## 25.twoe: An R package for modelling tropical forest dynamics from permanent sample plots using a hierarchical Bayesian approach to capture species diversity

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Permanent sample plots are commonly used in tropical forest ecology for conservation and management purposes. Longitudinal tree data can be used to estimate species demographic functions which can then be implemented in forest dynamics simulators to help decision. For tropical forests, with many species being rare species with few observations, the classical modelling approach assumes a restricted number of functional groups (pioneer, light-demanding and shade-tolerant species groups when light partitioning is supposed to be the main mechanism driving community, which is a frequent assumption). Although this simplified approach is convenient in practice, it relies on strong assumptions: i) that species can be grouped, ii) regarding a limited number of criteria, and it suffers from several pitfalls both on the theoretical and applied side. First, because of the principle of competitive exclusion and of the multidimensionality of the species niche, the functional group approach is likely to be biased and to lead to unrealistic simulations. Second, using functional groups impede conservation planning at the species level which should be the advised approach especially when considering rare species. In this study, we present the "twoe" (2e) software, available as a R package, which allows i) formatting the permanent sample plot data for demographic analysis, ii) estimating the parameters of growth, mortality and recruitment functions including a competition effect, iii) simulating forest dynamics with a forecast of the basal area (possibly carbon) and of the community composition. The modelling approach in the twoe software includes species random effects in a hierarchical Bayesian framework, allowing an independant dynamics for each species. The twoe software includes original MCMC algorithms to handle variable time-interval between census for the mortality and recruitment processes, is easy of use and product usefull objects (table with parameter estimates for each species, graphics) for ecological interpretations.

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tropical forest dynamics, simulator, software, demography, inference, hierarchical Bayesian approach, rare species

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