Moving from biodiversity to functional diversity (also at large spatial scales)

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Abstract

Assessments for science-policy interfaces like IPBES require reliable information on the state of biodiversity and ecosystem services at large spatial scales. Ideally, scenarios and models exist that project the impact of drivers, such as climate or land-use change, on biodiversity, ecosystem functioning and ecosystem services into the future. While traditional biodiversity models are strong in projecting biodiversity, they are usually weak in representing ecosystem functions and services. In contrast, traditional ecosystem service models are strong in reflecting ecosystem functions and services, but weak in incorporating biodiversity. Here, we show avenues on combining our understanding of the relationship between biodiversity and ecosystem functions from small-scale experiments with trait-based functional biodiversity research and large-scale biodiversity modelling. The combined approaches make use of functional traits, such as ecomorphological characteristics of species, to project species into a multidimensional trait space. These approaches take into account the distribution of species in functional space, and can quantify, for example, the redundancy or uniqueness and originality of individual species. The position of species in functional trait space can also be described using aggregate measures for the whole community such as functional identity, functional richness and functional dispersion. In a second step, it is possible to assess the impact of climate and land-use change, or other types of human impact, on functional trait space. Finally, we can link changes in functional trait space to changes in ecosystem functions and ecosystem services. The advantages of these approaches are that multiple measures of functional diversity can be linked to spatial gradients in environmental factors, for example climatic and land-use gradients, and to projected future scenarios of climate and land-use change. Furthermore, these approaches can be applied to a wide variety of organisms from the terrestrial, freshwater and marine realm and a wide range of ecosystem functions and services. Given the increasing availability of data on the geographic distribution of organisms and their traits, these approaches open up promising avenues for the development of better models on biodiversity, ecosystem functions and ecosystem services also at large spatial scales.

Keywords: biodiversity, functional diversity, biodiversity models, traits, land, use change, climate change

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