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A spatial implementation of the BIOME-BGC to model grassland GPP production and water budgets in the Ecuadorian Andean Region

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Many terrestrial biogeochemistry process models have been applied around the world at different scales and for a large range of ecosystems. Grasslands, and in particular the ones located in the Andean Region are essential ecosystems that sustain important ecological processes; however, just a few efforts have been made to estimate the gross primary production (GPP) and the hydrological budgets for this specific ecosystem along an altitudinal gradient. A previous study, which is one of the few available in the region, considered the heterogeneity of the main properties of the páramo vegetation and showed significant differences in plant functional types, site/soil parameters and daily meteorology.

This study extends the work above mentioned and uses spatio-temporal analysis of the BIOME-BGC model results. This was done to simulate the GPP and the water fluxes in space and time, by applying altitudinal analysis. The catchment located at the southwestern slope of the Antisana volcano in Ecuador was selected as a representative area of the Andean páramos and its hydrological importance as one of the main sources of a water supply reservoir in the region. An accurate estimation of temporal changes in GPP in the region is important for carbon budget assessments, evaluation of the impact of climate change and biomass productivity.

This complex and yet interesting problem was integrated by the ecosystem process model BIOME-BGC, the results were evaluated and associated to the land cover map where the growth forms of vegetation were identified. The responses of GPP and the water fluxes were not only dependent on the environmental drivers but also on the ecophysiology and the site specific parameters. The model estimated that the GPP at lower elevations doubles the amount estimated at higher elevations, which might have a large implication during extrapolations at larger spatio-temporal scales. The outcomes of the stand hydrological processes demonstrated a wrong consideration of a unique input of water in the system in addition to the poor estimation of the water storage leading to a wrong assessment of the water fluxes in the páramo ecosystem.

A further development of the BIOME-BGC is needed to be applicable in the spatio-temporal analysis of the páramo vegetation in the region that can potentially assess the changes in the terrestrial ecosystem due to variations in the climatic drivers.