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The impact of climate change on the water supply of the Andean highlands

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High altitudinal ecosystems are particularly vulnerable for climatic changes. An increase in air humidity decreases the lapse rate, which is the change in temperature with altitude. As a result, the increase in temperature predicted by current climate scenarios is highest in high altitudinal locations. Furhermore, because of their isolated locations on mountain tops and ridges, and therefore the lack of migration routes, they are very prone to disappearance, or at least reduction in area. From this viewpoint, the alpine ecosystem covering the upper regions of the northern Andes, locally called páramo, is extremely vulnerable. Given the importance of the páramo as the major water supplier of the Andean highlands of Venezuela, Colombia, Ecuador and northern Peru, it is necessary to consider the changes that will occur in this ecosystem over the next decades under the current climate change scenarios. In this study, we assess the possible impact of an accellerating climate change on the páramo ecosystem, based on the IPCC 2XCO2 scenario. Two major changes are identified: (1) an increase in temperature of 2.5 to 3^{o}C, and (2) a decrease in precipitation of about 10%. The major reaction to an increase in temperature is an upward shift of the ecosystem of about 450m, resulting in an area reduction up to 97%. A decreased precipitation not only affects the total water production capacity of the páramo but enhances soil organic carbon destruction. A decrease of organic carbon in the Andosols and Histosols covering the páramo is very likely to affect soil water storage and regulation capacity, as both are very closely related. These changes are further quantified using a data-based mechanistic model developed for the south Ecuadorian páramo region.