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Suggestion of a simple theoretical model

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CESAB CENTRE FOR THE SYNTHESIS AND ANALYSIS OF BIODIVERSITY

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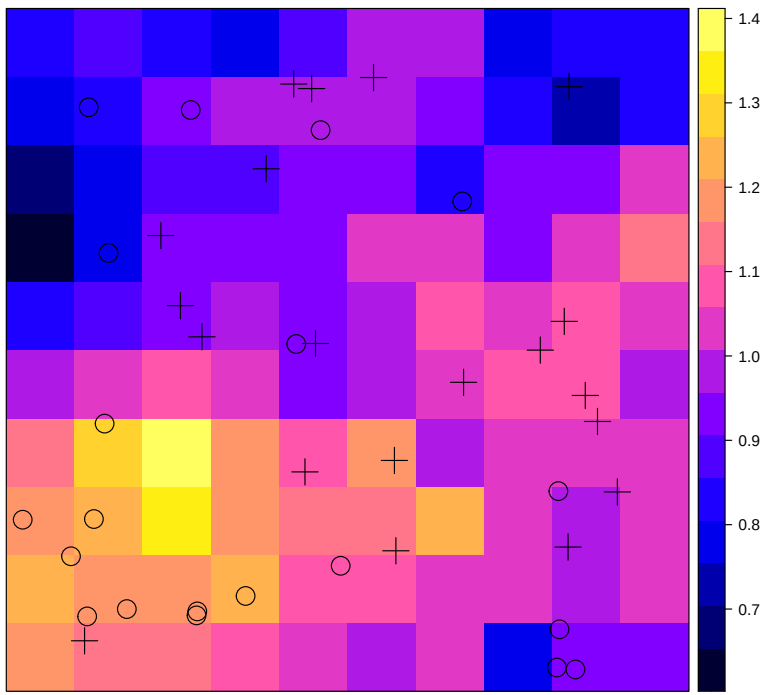
Objectives

- Tree community dynamics model
- Realistic model with demographic processes (cf. Hurtt and Pacala model): growth, fecundity/recruitment, mortality
- Species compete for resources (eg. light, water, nutrients)
- High dimensionality for species niche
- Density dependence mechanisms
- Concentrate competition within species (competition intra $>$ competition inter)
- Easy to step from theoretical model to empirical models
- Simple enough to test various hypothesis

Environment, individual, and species

- Set of trees i from different species j.
- Environment defined by a set of variables for each individual $X_i = x_{1,i}, \ldots, x_{n,i}$.
- Micro-habitat with spatially autocorrelated variables.
- Each species j will have a different set of growth parameters $\beta_j = \beta_{1,j}, \ldots, \beta_{n,j}$ for each of the environmental variables.



Demographic processes

Growth G:

- Growth depending on tree size, environment, and competition
- $G_i = f(\beta_j, X_i, \text{tree size}_i, \text{competition}_i)$
- Competition index can be basal area locally

Mortality M:

- Mortality depending on tree size and growth (or only growth)
- (Mortality indirectly depends on environment and competition)
- $M_i = f(\text{size}_i, G_i)$

Fecundity F:

- Fecundity depending on tree size (and maybe growth to include inter-annual variability)
- $F_i = f(\text{size}_i)$

Potential dynamics

- Species should increase in abundance in favorable habitats.
- **Density dependence:** in favorable habitats, abundance of the most performant species should be limited by high intraspecific competition for resources.
- No mandatory trade-offs

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Tests

With this simple model we could test or investigate:

- The effect of the number of dimensions on the number of coexisting species.
- The link with the Lotka-Volterra model (Georges' suggestion).
- The effect of spatially autocorrelated environmental variables.

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