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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.

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General comments

This study shows an application of NOAA-AVHRR snow cover images for calibration and validation of a distributed hydrologic model. The authors investigate the sensitivity of two snow model parameters on model performance. This assessment is based on comparison of model simulations against satellite snow cover images and at-site snow depth observations. The results indicate that the satellite images enable to improve the snow model parametrisation and that the model outputs fit well with satellite images

and ground observations.

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.

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.

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.

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.

Specific comments



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Interactive Comment



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?

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). There are several interesting issues to be focused in (e.g. how the model performance changes in different land-cover classes or elevation zones, how does it change seasonally, etc).(On p. 3137 l.16, there is probably a typo (NS efficiency should be probably 0.71, not 0.21.)

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...)?

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

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

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.

References:

Foppa, N., Hauser, A., Oesch, D., Wunderle, S., Meister, R., 2007. Validation of op-



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N. Foppa, S. Wunderle, A. Hauser, D. Oesch and F. Kuchen, Operational sub-pixel snow mapping over the Alps with NOAA-AVHRR data, Ann. Glaciol. 38 (2004), pp. 245-252.

J. Wang and W. Li (2003) Comparison of methods of snow cover mapping by analysing the solar spectrum of satellite remote sensing data in China, International Journal of Remote Sensing, Volume 24, Issue 21 November 2003 , pages 4129 - 4136

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