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The role of phenotypic plasticity for plant functional traits in tropical forests

Florian Hofhansl (1,2), Eduardo Chacón-Madrigal (2,3), Åke Brännström (1,4), Ulf Dieckmann (1), and Oskar Franklin (1)

(1) IIASA International Institute for Applied Systems Analysis, Laxenburg, Austria (hofhansl@iiasa.ac.at), (2) Department of Botany & Biodiversity Research, University of Vienna, Austria, (3) Escuela de Biología, Universidad de Costa Rica, San José, Costa Rica, (4) Department of Mathematics and Mathematical Statistics, Umeå University, Umeå, Sweden.

Tropical tree communities comprise high species richness and functional diversity in highly heterogeneous environments. Phenotypic plasticity is the main mechanism by which trees adjust their functional traits in response to environmental variation and climate change. However, the degree of plasticity is not well known for most plant functional traits.

We compiled a dataset based on 345 individuals from 35 tropical tree species investigating the role of phenotypic plasticity versus non-plastic variation among key plant functional traits, (i.e. wood density, total height, SLA, leaf N content). We hypothesized that trait variation due to plastic components are driven by environmental variability independently of geographic distance, whereas the non-plastic component increases with geographic distance due to local adaption of the population to different environments. Based on this hypothesis we partitioned total observed trait variation into phenotypic plasticity and non-plastic components and quantified how functional trait variation is related to environmental heterogeneity and geographic distance among tropical forest stands.

We found that overall trait variation was strongly related to spatial factors, thus often masking phenotypic plasticity in response to environmental cues. However, respective environmental controlling factors differed among functional traits, such that leaf traits varied in strong association with edaphic factors, whereas wood traits were more significantly affected by topography and light regime. We further show that the identified pattern of phenotypic plasticity versus non-plastic trait variation increased with the range size of congeneric tree species. Hence, this might indicate less plastic responses of endemic tree species compared to their widespread congeners, which thus could be more vulnerable to environmental changes under future scenarios.