



Introduction

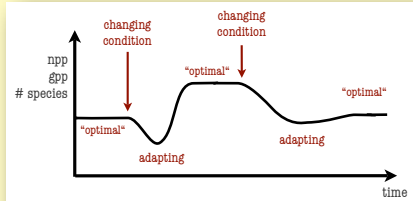


Fig. A: Due to changing condition, e. g. climatic changes or disturbances, vegetation needs to adapt in order to reach an steady state.

The spatial distribution of species changes in time due to external processes such as changing climatic conditions, and due to internal processes such as competition (fig. A). At longer time scales, historical processes such as extinction, speciation and migration also shape the species diversity patterns.

In order to simulate the dynamics of species distributions we use the individual based modeling approach from Kleidon and Mooney (Global Change Biology, 2000), that is able to represent global plant diversity patterns (fig. B). We extend the model from simulating individual plants towards simulating interacting populations of species in terms of their occupied area. Speciation, migration and extinction are implemented in a simple way.

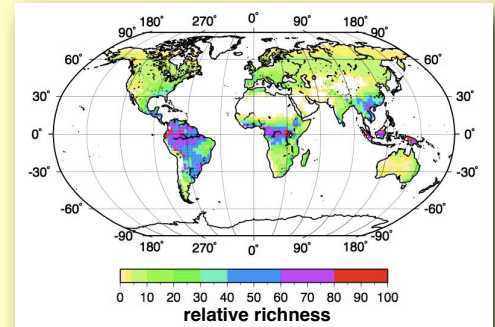


Fig. B: The resulting plant diversity map of Kleidon & Mooney 2000.

Methods

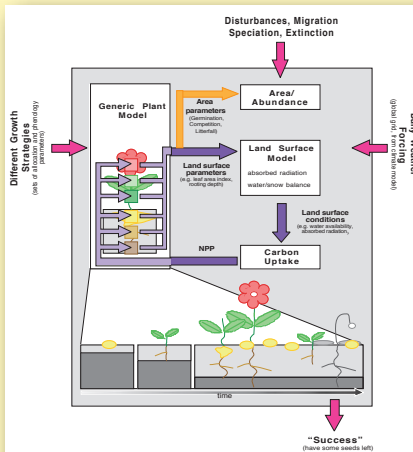


Fig. C: The model simulates populations of artificial plant "species" that differ in their plant growth strategies in terms of phenology and carbon allocation. The model runs on a global grid with realistic climate forcing.

Model Extensions

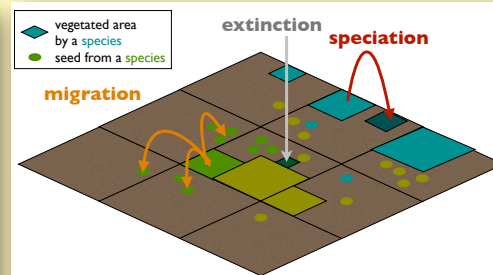


Fig. D: The Extensions of the model include historical processes such as extinction, speciation and migration of species.

- ◆ from individuals to population: explicit simulation of population dynamics (fig. C)
- ◆ simulation of the occupied area by a species
- ◆ abundance equates occupied area
- ◆ competition for space
- ◆ disturbances

Extinction: species population size reaches zero and no seeds left (fig. D)

Speciation: random variation of plant specific parameters (fig. D)

Migration: spread of seeds among adjacent grid cells (fig. D)

Next steps and Application

- ◆ Test speciation, migration and extinction
- ◆ Significance of speciation, migration and extinction for plant diversity patterns
- ◆ Effects of diversity dynamics on land surface exchange fluxes and biogeochemical cycles
- ◆ Testing a neutral model
- ◆ Intermediate-disturbance hypothesis
- ◆ Relationship between variability, diversity and productivity
- ◆ Importance of long distance seed dispersal
- ◆ Why is diversity highest in tropics?
- ◆ Long term evolution

Model Test

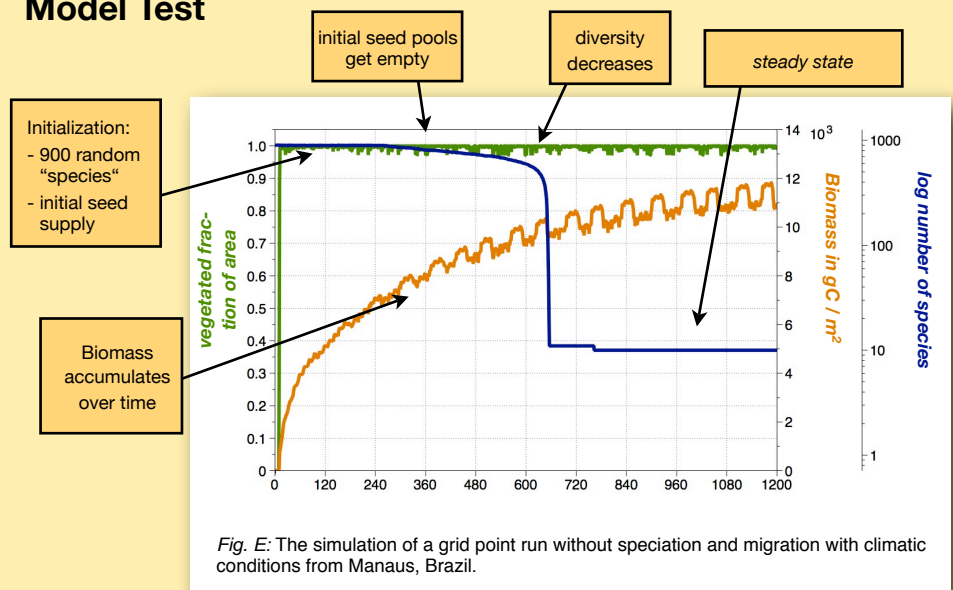


Fig. E: The simulation of a grid point run without speciation and migration with climatic conditions from Manaus, Brazil.

The first model run indicates that our approach is able to simulate the dynamics of interacting populations of species.