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Constraining carbon allocation in a terrestrial ecosystem model using long-term forest biomass time series

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Forests cover about 30% of the terrestrial surface of our planet and store a large part of the terrestrial carbon (C), indicating their fundamental role in terrestrial C dynamics. In recent years, significant advances have been made in understanding terrestrial C cycling across scales, albeit uncertainties remain about fundamental processes, such as photosynthesis, allocation, and mortality, which exert dominant controls on vegetation C dynamics. Allocation plays a critical role in forest ecosystem C cycling by partitioning the products of net photosynthesis into leaves, wood, and below-ground components but is still poorly represented mostly given limitations in process understanding as well as in both suitable and commensurate observations.

Here, we explore different approaches in constraining C allocation alongside processes driving assimilation and out fluxes in a terrestrial ecosystem model based on novel forest biomass datasets. More specifically, we use a series of temporally changing above-ground biomass (AGB) data from local (i.e. in-situ forest inventory data) to global (i.e. long-term C-band satellite retrievals from 1992 to 2018) scales, in a multi-constraint approach. We explore the information contained in a novel AGB time series to diagnose the potential of using changes in vegetation C stocks, jointly with C and water fluxes, to constrain and parameterize different C allocation modeling approaches. Both at FLUXNET site level and global scale, we will: i) present these novel AGB datasets, their strengths and limitations, ii) demonstrate the relevance of constraining C allocation with such temporally changing AGB estimates, and iii) provide a comparison of different C allocation approaches (i.e. fixed versus dynamic allocation, and an hybrid modeling approach) and their implications in representing ecosystem dynamics.