TYRE WEAR MAPPING

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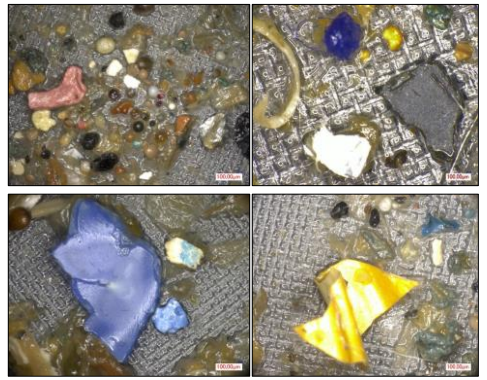
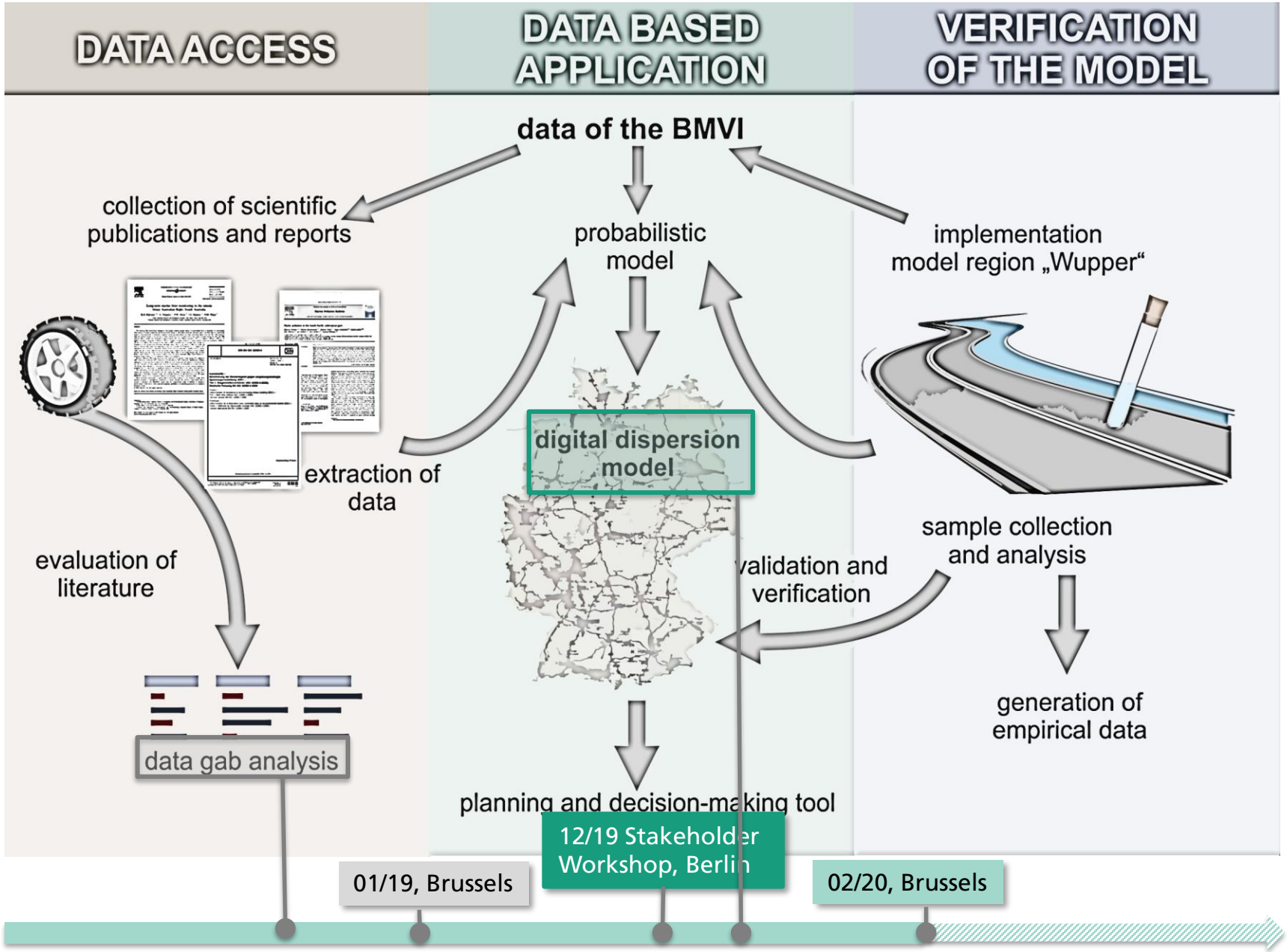
Microplastics at Fraunhofer UMSICHT

- Research projects
  - Multi-Client Study: Microplastics and marine plastic litter
  - Circular Plastic Economy Cluster
  - iMulch - Influence of polymers on a terrestrial ecosystem
  - PlastikBudget – Socioeconomic effects of plastics in the environment
  - FibrEX – Development of a bioinspired washing machine microplastics filter
  - **TyreWearMapping** – geographical distribution, fate and quantification of TRWP | 11/17-05/20



http://www.initiative-mikroplastik.de
https://www.umsicht.fraunhofer.de/de/forschung-fuer-den-markt/mikroplastik.html
http://www.umsicht.fraunhofer.de/content/dam/umsicht/de/dokumente/pressemitteilungen/2015/konsortialstudie-mikroplastik.pdf

TyreWearMapping Methodology



Modelling approach for the calculation and distribution of the total tyre wear

- **Mileage Approach**
  - driven kilometers (KBA 2016: 63.7 millions vehicle | 733 billions km/a)
  - number of tyres per vehicle type (car, trucks, buses, motor bikes etc.)
  - average runtime of tyres during their service life
  - tyre wear per vehicle[1]: 53 - 200 mg/km (car), 1500 mg/km (semitrailer)
  - masses losses during service life (car)[2]: 7,6 – 33 %

⇒ distribution of the entire mass over different road types by the means of statistical data (traffic distribution, stress intensity, road condition, weather, etc.)

⇒ allocation of typical, probable, distance based tyre wear emissions to classified roads




[1] *B. Kocher: Stoffeinträge in den Straßenseitenraum – Reifenabrieb, BASt- Bericht V 188, (2010)*
[2] *40 000 km run length, 7000 g weight of the new tyre*

TWM TyreWearMapping

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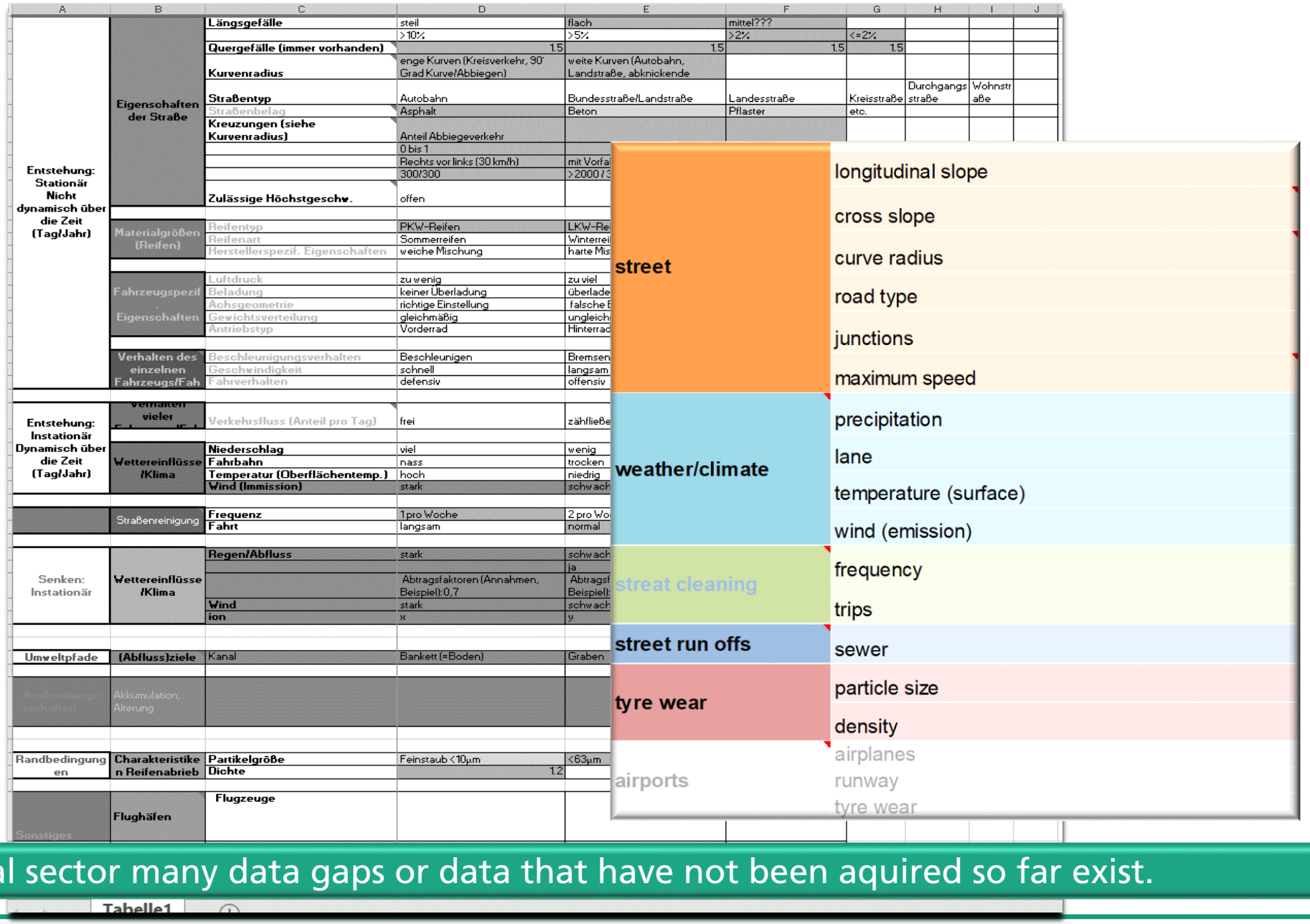
Data gap analysis

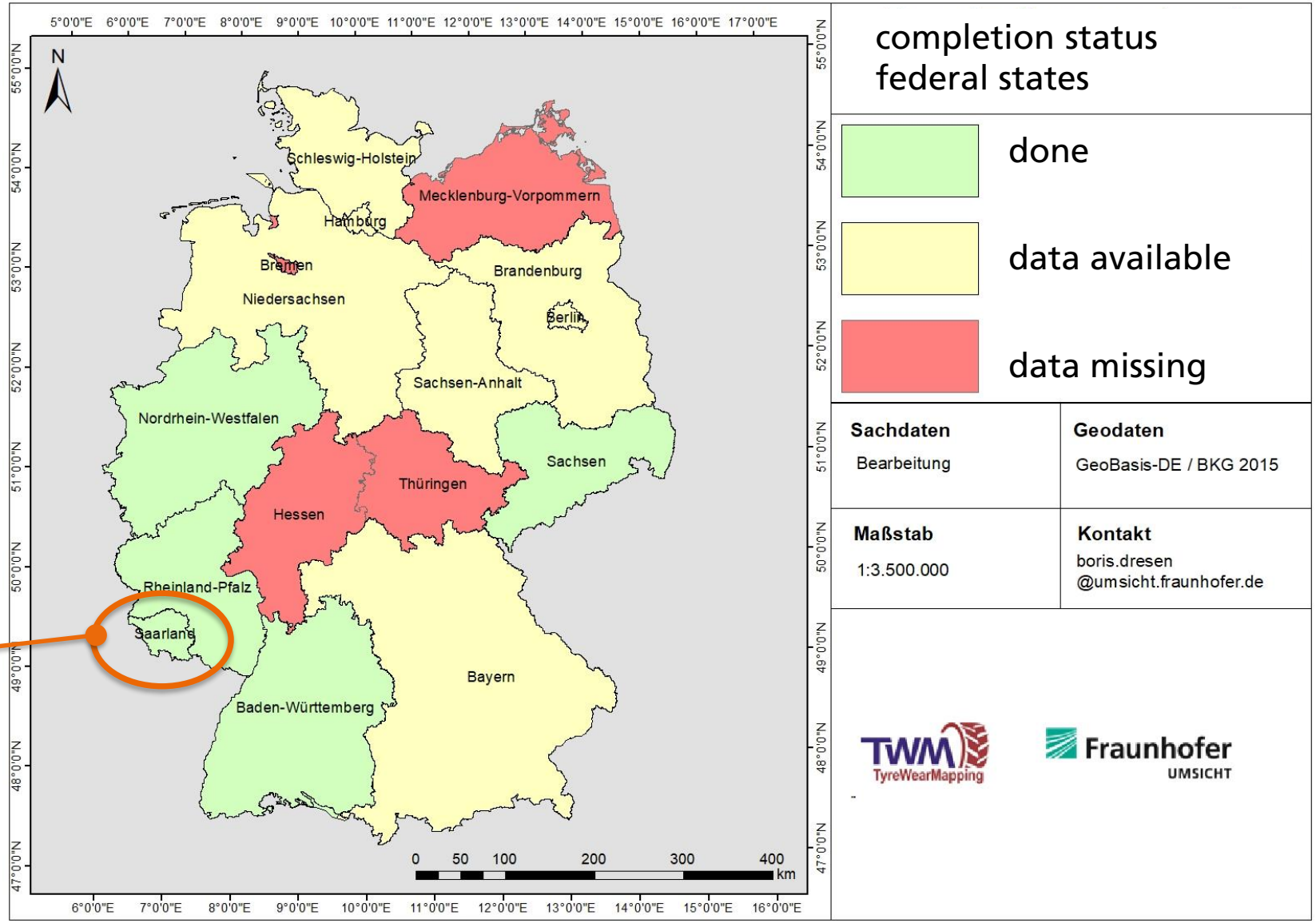


		Längsgefälle	steil	flach	mittel???					
			>10%	>5%	>2%	<=2%				
		Quergefälle (immer vorhanden)	1.5	1.5	1.5	1.5				
	Eigenschaften der Straße	Kurvenradius	enge Kurven (Kreisverkehr, 90° Grad Kurve/Abbiegen)	weite Kurven (Autobahn, Landstraße, abknickende						
		Straßentyp	Autobahn	Bundesstraße/Landstraße	Landesstraße	Kreisstraße	Durchgangsstraße	Wohnstraße		
		Straßenbelag	Asphalt	Beton	Pflaster	etc.				
		Kreuzungen (siehe Kurvenradius)	Anteil Abbiegeverkehr							
			0 bis 1							
			Rechts vor links (30 km/h)	mit Vorfa						
			300/300	>2000 / 3						
Entstehung: Stationär Nicht dynamisch über die Zeit (Tag/Jahr)		Zulässige Höchstgeschw.	offen							
	Materialgrößen (Reifen)	Reifentyp	PKW-Reifen	LKW-Rei						
		Reifenart	Sommerreifen	Winterrei						
		Herstellerspezif. Eigenschaften	weiche Mischung	harte Mis						
	Fahrzeugspezif. Eigenschaften	Luftdruck	zu wenig	zu viel						
		Beladung	keiner Überladung	überlade						
		Achsgeometrie	richtige Einstellung	falsche E						
		Gewichtsverteilung	gleichmäßig	ungleich						
		Antriebstyp	Vorderrad	Hinterrad						
	Verhalten des einzelnen Fahrzeugs/Fah	Beschleunigungsverhalten	Beschleunigen	Bremsen						
		Geschwindigkeit	schnell	langsam						
		Fahrverhalten	defensiv	offensiv						
Entstehung: Instationär Dynamisch über die Zeit (Tag/Jahr)	Verhalten vieler	Verkehrsfluss (Anteil pro Tag)	frei	zähfließe						
	Wettereinflüsse /Klima	Niederschlag	viel	wenig						
		Fahrbahn	nass	trocken						
		Temperatur (Oberflächentemp.)	hoch	niedrig						
		Wind (Immission)	stark	schwach						
	Straßenreinigung	Frequenz	1pro Woche	2 pro Wo						
		Fahrt	langsam	normal						
Senken: Instationär	Wettereinflüsse /Klima	Regen/Abfluss	stark	schwach						
				ja						
			Abtragsfaktoren (Annahmen, Beispiel):0,7	Abtragsf Beispiel):						
		Wind	stark	schwach						
		ion	x	y						
Umweltpfade	(Abfluss)ziele	Kanal	Bankett (=Boden)	Graben						
Ausbreitungsverhalten	Akkumulation, Alterung									
Randbedingungen	Charakteristiken Reifenabrieb	Partikelgröße	Feinstaub <10µm	<63µm						
		Dichte	1.2							
Sonstiges	Flughäfen	Flugzeuge								

street	longitudinal slope
	cross slope
	curve radius
	road type
	junctions
	maximum speed
weather/climate	precipitation
	lane
	temperature (surface)
	wind (emission)
streat cleaning	frequency
	trips
street run offs	sewer
tyre wear	particle size
	density
airports	airplanes
	runway
	tyre wear

⇒ In the municipal sector many data gaps or data that have not been aquired so far exist.

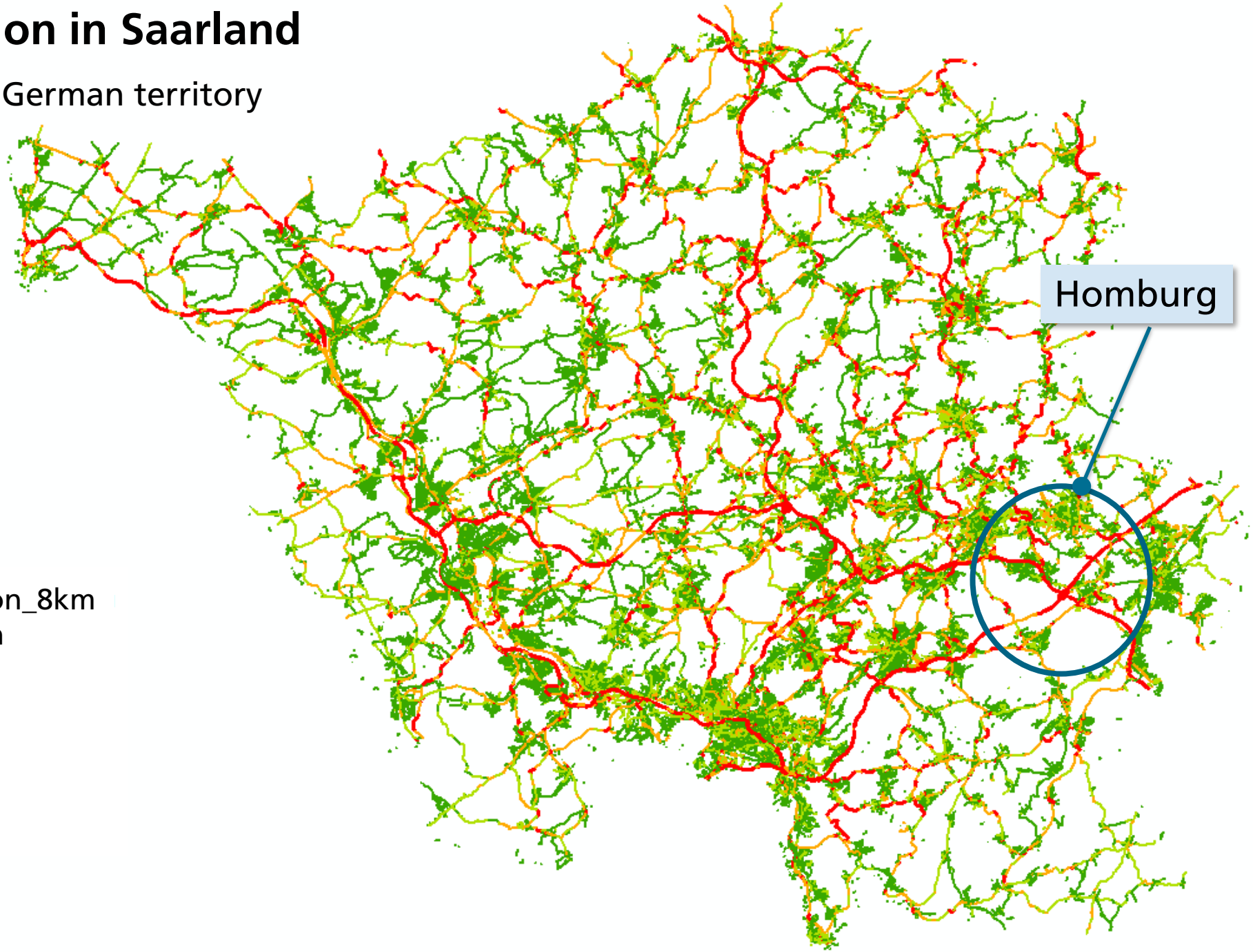
Results of TyreWearMapping as example of the Saarland



SAARLAND

Tyre wear distribution in Saarland

2,570 km² = 0.75 % of the German territory



[$kg_{TW}/(m_{road} * a)$]

Saarland_TW_selection_8km
TW_total_per_section

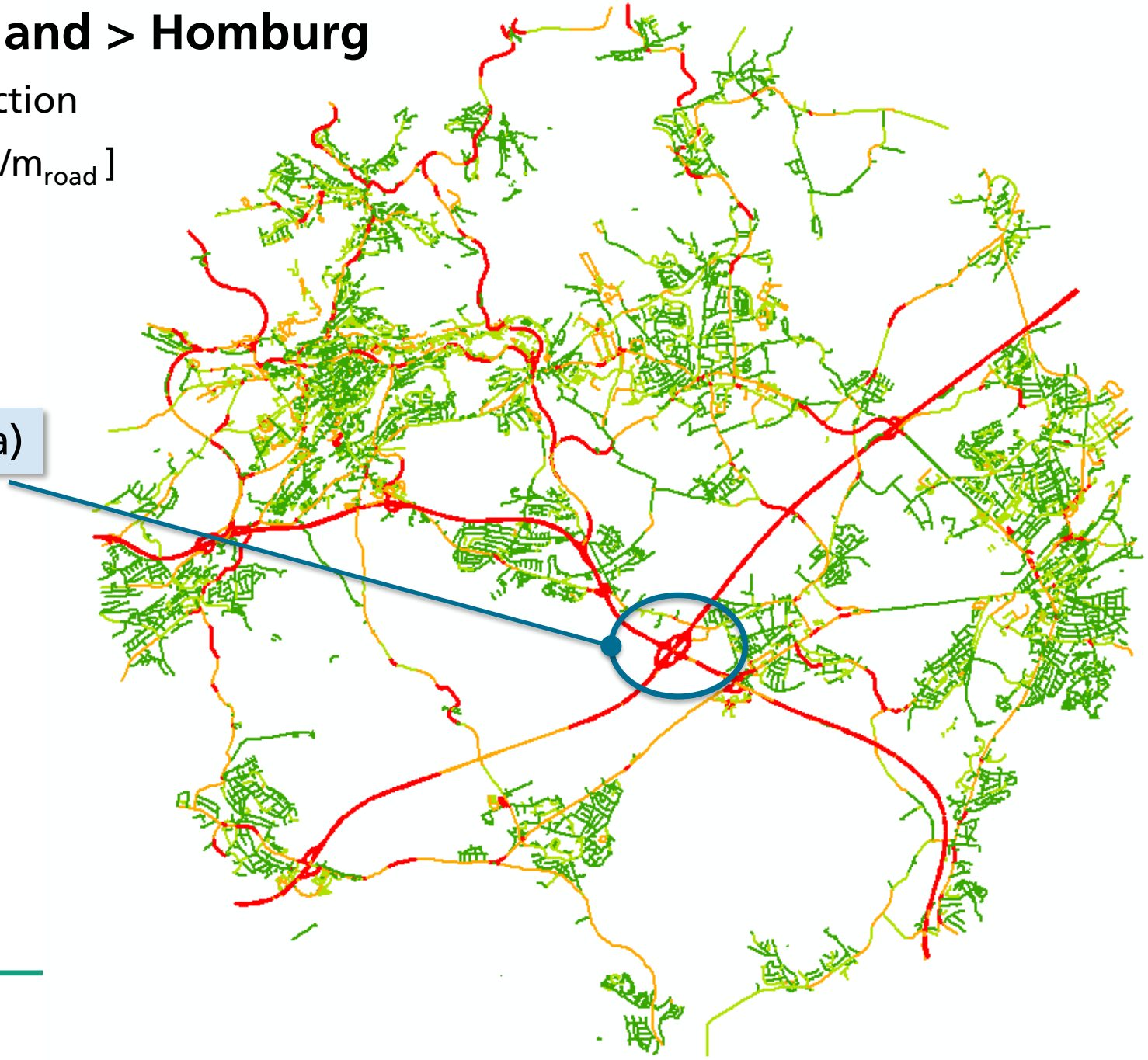
- 0,000 - 0,005
- 0,006 - 0,050
- 0,051 - 0,500
- 0,501 - 12,028

Tyre wear distribution in Saarland > Homburg

Average annual tyre wear mass for a section

(radius of 8 km) around Homburg [kg_{TW}/m_{road}]

HOTSPOT! 500 g/(m*a)



$[kg_{TW}/(m_{road} *a)]$

Saarland_TW_selection_8km
TW_total_per_section

- 0,000 - 0,005
- 0,006 - 0,050
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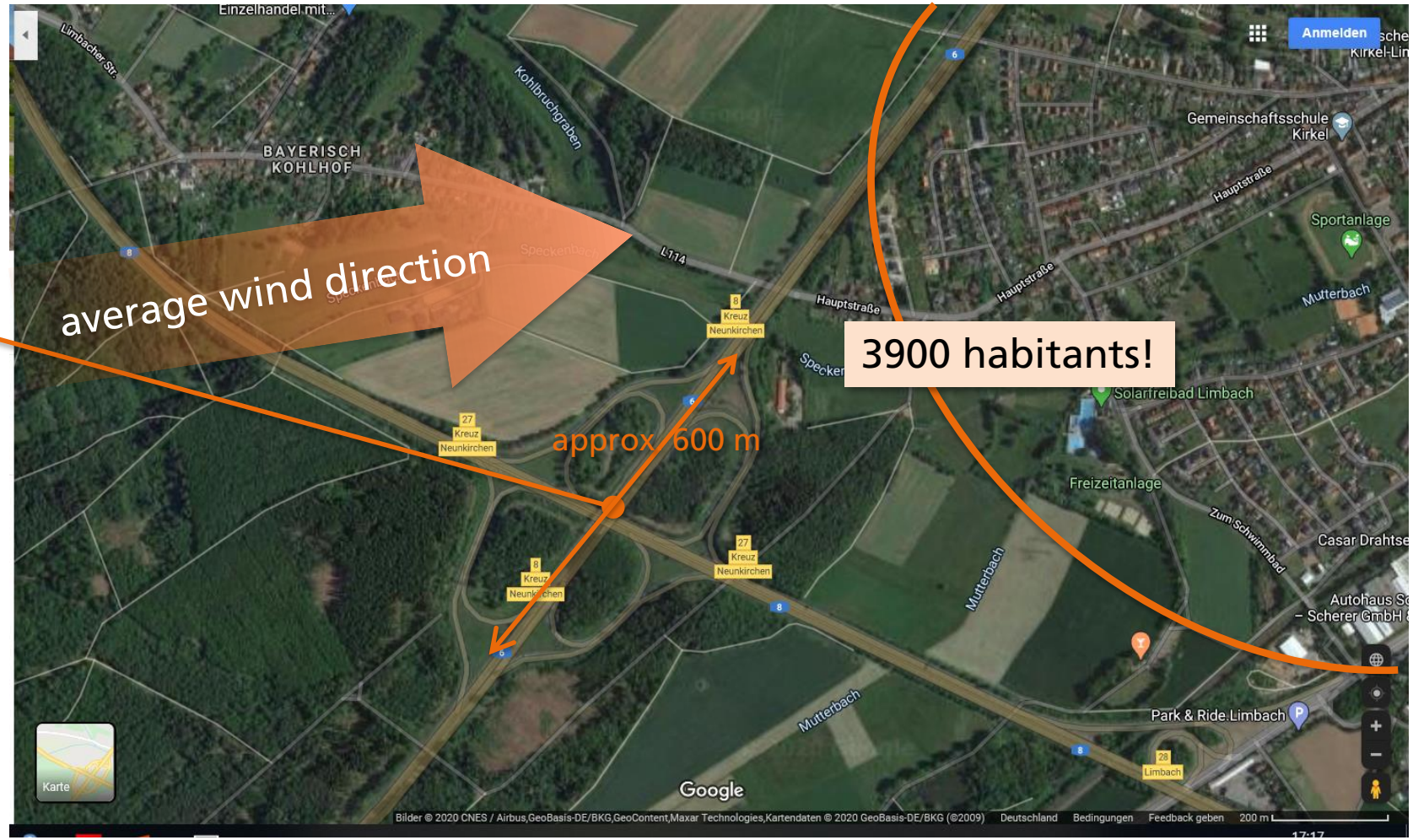
Tyre wear distribution in Saarland > Homburg

HOTSPOT! 300 kg/a[1]

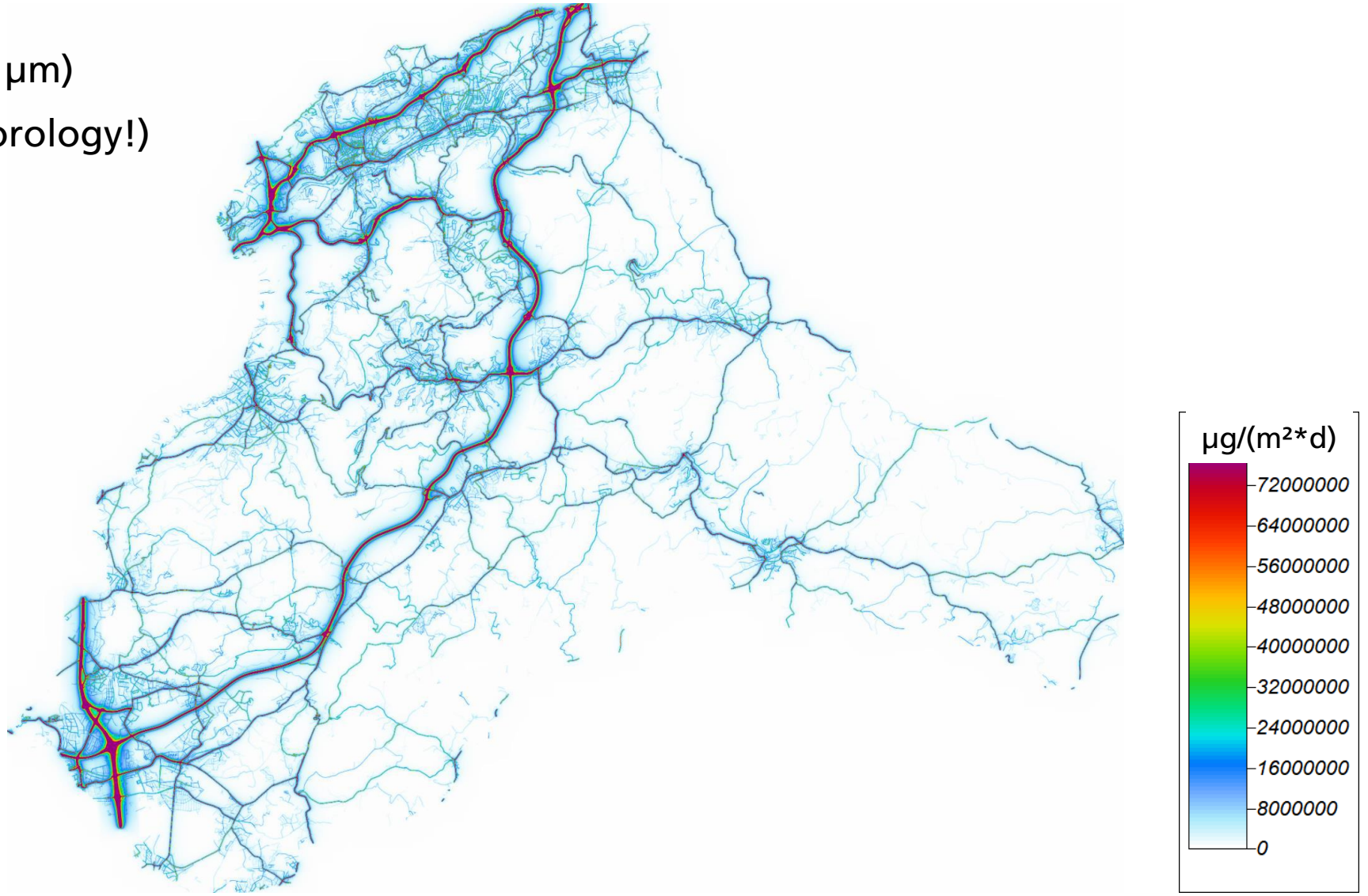


[1]600m*500 g/(m*a)=300kg/a

Atmospheric transport of tyre wear in the Wupper river basin

Total emission of pm-4 (>50 µm)

(no differentiation of meteorology!)



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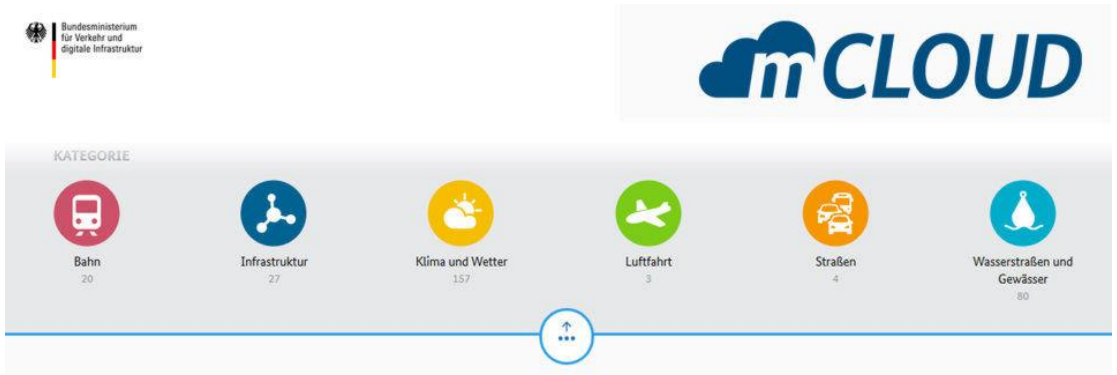
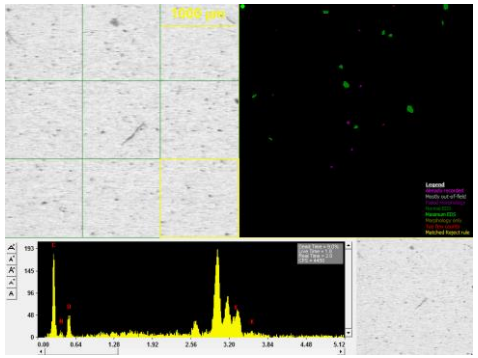
Glance into the future

- Tyre wear emission models for environmental friendly, future mobility scenarios (autonomic driving, e-mobility)
- Development of an overall data portal for tyre emission involving all relevant organizations
- Integration of municipalities and authorities for a common environmental and traffic strategy
- Evaluation of the emission model → metrological mapping





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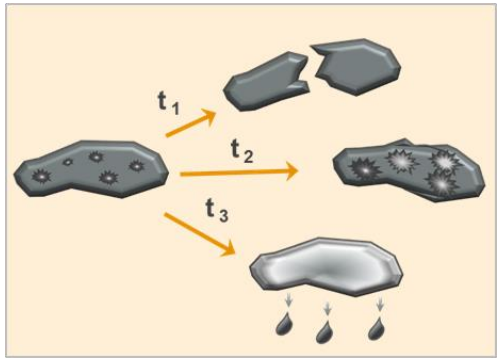

Sieker
Die Regenwasserexperten

TWM
TyreWearMapping

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Thank you for your attention!

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