Deriving patch topology in real-world settings from optimized resistance map using circuit theory and community differentiation

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Deriving patch topology in real-world settings from optimized resistance map using circuit theory and community differentiation

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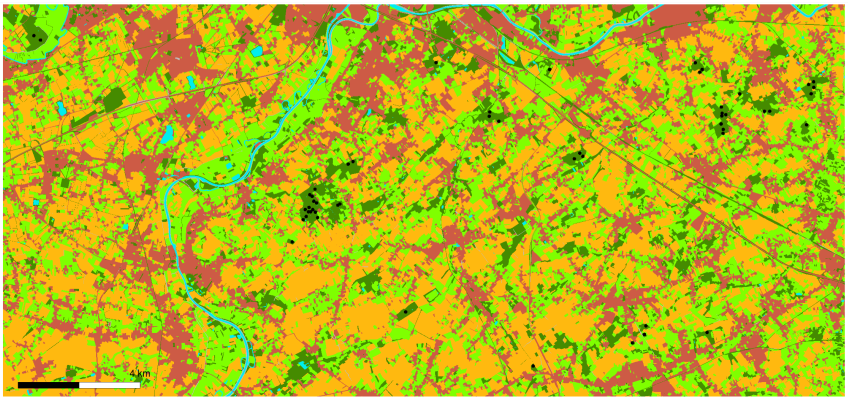
Motivation: how to derive patch connectivity from a real landscape?

Patch connectivity

Real landscape



- Metacommunity theory and models make predictions on the impact of patch **spatial structure** on community dynamic but also on **ecosystem functioning**, for instance highly connected network of patches should provide more stability against environmental forcing for the metacommunity
- A crucial element for these models is the **connectivity matrix** between habitat patches capturing the spatial structure and **species fluxes**, yet deriving such connectivity matrix from realized landscape is a challenge
- This poster present the development of an approach to derive connectivity matrices based on **landscape resistance** to species movement. The key aspect being that **landscape structure** between pairs of patches affect **community divergences**, pairs of communities connected via dispersal highways should have little divergence.

How?

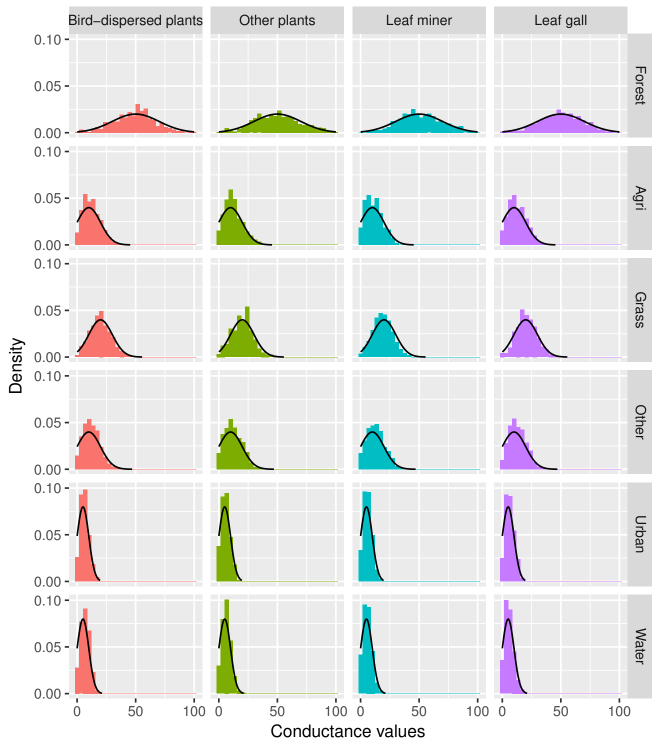
- The first step is to identify the relevant land-use classes, the parameter to estimate are the resistance values associated to each landscape class
- Landscape resistance between pairs of patches is estimated using the function commuteDistance in the **gdistance** package
- The landscape resistance is then compared to the observed pairwise community differentiation
- The optimization is done via an differential evolution MCMC algorithm implemented in the **BayesianTools** package

Testing the method

Four communities (understory plant dispersed by birds, understory plants not dispersed by birds, leaf-miner and leaf-gall) were used within monoculture of pedonculate oak of the **TREEWEB** research platform

Results

Posterior and prior densities
for the conductance of the different land−use classes



Correlation predicted and observed community divergence:

Community	Bird-dispersed plants	Other plants	Leafminer	Leafgall
Correlation	0.06	-0.51	0.02	0.05

Conclusion: So far the approach does not seem to work, maybe due to the specific landscape structure (no differentiation between patches) or to the little landscape signal present in the community used.

Next steps and take-home message

- Trying the approach for different datasets, potentially with different scales, also testing different diversity differentiation measures
- Explore ways to make the code faster (currently 40sec per iterations), explore historical legacies effect
- Our approach allow quantification of connectivity between habitat patches for communities under similar dispersal conditions and with no or little differences in environmental forcing effects

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