

A LINGUA FRANCA FOR NEUTRAL LANDSCAPE MODELS: DEVELOPING A CLASSIFICATION APPROACH TO ADVISE THEIR FUTURE USAGE



MARCO SCIAINI*†, ELISA REINEKE*, CRAIG ERIC SIMPKINS*, KERSTIN WIEGAND*

*DEPARTMENT OF ECOSYSTEM MODELLING, UNIVERSITY OF GOTTINGEN

†@MSCIAINI SCIAINI.MARCO@GMAIL.COM

What are neutral landscape models?

Neutral landscape models (NLMs) simulate landscape patterns based on theoretical distributions and can be used to systematically study the effect of landscape structure on ecological processes.

NLMs are commonly used in landscape ecology to develop new landscape metrics as well as in simulation studies to provide an underlying landscape.

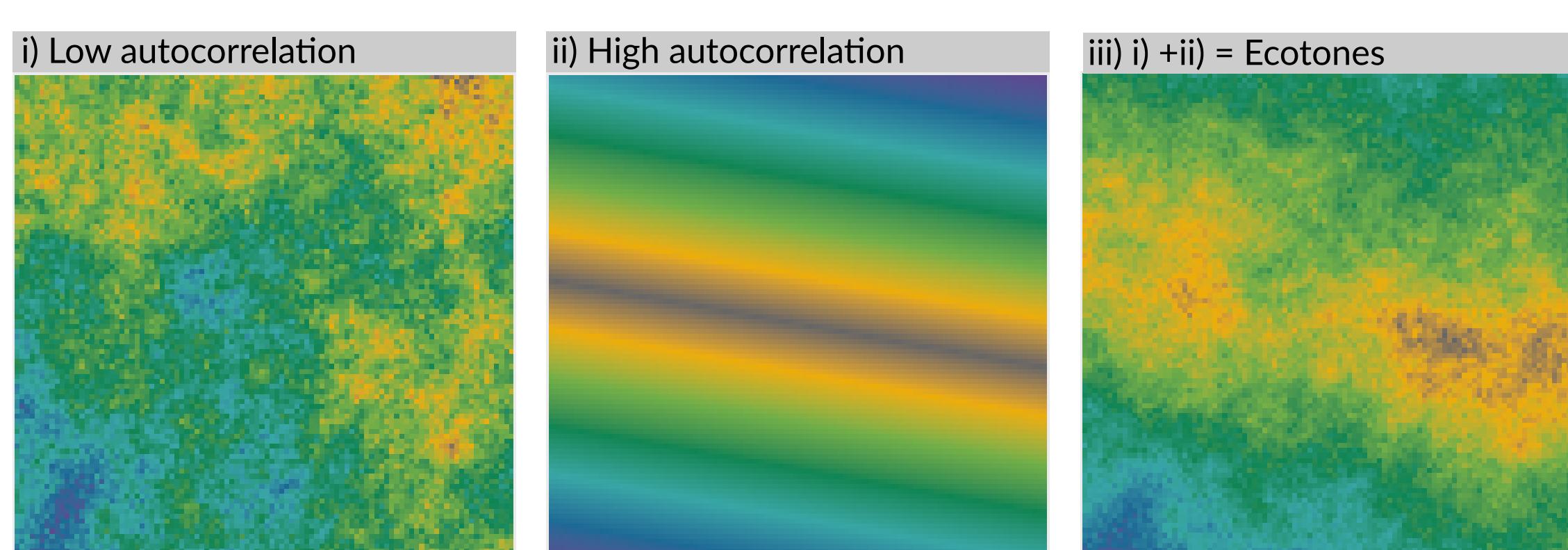


Fig. 1: Exemplary workflow of integrating neutral landscape models in simulation studies. Two landscapes with low and high spatial autocorrelation are merged to derive a landscape pattern that resembles ecotones.

Research Question

So far, there is no framework that provides guidance which of the models in the diverse variety of NLMs available can be applied in which specific context (when using NLMs to create null models with same statistical properties as a given landscape, or mimicking a certain landscape for a simulation model). Historically NLMs were divided into three categories i) random, ii) hierarchical or iii) fractal (With & King, 1997).

But given the fast development of more and more sophisticated landscape models and the shift to continuous NLMs rather than binary ones ... how would one justify the use of a specific landscape model over the other?

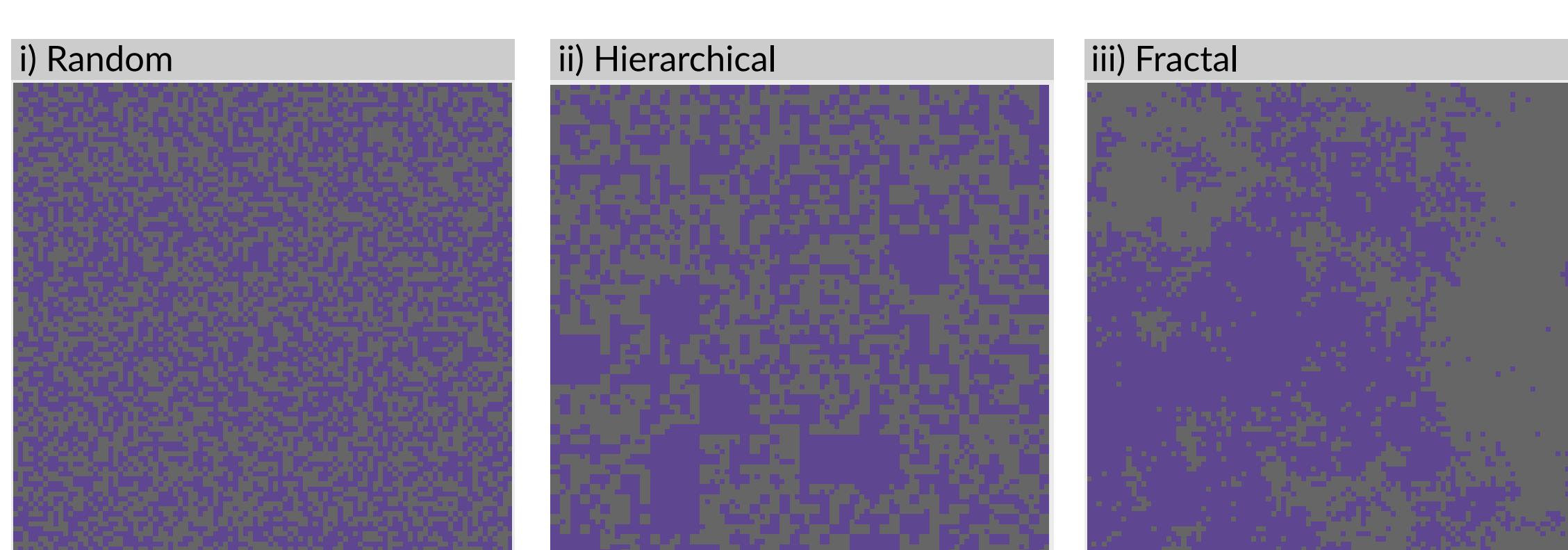


Fig. 2: Current classification scheme in the literature on neutral landscape models.

Classification Scheme and Agenda

A more appropriate classification scheme to guide the usage of NLMs would focus on the range of spatial configurations and more simplified the range of spatial autocorrelation each of NLM is able to cover with its parameter space. We therefore:

1. Simulate each NLM for every possible parameter combination
2. Classify resulting landscapes into 2 - 15 land cover classes
3. Calculate for each landscape and classification a selection of landscape metrics
4. Use the metrics to cluster the landscapes along a gradient of spatial autocorrelation

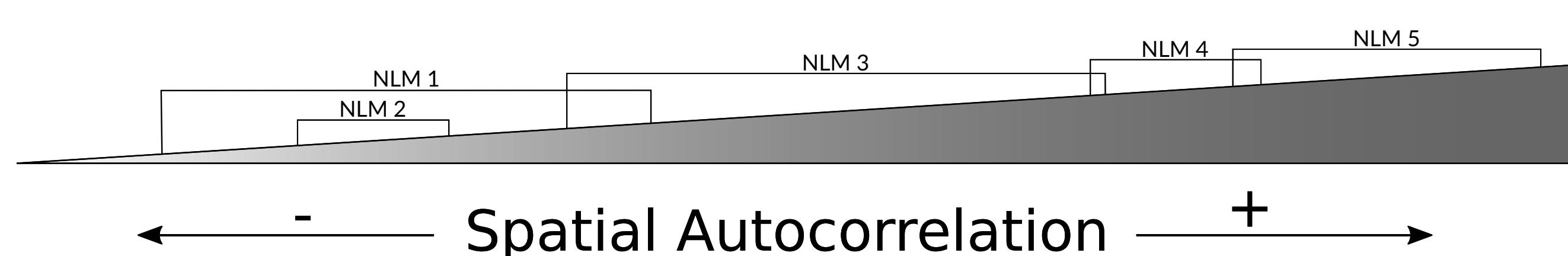
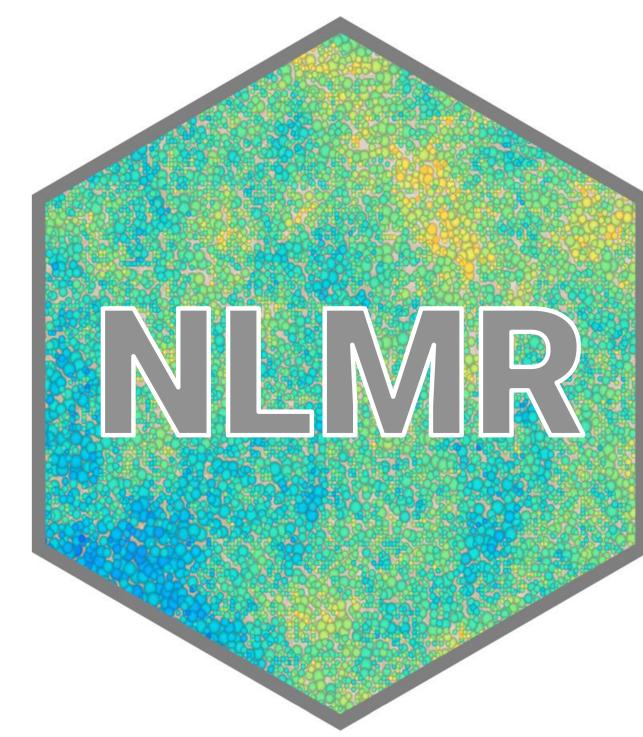


Fig. 3: Conceptual figure illustrating the research agenda.

Software tools



NLMR is an R package for simulating neutral landscape models (NLM). Designed to be a generic framework like *NLMpy*, it leverages the ability to simulate the most common NLM that are described in the ecological literature. *NLMR* builds on the advantages of the raster package and returns all simulation as RasterLayer objects, thus ensuring a direct compatibility to common GIS tasks and a flexible and simple usage. Furthermore, it simulates NLMs within a self-contained, reproducible framework.



landscapemetrics is an R package for calculating landscape metrics for categorical landscape patterns in a tidy workflow. The package can be used as a drop-in replacement for *FRAGSTATS* (McGarigal et al. 2012), as it offers a reproducible workflow for landscape analysis in a single environment. Besides the calculation of widely used landscape metrics, the package also includes several utility functions such as connected components labeling, correlation between metrics or a sample function for metrics around spatial sample points.

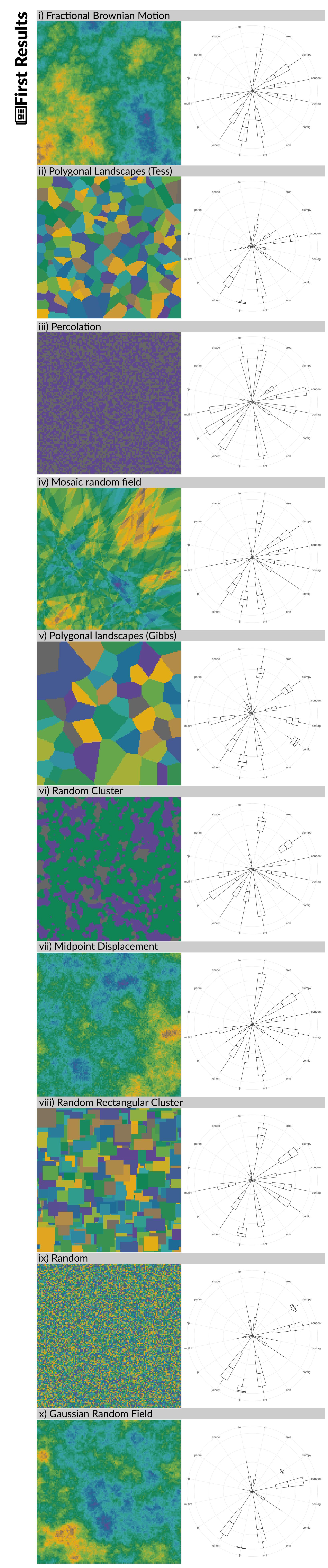


Fig. 4: Overview with all neutral landscape models (NLM) that were analysed and exemplary landscape metrics that were used to classify the models. The landscapes are shown continuous to give an overview of the original spatial pattern that is simulated with each NLM.