

***Interactive comment on “Assessing snow water equivalent of an Alpine catchment using snow dynamic model calibrated with satellite images” by C. Corbari et al.***

**C. Corbari et al.**

Received and published: 30 January 2009

General Comments 1. Consideration of satellite information on snow coverage can, in principle, lead to real refinement of the snow model parameters and improvement of the simulation results. However, the method of such a consideration presented in the paper looks questionable for me. First of all, it is unclear why the parameters of partitioning of precipitation into liquid and solid phase are selected by the authors for refinement on the basis of the satellite snow cover images. In my opinion, spatial distribution of snow covered area should not be too sensitive to these parameters affecting mainly the process of snow accumulation. According to my experience, the degree-day factor  $C_m$  which directly affects the melt rate is more important for this distribution. I suggest

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analyzing sensitivity of simulated snow coverage to the model parameters (including the parameters of snow melt) and then using the snow cover images for refinement of the most affecting parameters.

Response: The degree day parameters were calibrated in another work (Salandin, A., Rabuffetti, D., Barbero, S., Cordola, M., Volontè, G. and Mancini, M.: Il lago effimero sul ghiacciaio del Belvedere: monitoraggio e simulazione numerica del fenomeno finalizzata alla previsione e gestione dell'emergenza, Neve e Valanghe 51, 58-65, 2004) Results show that spatial distribution of snow covered area is sensitive to calibrated temperature parameters.

2. The criterion of the model performance, which is used for comparison of simulations with the snow cover images, looks not appropriate for the distributed snow model. This criterion reflects an ability of the model to reproduce total fraction of the catchment area covered by snow. It doesn't matter for this criterion where snow covers the area, say, if the upper half of the area is really covered by snow but the simulated snow exists only in the lower half of the area then the model performance is assessed as perfect according to this criterion. Such criterion could be used for a lumped snow model but it looks too weak for the distributed model. I suggest applying criterion reflecting snow coverage in the different parts of the area. However, even with the used weak criterion, the demonstrated results of the model validation are improper; the efficiency is 0.21. (Note that this value is not a typo as the Reviewer #1 suggested; Fig 6b confirms poor validation result). I believe that validation test could be more successful if the parameters of snow melt would be adjusted against the satellite data on snow cover.

Response: We appreciated the comment of the editor. The Nash and Sutcliffe efficiency, which is a bit unusual for snow coverage calibration, was eliminated. We substituted the index with a pixel to pixel analysis based on contingency table which has the advantage to take into consideration the spatial distribution of snow coverage.

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3. An approach allowing the authors to assess the model performance by comparison of simulated snow water equivalent (SWE) with the measured snow depth is not presented in details and, probably, that is why it looks questionable. Normalization of SWE and snow depth can not, in my opinion, result in avoiding the problem of comparison of the different characteristics of snow. Snow depth divided by its maximum (seasonal? multiyear?) value can not be compared with SWE normalized by the same way.

Response: We recall that the objective of the comparison, as well stated in the paper, is to verify the capability of the model to reproduce the timing of snow dynamic, and not to do a one-to-one comparison that is not possible if snow density is not known. The graphs were modified to report the snow depth.

Specific Comments 1. I agree with the Reviewer #1, the title should be changed.

Response: the title was changed to: Topographic correction of snow coverage retrieved from satellite images to improve model calibration. This should better highlight the objective of the work.

2. P. 3134, l. 10-13: What are the corrected images; here? Before this point, the authors do not describe any correction procedure. In addition, how are the pixels which are falsely classified as not covered by snow; determined? Probably the authors mean the elevation based correction procedure described in the following sentences. If this is the case, these sentences should be moved in the beginning of the paragraph.

Response: the sentence was reformulated

3. Table 1 looks as unnecessary because it simply shows that the applied correction procedure results in increasing of estimated fraction of snow cover. This result evidently follows from the description of the correction procedure.

Response: We think that Table 1 could be interesting because it shows which images

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we used for the analysis and how the choice of temperature parameters can influence the snow coverage extension.

4. P. 3136, l. 18-19: What are the other parameters of the distributed model?

Response: section 4 was added with the description of the hydrological distributed model and reference is supplied for the reader interested in further details.

5. P. 3137, l. 16: This is not a good result

Response: Nash-Sutcliffe is probably not a correct measure in such type of comparison. So in the new version of the manuscript, the images comparison is performed with the RMSE and with the contingency table with their performance index (CPI) (Ravazani et al., 2007) to catch the spatial distribution of the snow covered pixels.

6. Figures should be numbered in accordance with their references in the text. For instance, Fig. 4 is referred in the text after Fig. 1; Fig. 2 after Fig. 8, etc.

Comment: Figures numbering is corrected in the new version.

7. I suggest adding brief description of the FEST-WB model.

Response: A brief description has been added in the new version of the paper.

8. References in the text should be put into one-to-one correspondence with the list of references.

Response: references have been corrected

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 3129, 2008.

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