VALIDATION OF MODIS FAPAR PRODUCTS IN HULUNBER GRASSLAND OF CHINA

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Abstract: The fraction of absorbed photosynthetically active radiation (FAPAR) is a measure of how large of the incoming solar radiation in the photosynthetically active radiation spectral region (0.4μm to 0.7μm) that is absorbed by a photosynthetic organism, and thus expresses a canopy's energy absorption capacity (Fensholt et al., 2004). FAPAR is one of key structural variables required in modeling primary production, global climate, hydrology, biogeochemistry, and ecology (Sellers et al., 1997). Accurate values of FAPAR at both regional and global scales with sufficient temporal frequency are important for quantifying the energy and water fluxes at the atmosphere-biosphere interface, and also for characterizing and monitoring the biosphere and its functioning (Knyazikhin et al., 1998; Tian, 2002). Using the FAPAR values from satellites, carbon uptake in a large scale could also be estimated (Olofsson and Eklundh, 2007).

The Moderate Resolution Imaging Spectroradiometer (MODIS) FAPAR product provides global images with 1km resolution at eight-day intervals, based on global vegetation map

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which is stratified into six canopy architectural types, or biomes (Myneni et al., 2002). The FAPAR values derived from remote sensing data can be generated in two general approaches: Top-down statistical model and Bottom-up model (Fensholt et al., 2004).

Validation and assessment of MODIS/FAPAR products is essentially necessary to establish confidence in the use of the products (Steinberg and Goetz, 2009). The validation could be initiated to assess product accuracy by comparing high-resolution satellite imagery and *in situ* measurements (Steinberg et al., 2006; Yang, W. et al., 2006; Steinberg and Goetz, 2009). Further ongoing evaluations are still requited to help revealing uncertainties in the satellite estimates, and to provide a basis for improving the MODIS algorithms, which results in continual improvement of quality of the products (Steinberg and Goetz, 2009).

Recent validation efforts of the MODIS products have focused primarily on the assessment of LAI in forest, cropland, woodland and grassland in a number of reports (Shabanov et al.,2003; Fensholt et al., 2004; Steinberg et al.,2006; Hu, J. et al.,2007; Garrigues et al.,2008; Steinberg and Goetz, 2009). There have been only a few studies on the MODIS FAPAR products in West Africa and Senegal (Fensholt et al., 2004), in a Kalahari woodland, Africa (Huemmrich et al., 2005), in boreal forests of Alaska(Steinberg et al., 2006;Daniel et al., 2006) , and in temperate forests of the eastern United States(Steinberg and Goetz, 2009). However, only one study has so far examined the accuracy of a FAPAR product in relationship between ground-based measures in semi-arid grassland in Africa and the high resolution image estimate (Fensholt et al., 2004). Extension of validation efforts to other grass type in different area of the grasslands for MODIS FAPAR products is needed. Therefore, we assessed the accuracy of the MODIS FAPAR product in the temperate meadow-steppe grassland in Hulunber of China, using high-resolution satellite imagery in conjunction with *in situ* measurements of canopy light harvesting during growing season, and herewith report the result.

All field measurements were carried out in the State Hulunber Grassland Ecosystem Research Station (N 49°19′, E 120°03′, Alt. 628m), locating in northeast of Inner Mongolian Autonomous Region, China. The fieldwork was carried out in two sites of the center of the meadow steppe. One is Stipa baicalensis site (49°21'10.52" N, 120°6'8.63" E) and Leymus

chinensis + Mesophilic forbs site（49°19'9.78"N, 120° 5'52.32"E）of the research region. Incident radiation was measured using an AccuPAR Ceptometer (Model LP-80, Decagon Devices Inc., USA). A Tetracam Agricultural Digital Camera (Tetracam Inc., USA) was used to take photos for calculating normalized difference vegetation index (NDVI) using computing software PixelWrench2 .The all in situ measurements were carried out from June to September in 2007, and to August 15 in 2008 because of vegetable being cut. In order to compare with the MODIS FAPAR directly, we selected one 2km×2km size of grassland block within the Leymus chinensis + mesophilic forbs site and the Stipa baicalensis site respectively, and measured the PAR data as the picture showed (Fig.1).

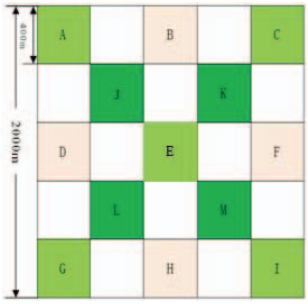
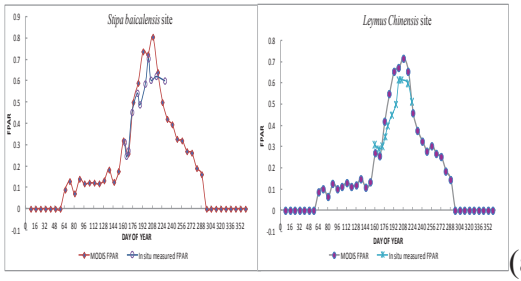
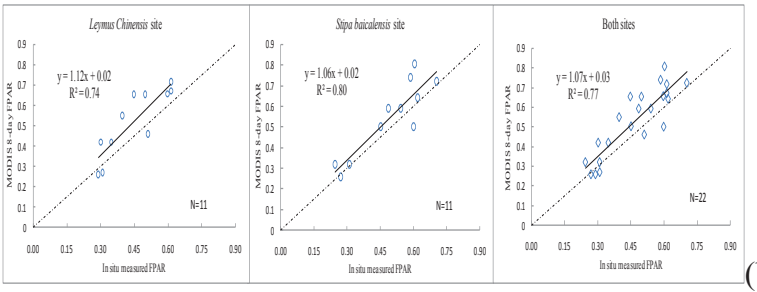


Fig. 1 Illustration of the sampling order for measuring PAR in grids. Measures were conducted in order of light green, pink, and dark green grids.

The FAPAR was calculated using the in situ PAR data, and compared with the MODIS FAPAR. The results The MODIS FAPAR product reflected very well the seasonal dynamics of *in situ* FAPAR(Fig.2), but tended to overestimate the value with averaged relative error at13.7% in the *Stipa baicalensis* site and 18.7% in the *Leymus Chinensis* site. It was found that the *in situ* FAPAR was linearly related to NDVI (R^2 from 0.76 to 0.85), exponentially related to LAI (R^2 from 0.91 to 0.97), and polynomially related to height of the (R^2 from 0.81 to 0.86). The MODIS FAPAR algorithm was derived based on the global land cover map, which may be too broad for local areas. More fieldwork for various types of the grasslands is necessary.



(a)



(b)

Fig.2 Time series of in situ measured FAPAR and MODIS 8-day FAPAR in the two fieldwork sites (a), and correlation analyses (b).

Keywords: MODIS, FAPAR, NDVI, validation, Hulunber, grasslands

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