

Accounting for complex environmental exposure situations: a classification approach

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Context



- At every moment, we are exposed to multiple environmental exposures
 - With various natures: air pollution (PM, O₃, NO₂, ...), water pollution (nitrates, PCB, ...), soils pollution (heavy metals, hydrocarbon, ...) ; noise, ...
 - From various sources: air, road, rail traffic, industrial plants, waste disposal, ...
 - Sometimes with positive effects : green spaces, ...
- In many studies: only one exposition took into account



Context (2)

- Call for more realistic approaches of exposures: take into account multiple exposure, cumulative exposure, complex cumulative exposure ...
- Already a little studied but ...
 - With pollutants within the same domain and/or with the same physiological effects
 - With “simple” aggregation technics (scores, weighted sums or products, ...)
- **Several methodological issues** : correlation and colinearity, mixture of quantitative and qualitative variables, different scales and units, weights, ...



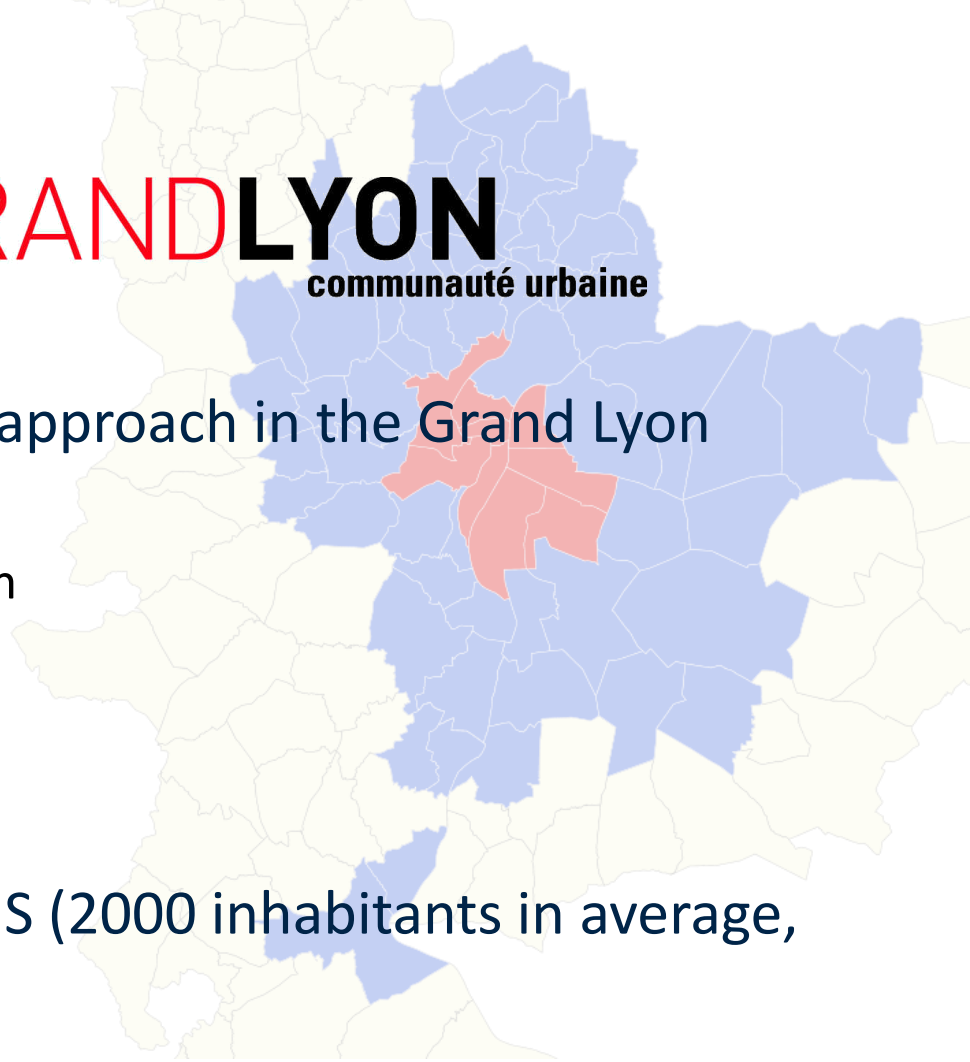
Approach

- Try to measure an “environmental burden” with a cumulative exposure index:
 - Indicator of the cumulative exposure endure by populations
 - Mixture of exposure with various natures, each able to have an effect (positive or negative) on health
- With data mining techniques:
 - Rarely used in this field
 - Yet adapted both to the constraints and to the purpose

Application – GRANDLYON

communauté urbaine

- Application and test of this approach in the Grand Lyon metropolitan area:
 - 58 municipalities around Lyon
 - 1.2 millions inhabitants
 - 527.15 km²
- Statistical unit and scale: IRIS (2000 inhabitants in average, defined by INSEE)
- Study period: 2002-2009



Application – Exposures

- Air pollution (NO₂)
- Noise
- Industrial plants proximity
- High traffic roads proximity
- Green spaces



NO₂ & Noise



- **NO₂:**

- Pollutant mainly emitted by road traffic
- Increase risk of respiratory diseases, decrease lung function, increased health effects for susceptible people (asthmatic people, children, aged people, ...)
- Modeled average annual concentrations (2002-2009)

- **Noise:**

- Road, rail and air traffic noise
- Increase stress, mental illness, sleep troubles, ...
- Modeled 24h noise exposition (including sensitivity differences in evening and night)





Industrial plants proximity

- Pollutant industries in EPER database (European Pollutant Emission Register) : emission above a regulatory threshold for some pollutants (air, water, soils)
- Health effects related to pollution + issues related with perceived risk
- Industrial plants proximity indicators:
 - Presence/absence of pollutant industry in the IRIS ; number in the IRIS
 - Presence/absence of a buffer (500m or 1km radius) in the IRIS ; number of buffers in the IRIS

Traffic & Green spaces



- Traffic:

- Modeled traffic by segment of road from Air Rhône Alpes
- Air pollution, noise, and all effects related
- Percentage of the IRIS population closer than 100/150/200/250 or 300m to a road with more than 5000 vehicle/day

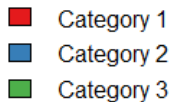
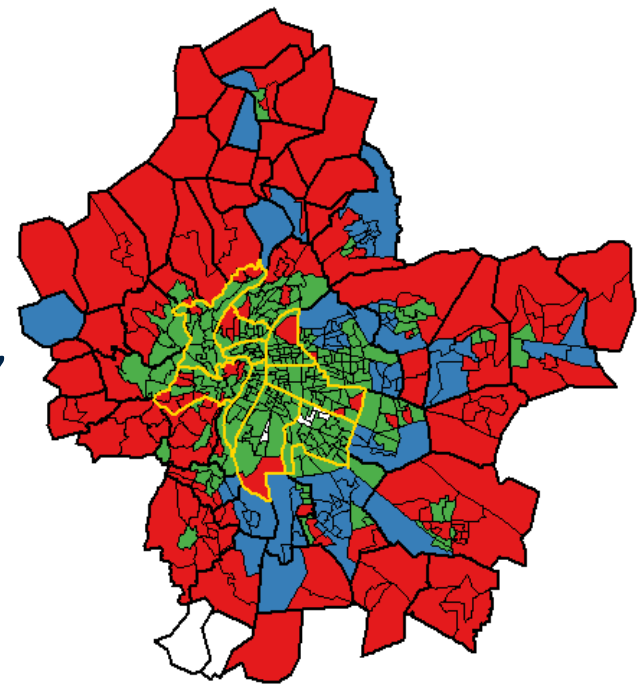
- Green spaces :

- Ground nature obtained by satellite imagery
- Positive health effects shown by recent studies
- Total green spaces area in the IRIS ; proportion of green spaces in the IRIS



Classification

- **Category 1** : IRIS far from pollutant industries, greener than average, with less air pollution, traffic exposition and noise
- **Category 2** : IRIS near polluting industries
- **Category 3** : IRIS far from pollutant industries, with less green spaces and more air pollution, traffic and noise than average



Moyennes par classes	Cl.1	Cl.2	Cl.3
L-ener-IRIS-i	65,94	68,57	69,12
L-arith-pop-IRIS-i	60,23	65,50	66,33
L-med-pop-IRIS-i	36,52	34,95	30,94
Moy2005	35,20	39,29	43,97
Moy2006	37,59	41,40	45,65
Surf-vert	451284	145191	35901
Indi-vert	18,08	8,62	9,10
R07-200m	46,99	82,83	94,31
R07-250m	56,62	89,26	97,98

Répartition des modalités par classes	Cl.1 (n=158)	Cl.2 (n=73)	Cl.3 (n=260)
Nombre_0	100%	74%	100%
Nombre_1	0%	18%	0%
Nombre_2	0%	8%	0%
Presence-Buff-500m_0	97%	0%	100%
Presence-Buff-500m_1	3%	100%	0%
Presence-Buff-1km_0	80%	0	85%
Presence-Buff-1km_1	20%	100%	15%
Count-Buff-500m_0	97%	0	100%
Count-Buff-500m_1	1%	74%	0%
Count-Buff-500m_2+	1%	26%	0%



Conclusion

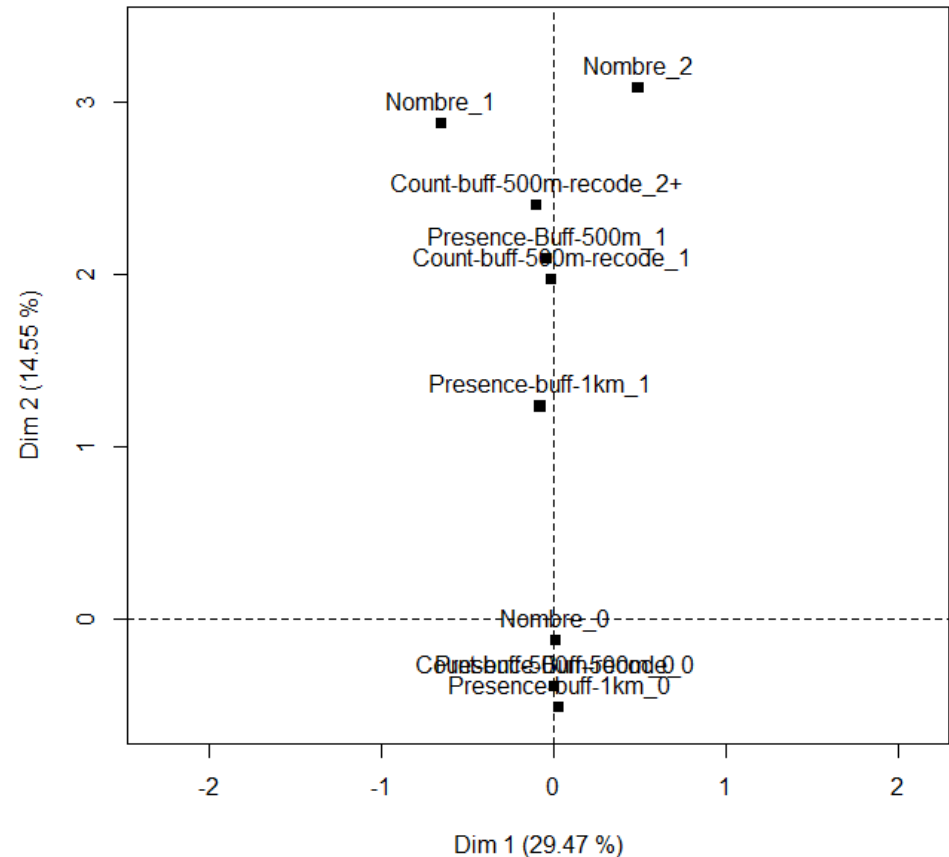
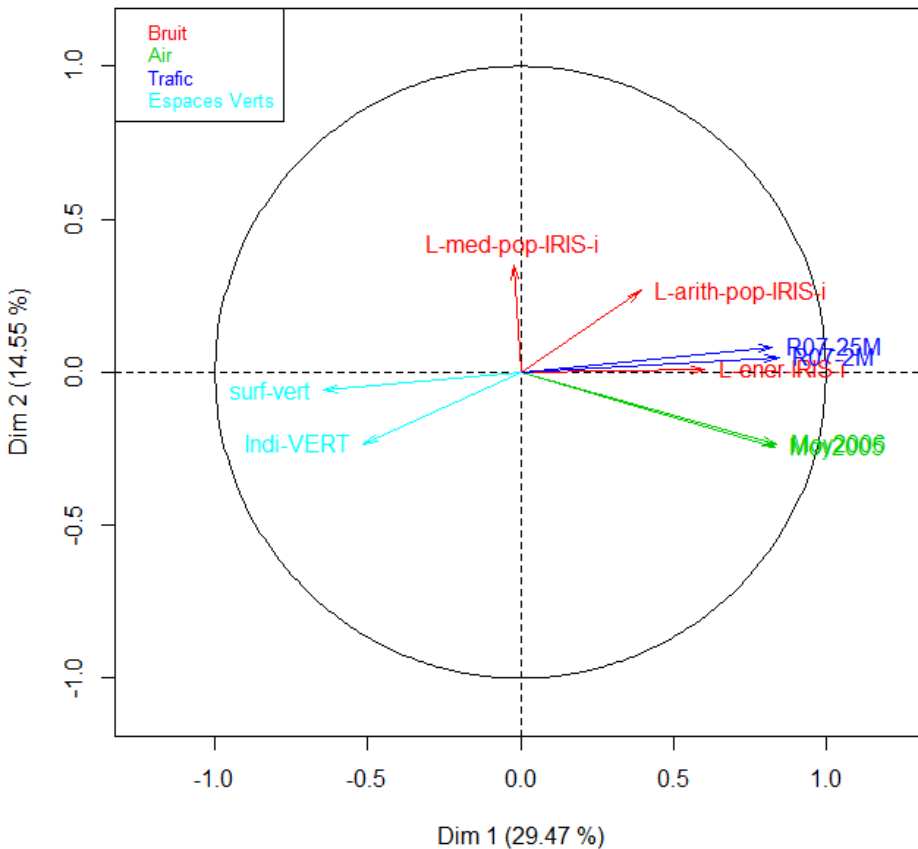
- Data mining and classification approach seldom use in the field, but clearly adapted
- Construction with a “simple” method of a coherent cumulative exposure index
- Others exploration with more exposures or a different number of classes could be interesting
- Possible applications in explanatory models of health events, identification of black spots for stakeholders, ...



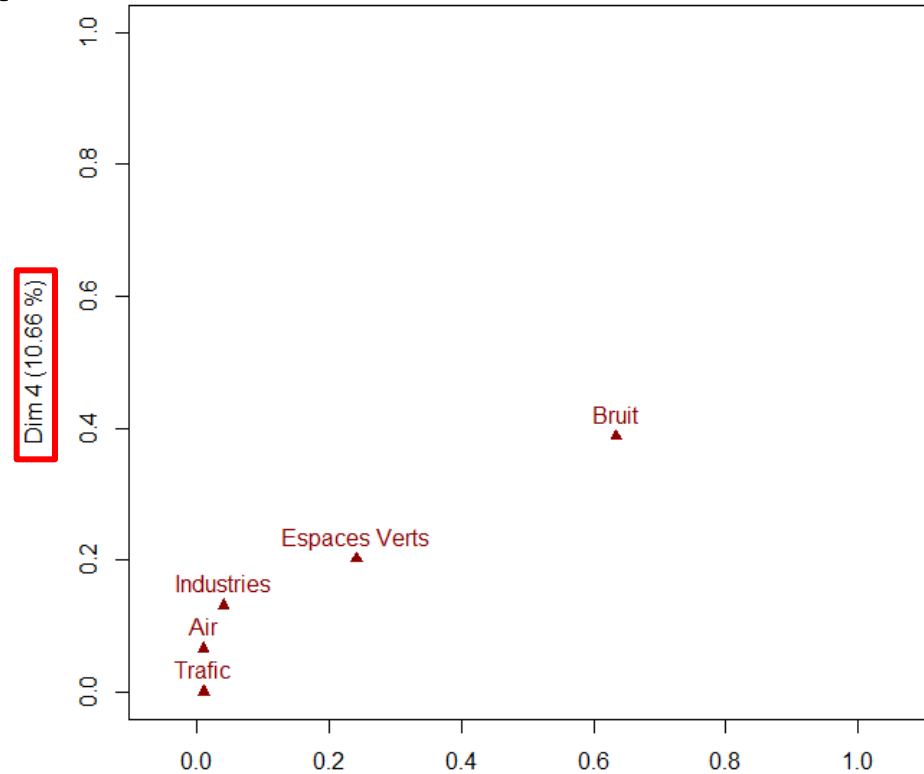
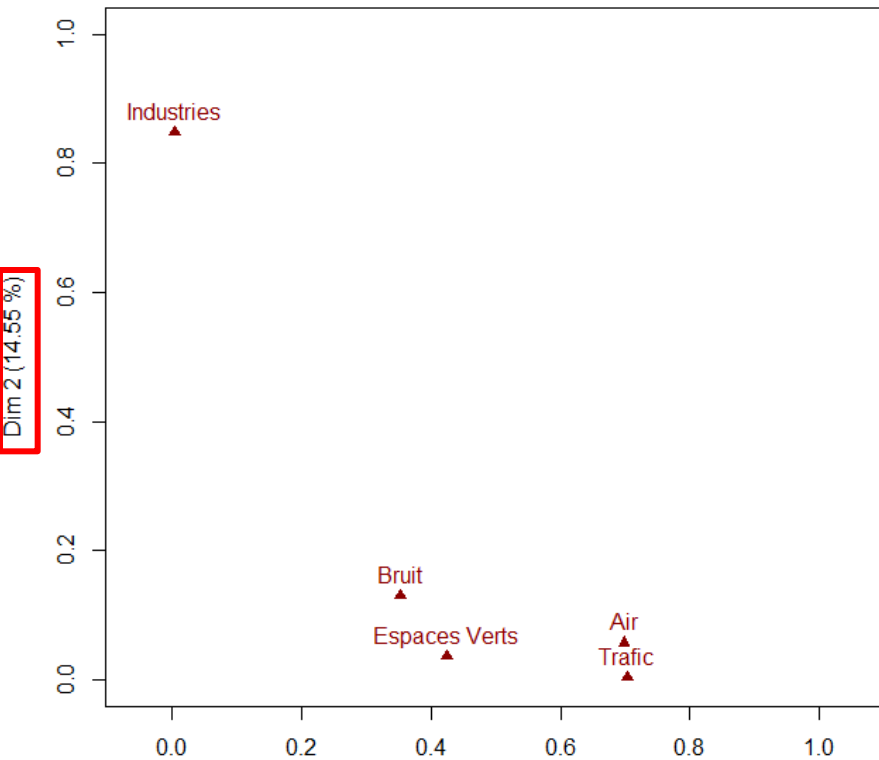
Thank you for your attention !

MFA – Results

- 1st axe : air pollution and traffic
- 2nd axe : industrial plants proximity
- 3rd axe : green spaces and noise

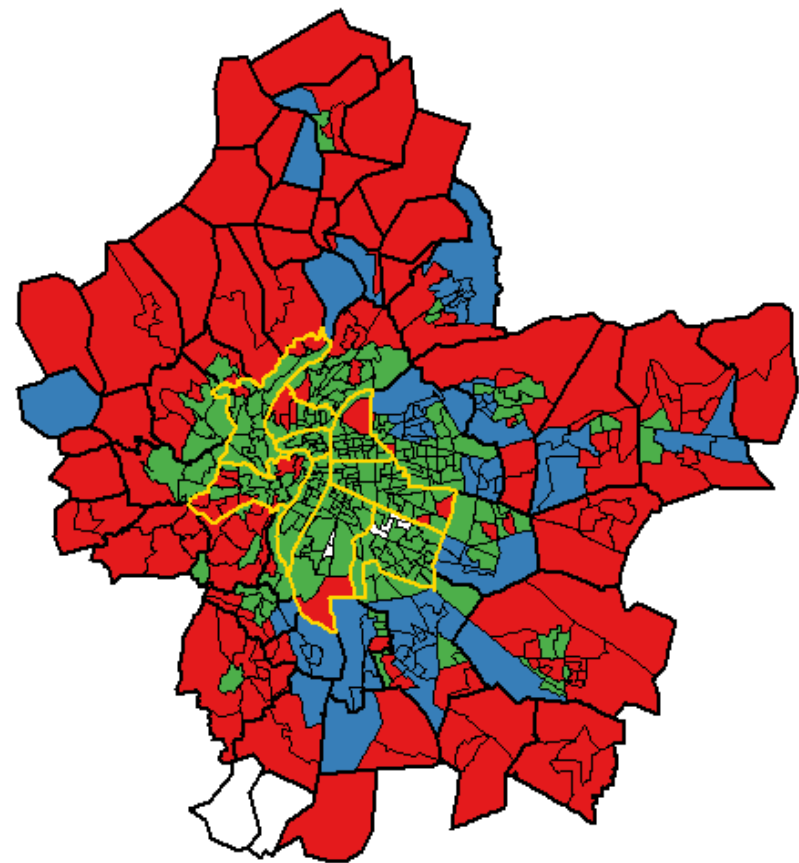


MFA – Results (1)



Contributions groupes/facteurs	Dim.1	Dim.2	Dim.3	Dim.4
Bruit	16,14	12,15	67,90	49,11
Industries	0,13	78,66	4,25	16,71
Air	31,99	5,34	0,97	8,42
Trafic	32,27	0,42	1,09	0,12
Espaces verts	19,47	3,43	25,79	25,64

Classification



- Category 1
- Category 2
- Category 3

