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Refining Maximum Light Use Efficiency for land carbon models using satellite data and climatology

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Maximum light use efficiency (LUEmax) is a key variable in most of the state-of-the-art global carbon models (GCMs). LUEmax defines the maximum photosynthetic capacity or maximum conversion rate of absorbed photosynthetically active radiation to vegetation biomass under non-environmental stress conditions. Despite its importance, this variable is usually over-simplified in most GCMs, and its range of variation is commonly set as an invariant limited by a reduced number of plant functional (PFTs) groupings. Such groupings neglect well documented key variability within individual PFTs, and largely ignore adaptation and acclimation processes constituting an important source of uncertainty in model estimates.

Recent studies have pointed out that moving forward from the PFTs based approach to spatially explicit maps of LUEmax would produce significant improvements in the actual ecosystem productivity modeling paradigm. In this work, we explore the feasibility of estimating spatially explicit global maps of LUEmax using different sources of information. We estimated the ecosystem light use effciency (LUE) using flux tower eddy covariance and moderate-resolution imaging spectroradiometer (MODIS) data. Different sites representing the most common ecosystems are considered assuming that during the multiannual records there are periods when the maximum rate of photosynthesis is reached. These data are then used to analyze the variability of LUEmax within PFTs and to test the explanatory power of different candidate remote sensing and climatological variables.