Geophysical Research Abstracts
Vol. 20, EGU2018-13829, 2018
EGU General Assembly 2018

Impact of the coordinated allocation of foliar ressources on simulated carbon assimilation with the ORCHIDEE model

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Adjustment of terrestrial ecosystems to changing climate and elevated CO_2 is a key source of uncertainty in future projections of global biogeochemical cycles and climate. The increase of CO_2 concentrations, climate warming and nitrogen deposition are major factors driving changes in plant productivity. Here, we use the coordination theory of photosynthesis at leaf level to model the adjustment of plant functional traits in the global vegetation model ORCHIDEE.

We show that the trade off in nitrogen use and allocation between the capture of light versus CO_2 reduces land photosynthesis by 28% (12 PgC yr-1) in 2100 (Representative Concentration Pathway 8.5) compared to a standard simulation without resource use coordination nor trait acclimation. The theory predicts a global reduction of the leaf nitrogen demand which, in the end, might alleviate nitrogen limitation in some part of the globe. The simulated reduction in future GPP estimates is of comparable magnitude to the effects of soil nitrogen and phosphorus limitations.