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Optimizing Moderate Resolution Optical Remote Sensing of Snow Fraction

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The information on fractional snow cover (FSC) becomes a standard user requirement. Subpixel snow fraction is needed for atmospheric correction and improves other retrieved from remote sensing parameters characterizing land surface, in particular albedo, land surface temperature, soil moisture, heat fluxes, vegetation parameters, etc. Using snow fraction derived from optical observations is considered the main approach in hydrologic, meteorological, land surface and climate modeling, data assimilation.
A large scale international snow products inter-comparison and validation project initiated by the European Space Agency (ESA) and recently completed at the Environmental Earth Observation company in Innsbruck, Austria used almost 500 Landsat images to estimate the performance of alternative fractional snow algorithms. The validation results demonstrate that the MODIS snow fraction algorithm proposed by Salomonson and Appel in 2004 and using the Normalized Difference Snow Index (NDSI), has advantages in comparison with other methods both on open land and in forested areas for two reference data sets created using different techniques.
The principles of the enhanced NDSI-based algorithm take into account that the reflectances of snow and non-snow are characterized by a very significant local variability and also by large changes from one scene to another. The local snow and non-snow endmembers are approximated in the algorithm by NDSI with a high accuracy. The magnitudes of snow and background Normalized Difference Snow Indexes are very variable and calculated on the fly to retrieve snow fraction.
The further modified NDSI-based algorithm calculates fractional snow cover on the basis of the equation

FSC = (NDSI - NDSInon-snow) / (NDSIsnow - NDSInon-snow),
where NDSIsnow and NDSInon-snow are scene-specific snow and non-snow endmembers.

Effective 1 January 2017 NASA stopped providing MODIS fractional and binary snow products, which is a matter of significant concern. The Sentinel-3 mission is well positioned to help restore retrieving systematic global observations on fractional snow cover from remote sensing observations.
More accurate information on snow cover could be retrieved from remote sensing measurements when specific features of a region and a time/date of measurements - snow and background surface types, the geometry of satellite observations, the state of the atmosphere - are taken into consideration. It can be considered beneficial to take into account changes in parameters of any algorithm to improve its performance.
The optimal way to derive moderate resolution optical remote sensing information on snow cover will combine allowing for the local variability of snow and non-snow reflective properties within a scene-specific algorithm to create unbiased and consistent information on fractional snow cover required for global studies as well as for numerous regional and local scale applications.
The approaches to retrieve snow fraction, proposed for MODIS and Sentinel-3 missions are noticeably different. Therefore it is reasonable to assume that the collaboration between researchers with experiences supplementing each other can be very promising to tackle the problem of optimizing fractional snow algorithm development. Such collaboration can be considered as a key recommendation for developing snow product algorithms and other related activities.