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The Dynamic Vegetation Model HUMBOLDT (LSMbio) The role of biodiversity and nutrient limitation in driving ecosystem processes on a tropical altitudinal gradient

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The HUMBOLDT-LSM_{bio} component is an expansion of the LPJ-GUESS dynamic vegetation model , including local diversity of plant traits and an organic matter module representing the Nitrogen and Phosphorus cycles. In the new trait variation module the initial full range of possible traits is filtered along the altitudinal gradient with the aim to predict the trait distribution of communities observed in the field. The model was parameterized using local trait data per species collected by field campaigns along the whole altitudinal gradient, considering the leaf and wood economics spectrum and tissue nutrient concentrations, and locally measured N and P flux data, in which we were able to use deposition and weathering rates, as well as soil organic and mineral layer nutrient concentrations. In order to evaluate the model with regards to nutrient limitation, the simulation experiment was designed with the NUMEX nutrient manipulation experiment in mind, meaning that the reference nutrient limited community was compared to simulations in which N or/and P limitations were deactivated (i.e. plants could grow independent of their N or P demands being met). Results in NUMEX suggested that the removal of nutrient limitation would produce more biotically homogenous communites, and taller trees with higher productivity and more allocation to belowground biomass.

Our results indicate that including trait diversity and nutrient limitation provide a significant improvement in relation to ecosystem representation especially at higher elevations. Deactivation of nutrient limitation suggests reduced community trait differentiation along the elevation gradient (e.g. specific leaf area), and increased productivity (i.e. Carbon and NPP values). Deactivation of trait diversity impels plant survival at higher altitudes. Significant model improvements are expected in the future with further field trait measurements from the RESPECT subprojects, and the inclusion of other significant processes such as leaf herbivory, seed dispersal and of course the coupled model runs with LSM_{atmo} and LSM_{hydro}.