



FAIRMODE WG7

## WG7 – High resolution emission inventories

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# Background - WG7

- Best – practise through QA/QC

Identifying best practices through **QA/QC approaches and drafting recommendations** for the compilation of **sectorial high resolution emission inventories** that are relevant at the urban scale.

- Metadata recommendation

Elaborating recommendations for a common system to **document the use of ancillary data and define the relevant meta-data** that support each emission inventory at the urban scale.

- Provide relevant feedback

To European inventories used for **regulatory purposes** (EMEP, CAMS-REG) and **research project** (e.g., REMI, RI-URBANS, NordicWelfAir, “Others”).

- Benchmarking and Emission dashboard

**Benchmarking and creating an emission dashboard** (EU, bottom-up national and local inventories) to monitor progress and identify inconsistencies among inventories. Regular inter-comparisons will be carried out to support this objective.

- Use of Composite mapping platform

i) as **spatial information** support to evaluate specific sectors/ topics identified as inconsistency by the dashboard;  
ii) to carry out **emission evaluation** in relation with activities of the composite mapping for **assessment purposes**

# Activities in 2024

- Best – practise through QA/QC

Identifying best practices through QA/QC approaches and drafting recommendations for the compilation of sectorial high resolution emission inventories that are relevant at the urban scale.

- Metadata recommendation

Elaborating recommendations for a common system to document the use of ancillary data and define the relevant meta-data that support each emission inventory at the urban scale.

- Provide relevant feedback

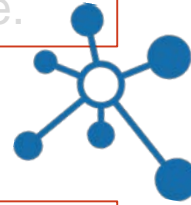
To European inventories used for regulatory purposes (EMEP, CAMS-REG) and research project (e.g., REMI, RI-URBANS, NordicWelfAir, “Others”).

- Benchmarking and Emission dashboard

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- Use of Composite mapping platform

i) as spatial information support to evaluate specific sectors/ topics identified as inconsistency by the dashboard;  
ii) to **carry out emission evaluation** in relation with activities of the composite mapping for assessment purposes



# Plenary Meeting programme

- Composite mapping of emissions: progress and current status
- Composite mapping exercise: workshop proposal
- (brief) example on the usage of the tool: Catalonia region
- Points for discussion



# Composite mapping of emissions



**Aim:** In addition to annual gridded concentration, we aim at assessing and comparing the underlying emissions to set up the basis for best-practices and recommendations for the compilation of emission inventories.



**What it is needed:** Annual emissions aggregated over pre-defined spatial areas (**non-gridded**):

- NUTS3 that are covered by the modelling domain
- predefined local areas; e.g., FUA (Functional Urban Area – a city and its commuting zone)



**How:** the screening methodology follows Thunis et al. (2022) to flag main inconsistencies when compared with EU wide inventories.



**Output:** Identification of inconsistencies at i) pollutant; ii) sector; iii) type (national, sector share, spatial distribution) levels



# Composite mapping of emissions

**FAIRMODE**

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Home > About the European Commission > EC Science Hub > FAIRMODE

### News

02/2023 Check-out the [Guidance document on the estimation of Spatial Representativeness and of Exceedance Situation Indicator](#)

< Previous | Next >

### Meetings

**26-27 FEBRUARY 2024**

The next FAIRMODE "PLENARY MEETING" will take place in Paris (FR)

[Agenda](#) [Logistics](#) [Register >](#)

View all the past meetings from 2008 with agendas, presentations and minutes

[Past meetings >](#)

### The initiative

The Forum for Air quality Modeling (FAIRMODE) was launched in 2007 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 modelers 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 [\[More...\]](#)

### Activities

**WG1** Source apportionment to support AQ management

**WG2** QA/QC of AQ assessment applications

**WG3** Quality control indicators for AQ forecasts

**Recent Activities & Revised Approaches**

[Recommendations >](#)

**About FAIRMODE**

[Terms of Reference >](#)

[Steering committee >](#)

[National Experts >](#)

[Roadmap >](#)

[Strategy >](#)

[Forum >](#)

**Guidance**

[Assessment >](#)

[Planning >](#)

**Tools**

[Δ - Delta Benchmarking >](#)

[SHERPA >](#)

[ECMap - Emission >](#)

[ECMap - Concentration >](#)

[ECMap - Database >](#)

- Opened and accessible from the FAIRMODE webpage
- Link circulated among WG7 participants (December 2023)

The screenshot shows the FAIRMODE web application interface. The top navigation bar includes 'FAIRMODE' and 'EU Composite Maps: pageEmisEval'. Below the navigation bar, there are several tool options: 'Switch to Free', 'Bottom Up', 'Left inventory: camx\_v01-v21\_2019', 'Bottom Up', 'Right inventory: AMS MINNI\_ENEA\_2019...', and 'Plot'. The 'Plot' section includes 'Min Emis. Const.' (0.50), 'Incom. Threshold' (2.00), and 'Limit to Main Country'. A large blue box in the center of the map area says '...waiting for selection...'. The map on the right shows Europe with various countries labeled. The bottom of the page has the European Commission logo and 'European Commission' text.



# Composite mapping of emissions

**FAIRMODE**  
Forum for air quality modeling in Europe

EU Composite Maps: pageEmisEval

Poly Type: NUTS2016

Switch to Free

Bottom Up / Top Down: Top Down

Left Inventory: cams\_v61-v21\_2019

Bottom Up / Top Down: Top Down

Right Inventory: AMS-MINNI\_ENEA\_2019...

Plot

Min Emis. Consid. 0.50

Incons. Threshold 2.00

Limit to Main Country

Horizontal resolutions available:

- NUTS
- FUA

Regional/global inventories available:

- EMEPv10 (2018)
- CAMS-REG-APv6.1-Ref2.1 (2019)
- EDGARv6 (2018)

Spatialisation Inconsistencies

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European Commission



# Composite mapping of emissions

Active iteration and testing process to go from first version to current version

Which plot is more relevant/should be showed first?







# Composite mapping of emissions

## Update guidance document to better describe input data requirements

### WG7 – Compilation of high resolution emission inventories

● Leaders

● More information

● Distribution list

S.Lopez-Aparicio (NILU)  
M.Guevara (BSC)

Contact us

Join

#### Description

The focus of this WG is on the compilation of high resolution emissions to be used as basis for air quality modelling applications at urban/local scales. This is because such compilation is not fully covered by the EMEP/EEA emission inventory guidebook, which focus on national emission totals, and therefore follows uneven practices across Europe, sometimes following approaches that are systematically different from those of emission compilation at national level. One of the main aims is to provide recommendations on the necessary steps to document and compile these emission inventories to support air quality assessments and the elaboration of national and local plans and programmes under EU legislation. Future activities will focus on:

- 1 Identifying best practices through QA/QC approaches and drafting recommendations for the compilation of sectorial high resolution emission inventories that are relevant at the urban scale.
- 2 Elaborating recommendations for a common system to document the use of ancillary data and define the relevant meta-data that support each emission inventory at the urban scale. The metadata recommendations will provide a common documentation framework to better understand the differences between inventories. Tests will be performed to assess the feasibility of reporting emission metadata for assessment and planning based on a simpler approach.
- 3 Benchmarking and creating an emission dashboard (based on available downscaled EU inventories; e.g. CAMS, and bottom-up national and local inventories) to monitor progress and identify inconsistencies among inventories. Regular inter-comparisons will be carried out to support this objective.
- 4 Using the Composite Mapping platform (1) as spatial information support to evaluate specific sectors/ topics identified as inconsistency by the dashboard and (2) to carry out emission evaluation in relation with activities of the composite mapping for assessment purposes
- 5 Providing relevant feedback to improve European inventories used for regulatory purposes in the context of EMEP, CAMS-REG and/or European research projects (e.g. RI-URBANS).

#### Related Documents

[FAIRMODE joint mapping benchmark exercise WG2 & WG7: Composite mapping of MQI and underlying emissions](#)

Recent Activities & Revised Approaches

Recommendations >

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ECMap - Database >

### Annex: Additional information regarding the upload of spatially aggregated emissions

The template for reporting emissions (either over NUTS3 or over FUA) is shown below. The output to be uploaded in the [composite mapping platform](#) should be one unique csv file (one for NUTS3 and one for FUA) containing emissions (expressed in kTons) for all sectors and pollutants mentioned in Table 3. It is important to use the following naming nomenclature:

Pollutants: PM2\_5, PM10, NOX, NMVOC, SO2, NH3

Sectors: GNFRAB, GNFRFC, GNFRD, GNFRE, GNFRG, GNFRHI, GNFRJ, GNFRKL

NUTS_ID/FUA_ID(*)	CNTR_CODE	NAME_LATN	POLLUTANT	YEAR	SECTOR	EMIS(kTons)
DE249	DE	Hof, Landkreis	NOX	2017	GNFRF	21586.23
AT311	AT	Innviertel	PM2_5	2017	GNFRIH	18000.01

(\*) NUTS\_ID for the NUTS3 csv file and FUA\_ID for the FUA csv file



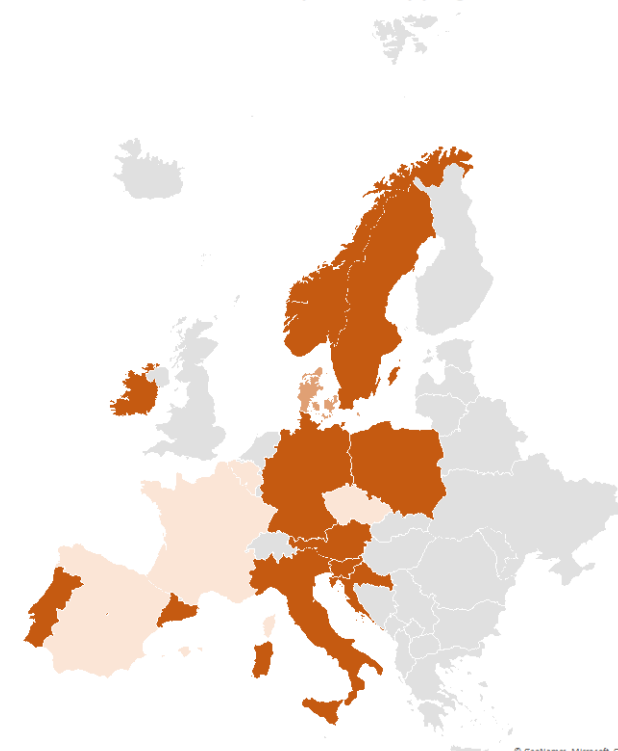
# Composite mapping of emissions

Increased number of contributors (thanks to all of you!)

Status by 27th February

Region or country	Contact	EMISSIONS	CONCENTRATION
🏠 Austria	Claudia Flandorfer		
🏠 Belgium	Frans Fierens		
🏠 Czech Republic	Nina Benesova		
🏠 Croatia	Milic Velimir		
🏠 Denmark	Matthias Ketznel		
🏠 France	Elsa Real		
🏠 Germany	Stephan Nordmann		
🏠 Republic of Ireland	Kate Johnson		
🏠 Italy	Antonio Piersanti		
🏠 Madrid	Rafael Borge		
🏠 Norway	Bruce Denby		
🏠 Norway	Susana Lopez-Aparicio		
🏠 Poland	Pawel Durka		
Po Valley, Italy	Michele Stortini		
🏠 Slovenia	Luka Matavz		
🏠 Spain	Mark Theobald		
🏠 Catalonia	Marc Guevara		
🏠 Portugal	Diogo Lopea		
🏠 Sweden	Helen Alpfjord		

Emissions - delivered for the Composite Mapping



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# Composite mapping of emissions

<https://doi.org/10.5194/egusphere-2023-1257>

Preprint. Discussion started: 28 August 2023

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- 1 Emission ensemble approach to improve
- 2 the development of multi-scale emission
- 3 inventories

4  
5 Philippe Thunis<sup>1</sup>, Jeroen Kuenen<sup>2</sup>, Enrico Pisoni<sup>1</sup>, Bertrand Bessagnet<sup>1</sup>, Manjola Banja<sup>1</sup>, Lech  
6 Gawuc<sup>3</sup>, Karol Szymankiewicz<sup>3</sup>, Diego Guizardi<sup>1</sup>, Monica Crippa<sup>1,4</sup>, Susana Lopez-Aparicio<sup>5</sup>,  
7 Marc Guevara<sup>6</sup>, Alexander De Meij<sup>7</sup>, Sabine Schindlbacher<sup>8</sup>, Alain Clappier<sup>9</sup>  
8

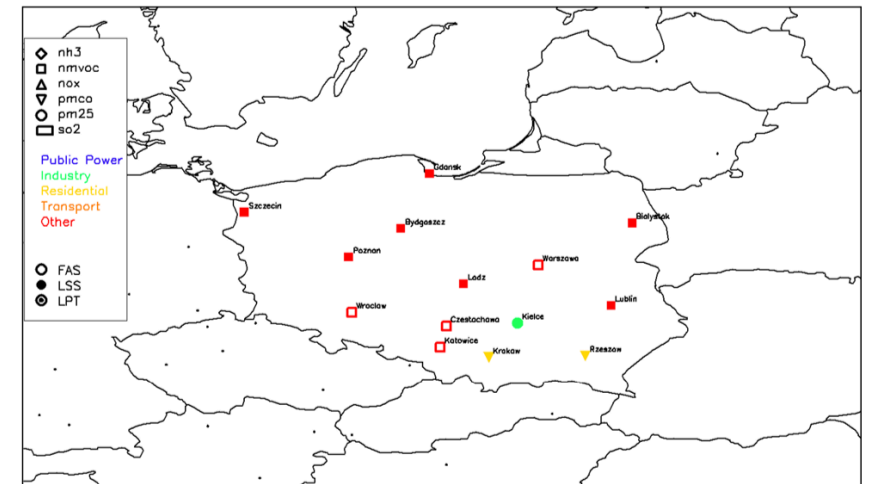


Figure 8: overview of inconsistencies for the comparison between local emission inventory in Poland and the Europe wide emission inventory ensemble

*The authors addressed the reviewer's comments adequately, so the paper can be published once the remaining minor issues are addressed.*



# Composite mapping exercise

Workshop proposal:

- **Who:** People who are responsible for the development of the uploaded emissions
- **When:** End of April 2024
- **How:** Online (ensure the participation of key people)
- **What:** Fill in a template that WG7 will distribute before the workshop (homeworks!), in which we will propose a guided exercise
  - What are the main inconsistencies found?
  - Do you find the same inconsistencies in CAMS-REG and EMEP?
  - Do you find the same inconsistencies in NUTS and FUA?
  - Are these inconsistencies expected?
  - Can we explain them?
  - What are the main lessons learned?
- **Why:** Identify reasons behind relevant inconsistencies, correct (some of) them, identify best practices, provide feedback to EU wide emission inventories



# Composite mapping exercise

Organisation of a webinar (previous to the workshop) on how to use the tool and interpret the results

The interface includes a control panel on the left with the following elements:

- Poly Type: NUTS2016
- Switch to Free
- Bottom Up / Top Down toggle (Top Down selected)
- Left Inventory: cams\_v61-v21\_2019
- Right Inventory: HERMES\_BSC\_2019\_(A...)
- Plot button
- Min Emis. Consid. slider at 0.50
- Incons. Threshold slider at 2.00
- Limit to Main Country toggle (checked)
- Status Bar and switch toggle

Three bar charts are displayed:

- (LPT) Country Pollutant Total:** Shows r\_LPT for ES (PM2.5) at 1.66. A red box highlights 'cams\_v61-v21\_2019' and a blue box highlights 'HERMES\_BSC\_2019\_(ALL)\_ES\_CATALONIA'.
- (LSS) Country Sectorial Share:** Shows Inconsistency Ratio for ES (PMCO TRANS) at 3.81. A red box highlights 'cams\_v61-v21\_2019' and a blue box highlights 'HERMES\_BSC\_2019\_(ALL)\_ES\_CATALONIA'.
- (FAS) Spatialisation:** Shows Inconsistency Ratio for ES511 Barcelona (PM2.5 RESID) at 2.41, ES513 Lleida (PM2.5 RESID) at 2.86, and ES512 Girona (SO2 PP\_IND) at 3.3. A red box highlights 'cams\_v61-v21\_2019' and a blue box highlights 'HERMES\_BSC\_2019\_(ALL)\_ES\_CATALONIA'.

Legend for POLLUTANT:

- NH3 (blue diamond)
- NMVOC (blue circle)
- NOX (blue square)
- PM2.5 (blue star)
- SO2 (blue pentagon)
- PMCO (blue triangle)

Legend for SECTOR:

- PP\_IND (purple square)
- RESID (pink square)
- FUGI (blue square)
- SOLV (cyan square)
- TRANS (green square)
- SHIP (dark green square)
- OTH\_TRA (yellow square)
- WASTE (orange square)
- AGRI (red square)

A map of Europe is shown on the right, titled 'Spatialisation Inconsistencies', with a red question mark over the Iberian Peninsula. The map includes a search bar, zoom controls, and a scale bar (300 km / 200 mi).



# Example: Catalonia (Spain)

Poly Type: NUTS2016

Switch to Free

Bottom Up / Top Down  
Left Inventory: cams\_v61-v21\_2019

Bottom Up / Top Down  
Right Inventory: HERMES\_BSC\_2019\_ (A...

Plot

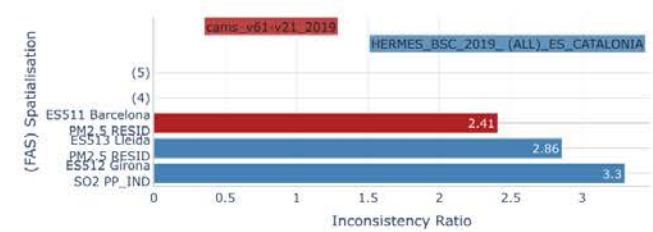
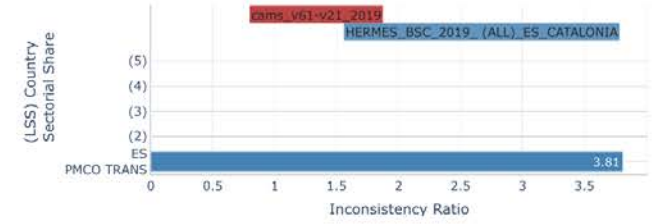
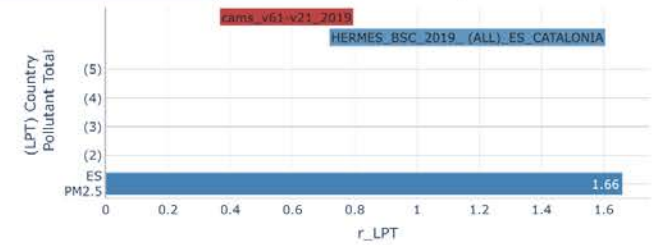
Min Emis. Consid. 0.50

Incons. Threshold 2.00

Limit to Main Country

Status Bar  
switch toggle

Priority Inconsistencies | All Inconsistencies overview | Diamond diagram



- POLLUTANT
- NH3
  - NMVOC
  - NOX
  - PM2.5
  - SO2
  - PMCO

- SECTOR
- PP\_IND
  - RESID
  - FUGI
  - SOLV
  - TRANS
  - SHIP
  - OTH\_TRA
  - WASTE
  - AGRI





# Example: Catalonia (Spain)

Poly Type: NUTS2016

Switch to Free

Bottom Up / Top Down (Left Inventory): cams\_v61-v21\_2019

Bottom Up / Top Down (Right Inventory): HERMES\_BSC\_2019\_ (A...)

Plot

Min Emis. Consid. 0.50

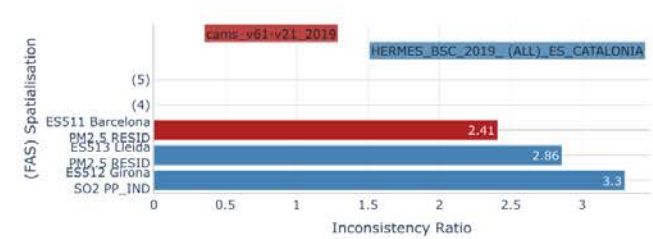
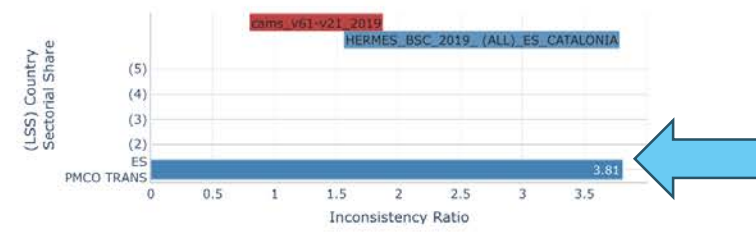
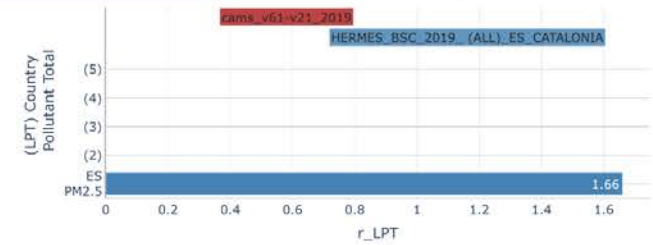
Incons. Threshold 2.00

Limit to Main Country

Status Bar

switch toggle

Priority Inconsistencies | All inconsistencies overview | Diamond diagram



- POLLUTANT
- NH3
  - NMVOC
  - NOX
  - PM2.5
  - SO2
  - PMCO

- SECTOR
- PP\_IND
  - RESID
  - FUGI
  - SOLV
  - TRANS
  - SHIP
  - OTH\_TRA
  - WASTE
  - AGRI



**Expected: Inclusion of resuspension emissions in HERMES (not reported in official inventories, used as a basis in CAMS-REG)**



# Example: Catalonia (Spain)

Poly Type: NUTS2016

Switch to Free

Bottom Up / Top Down  
Left Inventory: cams\_v61-v21\_2019

Bottom Up / Top Down  
Right Inventory: HERMES\_BSC\_2019\_(A...)

Plot

Min Emis. Consid. 0.50

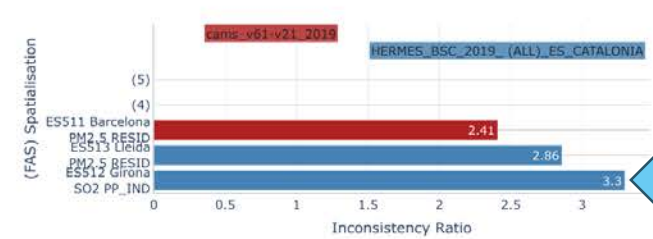
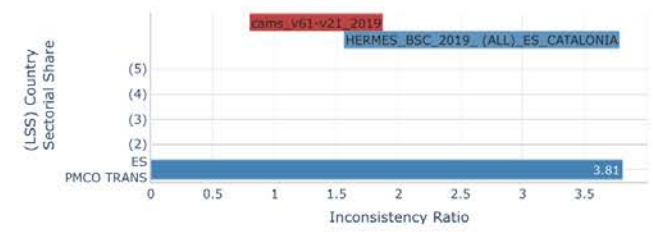
Incons. Threshold 2.00

Limit to Main Country

Status Bar

switch toggle

Priority Inconsistencies | All Inconsistencies overview | Diamond diagram



- POLLUTANT
- NH3
- NMVOC
- NOX
- PM2.5
- SO2
- PMCO

- SECTOR
- PP\_IND
- RESID
- FUGI
- SOLV
- TRANS
- SHIP
- OTH\_TRA
- WASTE
- AGRI



**ES512 Girona**

Sector : PP\_IND  
 Pollutant : SO2  
 "Country" scale (E) : 0.20 (1.59)  
 Spatialisation (FAS) : -0.52 (3.30)  
 Emis size : 0.87

**cams\_v61-v21\_2019 : 0.48**  
**HERMES\_BSC\_2019\_(ALL)\_ES\_CATALONIA : 1.00**

**Non-expected: use of official point source emissions both in HERMES and CAMS-REG inventories**





# Example: Catalonia (Spain)

FAIRMODE  
Forum for air quality modelling in Europe

EU Composite Maps: pageEmisEval



Poly Type:  
NUTS2016

Switch to Free

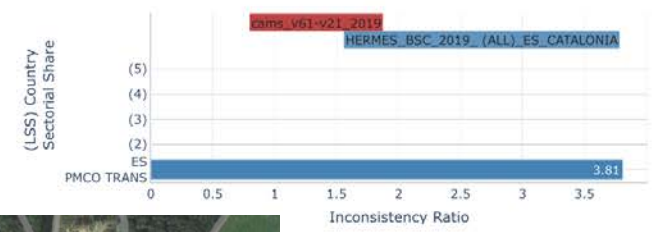
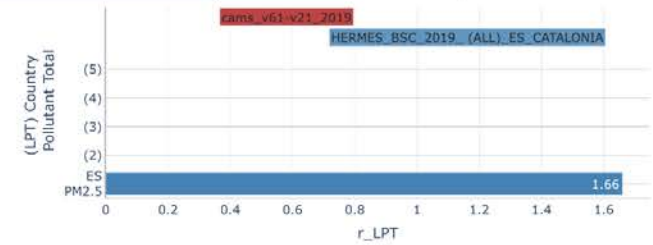
Bottom Up / Top Down  
Left Inventory:  
cams\_v61-v21\_2019

Bottom Up / Top Down  
Right Inventory:  
HERMES\_BSC\_2019\_ (A...

Plot

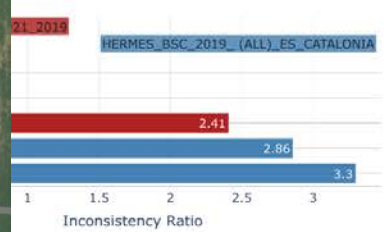
Min Emis. Consid. 0.50

Priority Inconsistencies All Inconsistencies overview Diamond diagram



- POLLUTANT
- NH3
  - NMVOC
  - NOX
  - PM2.5
  - SO2
  - PMCO

- SECTOR
- PP\_IND
  - RESID
  - FUGI
  - SOLV
  - TRANS
  - SHIP
  - OTH\_TRA
  - WASTE
  - AGRI



**66% of total SOx in this NUTS associated to 1 lime manufacturing facility in HERMESv3**



**ES512 Girona**

Sector : PP\_IND  
 Pollutant : SO2  
 "Country" scale (E) : 0.20 (1.59)  
 Spatialisation (FAS) : -0.52 (3.30)  
 Emis size : 0.87

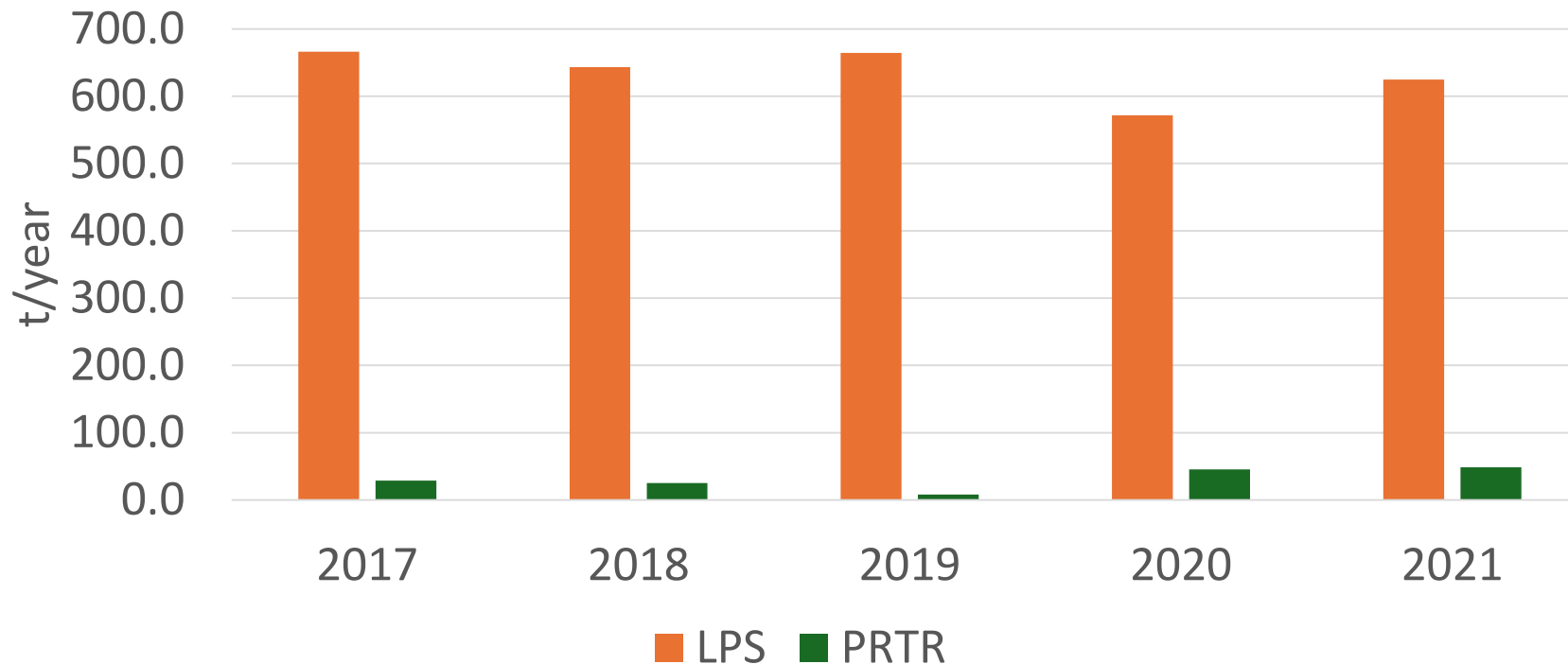
**cams\_v61-v21\_2019 : 0.48**  
**HERMES\_BSC\_2019\_(ALL)\_ES\_CATALONIA : 1.00**



## Example: Catalonia (Spain)

- HERMESv3 → LPS + PRTR
- CAMS-REG → distribution of national emissions according to PRTR + CORINE land use for “leftovers”

SOx annual emissions (PRTR facility 822)



If we replace LPS by PRTR in HERMESv3:  
0.99 kt/year → 0.35  
kt/year (closer to 0.48  
kt/year reported by  
CAMS-REG)



# Example: Catalonia (Spain)

**FAIRMODE** Forum for air quality modeling in Europe

EU Composite Maps: pageEmisEval

Poly Type: NUTS2016

Switch to Free

Bottom Up / Top Down (Left Inventory: emep\_v10\_2018)

Bottom Up / Top Down (Right Inventory: HERMES\_BSC\_2019\_(A...))

Plot

Min Emis. Consid. 0.50

Incons. Threshold 2.00

Limit to Main Country

Priority Inconsistencies | All inconsistencies overview | Diamond diagram

**(LPT) Country Pollutant Total**

Pollutant	Value
PMCO	1.57

**(LSS) Country Sectoral Share**

Sector	Value
PM2.5 RESID ES	1.96
PMCO TRANS ES	5.79

**(FAS) Spatialisation**

Location	Value
ESS11 Barcelona	2.46
ESS14 Tarragona	3.82
ESS13 Lleida	6.99

**POLLUTANT**

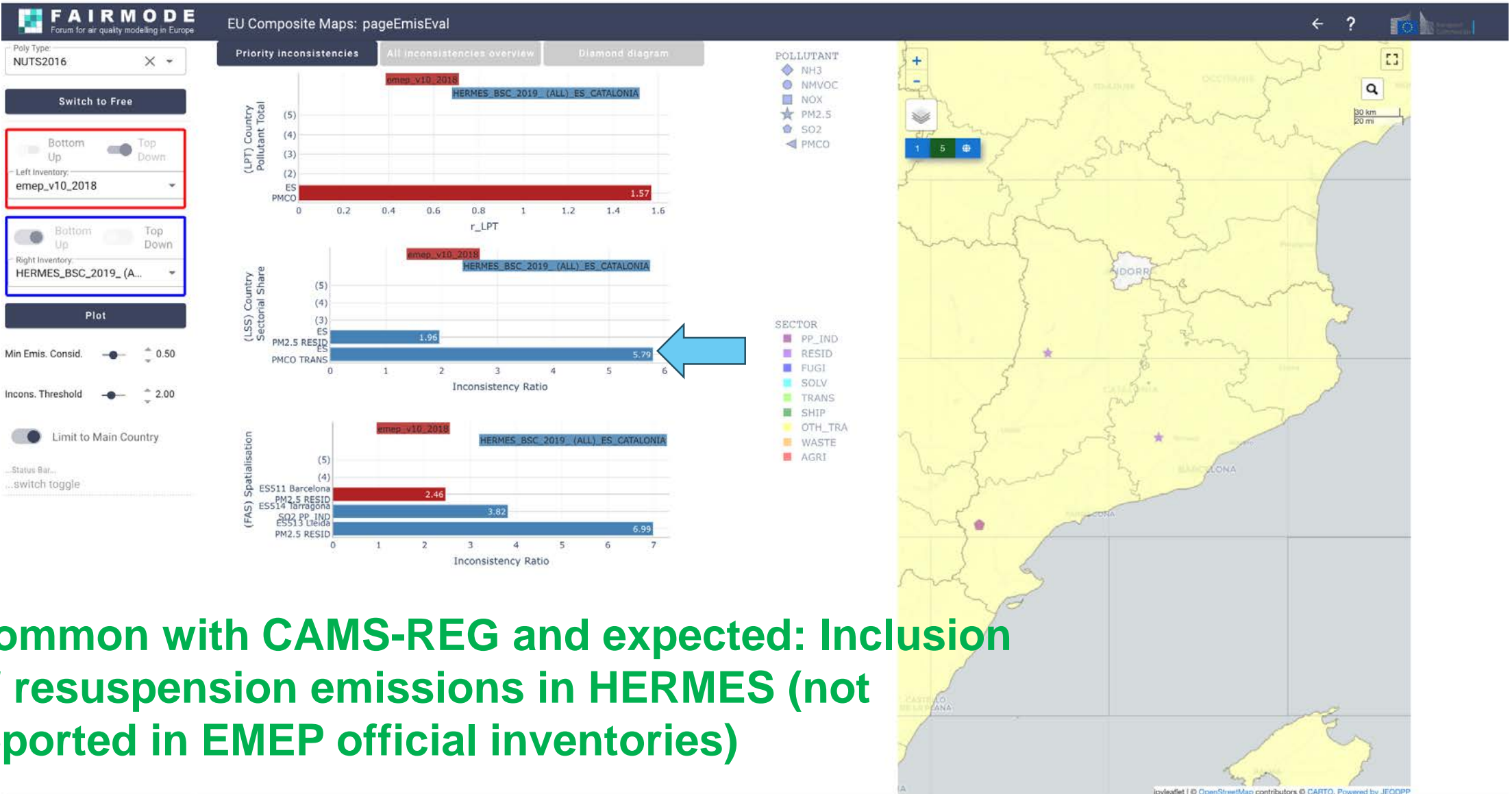
- NH3
- NMVOG
- NOX
- PM2.5
- SO2
- PMCO

**SECTOR**

- PP\_IND
- RESID
- FUGI
- SOLV
- TRANS
- SHIP
- OTH\_TRA
- WASTE
- AGRI



# Example: Catalonia (Spain)



Common with CAMS-REG and expected: Inclusion of resuspension emissions in HERMES (not reported in EMEP official inventories)



# Points for discussion

- Participation: Little feedback on the use of the platform, even when only targeting people who uploaded data → **How do we engage people?**
- Workshop proposal → **How do we design the first workshop to achieve relevant outcomes?**
  - Webinar previous to the workshop → **Useful?**
  - Questions to address before the workshop → **Any other ideas?**
    - What are the main inconsistencies found?
    - Are them the same in CAMS-REG and EMEP?
    - Are them the same in NUTS and FUA?
    - Are these inconsistencies expected?
    - Can we explain them?
    - What are the main lessons learned?
- Workshop outcomes → **How do we draw best practices from the benchmarking exercise?**
  - Focus on the contribution to the regional emission inventories?
  - Focus on new approaches for developing local emissions?
  - Both?