# Species and their interactions respond to different environmental variables

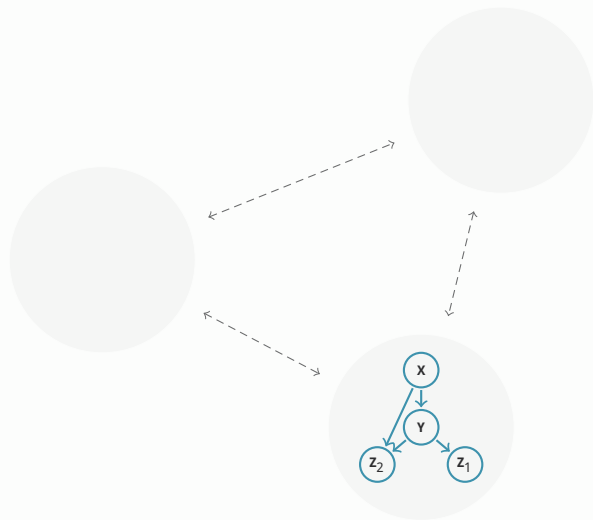Timothée Poisot    Cynthia Guéveneux-Julien

#ESA100, Baltimore, MD
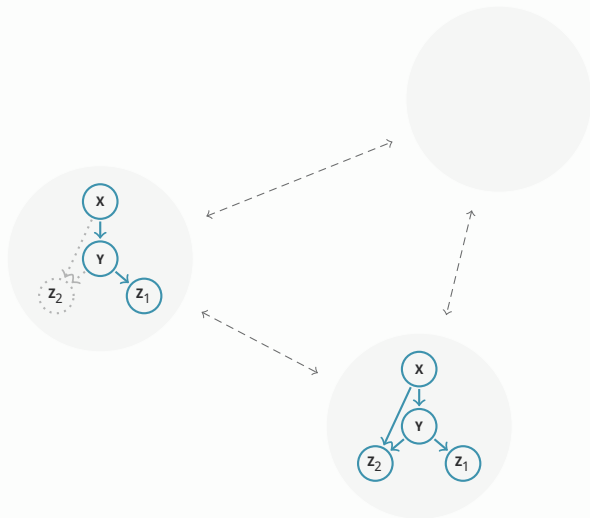
Université de Montréal – @PoisotLab

1. Species don't always co-occur
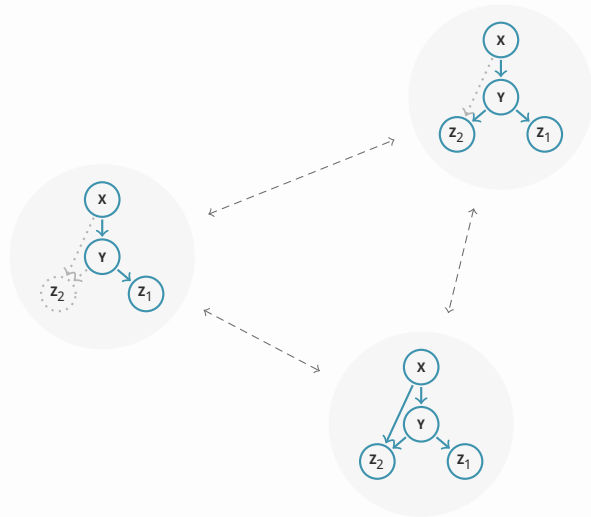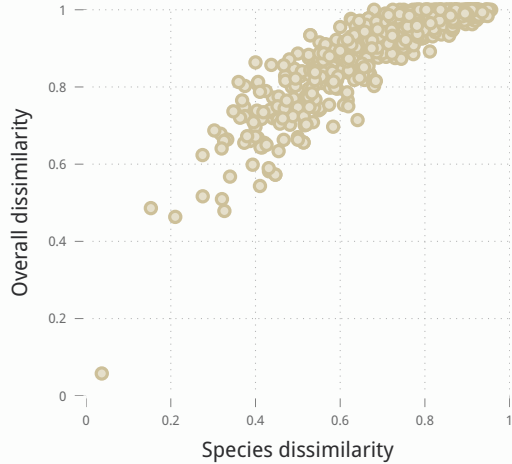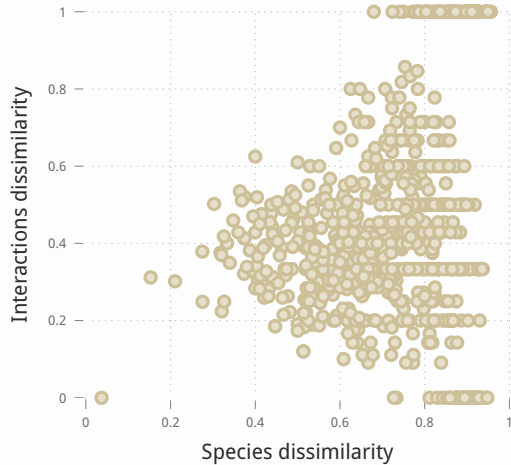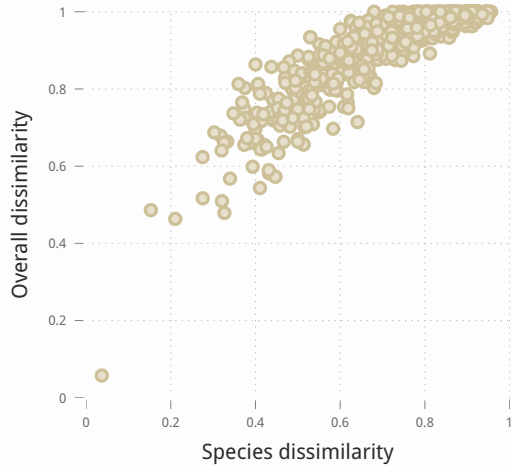
1. Species don't always co-occur
2. Species don't always interact

# How are communities different?

How are communities different?



Poisot et al. (2012) Ecol. Lett.

$$D(\ \blacksquare \leftarrow \blacksquare \rightarrow \blacksquare\ ) = D(\ \blacksquare\ \ \blacksquare\ \ \blacksquare\ ) \times D(\ \leftarrow\ \rightarrow\ )$$

Species and their interactions differ.

$$D(\ \blacksquare \leftarrow \blacksquare \rightarrow \blacksquare\ ) = D(\ \blacksquare\ \ \blacksquare\ \ \blacksquare\ ) \times D(\ \leftarrow\ \rightarrow\ )$$

Species and their interactions differ.

$$\blacksquare = f(\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_n)$$

Species have a niche.

$$D(\ \blacksquare \leftarrow \blacksquare \rightarrow \blacksquare\ ) = D(\ \blacksquare\ \ \blacksquare\ \ \blacksquare\ ) \times D(\ \leftarrow\ \rightarrow\ )$$

Species and their interactions differ.

$$\blacksquare = f(\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_n)$$

Species have a niche.

$$\leftarrow\ = f(\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_n)?$$

But what about interactions?

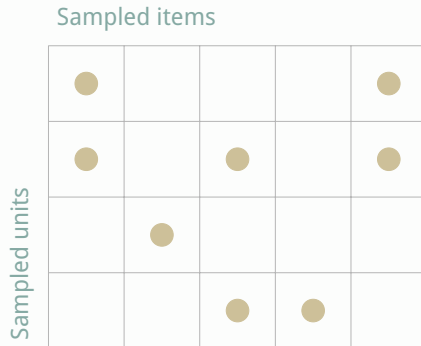# β-diversity as the variance of a community matrix
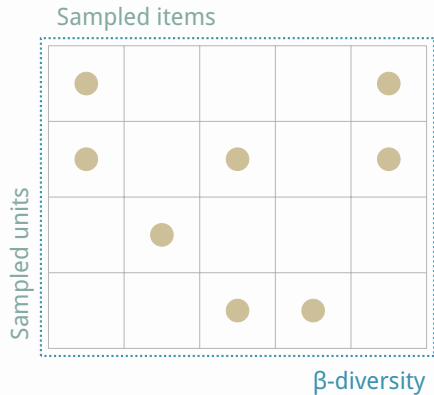
## Sampled items



Sampled units

# β-diversity as the variance of a community matrix

## Sampled items
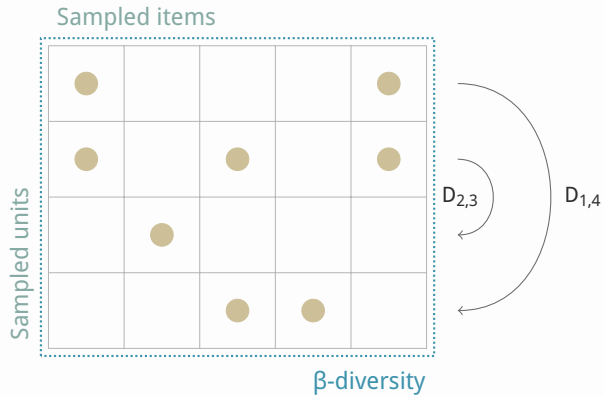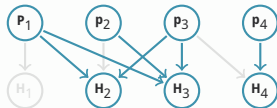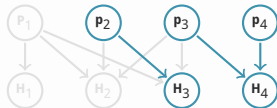


Sampled units

β-diversity as the variance of a community matrix

Sampled items



Sampled units

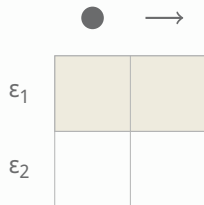β-diversity

β-diversity as the variance of a community matrix

dbRDA on the β-diversity matrices

- hosts, and parasites
- potential interactions
- observed interactions

with 19 *bioclim* variables at each sampling location

Krasnov et al. (2012) Am. Nat.; Hijmans et al. (2005) Int. J. Climatol.

$\varepsilon_1$

$\varepsilon_2$

| Predictor | ■→■ | ■→■ | ■┈▶■ | ■→■ |
|---|---|---|---|---|
| Rainfall seasonality | x | x | | |
| Daily θ fluctuation | x | x | x | x |
| θ seasonality | x | x | x | x |
| θ̄ (wettest season) | x | x | x | x |
| Rainfall (wettest month) | x | x | x | x |
| Rainfall (driest season) | x | x | x | x |
| Rainfall (warmest season) | x | x | x | x |
| Rainfall (coldest season) | x | x | x | x |
| θ̄ (year) | | | x | x |
| θ̄ (warmest season) | | | x | x |
| θ̄ (coldest season) | | | x | |

- **Species and interactions have different predictors.**
- Interactions seem to respond to temperature.
- The entire system responds to rainfall.
- The potential interactions explain how the realized interactions behave.
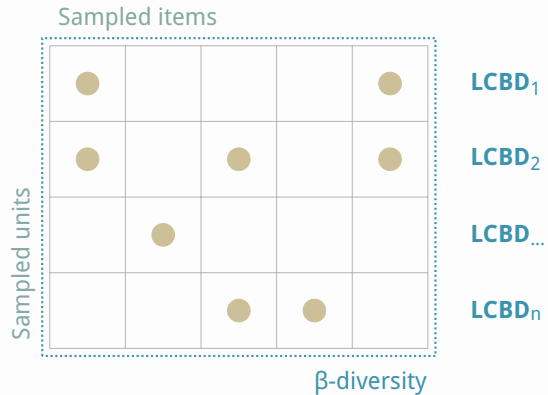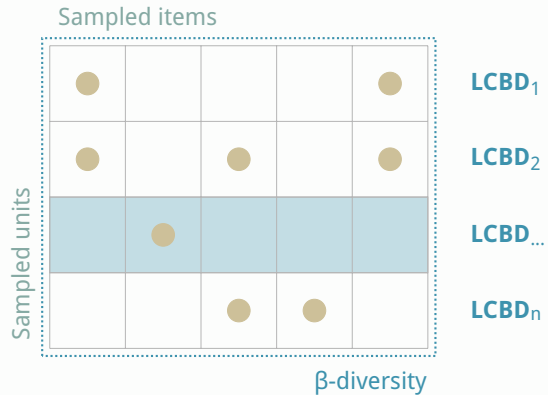
β-diversity as the variance of a community matrix



Sampled items

Sampled units

β-diversity

β-diversity as the variance of a community matrix

# β-diversity as the variance of a community matrix

## Most distinctive sites (species)

ε₁ → ●
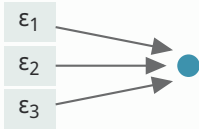ε₂ →
ε₃ →

**Simple SDMs**
Species respond to climatic variables

**Simple SDMs**
Species respond to climatic variables

**Current situation**
Biotic interactions act on distributions

**Simple SDMs**
Species respond to climatic variables

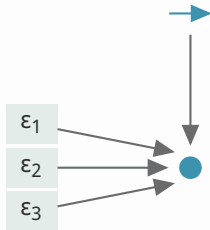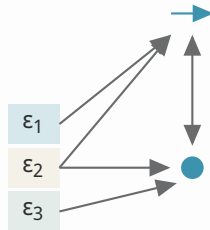**Current situation**
Biotic interactions act on distributions

**The road ahead**
IT'S SUCH A MESS!

Take-home messages

- Interactions and species have different environmental drivers
- Interactions are more informative than species
- We need to think about biotic interactions in SDM