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Hydrology and Earth System Sciences Discussions

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.

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Overall this is an interesting and relevant topic, which is within the scope of HESS. However in current form, there are several points which should be clarified, corrected and complemented before the publication:

1) Please consider to change the title. Estimation of the snow water equivalent is not (in recent form) the main objective of the paper.

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.

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2) I agree with the reviewer #2, that the description of satellite data and correction algorithm needs to be extended (source, format, georectification, etc ...). Eventually, the existing concept used for NOAA snow cover mapping presented e.g. by Wang and Li (2003) or Foppa et al. (2004, 2007) should be discussed and compared to the methodology applied in this study.

Response: More information about satellite images are added in the new version of the manuscript.

3) The topographic-shading correction of snow cover images is, in my opinion, difficult to validate only through model simulations. Distributed model simulations may be biased e.g by the uncertainty in model parametrisation, interpolation of air temperature and precipitation. Another source of information (at-site measurements, snow courses, another remote sensing products, etc) is needed for a robust validation. Is it possible to demonstrate the improvement gained by your correction also by comparison with ground based snow depth observations? Please complement this point in more detail.

Response: The model is validated through the satellite images changing the temperature throsholds Tup and Tlow. In the new version of the paper, as requested, a robust validation of the topographic-shading correction of snow cover images is made by the comparison with ground based snow depth observations in the two stations of the Toce basin.

4) The satellite snow cover images provide useful information, which may be helpful for hydrological modelling especially in two areas. First they provide a potential for the improvement of snow model simulations (more accurate model outputs and more consistent representation of the internal state of the model). Second there is an open question if the remote sensing data will also improve the runoff simulations. Comparison of total runoff volume does not adequately address this question and in my opinion it needs to be presented in more detail.

Response: more results regarding runoff simulations have been added, taking into

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considerations most significant events occurred on the investigated basin. In the last paragraph some comparison of the modelled and simulated discharges are presented for the cross section of Candoglia on the Toce river. A model improvement is evident after the calibration with the corrected satellite images in terms of flood volume and peak discharge errors and also of the Nash and Sutcliffe index.

Specific comments 1)Please add some information about the vegetation distribution within the basin. How large is the area covered by forest? What is the accuracy of snow cover mapping in the forest?

Response: in a preliminary analysis we verified that the falsely not covered pixels were not correlated to vegetated area. The sentence in section 3 was reformulated removing reference to the effect of vegetation.

2)Nash-Sutcliffe is probably not a standard measure in such type of comparison. I would suggest to change it with a more commonly used concept of error matrix (e.g. in a similar way as it is used in gauge data comparison).

Response: 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) (Ravazzani et al., 2007) to catch the spatial distribution of the snow covered pixels.

There are several interesting issues to be focused in (e.g. how the model performance changes in different landcover classes or elevation zones, how does it change seasonally, etc).

Response: we think that these considerations are interesting but not focused on the objective of the paper.

(On p. 3137 l.16, there is probably a typo (NS efficiency should be probably 0.71, not 0.21.)

Response: the Nash and Sutcliffe efficiency was removed from calibration procedure.

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3)Please add more information about the model calibration (in the case that compares runoff simulations). How many model parameters has the model? Are they distributed over the basin or are they considered as a constant over the basin (lumped)? How are the other model parameters estimated (by a comparison of model simulations against the observed runoff? automatic calibration? which objective function? etc...)?

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

4)The results indicate that there is probably no need for applying two threshold temperatures in snow simulation, but just one (for this type of model). Is there some evidence (observations)available that may confirm this finding (e.g. that the snow is only falling when the temperature is below 0, or it is always raining if the air temperature raises above 0)? I would suggest to discuss this finding in more detail.

Response: This result is specific to the investigated watershed and could not be extended to different area without a new calibration. We think that the major result is the procedure and not the values of the parameters themselves.

Did you test also an option that includes a fixed temperature range (e.g. -2 and +2) and changing just a melt temperature parameter?

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(in italian)).

5)Some of the x-axis labels in Fig. 7 and 10 are strange. Please correct.

Response: In the new version of the manuscript, the labels are corrected.

6)Please correct the reference (pages) of D. Rabuffetti, G. Ravazzani, C. Corbari, and M. Mancini (2008) Nat. Hazards Earth Syst. Sci., 8, 161-173.

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Response: In the new version of the manuscript, the reference pages are corrected.

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

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