COS 124-3 - Age-dependent leaf function and consequences for carbon uptake of leaves, branches, and the canopy during the dry season in an Amazon evergreen forest

Meeting Information

Thursday, August 10, 2017: 8:40 AM

D132, Oregon Convention Center

Loren P. Albert[1], Jin Wu[2], Neill Prohaska[1], Plinio B. Camargo[3], Travis E. Huxman[4], Edgard Tribuzy[5], Valeriy Ivanov[6], Rafael Oliveira[7], Sabrina Garcia[8], Marielle N. Smith[9], Raimundo C. Oliveira[10], Natalia restrepo-Coupe[11], Rodrigo da Silva[5], Scott C. Stark[12], Giordane Martins[13], Deliane V. Penha[14] and Scott R. Saleska[1], (1)Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ, (2)Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, NJ, (3)Cena, University of Sao Paulo, (4)Ecology and Evolutionary Biology, University of California, Irvine, Irvine, CA, (5)Federal University of Western Pará (UFOPA), Santarém, Brazil, (6)Civil and Environmental Engineering, University of Michigan, Ann Arbor, MI, (7)Departmento de Biologia Vegetal, Universidade Estadual de Campinas, (8)National Institute for Amazon Research, (9)Ecology & Evolutionary Biology, University of Arizona, Tucson, AZ, (10)Brazilian Agricultural Research Corporation (EMBRAPA), Brazil, (11)University of Arizona, Tucson, AZ, (12)Department of Forestry, Michigan State University, East Lansing, MI, (13)Brazil's National Institute for Amazon Research (INPA), Manaus, Brazil, (14)Society, Nature and Development, Federal University of Western Pará (UFOPA), Santarém, Brazil

Background/Question/Methods

Many tropical evergreen forests experience wet and dry seasons, but the implications of this seasonality for patterns of individual and ecosystem scale metabolism are unclear. Satellite and tower-based metrics of forest-scale photosynthesis generally increase with dry season progression across the equatorial Amazon, but ecosystem models poorly describe this phenomenon and the underlying mechanisms

promoting this from individual tree function to the ecosystem flux are uncertain. A current hypothesis is that leaf phenology drives this ecosystem level increase through a combination of high dry season leaf turnover (which increases the proportion of recently matured leaves within the canopy), and age-dependent leaf photosynthesis (which attributes highest photosynthetic capacity to these recently matured leaves). To test this hypothesis at the individual tree scale, we investigated age-dependent leaf physiology and seasonal shifts in leaf demography for five canopy trees representing abundant species in the Tapajós National Forest, Brazil. We monitored leaf demography (leaf age composition) of branches collected from five canopy trees. We assessed how leaf physiology varies with leaf age via biochemical limitations on photosynthesis and leaf chemistry for leaves of different ages. We used log response ratios to estimate the overall effect of leaf age for these variables.

Results/Conclusions

We found that photosynthetic capacity, as indicated by parameters of biochemical limitations on photosynthesis (V_{cmax}, J_{max}, and TPU), was higher in recently matured leaves than either young or old leaves. For example, V_{cmax} of mature leaves was on average ~60% greater than that of young leaves ($z = 7.47$, $p < 0.01$), and ~46% greater than that of old leaves ($z = 3.44$, $p < 0.01$). Leaf nitrogen content was higher in mature leaves than old leaves ($z = 8.67$, $p < 0.01$). Most tree branches had several different leaf age cohorts simultaneously present, and the number of recently mature leaves on branches of our five study trees increased as the dry season progressed (pre October 15 versus post October 15: $z = -2.97$, $p < 0.01$), as old leaves were exchanged for young leaves that matured. Together, these findings suggest that aggregated whole-branch V_{cmax} increases during the dry season, with a magnitude consistent with increases in ecosystem-scale photosynthetic capacity observed from flux towers. Interaction between ontogenetic changes in leaves and their fractional composition within the canopy should be considered in the representation of tropical evergreen forest canopy dynamics in land surface models.

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1990 M Street, NW, Suite 700
Washington, DC 20036
(202) 833-8773 | email esahq@esa.org