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
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.
• 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

**WG1 Assessment**
- S. Janssen
- P. Thunis

**WG2 Emissions**
- L. Tarrason
- J. Lumbreras

**WG3 Source App.**
- C. Belis
- G. Pirovano

**WG4 Planning**
- A. Clappier
- P. Thunis

- **Benchmarking (Methodology)**
- **Guidelines & Guidance**
- **Capacity Building and communication**

**CCA Spatial Repres.**
- O. Kracht

**CCA Forecasting**
- F. Meleux

**CCA Monit. & Model.**
- A. Miranda
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
<table>
<thead>
<tr>
<th>Shape</th>
<th>lon</th>
<th>lat</th>
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<th>Region</th>
<th>3.29</th>
<th>3.55</th>
<th>0.1</th>
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<td>42.4</td>
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<tr>
<td>lat</td>
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<table>
<thead>
<tr>
<th>Year</th>
<th>BU sectors abbreviation</th>
<th>BU sectors nomenclature</th>
<th>Correspondance with SNAP</th>
<th>Total [kTon]</th>
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</tr>
<tr>
<td>NOx</td>
<td>DOM</td>
<td>Domestic</td>
<td>S2</td>
<td>30</td>
</tr>
<tr>
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<td>Traffic</td>
<td>S7</td>
<td>300</td>
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<tr>
<td></td>
<td>zOTH</td>
<td>Others</td>
<td>S1+S4+S5+S6+S7+S8+S9+S10</td>
<td>116</td>
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<tr>
<td>PM25</td>
<td>DOM</td>
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<td>Traffic</td>
<td>S7</td>
<td>11</td>
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<tr>
<td></td>
<td>zOTH</td>
<td>Others</td>
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<td>12</td>
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<tr>
<td>VOC</td>
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<td>S2</td>
<td>25</td>
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<td>TRA</td>
<td>Traffic</td>
<td>S7</td>
<td>140</td>
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<tr>
<td></td>
<td>zOTH</td>
<td>Others</td>
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<td>350</td>
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<tr>
<td>END</td>
<td></td>
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</table>

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 Ratio Plot

EC4MACS

MACC-TNO
Example: PO Valley Diamond diagram

**EC4MACS**

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

\[ \frac{E_{TD}^{m_u,p}}{pop} \]

Again symbol can be made color (sector) and shape (pollutant) specific.
Example: PO Valley

EC4MACS

MACC-TNO
Example: PO Valley

**EC4MACS 2009**

- **BU_POVALLEY_info**
- **EC4MACS 2009**

**MACC-TNO 2006**

- **BU_POVALLEY_info**
- **MACC-TNO 2006**

Per Capita Emission Ranking

BU/P/TOD (log-scale)

EU Region percentile

**EC4MACS_TO**

ORDERED_REGIONS

POP_SHAPE = 23772 km²

183 ESP-VLC => 43.1479
184 HUN-BPH => 43.7026
185 AUT-INDR => 43.9490
186 DNK-STR => 44.1805
187 DNK-RBH => 44.1811
188 FIN-VKS => 44.4665
189 FIN-VRV => 44.6531
190 POL-IJV => 44.7084
191 PRT-BRG => 45.3682
192 RUS-ALB => 45.6057
193 BEL-XAI => 45.6341

**MACC-TNO_TO**

ORDERED_REGIONS

POP_SHAPE = 23772 km²

161 NLD-NBR => 45.3662
162 POL-ELB => 45.6057
163 SVK-VVC => 45.9432
164 DEU-NIR => 46.0608
165 FIN-NHR => 46.3181
166 CYP-LNS => 46.5535
167 CYP-SNM => 46.7034
168 DEU-NIR => 47.0039
169 POL-PST => 47.1884
200 ITA-CUP => 47.5059
201 NLD-UFR => 47.7335

SHAPE_BU => 47.9810 km²

202 HUN-VPA => 47.9910
203 PRI-FAR => 48.2185
204 HUN-NBR => 48.4661
205 PRI-STG => 48.6535
206 ORP-VAG => 48.6681
207 DVL-SPA => 48.6666
208 ALB-ANB => 48.6683
209 ITA-CIG => 49.6437
310 PRI-AVE => 49.8972
311 POL-LSZ => 50.1188

421 ...
Tool has been applied to

<table>
<thead>
<tr>
<th>BOTTOM-UP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8 cities:</strong></td>
</tr>
<tr>
<td>Antwerp</td>
</tr>
<tr>
<td>Barcelona</td>
</tr>
<tr>
<td>London</td>
</tr>
<tr>
<td>Lisbon</td>
</tr>
<tr>
<td>Milan</td>
</tr>
<tr>
<td>Oslo</td>
</tr>
<tr>
<td>Porto</td>
</tr>
<tr>
<td>Sofia</td>
</tr>
<tr>
<td><strong>5 regions:</strong></td>
</tr>
<tr>
<td>Alsace</td>
</tr>
<tr>
<td>Antwerp Prov.</td>
</tr>
<tr>
<td>Catalonia</td>
</tr>
<tr>
<td>Flanders</td>
</tr>
<tr>
<td>Po Valley</td>
</tr>
<tr>
<td>Strasbourg</td>
</tr>
</tbody>
</table>

**10 countries**: in EU
Barcelona Region

BU_BarcelonaRegionBSC 2009
TNO-MACC2 2009

Emission BUP/TOD

NH3
VOC
NOx
PM10
PM25
SO2
x NaValue

BUP/TOD (Log-scale)

AGRI   DOM   ENER   ExtDFF   INDU   OMOB   SOLV   TRAFF   WAST

User_MacroSectors
Barcelona Region
Antwerp Province
Antwerp Province
TOD vs TOD → MACC2 vs MACC3

Italy
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. Guevara¹, S. Lopez-Aparicio², C. Cuvelier³, L. Tarrason², A. Clappier⁴ and P. Thunis⁵

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

P. Thunis¹, B. Degraeuwe¹, C. Cuvelier², M. Guevara³, L. Tarrason⁴ and A. Clappier⁵

WebSite:

http://fairmode.jrc.ec.europa.eu/
Register – Tool freely available