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Integrating Species Connectivity Into Global Species Distribution Modeling To Improve Biodiversity Forecasts

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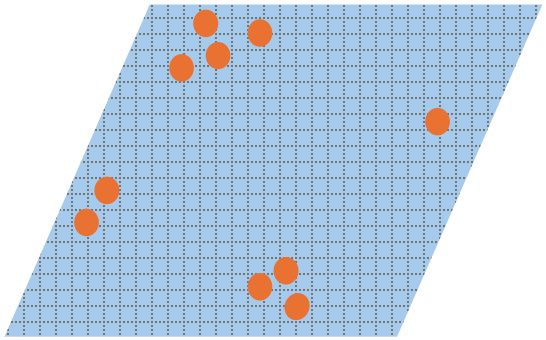
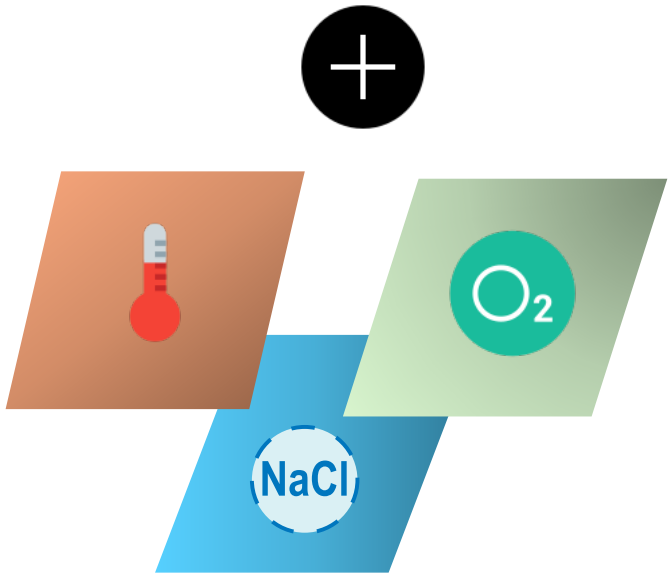
AquaMaps

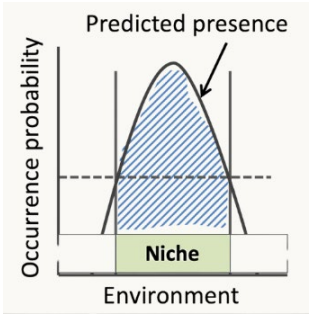
How do we predict species distribution ?

- Species occurence

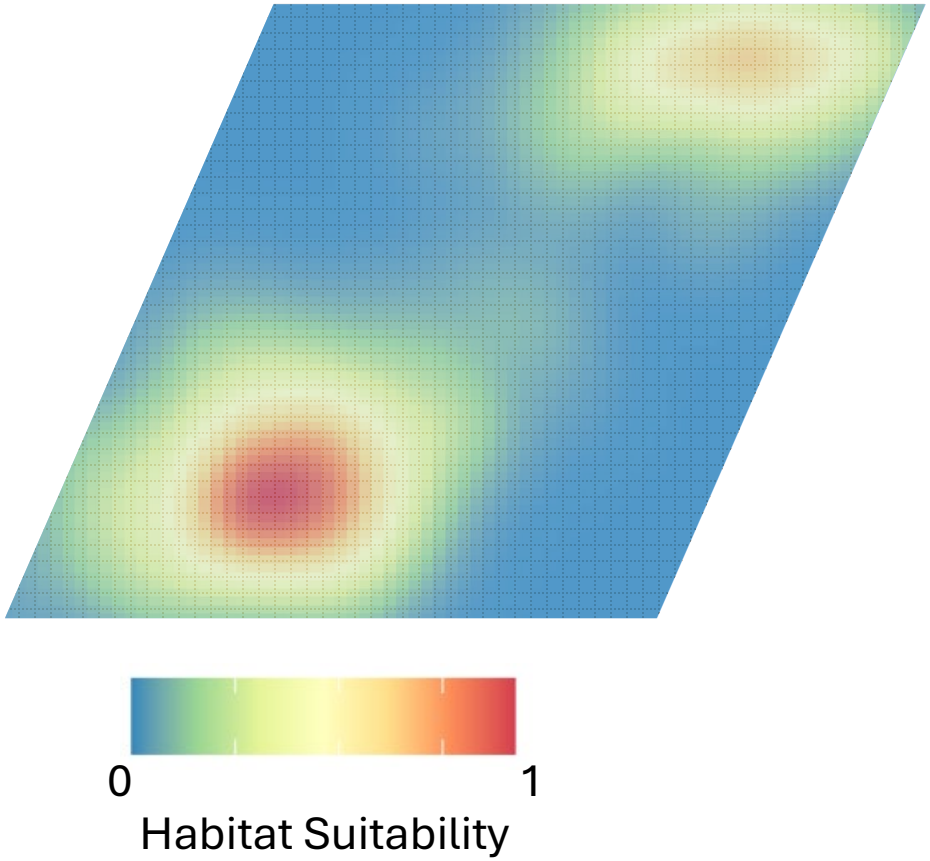




Environmental data



SDM



Climate change expectations

Climate change is expected to produce **strong poleward migration patterns** :

- Higher latitudes become future habitats
- Large scale redistribution of species by 2100

Reygondeau et al., in rev

What about connectivity ?

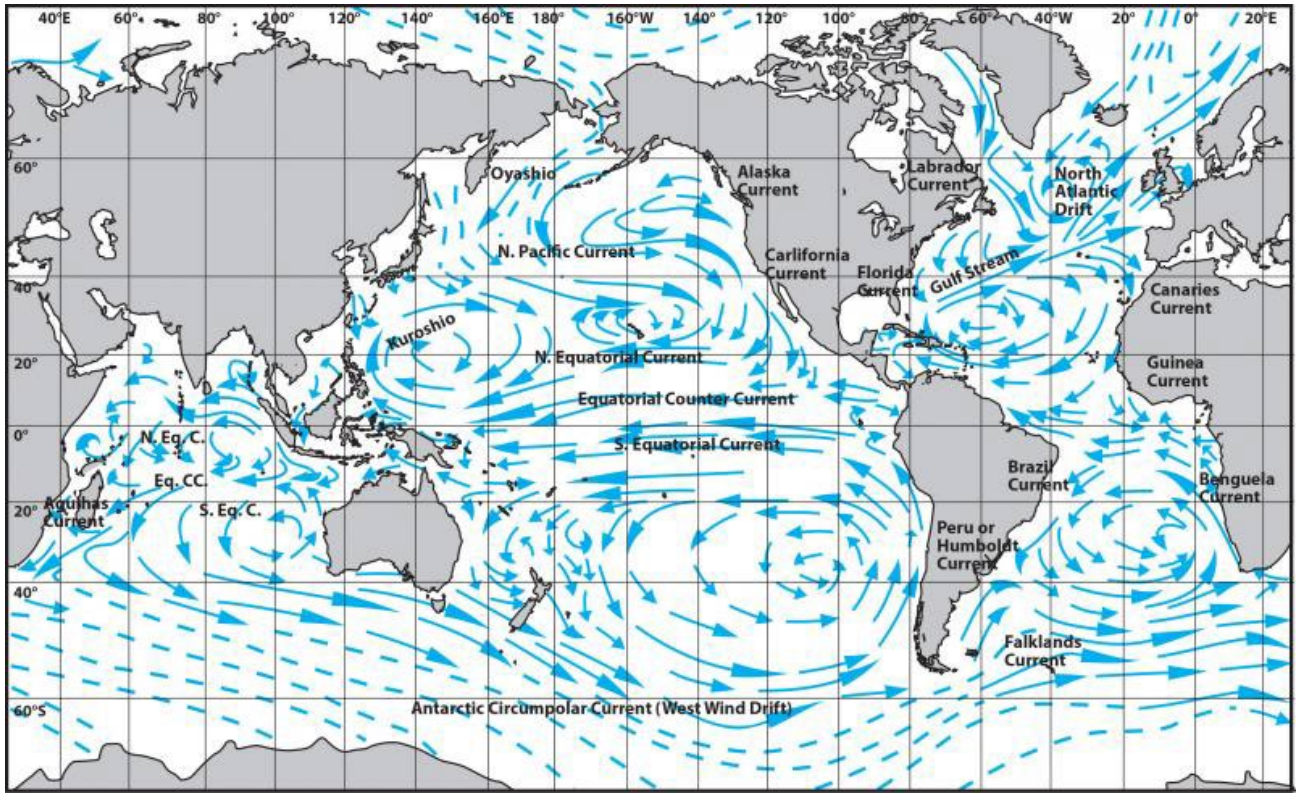
Even if new habitats become suitable, can species reach them ?

Marine species rely on ocean currents to disperse :

- Species movements
- Link between population
- How fast species can shift their range

CONNECTIVITY

Traditional SDMs do not include connectivity



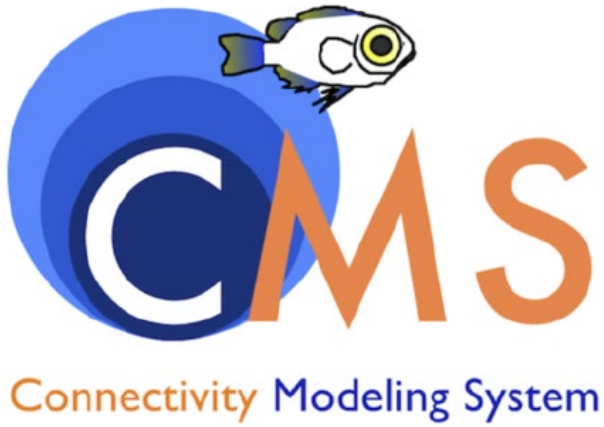
The Open University, Ocean Circulation, 2004

Approach

Ensemble SDM Framework

Global habitat suitability under multiple climatic scenarios and years

+

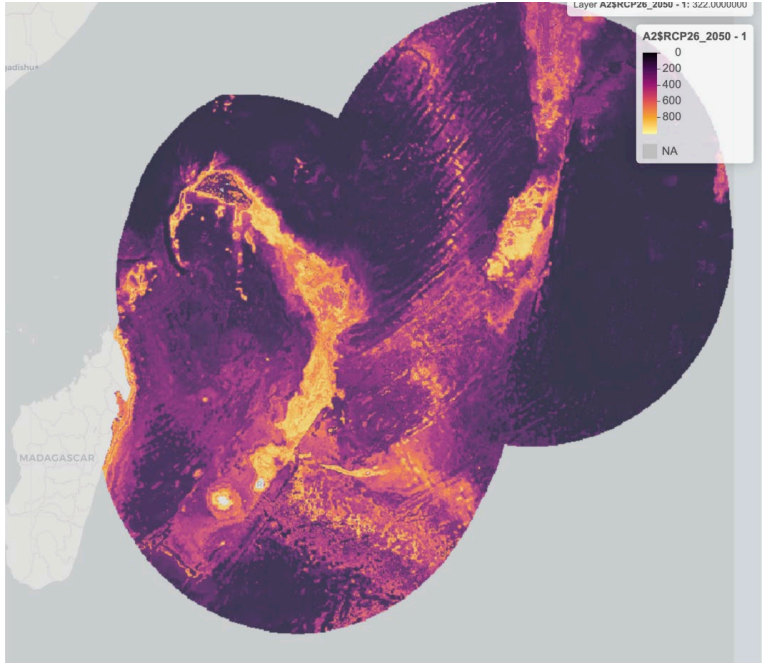


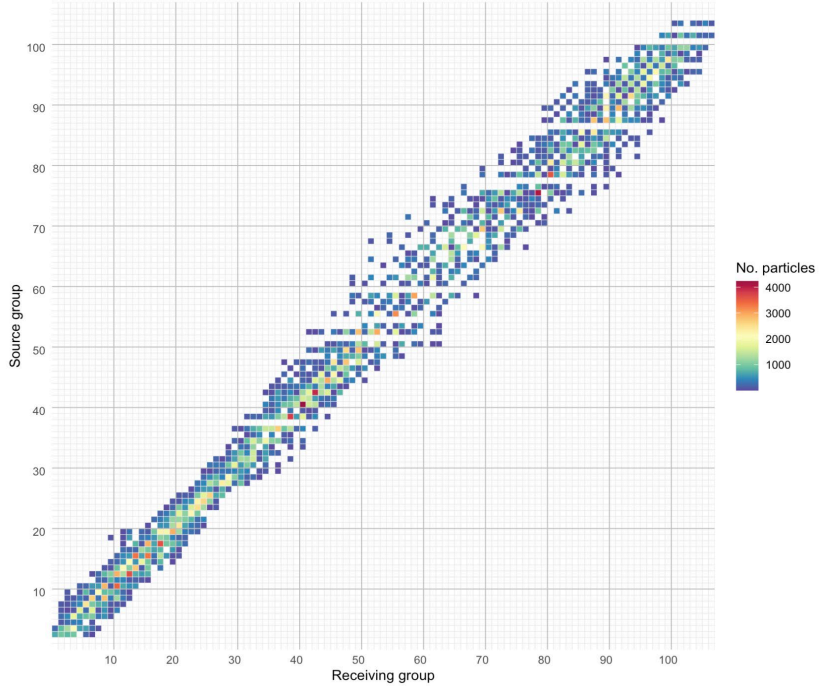
Multiscale stochastic Lagrangian framework

Particle tracking based on ocean currents

Habitats that are **SUITABLE** and **REACHABLE**

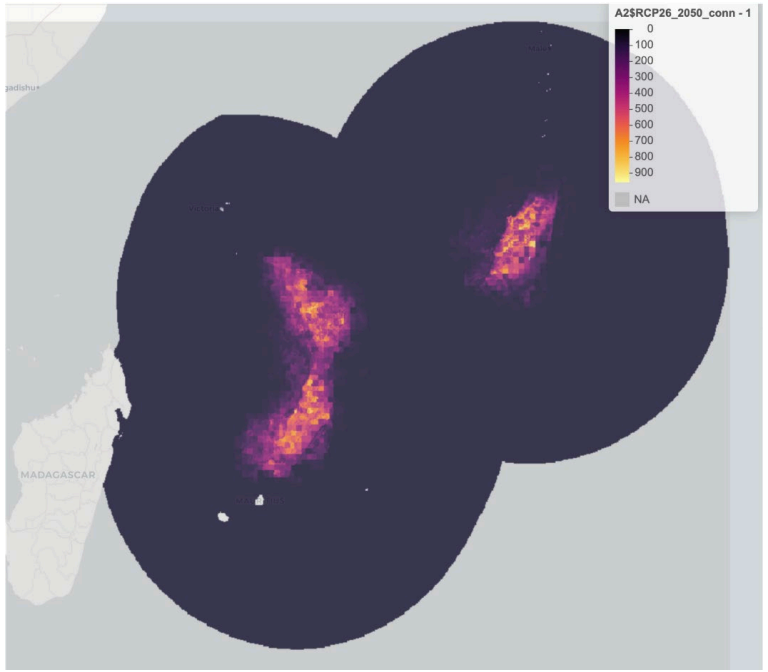
AquaX results :
Expected habitat suitability for 2050





CMS results :
Simulated dispersal over 50 years

Chagos brain coral



Updated habitat suitability :
Suitable and reachable habitats
Large reduction once connectivity is considered

Implications

Connectivity reshapes future expectations :

- Many predicted refuges may be unreachable
- Redistribution may be more limited than previously thought
- Need to update global forecasts with dispersal constraints

Reygondeau et al., in rev

Challenges

Scaling to global diversity :

- 32k marine species
- 5km global resolution

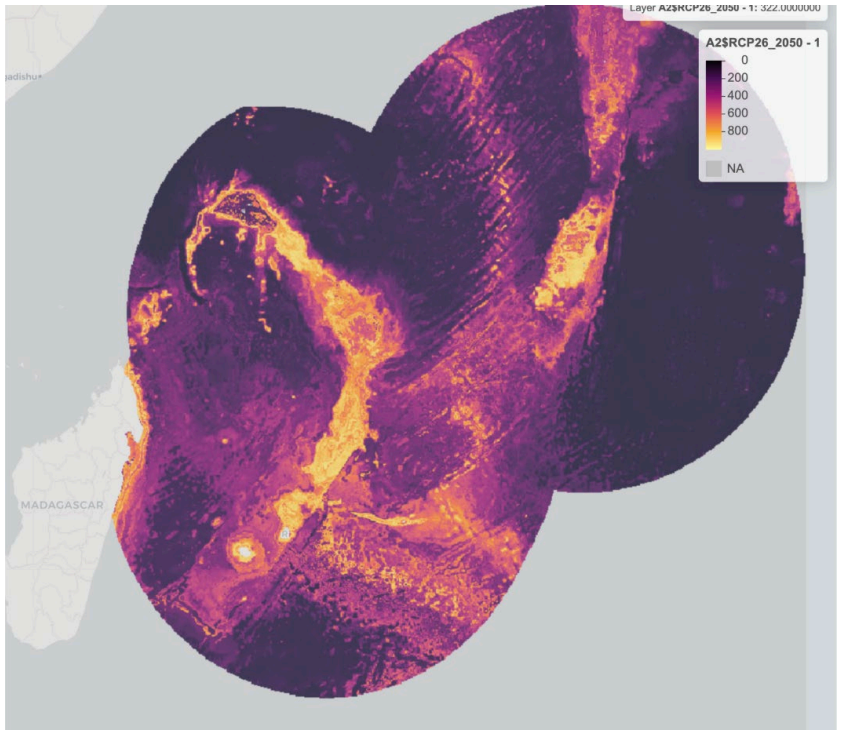
Goals :

- Parallelization and optimized workflow
- Minimize runtime
- Reproducibility

Egorova et al. (in prep.)

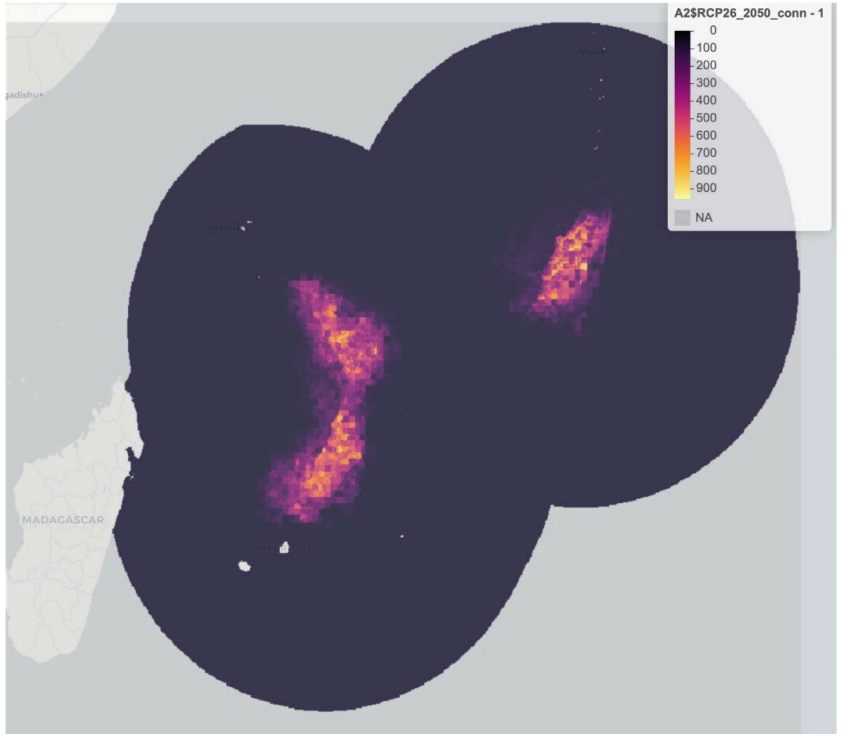
Expected outcomes

- More realistic global biodiversity projections
- Identification of habitats that species can really occupy and reach
- Useful insights for conservation and marine spatial planning
- From simple predictions to realistic scenarios



Current habitat suitability in 2050

SDM + connectivity



More **realistic** habitat suitability in 2050

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