

# **GlobEmission Workshop**

## **Doha Qatar, 24-25 November 2015**

**A Benchmarking Tool to screen and compare  
bottom-up and top-down  
emission inventories**

- Kees Cuvelier, ex European Commission JRC**
- Participants WG2 Fairmode**

# Developed in the frame of Fairmode



- <http://fairmode.jrc.ec.europa.eu/>
- Principles of the Emission Tool
- Some applications

# FAIRMODE

Forum for air quality modelling in Europe



## FAIRMODE

Forum for air quality modelling in  
Europe

- The Forum for Air quality Modeling (FAIRMODE) was launched in 2007/10 as a joint response initiative of the European Environment Agency (EEA) and the European Commission Joint Research Centre (JRC). The forum is currently chaired by the Joint Research Centre.
- Its aim is to bring together air quality modellers and users in order to promote and support the harmonized use of models by EU Member States, with emphasis on model application under the European Air Quality Directives.

# FAIRMODE

Forum for air quality modelling in Europe

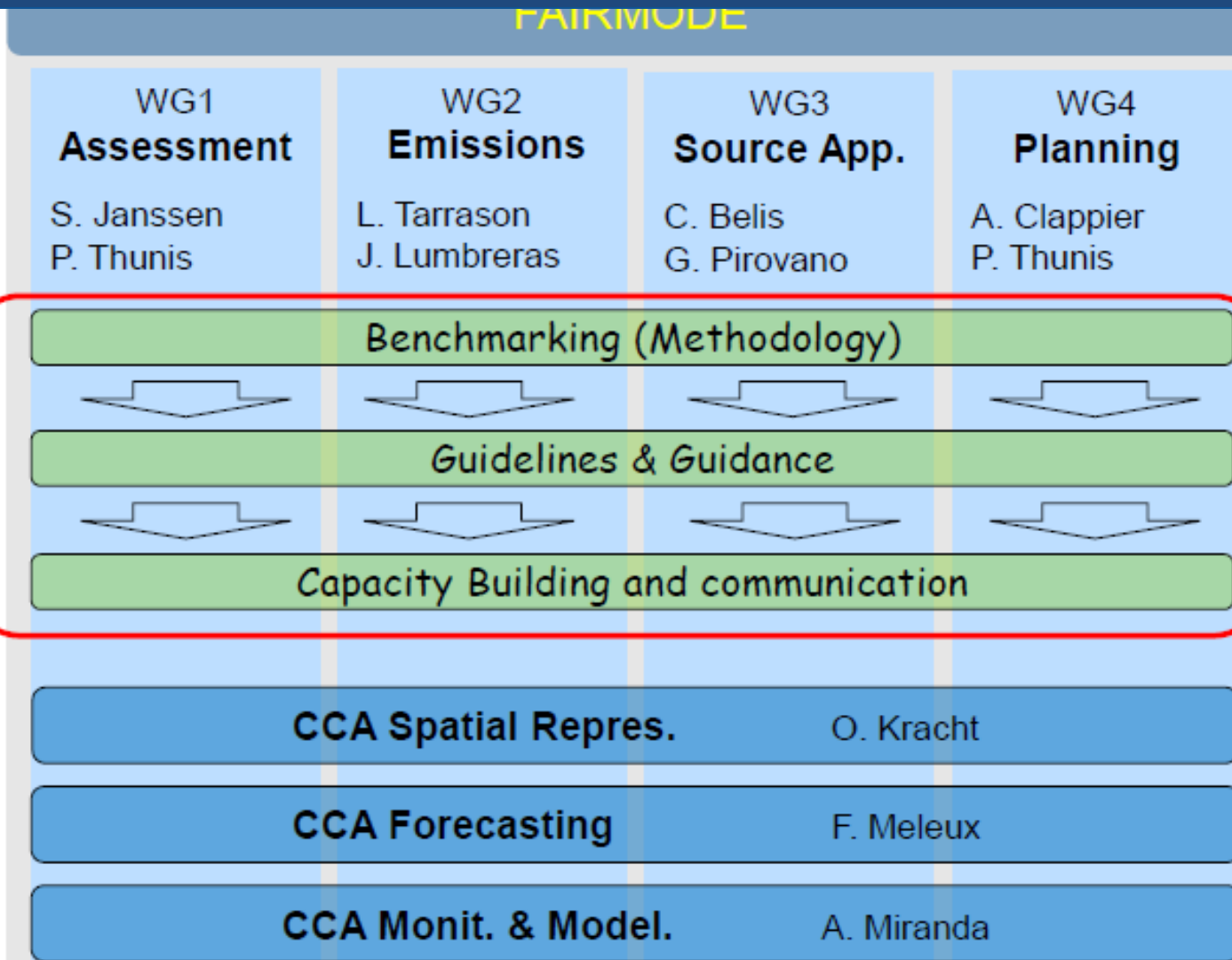


## FAIRMODE

Forum for air quality modelling in  
Europe

- A yearly plenary meeting aimed at participation of national, regional and local policy makers;
- Technical meetings dedicated to model experts to develop and agree on common methodologies, carry out actual benchmarking and establish good procedures and guidance.

# Fairmode Activities and Structure



# Fairmode working structure



# EMIS\_Benchmark visualization tool

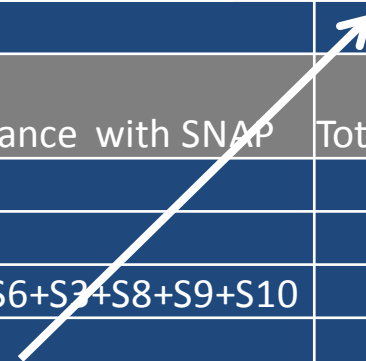
- EB User input file – BUP emissions
- EB input files
- Diagram types
- Examples of Diagrams (... from the Tool)
- Remarks

# User input file: BU\_POVALLEY\_info.csv

Shape	0	Region			
lon	-0.16	3.29	3.55	0.1	
lat	40.36	40.21	42.4	42.4	
					bol

2006				
#Species	BU sectors abbreviation	BU sectors nomenclature	Correspondance with SNAP	Total [kTon]
NOx	DOM	Domestic	S2	30
NOx	TRA	Traffic	S7	300
NOx	zOTH	Others	S1+S4+S5+S6+S3+S8+S9+S10	116
PM25	DOM	Domestic	S2	10
PM25	TRA	Traffic	S7	11
PM25	zOTH	Others	S1+S4+S5+S6+S3+S8+S9+S10	12
VOC	DOM	Domestic	S2	25
VOC	TRA	Traffic	S7	140
VOC	zOTH	Others	S1+S4+S5+S6+S3+S8+S9+S10	350
END				

$$S1+0.5*S3+.25*S8$$





# EB input files:

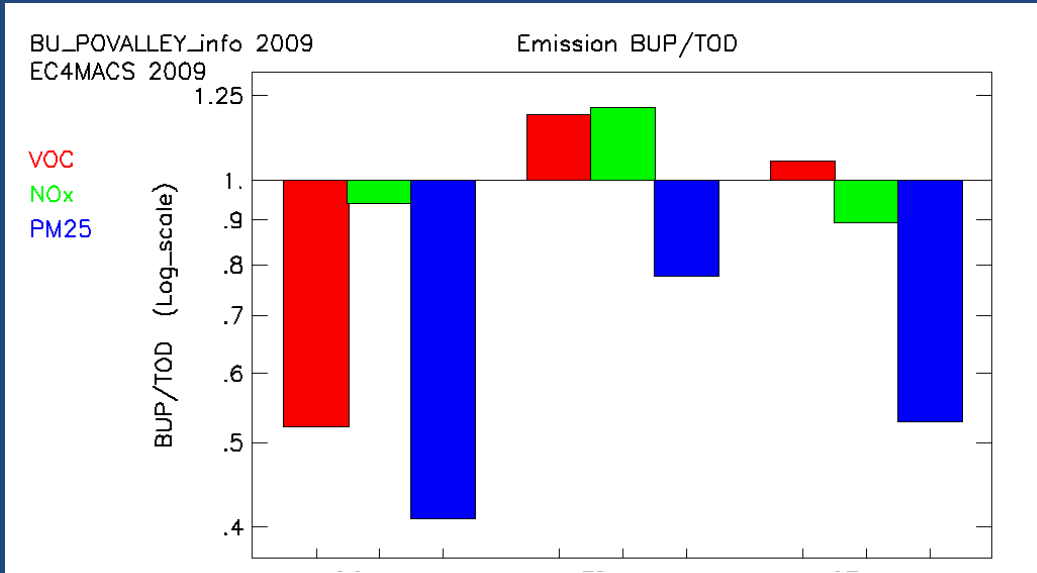
- Gridded TopDown emission inventory for the 7 main pollutants
  - MACC2/3-TNO (years 2000-2011) 7x7km
  - EC4MACS (year 2009) 7x7km
  - JRC (year 2010) 7x7km => 1x1 km => 100x100m  
➔ SNAP1 - SNAP10, and SNAP7.1 - 7.5
- IIASA SNAP-Level1 country emissions for 7 main pollutants
- Gridded Population file
  - INERIS Pop inventory 1x1 km
- Shape files (predefined)
  - 39 Country shape files
  - 428 Region shape files
  - 477 City shape files
- Pre-processed emissions (10 SNAP, 7 Pollutants) on each Country/Region/City .... For use in the ranking diagram

# Diagram types

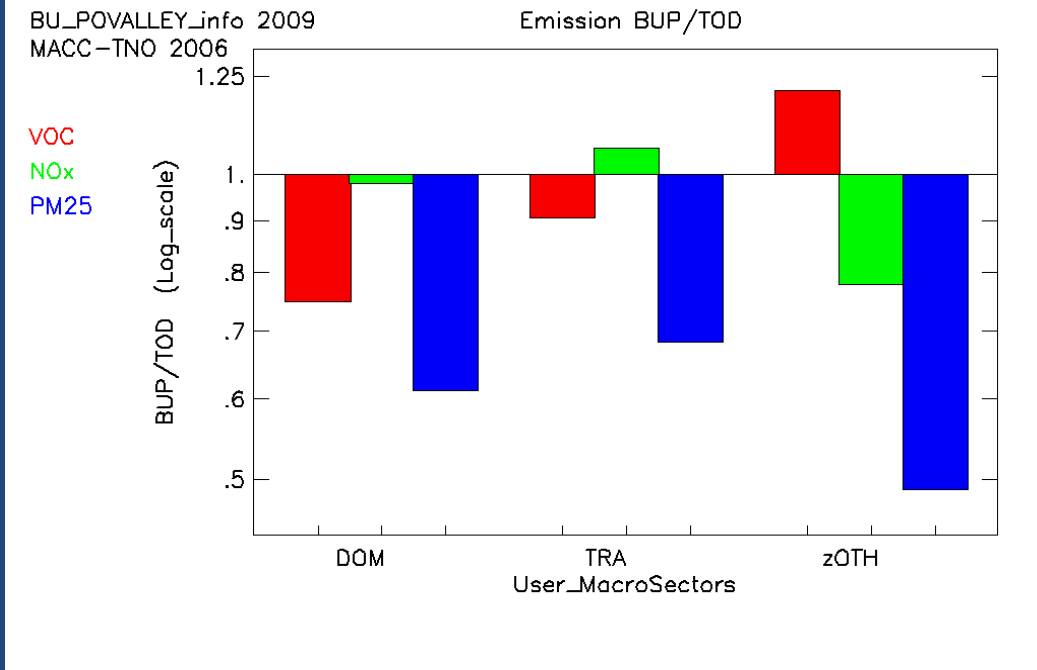
- BUP/TOD BarPlot for each User MS and each POL
- BUP and TOD Ratios Pol1/Pol2 compared to IIASA\_CR
- BUP(Pol1/Pol2) vs TOD(Pol1/Pol2)
- Diamond diagram
- Per capita emission ranking for C/R/C - based on the predefined shape files
- BUP/IIASA and TOD/IIASA – only for Countries

# Example: PO Valley BarPlot

EC4MACS

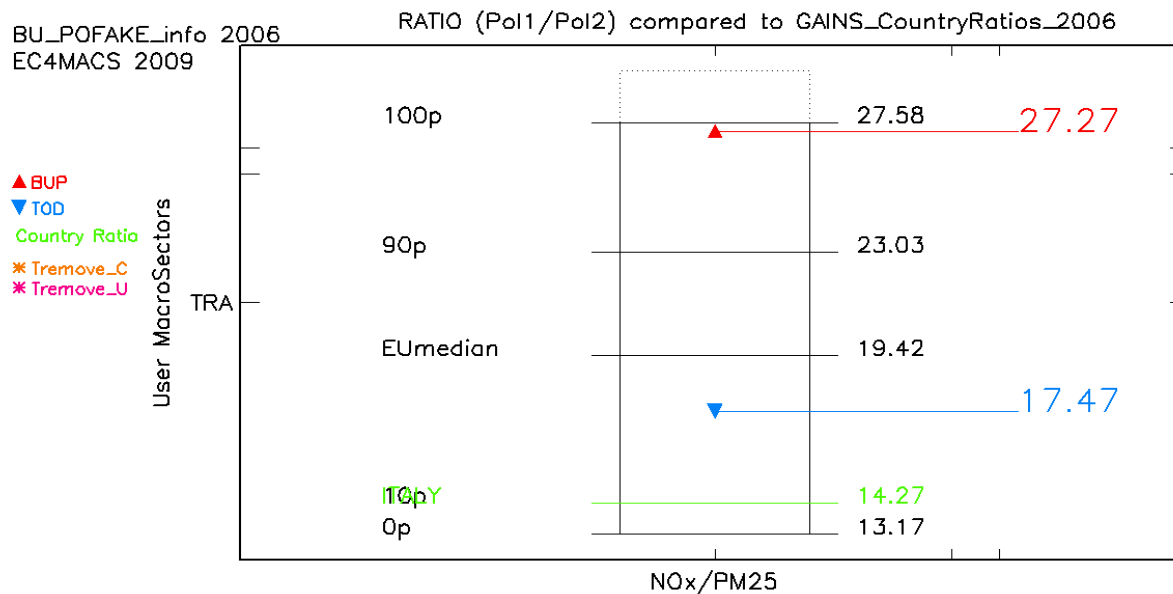


MACC-TNO

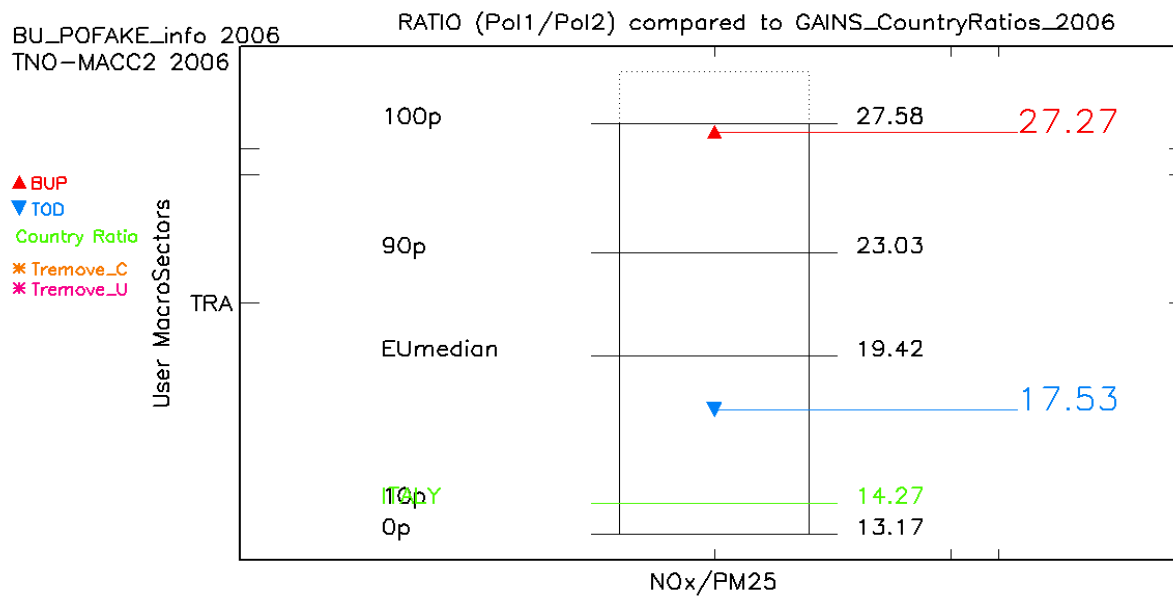


# Example: PO Valley RatioPlot

EC4MACS

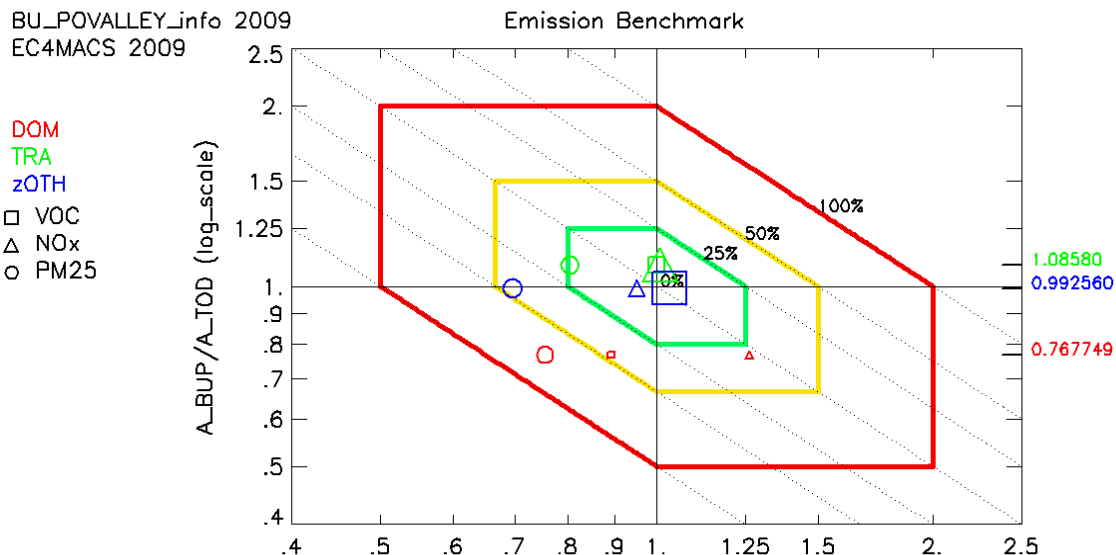


MACC-TNO

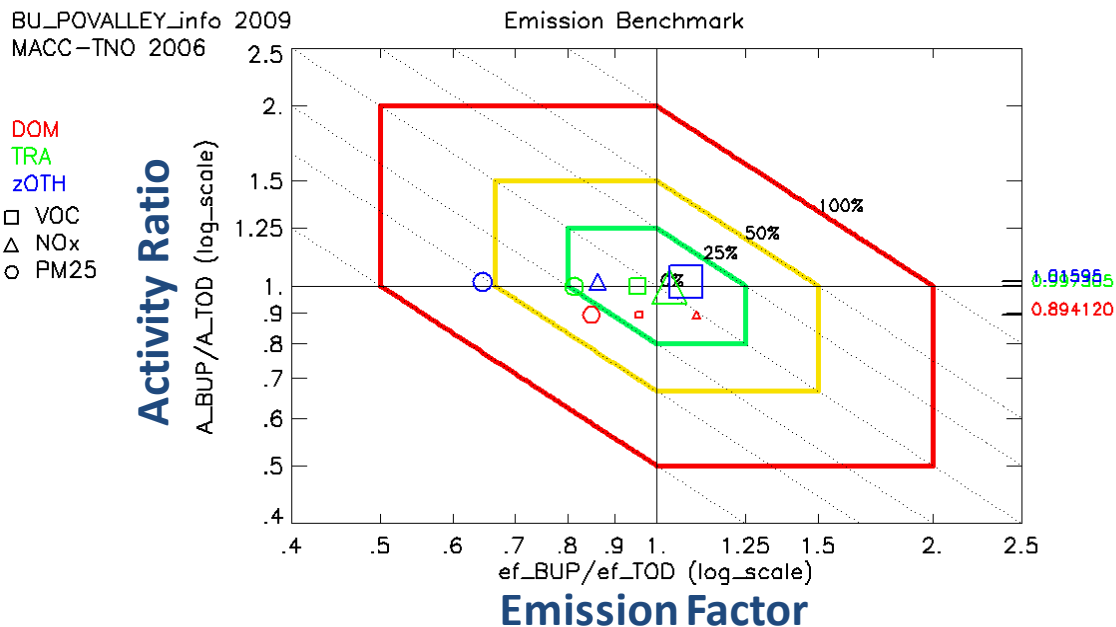


# Example: PO Valley Diamond diagram

EC4MACS



MACC-TNO



City



Region



Difference  
TD - BU

The chosen city has per capita  
Emission larger than 80% of EU  
cities and overestimates by  
25% the TD value.

50%

25%

-25%

-50%

25%

50%

75%

EU city/Region  
percentile



Again symbol can be made color (sector)  
and shape (pollutant) specific

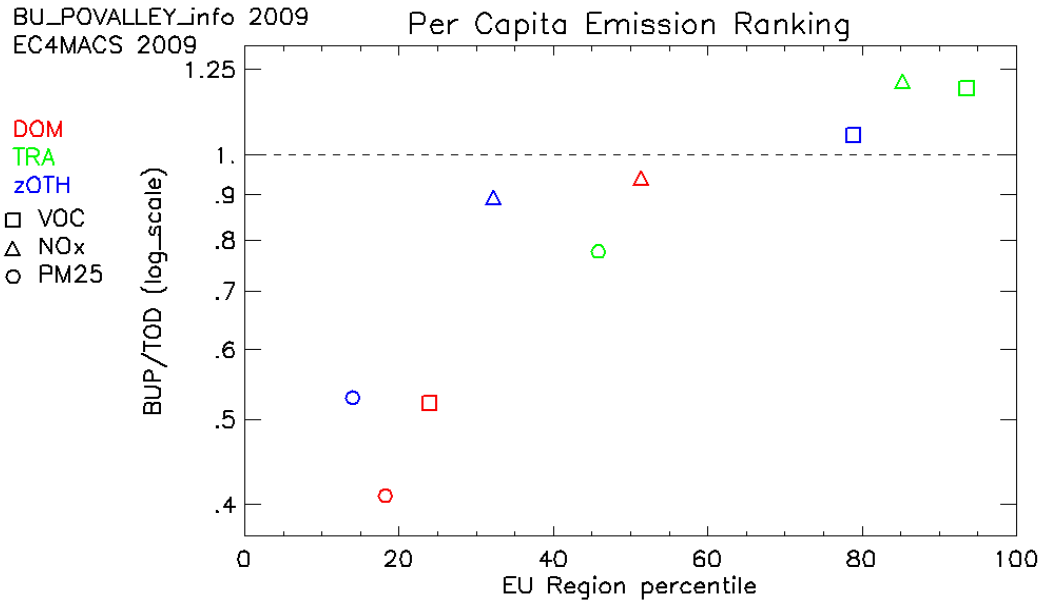


$$\left\{ \frac{E_{TD}^{m^u, p}}{pop} \right\}$$

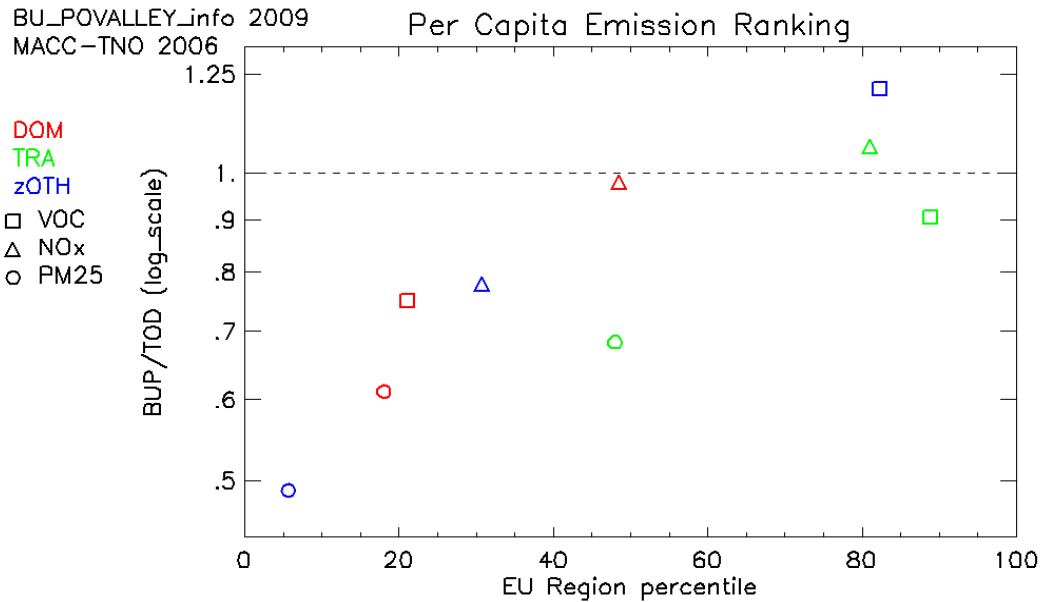
$$\left\{ \frac{E_{TD}^{m^u, p}}{pop} \right\}$$

# Example: PO Valley

EC4MACS



MACC-TNO



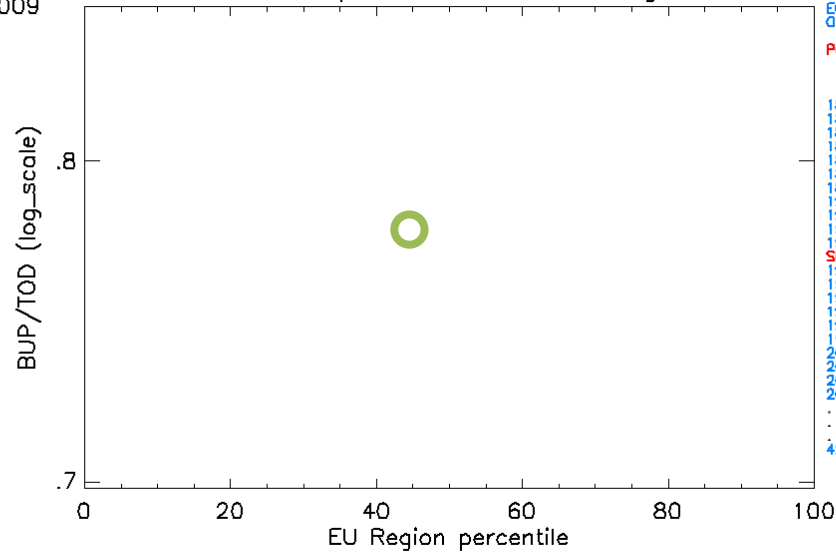
# Example: PO Valley

EC4MACS

BU\_POVALLEY\_info 2009  
EC4MACS 2009

Per Capita Emission Ranking

TRA  
○ PM25



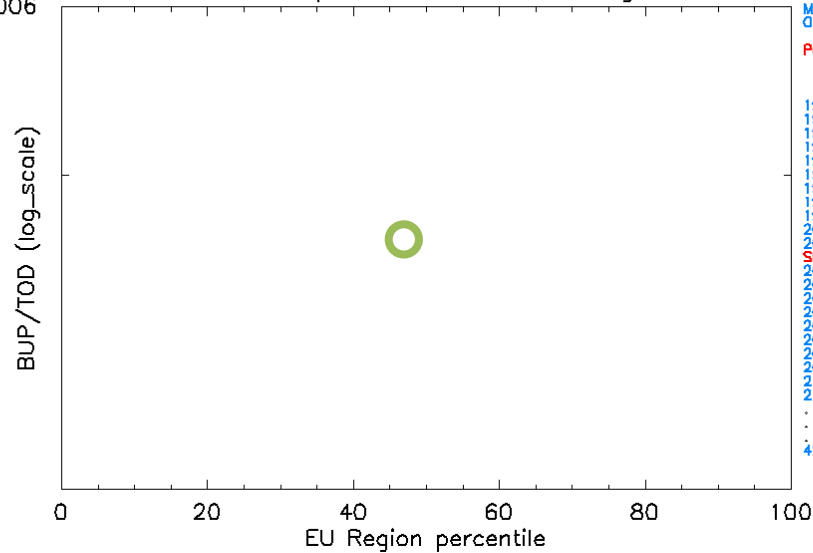
```
EC4MACS_TD
ORDERED_REGIONS
> Percentile
POP_SHAPE = 23772 KP
.
.
183 ESP-VLN => 43.4679
184 HUN-BRN => 43.7055
185 AUT-NDR => 43.9430
186 DNK-SIR => 44.1805
187 DNK-RIB => 44.4181
188 PRT-VIS => 44.6556
189 HRV-HRV => 44.8931
190 POL-KTW => 45.1306
191 PRT-BRG => 45.3682
192 ROM-ALB => 45.6057
193 BEL-HW => 45.8432
SHAPE_BI => 45.8432 th%
194 DNK-VST => 46.0808
195 ITA-LAZ => 46.3183
196 FRA-ALS => 46.5558
197 HUN-NGR => 46.7934
198 POL-JGO => 47.0309
199 ITA-SRD => 47.2684
200 NOR-NRD => 47.5059
201 POL-KRK => 47.7435
202 POL-SOL => 47.9810
203 POL-SZC => 48.2185
.
.
421 ...
```

MACC-TNO

BU\_POVALLEY\_info 2009  
MACC-TNO 2006

Per Capita Emission Ranking

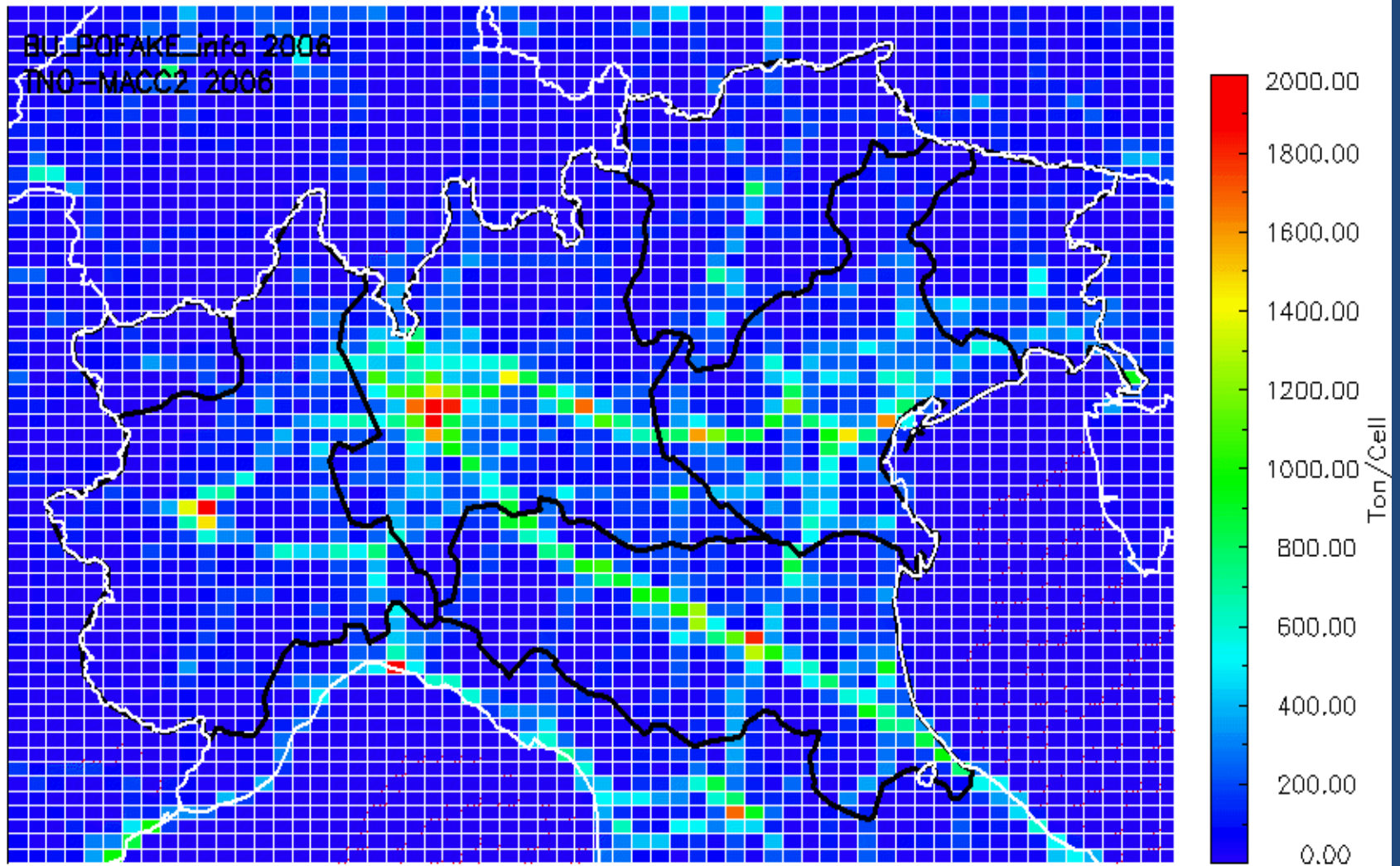
TRA  
○ PM25



```
MACC-TNO_TD
ORDERED_REGIONS
> Percentile
POP_SHAPE = 23772 KP
.
.
191 NLD-NBR => 45.3682
192 POL-ELB => 45.6057
193 SVK-VYC => 45.8432
194 DEU-THR => 46.0808
195 FRA-NPC => 46.3183
196 CYP-LNS => 46.5558
197 CZE-SVM => 46.7934
198 DEU-RPF => 47.0309
199 POL-KSZ => 47.2684
200 ITA-CMP => 47.5059
201 NLD-UTR => 47.7435
SHAPE_BI => 47.9810 th%
202 ALB-FIE => 47.9810
203 PRT-FAR => 48.2185
204 NOR-AKR => 48.4561
205 PRT-STB => 48.6936
206 NOR-VAG => 48.9311
207 DEU-SCA => 49.1686
208 ALB-MRD => 49.4062
209 ITA-CLB => 49.6437
210 PRT-AVE => 49.8812
211 POL-LSZ => 50.1188
.
.
421 ...
```



# Example: PO Valley



# Tool has been applied to

## **BOTTOM-UP**

### **8 cities:**

Antwerp  
Barcelona  
London  
Lisbon  
Milan  
Oslo  
Porto  
Sofia

### **5 regions:**

Alsace  
Antwerp Prov.  
Catalonia  
Flanders  
Po Valley  
Strasbourg

**10 countries: in EU**

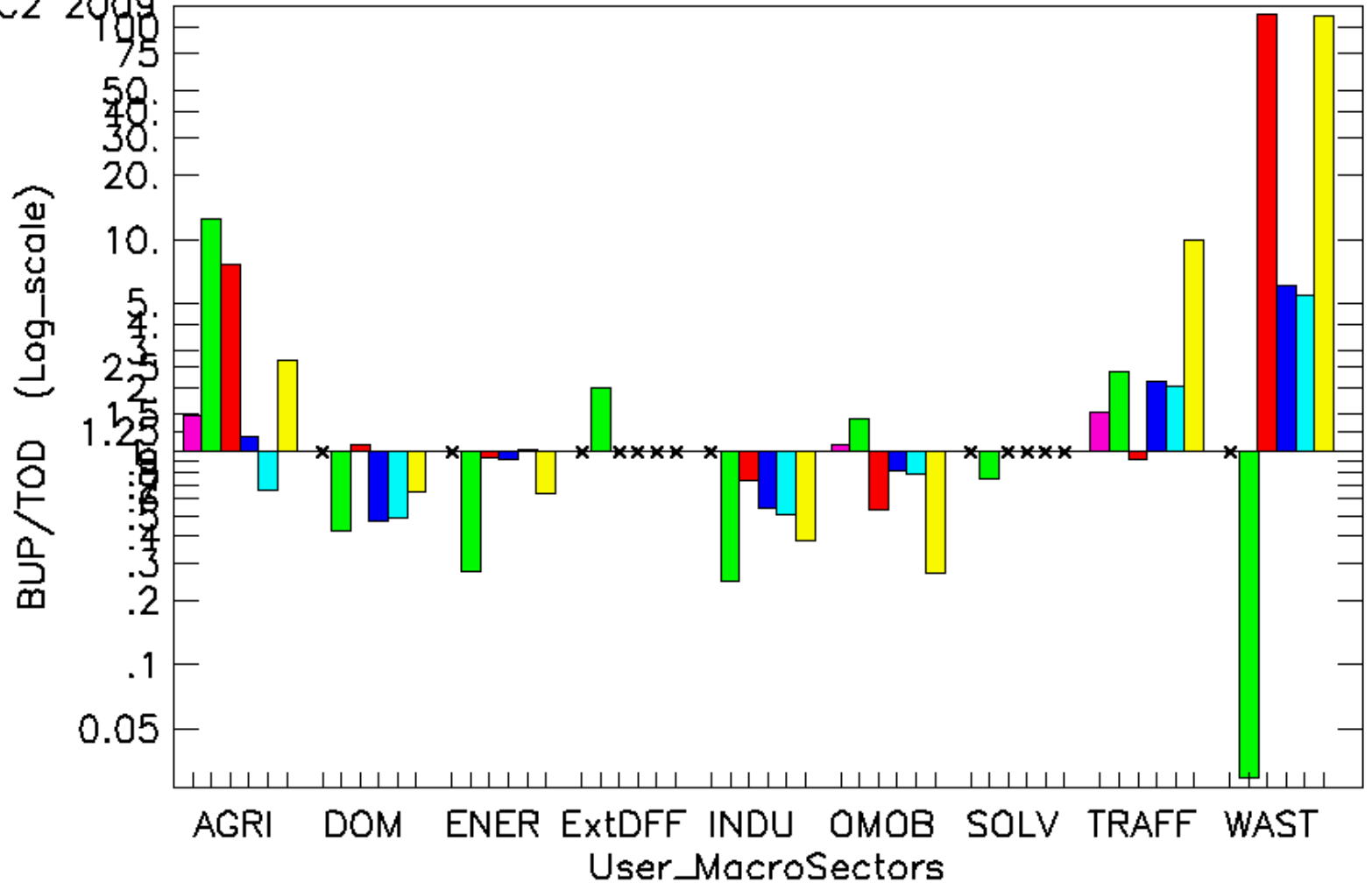
# Barcelona Region

BU\_BarcelonaRegionBSC 2009

Emission BUP/TOD

TNO-MACC2 2009

- NH3
- VOC
- NOx
- PM10
- PM25
- SO2
- x NaValue



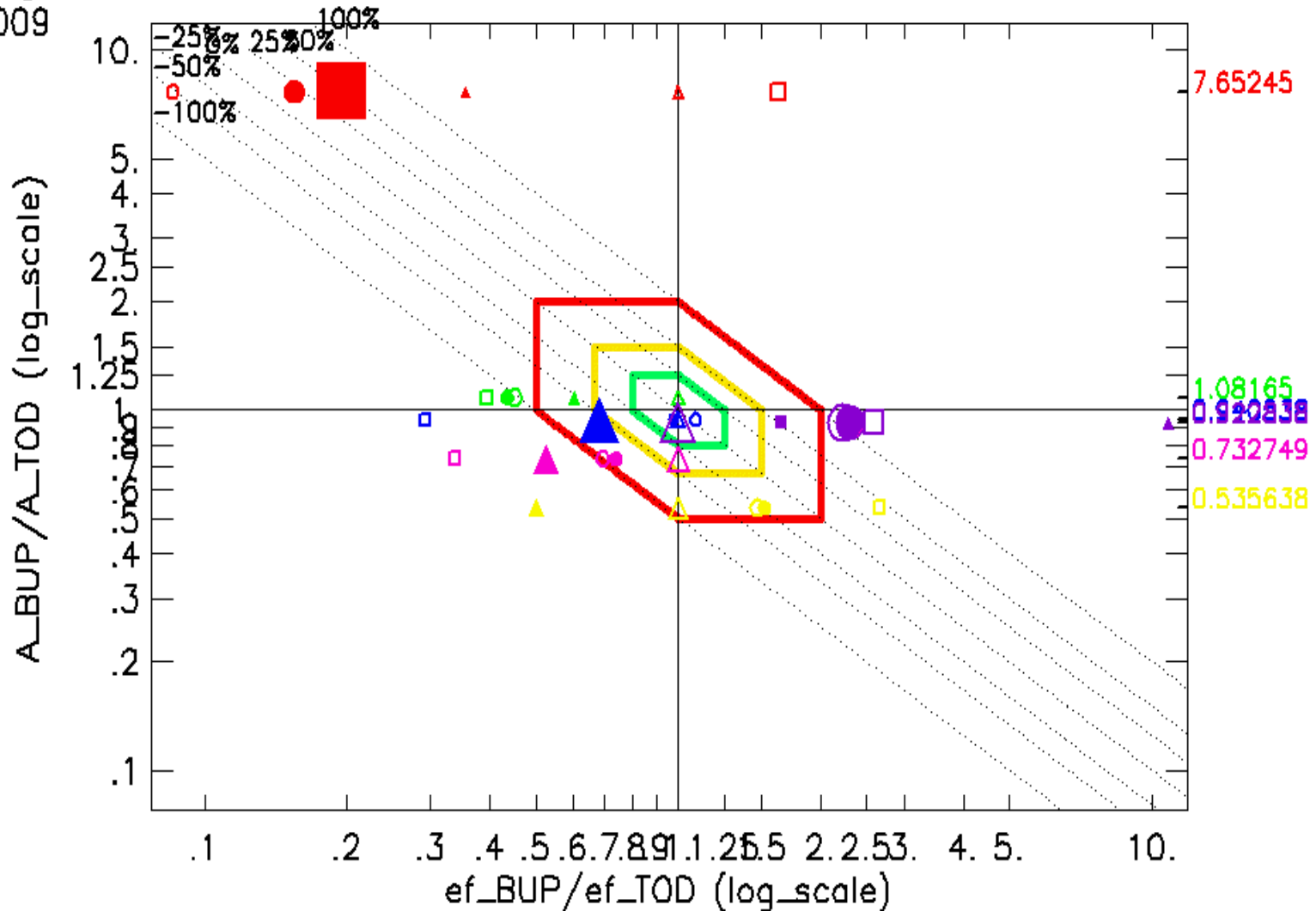
# Barcelona Region

BU\_BarcelonaRegionBSC 2009  
TNO-MACC2 2009

Emission Benchmark

AGRI  
DOM  
ENER  
ExtDFF  
INDU  
OMOB  
SQLV  
TRAFF  
WAST

■ NH3  
□ VOC  
△ NOx  
● PM10  
○ PM25  
▲ SO2



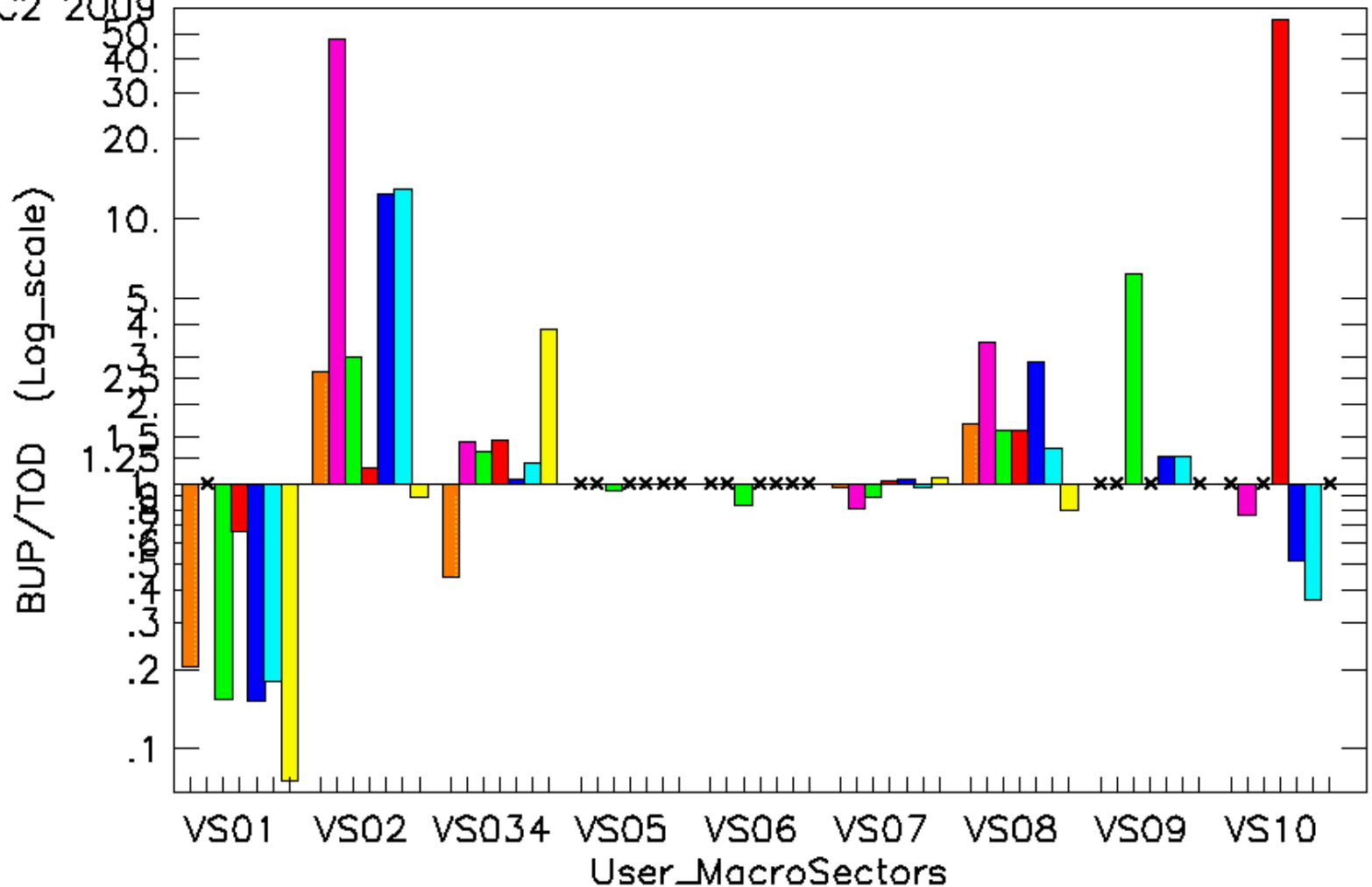
# Antwerp Province

BU\_AntwerpProvVITO\_info 2011

Emission BUP/TOD

TNO-MACC2 2009

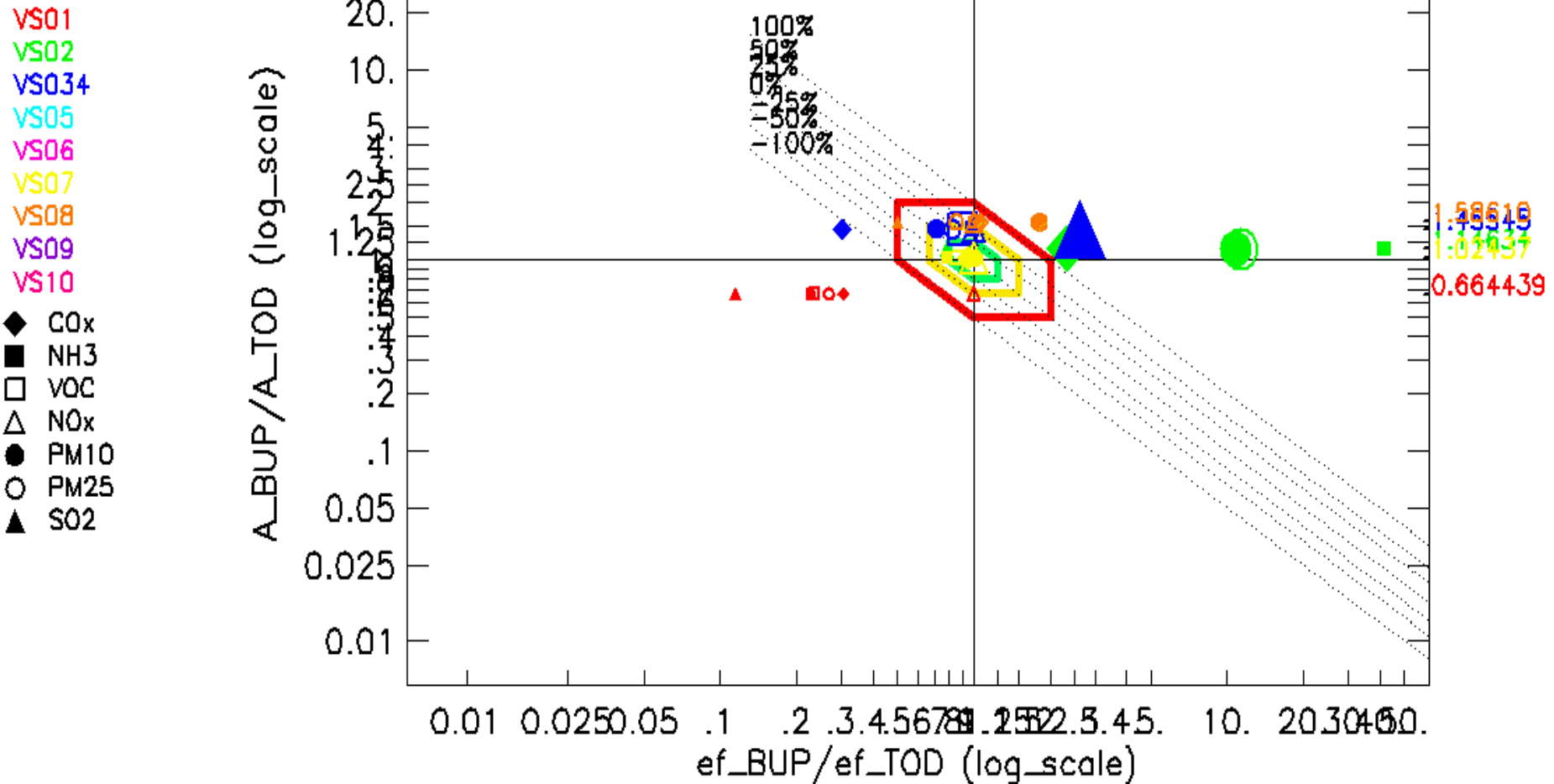
- COx
- NH3
- VOC
- NOx
- PM10
- PM25
- SO2
- x NoValue



# Antwerp Province

BU\_AntwerpProvVITO\_info 2011  
TNO-MACC2 2009

Emission Benchmark

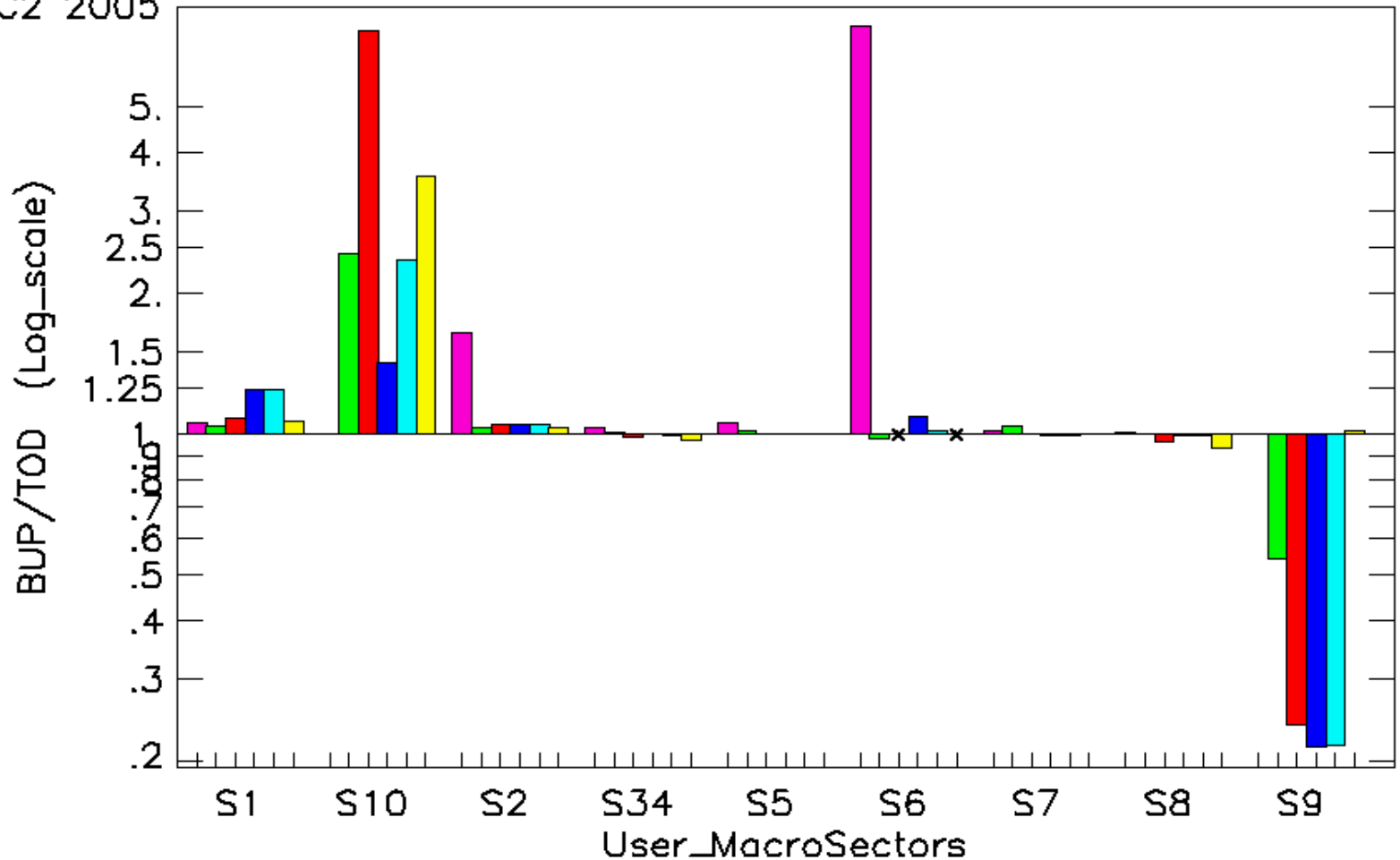


# TOD vs TOD → MACC2 vs MACC3 Italy

BU\_TNO-MACC3\_ITA-2005\_info 2005  
TNO-MACC2 2005

Emission BUP/TOD

NH3  
VOC  
NOx  
PM10  
PM25  
SO2  
x NaValue



# Summary

- **Tool for screening and comparing Emission inventories: TOD vs BUP, TOD vs TOD**
- **Shows the basic characteristics of inventories  
Graphical representations, Data dumps**
- **Easy to install (after download: 1-click)  
idl based – no license needed**
- **Windows, Linux, and Mac versions**
- **Easy to use**



# Publications:

**A benchmarking tool to screen and compare bottom-up and top down emission inventories**

M. Guevara<sup>1</sup>, S. Lopez-Aparicio<sup>2</sup>, C. Cuvelier<sup>3</sup>, L. Tarrason<sup>2</sup>, A. Clappier<sup>4</sup> and P. Thunis<sup>5</sup>

**A novel approach to screen and compare bottom-up vs. top-down emission inventories**

P. Thunis<sup>1</sup>, B. Degraeuwe<sup>1</sup>, C. Cuvelier<sup>2</sup>, M. Guevara<sup>3</sup>, L. Tarrason<sup>4</sup> and A. Clappier<sup>5</sup>

# WebSite:

<http://fairmode.jrc.ec.europa.eu/>

**Register – Tool freely available**