IRTEMS project main results and takeaways

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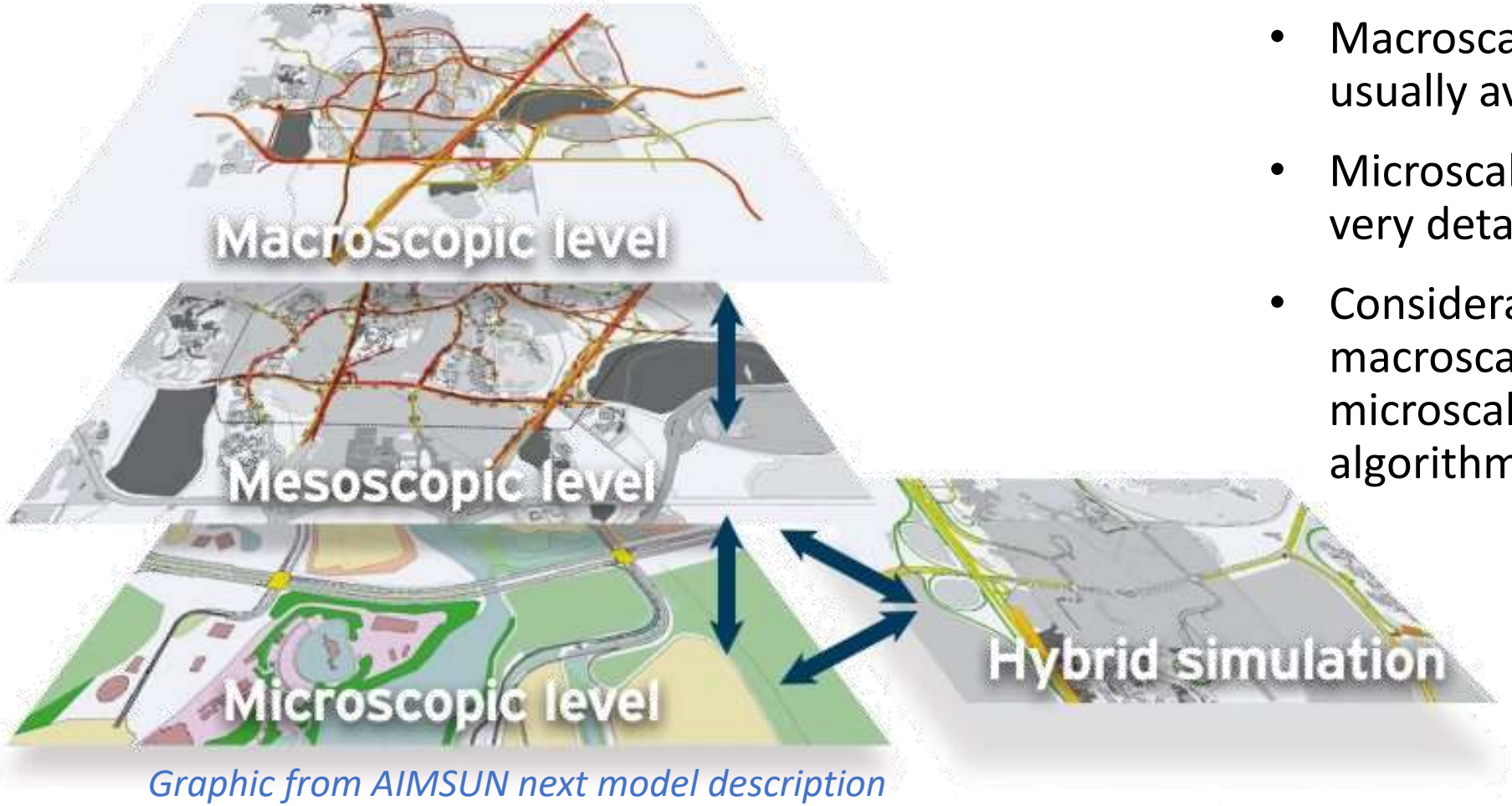
Challenge: fill the gap between macro and micro



Graphic from AIMSUN next model description

- Macroscale traffic data are usually available at city scale
- Microscale models require very detailed data
- Considerations to use macroscale traffic data for microscale emission algorithms

From macroscale to microscale

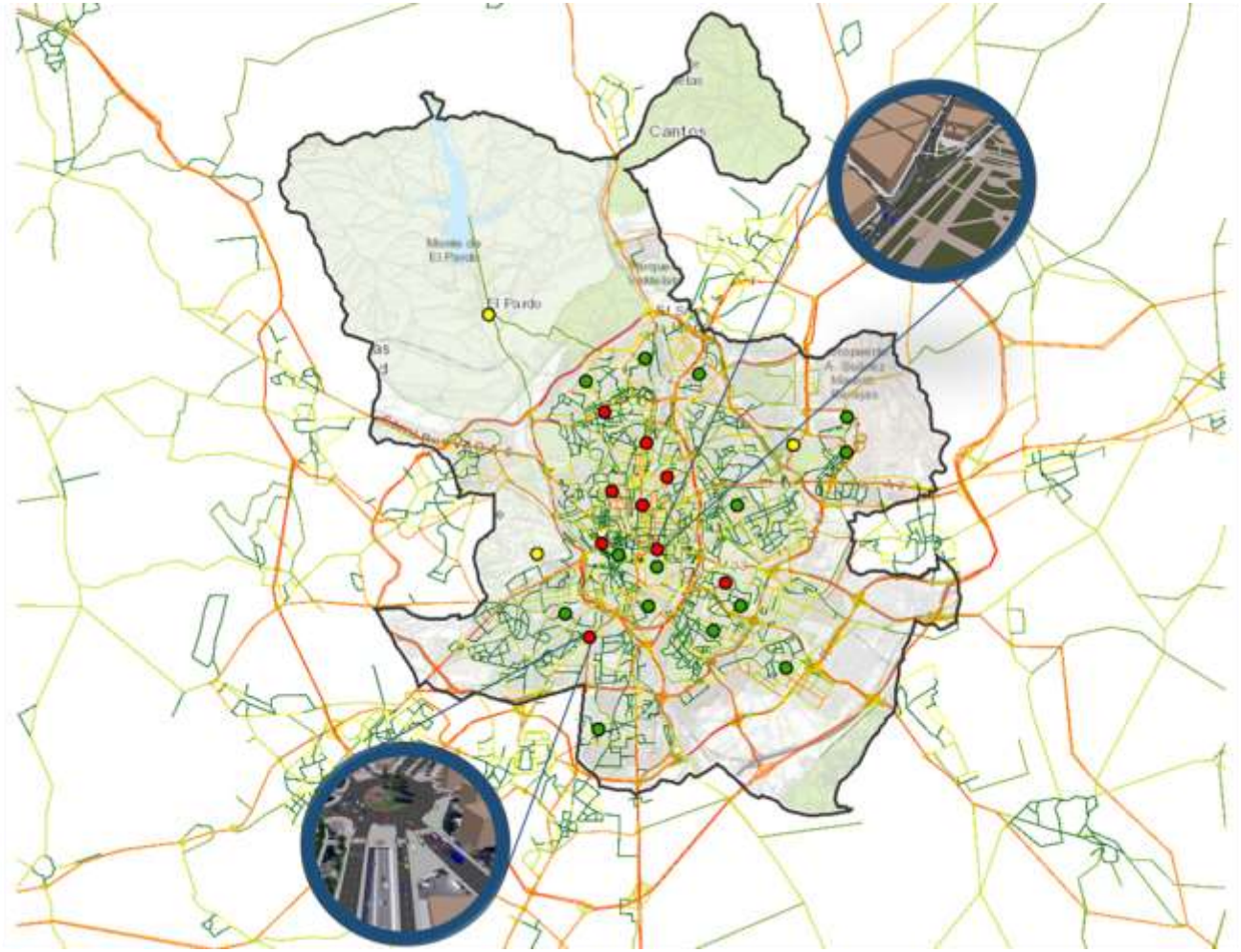
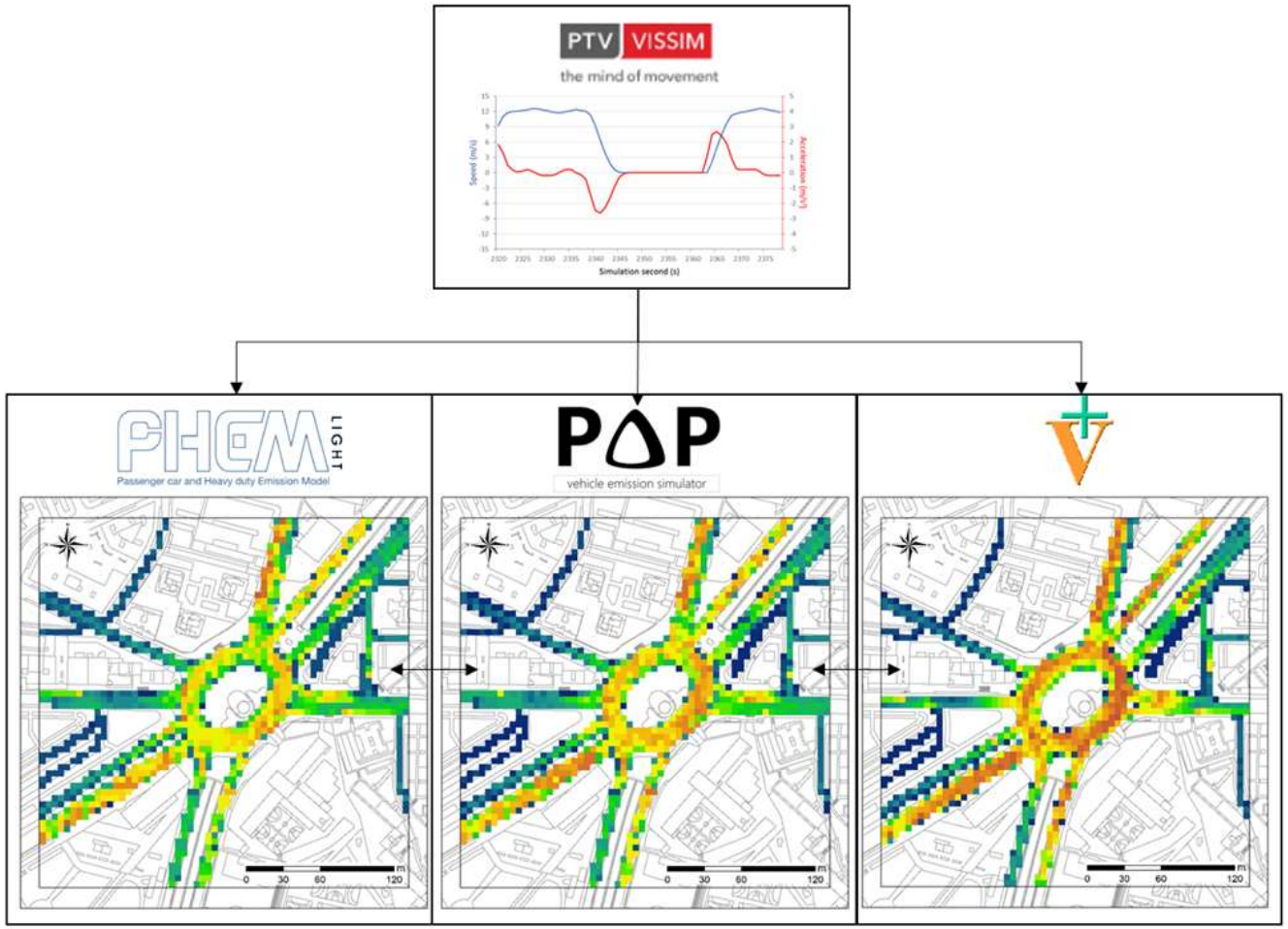


Figure from Quaassdorff, 2018

Comparison of microscale emission models



Quaassdorff et al, 2022

"**consistent emission estimates can be achieved** with any of the models, as long as reliable information on the **vehicle fleet composition and vehicle characteristics** is provided as input but **local calibration** of vehicle emission models is essential for accurate modelling".

U.S.A. modal model evaluation

US-EPA MOVES

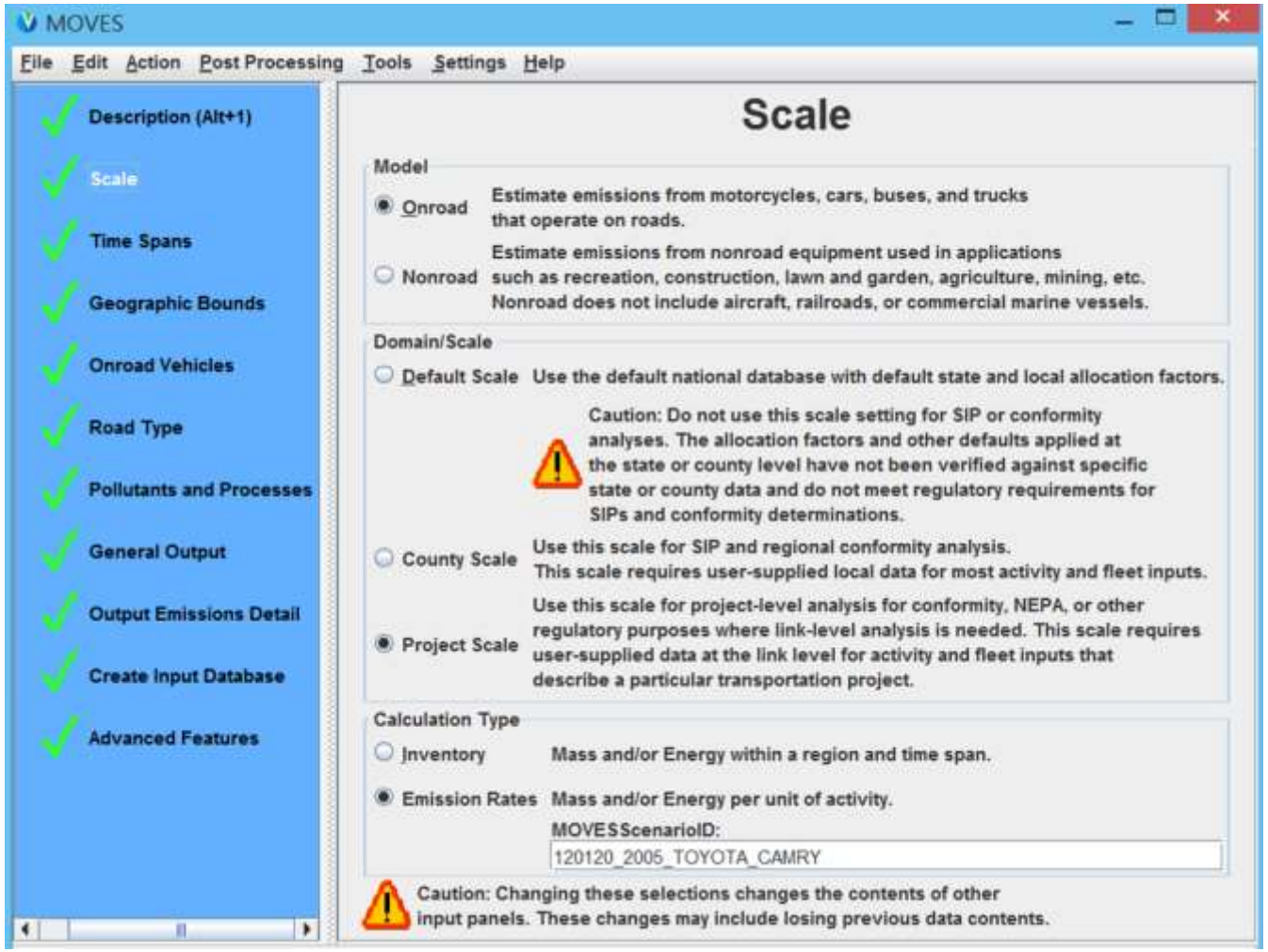
Vehicle type (passenger car)

Vehicle age

Vehicle activity (1Hz speed profiles and RG)

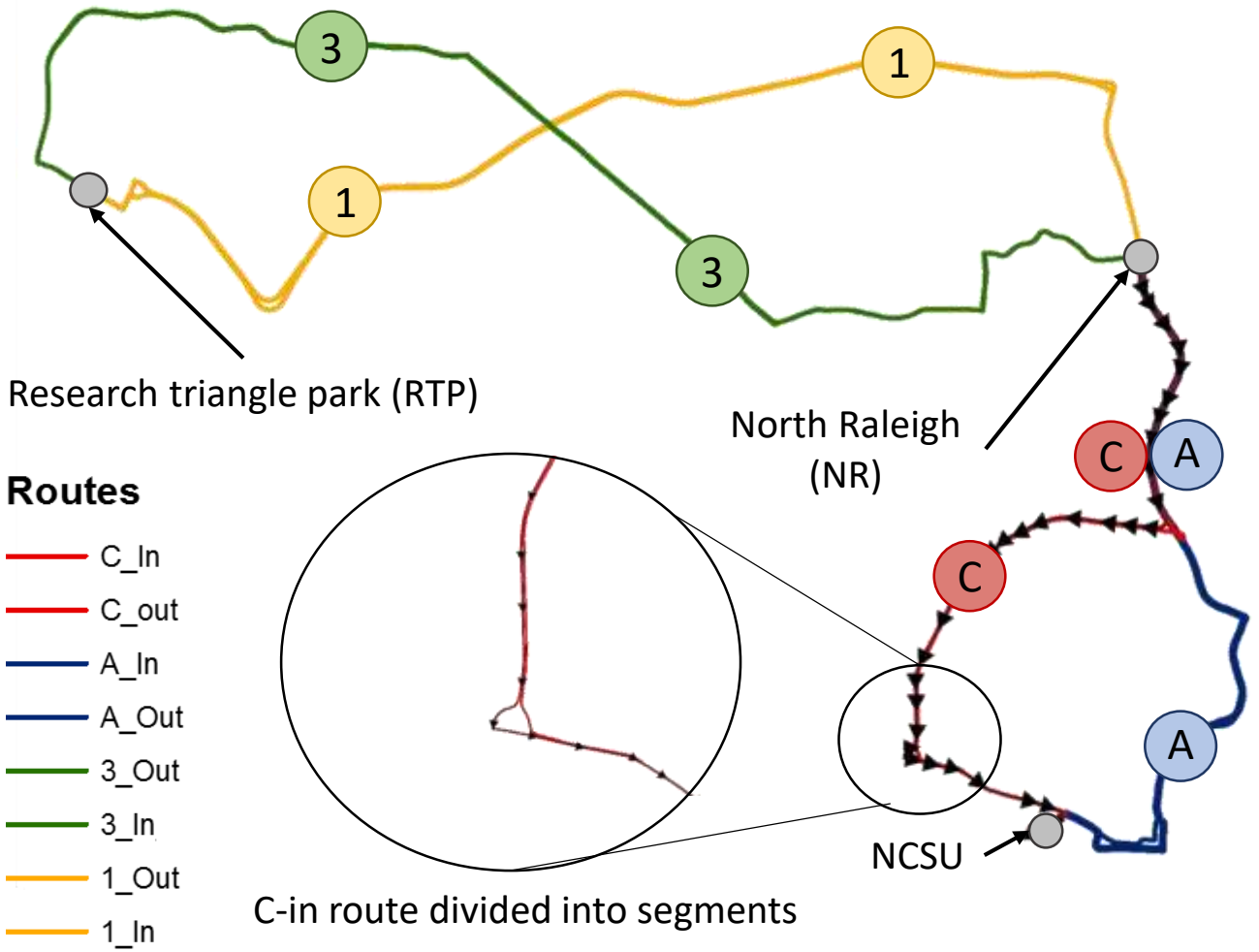
Ambient condition

Fleet average segment based emission rates



Measured routes for individual vehicles

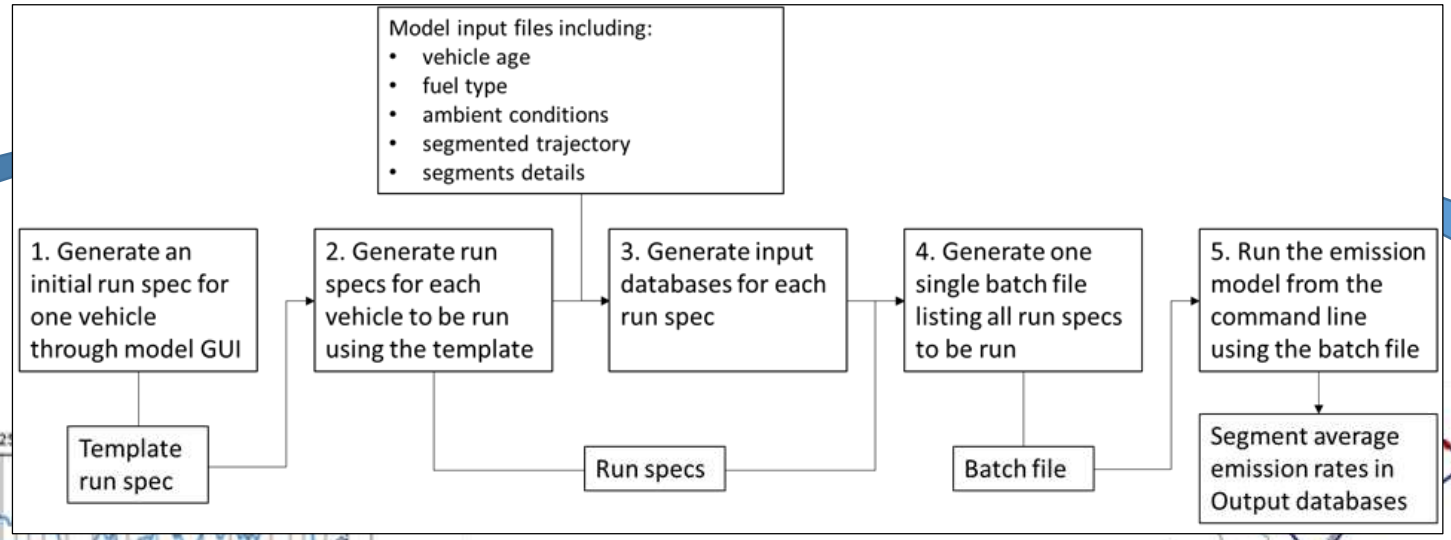
- 8 one-way routes:
  - 4 out routes from NCSU to NR and from NR to RTP
  - 4 in routes from RTP to NR and from NR to NCSU
- Broad coverage of road types, speed limits and RG
- Total distance 177 km
- 450 segments, based on:
  - constant RG
  - speed limits
  - road types
- Average length of 400 m (8-800 m)

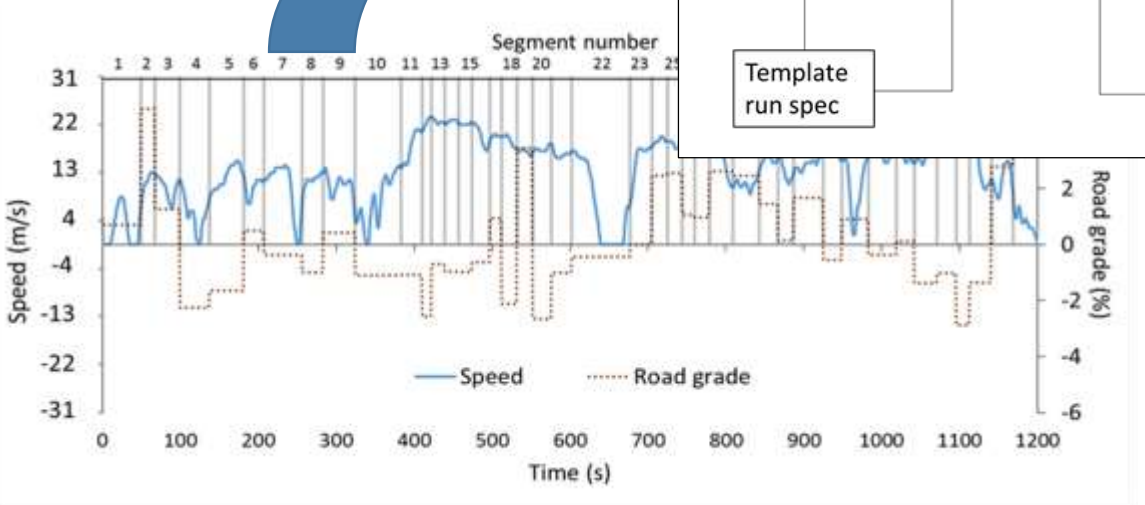


C-in route divided into segments

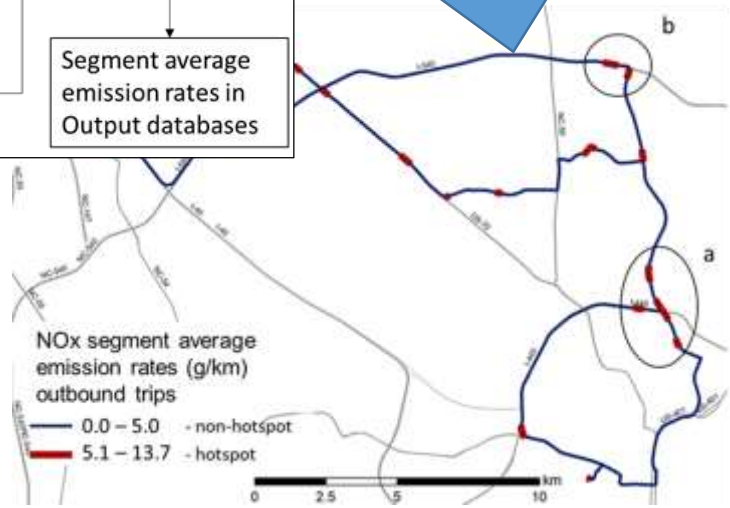
Emission model input requirements automation

Case study:
10 Light Duty Gasoline Vehicles





232 automated simulations in 20h Vs.
15 days of manual work for the same output



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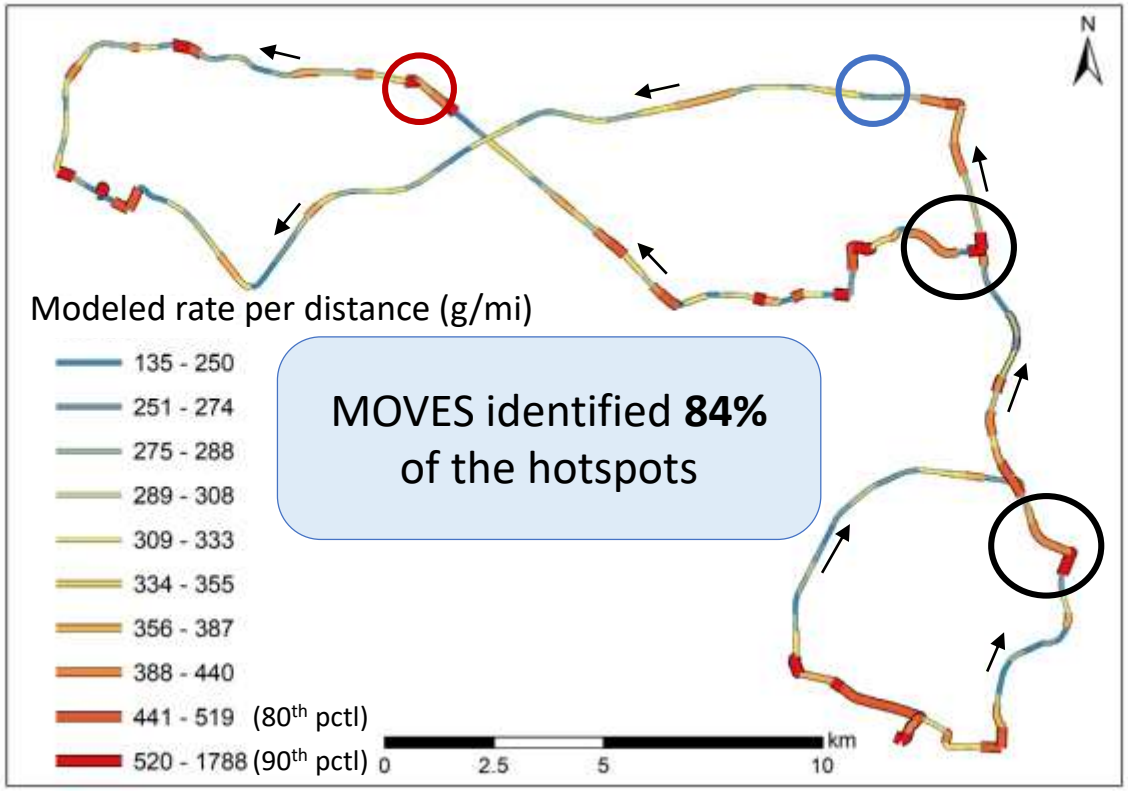
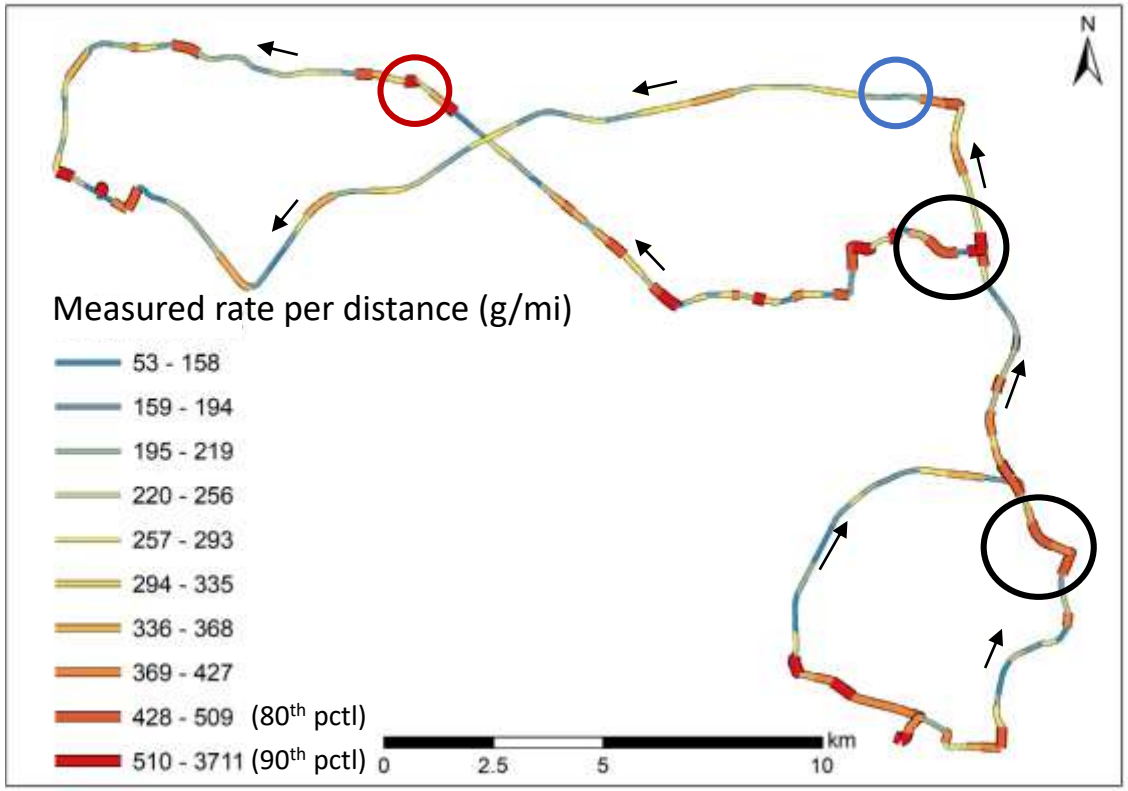
MOVES modeled and measured emission rates per segments – 10 vehicles average CO_2

Model predicted hotspots



MOVES identified **84%** of the hotspots

Measured hotspots



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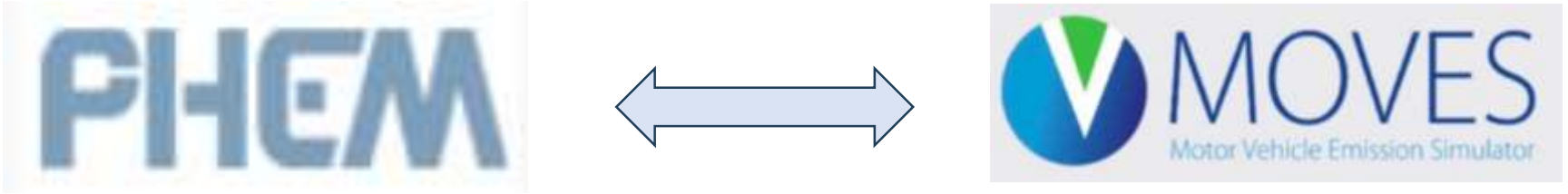
Alignment possibilities between EU-PHEM and US-MOVES emission models



- Analyzed possibilities to align European model to US fleet data using 15 driving cycles and identified calibration opportunities.

Short research stay in collaboration with TUGraz

Road transport emission parameterization for microscale applications based on macroscale measurable traffic information

- Identify the capabilities of macroscale approaches to capture microscale high emission values of speed, road grade and vehicle specific power, based on 9 time averaged datasets from 1Hz measured data of 10 vehicles.

Quaassdorff and Borge, 2024
Unpublished work, accepted for presentation at Transport Research Arena (TRA), April 15-18, 2024.

Key takeaways

- Consistent emission estimates can be achieved with different microscale models, as long as reliable information on the vehicle fleet composition and vehicle characteristics is provided.
- Context dependent segmented trajectories of speed to estimate segment average emission rates are useful to identify emission hotspots in comparison to measured data. Interesting for environmental justice analysis.
- Macroscale approaches can capture microscale high emission values for short average time periods.