Snow modelling from MODIS in a highly cloudy region (Scotland).

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Moderate Resolution Imaging Spectroradiometer (MODIS) snow cover products are important for hydrological applications because of their good accuracy and daily availability. Their main limitation, however, is cloud cover. In this study we present a methodology to fill clouds gaps in a region with high cloud occurrence and without a well-defined seasonal pattern for snow. The methodology is based on different approaches and statistical methods, using the MODIS snow product derived from MODIS terra:
1. Pixels defined as snow in the QA layer of the snow product were masked as snow;
2. A focal filter was used to eliminate isolated pixels between May and September where elevation is below 400m;
3. A binomial (0=no snow, 1=snow) Generalized Additive Model (GAM) was fitted with the support of numerous covariates derived from Digital Elevation Model, including solar radiation;
4. A Random Forest approach was used to combine the binary GAMs;
5. The so obtained predictions were mosaicked with the original values;
6. A threshold based on temporal analysis of Land Surface Values for snow ad land pixels in the available years was used to reduce misclassification especially in the low-lands.
The models were validated using artificial cloud masks and the obtained agreement was good, from > 99% correctly classified pixels with a limited amount of clouds (5%) to >80% correctly classified pixels with a important amount of pixels (80%). The so obtained mosaics were used to derived statistics such as snow length, first and last day of snow for Scotland for the period 2000-2011. Various summary statistics were prepared, temporal (every year, over the considered period and per Day of Year over the considered period) and by habitat. The habitats were derived from LCM2007, a detailed land use data set for UK. The results showed differences between habitats providing a spatio-temporal measure of snow cover in Scotland with dynamic temporal modelling and estimation of confidence intervals. The study was implemented using open source software, in particular GRASS and R.