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Impacts of revised PFTs on JULES simulated carbon and moisture fluxes

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JULES is the land surface model in the Hadley Centre GCM, which is used for investigations of climate and climate change. We analyze the impacts on the simulated carbon and moisture fluxes of extending the PFTs in a manner consistent with observed leaf traits. The model currently represents global vegetation with five PFTs (needleleaf and broadleaf trees, C3 and C4 grasses, and shrubs). We add three new PFTs to delineate between deciduous and evergreen trees and shrubs. Since the inception of JULES in the late 90's, a tremendous amount of new data linking leaf traits and potential photosynthesis is available. We use data from the TRY plant trait data base to revise the relationships between leaf area, leaf lifespan, leaf nitrogen content, and Vcmax.

In addition, JULES now includes a canopy radiation scheme based on fractions of sunlit and shaded leaves at 10 levels in the canopy. This results in a vertical distribution of nitrogren and Vcmax through the canopy and enables multilayer scaling from leaf to canopy level photosynthesis. The scheme is more physically realistic than previous canopy radiation schemes, but remains to be evaluated outside of the Tropics. Within the constraints of observed values, we optimize new parameter values related to the canopy radiation and photosynthesis, using optimization software developed at the University of Exeter.

Impacts on simulated GPP, respiration, and latent heat flux are examined. In particular, we are interested in a better understanding of carbon cycle dynamics in tropical forests. Using data from TRY, carbon fluxes are improved across all PFTs compared to observations from Fluxnet tower sites. We adopt a regional analysis to compare JULES fluxes in certain regions (e.g. tropical forests, and boreal and tropical shrub-dominated landscapes).