Spatially continuous identification of beta diversity hotspots using species distribution models
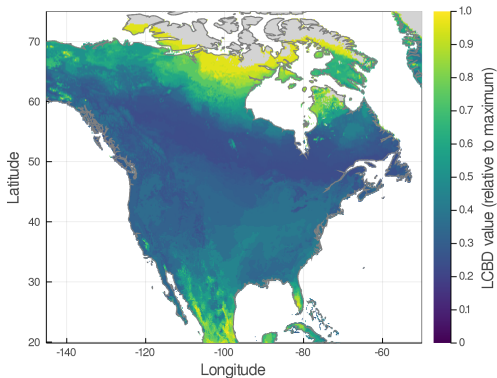
Gabriel Dansereau

December 4, 2019

Objective

Bring together 2 elements:

1. Identification of beta diversity hotspots $\rightarrow$ LCBD calculation
2. Species distribution modelling on continuous scales $\rightarrow$ SDMs

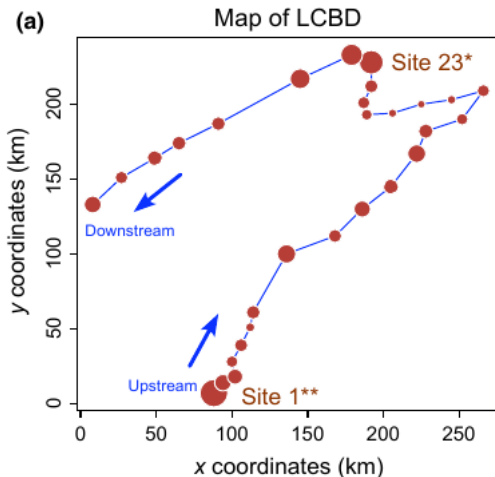# Why continuous scales?

Figure 1: Example of discontinuous LCBD calculation along a river stream
(Legendre & De Caceres, 2013)
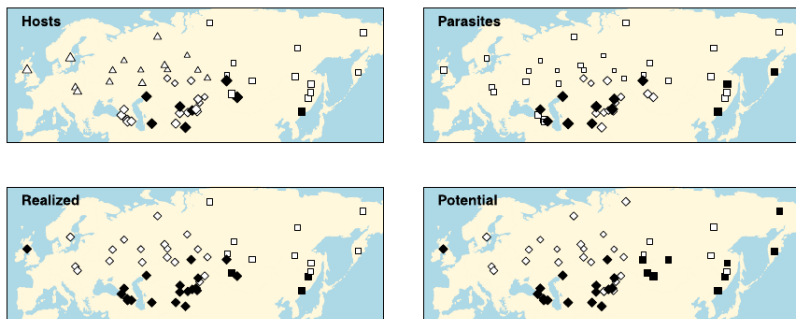
Why continuous scales?

Figure 2: Example of discontinuous LCBD calculation on an extended scale (Poisot et al., 2017)

Why continuous scales?

- ▶ Online data increasingly accessible
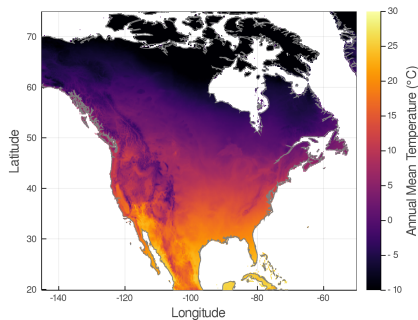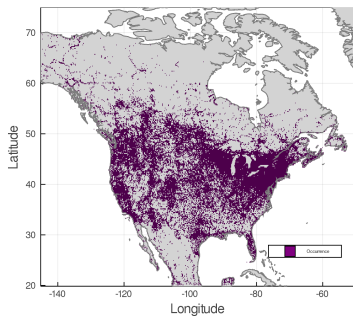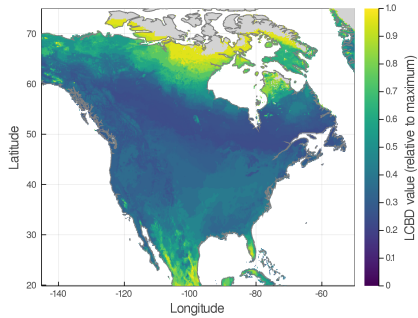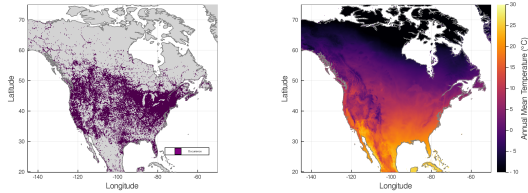- ▶ Potential for novel ecological insights

Figure 3: Example of Yellow Warbler occurrence data from eBird (left) and annual mean temperature data from WorldClim 2 (right)
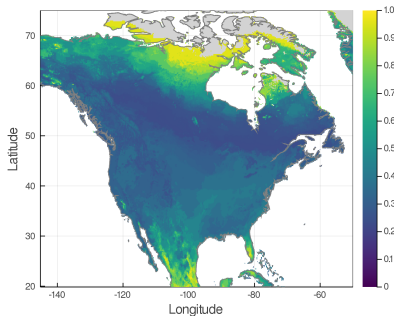
Objective

Relevance

Novel ecological insights

- ▶ Tool for poorly sampled regions, or with sparse sampling
- ▶ Identification of conservation targets

Combination with IPCC climate change scenarios

- ▶ Model beta diversity changes
- ▶ Identify sites with significant changes

⇒ Reminder: Exploratory analyses for now, insight-oriented approach

Data - Why eBird & Warblers

According to Johnston et al. (2019):

1. Complete checklists to infer absences
2. Sampling effort metadata to reduce biases

Figure 4: Structure of the Warblers (*Parulidae*) occurrence data for North America as checklists in the eBird Dataset

Country	Observations	Checklists	Species	Species per checklist (mean)	Species per checklist (median)	Species per checklist (maximum)
US	19 206 453	7 840 526	56	2.450	2.0	34
CA	3 360 650	1 115 625	45	3.012	2.0	31
MX	407 227	147 599	61	2.759	2.0	21
Total	22 974 330	9 103 750	63	2.523	2.0	34

Data - Why WorldClim 2

- Interpolated climate data
- Global range
- Resolutions from 10 arc-minutes to 30 arc-seconds
- High cross-validation coefficients

| Variable	Description
1	Annual Mean Temperature
2	Mean Diurnal Range
3	Isothermality
4	Temperature Seasonality
5	Max Temperature of Warmest Month
6	Min Temperature of Coldest Month
7	Temperature Annual Range
8	Mean Temperature of Wettest Quarter
9	Mean Temperature of Driest Quarter
10	Mean Temperature of Warmest Quarter
11	Mean Temperature of Coldest Quarter
12	Annual Precipitation
13	Precipitation of Wettest Month
14	Precipitation of Driest Month
15	Precipitation Seasonality
16	Precipitation of Wettest Quarter
17	Precipitation of Driest Quarter
18	Precipitation of Warmest Quarter
19	Precipitation of Coldest Quarter

Methods - BIOCLIM
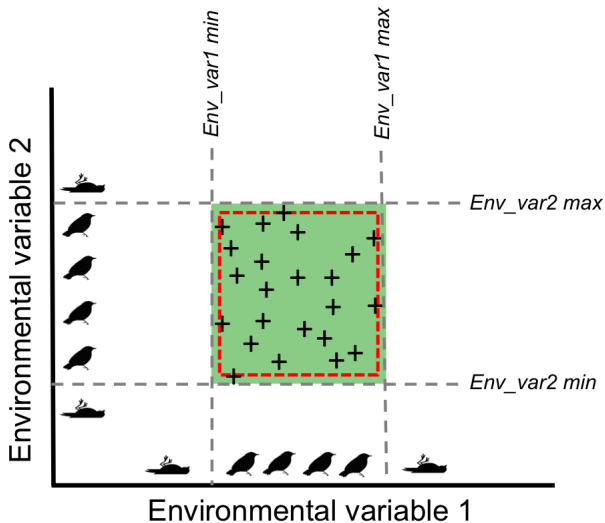
Figure 5: Representation of the climate envelope in the BIOCLIM method[1]

[1]https://support.bccvl.org.au/support/solutions/articles/6000083201-bioclim

Preliminary Results
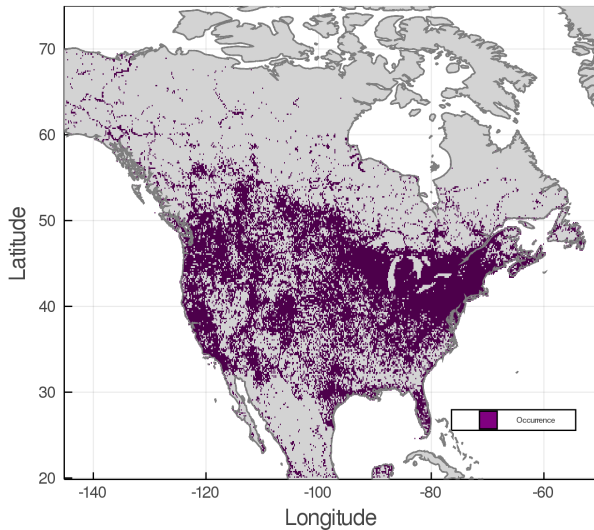
Single species SDM example

Figure 6: Yellow Warbler Distibution based on the raw data (presence-absence per site)
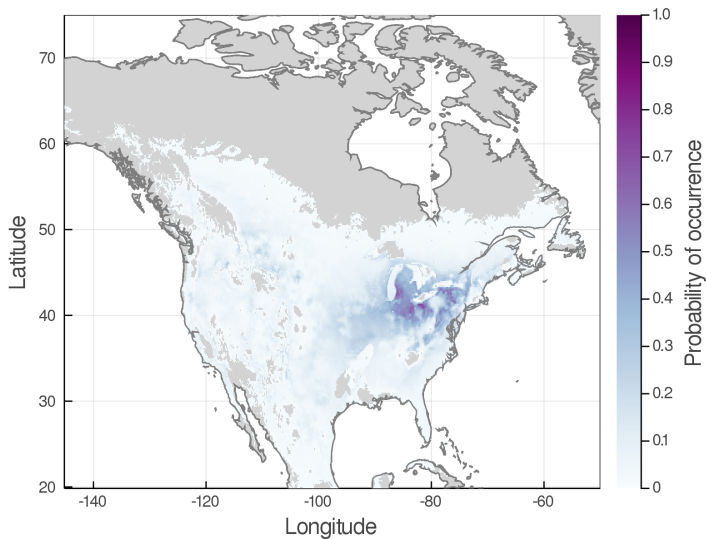
Single species example - Raw data

Figure 7: SDM predictions with threshold (5%) for the distribution of Yellow Warblers
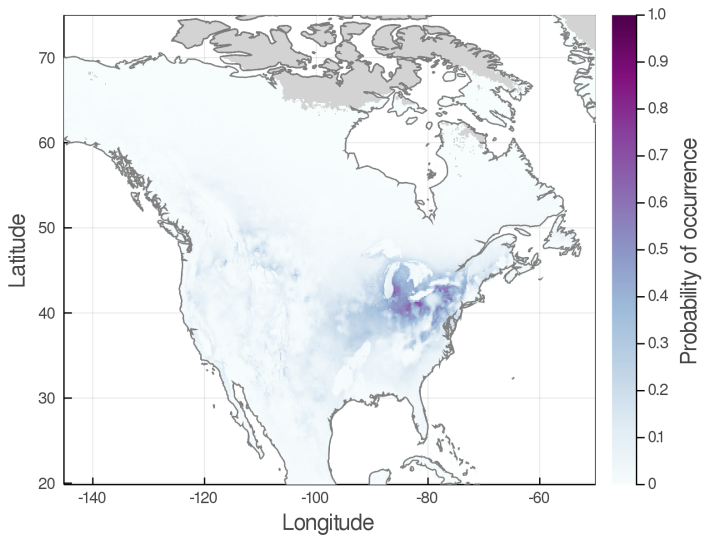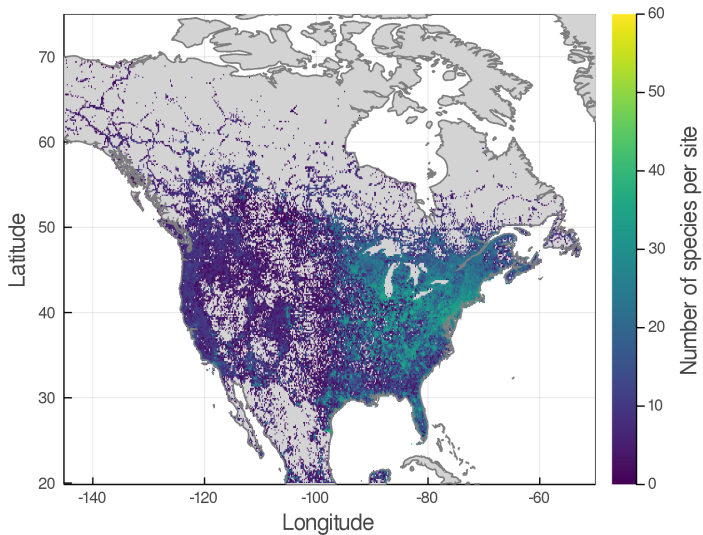
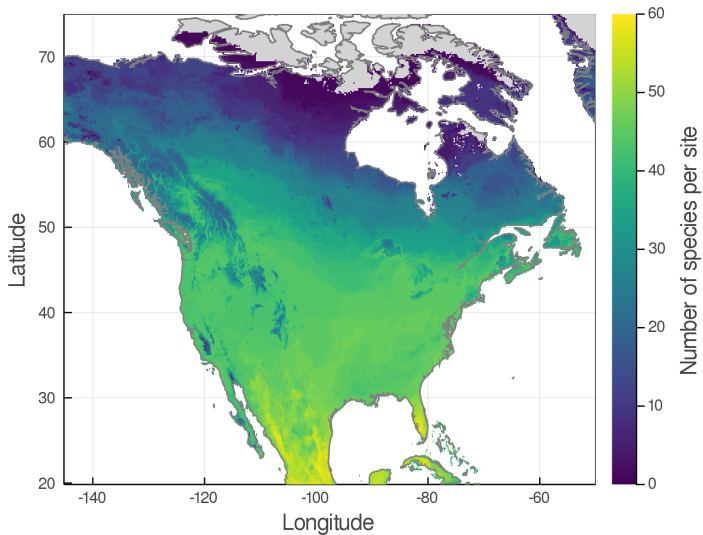# Single species example - SDM with threshold

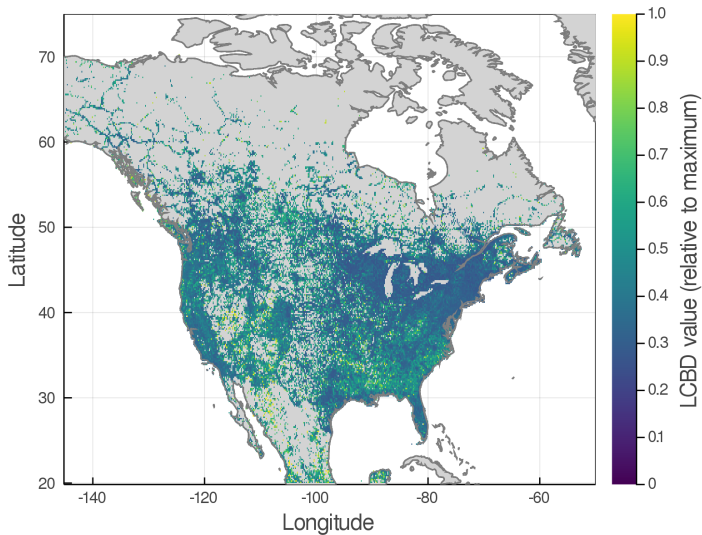Figure 8: SDM predictions without threshold for the Yellow Warbler
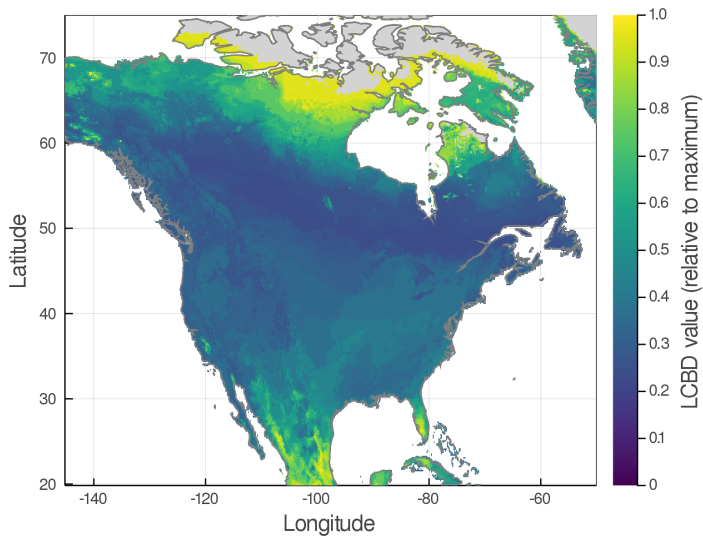
Species richness - Raw data
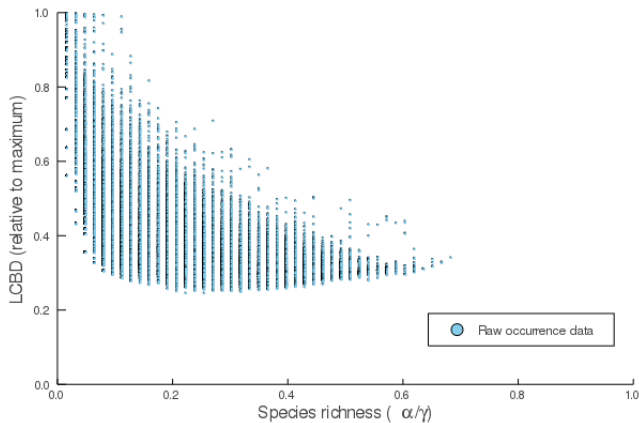
Species richness - SDM without threshold

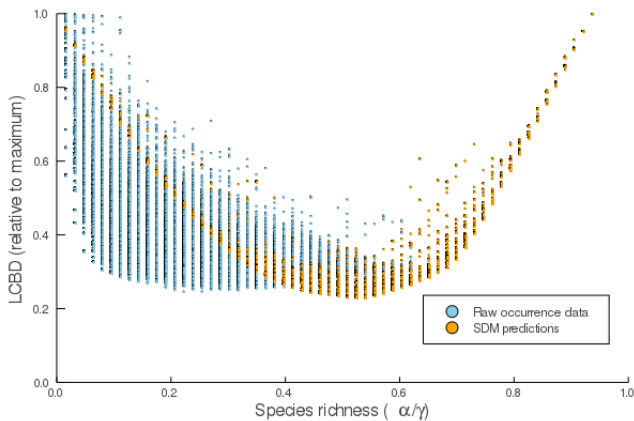# LCBD - Raw data (with Hellinger transformation)

LCBD - SDM without threshold (no transformation)

LCBD-richness relationship

LCBD-richness relationship

Elements to discuss

- Relevance of the approach
- Improving SDM predictions: MAXENT, Random Forests, Neural Networks, Joint SDMs
- Data transformation for LCBD calculation
- Scales to focus on