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Congenital anomalies and environmental exposure - susceptibility to atmospheric pollution

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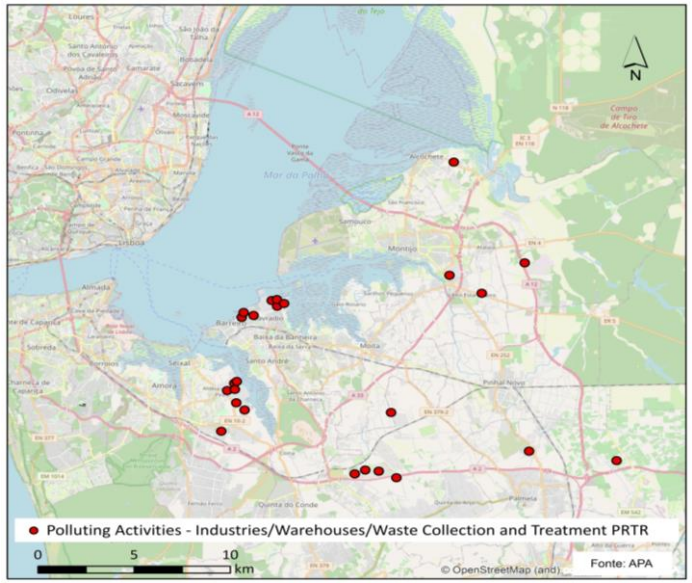
Background/Objectives

- Environmental exposure to teratogenic factors during pregnancy may have consequences for the development of the embryo and fetus.
- Air pollutants such as PM10, PM2.5, NO2, SO2 and CO are associated with some congenital anomalies (CA).
- Industries presence of the petrochemical, fertilizer and steel sectors on the south bank of the Tagus River, Lisbon region.
- In 2015, a cluster of CA in newborns (NB) was detected, in this area.
- An observational, case-control epidemiological study was developed between 2016 and 2021, in Barreiro hospital.
- Analyze a possible association between births with CA and maternal exposure to environmental teratogenic substances, namely PM10, NO2 and SO2 .



Methods

1. Set up of the database "Survey Mothers NB Cases / Mothers NB Controls"

2. Georeferencing of cases (n=134) and controls (n=268)

3. Collection, processing and validation of vector and alphanumeric geographic data

4. Multicriteria spatial analysis

(i) Distance to polluting activities
(ii) Density of polluting activities
(iii) Distance to main road traffic routes
(iv) Type of land cover
(v) Foggy areas

Weighted Linear Combination

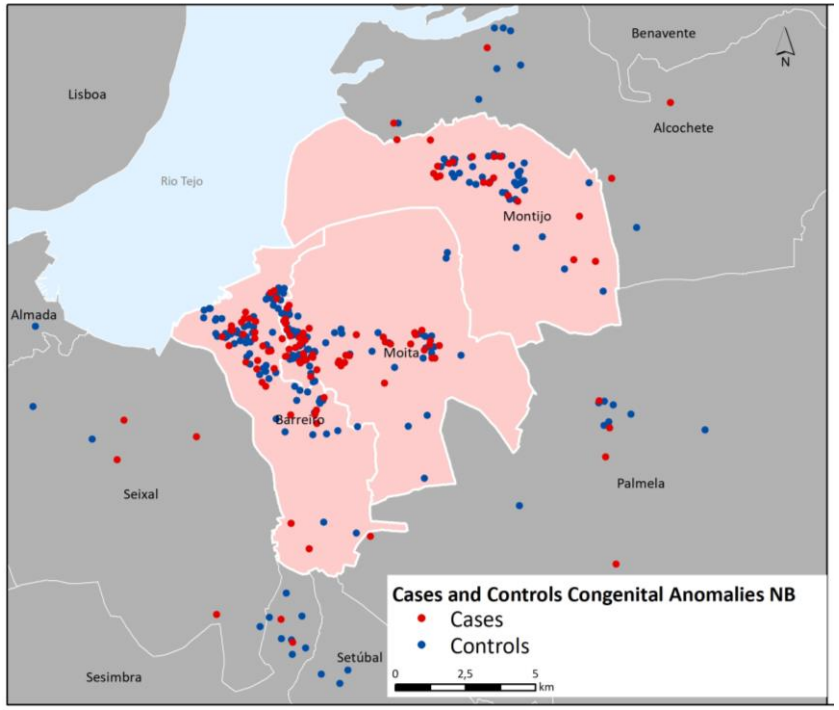
$S = \Sigma i\ wi*xi$

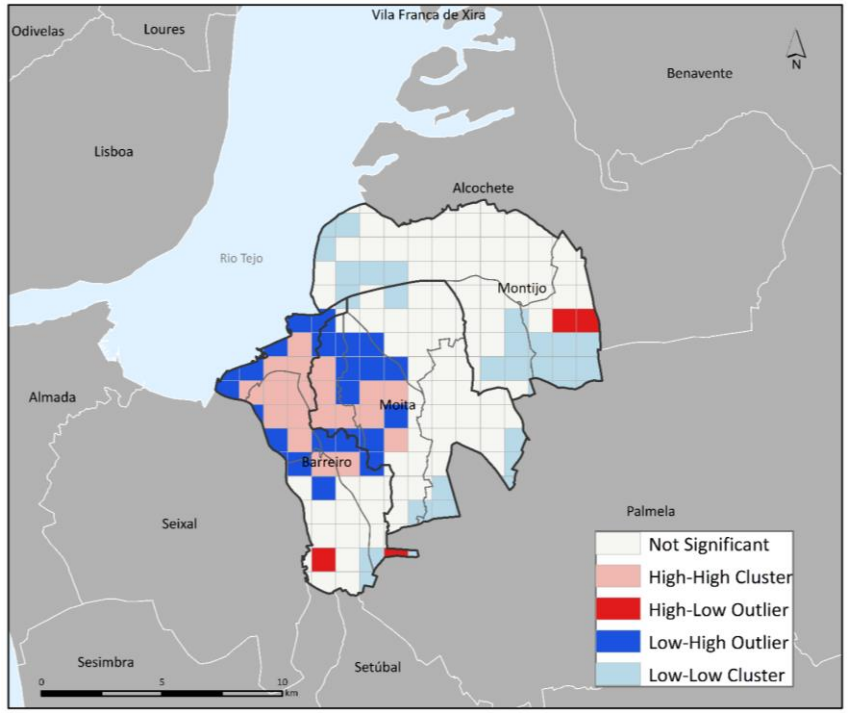
Pollution factors → Susceptibility to atmospheric pollution

5. Análise Estatística

Methods

- Georeferencing of residence mothers of cases and controls, recruited for the study between 2016 and 2021.
- Spatial Cluster Analysis, Anselin Local Moran's I.
- Study area: municipalities of Barreiro, Moita and Montijo.

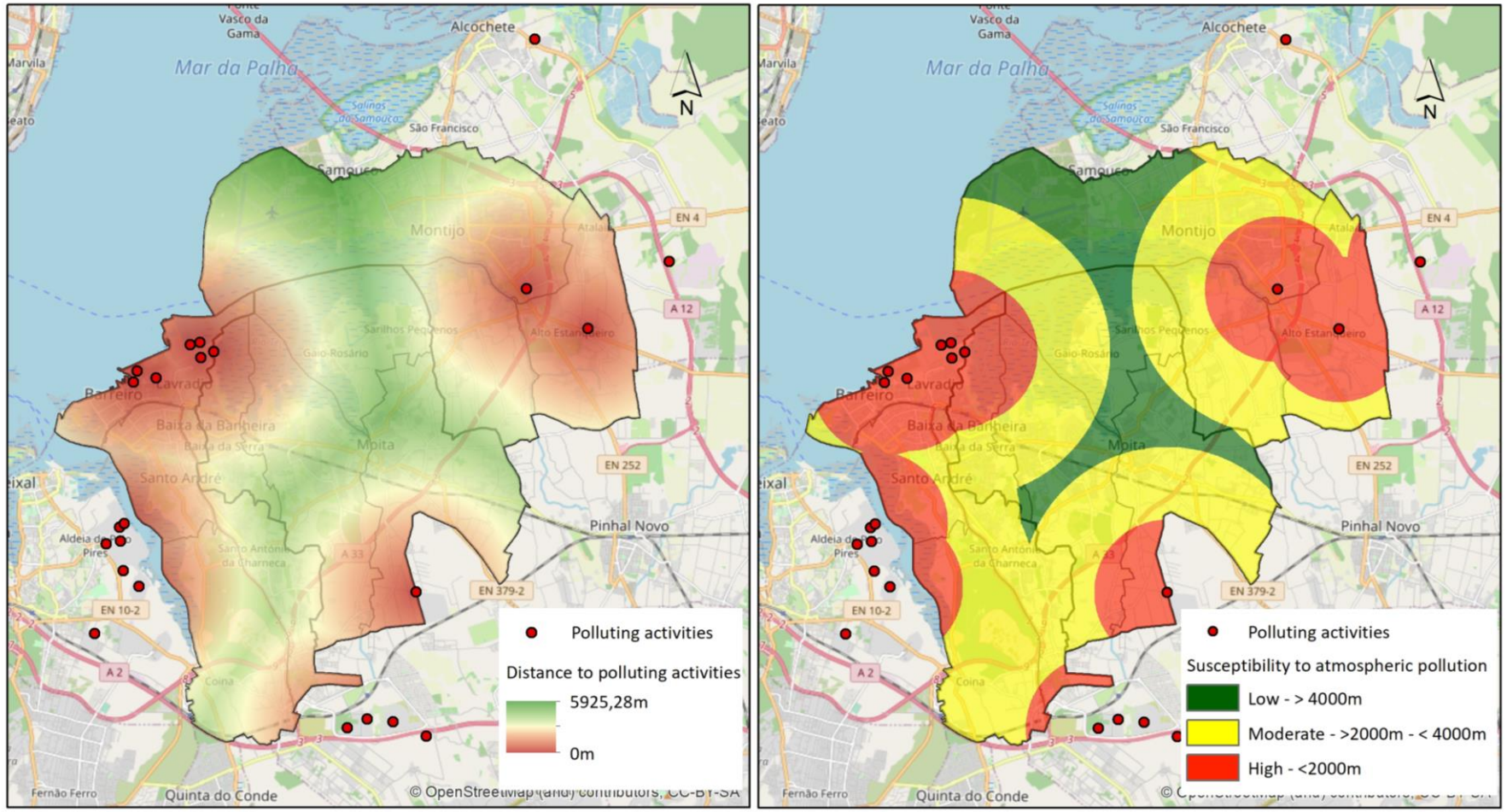




Methods

- Calculated by Euclidean Distance
- Higher susceptibility at higher proximity

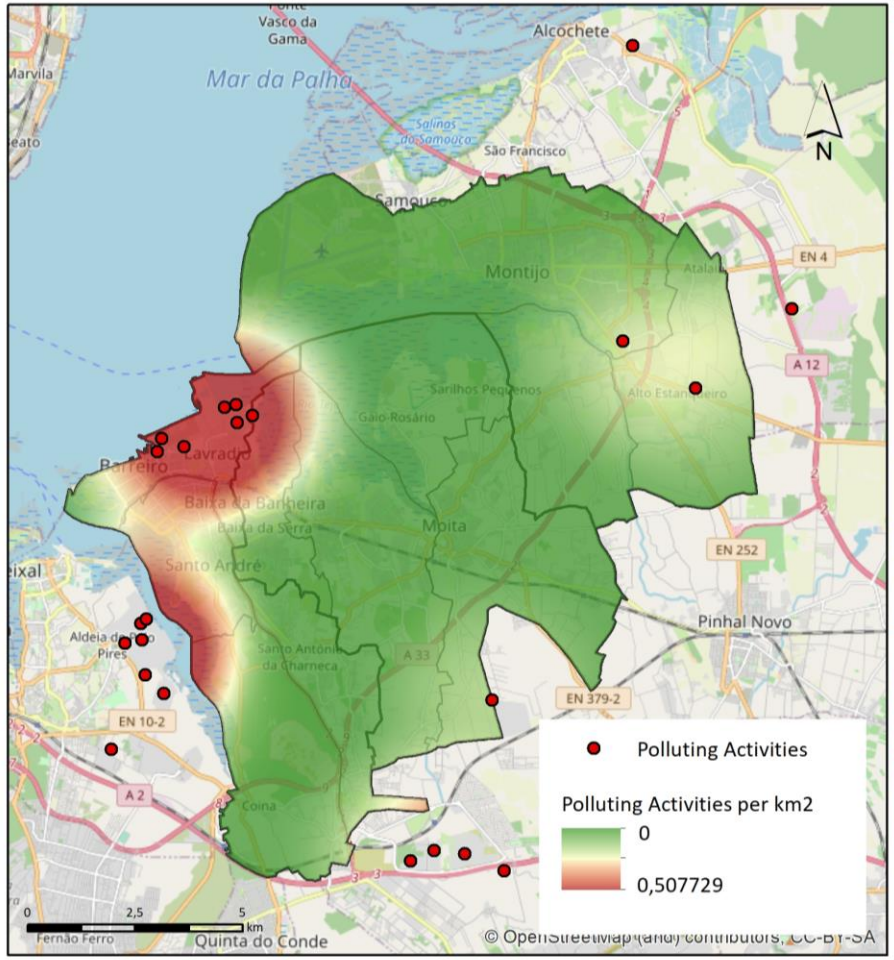
Distance to polluting activities

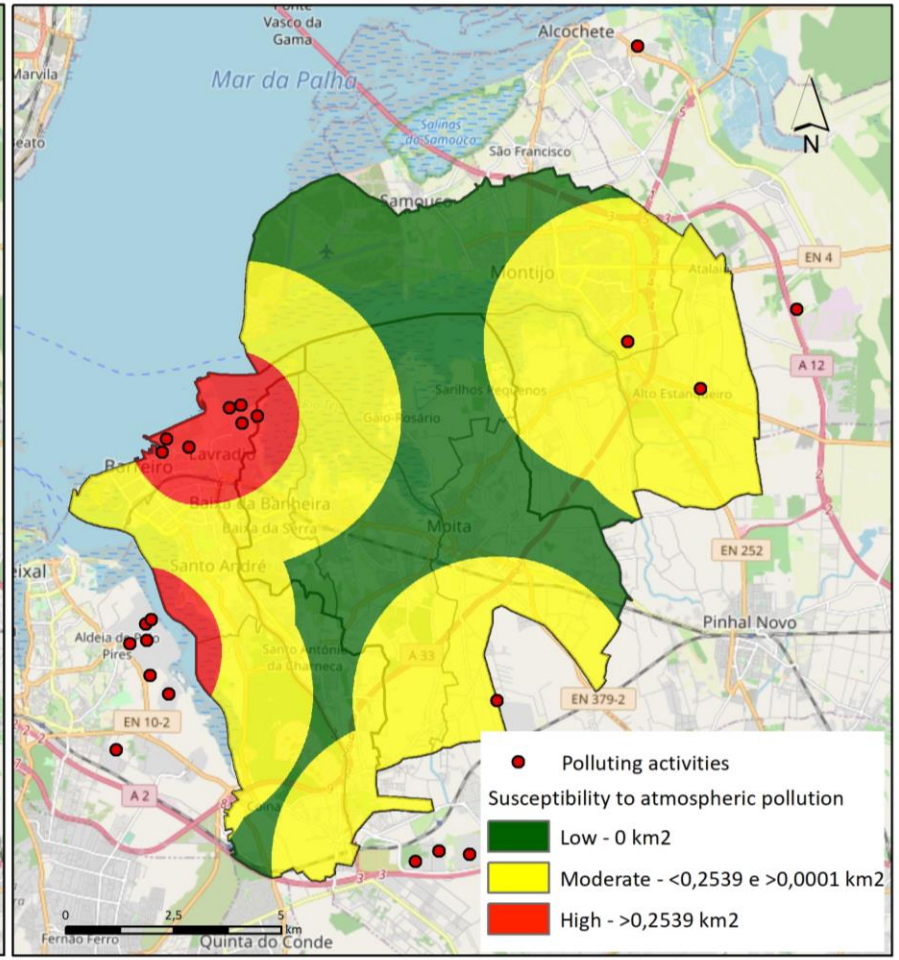


Methods

- Calculated by Kernel Density Estimation
- Higher susceptibility at higher densities

Density of polluting activities

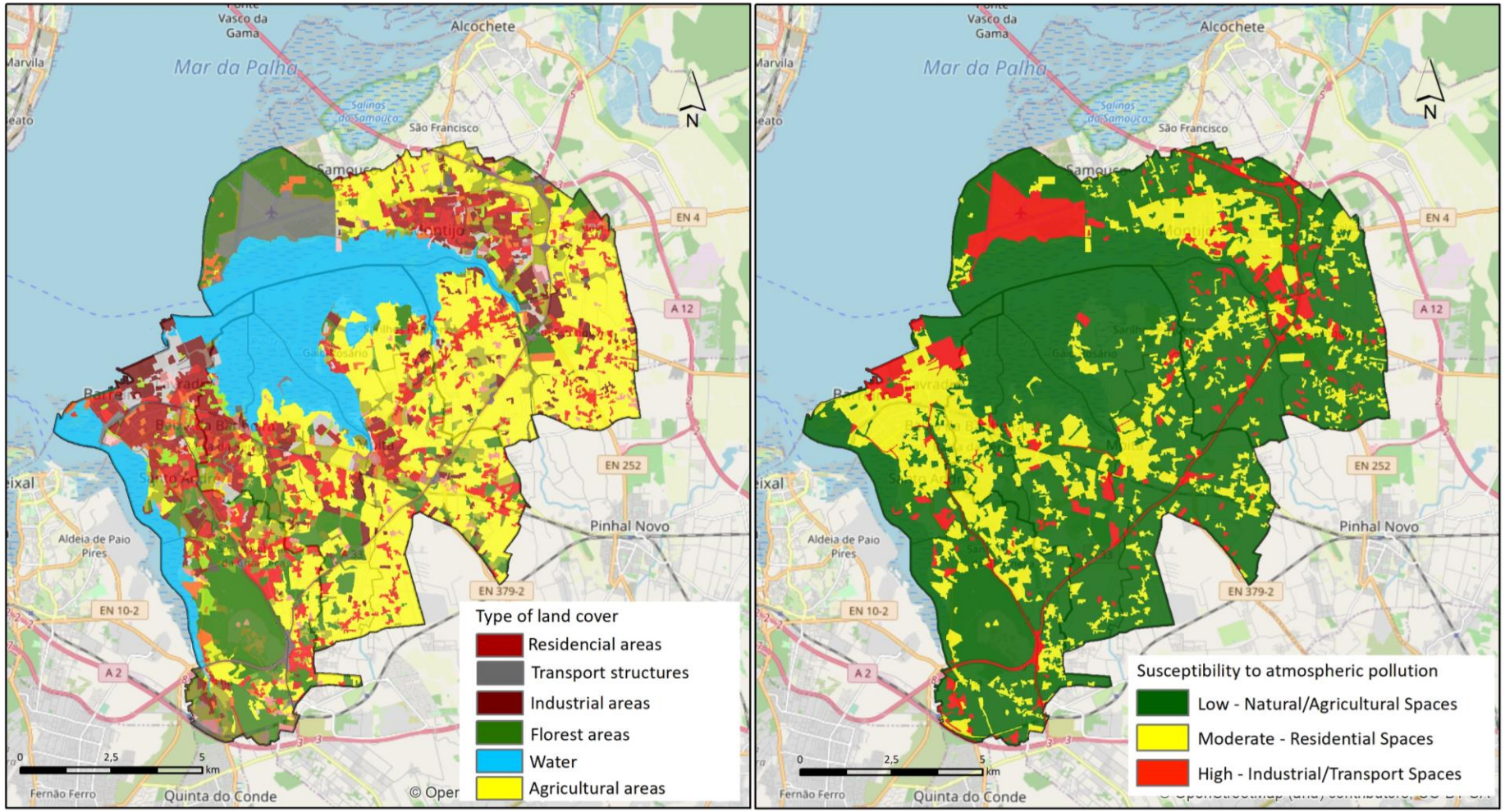




Methods

- Higher susceptibility in industrial/transport spaces

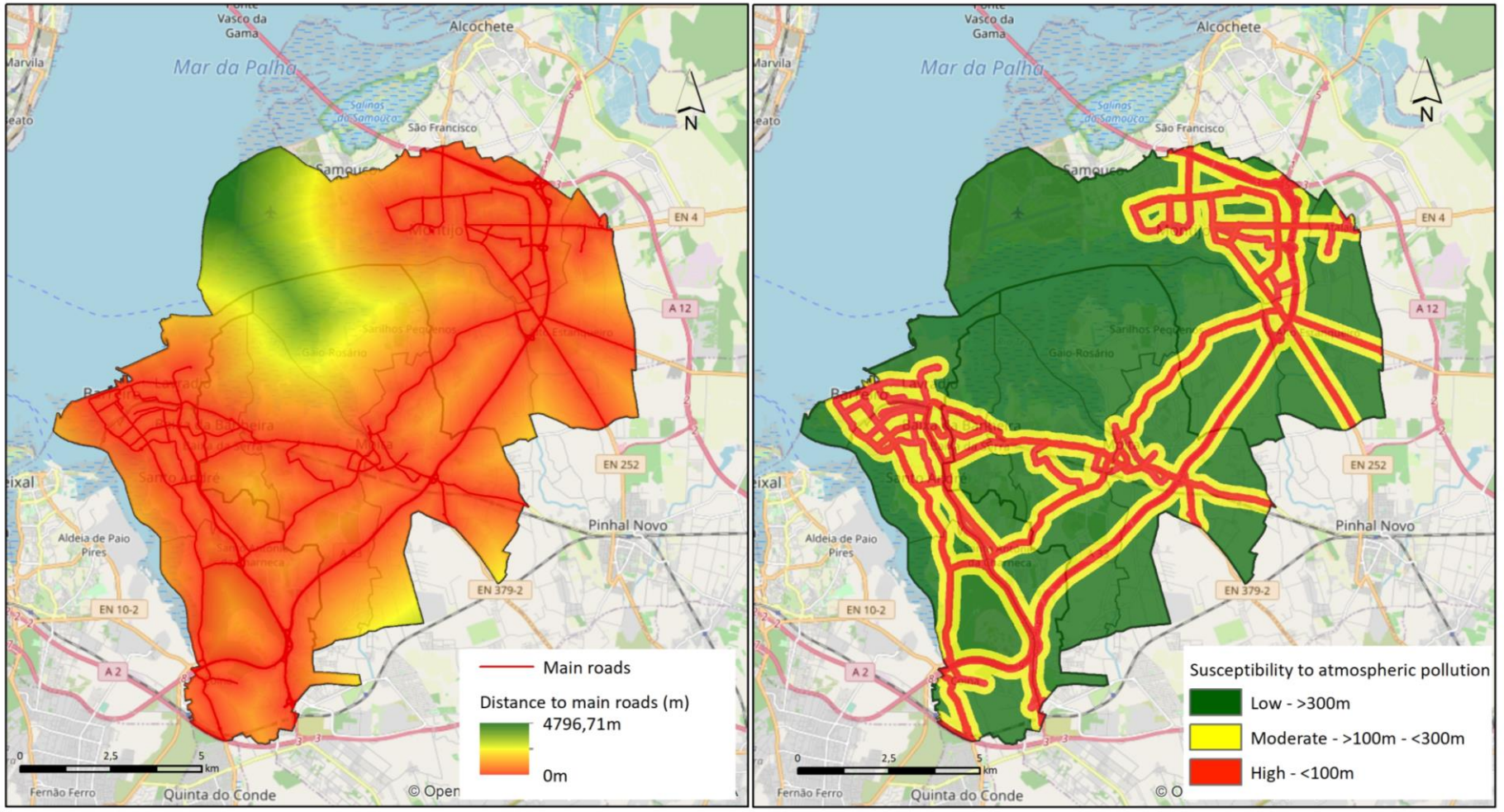
Type of land cover



Methods

- Calculated by Euclidean Distance
- Higher susceptibility at higher proximity

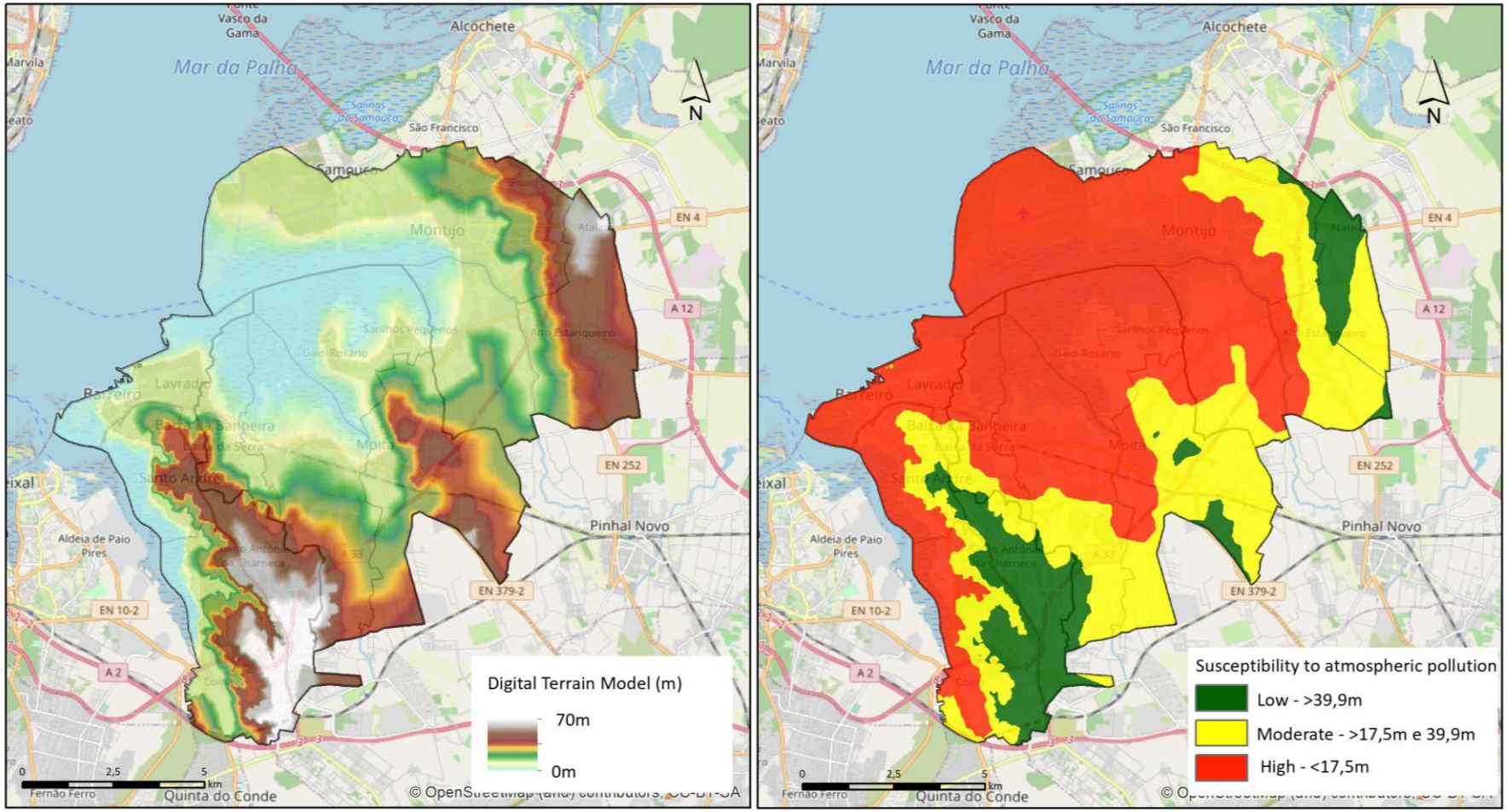
Distance to main road traffic routes



Methods

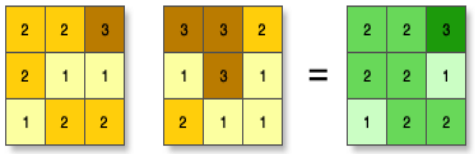
- Higher susceptibility at low altitudes
- Pollutants tend to concentrate in water particles

Foggy areas



Methods

- **Weighted Linear Combination**
  - Crossing of variables, normalized into 3 classes.
  - Weighting of the variables, defined by the **Analytic Hierarchy Process**, according to their importance for the emission and concentration of pollution.



1 = Low susceptibility
2 = Moderate susceptibility
3 = High susceptibility

Factor	Influence (% weight)	Category or range	Class	Degree of susceptibility
Distance to polluting activities PRTR (m)	30	<2000	3	High
		2000-4000	2	Moderate
		>6000	1	Low
Density of polluting activities PRTR (km2)	30	>0,2539	3	High
		0,2539-0,001	2	Moderate
		0	1	Low
Distance to main road traffic routes (m)	15	<100	3	High
		100-300	2	Moderate
		>300	1	Low
Type of land cover	15	Industrial areas, infrastructure, landfills/dumps	3	High
		Residential, commercial, leisure/tourism facilities	2	Moderate
		Natural, forest, agricultural areas	1	Low
Foggy areas (m)	10	<17,5	3	High
		17,5-40	2	Moderate
		>40	1	Low

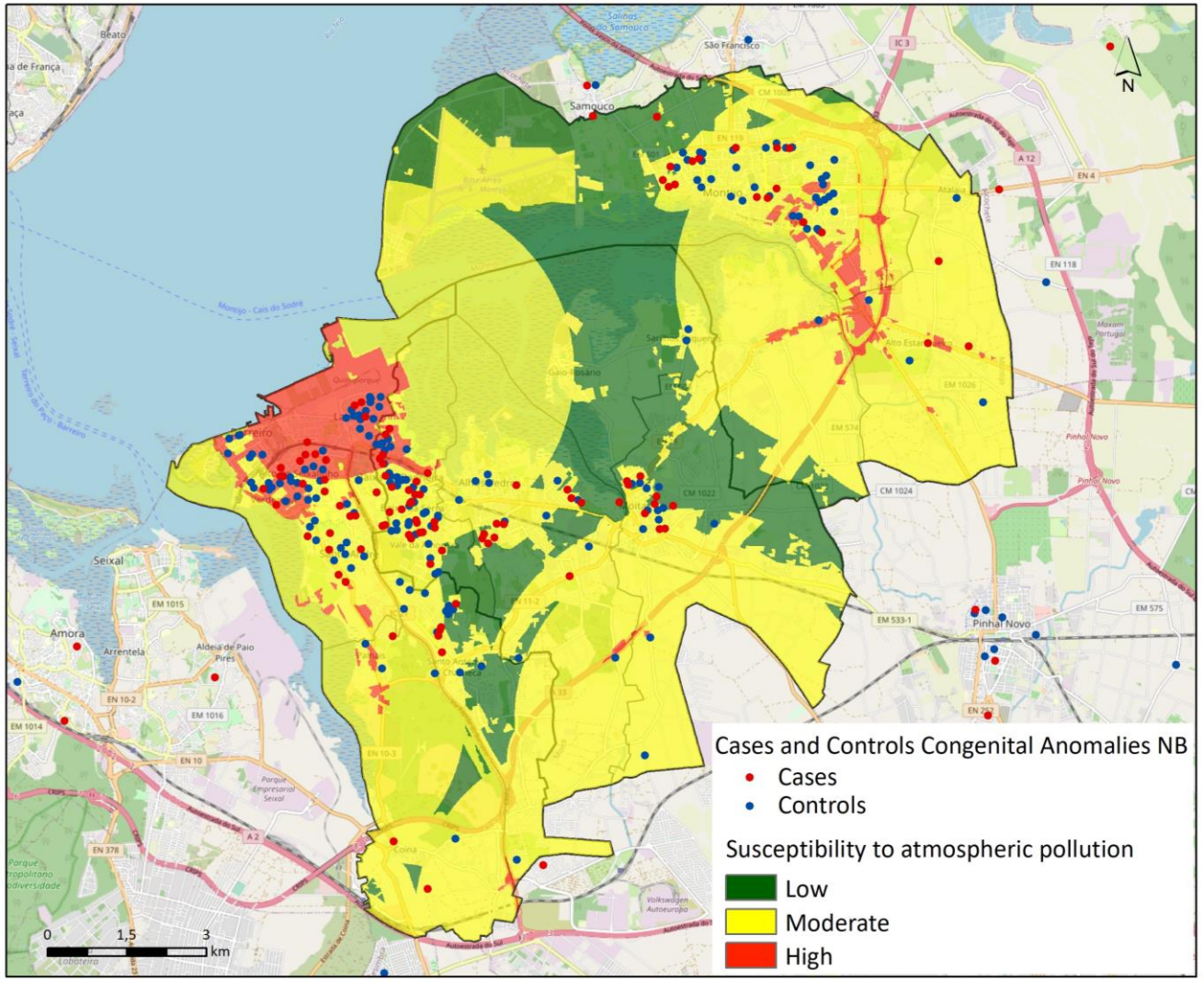
Results

Map of Susceptibility to Atmospheric Pollution

High susceptibility:

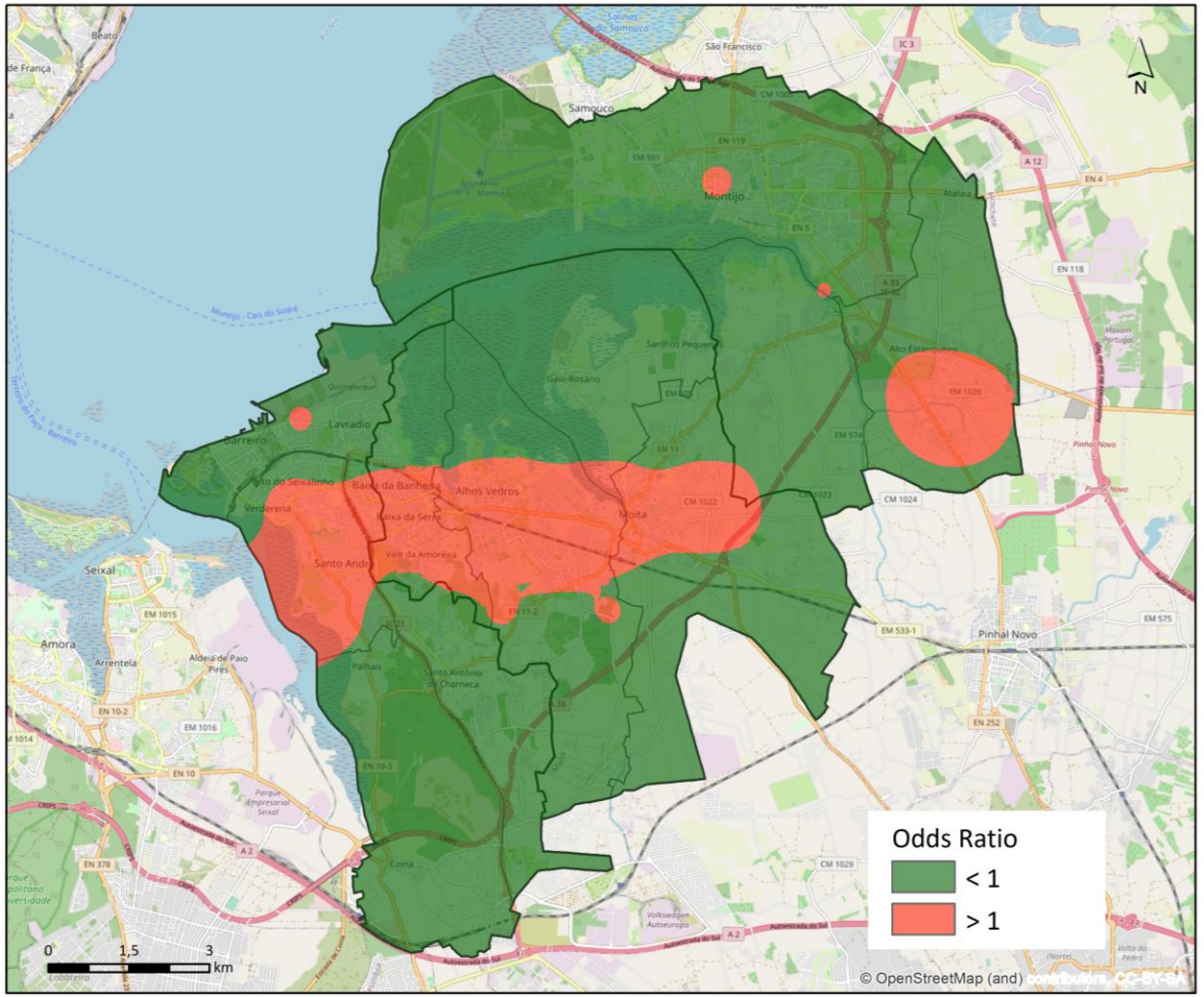
1. Consolidated urban area of Barreiro and Baixa da Banheira;
2. Periurban area of Palhais;
3. South zone of the urban area of Montijo.

	Cases		Controls		*p*
	n	%	n	%	
Susceptibility					0,51
Low	4	3,8	9	4,3	
Moderate	79	75,9	145	69,7	
High	21	20,1	54	25,9	



Results

Map of the odds ratio of exposed and unexposed cases and controls, according to the area of residence of the mothers.



Higher proportion of cases, compared to controls in:

- Santo André;
- Baixa da Banheira;
- Vale da Amoreira;
- Alhos Vedros;
- Moita.

Discussion/Conclusions

- Limitations:

  Selection bias - pregnant women who opted for voluntary termination of pregnancy due to the presence of a serious anomaly in the fetus or who gave birth in other hospitals were excluded from the analysis;

  Classification bias of cases and controls, since the measurement of exposure was made to the territory and not to the individual.

  Other environmental exposures not evaluated in this presentation.

- Strenghts:

  Strengthens CA national registry monitoring and surveillance capacity in geographical terms;

  Demonstrates the potential of using spatial analysis methodologies in public health and epidemiology studies.

- The atmospheric pollution susceptibility map proved to be useful to assess the possible environmental exposure of pregnant women to chemical agents;

- The ability of spatial analysis to associate variables in a judicious way and create scenarios was demonstrated.

References

Muito obrigado/Thank you

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The scientific protocol was submitted to the Ethics Committee of the Centro Hospitalar do Barreiro Montijo, and to the Ethics Committee for Health of National Institute of Health Doutor Ricardo Jorge. As this is a study that involved the collection of sensitive personal data, authorization was granted from the National Data Protection Commission.