LETTER

REPLY TO REMY ET AL.:

Local and global limitations to forest productivity as mediators of biogeochemical response to forest edge effects

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Despite the heavily fragmented nature of the world's forests (1), the response of forest carbon (C) and nitrogen (N) dynamics to edge effects is understudied. Contrasting our findings that edge effects did not alter soil C and N storage of temperate forests within residential landscapes in New England (2), Remy et al. (3) point to their work showing that belowground C and N storage increases near temperate forest edges in an agricultural region of Belgium (4). Similar to other findings from the temperate region (5), Remy et al. (4) found increased N deposition at the forest edge and implicate shifts in N cycling resulting from increased deposition and changes in microclimate as the driver of increased above- and belowground C and N near forest edges. We suspect that differences in the soil N responses between our studies are driven by site characteristics and background N deposition rates for these two regions. Although both studies were conducted in temperate forest fragments, Remy et al. (4) collected data from plots with edges facing the prevailing winds in a region with high rates of throughfall N deposition in deciduous forests (18.5–30.2 kg of N per hectare), while our study (2) spanned a range in edge aspects in a region experiencing comparatively lower rates of throughfall N deposition (5.7–12.3 kg of N per hectare) (6). These differences in the response of belowground C and N storage to forest edge effects highlight the spatially heterogeneous nature of the complex interactions between forest edges, land cover adjacencies (e.g., urban development, agriculture), and different facets of global change that cause shifts in forest edge microenvironments.

Characterizing the role of forest fragmentation in regional and global biogeochemical cycles necessitates advancing our understanding of how shifts in microenvironment at the forest edge interact with local prevailing drivers of global change and limitations to microbial activity and forest growth. For example, while forest fragmentation might alter patterns of N deposition and availability, the ensuing cascade of effects on ecosystem processes will depend on local rates of N deposition and the response of different tree species and forest types to increased N availability. Across forest biomes, increases in soil N availability tend to reduce microbial biomass and rates of soil respiration (7); however, the effects on forest growth are less consistent. Although N is generally thought to limit forest growth in the temperate and boreal regions (8), forest growth has been shown to be stimulated, reduced, or unaffected (9, 10) by increased N deposition. Further, tropical forests are experiencing some of the most rapid fragmentation, with phosphorus generally thought to limit forest growth in the tropics (11); it is unclear how the phosphorus cycle responds to the fragmented edge environment. Changing deposition and cycling patterns of atmospherically derived nutrients at the forest edges could also alter stoichiometric relationships among nutrients. Our understanding of the impacts of forest edges on C storage and biogeochemical cycles is in its nascency, but the large shifts in microenvironment and landscape structure associated with forest fragmentation are likely having profound global impacts on forest productivity and biogeochemical cycles.

Acknowledgments

We thank Pamela Templer for providing feedback on this manuscript. This research was supported primarily by National Oceanic and Atmospheric Administration Grant NA14OAR4310179, with additional support from a Career Award from the US National Science Foundation (Grant DEB-1149471) and from National Aeronautics and Space Administration Grant NNX12AM82G.

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The authors declare no conflict of interest.

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