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Study of vegetation in snowy regions by satellite remote sensing and the future prospect

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Satellite remote sensing is a useful mean to monitor the vegetation distribution and its variability over extensive regions. The chlorophyll in plant has large reflectance in near infrared band and small reflectance in visible band. According to this spectral reflectance characteristic, the vegetation index, which represents the greenness of land surface, is calculated. By the continuous observation of the sensor "AVHRR" of the satellite "NOAA" etc., the time series of the vegetation index is available for global region from 1980s. These data have enabled us to study the spatio-temporal variability of the vegetation.
Increasing trends of the vegetation index from 1980s were reported in some regions of Siberia by several literatures. These increasing trends are supposed as signals of the extension of the growing season of the vegetation or the northward shift of the vegetation biome due to the warming.
Investigations of the vegetation index in association with meteorological data reveal close relationships between vegetation behaviors and hydrological circumstances including the snow cover. For example, the seasonal cycle of the vegetation index over the steppe in Mongolia shows its annual maximum around the end of July, while that over the steppe in Kazakh has its maximum in the end of May, about 2 months earlier than Mongolia. It appears that the available water for the plants in Kazakh, where the precipitation is small throughout the year, is only snow thaw water in spring to summer, whereas the rain water in summer season in Mongolia.
The snow cover strongly affects the measurement of satellite remote sensing. Because the reflectance of snow is much higher than that of vegetation, the snow cover remained on the forest floor spuriously diminishes the vegetation index of the forest. Consequently, the greenness of the forest will be under-estimated. However, such snow cover remained on the forest floor enables us to extract the information of only forest crown concealing the forest floor vegetation. By exploiting this condition, an estimation study of the Leaf Area Index (LAI) of the forest crown was carried out based on vegetation index data over the larch forest in eastern Siberia.
In addition to the remote sensing by visible and infrared bands afore-mentioned, remote sensing by the microwave radar (synthetic aperture radar) is applied to estimate forest structure. Since the sparse forest in boreal region is suitable for this microwave radar remote sensing, advances are anticipated in the future.

Keywords: boreal forest, vegetation index, global warming, snow cover, SAR, steppe