Monitoring plant cover on the Tibetan Plateau: A multi-scale remote sensing based approach

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The degradation of the grasslands on the Tibetan Plateau (TP) is seen as ongoing process. This general assumption is based on small scale studies which are not comparable because field methods and indicators differ among the investigations. Thus, especially for remote areas, a remotely sensed monitoring system is critically needed to monitor degradation. Additionally, a single and comparable product for the entire TP is of urgent concern to evaluate the ecological consequences of the assumed ongoing degradation on ecosystem services provided by the grasslands on the TP. As indicator for degradation plant cover was used in this study because a close link between degradation and plant cover has been identified by several previous studies on the TP. Thus, we implemented a four-scale remote sensing approach to derive plant cover. As reference and validation data, field records were taken between 2011 and 2013 at 15 locations spanning the entire TP and covering all grazed grassland vegetation types. Plant cover was measured in situ at up to 210 plots per location using standardized taken digital photos. To classify green vegetated parts in the digital photos, simple threshold classifications were applied to the ratio of red and green color values. The geographical position of all plots was recorded using a differential GPS. Plant cover was derived from satellite data at three scales using spectral angle mapper (SAM), normalized difference band indices and linear spectral unmixing. The result of the first two approaches was transferred to plant cover using multiple linear regression techniques. Reference spectra and endmember spectra for SAM and linear spectral unmixing were recorded using a field spectrometer. The hyperspectral information was resampled to satellite bands using the spectral response functions of the sensors. To derive plant cover at local scale, we classified 35 high resolution WorldView-2, Quickbird and RapidEye satellite images using the in situ measured plant cover. At regional scale Landsat ETM and Landsat 8 images were classified. Therefore, the locally derived plant cover was used as reference and validation data. To provide a plant cover product for the entire TP and to achieve a sufficient high temporal resolution for monitoring purposes, plant cover was finally derived from MODIS BRDF corrected composites. Therefore, the plant cover derived from the Landsat scenes was used to train and validate the predicted plant cover on the TP.