Spatial analysis of ecological networks (2 years post-doc in Lyon/Grenoble)

Objectives:

The study of species interactions, modelled by 'networks', is crucial to understand the functioning of ecological communities and their resilience to global changes. Nowadays, the ever-increasing availability of multiple ecological networks sampled at different spatial locations (see Kortsch et al) allows for studying species interactions at large spatial scales. New questions arise on the variability and plasticity of species interactions in space. This variability is necessarily driven by species turnover that induce changes in network composition (i.e. species/nodes identity can change between different locations) but not always in network structure. In other words, if we are able to characterize the internal structure (or the "shape") of the ecological networks, it could be possible to compare this structure along spatial gradients putting aside species identity. For instance, two networks with different species can have a similar shape because they share common ecological compartments (e.g. in food webs, see Ohlmann et al).

The postdoc project aims at developing a new mathematical framework to study the spatial process driving the variations of network structure. It will rely on two intertwined objectives. The first one consists in proposing the most appropriate way to characterize/measure and compare network structure (that is, converting the network data into quantitative therefore comparable information). Different approaches could be considered, including (but not only):

- machine learning-based techniques, such as nodes/network embedding techniques (see Hamilton et al)
- statistics-based frameworks, such as network models (see Kéfi et al) or network statistics (e.g. beta-diversity, see Ohlmann et al).

The second objective consists in modelling the spatial process that drives changes observed in the light of the aformentionned structure measure. This process will ultimately integrate spatial information (coordinates, ecological barriers,...) and environmental variables (e.g. climate or landscape configuration). In the end, the implemented framework will allow for mapping the biogeography of the internal structure of networks.

Several available datasets could be used to evaluate and calibrate the methods developed during the project.

Prerequisites:

PhD in ecology or machine learning or statistics or network science, with a strong interest for at list a second element in this list.
Proficiency in at least one programming language (Python, R and/or C++).
Motivation to work in an interdisciplinary team.

Work environment:

The candidate will benefit from an interdisciplinary team of co-advisors, including Stéphane Dray and Vincent Miele (LBBE, campus de la Doua, Lyon), Catherine Matias (LPSM, Paris) and Wilfried Thuiller (LECA, Univ. Grenoble Alpes).
The candidate will be located in Lyon (LBBE, campus de la Doua, Lyon) or in Grenoble (LECA, Univ. Grenoble Alpes), depending on his/her preference. Travels to Lyon/Grenoble/Paris have to be expected.
This 2-year position is funded by the French National Research Agency (ANR) as part of the project "EcoNet: Advanced statistical modelling of ecological networks".

Salary:

Around 25-26,000€/year net depending on the experience.

How to apply:

The expected starting date of this 2-year position is from September 2019 to January 2020.
Send your CV, a cover letter, and 2 contact references by email to Stéphane Dray and Vincent Miele (*stephane.dray@univ-lyon1.fr*/*vincent.miele@univ-lyon1.fr*), Wilfried Thuiller (*wilfried.thuiller@univ-grenoble-alpes.fr*) and Catherine Matias (*catherine.matias@math.cnrs.fr*). Informal inquiries by emails are welcome,

References:

Kortsch et al, *Food-web structure varies along environmental gradients in a high-latitude marine ecosystem*, Ecography 42 (2), 295-308 (2018)
Hamilton et al, *Representation learning on graphs: Methods and applications*, arXiv preprint arXiv:1709.05584 (2017)
Ohlmann et al, *Diversity indices for ecological networks: a unifying framework using Hill numbers*, Ecology Letters 22, 737-747 (2019)
Kéfi et al, *How structured is the entangled bank? The surprisingly simple organization of multiplex ecological networks leads to increased persistence and resilience*, PLoS biology 14-8 (2016)