. Bassani, E. Bucchignani, A. Campanale, D. Cinquegrana, R. Dumitrache, G. Fedele, V. Garbero, W. Interwicz, A. Iriza-Burca, A. Jaczewski, P. Khain, Y. Levi, B. Maco, A. Mandal, M. Milelli, M. Montesarchio, M. Raffa, A. Reder, L. Uzan, H. Wouters and A. Wyszogrodzki: **“A new urban parameterisation for the ICON atmospheric model”**
- **Rafiq Hamdi: “Implementing drip irrigation underneath plastic mulch in SURFEX: application on a typical Mountain-Oasis-Desert System in Northwest China”**
- **Samuel Viana and Metodija Shapkalijevski: “Testing the roughness sublayer in SURFEX: Implications for vegetation- atmosphere coupling”**
- **Discussion**



THANKS!