Probing Polarization to Assess the Cuticular Condition of a Terrestrial Canopy

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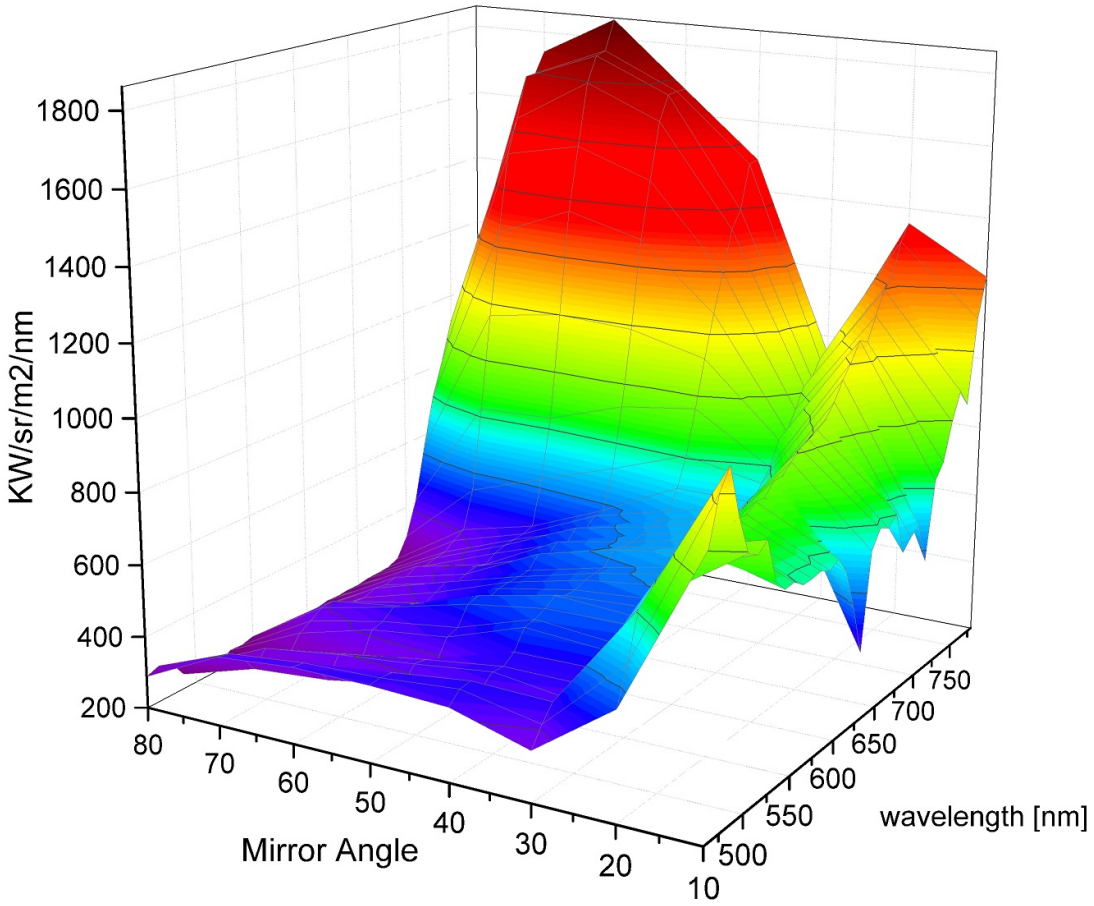
This study presents an empirical study of the polarized-light phenomena on a leaf surface under the laboratory condition, using a Liquid Crystal Tuneable Filter (LCTF) camera with a linear polarizer filter attached on front of its lens and were rotated to obtain the degree of polarization (DoP) of the target. The instrument was capable to capture the spectrum between 460nm to 780nm with the step of 10nm. The experiment was focused to capture the specular reflectance from the surface of the leaf, thus we set the angle between the light source and the sensor always in mirror angle. Several different leaves with distinct different feature on its surface were observed in a dark-room laboratory and outdoor measurement. Results show that a polarization measurement is capable to distinguish changes on the drought-stress plant, thus it remains a key component of the remote sensing probe to understand the vegetation cuticular condition, and in a broader range, terrestrial canopy.

Keywords: Degree of Polarization, Drought, Hyperspectral, Forest Canopy, Specular Reflection



Long-term monitoring of land surface phenological changes

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Land surface phenology (LSP) is associated with climate over space and time, and the monitoring of LSP help understandings of the terrestrial environmental changes. The LSP is often inferred by satellite observation, and long-term and regularly composite satellite imagery is now freely available. In this study, we demonstrate how LSP changes over space and time at the global scale over the last three decades by using GIMMS3g datasets. We focus on the magnitude and the timing of the peak of yearly phenological activity, estimated from a harmonic analysis. The first harmonic curve is regarded as a proxy of the overall productivity of vegetation and the second one is interpreted as a sensitive bimodal system changes. Results show the long-term trend of LSP changes; for example the peak of phenogical activity tend to be earlier in high-latitude regions.

Keywords: Phenology, Remote sensing, Harmonic analysis

Spatial correlation for phenological responses to climate

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Phenological and climate data are highly variable across time and space, and have been shown to display both spatial and temporal non-stationarity. In time series analysis, such variability in the time domain may be described in one variable by autocorrelation, or between two or more variables by cross-correlation and cross-partial correlation expressions using time lags. In spatial analysis, this variability may be captured by creating local models using approaches such as geographically weighted modeling techniques that utilize spatially weighted kernel functions. Although many previous studies regarding phenology focus on how phenological events respond to climate temporally, it is apparent that the spatial relations which may also influence such events have not yet been thoroughly considered. Hence this study demonstrates how spatial and temporal effects may be included in statistical analyses of phenological responses to climate data by including geographically weighted modeling techniques in time series analysis of NDVI values, temperature, and precipitation. This study uses monthly climate and phenological data from the CRUTS and GIMMS3g time series data sets over the last three decades. Cross correlation and cross partial correlation between the three variables are observed to find time lags that display higher positive and negative correlation coefficients; following this, geographically weighted correlation and partial correlation techniques are applied to the lagged data. It is expected that this will allow for a more careful examination of the relationship between temperature, precipitation, and NDVI.

Keywords: phenology, geographically weighted approach, time series, spatial relation

Afforestation monitoring using long-term remotely sensed data in Chinese semi-arid area

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The Conversion of Cropland to Forest Program (CCFP) has been implemented since 1999 to prevent the land degradation in the Loess Plateau, China. Many croplands in this region has been converted into plantation sites according to the CCFP, however the situation (such as growth, stability, or adaptation) of planted trees is not well monitored continuously over space. Satellite sensors have observed terrestrial surface since 1980s which fully covers the pre/post implementation period of the CCFP and available multi-temporal satellite images enable us to analyze vegetation response through the trajectory of Vegetation Index (VI). Therefore we attempt to evaluate the afforestation program by using VI time-series of LANDSAT and MODIS over the long term. The occurrence of afforestation, timing of planting, and temporal greenness trends are analyzed by Breaks For Additive Season and Trend method. As a case study, we choose Wuqi County in the northwest Shaanxi Province, located in the central Loess Plateau. This county is on the semi-arid transit zone between forest and grasslands, and has been designated as the national pilot model county for CCFP. Results showed that VI time-series could detect and measure the plantation forest growth spatially as a consequence of CCFP. It can be said that this study explored the new possibility for understanding the positive/negative effects of CCFP and evaluating how the afforestation by CCFP worked against land degradation.

Keywords: Remote sensing, Vegetation-Index time series, Afforestation, Semi-arid areas, Chinese Loess Plateau

Impact of spatial scale for phenological indices derived from remotely sensed data

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Land surface phenology (LSP) characterizes the vegetated land surface and is practical to understand terrestrial environmentals at a global scale. Regularly observed remotely sensed data such as Landsat, MODIS, and AVHRR contributes to analyze LSP spatially. However, at least two main challenges should be addressed such that (i) the spatial resolution which attributes to the data source may significantly impact to LSP estimation, and (ii) the estimated LSP may not represent the vegetated land surface well due to the mixed land cover. Previous studies have shown that the estimation of LSP from different data is not consistent due to the spatial scale of data but yet fully linked with the mixed land cover problem. Thus, in this study, we attempt to analyze the impact of spatial scale issue to the estimated LSP in homogenous land cover areas. We use freely available remotely sensed data with different spatial resolution such as Landsat (30m), MODIS (250m, 500m, 1km), and GIMMS3g (8km) and estimate phenological indices for each. As land cover description differs among data products, land cover classes are aggregated into 12 classes globally from major global land cover producs (GLCC, GLC2000, and globcover), then spatially homogenuous land cover are only picked up. Phenological indices such as the magnitude and the peak of DOY are calculated by harmonic analysis to compare results among different spatial scales. The variability of phenological indices is explored according to the different spatial scale under the condition of homogenuous land cover. It is expected to model such variability to overcome the spatial scale impact and such characteristics depending on the spatial scale should be taken into account when considering LSP from satellite.

Keywords: Spatial scale, Land surface phenology, remotely sensed data

Remote sensing of reflectance properties related to ecological shifts post-fire in southern Siberia

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Rapid ecological shifts such as the replacement of forest ecosystems by grasslands can be detected using remotely sensed reflectance data. In addition to detecting forest losses, a longer time series of reflectance data can provide information about the persistence of these shifts, or alternatively about ecosystem recovery. In addition to changes in the amount of reflected energy, ecological shifts can be detected from the timing of phenological events that may change as the result of the replacement of one plant functional type with another. Our ability to detect forest recovery from disturbance depends on the length of the remotely sensed data record in relation to the recovery signal. Monitoring ecosystem recovery often relies on some proxy for a fully recovered ecosystem, usually the signal from the period prior to disturbance or from an adjacent, undisturbed area. The requirement of a pre-disturbance signal means an even longer time series of data are needed, and finding nearby undisturbed areas for comparison can be unreliable and time-consuming. The pattern of reflectance time series data is also likely vary depending on the spatial and temporal resolution of the data used to analyse them. In the southern boreal forests of Siberia, recovery of reflectance properties post-disturbance may take several decades or more, or it may appear suddenly after a prolonged period without a discernible trend. We analyse several areas of known forest loss post-fire as well as some normally recovering sites to determine typical trajectories of recovery in reflectance properties from several remotely sensed datasets.

Keywords: boreal, wildfire, disturbance, recovery, remote sensing, ecology

