Seasonal variation in aboveground production and radiation use efficiency of temperate rangelands estimated through remote sensing

Gervasio Piñeiro, Martín Oesterheld and José M. Paruelo.

Abstract.

Aboveground net primary production (ANPP) of grasslands varies spatially and temporally. Spectral information provides a promising tool to estimate ANPP in real time and at low cost. The objectives of this article are: (1) to evaluate at a seasonal scale the relationship between ANPP and the normalized difference vegetation index (NDVI), (2) to estimate seasonal variations in the coefficient of conversion of absorbed radiation into aboveground biomass (?$_a$), and (3) to understand the environmental controls on such temporal changes. We used field, biomass-based determinations of ANPP for two grassland sites in the Flooding Pampa, Argentina and related them with NDVI data derived from the NOAA/AVHRR satellites through three different models. Results were compared with data obtained from the new MODIS sensor at an additional site. The first model was based solely on NDVI; another was based on the amount of photosynthetically active radiation absorbed by the green vegetation ($APAR_g$), which was derived from NDVI and incoming photosynthetically active radiation (PAR); and the third was based on $APAR_g$ and ?$_a$, which was in turn estimated from climatic variables. NDVI explained between 63% and 93% of ANPP variation depending on the site considered. ANPP estimates were not improved by considering the variation in incoming PAR. In both sites, ?$_a$ varied seasonally (from 0.2 to 1.2 g DM/MJ) and was significantly associated with combinations of precipitation and

temperature. Combining $?_a$ variations with $APAR_g$ increased our ability to account for seasonal ANPP variations in both sites. Our results indicate that NDVI produces good, direct estimates of ANPP only if NDVI, PAR and $?_a$ are correlated throughout the seasons. Thus, in most cases, seasonal variations of $?_a$ associated with temperature and precipitation must be taken into account to generate seasonal ANPP estimates with acceptable accuracy.