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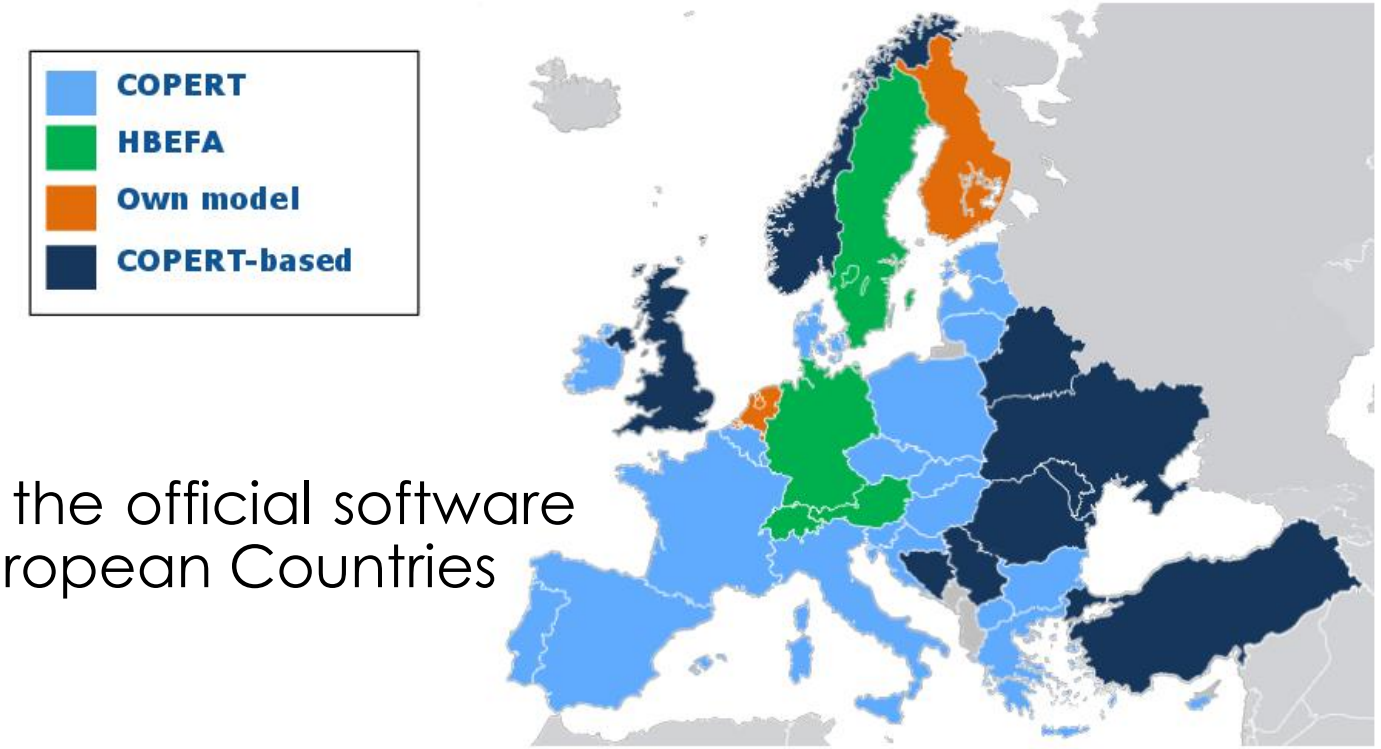
The use of traffic flow models for traffic emissions calculations

Cristina Pozzi - 6-10-2023. Webinar : «Claves para el éxito en la ejecución de los nuevos proyectos de zonas de bajas emisiones según RD 1052/2022 »

Traffic emissions calculation methodologies

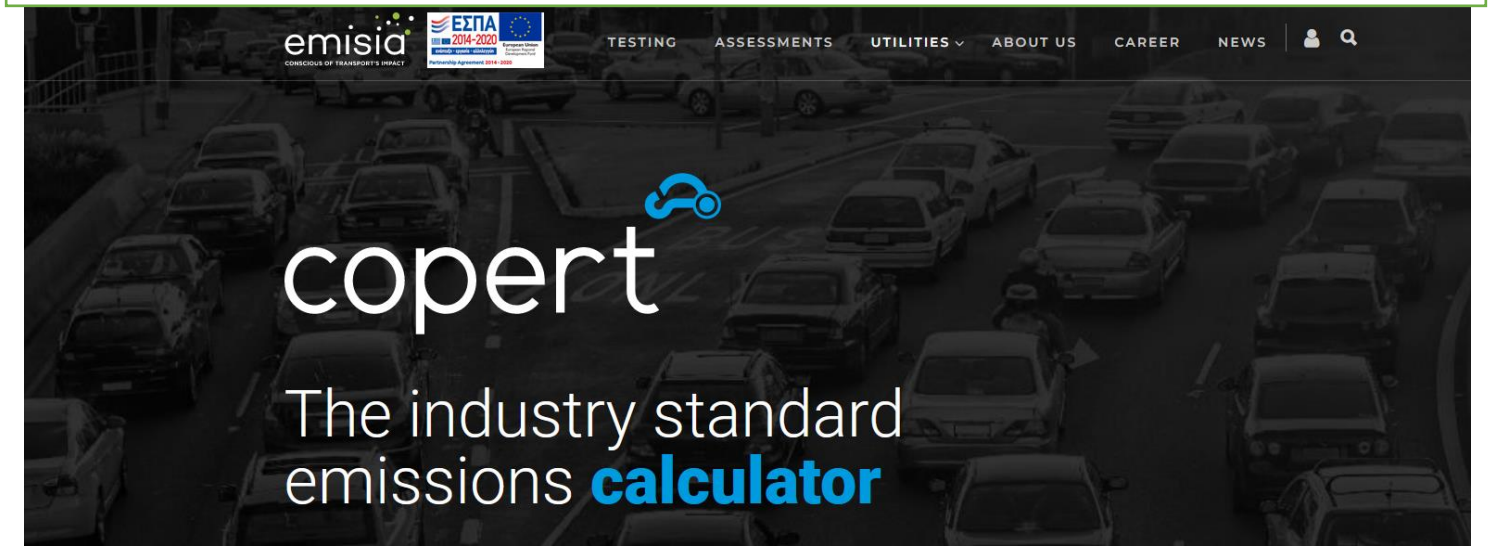
European Commission

Vehicle emission models usage in Europe



COPERT is the official software in most European Countries

Road traffic emissions methodology



COPERT is the EU standard vehicle emissions calculator. It uses vehicle population, mileage, speed and other data such as ambient temperature and calculates emissions and energy consumption for a specific country or region.

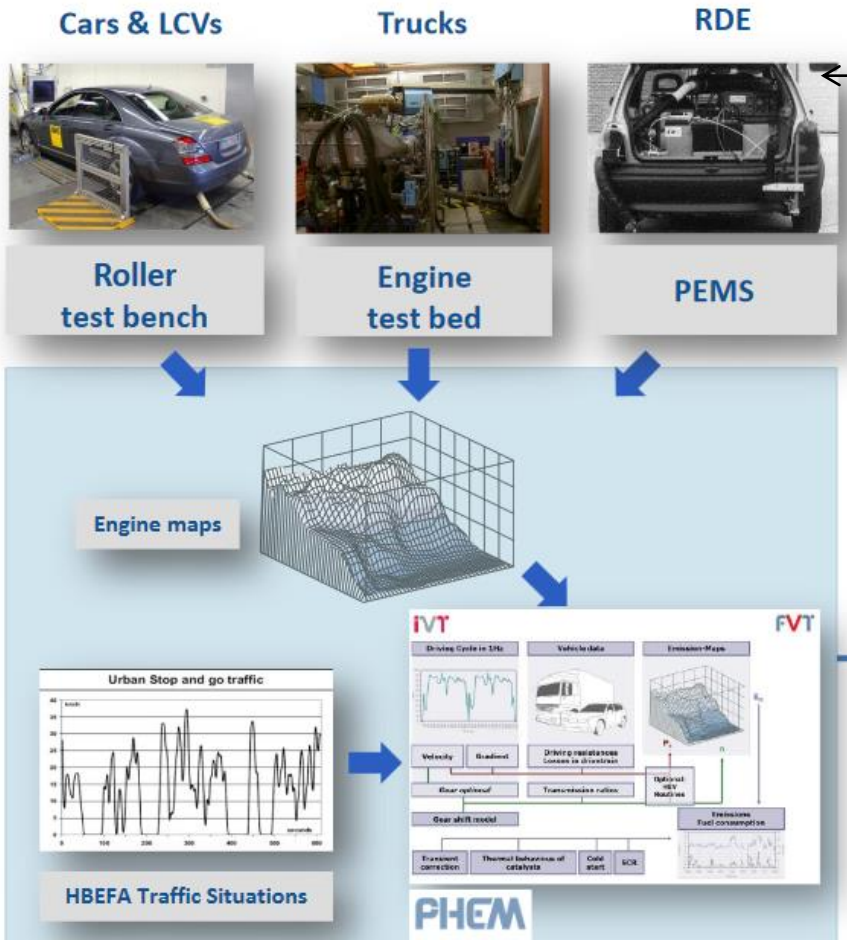
COPERT SW calculates emissions at a national, regional or local scale, and for annual to daily estimates

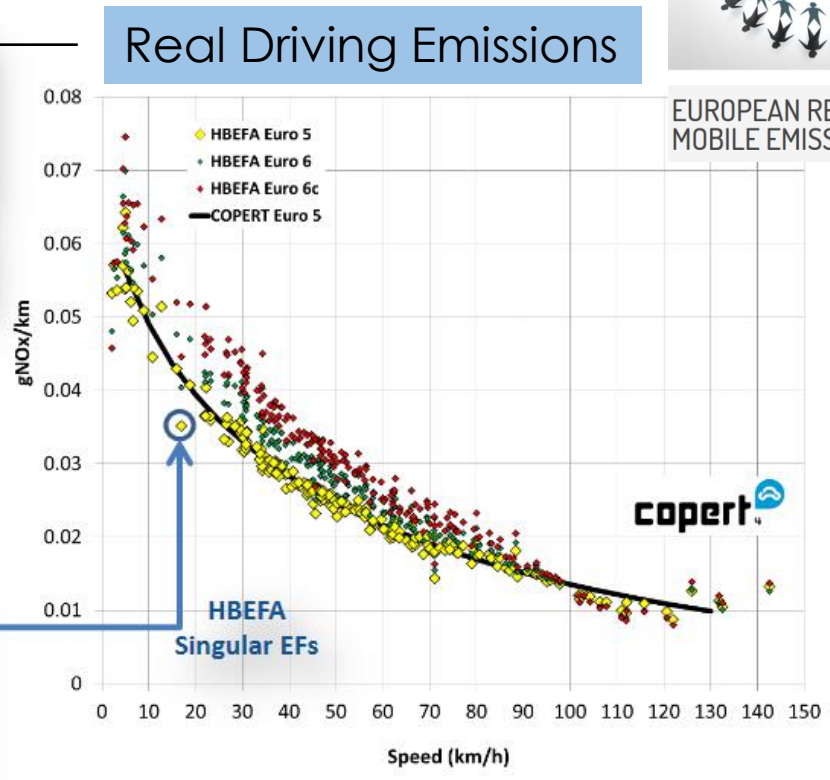
COPERT contains emission factors for more than 450 individual vehicle types

Emission types:

- ✔ thermal stabilised engine operation ('hot' emissions);
- ✔ the warming-up phase ('cold start' emissions);
- ✔ non-exhaust emissions (from fuel evaporation, tyre and brake wear emissions).

Road traffic emissions factor estimation





EUROPEAN RESEARCH ON MOBILE EMISSION SOURCES

Note: VERSIT+ uses only PEMS data w/o modelling since Euro 5/V

Institution logo	Institution short	Institution	Country
	ACEA	Association des Constructeurs Européens d'Automobiles	INT
	ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie	FR
	ARIANET	ARIANET - Modellistica ambientale	IT
	ARPALo	ARPA Lombardia	IT
	AVL-MTC	AVL MTC Motortestcenter AB	SE
	BAST	Federal Highway Research Institute	DE
	CASANZ	Clean Air Society of Australia and New Zealand	AUS
	CONCAWE	CONservation of Clean Air and Water in Europe	INT
	DAC-HS	Data Analysis and Consultancy	DE
	DSITIA	Queensland Government, Department of Science, Information Technology, Innovation and the Arts (DSITIA), Australia	AUS
	EEA	European Environment Agency	INT
	EMISIA	EMISIA consulting	EL
	EMPA	Swiss Federal Laboratories for materials science and technology	CH
	EPA-Ireland	Environmental Protection Agency Ireland	IE
	ISPRA	Environmental Protection Agency Italy	IT

Road traffic emissions model

Mileages and speeds

Autovetture benzina	499,466
Autovetture metano	634
Autovetture diesel	57,076
Autovetture GPL	15,147
Autocarri benzina	38,114
Autocarri metano	17
Autocarri GPL	178
Autocarri diesel	46,476
Autobus benzina	21
Autobus diesel	1,889
Motocicli benzina	38,215
Motocarri benzina	1,925
Totale veicoli immatricolati	699,078

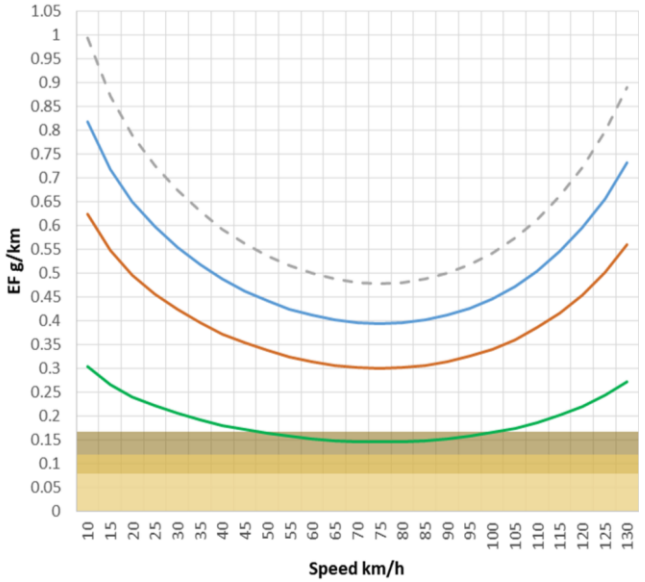
Fleet composition

TREFIC

TRaffic Emission Factors Improved Calculator

- Geographical: interfaced with GIS systems
- Space and time disaggregation
- Lumping of chemicals
- Linux version for real-time modelling chains
- Interfaced with dispersion models

- Metodology : set of emission factors
- Software: calculates aggregated emissions for a specific country or region



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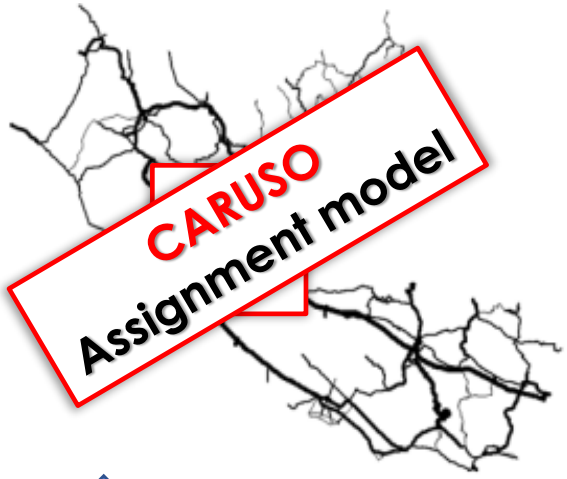
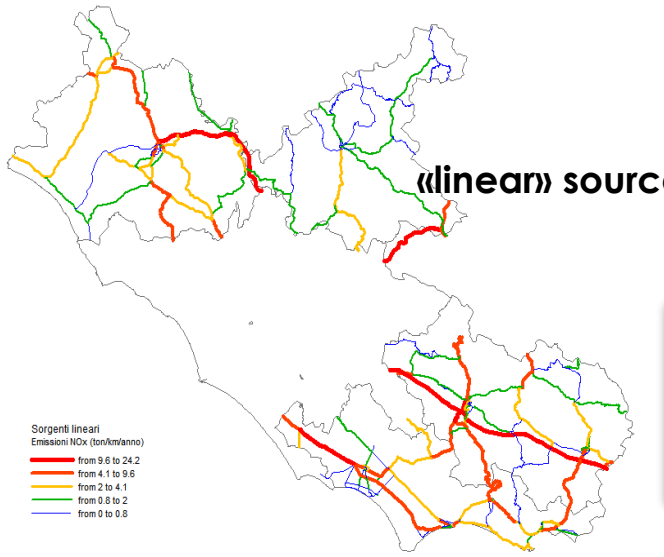
Road traffic modelling scheme

Mileages and speeds



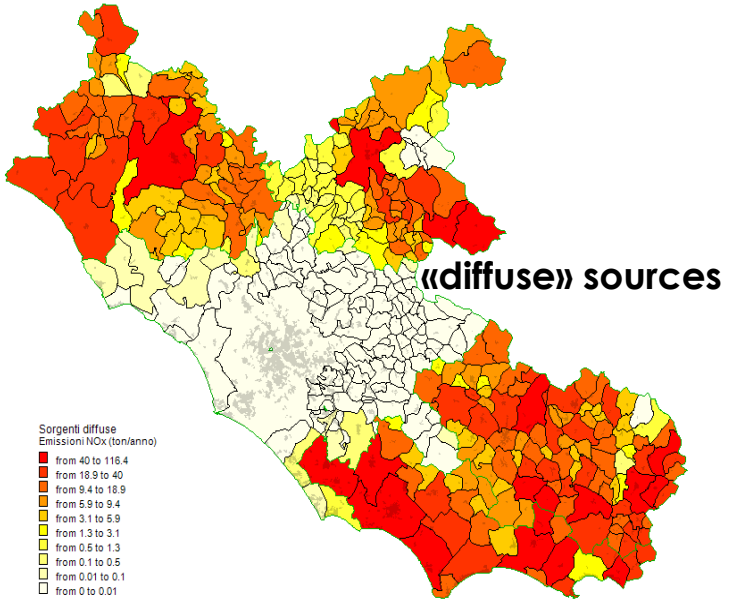
CARUSO
Assignment model

TREFIC
Emissions model



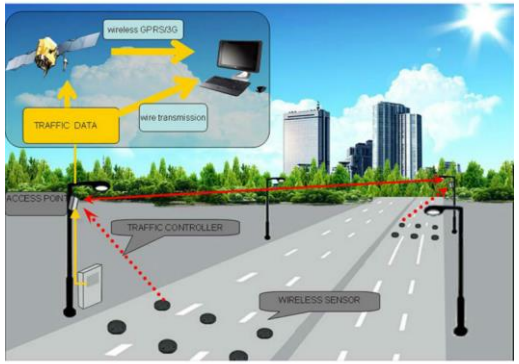
«linear» sources

PMSS
Dispersion model

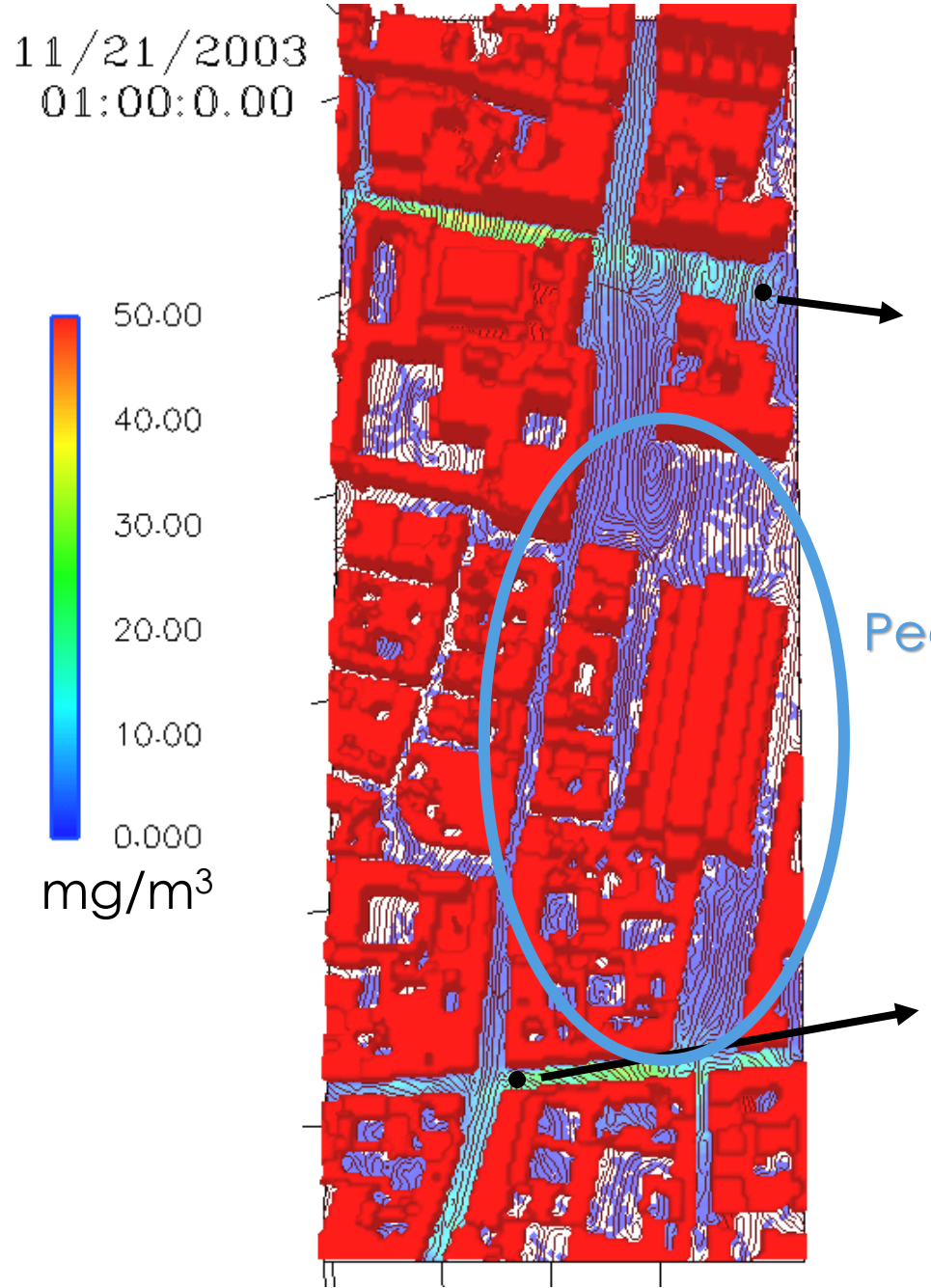


«diffuse» sources

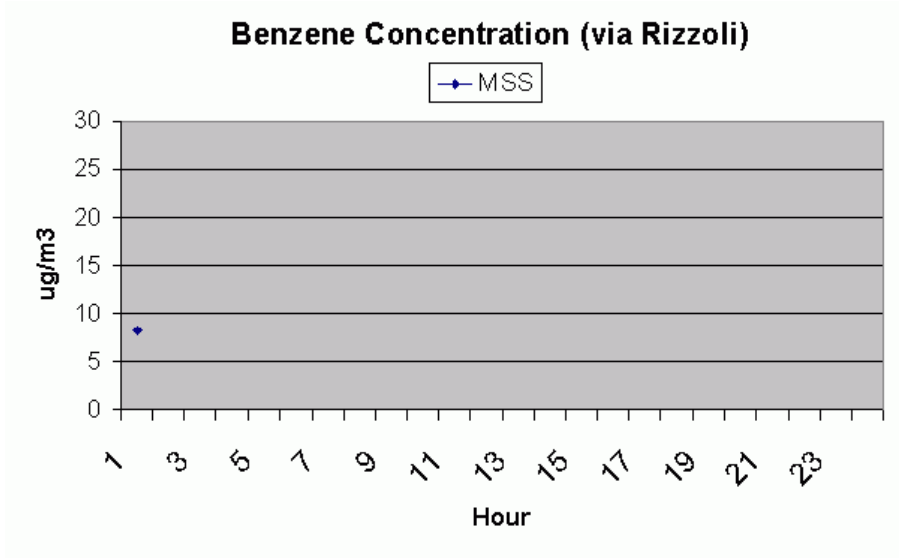
Traffic countings / OD interview

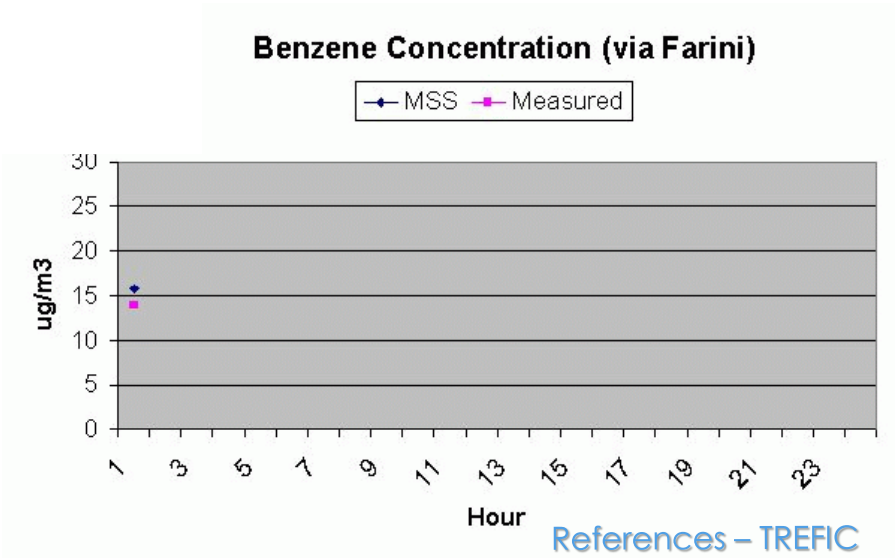


Dispersion model application at urban level – TREFIC+MSS



Pedestrian area

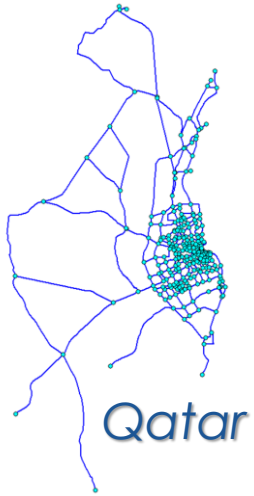




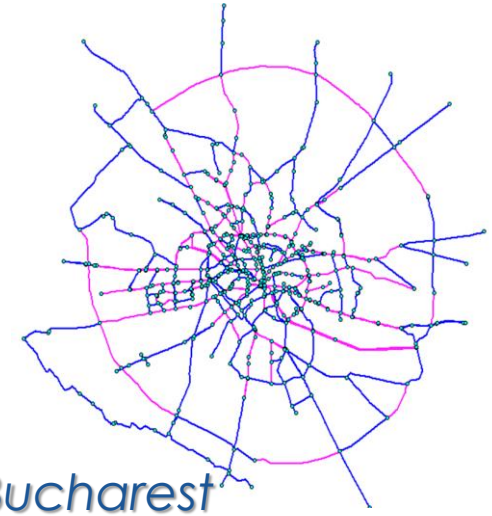
References – TREFIC

Road traffic flows model

CarUSO – *"**Car U**sage **S**ystem **O**ptimizator" : light, speedy, flexible and complete road traffic model very suited to real time applications*



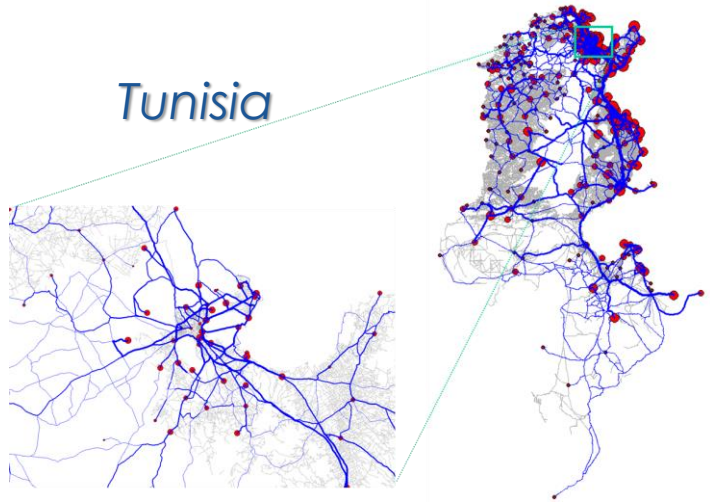
Qatar



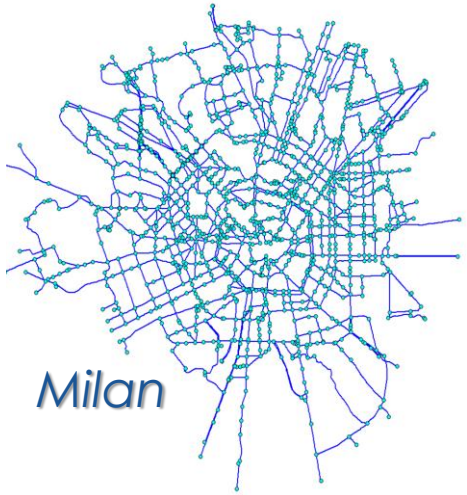
Bucharest

Hong Kong

Tunisia



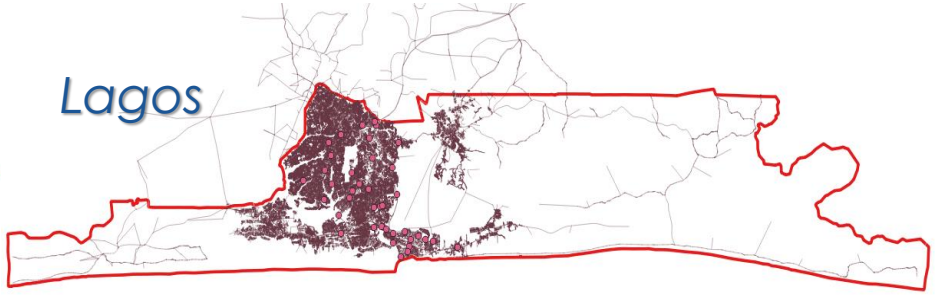
Lazio



Milan

Kaliningrad

Lagos



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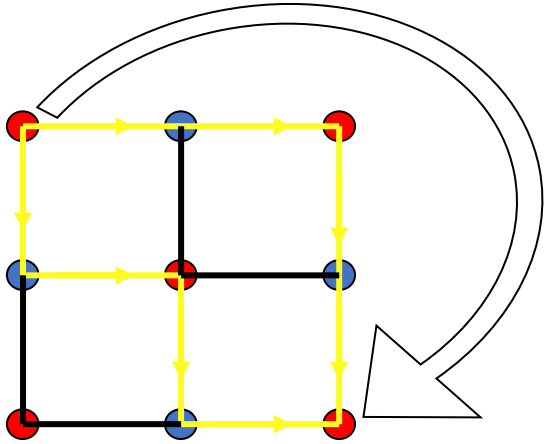
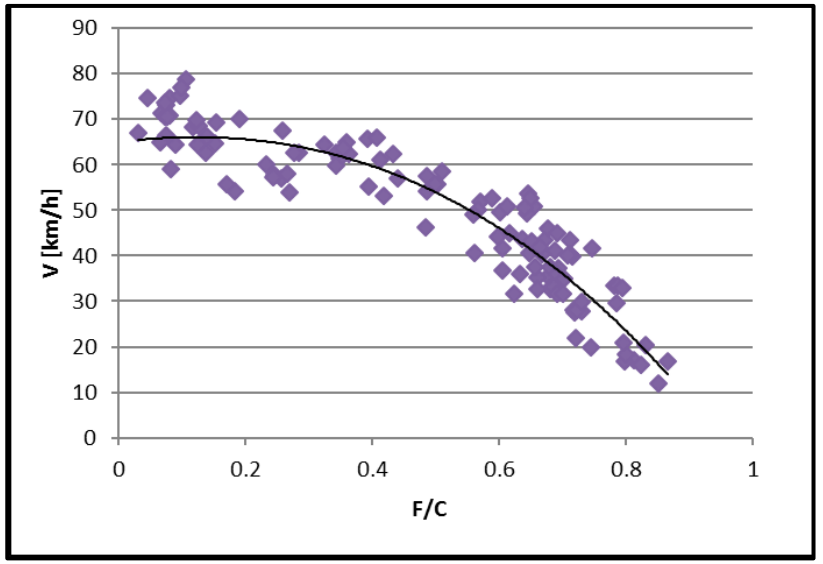
CarUSO: Road traffic flows model



THEORETICAL Bases

1. "Wardrop's equilibrium principle": flows are routed along paths with minimum "effective cost"
2. "Willumsen's entropy principle": the best O/D matrix maximizes "dispersion"

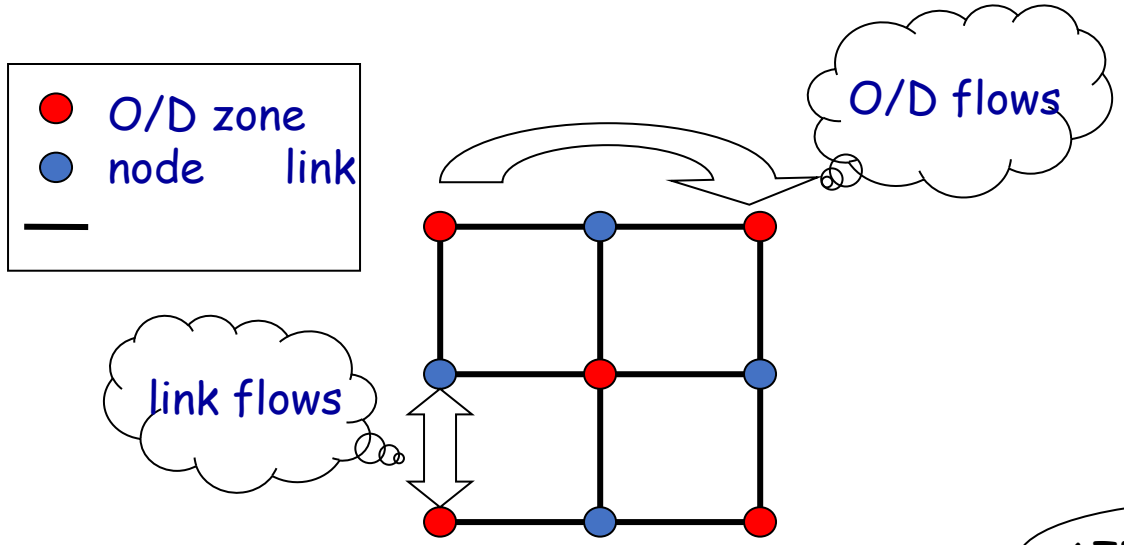


THE COSTS OF ROADS are generally related to travel times and thus speeds, thus to the functional characteristics of the roads and the flows on them: the speed-flow relation graph (v=speed ; F/C=flow to capacity ratio)

Assignment models work **minimizing the travelling cost** between Origin/Destination zones.

Constraints	**traffic data on some arcs** (initial O/D matrix)
Variables	OD(i,j) – OD matrix elements
Assignment	Multiple paths

CarUSO: Road traffic flows model



MAIN RESULTS
> Estimation of the **load level** of a road transport network
> estimation of the new **O/D matrix**
> estimation of the average **speed** on road links

AIR QUALITY

NOISE

APPLICATION FIELDS
> Transport and mobility planning
> Near real time control systems
> Environmental modelling

LEZ and ZEZ low- and zero-emission zones

TRAFFIC MODELS for mobility planning

LEZ and ZEZ low- and zero-emission zones : deployed by city governments to mitigate air pollution, congestion, and carbon emissions from road traffic.

… mitigate air pollution

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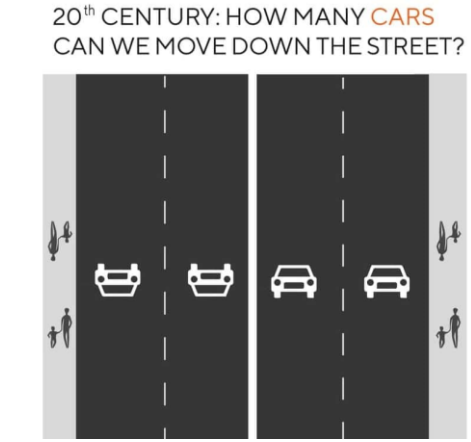
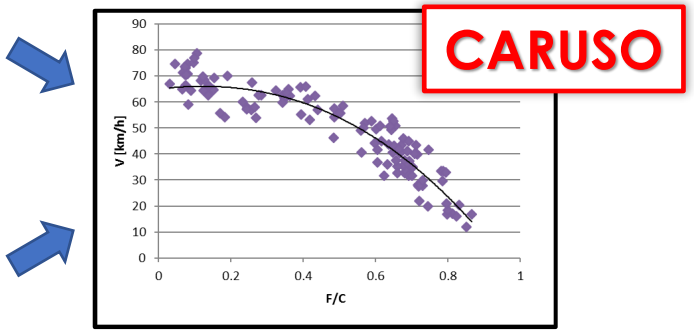
Cleaner fleet composition

TREFIC

TRAFFIC MODELS for mobility planning

… mitigate congestion





Model support policy makers in SCENARIO comparison

COST function design	Money (ticket, fee, fuel, parking)
	Social - health
	Time (tpl rapid transit)
	Environmental

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THANK YOU FOR YOUR ATTENTION

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