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Homeostatic response of carbon exchange related process to experimental warming in tropical alpine ecosystems (Paramos) of the Northern Andes

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The world is getting warmer and mountaintops are warming faster. In the mountaintops of the Northern Andes we can find paramos; ecosystem of enormous importance for the services they provide, and which have historically stored large quantities of soil organic carbon, being also home to more than thousands of endemic species. It is of global importance to understand the future of this extremely vulnerable carbon rich ecosystems in a warmer world and their role on global climate feedbacks. In this study, we present the result of the first in situ warming experiment in two paramos from Colombia using open top chambers (OTC), which evaluate the response to warming of several ecosystem carbon-balance-related processes such as decomposition, soil respiration, photosynthesis, plant productivity and soil and vegetation composition. Twenty OTC were established in 2016 in two paramo sites located in the oriental range of the Colombian Andes, 10 on each site Environmental variables monitored inside and outside the OTC indicates that OTCs increased mean air and soil temperature by 1.7 oC and 0.2 oC respectively, and maximum air and soil temperature by 12 oC and 0.7 oC respectively. After two years of warming we found no evidence that warming increases CO_2 emissions from soil respiration, nor increases decomposition rate, photosynthesis or productivity (below and aboveground) in any of the two paramos studied. Likewise, soil properties and carbon and nitrogen pools have not changes in response to warming. The turnover in microbial community composition shows greater correlation with plant cover and soil water content than with warming. However, the plant community and vegetation structure is slowly changing as result of warming and the change is site dependent. In one paramo, grasses are increasing in dominance while in the other paramo mosses and lichens are increasing and grasses decreasing. Our results suggest that relatively healthy paramos ecosystems can resist an increase in temperature with not significant alteration of ecosystem carbon-balance-related processes, but that the long-term effect of warming could depend on the vegetation changes and the initial conditions of the paramo community. We might expect that paramos could shift from carbon sink to sources only if longer-term changes in vegetation and microbial community composition and/or metabolism, in combination with warmer and drier conditions, leads to changes in substrate stoichiometry, which subsequently could contribute to increases in decomposition, rates of soil metabolic activity and hence soil respiration. More warming experiments in paramo are urgently needed to understand how specific site characteristics will affect their global role in the climate feedbacks.