Geosci. Model Dev. Discuss., 4, C884–C888, 2011
www.geosci-model-dev-discuss.net/4/C884/2011/

Geoscientific
Model Development
Discussions

Interactive comment on "The detailed snowpack scheme Crocus and its implementation in SURFEX v7" *by* V. Vionnet et al.

H.-W. Jacobi (Referee)

jacobi@lgge.obs.ujf-grenoble.fr

Received and published: 18 October 2011

General comments

The authors describe the implementation of a detailed snowpack model into a platform to calculate the energy and mass exchanges between the atmosphere and the different types of the Earth surface. This platform also includes a land-surface scheme and, thus, allows the simulation of the exchange of energy and mass in the entire column from the soil through the snowpack to the atmosphere. The different models (CROCUS, SURFEX, ISBA) have been developed and validated previously and have been routinely used by the French meteorological service Météo France in different operational and scientific set-ups. CROCUS is one of only two snowpack models currently available, which include the metamorphism of the snow grains. Therefore, the imple-

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

mentation of the detailed snowpack model replacing previous more simplified representations of the snow in the land-surface scheme appears to be a logic improvement. The snowpack and processes in the snowpack can play an important role in several fields like weather forecast, climatology, hydrology, or even atmospheric chemistry. A better and more detailed simulation of the snowpack can bring major advantages in the performance of models addressing these issues and can deliver unprecedented information about the snow and its role for different applications. Since this model set-up can be coupled to other models of the Météo France family, it may have the capacity to serve as a benchmark model for snow-related issues at different temporal and spatial scales. Although the authors present an example of simulations for Antarctica, a thorough validation of the model in non-alpine environments is still needed in the future, since CROCUS was mainly developed based on alpine observations and conditions. Overall, the paper describes advances in modeling science within the scope of EGU and should be published in GMD. As a previous user of CROCUS, I find that the authors present the model in sufficient detail. I believe that this also applies to a first time user of the snowpack model. For most processes, all necessary information and parameterizations used in the snowpack model, which were spread in several publications or non-existing in the scientific literature before, are presented in an updated form. I recommend this manuscript for publication after the authors address the minor specific comments below.

Specific comments:

P. 2366, l. 21f: I think this statement is a too general because the snow is not always needed for correct weather or hydrological forecasts.

P. 2366, l. 25f: My understanding is that Flanner et al. found that on average the land snow cover and the sea ice contribute equally to the radiative forcing of the cryosphere in the northern hemisphere.

P. 2369, 1. paragraph: It should also be mentioned that the major elements of CRO-

GMDD

4, C884–C888, 2011

CUS were implemented before in the land-surface scheme of the regional climate model MAR, mainly applied in polar regions (e.g. Gallée, H., G. Guyomarc'h, and E. Brun, Impact of snow drift on the Antarctic ice sheet surface mass balance: Possible sensitivity to snow-surface properties, Boundary-Layer Meteorol. 99, 1-19, 2001.)

P. 2371, l. 4ff: The description here is somewhat difficult to follow. A figure may help to demonstrate the layer numbering and how the projections of the layers and the fluxes are handled and by which component of the model. This figure may be combined with figure 1 or 3? Refer also to chapter 3.2, where the rules for the layering of the snowpack are described.

P. 2372, ch. 2.3: The previous stand-alone version of CROCUS used the cloudiness to divide the radiation into direct and diffuse short-and long-wave radiation. Is this not needed any more? If coupled to an atmospheric model, it can deliver directly the needed radiative fluxes. But what happens if CROCUS/SURFEX is run in the stand-alone mode?

P. 2374, eq. 3: In my opinion, in the current form the equation for sfall always returns a value of 0.1.

P. 2375, l. 5f: Give a bit more detail how a thin fresh snow layer is handled in the model. Can it be just one layer or always at least three layers? When does the model switch to the maximum number of layers.

P. 2378, ch. 3.5: If I understand correctly, in the stand-alone runs the blowing snow is actually not transported, but rather the impact on the physical properties of the top layer(s) is considered. Is this also the case in the multi-grid simulations meaning that the transport of snow from one grid cell to another cell is not possible? According to ch. 5.3, if coupled to Meso-NH, snow can be transported. However, the description of the implementation of this process is not very convincing. It lacks many details (especially if compared to the rest of the manuscript) and refers to a 1-page abstract in the proceedings of a conference. I recommend to delete this chapter and to refer in

GMDD
4, C884–C888, 2011

ch. 3.5 to the work in progress for the model coupled to Meso-NH.

P. 2383, l. 5ff: What input information regarding the soil is needed to use ISBA? Does the user need to provide the information?

P. 2385, l. 3ff: Is there any limit for the flow rate of liquid water from one layer to the next?

P. 2388, l. 24f: Give information if and where the file with the input data is publicly available.

P. 2390, l. 13ff: What about other parameters like temperature and pressure? Were they also corrected according to topography?

Technical corrections:

P. 2366, l. 19: . . . over the East Antarctic Ice Sheet (Dome C).

P. 2367, l. 4: . . . of the properties of the interior of the snowpack . . .

P. 2368, l. 6: The ECMWF model has a different name, hasn't it?

P. 2369, l. 6: . . . the conductive heat flux . . .

P. 2371, l. 3: . . . accounted for in CROCUS.

P. 2371, l. 11: . . . needs to be taken into account.

P. 2371, l. 21: These variables . . .

P. 2373, l. 8f: . . . described in detail.

P. 2380, l. 5: I am not familiar with the term "snow browning". Is it normally used?

P. 2380, l. 13: micro meter, not mm.

Figures 4 and 6: In the printed form, axis labels and / or legends are not readable.

Figures 8 and 9: These figures are essentially identical to those published in Brun et

GMDD
4, C884–C888, 2011

al., 2011. I don't think they need to be reproduced.

Interactive comment on Geosci. Model Dev. Discuss., 4, 2365, 2011.

GMDD

4, C884–C888, 2011

Interactive Comment