Spatial data aspects: examples in biological data

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ELEFTHERIOS (LEFTERIS) ZORMPAS

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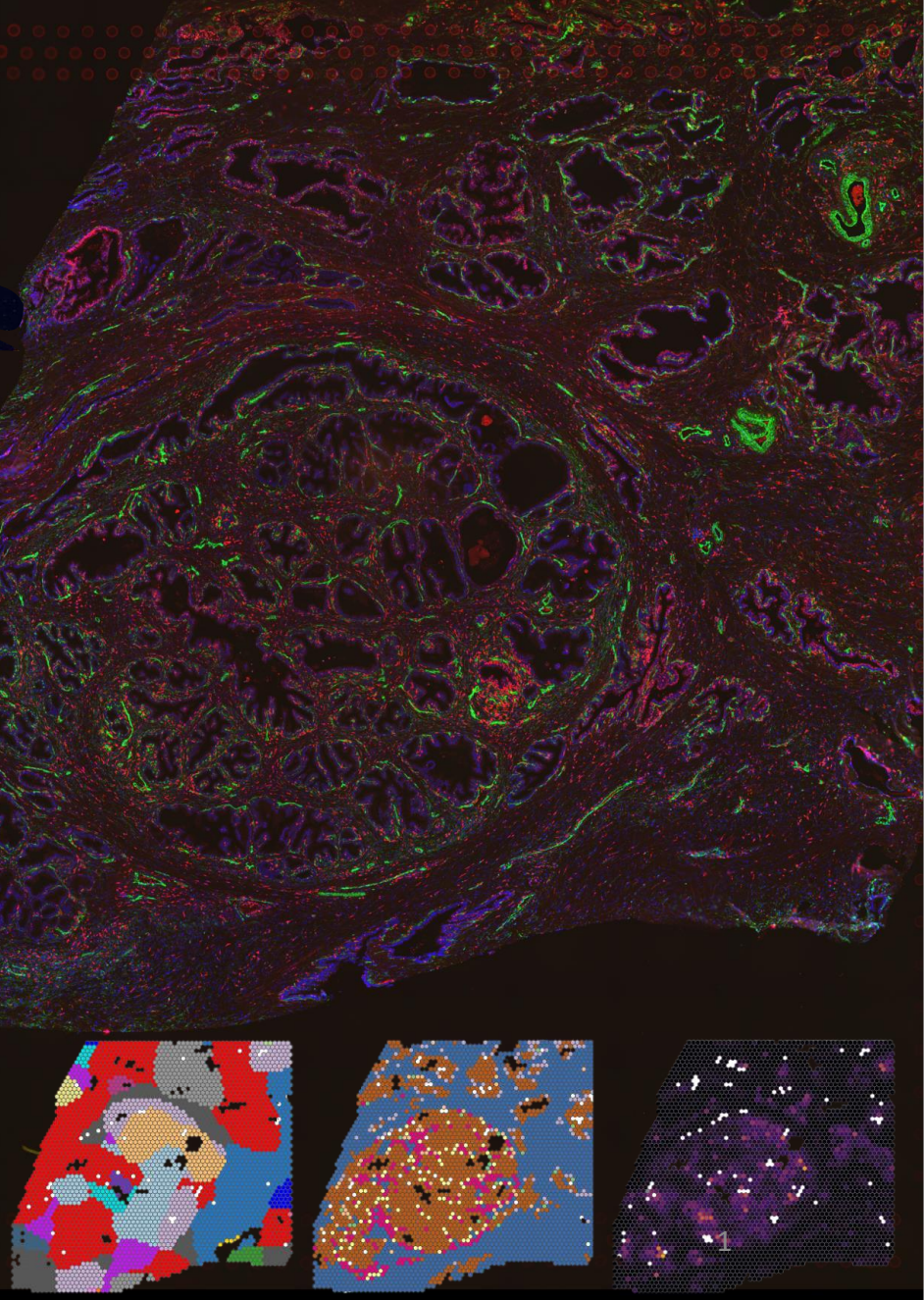
23/07/2023



GOAL AND IMPORTANCE

USE GEOCOMPUTATIONAL TOOLS AND METHODS FOR THE ANALYSIS OF SPATIALLY ORIENTED DATA

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- Modifiable Areal Unit Problem (MAUP)
- Spatial Autocorrelation (SA)
- Spatial Heterogeneity (SH)

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You should select the appropriate scale for data analysis.

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Your observations are NOT independent of each other.

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Model system: Spatial Transcriptomics (STx), 10x Visium

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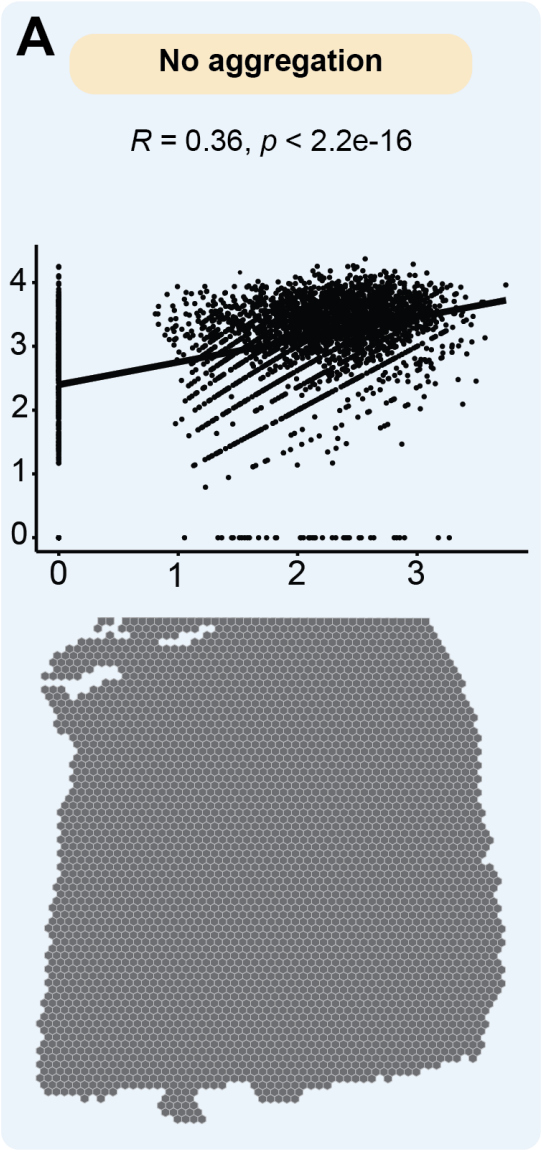

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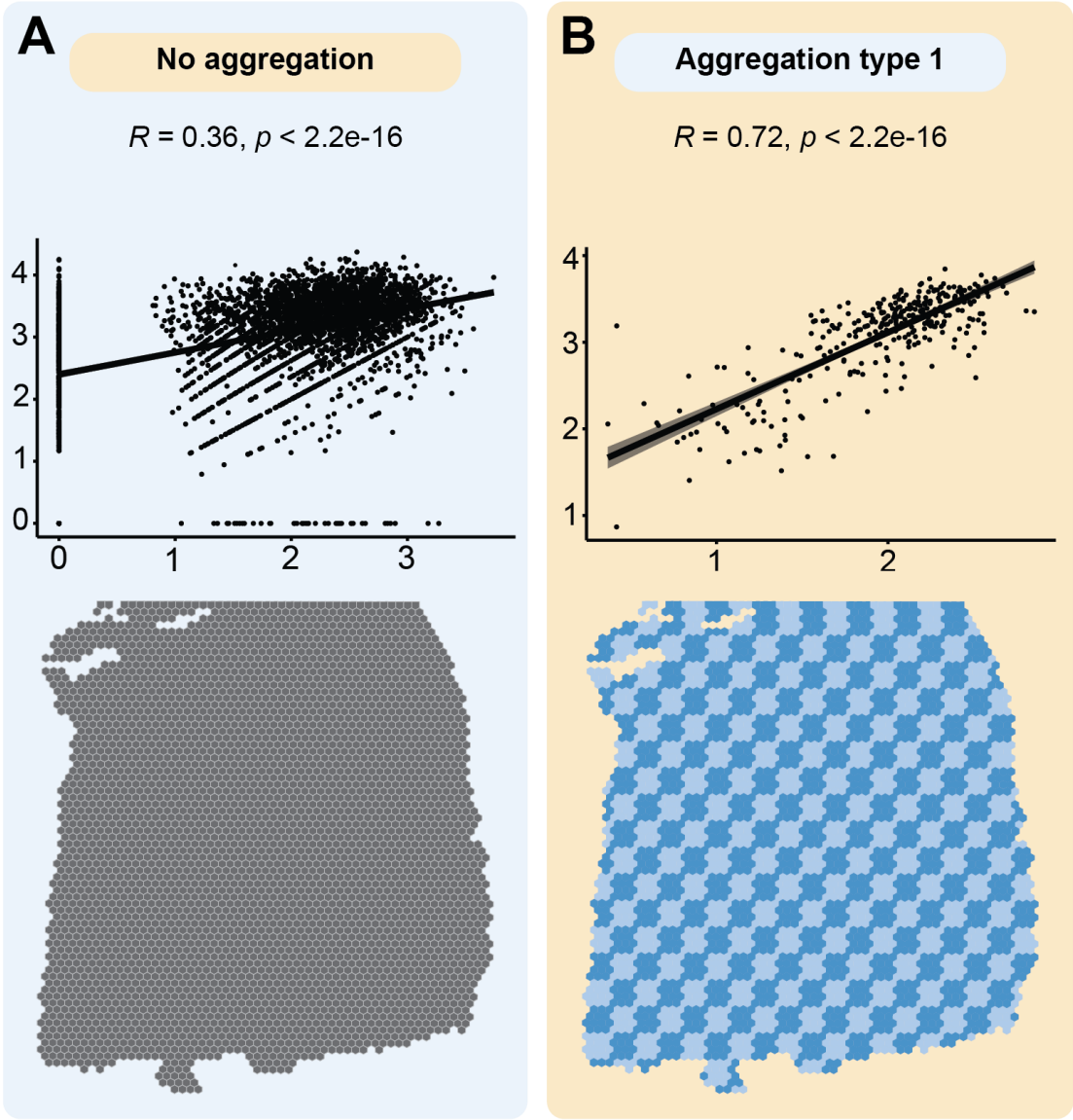

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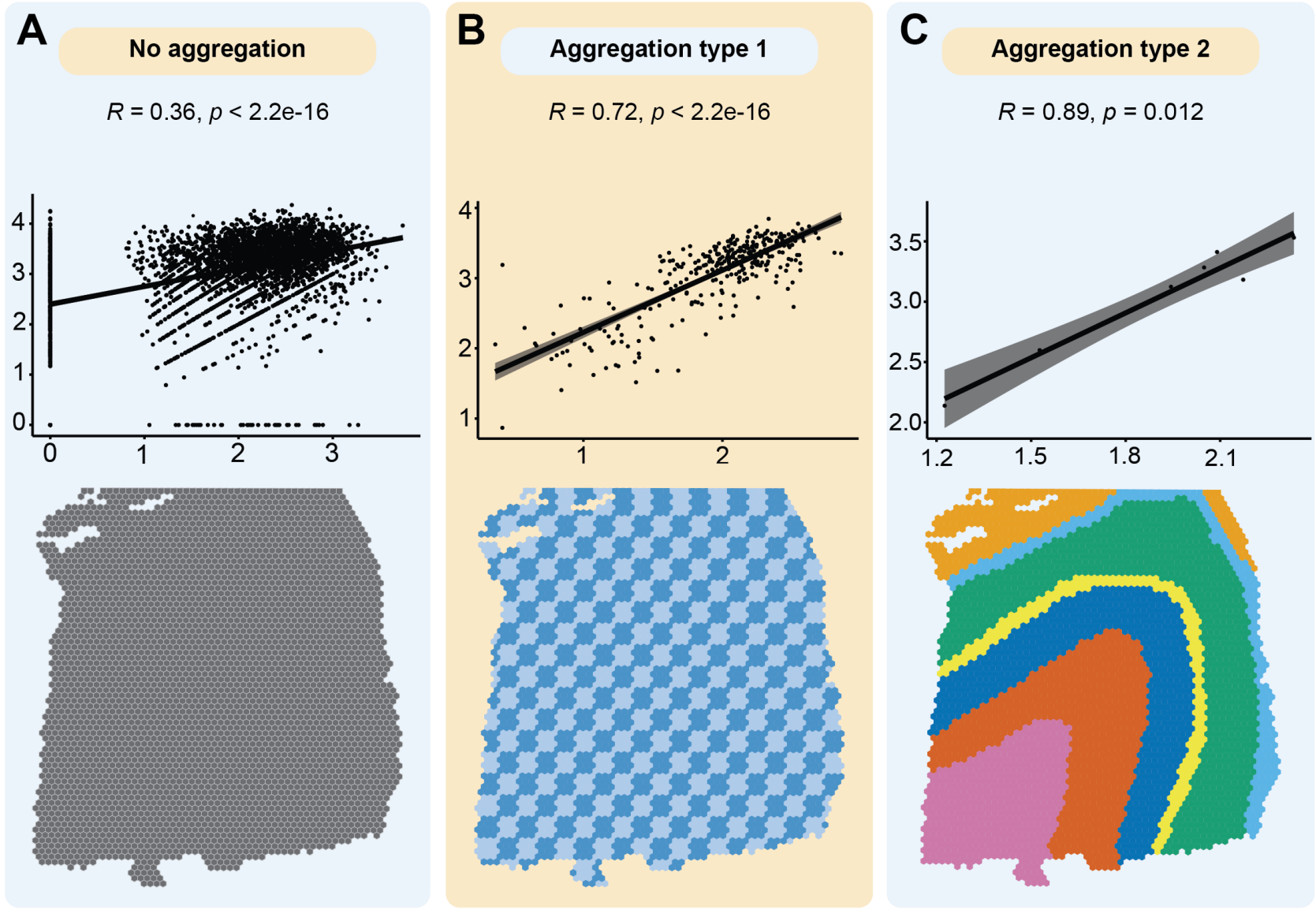

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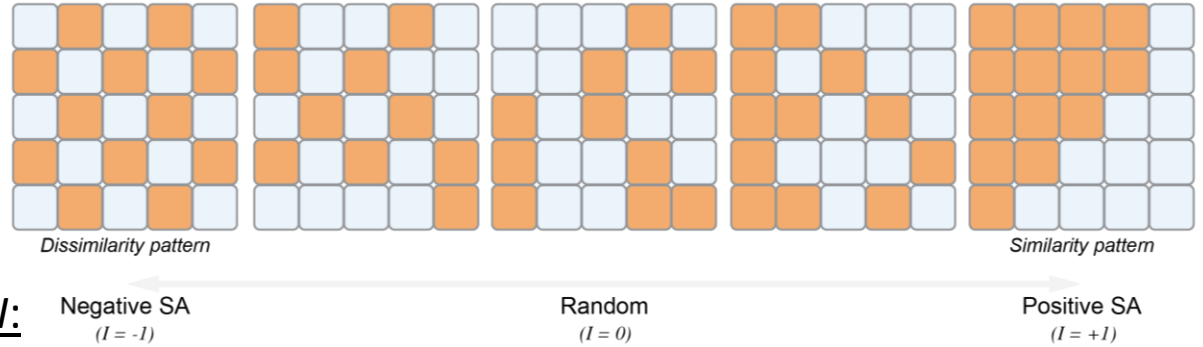

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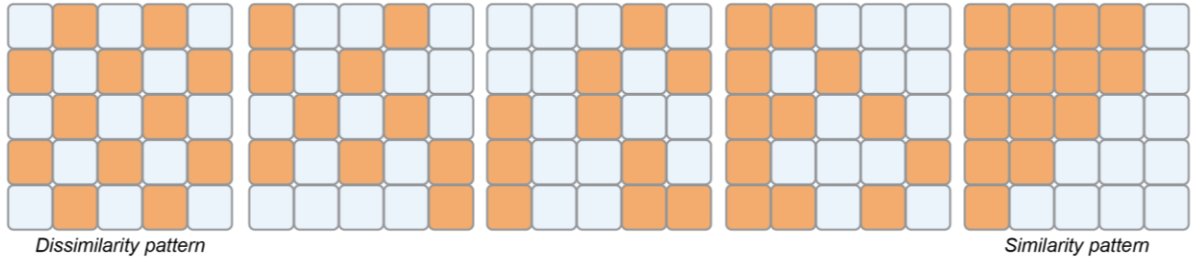
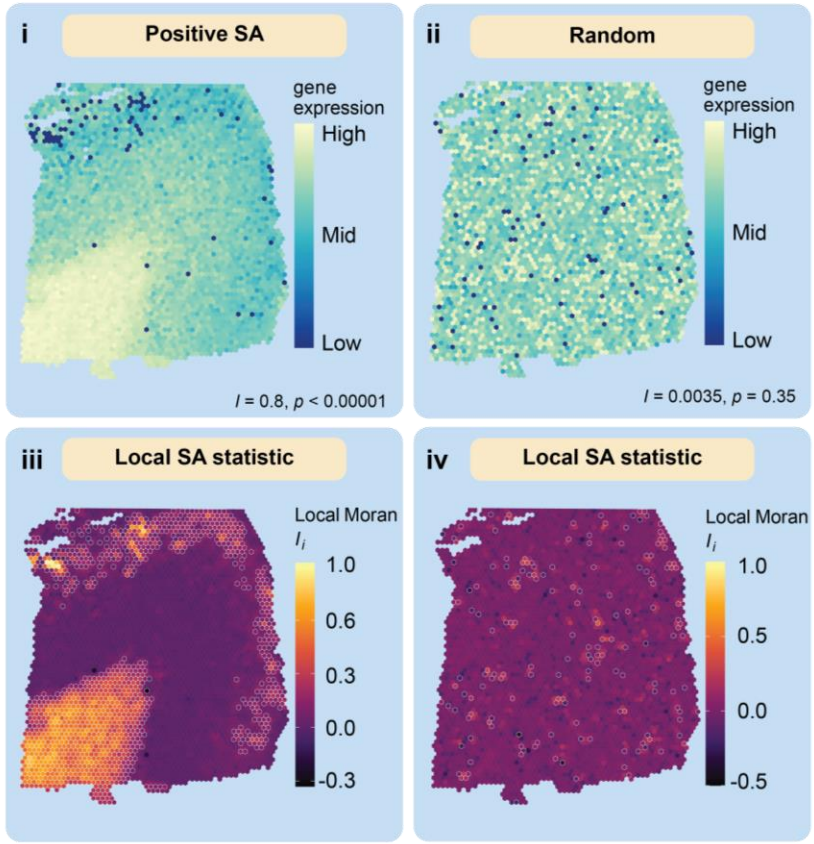


Moran's *I*:

Negative SA (*I* = -1) — Random (*I* = 0) — Positive SA (*I* = +1)



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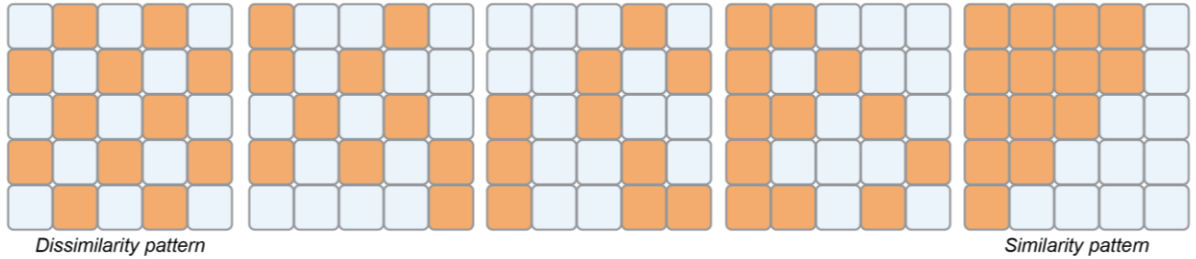

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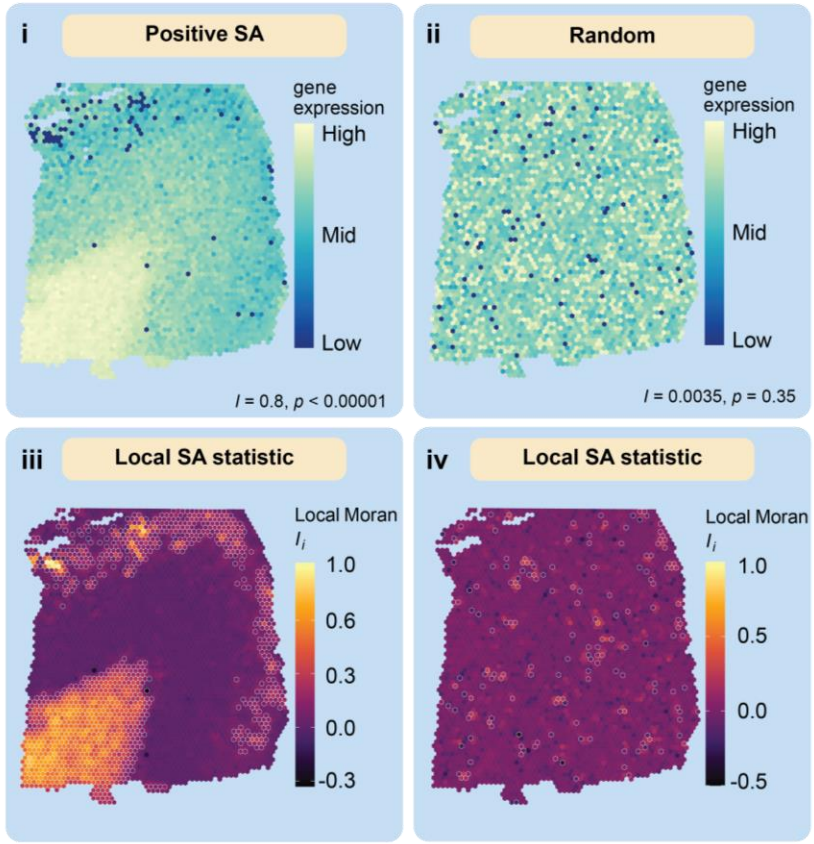

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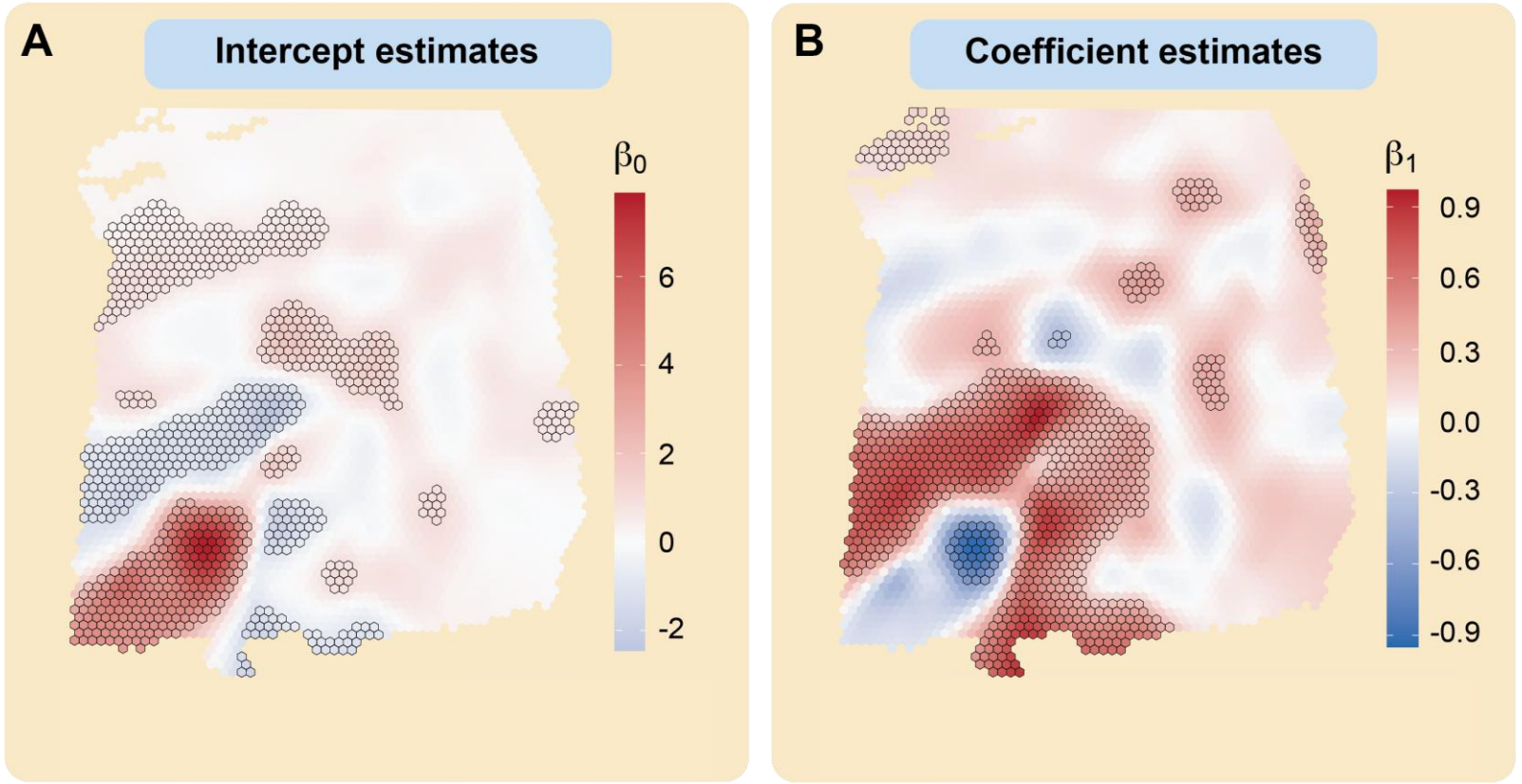

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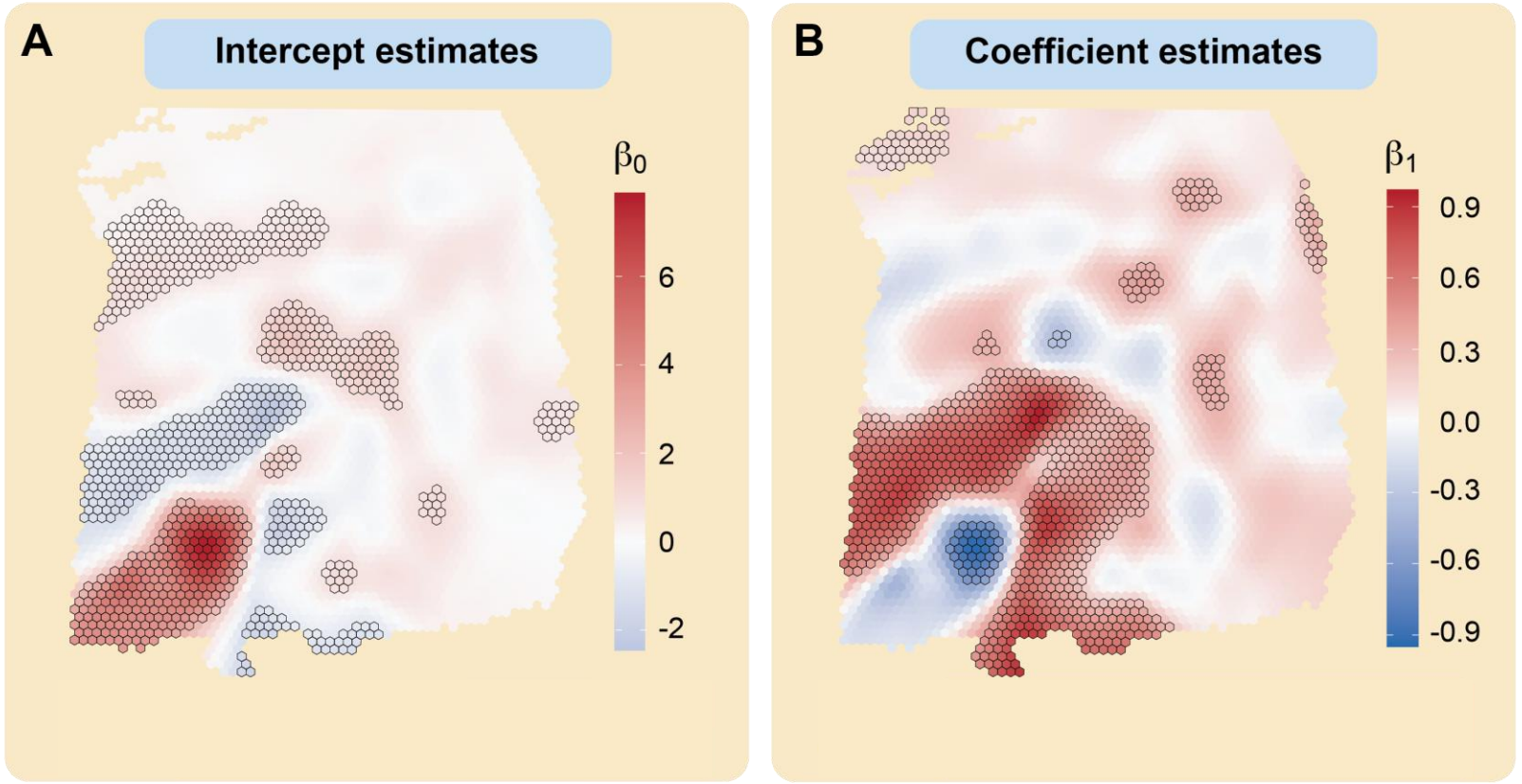

C

Summary of GWR coefficient estimates

	Min.	1st Qu.	Median	3rd Qu.	Max.
β_0	-2.45	0.02	0.256	0.617	7.88
β_1	-0.947	0.013	0.106	0.26	0.97

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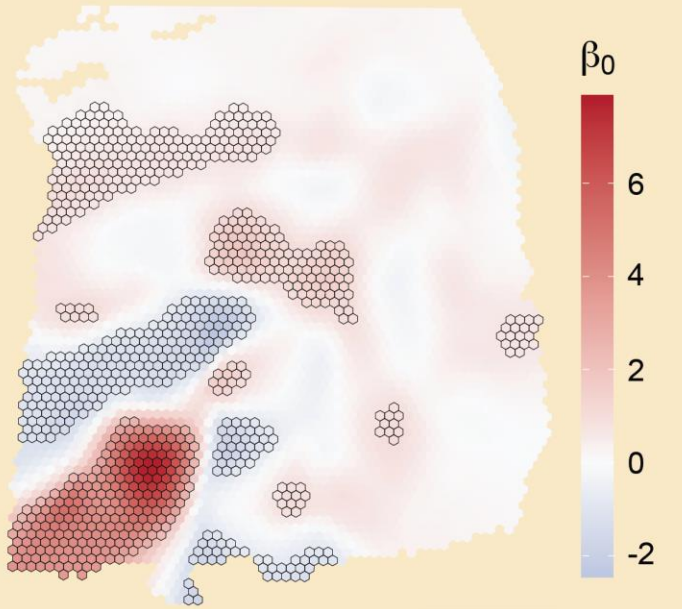
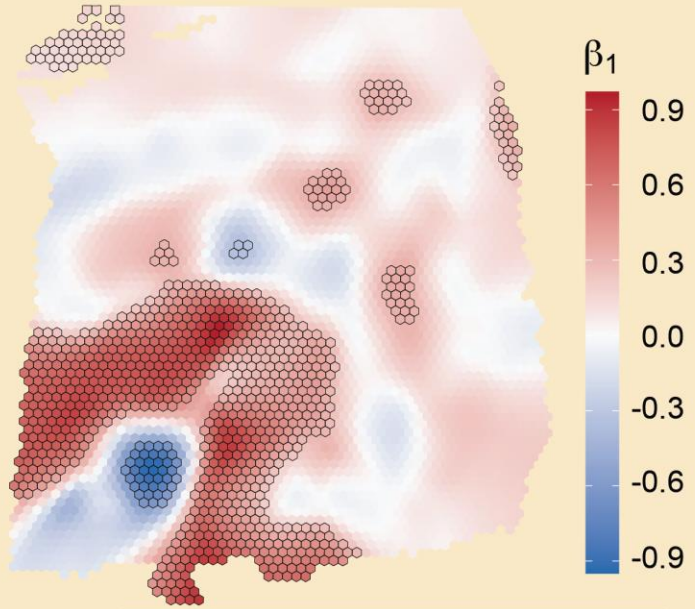
A Intercept estimates



	Estimate	Std. Error	t-value	p-value
Intercept	-1.011	0.039	-26.04	0

B Coefficient estimates



	Estimate	Std. Error	t-value	p-value
Covariate	0.65	0.012	55.998	0

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β1	-0.947	0.013	0.106	0.26	0.97

SUMMARY

MAUP

SA

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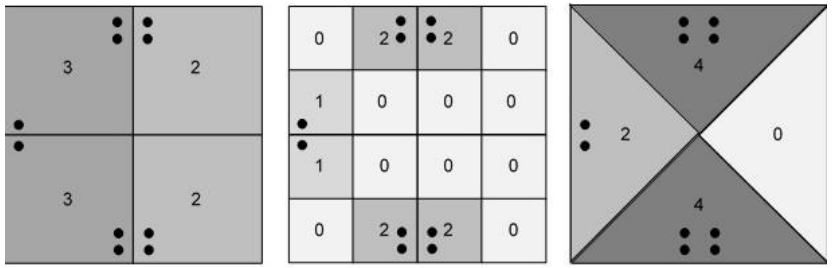
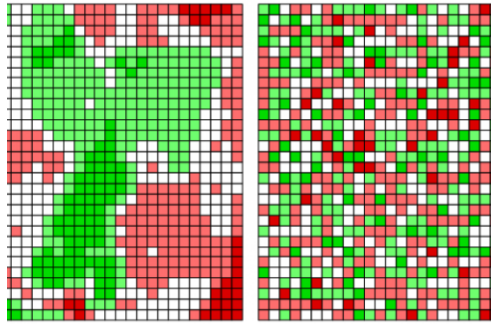
Modifiable Areal Unit Problem (MAUP)



Source: https://gistbok.ucgis.org/bok-topics/problems-scale-and-zoning

The impact on aggregating data for a set of points to an original partitioning scheme (left panel) due to differences in scale (middle panel) and zoning (right panel). explanation.

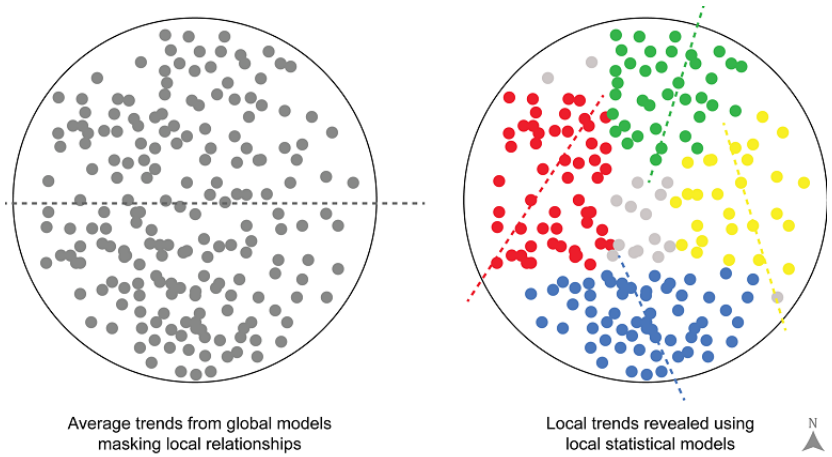
Spatial Autocorrelation (SA)



Source: https://gistbok.ucgis.org/bok-topics/spatial-autocorrelation

Everything is related to everything else, but nearby things are more related than distant things.

Spatial Heterogeneity (SH)



Source: https://gistbok.ucgis.org/bok-topics/geographically-weighted-regression-framework

Local trends are revealed using local statistical models (right) which are otherwise masked by 'averaged' global trends (left).

AKNOWLEDGEMENTS

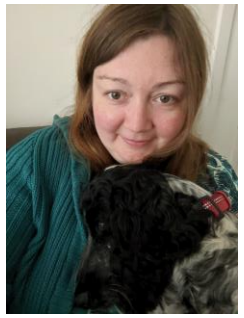
Eleftherios Zormpas

Newcastle University

Dr Simon J Cockell

Newcastle University

Dr Rachel Queen



Newcastle University

Prof. Alex Comber

UNIVERSITY OF LEEDS

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UKRI Medical Research Council

MRC DiMeN Doctoral Training Partnership