Geophysical Research Abstracts
Vol. 21, EGU2019-18454, 2019
EGU General Assembly 2019

Scaling up leaf photosynthesis for routine monitoring of canopy GPP

Bart Kruijt (), Sabrina Garcia (), Adriana Grandis (), Juliane Menenzes (), Mariana Reis (), and Richard Norby ()
(1) Wageningen University, Wageningen, Netherlands, (2) National Institute of Amazonian Research (INPA), Manaus (AM) - Brazil, (3) Instituto Nacional de Ciência e Tecnologia do Bioetanol, Sao Paulo, Brazil, (4) Oak Ridge National Laboratories, Oak Ridge, Tennessee, USA

When studying the dynamics of FACE plots such as AMAZON-FACE, and the impact of elevated CO_2 in these the ecosystem carbon budget is one of the key indicators that should be studied. A base line data set and time series of ecosystem carbon uptake and release are indispensable for any further studies on ecosystem change induced by increasing CO_2, and it is important to monitor the components of this budget with sufficient time resolution.
The carbon budget represents all the fluxes and fluxes into and out of the ecosystem plots. Major components of the net carbon uptake (‘net ecosystem production, NEP) are the primary carbon uptake: Gross primary productivity (GPP); the autotropic respiration (Ra) by plants, and the heterotrophic respiration (Rh) from the rest of the food chain, which is usually dominated by the decomposers in the soil. Minor components may include leaching, non-CO_2 gaseous emissions and lateral carbon transport. Efficient monitoring of canopy-scale GPP is important for any FACE experiment.
In tall forest treatment plots, bulk ecosystem methods for NEP carbon budget measurements such as eddy covariance are not an option, due to the mismatch between turbulent exchange footprints and plot size. Instead, advanced proximal ‘remote sensing’ techniques, such as those using ‘Solar induced Fluorescence’ are promising but still experimental and indirect. Measurement of (net) photosynthesis on individual leaves, using a chamber and gas change equipment remains the most direct method. However, to frequently and representatively sample an entire canopy and cumulate GPP from that is a prohibitively time-consuming task. In addition, net photosynthesis includes Ra of the leaves.
With the aim to enable frequent GPP estimation, we test proxy methods, where canopy GPP is scaled up from measurements on leaves in only one or a few key canopy positions. One of these relies on photosynthesis or photosynthetic capacity to scale linearly with the absorbed PAR. Photosynthesis measurements were collected throughout the canopy of two Amazon-FACE plots, over two full 24-hour periods in the dry and wet season, as well as photosynthetic CO_2-response curves. In parallel, hemispherical photographs were taken at the leaf locations while a continuous vertical profile of incoming PAR was monitored over several years.
First results suggest that Photosynthesis nor Vcmax scale only in a very non-linear way with PAR, and might even considered constant with height. We will explore the consequences of this observation as well as alternative scaling options.