The role of functional diversity on Amazon forest carbon stock: employing a new trait-based model

Bianca Rius, João Paulo Darela Filho, David Lapola

The effects of climate change on functional diversity and its impacts on ecosystem functioning is still contradictory. This gap of knowledge is especially important in hyperdiverse ecosystems such as Amazon forest, also responsible for a big part of the world's terrestrial carbon sink. This study aimed to understand the role of functional diversity on the response of Amazon forest carbon sink ability in a reduced precipitation scenario (minus 50%) and how functional diversity *per se* responds to this drier condition. For this, we used two versions of the trait-based model named CAETÊ (Carbon and Ecosystem Functional Trait Evaluation model): a low functional diversity (LD) version using five tropical PFTs (plant functional types); and a high functional diversity (HD) version, that employed thousands of plant life strategies (PLSs) that are unique combinations of trait values. Six functional traits were used: allocation and residence time of carbon on leaves, aboveground woody tissues and fine roots. The HD version avoided the loss of 1.6 Pg of carbon in comparison with the LD version. This result was because the former was able to rearrange the community in terms of the strategy dominance and traits abundance with the new climate condition: we observed a decrease on the hyperdominance of some PLSs, what enabled other strategies (including new ones) that coped better with the new environmental condition to stablish and increase their abundance (in agreement with the compensatory dynamics theory). It has lead to a higher and more uniform occupancy of the functional trait space, driving to an expressive increase in functional richness and in functional evenness. Also, the drier condition selected strategies that presented a higher investment in fine roots to the detriment of other compartments, especially to aboveground woody tissues. Thereby, these results indicate that the change on functional diversity can increase the ability of the forest to deal with drier conditions, at least in short term. However, in long term a community with less investment in woody tissues may decrease the ability of forest to store carbon. This type of community rearrengement is not possible to be observed in a PFT modelling scheme. The present study shows the importance of incorporating the diversity of trait values in vegetation models when researching for the effects of climate change in terrestrial ecosystems and the link between functional diversity and ecosystem functioning.

Este trabalho foi apresentado oralmente no evento científico GINGKO Workshop ocorrido de 07/10/19 a 08/10/19 em Frankfurt, Alemanha.