FAIRMODE WG7

Welcome and Introduction – WG7

S. López-Aparicio[1], M. Guevara[2]

[1] NILU – The Climate and Environmental Research Institute

[2] Barcelona Supercomputing Center

European Commission

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.

- 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

- Provide relevant feedback

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

European Commission

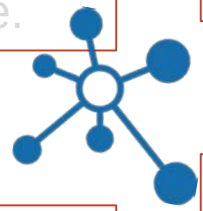
Activities in 2023

- 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.



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European Commission

Technical Meeting programme

The New Composite Mapping for Emissions

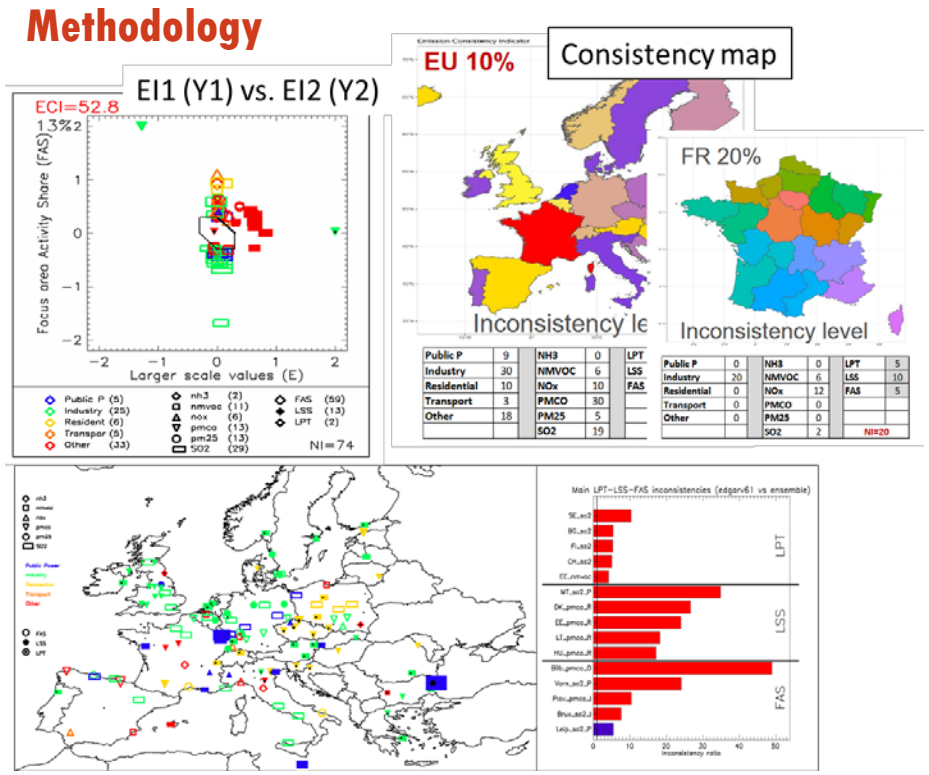
Functionalities:

i) Dashboard:

EU wide emission inventories, EMEP, CAMS-REG, EDGAR;

ii) Aggregated emission composite mapping:

emission evaluation for assessment purposes



PROGRAMME

- **Welcome and Introduction to WG7 session** (Susana Lopez-Aparicio)
- **Methodology behind benchmarking of emissions** (Marc Guevara)
- **Emission composite mapping – Status and way forward** (Susana Lopez-Aparicio)

FAIRMODE WG7

Methodology behind benchmarking of emissions

M. Guevara[1], S. López-Aparicio[2], P. Thunis[3], M. Marioni[3] and E. Pisoni[3]

[1] Barcelona Supercomputing Center

[2] NILU – The Climate and Environmental Research Institute

[3] JRC - European Commission Joint Research Centre

The screening method

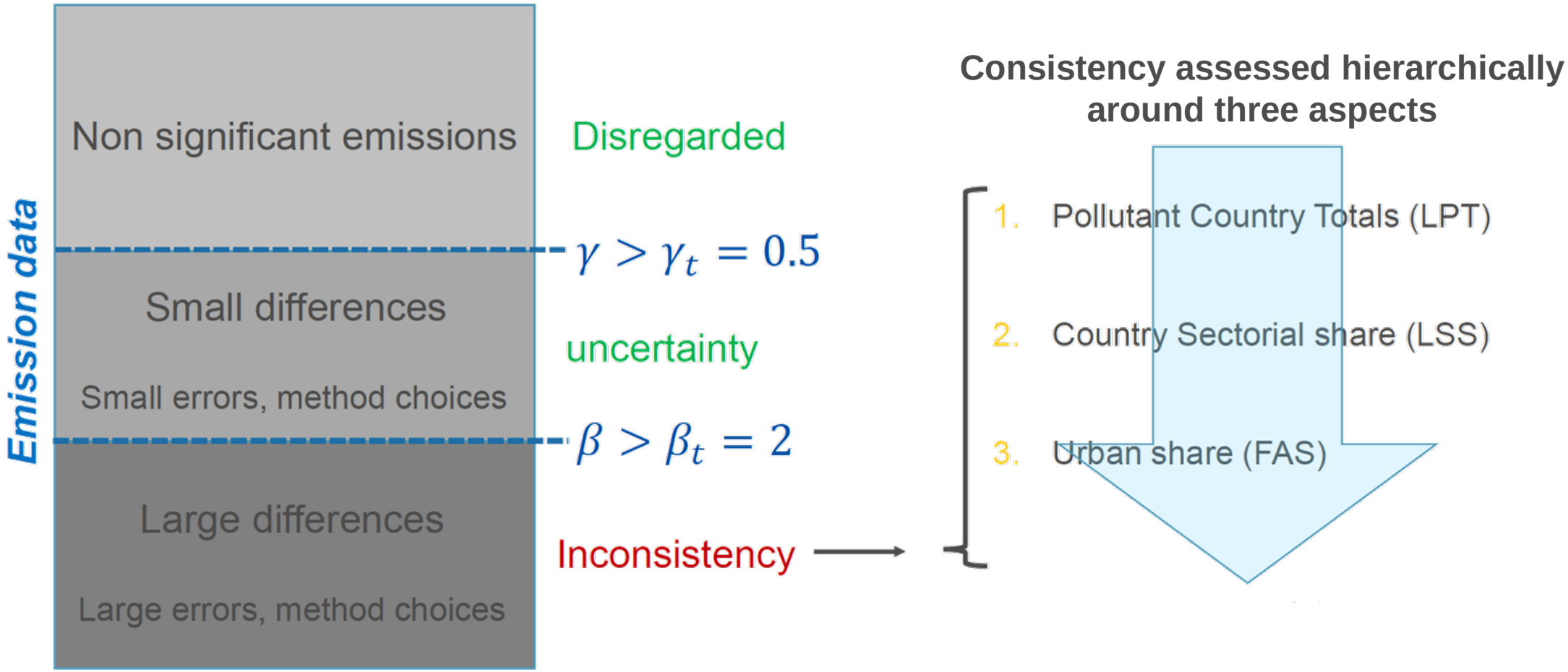
The approach intends to answer the following questions:

- Are there inconsistencies in total pollutant emissions at the country/region level?
- Are there inconsistencies in the sectoral contributions to the total emissions at the country/region level?
- Are there inconsistencies in the spatial distribution of emissions across urban areas (NUTS3 / FUA)?

Inconsistencies are assessed per pollutant, sector and urban area (NUTS3/FUA)

The screening method

Detection of **relevant** inconsistencies



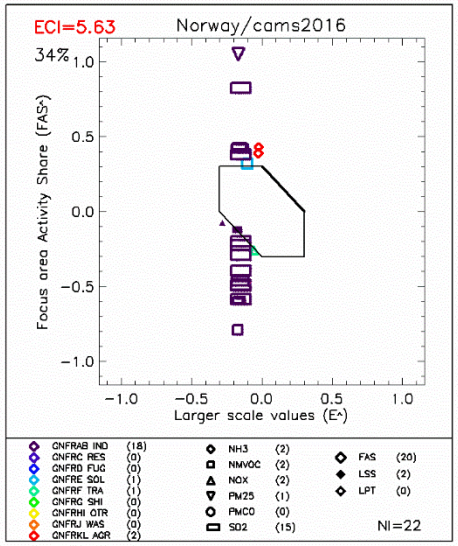
The screening method

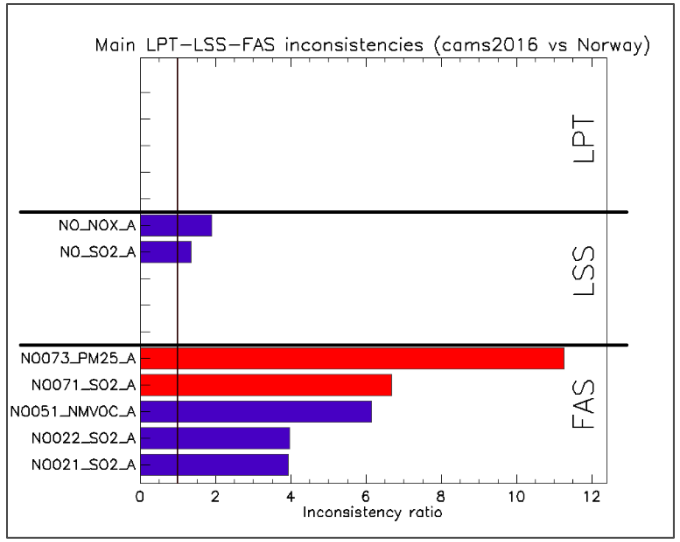
- **Spatial coverage**: Country/Region/Model domain
- **Focus areas**: NUTS3/FUA (only aggregated – non gridded – emissions are needed)
- **Sectors**: Traffic (GNFR F), commercial and residential (GNFR C), agriculture (GNFR K + L), industry (GNFR A + B), shipping (GNFR G), Solvents (GNFR E), Fugitive (GNFR D), Off-road (GNFR I + H), Waste (GNFR J)
- **Pollutants**: SO2, NH3, PM2.5, PMCO, NOx, NMVOC
- **Regional emission inventory:** CAMS-REG-APv6.1 (year 2019) (EMEP, EDGAR, ens)
- **Default relevance threshold (γt) =** 0.5
- **Default inconsistency threshold (βt) =** 2

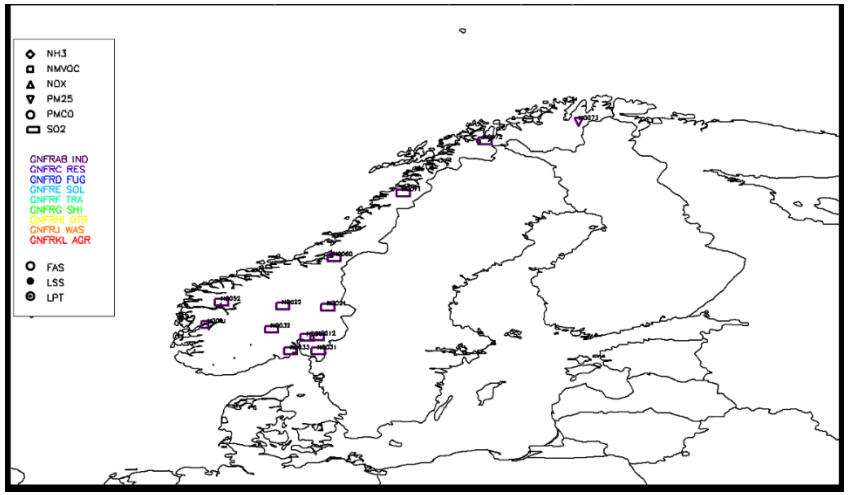
The screening method

Inconsistencies represented using three graphical forms:

- Overview diamond diagram (all inconsistencies considered)
- Bar chart (only largest inconsistencies shown)
- Overview map (only spatial inconsistencies shown)



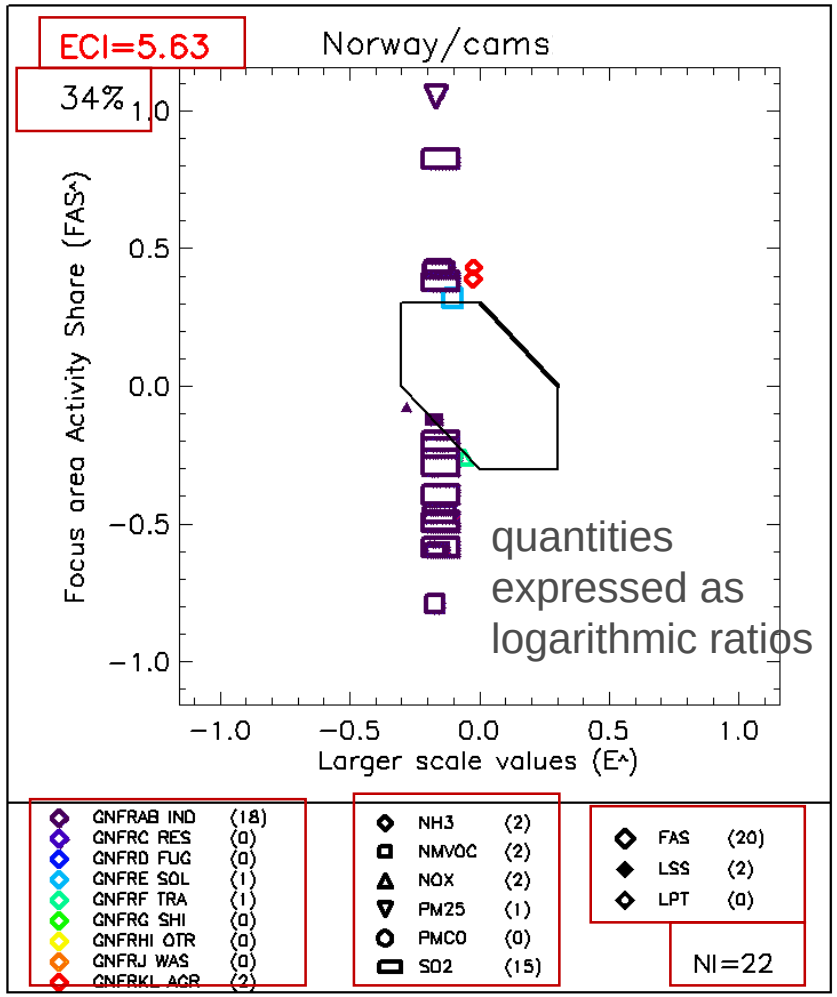




European Commission

The screening method

Overview diamond diagram

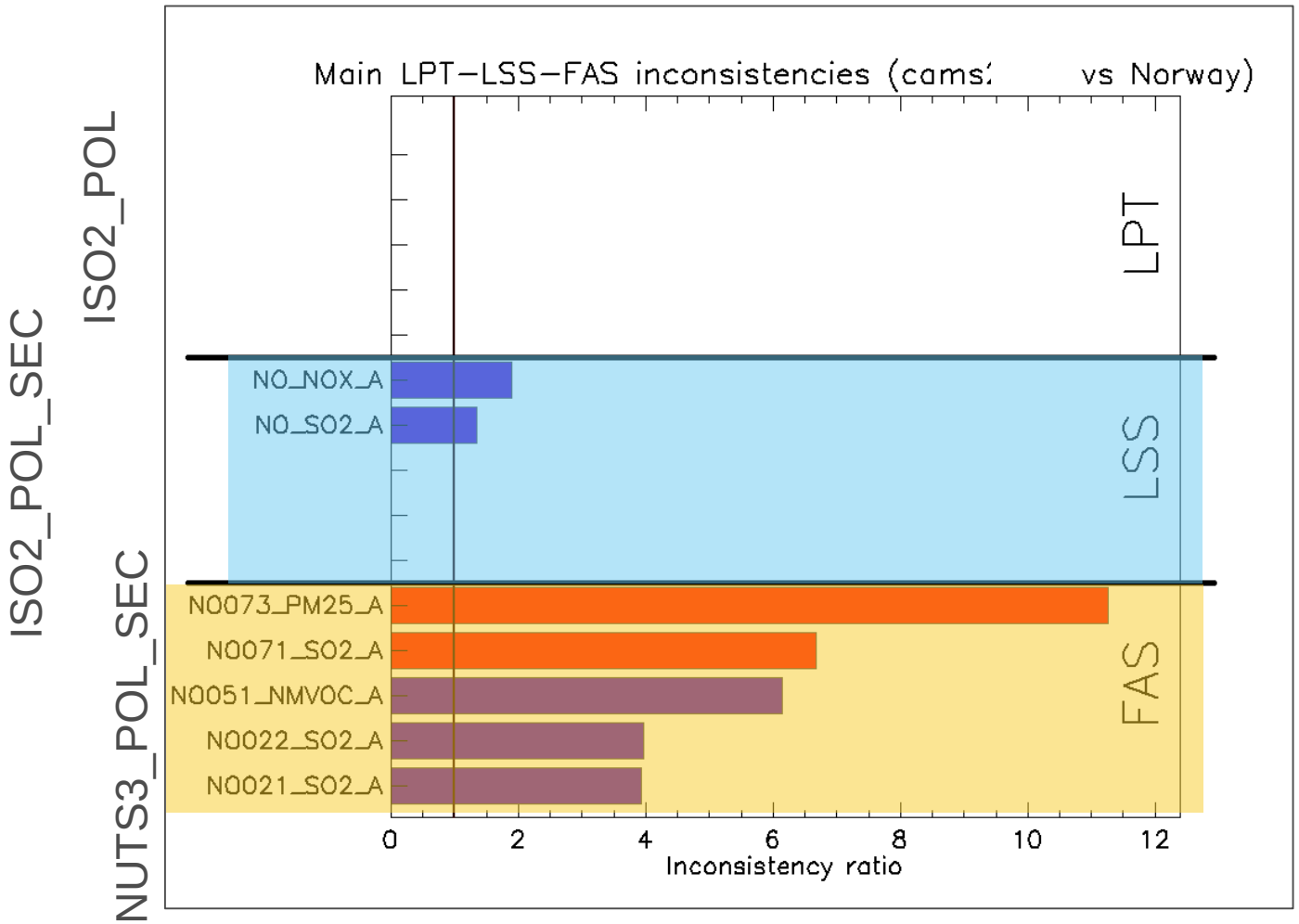


- Number of Inconsistencies (NI) = 22 (34%)
  - FAS = 20 = Nº of inconsistencies for urban share
  - LSS = 2 = Nº of inconsistencies for country sectoral share
  - LPT = 0 = Nº of inconsistencies for country totals
- 18 inconsistencies from GNFR A+B (industry)
- 15 inconsistencies from SO2
- Emission Consistency Indicator (ECI) = 5.63: Inconsistencies are up to 5.63 times the assumed level of uncertainty (factor of 2 by default)
- Colours to identify sector, shape to identify pollutant and filling to identify cause of inconsistency and size the magnitude of the inconsistency

European Commission

The screening method

Bar chart



Identify the top 5 inconsistency ratios for each of the three targeted aspects:

- LPT (country pollutant total)
- LSS (country sectorial share)
- FAS (spatialisation)

Red shading indicates an **overestimation** and **blue shading** an **underestimation** of the local emission inventory with respect to the regional inventory

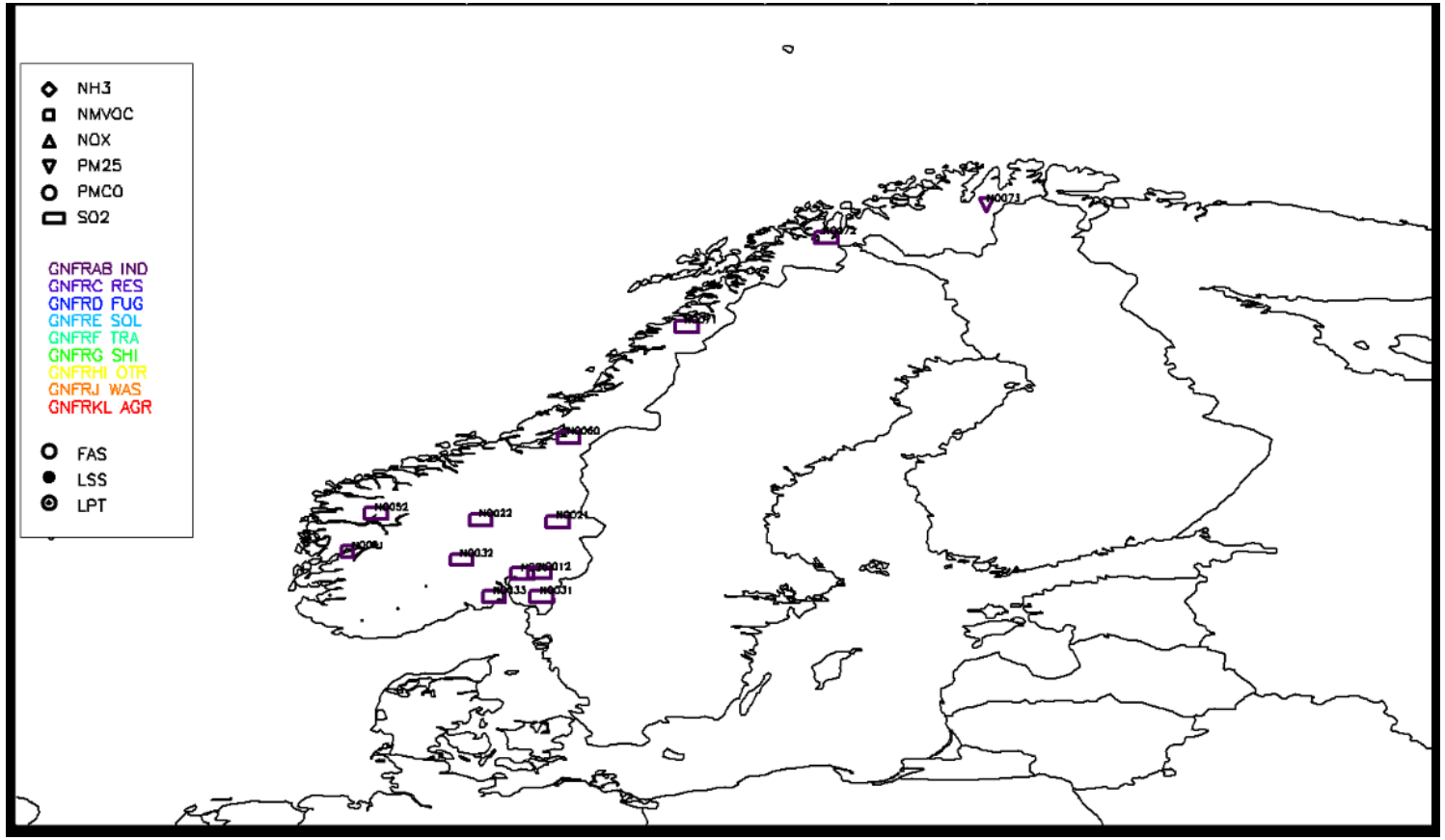
NOx / SO2: Check sectoral allocation at country level: less emissions in local inventory for GNFR A + B (industry)

SO2 / PM2.5: check spatial allocation in several NUTS3 for GNFR A + B (industry)

European Commission

The screening method

Overview map Identify the most important **spatial** inconsistency for each NUTS3/FUA



- size is proportional to the magnitude of the inconsistency
- symbol shapes, colors, and filling remain similar to the overview diamond.

European Commission

The screening method

More details and examples:

Thunis, P., Clappier, A., Pisoni, E., Bessagnet, B., Kuenen, J., Guevara, M., and Lopez-Aparicio, S.: A multi-pollutant and multi-sectorial approach to screening the consistency of emission inventories, Geosci. Model Dev., 15, 5271–5286, https://doi.org/10.5194/gmd-15-5271-2022, 2022.

Thunis, P., Kuenen, J., Pisoni, E., Bessagnet, B., Banja, M., Gawuc, L., Szymankiewicz, K., Guizardi, D., Crippa, M., Lopez-Aparicio, S., Guevara, M., De Meij, A., Schindlbacher, S., and Clappier, A.: Emission ensemble approach to improve the development of multi-scale emission inventories, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2023-1257, 2023.

FAIRMODE WG7

Emission Composite Mapping –
Status and way forward

S. López-Aparicio[1], M. Guevara[2], P. Thunis[3], M. Marioni[3] and E. Pisoni[3]

[1] NILU – The Climate and Environmental Research Institute

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European Commission

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 will follow Thunis et al. (2021) to flag main inconsistencies when compared with EU wide inventories.

Output: Having concentration and MQI as reference, identification of inconsistencies at i) pollutant; ii) sector; iii) type (national, sector share, spatial distribution) levels

Composite mapping of emissions

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; FUA

INPUT

Precursor considered	NO_x, NMVOC, NH_3, SO_2, PM25, PM10
Temporal	Annual totals
Year considered	Year used as basis for assessment
Sector considered	Traffic (GNFR F), commercial and residential (GNFR C), agriculture (GNFR K + L), industry (GNFR A + B), shipping (GNFR G), Solvents (GNFR E), Fugitive (GNFR D), Off-road (GNFR I + H), Waste (GNFR J)
Spatial aggregation	Emissions aggregated to NUTS3 covered by the modelling domain PLUS emissions over a series of smaller areas defined by shape files A pre-processing programme is made available by the JRC to aggregate emissions over the different areas starting from gridded data.
Data format	Spatially aggregated: 2 excel files (output of the JRC pre-processor): 1 for the NUTS3 entirely covered by the modelling domain, the second for all local areas (FUA). A template and additional information is provided in the annex of this document

Table 3: Requested data for spatially aggregated emissions

METADATA

Basic information	Inventory code (visualisation name)
	Inventory name (e.g. CAMS-REG)
	Inventory version
	Reference year
	Country (main country covered)
	Area (sub-national area – optional)

European Commission

Composite mapping of emissions

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

→ NUTS3 that are covered by the modelling domain
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INPUT

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Table 3: Requested data for spatially aggregated emissions

Some lessons learned

- NUTS shapefiles (2021 vs 2016);
- Follow recommended guidelines, e.g., naming convention.
  - PM25: either written as PM25, PM2.5, PM2_5
  - GNFR: sometimes inverted GNFRIJ vs GNFRJI.
- The number of columns in the file is not always correct.
- Problems with the pre-processing programme → Improving is an on-going process, if you experience problems, please report it.

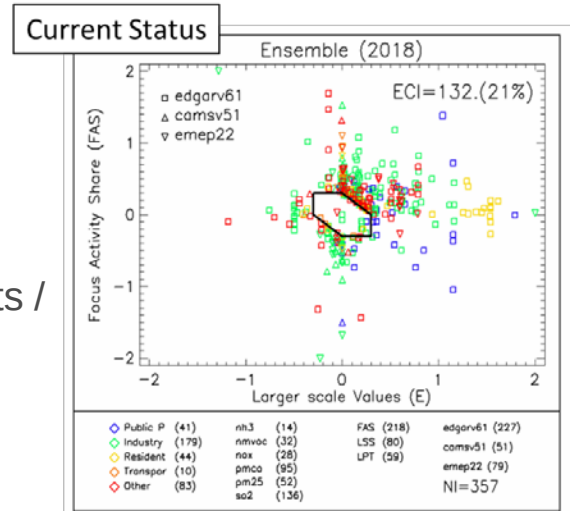
European Commission

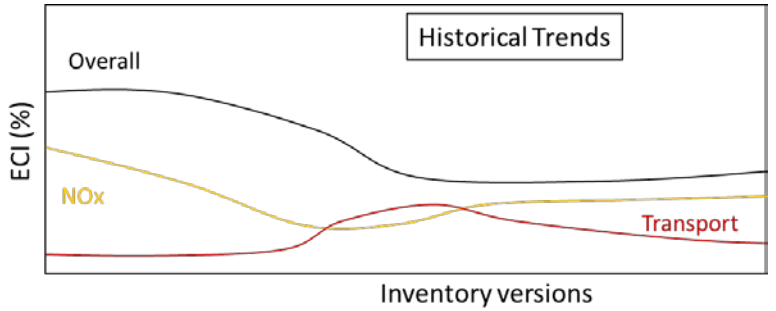
The Composite mapping (CM) platform (emissions)

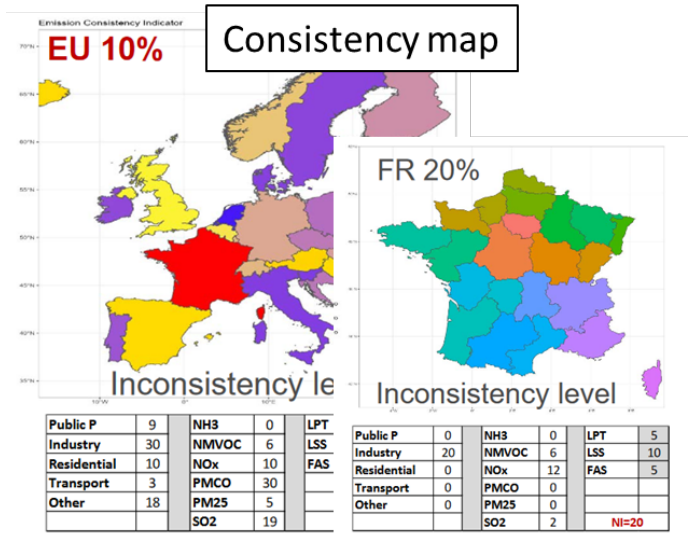
Funtionalities: i) **Dashboard:** EU wide emission inventories, EMEP, CAMS-REG, EDGAR;
ii) **Aggregated emission composite mapping:** emission evaluation for assessment purposes

i) DASHBOARD

1. Three main figures
   a. current status based on latest version and **latest reporting year**. Includes details inconsistencies in terms of sectors / pollutants / type / inventory.
   b. Historical trends (for inconsistency levels)
   c. Consistency map
2. User-free comparison interface







Public P	9	NH3	0	LPT	
Industry	30	NMVOC	6	LSS	
Residential	10	NOx	10	FAS	
Transport	3	PMCO	30		
Other	18	PM25	5		
		SO2	19		

Public P	0	NH3	0	LPT	5
Industry	20	NMVOC	6	LSS	10
Residential	0	NOx	12	FAS	5
Transport	0	PMCO	0		
Other	0	PM25	0		
		SO2	2	NI=20	

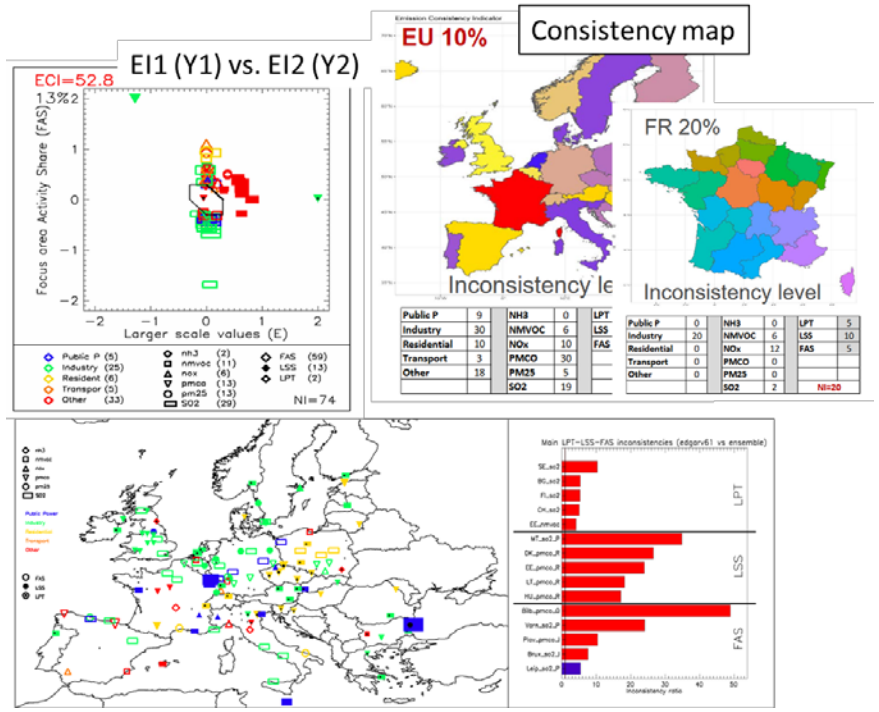
NUTS3 / Urban

Zoom: EU / Country

The Composite mapping (CM) platform (emissions)

Funtionalities: i) **Dashboard:** EU wide emission inventories, EMEP, CAMS-REG, EDGAR;
ii) **Aggregated emission composite mapping:** emission evaluation for assessment purposes

i) DASHBOARD – User interphase



Sectors to visualize	Pollutants to visualize
Thresh. Relevance	Thresh. Inconsistency
NUTS3 / Urban	Zoom: EU / Country

Year 1	Year 2
EI 1	EI 2
CAMS X	CAMS X
CAMS Y	CAMS Y
…	…
EMEP X	EMEP X
EMEP Y	EMEP Y
…	…
EDGAR X	EDGAR X
EDGAR Y	EDGAR Y
…	…
ENS X	ENS X
ENS Y	ENS Y
…	…

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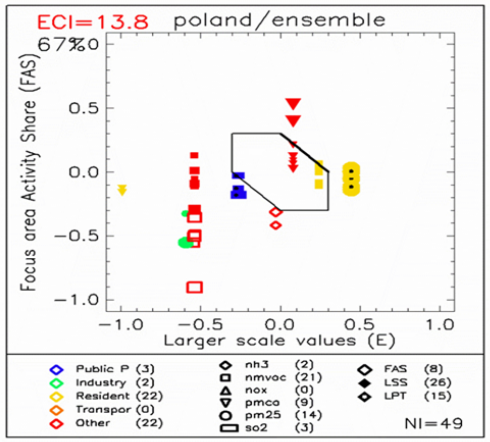
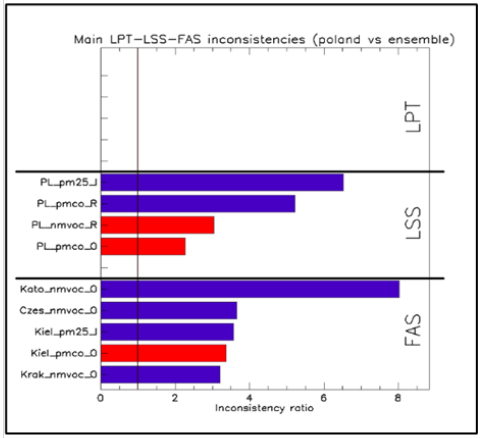
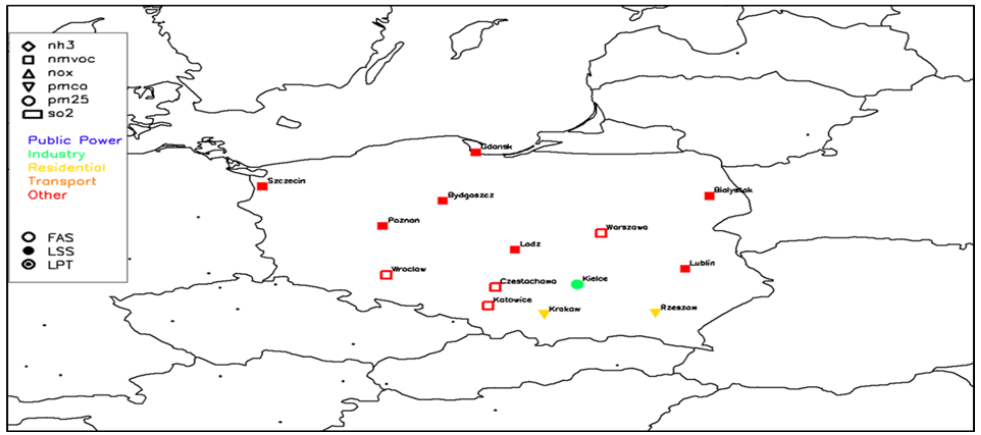
The Composite mapping (CM) platform (emissions)

ii) Aggregated emission composite mapping; benchmark local emission inventories with EU wide inventories to assess inconsistencies.







Sectors to visualize | Pollutants to visualize

Thresh. Relevance | Thresh. Inconsistency

NUTS3 / Urban

Year

EI 1 | EI 2

Country 1
- BU 1
- BU 2
- …

Country 2
- BU 1
- BU 2

…

CAMS X
CAMS Y
…
EMEP X
EMEP Y
…
EDGAR X
EDGAR Y
…
ENS X
ENS Y
…

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The Composite mapping (CM) platform

OPENING SOON

FAIRMODE
Forum for air quality modelling in Europe

EU Composite Maps: pageEmisEval

Poly Type: NUTS2016

Bottom Up | Bottom Up

Top Down | Top Down

Search Inventory1... | Search Inventory2...

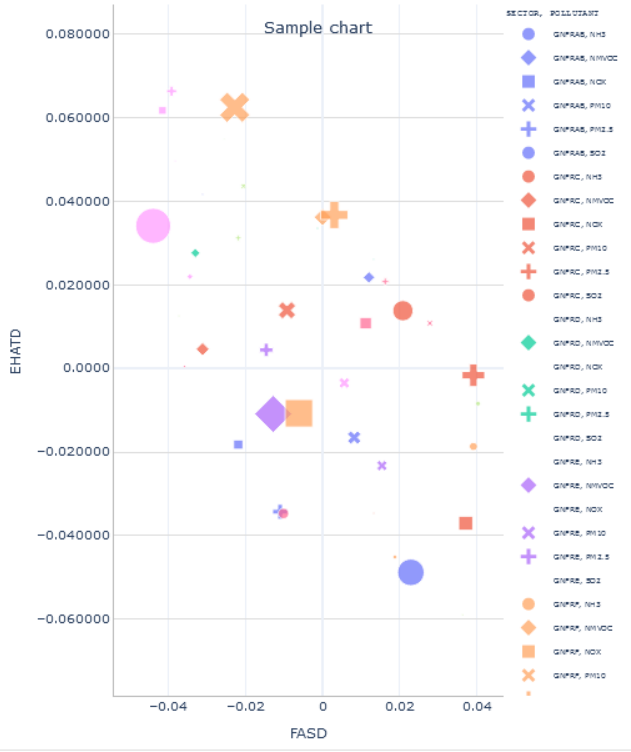
- DHMZ NUTS_2019_ (...
- JRC_TEST_2019_ (AL...
- JRC_TEST_2019_ (AL...
- MAPEIRE_2019_ (ALL...
- MAPEIRE_2019_ (ALL...
- NILU_2019_ (ALL)_N...
- NILU_2019_ (ALL)_N...
- PREPAIR_2017_ (ALL...
- PREPAIR_2017_ (ALL...
- UBA_2018_ (ALL)_DE
- UBA_2018_ (ALL)_DE
- UBA_2018_ (ALL)_DE
- UBA_2018_ (ALL)_DE
- UBA_2018_ (ALL)_DE
- UBA_2018_ (ALL)_DE
- cams_v61_2015
- cams_v61_2016

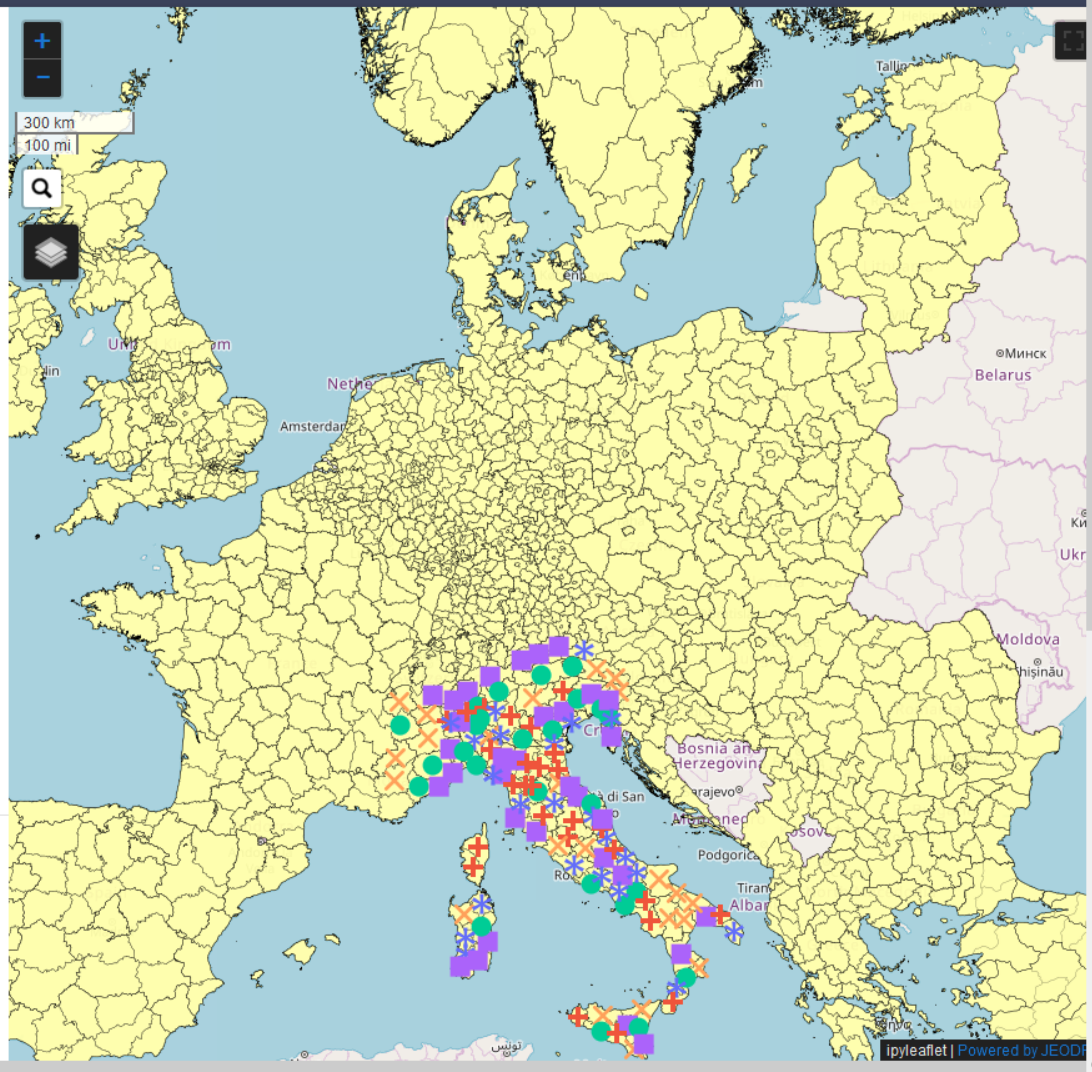
- JRC_TEST_2019_ (AL...
- JRC_TEST_2019_ (AL...
- MAPEIRE_2019_ (ALL...
- MAPEIRE_2019_ (ALL...
- NILU_2019_ (ALL)_N...
- NILU_2019_ (ALL)_N...
- PREPAIR_2017_ (ALL...
- PREPAIR_2017_ (ALL...
- UBA_2018_ (ALL)_DE
- UBA_2018_ (ALL)_DE
- UBA_2018_ (ALL)_DE
- UBA_2018_ (ALL)_DE
- UBA_2018_ (ALL)_DE
- UBA_2018_ (ALL)_DE
- cams_v61_2015
- cams_v61_2016
- cams_v61_2017

Create

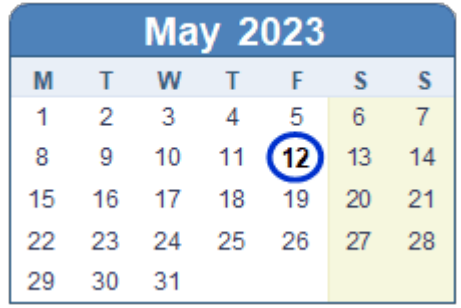
Demo Show Map

...Status Bar...
cams_v61_2017(cams_NUTS2016_3_v61.csv)





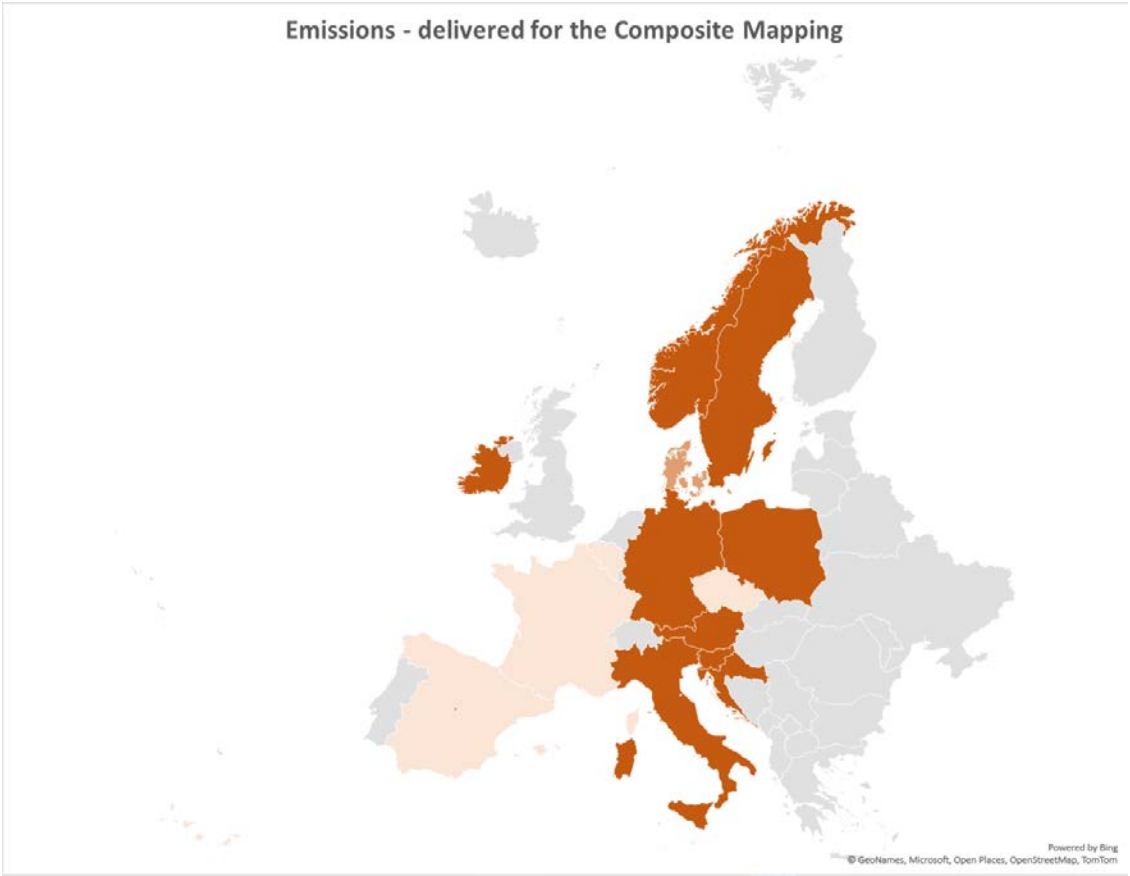
Launch – CM exercise



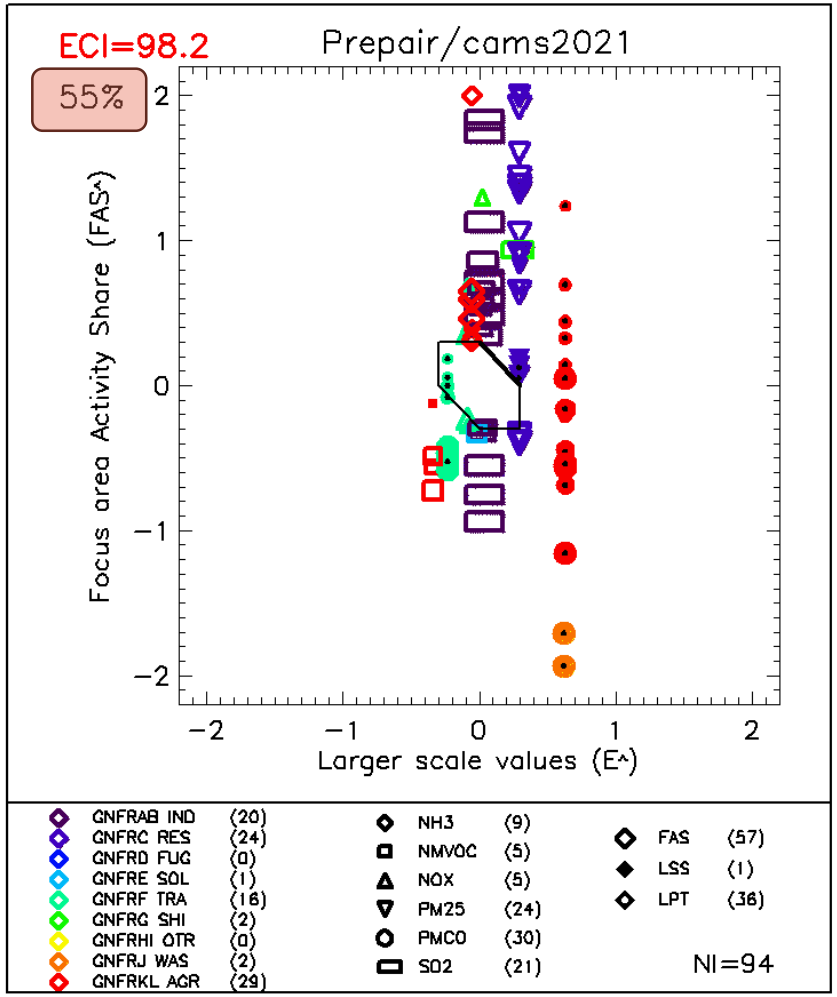
- Kick off meeting on the new compositite mapping (12/05)
- Contribution: Annual emissions aggregated over pre-defined spatial areas

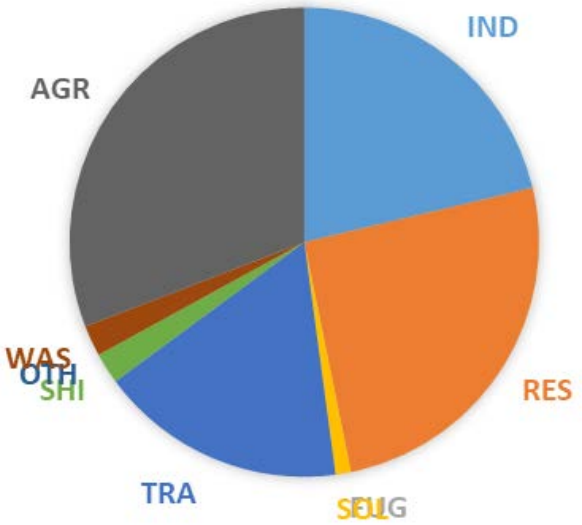
Status by 28th September

Region or country	Contact	EMISSIONS	CONCENTRATION
Austria	Claudia Flandorfer		
Belgium	Frans Fierens		
Czech Republic	Nina Benesova		
Croatia	Milic Velimir		
Denmark	Matthias Ketzel		
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		
Sweden	Helen Alpfjord		

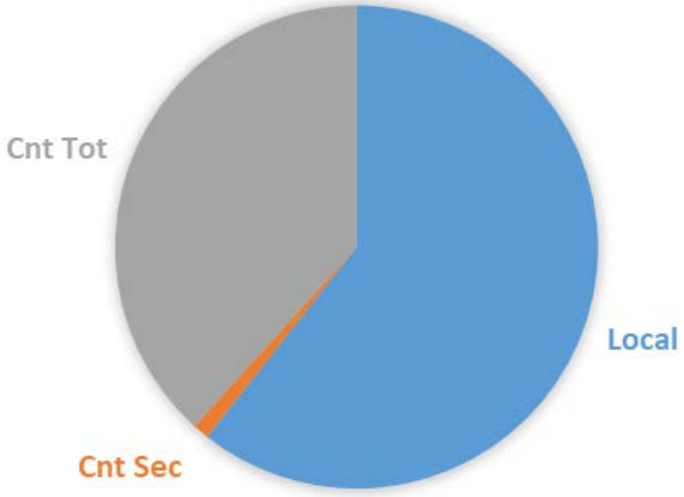


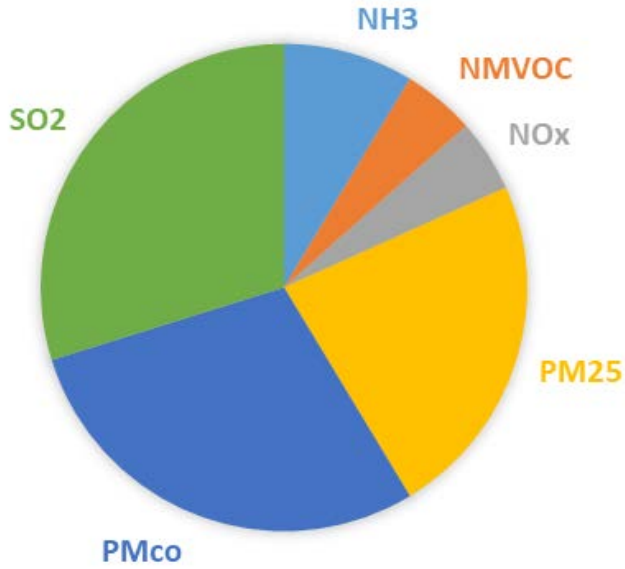
Examples



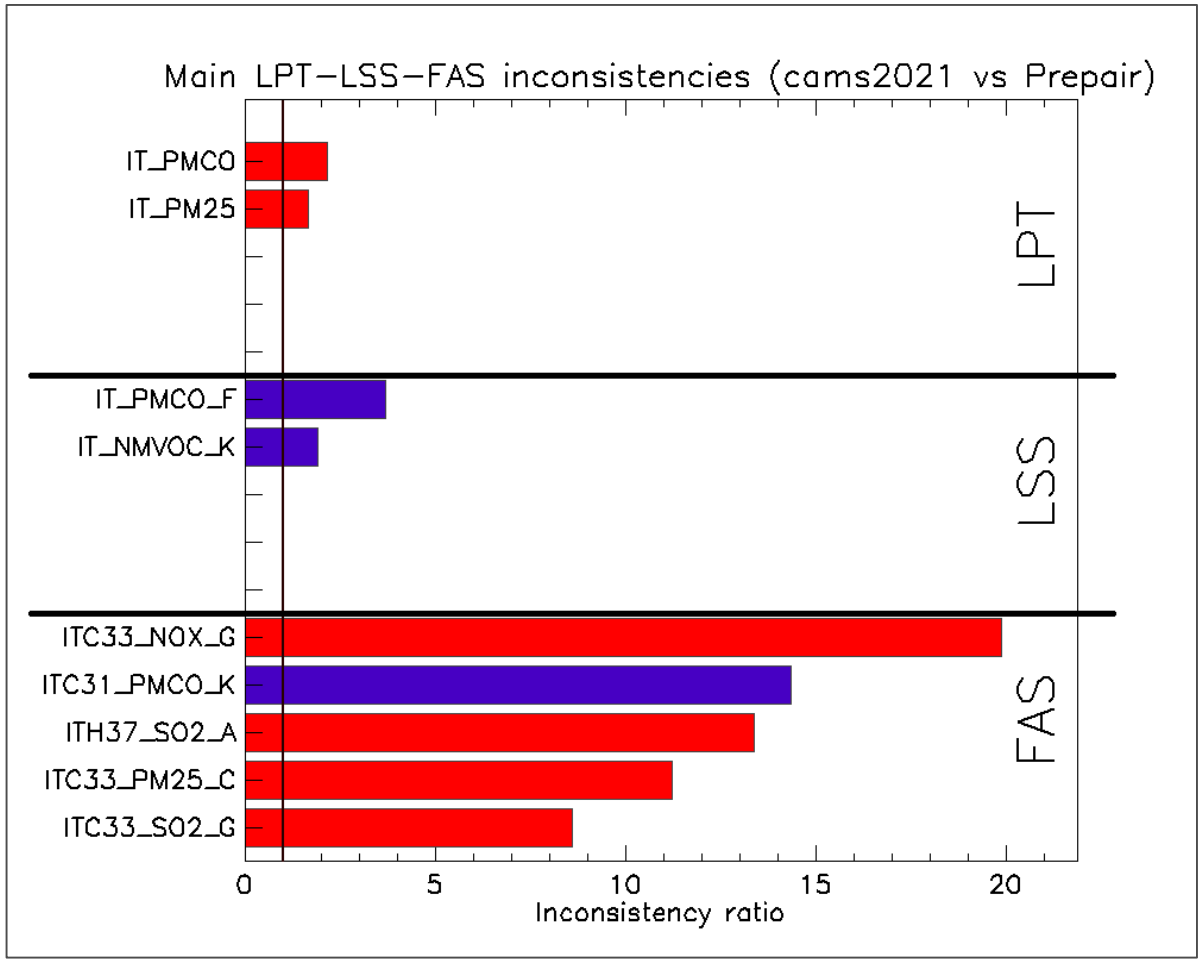


Po Valley





Examples

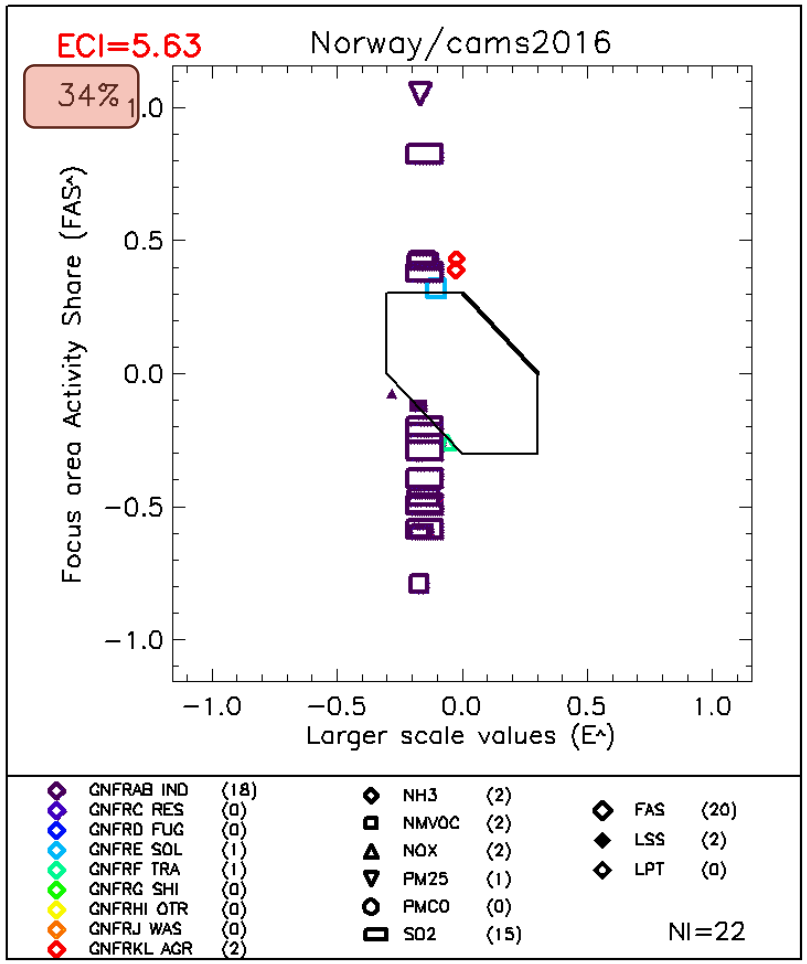


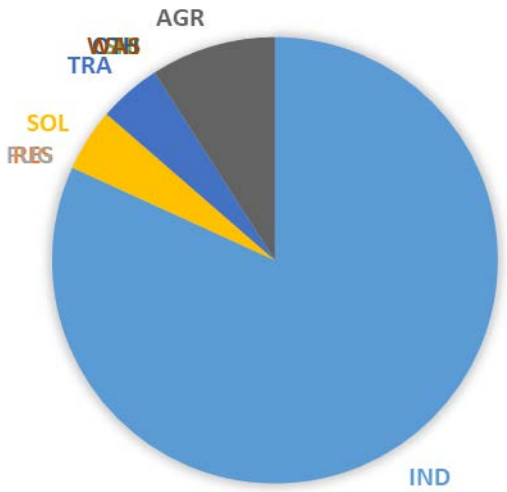
Po Valley

Priorities

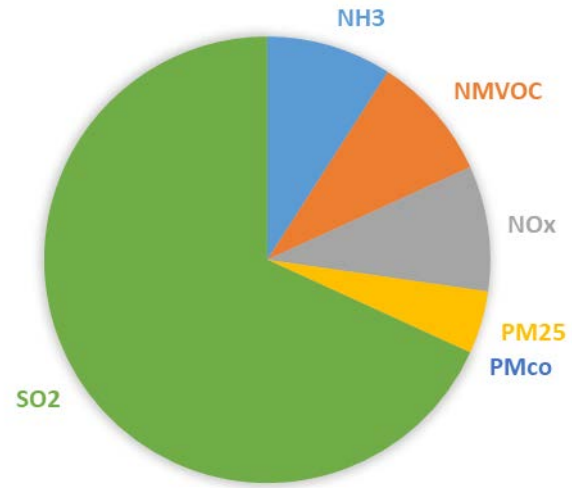
- **PMco and PM25**: Issue in overall total (fact 2 +)
- **PMco**: less emissions in transport at country level in local inv.
- **NMVOC**: less emissions in agriculture at country level in local inv.
- **SO2**: check spatial allocation in several NUTS for industry (up to fact 12)
- **PM2.5:** check spatial allocation in several NUTS for residential (up to fact 10)
- **Shipping:** spatial allocation issue in ITC33 (**NOx and SO2**) (up to fact 20)
- **NH3**: check spatial allocation in several NUTS for agriculture

Examples



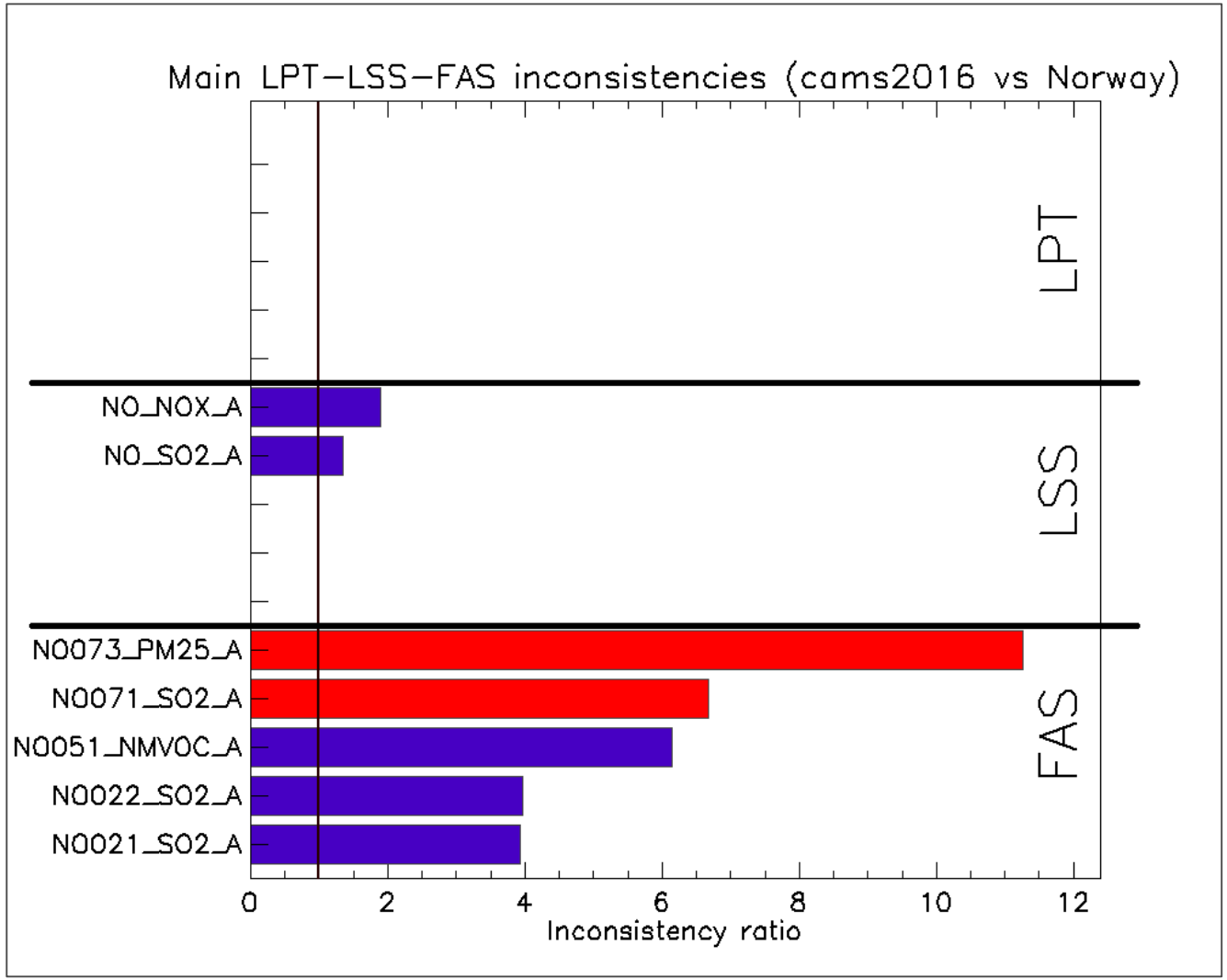


Norway



European Commission

Examples



Norway

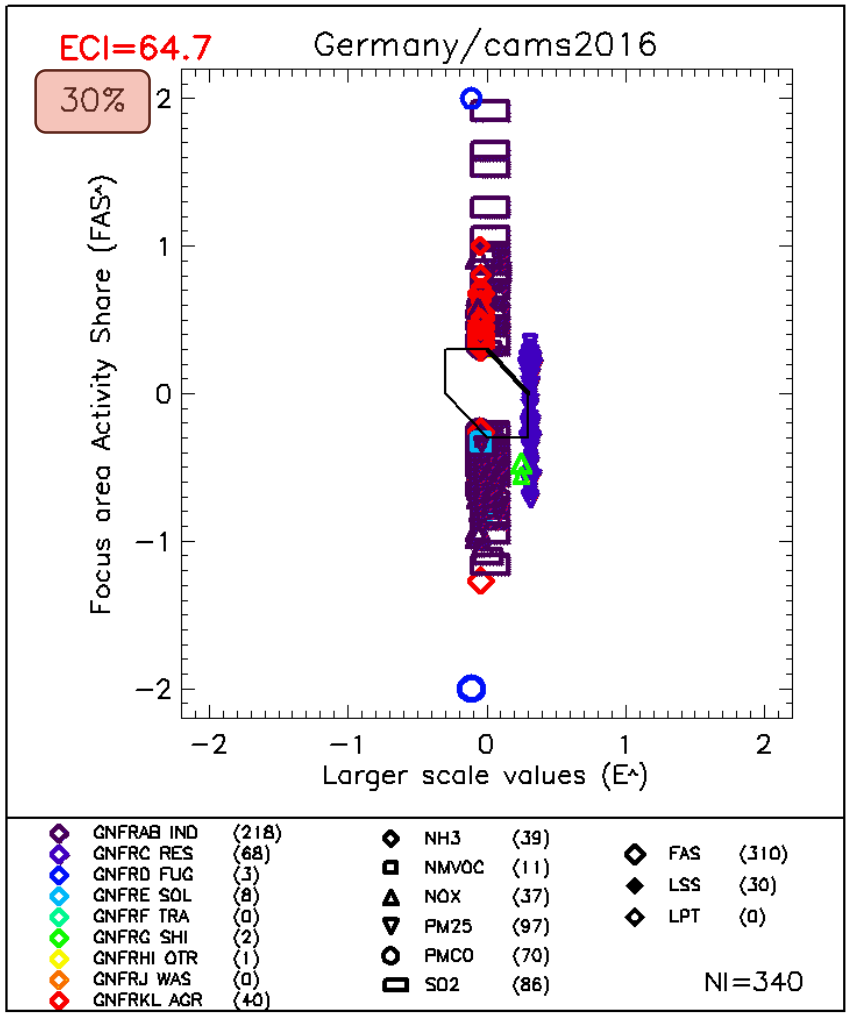
Priorities

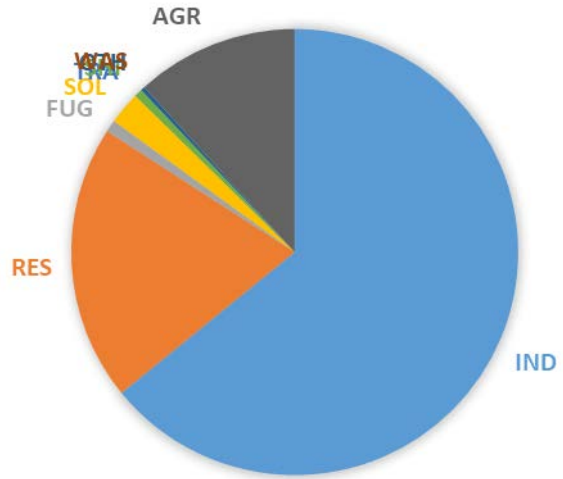
- **NOx and SO2:** Check sectoral allocation at country level: less emissions in local inventory for industry
- **SO2**: check spatial allocation in several NUTS for industry (up to fact 6)
- **PM2.5:** check spatial allocation in several NUTS for industry (up to fact 10)

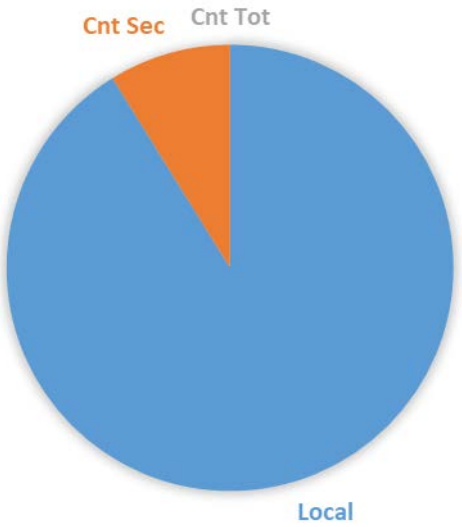
European Commission

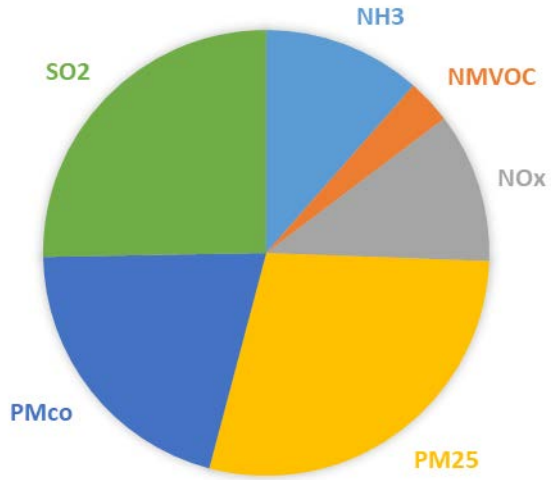
Examples

Germany





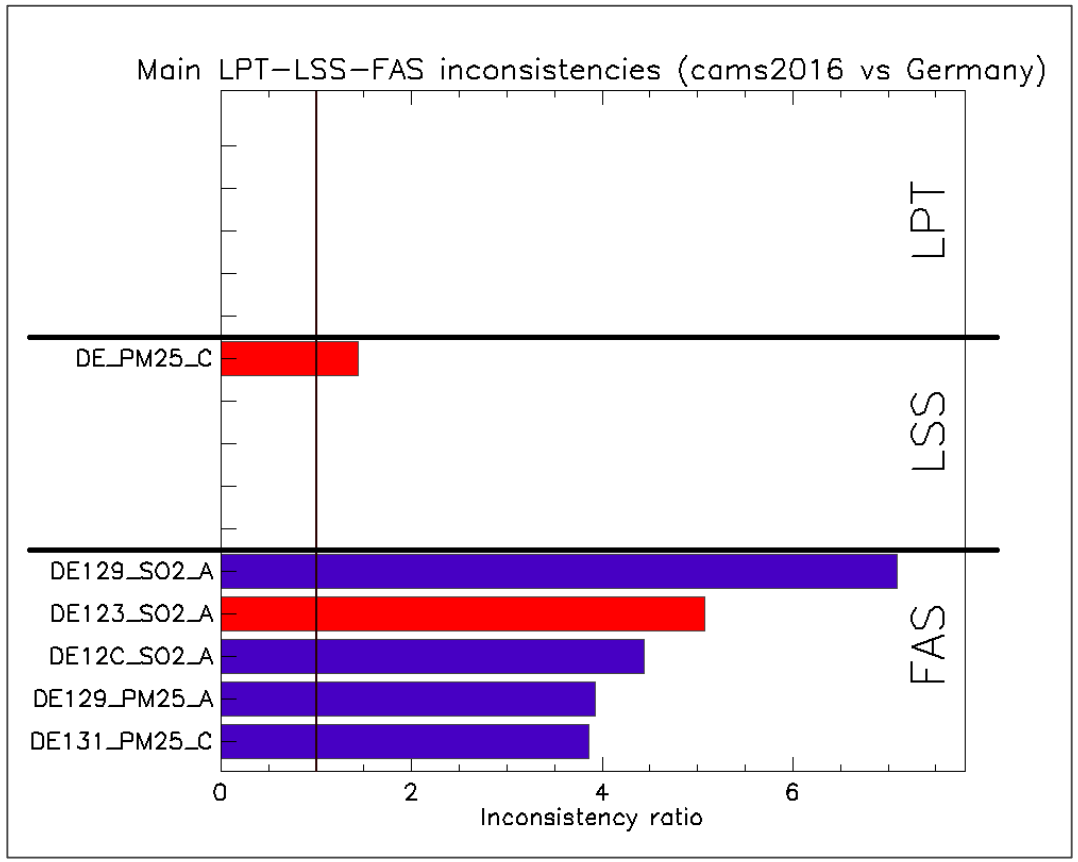




European Commission

Examples

Germany



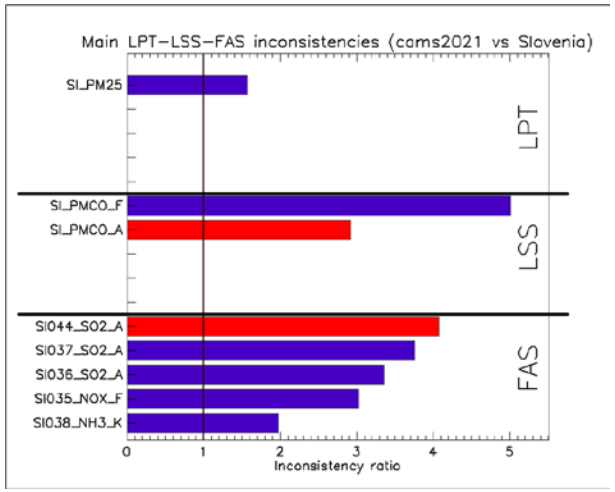
Priorities

- **PM2.5:** Country sectoral shift (check residential)
- **SO2**: check spatial allocation in several NUTS for industry (up to fact 7)
- **PM25**: check spatial allocation in several NUTS for residential (up to fact 4)

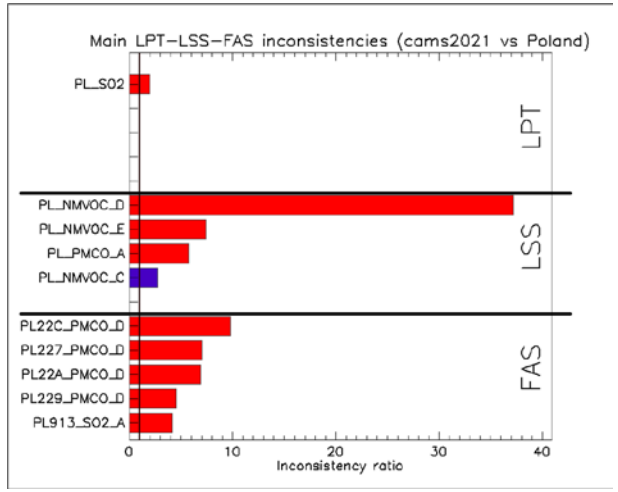
European Commission

Examples

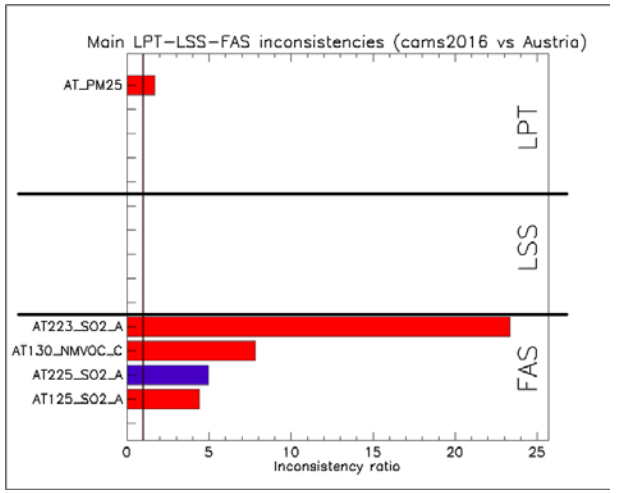
Slovenia



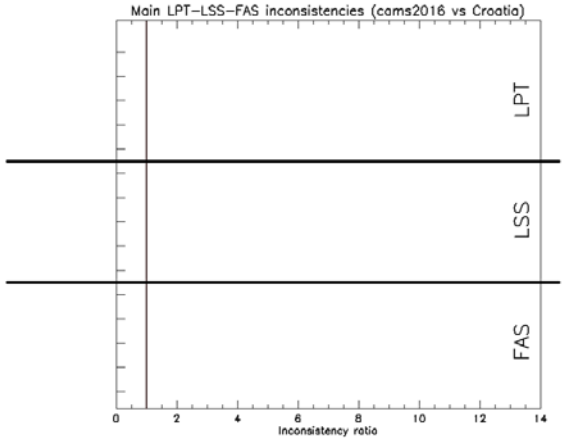
Poland



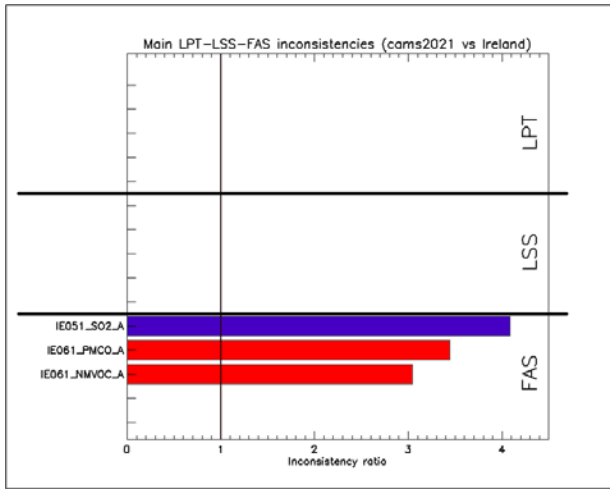
Austria



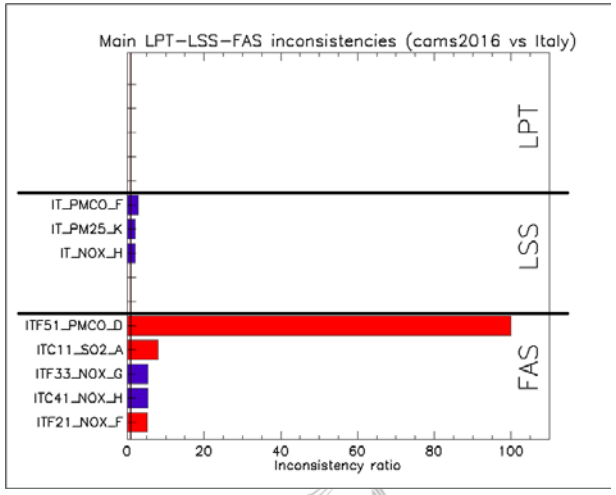
Croatia



Ireland



Italy



WG7 - Way Forward (Short term)

- Contributions are still welcome
- Distribute available results to the contact persons so they can start interpreting the results;
- Open the dashboard to FAIRMODE community to evaluate results and inconsistencies (incl. modifying parameters / focuss on specific sectors);
- Organize a first online workshop to discuss inconsistencies (before Xmas);
- Start drafting lessons learned to draw «best practise and recomendations» for the development of emission inventories;

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