



How can we predict shifts in pine's plant community composition following repeated fires?

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Introduction

Context

The intensity and recurrence of anthropogenic activities experienced dramatic changes in the past decades, resulting on the one hand in marginal land abandonment and, on the other hand, on intensive reforestation using pine plantations (Vallejo et al. 2012).

Problem

In Portugal, frequent fires and land use are favoring the occurrence of fire-prone shrublands over cork or pine forests (Acacio et al. 2009; Moreira et al. 2011). In the case of pine systems, the occurrence of a fire in a young pine forest can cause the local extinction of pine trees by limiting the availability of their seeds. (De las Heras et al. 2012).

Litter deposition is expected to play a key role in seeds retention through mechanisms such as: (i) the reduction of predation or improvement of moisture conditions in the case of oak and (ii) reduction of germination in the case of seeders.

What will be the successional trajectory of the system after high fire recurrence?

To address this question, we developed a mathematical model that simulates the population dynamics of three plant functional types.

Hypothesis

The period without anthropogenic disturbance following pine plantation will determine the successional trajectory of the system

When pine, by litter deposition, ameliorates the environment for long enough, oak establishes as dominant;

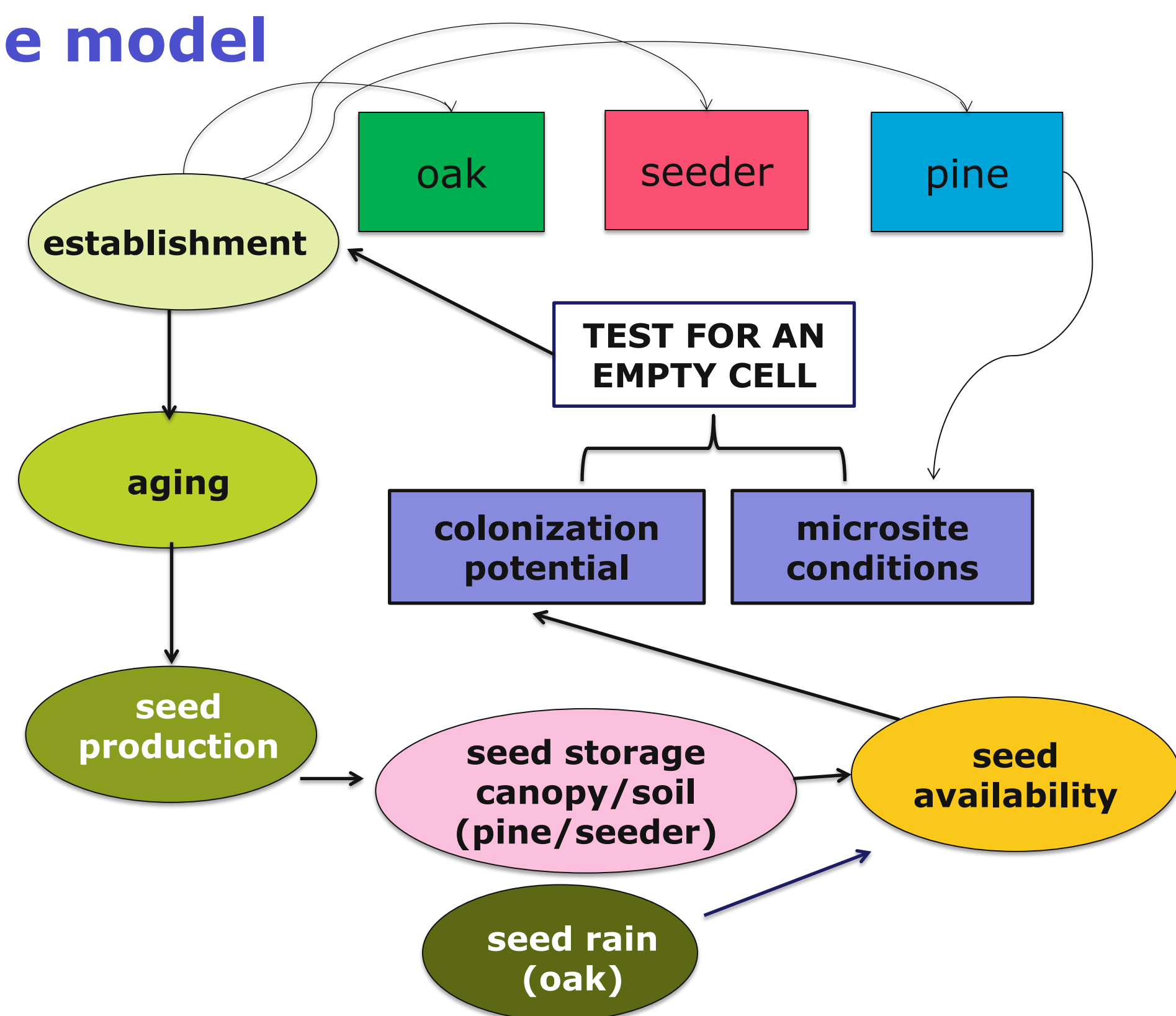
Seeders dominate poor sites, i.e. sites that were not ameliorated long enough by pine.

Objectives:

- Study the dependence from the initial conditions in terms of seed availability
- Study the moment in time when oak becomes dominant without needing pine



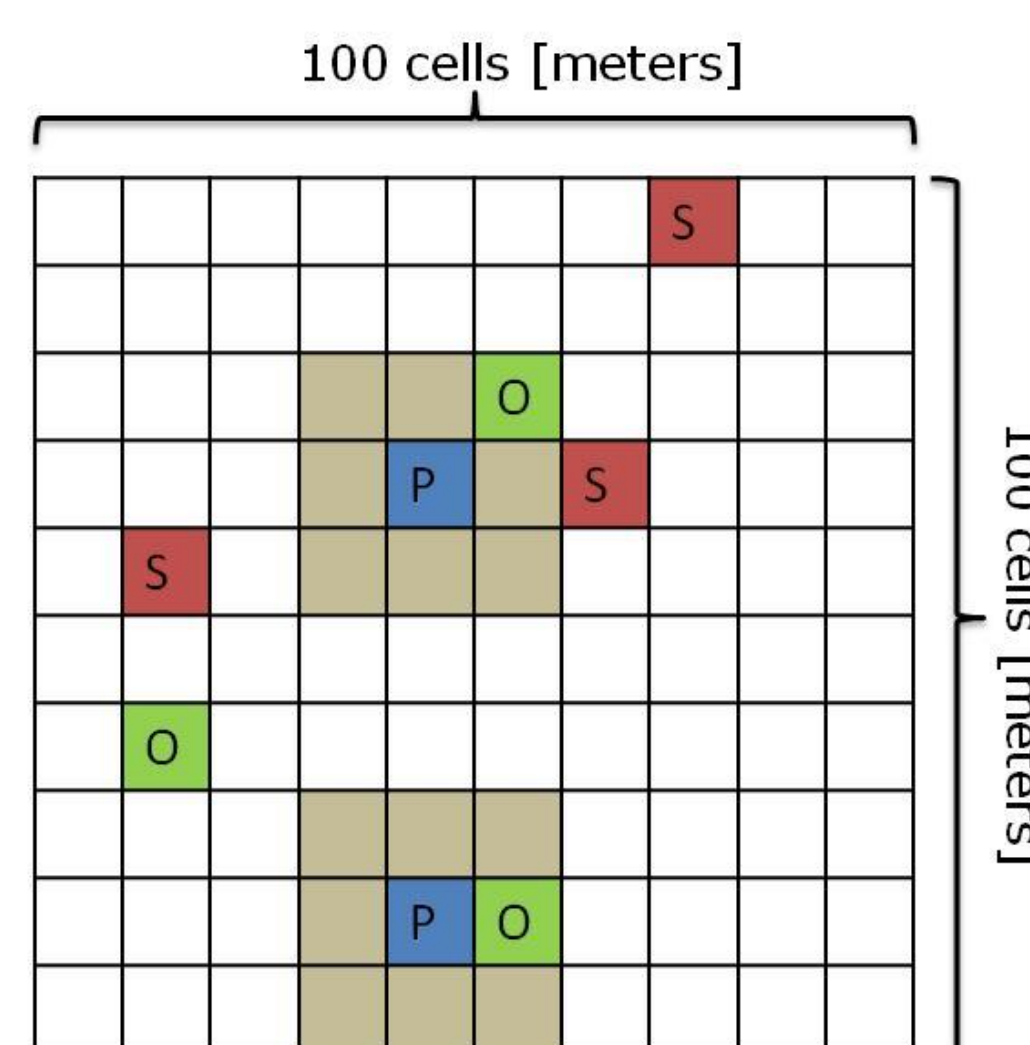
The model



Type of model

3 functional types

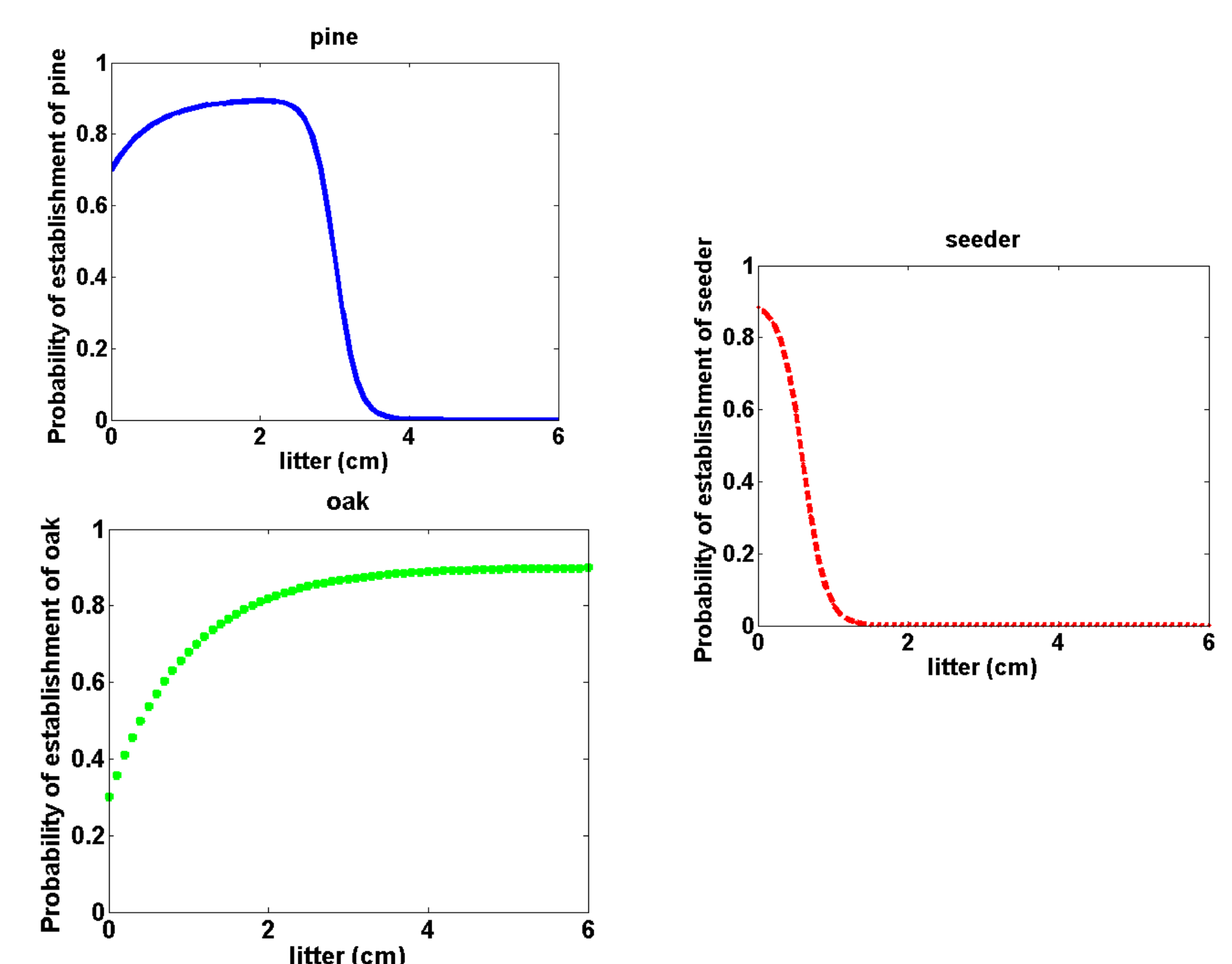
Pine (P; tree seeder)
Seeder (S; shrub seeder)
Oak (O; tree resprouter)



Cellular automata

Conway (1979)
Kéfi et al. (2007)

Microsite conditions (litter depth)

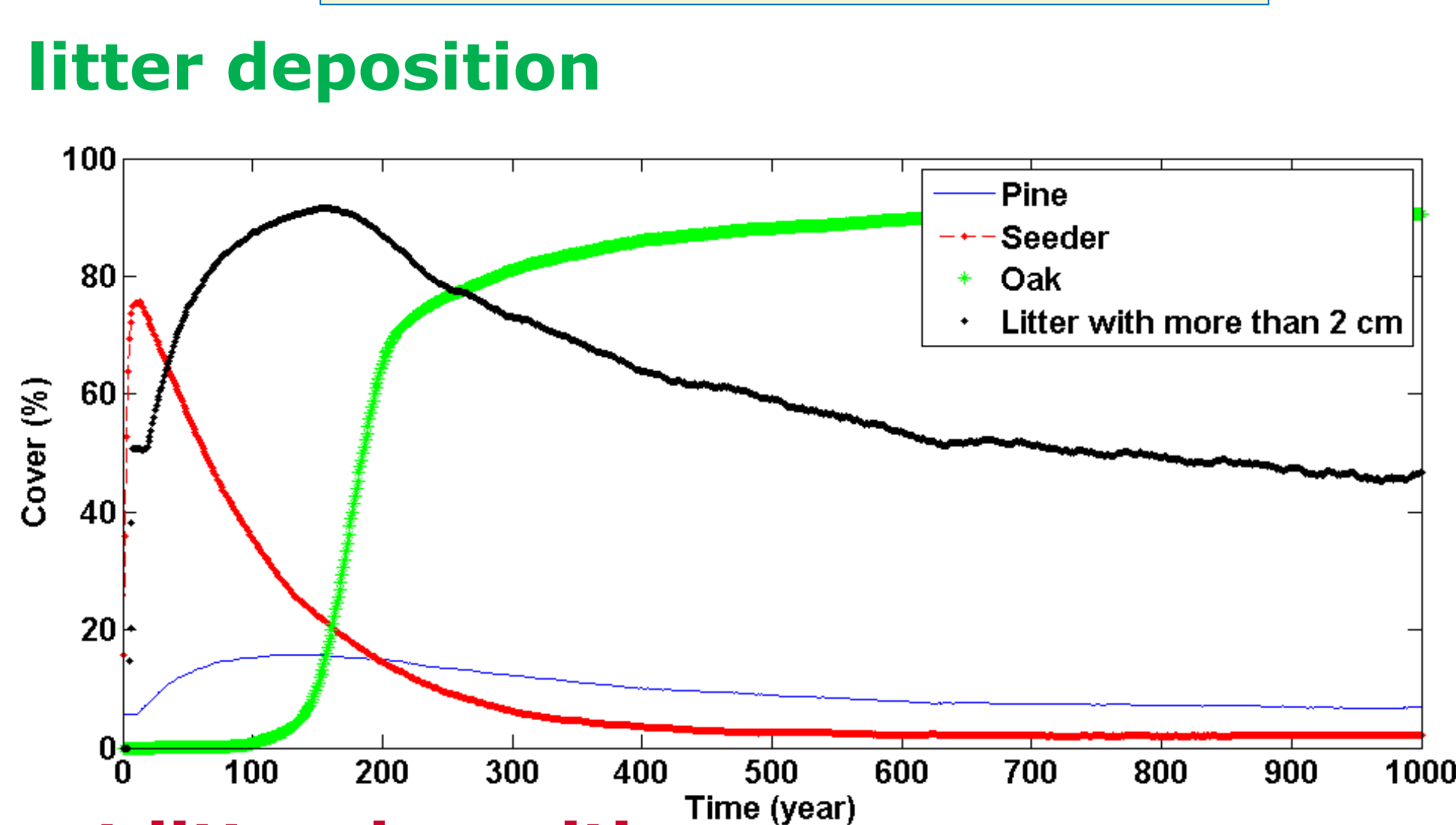


Fire regime: stochastic events Baudena et al. (2010)

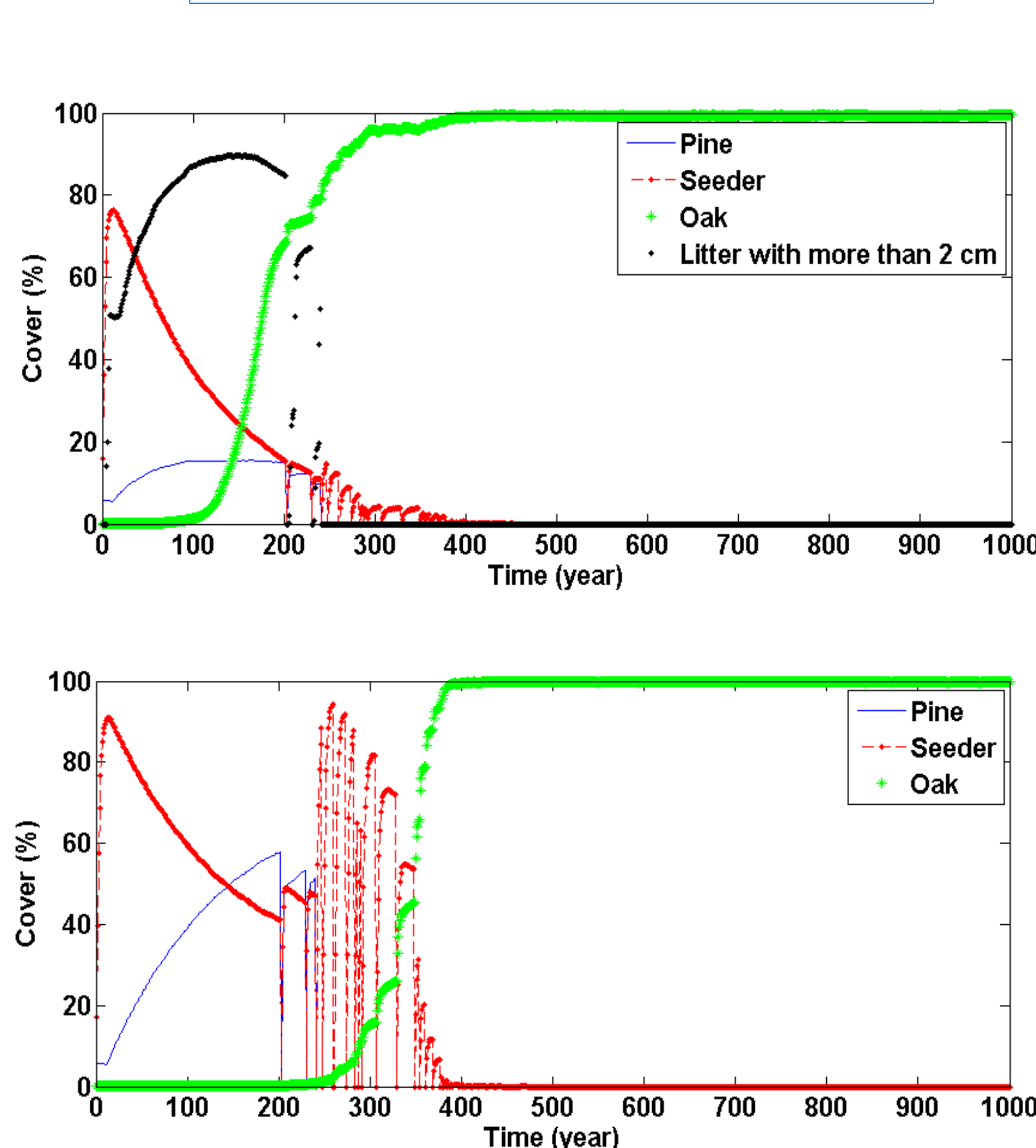
Preliminary output

- In the absence of disturbance, litter accumulation leads to a faster oak dominance (after 200 years) whilst without litter pine continues to be dominant for at least 1000 years;
- Seeders tend to be dominant following disturbance but oaks become dominant after a transient period;
- With litter, the period without disturbance does not determine the successional trajectory of the system; But if pine ameliorates the conditions for long enough, oak becomes dominant under disturbance.

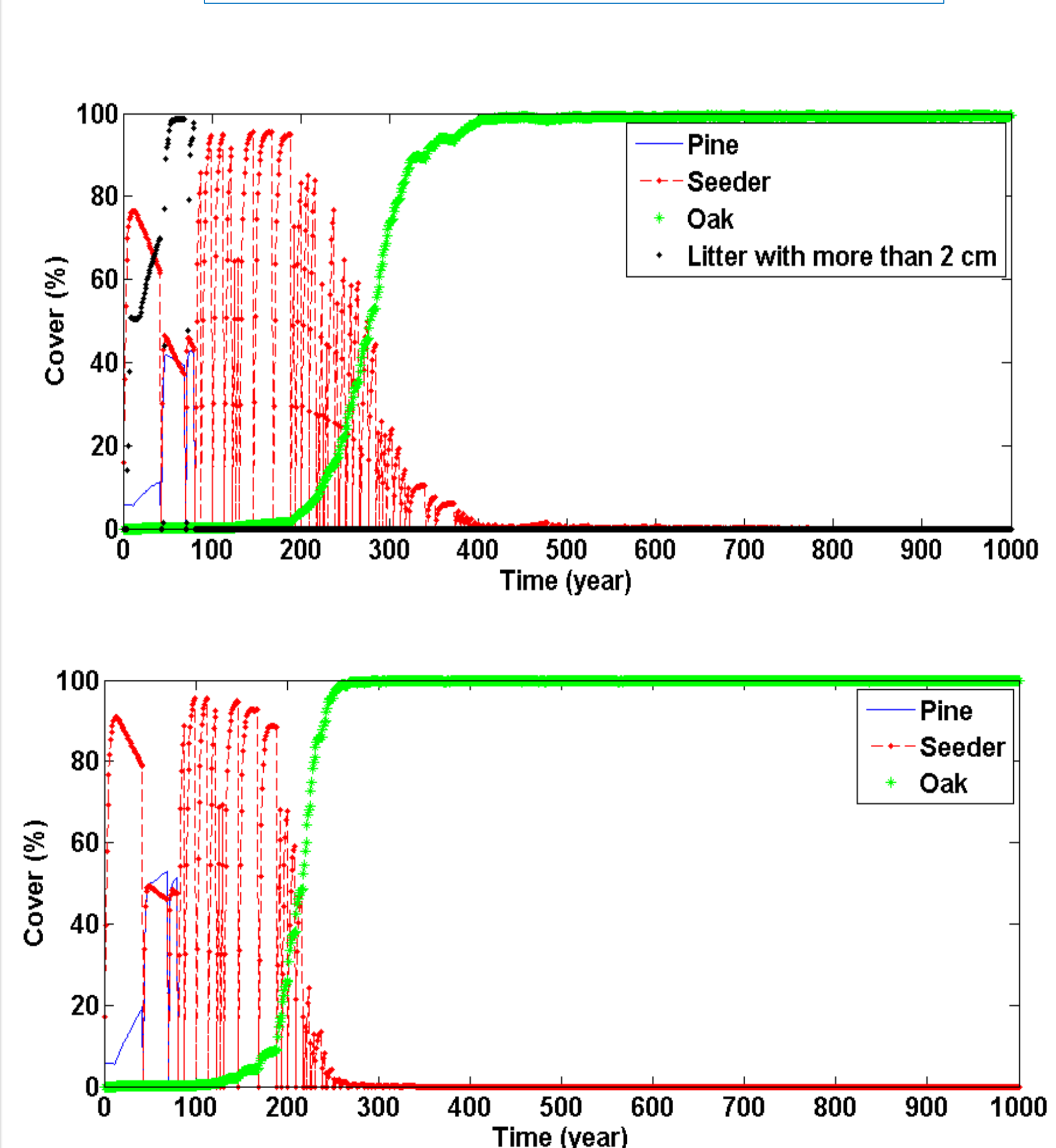
NO fires



Frequent fires after 200 years



Frequent fires after 40 years



With litter deposition

Without litter deposition

References

- Acácio et al. (2009) Agr Sys 76(2), 389-400
Baudena et al. (2010) J Ecol 98:74-80
Conway (1976) On numbers and games
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