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Status of multi-energy balance (MEB) in SURFEX

Patrick Samuelsson **Stefan Gollvik**
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Aaron Boone **Christophe Canac**
Meteo France

Current SURFEX ISBA

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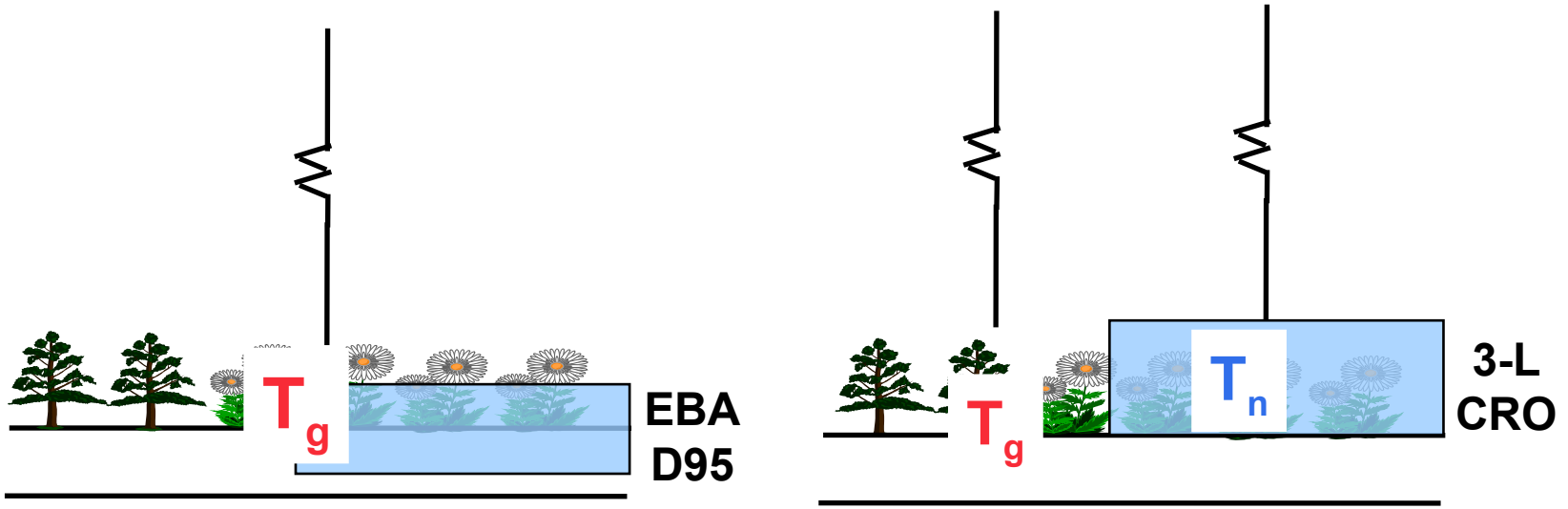
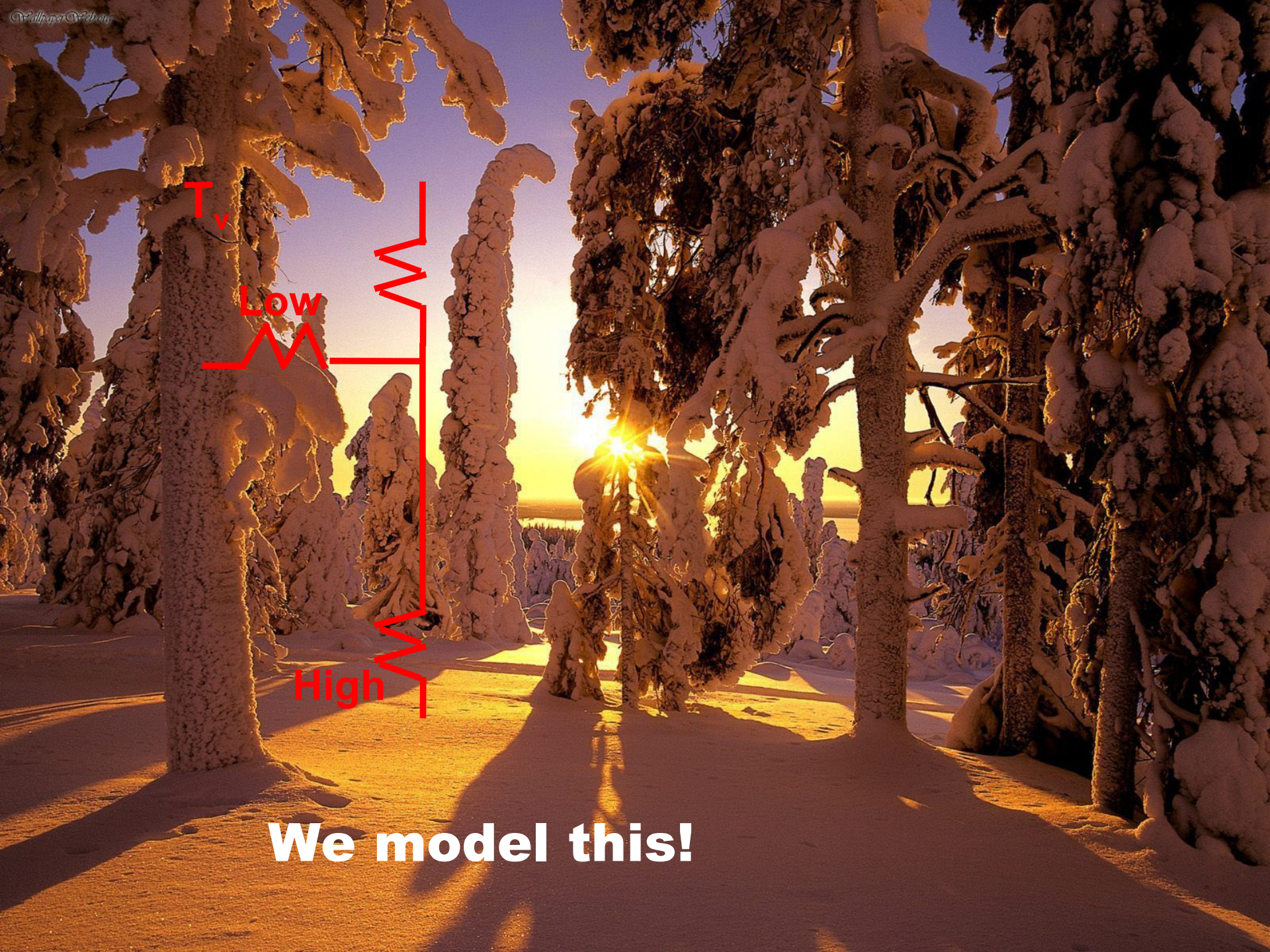


No explicit canopy vegetation energy balance (temperature)!



We model this!


...and this!
High
Low
T_v

Multi-Energy Balance (MEB)

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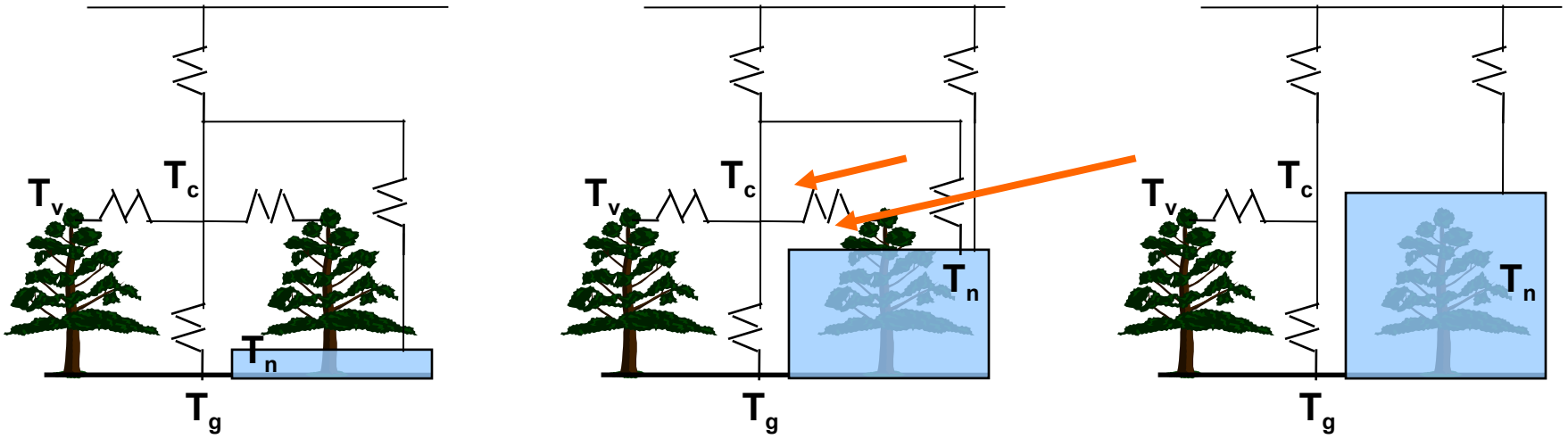
Snow well below the canopy

Snow partly buries the canopy

Snow buries the canopy



MEB is designed to work with

- snow schemes 3-L and CRO (requires separate snow energy balance)
- soil schemes 2-L & 3-L (force restore) and DIF (diffusion)

What has happen since Norrköping last year?

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- What you saw in Norrköping was first 0D results based on new MEB physics introduced in the ISBA physics part of SURFEX6.1 (isba.F90 and below).

Since then:

- 0D SnowMIP2 experiments have been performed including some tuning of MEB parameters. Then 2D simulations were performed to investigate large scale impact of MEB on snow, albedo, river discharge --> rest of talk

- PGD (physiography parameters based on ECOCLIMAP) and PREP (initialize prognostic variables) parts were developed in SURFEX6.1

- Now all MEB development is implemented into SURFEX7.2 as a branch from DEV under the SURFEX-lab environment (see talk by Eric Martin).

- First tests of MEB in SURFEX7.2 are now performed.

Conclusions from 0D SnowMIP2 experiments

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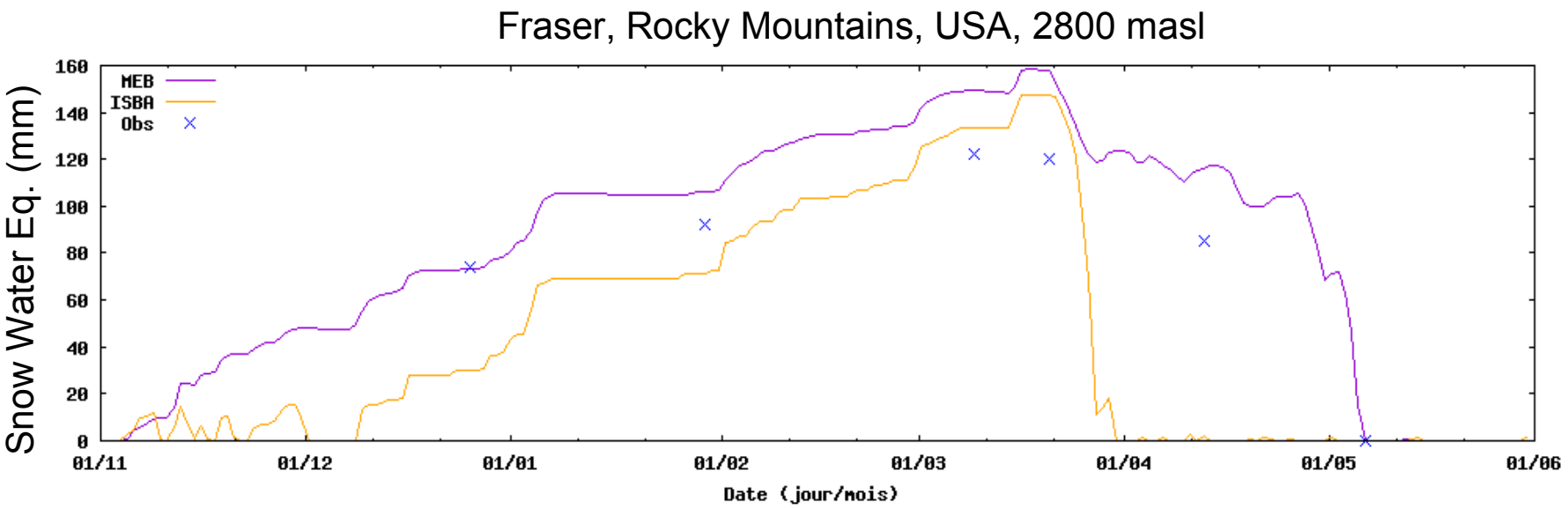

ISBA with D95 snow scheme

MEB with 3-L snow scheme

Observations

Using forest-snow tower data from several SnowMIP2 sites a few MEB parameters were tuned. After that MEB gives improvements:

- Accumulation period is greatly improved.
- Date of last presence of snow is much better simulated.

2D offline experiment

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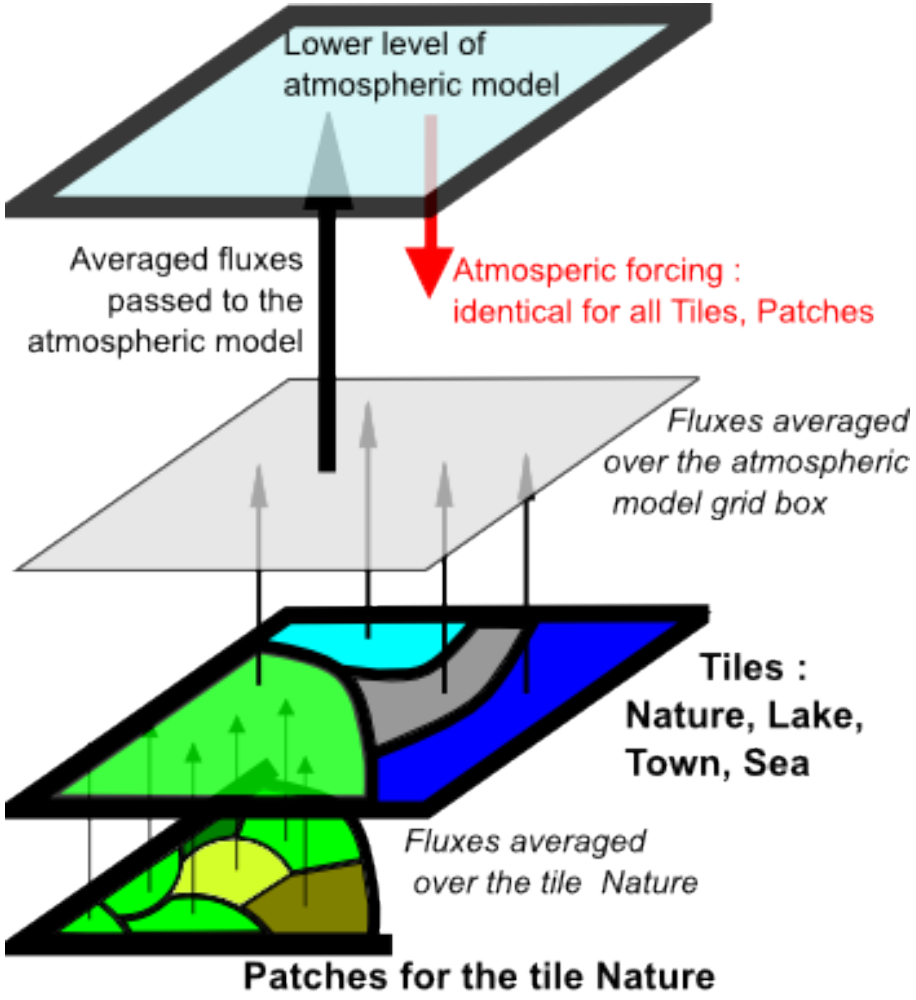

SURFEX tiling and coupling with an atmospheric model

The forcing is based on the Sheffield data set:

This data set is specifically designed to be used as forcing for hydrological and land surface modelling.

Based on NCEP reanalysis on 1 deg where a few forecast variables have been corrected using observations.

Forcing data frequency: three hours

Sheffield, J., G. Goteti, and E. F. Wood, 2006: Development of a 50-yr high-resolution global dataset of meteorological forcings for land surface modeling, J. Climate, 19 (13), 3088-3111. http://hydrology.princeton.edu/data.php

2D offline experiment – Snow Water Eq.

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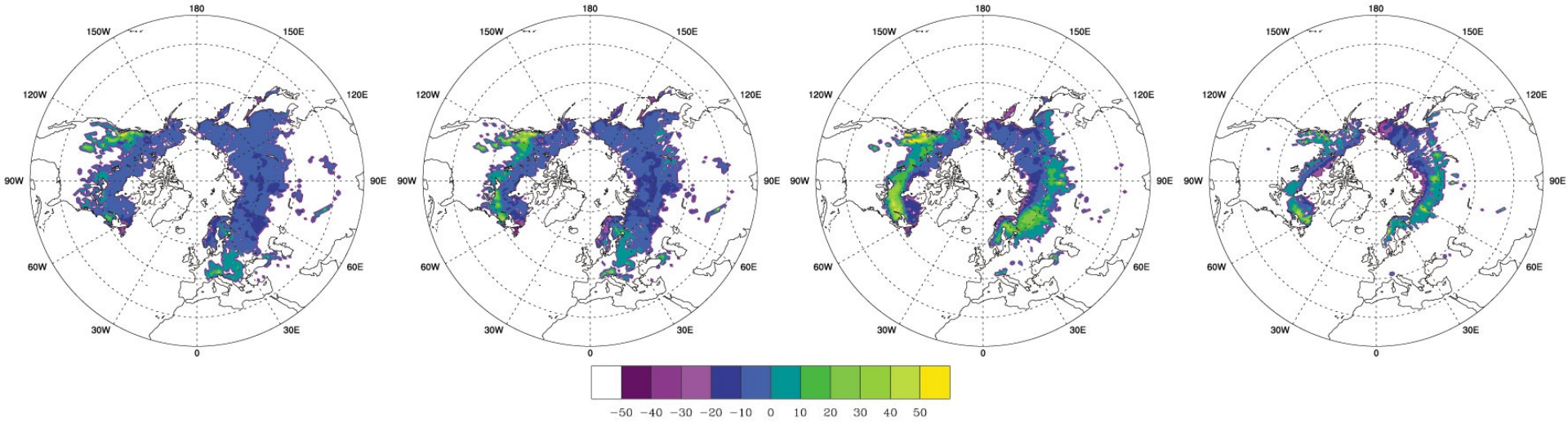
With MEB:

- Less snow in forested areas in mid winter (10-20 kg m^{-2}) due to snow interception
- More snow in forested areas late in winter (20-50 kg m^{-2}) due to a combination of radiation and turbulence effects
- The melting is delayed

January February March April



Difference SWE ISBA-MEB – ISBA
Average over 1978-2008 in kg m^{-2}

2D offline experiment – Albedo

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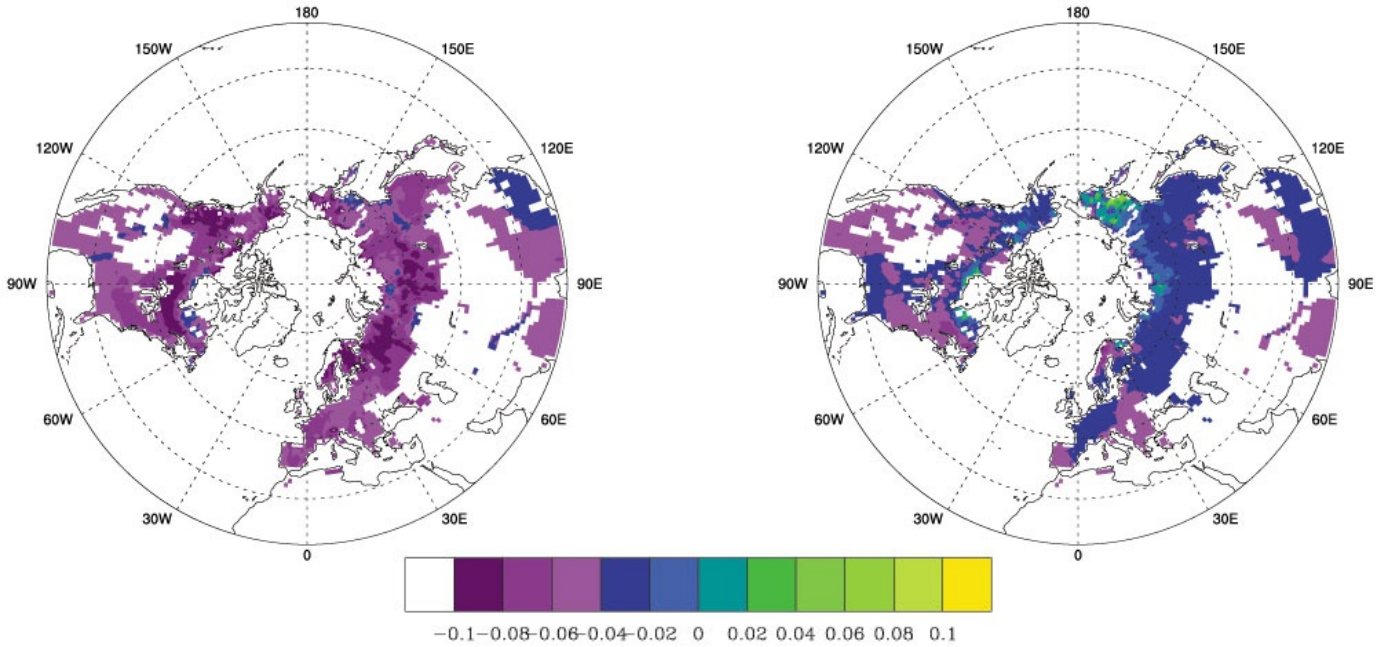
MEB gives lower grid albedo at the presence of snow due to method of calculation.
The ISBA snow fraction is a function of roughness length.
The MEB snow fraction is partly hidden by canopy in forested areas and vegetation albedo not yet affected by intercepted snow
This effect on grid albedo has not yet been evaluated.

January

March



Difference in albedo ISBA-MEB – ISBA
Average over 1978-2008

2D offline experiment – River discharge

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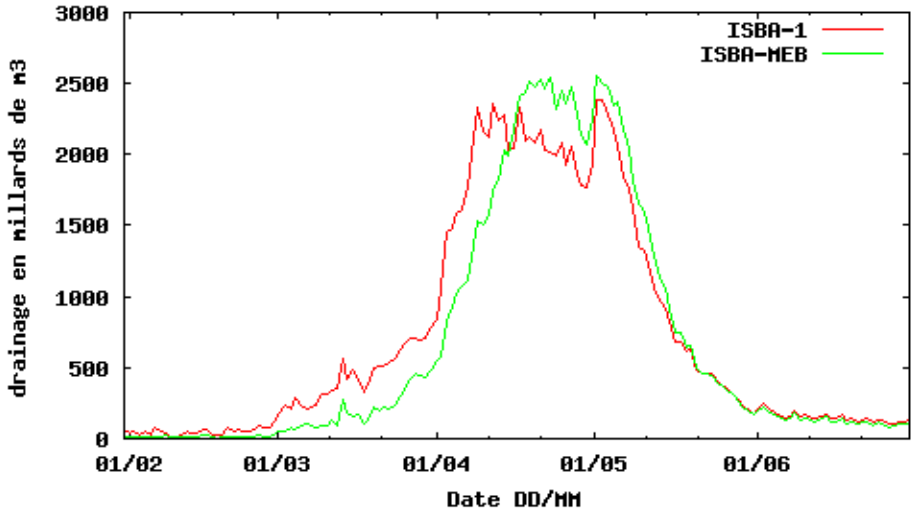
River discharge for ISBA (red) and ISBA-MEB (green) for two Arctic river basins: Mackenzie and Yenisey.
MEB melting is delayed by 1-2 weeks at the beginning of melting

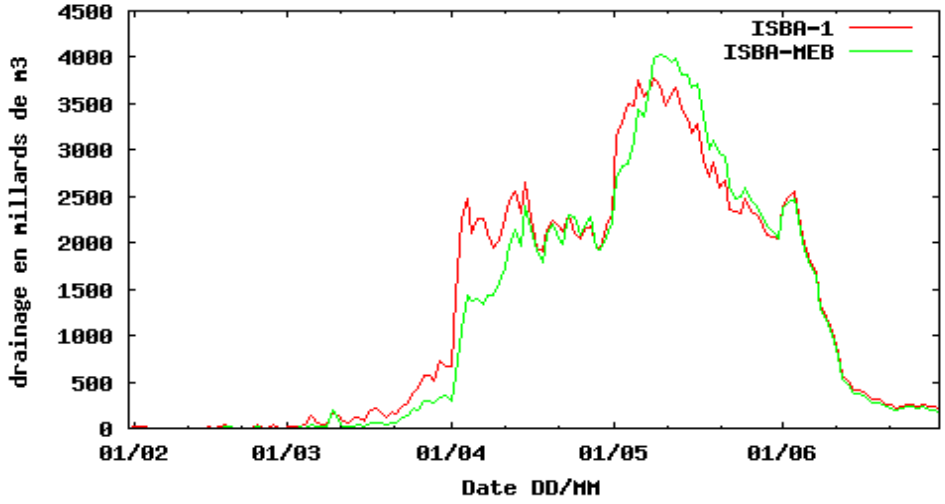
Other basins show no change in time of melting (sublimation)

These river discharge simulations have not yet been evaluated.

Mackenzie



Yenisey



Summary

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- Multi-energy balance (MEB) has shown important improvements in the hydrological cycle in forest-snow areas.
- MEB parametrisation is now running under SURFEX7.2.
- MEB is designed for all vegetated patches (forest to grass) but will probably be used mostly for forest patches. Not yet compatible with Canopy model.
- MEB is presently under testing for a Morocco orange grow site in the Tensift river basin!
- MEB will now be further evaluated using a multi-decadal Russian data set of parallel observations of snow in open land and forest areas that is provided via Eric Brun at Meteo France.


THANKS!