

Modelling urban traffic emissions for the city of Hamburg

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Left: Example results from simulating NO₂ dispersion within the Hamburg city center on 15th of March 2022, 9:00 a.m., using PALM-4U with a spatial resolution of 5×5 m. The simulation is powered by TerraByte (a cooperation between DLR and LRZ)

Below: Screenshot from the microscopic traffic flow simulation SUMO showing the used road network obtained from OpenStreetMap.



Demand modelling

The simulation relies on different sources for representing the demand:

- the agent-based demand model TAPAS
- different traffic segments from the German national model DEMO
- a model of parcel services
- a model of food distribution and deliveries
- public transport

Flows (numbers of vehicles) on the road network obtained from the different sources.

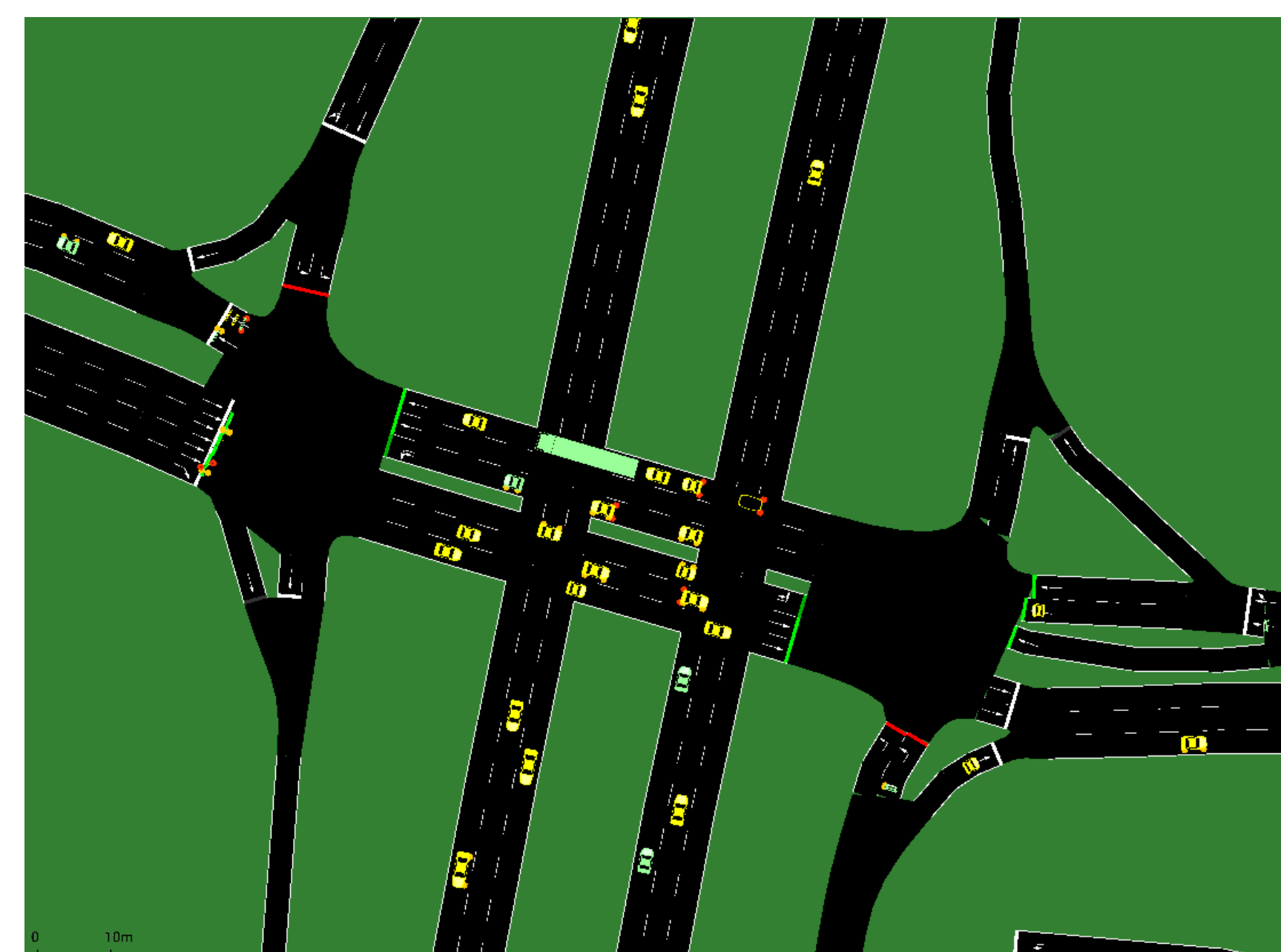


Microscopic simulation

The demand is simulated using the microscopic road traffic simulation SUMO which runs with a time resolution of 1 second. Input are the traffic flows from different segments and a road network obtained from OpenStreetMap. The complete city and the surroundings are simulated.

The resulting positions and speeds of the vehicles are the input to the emissions calculation.

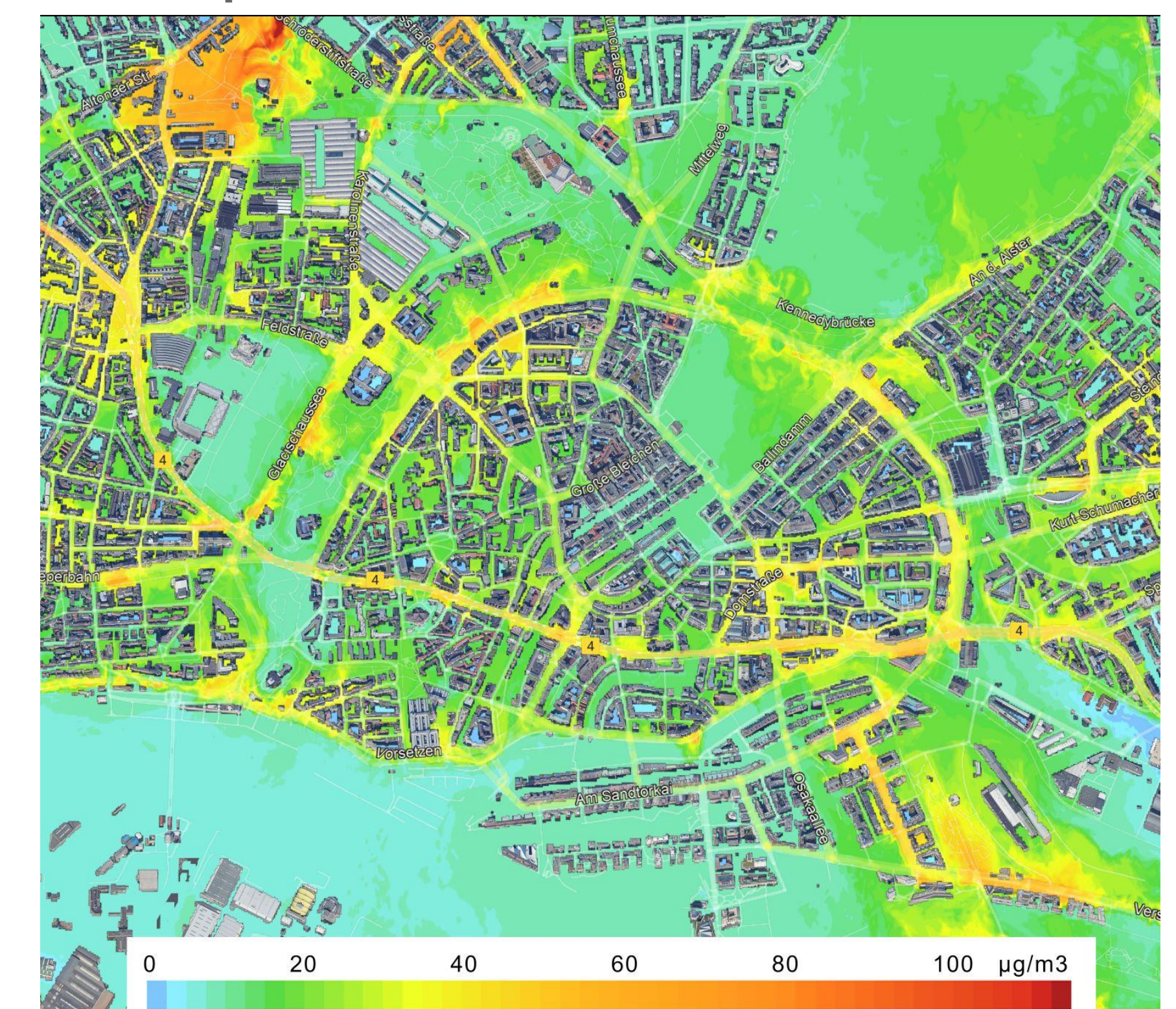
Focus on a part of the road network simulated using SUMO.



Pollutant emissions and dispersion modelling

Pollutant emissions are calculated using the emission models available in SUMO. The dispersion of pollutants is calculated by applying the models EPISODE, City-Chem and PALM-4U using boundary conditions from regional simulations with MECO(n) and MADE3 aerosol microphysics.

Example results from simulating NO₂ dispersion within the Hamburg city center using PALM-4U with a spatial resolution of 5×5 m.



See also: Erbertseder, T., Matthias, V., Krajzewicz, D., Mertens, M., Badeke, R., Baier, F., Handschuh, J., Khorsandi, E., Ramacher, M., Quante, M., Thaller, C., Righi, M.: Der Einfluss verschiedener Verkehrsträger auf die Luftqualität von Hamburg, Immissionsschutz, 3/2023, <https://doi.org/10.37307/j.1868-7776.2023.03.04>