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

2a) That JSDMs and ordination are both used to study co-occurrence patterns of species

2b) And that these are the same in terms of GLLVM implementation

3) How to use the **gllvm** R-package Niku et al. 2019

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: $\boldsymbol{u}_i \sim \mathcal{N}(0, s(\boldsymbol{H}))$
  - Spatially structure latent variables

- Species are related: $\boldsymbol{\theta}_j \sim \mathcal{N}(0, \boldsymbol{G})$
  - Where $\boldsymbol{G}$ is a matrix of relatedness (e.g. phylogeny)

- Constrained ordination: $\boldsymbol{u}_i \sim \mathcal{N}(\boldsymbol{\mu}_i, \boldsymbol{I})$
  - Regress the mean of latent variables: $\boldsymbol{\mu}_i = \boldsymbol{\alpha} + \boldsymbol{X}_i \beta$

- Species associations as function of the environment:
  - $\boldsymbol{\theta}_j = \boldsymbol{\alpha}_j + \boldsymbol{X}\boldsymbol{\beta}_j$ Perrin et al. in review
- Spatial-temporal JSDM/ordination: species associations through time and/or space

Bayesian Ordination and Regression

- For GLLVMs (ordination) with spatial effects
- Bayesian, with MCMC (i.e. can be **slow**)

Methods in Ecology and Evolution

APPLICATION

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

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Hierarchical Modeling of Species

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

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APPLICATION | 🔒 Open Access | (cc) (i) (s)

Joint species distribution modelling with the R-package HMSC

Gleb Tikhonov, Øystein H. Opedal, Nerea Abrego, Aleksi Lehikoinen, Melinda M. J. de Jonge, Jari Oksanen, Otso Ovaskainen ✉

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Thanks for your attention

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On github: https://github.com/BertvanderVeen/BES2020GLLVMworkshop/discussions