

FAIRMODE

Urban Emissions Working Group

Leonor Tarrasón (NILU) and the JRC team - Philippe Thunis and Kees Cuvelier



Outline

1. The JRC benchmarking emission tool
2. Urban Emissions in FAIRMODE – best practices
3. Cooperation with ERMES
4. Publications and co-operation

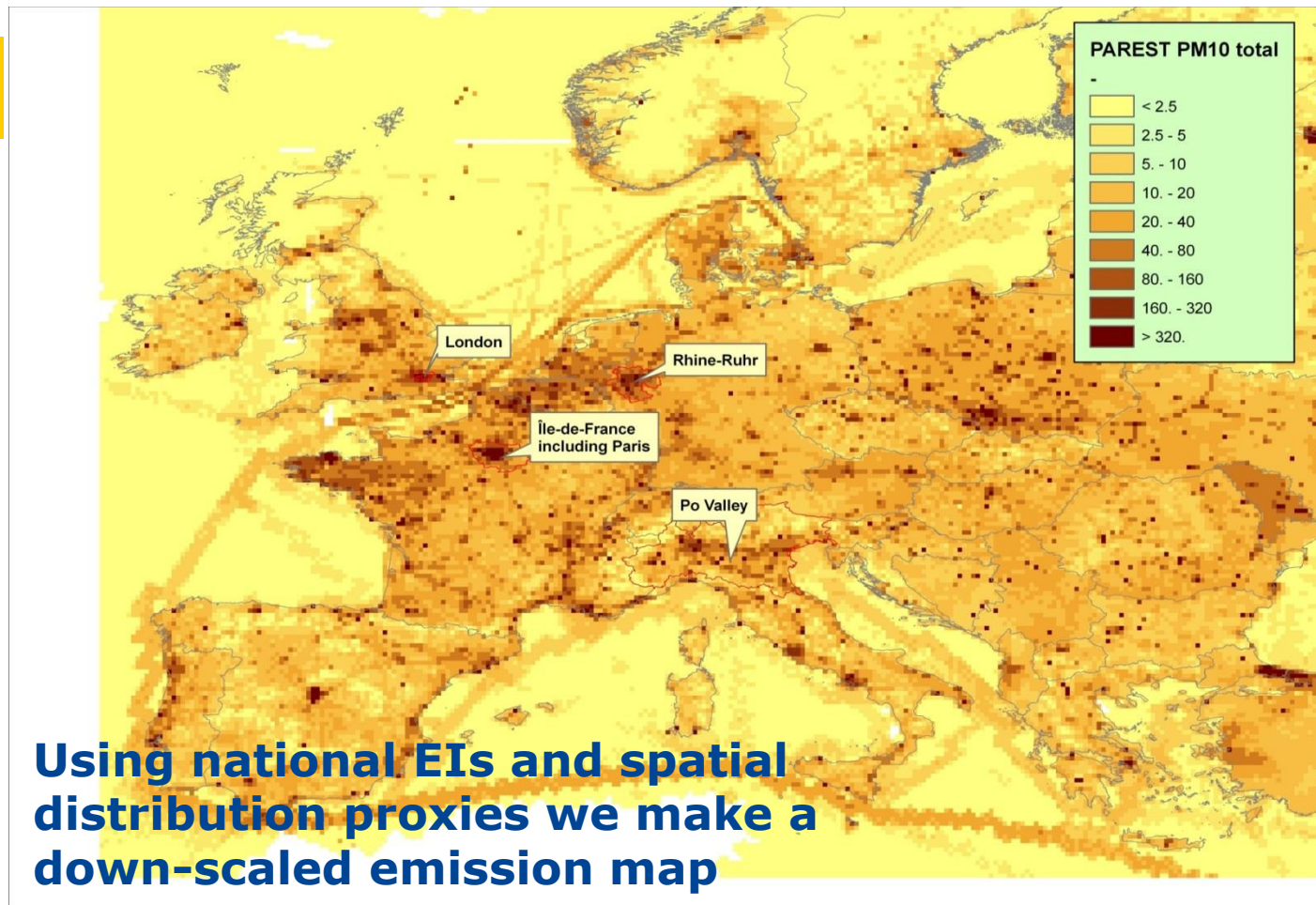


1. The JRC benchmarking emission tool



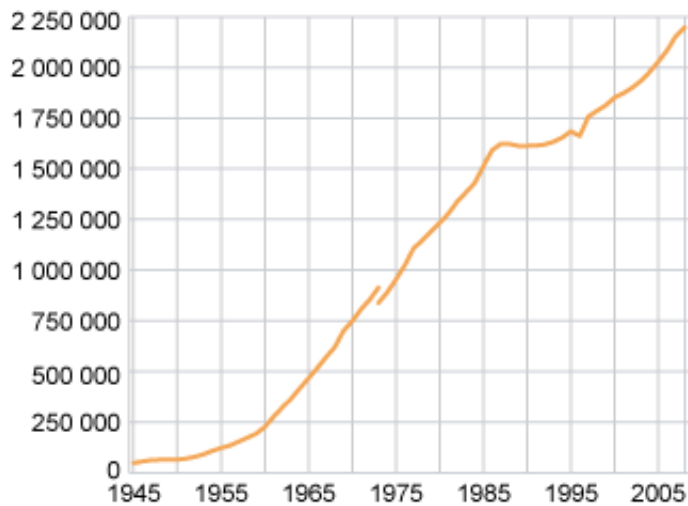
Top down approach: DOWNSCALING APPROACH TO URBAN SCALE INVENTORIES

**MACC / MEGAPOLI
2005 PM10 total**



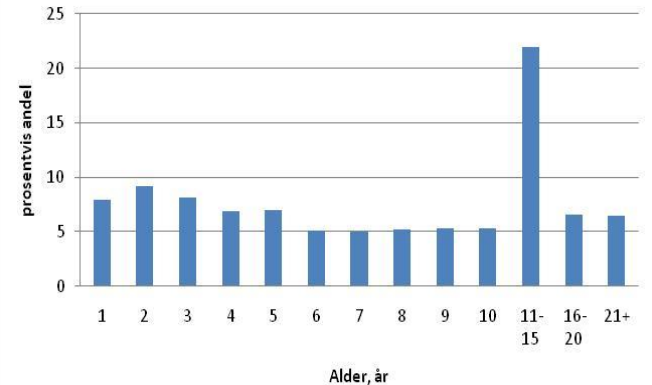
ALTERNATIVE APPROACH: bottom-up BU emission models, with information on the traffic volume, vehicle stock, and vehicle emission factors

Antall personbiler. 1945-2008¹

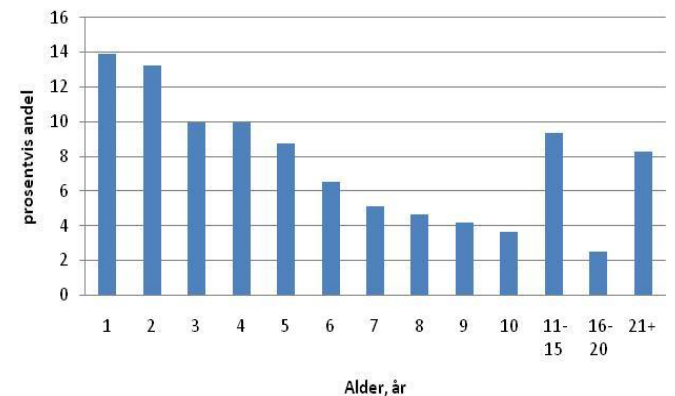


¹Fram til 1973 omfatter tallene både biler med påmontert skilt per 31. desember og biler som var avskiltet i løpet av året. Fra og med 1973 omfatter tallene bare biler med påmontert skilt per 31. desember.

Aldersfordeling lette kjøretøy

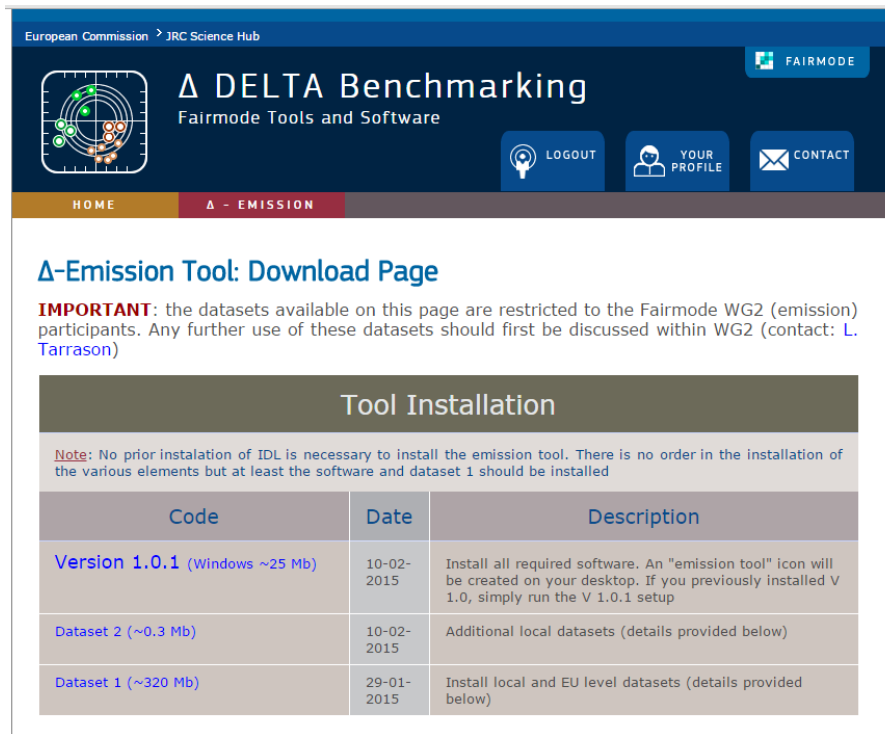


Aldersfordeling tunge kjøretøy



IMPORTANT MILESTONE!

<http://aqm.jrc.ec.europa.eu/DELTA/emission/emission.aspx>



The screenshot shows the website interface for the DELTA Benchmarking tool. The header includes the European Commission and JRC Science Hub logos, along with the FAIRMODE logo. The main navigation bar features 'HOME' and 'Δ - EMISSION' tabs, and buttons for 'LOGOUT', 'YOUR PROFILE', and 'CONTACT'. The page title is 'Δ-Emission Tool: Download Page'. An important note states that datasets are restricted to Fairmode WG2 participants. Below this is a table titled 'Tool Installation' with columns for Code, Date, and Description.

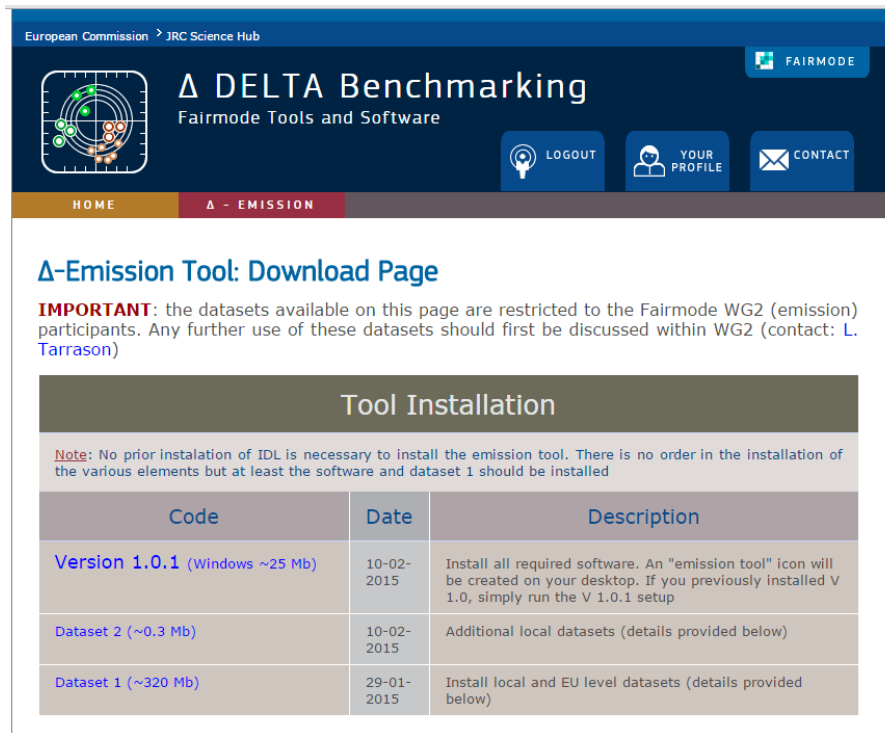
Code	Date	Description
Version 1.0.1 (Windows ~25 Mb)	10-02-2015	Install all required software. An "emission tool" icon will be created on your desktop. If you previously installed V 1.0, simply run the V 1.0.1 setup
Dataset 2 (~0.3 Mb)	10-02-2015	Additional local datasets (details provided below)
Dataset 1 (~320 Mb)	29-01-2015	Install local and EU level datasets (details provided below)

Purpose of the JRC benchmarking tool

1. Compare bottom-up and top down emission inventories
2. Enhance communication between national and city authorities by understanding main features of the comparison

IMPORTANT MILESTONE!

<http://aqm.jrc.ec.europa.eu/DELTA/emission/emission.aspx>



European Commission > JRC Science Hub

FAIRMODE

Δ DELTA Benchmarking

Fairmode Tools and Software

LOGOUT YOUR PROFILE CONTACT

HOME Δ - EMISSION

Δ-Emission Tool: Download Page

IMPORTANT: the datasets available on this page are restricted to the Fairmode WG2 (emission) participants. Any further use of these datasets should first be discussed within WG2 (contact: L. Tarrason)

Tool Installation

Note: No prior installation of IDL is necessary to install the emission tool. There is no order in the installation of the various elements but at least the software and dataset 1 should be installed

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BOTTOM-UP

8 cities:

Antwerp
Barcelona
London
Lisbon
Milan
Oslo
Porto
Sofia

5 regions:

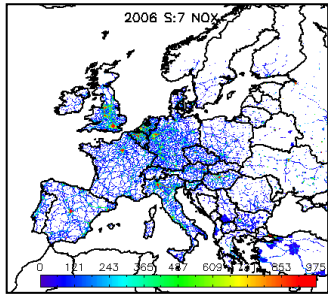
Alsace
Antwerp Prov.
Catalonia
Flanders
Po Valley
Strasbourg

1 country: Bulgaria

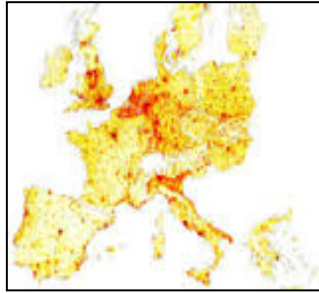
TOP DOWN: 4 inventories: EC4MACS, MACC-TNO, JRC 1km & 100m

FAIRMODE Emission Benchmarking

What we need



MACC 7km
sector/pollutant
maps



Population map

Macrosector – Emission Info Table			
Reference year			
Domain (4 corners lat-lon coord) or administrative boundaries (city, region)			
Precursor	Macrosectors (yours)	CORINAIR conversion	Total emitted (kt/ y)
Nox	Traffic	S7	XX1
Nox	Domestic	S2	XX2
Nox	Point sources	0.5*S3+S1	XX3
NOx	Other	0.5*S3+S4+S5...	XX4
VOC	Traffic	S7	YY1
VOC	Domestic	S2	YY2
VOC	Point sources	0.5*S3+S1	YY3
VOC	Other	0.5*S3+S4+S5...	YY4
...			

Info request to participants

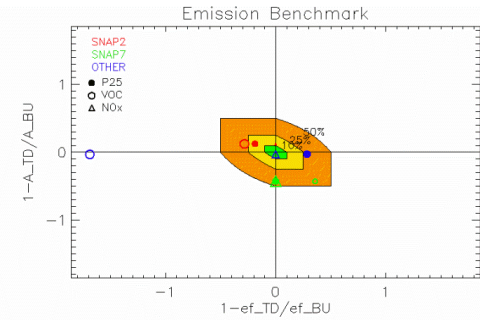
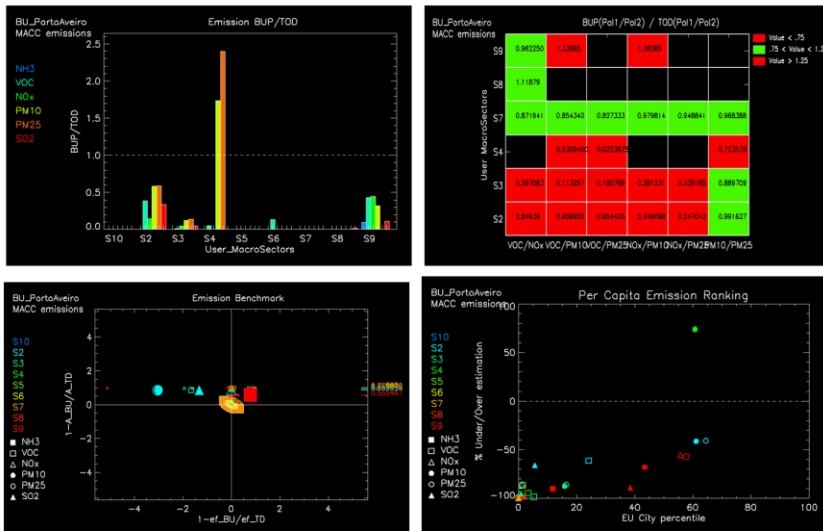
From you

Shape		7		
ITA-Region-VDA				
ITA-Region-PMN				
ITA-Region-LMB				
ITA-Region-TAA				
ITA-Region-VEN				
ITA-Region-FVG				
ITA-Region-ERM				
2006				
#Species	BU sectors	BU sectors	Correspondance with SNAP	Totals
NOx	DOM	Domestic	S2	30
NOx	TRA	Traffic	S7	300
NOx	zOTH	Others	S1+S4+S5+S6+S3+S8+S9+S10	116
PM25	DOM	S2	S2	10
PM25	TRA	S3	S7	11
PM25	zOTH	Others	S1+S4+S5+S6+S3+S8+S9+S10	12
VOC	DOM	S2	S2	25
VOC	TRA	S3	S7	140
VOC	zOTH	Others	S1+S4+S5+S6+S3+S8+S9+S10	350
END				

FAIRMODE Emission Benchmarking

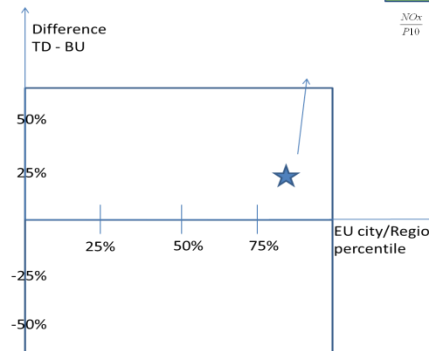
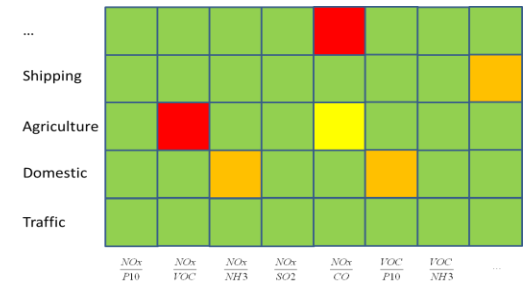
What you get

PORTO UnivAVEIRO



□ General overview

□ Precursor ratios

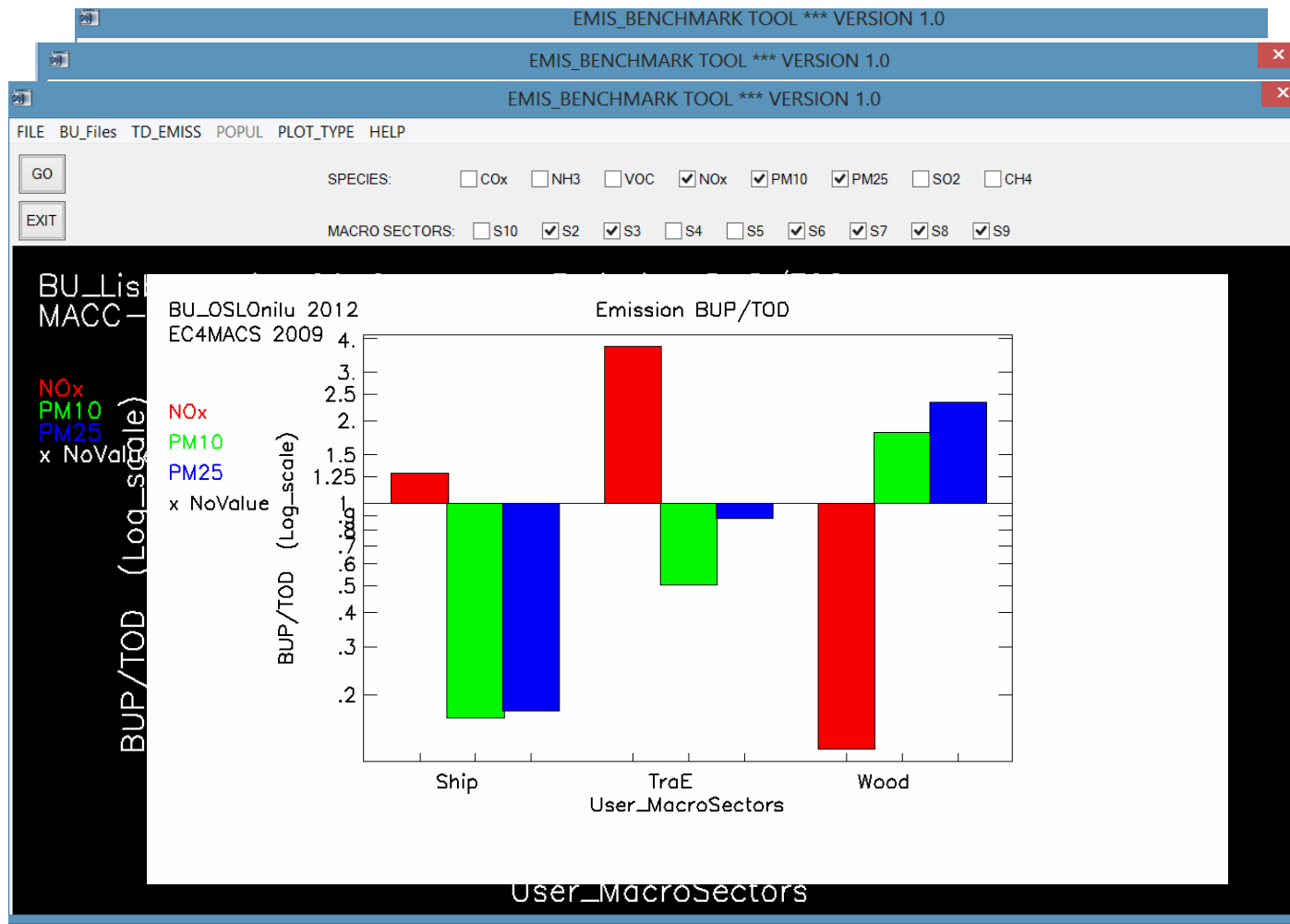


□ Per Capita comparisons



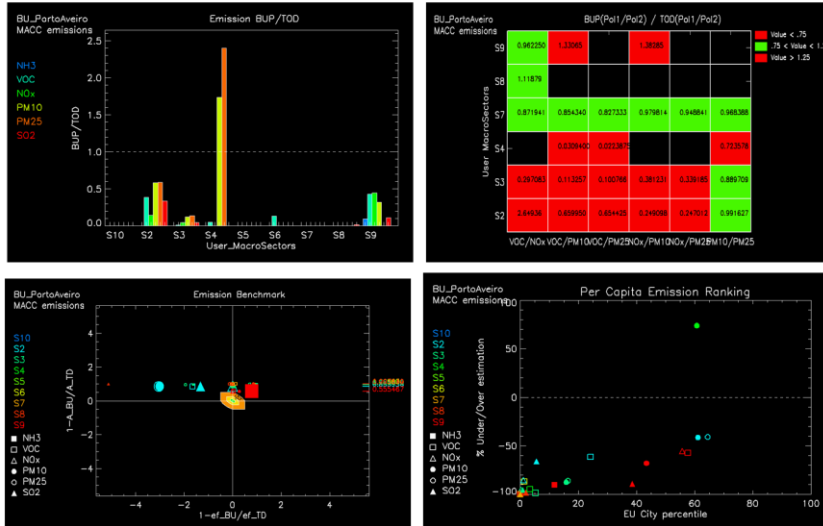
Bottom-up vs Top-down estimates comparison by sector and component

Antwerp and Barcelona and Aveiro



FAIRMODE Emission Benchmarking

PORTO UnivAVEIRO



We need your help

- to refine the tool
- to test it & give us feedback
- to interpret the data
- to assess the usefulness of the tool

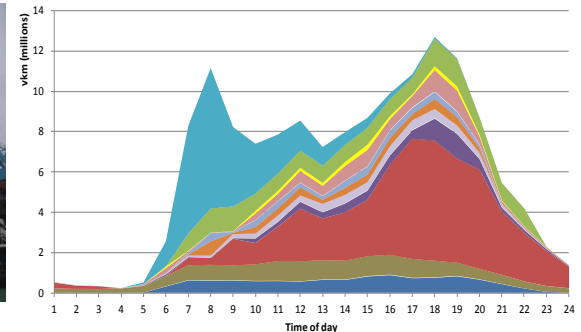
We need your help!

2. Urban Emissions in FAIRMODE – Best practices



WG2 focuses at present on the compilation of good practices for **urban** emission compilation, with focus on mobile sources

- Identification of best available data sources and methods
- Methodologies to understand emission processes
- Comparison of emission factors



EMEP CORINAIR
Emission Guidebook

National scale

Exhaust traffic emission
Tier 2 and Tier 3

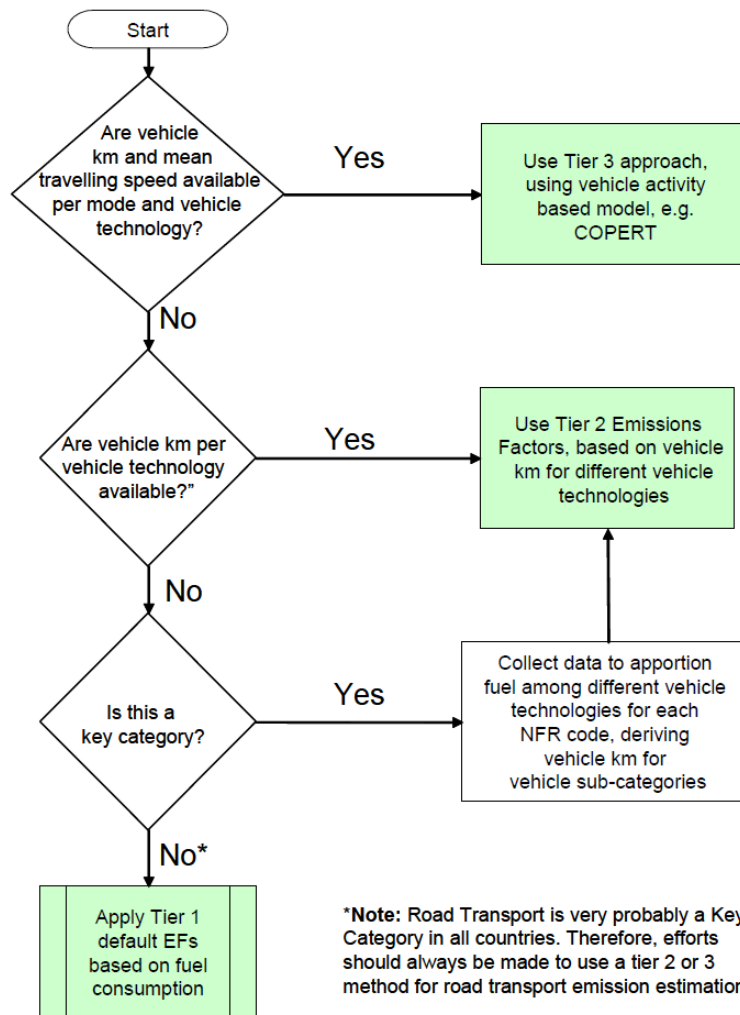
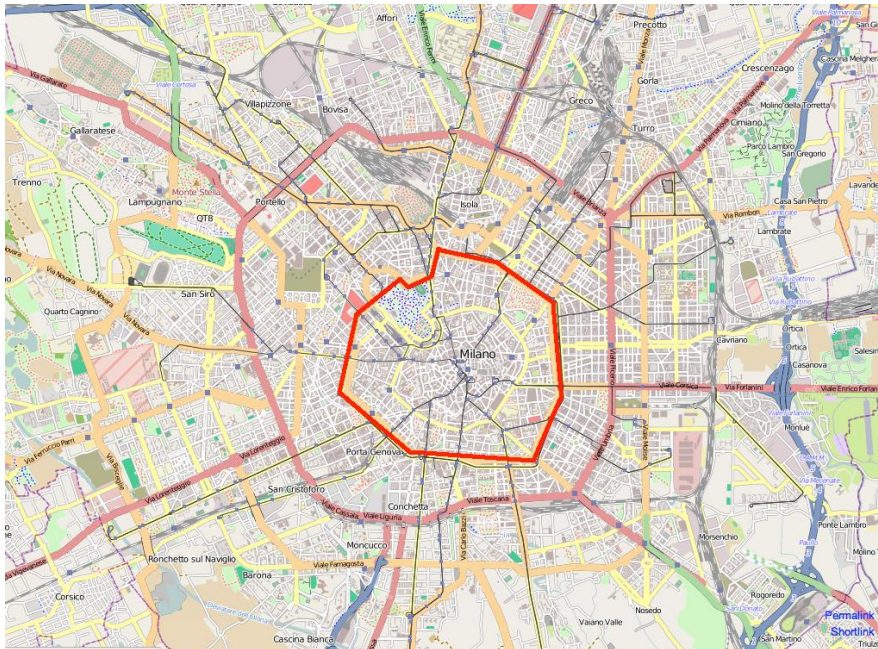


Figure 3-1 Decision tree for exhaust emissions from road transport

FAIRMODE WG2 Best practices

TIER 4 for urban emissions?



Urban scale emissions testing
with detailed activity data

Vehicle Speed
dependencies imply up to
20% differences in NO_x
emissions

Comparison of road traffic emission models in
Madrid (Spain) *R. Borge et al., Atmospheric
Environment 62 (2012) 461, 471*

EF emission factor information from COPERT

Model	Motor type	CO ₂ (g/km)	NO _x (mg/km)	NO ₂ (mg/km)	HP
Toyota Prius	Gasoline/EL Hybrid	89	6	0,6	136
VW Golf 1,4 TSI aut	Gasoline	138	25	2,5	122
Audi A3 2,0 TDI aut	Diesel	143	142	71,5	140
BMW 118 d aut	Diesel	140	158	79	143
SmartForTwo	Diesel	86	160	79	54

NO₂ conservativte share 10% for gasoline, 50% for diesel.

NO₂ emissions:

- Hybrid vs Gasoline, a factor of 4
- Gasoline vs Diesel, a factor of 30
- Hybrid vs Diesel, a factor of 125

Traffic volume information

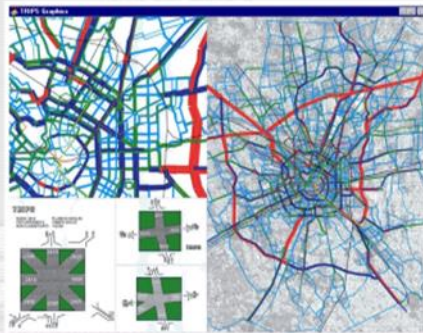
In BU urban scale inventories. Traffic volume information comes from

- Traffic models (Milan) or
- Actual traffic counts (Barcelona, Oslo)

3.2 THE TOTAL MILEAGE

$$E_{p,j} = FE_{p,j} * M_i * f_{j(i)}$$

The daily total mileage (together with the mean speed) of each vehicle category 'i' is usually provided by traffic models.



Milano



Comune di Milano



Methodology – On-road traffic (SNAP07)

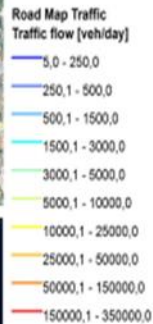
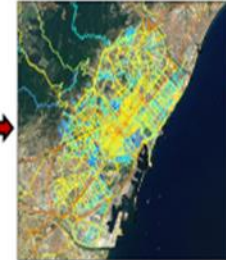
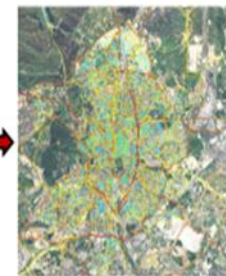
((A complete digital road map with traffic flow information



3,198 Traffic Stations



2,575 Traffic Stations



Vehicle stock information

Vehicle stock information from

- Urban statistics (Oslo) or
- Actual traffic observations (Milan, Barcelona)

Limitations associated with data privacy legislation

Methodology – On-road traffic (SNAP07)

(Different composition fleets per district (256 vehicle categories)



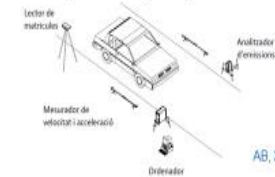
7 fleet composition profiles obtained from statistics

Zone	Buses	HDV	Taxis	Motocycles	PC
1	3.4%	8.6%	17.4%	7.1%	63.5%
2	2.2%	6.7%	14.3%	4.4%	72.3%
3	2.3%	6.3%	15.3%	5.9%	70.2%
4	2.1%	5.4%	9.2%	4.7%	78.5%
5	2.4%	6.4%	10.6%	4.8%	76.1%
6	1.4%	6.2%	3.7%	1.6%	87.1%
7	2.6%	7.6%	4.7%	2.6%	82.5%
TOTAL	2.5%	6.9%	9.1%	4.0%	77.5%

AM, 2009



12 fleet composition profiles obtained from Remote Sensing Device (RSD) data



AB, 2010a



Vehicle image



Plate area identification

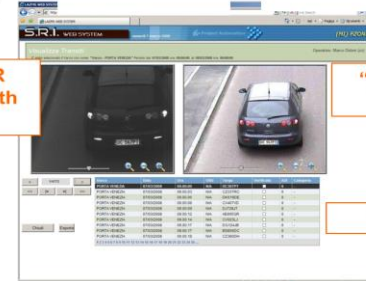


Plate characters segmentation



Characters string extraction

Integrated IR illuminator with OCR



"Context" CCTV Camera

Transits List

3.3 THE FRACTION OF TOTAL MILEAGE



AGENZIA MOBILITÀ AMBIENTE TERRITORIO



3. Cooperation with ERMES





European Research Group on Mobile Emission Sources

Maria Cristina Galassi participated at FAIRMODE WG2 Technical Meeting Norway - April 28th-29th, 2014
Leonor Tarrason participated at ERMES Plenary Meeting, *Graz, Austria- September 17th, 2014,*



FAIRMODE WG2: Urban Emissions

	2014	2015	2016
	Traffic emissions methodologies review	Benchmarking Traffic emissions	GHG and AQ emissions from traffic
	Link to TFEIP	Link to ERMES and MACC	Link to ICLEI
	Determination of good practices for traffic emissions	Differences between national and urban traffic inventories	Guidance on traffic emissions methodology

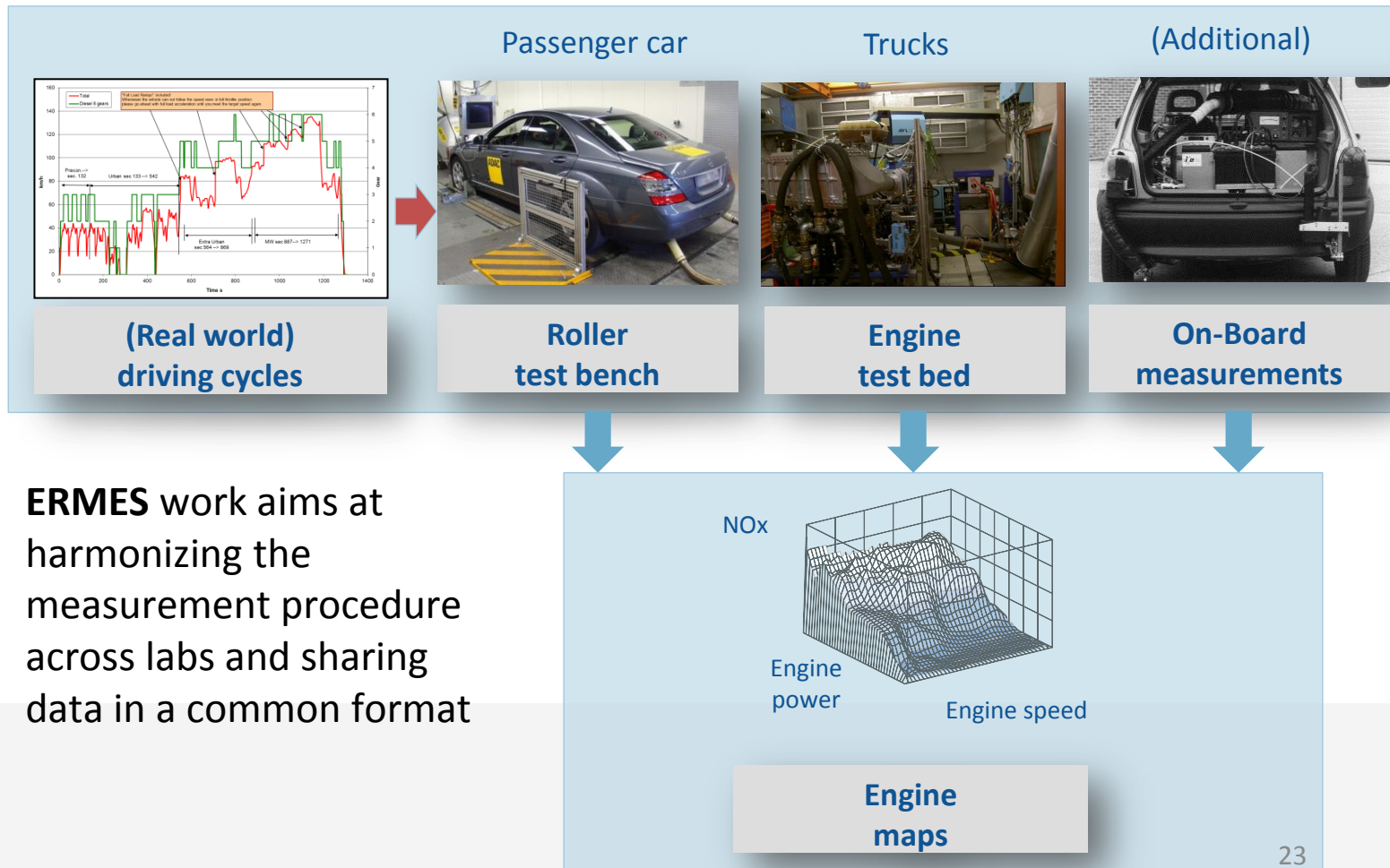
ERMES Mission – links to WG2

- ✓ to **coordinate research** and measurement programmes for the improvement of transport emission inventories in Europe
- ✓ to become a **permanent network** of mobile emission modellers and model users
- ✓ to become an international **reference point** for mobile emissions modelling and related topics in Europe

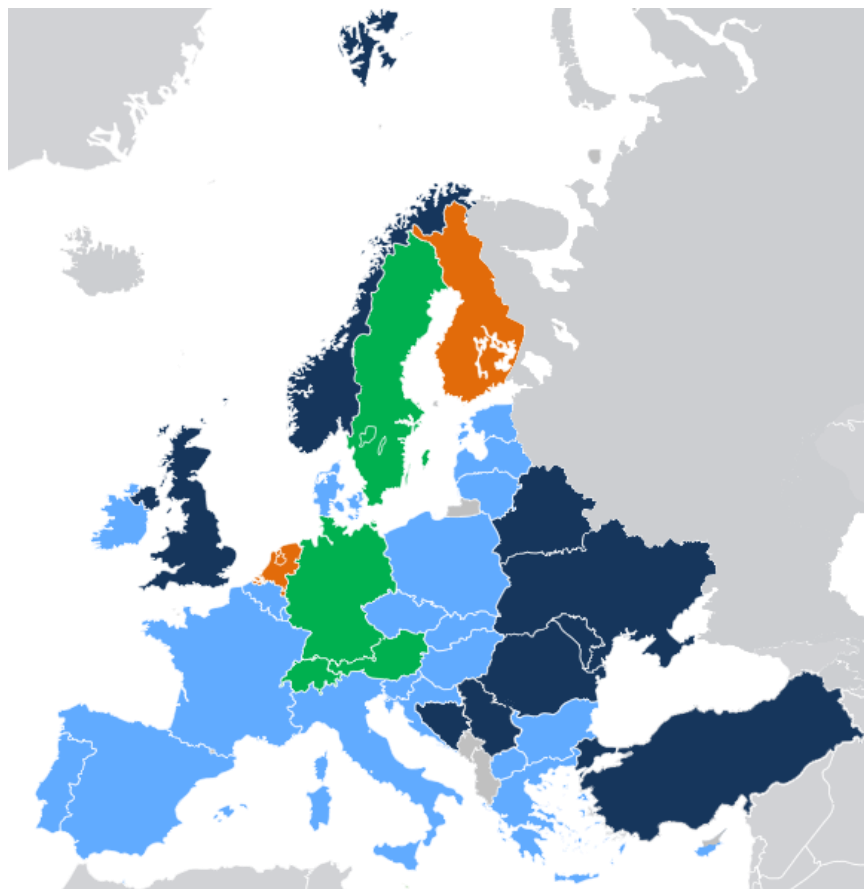






Measurements

Harmonization and data sharing



Modelling



-  COPERT
-  HBEFA
-  Own model
-  COPERT-based

**Emission models
usage in Europe**

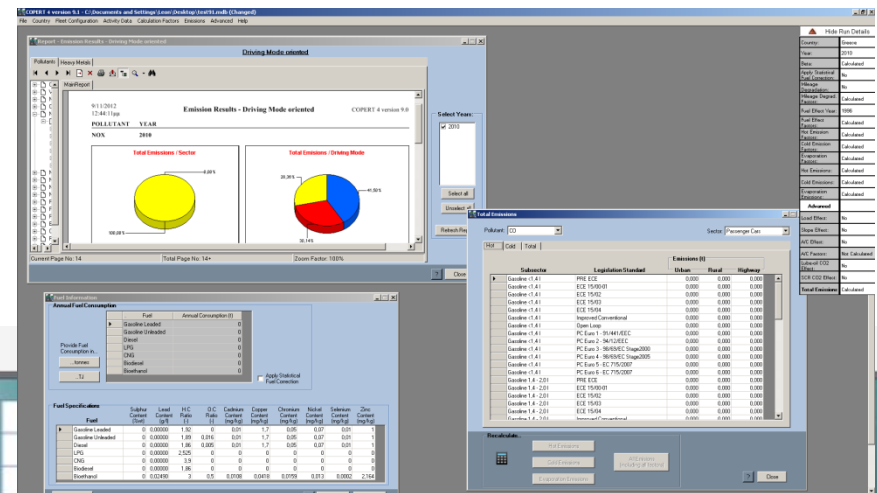
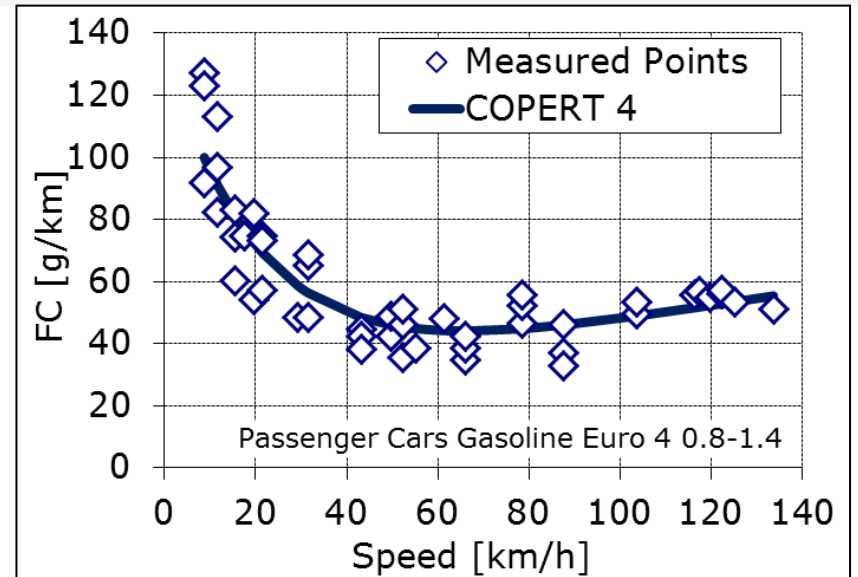
COPERT Approach

Emission factors from interpolation of measurements as a function of average speed

- Straightforward and easy to obtain at national level
- Lacks sensitivity as temporal/spatial resolution increase

- The methodology is describe in the EEA emission guidebook
- A single free software package is available at www.emisia.com

Source: LAT



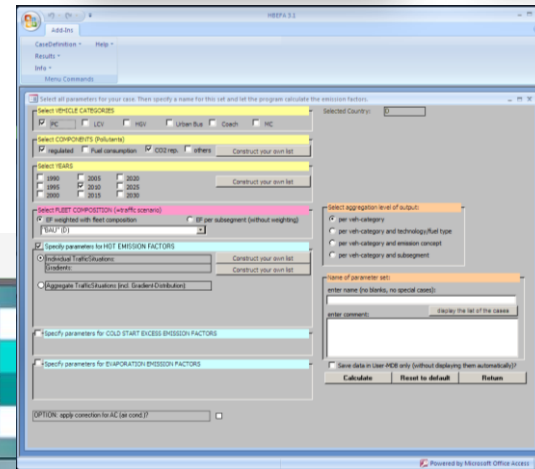
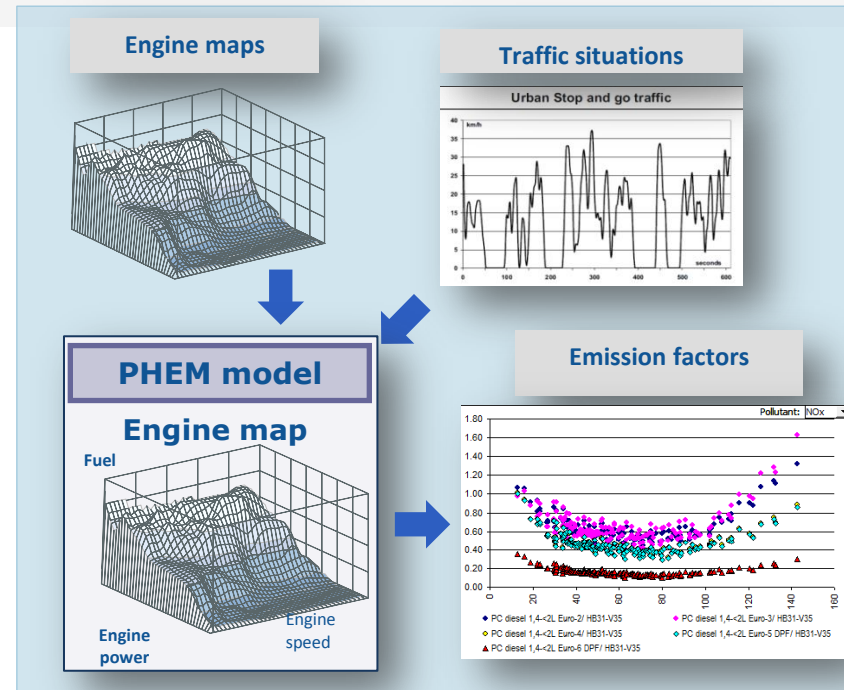
HBEFA Approach

Emission factors are the weighted average of the PHEM model results

- PHEM is calibrated on vehicle measurements
- PHEM runs for 276 individual traffic situations classified by: road type; level of service; speed limit.

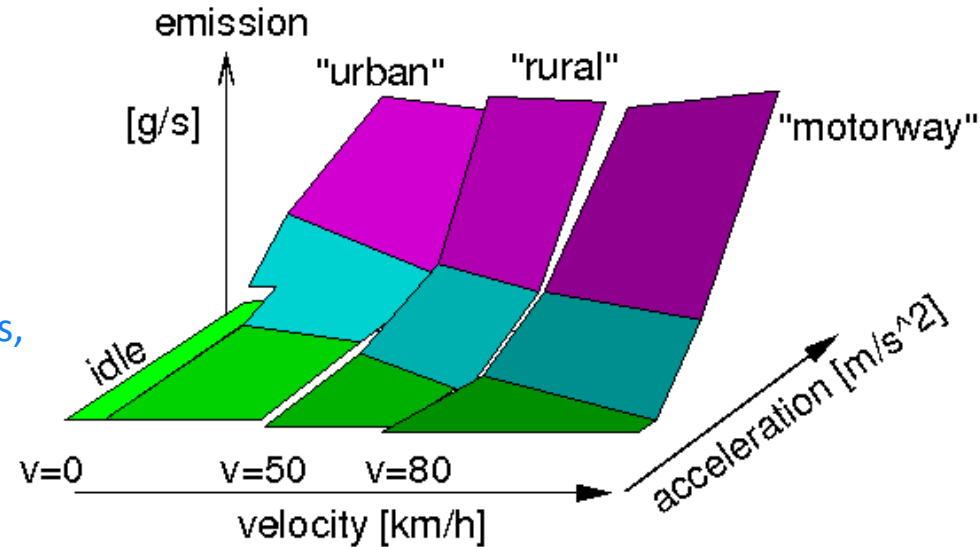
- The Software is available at www.hbefa.net
- Software database allows selection of emission factors

Source: INFRAS



VERSIT+ Approach

- Velocity-and-acceleration based
- Statistical analyses:
 - sufficient data per vehicle
 - sufficient vehicles per category
 - no reliance on engine maps, etc.: data focussed
- Shift towards on-road testing (PEMS) is in progress
 - Euro-V HD emission factors based on PEMS since 2010
- 10+1 parameters per vehicle category (1 for cold start)
 - 20 parameters for heavy duty (to cover payload)



- Emission factors published for national usage, changes reported annually on March 14th

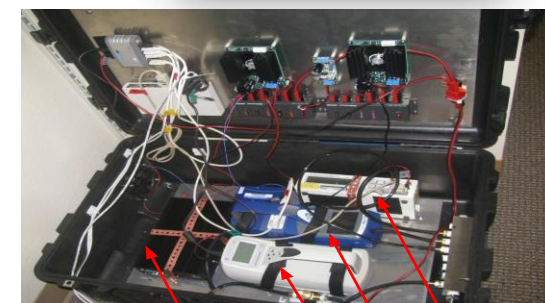
Cooperation topics

- Cooperation with ERMES program with focus on testing their emission factors (EF)
 - a) feedback to ERMES labs
 - b) comparability analysis
 - c) requests for new Efs



Possible questions to address jointly, with WG3 FAIRMODE

1. Real world emission measurements
2. Repository of European source profiles
(shipping emissions, crustal emissions...)



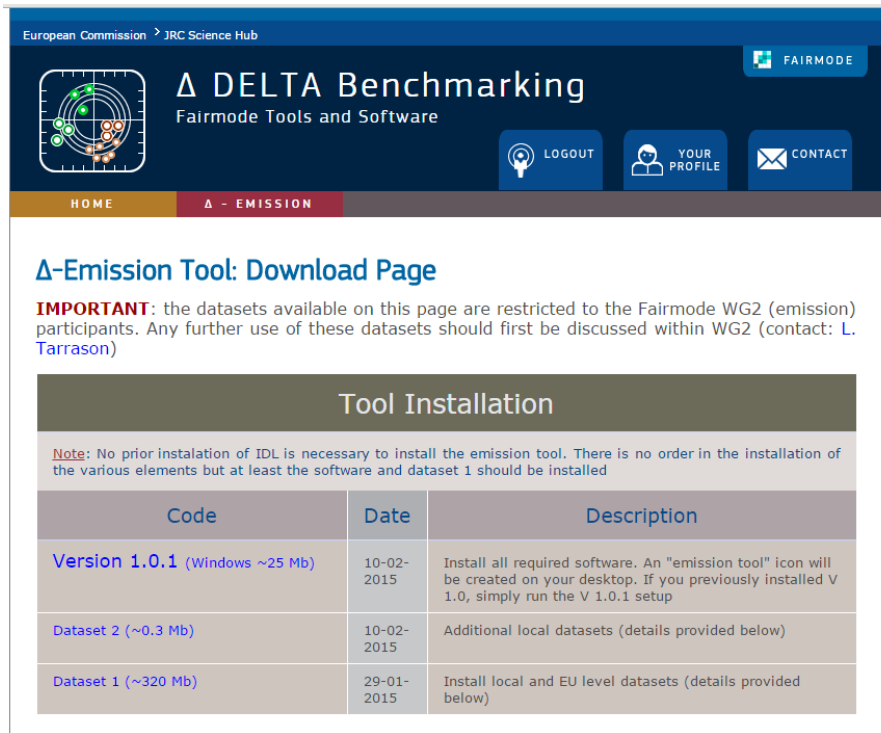
Computer CPC DRX OPC

4. Publications and Co-operation



Training session

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European Commission > JRC Science Hub

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Δ DELTA Benchmarking

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Be acquainted with the JRC emission benchmarking tool

Today at 18:30- 19:30, here at the Fedora meeting room

FAIRMODE WG2 synthesis

1 **Indicators and diagrams to support the**
2 **consistency of emission inventories**

3
4 P. Thunis, B. Degrauwe, C. Cuvelier, L. Tarrason, M. Vogt, L.
5 White, A. Clappier

6 **Abstract**

7
8 **Keywords:**

9 **1. Introduction**

10
11 Air quality models are nowadays widely used to support regulatory
12 decisions, e.g. air quality planning, assessment of concentration
13 levels over a given territory... (references). In this respect the
14 uncertainties related to the air quality modelling process become one
15 essential element to consider in order guaranteeing that model-based
16 decisions are robust. Model uncertainties are commonly and widely
17 discussed (reference) and can result from many different elements of
18 the air quality modelling chain (emissions, meteorology, boundary
19 conditions, model parameterizations...). Many works have
20 highlighted the importance of using correct estimates of emissions in
21 this modelling process but so far emissions remain one of the model
22 input data characterized by a high level of uncertainty. Building an
23 emission inventory over a given city, region or country is always a
24 challenge as highly detailed local information for a large variety of
25 emission sources needs to be collected but is generally not always
26 available with the requested level of accuracy for all emitting sectors
27 and/or pollutants. Uncertainty also arise during the spatial allocation
28 process where emissions are distributed geographically using some
29 proxy variables. In many studies the emission inventory has been
30 referred to as the most uncertain input of the air quality modelling
31 chain (references, Appraisal...)
32
33

1. Publication to present the emission benchmarking tool for bottom-up vs top-down emission inventories

We need voluntaries to form an interpretation group

2. Preparation of best practices for urban emission compilation – definition of Tier 4 based on experience from Barcelona, Madrid, Oslo and Milano

We need voluntaries to participate in the development of the first draft of the urban Tier 4 approach

To be presented and discussed in the technical meeting in Aveiro

We need your contribution 😊

1. Download the JRC emission benchmarking, upload you data and give us your feedback!
2. Indicate your interest to join the interpretation group for the BUvsTD comparison
3. Indicate if you are interested to join the development of Tier 4 urban traffic emission draft for the 2015 technical meeting



Thank you

The screenshot shows the FAIRMODE website interface. At the top, it identifies itself as the European Commission's in-house science service. The main header features the FAIRMODE logo and the tagline 'Forum for air quality modelling in Europe'. Navigation links for 'Home' and 'Contact' are provided. The 'News and events' section includes a 'Mailing list' link, a 'Meetings' link, and a prominent announcement for the 'FAIRMODE TECHNICAL MEETING' on 28 April 2014 in Kjeller, Norway, with a 'Registration form...' link. A 'Working groups' section lists 'Assesment', 'Emissions', 'Source Apportionment', and 'Planning'. A 'Cross cutting activities (CCA)' section is also visible. On the right, an 'About FAIRMODE' sidebar contains links for 'terms of reference', 'steering committee', 'national experts', 'roadmap', and 'strategy'.

fairmode.jrc.ec.europa.eu

FAIRMODE
Forum for air quality modelling in Europe



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