ASSESSMENT OF THE DISPERSIVE CAPACITY OF NEIGHBOURHOODS BASED ON LOCAL CLIMATE ZONES CLASSIFICATION

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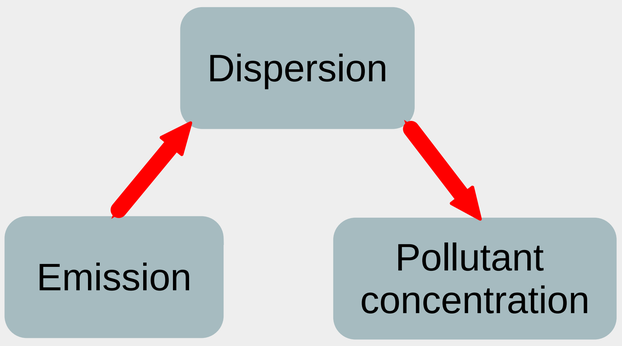
INTRODUCTION



Emission:
- Traffic
  - Traffic reduction (LEZ)
  - Technology improvement
- Residential
  - Building design

Dispersion:
- Meteorology
- Urban morphology
  - Smart design

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Dispersion capacity

Dispersion capacity: ability of an urban canyon to **release** the **pollution** emitted within. It is characteristic of each urban canyon and depends on urban morphology.

Local Climate Zones classification (LCZ)[1]: characterization of neighbourhoods of their interaction with the atmosphere. It is based on their **fabric**, **land cover**, **structure** and **metabolism**. It has been widely used in urban climate as model input [2] or guidance for climate impact assessment, need of design interventions analysis, etc.

Can we use LCZ to assess the the dispersion capacity of neighbourhoods?

RESULTS

VALIDATION

+ Qualitatively represent the observed increase of NO_x (03 – 05/01/2017).
+ Captures qualitative differences between stations

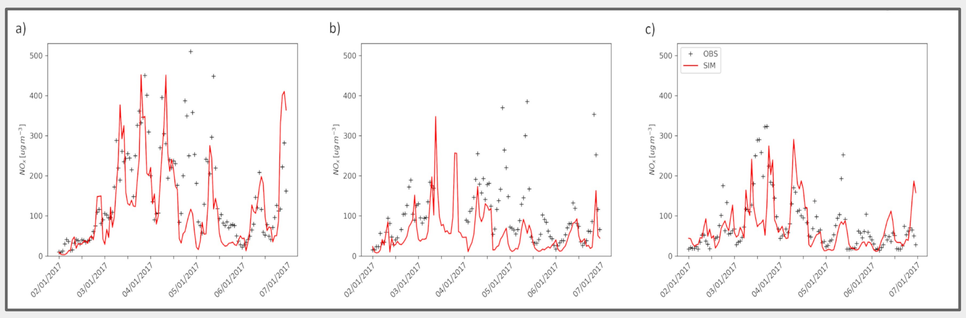

Figure 4: Observed (black crosses) and simulated (red line) hourly NO_x in the three air quality stations: a) Av. Gasteiz, b) 3 de Marzo and c) Judimendi.

DISPERSION CAPACITY ANALYSIS

+ Maximum values not located where emission is higher:
  - Different dispersive capacity
  - Wind convergence.

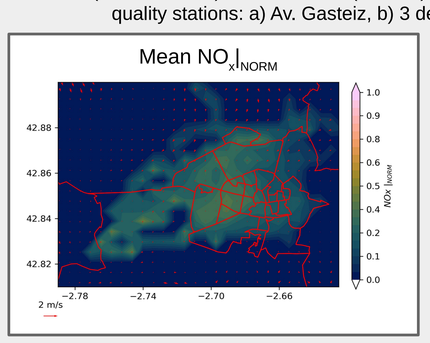

Figure 5: Mean hourly $NOx|_{NORM}$ and wind vectors (red arrows), calculated as the average hourly $NOx|_{NORM}$ and wind, respectively, with local averaged wind speed below the 50th percentile situations. The area with longitudes between -2.76º and -2.63º and latitudes between 42.8º and 42.9º is considered for the spatial average.

BOX PLOTS

+ Lower dispersion capacity (↑$NO_x|_{NORM}$):
  - LCZ3 < LCZ2 < LCZ5 < LCZ8 < LCZ6
+ High spread of distribution
  - Difficult to avoid non local impacts (pollution advection)
  - Different morphology between LCZs - real areas are mixed

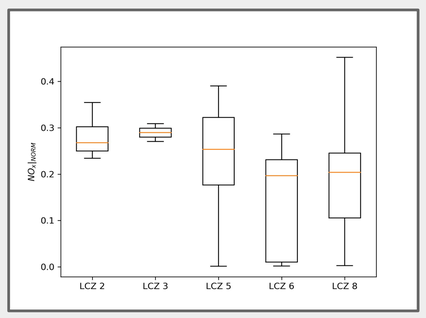

Figure 6: Box plots of $NO_x|_{NORM}$ for each LCZ. Values are the time mean in each point belonging to a specific LCZ.

DISPERSION CAPACITY EVOLUTION

+ LCZ3 lower during daytime, when emission is higher
+ LCZ2 and 5 higher night $NO_x|_{NORM}$ values
+ Curves remind to emission diurnal profile
  - Difficult to avoid non local impacts

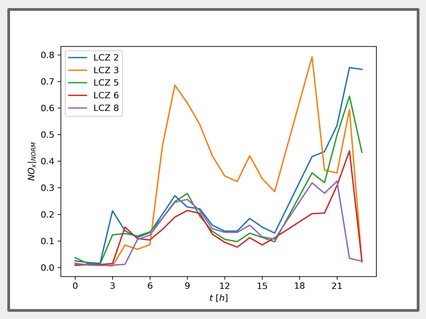

Figure 6: Diurnal cycle of the median of $NO_x|_{NORM}$ for each LCZ.

METHODOLOGY

MODEL CONFIGURATION:
+WRF model v3.8 [3]
+3 domains:
- D1: 4.5 x 4.5 km
- D2: 1.5 x 1.5 km
- D3: 500 x 500 m

Urban canopy model:
+BEP – BEM [4,5]

Location:
+Vitoria – Gasteiz (Small - size town in the north of the Iberian Peninsula)

Urban morphology:
+LCZ classification (LCZ generator [6], w2w tool [7]

Period of study:
+1- 6 January 2017
+High pollution episode

Emission:
+NO_x from traffic and residential sectors

Dispersion:
+WRF passive tracer variable
+No deposition
+Wind and turbulence in urban canyon represented by BEP - BEM

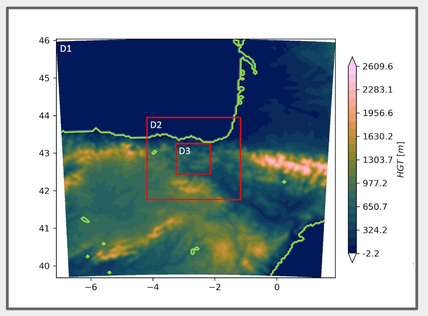

Figure 1: WRF simulation domains

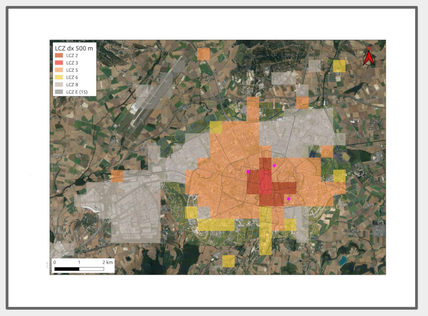

Figure 2: LCZ map of Vitoria-Gasteiz used for the simulations

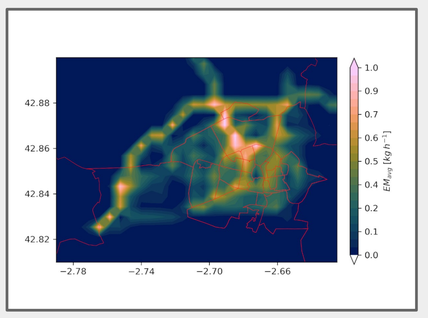

Figure 3: Mean hourly emission in kg/h

Normalized NO_x:

$$NOx|_{NORM} = \frac{[NO_x]}{EM_{NO_x}}$$

+ Case study with emission in the first vertical layer to minimize pollution advection.
+ $NO_x|_{NORM}$ calculated as grid cell average between situations with local wind speed < 50th percentile

CONCLUSIONS

+ **Different LCZ show different dispersive capacities**
  - LCZ classification has potential for air quality screening
+ **LCZ3, LCZ2, LCZ5 lower dispersive capacities**
  - LCZ 2 & LCZ 5 high traffic load and highly populated
+ **Advection of pollution hinders local dispersion**
  - More understanding of impact of wind on pollutants dynamics in urban areas is needed
+ **Understanding the dynamics inside urban areas, as well as the capacity to disperse of different neighbourhoods, would help optimizing traffic and hence designing cities as healthier places.**

ACKNOWLEDGEMENTS

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