Reply to Silva: Dynamic human-vegetation-climate interactions at forest ecotones during the late-Holocene in lowland South America

Article

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Reply to Silva: Dynamic human-vegetation-climate interactions at forest ecotones during the late-Holocene in lowland S. America

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We are pleased that the publication of our recent study (1) has stimulated further discussion of the complexities of past human-vegetation-climate interactions in the Neotropics and that Silva (2) considers that our study *'fundamentally changes our understanding of the magnitude and nature of pre-Columbian land use in the Amazon region'*. However, we wish to address several of the points raised by Silva.

Ecotonal shifts in the South American lowlands: We acknowledge that ecotonal shifts have not been limited to the southern Amazon. These records were not discussed in our paper because they were not pertinent to its specific focus. We agree, however, that our model of human occupation overlapping with climatically-driven ecotonal shifts could apply in other regions.

While climate-driven vegetation shifts have occurred across many regions of the S. American lowlands, we would caution against the oversimplified "predictable latitude-dependant pattern of vegetation dynamics" proposed by Silva. Firstly, there exist examples of ecotones which do not fit into Silva's proposed latitude-dependent timescale, such as Serra Sul dos Carajás (3), which is located north of site no. 2 in his map fig 1., but experiences an earlier forest expansion, occurring from ~3400 years BP. Secondly, it is questionable whether comparing single age estimates of the initial increase in tree taxa at widely dispersed sites is an accurate representation of continental ecotonal dynamics. At some sites, such as Lago do Pires (4), while there was an initial increase in tree density ~2800 BP, full forest expansion did not occur until the late Holocene ~970 BP. More

fundamentally, we would question what climatic forcing mechanism could potentially explain this supposedly predictable pattern of ecotonal transition between 13˚S and 30˚S proposed by Silva. While the climate at sites 1-4 on Silva's map arguably fall within the influence of monsoonal moisture delivered from the Amazon basin via the Low Level Jet, and the latitudinal position of the Intertropical convergence zone and South Atlantic convergence zones, site 5 is most definitely sub-tropical, and in a region whose modern climate is significantly influenced by polar advections.

Records of late-Holocene climate change: Silva claims that the climate records discussed in our paper are all located in the high Andes, and questions the degree to which they represent lowland precipitation. As we argue in the paper, these regions receive the majority of their precipitation from the Amazonian lowlands in the Holocene, and are therefore broadly representative of lowland precipitation history. We also refer the author back to the section on *Mid-Holocene climate change* in the SI of the original article, which cites several paleoclimate studies from sites in lowland Bolivia. More recent records of Holocene climate change have also been published from the Pantanal region (which is representative of precipitation changes in the Amazon basin) (5). Together, these records demonstrate increased precipitation between the middle and late Holocene in the Amazon lowlands. We do acknowledge, however, that there is a need for more direct paleoclimate proxies from the lowlands and agree that this is an important research priority.

References

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