

Progress with SURFEX in HIRLAM

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General surface thoughts and comments

Surface physics in SURFEX is in many aspects well beyond the needs in NWP applications but plenty of non-utilized potential exist! SURFEX includes more processes, implemented in a more consistent way, than HIRLAM surface ever did.

At the same time, our current operational cy38h1.2/40h1.1 ALADIN-HIRLAM NWP system (HARMONIE-AROME model configuration) is in some important aspects less “advanced” over land than latest HIRLAM (still running at some centres):

	cy38h1.2/40h1	HIRLAM
Land		
Patches	1	1-3 (incl. “MEB” patch)
Soil	Force-restore	Diffusion
Snow	Composite	Bulk-1L
Glacier	-	soil with ice properties
Assimilation	OI	OI
Sea	SICE (MetCoOp)	2-layer ice scheme
Lake	Deep soil temp	Deep soil temp/Flake
Town	TEB	No (open land)
Physiog.	ECOCLIMAP	FAO

General surface thoughts and comments

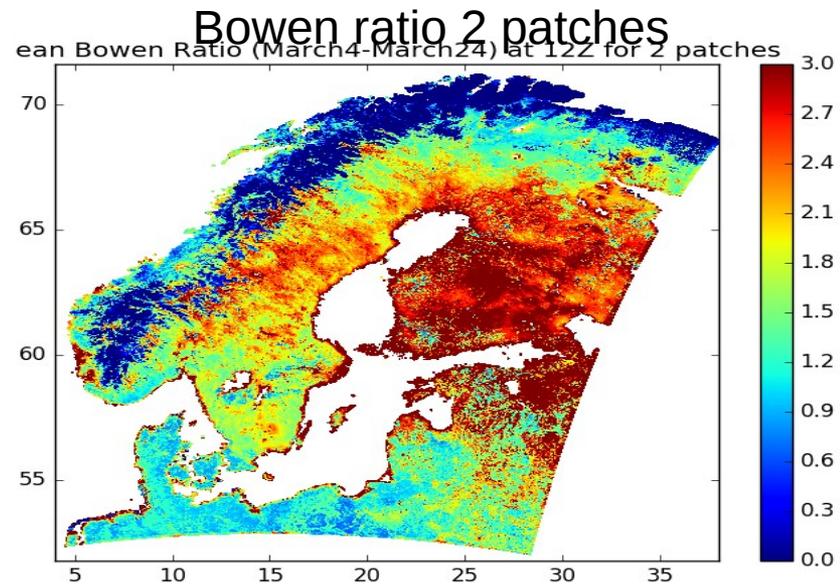
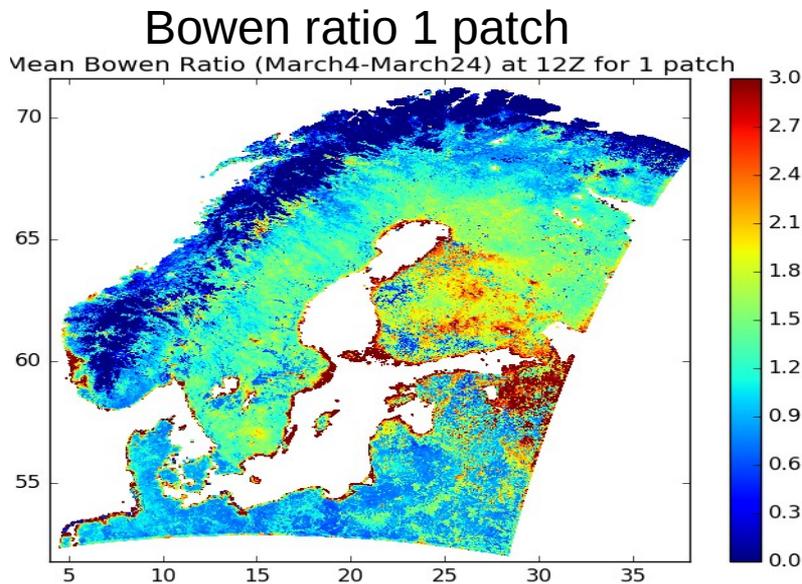
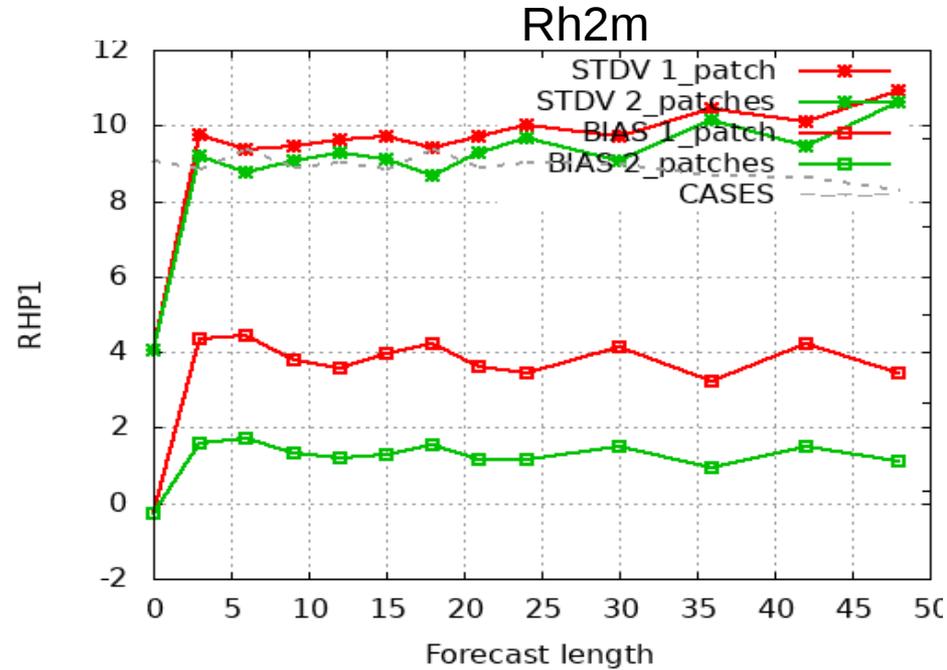
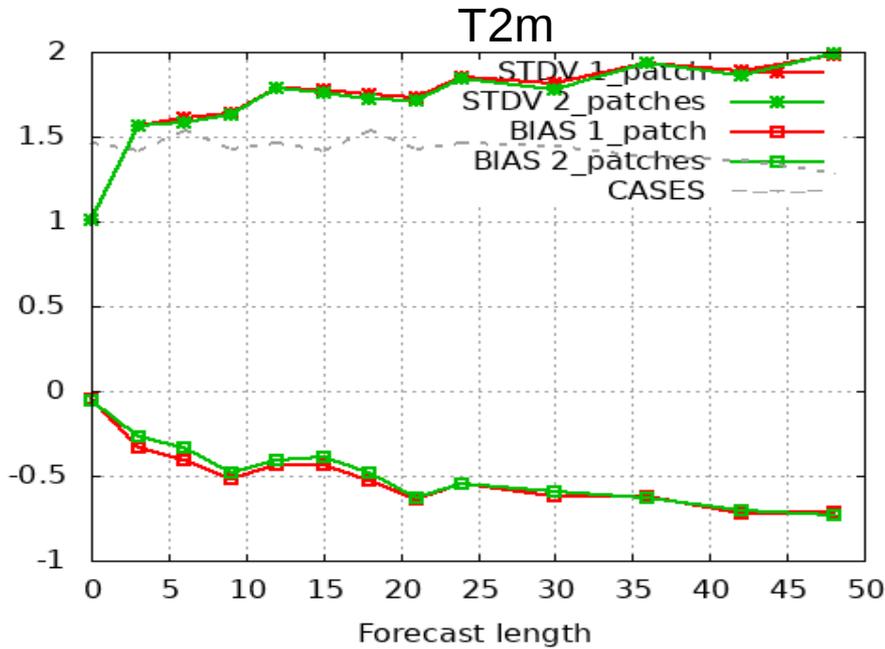
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	cy38h1.2/40h1	HIRLAM	cyxxh
Land			
Patches	1	1-3 (incl. “MEB” patch)	2 patches with MEB
Soil	Force-restore	Diffusion	Diffusion (14 layers)
Snow	Composite	Bulk-1L	Explicit snow (12 layers)
Glacier	-	soil with ice properties	Explicit snow as glacier
Assimilation	OI	OI	EKF
Sea	SICE (MetCoOp)	2-layer ice scheme	Sea ice
Lake	Deep soil temp	Deep soil temp/Flake	FLake (later with EKF)
Town	TEB	No (open land)	TEB (more options)
Physiog.	ECOCLIMAP	FAO	Utilize high res. data



MetCoOp domain March 2016 (cy40h1.1 + 2 patches)



HIRLAM Rolling Plan for “Surface analysis and modelling” 2016-2018

- SU1: Introduce and assess more advanced data assimilation algorithms in SODA framework
- SU2: Introduce and assess new surface observations
- SU3: Explore and validate available SURFEX physics components
- SU4: Further develop Surfex surface model components
- SU5: Assess and improve quality of surface description

SU1: Introduce and assess more advanced data assimilation algorithms in SODA framework

In cooperation with the ALADIN/LACE/SURFEX community, develop SODA in SUFEXv8/cy43 for EKF methods. For each tile respectively:

- **Nature:** Gradually go from OI in combination with Force-restore and SYNOP to EKF in combination with DIF/ES/MEB and SYNOP and satellite surface products.

Tests and applications with MESCAN instead of CANARI should be done. Also investigate sensitivity of anisotropic horizontal/vertical structure functions. Consider Short Time Augmented Extended Kalman Filtering (STAEKF) for unobserved variables, like LAI.

- **Sea ice:** Go from sea-ice model SICE without any assimilation to SICE with EKF and satellite surface products.
- **Lake:** Introduce FLake in peaceful coexistence and keep on working on EKF methods for lakes.
- **Town:** Keep on using TEB in peaceful coexistence. Utilize Nature EKF development later.

Longer term: Start to consider EnKF methods, also coupled to the atmosphere (would probably mean also a replacement/elimination of CANARI/MESCAN).

SU2: Introduce and assess new surface observations

Introduce new observations via satellite products/radiances representing surface temperature (land/sea-ice/lake), surface soil moisture, snow cover, snow water equivalent, snow albedo (land, sea-ice), sea-ice cover, LAI. Unconventional surface observation include sea-ice mass balance (SIMBA).

Priority should be given to operationally available products (temporary research products should in principle be avoided).

The satellite products should not be spatilaized/interpolated as SYNOP data in CANARI/ MESCOAN but applied based on existence. Thus, a modification of CANARI/ MESCOAN is necessary to allow this or it is done in parallel to existing CANARI/ MESCOAN (how to proceed?).

First apply (or calculate) products (e.g. top soil moisture). When that works utilize the radiance via an observation operator.

SU2 will first concentrate on needs for sea-ice assimilation.

SU3: Explore and validate available SURFEX physics components

Latest release of SURFEX, SURFEXv8 as available in cy43, includes a number of processes whose potential has not yet been explored for NWP purposes in the HARMONIE-AROME model configuration. The potential of these is often tightly connected to corresponding assimilation methods in WP SU1.

The options concern e.g. (in priority order)

- Multi-layer explicit snow scheme (ES) with 12 layers
- Diffusion soil scheme (DIF) with 14 layers
- Multi-Energy Balance (MEB), i.e. explicit canopy vegetation.
- Garden option in TEB.
- 1D oceanic mixing layer model (OML).
- Building-Energy Model (BEM) in TEB.

When one or more of these options are activated and tested we should complement the validation by Monitor with e.g. non-conventional near-surface observations, flux tower data, satellite products.

All parametrisations include more or less certain parameters. Thus, in the process of tests and validations, methods including estimation/optimisation of parameter values can be included.

Utilize the potential of running cy43h in climate mode to choose and validate an optimal combination of SURFEX options for NWP purposes.

SU4: Further develop Surfex surface model components

In SURFEX there are less developed, or still missing, processes where HIRLAM does, or have the potential to, contribute (see list below).

Release of SURFEXv8.1 is planned for summer 2017 and will include technical developments only. Release of SURFEXv9 is planned for end of 2018 and will include both both scientific and technical developments.

The ambition is that all HIRLAM contributions to new cy/SURFEX releases should go via the SURFEX repository and not at all via cycle phasing.

- Implementation of **SICE** as an official sea-ice option in SURFEXv9.
- Further improve aspects of **SICE** as e.g. snow on ice and prognostic ice thickness.
- Implementation of **FLake** modifications/developments into SUREX trunk based on what is currently done in cy40h (consider “technical” modifications for SURFEXv8.1). Includes modifications of PGD physiography averaging methods.
- Development of a physically based **glacier** model into SURFEXv9 (temporary pragmatic NWP glacier solution for cy40h needs to be fulfilled outside official SURFEX development).
- Evaluate the **orographic/radiation** implementation in cy43 and apply further modifications/developments.
- Evaluate and further modify/develop **orographic roughness** parametrisation.
- Implementation of removal of snow on streets in **TEB**.
- Modifications of SURFEX parametrisation of **fractional snow** in complex terrain.
- Validation/optimisation/documentation of **MEB** for winter conditions.
- Collaborate to make an **ocean wave model** operational.
- **Diagnostic LAI**

SU5: Assess and improve quality of surface description

SURFEX official releases of physiography data bases are published at the SURFEX web site. Among these, HIRLAM currently uses as default (cy40h1): **ECOCLIMAP v2.2, FAO at 10 km, GMTED2010. Soon in addition, with Flake activated, also: GLDB.**

In order to replace ECOCLIMAP, Météo-France is developing a strategy to build a new database relying on operational products (mainly COPERNICUS). Hence it is envisaged to base this new map on the ESA-CCI land cover map and automatic transformations to easily update the map when ESA-CCI updates are published. In order to strengthen the product, co-operations within the SURFEX community will be searched.

- Continue to critically evaluate currently used physiography and gather modifications for updated releases via the SURFEX team at Météo-France. (Iceland, Greenland, lake depths)
- Document how MODIS LAI information should be processed to make validation possible for LAI fields over specific domains.
- **Work plan for applied LAI fields: (i) Modify physiography, and/or (ii) implement diagnostic LAI and/or (iii) concentrate on STAEKF for LAI.**
- Become actively involved in the ESA-CCI land cover process.
- Evaluate/develop TEB specific parameters.
- Evaluate/develop TEB BEM specific parameters.

HIRLAM/ALADIN/LACE/SURFEX surface working days

EKF data assimilation methods with corresponding development in surface processes related to force-restore/diffusion soil scheme/snow, lakes and sea-ice. And of course corresponding observations SYNOP/satellite products in combination with development of observation operators. But, surface people not involved in EKF but see this gathering as useful please feel welcome and please suggest topics of interest.

An active doodle shows currently that **October 24-26** is the most popular period. Currently, 15 out of 18 people can make it these dates.

Now looking for a good meeting location....