Web-based Air Quality Screening Tool for Near-port Assessments: Example of Application in Porto, Portugal

Vlad Isakov, Timothy Barzyk
U.S. EPA, ORD, National Exposure Research Laboratory, Research Triangle Park, North Carolina, USA

Saravanan Arunachalam, Brian Naess, Catherine Seppanen
UNC Chapel Hill, Institute for the Environment, Chapel Hill, North Carolina, USA

Alexandra Monteiro, Sandra Sorte
CESAM, Department of Environment, University of Aveiro, Portugal

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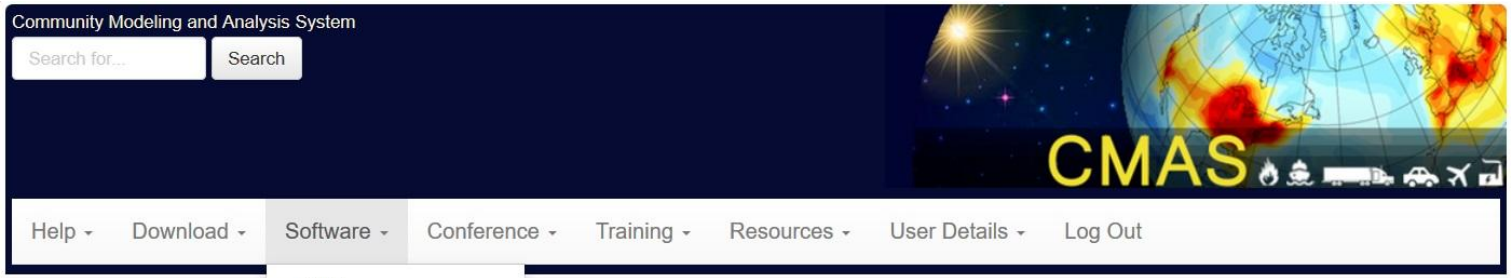
C-PORT Air Quality Screening Tool

- C-PORT web-based tool has been developed for estimating pollutant concentrations related to port-related activities at fine spatial scales in the near-source environment *
- C-PORT is designed to conduct these assessments in rapid time, and to evaluate the impact of various emissions scenarios on-demand
- C-PORT has been developed and applied to areas within the U.S. to date
- We are expanding the C-PORT capabilities so that it can be applied in other port areas outside the U.S., to study near-source pollution in an easy manner, and explore the benefits of improvements to air quality and exposures

* Env. Modeling & Software, 2017 (https://authors.elsevier.com/sd/article/S1364815216311367)

C-PORT: Web-based Air Quality Screening Tool



C-PORT: web-based screening tool

Model inputs:
- pre-loaded emissions
- pre-loaded meteorology

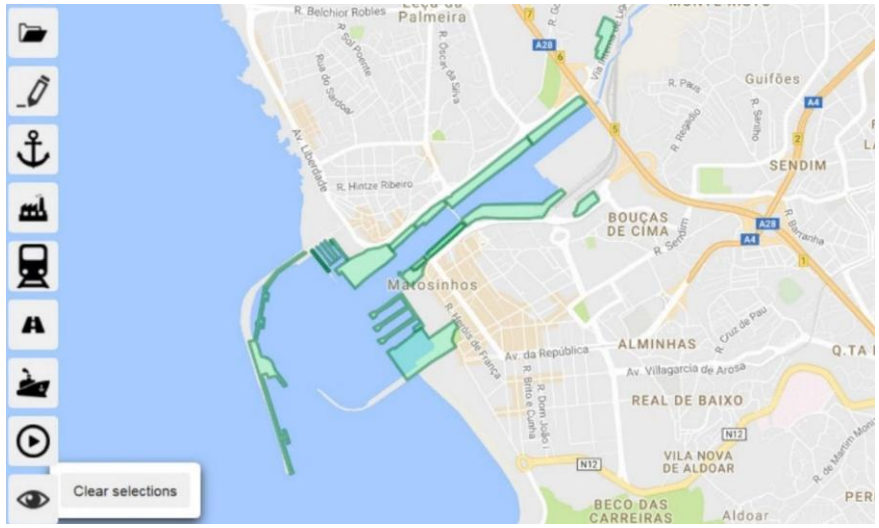
Dispersion algorithms for area, point, line sources related to freight-movement activities, and emissions from port terminals

Model outputs: geospatial maps

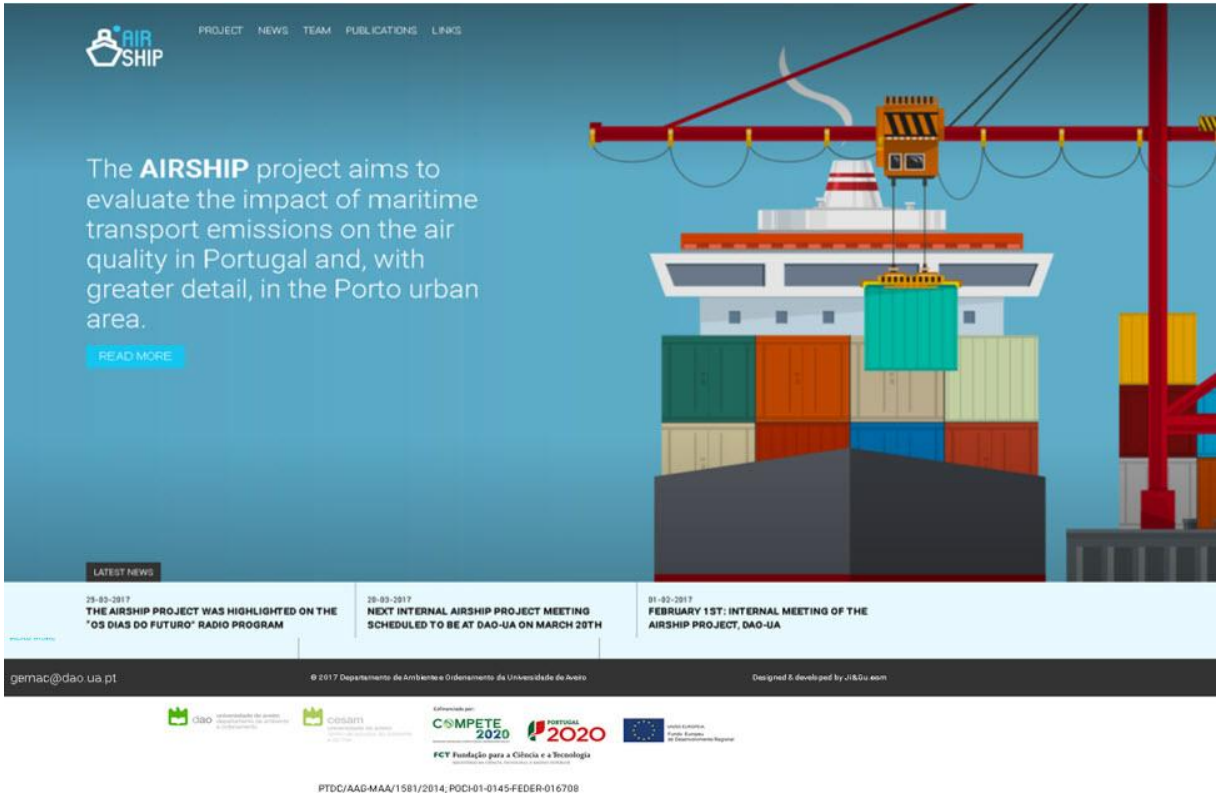
Analysis capabilities through easy-to-use GUI to assess air quality impacts of 'what if' scenarios

Example of application in Porto, Portugal

- C-PORT application in Port of Leixões as an illustration for extending to other ports of the world
- Discuss data needs for easy adaptation and implementation for new ports



The AIRSHIP project http://airship.web.ua.pt/



AIRSHIP project: 2016-2019

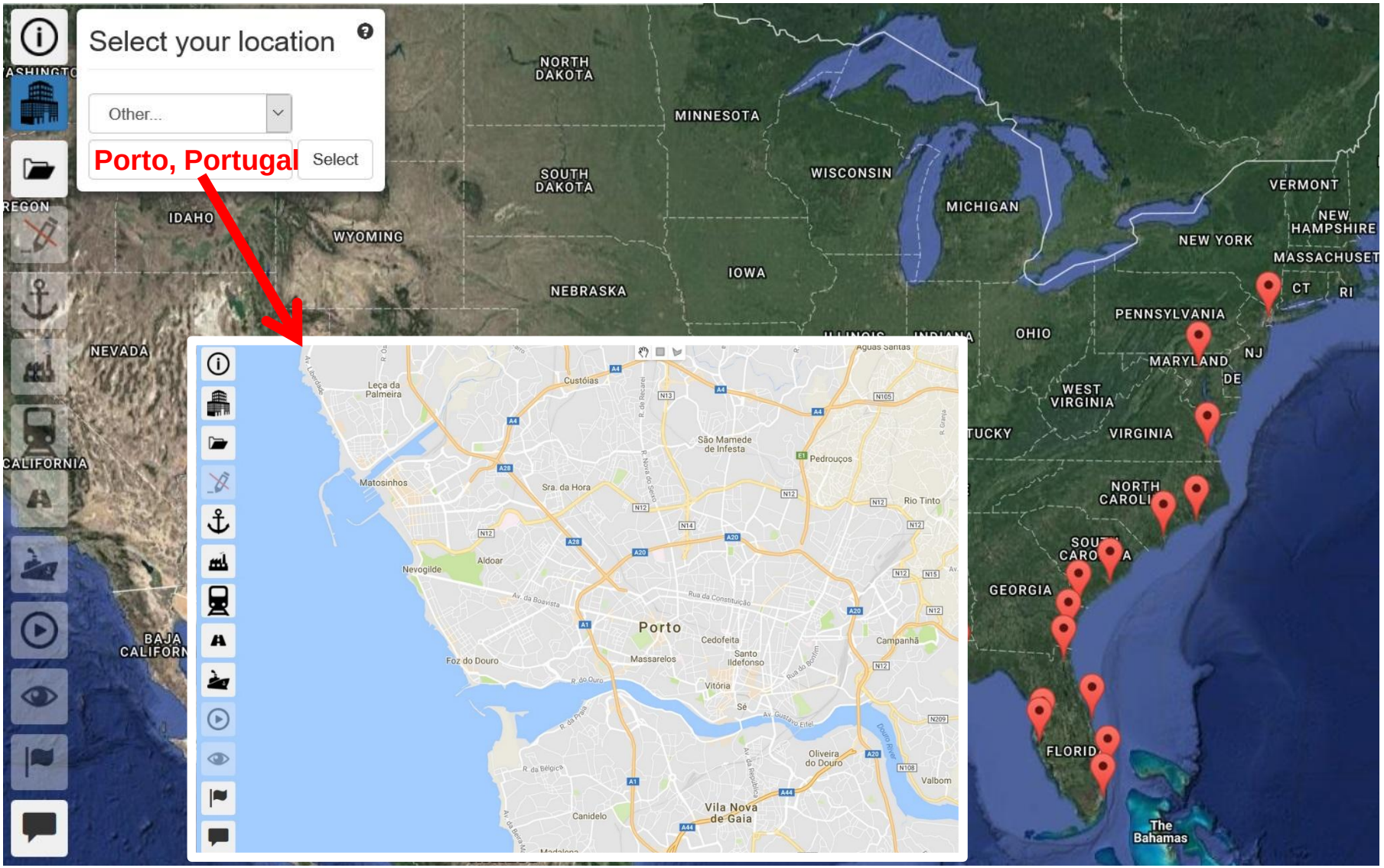
Task 1. Maritime transport emissions inventory and projections

Task 2. Impact of the maritime transport emissions on AQ over Portugal

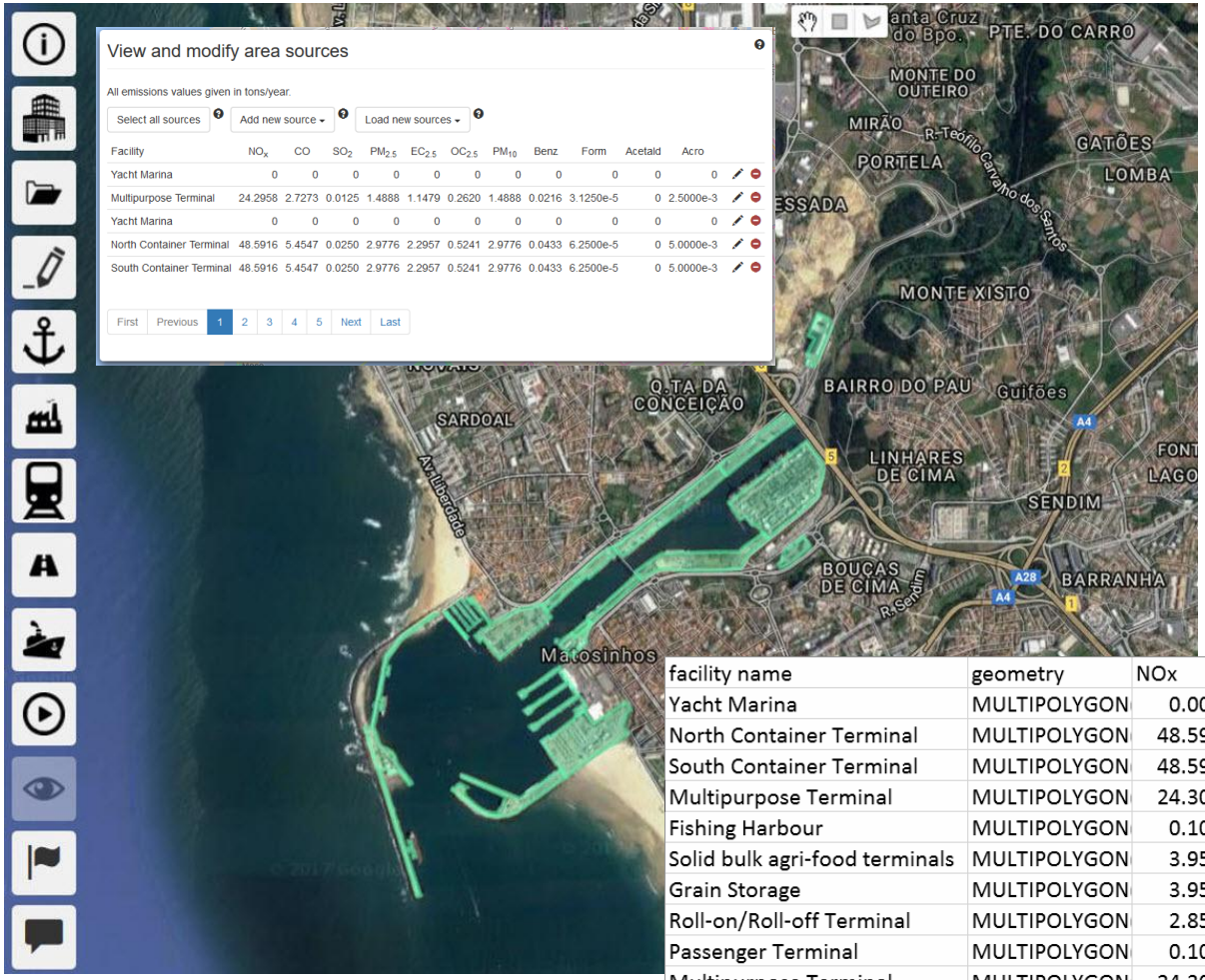
Task 3. Case study: Port of Leixões

Task 4. Guidelines about contribution of maritime transport to AQ strategy

First step: selecting modeling domain



Uploading emissions: port terminals

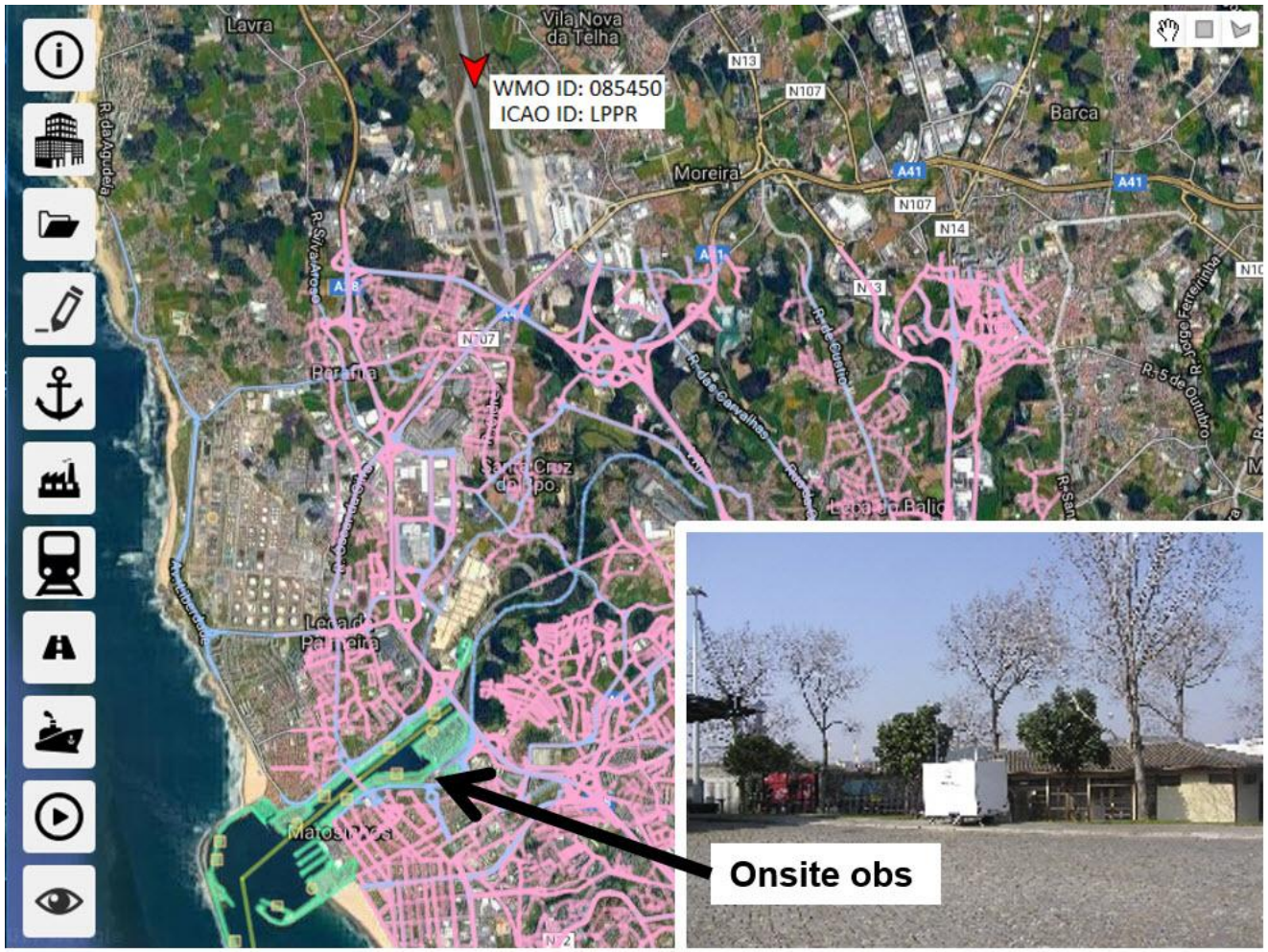


Example of input file

facility name	geometry	NOx	CO	SO2	PM 2.5	EC 2.5	OC 2.5	benzene	PM 10
Yacht Marina	MULTIPOLYGON	0.00	0.000	0.0000	0.000	0.000	0.000	0.0000	0.000
North Container Terminal	MULTIPOLYGON	48.59	5.455	0.0250	2.978	2.296	0.524	0.0433	2.978
South Container Terminal	MULTIPOLYGON	48.59	5.455	0.0250	2.978	2.296	0.524	0.0433	2.978
Multipurpose Terminal	MULTIPOLYGON	24.30	2.727	0.0125	1.489	1.148	0.262	0.0216	1.489
Fishing Harbour	MULTIPOLYGON	0.10	0.011	0.0001	0.006	0.005	0.001	0.0001	0.006
Solid bulk agri-food terminals	MULTIPOLYGON	3.95	0.444	0.0020	0.242	0.187	0.043	0.0035	0.242
Grain Storage	MULTIPOLYGON	3.95	0.444	0.0020	0.242	0.187	0.043	0.0035	0.242
Roll-on/Roll-off Terminal	MULTIPOLYGON	2.85	0.320	0.0015	0.175	0.135	0.031	0.0025	0.175
Passenger Terminal	MULTIPOLYGON	0.10	0.011	0.0001	0.006	0.005	0.001	0.0001	0.006
Multipurpose Terminal	MULTIPOLYGON	24.30	2.727	0.0125	1.489	1.148	0.262	0.0216	1.489
Cruise Terminal	MULTIPOLYGON	0.10	0.011	0.0001	0.006	0.005	0.001	0.0001	0.006
Cements Terminal	MULTIPOLYGON	3.95	0.444	0.0020	0.242	0.187	0.043	0.0035	0.242
Solid Bulk - Dock 1 South	MULTIPOLYGON	3.95	0.444	0.0020	0.242	0.187	0.043	0.0035	0.242
Oil Terminal	MULTIPOLYGON	3.95	0.444	0.0020	0.242	0.187	0.043	0.0035	0.242

Adding roadways, railways, point sources

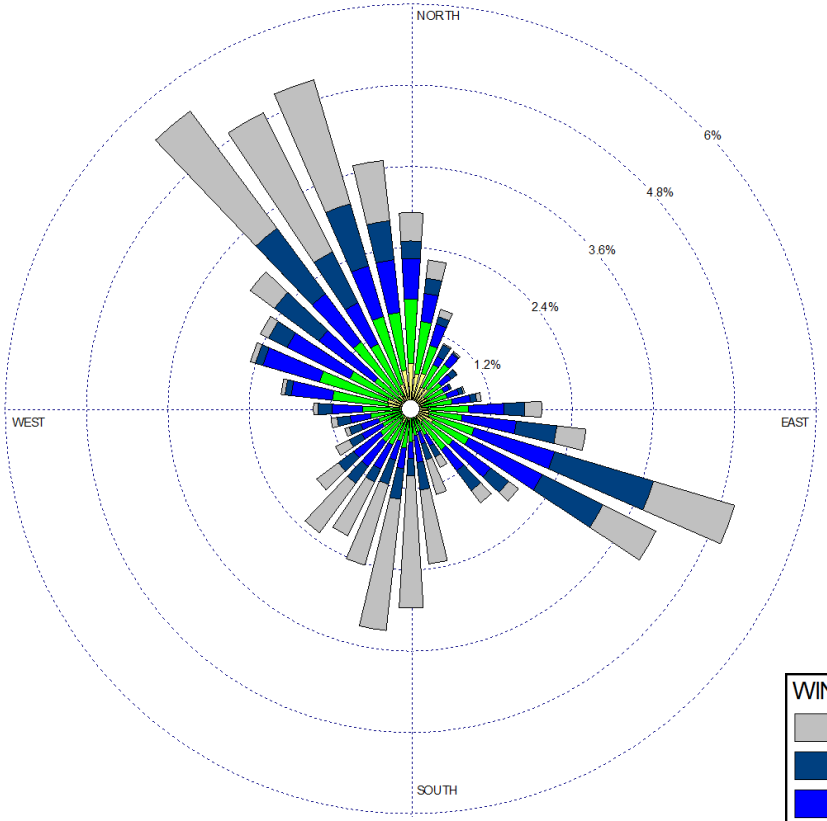
Meteorology used in C-PORT



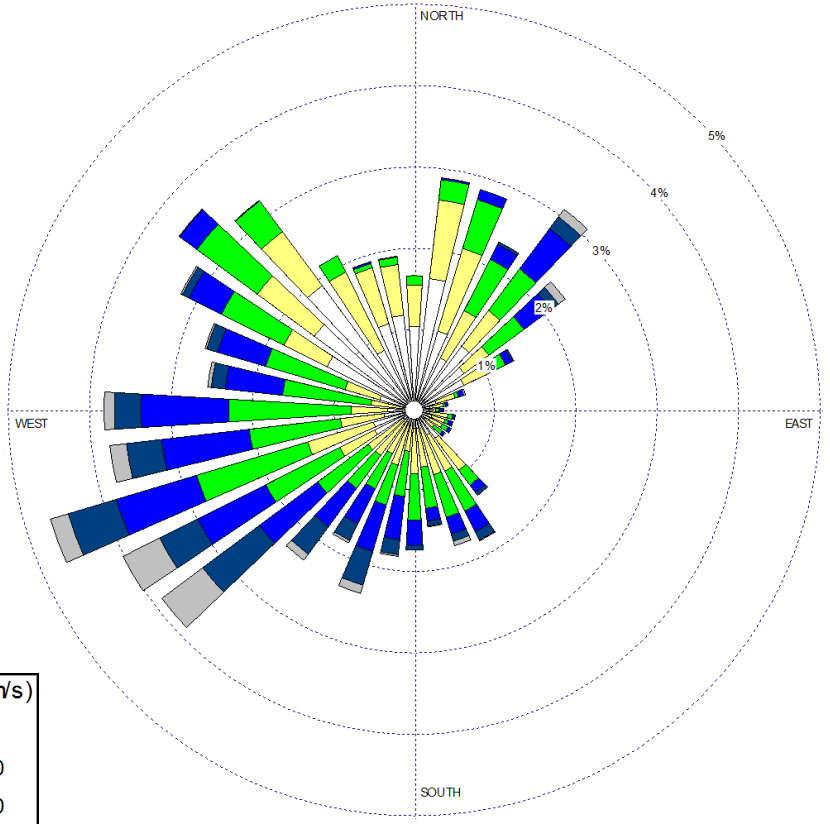
- Hourly observations from Porto Airport (085450, LPPR, 41.248/-8.681)
- Onsite observations for 2014-2016

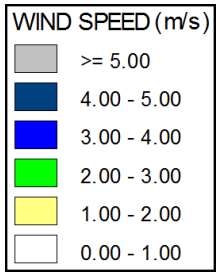
Meteorology: airport vs. onsite obs.

Porto airport 2016



Porto onsite 2016





Onsite observations 2014 - 2016

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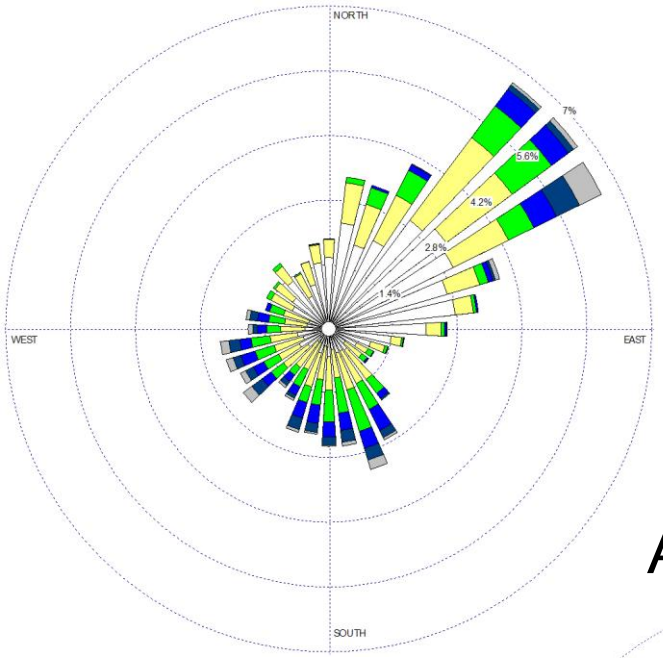
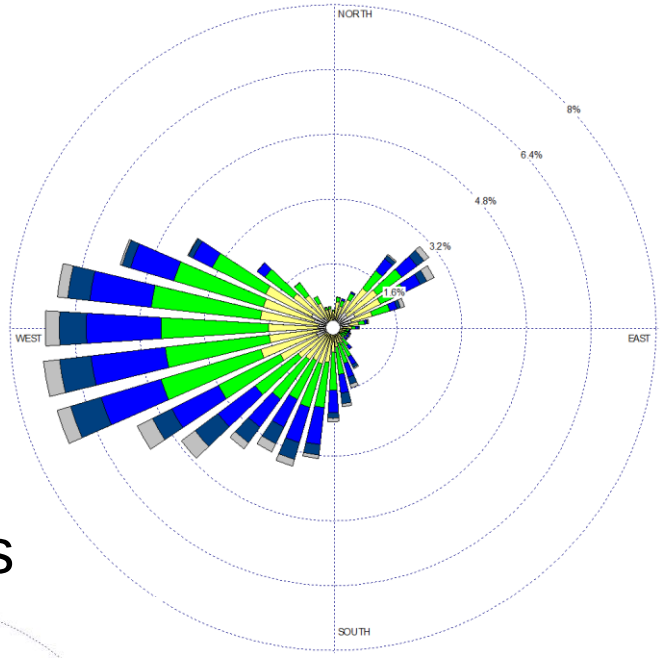
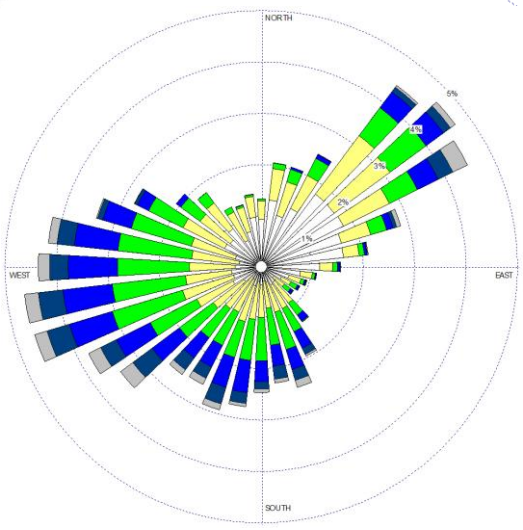
Nighttime (0 to 9am)



Daytime (10am - 8pm)

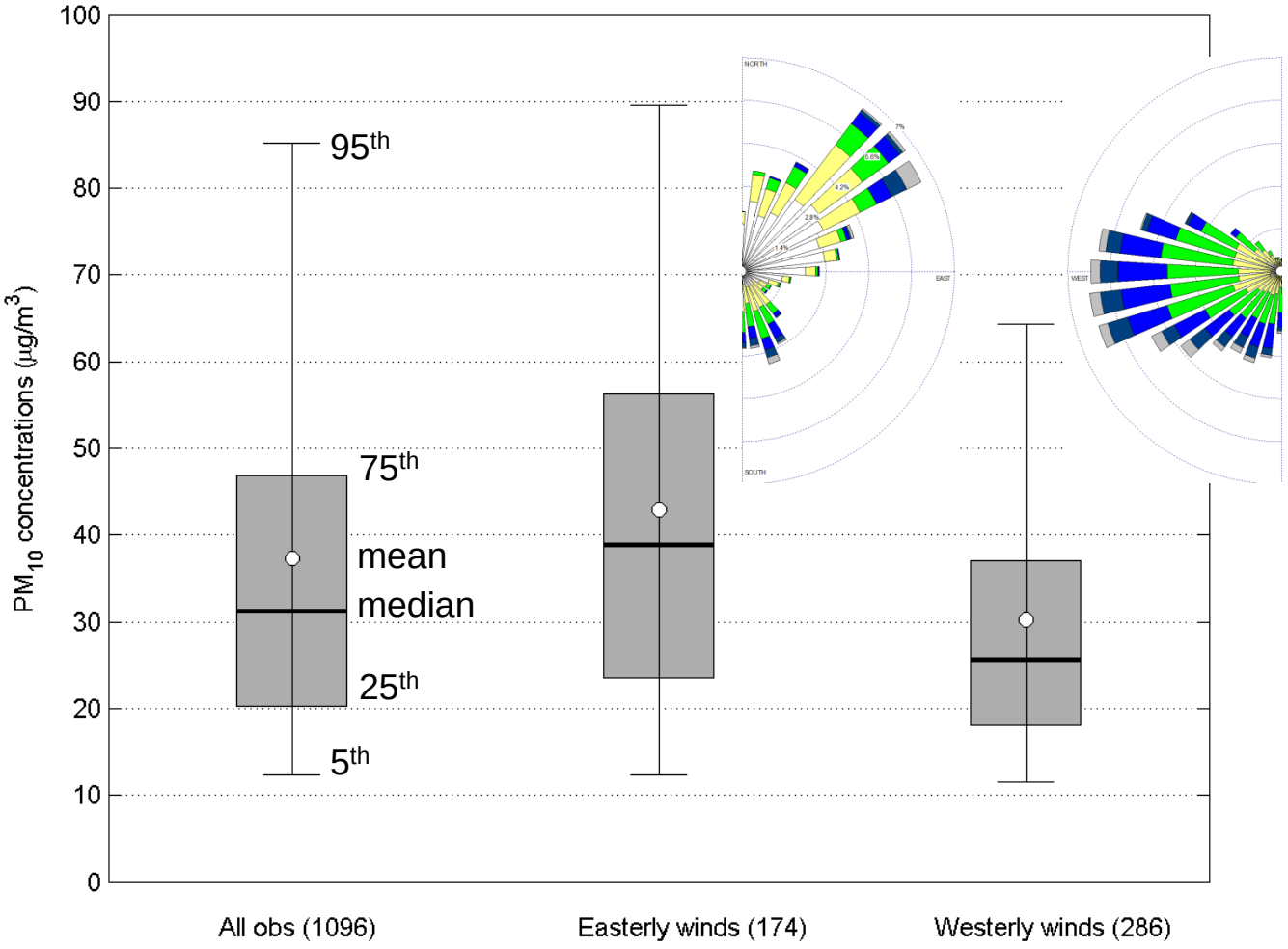


All hours



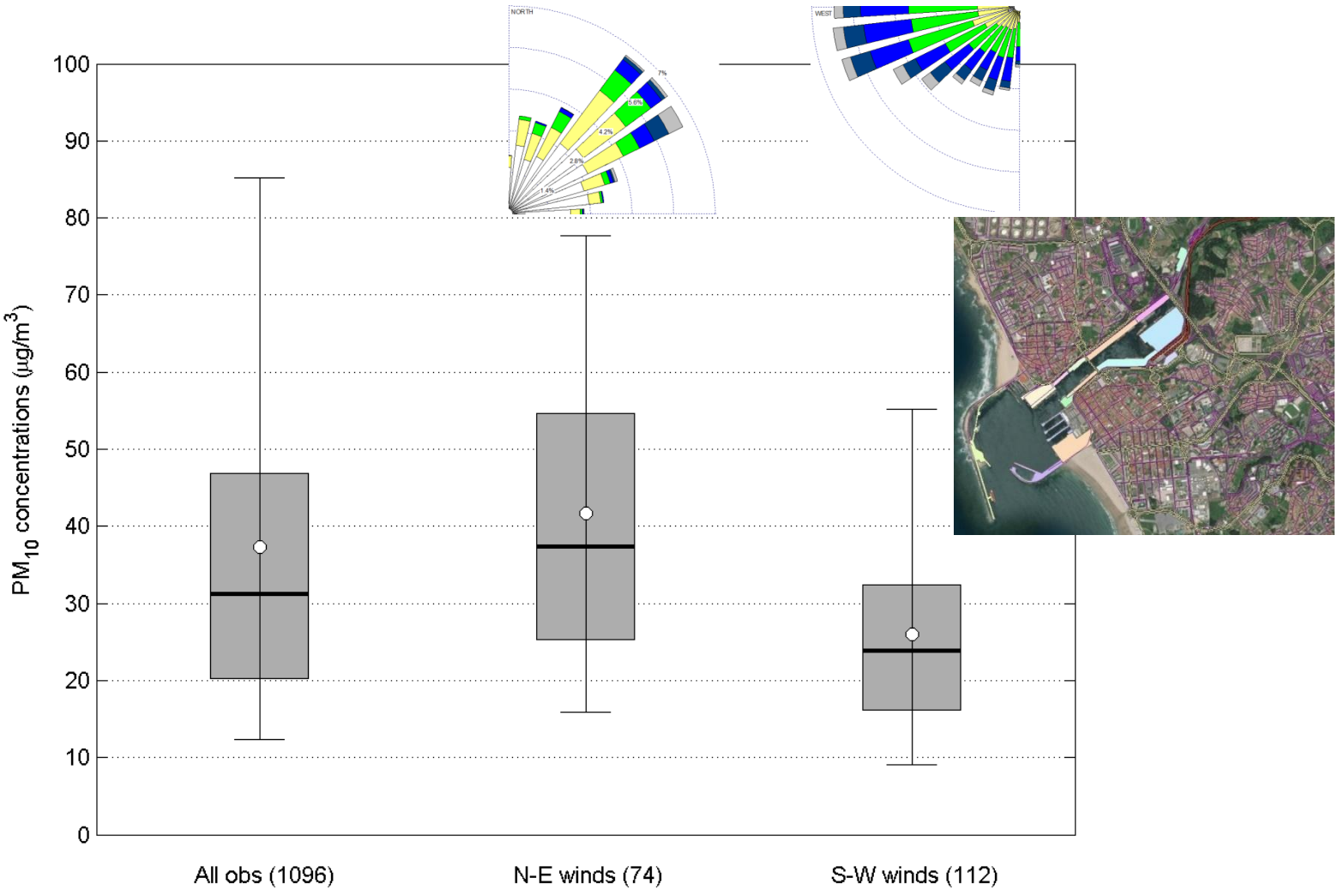
WIND SPEED (m/s)
- >= 5.00
- 4.00 - 5.00
- 3.00 - 4.00
- 2.00 - 3.00
- 1.00 - 2.00
- 0.00 - 1.00

PM_{10} measurements



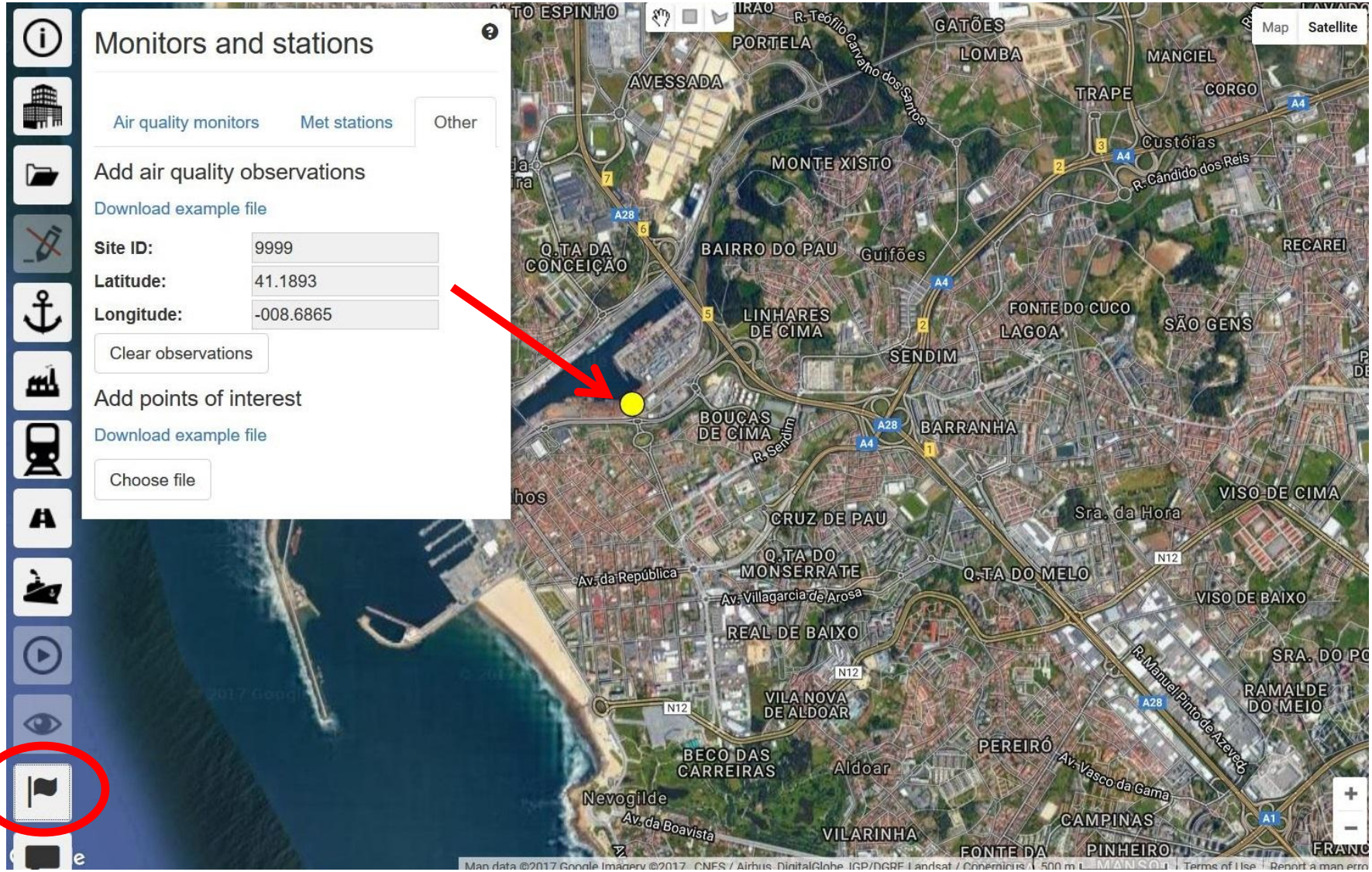
Note: wind direction analysis is based on hourly onsite observations, using 25-75 range (IQR) to determine prevailing wind direction for each day

PM_{10} measurements



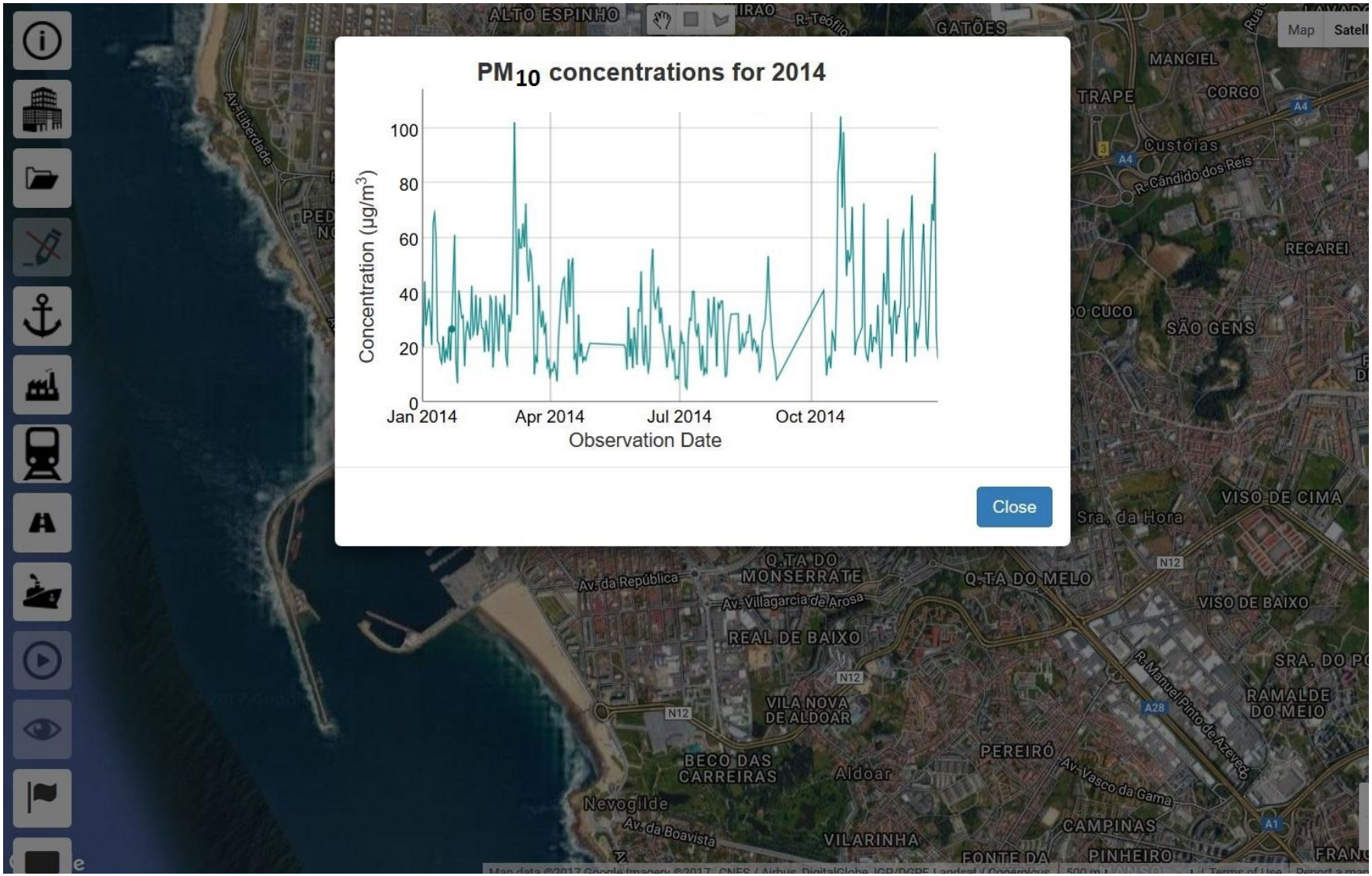
Note: wind direction analysis is based on hourly onsite observations, using 25-75 range (IQR) to determine prevailing wind direction for each day

Onsite observations in C-PORT



Summary statistics

Time series


PM10 concentrations for 2014
Concentration (µg/m3)
0
20
40
60
80
100
Jan 2014
Apr 2014
Jul 2014
Oct 2014
Observation Date
Close
ALTO ESPINHO
GATÕES
MANCIEL
TRAPE
CORGO
Custóias
RECAREI
SÃO GENS
VISO DE CIMA
Sra. da Hora
Q.TA DO MONSERRATE
Q.TA DO MELO
VISO DE BAIXO
REAL DE BAIXO
VILA NOVA DE ALDOAR
RAMALDE DO MEIO
BECO DAS CARREIRAS
Aldoar
PEREIRÓ
Nevogilde
VILARINHA
CAMPINAS
PINHEIRO
Av. da República
Av. Villagarcia de Arosa
Av. Vasco da Gama
R. Manuel Pinto de Azevedo
Av. da Boavista
Av. Liberdade
R. Cândido dos Reis
N12
A4
A28
A1

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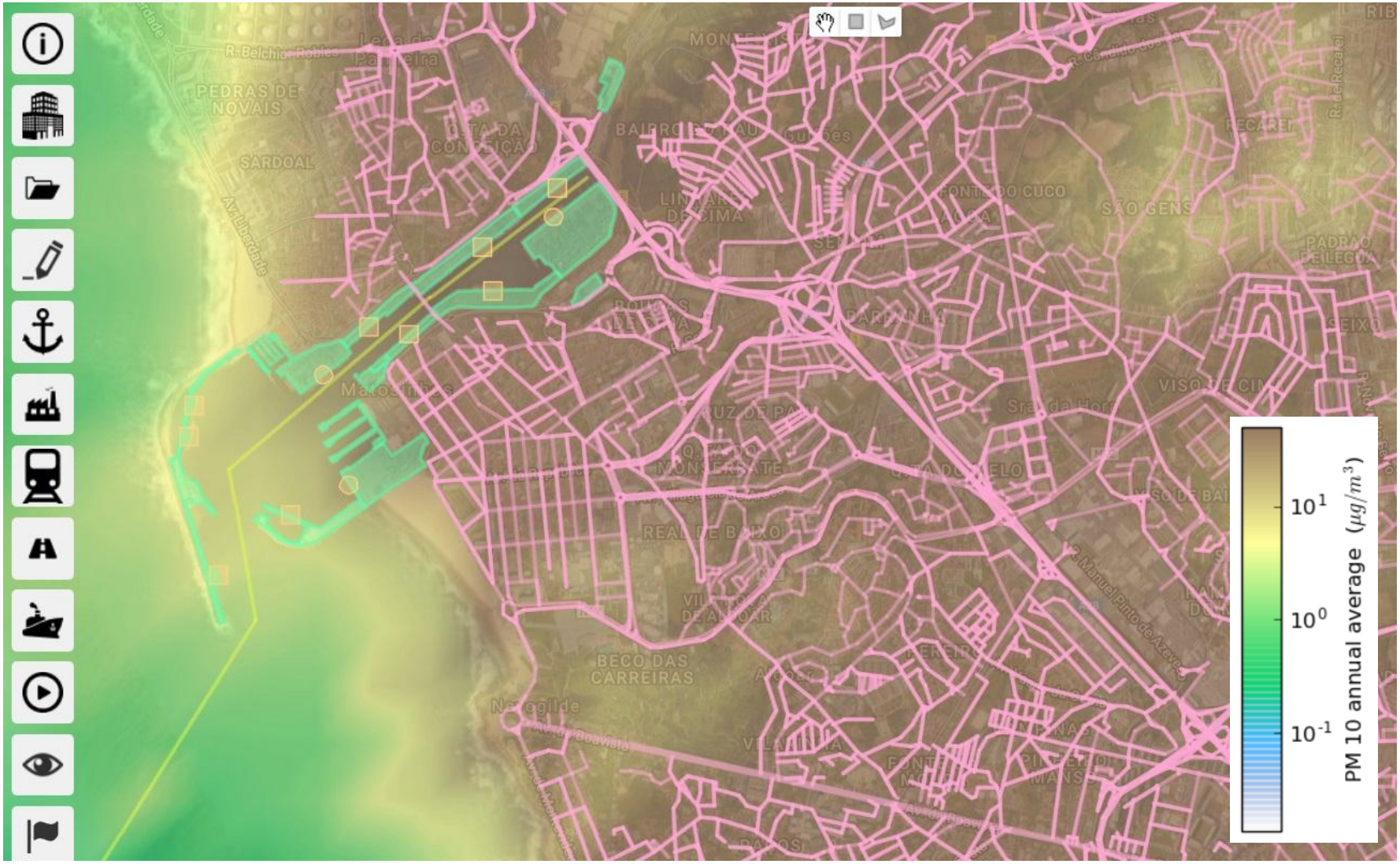
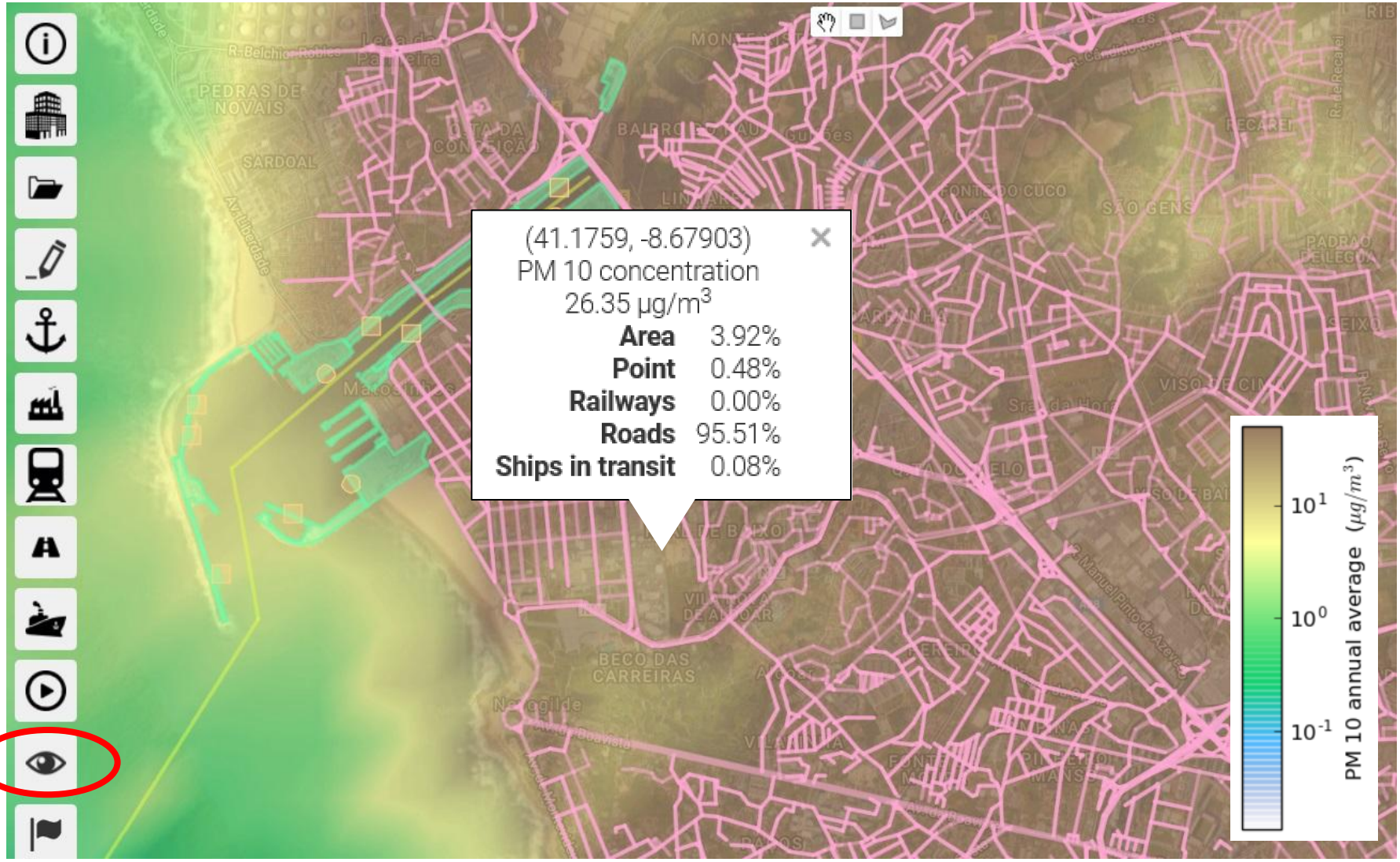
Examples of C-PORT results

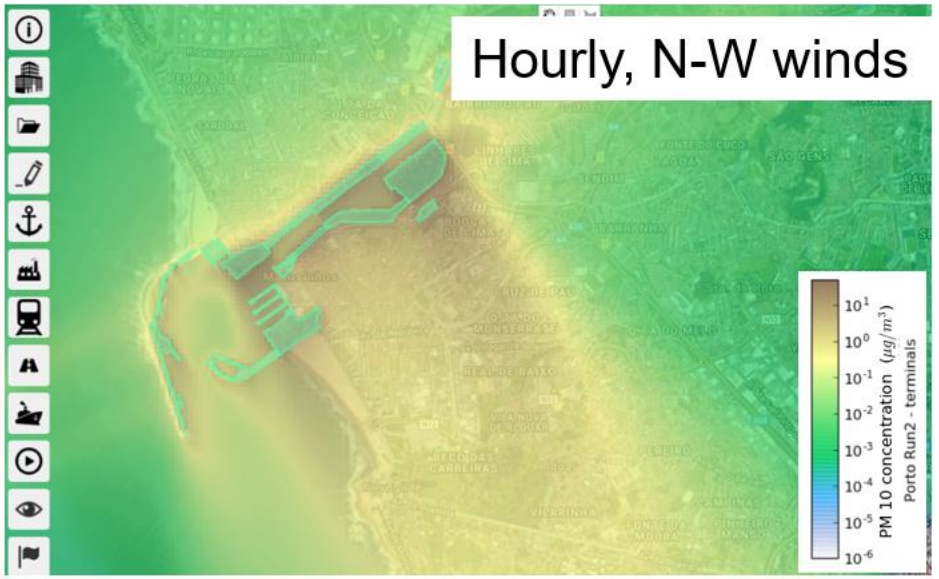
C-PORT Results: All Sources



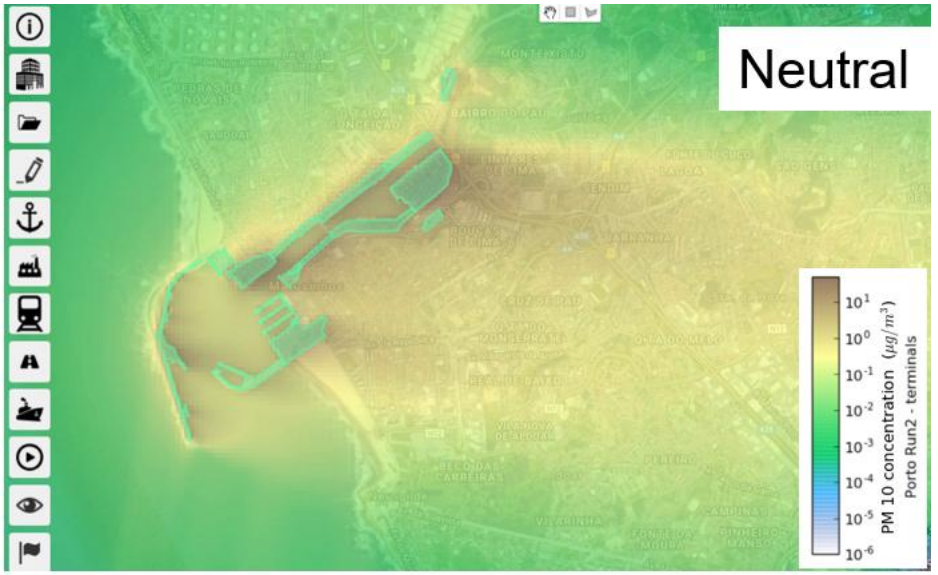
“Inspect” mode in C-PORT



Analyzing impact of wind direction



Analyzing impact of stability



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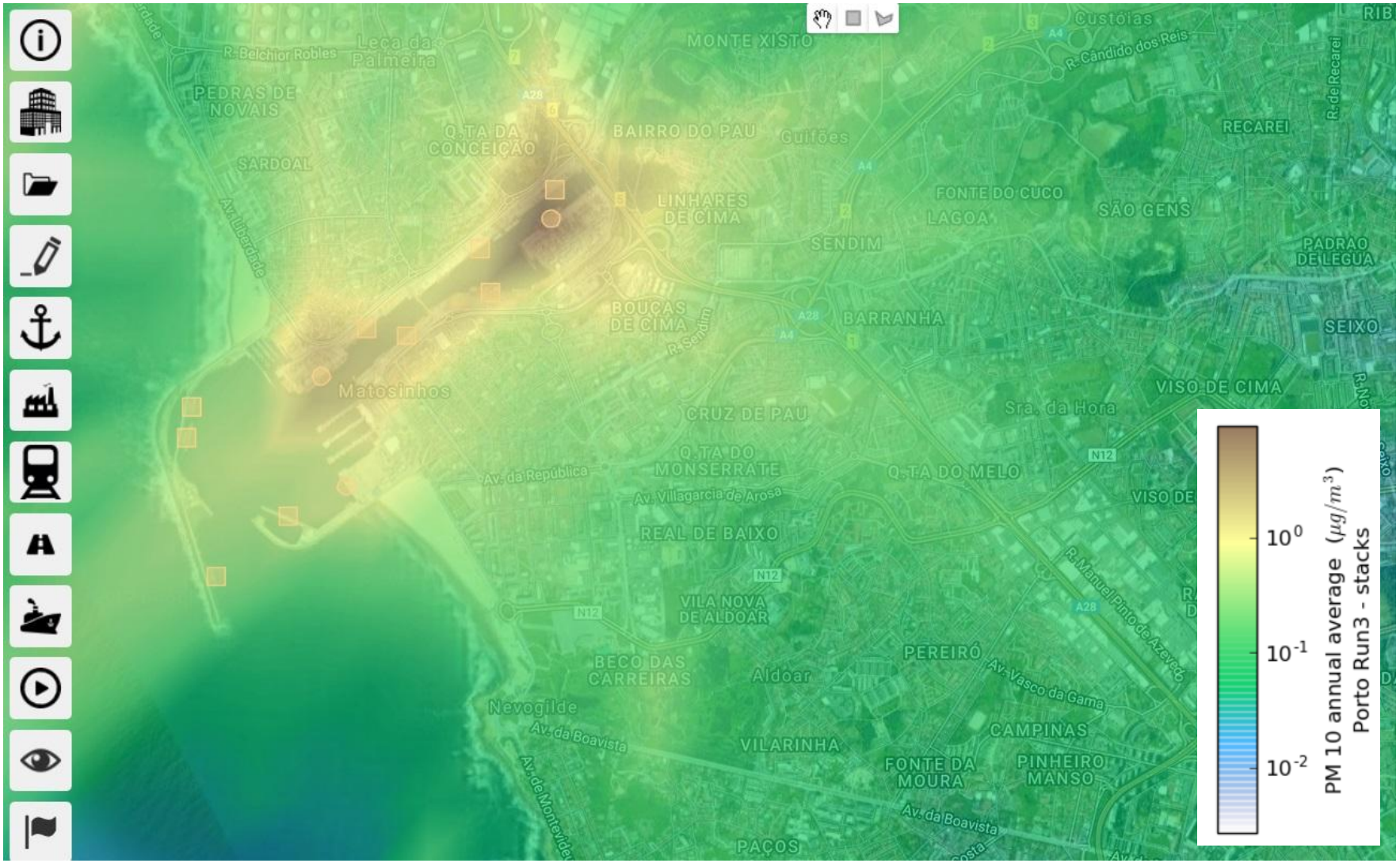
Analyzing impact of various source sectors

Port terminals

Docked ships and other stationary sources



Ships-in-transit

Roadways


PEDRAS DE NOVAIS
SARDOAL
BECO DAS CARREIRAS
10^{1}
10^{0}
10^{-1}
10^{-2}
PM 10 annual average $(\mu g/m^3)$
Porto Run8 - roads

Summary

- C-PORT application in Port of Leixões – an illustration for extending to other ports of the world

- C-PORT allows the user to estimate relative contributions of various source sectors: terminals, ships, roadway traffic and other port-related sources potentially affecting the local community

- C-PORT allows to change the meteorological conditions in order to estimate the range of changes in pollutant concentrations related to different conditions, and the extent the local sources would impact different neighborhoods around the port

- Furthermore, the user can change activity related to each source type using the web-based GUI, and assess the impacts of these changes in activity / emissions on ambient pollutant concentrations that can be further be used to develop mitigation options in support of the AIRSHIP study

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