Geophysical Research Abstracts
Vol. 21, EGU2019-11881-1, 2019
EGU General Assembly 2019

Ecosystem total LAI partitioning in a seasonally dry tropical forest

Rodolfo Nóbrega (1,2), Magna S. B. Moura (2,3), Desirée Marques Ramos (2,4), Cloves V. B. dos Santos (5), Rodrigo Miranda (5), Patricia Morellato (4), Jon Lloyd (1), Iain Colin Prentice (1), and Anne Verhoef (2)

(1) Imperial College, Life Sciences, Ascot, United Kingdom (r.nobrega@imperial.ac.uk), (2) University of Reading, Department of Geography and Environmental Sciences, Reading, United Kingdom, (3) Embrapa Tropical Semiarid, Petrolina, Brazil, (4) Laboratório de Fenologia, Departamento de Botânica, UNESP Rio Claro, Brazil, (5) Universidade Federal de Pernambuco, Recife, Brasil

The leaf area index (LAI) is a measure of the one-sided leaf area per unit ground area; it is a crucial parameter used in different environmental modelling frameworks, such as climate-, soil-plant-atmosphere-, and hydrological models. LAI has been quantified for different vegetation types around the world by using methods that are usually non-destructive, and based on remote sensing and indirect field measurements (e.g. via measuring light extinction). Although these methods are useful for estimation of ecosystem total LAI (hereafter referred to as total LAI), there is a lack of studies that partition the total LAI into LAI for individual plant species within the ecosystem. This is particularly important for biodiverse (semi-) natural ecosystems, but also has value in an agroforestry or inter-cropping context. Here, we present an effort to estimate LAI for specific species of the Caatinga biome, a seasonally dry forest in the semi-arid northeast of Brazil, with 30–60 plant species per ha. The trees and shrubs of the Caatinga have a strong seasonal and inter-annual variation in phenology, which causes LAI to vary widely. The vegetation reaches a LAI of 4 m2 m-2 during the wet season (despite the low ratio ($\sim$ 0.2) of precipitation over potential evaporation), and most of the species become leafless for periods ranging from weeks to months during the dry season. In this study, we partitioned the total LAI for a caatinga site located in Petrolina, Pernambuco state. We used a total LAI daily time series from 2011 to 2017 and the coverage fraction of each species as primary data to apply criteria to obtain the LAI for individual plant species. First, we collected species-based field LAI measurements to establish the relation of LAI between species during the wet and dry seasons. We then obtained data from a phenological camera to assess how the leaf growth and senescence differ between the species in response to soil moisture variations. We considered these analyses to develop a LAI partitioning algorithm for this caatinga vegetation. Our results show that species that are dominant in terms of coverage fraction have a determining role in the ecosystem LAI, but that this can also mask low or peak values in LAI of species that possess low coverage fraction. This finding has essential ecosystem implications because plant species have different traits (such as maximum carboxylation velocity and maximum rate of photosynthetic electron transport), which will, together with the LAI, quantify the water and carbon fluxes of an ecosystem. Our study supports the development of model approaches for the Caatinga biome by overcoming the limitations of using total LAI values, which allows the discretization of LAI time series for different species in terrestrial Caatinga ecosystem models.