



IRTEMS

H2020-MSCA-IF-2019,
Grant Agreement 896417

IRTEMS project closure workshop:
Modelling instantaneous road transport emissions
February 13, 2024

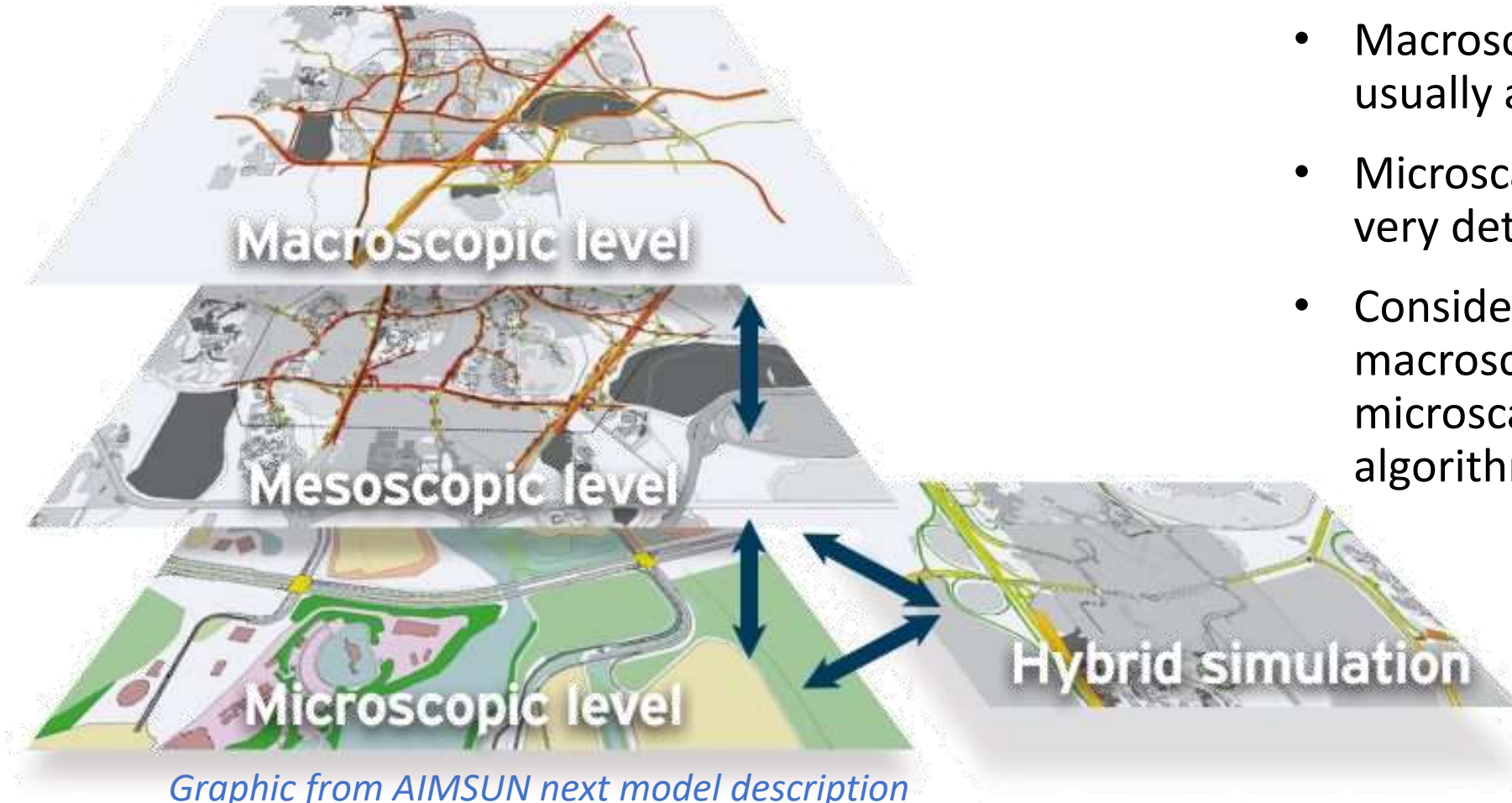


IRTEMS project main results and takeaways

By: **Christina Quaassdorff (UPM)**



Challenge: fill the gap between macro and micro



- 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



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From macroscale to microscale

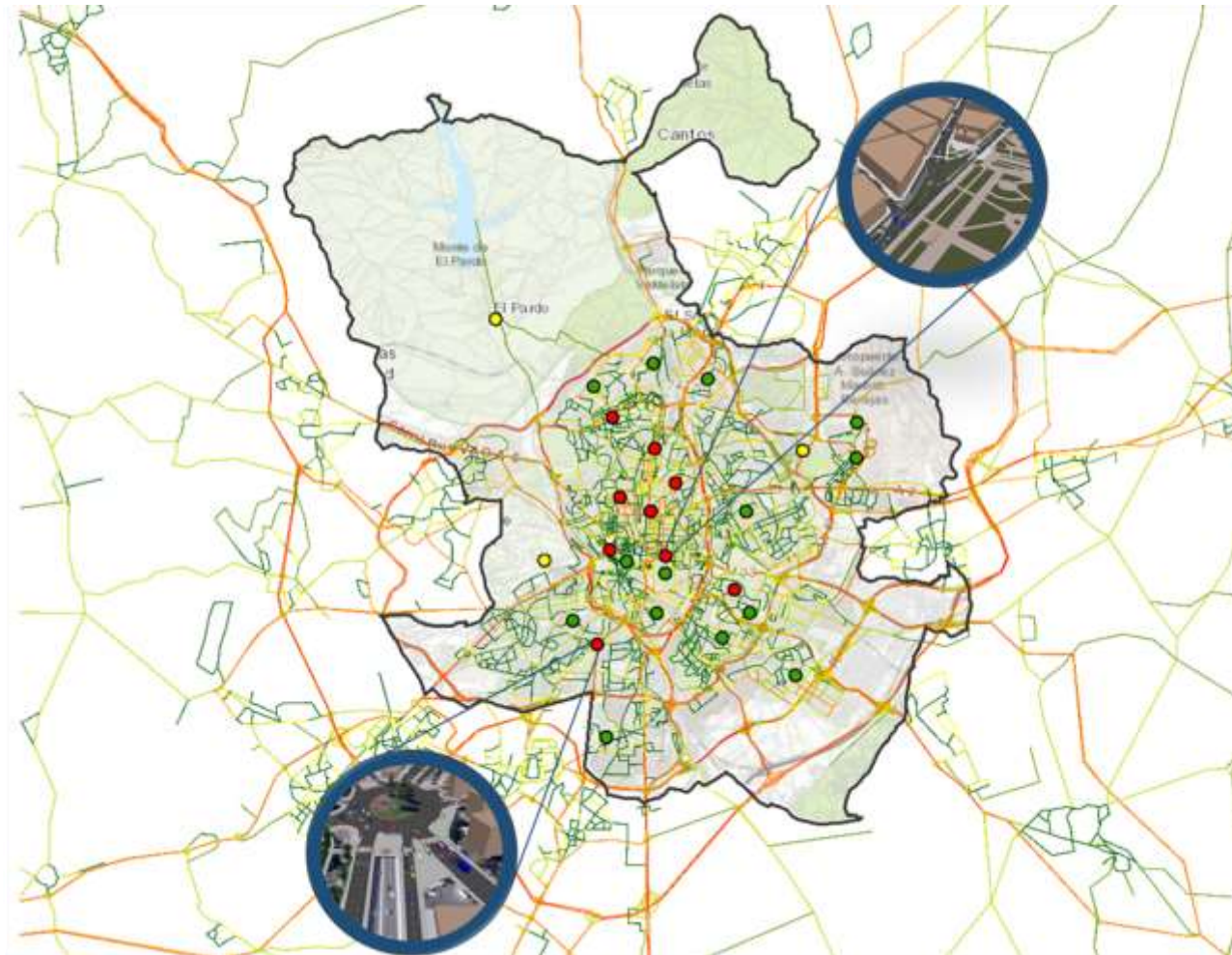
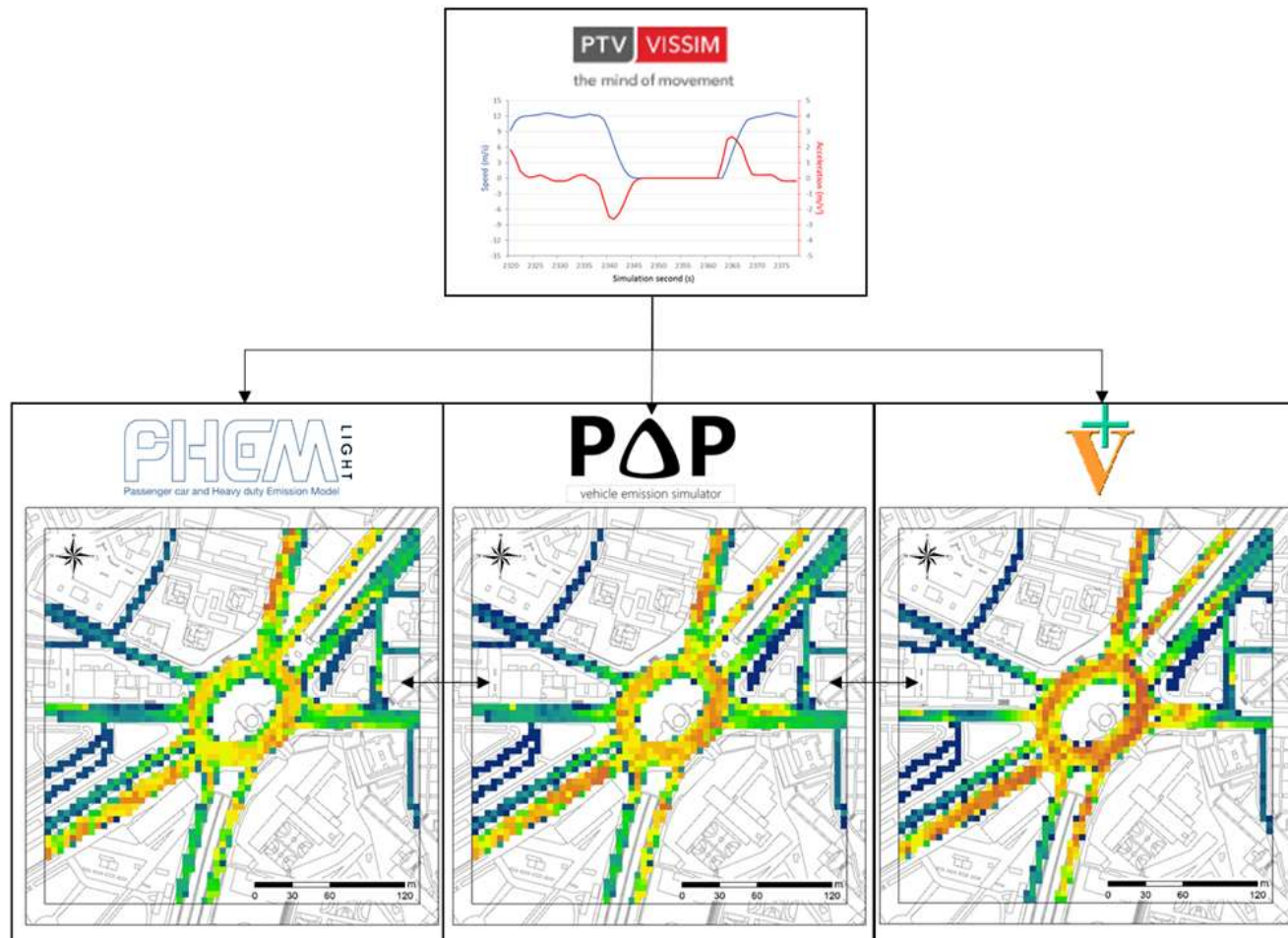


Figure from Quaassdorff, 2018



Comparison of microscale emission models



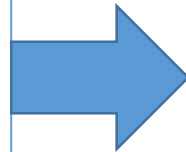
“consistent emission estimates can be achieved with any of the models, as long as reliable information on the vehicle fleet composition and vehicle characteristics is provided as input but local calibration of vehicle emission models is essential for accurate modelling”.



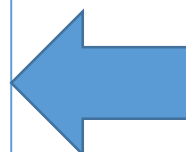
U.S.A. modal model evaluation

US-EPA MOVES

Vehicle type (passenger car)
Vehicle age
Vehicle activity (1Hz speed profiles and RG)
Ambient condition



Fleet average segment based emission rates



The screenshot shows the MOVES software interface with the 'Scale' settings panel open. The left sidebar lists various settings, all of which are checked with green checkmarks: Description (Alt+1), Scale, Time Spans, Geographic Bounds, Onroad Vehicles, Road Type, Pollutants and Processes, General Output, Output Emissions Detail, Create Input Database, and Advanced Features. The main panel is titled 'Scale' and contains the following sections:

- Model:**
 - Onroad** Estimate emissions from motorcycles, cars, buses, and trucks that operate on roads.
 - Nonroad** Estimate emissions from nonroad equipment used in applications such as recreation, construction, lawn and garden, agriculture, mining, etc. Nonroad does not include aircraft, railroads, or commercial marine vessels.
- Domain/Scale:**
 - Default Scale** Use the default national database with default state and local allocation factors.

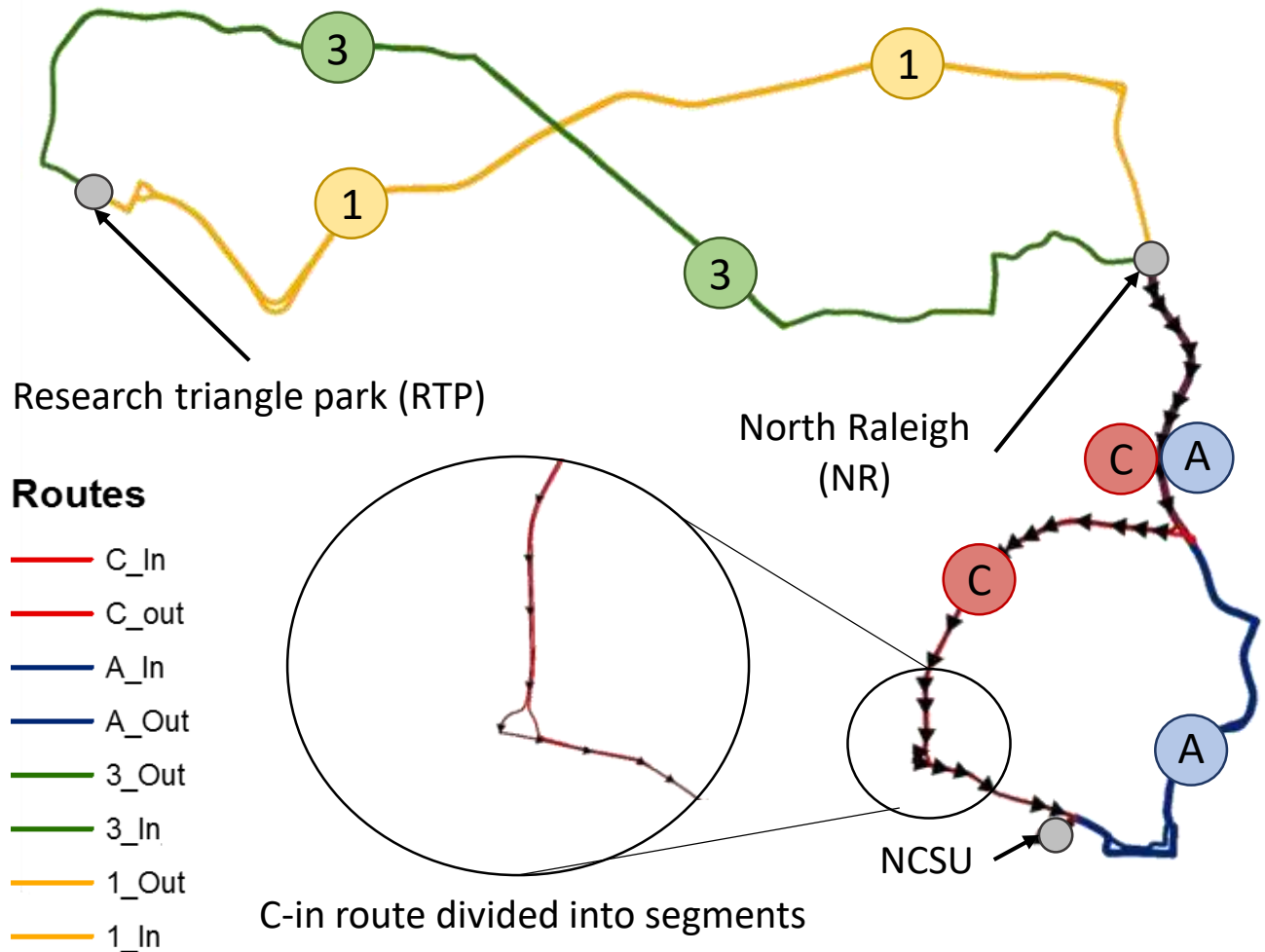
Caution: Do not use this scale setting for SIP or conformity analyses. The allocation factors and other defaults applied at the state or county level have not been verified against specific state or county data and do not meet regulatory requirements for SIPs and conformity determinations.
 - County Scale** Use this scale for SIP and regional conformity analysis. This scale requires user-supplied local data for most activity and fleet inputs.
 - Project Scale** Use this scale for project-level analysis for conformity, NEPA, or other regulatory purposes where link-level analysis is needed. This scale requires user-supplied data at the link level for activity and fleet inputs that describe a particular transportation project.
- Calculation Type:**
 - Inventory** Mass and/or Energy within a region and time span.
 - Emission Rates** Mass and/or Energy per unit of activity.

At the bottom of the panel, there is a text input field for 'MOVESScenarioID:' with the value '120120_2005_TOYOTA_CAMRY'. A warning icon and text at the bottom state: 'Caution: Changing these selections changes the contents of other input panels. These changes may include losing previous data contents.'



Measured routes for individual vehicles

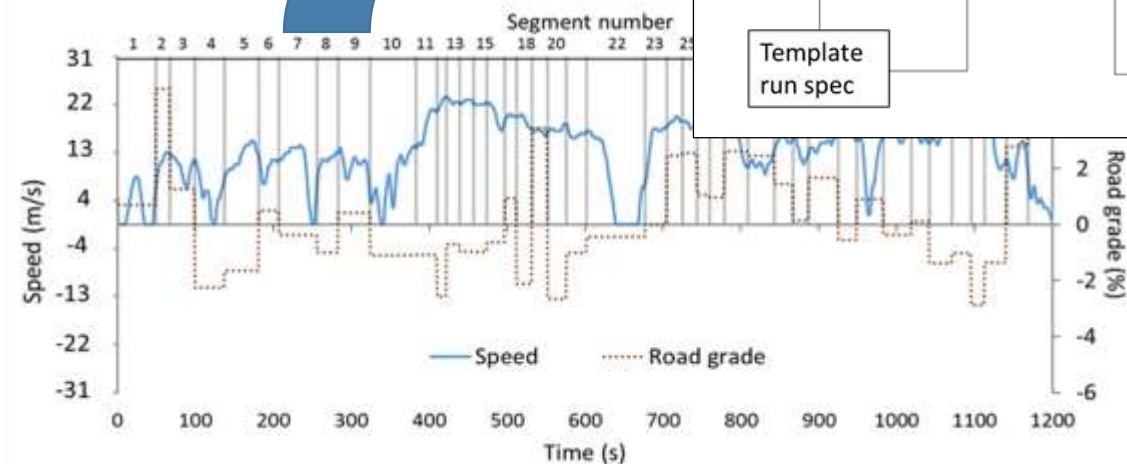
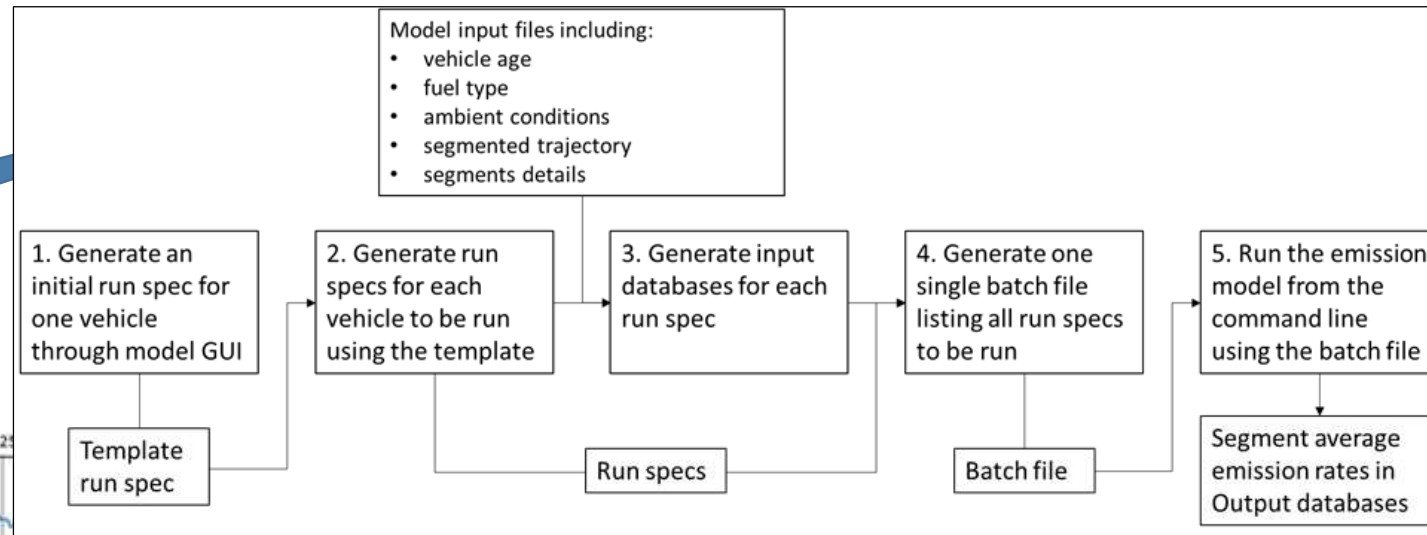
- 8 one-way routes:
 - 4 out routes from NCSU to NR and from NR to RTP
 - 4 in routes from RTP to NR and from NR to NCSU
- Broad coverage of road types, speed limits and RG
- Total distance 177 km
- 450 segments, based on:
 - constant RG
 - speed limits
 - road types
- Average length of 400 m (8-800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



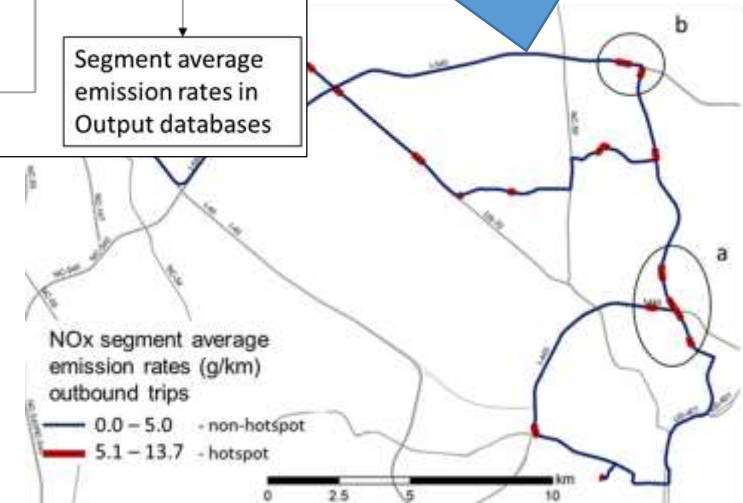


Emission model input requirements automation

**Case study:
10 Light Duty
Gasoline Vehicles**



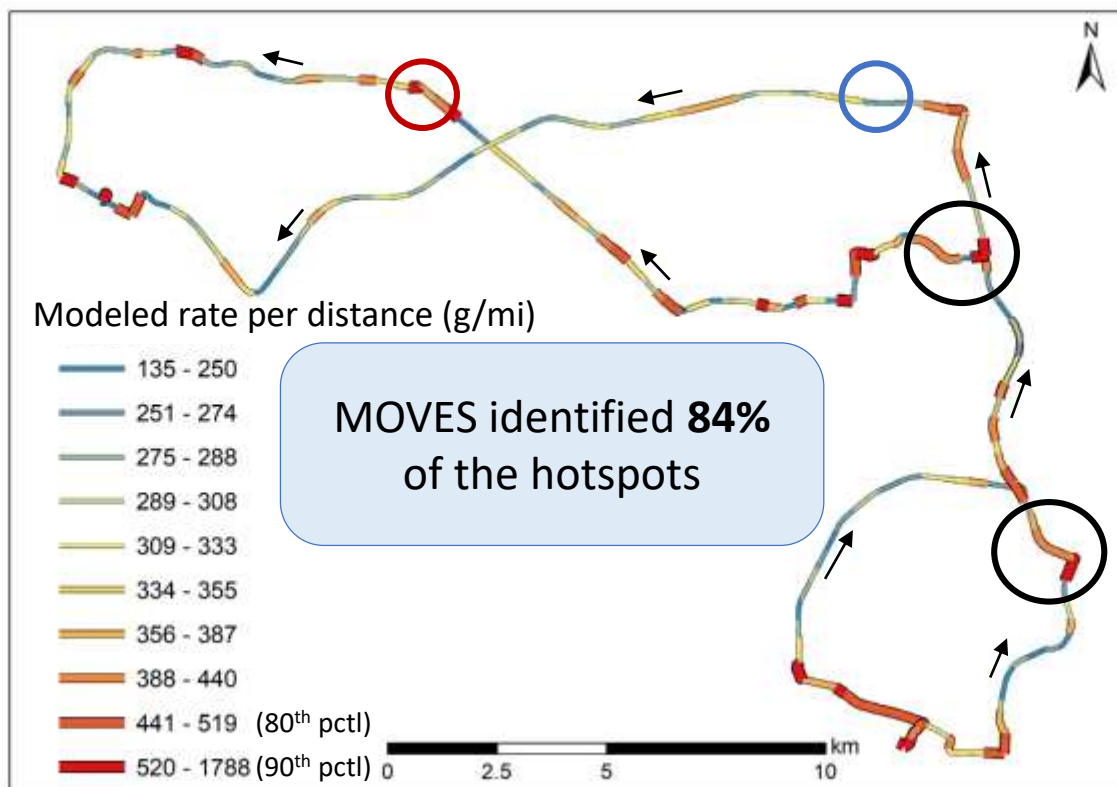
232 automated simulations in 20h Vs. 15 days of manual work for the same output



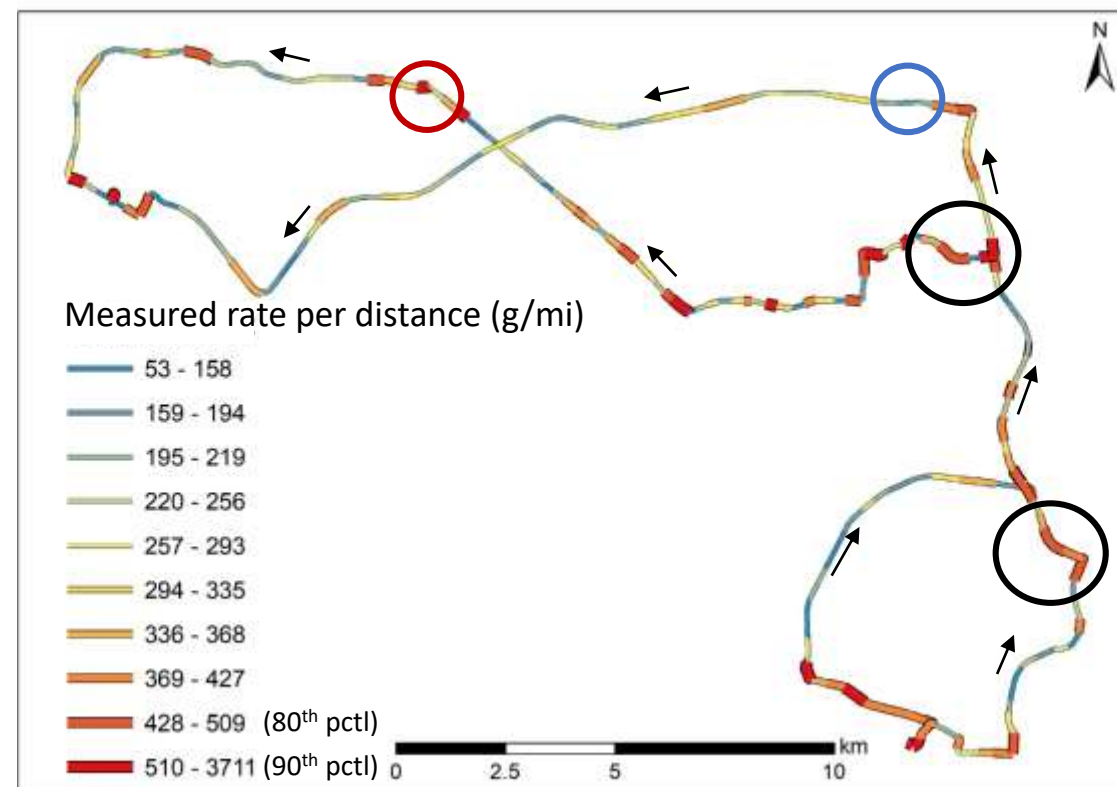


MOVES modeled and measured emission rates per segments – 10 vehicles average CO₂

Model predicted hotspots



Measured hotspots





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



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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.



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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.