Development of a demo-genetic model for SFE and parameter estimation using Approximate Bayesian Computing methods

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Applibugs - 21/06/2018

UNIVERSITY OF HOHENHEIM

Study sites and species

Collected data

- 15 "isolated" patches of spontaneous forests

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- 15 "isolated" patches of spontaneous forests
- Exhaustive tree mapping (location and size)
- Dendrochronological data
- Genetic data

Model overview

- Individual based model of tree population
- Spatialized on a grid of 1m2 cell
- One year time step

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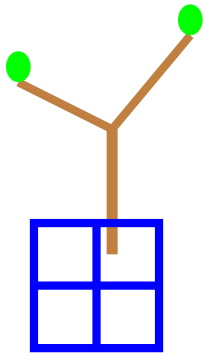
- Spatialized on a grid of 1m2 cell
- One year time step
- Included processes : growth, mortality, fecundity, pollen and seed dispersal, tree establishment, parenthood relationship between trees

Model overview



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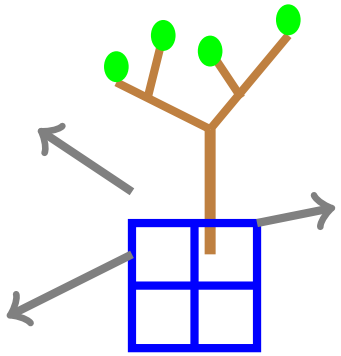

Growth
dbh and neighbours

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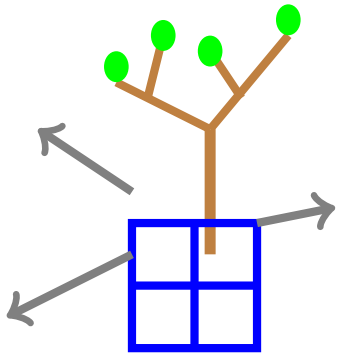

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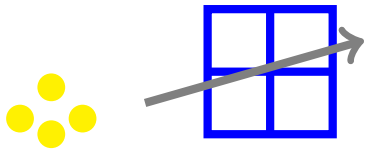

Pollen fecundity dbh
Dispersal

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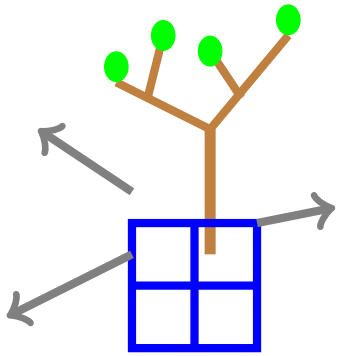

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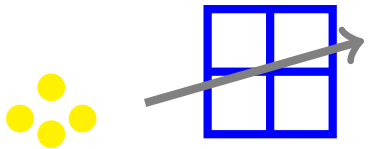

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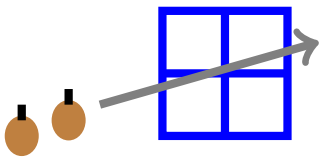

Seed fecundity dbh
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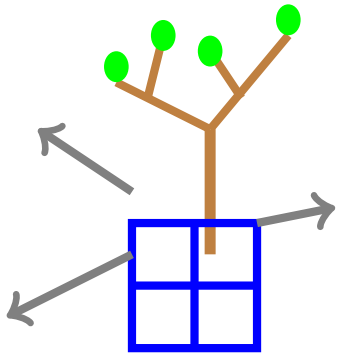

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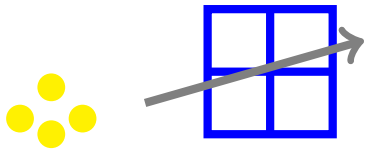

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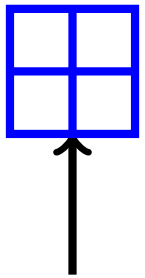
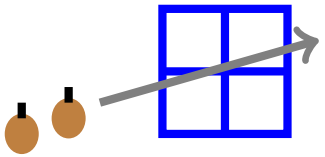


Seed and pollen
immigration



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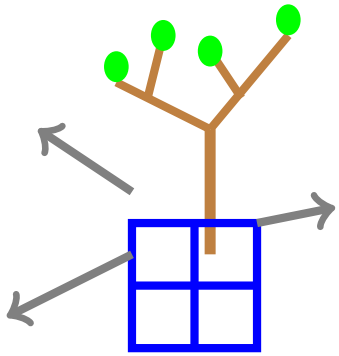

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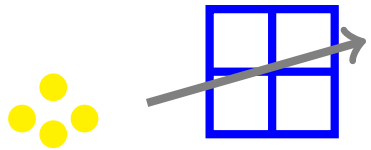

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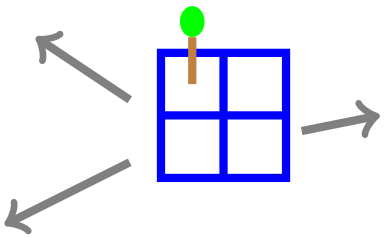
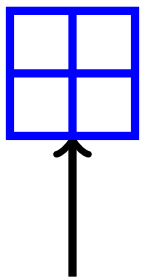


Young tree establishment
neighbours



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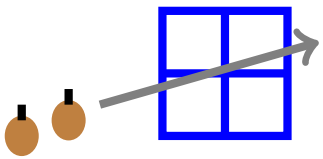

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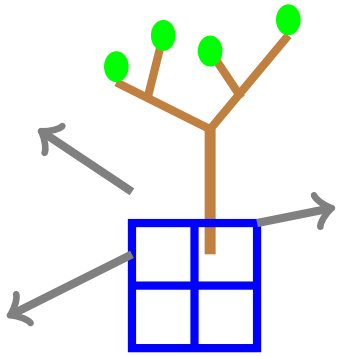

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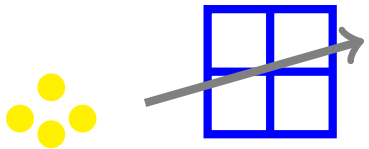

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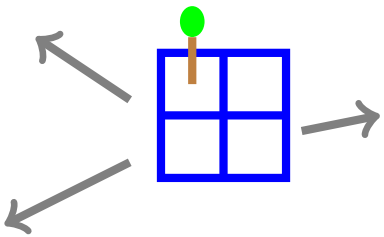
Parenthood assignation



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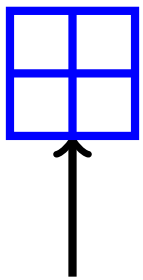

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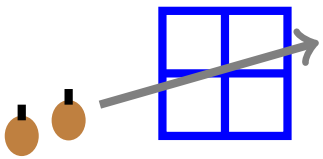

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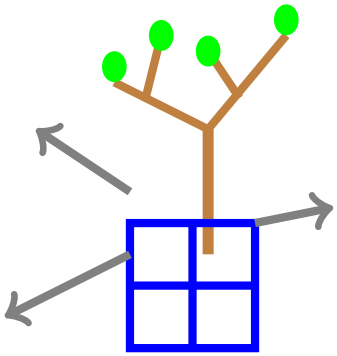
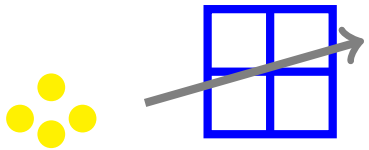


Growth
dbh and neighbours

Mortality
dbh and growth rate



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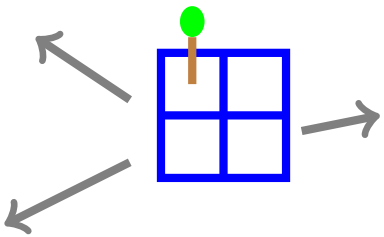

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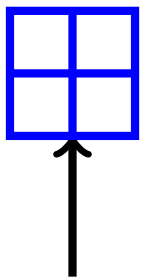

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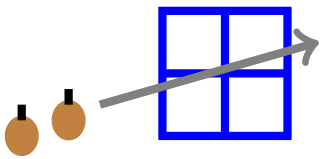

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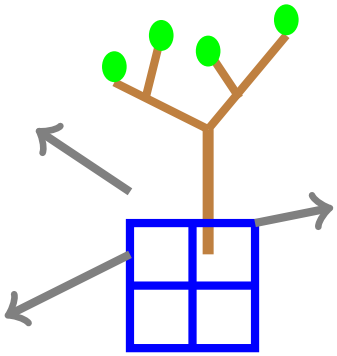

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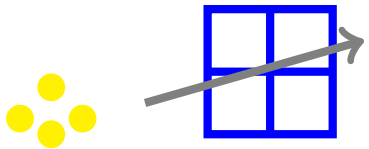

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22 parameters

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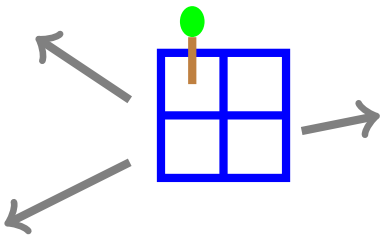

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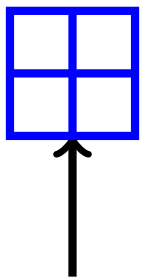

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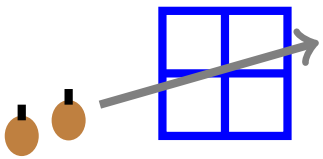

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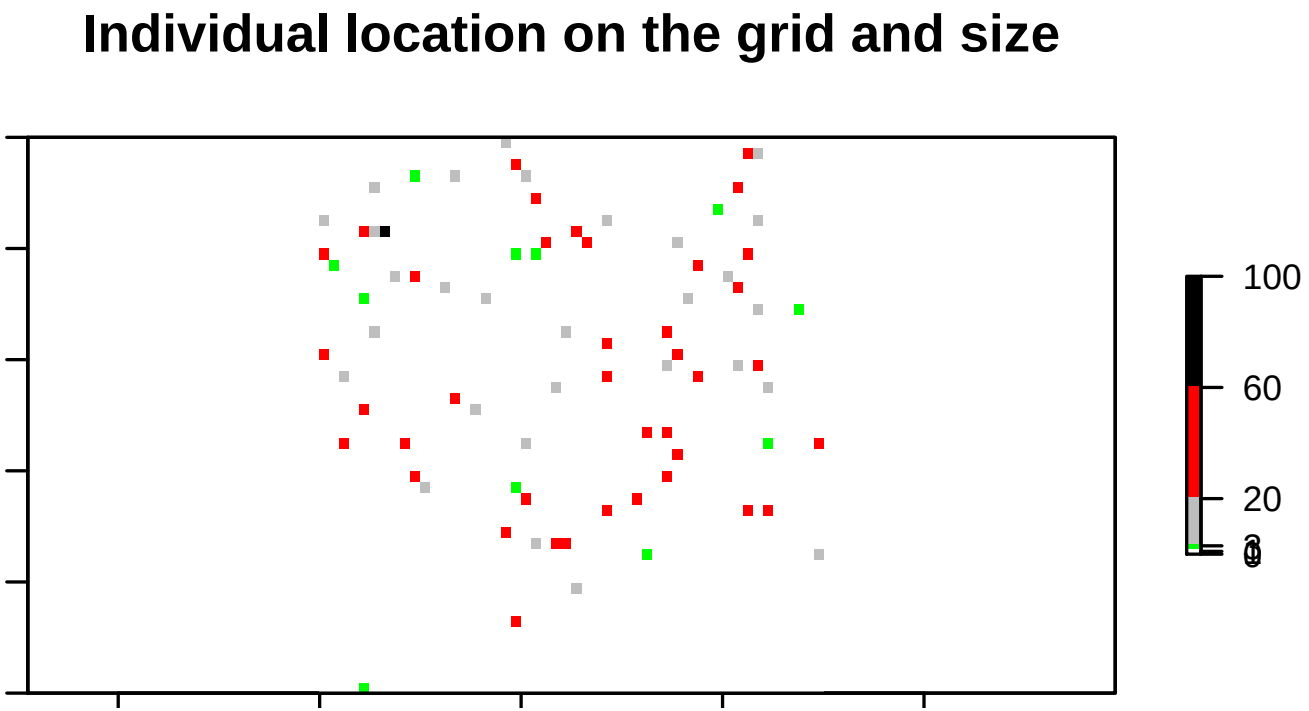
Simulated forest development



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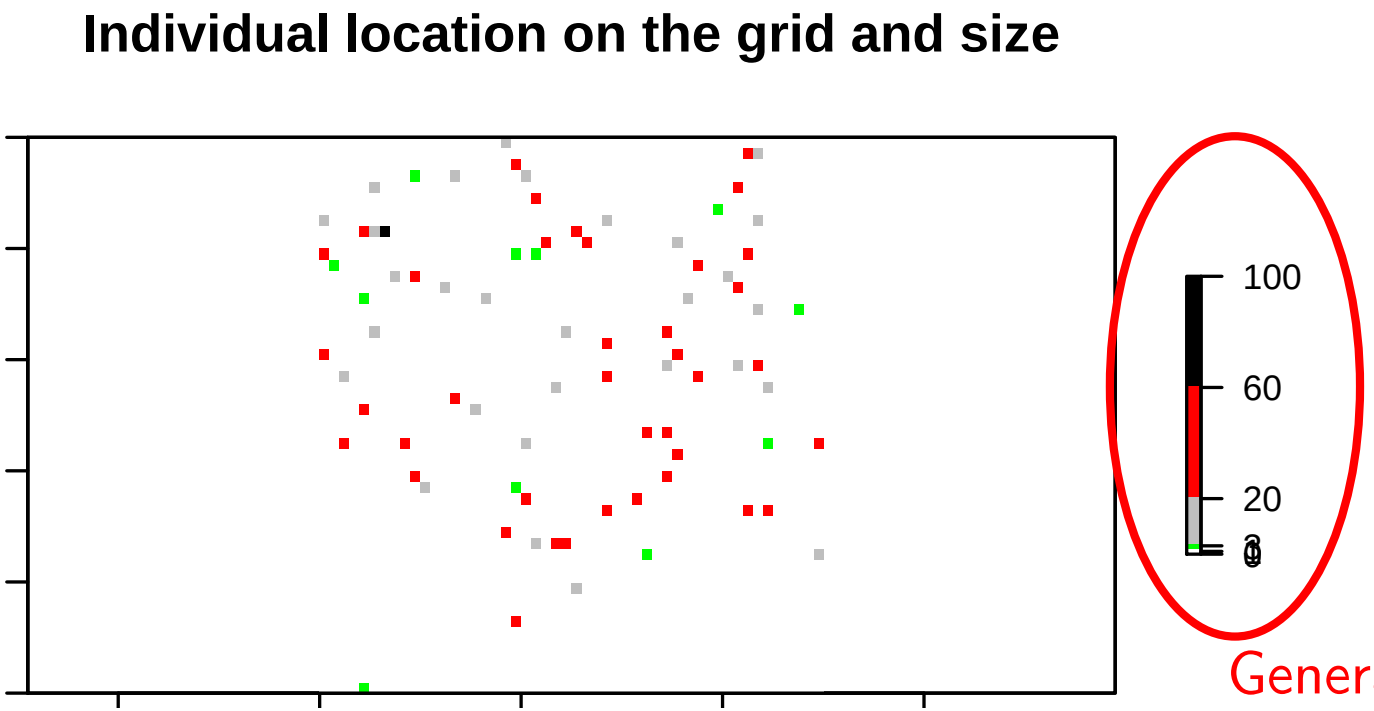
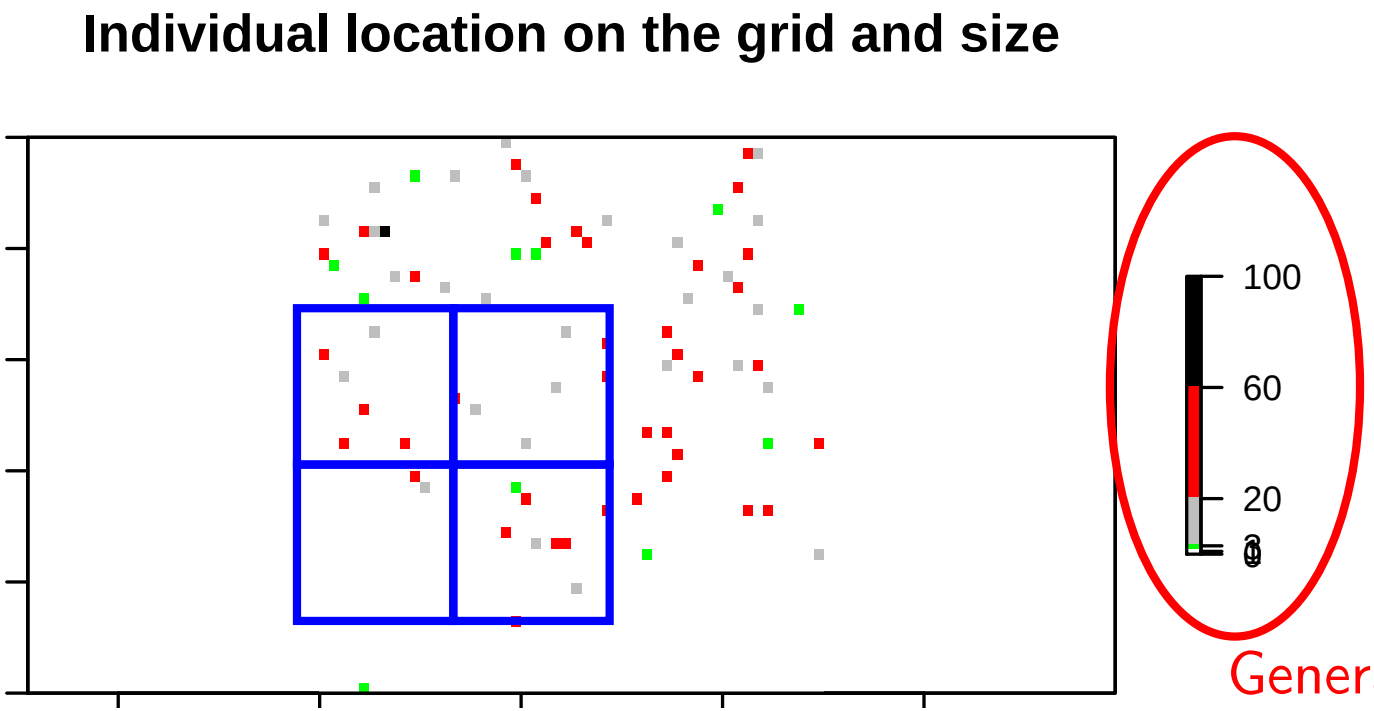


General data

eg final size distribution

Simulated forest development

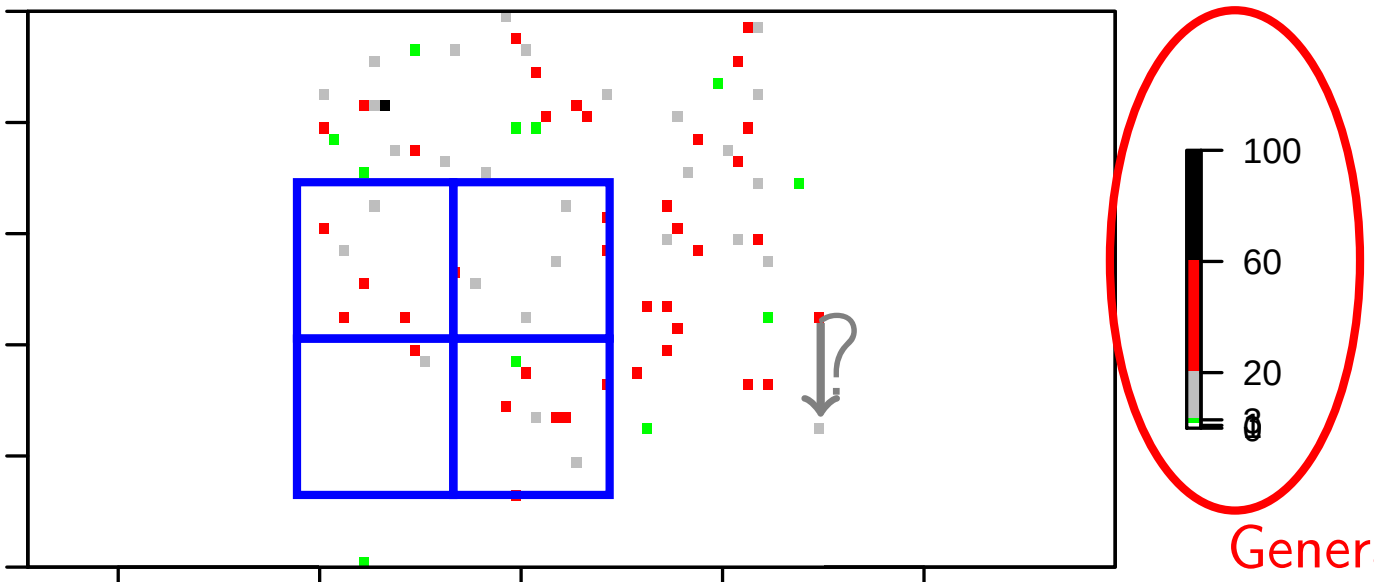


Spatial data
eg clumping index

General data
eg final size distribution

Simulated forest development

Individual location on the grid and size



Spatial data
eg clumping index

General data
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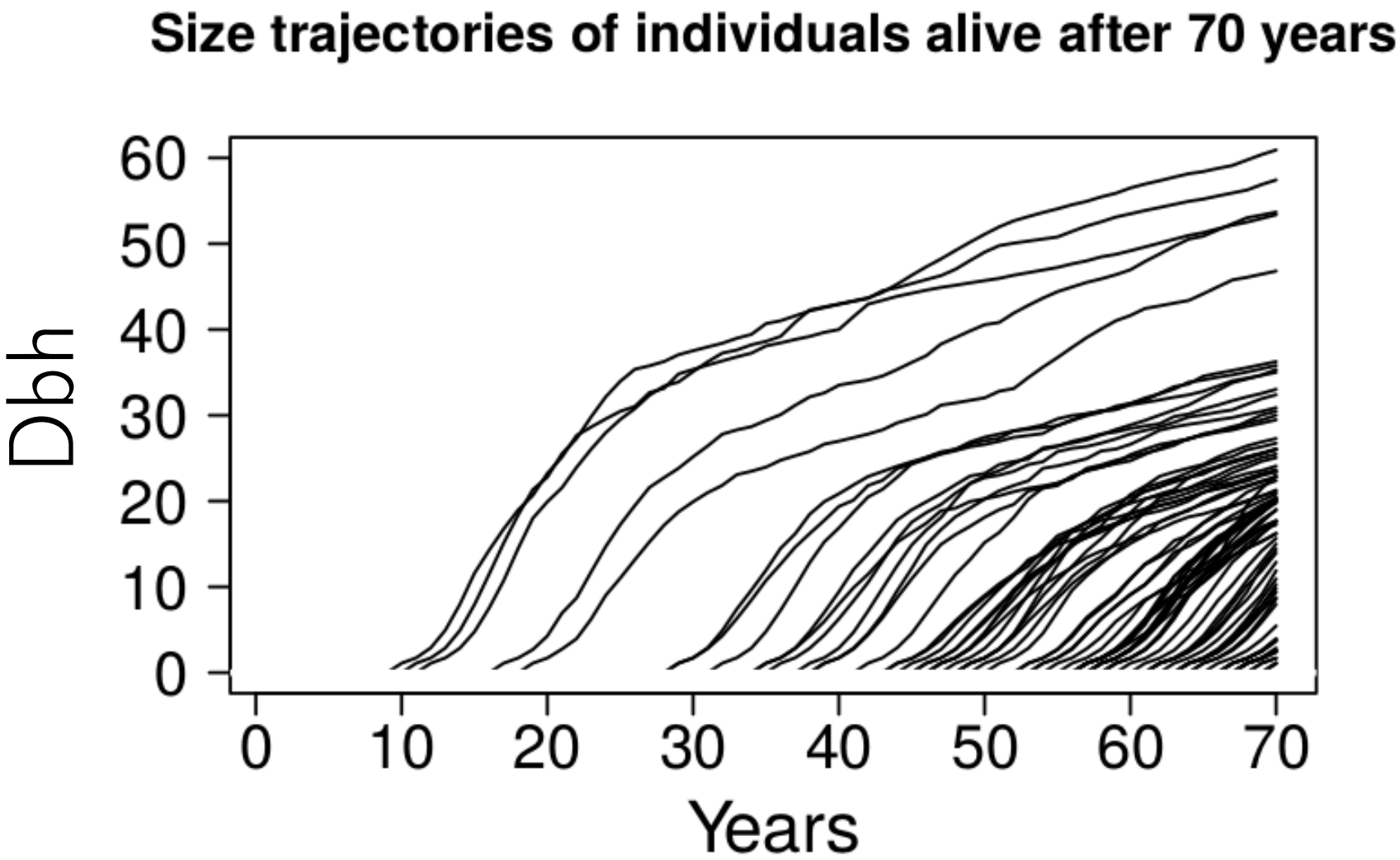
Genetic data
eg number of relatives

Simulated forest development



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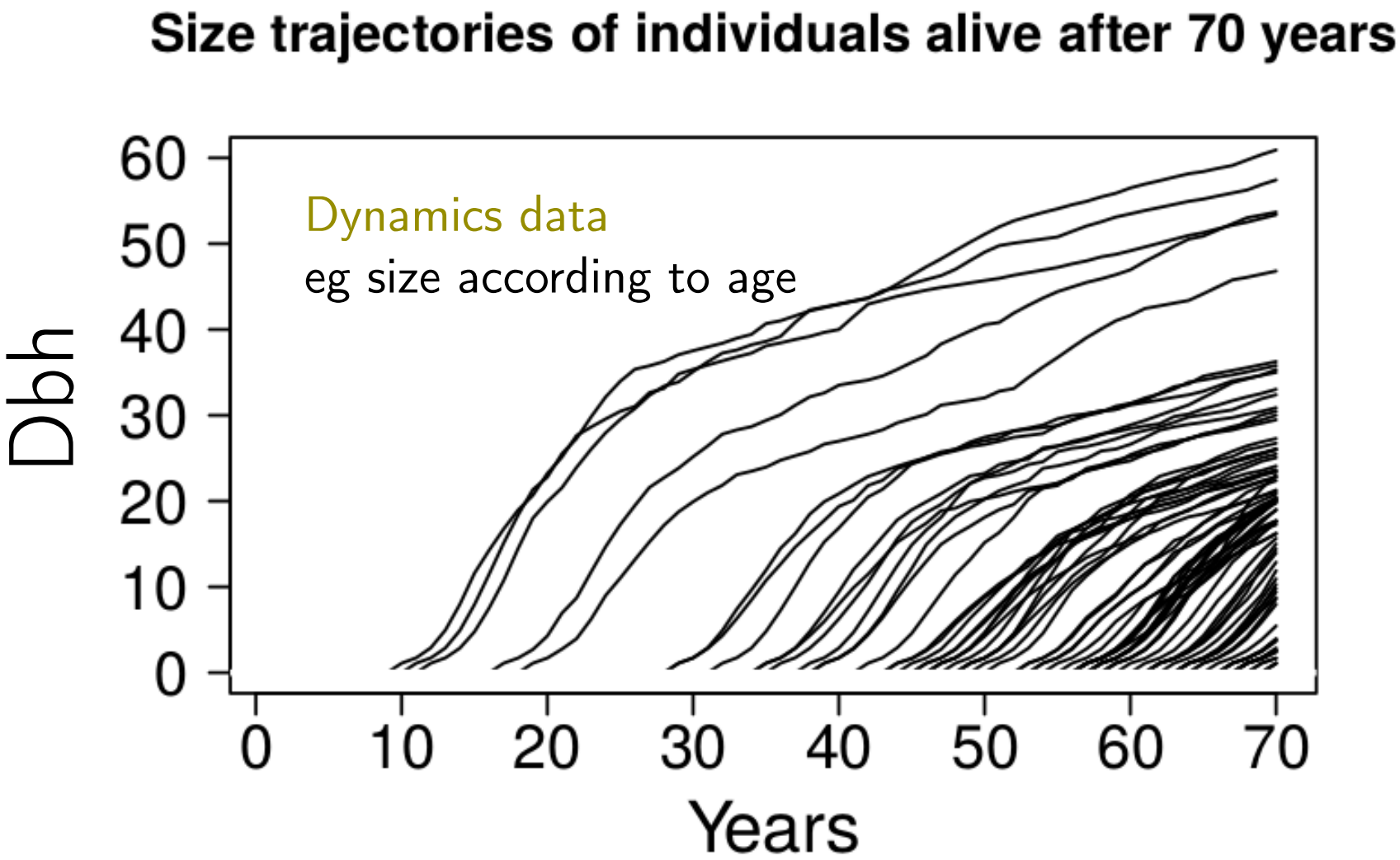

Summary statistics

- Summary of model outputs to compare simulated and observed data
- Around 20 different sumstats for now (tree density, mean size, clumping indexes, fit of size according to neigbourhood index, fit of age according to size, etc.)

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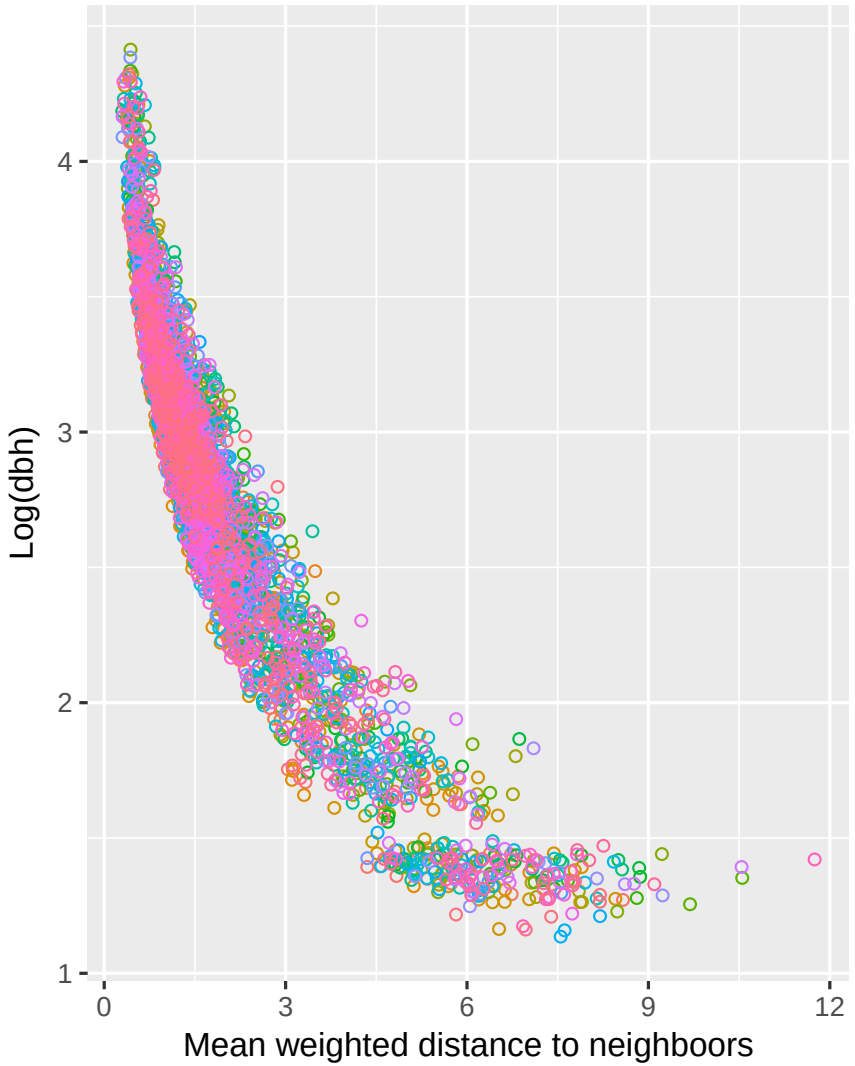

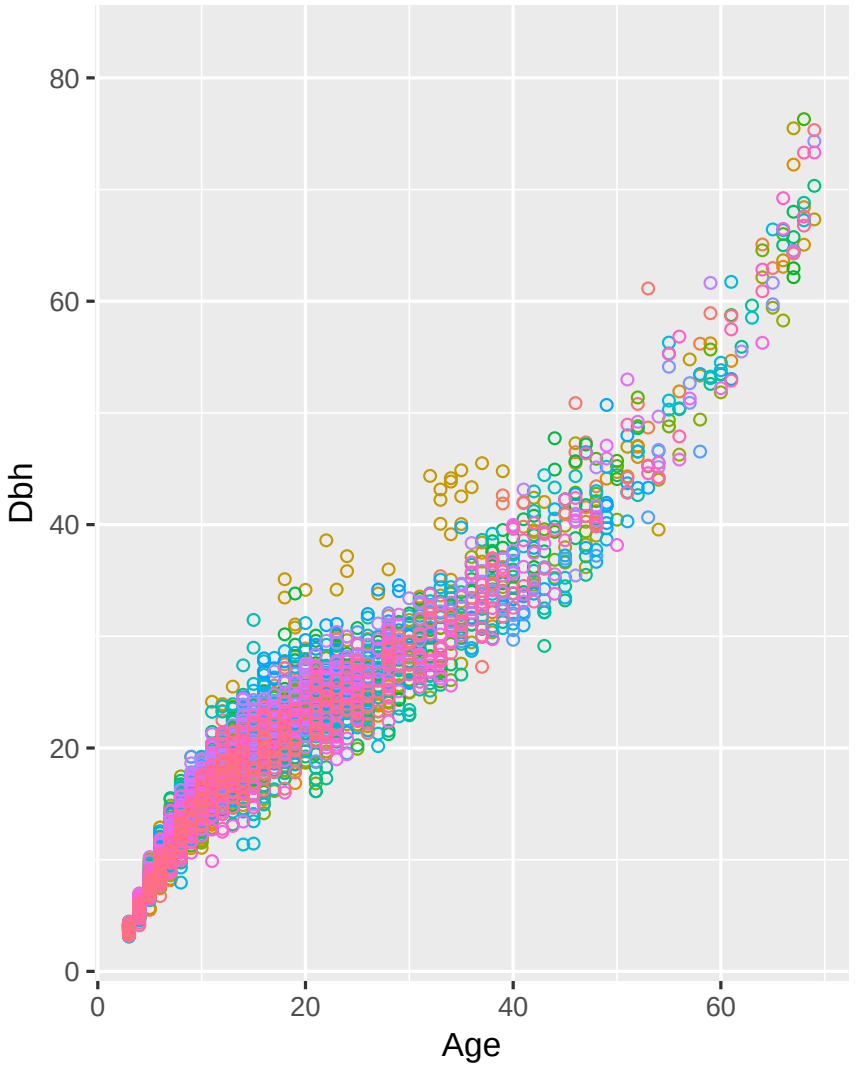

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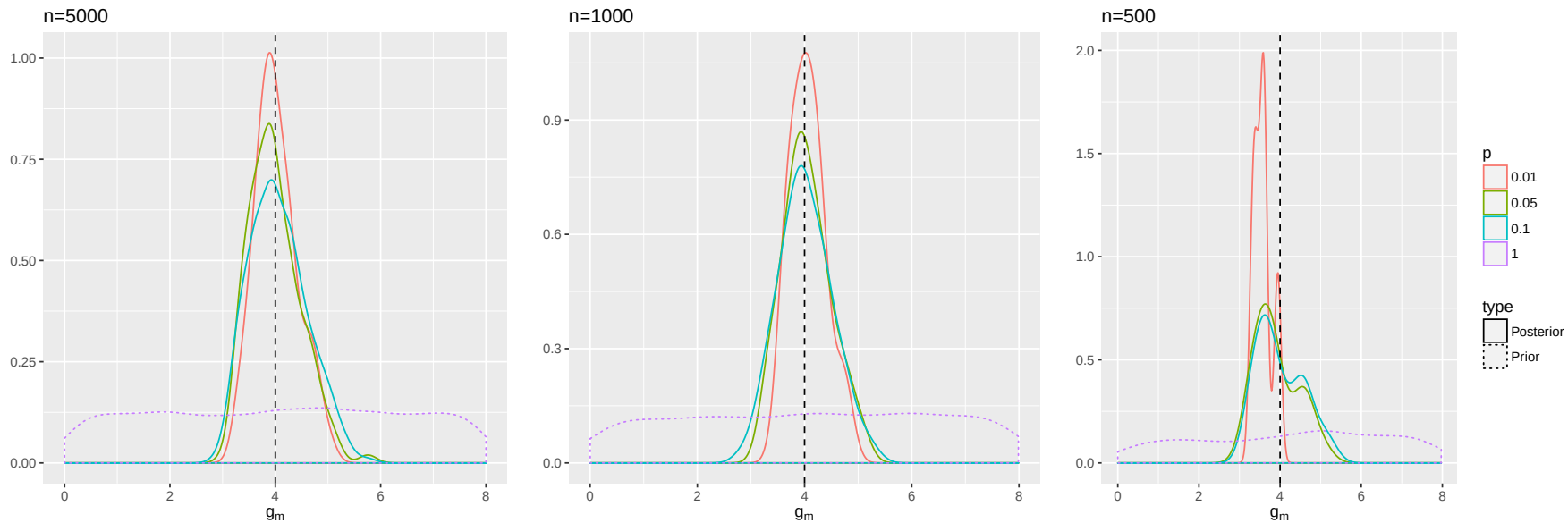
- Choice of the summary statistics ?

Number of simulations to run



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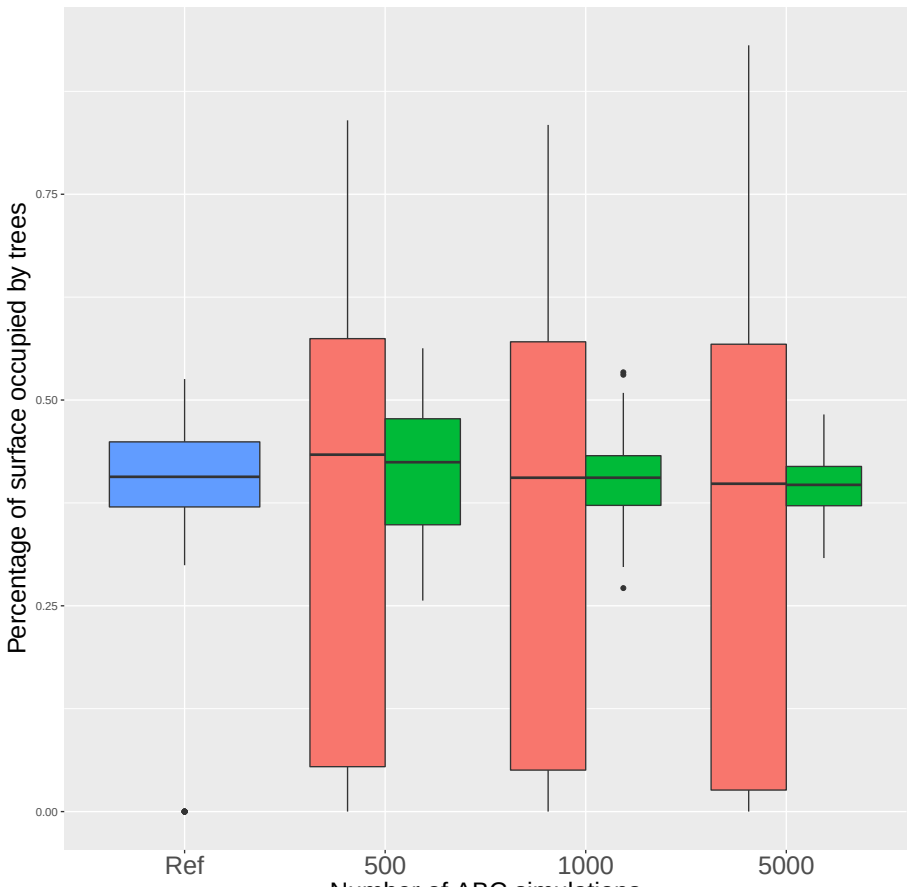
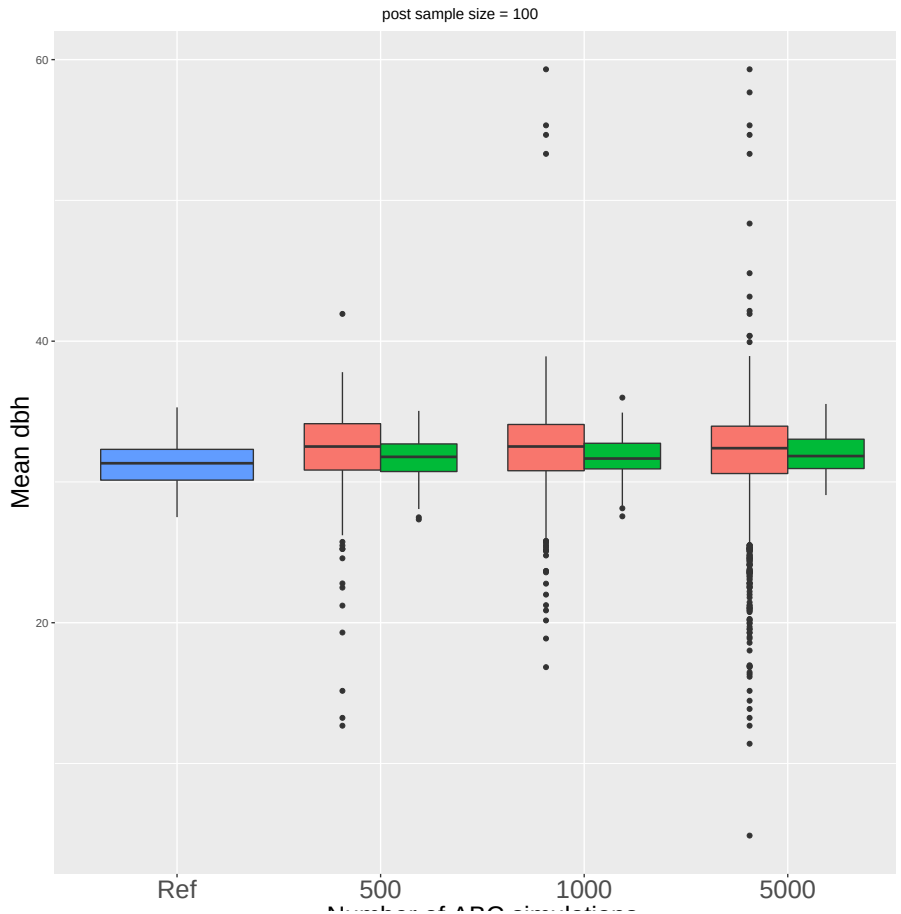
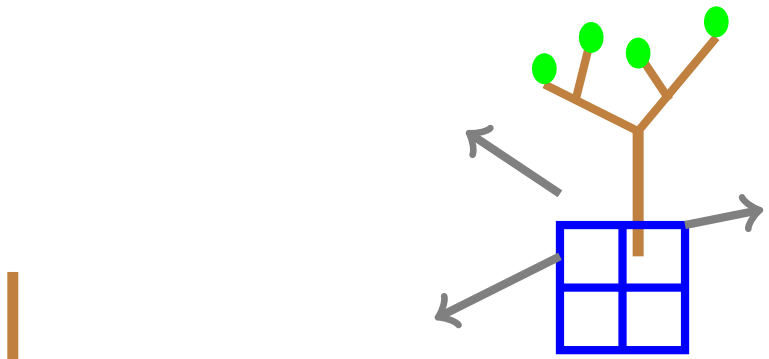
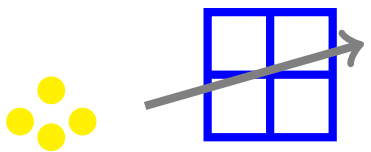


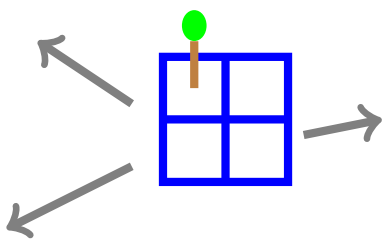


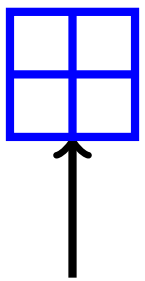
Quantification of data information

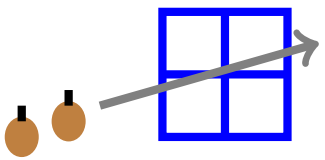




Parenthood assignation







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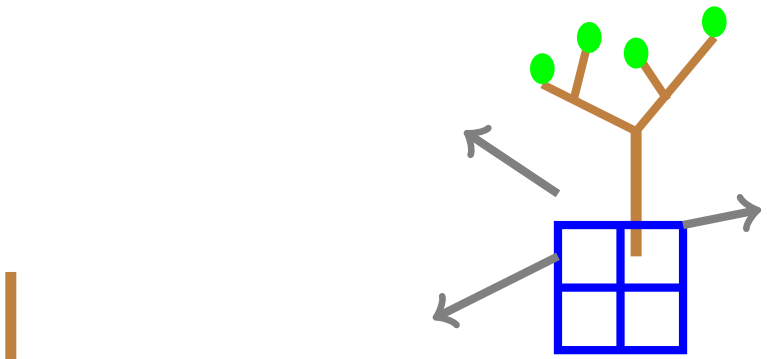

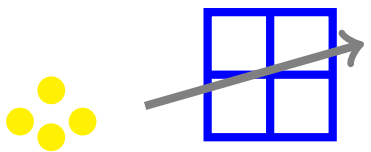

General data

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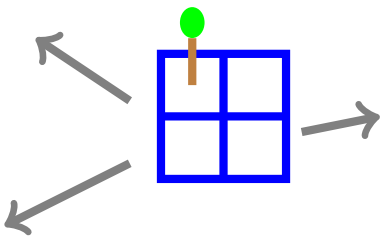

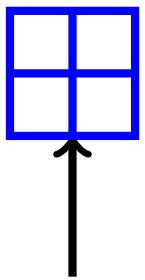

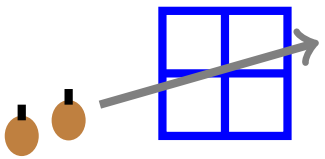

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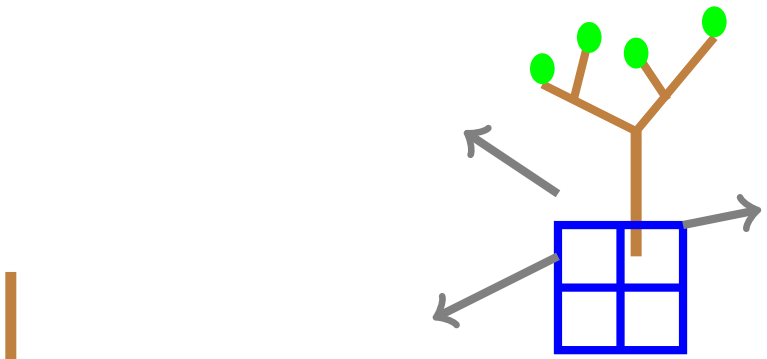

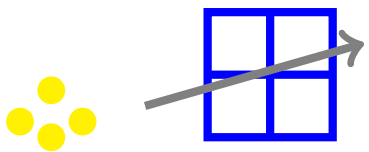

Spatial data

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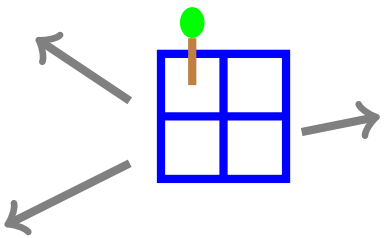
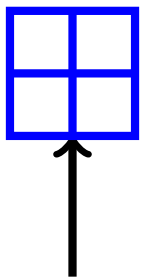
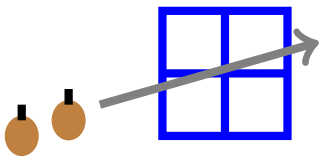
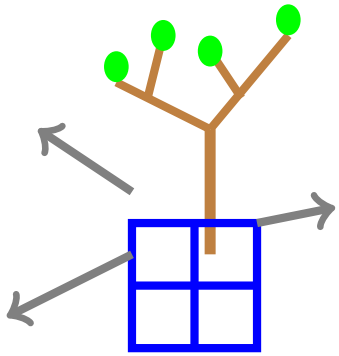
Parenthood assignation



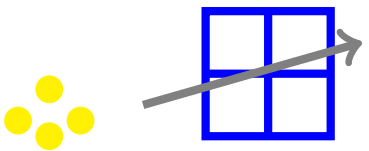




Quantification of data information



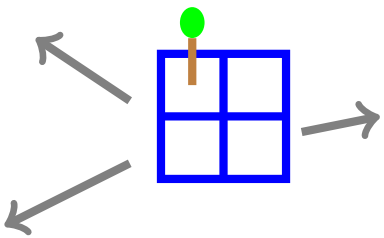
Dynamics data

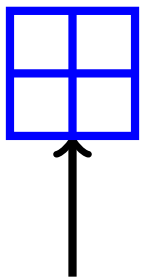


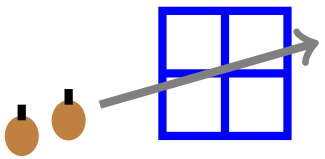
Spatial data

General data

Parenthood assignation







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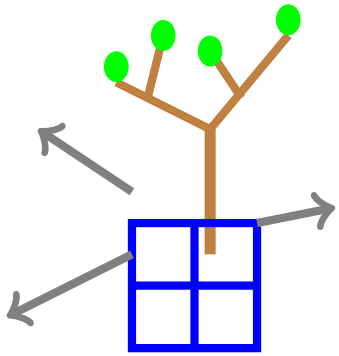
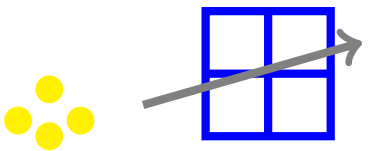


Dynamics data

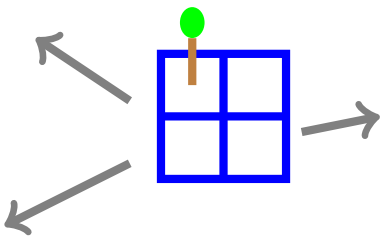


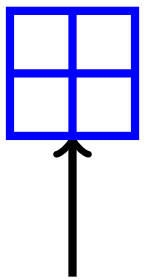
Spatial data

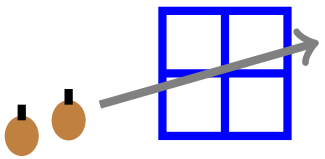
Genetic data

General data

Parenthood assignation







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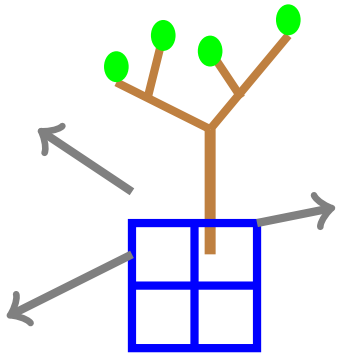
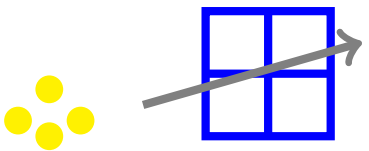


Dynamics data



Spatial data

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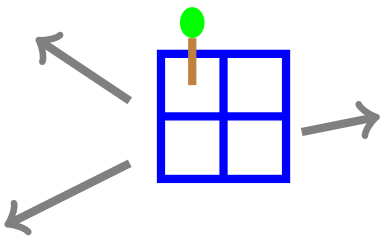
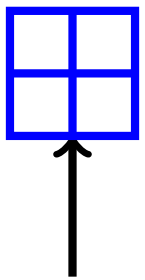
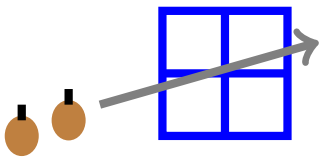


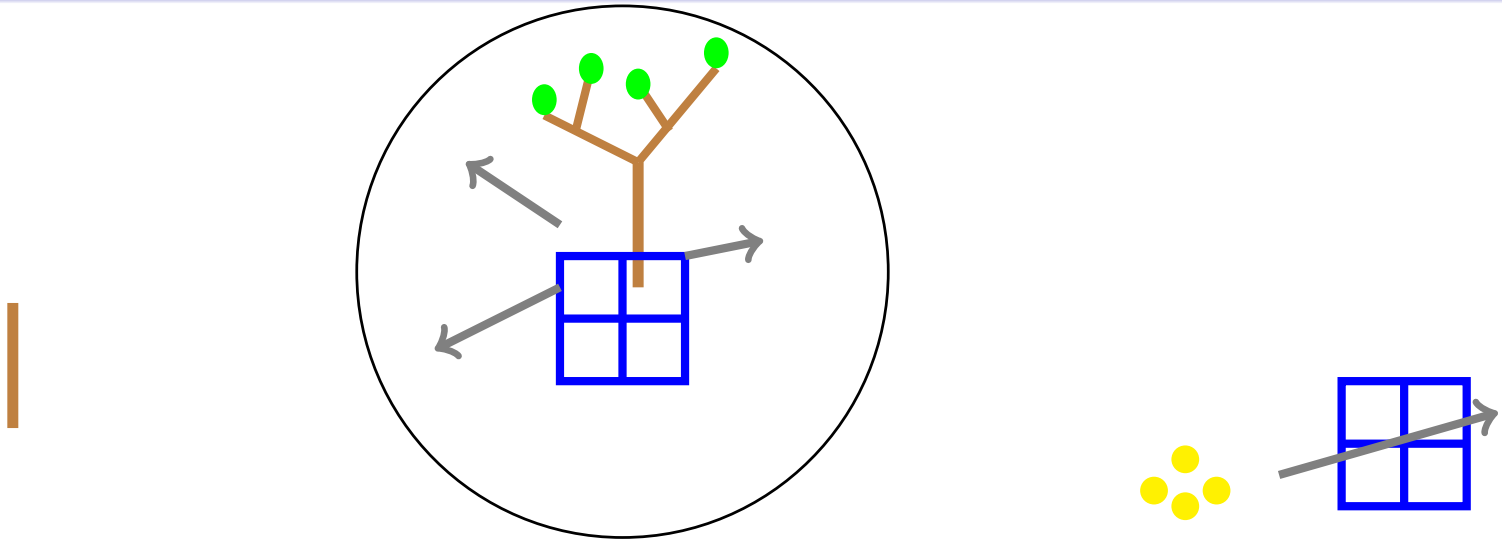




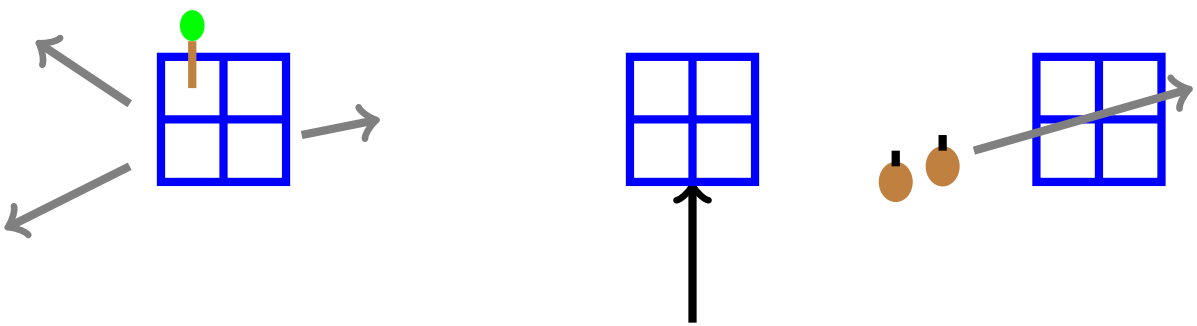
Recruitment and

fecundity data

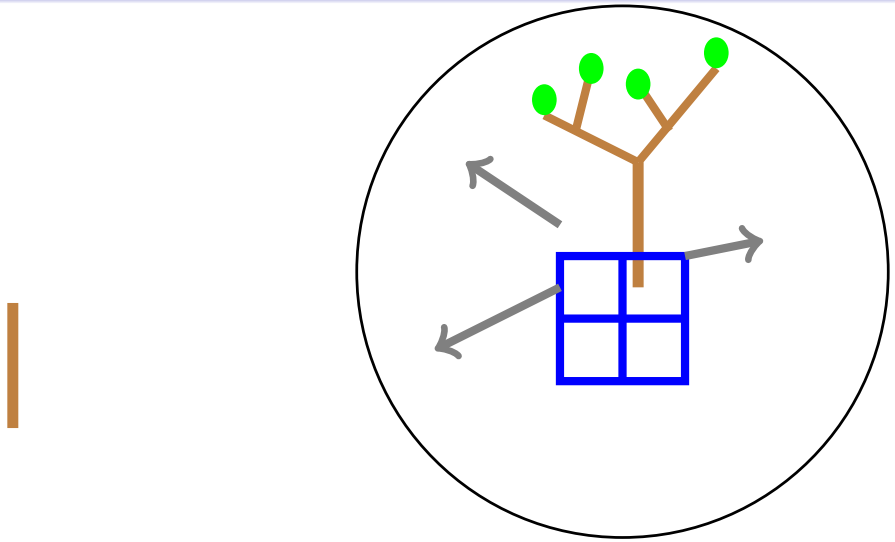
Exemple with growth rate parameters

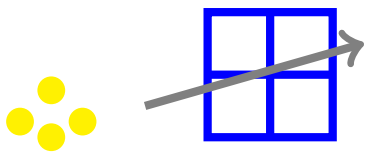


Parenthood assignation



Exemple with growth rate parameters

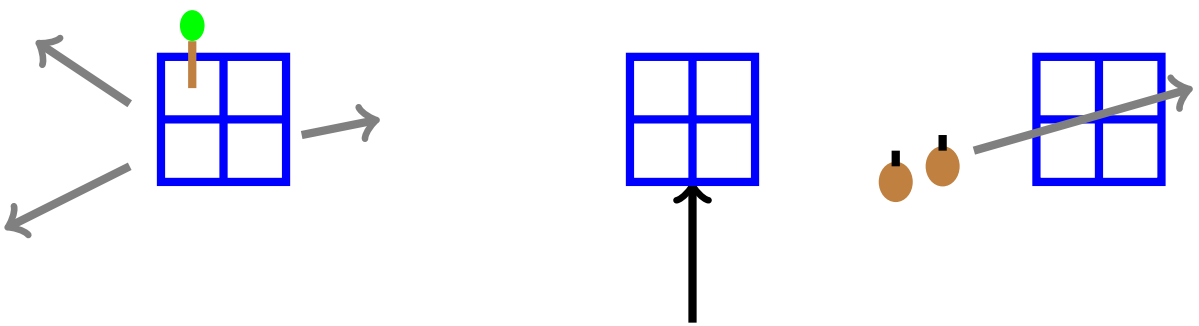




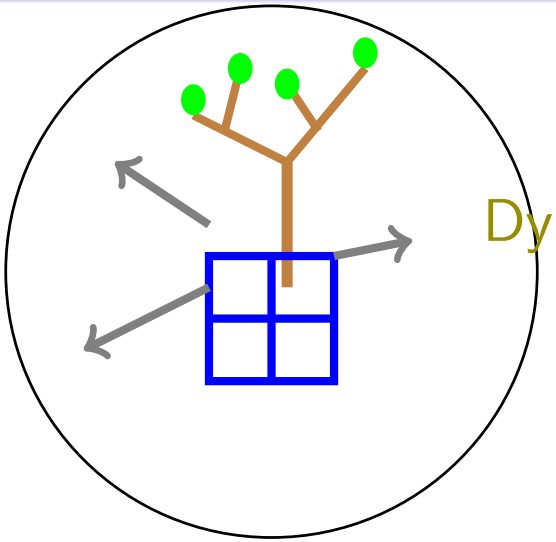
Spatial data

General data

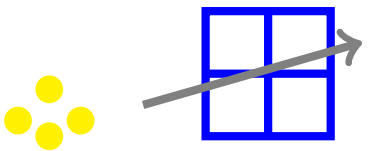
Parenthood assignation



Exemple with growth rate parameters



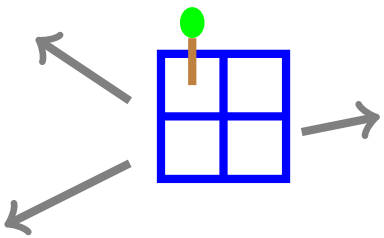
Dynamics data

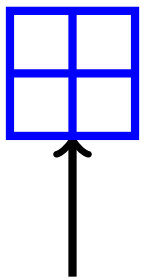


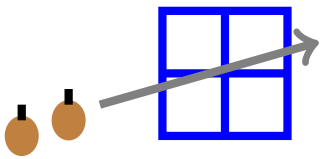
Spatial data

General data

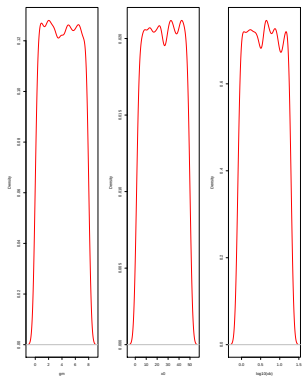
Parenthood assignation



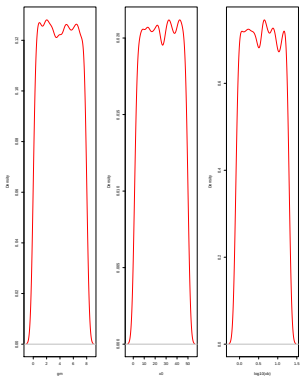




Prior densities

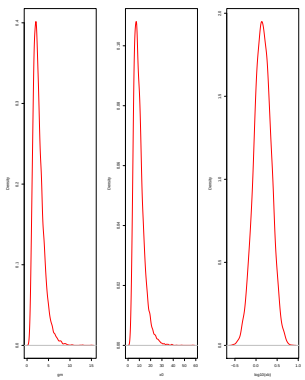


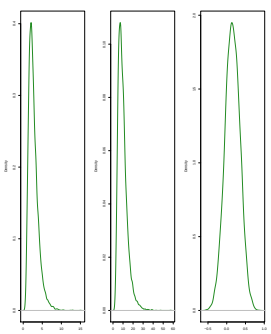
Prior densities



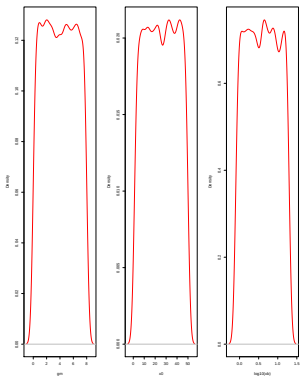
ABC without dynamics data

ABC with dynamics data

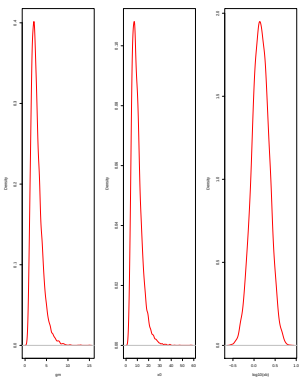




Prior densities

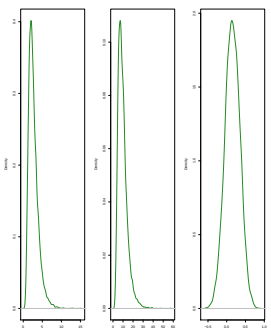


MCMC only dynamics data



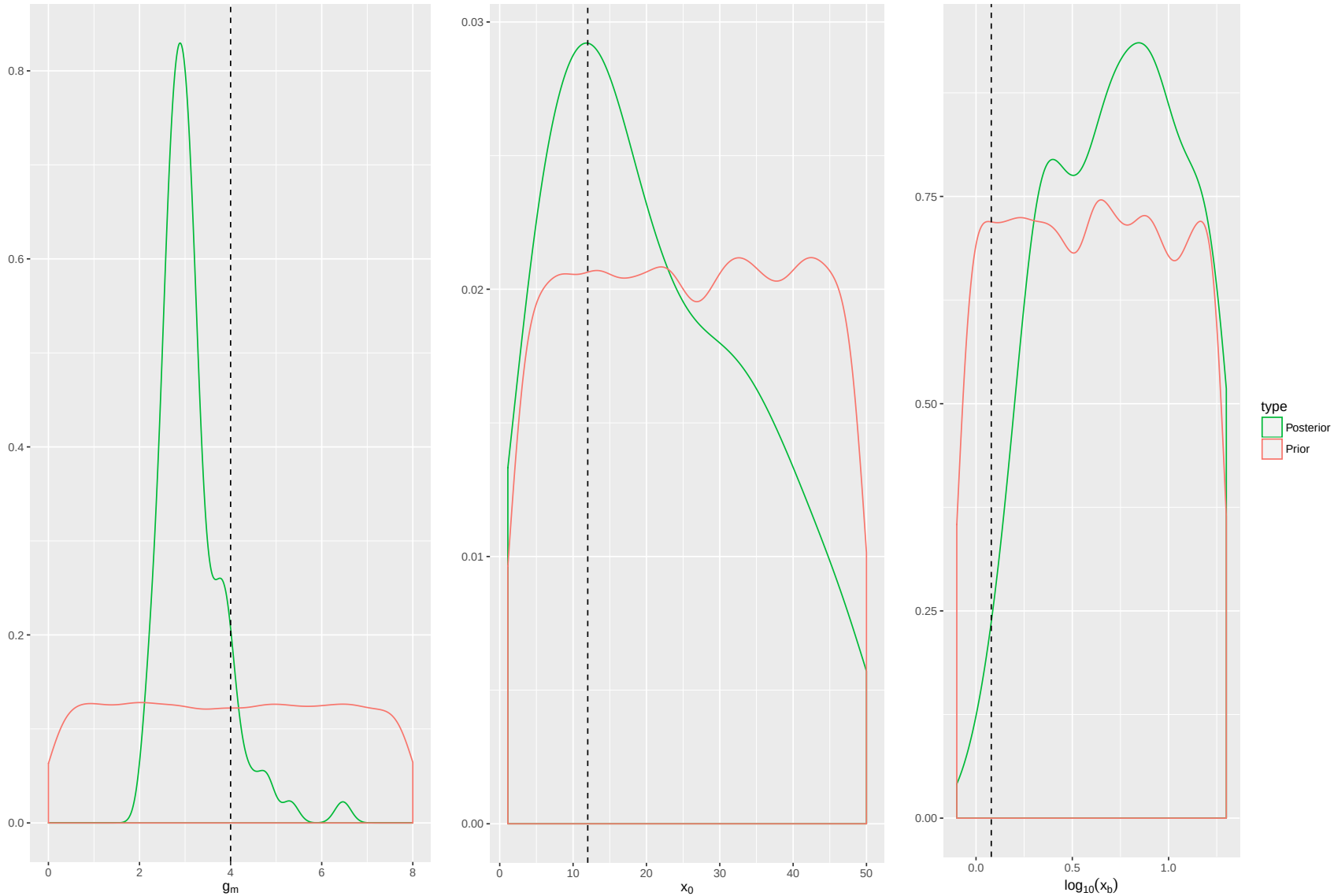
ABC without dynamics data

ABC with dynamics data

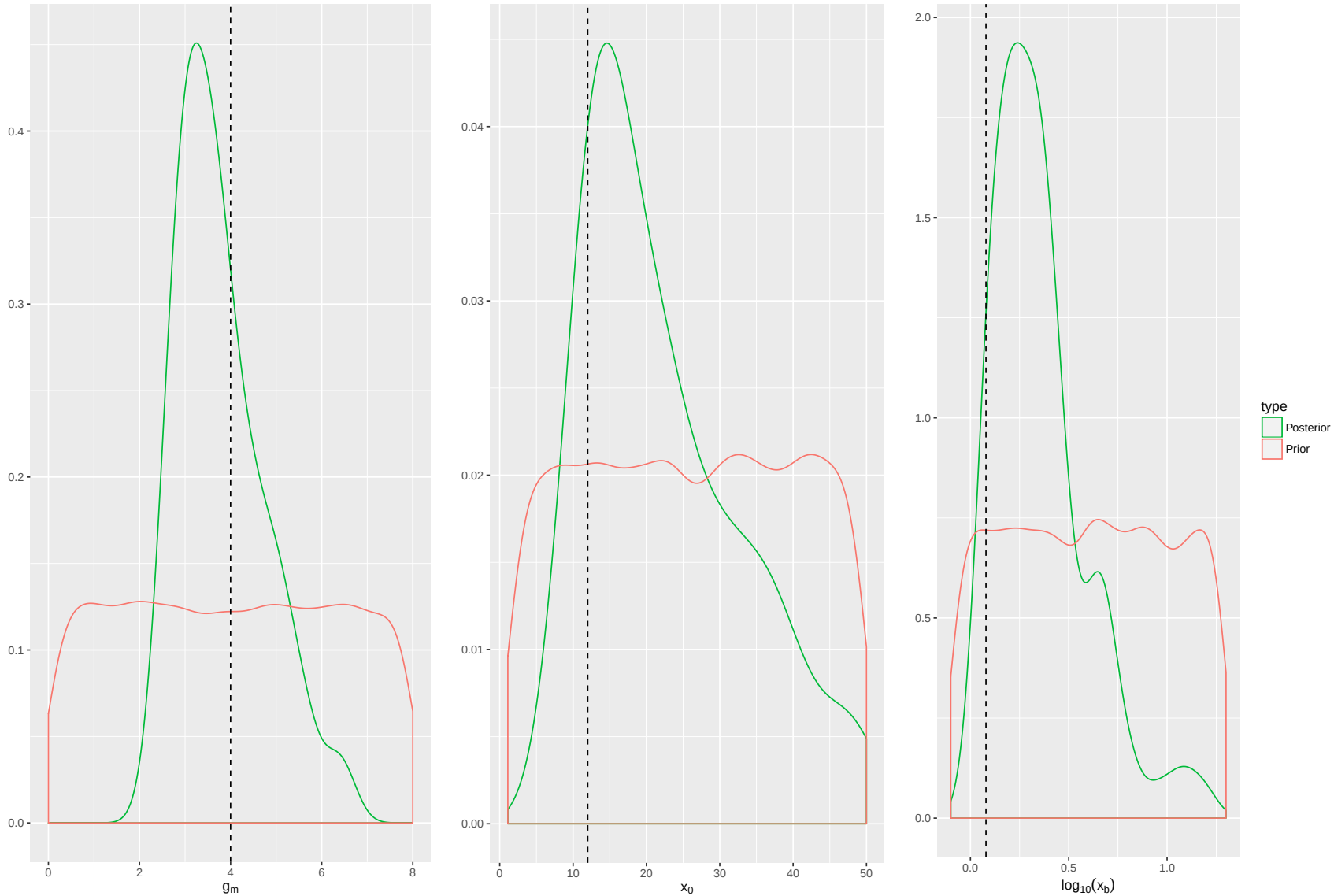


ABC without dynamics data

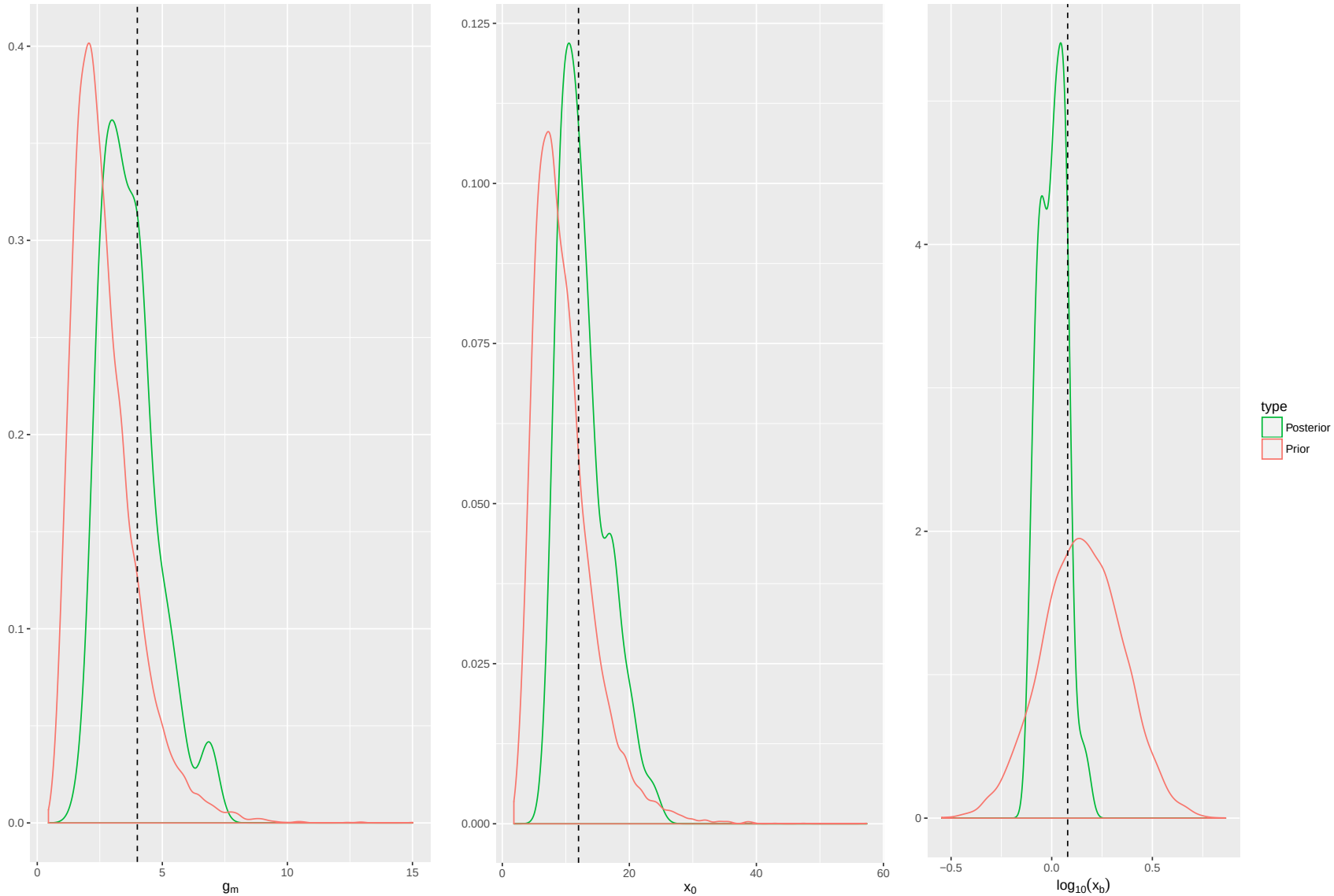
Results without dynamics data



Results with dynamics data method 1



Results with dynamics data method 2



Future work

- Parameter estimation
  - All parameters
  - Quantification of information for all types of data
  - Prior information
  - Effect of patch size

Future work

- Parameter estimation
  - All parameters
  - Quantification of information for all types of data
  - Prior information
  - Effect of patch size
- Model changes
  - Two size class
  - Processes (mortality, masting, etc.)
  - Hierarchy on patches ?
  - Demo-**genetic** model ?

Thank you for your attention.