EGU21-15784
https://doi.org/10.5194/egusphere-egu21-15784
EGU General Assembly 2021

New plant hydraulic architecture reproduces impacts of droughts in the Amazon rainforest

Phillip Papastefanou[1], Christian Zang[1], Thomas Pugh[2], Daijun Liu[3], David Lapola[4], Katrin Fleischer[5], Thorsten Grams[1], Thomas Hickler[6], and Anja Rammig[1]

[1]Technical University of Munich, Freising, Germany (pp.papastefanou@gmail.com)
[2]Department of Physical Geography and Ecosystem Science, Lund, Sweden (thomas.pugh@nateko.lu.se)
[3]Department of Botany and Biodiversity Research, Vienna, Austria (daijun.liu@univie.ac.at)
[4]University of Campinas, Campinas, Brazil (lapoladm@gmail.com)
[5]Max Planck Institute for Biogeochemistry, Jena, Germany (kfleischer37@gmail.com)
[6]Senckenberg Research Institute Frankfurt am Main, Germany (thomas.hickler@senckenberg.de)

The Amazon rainforest has been hit by extreme drought events in recent decades. Thereby, plant hydraulics are essential to better understand the impacts of droughts on single plants and whole forest ecosystems. Plant hydraulic mechanisms such as stomatal closure and leaf water potential are very complex, still posing challenges for current vegetation model development and parameterization. Here, we present the new hydraulic architecture of the Dynamic Global Vegetation Model LPJ-GUESS, accounting for leaf stomatal responses to plant water status and subsequent drought-induced mortality. We show that when applying the model to the Amazon rainforest we can reproduce the observed increasing trend in carbon losses and the decreasing trend in net carbon sink from plot observations over the past two decades. Our model simulations suggest that the increasing historical trend in carbon losses from mortality can be explained by hydraulic failure and associated mortality.

The high biodiversity of the Amazon tropical rainforest poses further challenges for process-based models. Here we present an approach to include the diversity of plant responses to drought by simulating 37 individual Plant Functional Types (PFTs) differing in their leaf water potential regulation- and resistance to soil water stress, and provide a simple solution how to cover a wide range of species and species-specific parameters. Future modelling studies should also take species interaction and competition of different hydraulic strategies into account.