Status of the new surface scheme in HIRLAM

A version with seven tiles:

sea (1), partly snow covered ice (2), snowfree open land (3), snowfree low vegetation (4), snowfree forest (5), snow covered openland+low veg (6), snow in forest (7).

This is ready for 6.3.5 (some testing done by Ernesto) and **also written** for 6.4.0. Also SPAN is coded for both 6.3.5 and 6.4.0

A version with eight tiles:

The same as above but the snow on ice moved to fraction 8, snow covered ice. Ready for 6.3.5, minor work remains to be done in SPAN. Not coded for 6.4.0.

The code structure of the new surface scheme, version with 8 tiles, (everything holds also for 7 tile version)

GETGRB can read an ordinary HIRLAM-file and estimate values on new variables, in case of cold start. *Comment*: the three snow-tiles 6,7 and 8 have zero fractions when stored. The fractions 2,3,4 and 5 can all have snow amounts different from zero.

GEMINI is calling **INT_SNCRIT** to be used in **DFI** and **SL2TIM**

Within **PHYS** and below:

NEWFRACTIONS is estimating the fractions of snow 6,7 and 8 using the tuning values of *sncrit*, from **INT_SNCRIT**. The routine is moving the snow from fractions 2-5, which now are locally snowfree.

A mean surface temperature for use in e.g. condensation routines is locally computed in **PHYS**. *fracsni* is put to zero, except for tiles 6,7 and 8 where it is 1.

SURF2RAD and **RAD2SURF** are modified mainly due to the new forest tile which has a separate temperature for the canopy. *Tskin* calculated in **SURF2RAD** is the effective grid average skin temperature, taking these new radiation between the canopy and the forest floor (partly snow-covered) into account. The output from **RAD2SURF** now contains new variables, and their different partial derivatives, due to the more complex forest radiation.

In **ISBAH4** we do a loop over tiles 1 to 8, (tile nr 7, snow covered forest, is treated at the same time as tile nr 5, snowfree forest, due to a common canopy temperature)

Also the snowfractions *frsn*(nhor,3) (fraction of snow as compared to the whole
grid square for sea ice, open land and forest respectively) is calculated within **ISBAH4** and transported to postprocessing.

I have written some help routines to faciltate the coding. Within the routines **SURTEND_ICE, SURTEND_LAND, SURTEND_FOREST, SURTEND_SNOW** and **SURTEND_SNICE,** I use a routine, **CALCTEND**, which is calculating the heat conduction and/or the change in snow parameters. It is written so it can use also more layers in the soil, and with or without a climatological temperature forcing from below. **CALCTEND** is calling **FIXWABCR** which calculates the coefficients for an implicit solution of the heat conduction and solves for the temperatures at next timestep.

At present only one snow layer can be used, and the fractional substepping due to phase shift and/or snow temperature changes is confined within the routine **CALCTEND.** In **SURTEND_FOREST, CALCTEND** is called twice, for the snow and snowfree forest floor.

The routine **MIRRORING** is doing the reverse of **NEWFRACTIONS**, i.e. put back the snow to tiles 2,3,4 and 5. The temperature in the ground is adjusted so that the energy is conserved.

T2m and Q2m:

In the forest (tiles 5 and 7) canopy air temperature and humidity are used as 2-m values.

Changes in SPAN (somewhat different for 6.3.5 and 6.4.0)

Put the analysis increment for surface values also in the snow temperatures (maximum 273 K).

To update what is happening in the soil, in a consistent way, we read the prevoius analyzed ts (-6h) and also the +3h forecast starting from that and put a 2-degree spline through those values and the current analysed ts. We then solve the heat conduction starting from -6h, forcing with the surface temperature, to update the soil temperatures. This is done in **TEMPCORR**, for not snow covered tiles. It is at present assumed that the changes below the snow is handled by the model.

The snow analysis (which are different in 6.3.5 and 6.4.0) is modified so that only open land and low vegetation mean snow depth is extracted as the first guess. The snow increments are distributed also to sea ice and forest but multiplied with ad hoc factors of 1. and 0.5 respectively.

I could perhaps defend these ideas!

In the 6.4.0 version the changes in the analysis phase of density and albedo is taken away, since that is now included in the model.