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Response of simulated above ground biomass and net primary productivity in the Amazon to spatial and temporal variability in the physical environment

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Field observations in undisturbed Amazonian forest sites show large spatial heterogeneity in the tropical forest net primary productivity. The heterogeneity is thought to be associated with differences in the biophysical environment such as; soil fertility, soil properties, and climate or carbon allocation. Observations also indicate a trend in the last several 30 decades of increasing net biomass throughout the Amazon, which are believed to be a result of a combination of climate variability, atmospheric CO2 concentration, recovery from natural disturbance, and increases in nutrient availability. This work simultaneously explores the possible drivers of the spatial variability of forest productivity and the effect of climate variability and historical CO2 changes on total biomass using the IBIS dynamic vegetation model.

From 1970 to 2005 the Amazonian forest has been exposed to an increase of approximately 50 ppm in the atmospheric CO2 concentration. Preliminary analyses with the IBIS dynamic vegetation model shows the CO2 fertilization effect would account for an increase in above ground biomass of 0.03 KgC/m2/yr on average for the Amazon basin. The annual biomass response varies temporally and spatially from about 0.01 – 0.08 KgC/m2/yr, indicating a significant combined effect of the physical environment and climatological variability. The time and spatial variability of the fertilization effect of CO2 on above ground biomass will be explored in more detail in this work. The change in biomass due to CO2 fertilization in this study is about one third of the change that has been observed in the field (0.097+-0.58 KgC/m2/yr), which suggests that other factors must also be considered to explain the total amount of biomass increase observed in the field.