

URBAN  
CO-CREATION  
DATA LAB

Project status 23/03/2021

Development of analytical services for 5 city domains in  
Lisbon + 2 European cities



#1 Micromobility



#2 Waste  
management



#3 Parking



#4 Pollution



#5 Emergency

# Activities

## A1 Data preparation and open data infrastructure assessment

T1.1 Definition of data requirements

T1.2 Services and use cases refinement

## A2 Services analytics refinement and HPC preparation

T2.1 Data models and analytical services

T2.2 HPC and services set-up and deployment

## A3 Co-Creation Labs: perform experiences and validation by cities

T3.1 Expand Co-Creation Labs: methodology, framework and technological tools definition

T3.2 Coordination of Co-Creation Labs: use cases implementation

## A4 Dissemination and communication results

## A5 Future sustainability

## A6 Project management

# A1 Data preparation and open data infrastructure assessment

## T1.1 Definition of data requirements

- Completed for Lisbon (could need adjustments for the other 2 cities)

## T1.2 Services and use cases refinement

- Completed for Lisbon. The #5- Crowd management case study was changed for #5 - Emergency as for Lisbon we didn't had access to enough bus ticketing data
- Could need adjustments for the other 2 cities depending on the available data

D1.1 Datasets definition and requirements definition

D1.2 Service and use cases full definition for all 3 cities

# #1 Micromobility



What are the estimated bike pickups in the bike stations for a certain day period?

## #2 Waste management



What is the estimated produced waste to be collected by the city services?

# #3 Parking



Where and at what time of day is expected to exist a higher number of illegalities regarding irregular parking?

## #4 Pollution



How is the propagation of nitrobenzene and methane in the city, in case of an accident?

# #5 Emergency



Where and at what time of day is expected to exist a higher number of traffic accidents?

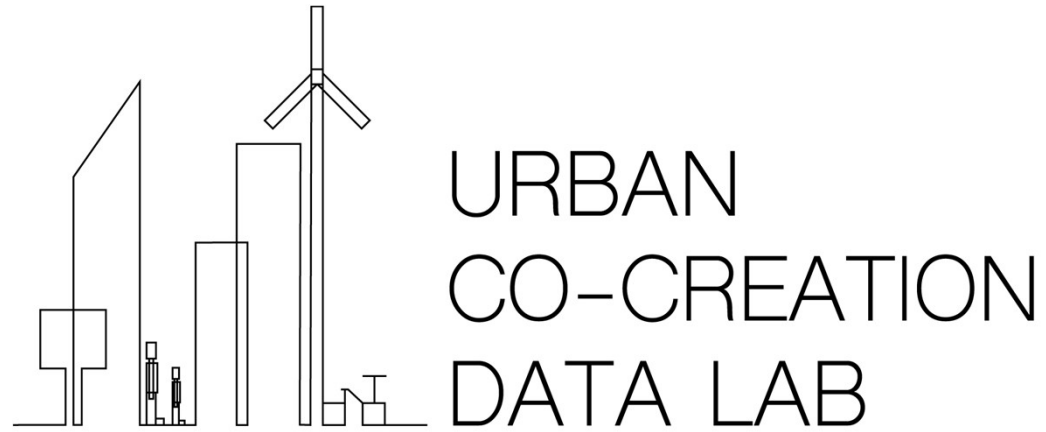
# A2 Services analytics refinement and HPC preparation

## T2.1 Data models and analytical services

- Completed for Micromobility (cluster level) and Waste management (cluster and circuit level).
- Parking and Emergency in development

D2.1 Data models and analytical services specifications (delayed)

D2.2 Services HPC configuration report (30/09/2021)



# Micromobility

# Research question

What are the **estimated bike pickups** in the bike stations for a certain day period?



# Data



Mobility	Environment	Infrastructures	Calendar
Docked bike sharing service trips	Temperature	Bike stations	Buisness days
	Precipitation		

# Pré-processing

- 9 months of bike trips historical data (Nov 2017 – Jul 2018)
- 697415 bike trips aggregated to 73 bike stations in periods of 3 hours
- 3 clusters of stations



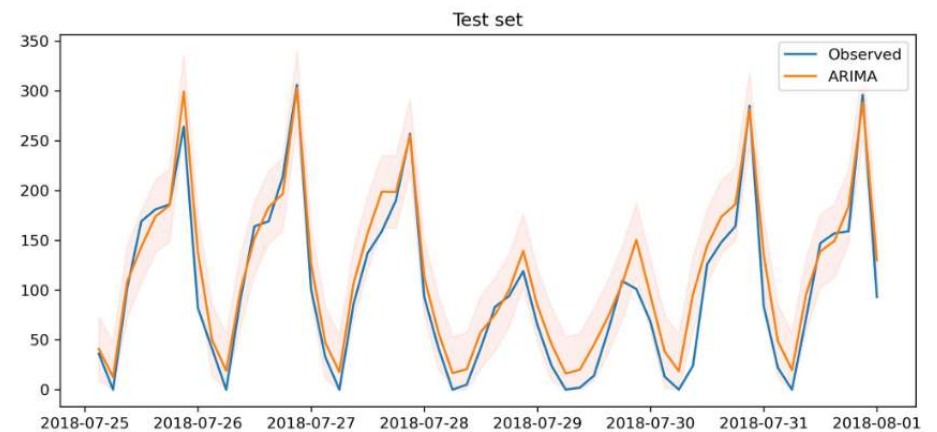
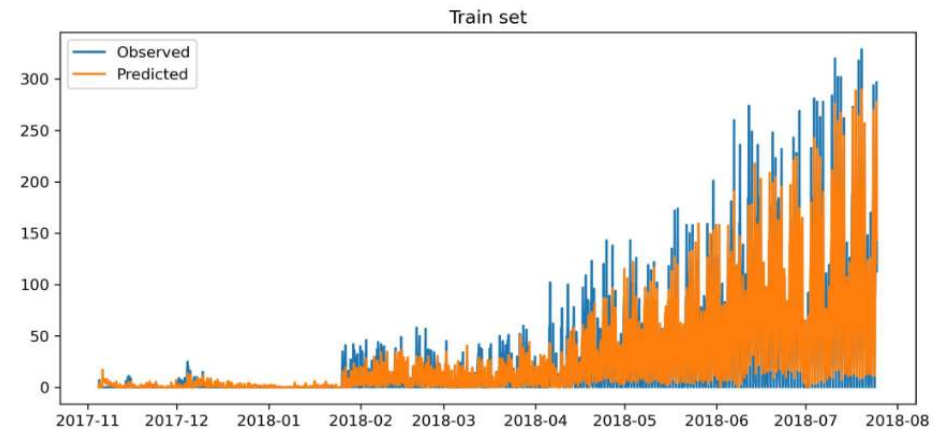
# Modeling and evaluation

## SARIMAX model

- Seasonal component
- 3 exogenous variables
- 3 clusters of bike stations

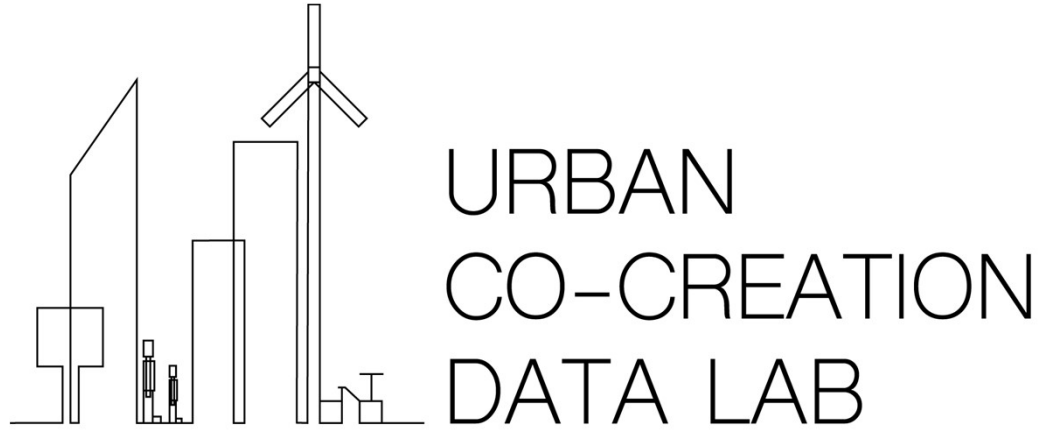
Cluster	MAE	WMAPE
0	23 trips	16% (good forecast)
1	19 trips	18% (good forecast)
2	9 trips	22% (reasonable forecast)

The models are capable of forecasting bike trip demand at cluster level with an error varying between 14 trips and 21 trips for each 3 hours



# Next steps

- At this moment BSC is **training a model for each bike station**, to have forecast for each one of them
- All models at GIRA station level will be used as the **basis of the analytical service to be deployed in Lisbon** regarding micromobility



# Waste management

# Research question

What is the **estimated undifferentiated waste** to be collected by the city services?

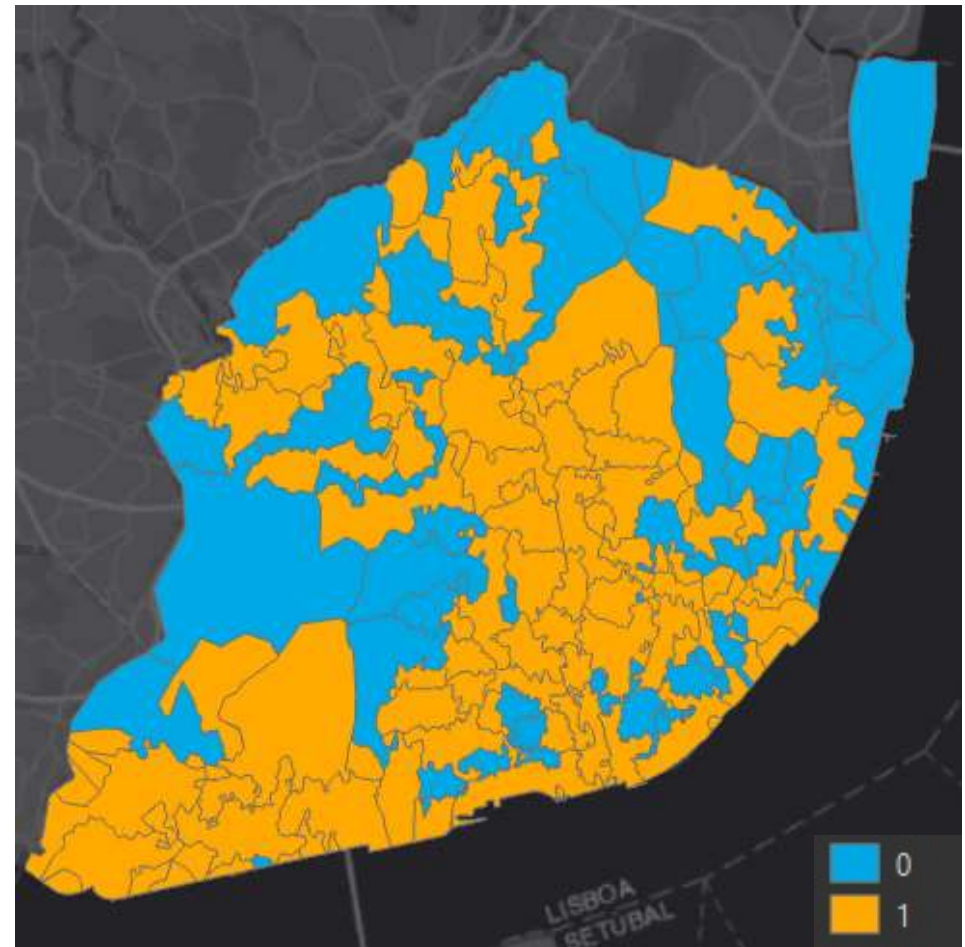




Urban hygiene	Calendar
Undifferentiated waste collection freights	Holidays and weekends
Waste collection points	

# Pré-processing

- 4 years of undifferentiated waste collection data (2017 – 2020)
- Aggregated to 97 waste collection circuits on a weekly basis
- 2 clusters of circuits



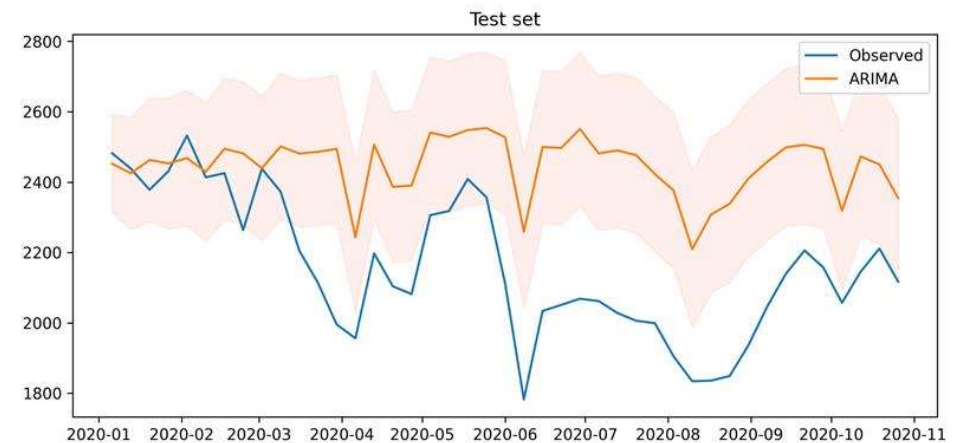
# Modeling and evaluation

## SARIMAX model

- Seasonal component
- 1 exogenous variables
- 2 clusters of circuits

Cluster	MAE	MAPE
0	134 t	14% (good forecast)
1	292 t	12% (good forecast)

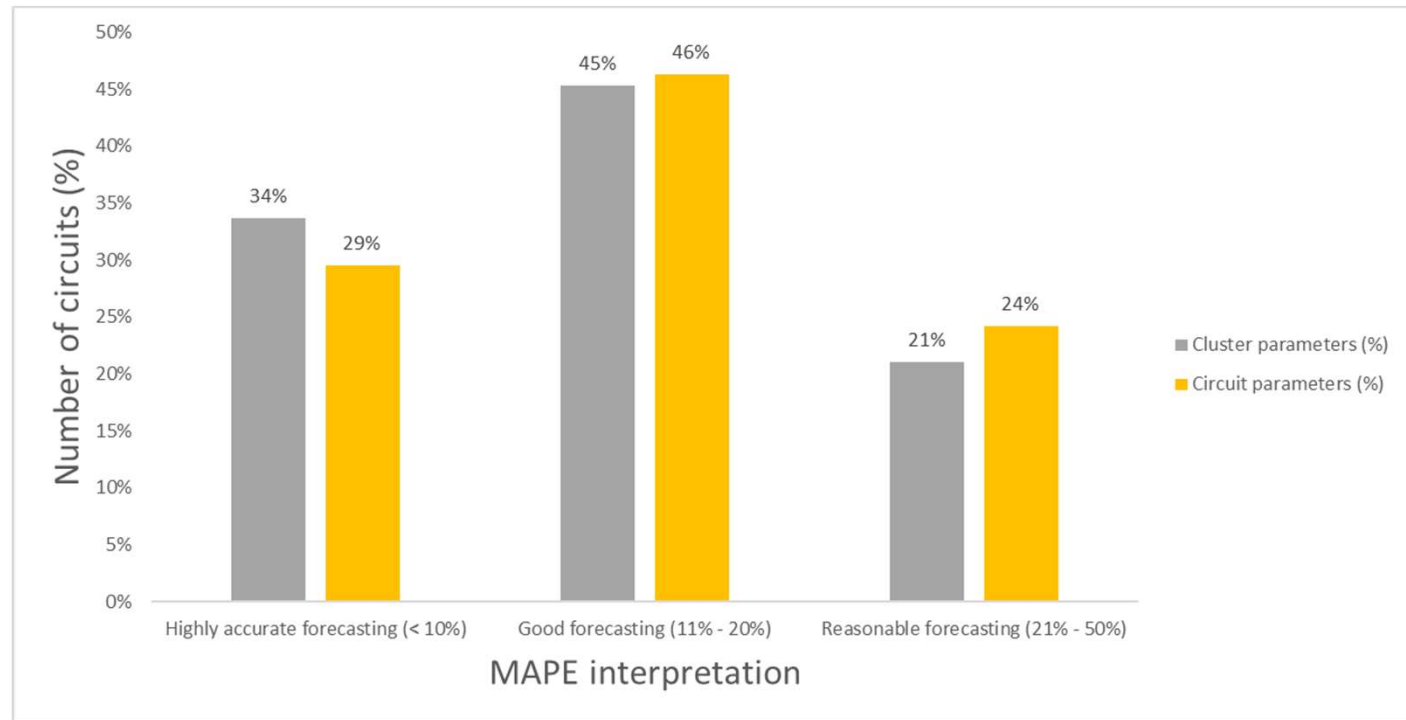
The models are capable of forecasting waste produced at cluster level **with an error varying between 134 t and 292 t on a weekly basis**



# Modeling and evaluation

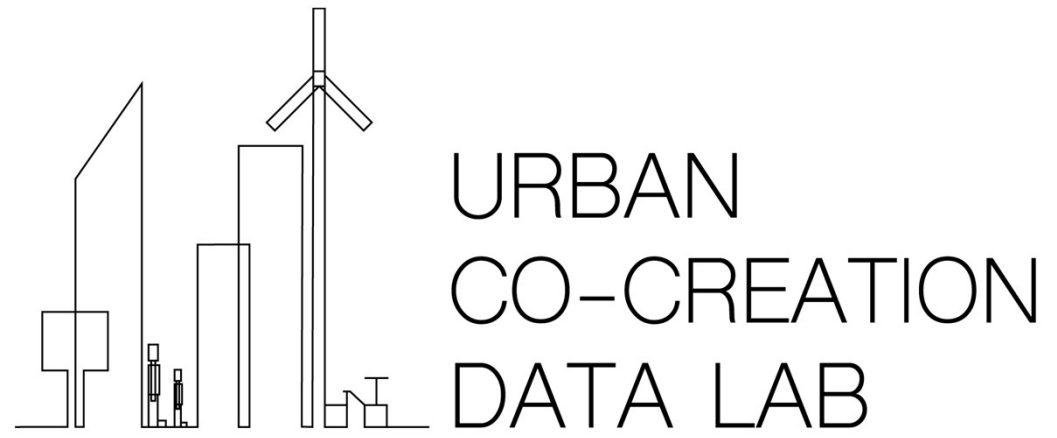
## SARIMAX model

- Seasonal component
- 1 exogenous variables
- 97 circuits
- Training with parameters defined at cluster and circuit level



# Next steps

- All models at circuit level will be **deployed in Lisbon**







# Parking

# Research question

Where and at what time of day is **expected to exist a higher number of illegalities** regarding irregular parking?



# Data

			
Parking	Infrastructures	Mobility	Calendar
Irregular parking occurrences	Roads	Waze jams	Business days

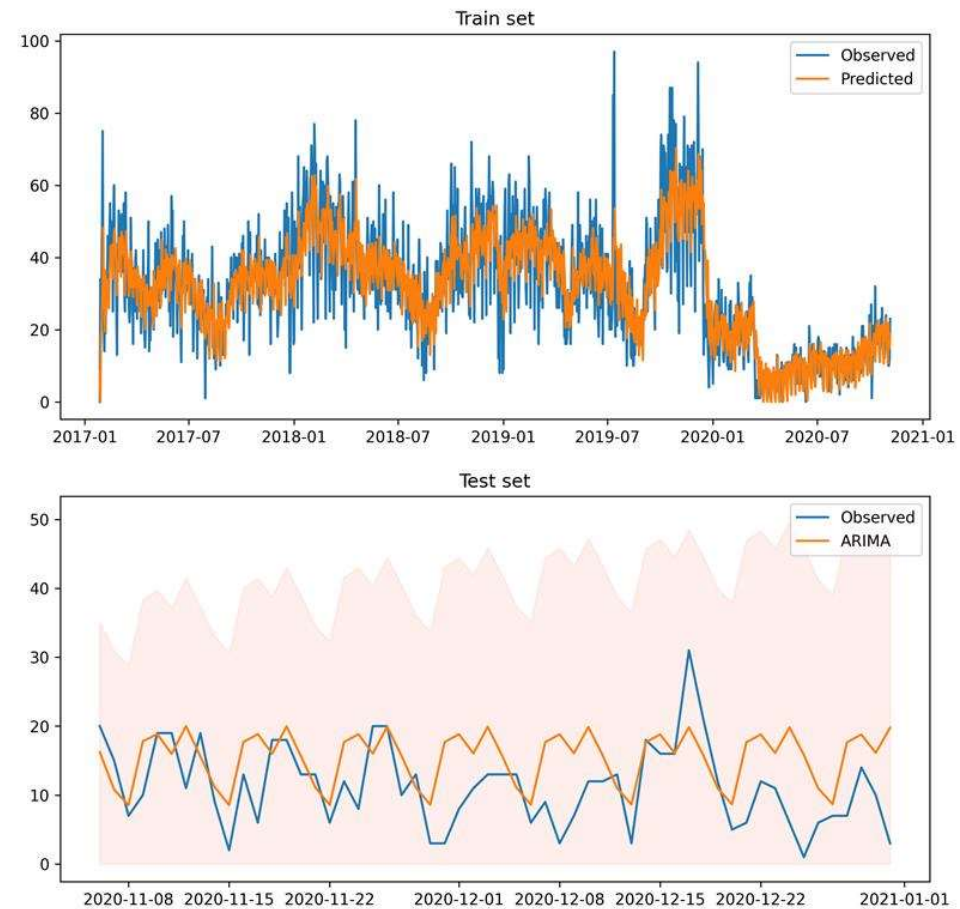
# Pré-processing

- 4 years of irregular parking occurrences between 2017 and 2020
- 89126 irregular parking occurrences aggregated to 4860 streets



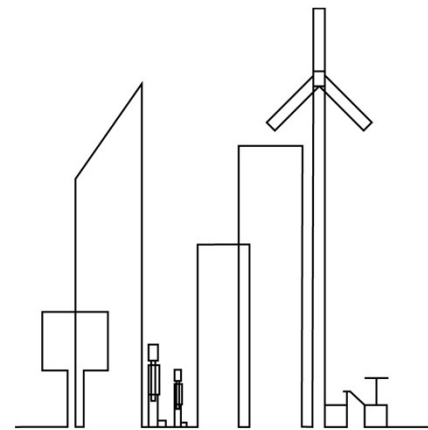
# Modeling and evaluation

- Due to the sparse number of occurrences along the time period, **several time aggregation schemes are being tested (business hours, day)**
- The model **identifies some cycles with seasonality (weekly cycles)** when data is aggregated daily
- It is missing more explanatory variables **that vary along time and space** to model correctly weekdays



# Next steps

- Train the models with **different time aggregation levels**
- Check if **traffic jams and weather data** are also explanatory variables regarding irregular parking (variables that vary in time and space)
- Experiment ML classification models



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# Pollution

# Research question

How is the propagation of nitrobenzene and methane in the city, in case of an accident?



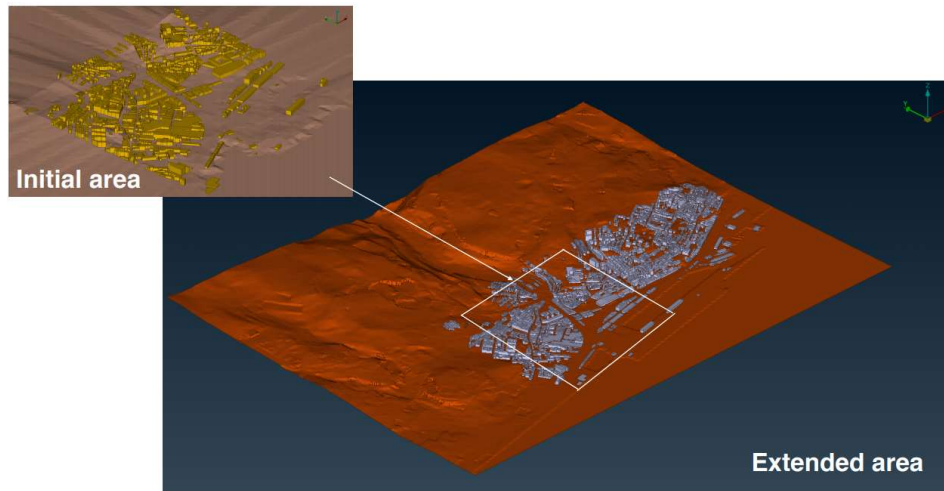
# Data



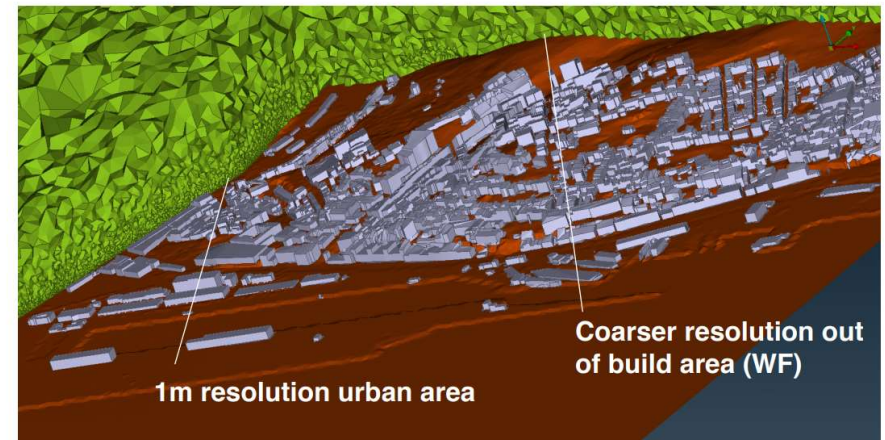
Environment	Infrastructures	Physical and chemical properties
Terrain	Buildings (3D)	Methane
Weather		Nitrobenzene

# Pré-processing

- 5 years of weather data (2013 – 2018)
- 3D buildings geometry mesh (Alcântara)
- 3D Terrain mesh (Alcântara)



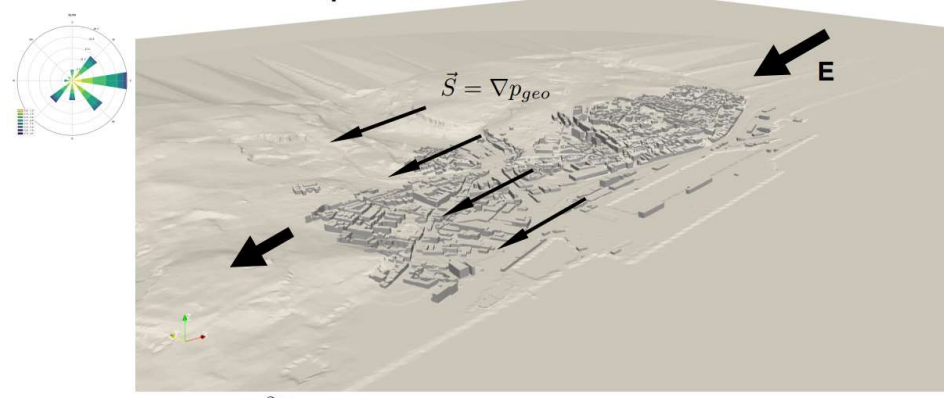
Mesh at street level:



# Modeling and evaluation

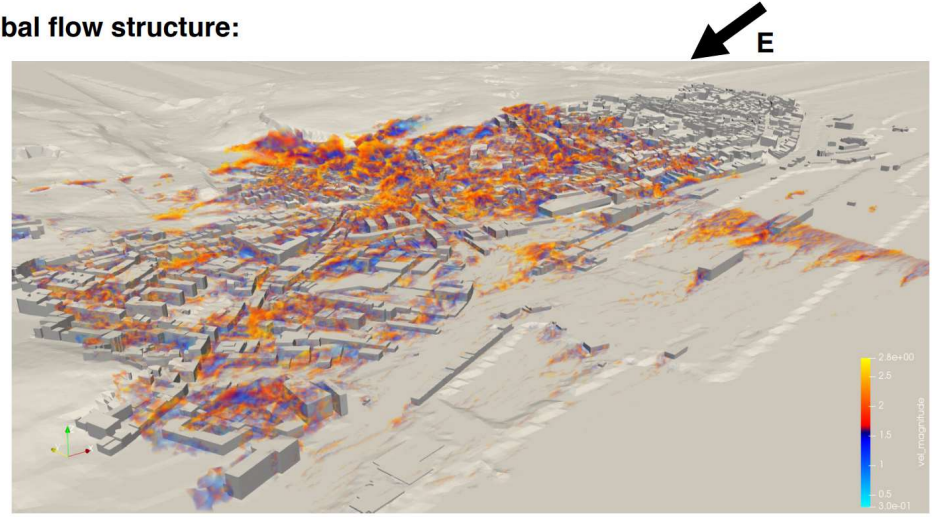
- Spatially filtered incompressible Navier-Stokes Equations
- Subgrid model: Vreman
- Wall model: Atmospheric Boundary layer with roughness
- Passive scalar transport

Initial test: East wind component



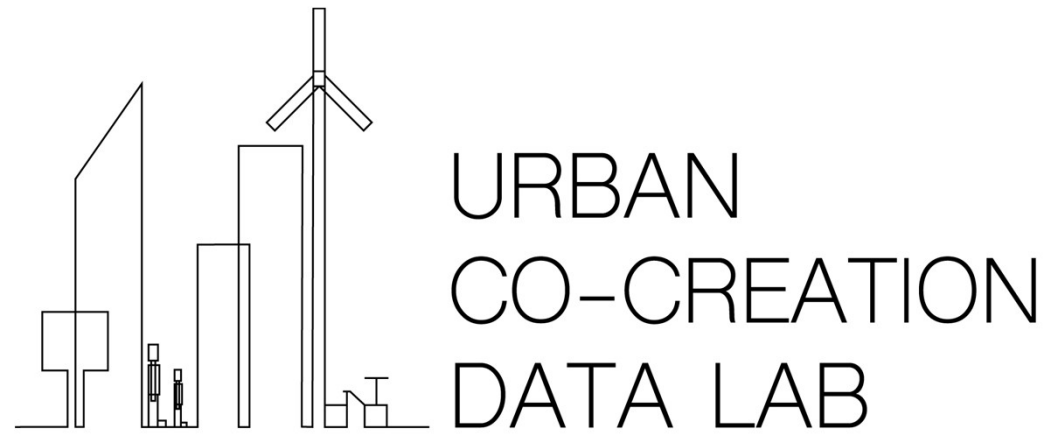
$$\frac{\partial \bar{u}}{\partial t} + (\bar{u} \cdot \nabla) \bar{u} = \nabla \cdot [2(\nu + \nu_{sgs})S(\bar{u})] - \nabla \bar{p} + \vec{S}$$

Global flow structure:



# Next steps

- Make the simulation with real weather
- Start the simulation for the propagation of nitrobenzene for Roma-Areeiro



# Emergency

# Research question

Where and at what time of day is **expected to exist a higher number of traffic accidents?**



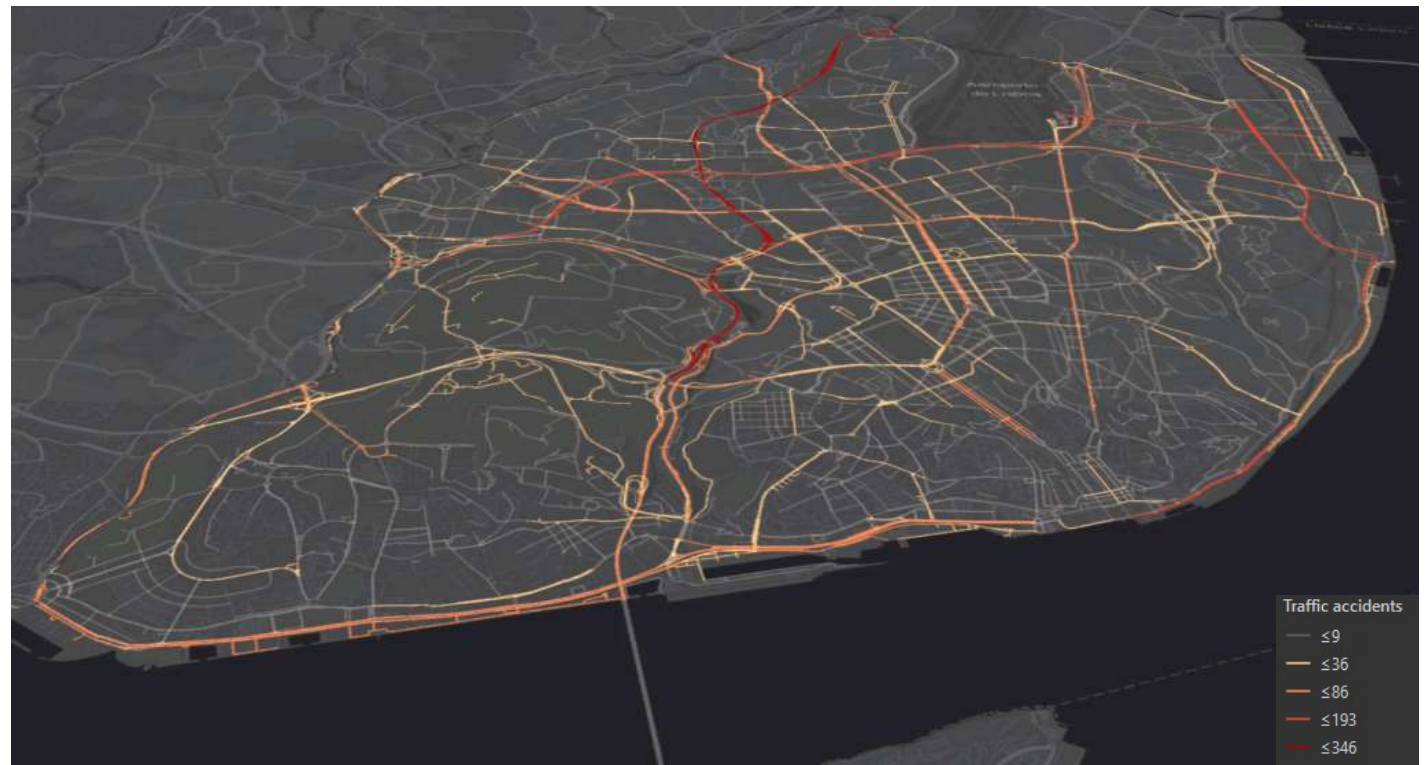
# Data



Emergency	Environment	Infrastructures	Calendar
Traffic accidents occurrences	Weather	Roads	Business days
		Roads slope	
		Intersections with traffic lights	

# Pré-processing

- 7 years of traffic accidents (2013 – 2020)
- 6076 traffic accidents aggregated to 4860 streets



# Modeling and evaluation

## In development



# A2 Services analytics refinement and HPC preparation

## T2.2 HPC and services set-up and deployment

- CML is providing the access to the H2O platform to start the models deployment
- NEC is developing the user interface of the analytical services (at this moment for micromobility)
- AMA is testing the compliance with the Metadata Quality Assessment for a dataset (to extend the methodology to all datasets used in the project that will be made available via Lisbon Open Data Portal)

D2.3 Lisbon use cases implementation in CML platform (delayed)

D2.4 Validation of datasets per service with the European Data Portal (30/09/2021)

# A3 Co-Creation Labs: perform experiences and validation by cities

## T3.1 Expand Co-Creation Labs: methodology, framework and technological tools definition (two additional pilot city sites)

- Region of Córdoba accepted integrate the project. The list of data needed for the development of each use case was sent so they can evaluate if they have the data to develop each use case.
- Rotterdam was invited but didn't provided any feedback

## T3.2 Coordination of Co-Creation Labs: use cases implementation (in the two participating cities)

D3.1 Report on Co-creation labs: methodology framework and technological tools (delayed)

D3.2 Report on the legal and regulatory frameworks applicable to open data collection in each city (delayed)

D3.3 Report of use cases implementation and performance in each city (30/09/2021)

D3.4 Recommendations for implementation: handbook for smart cities Co-creation labs (30/09/2021)

# Urban Co-Creation Data Lab workshop

- Encourage smart cities experts and researchers to present their research regarding the UCD Lab challenges to improve the developed analytical models
- Present the results of the application of the methodology applied to Lisbon using the data of 2 invited cities

# Urban Co-Creation Data Lab workshop

14 – 16 July 2021 @ NOVA IMS – Lisbon – Portugal & remotely via Teams

**During the three-day workshop will be made a presentation for each challenge:**

- by each city (Lisbon + 2 European cities (Córdoba region and ?))
- 3 invited researchers

## Submission guidelines

- Papers should be written in English accordingly with the guide for authors of Sustainability journal
- 1st Author CV
- All abstracts and CVs will be evaluated by a panel of experts from academia and city managers
- Authors of accepted abstracts will be encouraged to submit a full paper in the special issue “Urban Analytics and Creation of Services for Sustainable Cities” of journal Sustainability that will be funded by the project
- Expenses related with accommodation, travel and publication are covered

# Urban Co-Creation Data Lab workshop

## Draft program

### DAY 1

14 July	
9h00	<b>Opening (NOVA IMS + partners)</b>
	<b>Session 1 - Micromobility</b>
9h30	UCD Lab Lisbon
9h50	UCD Lab EU city 1
10h10	UCD Lab EU city 2
10h30	<b>Coffee break</b>
11h00	Researcher 1
11h20	Researcher 2
11h40	Researcher 3
12h00	Brain storming
13h00	<b>Lunch</b>
	<b>Session 2 – Waste management</b>
14h00	UCD Lab Lisbon
14h20	UCD Lab EU city 1
14h40	UCD Lab EU city 2
15h00	<b>Coffee break</b>
15h30	Researcher 1
15h50	Researcher 2
16h10	Researcher 3
16h30	Brain storming

### DAY 2

15 July	
	<b>Session 3 - Parking</b>
9h30	UCD Lab Lisbon
9h50	UCD Lab EU city 1
10h10	UCD Lab EU city 2
10h30	<b>Coffee break</b>
11h00	Researcher 1
11h20	Researcher 2
11h40	Researcher 3
12h00	Brain storming
13h00	<b>Lunch</b>
	<b>Session 4 - Pollution</b>
14h00	UCD Lab Lisbon (BSC)
14h20	UCD Lab EU city 1
14h40	UCD Lab EU city 2
15h00	<b>Coffee break</b>
15h30	Researcher 1
15h50	Researcher 2
16h10	Researcher 3
16h30	Brain storming

### DAY 3

16 July	
	<b>Session 5 - Emergency</b>
9h30	UCD Lab Lisbon
9h50	UCD Lab EU city 1
10h10	UCD Lab EU city 2
10h30	<b>Coffee break</b>
11h00	Researcher 1
11h20	Researcher 2
11h40	Researcher 3
12h00	Brain storming
13h00	<b>Lunch</b>
	<b>Conclusion and recommendations</b>
14h00	Micromobility
14h15	Waste management
14h30	Parking
14h45	Pollution
15h00	Emergency
15h15	Debate
16h00	<b>Closure</b>

# Urban Co-Creation Data Lab workshop

## Important dates

- **21 May 2021:** Deadline for full papers and CV submission
- **16 June 2021:** Application results communication to authors
- **23 June 2021:** Invitations to assist with the final version of the program (academia, municipalities) and reservations (accommodation and trips)
- **14 - 16 July:** Workshop
- **31 Sep 2021:** Deadline paper submission in the Sustainability journal special issue

# A3 Co-Creation Labs: perform experiences and validation by cities

## Organization Urban Co-Creation Data Lab workshop

- Number of papers submitted to the call?
- Presential or remote (18 – 21 May 2021)?
- Invite a second city

# A4 Dissemination and Communication of results

T4.1 Dissemination and Communication strategy and set up dissemination channels and material

T4.2 Implementing Dissemination & Communication activities

T4.3 Monitor and measure impact of dissemination activities and other measurable impact objectives

# A4 Dissemination and Communication of results

- Find solutions for UN SDG – Sustainable cities and communities
- Aligned with use cases from UCD Lab using open data from other cities

The image shows a screenshot of the World Data League website. The page has a green header with the WDL logo on the left and navigation links for Home, The League, About us, and FAQ on the right. The main content area features a large green background with a circular inset image of four people (three women and one man) looking at a laptop. The text on the page reads: "World Data League" in white, followed by "The quest to find the best data scientists by solving social-oriented problems." in white and pink. Below this, a calendar icon is next to the text "League April and May 2021" and "Finals July 2021". At the bottom left, there is a button labeled "Rules".

# A4 Dissemination and Communication of results

## Publications

Challenge	Journal	Status
#1 Micromobility	Transportation Research Part C: Emerging Technologies	Draft
#2 Waste management	Waste management	Draft
#3 Parking	Transportation	To initiate
#5 Emergency	Accident Analysis & Prevention	To initiate

# A5 Future sustainability

T5.1 Exploitation possibilities analysis

T5.2 Exploitation and Sustainability Planning

D5.1 Report for all services (identification of viable business models and willingness to buy verified) (30/07/2021)

# Critical tasks for the last semester

- Finish the analytical models for #3 – Parking, #4 - Pollution and #5 – Emergency (NOVA IMS and BSC)
- Analytical models disclosed via Lisboa Aberta (CML and NOVA IMS)
- H2O platform ready to deploy the models in Lisbon (CML)
- Development of the user's interface for each service in Lisbon (NEC)
- Start the metadata quality assessment (AMA?)
- Invite a second city to participate in the project (consortium)
- Test the methodology with the data from Córdoba and city 2 (NOVA IMS)
- Workshop organization (consortium)

# Questions ?