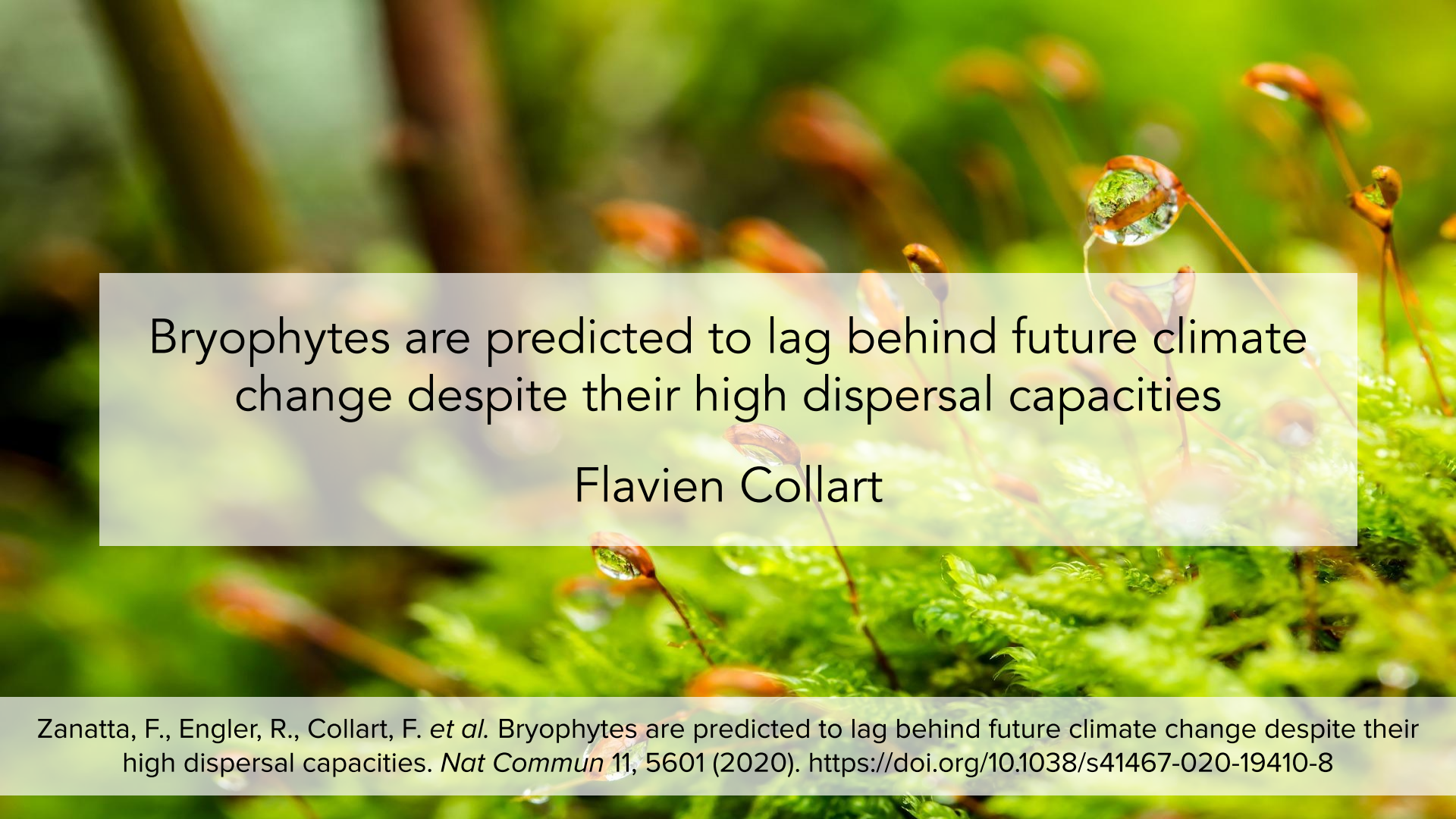

Bryophytes are predicted to lag behind future climate change despite their high dispersal capacities

Flavien Collart

Zanatta, F., Engler, R., Collart, F. *et al.* Bryophytes are predicted to lag behind future climate change despite their high dispersal capacities. *Nat Commun* 11, 5601 (2020). https://doi.org/10.1038/s41467-020-19410-8

Species distribution models

- Based on niche concept
- Main assumption:

  species are at equilibrium with their environment

  → No dispersal limitations

  → Importance to develop framework (Zurell et al 2016, *Glob. Chang. Biol.*)

MigClim

- Automaton (Engler & Guisan, 2009.*Divers. Distrib.)*
- Few required parameters

But not spatially explicit

→ Important to include spatial variation

Bryophytes, good models to study climate change

- Good wind disperser

Bryophytes, good models to study climate change

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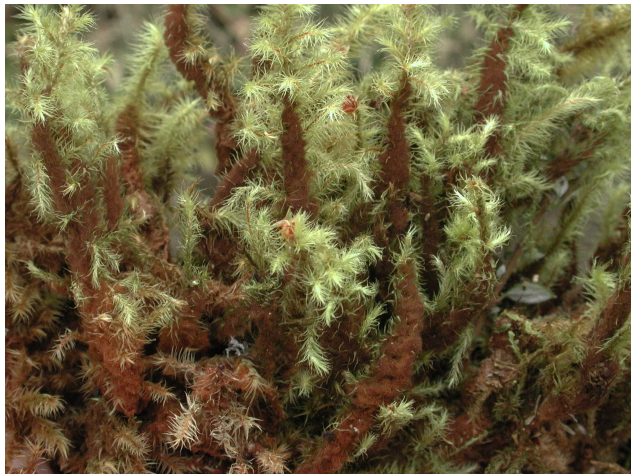
- Importance in the control of global carbon fluxes (Shaw *et al.*, 2019. Glob. Change Biol.)

Sphagnum affine; M. Luth, 2014; swissbryophytes 28686

Bryophytes, good models to study climate change

- Good wind disperser
- Importance in the control of global carbon fluxes (Shaw *et al.*, 2019. Glob. Change Biol.)
- No roots → only rely on atmospheric precipitations



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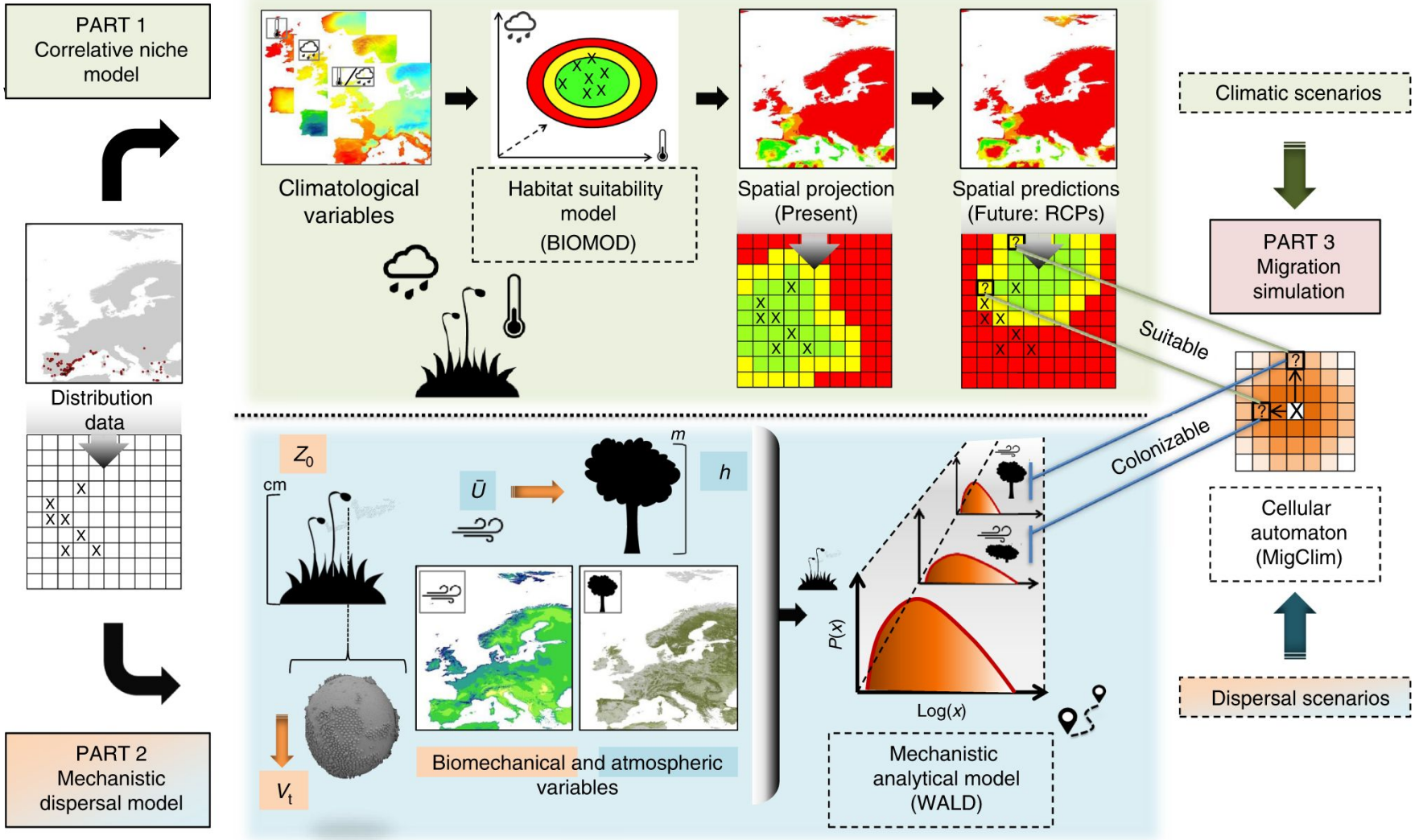
Highly sensitive to climate change

He *et al.*, 2016. *Persp. Plant Ecol. Evol. Syst.*

Objective

- Implement a hybrid statistical-mechanistic approach that accounts for temporal and spatial variation of both climatic conditions and wind connectivity for wind dispersal organism

→ Determine the extent to which highly efficient dispersers like bryophytes can mitigate the loss of suitable habitats through rapid colonization of newly suitable areas


PART 1
Correlative niche model
Climatological variables
Habitat suitability model (BIOMOD)
Spatial projection (Present)
Spatial predictions (Future: RCPs)
Climatic scenarios
PART 3
Migration simulation
Distribution data
Suitable
Colonizable
Cellular automaton (MigClim)
Dispersal scenarios
PART 2
Mechanistic dispersal model
Biomechanical and atmospheric variables
Mechanistic analytical model (WALD)
Log(x)
P(x)

Part 1: Correlative SDMs

- 4 different biomes
- 40 bryophyte species
- 5 bioclimatic variables at 1km resolution

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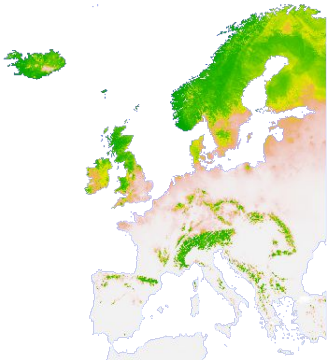
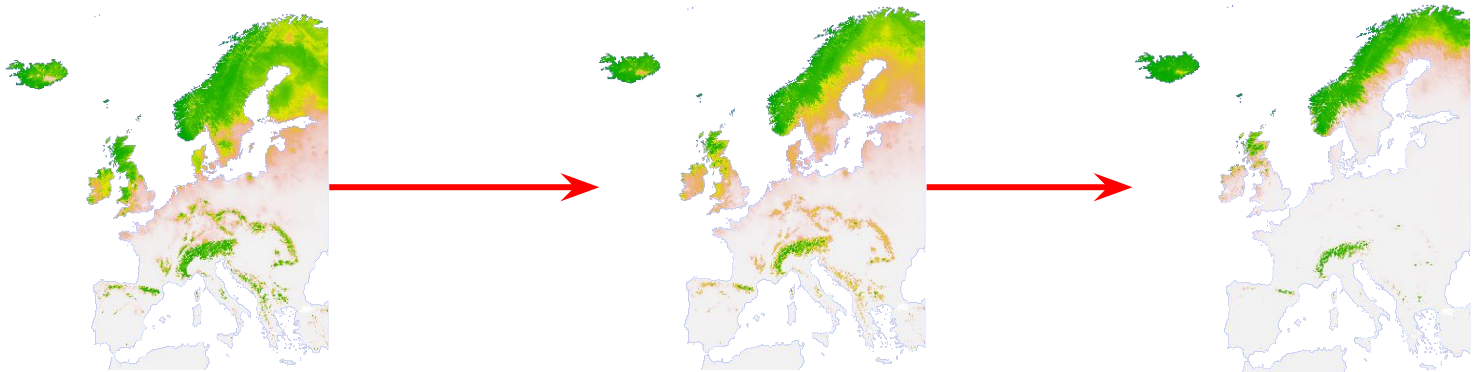


Present

Part 1: Correlative SDMs

- 4 different biomes
- 40 bryophyte species
- 5 bioclimatic variables at 1km resolution



Part 2: Dispersal kernels

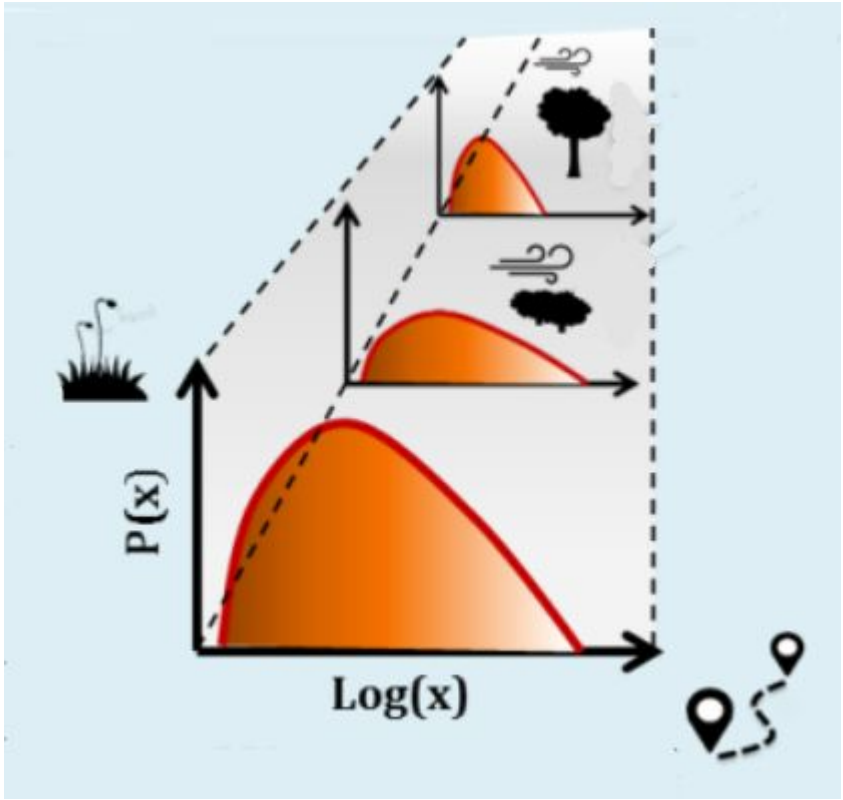
Settling velocity

Release height

Wind speed

Canopy height

Dispersal probability curves

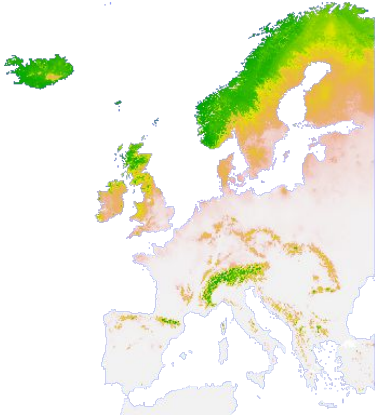


1 to 10 km

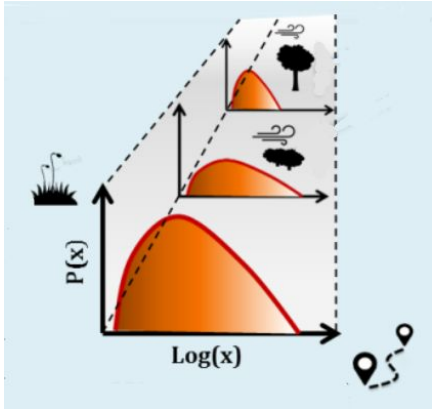
After 10km → long distance dispersal probability from phylogenetic evidence

Katul *et al.* 2005. *Am. Nat.*

Part 3: Simulation

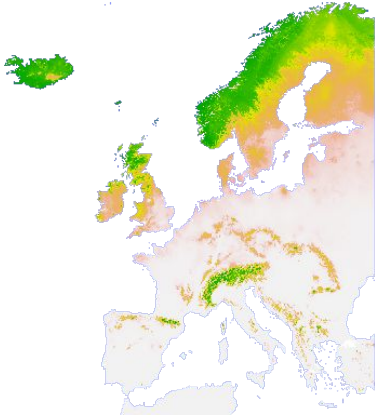


Binarized Maps

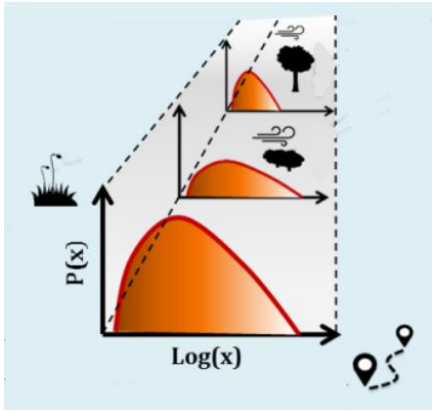


Dispersal kernels

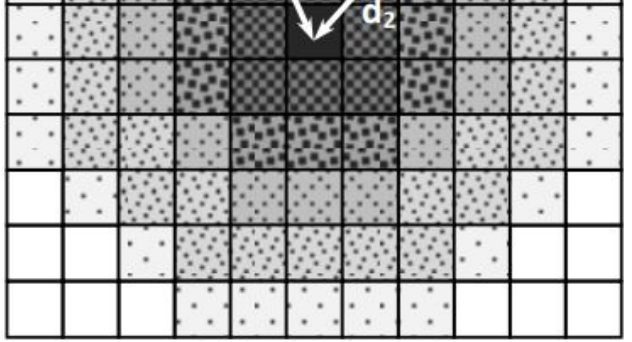
Part 3: Simulation



Binarized Maps

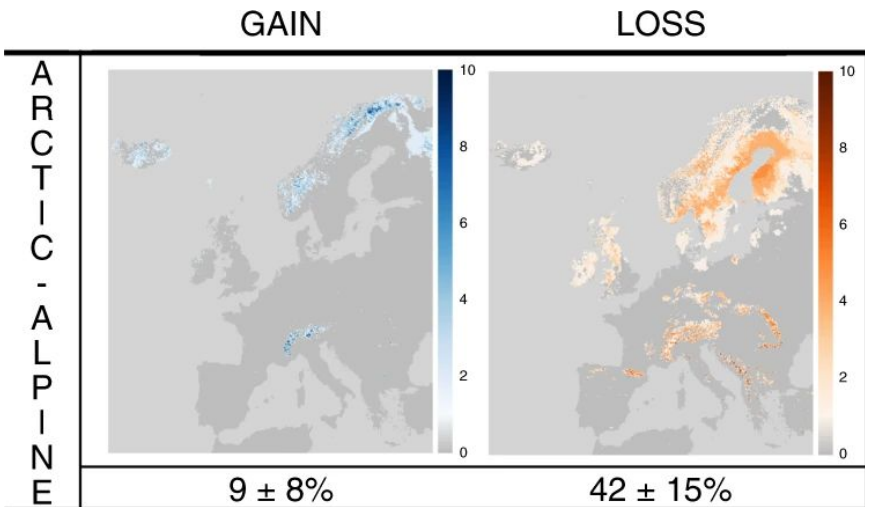


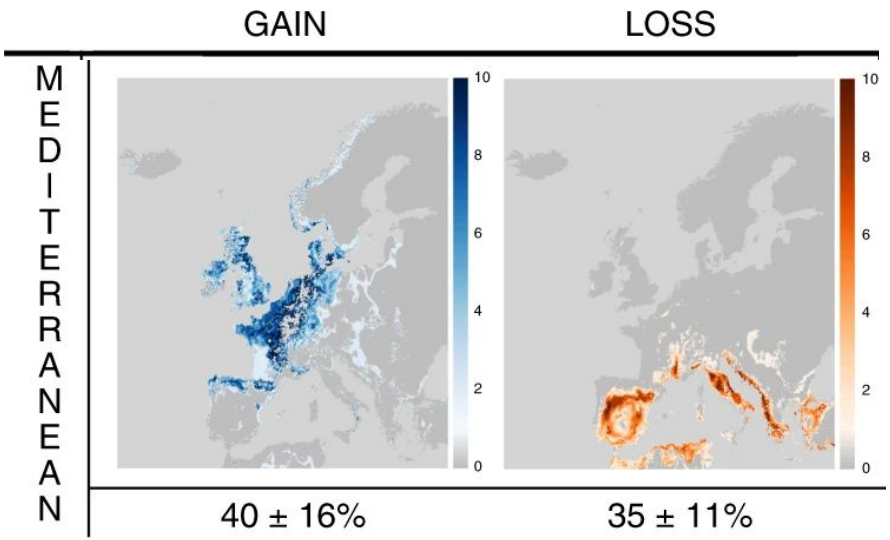
Dispersal kernels



MigClim simulator

Correlative SDMs





- Arctic-Alpine species are the most impacted by climate change
- Opposite situation for the mediterranean one

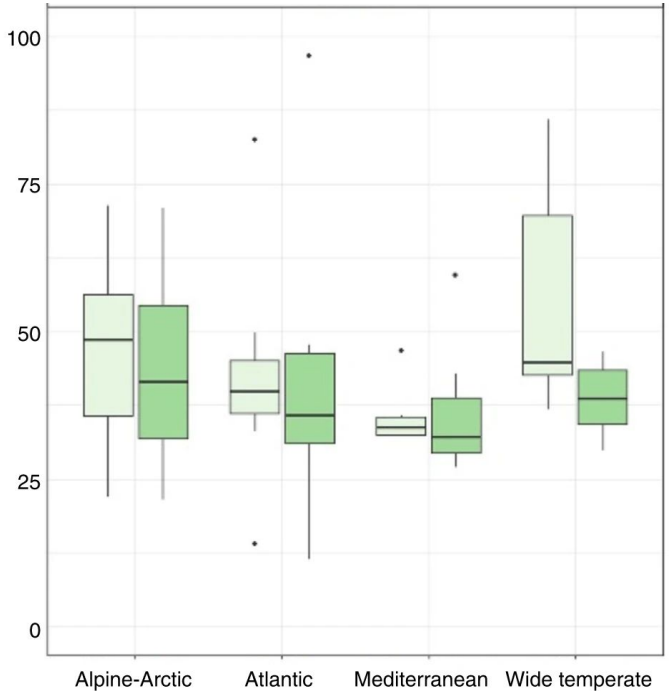
Needed time to fully colonized new suitable areas in 2050

	P(LDD) = 0	P(LDD) = 0.1
Failed after 500 yrs	98%	35%
Succeed in 2050	0	25%

Extinction is higher than colonization

Extinction rate

Colonization rate



Substantial range contraction for all studied species

P(LDD) = 0

P(LDD) = 0.1

Conclusion

- Important to incorporate dispersal in SDMs

- Bryophytes are not equipped to track the very fast rates of ongoing climate change for the course of the next decades.

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