Schnitzer, S.A. and van der Heijden, Geertje M.F. and Powers, J.S. (2015) Response to Verbeeck and Kearsley: addressing the challenges of including lianas in global vegetation models. Proceedings of the National Academy of Sciences . ISSN 1091-6490

Response to Verbeeck & Kearsley: Addressing the challenges of including lianas in global vegetation models

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Verbeeck and Kearsley[(1)] rightfully point out that global vegetation models would greatly benefit from implicitly including the effects of lianas. Recent experimental evidence that lianas substantially reduce the capacity of tropical forests to uptake and store carbon is compelling[(2,3)]. Furthermore, lianas are increasing relative to trees rapidly in neotropical forests[(4)], which will further change the way that forests uptake, cycle, and store carbon.

We agree that lianas should be incorporated in global vegetation models; however, to do so accurately we must address several important challenges. First, a greater breadth of experimental data on the effects of lianas on tropical forest carbon dynamics is critical. Experimental data on the effects of lianas on carbon uptake, cycling, and storage currently come from studies conducted in one secondary forest in central Panama[(2,3)]. Liana abundance and biomass, however, is highly variable across the tropics, and lianas may have a greater effect in secondary forests and highly seasonal tropical forests, where they are particularly common[(4)]. Second, experimental studies will need to be conducted for long enough to capture important long-term community dynamics and to integrate annual variation in the effect of lianas on carbon dynamics. Lianas may affect the growth and mortality patterns of tree species[(5)], possibly changing tree community composition, which could significantly change forest carbon dynamics. Also, the strength of liana competition may vary annually, with mean annual precipitation, the severity of seasonal drought, and other factors, and this type of variation needs to be quantified to provide a more accurate integrated estimate of the effects of lianas on tropical forest carbon dynamics. Third, the increase in lianas relative to trees is probably not uniform throughout the tropics. While we have strong evidence that lianas are increasing in neotropical forests, there is little evidence that this is a pantropical phenomenon, and we have little knowledge of the conditions where they are increasing the fastest[(4)]. Understanding the causes of liana increases and where lianas are increasing most rapidly will become crucial for modeling future effects of lianas on forest carbon dynamics.

The best way to address these challenges is to establish a network of observational and experimental studies on the effects of lianas in a variety of forest types throughout the tropics. While empirical data from recent experimental studies[(2,3)] can certainly provide initial parameter estimates for global vegetation models, long-term data from across the tropics will provide a much more robust solution to the current challenges of accurately parameterizing global vegetation models. The incorporation of lianas in global vegetation models will rely on a combination of empirical data and the development of these models themselves. The inclusion

of a greater diversity of plant functional traits in global models[6], for example, may be critical to improving these models and for predicting how lianas affect future carbon dynamics and storage in tropical forests.

Acknowledgements
This work was supported by the National Science Foundation Grants DEB-0613666, DEB-0845071, and DEB-1019436 (to SAS), and DEB-1019441 (to JSP), and an Anne McLaren Research Fellowship from the University of Nottingham (to GMFH).

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