



CREATE-SOL-1: Multi-scale multi-pollutant air quality system

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CREATE Final exploitation event

Naples, 13 September 2022



Horizon 2020 SESAR project **CREATE**



Climate and weatheR modElS to improve
ATM resilienCE and reduce its impacts

Project Objective

Analysis of short and long-term **aviation impact** on the environment at:

- **Urban/local scale** (air quality impact over the airport surroundings);
- **global scale** (overall aviation emissions impact on air quality and climate).

Method & Tools

A cascade of interconnected air quality models:

- **chemical transport models** FMI/SILAM (global and continental scale) and FARM (urban scale), nested through boundary conditions
- **Lagrangian particle model** SPRAY (local scale);
- **obstacle resolving** Lagrangian particle **model** PMSS (microscale, airport vicinity).

Case studies

- Naples Capodichino: mid-size European airport located in urban environment
- Continental/Global scale analysis of the aviation impact on air quality and climate

10,860,068 passengers (2019)
 5° airport in Italy
 53° airport in Europe



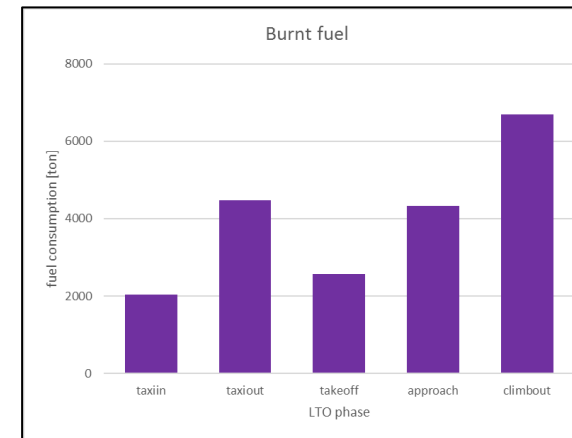
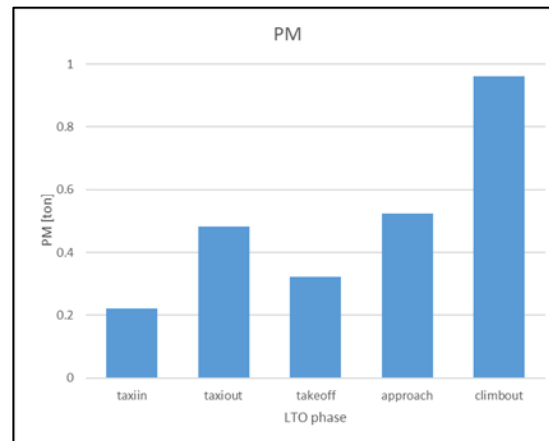
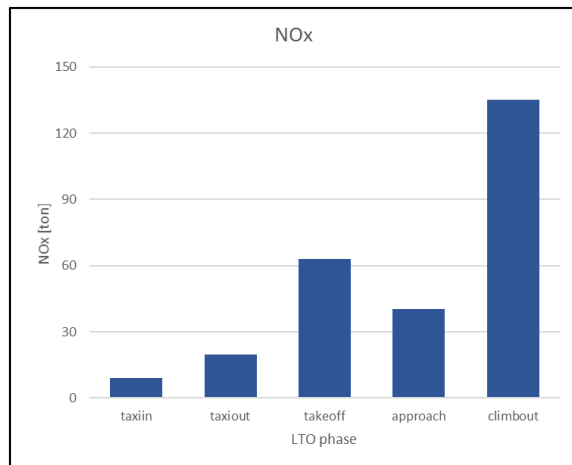
Napoli Capodichino: urban airport

Airport bottom-up inventory (including LTO cycles and flight trajectories inside the 180x176 km² computational domain) vs total emissions over Campania Region (5.6 M inhabitants)

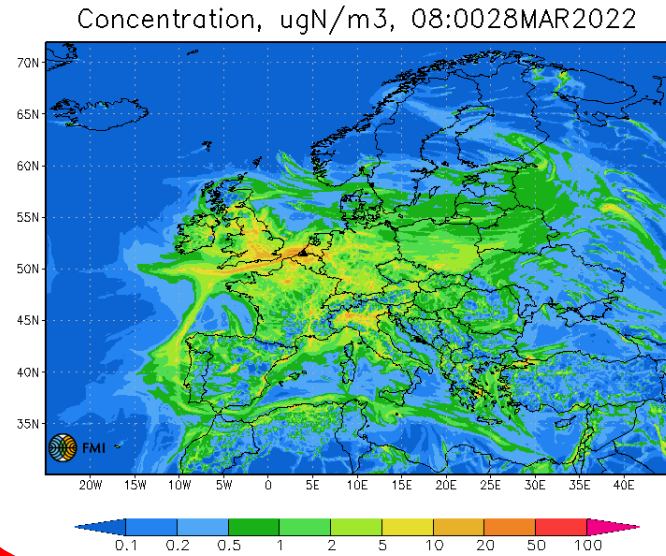
	CO/10	NMVOC	NH3	NOx	PM2.5	PM10	SO2
Capodichino airport (t/year)	24	27	0	1407	13	13	71
% Campania Region	0.13%	0.05%	0.00%	2.48%	0.08%	0.06%	3.08%

Bottom-up annual emission estimate for the Napoli Capodichino airport

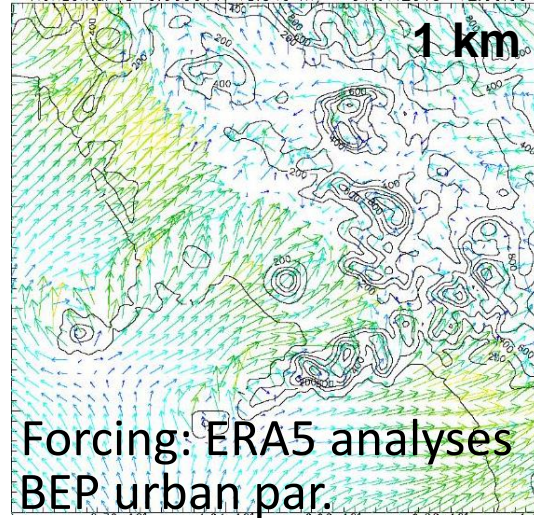
- Methodology : AEM Kernel emission calculation: E.F. [g_{Fuel}/s] and [g_{Poll}/g_{Fuel}] by each LTO phase.
- Input data: flight register from/to Napoli Capodichino (LIRN) in 2018 (61,896 flights: aircraft type, number and model of engines, specific time in mode)
- Aggregated emission results by phase:



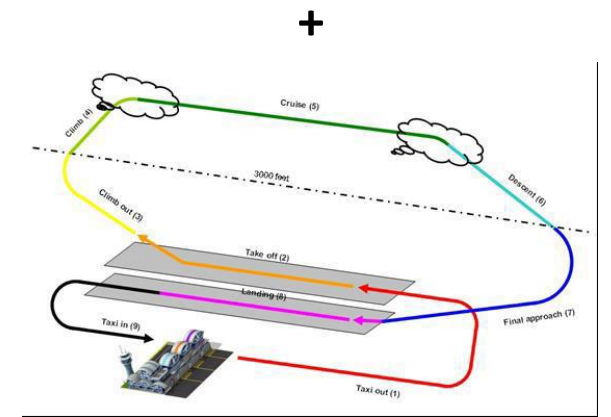
Regional scale air quality (SILAM)



Urban scale meteorology (WRF)



Italian emission inventory

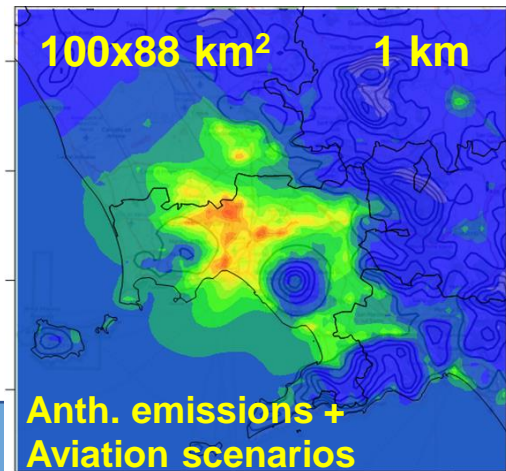


Aircraft+airport emissions

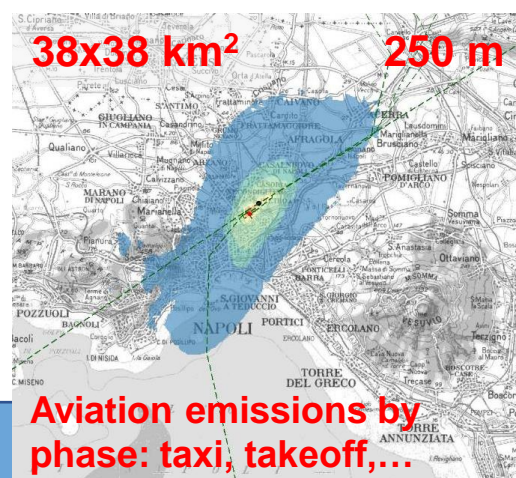
air quality

air quality

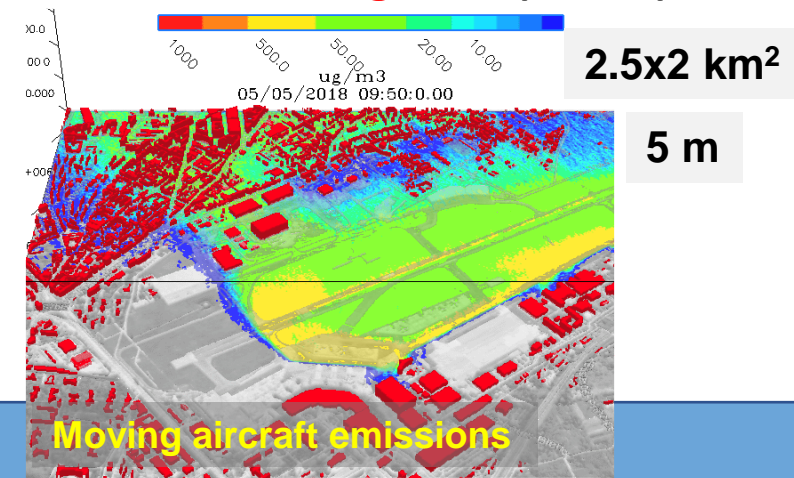
Urban scale CTM (FARM)



Local scale LPM (SPRAY)

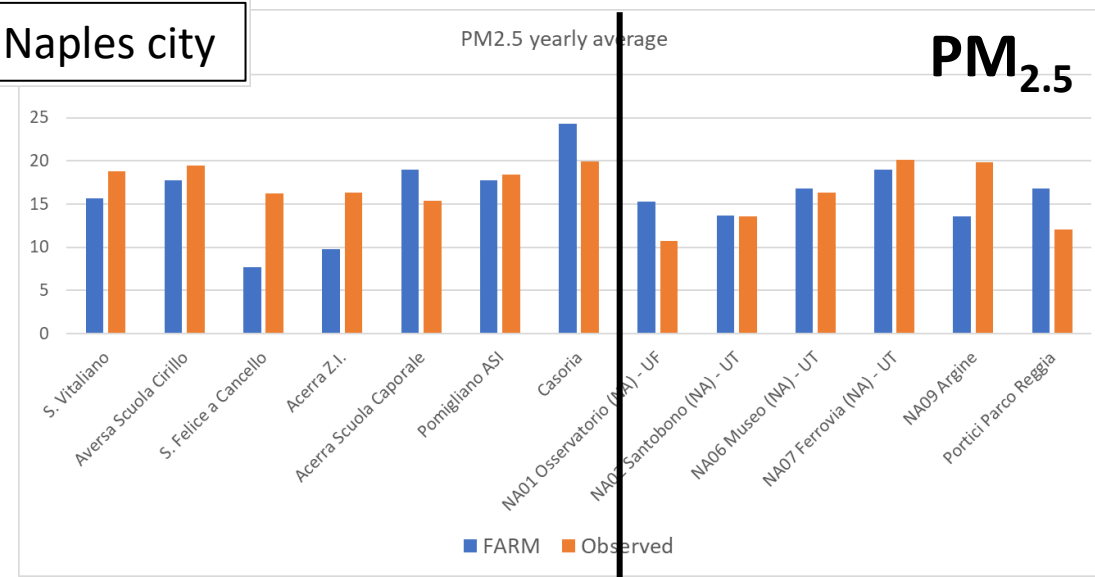
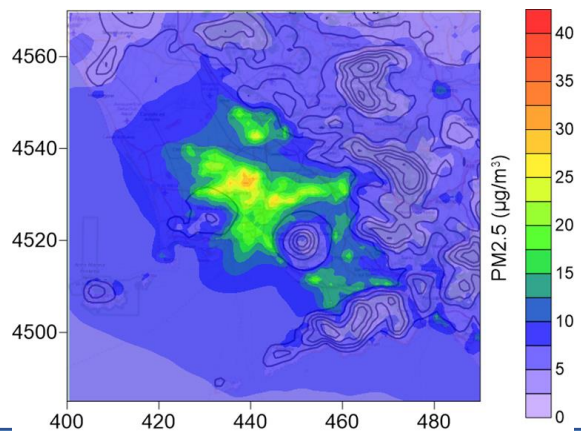
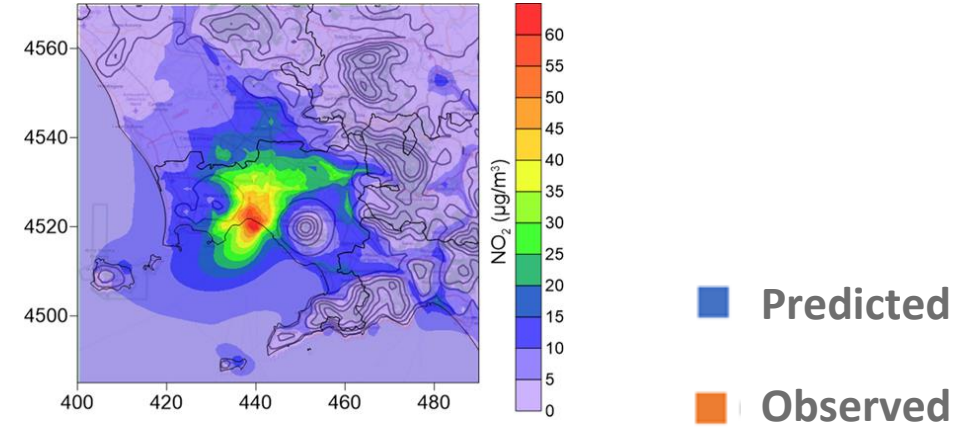
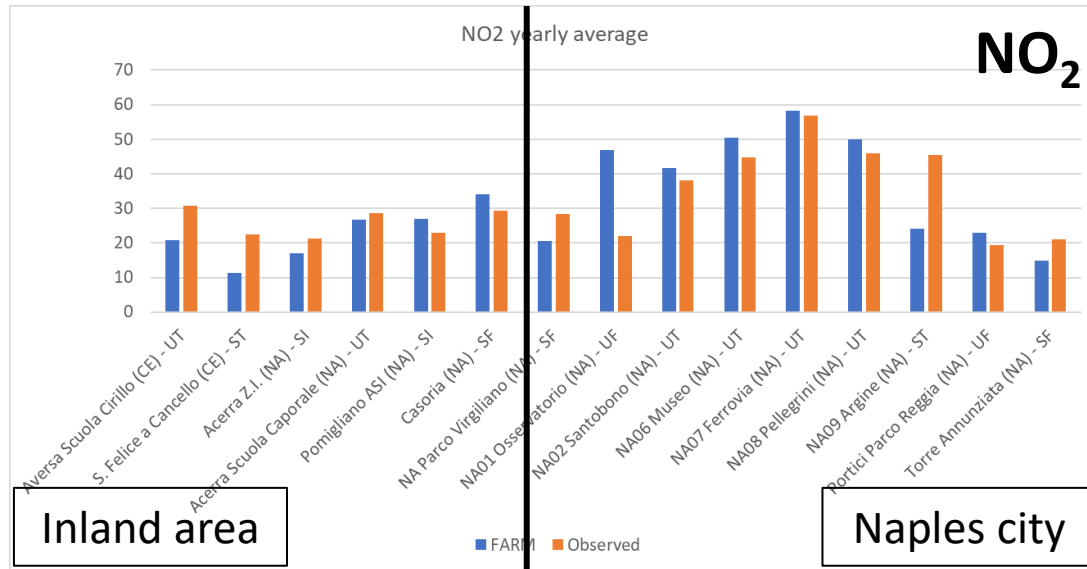


Obstacle resolving LPM (PMSS)



CTM results comparison with local observations

2018 - yearly average concentrations



Airport and air traffic contribution

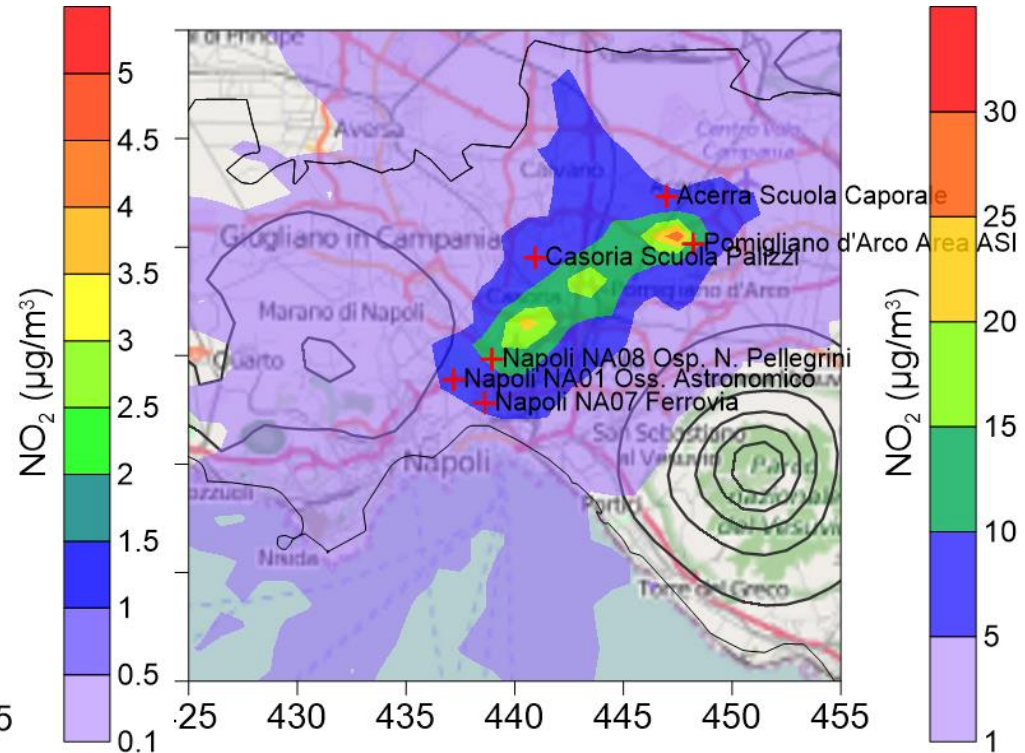
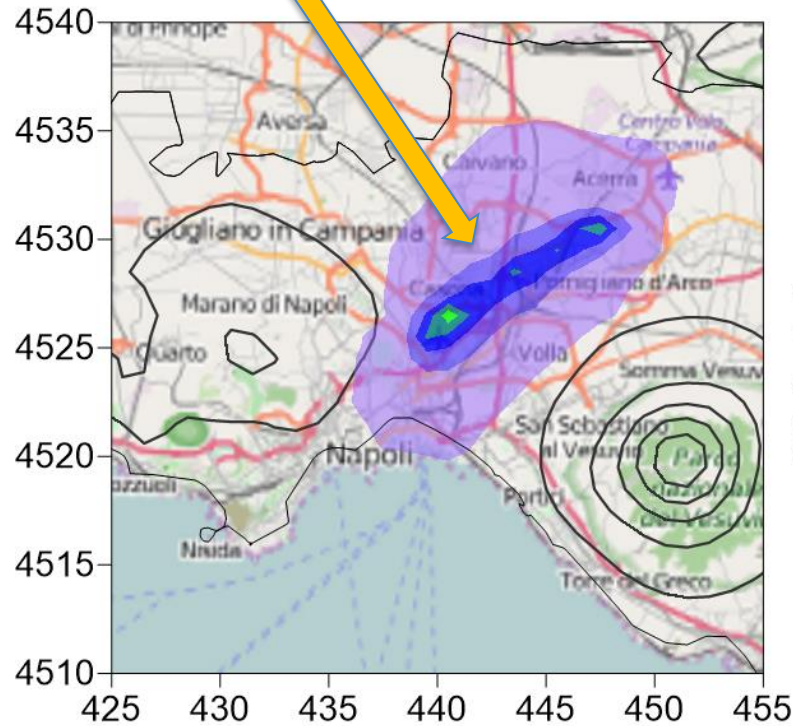
Takeoff-landing plume towards Acerra-Pomigliano

NO₂

Year 2018

mean

hourly maximum



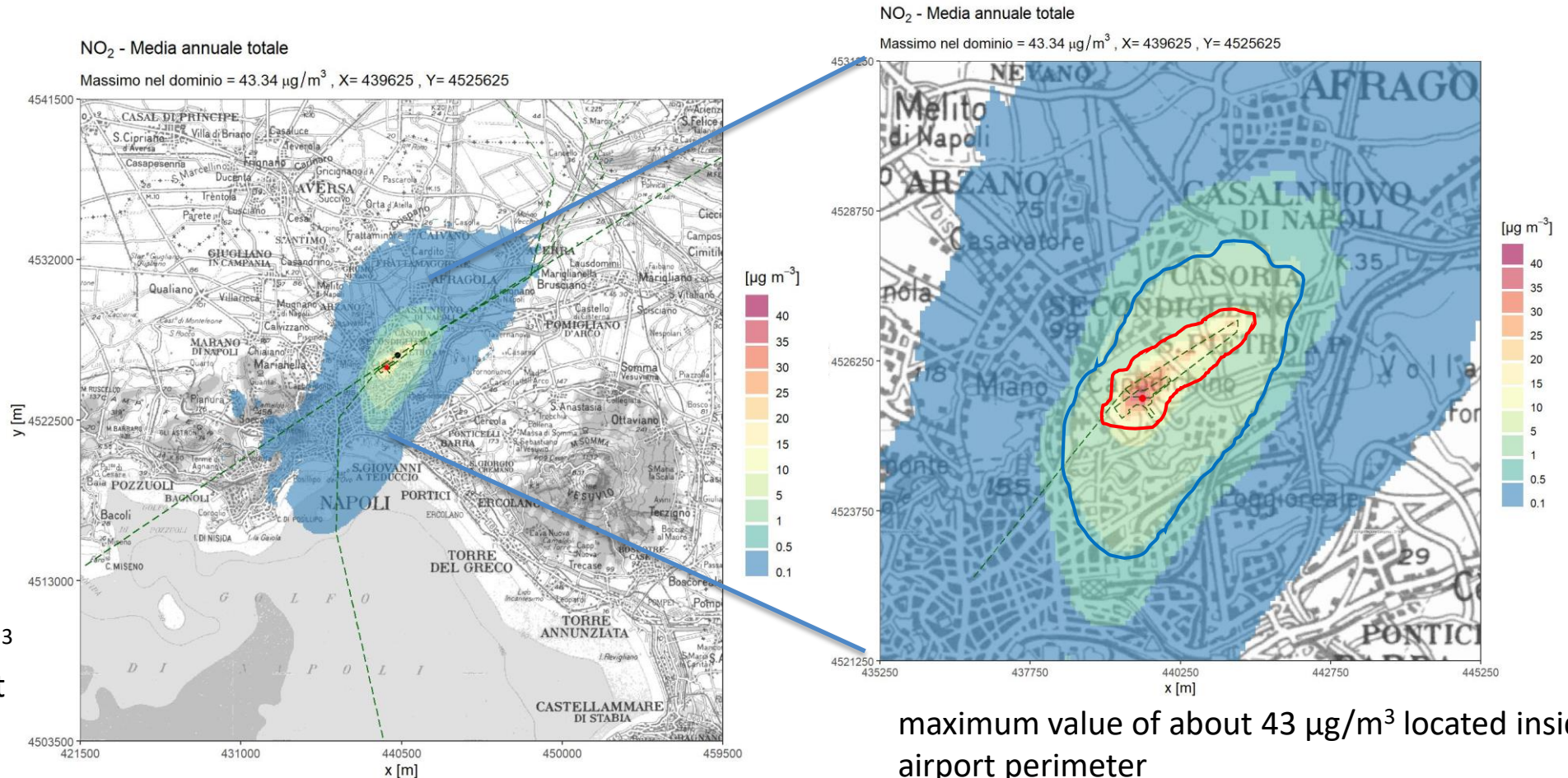
values > 1 µg/m³ nearby the airport and under the landing/takeoff trajectories

Hourly max. reaching 20-30 µg/m³

Detailed simulation of the airport emissions

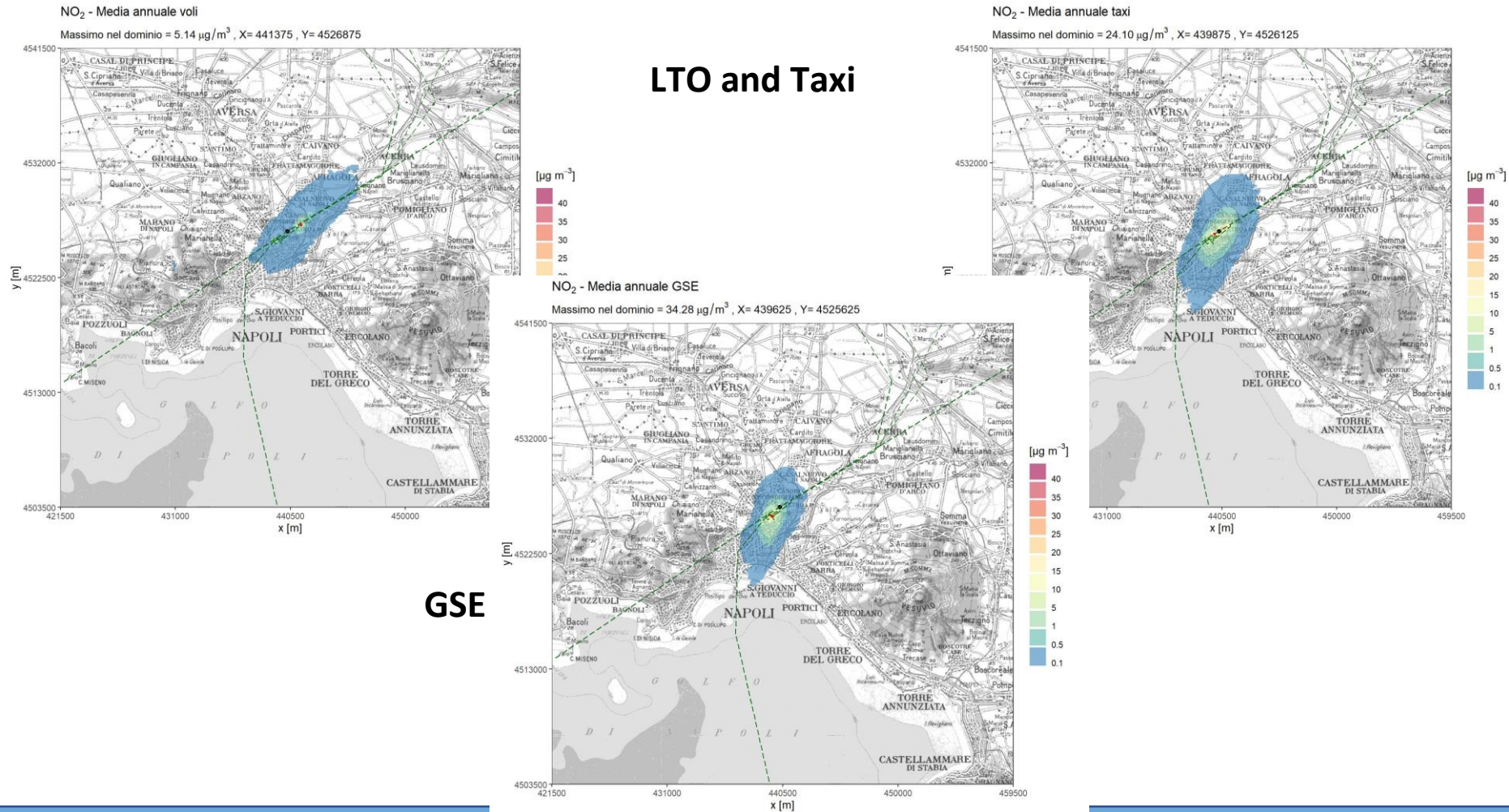
Lagrangian particle model results

NO₂ concentrations, yearly average, all the aviation activities



Detailed simulation of the airport emissions

Lagrangian particle model results NO₂ concentration, yearly average, contributions



Obstacle resolving LPDM to resolve buildings nearby the airport



Investigated critical conditions:

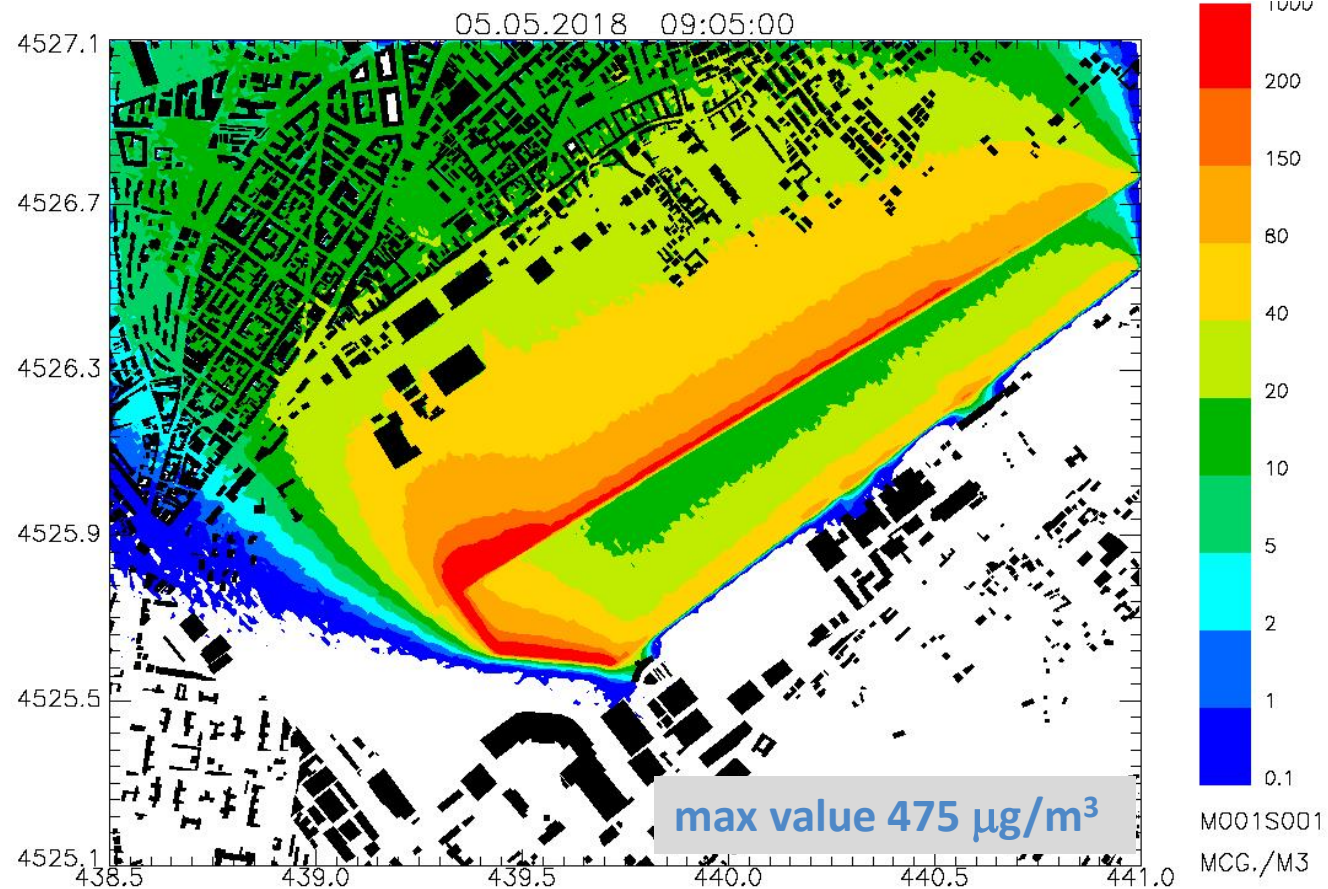
- Light winds blowing from the airport towards the most urbanized region
- takeoffs towards South-west



Case study: 05/05/2018 09:00-10:00

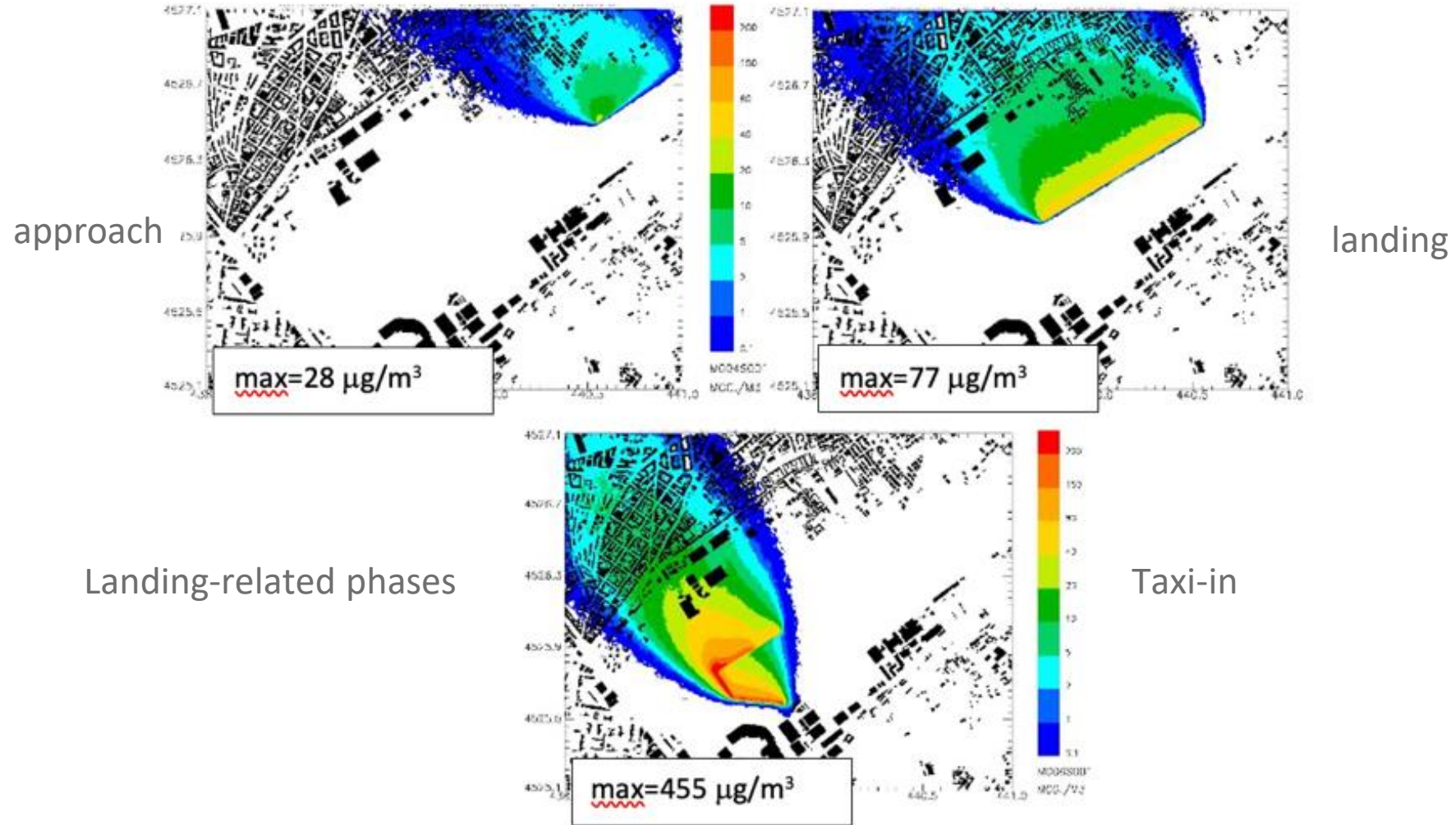
6 takeoffs towards the west & 12 landings from east: one airplane movement every ~ 3.5 minutes (discretized in 1s segments)

Dispersion simulation: NOx 1 h average concentration

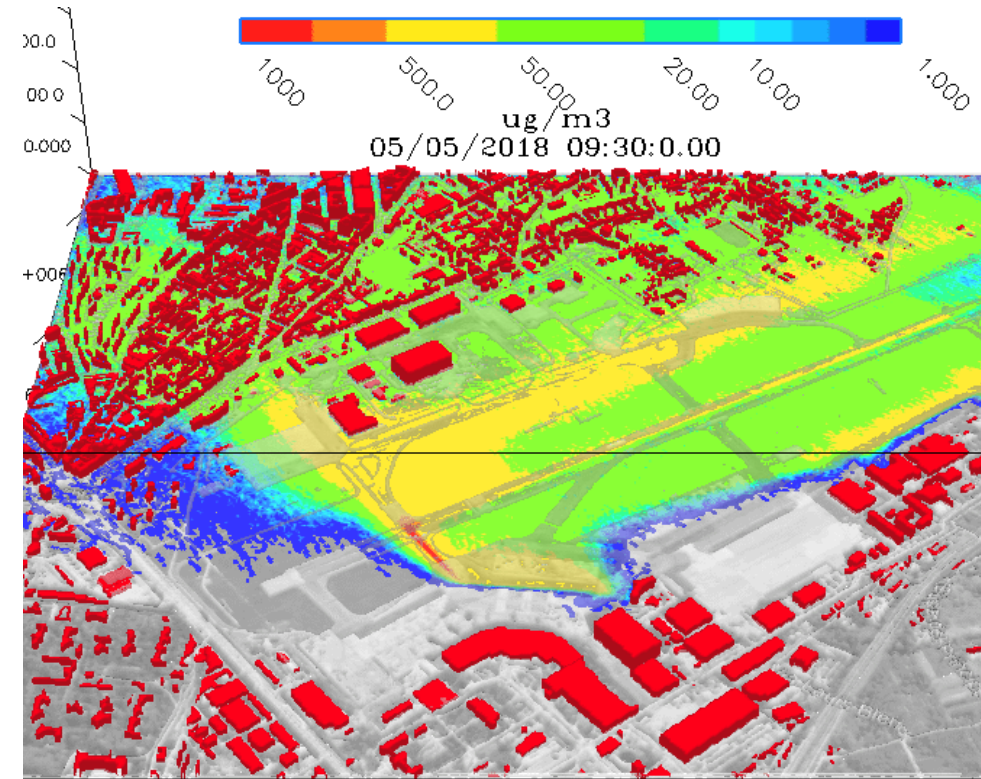
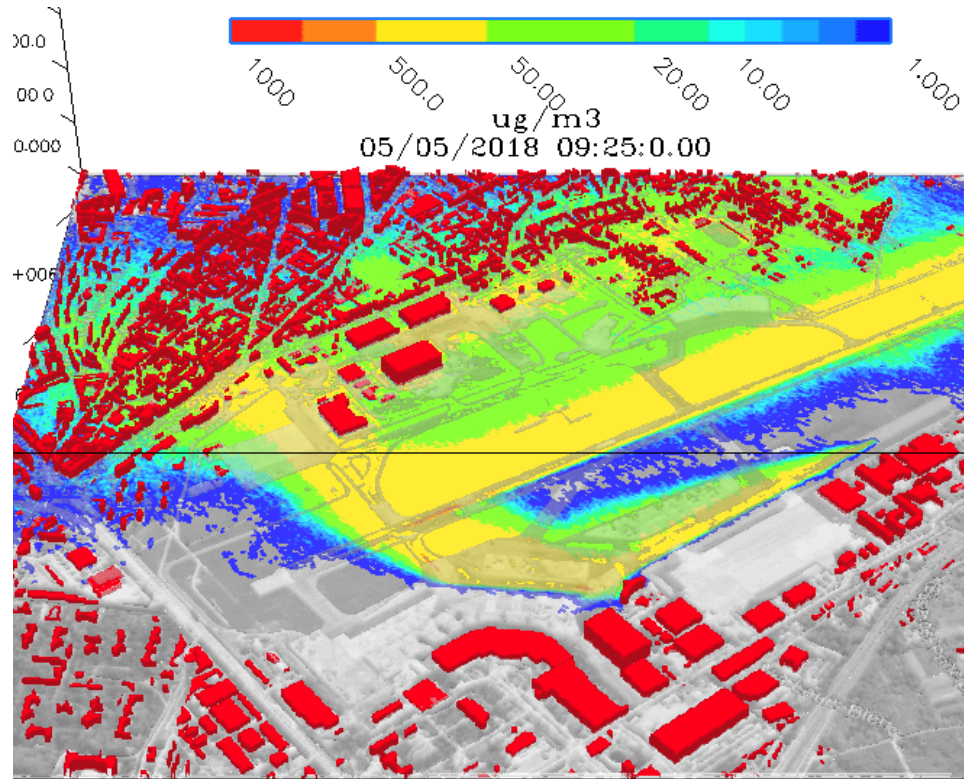


The population is exposed to a maximum of 20-50 $\mu\text{g}/\text{m}^3$

Dispersion simulation: NOx 1 h average concentration



Short-time concentration variability (5 min averages)



Larger values are close to the main takeoff/landing runway & the taxi lanes. Maximum concentrations exceed 500 $\mu\text{g}/\text{m}^3$

Maximum values are located very close to the emissions, where NO is expected to be a large fraction of NO_x

The populated area is exposed to max NO_x concentrations of the order of 100 $\mu\text{g}/\text{m}^3$

Airport and air traffic contribution



Ozone production

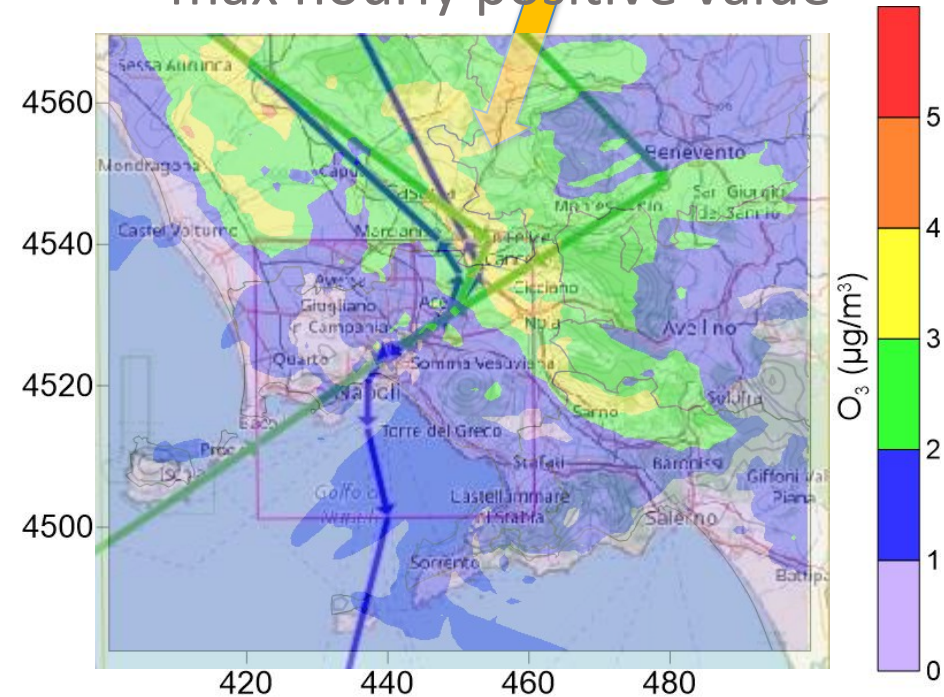
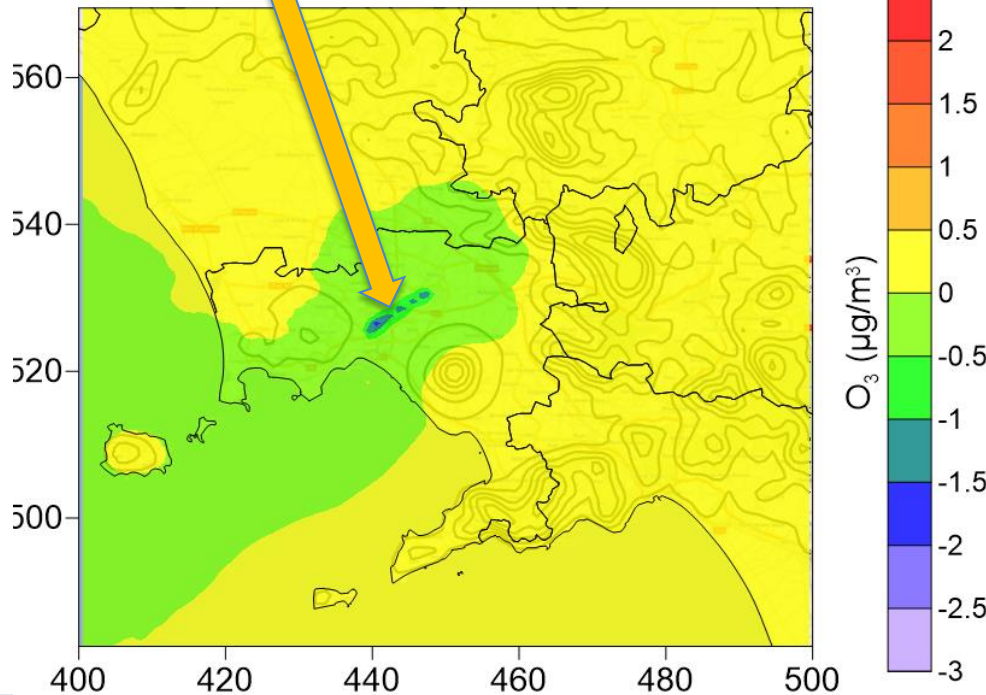
Negative values, prevailing ozone titration

Year 2018

Whole computational domain

mean value

max hourly positive value



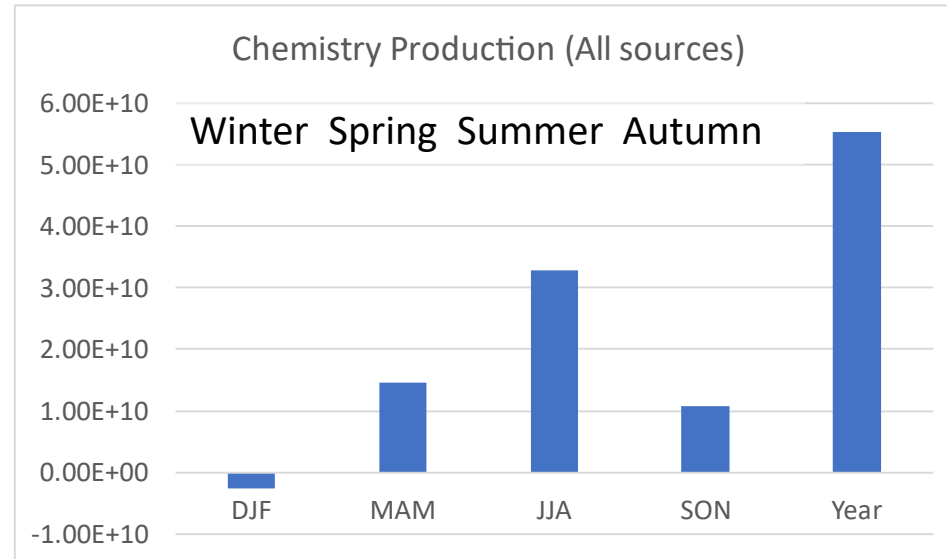
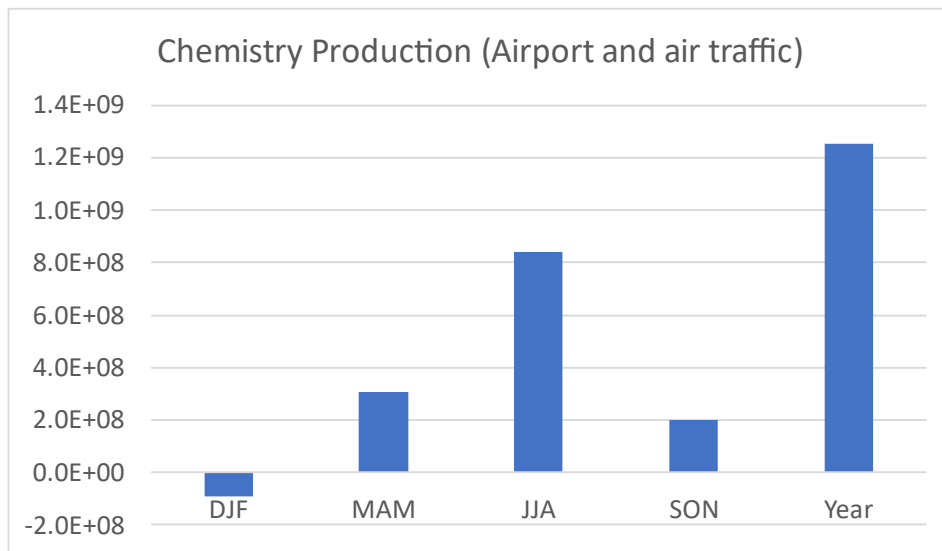
Ozone production (whole domain)

2018

Yearly and seasonal ozone production (g)

All sources

Airport and air traffic



Airport+air traffic contribution: 1252 tons \cong 2.3% of all sources on a yearly basis

Concluding remarks

The airport activities and flights emissions impact:

- Aviation emissions mainly affect air quality in areas nearby the airport (<2-3 km)
- Aviation contribution is usually not detectable from urban air quality networks
- High episodic concentrations can occur in the vicinity of the airport
- Concentration over short time periods (<1h) should be investigated by obstacle resolving modelling and short time measurements



Climate and weather modElS to improve
ATM resiliencE and reduce its impacts

For more details, please download deliverables:

2.1 Aviation impact on local environment and long term & global phenomena

3.1 Local and regional models integrated with weather and climate information

From CREATE web site:

<https://create-project.eu/>

Thank you for your attention!

