

Land-use impact on ecosystem functioning in eastern Colorado, USA

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Abstract

Land-cover change associated with agriculture has had an enormous effect on the structure and functioning of temperate ecosystems. However, the empirical evidence for the impact of land use on ecosystem functioning at the regional scale is scarce. Most of our knowledge on land-use impact has been derived from simulation studies or from small plot experiments. In this article we studied the effects of land use on (i) the seasonal dynamics and (ii) the interannual variability of the Normalized Difference Vegetation Index (NDVI), a variable linearly related to the fraction of the photosynthetically active radiation (PAR) intercepted by the canopy. We also analysed the relative importance of environmental factors and land use on the spatial patterns of NDVI. We compared three cultivated land-cover types against native grasslands. The seasonal dynamics of NDVI was used as a descriptor of ecosystem functioning. In order to reduce the dimensionality of our data we analysed the annual integral (NDVI-I), the date of maximum NDVI (D_{MAX}) and the quarterly average NDVI. These attributes were studied for 7 years and for 346 sites distributed across eastern Colorado (USA).

Land use did modify ecosystem functioning at the regional level in eastern Colorado. The seasonal dynamics of NDVI, a surrogate for the fraction of PAR intercepted by the canopy, were significantly altered by agricultural practices. Land use modified both the NDVI integral and the seasonal dynamics of this spectral index. Despite the variability within land-cover categories, land use was the most important factor in explaining regional differences of the NDVI attributes analysed. Within the range of environmental conditions found in eastern Colorado, land use was more important than mean annual precipitation, mean annual temperature and soil texture in determining the seasonal dynamics of NDVI.