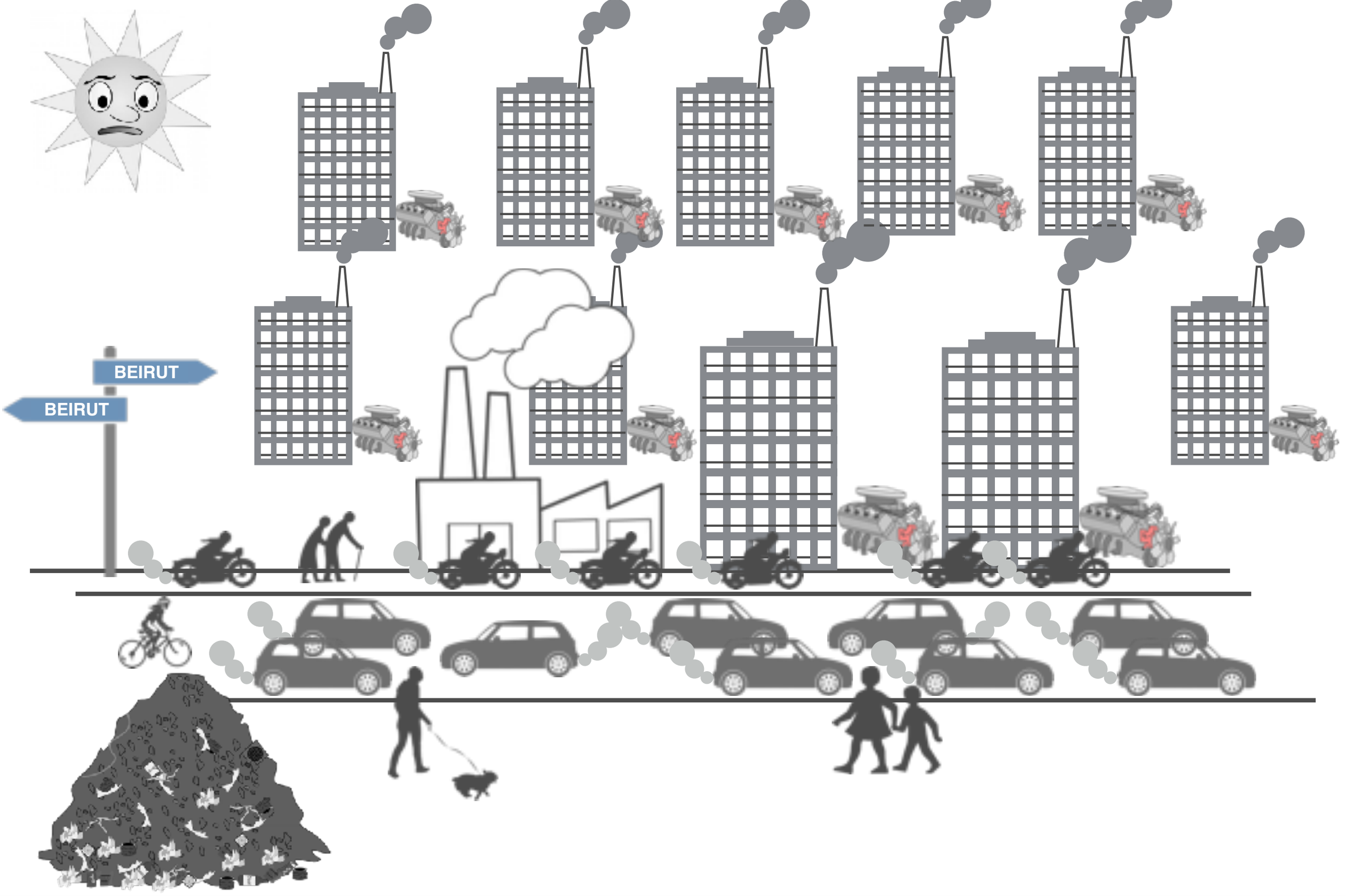


Courtesy of The AUB Collaborative for the Study of Inhaled Atmospheric Aerosols (CARS)

Does it matter where in Beirut we put the incinerators?

Microflows and Microscale Heat Transfer Laboratory
ilakkis.wixsite.com/microflows
Irani-Oxi Engineering Complex, 311
Department of Mechanical Engineering
Faculty of Engineering and Architecture
American University of Beirut

issam lakkis

samer salloum

CARS
The AUB Collaborative for the Study of Inhaled Atmospheric Aerosols

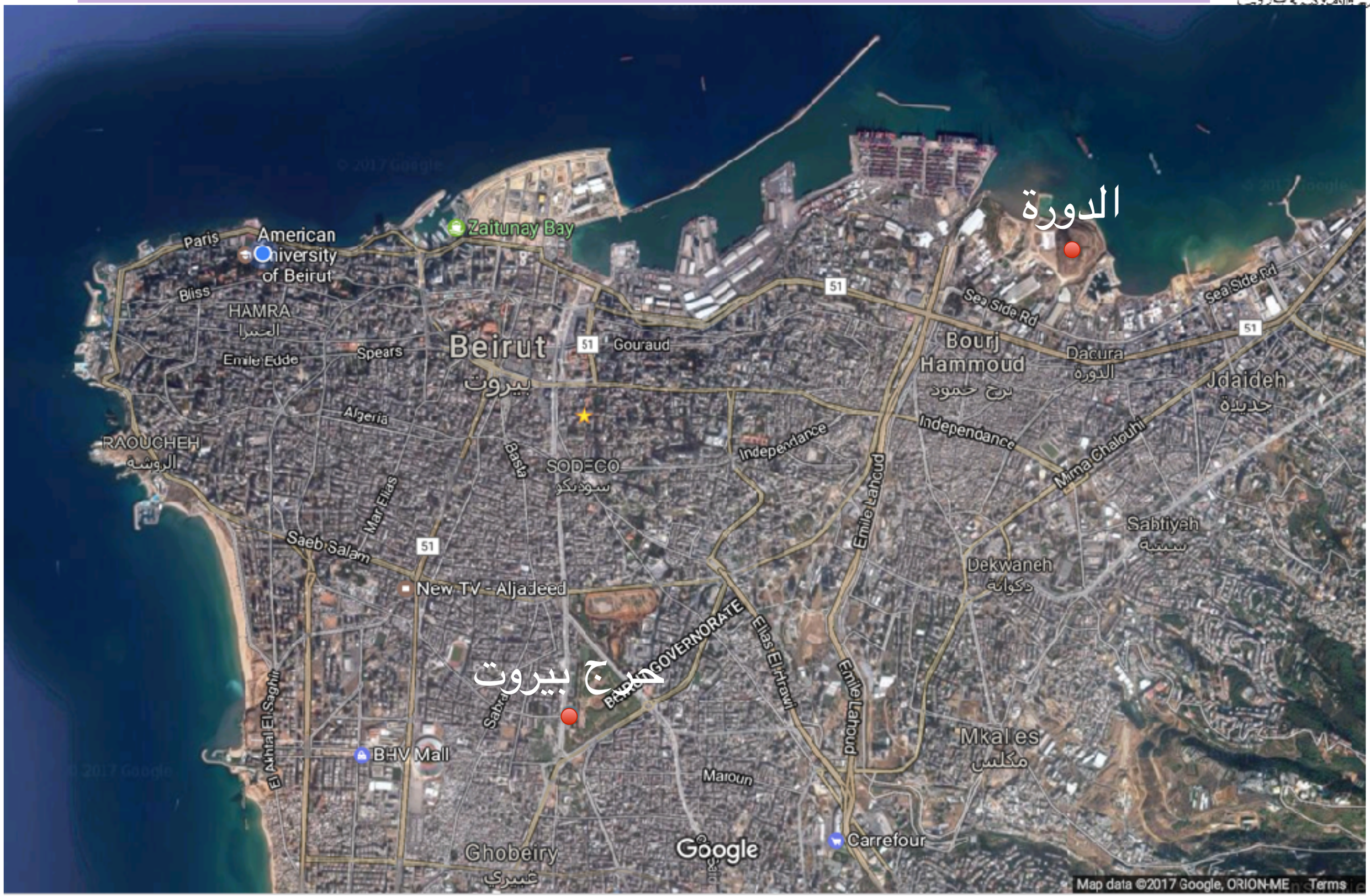
Outline

- Locations investigated
- What goes into the simulation
- Conditions of the two simulations
- Results
- Conclusions

Locations Investigated

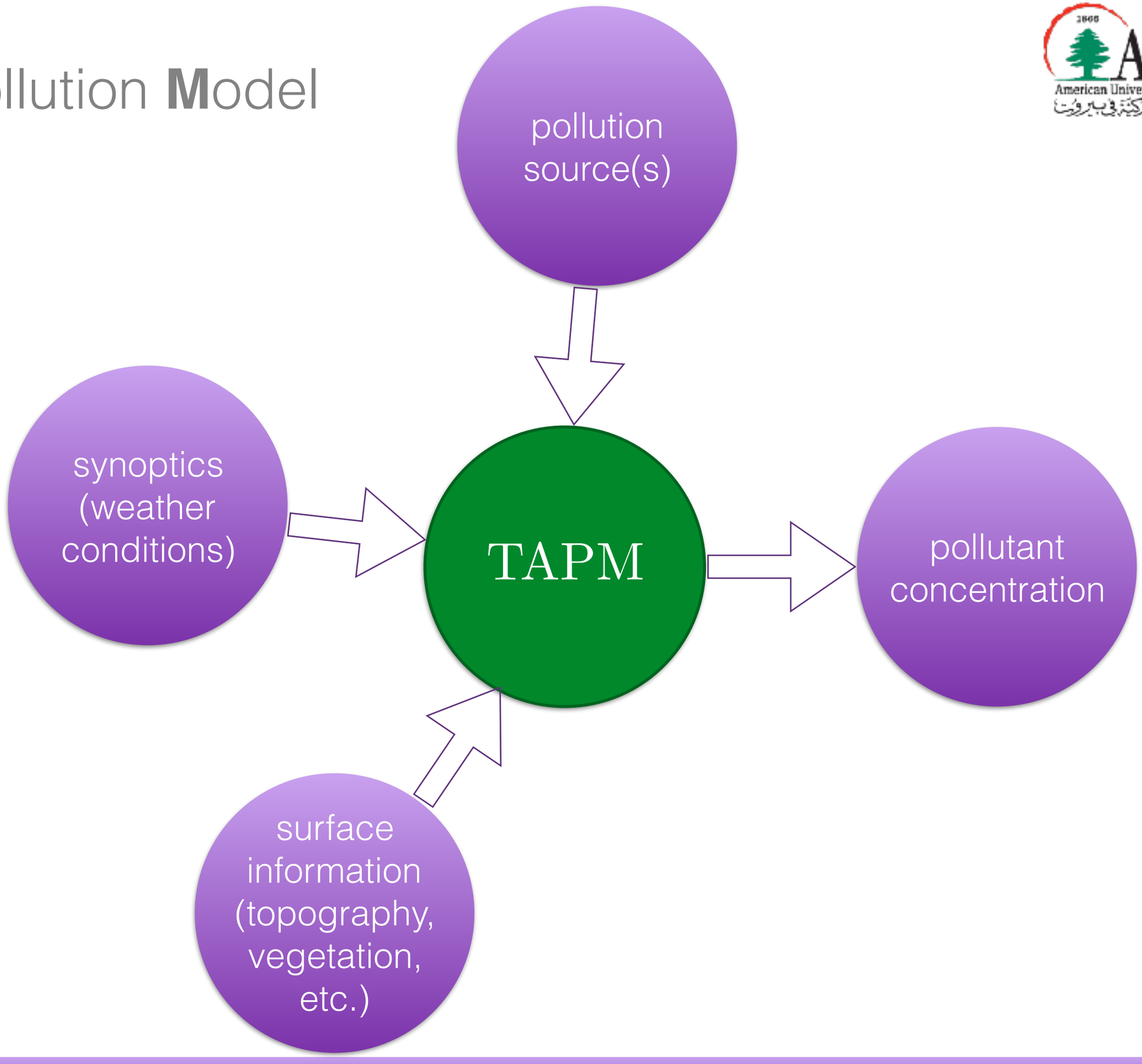
Courtesy of The AUB Collaborative for the Study of Inhaled Atmospheric Aerosols (CARS)

Locations Investigated



Courtesy of The AUB Collaborative for the Study of Inhaled Atmospheric Aerosols (CARS)

The Air Pollution Model



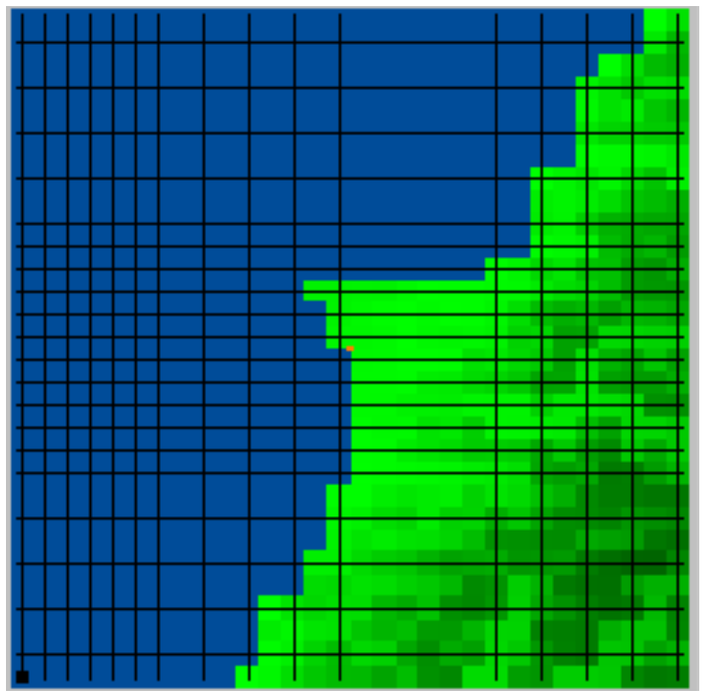
The Air Pollution Model

- TAPM is a software that predicts weather patterns and combines it with atmospheric chemical reactions to show pollutant transport.
- TAPM solves the Navier Stokes (N-S) equations to output the wind velocity field over a selected period of time and in a selected region.
- The wind velocity profile is then used as an input to solve the species transport equation in order to obtain the concentration profile for the pollutants.
- The model employs a nested grid:
  - It starts solving the outer grid by getting the boundary and initial conditions by global synoptic analyses;
  - It then passes larger scale information as boundary conditions to the next (finer) grid.

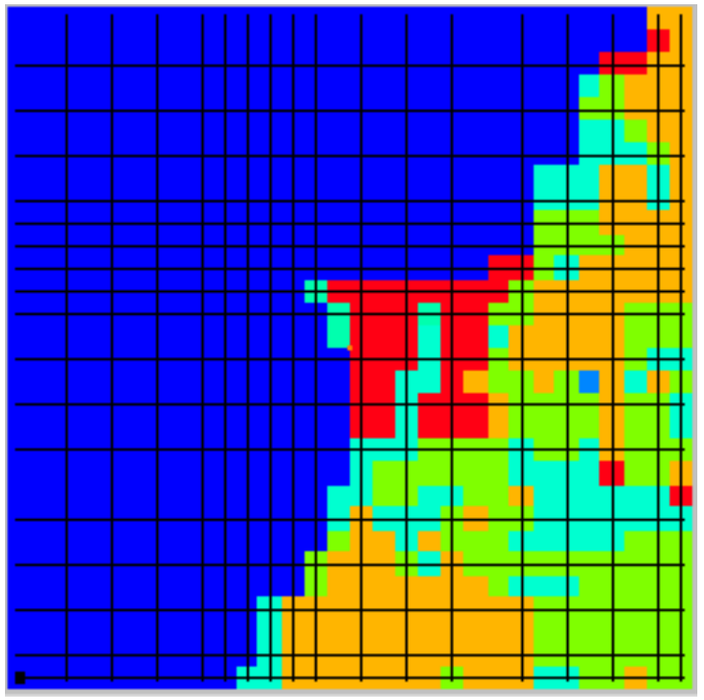
The Air Pollution Model

- The N-S equations and the pollution transport equations are solved for three nested grids that go from 14, 4, and 1 km spacing to accurately represent the Beirut Area.
- Each grid is 30 x 30 x 20
- Gridded Global terrain height, vegetation and soil type, leaf area index and sea surface temperature are accounted for.
- Six-hourly synoptic scale analyses for the year of 2014 are provided on a longitude/latitude grid from the Australian Bureau of Meteorology who have kindly allow us to use the data as initial and boundary conditions to start TAPM simulation.
- The pollution source stack height is taken to be 50 m.

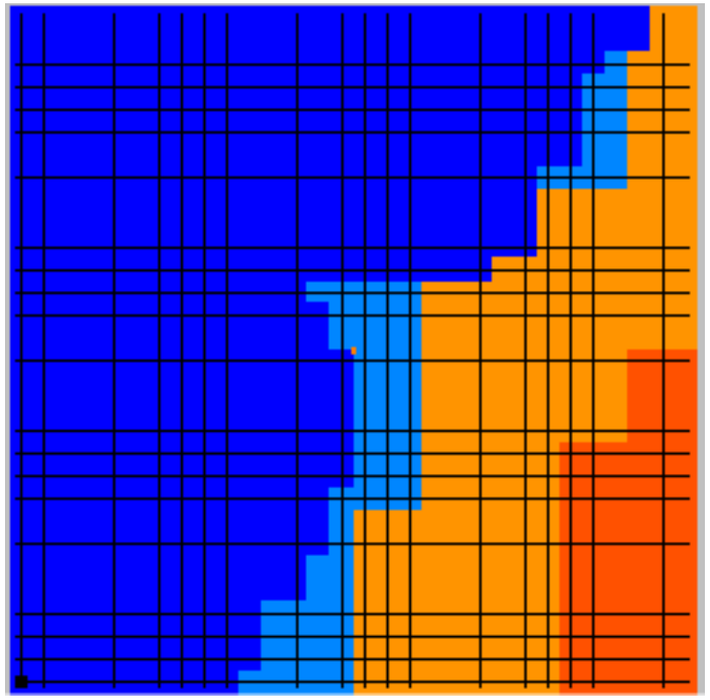
Simulation Settings ▸ Surface Data



Topography



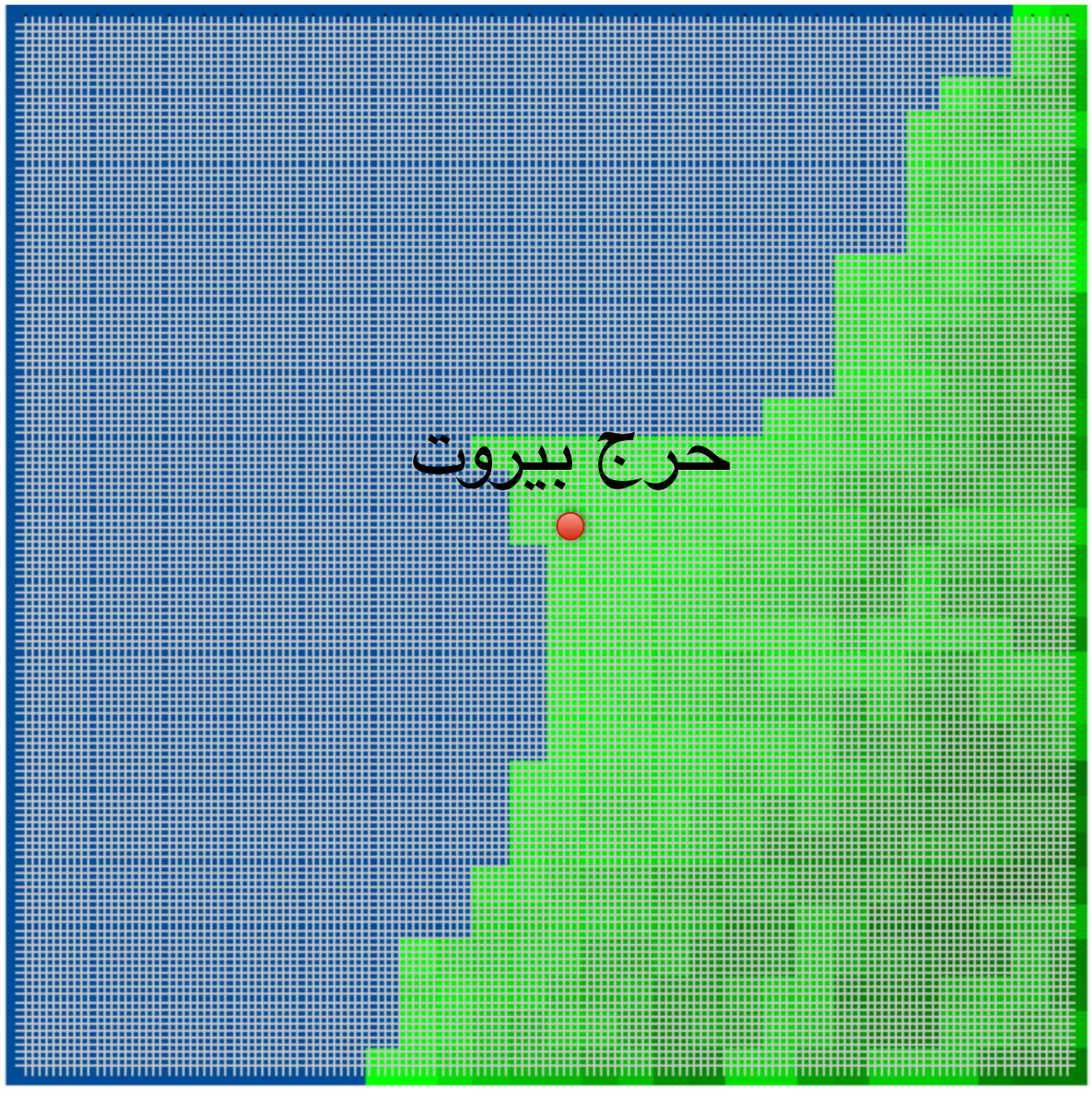
Vegetation



Soil

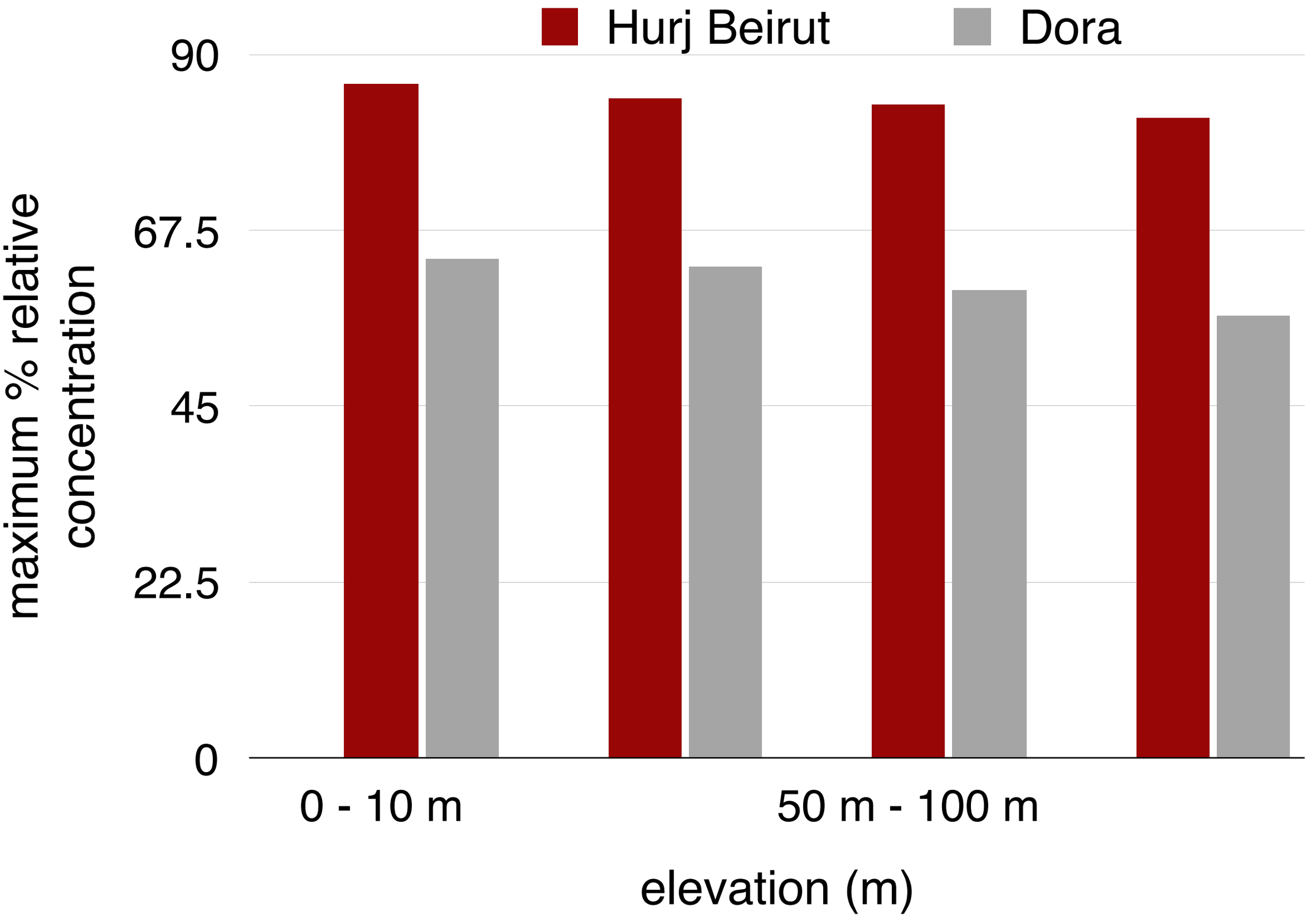
$$\text{N-S grid 1 spacing} = 14 \text{ km}$$
$$\text{N-S grid 1 spacing} = 4 \text{ km}$$
$$\text{N-S grid 1 spacing} = 1 \text{ km}$$

Simulation Settings ▸ pollution grid

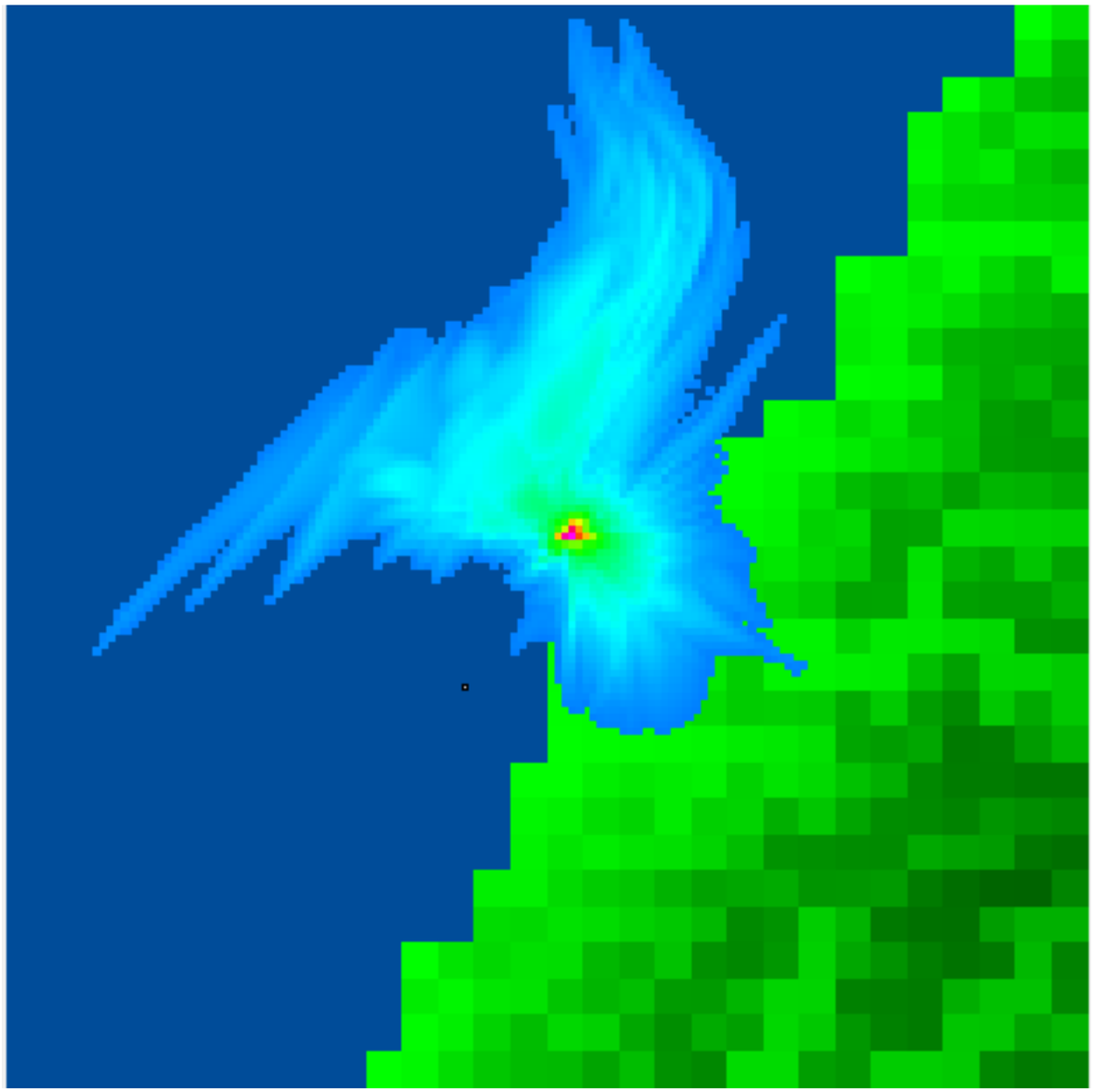


$$\text{pollution grid spacing} = 200 \text{ m}$$

Results ▸ maximum concentration vs elevation



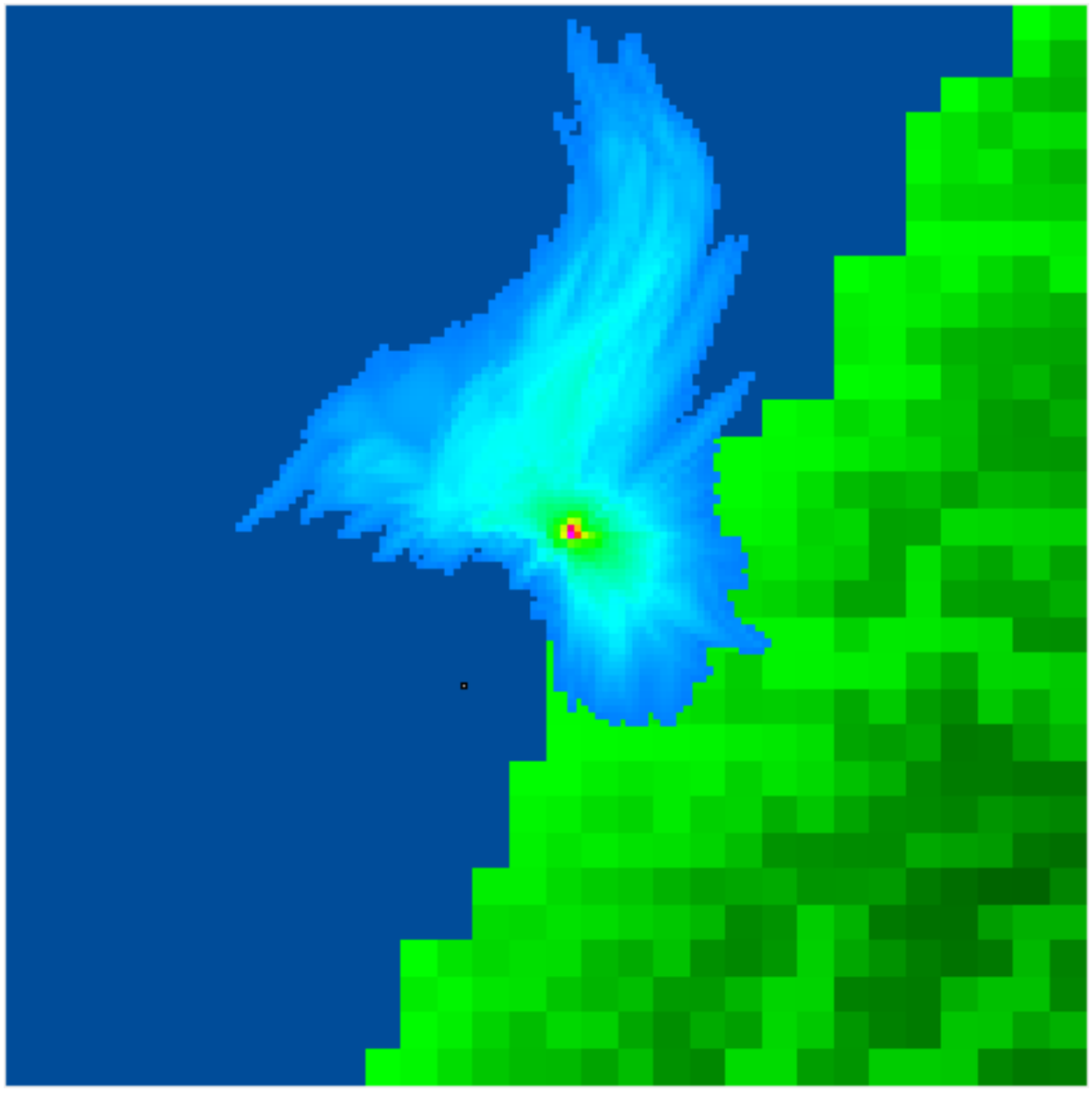
Average pollutant distribution:
z in [0, 10 m]



colors included down to 10% of local maximum (86%)

Average pollutant distribution:

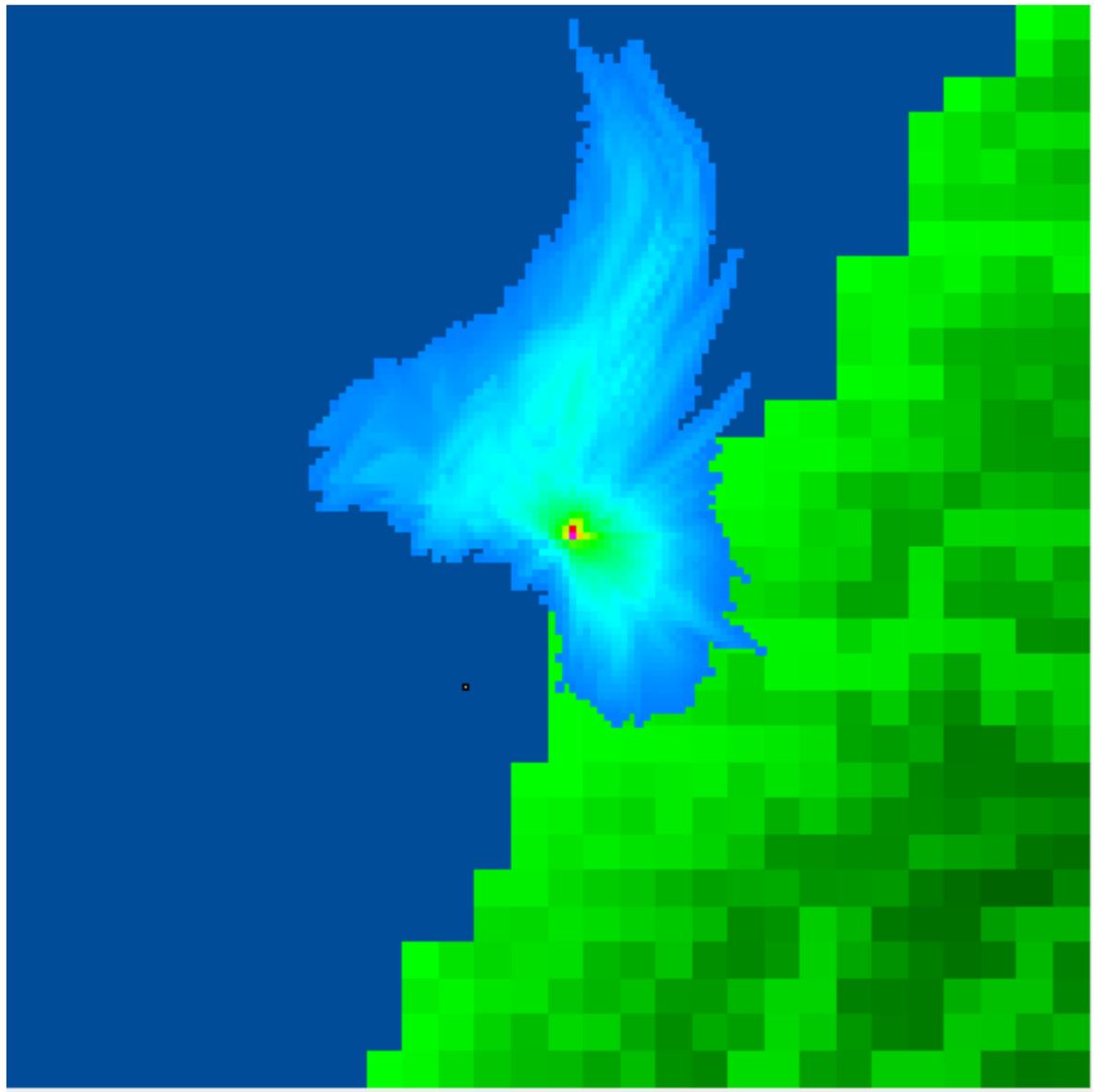
z in [10 m, 50 m]



colors included down to 10% of maximum (84%)

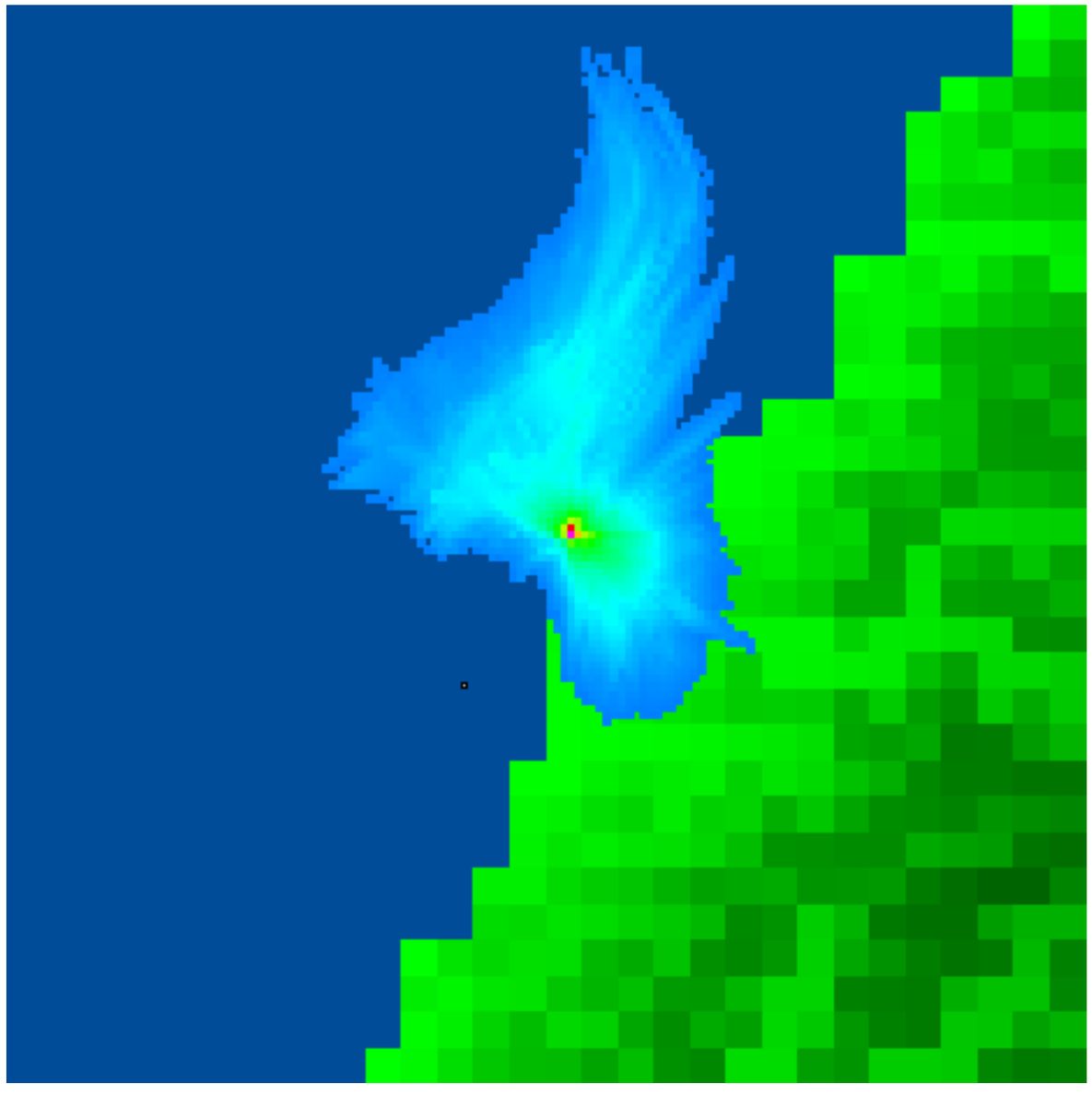
Average pollutant distribution:

z in [50 m, 100 m]



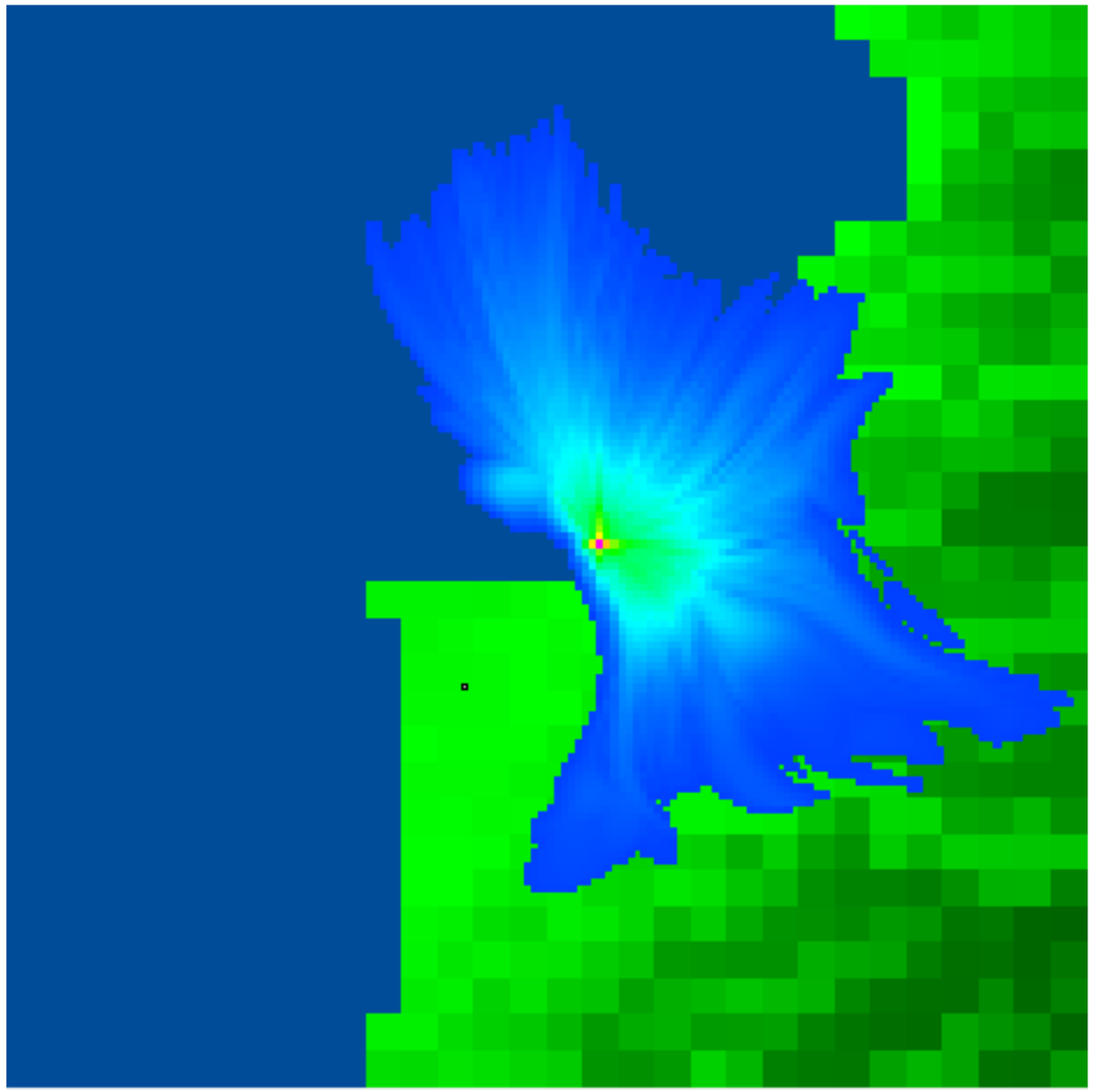
colors included down to 10% of maximum (83%)

Average pollutant distribution:
z in [100 m, 150 m]



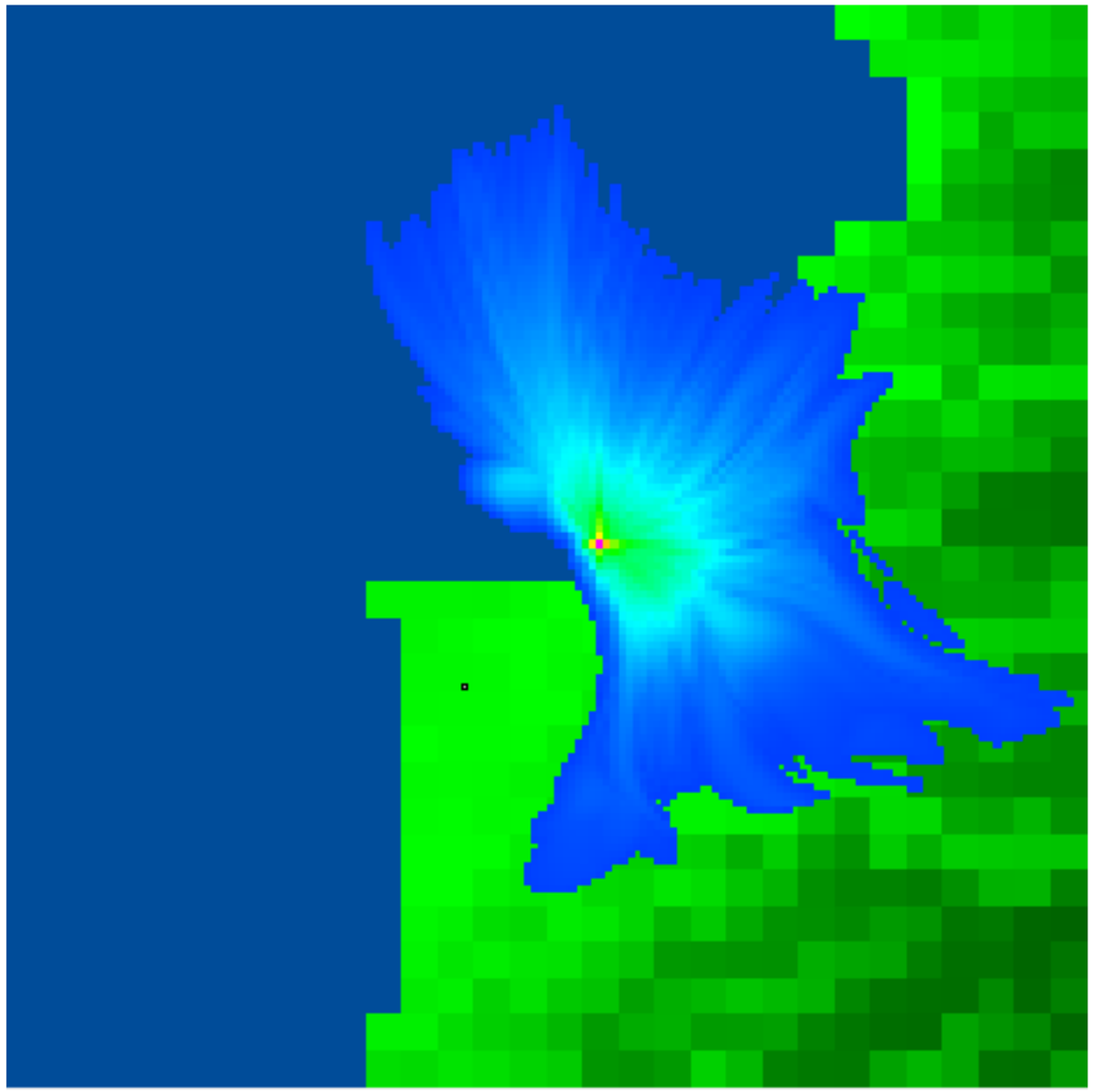
colors included down to 10% of maximum (82%)

Average pollutant distribution:
z in [0, 10 m]



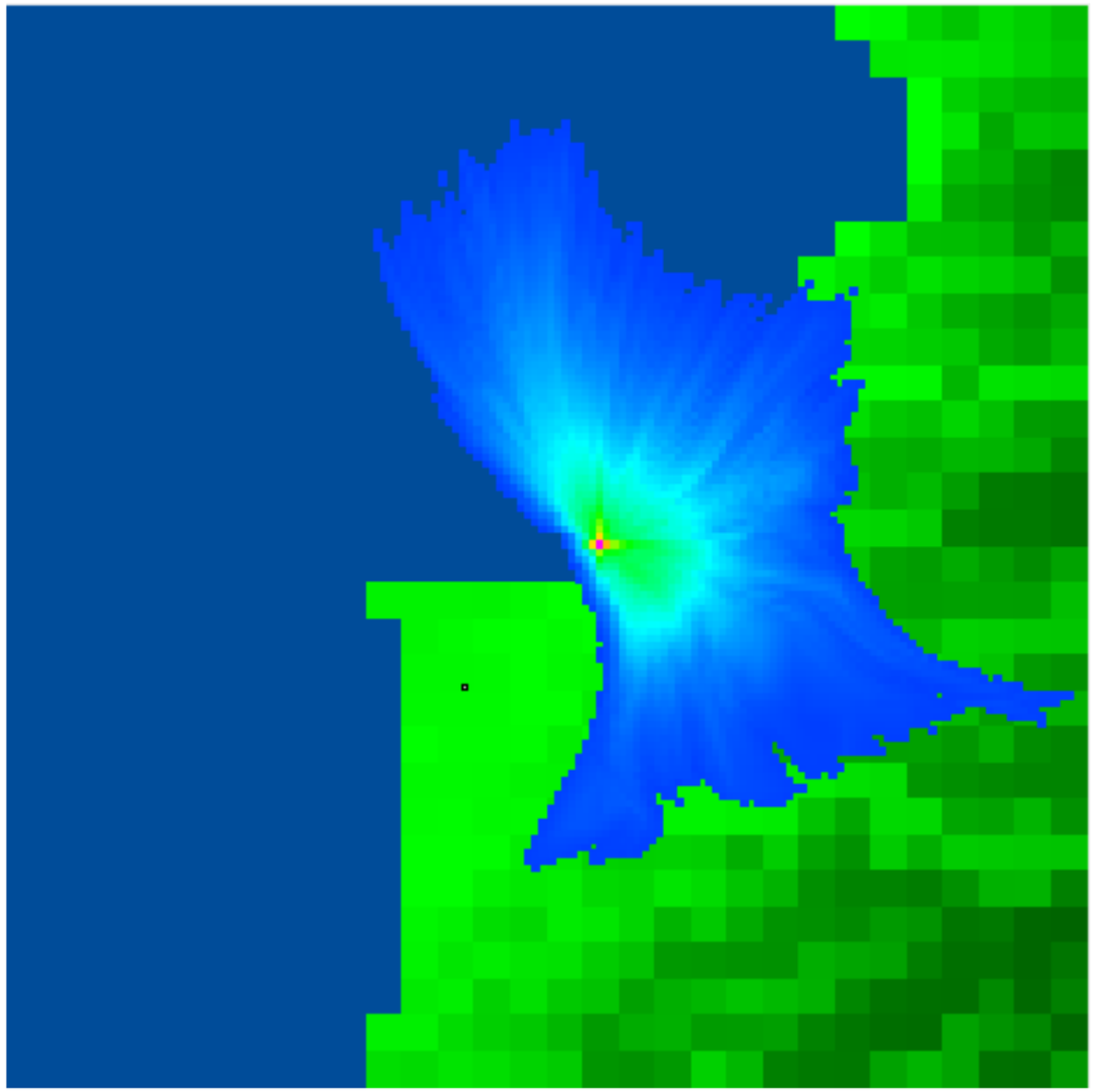
colors included down to 10% of local maximum (64 %)

Average pollutant distribution:
z in [10, 50 m]



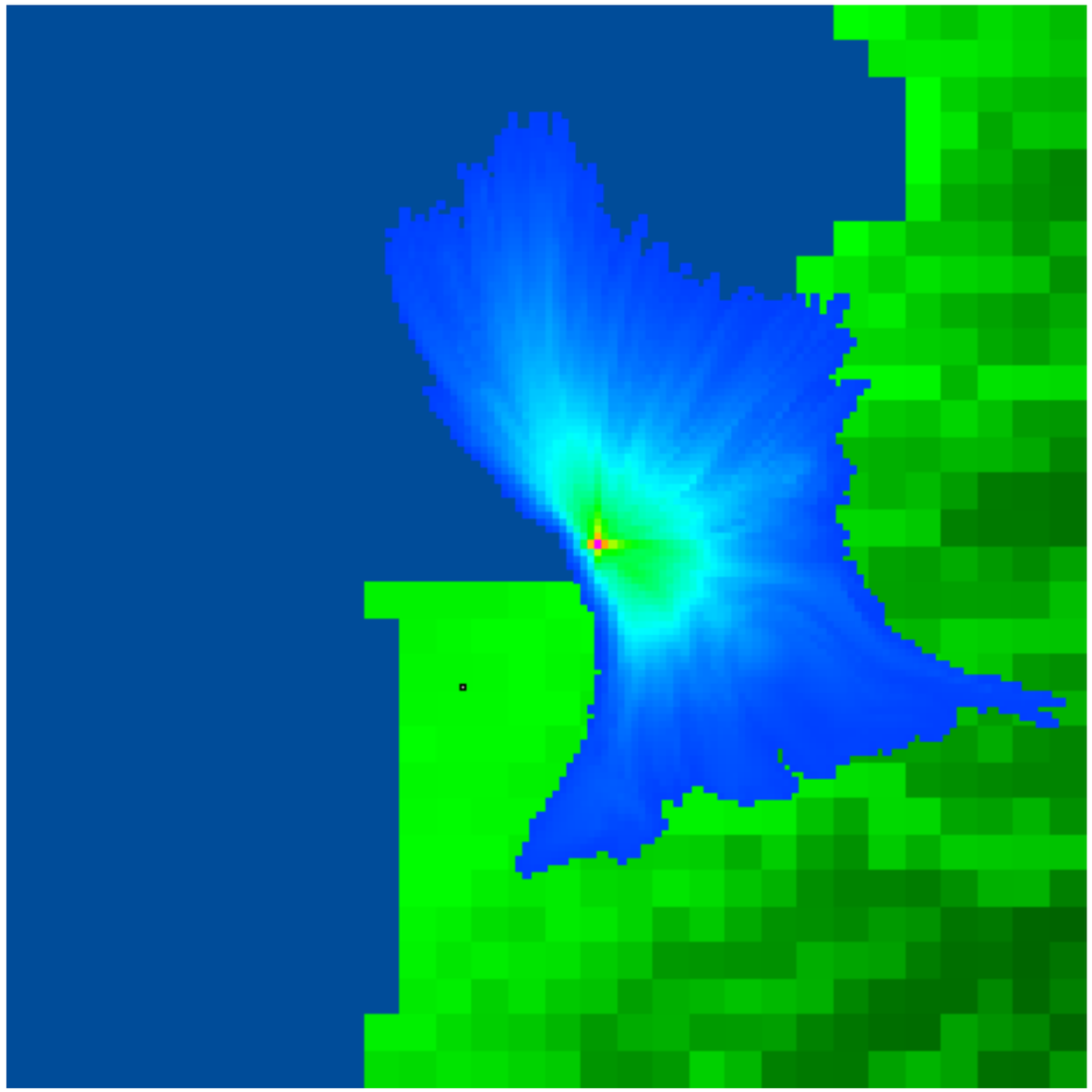
colors included down to 10% of local maximum (63%)

Average pollutant distribution:
z in [50, 100 m]



colors included down to 10% of local maximum (60%)

Average pollutant distribution:
z in [100, 150 m]



colors included down to 10% of local maximum (57%)

Simulations Videos

- HurjBeirut Incinerator Pollution Transport (**حرج بيروت**)

https://youtu.be/QO2BczxdgTU

- Dora Incinerator Pollution Transport (**الدورة**)

https://youtu.be/lWfz7ZU0rHU

Acknowledgments

- University Research Board
- FEA Dean's office