

Analysing multivariate ecological data with Generalized Linear Latent Variable Models

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Wrap-up

You now know:

- 1) What ecological gradient analysis is
 - 2) That JSDMs (GLLVMs) and ordination are both used to study co-occurrence patterns of species
- And are the same in terms of GLLVM implementation 3) How to use the **gllvm** R-package Niku et al. 2019

"Vanilla" GLLVMs in the **gllvm** R-package

You might want to

- Include random-effects
- Assume sites are not independent
- Assume species are not independent
- Perform constrained ordination
- Assume species associations depended on the environment
- Model multiple time points
 - Some of these will hopefully come to **gllvm** in the future

GLLVM extensions

- Spatial autocorrelation: $\mathbf{u}_i \sim \mathcal{N}(0, s(\mathbf{H}))$
 - Spatially structure latent variables
- Species are related: $\boldsymbol{\theta}_j \sim \mathcal{N}(0, \mathbf{G})$
 - Where \mathbf{G} is a matrix of relatedness (e.g. phylogeny)
- Constrained ordination: $\mathbf{u}_i \sim \mathcal{N}(\boldsymbol{\mu}_i, \mathbf{I})$
 - Regress the mean of latent variables: $\boldsymbol{\mu}_i = \boldsymbol{\alpha} + \mathbf{X}_i\boldsymbol{\beta}$
- Species associations as function of the environment:
 - $\boldsymbol{\theta}_j = \boldsymbol{\alpha}_j + \mathbf{X}\boldsymbol{\beta}_j$ Perrin et al. in review
- Spatial-temporal JSDM/ordination: species associations through time and/or space

Bayesian Ordination and Regression

- For ordination with spatial effects

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APPLICATION

BORAL – Bayesian Ordination and Regression Analysis of Multivariate Abundance Data in R

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Hierarchical Modeling of Species Distributions (HMSC)

- For other cool GLLVM stuff
- Bayesian, with MCMC (i.e. **slow**)

Thanks for your attention

- Ask for feedback: my e-mail or our twitters

