**Hydrology and
Earth System
Sciences
Discussions**

Interactive
Comment

Interactive comment on "Validation of MODIS snow cover images over Austria" *by* J. Parajka and G. Blöschl

J. Parajka and G. Blöschl

Received and published: 17 August 2006

We would like to thank Prof. Sorman for his helpful comments on the manuscript. We have addressed his comments as follows:

General comment

In response to the general comment we have added the reference to Tekely et al. (2005) to the Introduction section: "... The lowest accuracies were found for the snowmelt periods in forested areas. Tekeli et al. (2005) validated MODIS snow cover maps against ground-based snow courses in and around the upper Euphrates River in Turkey, using data from the 2002/03 and 2003/04 winter seasons. The accuracy obtained by comparing synchronous MODIS and ground data was 62% and increased to 82% when allowing for a 2 day time shift. Cloud cover was considered to be the

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

EGU

main reason for the relatively low classification accuracies. Recently, ..."

Technical comments:
Most of the technical comments are not directly related to specific paragraphs of the manuscript and some of them we consider as very interesting and useful suggestions for further research. We respond to the comments in the sequence listed by the referee.

Abstract: In response to the request for a more complete summary of the error sources we have added the following text at the end of the abstract: "The comparison of daily air temperature maps with MODIS snow cover images indicates that almost all MODIS overestimation errors are caused by the misclassification of cirrus clouds as snow."

No correction to existing mapping algorithm, more discussion to compare the daily and 8-day MODIS products, timing of processing and number of images necessary for real time runoff forecasting: The main objective of this study was to focus on the validation of the existing daily snow cover product, rather than to improve or develop classification schemes. In a recent project (see www.aware-eu.info) we examine, together with remote sensing specialists, potential improvements of the classification methodology using adjustments to the cloud mask and we test different classification schemes (e.g. fuzzy classifiers). Within this ongoing research we also plan to compare daily and 8-day MODIS snow products and to identify the representative number of snow cover images needed for real time runoff simulation and forecasting. However, these activities are beyond the scope of this paper and we hence prefer to retain the methodological and discussion parts of the paper.

Other snow cover products: Our preliminary analysis of a passive microwave satellite product (the AMSR product of NSIDC) over Austria (not mentioned in the paper) did

not show any relevant improvement in snow cover mapping over MODIS at the regional scale. Recommending the application of passive microwave images for Austria may hence be premature.

Representativeness of pixels where snow depth is observed: We agree with the reviewer that taking the neighbouring cells may reduce the misclassification errors to some extent which would be an interesting topic for future analyses.

MODIS classification improvement: Extending the MODIS mapping classes is, again, an interesting idea, well worth to be addressed in future research activities.

Increase in accuracy using time shifted maps: In order to highlight this suggestion we have added the reference to Tekeli et al. (2005) to the Introduction section of the manuscript as indicated above.

Snow depth threshold: We agree with the reviewer that different thresholds may be subjectively proposed and tested depending, e.g., on elevation and topographic variability. The thresholds may also depend on the resolution of the snow depth measurements. For example, the Co-op stations (North America) analysed in the study of Maurer et al. (2003) report snow depths in inches, with a minimum reported value of 1 inch (25.4 mm). In Austria, the snow depths are reported as centimetre integer values with a minimum of 1 cm which was selected as a threshold in our study. This is consistent with the results of Simic et al. (2004) who suggested the 1 cm threshold to be most representative of areal snow cover within a pixel.

Accuracy reduction in forests: As indicated in the paper, the comparison of snow mapping accuracies with respect to different land cover categories may not be fully

representative, as the snow depth measurements are routinely performed at open grassy sites. Interestingly, the results indicate that the largest misclassification errors occurred for the pasture and shrub dominant classes and not for forest. Snow courses in different vegetation types may be more suitable than station data for examining canopy effects on the mapping accuracy.

Cumulative frequency diagram: There exist several alternative methods for evaluating the station arrangement, including the one proposed here. As they likely give similar results, we have chosen to retain the layout of the frequency comparison as it is.

Format: Our ambition in this study was to validate an existing snow cover product, rather than to focus on the specific processing steps of the mapping algorithm. Detailed information of the MODIS snow mapping scheme has been published by the product provider (NSIDC), and is referred to in the text. Providing the detailed information in this paper would be repetitive. We have therefore chosen to give a summary description of the mapping algorithm as in the original manuscript.

We welcome any additional discussion as it is, in our opinion, one of the main advantages of the HESSD journal.

References:

Maurer, E. P., Rhoads, J. D., Dubayah, R. O. and Lettenmaier, D. P.: Evaluation of the snow-covered area data product from MODIS. Hydrological Processes, 17, 59-71, 2003.

Simic, A., Fernandes, R., Brown, R., Romanov, P. and Park, W.: Validation of VEGETA-TION, MODIS, and GOES+SSM/I snow cover products over Canada based on surface

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

EGU

snow depth observations. Hydrological Processes, 18, 1089-1104, 2004.

Tekeli, A. E., Akyürek, Z., Sorman, A. A., Sensoy, A., and Sorman A. Ü.: Using MODIS snow cover maps in modeling snowmelt runoff process in the eastern part of Turkey. Remote Sensing of Environment, 97, 216-230, 2005.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 1569, 2006.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

EGU