Environmental controls over carbon dioxide and water vapor exchange of terrestrial vegetation - DTU Orbit (01/01/2019)

Environmental controls over carbon dioxide and water vapor exchange of terrestrial vegetation

The objective of this research was to compare seasonal and annual estimates of CO2 and water vapor exchange across sites in forests, grasslands, crops, and tundra that are part of an international network called FLUXNET, and to investigating the responses of vegetation to environmental variables. FLUXNETs goals are to understand the mechanisms controlling the exchanges of CO2, water vapor and energy across a spectrum of time and space scales, and to provide information for modeling of carbon and water cycling across regions and the globe. At a subset of sites, net carbon uptake (net ecosystem exchange, the net of photosynthesis and respiration) was greater under diffuse than under direct radiation conditions, perhaps because of a more efficient distribution of non-saturating light conditions for photosynthesis, lower vapor pressure deficit limitation to photosynthesis, and lower respiration associated with reduced temperature. The slope of the relation between monthly gross ecosystem production and evapotranspiration was similar between biomes, except for tundra vegetation, showing a strong linkage between carbon gain and water loss integrated over the year (slopes = 3.4 g CO2/kg H2O for grasslands, 3.2 for deciduous broadleaf forests, 3.1 for crops, 2.4 for evergreen conifers, and 1.5 for tundra vegetation). The ratio of annual ecosystem respiration to gross photosynthesis averaged 0.83, with lower values for grasslands, presumably because of less investment in respiring plant tissue compared with forests. Ecosystem respiration was weakly correlated with mean annual temperature across biomes, in spite of within site sensitivity over shorter temporal scales. Mean annual temperature and site water balance explained much of the variation in gross photosynthesis. Water availability limits leaf area index over the long-term, and inter-annual climate variability can limit carbon uptake below the potential of the leaf area present. (C) 2002 Elsevier Science B.V. All rights reserved.

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