



CALIBRATION AND VALIDATION OF A SPATIALLY EXPLICIT MODEL USING IMAGE ANALYSIS AND APPROXIMATE BAYESIAN COMPUTATION

Background

Spatially explicit models (SEMs) are a valuable modelling paradigm because they explicitly take into account the heterogeneity of the space and the individual variability between organisms, which is essential for a realistic view of natural ecosystems. Therefore SEMs have been recognized as a more realistic alternative to macroscopic models based on partial differential equations.



SEMs can be used to make predictions, for example relating to the dynamics of communities under varying environmental conditions, which is necessary to study future scenarios relating to important topics such as invasion or climate change. However, before such SEMs can be used to make sound and well-supported predictions, they must be calibrated and validated. Being spatially explicit, these models require spatial information, which presents questions of how to obtain these parameters.

A possible approach is based on image analysis, which uses a time series of images of growing and interacting organisms in order to extract the relevant model parameters. These can relate to the organisms' growth, mobility or their interactions with each other and their environment.

Scope of the thesis

As part of this thesis, the student will survey and analyze the existing possibilities for calibrating SEMs based on information obtained from image analysis. Using a dataset of time series of scanner images following the evolution through time of a community of several microbial species, the student will implement image processing and analysis methods in order to extract parameters from the image series, and then proceed with the calibration of a SEM of the community's dynamics. The model will be evaluated using Approximate Bayesian Computation, which allows for the uncertainty in the predictions of stochastic models to be assessed. For that purpose, we will resort to the high-performance computing infrastructure of Ghent University.

SUPERVISORS

Prof. dr. Bernard De Baets
Dr. ir. Jan Baetens

TUTOR

MSc. Aisling Daly

BACKGROUND

B&N, C&G, L, L&W, M

MORE INFO

aisling.daly@ugent.be

