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Air quality assessment at the street level: sensitivity analysis of a road traffic-emissions-CTM model chain for the Paris region

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INTRODUCTION

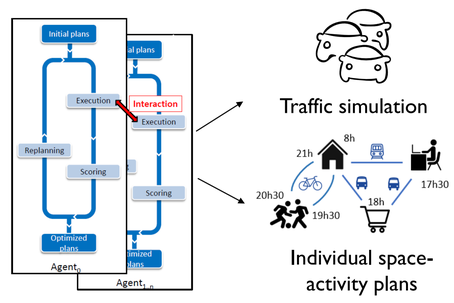
- Public policies aiming to **improve air quality** focus mainly on vehicle fleet regulation & low emission zones
- Need to assess the **effect of public transport policies** on urban air quality and personal exposure
- Development of **modeling chain** from road traffic to chemical transport models (CTM) in recent years [1] [2]
- Uncertainties and model **sensitivity** to hypotheses remain little studied

RESEARCH QUESTIONS

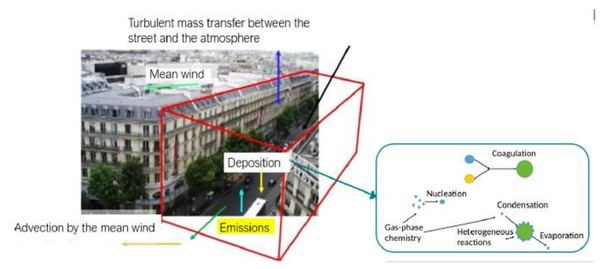
1) *How to integrate high resolution traffic emissions into an air quality model based on street canyons?*

2) *How sensible to modeling hypotheses is the modeling chain?*

MODELS



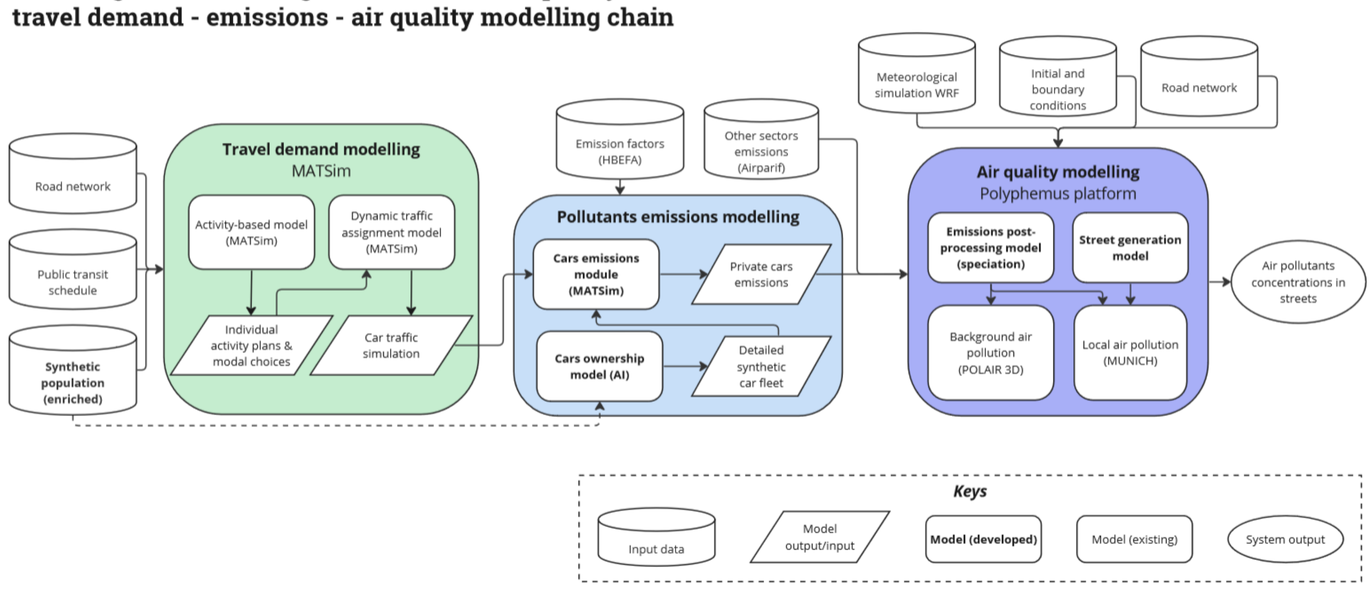
Multi-Agent Transport Simulation MATSim
(figure adapted from [4])



Representations of the different processes considered by MUNICH to compute concentrations in the street [3]

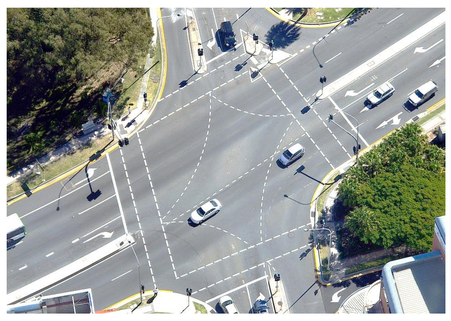
METHODOLOGY

The integrated modelling framework for air quality assessment: travel demand - emissions - air quality modelling chain



Modeling challenges

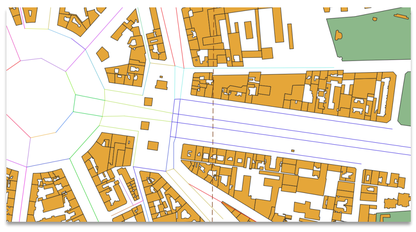
1. **Urban modeling**: based on roads vs. streets
2. **Computational cost** due to level of details required
3. **Pollutants speciation** (e.g. from PM emissions to emissions by size class and species)



- In transportation models, **traffic lines** and **junctions** are used as a basis for urban modeling
- Chemical transport models rely on a **built environment** model based on streets and intersections

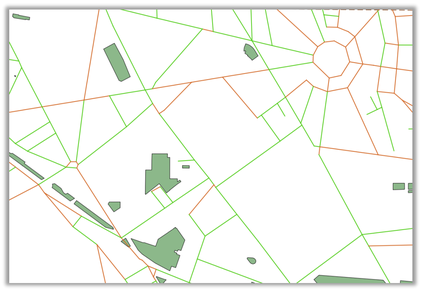
MODELS COUPLING

1) Grouping roads



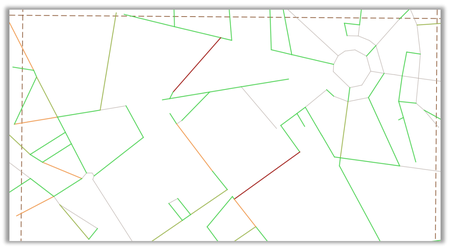
2) Street graph generation

3) Urban canyon streets selection

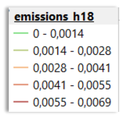


R = height / width
R_{lim} = 1/3

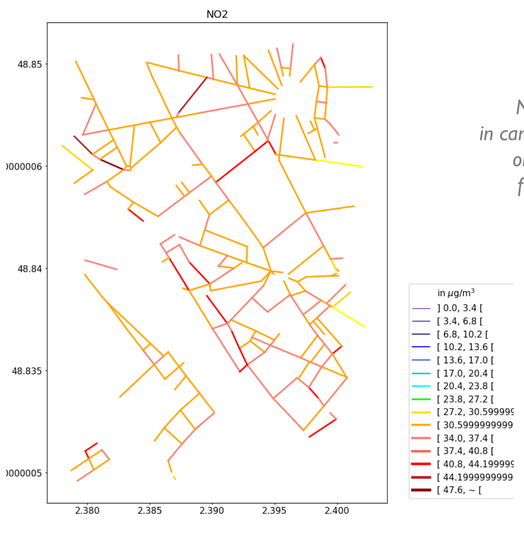
4) Spatiotemporal aggregation of emissions by street and speciation



NO2 emissions (in g/s) from 6 pm to 7 pm

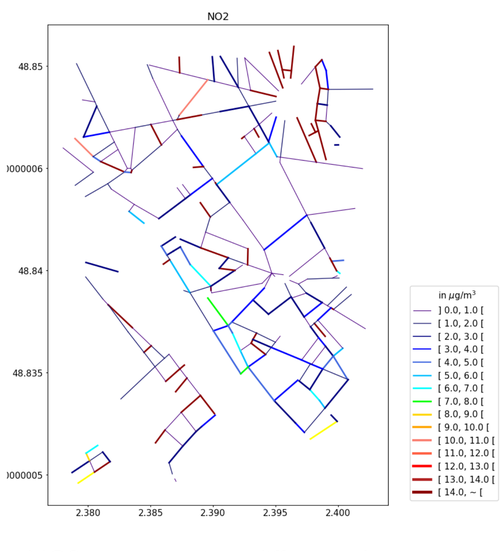


SENSITIVITY ANALYSIS



NO2 concentrations using urban street model MUNICH

NO2 concentrations in canyon streets (R_{lim} = 1/5) on January 15, 2014 from 6 pm to 7 pm



NO2 concentrations difference between MUNICH simulation and background concentrations (POLAIR 3D)

CONCLUSIONS

Development of an **open-source** air quality modeling platform based on multi-agent transportation model MATSim, CTM and urban street-network model.

Calculation costs : ~1 week simulation for the street network model

Sensitivity analysis show the contribution of street-level resolution for both road traffic emissions and air quality modeling.

Perspectives :

- Development of an **exposure model**
- Complementary sensitivity tests including cars emissions, temporal resolution…

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[4] W Axhausen, K., Horni, A., & Nagel, K. 2016. 'The multi-agent transport simulation MATSim' (p. 618). Ubiquity Press.

Source icons: flaticon.com, svgrepo.com

online version

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