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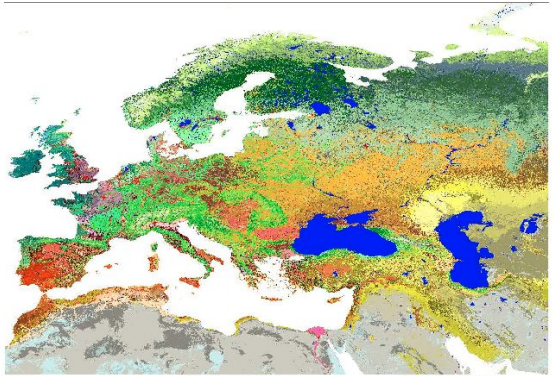
A Consortium for COnvection-scale modelling Research and Development

ACCORD Overview of Surface activities

Patrick Samuelsson and Ekaterina Kurzeneva, 2022-09-29,
44th EWGLAM and 29th SRNWP Meeting

Land cover in ACCORD

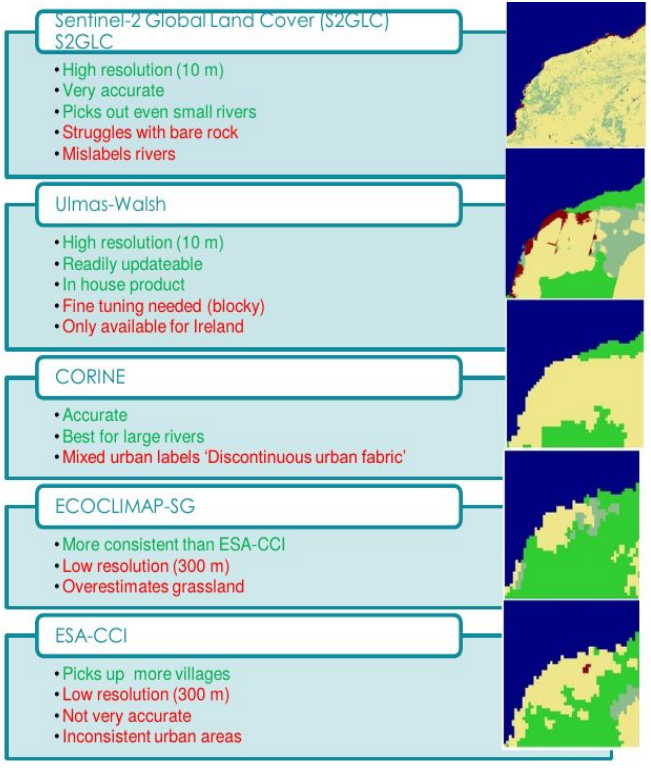
- Operationally based on ECOCLIMAP 1st (1 km) and 2nd (ESA-CCI land cover 300 m) generations.
- The 2nd generation one comes with parameter maps (LAI, albedo, …). Lately efforts have been made to complement these parameter maps for the Arctic area where many parameters were missing in the original maps.
- During the last year work on alternative land-cover databases has been intensified for a couple of reasons
  - To overcome the issues with ESA-CCI land cover as reported last year (e.g. too homogeneous).
  - The need for even higher resolution O(50-100 m).



New high-resolution European land cover for ACCORD

Development by Geoffrey Bessardon et al. (Met Éireann)

- Many options available and new maps are appearing regularly
- None of the maps have the same labels as ECOCLIMAP-SG
- Machine learning maps are of higher resolution and are quite accurate
- No existing land-cover product can be set as a substitute to ECOCLIMAP-SG without modifications



Suggested way forward

Create a framework, flexible enough, for future data input:

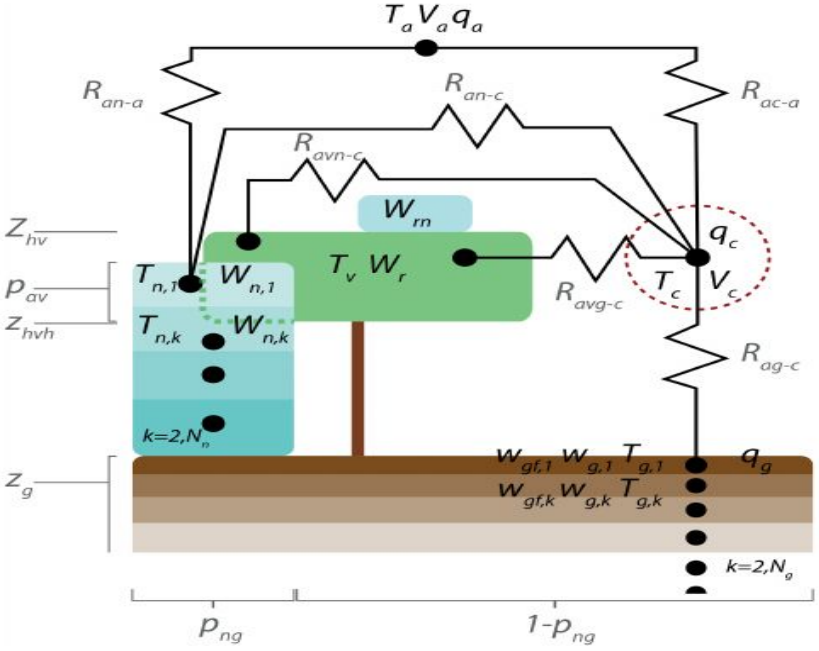
- Translate a background map into primary label
- Choose additional maps for the identification of each label (i.e bare land, DEM, urban density, phenology data)
- Run identification tasks
- Merging the map with some decision making using the confidence map

The European NWP goes towards multi-layer land physics

	SURFEX ForceRestore	SURFEX DIF/ExplSnow/MEB	COSMO-TERRA	ECMWF-ECLand
Soil	2 layers for temp, 3 for water	14 layers to 12 m depth for temp, water levels defined by root depth	8 layers to 21.9 m depth	10 layers to 8 m depth
Snow	Bulk 1 layer	12 layers	SNOWPOLINO 25 layers	1-5 layers
Vegetation	Composite veg/soil	1 layer canopy with expl energy balance + surface litter layer	2 layer canopy (leafs and trunk)	1 layer canopy for forest
Land tiles	1-MAXPATCH (19/20)	1-MAXPATCH (19/20)	Three dominating tiles in ICON	7 (including lake)

SURFEX Land - Towards multi-layer physics in NWP

- Since last year the exploration of multi-layer nature physics has been intensified.
- Combinations of the 14-layer diffusion soil scheme, the 12-layer explicit snow scheme and the explicit canopy (Multi-Energy Balance) is running over a few domains:
  - Pre-operational over the Norwegian Arctic domain since Sept 2019.
  - For evaluation towards operation over Nordic, Irish and Spanish domains.
  - For evaluation over the French domain.
  - Offline in Austrian domain.
  - Planned for pan-Arctic reanalysis project CARRA2.



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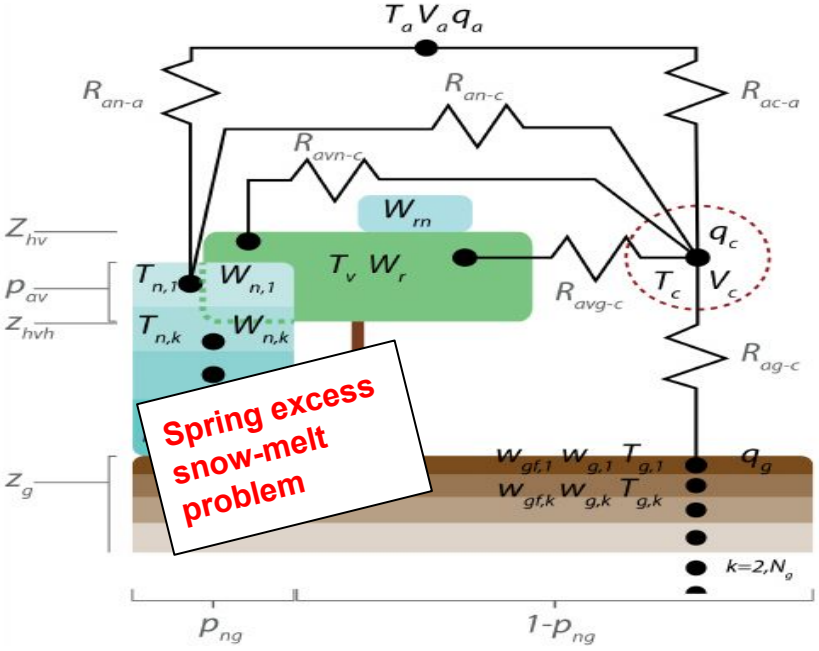

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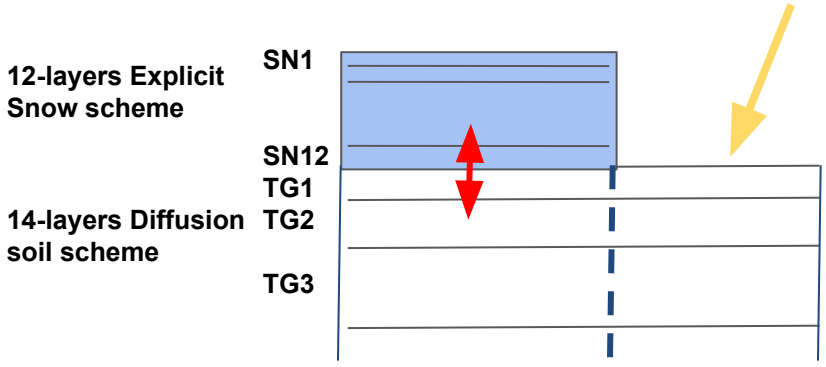
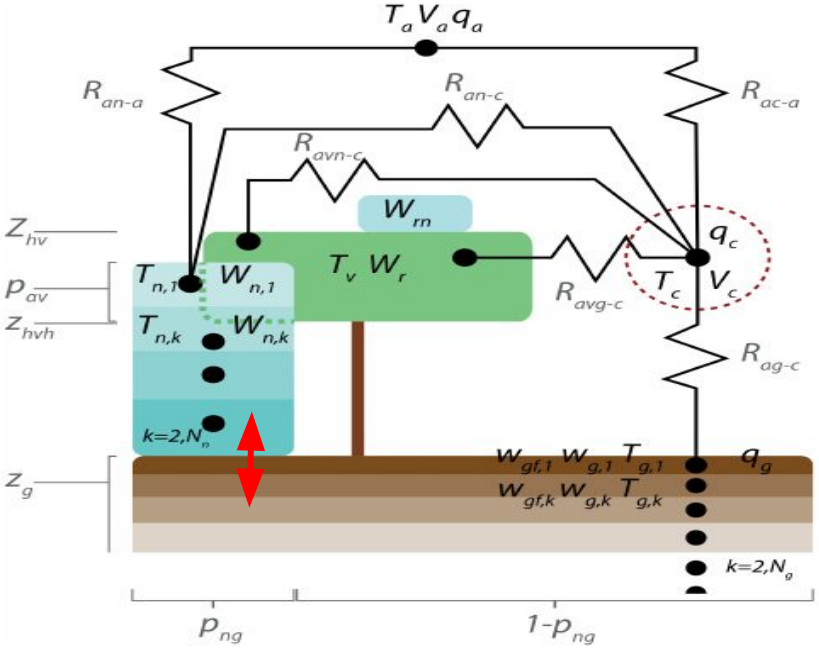
SURFEX Land - Towards multi-layer physics in NWP

- Until now the soil column has been shared for snow-covered and non-snow covered surfaces which leads to excess snowmelt in spring time.



- A separation of the soil columns is now planned.



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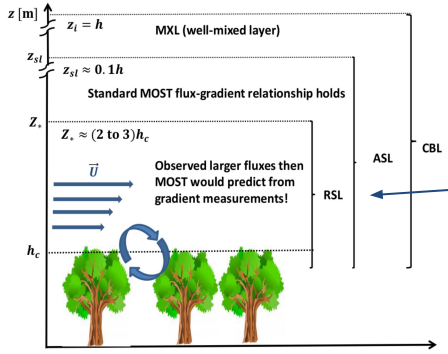
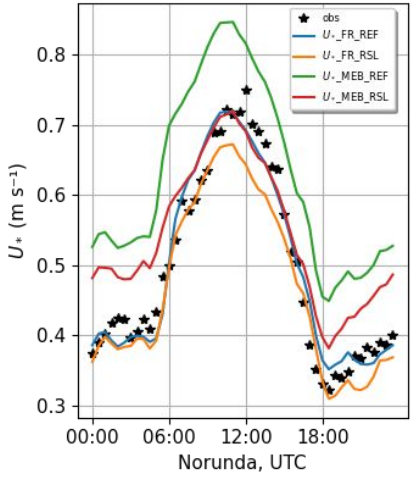
SURFEX Land - Roughness sublayer

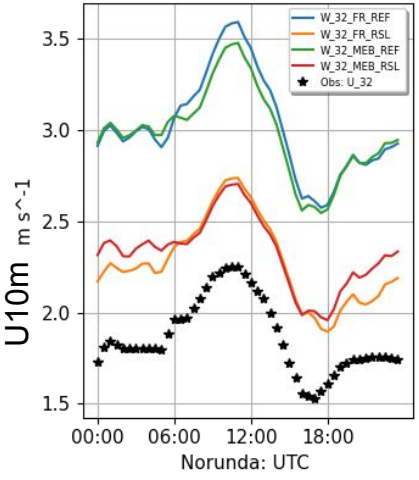


ACCORD colleagues Metodija Shapkalijevski (SMHI) and Samuel Viana (AEMET) are implementing and testing the [Harman & Finnigan (2007)] Roughness SubLayer model in SURFEX.

Forest OFFLINE: Force restore (+RSL) vs MEB (+RSL)

- Confirmed (with respect to ACCORD newsletter#2 results) improvement in flux-gradient relationships over forest
- Forced and validated using data from 4 ICOS sites: flux, radiation, wind, temperature/humidity measurements at several levels **above canopy**
- Largest effects on friction velocity and wind above canopy (diagnostics)





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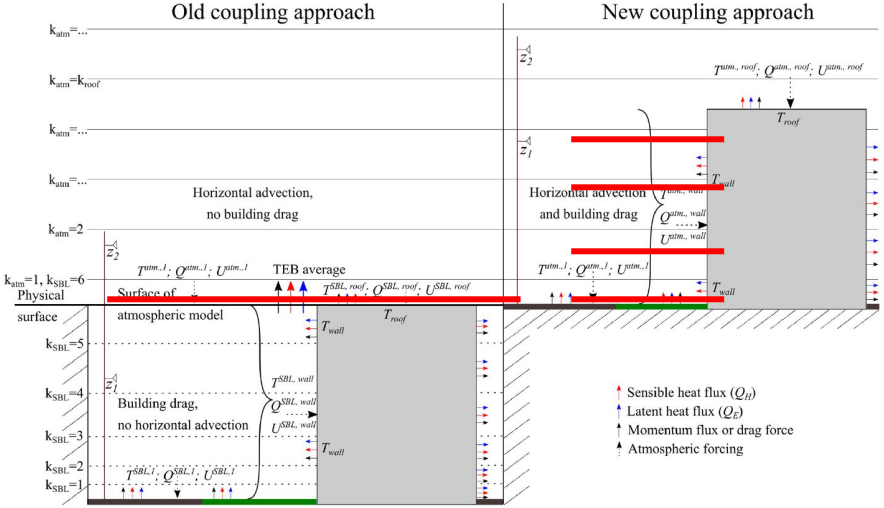
SURFEX Town-Energy Balance

Multi-layer coupling between SURFEX-TEB and Meso-NH atmospheric model for urban high-rise cities (Schoetter et al. 2020, doi: 10.5194/gmd-13-5609-2020)

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.

Two positions dedicated to implementing this concept in AROME are now being arranged. One at RMI in Belgium and one at KNMI in the Netherlands.

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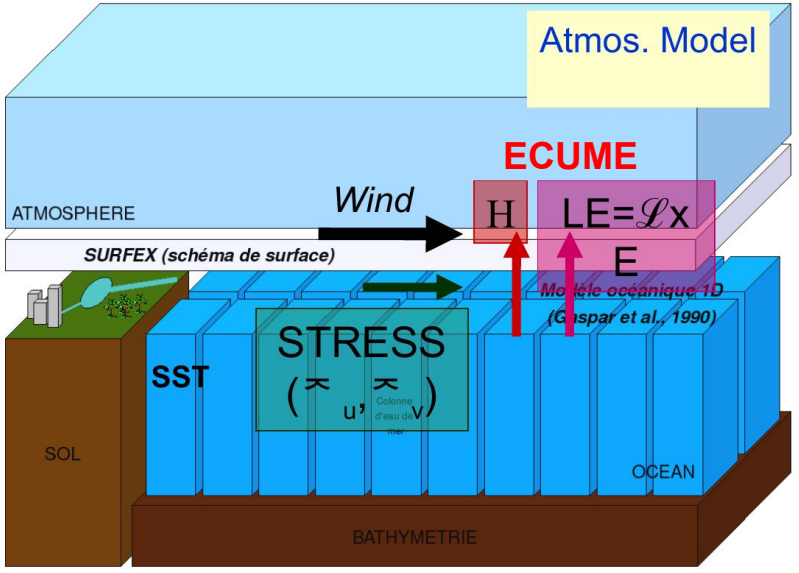
SURFEX Ocean - surface fluxes and 1D column

- The dominating operational method is to prescribe SST from different sources.
- The surface fluxes are parametrized, mostly by the so called ECUME schemes. The latest ECUME scheme is now being evaluated in our NWP systems using observed fluxes.
- We know that constant SST during the forecast has a detrimental effect on some weather events (e.g. tropical storms and convection). Prognostic SST (SURFEX 1D ocean component) has been activated by Météo-France for some low-latitude domains and is now being evaluated also for other domains.

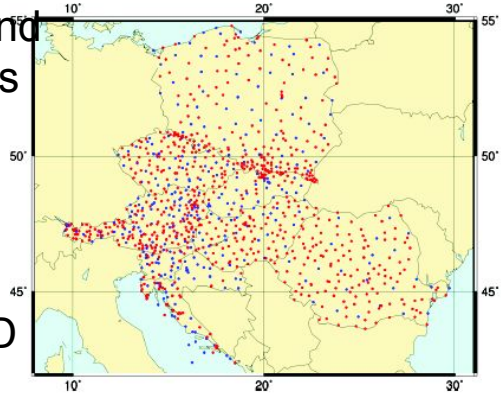


How ACCORD surface researchers join in common code

- Although ACCORD share the NWP system and code, the code development itself has not been continuously shared among all developers but only intermittently through phasing activities in each cycle update.
- However, since April this year we have a shared NWP repository of the surface code (SURFEX). This repository is currently being updated with contributions from different sub-repositories.
- This shared repository is available for contributions for all ACCORD NWP SURFEX developers and will be used to build new cycle releases.

Land surface DA: CANARI / OI_MAIN setup

- CANARI: OI to perform the horizontal analysis of T2m, RH2m and snow from SYNOP and SHIP observations. Correlation functions may depend on distance, diff. in height and land/sea fraction.
- OI_MAIN: OI to perform the vertical analysis of superficial and deep soil temperature and moisture of ISBA model (mainly, ISBA-FR).
- CANARI+OI_MAIN setup runs operationally in most of ACCORD countries.

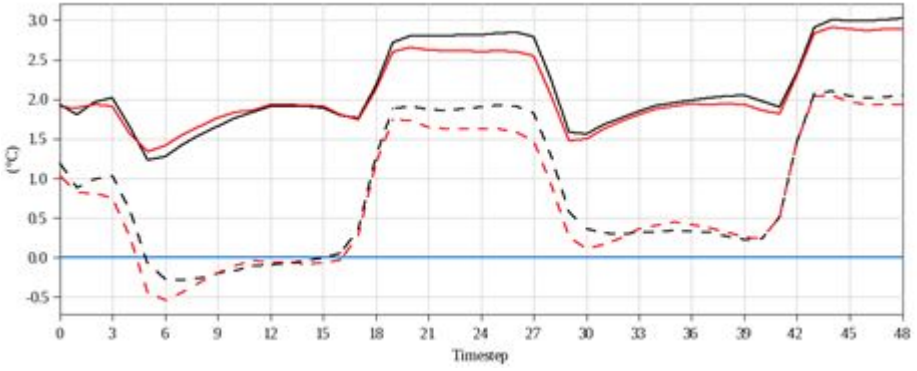


- Belgium runs CANARI+OI_MAIN setup in Rapid Update cycle.
- LACE countries tested different correlation functions of CANARI against national dataset and formulations of OI coefficients in vertical depending on zenith angle (Czech Rep.).
- Morocco and Turkey are testing CANARI+OI_MAIN setup to run it operationally.

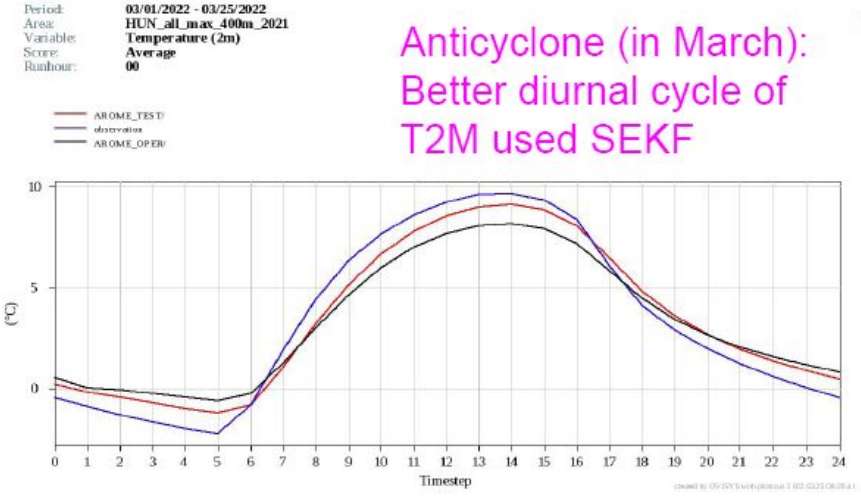
Land surface DA: CANARI / SEKF setup

- CANARI: OI to perform the horizontal analysis.
- SEKF to perform the vertical analysis of superficial and deep soil temperature and moisture of ISBA model (ISBA-FR).
- CANARI/SEKF runs operationally in Hungary since 29.07.2022

by H. Toth



Exp. May 2022: improved T2m scores and high precipitation scores



Anticyclone (in March): Better diurnal cycle of T2M used SEKF

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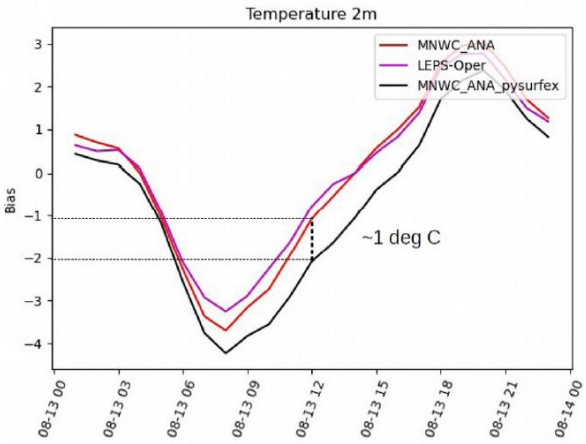
Land surface DA: gridPP / OI_MAIN setup

- pysurfex/gridPP/Titan: alternative OI software to perform the horizontal analysis of T2m, RH2m and snow from SYNOP observations. Based on max. probability. Anticorrelation functions may depend on distance, diff. in height. Modular QC, handy for tuning. Intention to use it for crowd-source observations.
- OI_MAIN: OI to perform the vertical analysis of superficial and deep soil temperature and moisture of ISBA model (ISBA-FR).
- Runs in MetCoOp nowcasting suit. No cycling.
- First experiments with NetAtmo obs showed that observations are biased and perhaps shifted in time. Currently no NetAtmo data is used, but plans are to study the problem.

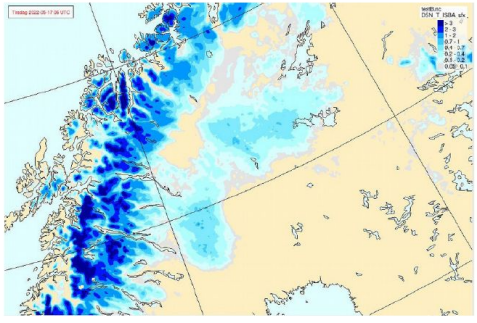
by E. Gregow

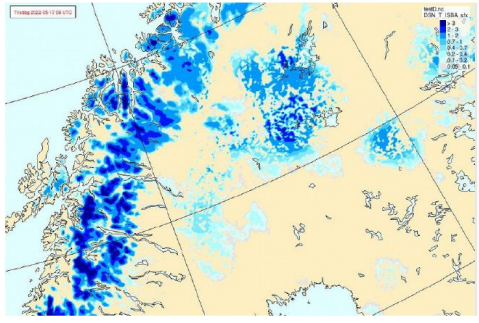


Land surface DA: gridPP / SEKF setup

- pysurfex/gridPP/Titan: for the horizontal analysis of T2m, RH2m and snow from SYNOP observations.
- SEKF to perform the vertical analysis of superficial and deep soil temperature and moisture of ISBA model (ISBA-DIF). 2 patches (low and high vegetation).
- Extensive testing in HIRLAM countries with cy46h over different domains and different seasons. Ongoing work.
- Currently struggling with too intensive snow melt in spring, patchiness in snow fields, increased U10m bias.

by M. Homleid

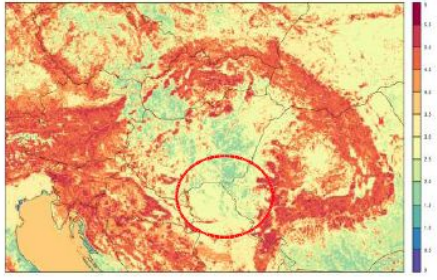




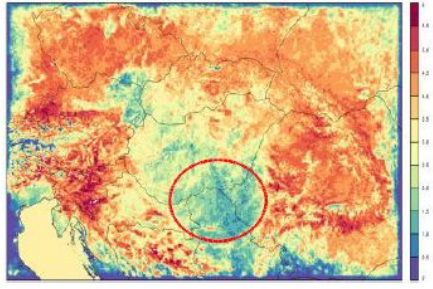
Land surface DA: assimilation of LAI

- Developments in Hungary and experimenting in Austria
- Sentinel-2 and Sentinel-3 LAI observations
- Two-stream setup: the main steam, and the additional offline SURFEX stream with the active prognostic vegetation ISBA-Ags scheme and assimilated LAI.
- LAI from the second stream is transferred to the first stream once per day.

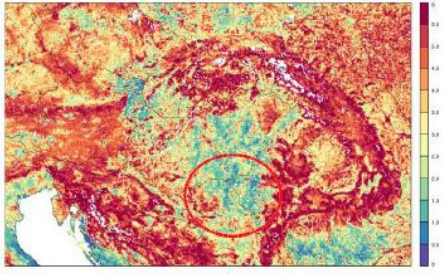
AROME-oper LAI (2.5 km) 2021-07-15



ISBA-Ags LAI (2.5 km) 2021-07-15



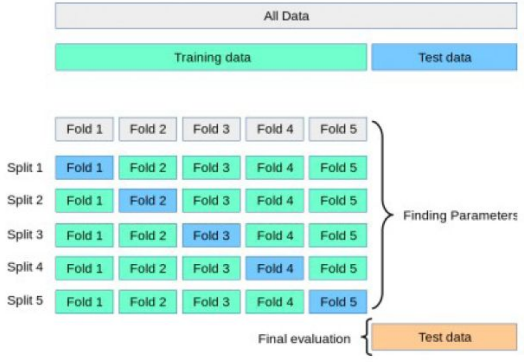
Sentinel-3 LAI (2.5 km) 2021-07-20



by B. Szintai

Land surface DA: ongoing research topics

- SE observations: HSAF snow barrels and Cryo: Finland, Norway. Operational MetCoOp (ongoing work), CARRA reanalysis.
- Soil moisture from Sentinel-1 C-band SAR and Metop ASCAT, with CDF matching: Hungary, Norway
- Comparison of different SIC products: Norway
- Development of EnKF from the perturbed forcing: Norway
- Using of the surface state in the assimilation of MW satellite data for UA over land: Sweden, Norway
- Ideas towards strongly coupled DA
- Snow depth from Sentinel 1: Norway
- Cross-validation tool to define parameters of a DA system: Sweden



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THANKS!