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Accounting for complex environmental exposure situations: a classification approach

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Background

- ✓ Everyone is constantly exposed to several environmental exposures with positive or negative health effect.
- ✓ Studies which consider this complex environmental setting are rare.
- ✓ There is a scientific and political call for a realistic and “holistic” approach of cumulative exposure.
- ✓ There is a need for methods able to handle cumulative exposures.

Study design and data

- ✓ Lyon metropolitan area (1.2 million inhabitants, 527km²), France
- ✓ French census blocks (2000 inhabitants on average)
- ✓ Environmental exposures groups :
 - NO₂ annual concentration (2 variables)
 - Noise levels (3 variables)
 - Traffic exposition (2 variables)
 - Industrial proximity (4 variables)
 - Green spaces (2 variables)

Results (MFA)

- ✓ The four first components explain respectively 30%, 15%, 13% and 11% of the total variance
- ✓ Major components interpretation:
 - 1st: air pollution and traffic proximity
 - 2nd: industrial proximity
 - 3rd: noise and green spaces

Components:	1	2	3
Air Pollution	31.98	5.06	1.04
Noise	15.97	13.23	68.00
Industrial Proximity	0.13	78.34	5.13
Traffic Proximity	32.22	0.38	1.09
Green Spaces	19.71	2.99	24.74

Table 1: Contribution of each groups to the three first components (in %)

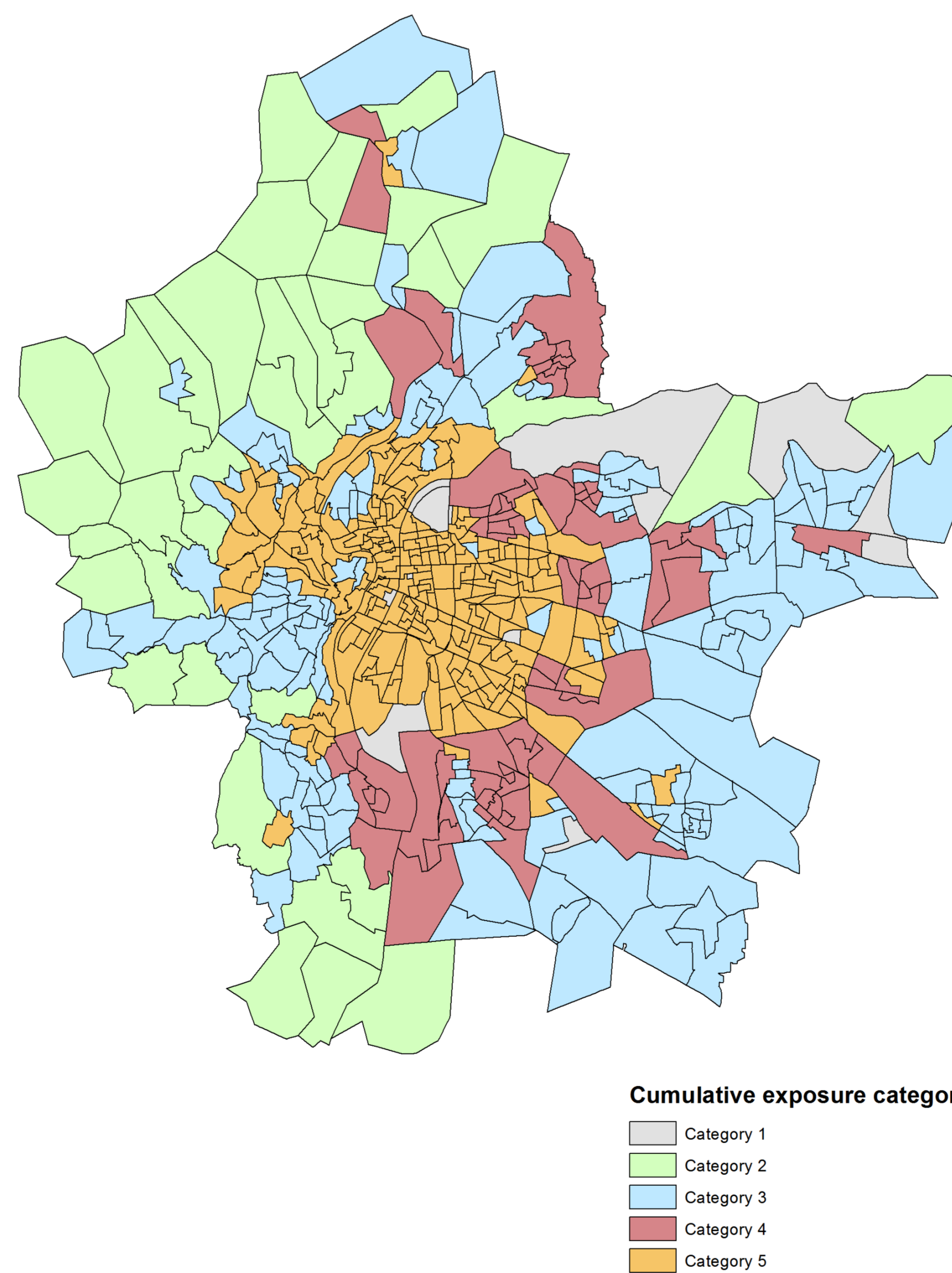


Figure: Lyon metropolitan area cumulative exposure categories created by HC

Objectives

- ✓ Use data mining techniques to create a composite exposure index.
- ✓ Assess the environmental burden experienced by populations in their living environment.
- ✓ Illustrate this approach on a large French metropolitan area.

Methods

- ✓ Data mining technics, highlight underlying structures in data
- ✓ Multiple Factor Analysis (MFA): analyze variables by groups, give the same weight for each group and can include both quantitative and qualitative variables.
- ✓ Hierarchical Clustering (HC): minimizing the within-category inertia and maximizing the between-categories inertia.

Results (HC)

- ✓ HC applied on the 10 first components of the MFA
- ✓ 5 cumulative exposure categories have been created using HC

Category:	1	2	3	4	5
<i>NO₂</i>	≈	--	--	-	++
<i>Noise</i>	---	-	-	≈	+
<i>Traffic</i>	--	---	--	+	+++
<i>Industries</i>	-	--	--	+++	---
<i>Green spaces</i>	++	+++	-	-	---

Table 2: Categories' characteristics (from +++:extremely higher than average to ---: extremely lower than average, ≈: near the average value)

Conclusion and perspectives

- ✓ Data analysis technics can help to obtain insight about the different exposure profiles in an area with easily performed and interpreted tools
- ✓ This approach can help stakeholders to identify areas of higher “environmental burden”
- ✓ As a perspective, extend to other areas and indicators of living environment (public transport accessibility, health professionals density, primary good store availability ...)