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Predicting plants –modeling traits as a function of environment

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A central problem in understanding and modeling vegetation dynamics is how to represent the variation in plant properties and function across different environments. Addressing this problem there is a strong trend towards trait-based approaches, where vegetation properties are functions of the distributions of functional traits rather than of species. Recently there has been enormous progress in in quantifying trait variability and its drivers and effects (Van Bodegom et al. 2012; Adier et al. 2014; Kunstler et al. 2015) based on wide ranging datasets on a small number of easily measured traits, such as specific leaf area (SLA), wood density and maximum plant height. However, plant function depends on many other traits and while the commonly measured trait data are valuable, they are not sufficient for driving predictive and mechanistic models of vegetation dynamics -especially under novel climate or management conditions. For this purpose we need a model to predict functional traits, also those not easily measured, and how they depend on the plants' environment. Here I present such a mechanistic model based on fitness concepts and focused on traits related to water and light limitation of trees, including: wood density, drought response, allocation to defense, and leaf traits. The model is able to predict observed patterns of variability in these traits in relation to growth and mortality, and their responses to a gradient of water limitation. The results demonstrate that it is possible to mechanistically predict plant traits as a function of the environment based on an eco-physiological model of plant fitness.

References

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