

Quantifying Transport Emissions and the Impact of Mitigation Measures: Introducing the Application Suite Emissions (ASE) tool for Climate Assessment

European Transport Conference (ETC), Antwerp, Belgium

17.09.2025

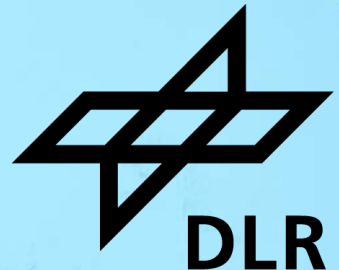
Nina Thomsen et al.



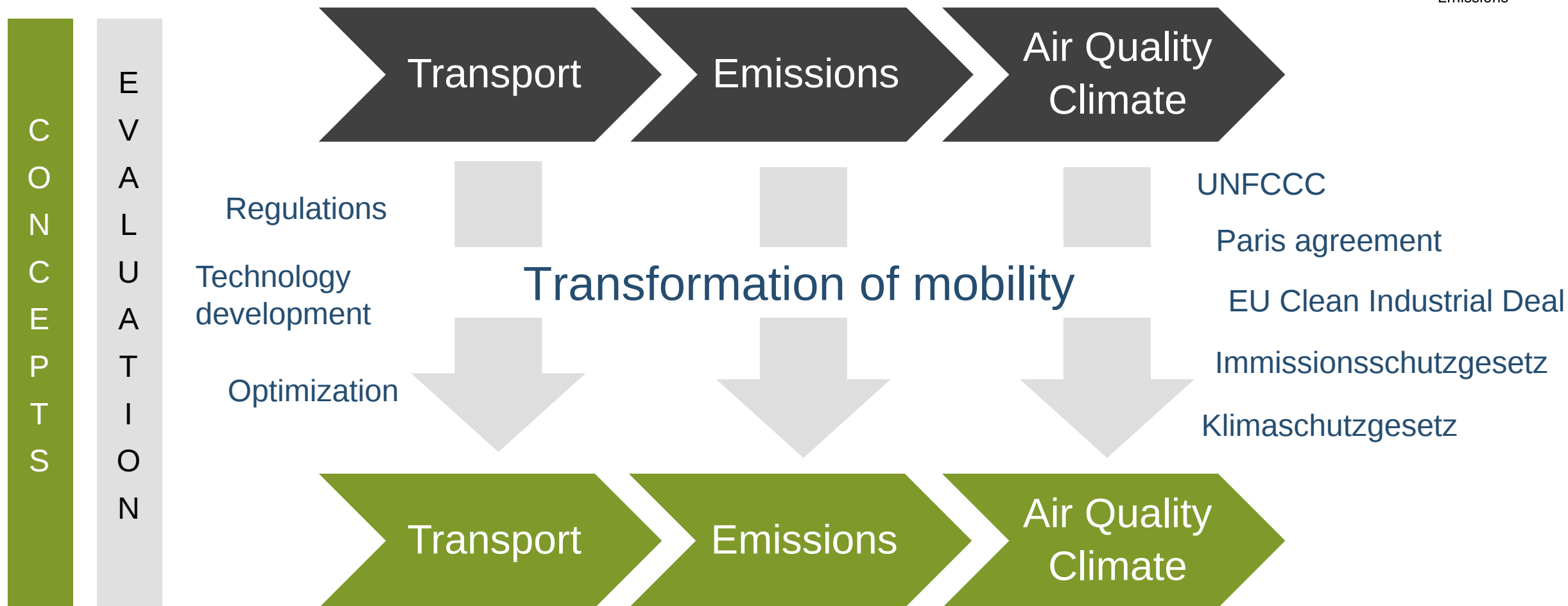
Models and Data for
Future Mobility



Application Suite
Emissions



MoDa “Application Suite Emissions” (ASE) – Assessing land transport emissions and their climate impacts





ASE enables scenario-based analysis of transport emissions and mitigation measures at the urban, European, and global scales.

- ASE combines **established and validated models** that produce results for the relevant drivers of emissions and climate impact
 - Transport activity (Travel volumes, spatial distribution)
 - Technology developments (emission factors)
 - Climate response (distribution of emissions in the atmosphere)
- **Scenario capability** in contrast to purely data driven approach
 - Consistent results and scenarios across different spatial granularities (urban, European, global)
 - Visualization of results for stakeholder communication



Applied models in ASE

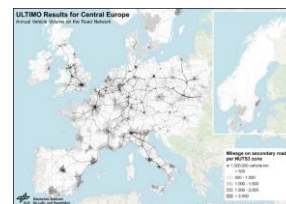


Toolbox

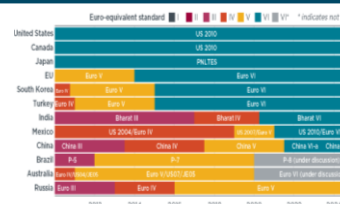
SUMO: Simulation of Urban Mobility
Travel times, waiting times, occupancies,
emissions → optimization
→ emission reduction



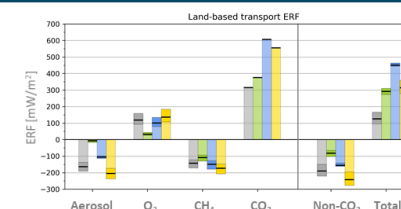
ULTImodel: Universal Transport Distribution Model
Spatial distribution of European road-based transport
and its emissions



TRAEM: Transport Emission Model
Land-based transport activity, emissions,
global coverage, spatial disaggregation



TransClim: Climate Response Model
Effects of land-based transport and
shipping → climate/air quality metrics





Modelling urban transport

The microscopic transport model SUMO (Simulation of Urban Mobility)

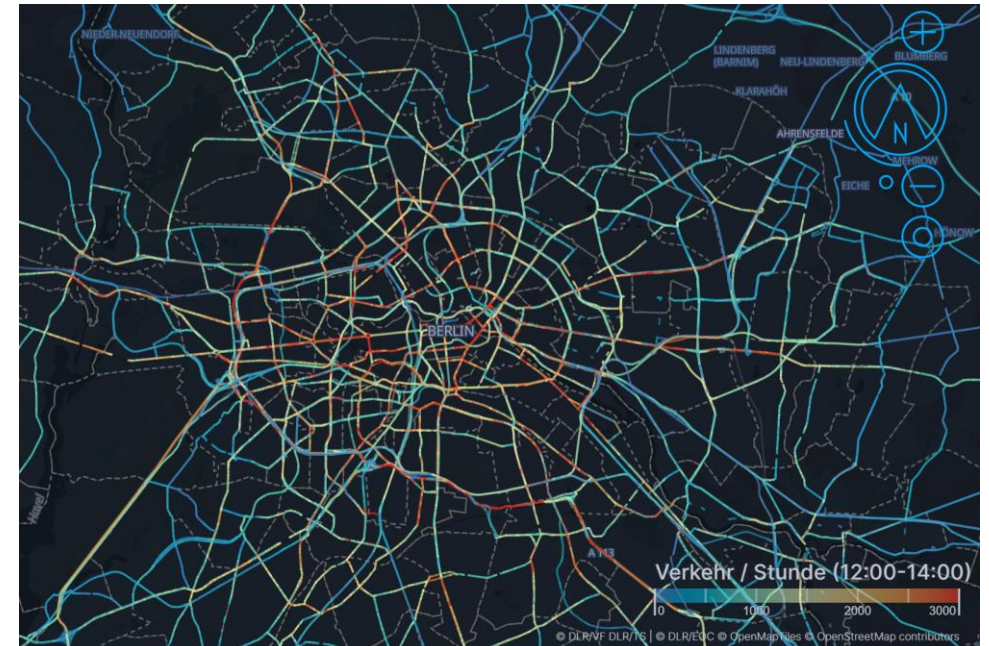
Approach

- Generation of **road network** and **transport demand** (including public transport, rail transport)
- **Vehicle and person-resolving simulation** of movements → calculation of emissions
- Input from ULTIModel (**boundary conditions**) and TRAEM (**fleet composition, emission factors, tech. scenarios**)



Microscopic
traffic simulation

Example: transport activity in Berlin





Modelling European transport

European transport model ULTImodel (Universal Transport Distribution Model)

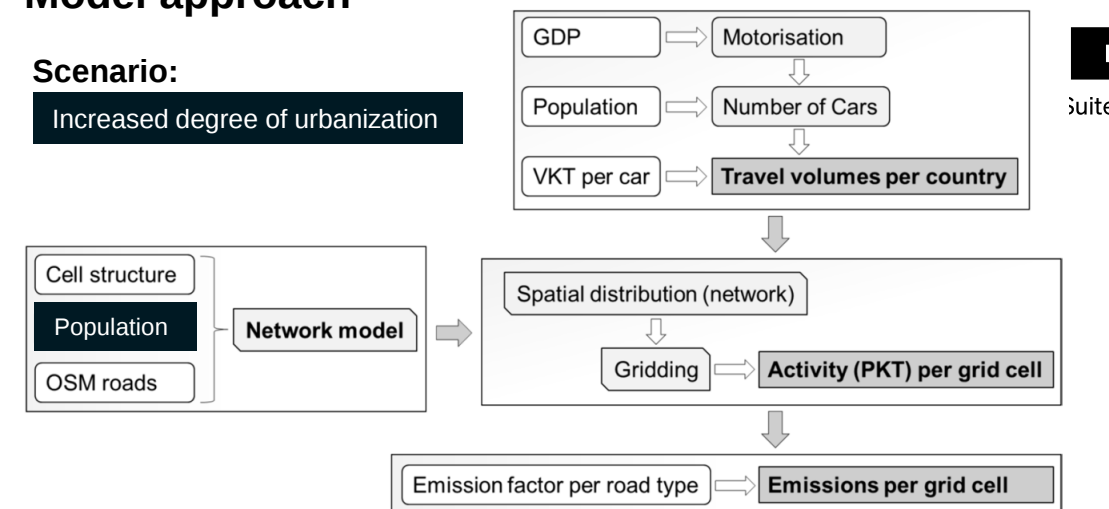
Approach

- Distribution of **European road traffic** in road network based on Open Data → **emissions**
- Input: aggregated national transport activities in **passenger and freight transport**
- Input from TRAEM (**fleet composition, emission factors, tech. scenarios**)
- Consideration of **socio-economic development**

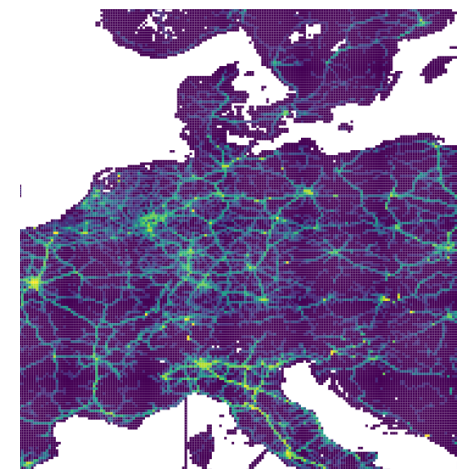
Model approach

Scenario:

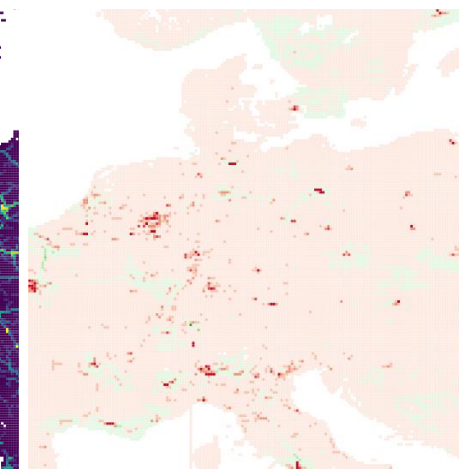
Increased degree of urbanization



Emission inventory



Scenario difference





Models and Data for
Future Mobility

Modelling global transport and technology diffusion

Emission model TRAEM

(Global Land Transport Emission Model)

Approach

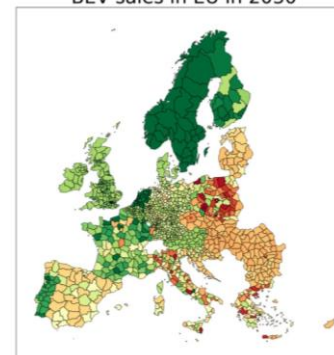
- Emissions of **CO₂** and **non-CO₂** compounds
- **Vehicle types**: passenger cars, heavy/light duty vehicles, two-wheelers, rail transport
- Scenario-based **future projections**
- **Global coverage**
- Optional: Emissions from **vehicle production**



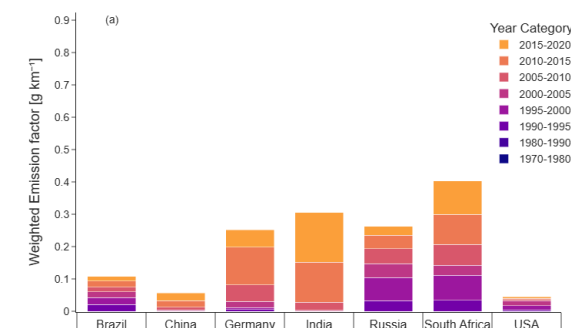
Application Suite
Emissions

Market share projections of vehicle types

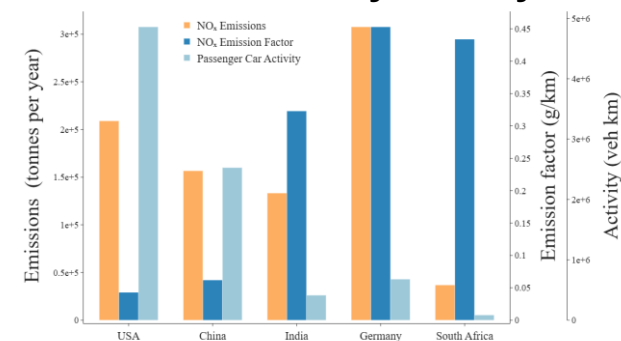
BEV sales in EU in 2030



Fleet composition and emission factors by country



Emission factors, transport activity → Total emissions by country





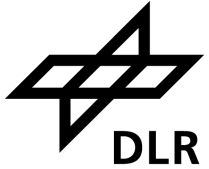
Climate and air quality metrics

Climate assessment model TransClim

(Modelling the effect of surface Transportation on Climate)

Approach

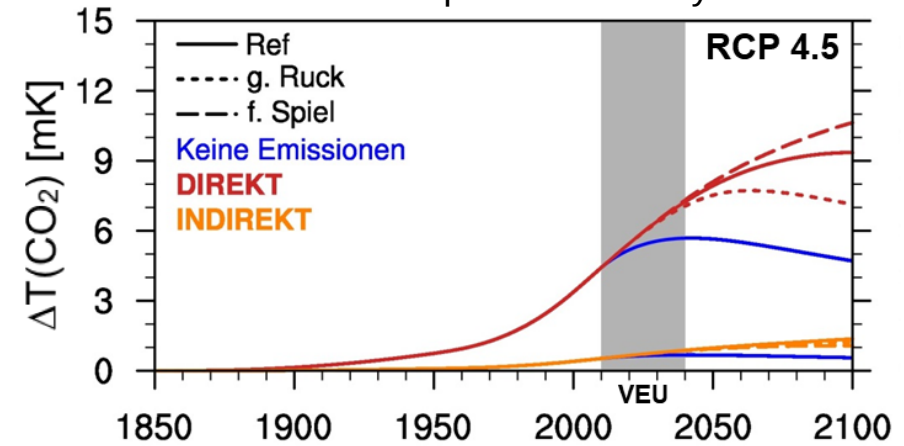
- Purpose: **efficient calculation** (within seconds) of **climate and air quality metrics** for changes in transport emissions (land-based transport and shipping)
- Basis: dedicated, pre-run simulations with **detailed chemistry-climate models** (runtime of weeks)
- Considered components: **aerosol particles, short-lived trace gases** (NO_x , VOC, CO), **GHGs** (O_3 , CH_4 , CO_2)
- New: metrics for **air quality**



Application Suite
Emissions

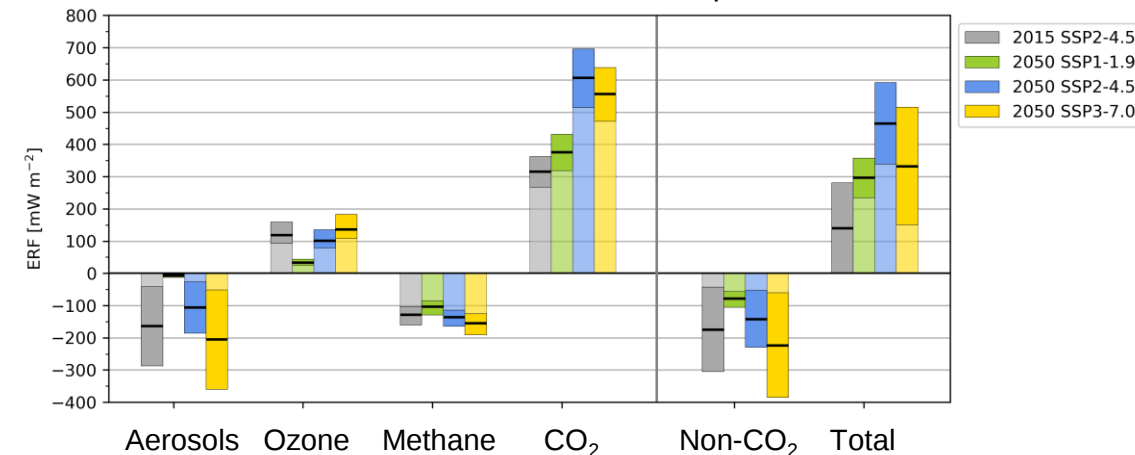
Temperature change

Transport in Germany

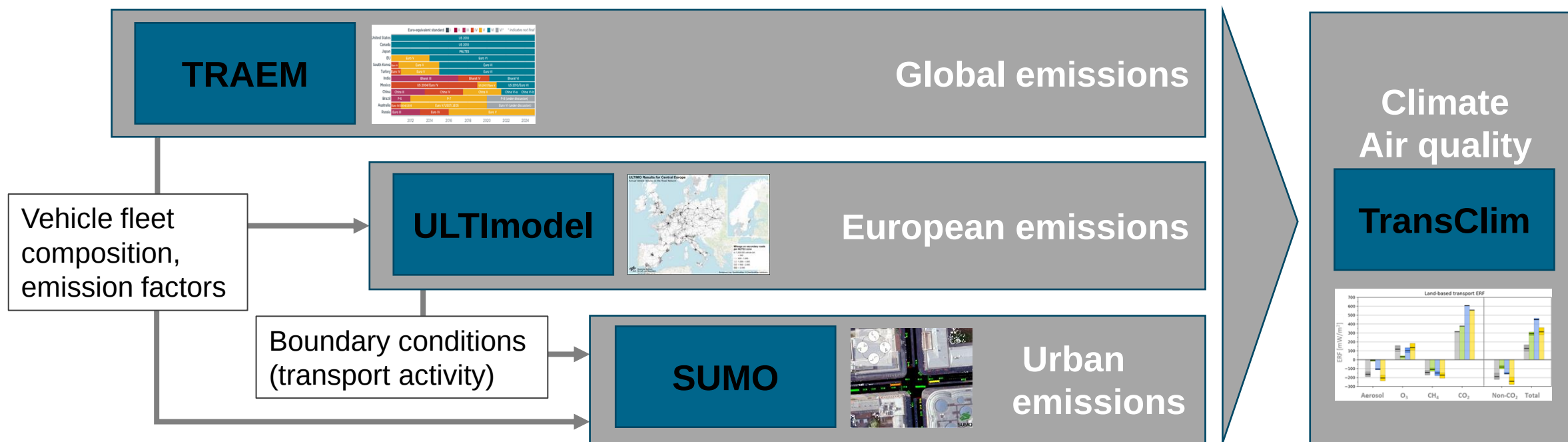


Climate forcing

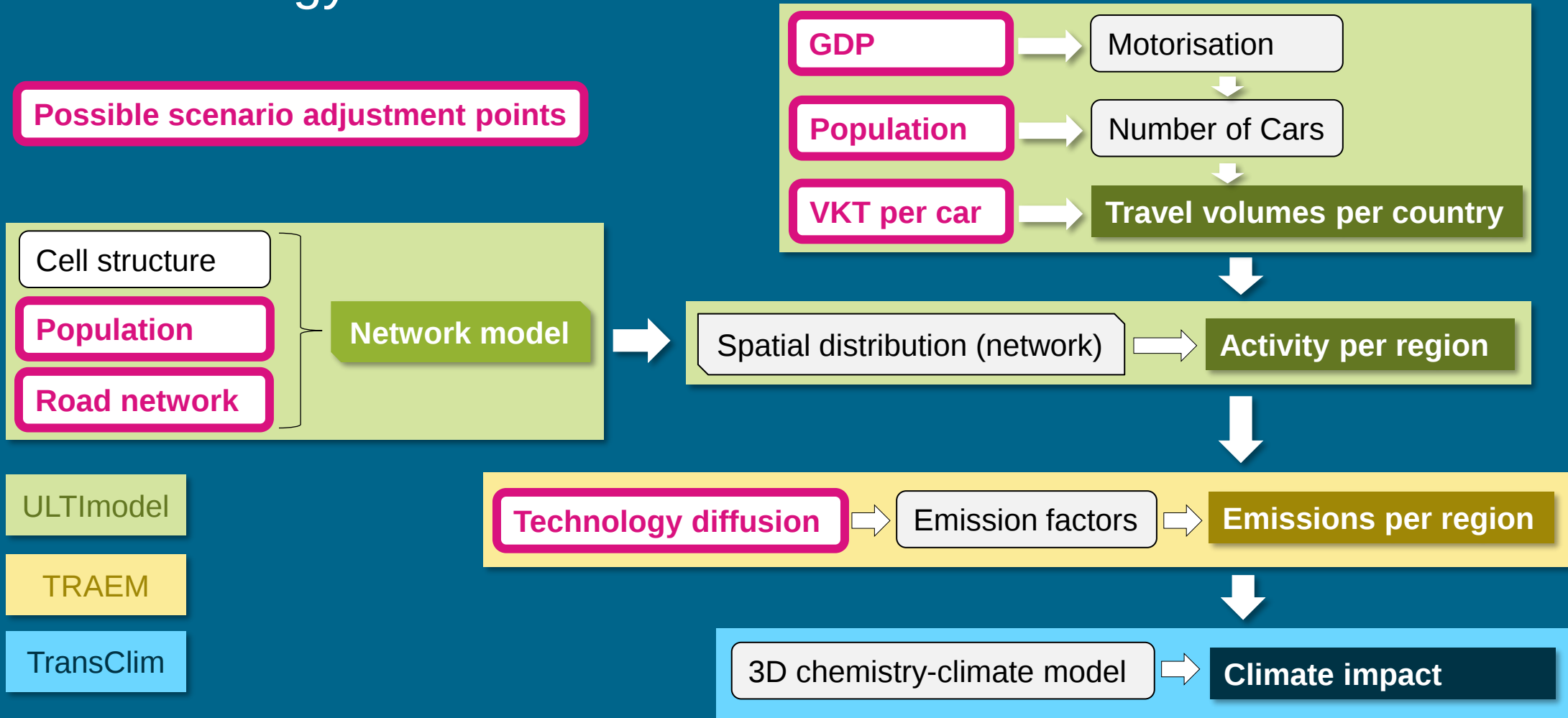
Global land-based transport



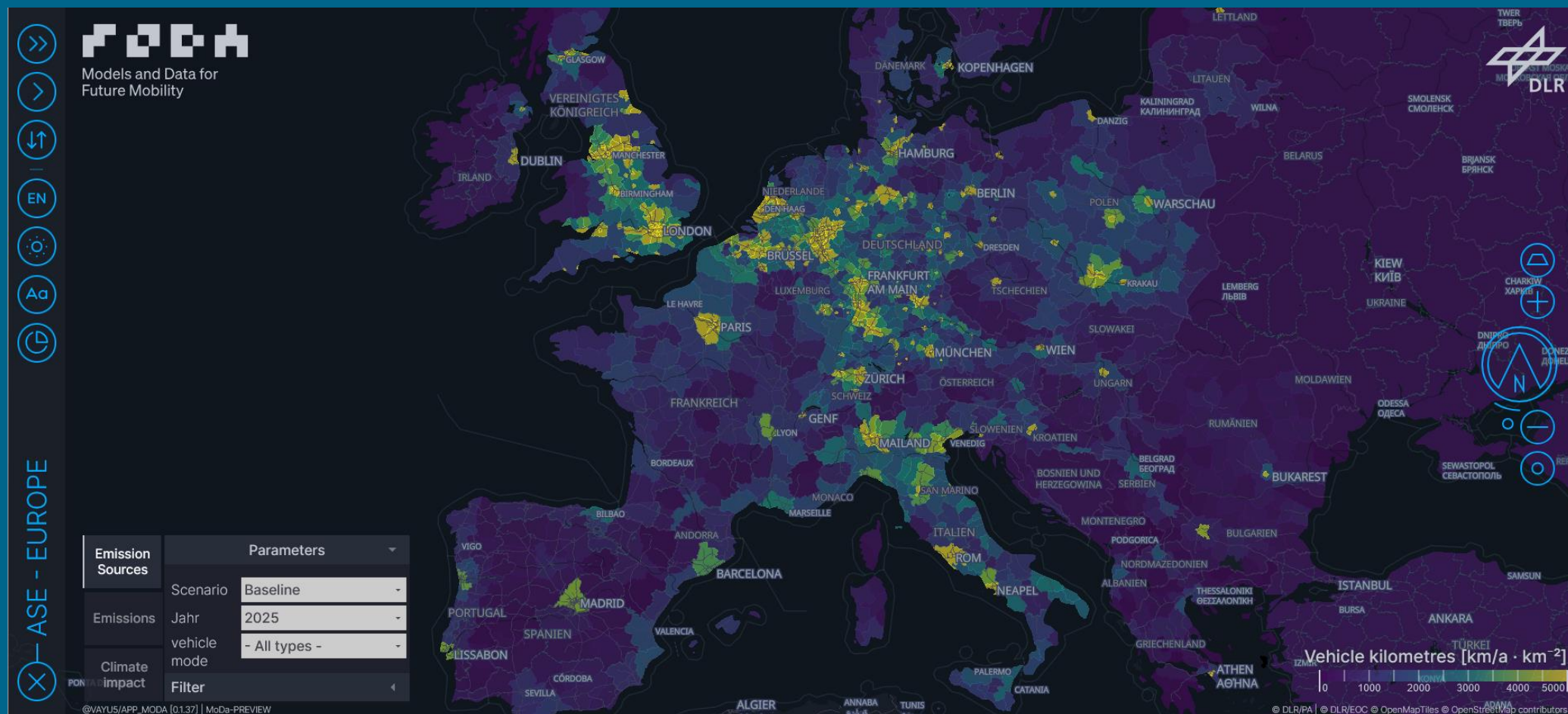
Interfaces between models ensure consistent scenarios and boundary conditions on different scales.



Dive into ASE: European road-based transport Methodology



Dive into ASE: European road-based transport Visualization in the DLR Mobility Laboratory



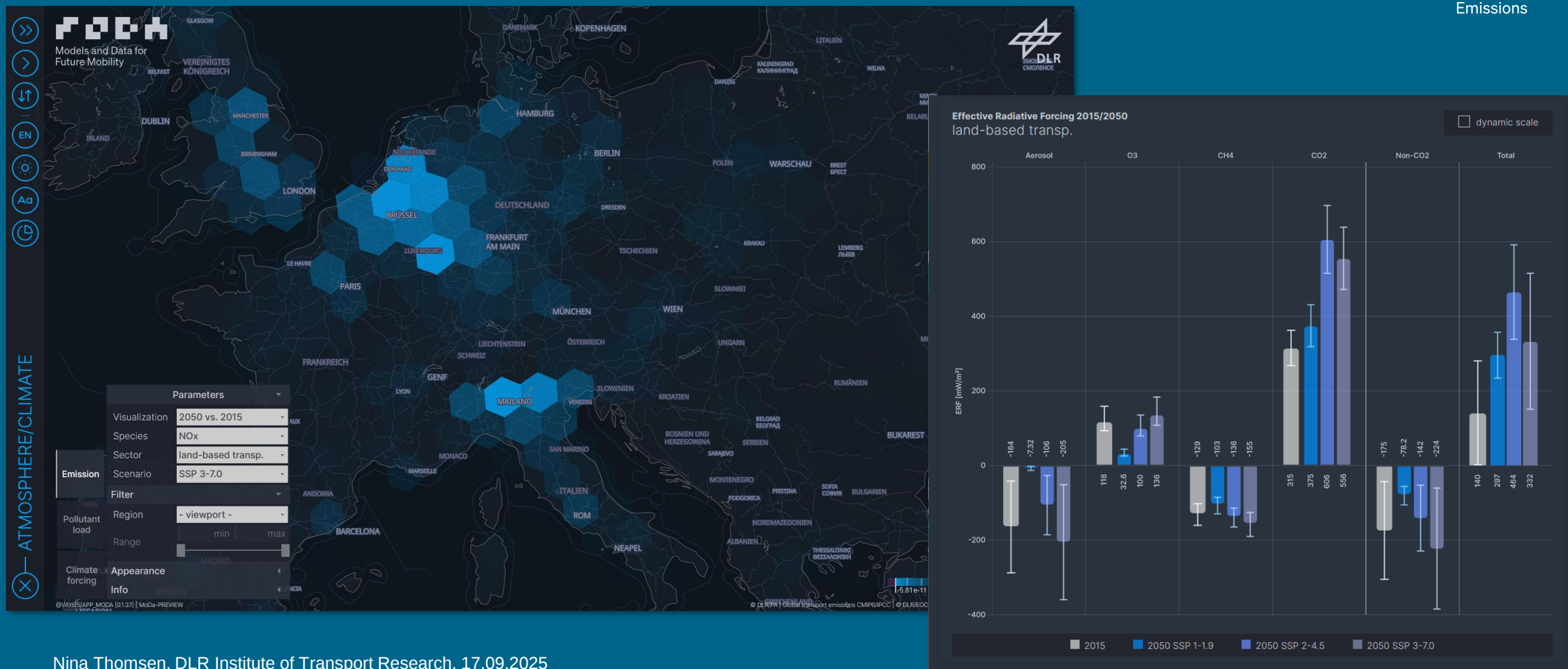


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Dive into ASE: European road-based transport Visualization in the DLR Mobility Laboratory

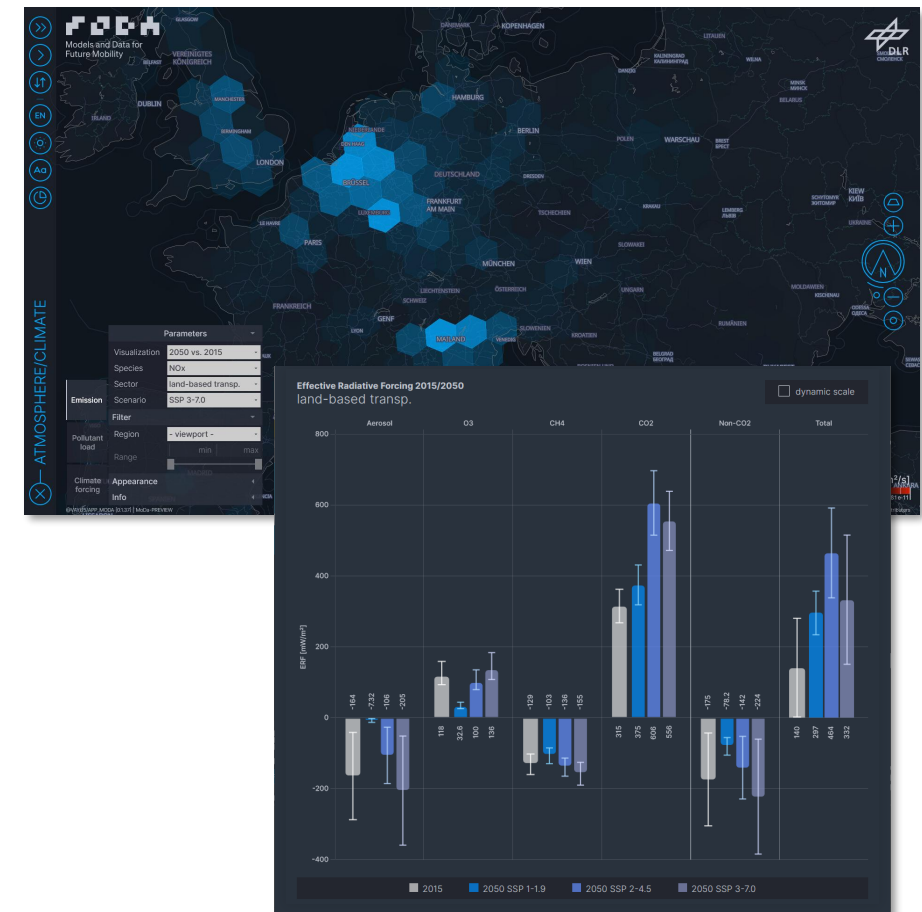
Application Suite
Emissions



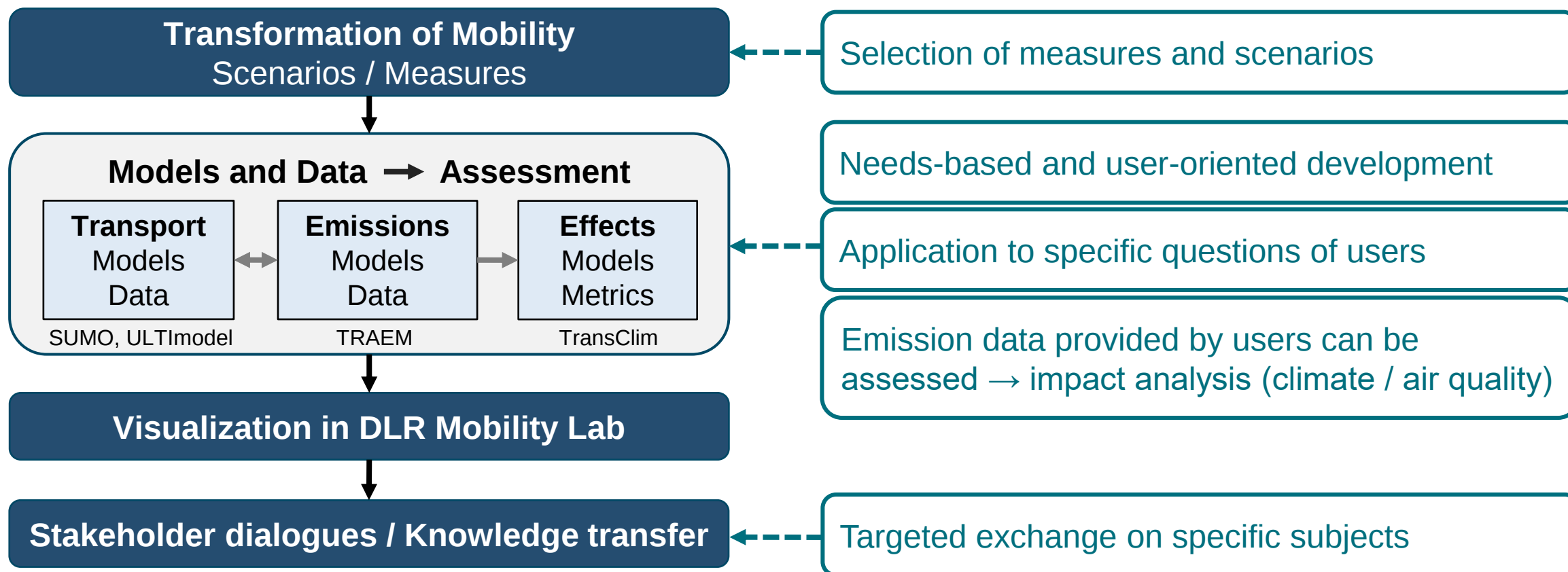


Outlook: Possible applications and mitigation pathways

- **Exploration of large-scale emission reduction measures from a global, regional and urban level**
 - Effects of socio-economic and demographic development (e.g. SSP pathways)
 - effects of low-emission vehicle market share regulations or new fleet CO2 limits
 - shifts to active transport modes (walking and cycling) in cities
- **Urban case studies within large-scale mitigation pathways**
 - Changes in traffic regulations
 - Analysis of medium-term traffic disruptions (e.g., construction projects or large events)
 - Break and tire wear emissions



Potential users are invited to get involved!



Thank you for your attention!

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Imprint

Topic: **Quantifying Transport Emissions and the Impact of Mitigation Measures: Introducing the Application Suite Emissions (ASE) tool for Climate Assessment**

Date: 2025-09-17

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Institute: German Aerospace Center (DLR) – Institute of Transport Research

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