

## What are the important spatial scales in an ecosystem?

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### Abstract

Spatial heterogeneity of ecological structures comes either from the physical forcing of environmental variables or from community processes. In both cases, spatial structuring plays a functional role in ecosystems. Ecological models should explicitly take into account the spatial organization of ecosystems.

A canonical (regression-type) modeling method has been developed, which allows the decomposition of the variance of multivariate (e.g., species abundance) data table into four components: (a) a non-spatially-structured component explained by the environmental variables in the model, (b) a spatially-structured component of environmental variation, (c) a spatially structured fraction which is not explained by the environmental variables and possibly results from community dynamics, and (d) a residual fraction. The first three components can be mapped separately, providing new insights into community dynamics.

In previous work, we used a polynomial function of the geographic coordinates of the sampling sites to represent broad-scale spatial variation. We found a way of representing spatial structures at all scales in these analyses. This is obtained by eigenvalue decomposition of a truncated distance matrix among sampling sites. The behavior of this method has been investigated using numerical simulations and real data sets. When sampling occurred along a transect or a regular grid, this modeling method allows the estimation of the variance associated with each spatial scale in the observation window. A graph of the resulting F statistic against scales is called a Scalogram. It indicates the

significant spatial scales present in the multivariate data under study  
— for example, a community composition data table.

### References

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