Direct multiscale ordination

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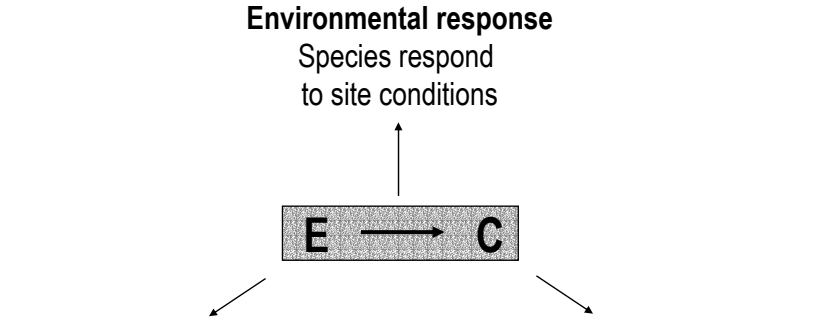
Overview

- Spatial effects in gradient analysis
- Direct multiscale ordination
- Application to oribatid mite data

Photo: Ray Norton (http://www.fcps.k12.va.us)

Gradient analysis



Non-spatial data analysis

Data matrix

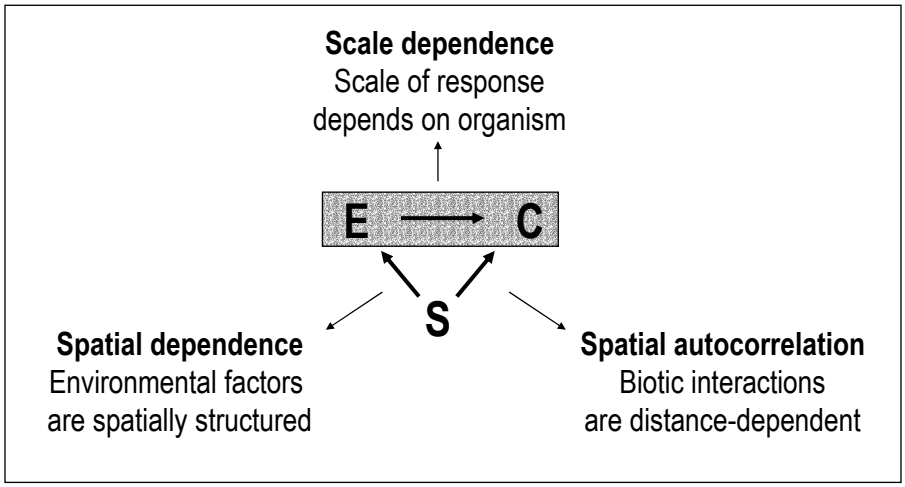
	Sp1	Sp2	Sp3
A1	1		
A2		1	1
A3	1		
A4	1	1	
B1	1	1	
B2			1
B3		1	1
B4	1		1

Variance-covariance matrix, resemblance matrix

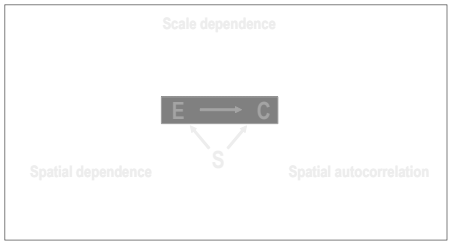
	Sp1	Sp2	Sp3
Sp1	0.27	-0.07	-0.21
Sp2	-0.07	0.29	0.00
Sp3	-0.21	0.00	0.29

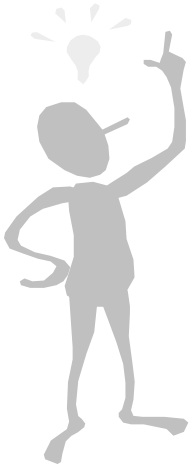
Correlation, ordination, etc.

Gradient analysis in a spatial paradigm



In short ...



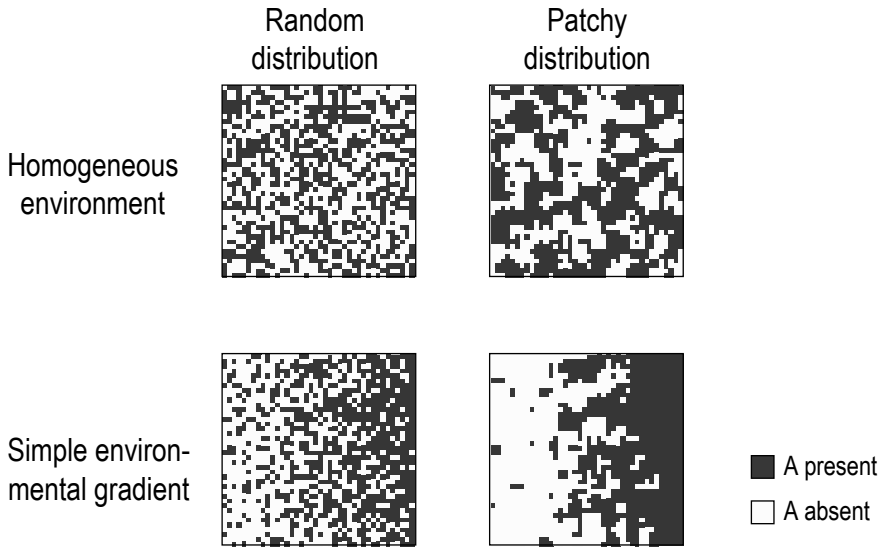


Three causes of spatial structure:

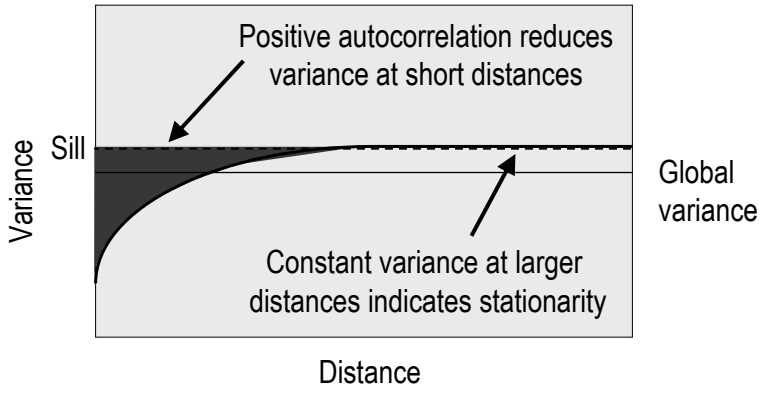
- How to distinguish between them?
- How to account for them?

→ Direct multiscale ordination

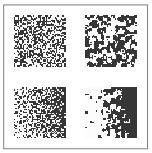
Simulated species distribution

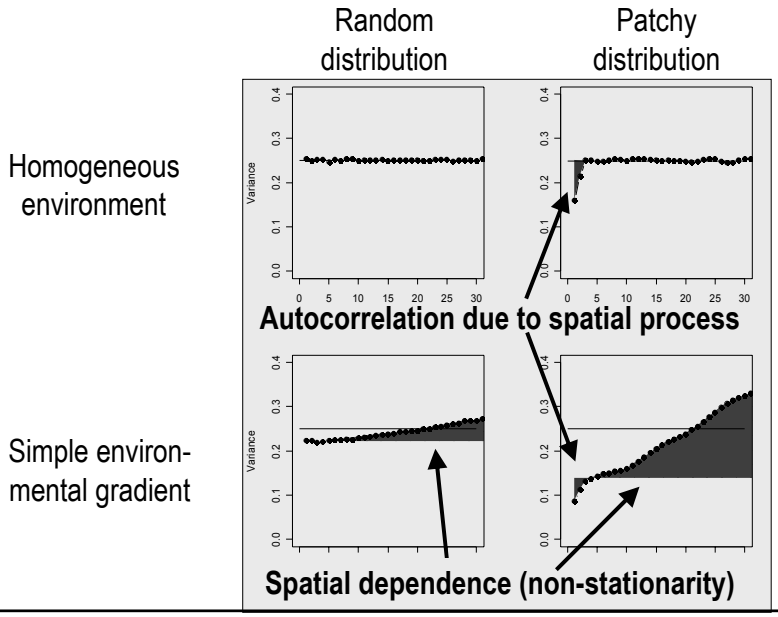


Variogram interpretation

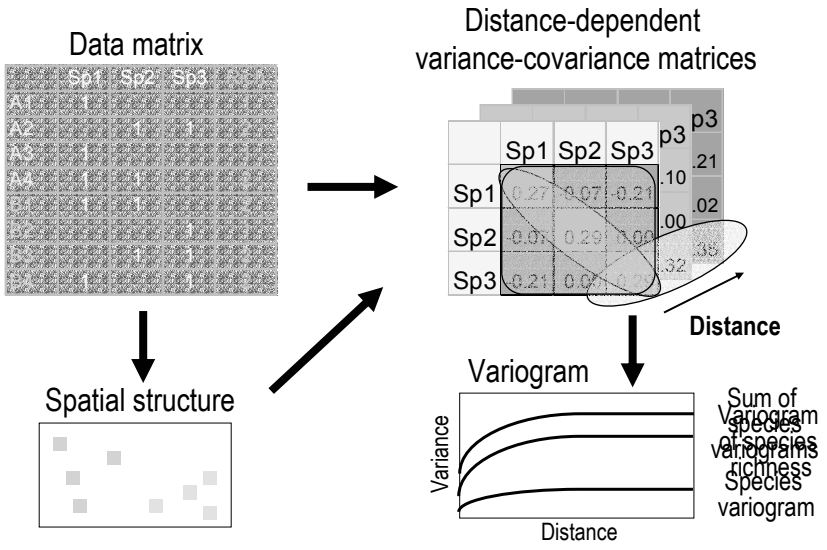


Variograms of simulated species

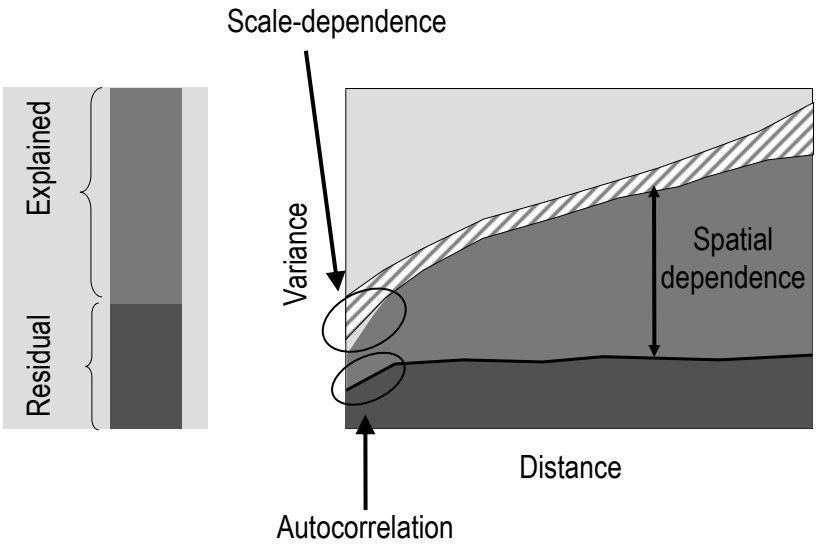




Spatial partitioning



Direct multiscale ordination



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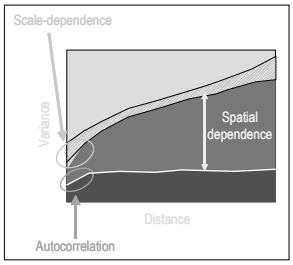
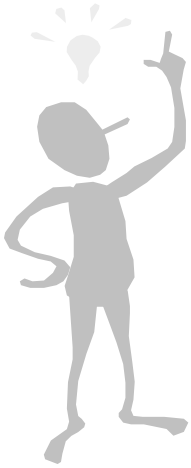




Direct multiscale ordination provides:

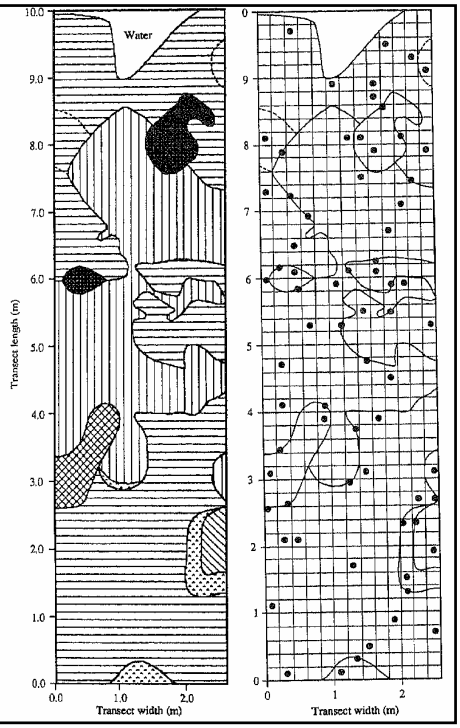
- A simple test for residual autocorrelation
- A simple test for a mismatch of the scales of observation and response
- Separation of spatial dependence, spatial autocorrelation, and scale dependence

→ Application to Oribatid mite data

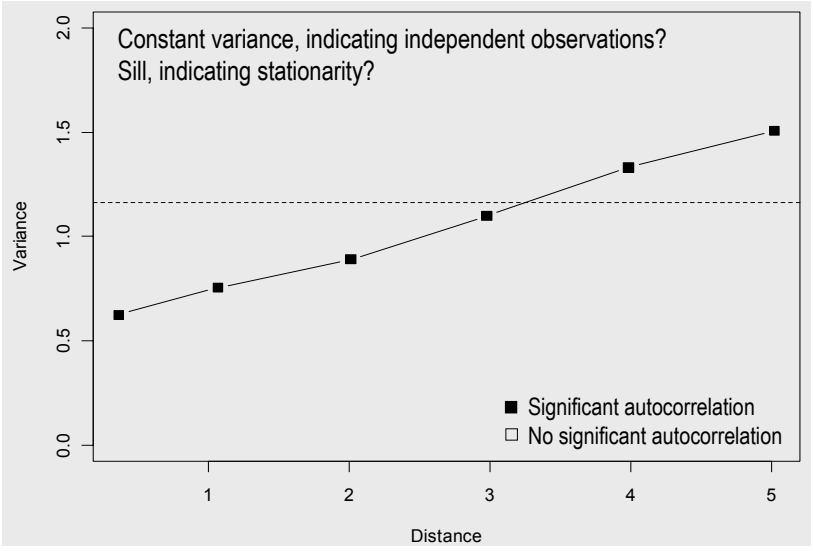
Oribatid mite data

(Borcard et al. 1992, Borcard & Legendre 1994)

- Grain: 0.2 m grid
- Extent: 10 m x 2.6 m
- Samples: 70 cores
- Response:
  - 35 mite species
- Predictors:
  - Substratum (7),
  - shrub cover (3),
  - microtopography (2),
  - substratum density,
  - water content



Original data (CA)



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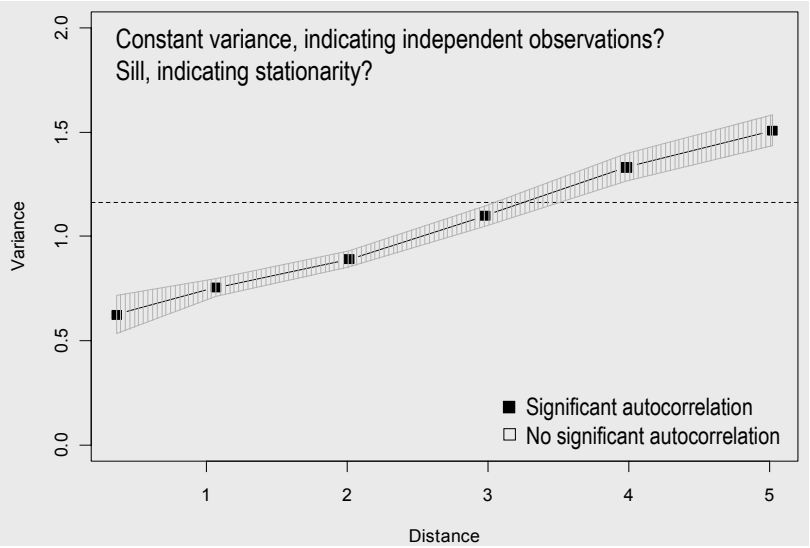
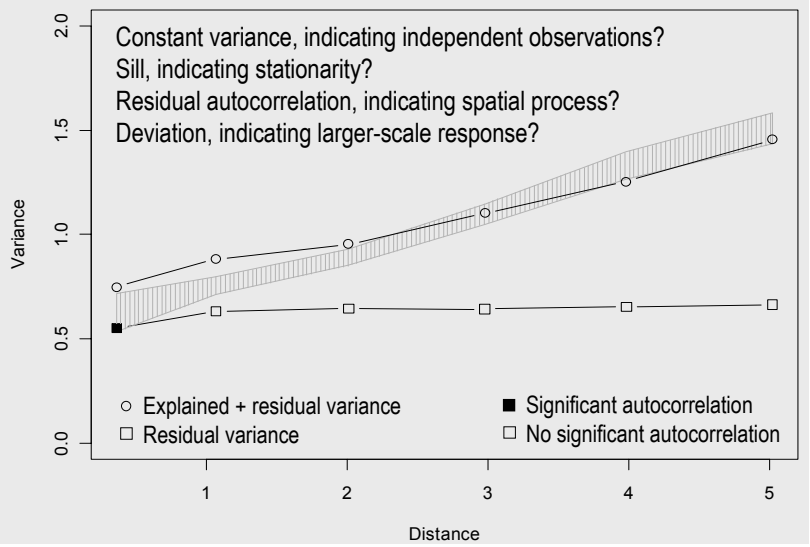
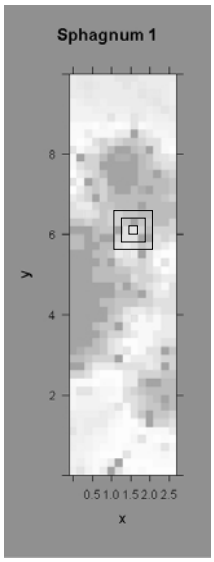


Accounting for environment (CCA)



Aggregation of environmental data



For each predictor variable:

- Linear interpolation
- Mean within windows:

1 cell (original data)

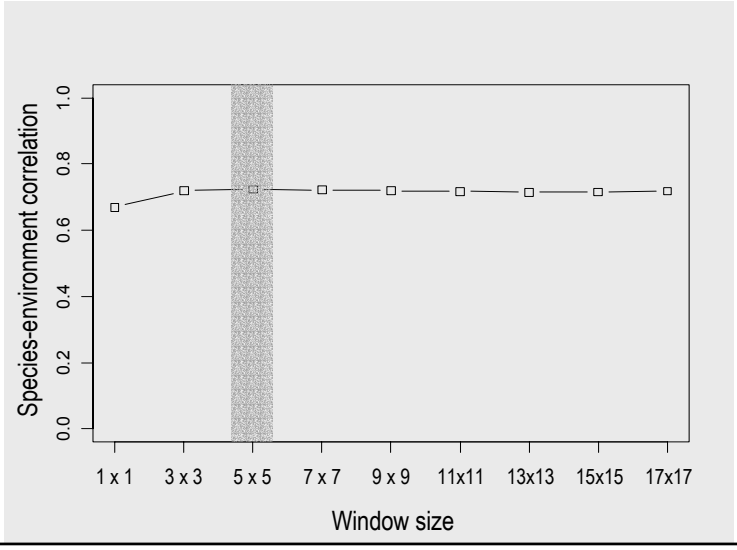
3 x 3 cells

5 x 5 cells

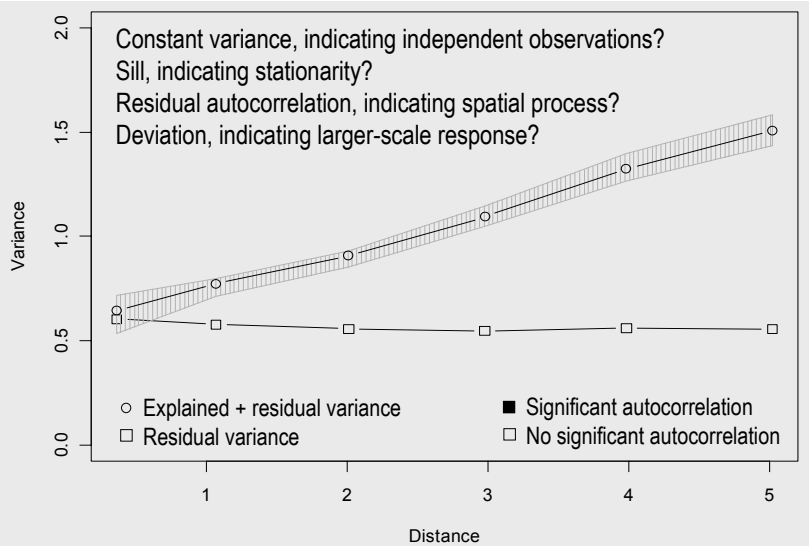
…

17 x 17 cells

Identifying scale of response



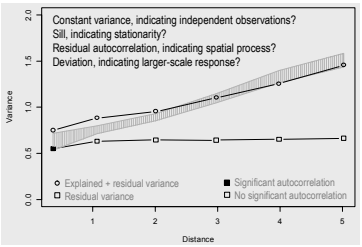
Accounting for larger-scale response



Model comparison

	Local response model	Larger-scale response model
Scale of response	1 cell (0.2 m)	5 x 5 cells (1 m)
Rsquare	0.45	0.52
Residual autocorrelation	< 1 m	none

In short ...



- Natural communities are likely to contain spatial structure due to several processes
- The components of spatial structure cannot be estimated independently
- Failing to account for one component is likely to lead to wrong conclusions

→ Direct ordination requires residual analysis, as provided by MSO.

More details?

Spatial partitioning of variance:
Wagner (2003), Ecology 84: 1045-1057.

Direct multiscale ordination (incl. R library):
Wagner (2004), Ecology 85: 342-351.

Multiscale response:
Wagner et al. (submitted), Journal of Animal Ecology.

Generalized multiscale ordination (incl. R library):
Couteron and Ollier (2005), Ecology 86: 828-834.

Spatial analysis of landscapes:
Wagner and Fortin (2005), Ecology 86: 1975-1987.

Acknowledgments

VIP

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