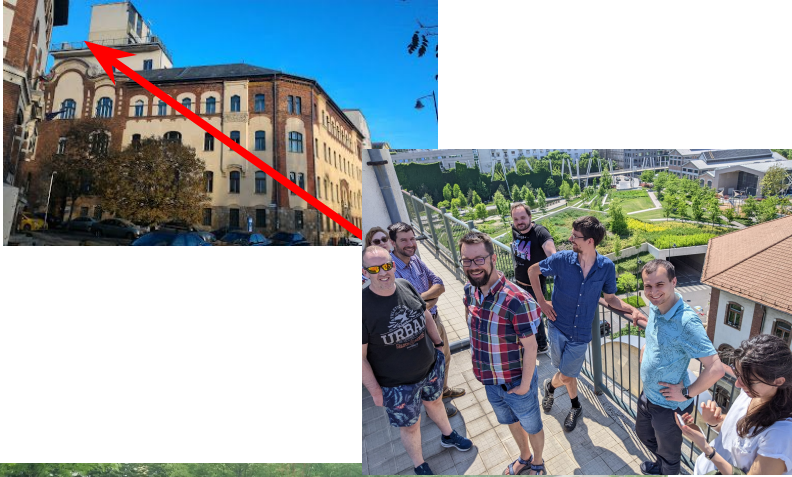


A Consortium for CONvection-scale modelling  
Research and Development

## **ACCORD surface activities**

Patrick Samuelsson, 2023-03-27, All Staff Workshop, Tallinn

# ACCORD NWP SURFEX training in Budapest last May



We were kindly invited by OMSZ to enjoy a May week in Budapest for our NWP SURFEX training. It was a hybrid meeting with 12 participants on site and some 30 remote. [Link to wiki page here.](#)

The agenda included a number of lectures, training activities and discussions on how to proceed with SURFEX for our NWP needs.

A lot of material is available and the wiki has been used by newcomers after the training to achieve some first introduction and exercises of SURFEX. Thus, **the material is still relevant and useful!**



# Autumn ACCORD Surface online Working Week last November

All presentations available as pdf:s or with links to them [at the wiki](#).

Also, BlueJeans recordings are available.

Seven sessions (15-30 people attending each session):

- Surface-atmosphere energy exchange and diagnostics including stable BL issues.
- Surface data assimilation
- New development and experiences with multi-layer surface physics (DIF, ExplSnow, MEB) and vegetation (A-gs)
- Urban - Town Energy Balance
- Physiography and ECOCLIMAP
- Technical SURFEX aspects for PGD, PREP, Forecast and SODA steps
- Snow-related development



# Next ACCORD Surface Working week at SMHI in May



**Welcome to join the ACCORD Surface Working week at SMHI during the days May 22-26:**

- **Plenum presentations in hybrid format.**
- **Working teams on different subjects.**

**[See wiki for more information.](#)**

**Please sign up via the wiki latest May 1st.**

**The meeting is co-arranged with the [NordSnowNet](#) project.**

# Towards common SURFEX code in ACCORD



Integration leader, system and surface ALs celebrating progress :-)

During All Staff in Ljubljana we achieved to reach the first version of the [common SURFEX code](#) under the ACCORD-NWP GitHub environment.

Since then Adrien, Yurii and Patrick have succeeded to merge together HIRLAM and Météo-France versions of SURFEXv8.1 and we can now reproduce cy46h and cy48t AROME behaviours with this code. A few updates still remain to reach latest version of h-cycle in this common code. After that we will continue with other contributions.

The plan is that this code will be in sync with the SURFEX version used for cy49t. Here also the LACE SURFEXv8.1 contributions will enter.

# Towards common SURFEX code in ACCORD

The [common SURFEX code](#) is hosted under the ACCORD-NWP GitHub environment. There is a very careful and well defined procedure in how to contribute with code development to the ACCORD-NWP GitHub environment.

A careful code contribution procedure makes common code development safe and consistent. **The surface side meeting on Thursday afternoon will be a training devoted to this general procedure with focus on the common SURFEX repository.** [See this wiki for more details.](#)

Important components still to be developed and decided:

- A suitable test environment for the NWP SURFEX contributions.
- A team of code managers.

## How do we proceed with surface activities in ACCORD:

- **Physiography**
- **Physical processes**
- **Observations and data assimilation**

# Physiography



## Working week on ML in physiography, last October, FMI

**Involved people: Geoffrey, Thomas R., Sandro, Olli, Ekaterina, Thomas V., Emily, Bolli, Kristian, Margarita, Natalie**

**A plan was developed for how to produce a high resolution ML-based physiography map over Europe to substitute ECO SG.**

**Data to be used: WorldCover10 map by ESA, ECO SG, thematic maps (e.g. water, trees, grassland,...), sentinel data, auxiliary info.**

**Agreed resolution and projection: 60m, UTM projection**



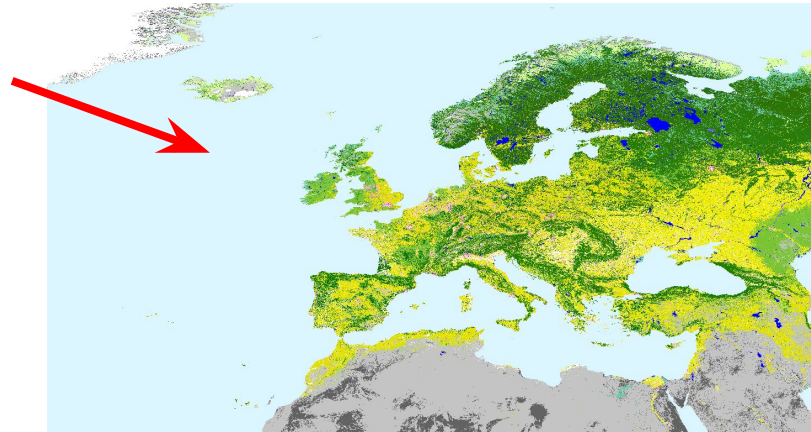
# Physiography

The VHR domains and domains with many grid points (like 3000 x 3000) in combination with ECOCLIMAP Second Generation have created a problems with

- very long PGD processing on 1 core
- very big PGD file, more than 200 GB

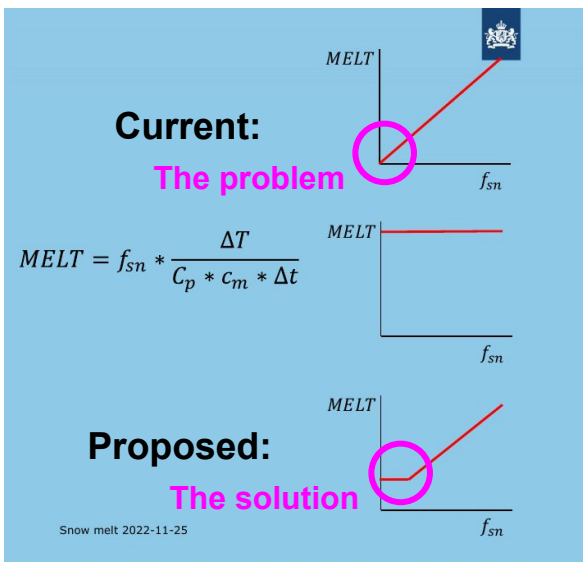
Solutions are presented and discussed:

- PGD can be ran with MPI multi-core setup which reduces processing time considerable
- Input to PGD is reduced to cut-out regions (ongoing work by Bolli).
- Idea to divide the PGD output file into many smaller files (e.g. one for each decade, 10 days)



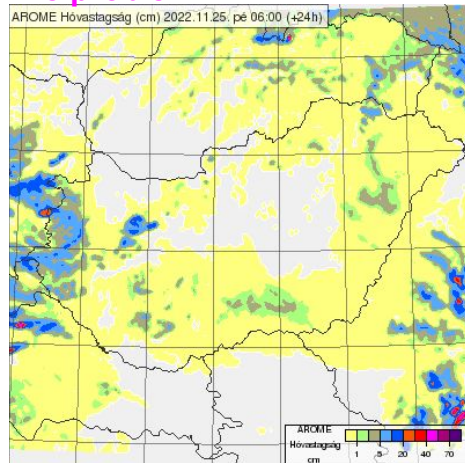
# Physical processes - snow melt in D95 snow scheme

Sander Tijm and Michael Adriaens (KNMI, the Netherlands): **Melting the last few cm of snow with D95 snow scheme**. A long-lasting problem in ACCORD operational systems where no snow data assimilation is used (outside MetCoOp).

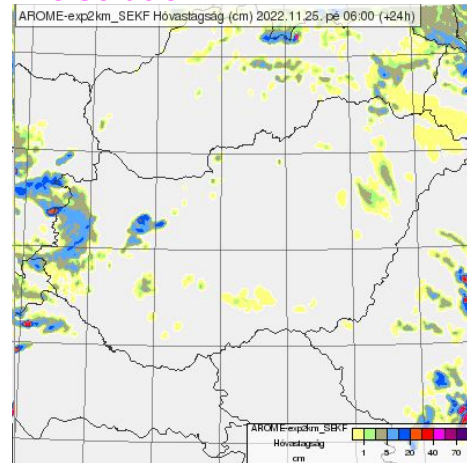


Test reported by Baláz: Snow depth [cm] in AROME-Hungary on 25th November 2022 at 06 UTC (+24h forecasts).

The problem



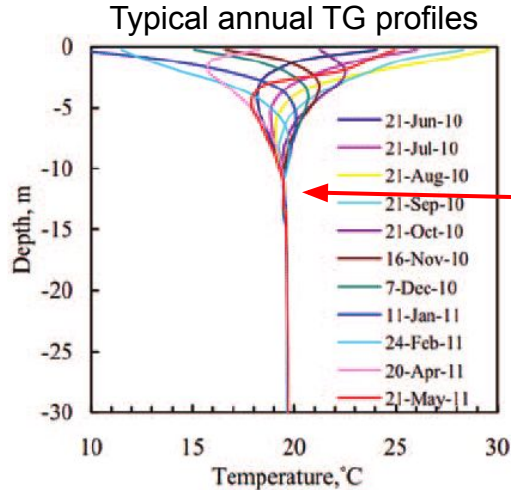
The solution



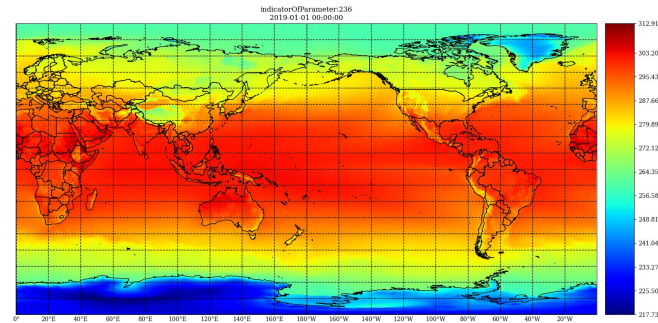
Reality: no snow over the Eastern part of Hungary

# New development and experiences with multi-layer surface physics (DIF, ExplSnow, MEB)

Improved cold start profile for the 14-layer dussion soil scheme:

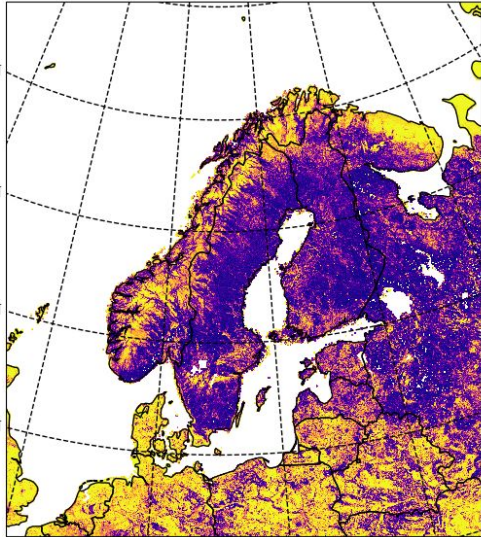


Current IFS TESSEL scheme reaches 3 m depth which is not enough to initialize the deep layers of the 14-layer DIF scheme (mid depth of deepest layer is 10 m).



Solution worked on: Use ERA5 TESSEL deep soil multi-year (3 years) mean value at 10 m.

# New development and experiences with multi-layer surface physics (DIF, ExplSnow, MEB)



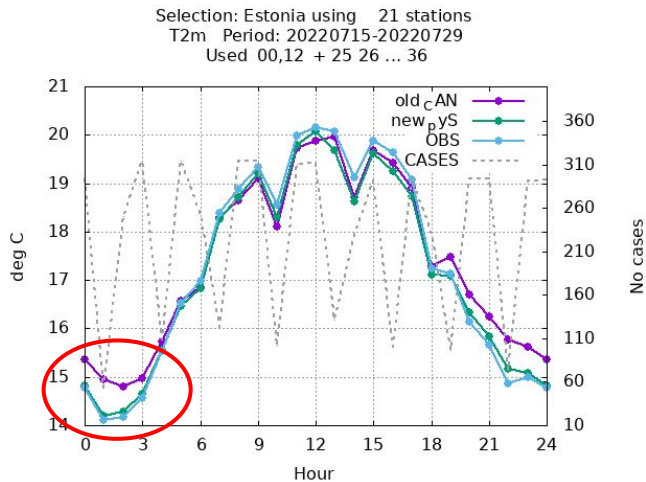
During the period September-January the HARMONIE-AROME cy46h experiment with new surface physics was on break. The ECMWF cca machine was retired in September and the setup was not running smoothly at new Atos machine until February. Now experiment activities are resumed...

The setup includes SURFEXv8.1 for the surface with ECOCLIMAP Second Generation. 2 patches (forest and open land), Diffusion soil scheme (14 layers), Explicit snow scheme (12 layers), Explicit canopy (MEB). This is also the agreed Deode surface setup.

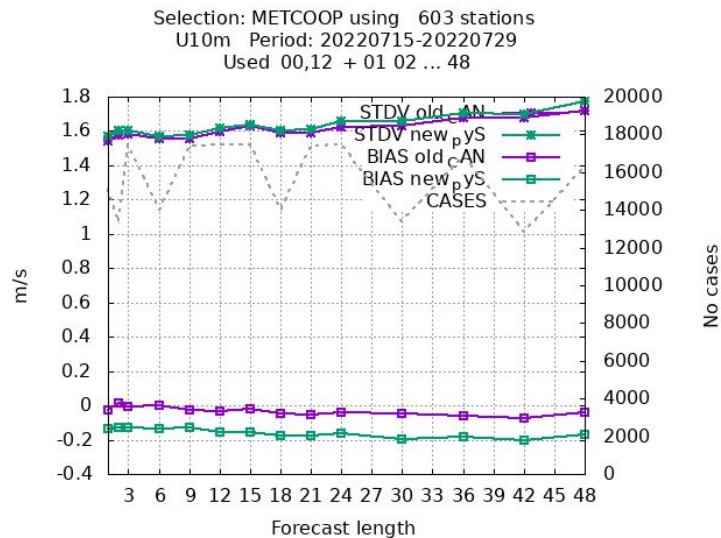
In addition cy46h uses pySurfex and SEKF for surface assimilation (not used by Deode).

# New development and experiences with multi-layer surface physics (DIF, ExplSnow, MEB)

## A couple of features from running experiments



Increased T2m summer diurnal cycle due to colder (better compared to **observations**) nighttime temperature with **new physics** compared to **ForceRestore**. Here example from Estonia area.



**New physics** shows lower (worse) U10m compared to **ForceRestore**. Here example from whole MetCoOp domain. Hmm, not easy to understand... maybe due to different stability in surface layer... As usual, to achieve good U10m tuning is needed (tree height,...)

# Surface data assimilation

Operationally, OI surface assimilation is still our working horse in most setups with assimilation.

Circumstances decide how short-medium term solutions beyond OI look in our consortia:

Ensemble NWP system:  
OI for soil with EPS-coeff.

**Météo-France**

Ensemble NWP system:  
EnKF-based solution

**MetNorway**

Deterministic and Ensemble NWP system:  
(S)EKF-based solution

**MetHungary  
GeoSphere Austria  
HARMONIE-AROME**

Crowd-sourced focus:  
TITAN/gridPP spatialisation

**MetCoOp nowcasting system (pySurfex and Netatmo)**

Less weakly coupled atm-surface assimilation

**Roel and Katya leading RT9 Coupled Atmosphere-Surface DA**

OI soil for the diffusion soil scheme

**Special Deode case**

# Surface data assimilation

Jean-Christophe Calvet and Bertrand Bonan (SURFEX team): Sequential assimilation of **LAI**, root-zone soil moisture analysis from assimilation of **LAI**, assimilation of snow water equivalent, assimilation of microwave Vegetation Optical Depth, assimilation of radiances using **Machine Learning**.

Stefan Schneider, Polly Schmederer, Sandro Oswald (GeoSphere Austria): New approach in assimilation of **LAI** using 12 patches in SURFEX: provide specific observed LAI for broadleaf, needleleaf, grassland in grid cell instead of only one average LAI.

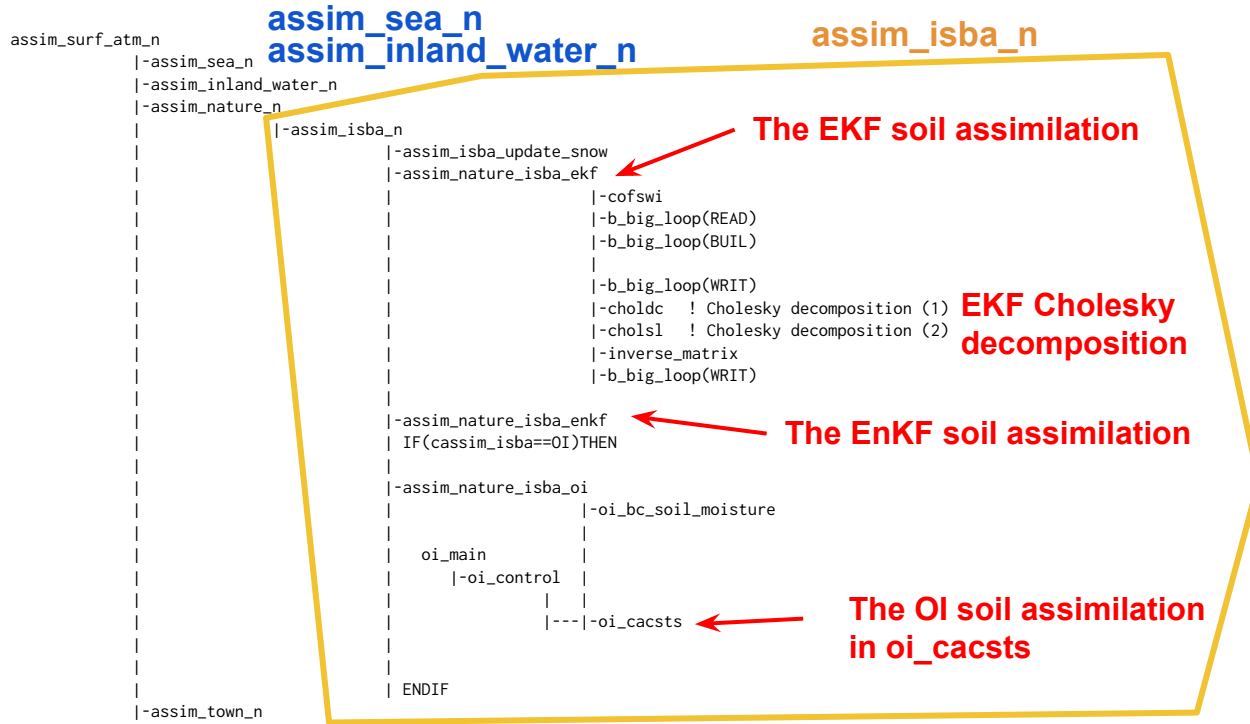
Helga Toth (OMSZ, Hungary): **SEKF in the Hungarian AROME deterministic** and AROME EDA EPS system.

Åsmund Bakketun (MetNorway): **Monitoring of the SEKF** in AROME-Arctic preop2.

Jostein Blyverket, Åsmund Bakketun and Trygve Aspelien (MetNorway): **Exploring machine learning methods for observation operators** (to be applied in the EnKF).

**Summary verification scores show very small differences between the EnKF and SEKF** (short time-period). Small differences also seen in data assimilation diagnostics (for TG) over a limited time-period.

# Surface data assimilation - the SODA call tree



Currently, in SODA, the **algorithms** are integrated in the **isba** tile. Better would be to separate the algorithms from the tile.

Also, as shown in last slide, SODA is currently developed separately for different purposes by different groups and there is quite some diversity in codes.

Therefore, a SODA development focus is on the agenda for the May surface WW.



# THANKS!!



**SURFEX training in Budapest last May**



**Virtual Surface WW  
last November**

# Physical processes - snow melt in D95 snow scheme

Eric Bazile and Patrick Samuelsson identified a problem with unrealistic snow melt occurring after initial cold start in a VHR setup over Austria. The ground temperature (TG1) was negative while T2m was positive.

Karl-Ivar Ivarsson (SMHI) has implemented a fix for this (D95\_ZTN\_LIMIT) in the h-cycle:

In the h-cycle, with D95\_ZTN\_LIMIT=.T., snow melt cannot occur if TG1 is frozen.

```
IF ( D95_ZTN_LIMIT ) THEN
    ZTN(:) = MIN(PEK%XTG(:,1), (1.-PEK%XVEG(:))*PEK%XTG(:,1) + PEK%XVEG(:)*PT2M(:))
ELSE
    ZTN(:) = (1.-PEK%XVEG(:))*PEK%XTG(:,1) + PEK%XVEG(:)*PT2M(:)
ENDIF
```

In default setup, only T2m decides snow melt for 100% vegetated ISBA tile. Melt occurs independent of TG1.  
Can drop TG1 unrealistically since the energy is still taken from the soil.