ALADIN-HIRLAM Surface strategy

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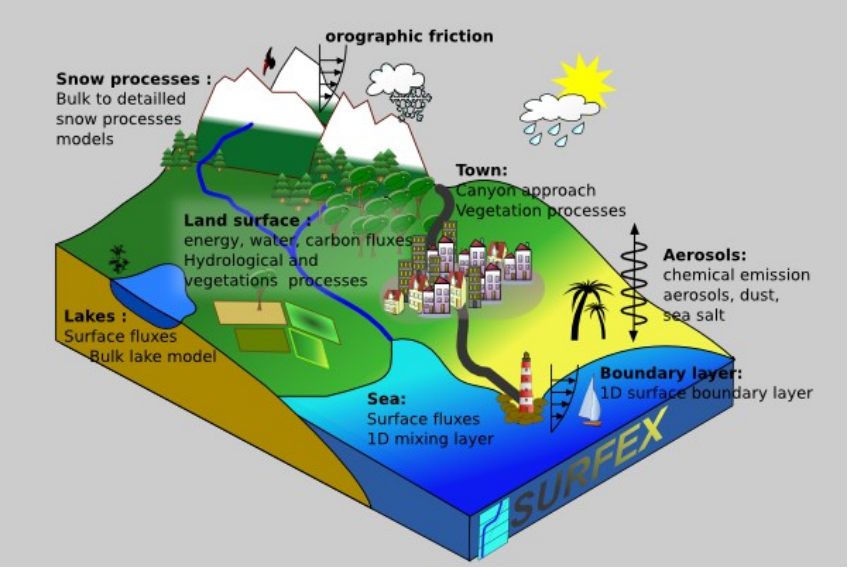
General comments



As NWP consortia we are in a good position, SURFEX offers advanced and often well evaluated surafce parametrisations for all tiles (land, sea, urban, lake). These have been used by our climate modelling colleagues for years already.

But, the big job for us is that we need to keep the model on track by data assimilation (DA). However, with more realistic parametrisations the DA can do the job it's supposed to do and not correct biases caused by too simple representations of the processes.

Thus, the main effort for us the next few years is to find a suitable balance between existing parametrisations and corresponding need for DA. And in the end a truly coupled atmosphere-surface-… system.

The first goal is of course that all ALADIN-HIRLAM partners have switched to SURFEX within the next five years.

We should utilize more of available satellite radiances for surface DA. Use of radiances also requires refined descriptions at the surface for relevant input to observation operators.

Next slides on processes are in order of priority.

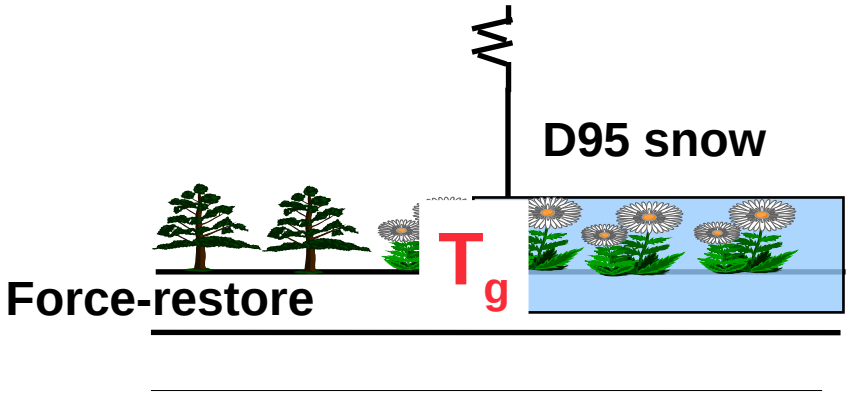
1) Land surface and snow cover

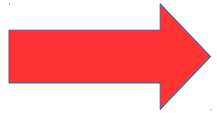
With simple physics we cannot correctly capture all diurnal and annual variability in the soil/snow/vegetation system. Now we partly lean up on the DA system to solve the problem for us.

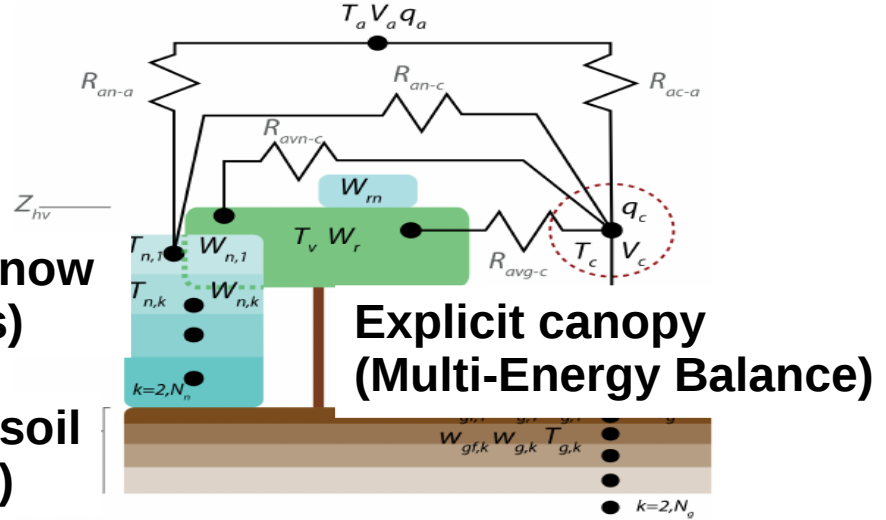
The goal is that some partners consider the advanced surface physics in NWP mode within the next five years. The longer-term goal is that all partners are applying the advanced surface physics operationally.
Also, new physics require new tuning which is now seldom shared systematically. We spend a lot of time to run experiments and evaluate. More systematic sharing of tuning experiences would be helpful…

Challenges:
For advanced surface physics, v8.1 or later of SURFEX is recommended. However, cy43t and cy46t include v8.0. Thus, for activation of advanced surface physics in recent cycles an extra action is needed with local upgrade of SURFEX version (done for cy43h & cy46h).
Possible solution: Build new cycles with as late version of SURFEX as possible.

Advanced surface physics cannot be combined with the OI assimilation scheme as it looks today (SURFEXv8.1). Thus, steps forward here are very needed (part of the Data Assimilation strategy).







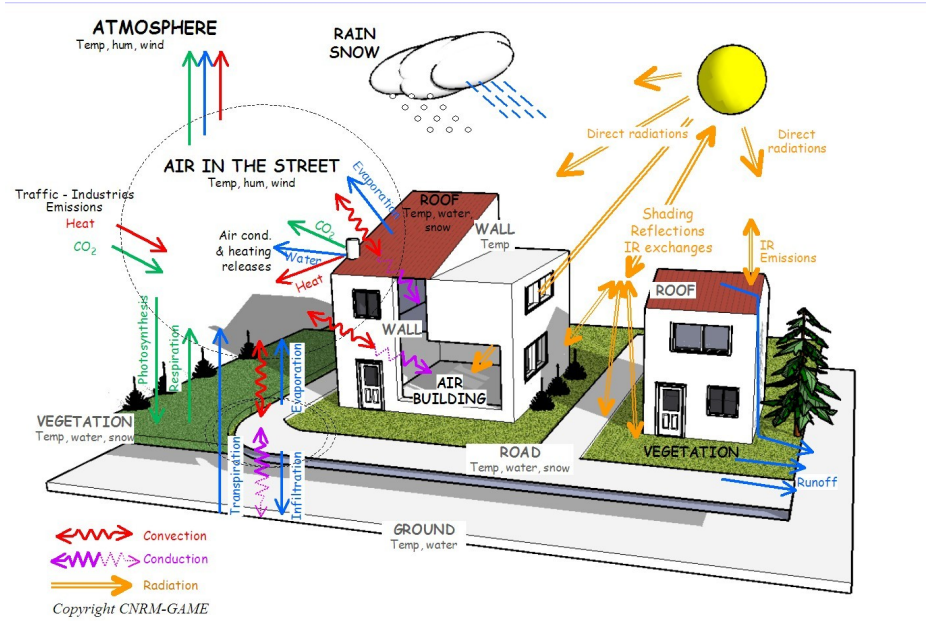
2) Urban areas

Most of our customers live in urban areas which make them an important focus for forecasting products. Although, from a NWP atmosphere perspective the urban areas are often of lower importance than natural and sea areas.

The basic TEB settings (excluding e.g. gardens) are still a big step forward compared to no urban treatment at all. Utilization of more advanced settings (like e.g. garden option or the Building Energy Model) require careful evaluation of the urban physiography.

The goal is that all partners activate TEB (with basic settings) in their NWP setups with SURFEX within the next five years.
Also within the next five years, some partners investigate how a combination of TEB settings and refined urban physiography description can improve our ability to forecast the urban weather conditions more realistically.
If this is to be done in our 3D setups or is better done as part of postprocessing in offline setups should also be considered.

Potential challenge: It may happen that physiography data available by default are considered to imprecise to gain much. If so, an effort to look for more precise physiography data is needed.



3) Physiography

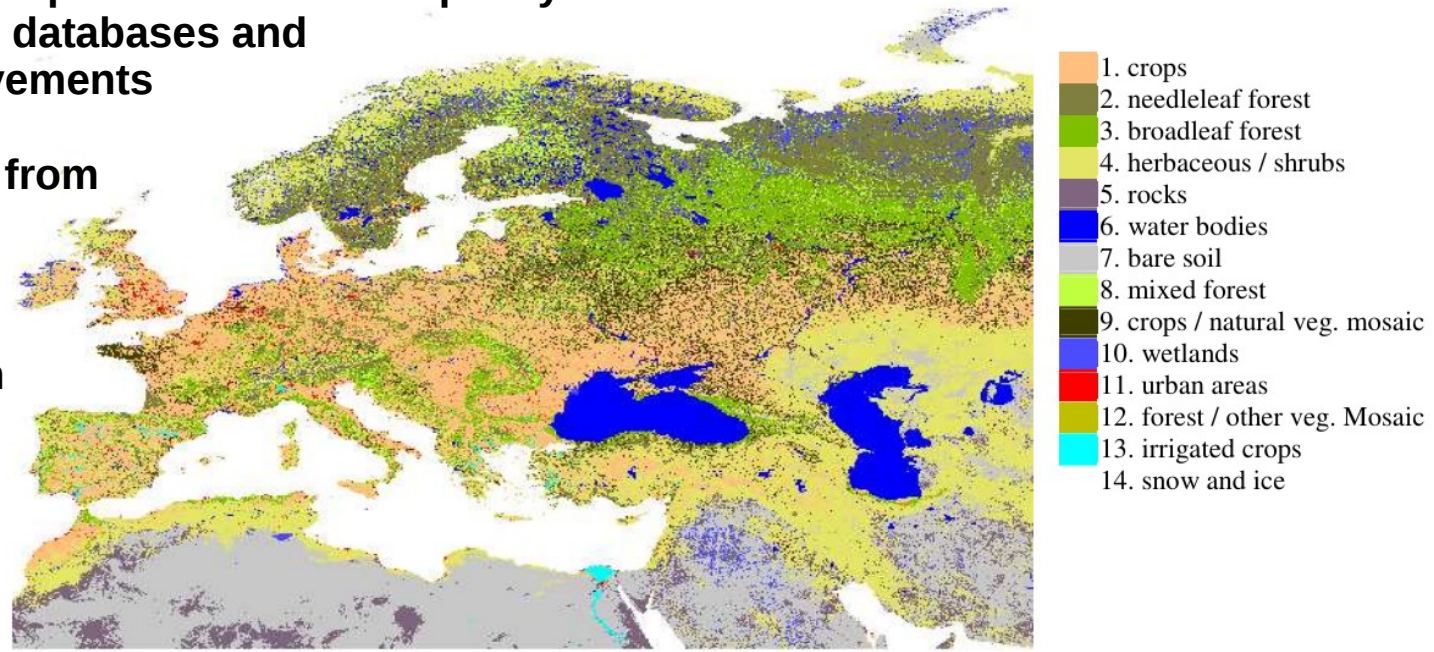
It has been shown that tiled schemes in general perform better than non-tiled, or less tiled, schemes. But to keep the tiling approach as our models increase in resolution we need to strive for higher resolution in our applied physiography.

New alternatives of physiography continuously appear, like e.g. the ESA-CCI land cover product now available for us with 300 m resolution as ECOCLIMAP Second Generation (requires at least SURFEXv8.1).

Updates of physiography involves quite some efforts with respect to e.g. identification of discrepancies (and handling of them) and corresponding tuning of the surface parametrizations (e.g. roughness formulations, surface heat capacities).

The goal is to continue to examine the potential for improvements in the quality of our NWP products by considering various new physiography databases and that physiography is treated as important as improvements in model components.
We could also benefit more by sharing experiences from tuning exercises.

The goal is not to build consortia-wide upgrades of physiography databases based on a combination of specific national databases (e.g. national sand/clay data). But it would be useful to share experience with useful tools (GIS software setups).



4) Sea

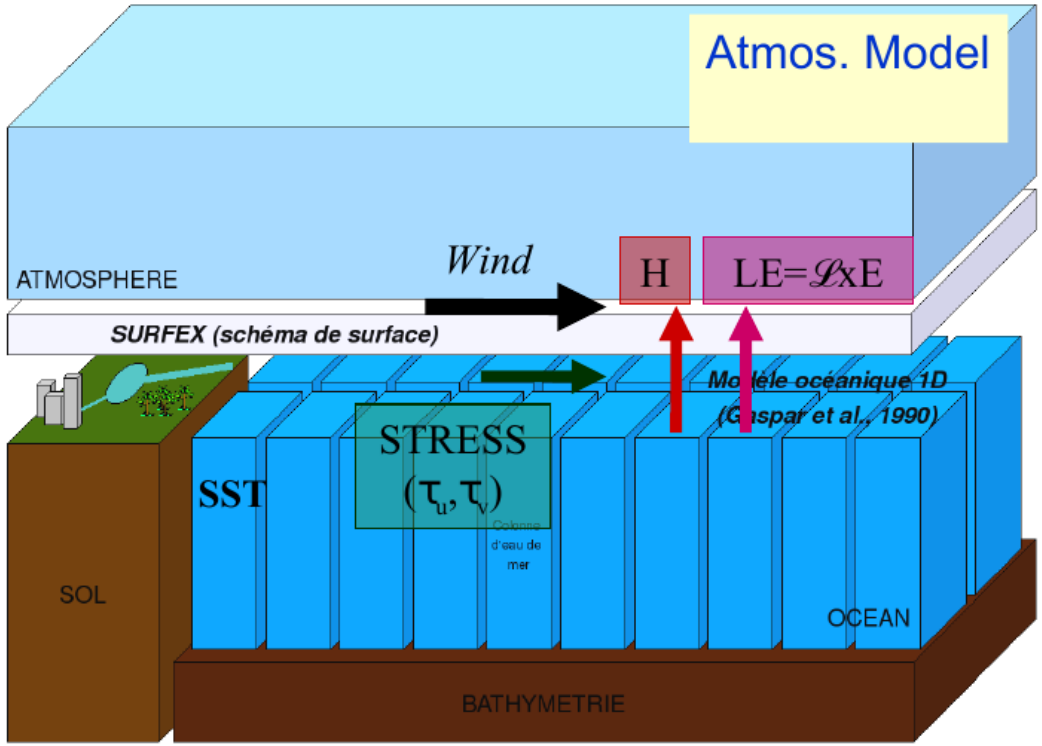
A correct sea-atmosphere energy exchange is very important for most of our model domains.

SURFEX offers different formulations of fluxes over sea where e.g. ECUME6 is the newest one. It can be beneficial to evaluate alternative flux formulations for our NWP setups.

Evaluate the role and impact of evolving SST, but how to evolve SST?
Read SST from operational ocean models, use a slab ocean model (compare FLake), use a 1D ocean column (SURFEX), couple to a 3D ocean model,…?
Computational costs!? Ocean models are already used operationally in many countries, right? So we just need to couple them :-)

The goal is to, within the next five years, evaluate alternative flux formulations over sea and to continue to evaluate the role and impact of evolving SST in NWP setups and to come up with recommendations on how to proceed (e.g. level of advancement against computational costs).

The long-term goal is that SST is prognostic in some ALADIN-HIRLAM NWP LAM setups.



5) Sea-waves

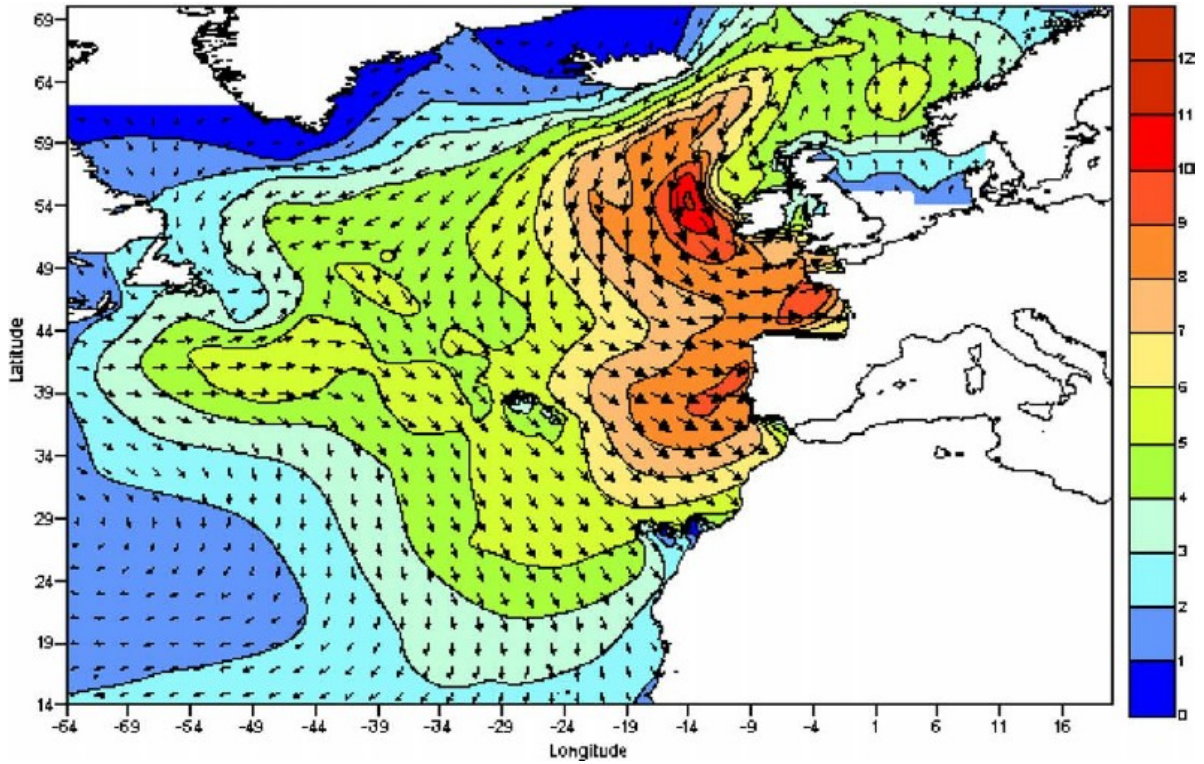
We know that consideration of the atmosphere-wave interaction is beneficial for correct forecasting of air-sea interaction and its impact on the atmospheric evolution (mostly wind).
Active development in this area is ongoing and test setups of the ALADIN-HIRLAM NWP system exist where coupling to wave model is applied.
This means different combinations of SURFEX, OASIS coupler and wave models WAM and WW3.

The goal is to continue this development and that a few partners may apply coupling to wave models within the next five years if it is considered affordable and beneficial enough.

Potential challenges:

Wave models tend to be computationally very expensive which may be a serious bottleneck for operational setups…

Should we try to join around one wave model or no problem to have alternative models around…?



6) Sea ice

A proper handling of the sea ice development is essential for NWP domains where the sea ice cover is considerable.

Sea ice models exist and are developed by NWP institutes (SICE by HIRLAM and GELATO by Météo-France). Some HIRLAM partners have been running SICE operationally for several years and GELATO is now under testing by the NWP group of Météo-France. The sea-ice models are under continuous development.

Assimilation of sea-ice properties (temperature, albedo) is now under development (part of the Data Assimilation strategy).

The goal is that all partners who have NWP domains where the sea ice cover is considerable have sea-ice models operational during the next five years.

The goal is also that these models are connected to data assimilation of sea-ice properties (part of the Data Assimilation strategy).

The long term goal for sea-ice modelling is dependent on the long term goal where coupling to ocean models is considered.

Potential challenge: As for wave models, should we try to join around one sea-ice model or no problem to have alternative models around…?

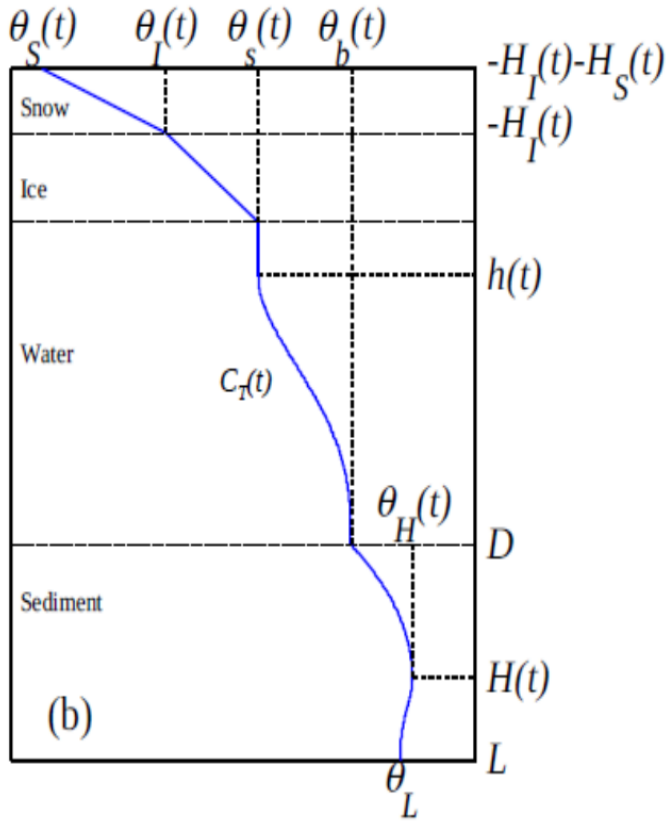
7) Lakes and rivers

The lake model FLake, as part of SURFEX, has proven itself as a very suitable model for modelling of lake thermal conditions. Applying FLake for lakes is superior to any other, quite crude, ways of handling lakes currently or recently used in our NWP systems. Activating FLake is also quite easy :-)

FLake has been used operationally by some NWP partners for a while and it is in the plan for more partners to activate it. Please note that care should still be taken with respect to compatibility between versions of Flake, ECOCLIMAP and the Global Lake Data Base (GLDB).

The SURFEX team is currently developing FLake to also include the hydrodynamic component (lake water volume or lake level) to fulfil needs connected to modelling of the full water cycle (including rivers and lakes). Such a component, if relevant, would also allow assimilation of e.g. satellite estimated fresh-water levels in rivers and lakes.

The goal is to activate FLake in operational systems for most partners within the next five years.

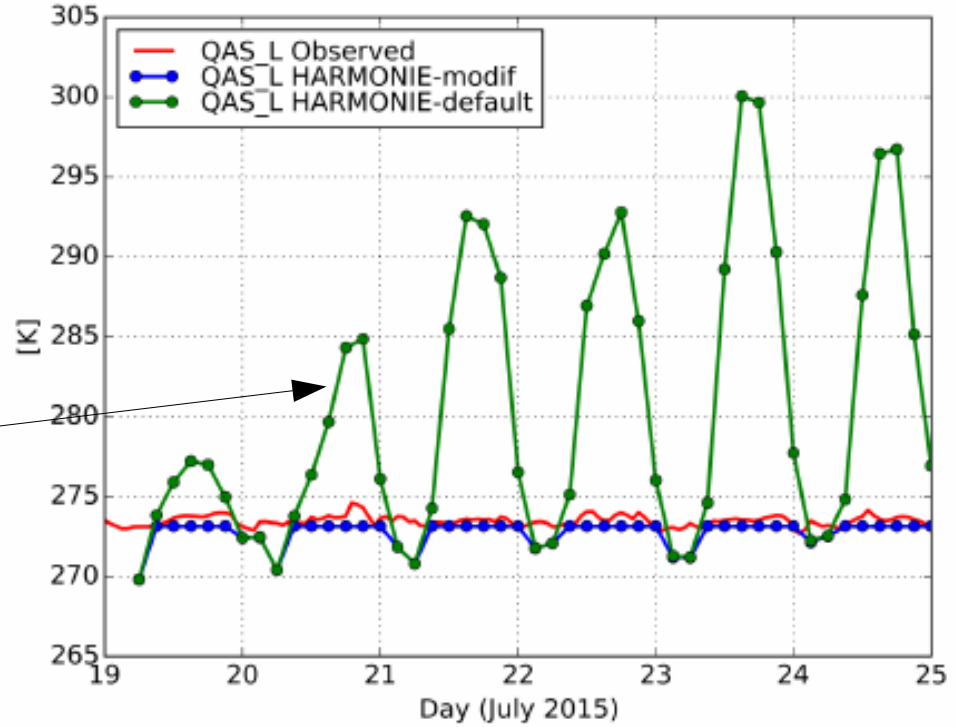


8) Glaciers

Glaciers:

Current treatment of glaciers in SURFEX is very simplistic...

When snow disappears and the “ice surface” is exposed the surface temperature gets unrealistically warm.



Concrete ideas on how to utilize one of the multi-layer snow schemes in SURFEX as glacier model exist.

The goal is that some partners, within the next five years, have developed and activated a more proper glacier model for glaciers in their domains.

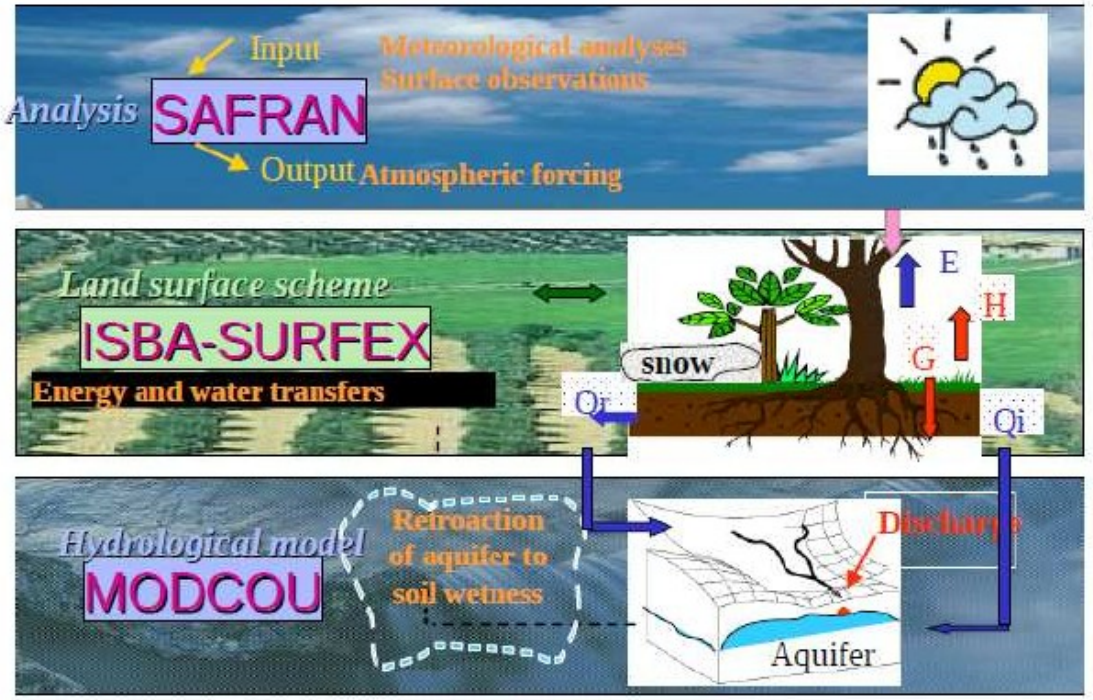
9) Hydrology

The NWP community, until now, seldom cares about the water budget below the soil zone. However, requests and ideas start to appear within our NWP community to also account for the water budget beyond the soil, e.g. groundwater and river discharge. Offline applications with SURFEX coupled (via OASIS) to e.g. river discharge modules exists, e.g. SIM (SAFRAN-SURFEX/ISBA-MODCOU).

The NWP driving force is partly connected to long-term goals in coupled atmosphere-surface data assimilation (see the Data Assimilation strategy) where the idea is that ensemble members should represent alternatives of snow/soil-water storages connected to changes in river discharge.

The goal is to consider this development in close connection to needs for coupled atmosphere-surface data assimilation.

Potential challenge: Depending on level of complexity, communication and cooperation with hydrologist may be needed to make progress here. However, one of the challenges is that hydrology is traditionally the responsibility of other R&D groups or often even other agencies.



HOW

SURFEX processes are in general relatively cheap and and computational limitations are seldom an issue… Exceptions are e.g. wave models (e.g. WW3) which are quite expensive…. And 3D ocean models…

How SURFEX may be affected by the ATLAS and OOPS development is still not clear…

Ascending compatibility of NWP relevant part of SURFEX: The Force-restore option is usually kept stable by its default options. However, for more advanced physics this is less considered.

Quick sharing of development between CSCs is not easily possible now because we deviate in versions, systems and repositories. Thus, already implemented functionality in one CSC may still require considerable effort to implement in other CSCs (concerns especially the DA aspect of surface). Thus, the surface strategy team urge the need for common version, system and repository.