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Northern Hemisphere Fractional Snow mapping with VIIRS: First experiments in ESA DUE GlobSnow-2

Sari Metsämäki, Kari Luojus, Mwaba Kangwa-Hiltunen, Jouni Pulliainen, Andreas Wiesmann
Finnish Environment Institute, Finland

Interannual changes in the extent and duration of the Northern Hemisphere (NH) seasonal snow is an important climate change indicator. During snow melting period, the transitional zone exhibiting patchy snow cover can be wide, implying that mapping of FSC would be more useful information than binary ('snow/not snow') classification. This is expected to be relevant e.g. in global albedo retrievals. Accurate mapping of FSC also gives indication of start of the melting season and is therefore useful e.g. in hydrological applications. Remote sensing techniques often suffer from inaccuracies over forested areas, which is a defect as boreal forests cover vast areas in the NH. The optical remote sensing method SCAmod is particularly designed for FSC-retrievals in boreal forests. In SCAmod the masking effect of forest canopy is accounted for by apparent forest transmissivity employed in the radiative transfer-based reflectance model. ESA DUE-project GlobSnow applies SCAmod in the production of 16 years' Climate Data Record on Snow Extent, using ERS-2/ATSR-2 and Envisat/AATSR-data. Since spring 2013, NPP Suomi/VIIRS data has been used for near-real time FSC-production in GlobSnow, in order to fill the data needs after the end of AATSR acquisition and before ESA Sentinels. Compared to AATSR with narrow swath width, the global coverage of VIIRS enables daily mapping of FSC. This enables (1) the use of FSC-retrievals as supportive information for daily NH SWE mapping based on microwave radiometer data and (2) the comparison of the results with other global products. Here we demonstrate the first NH FSC retrievals applying SCAmod to VIIRS, and compare the results to NASA MOD10C2 snow maps.

Here, the difference between SCAmod-based SE and NASA MODIS MOD10_C2 for the Northern Eurasia is demonstrated. MOD10C2 provides 8-day maximum on Climate Modeling Grid (CMG). The 8-day composite provides clear-sky observations with large spatial coverage, which enables the investigation of differences in the snow maps. Accordingly, we can identify the locations of discrepancies and focus the future investigations to those particular areas. We employ NPP Suomi/VIIRS daily global reflectance data to provide FSC with SCAmod, and then convert those to maximum 8-day product to be compatible with MOD10C2. Three 8-days period during spring 2013 are cover in the analysis. The results indicate that SCAmod is more able to detect snow in dense forest. In all three periods, SCAmod-based snow maps show higher FSC for forested areas throughout the season, with more than 10% (range 0-100%) for the densest forests. Another distinctive difference between SCAmod and MOD10C2 is the width of the transitional zone: proportion of fractional snow area out of total snow-covered area is clearly higher for SCAmod based snow map. Most likely, this is because MOD10C2 is based on binning binary data in CMG-cells, which evidently leads to overestimation of high snow

fractions and underestimation of low snow fraction. As a result, width of the fractional snow zone is reduced.

Cloud screening is one of the challenges in optical remote sensing of the Earth's surface. Particularly the presence of snow on the ground poses a problem for many otherwise appropriate methods. Cloud identification over snow-covered terrain typically fails due to the similar spectral properties of certain cloud types and snow. Discrimination between snow and cloud is however very important for snow mapping in two ways: 1) undetected clouds are typically falsely interpreted as snow and 2) the false cloud commissions i.e. overestimation of clouds over snow-covered terrain reduces the application area for snow assessments. Overestimation of clouds over snow-covered or partially snow-covered terrain has found to be very problematic e.g. for official AATSR cloud mask (provided in level 1b-product). The cloud screening method SCDA developed in GlobSnow-1 partially overcame this problem, but false cloud commissions at the edges of snow-covered terrain particularly at mountainous areas remained. Therefore in GlobSnow-2, a new cloud screening algorithm based on thresholding for single-bands and their-related ratios has been developed. The method uses a limited number of bands, which are common for MODIS, AATSR and VIIRS. Compared to the earlier SCDA, it shows a csignificantly better capability to identify clouds over seasonally snow-covered areas. In many areas, issues of false cloud commsiions at the edges of snow coverd terrain have been solved. Still, false cloud omissions occur in certain high-altitude areas in Asia. Here we present some results of cloud screening issues and demonstrate the recent improvements.