Hydrol. Earth Syst. Sci. Discuss., 9, C1489–C1493, 2012
www.hydrol-earth-syst-sci-discuss.net/9/C1489/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "MODIS snow cover mapping accuracy in small mountain catchment – comparison between open and forest sites" *by* J. Parajka et al.

Anonymous Referee #2

Received and published: 15 May 2012

Review of "MODIS snow cover mapping accuracy in small mountain catchment – comparison between open and forest sites"

By J. Parajka, L. Holko, Z. Kostka, and G. Blöschl

Submitted to Hydrology and Earth System Sciences Discussion

In this paper, the authors assess the accuracy of the MODIS snow cover mapping accuracy at open and forested sites in a mountain catchement in Slovakia. For this purpose snow course measurements are used as ground truth. The paper addresses a known problem in the field of remote sensing of snow with optical sensors: the detection of

snow in forested areas, where snow is often masked by tree canopy. In accordance with previous MODIS validation assessements, this study confirms, that the MODIS snow mapping accuracy depends on landcover and is reasonably high also in forested areas. The results suggest an overall accuracy of 91.5% for MODIS snow data at this specific location. Slightly lower values are found in forested areas compared to open sites. By applying a 2-day temporal filter to mitigate cloud coverage, the snow mapping accuracy remains high (open sites) or even increases (forest sites).

Continuous validation of remote sensing snow products is of vital importance as every single validation effort increases the confidence in such data. Therefore, the paper is recommended for publication, if the concerns below are properly addressed. Formally, the paper is mostly well-written, follows a clear structure and the figures are well-presented. However, the authors may seek help from a native English speaker to polish this manuscript for final publication.

General comments:

1. Additional information on the MODIS snow map pre-processing might be useful, particularly for geolocation error interpretation. Please provide some more details on the MODIS data processing in Section 2.2: were the images reprojected? Are these images orthorectified?

2. The title term "mountain catchment" implies more than just the difference between open and forested sites. The reader may expects also some statements on the snow mapping accuracy depending on topography (i.e. slope/aspect/elevation), which is also of major interest in this field of research as snow in mid-latitudes is predominatly bound to mountain regions. Even though the number of snow courses and sites is limited, such kind of analysis extention might substiantially rise the contribution of this study. (From the naming of the profiling sites in Table 1 it seems that you have different aspects available for such analysis).

3. Likewise, the SI could be analyzed seasonally. How doe the MODIS snow detection

performance vary over time? How good is the accuracy in the accumulation vs. the ablation phase?

Specific comments:

- Title: change to "MODIS snow cover mapping accuracy in "a“ small mountain catchment – comparison between open and forest sites“

- 4074, 20-26 and p. 4075, 1-10: All the listed general statements on the importance of snow and other studies conducted (like "Numerous studies...“, "A range of MODIS snow cover products have been used“) in this field require references!

- 4075, 6-7: What about Klein et. al. (2003)? This validation was also based on snow courses in a mountain catchment (see below for exact reference).

- 4075, 10: Climate station bias: this is generally true, but the study area covered here does not exceed this critical altitude (i.e. in Parajka&Blöschl 2006: station altitudes up to 2290m a.s.l. were used). So, this is not quite a reason for the study at hand.

- 4076, 5: Please also refer to Klein et al. (1998), where a snow reflectance model was used in conjunction with a canopy reflectance model to model the reflectance of a snow-covered forest stand and the MODIS snow detection scheme was extended with the inclusion of the NDVI. Are these model assumptions/outputs maybe not valid globally leading to over-/underestimation of snow cover? This could be included this in your discussion as well.

- 4076, 12: What difference in the results between mountain forested areas and other forested areas can be assumed? And what are the reasons for such different validation results concerning forested areas, can you speculate?

- 4076, 19: add "The“ lower part

- 4076,20: forest line = tree line, add "the“ forest "is“

- 4076,21: add "and“ covers

- 4076, 25: add "the“ Forest Management Plan

- 4076, 25: briefly introduce "stand density“ here

- 4077, 5: specify "in the middle“ is this every 25 m, starting at 12.5m?

- 4078, 11: NDVI, NDSI: abbreviations need to be introduced at their first mention, without the explanation of NDSI, the follow-up sentence in unclear.

- 4078, 16-18: Does the fact, that only MODIS Terra images can be accounted for NDVI influence your results? How can you consistently combine the products when snow detection algrithms (i.e. thresholds) slightly differ between the sensors?

- 4078, 18: "false snow detection“ = "false alarms“?

- 4083, 13-14: This is not quite correct: Higher SI values in the 2-day composites does not mean a better MODIS algorithm performance. The 2-day compositing basically rises the number of clear-sky days which finally results in a increased SI (which, in turn, says that the 2-day compositing is accurate, but it does not say anything about the SI of the MODIS snow algorithm).

Figures and Tables:

- Be consisten with Tab./Table and Fig./Figure in the text

- Fig.2 : it would be helpful to add the lat/long information (Some of the "open“ areas (H1400,B1500W) might be locally open, but it seems that a MODIS pixel covers a large part of the surrounding forest? Or what season is represented in the Google image?)

- Figure 3 is not necessary or could be included in Figure 2

- Figure 4,6,8: please add a legend

- Figure 4/Table 3: Are there no open site measurements in 2009? Or no MODIS data?

- Figure 5: May indicate that this figure refers to Fig.4 (the same holds for the following figures, that refer to each other)

- Table 3: what does "OK“ mean in the row name?

- Figure 9: For consistency, display the missclassification in red as in the other figures. The snowmelt in the MODIS product from March 24 to the 25 in 2010 seems kind of unrealistic. Are there any explanations for this?

Proper citation for the MODIS data:

Hall, Dorothy K., George A. Riggs, and Vincent V. Salomonson. 2006, updated daily. MODIS/Terra Snow Cover Daily L3 Global 500m Grid V005. Boulder, Colorado USA: National Snow and Ice Data Center. Digital media.

References:

Klein, A. G., Hall, D. K., & Riggs, G. A. (1998). Improving snow cover mapping in forests through the use of a canopy reflectance model. Hydrological Processes, 12(10–11), 1723–1744.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 4073, 2012.