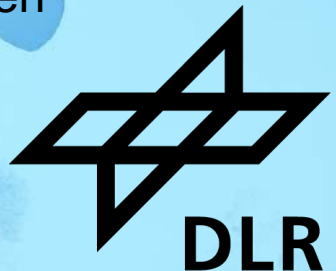


A NEW BOTTOM-UP APPROACH FOR GLOBAL ROAD TRANSPORT EMISSIONS CALCULATION

EGU 24 Vienna

16th April AS3.25

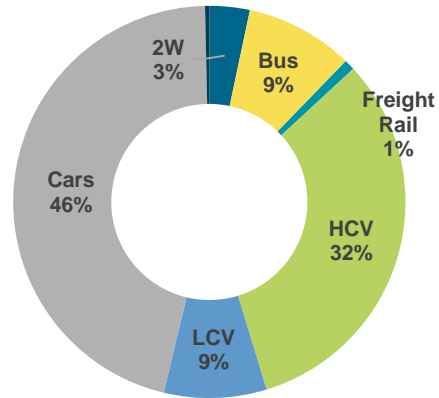
Isheeka Dasgupta, Mario Feinauer, Simone Ehrenberger, Jens Hellekes, Nina Thomsen



The need for better global transport emission inventories

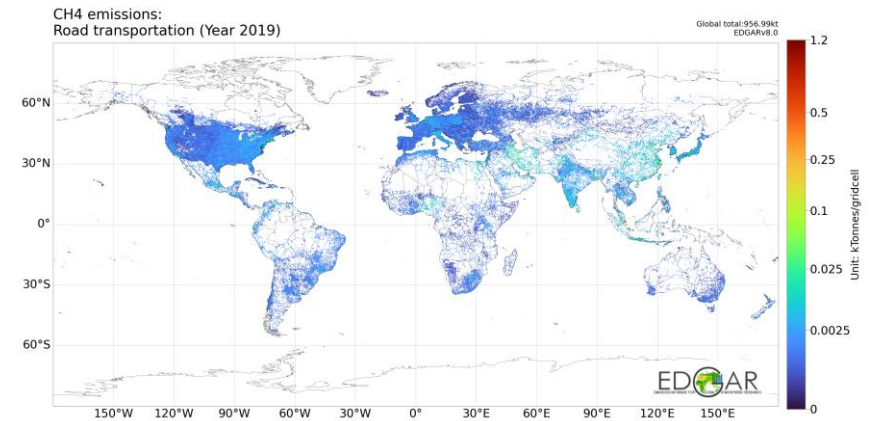
Transport Sector emission input to climate change models

CO₂ emissions from road transport

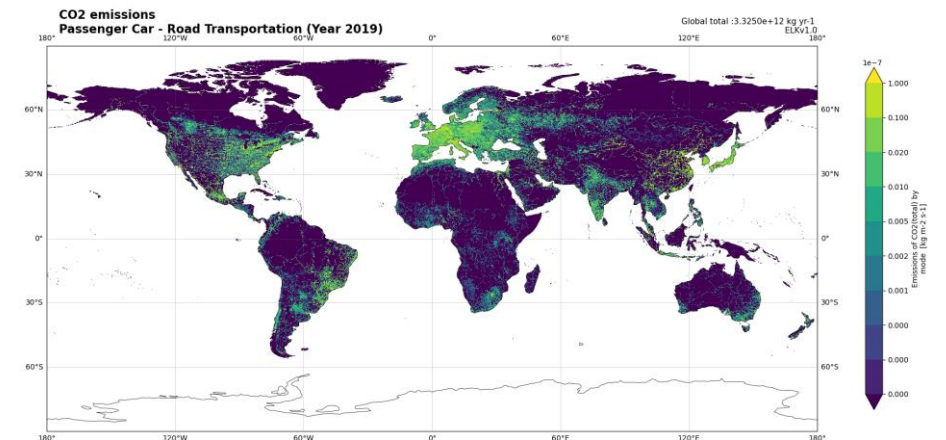


Source: authors

- Subsector specific
- Scenario capable and UI based
- Improved spatial disaggregation
- Transparent and open data based sources
- Exhaust and non-exhaust pollutant species
- Uncertainty metrics



Source: EDGAR (Emissions Database for Global Atmospheric Research) Community GHG Database



Source: authors

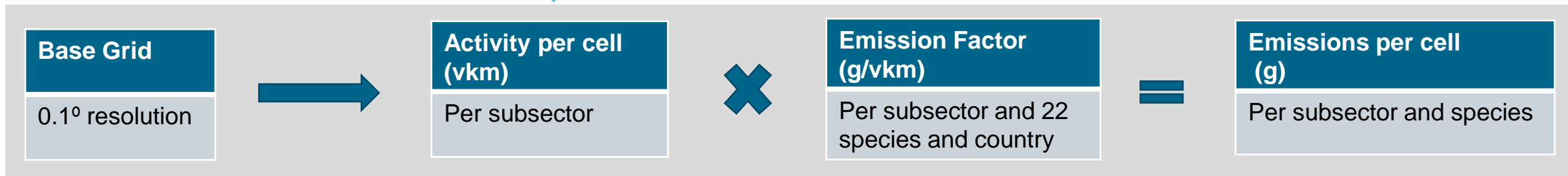
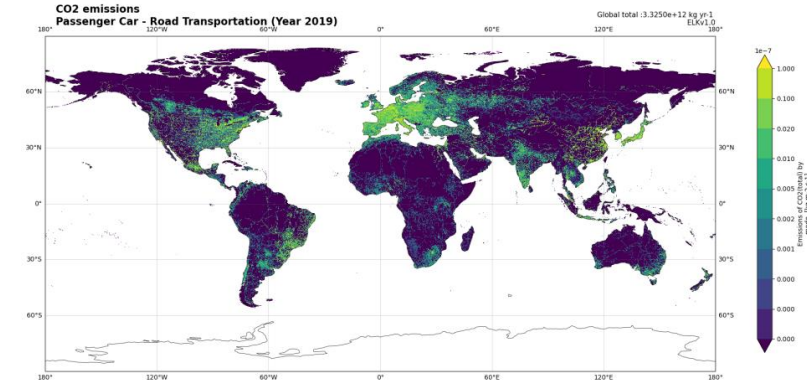
Methodology



Travel volumes per country in 2019			
Road		Rail	
Personal	Freight	Personal	Freight



Spatial Disaggregation Proxy		
Population, density	Proximity	In-betweenness

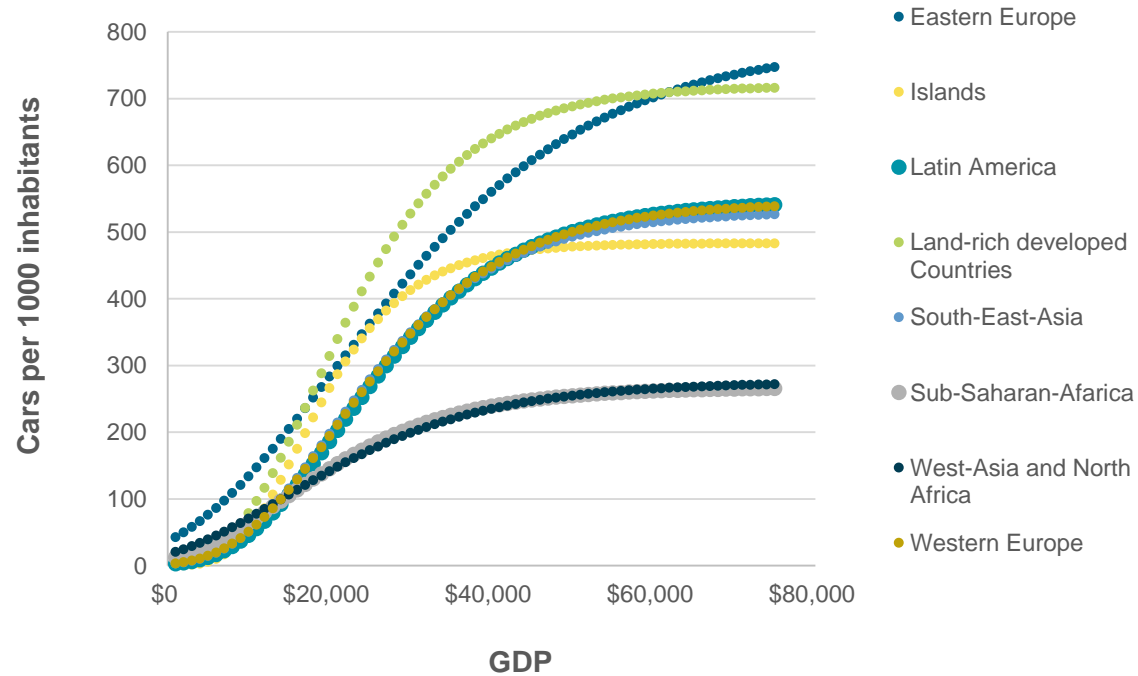


Emission factor		
Stock database	Emission regulation	Emission factor database

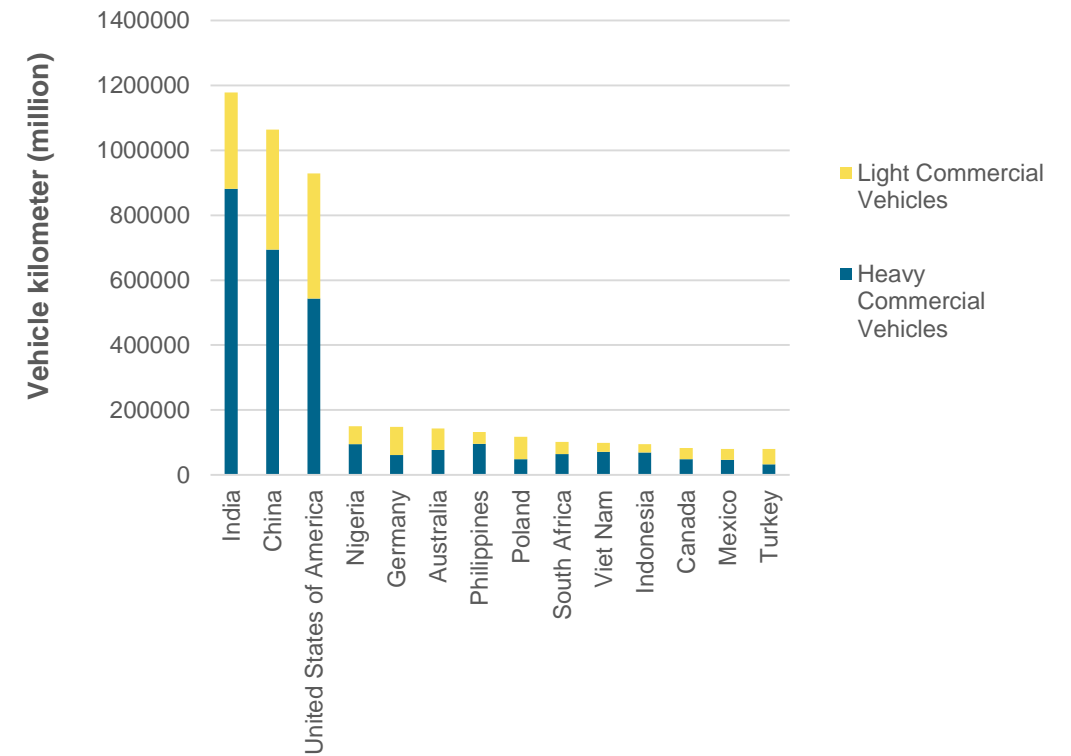
Activity per Country



Passenger Travel demand (annual)



Freight travel demand (annual)



Activity for other passenger and freight modes based on modal splits

Spatial disaggregation of Activity per cell

Algorithm

- Graph neural networks to predict annual passenger car traffic count

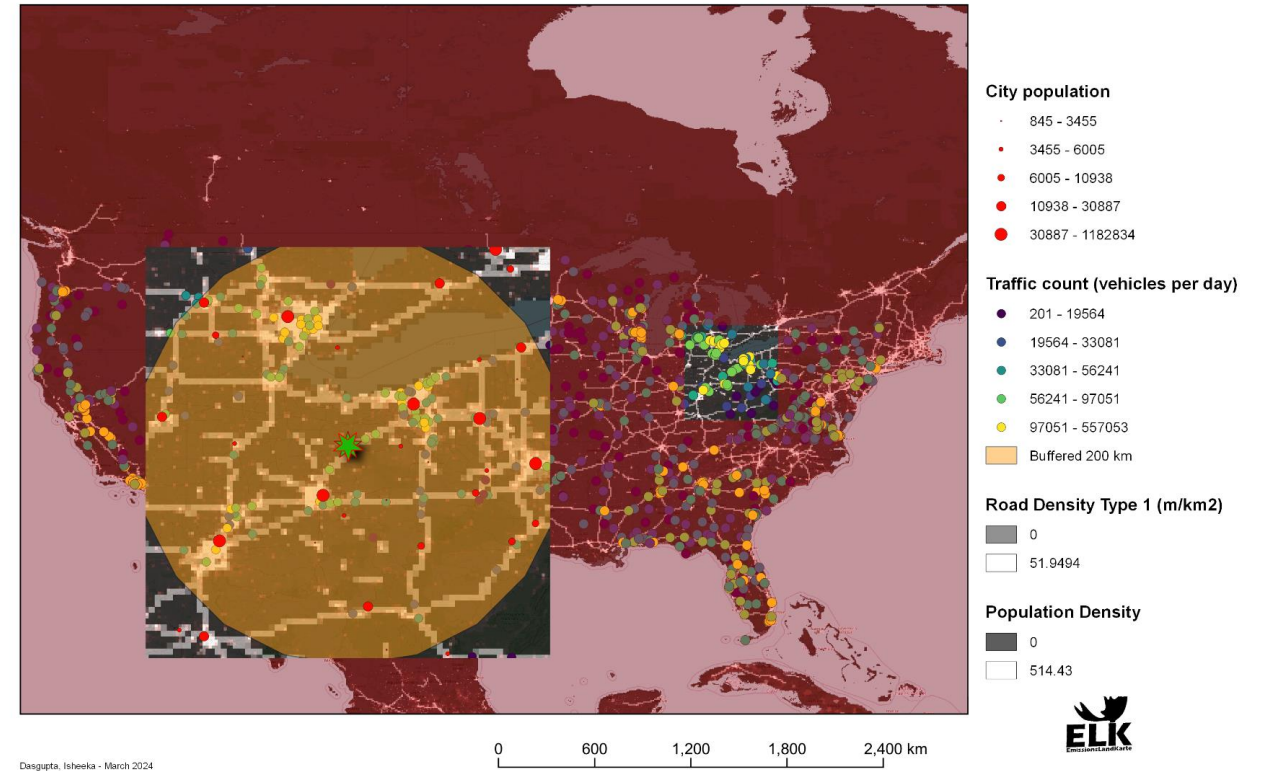
Training data

- Traffic count data from USA, UK, Germany

Features

- Population density aggregations, proximity to city, in-betweenness parameters

Traffic count points in-betweenness

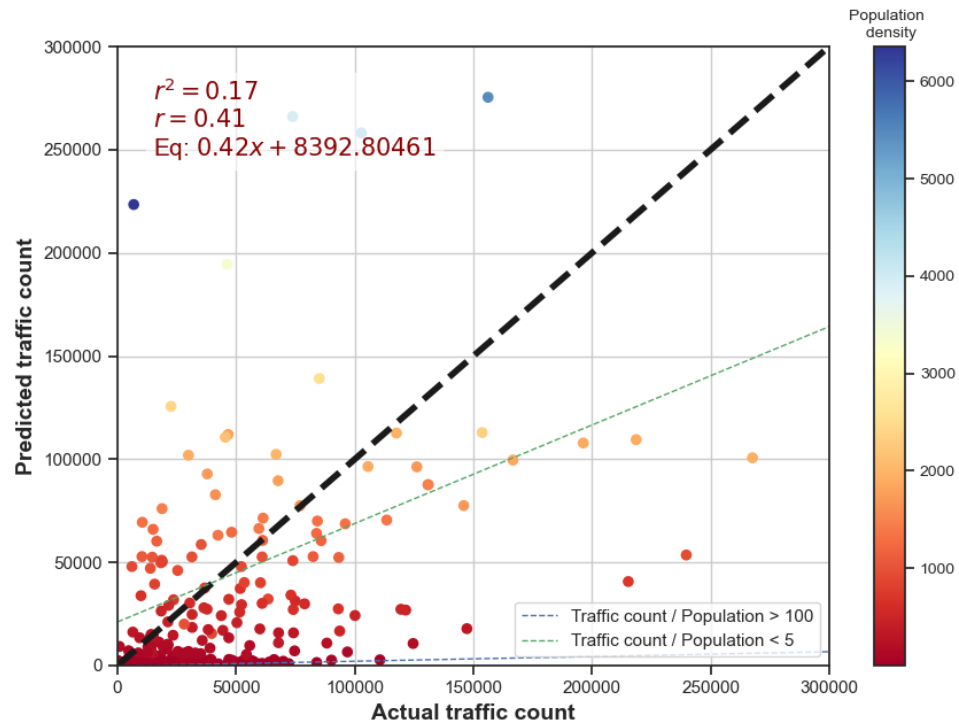


Spatial disaggregation

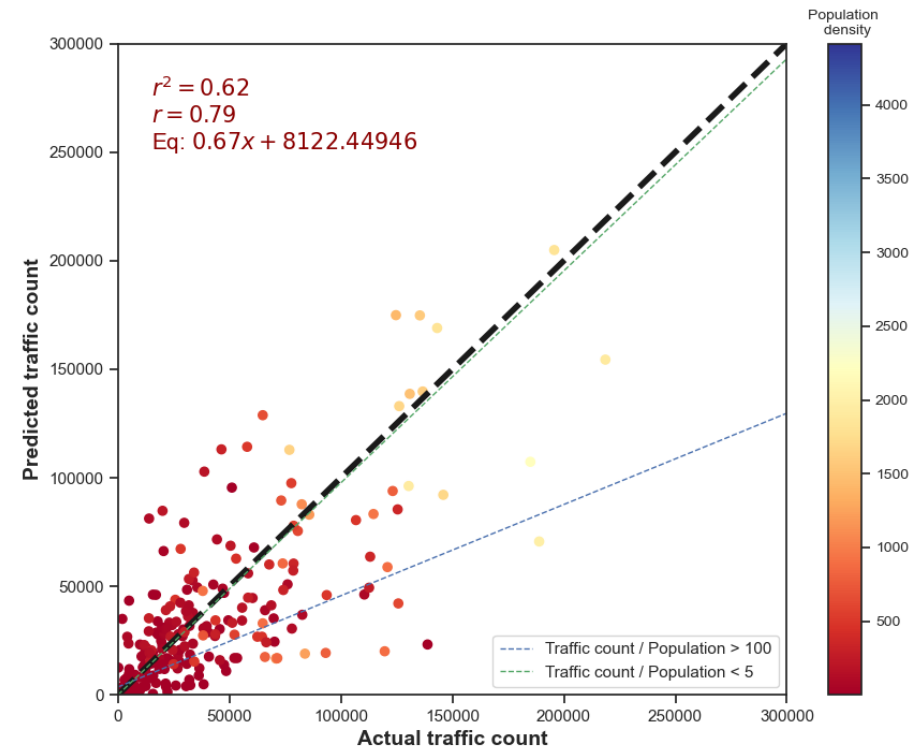


Performance

Excluding in-betweenness parameters



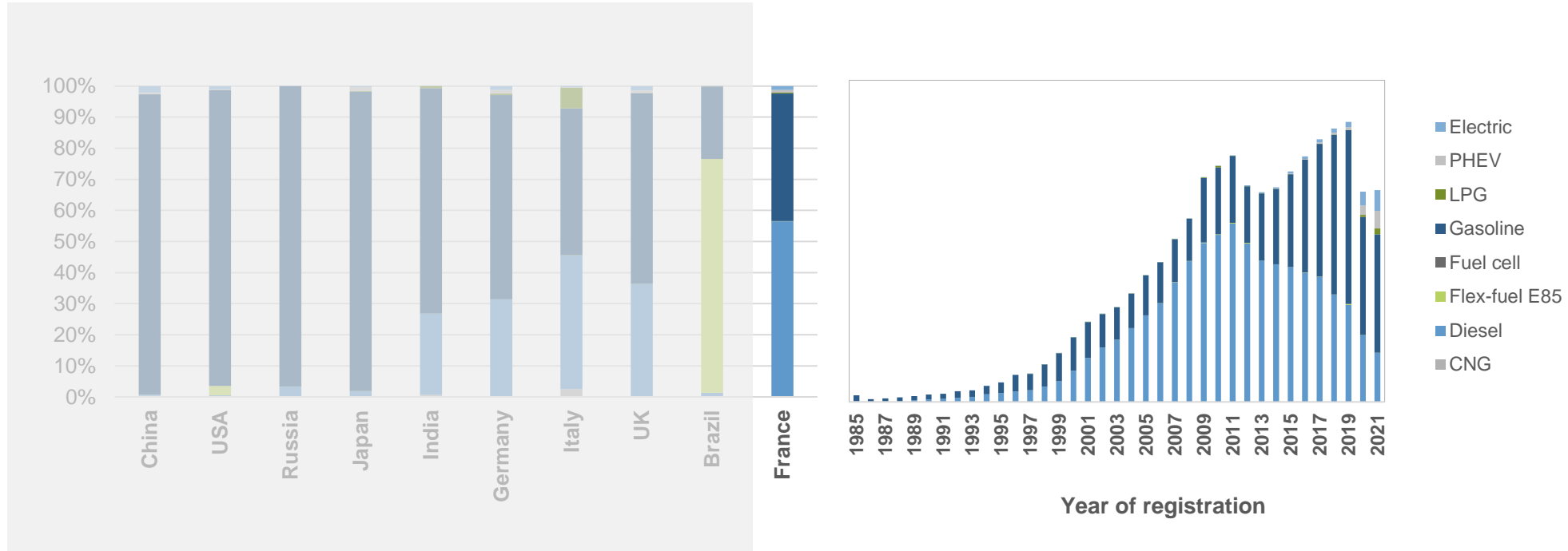
Including in-betweenness parameters



Emission Factor per country and subsector

Vehicle stock data

- Passenger cars and Commercial vehicles of 76 countries



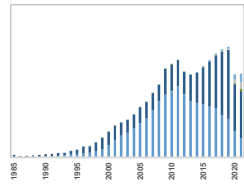
Source: IHS data

- Need for harmonized data across data sources and databases for all vehicle categories

Emission Factor

Emission regulation introduction

- For Passenger cars and Commercial vehicles of major countries



Year of registration

	1970	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Europe	Euro 0										Euro 1		Euro 2			Euro 3			Euro 4			Euro 5			Euro 6													
Republic of Korea	Euro 0										Euro 1		Euro 2			Euro 3			Euro 4			Euro 5		Euro 6														
Japan	Euro 0		Euro 1								Euro 4			Euro 5									Euro 6															
Australia	Euro 0										Euro 1			Euro 2	Euro 3		Euro 4		Euro 5			Euro 6																
China	Euro 0										Euro 1			Euro 2		Euro 3		Euro 4			Euro 5		Euro 6															
India	Euro 0										Euro 1			Euro 2		Euro 3			Euro 4		Euro 6																	
Brazil	Euro 0										Euro 1			Euro 2	Euro 3	Euro 4		Euro 5																				
Russian Federation	Euro 0										Euro 1			Euro 2	Euro 3		Euro 4	Euro 5																				
Argentina	Euro 0										Euro 1		Euro 2		Euro 3	Euro 4		Euro 5																				

Source: authors, based on data collection from various country authorities

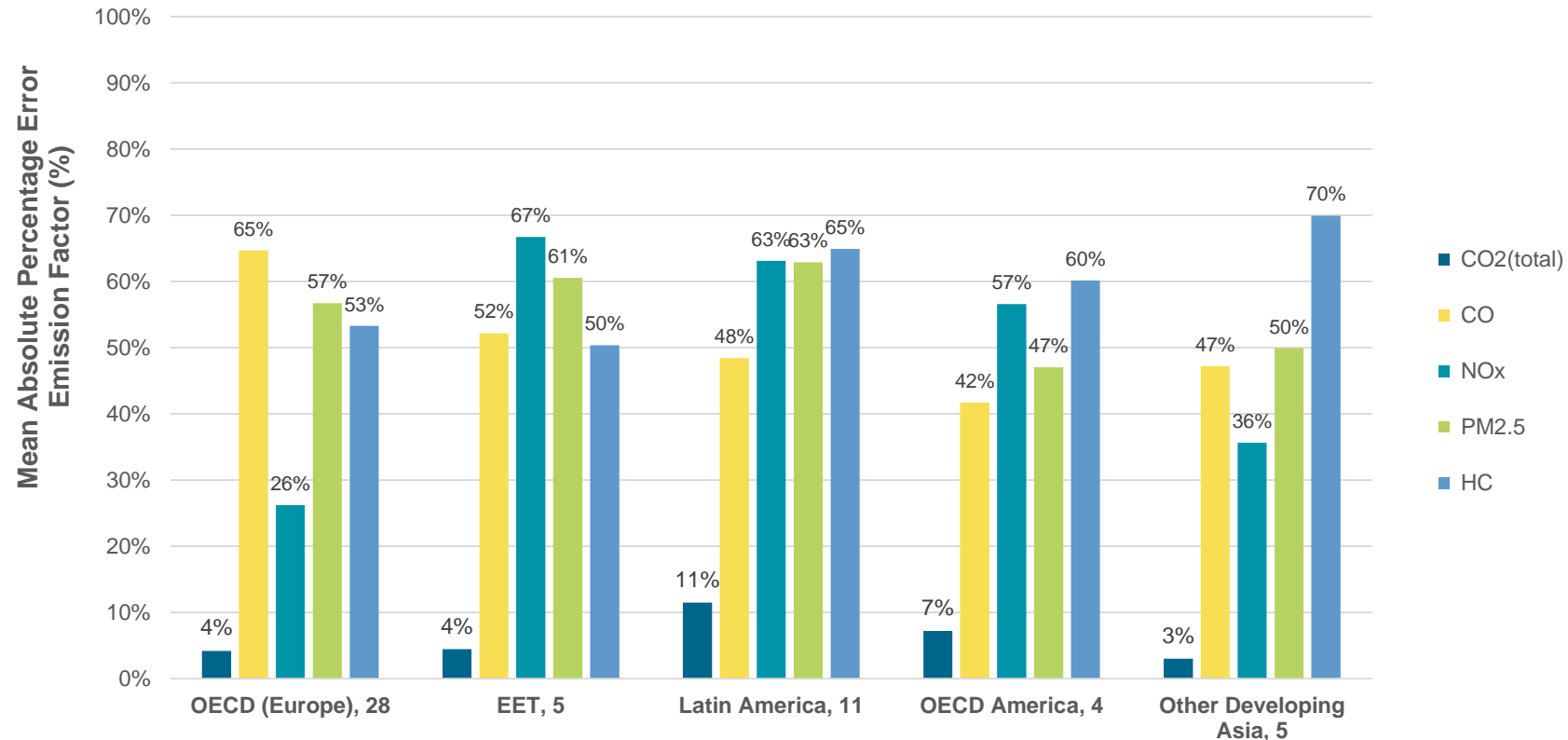
Emission factor databases

- HBEFA and US EMFAC, Australia COPERT based emission factor values for exhaust and non-exhaust species for passenger cars and commercial vehicles for Euro levels and US regulations

- Match remaining countries to regulations of selected major countries

Emission Factor

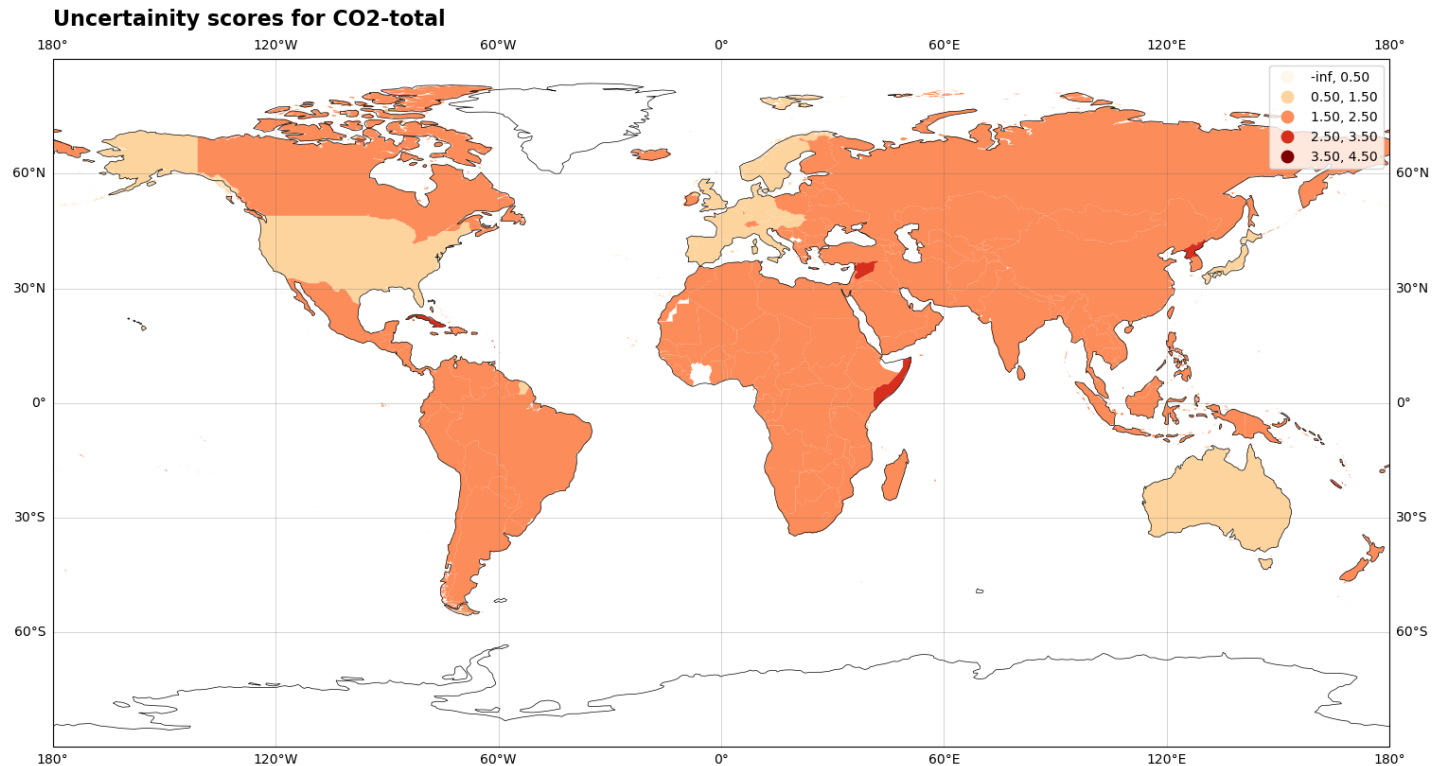
Error in Emission factor when using stock shares of single representative country for countries in region.



- High influence of exact stock shares of vehicles on non CO₂ pollutants.

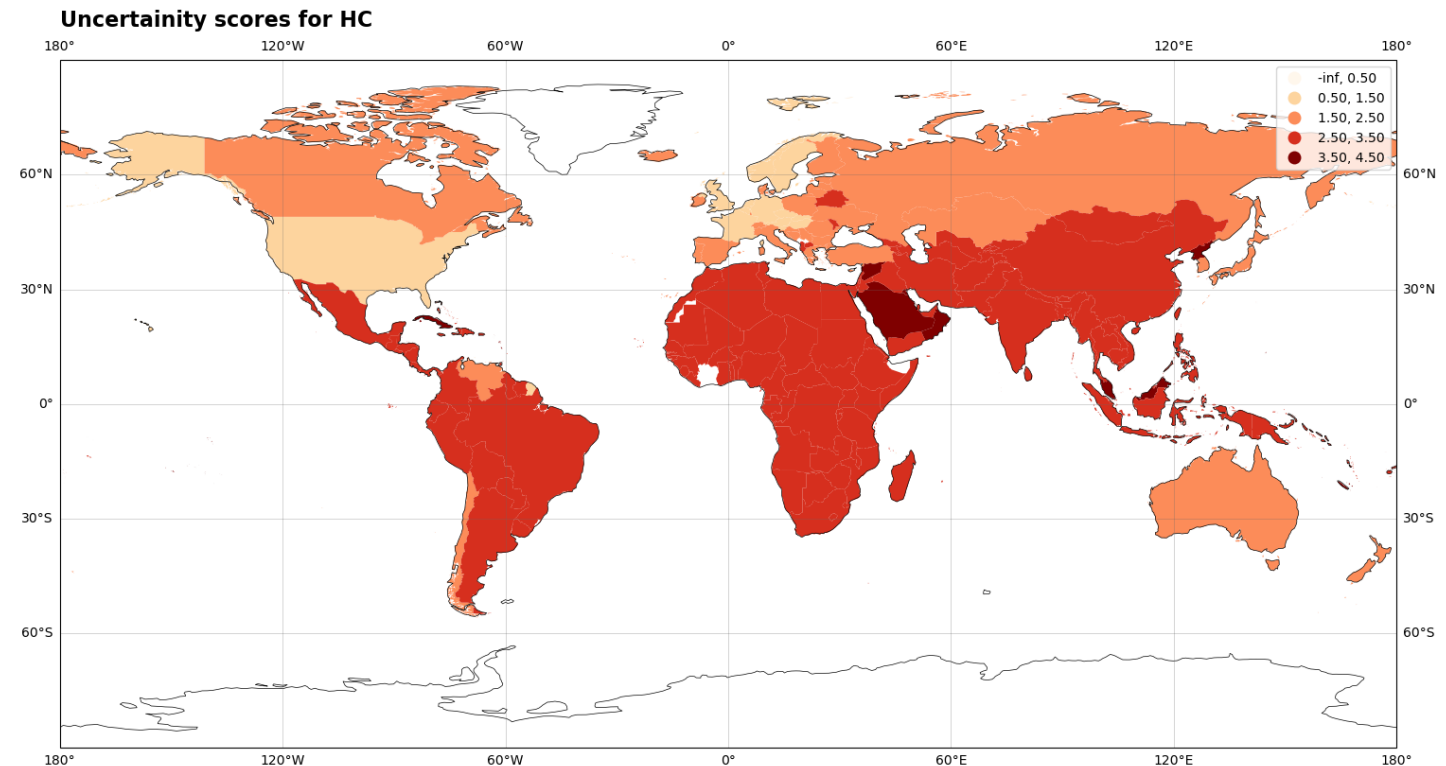
Uncertainty and their sources considered

Activity	Emission Factor (exhaust species)
<ul style="list-style-type: none"> Ownership data 	<ul style="list-style-type: none"> Absence of country specific EF database
<ul style="list-style-type: none"> Modal splits and load factors 	<ul style="list-style-type: none"> Age mileage distribution
	<ul style="list-style-type: none"> Absence of stock information
	<ul style="list-style-type: none"> Cold start parameters
	<ul style="list-style-type: none"> Imports/ Exports
	<ul style="list-style-type: none"> Driving behavior and conditions



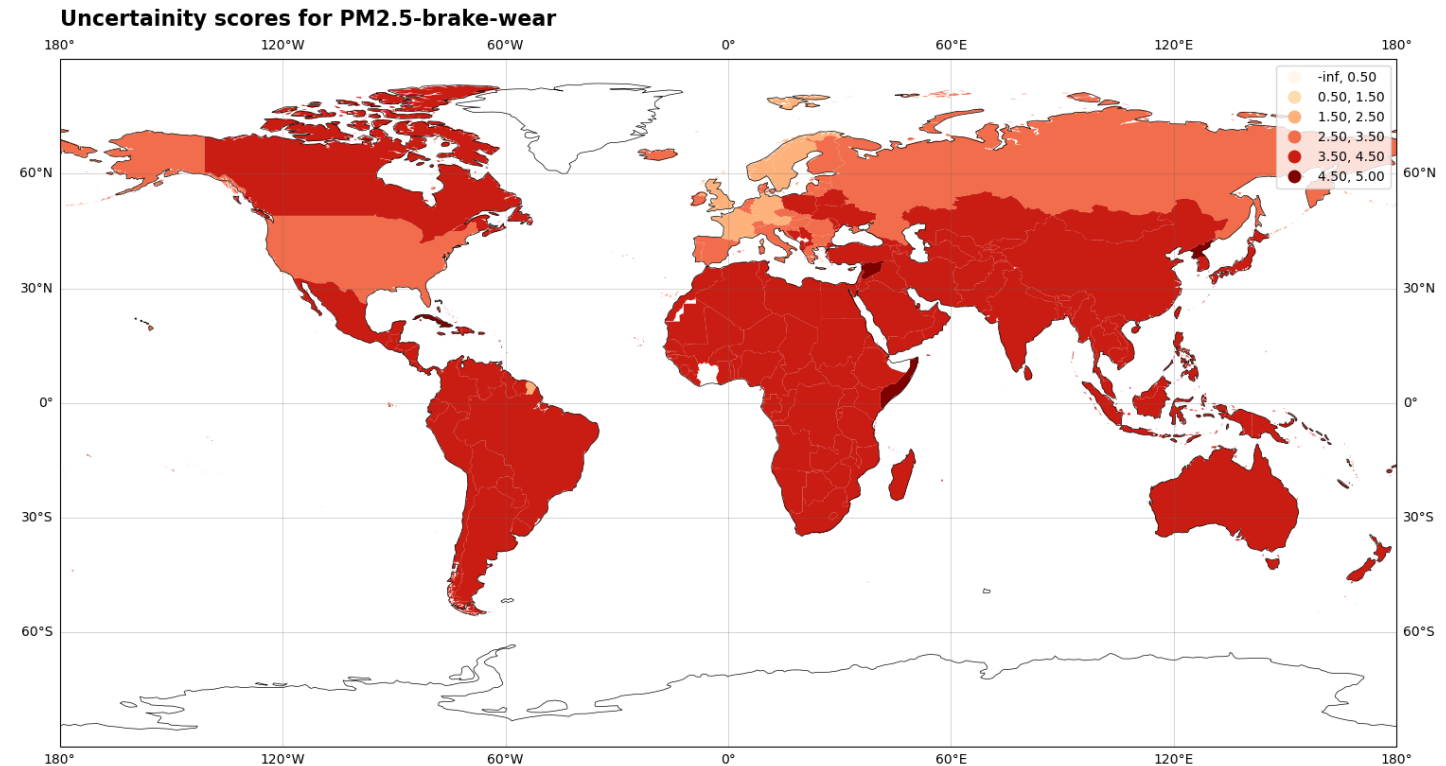
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Thank you!



Date: 2024-16-02

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Mario Feinaur, Simone Ehrenberger, Jens Hellekes, Nina
Thomsen

Institute: German Aerospace Centre, Institute of Vehicle Concepts

Project: ELK, [Elkis \(dlr.de\)](#)