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Considerations on a data-driven approach to identify plant's imprint on ecosystem functioning

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Terrestrial ecosystems strongly determine the exchange of carbon, water and energy between the biosphere and atmosphere. These exchanges are influenced and partly driven by environmental conditions (e.g. local meteorology, soils), but generally mediated by organisms. In commonly used terrestrial biosphere models, this principle is implemented by process-based descriptions of plant functioning at the organ level. In order to validate these model formulations, we need an independent empirical approach to understand the plant's imprint on ecosystem functioning. We use land-atmosphere exchange of fluxes of CO_2, H_2O and energy in tandem with environmental controls available in FLUXNET to quantify "ecosystem functional properties" (EFPs). The latter are generally time-invariant ecosystem specific properties, for instance process sensitivities or efficiencies that shape ecosystem scale responses. Our crucial question is if plant traits measured at the organ level (available e.g. in the TRY database) can elucidate the characteristics of EFPs. In this study we follow this new avenue and link the two global databases FLUXNET and TRY to study the role of plants for biogeochemical cycles across a large number of different globally distributed ecosystem types. We aim to address emerging difficulties and possible solutions. For instance, we show that using average values of plant traits from TRY that are not necessarily measured at the fluxnet sites is of use but has clear limitations. However having information on the amount of vegetation at the sites derived from remote sensing is needed for weighting the plant traits. In addition, we have to consider that EFPs are not really time-invariant and subject to alterations after disturbance, meteorological extremes, management etc. Overall, we provide an outlook on perspectives and applications of empirical analyses of plants' imprint on ecosystem functioning by combining remote sensing, in situ measured plant traits and ecosystem flux measurements.