

Interactive comment on “A Factorial Snowpack Model (FSM 1.0)” by R. Essery

Anonymous Referee #3

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This paper presents the development of a new snowpack model that contains 2 two levels of complexity for the parametrizations of 5 processes affecting the snowpack energy and mass balance. As illustrated by the example in Section 3, this model offers a general framework to discuss the influence of these parametrizations on snowpack simulations.

The model is clearly described in Section 2 and Section 3 provides a relevant example of model simulation (done at Col de Porte, French Alps) illustrating its potential. The model source code is freely available on github. This paper should be published in GMD. Prior to publication, minor revisions should be made to better explain differences and novelties compared to a previously published model (JIM, Essery et al., 2013) and to provide more references for the parametrizations used in FSM. Specific and technical comments are listed below.

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Specific comments

1. A previous paper (Essery et al., 2013) describes the development and the use of a snowpack model that combines parametrizations of different complexity allowing the generation of large ensemble of simulations. This model is referred as JULES Investigation Model (JIM). In the introduction (P 6585, l. 15-23), the author mentions the earlier development of JIM. It would be very valuable to better describe the benefit of FSM compared to JIM (either in this part of the introduction or later in the paper). For example, JIM explores the influence of additional parametrizations (fresh snow density, snow cover fraction). Maybe briefly justify the choices of parametrizations investigated in FSM.

2. Section 2.3 contains the description of the parametrizations of varying complexity. Even if the author mention at P 6585 (l 27-29) that these parametrizations are taken from previously published models, it would be useful to have the references for each parametrization used in FSM.

3. At P 6587 l. 1 the author mentions that mass can be removed from the snow surface by vapour flux (i.e. sublimation at the top of snowpack). What about solid condensation adding mass to the top of the snowpack? In Eq. 21 it seems that the latent heat flux can be positive or negative suggesting that FSM accounts for sublimation and solid condensation. If it is the case it should be mentioned in the text.

Technical comments

P 6589 Eq. 10: check the units of S_α and adapt the value given in Tab. 2 accordingly. S_f is defined as the snowfall rate at the surface ($\text{kg m}^{-2} \text{s}^{-1}$). S_α should have the same units.

P 6592 l 9-10: mention if the specific humidity at saturation is computed with respect to water or ice.

References

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Essery, R., Morin, S., Lejeune, Y., Ménard, C. B. (2013). A comparison of 1701 snow models using observations from an alpine site. *Advances in Water Resources*, 55, 131-148.

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