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Intercomparison between modelled and satellite-derived snow cover extent within the alpine and subalpine zone of the Swiss Alps

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Validation of remote sensing products

Snow cover represents an important variable with a wide impact on the environmental and socio-economic system within alpine regions such as the Swiss Alps. Snow cover has a relevance within the alpine environment at different spatial scale and is therefore a small to large-scale phenomenon.

This presentation reports on comparisons made between the spatial distribution of snow cover derived from a distributed numerical snowpack heat and mass balance model (ALPINE3D) and an operational snow cover product derived from NOAA AVHRR data. These two methods were applied at the landscape scale represented by the region of Davos in southeastern Switzerland. In area of approximately 630 km^2 we selected data from several days with different snow conditions during the snowmelt season in 2003 and 2004.
The comparative analysis between the model and snow cover product based on earth observation data was performed using a visual pixel-by-pixel comparison and skill score measures based on 2x2 contingency-tables. The comparison includes two different scaling approaches: aggregating the high-resolution model output to the coarser satellite data and disaggregating the AVHRR pixels to the model grid cells. The snow extent simulated by ALPINE3D was reasonably consistent with AVHRR-derived snow cover maps. However, ALPINE3D exhibited a slight underestimation of the snow-covered area compared to the satellite observations. The average agreement between simulated snow-covered grid cells and satellite snow cover determination was 88%. A decrease of the relative spatial accuracy (from 90% to 75%) between model and satellite was observed for the snow-covered area with an advance of the snowmelt period. For forested areas, accuracy decreases below 70% when satellite data estimates less snow than the model. Scaling the data to different spatial resolutions does not have a significant effect on the overall comparison between model and satellite data.
However, discrepancies between the two methods may be attributed to inherent errors associated with either method. For instance, ALPINE3D derived snow cover maps may overestimate snow cover on south exposed slopes and overestimate snow cover on north orientated slopes due to insufficiently modelled topographic effects. Additionally, the AVHRR product shows an underestimation of the snow cover for pixels where forest is present within the subalpine zone.

The results from this intercomparison study represent the initial stage of studies planned in the future to investigate the potential value of assimilating satellite-based snow cover data into ALPINE3D.