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Testing the space-for-time substitution on the temperature sensitivity of terrestrial vegetation

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Space-for-time substitution has been used to infer long-term ecological processes such as vegetation dynamics, turnover of species, nutrient cycling, etc. The theory of space-for-time substitution was established to understand temporal processes from contemporary spatial patterns or gradients due to the lack of long-term temporal observations on the response of vegetation to climate change. However, the validity of this theory has been largely debated mostly due to the fact that the fundamental assumption, a climate or an environmental driver of the spatial gradient also drive its temporal change, has not been systematically tested. There is still lack of quantitative understanding of the interaction between climate and vegetation at different spatial and temporal scales. In this study, we used global observations of spatiotemporal changes in several proxies of vegetation (e.g., NDVI) to investigate the link between space and time in the responses of vegetation to climate. We show that the temperature sensitivities of vegetation derived from large scale spatial gradient (space) are highly correlated with the temporal temperature sensitivity (time). Our goal of this study is not only providing quantitively analysis on the spatiotemporal linkage in terrestrial vegetation but also to provide a broader perspective on the methodology that links space and time in understanding the variability of global vegetation.