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Estimating variation of Snow cover mapping using MODIS satellite time series

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Satellites are well suited to the measurement of snow cover because the high albedo of snow presents a good contrast with most other natural surfaces except clouds. Over the years, using a variety of sensors, including the Scanning Radiometer (SR), Very High Resolution Radiometer (VHRR) and AVHRR sensors, snow cover has been mapped in the Northern Hemisphere on a weekly time basis by the NASA. Current state of the art space borne imaging instruments like the Advanced Very High Resolution Radiometer (AVHRR), the Moderate Resolution Imaging Spectrometer (MODIS) or the Medium Resolution Imaging Spectrometer (MERIS) offer great possibility for remote sensing of snow and generation of snow cover products for global to regional scale.

Traditional approaches generally used to map snow are based on a combinations on bands and fixed thresholds . The retrieval of sub-pixel information of snow is presented in many studies. The linear spectral mixture algorithm is one of the most commonly used technique to estimate sub-pixel snow cover and has proven to be effective at local scale.

Data processing chain included the pre-processing (as detailed at point a and data analysis as at point b):
(a) The pre-processing includes calibration, georeferencing and atmospheric correction of the visible channels. Data sets were orthorectified, to take into account the geometric distortions introduced by the complex relief and the scan geometry. Atmospheric correction and Cloud detection and masking were carried out

(b) The methodological approach to discriminate and map snow will be based on spectral indices, likethe Normalized Difference Snow Index (NDSI) which is an effective way to distinguish snow from many other surface features being that snow has strong visible reflectance and strong short-wave IR absorbing characteristics.
Normalized Difference Snow Index (NDSI)
The NDSI is a measure of the relative magnitude of the characteristic reflectance difference between the visible and short-wave IR reflectance of snow.

The usefulness of the NDSI is based on the fact that snow and ice are considerably more reflective in the visible than in the shortwave IR part of the spectrum, and the reflectance of most clouds remains high in the short-wave IR, while the reflectance of snow is low.

The current scheme in NASA's Earth Observing System (EOS) applies this method to the MODIS (Moderate-Resolution Imaging Spectrometer) instrument for its standard snow map product.
The NDSI helps distinguish snow from similarly bright soil, rock and cloud and has been shown to be an effective index for mapping snow cover in rugged terrain.
In this paper, spectral mixture algorithms have been used to estimate sub-pixel snow cover and comparison with higher spatial resolution data has proven the effectiveness these techniques.