

# Characteristics of bi-directional and spectral reflectance over a steppe

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A field experiment for spectral and bi-directional reflectance are performed over a typical steppe in the Khrlen river watershed which flows in the north-eastern part of Mongolia. We have obtain diurnal and seasonal variations of spectral reflectance characteristics according to the over the steppe.

## Location, method, and period of the field experiment

Locations of the field experiment were five places where were all in the Kherlen river watershed, Mongolia (Baganuur, Kherlen-Bayan, Ulaan, Undurkhaan, Jargalkhaan, Darkhan). The five locations are in a range of 46.5-48degN in latitude and 108-110.5degE in longitude. They are located in a plain surrounded by gentle slope hills, and their altitude above sea level are within 1000-1350m. Flora is typical steppe, and average height of grass is within 10-30cm. The leaf area index seasonally varied from around 0.1 to 0.5, LAI had maximum value in the last half of August, and almost all grass had been senescent in October. The field experiment was performed from June to October, 2003. The spectrometry was done by a hyper-spectrometer named FieldSpec Pro (made by Analytical Spectral Devices Inc.) whose range of available spectral band is between 350-2500nm with the resolution being 10nm. Spectrometry of vegetation surface was done with the sensor part of the spectrometer was set at the height of about 2m, and we measure surface reflective radiance in 26 viewing angles including a hemispheric measurement. Sky radiance was also measured in the same way. The field of view of the spectrometry was 8deg or 18deg. A cosine receptor was attached to the sensor in case of the hemispheric measurements. The measurements were done during daytime from about 0900 through 2000 LST. Time required for a series of measurements was between 10-30 minutes that was short enough to neglect variations of characteristics of reflectance. Based on results of the above field experiment, we estimate viewing angle dependence of hemispheric-directional reflectance (HDR) and normalized difference vegetation index (NDVI). The hemispheric-directional reflectance is defined as a ratio of directional reflective radiance and incident flux that is integrated over hemisphere.

## Results

We can obtain preliminary results as follows:

- (1) back scattering of HDR is found primarily for typical steppe, but not so much for bare ground.
- (2) Diurnal variations of both HDR and NDVI are large for typical steppe.
- (3) Seasonal variation of HDR is rather smaller than NDVI for typical steppe.
- (4) Azimuth angle dependence of HDR and NDVI is found for typical steppe even the nadir angle are the same.

## Future Issues

Parameterization of viewing angle dependence of HDR and Vegetation indices. Parameterizations of diurnal and seasonal variations of HDR and VIs. Finding the most optimal VI for evaluating LAI.