Benchmarking EDGAR emissions

High resolution emission inventories (WG7)

FAIRMODE "TECHNICAL MEETING"

Diego Guizzardi, EC/JRC, EDGAR

Dublin (IE) – 07-09 October 2024

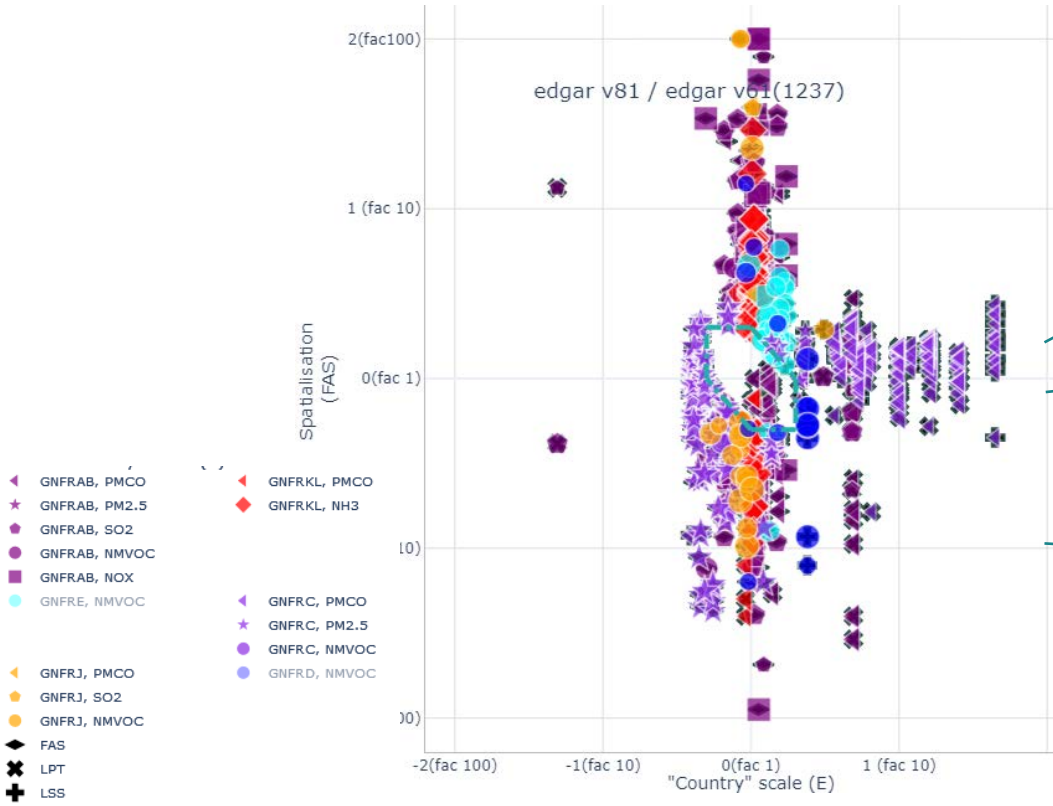
Following the protocol

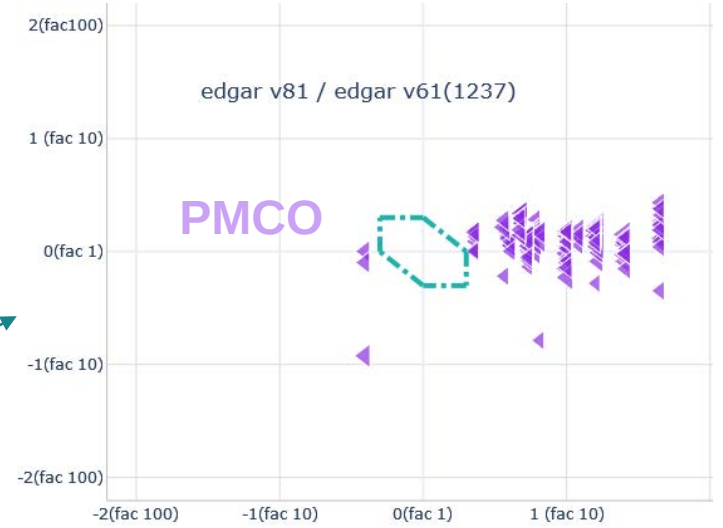
- What are the main inconsistencies found?
- Are these inconsistencies expected?
- Can we explain them?
- What are the mail lessons learned?
- Wishlist

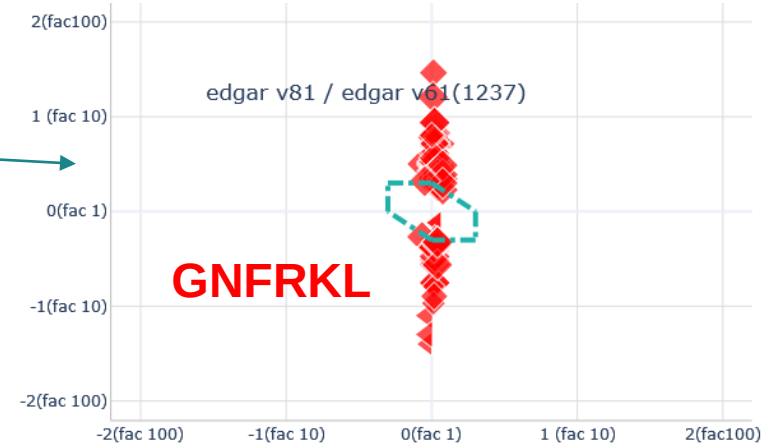
European Commission

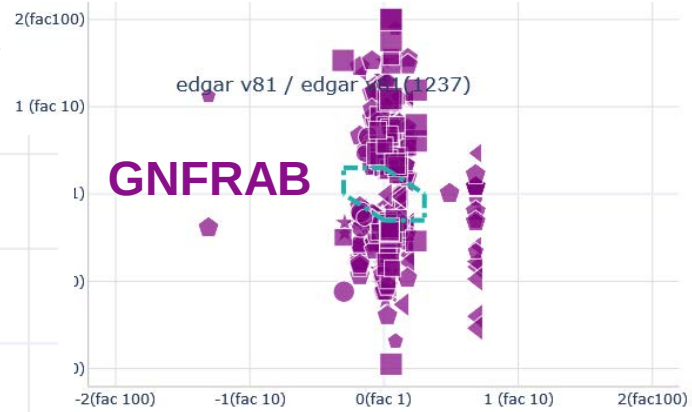
EDGARv61vsEDGARv81

What are the main inconsistencies found?









NUTS polygons, year 2018, “Min Emission Consideration" and "Inconsistency Threshold" default values (0.5 and 2.0)

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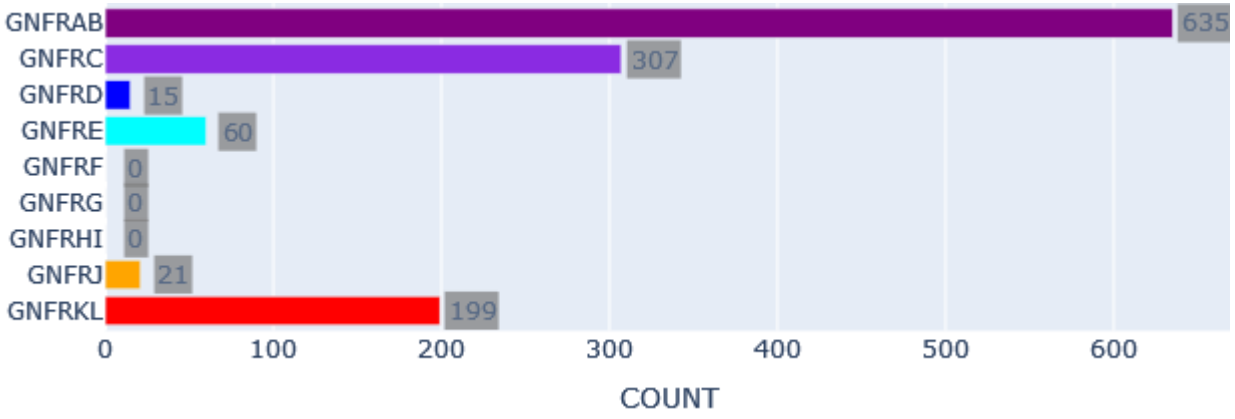
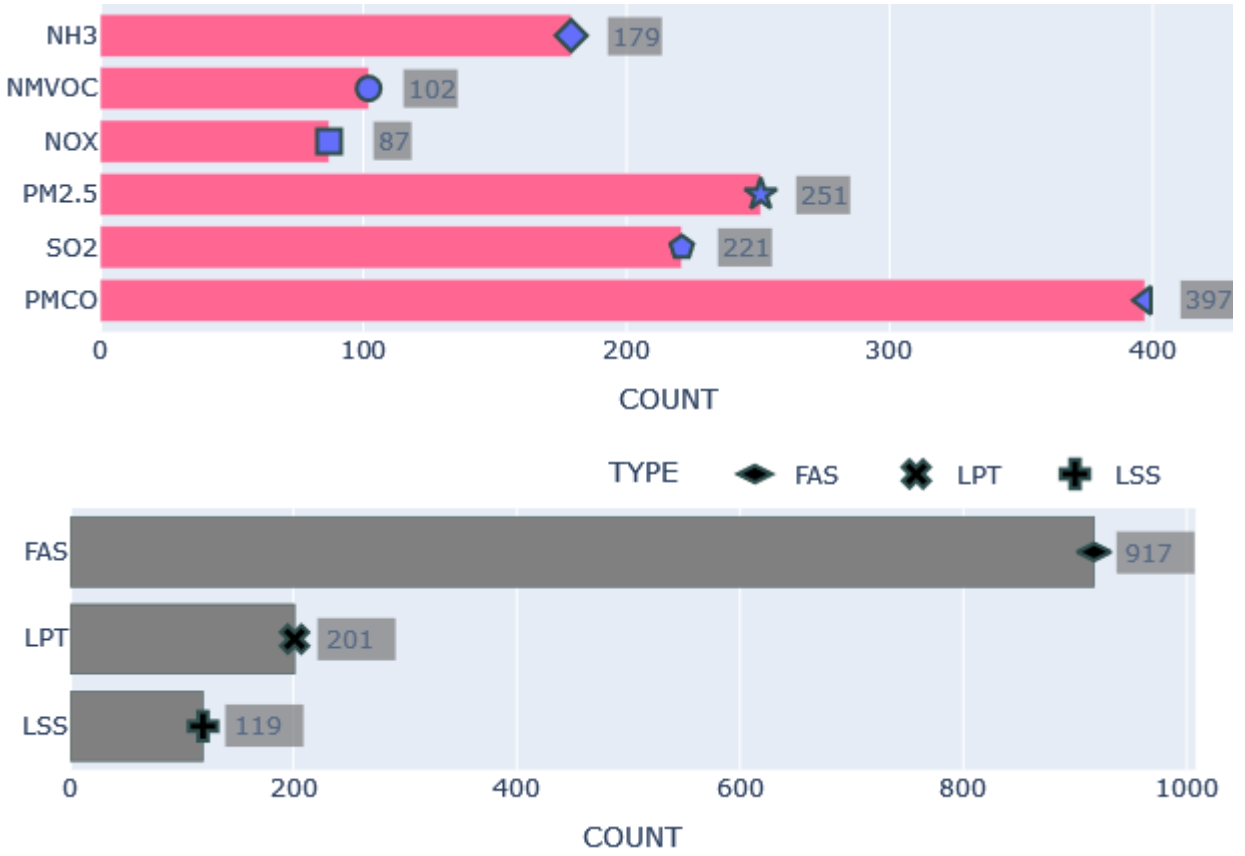
EDGAR: v61vs81

Are these inconsistencies expected?





We expect differences for some sectors in the spatial distribution due to an extended update in the spatial proxies

We expect differences for some compounds due to the update of activity data (regular revision) and mainly to the update of technologies split and revision of few emission factors (Residential and Power Generation sectors)

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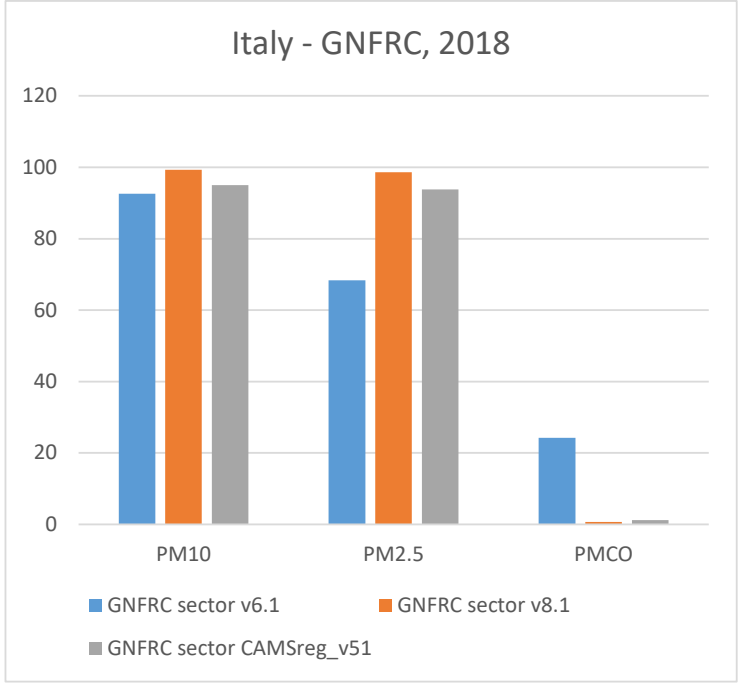
EDGAR: v61vs81

Can we explain them?



PM2.5 difference is due to an update technologies related to the solid biomass combustion also including specific emissions factors and leading to an important difference in the emissions estimates for this specific sub-sector.

New techs also for PM10 are included but the EF are similar to the default ones then the impact is less relevant.

Similar behavior can be observed for all EU countries

This is an improvement in the emissions inventory

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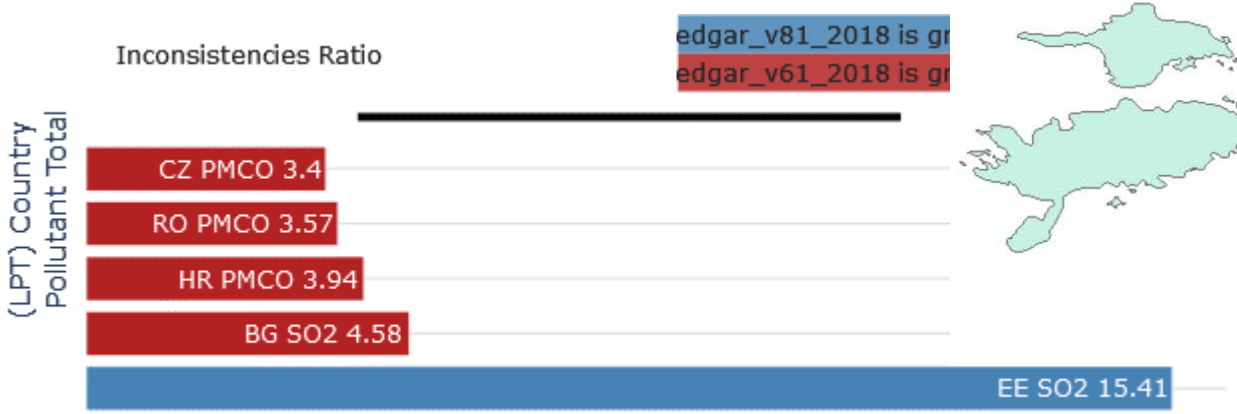
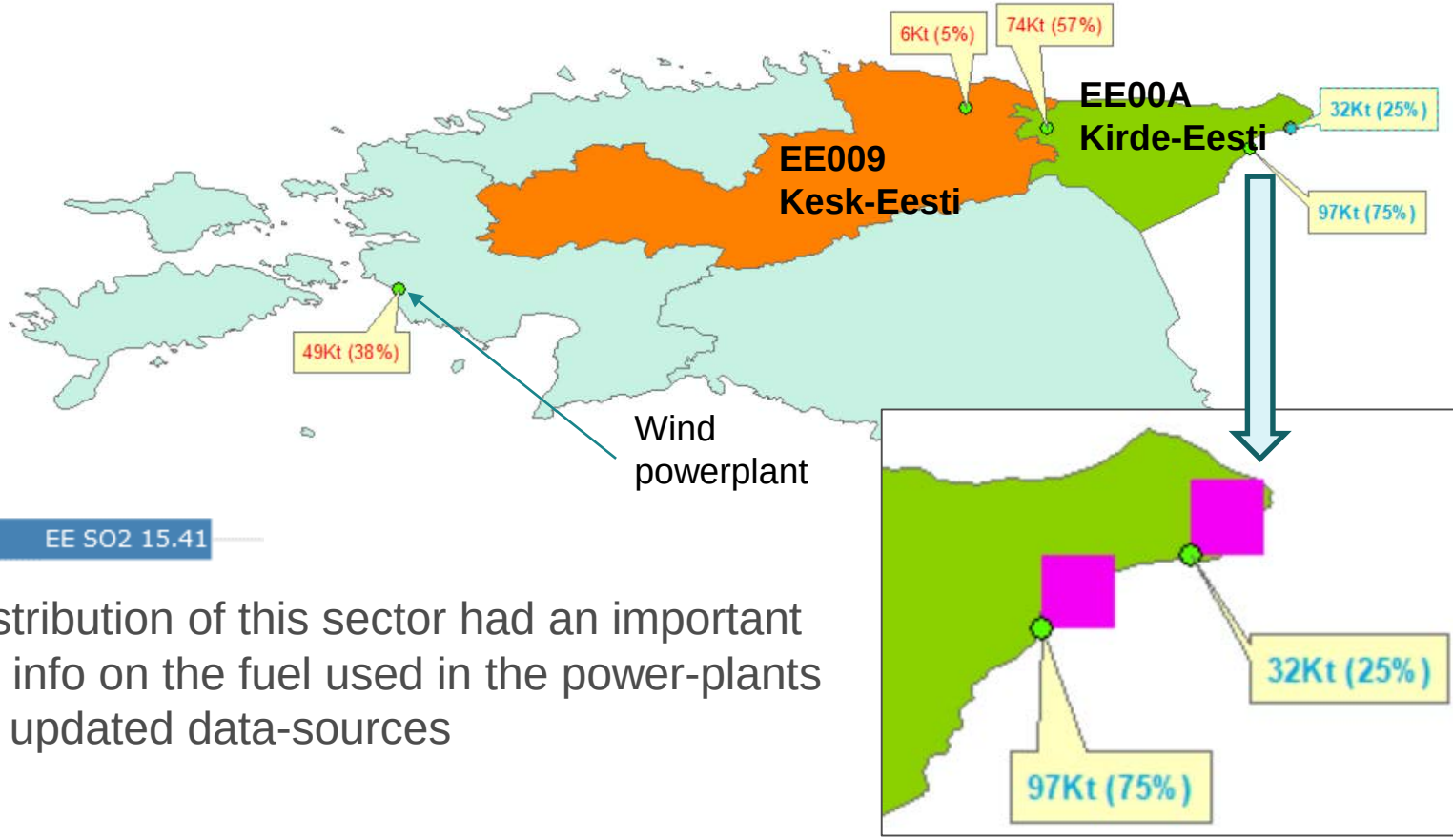
EDGAR: v61vs81

Can we explain them?





The update of the proxy for the emissions distribution of this sector had an important impact. The update consisted in refining the info on the fuel used in the power-plants and the lifespan of the plants making use of updated data-sources

Emissions from Power Generation in Estonia are almost the 95% of country SO2 emissions having as a main fuel "Oil shale".

The inventory resolution is 0.1degx0.1deg and when important sources of emissions falls on the country border, the extraction methodology can lead in accounting the emissions to a neighbor country.

This is an improvement in the emissions spatialisation

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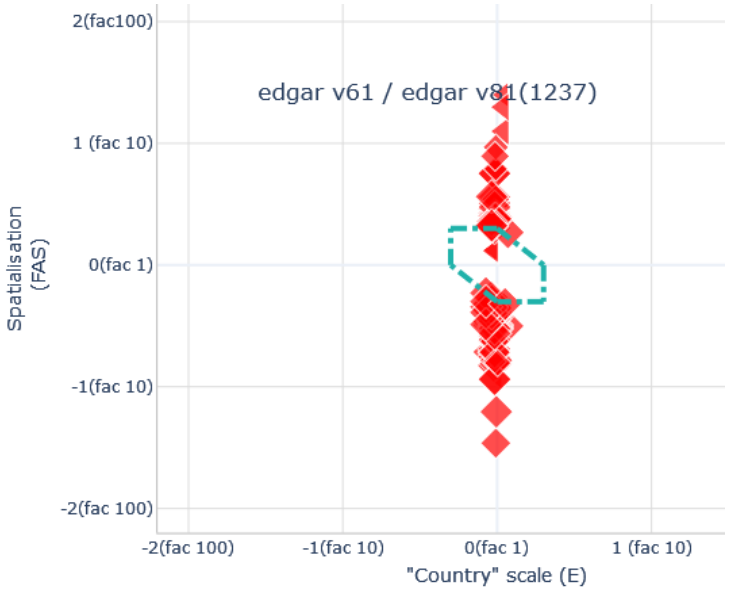
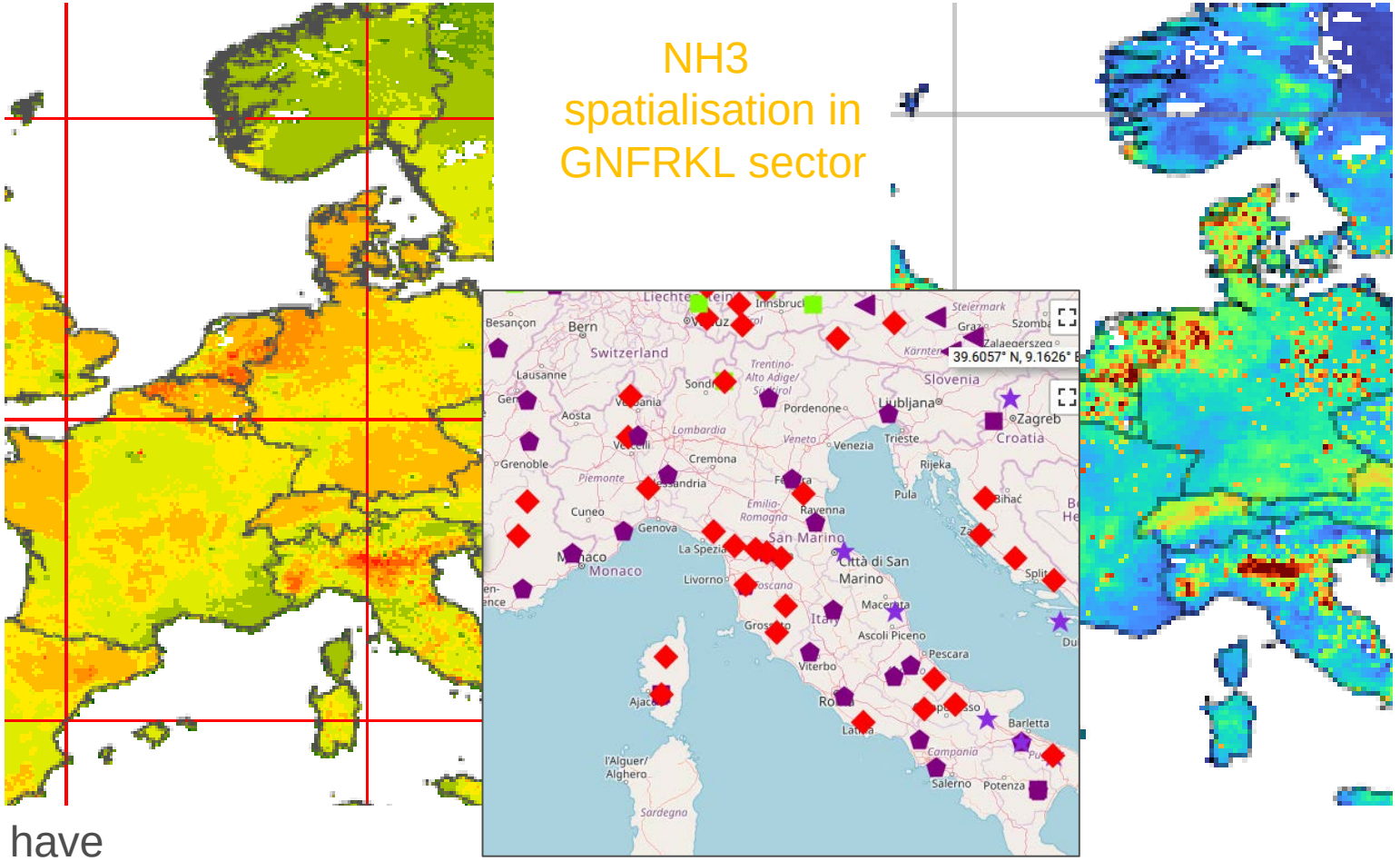
EDGAR: v61vs81

Can we explain them?



NH3 spatialisation in GNFRKL sector



Intensive livestock emissions distribution have been improved including specific point-sources (previously the distribution was done only on animals population density proxy)

This is an improvement in the emissions spatialisation

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What are the mail lessons learned?

- The continuous update of activity data, emissions factors and technologies in addition to the revision and refining of the spatialisation of the emissions possibly lead to sensible differences between EDGAR data releases as identified by the tool.

- Point sources / hotspots location are source of uncertainty in emissions grid-maps geo-processing.

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Wishlist

- it would be useful to have the GNFR sectors description somewhere (even as hint on the codes)
- The possibility to have the benchmarking done at nuts2 level would be of help when comparing global inventories
- Include a “country attribute” to the “top down” inventories to limit the issue on the borders gridcell allocation
- Comparison between EDGAR v8 and CAMS and/or local inventories would be useful to better understand EDGAR, and the direction of changes in comparison to other dataset

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Thank you

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FAIRMODE WG7
Contribution from Germany

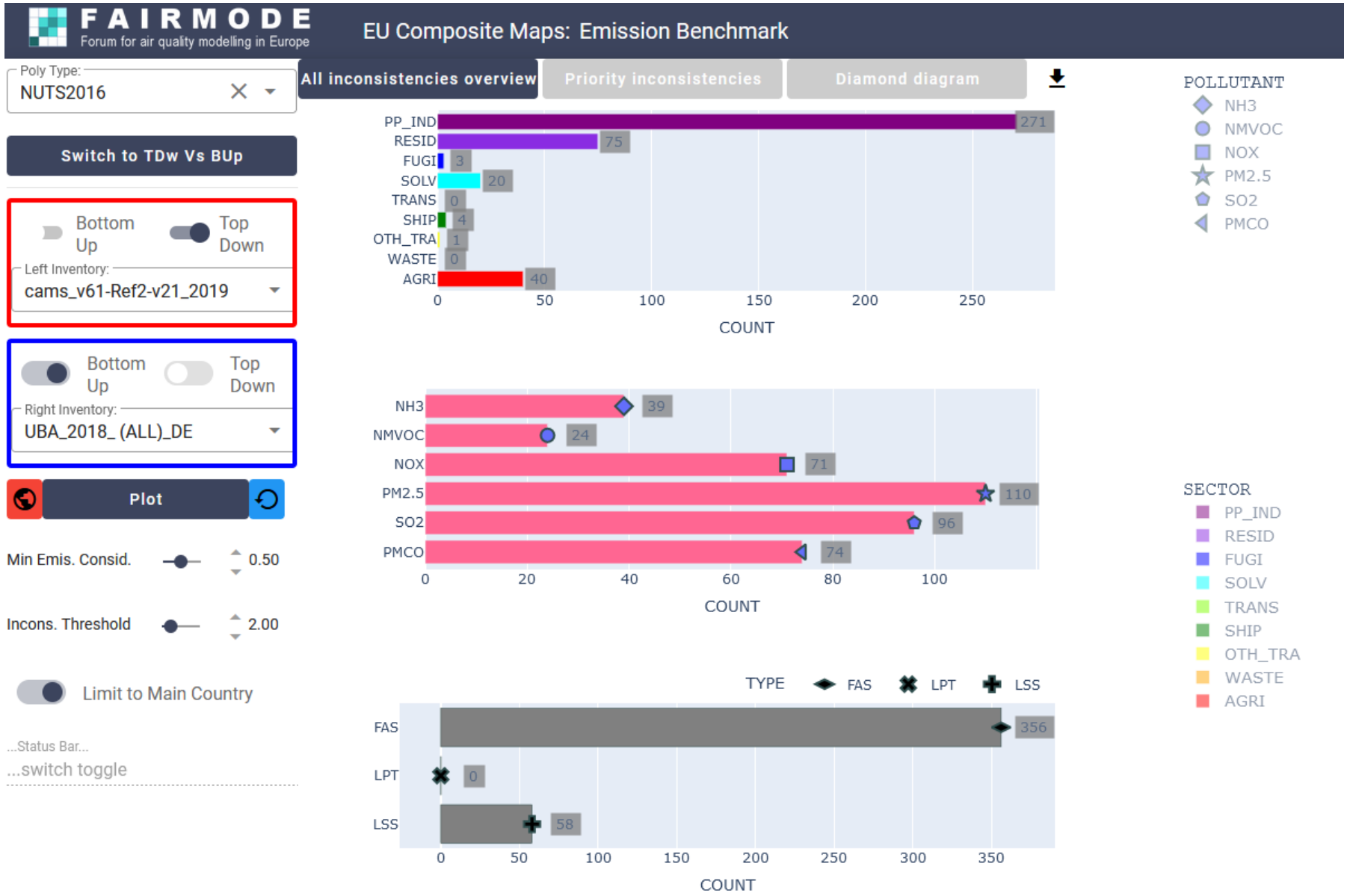
European Commission

Joint Research Centre

Introduction – Test for Germany

- Germany national emission inventory year 2018 (Submission 2020)
- Used for model run for the year 2019 (link to QGIS composite mapping)
- Greta (Gridding Tool for ArcGIS) version 1.2 → spatial distribution of national emissions
- Suggestion: Label the inventory / Gridding tool version (metadata) → document changes in the emission inventory and the Gridding Tool (add metadata for each dataset)
- Greta documentation: https://iir.umweltbundesamt.de/2024/general/griddes_data/start
- Kontakt: German Environment Agency, Stefan Feigenspan, stefan.Feigenspan@uba.de

What are the main lessons learned?



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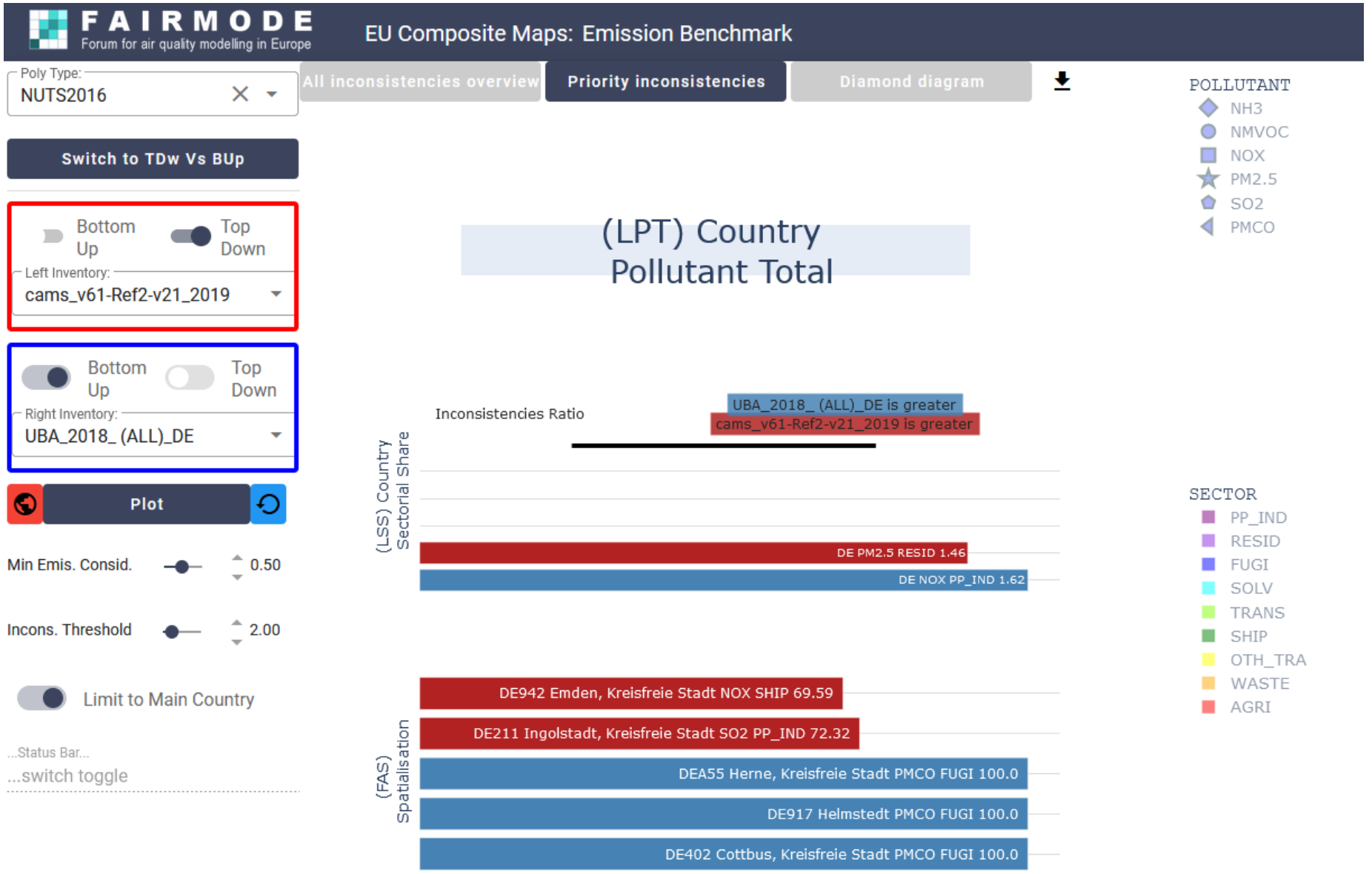

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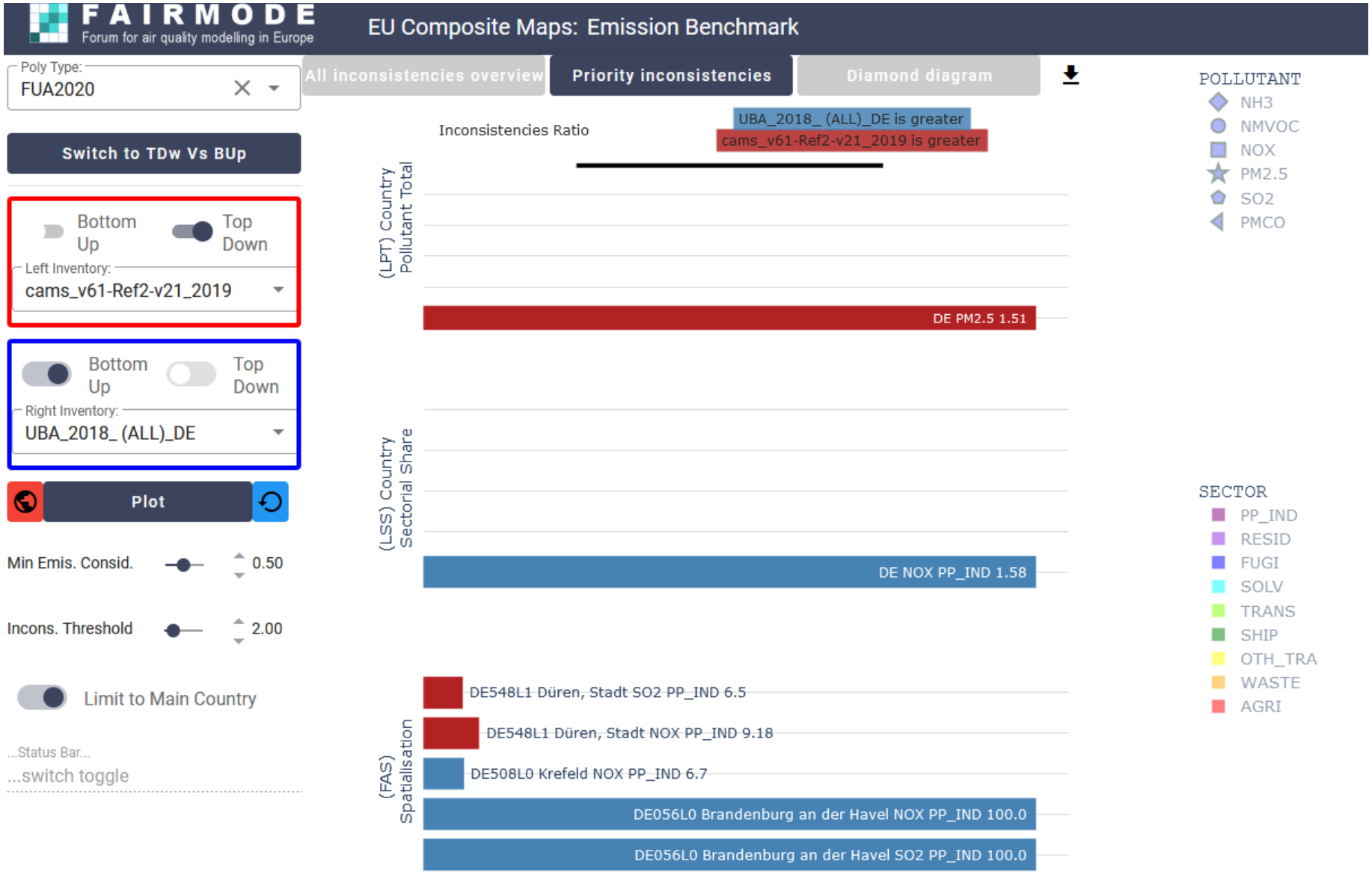
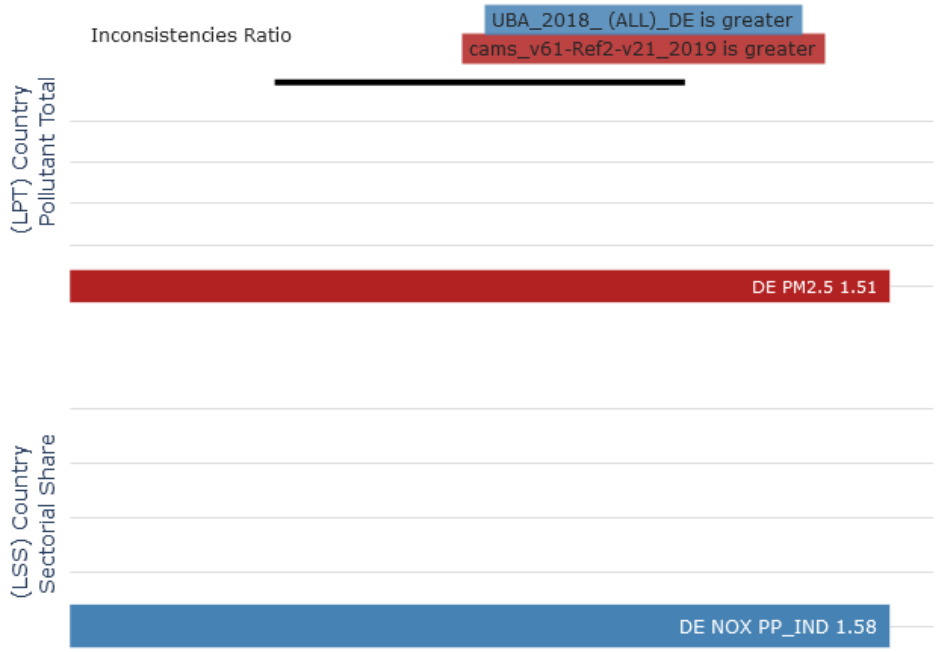
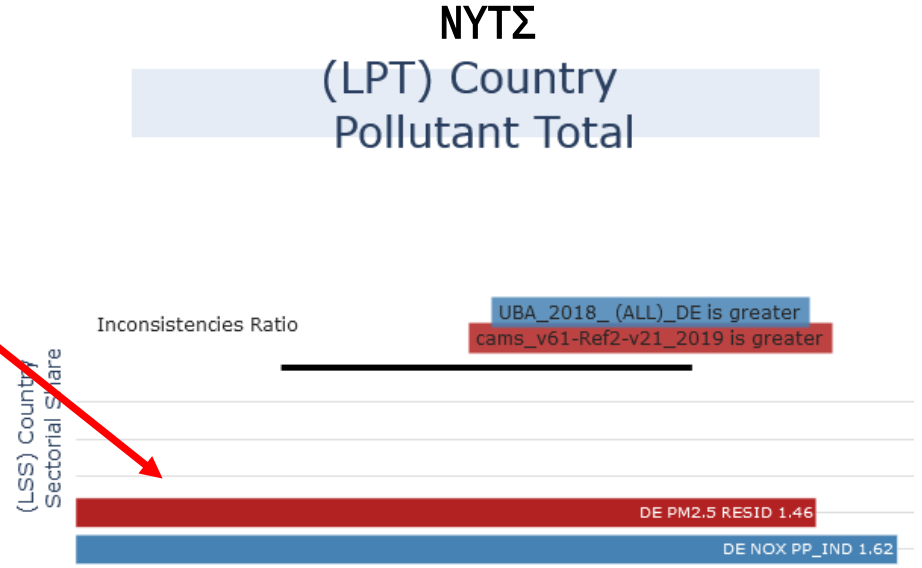


- Αρε τηεμ τηε σαμε ιν ΝΥΤΣ ανδ ΦΥΑ? – ΧΑΜΣ ωσ Γρετα

ΦΥΑ



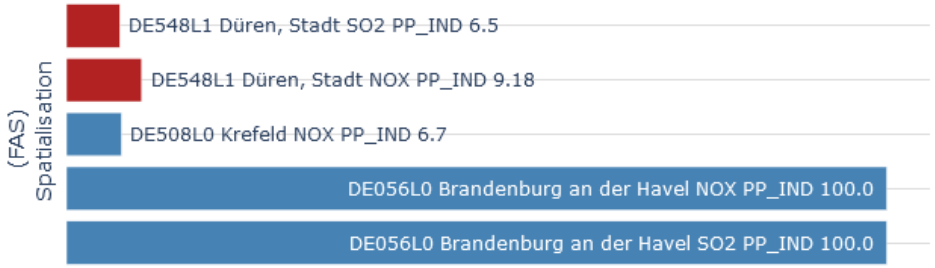
ΝΥΤΣ



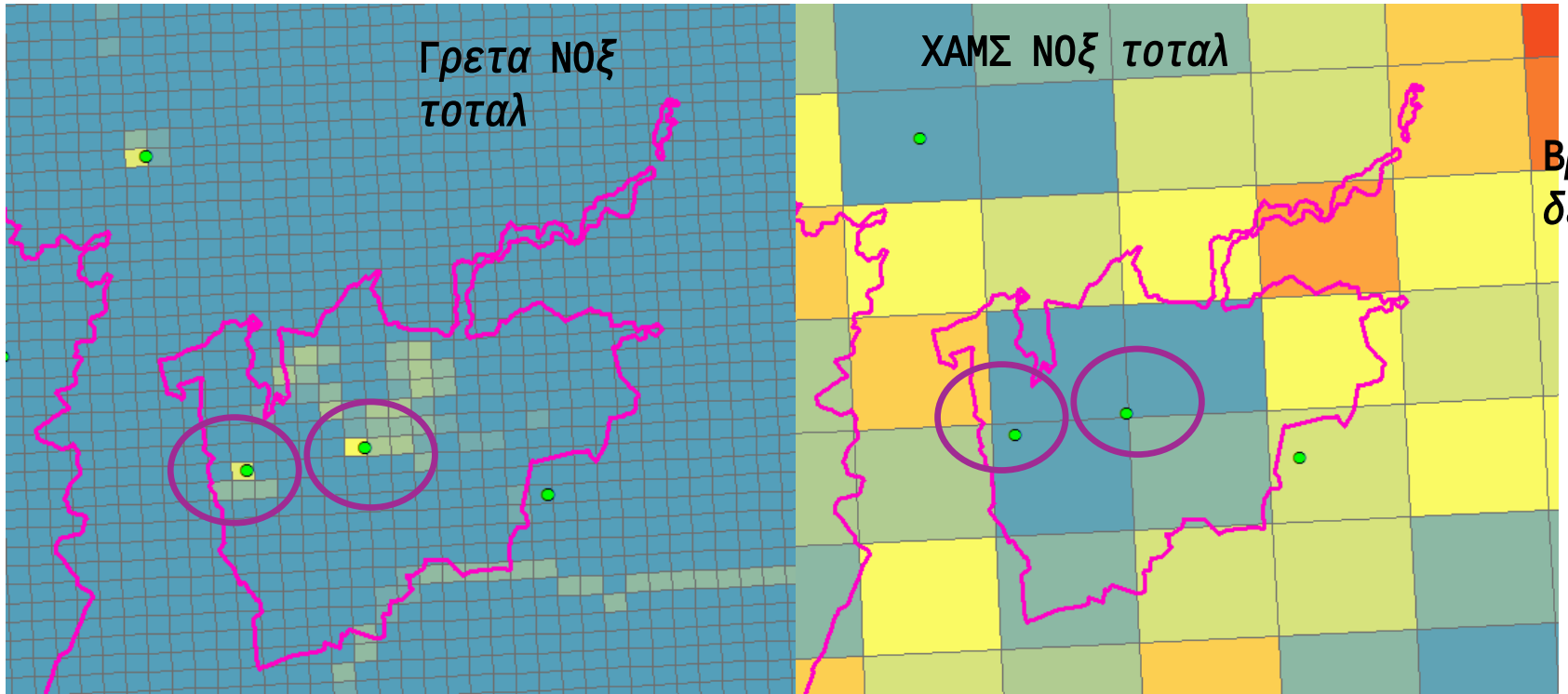
- ΦΥΑ δον't χοωερ τηε ωηολε χουντρψ
- ΠΜ2.5 ρεσιδεντιαλ (χονδενσαβλε ισσυε) σωιτχηεσ φρομ ΛΣΣ το ΛΠΤ? → δυε το διφφερεντ εμισσιον τοταλ (νατιοναλ τοταλ ωσ. ΦΥΑ τοταλ)?
- ΦΥΑ χοωερ μοστ οφ ρεσιδεντιαλ ηεατινγ εμισσιονσ → ηιγηερ σηαρε οφ ηεατινγ εμισσιονσ ιν ρελατιον

- Αρε τηεμ τηε σαμε ιν ΝΥΤΣ ανδ ΦΥΑ? – ΧΑΜΣ ωσ Γρετα

ΦΥΑ



ΝΥΤΣ

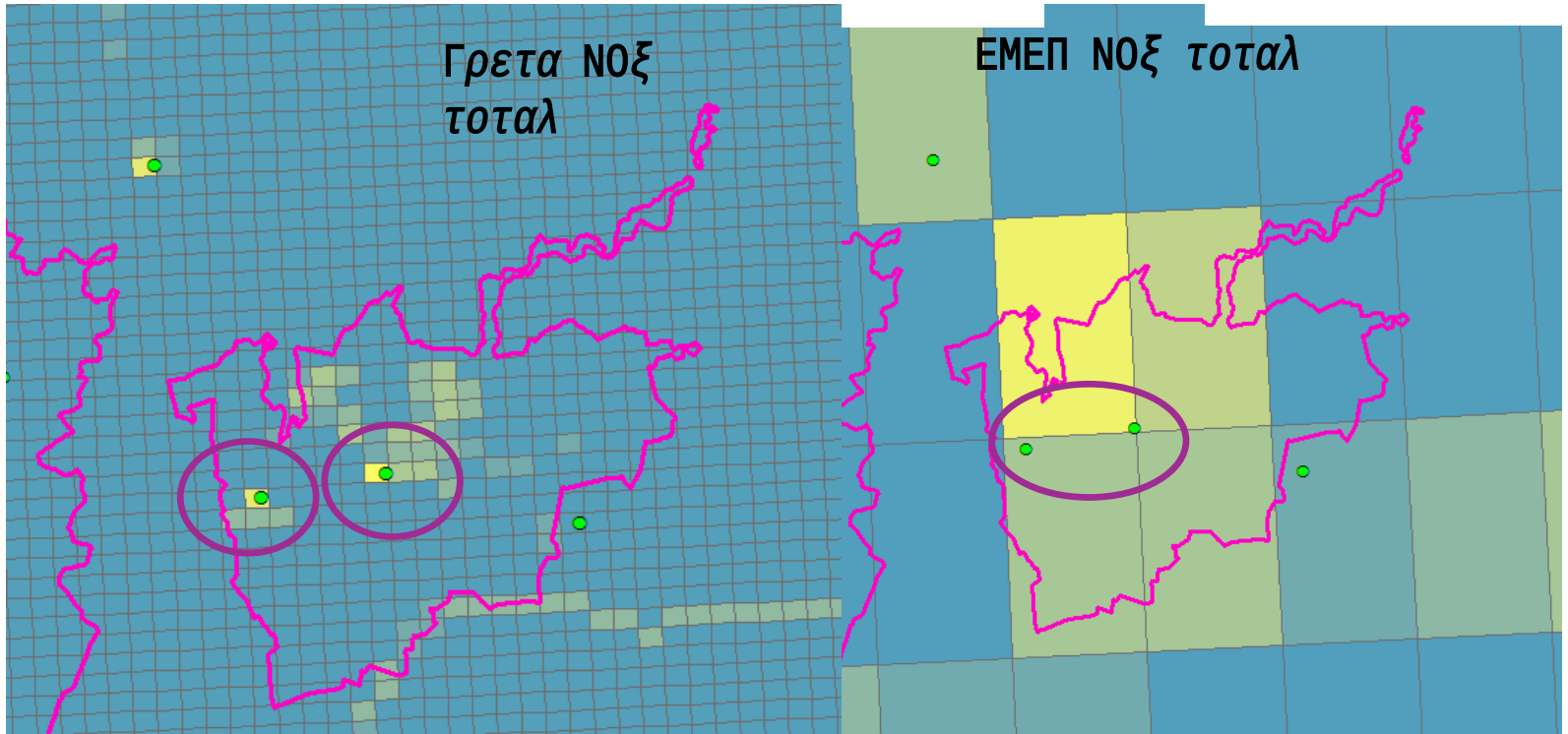


Βρανδενβυργ αν δερ Ηαωελ

- Αρε τηεμ τηε σαμε ιν ΝΥΤΣ ανδ ΦΥΑ? – ΧΑΜΣ ωσ Γρετα

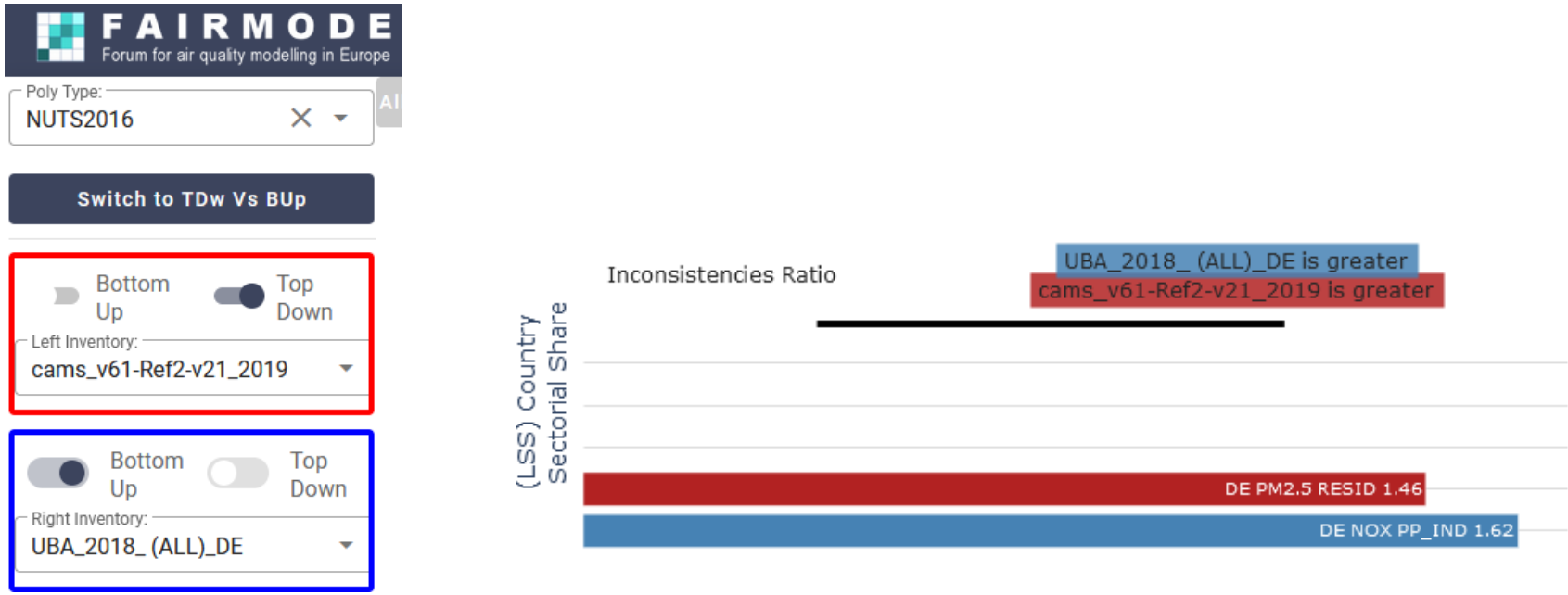
ΦΥΑ

ΝΥΤΣ



Βρανδενβυργ αν δερ Ηαωελ

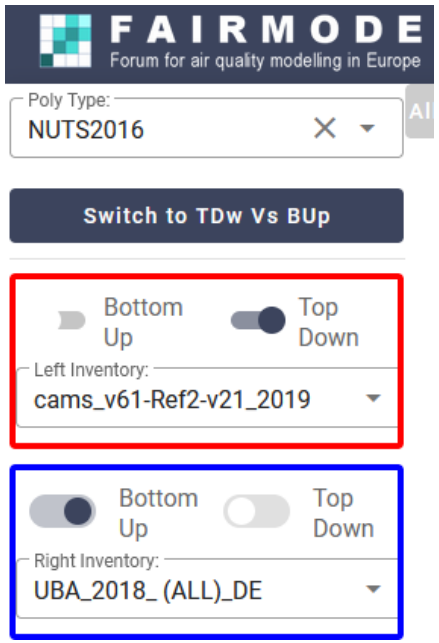
- *Χαν ωε εξπλαιν τηεμ? – ΛΣΣ ινχονσιστενχιεσ*



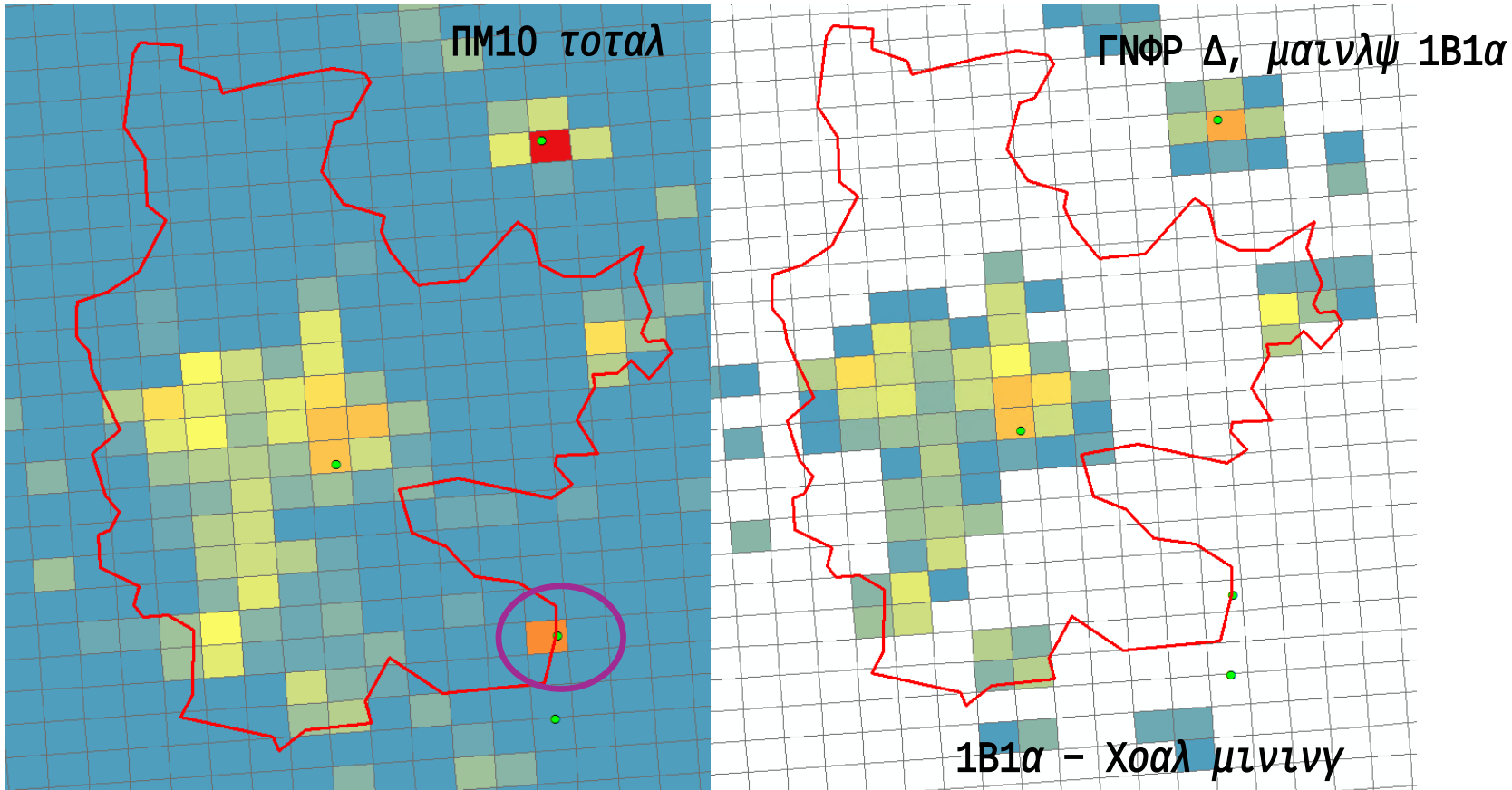
- ΔΕ ΠΜ2.5 *ρεσιδεντιαλ* → ΧΑΜΣ *ινχλυδεσ χονδενσαβλε εμισσιον, ωηιχη αρε νοτ ρεπορτεδ ιν τηε Γερμαν ινωεντορψ φορ ρεσιδεντιαλ ηεατινγ*

- ΔΕ ΝΟξ ΠΠ_Ινδ → *χομπαρισον βετωεεν* 2018 / 2019? → *ηιγηερ εμισσιον ιν* 2018?

- Χαν ωε εξπλαιν τηεμ? – ΦΑΣ ινχονσιστενχιεσ

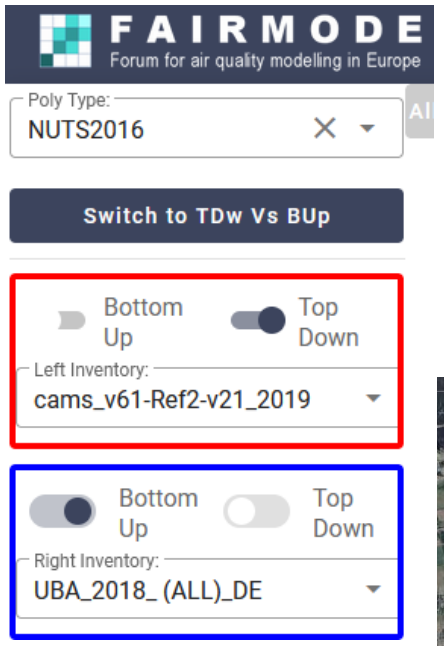


Χοττβυσ – ΠΜΧΟ

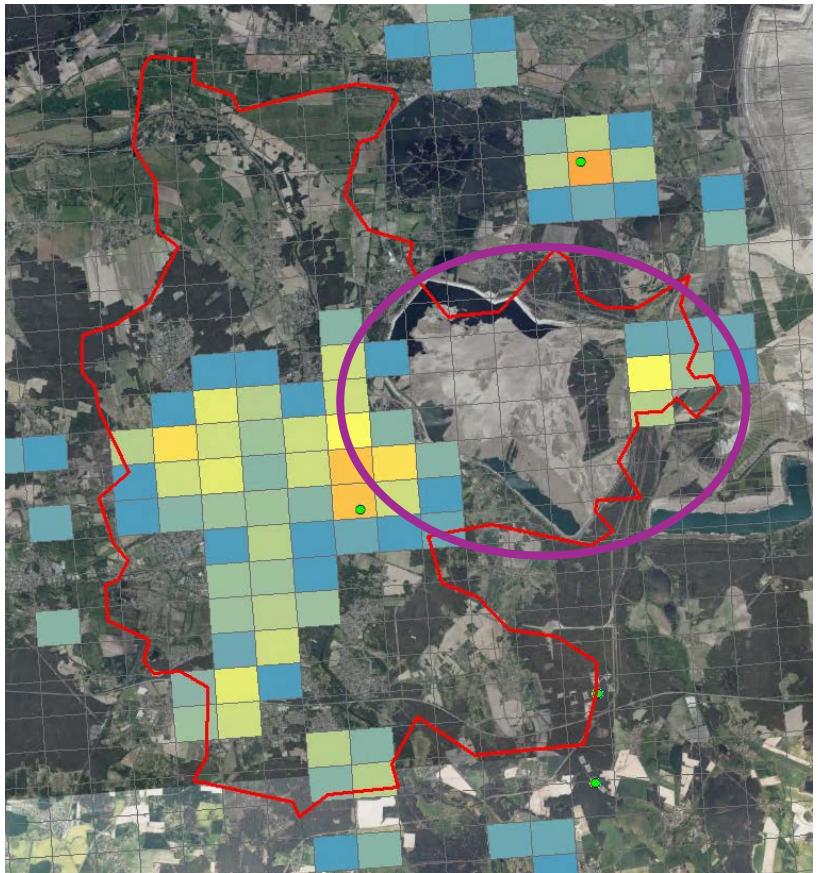


- Χαν ωε εξπλαιν τηεμ? – ΦΑΣ ινχονσιστενχιεσ

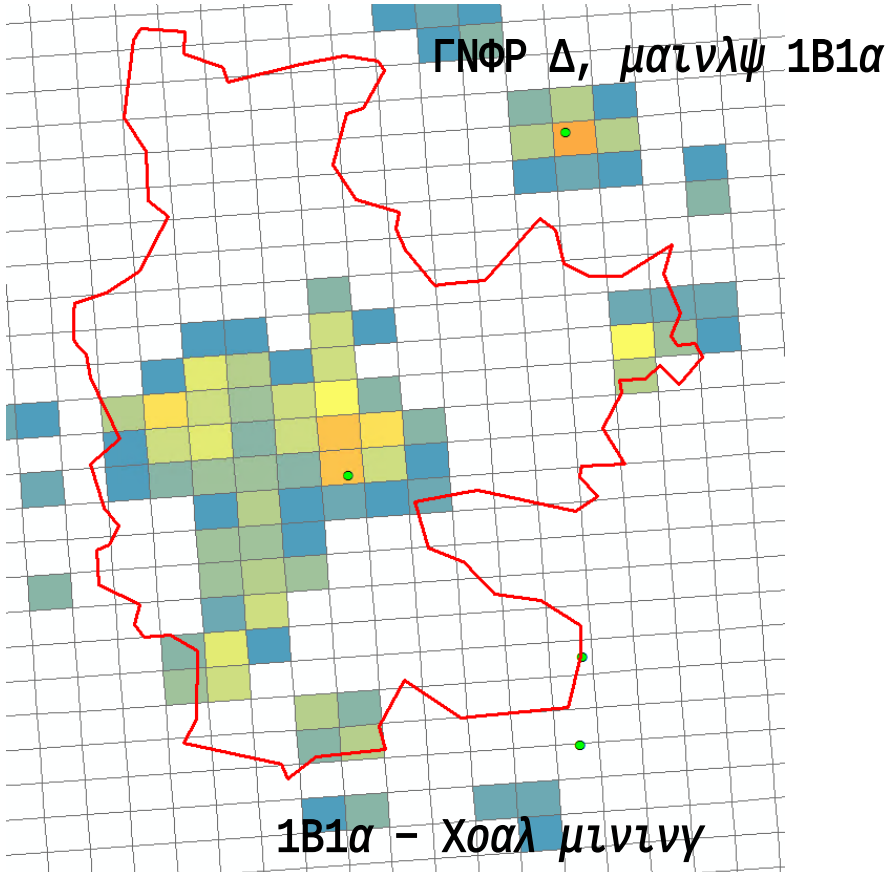
Ουτχομε: Αλλοχατιον ισσυε οφ 1Β1α



- Στατιστιχαλ δατα “εμπλοψεεσ” ατ διστριχτ λεωελ χοαλ μινινγ → ινδυστριαλ αρεασ ΧΟΡΙΝΕ
- Διφφερεντ διστριβυτιον ιν ΧΑΜΣ?



Χοττβυσ – ΠΜΧΟ

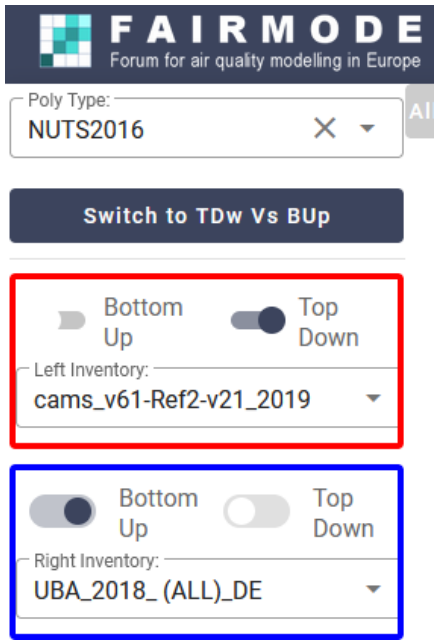


ΓΝΦΡ Δ, μαινλψ 1Β1α

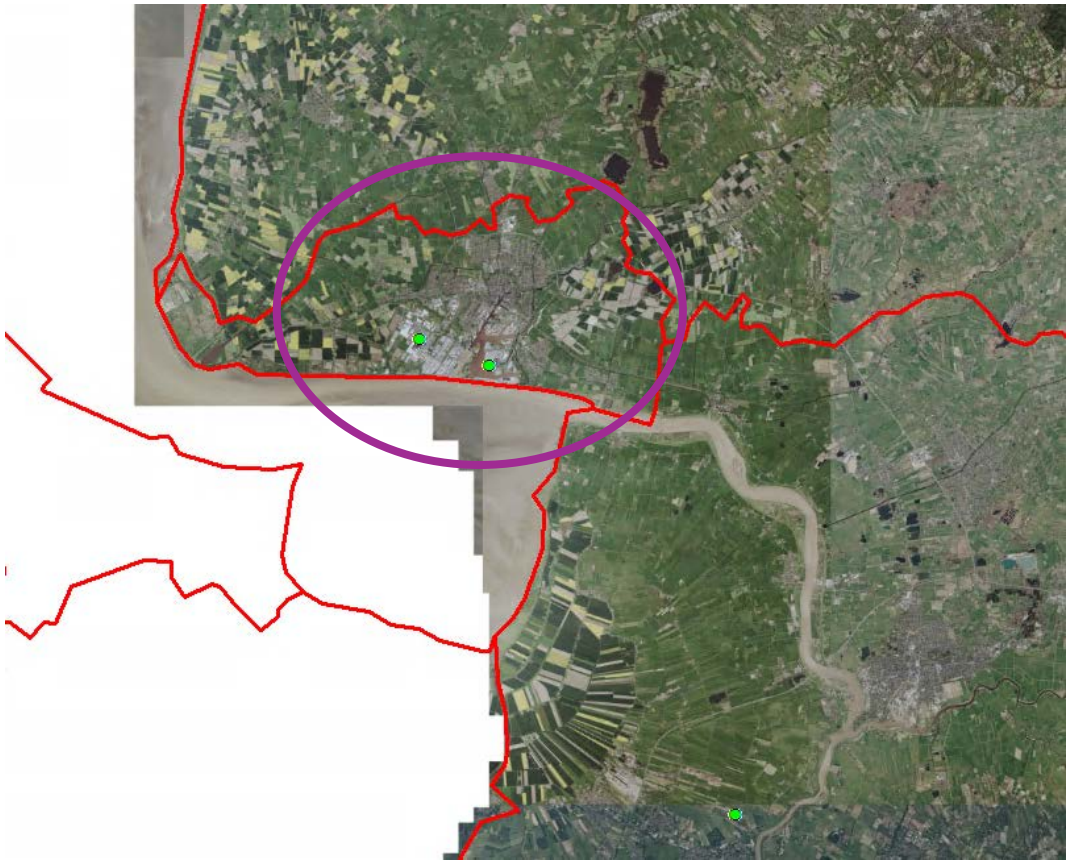
1Β1α – Χοαλ μινινγ

- Χαν ωε εξπλαιν τηεμ? – ΦΑΣ ινχονσιστενχιεσ

Ουτχομε: ιντερνατιοναλ σηιππινγ νοτ ινχλυδεδ ιν νατιοναλ ινωεντορψ



Εμδεν ΝΟξ Σηιπ



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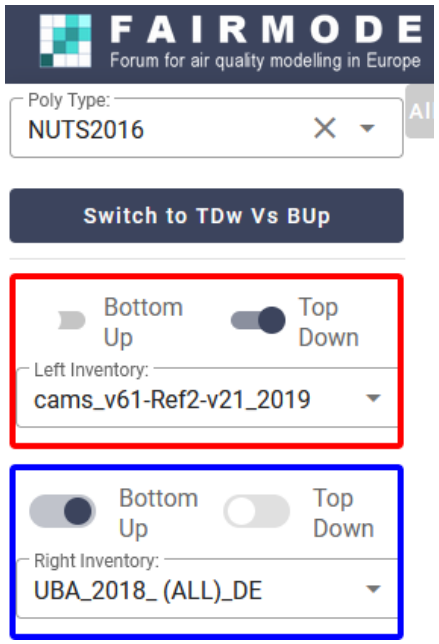
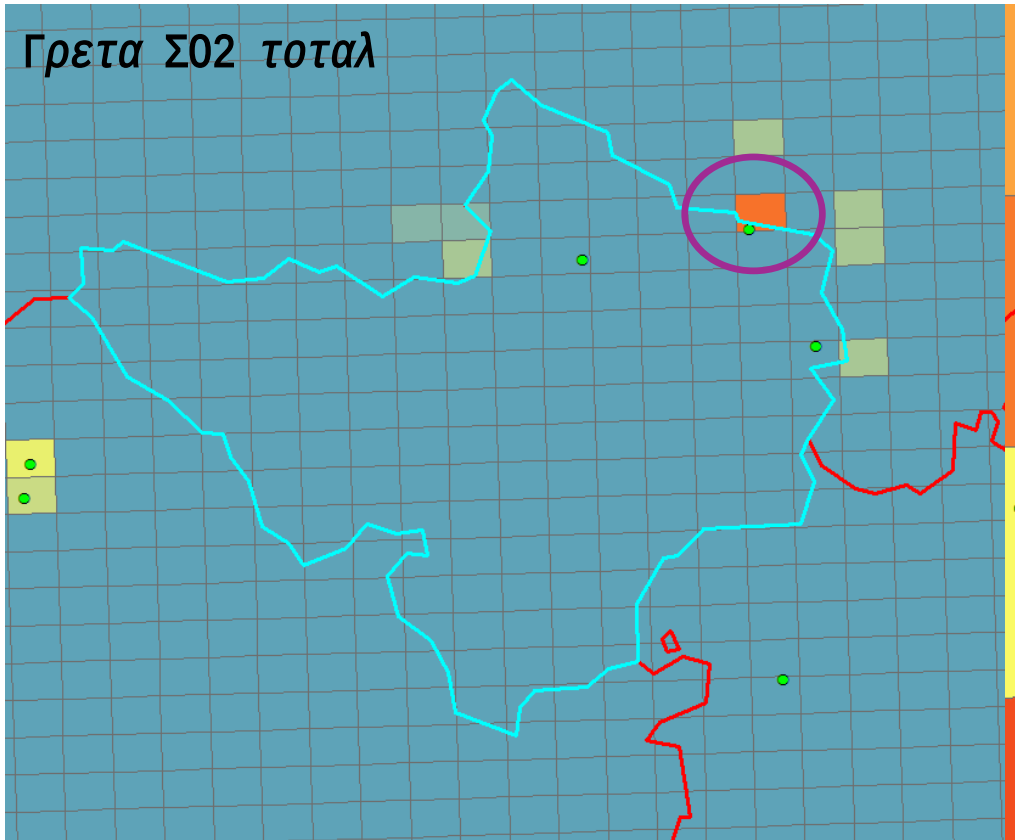
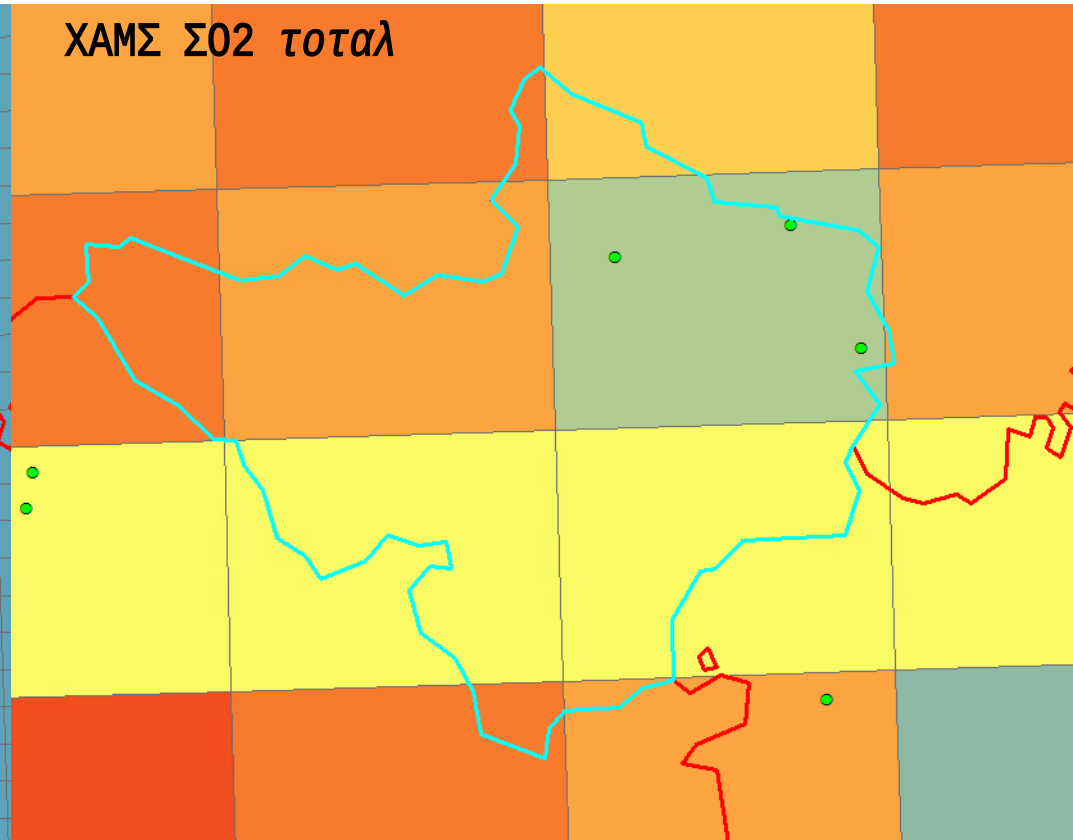


Ουτχομε:

- ΣΟ2 ποιντ σουρχε λοχατεδ ιν τηε διστριχτ
- ΒΥΤ γριδ χελλ χεντροιδ ισ ουτσιδε (γριδσ αρε αλλοχατεδ το α πολψγον, ιφ τηειρ χεντροιδ ισ ινσιδε)

Ινγολσταδτ
ΣΟ2 ΠΠ_ΙΝΔ





- Ωηατ αρε τηε μαιν ινχονσιστενχιεσ φουνδ?
  - (ΦΑΣ) σπατιαλιζατιον

- Αρε τηεσε ινχονσιστενχιεσ εξπεχτεδ?
  - Ψεσ:
    - ιντερνατιοναλ σηιππινγ νοτ ινχλυδεδ ιν νατιοναλ ινωεντορψ
    - ΠΜ εμισσιονσ ΓΝΦΡ Χ → ΧΑΜΣ-ΡΕΓ χονταινσ χονδενσαβλε εμισσιονσ
    - Ισσυεσ οφ ποιντ σουρχεσ → σπατιαλ ρεσολυτιον ισσυε → αλλοχατιον οφ ποιντ σουρχεσ
  - Νο:
    - ΠΜΧΟ ΓΝΦΡ Δ (φυγιτιωε) ισσυε → σεε εξπλανατιον

- Αρε τηεμ τηε σαμε ιν ΝΥΤΣ ανδ ΦΥΑ?
  - Νο:
    - (ΛΠΤ) → ΠΜ2.5 ΓΝΦΡ Χ ινχονσιστενχψ ιν ΦΥΑ χομπαρισον → χονδενσαβλε
    - ΠΜΧΟ ΓΝΦΡ Δ (φυγιτιωε) νοτ ιν ΦΥΑ → ΝΥΤΣ ρεγιονσ Ηερνε, Ηελμστεδτ, Χοττβυσ αρε ινσιδε βιγγερ ΦΥΑ αρεασ (λοωερ ρελεωανχε οφ σεχτορ 1Β1β)

- Αρε τηε ινχονσιστενχιεσ τηε σαμε ωηεν χομπαρινγ το ΧΑΜΣ-ΡΕΓ ανδ ΕΜΕΠ?
  - Νο → σεε σχρεενσηοτσ

Ιμπορταντ ουτχομε φορ χομπαρισον το ΕΜΕΠ:

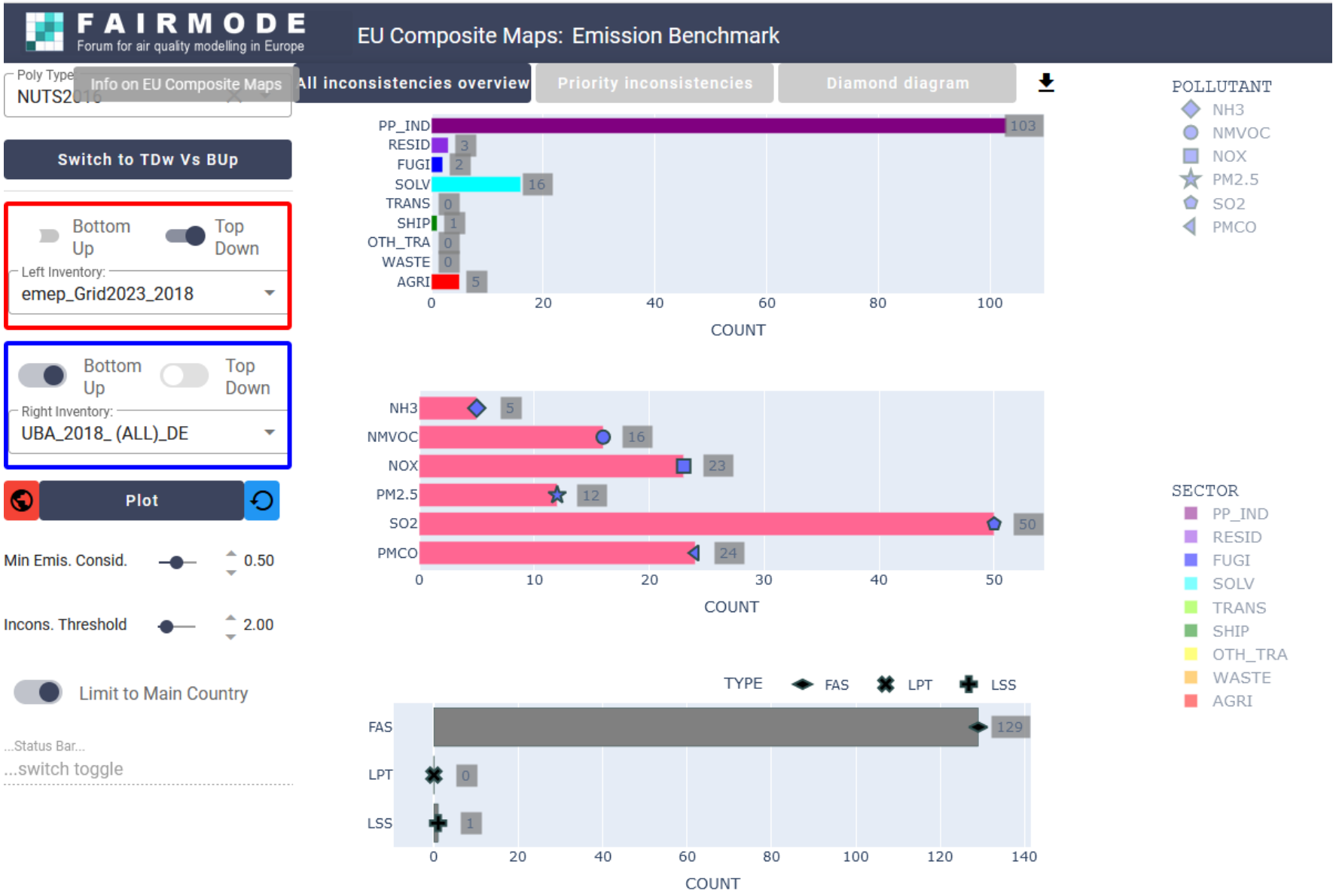
- Ιμπορτανχε οφ ρεσολυτιον → σπατιαλιζατιον ηασ το βε δονε φορ διφφερεντ ρεσολυτιον σεπαρατελψ → δοωνσχαλινγ φρομ χοαρσερ γριδ το ηιγηερ ρεσολυτιον μαψ λεαδ το α δισπλαχεμεντ οφ (ποιντ, λινε)

- Anψ συγγεστιονσ το ιμπροωε τηε τοολ?

  - Λαβελ δατασετσ → ινωεντορψ συβμισσιον, Γριδδινγ τοολ ωερσιον
  - Πλεασε υσε οφφιχιαλ ΓΝΦΡ χατεγορψ ναμεσ
  - Υπλοαδ ιμπροωεδ εμισσιον δατασετσ (νεω συβμισσιον, Γριδδινγ τοολ) ανδ ρεπεατ χομπαρισον → τραχκ ιμπροωεμεντσ
  - ΠΜΧΟ = ΠΜ10? ορ ΠΜ10 – ΠΜ2.5? → πλεασε χλαριφψ!
  - Πλεασε σιμπλιφψ υπλοαδ οφ δατασετσ

GNFR category	GNFR category name
A	A_PublicPower
B	B_Industry
C	C_OtherStationaryComb
D	D_Fugitives
E	E_Solvents
F	F_RoadTransport
F1	F_RoadTransport_exhaust_gasoline
F2	F_RoadTransport_exhaust_diesel
F3	F_RoadTransport_exhaust_LPG_gas
F4	F_RoadTransport_non-exhaust
G	G_Shipping
H	H_Aviation
I	I_OffRoad
J	J_Waste
K	K_AgriLivestock
L	L_AgriOther

What are the main lessons learned?



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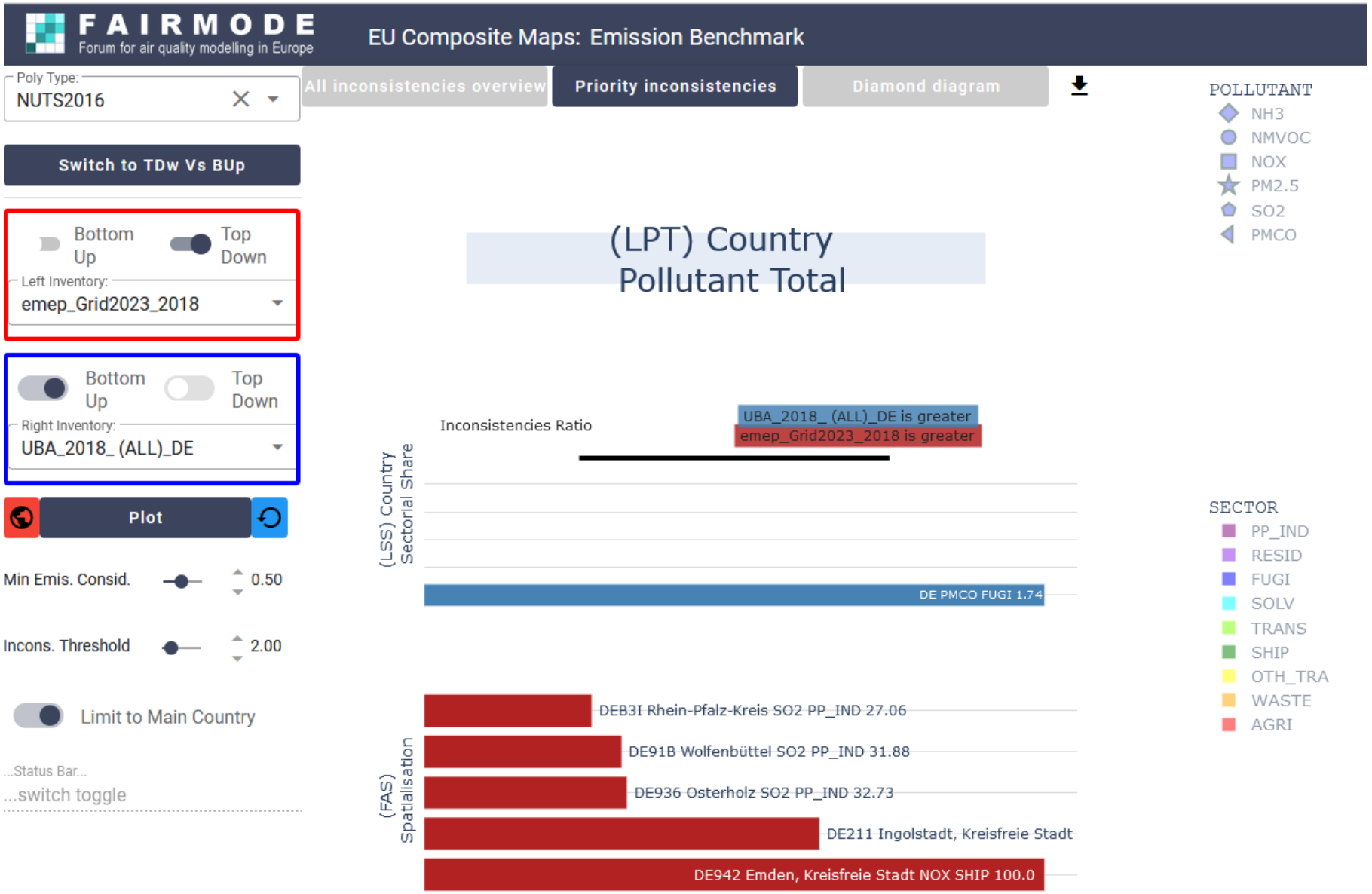
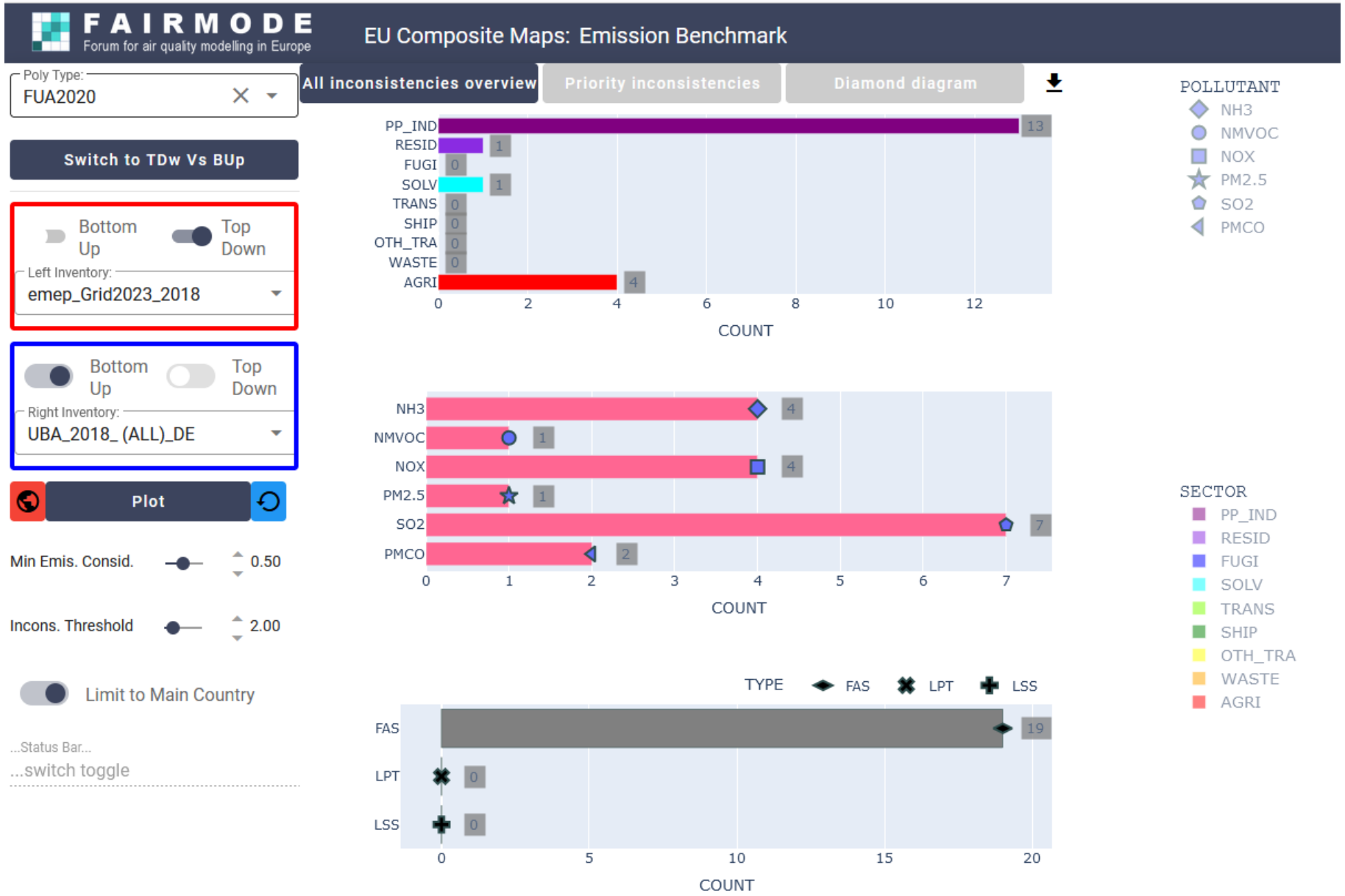


What are the main lessons learned?



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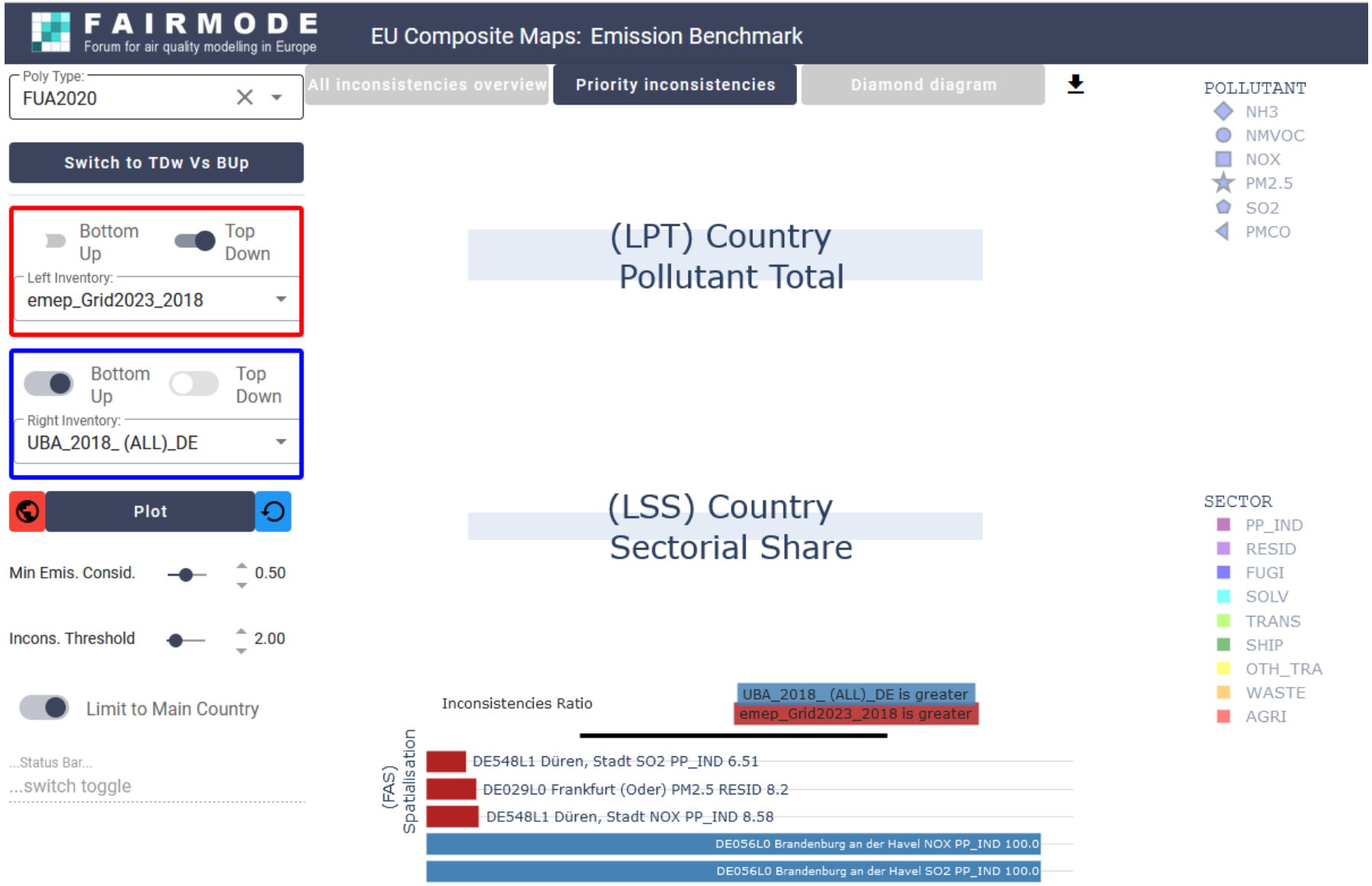


FAIRMODE
Forum for air quality modelling in Europe

Help ?

European Commission
Joint Research Centre

High resolution emission inventories (WG7)

Fairmode technical meeting Dublin 07-09.10.2024

Emissions App

The emission benchmarking tool allows to compare top-down and bottom-up emission inventories, to evaluate inconsistencies among emission inventories estimated with different approaches and at different scales

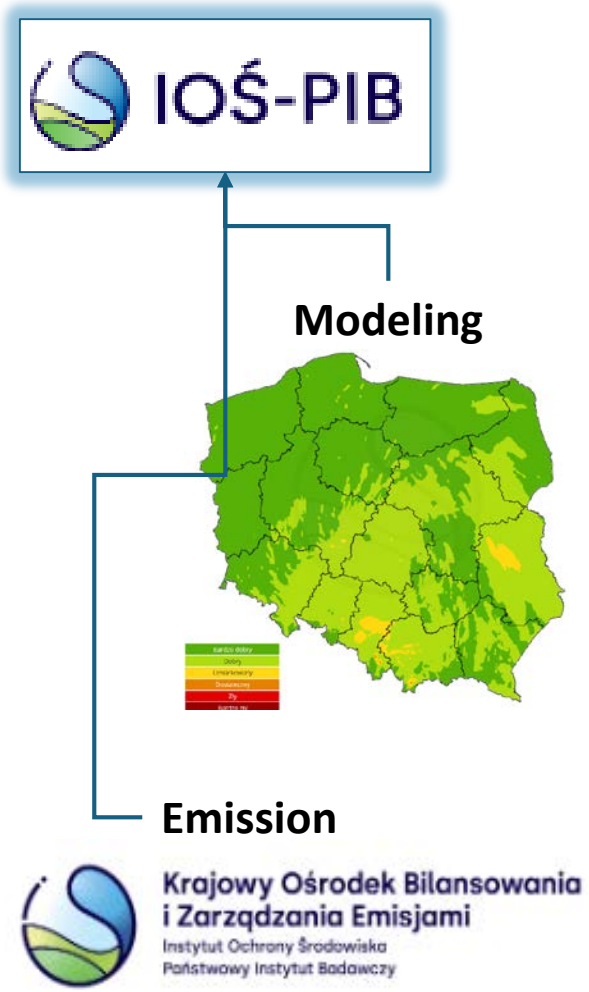
The Institute of Environmental Protection – National Research Institute
National Centre for Emissions Management (KOBiZE)
karol.szymankiewicz@kobize.pl

The Institute of Environmental Protection – National Research Institute (IEP –NRI)

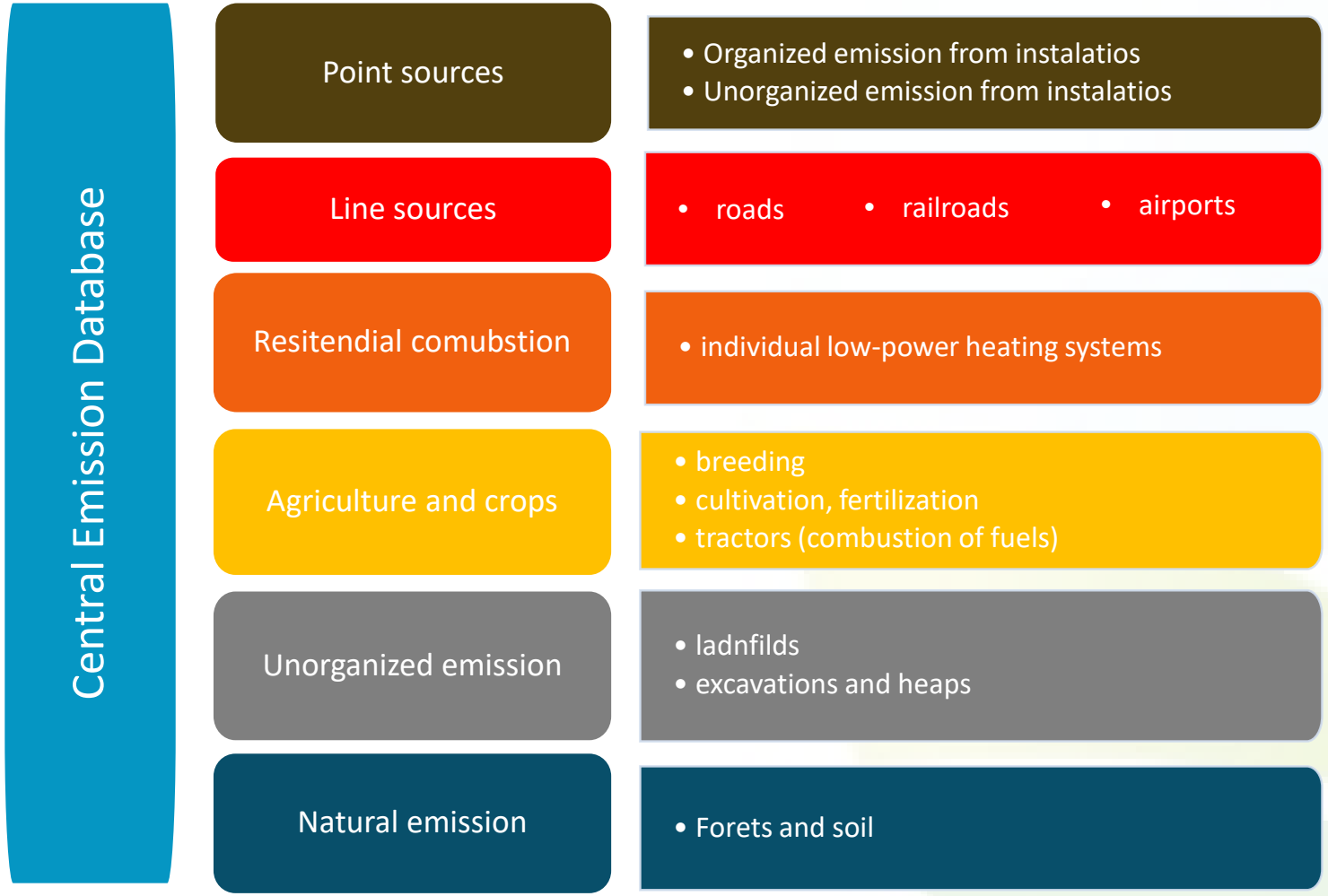
Since 2018 IEP – NRI is responsible for mathematical modelling of the transport and transformation of substances in the air and the analysis of the results on the national level.

Part of IEP-NRI is The National Centre for Emissions Management (KOBiZE) which is responsible for preparation input database of surface, linear and point emission – Central Emission Database (CED).

KOBiZE is also responsible for developing methodologies for determining the size of emissions and collecting data necessary to calculate them.



Central Emission Database



Purpose

Consistent database for national AQ modelling

Pollutions

- sulfur oxides, nitrogen oxides
- CO, PM10, PM2.5
- B(a)P, NMVOC, NH_3 CH_4

Method

- BUP (bottom-up): residential combustion, industrial, road transport
- TOD (top-down): airports, agriculture

Emissions in SNAP and GNFR category

Resolution

- Vector data for each sector
- Sharing in 0.005^ox0.005^o

WG7 benchmarking exercise: Central Emission Data Base for 2020

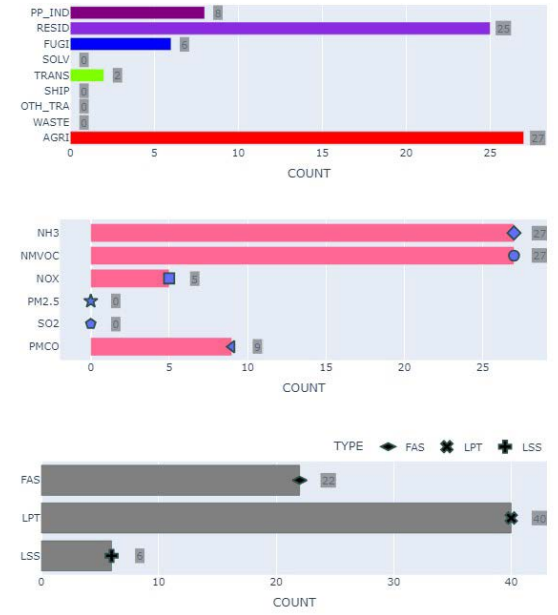
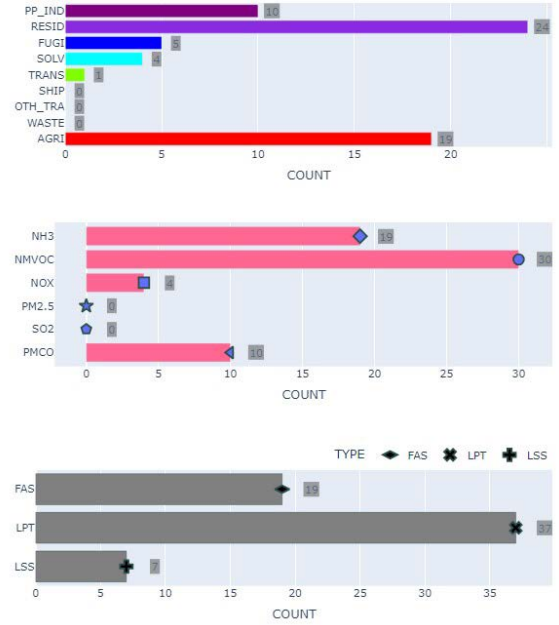
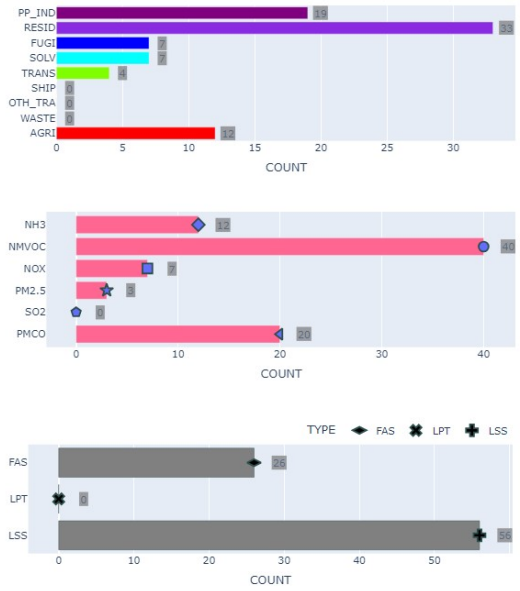
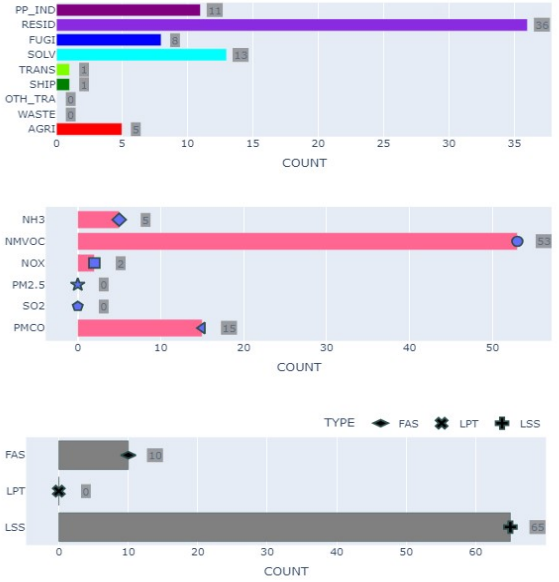
Key questions

- What main inconsistencies were detected?
- Can such inconsistencies be expected?
- Are they the same in NUTS and FUA?
- Are the inconsistencies the same when comparing CAMS-REG and EMEP?

NMVOC – Residential
NH3 - Agriculture
NMVOC – Solvent & Fugitive
PMCO - Industry

FUA – more inconsistence in LPT (FUA not cover whole country)
NUST - more inconsistence in LSS

CAMS-REG ≈ EMEP

	ΧΑΜΣ	ΕΜΕΠ
ΦΥΑ		
ΝΥΣΤ		

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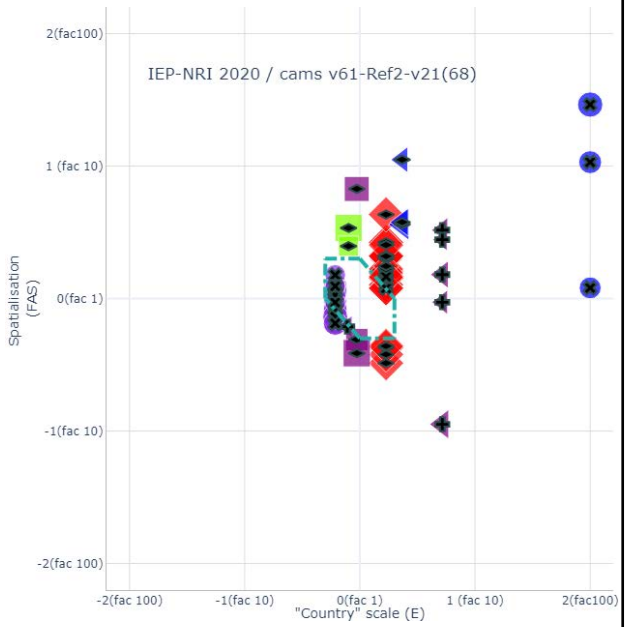
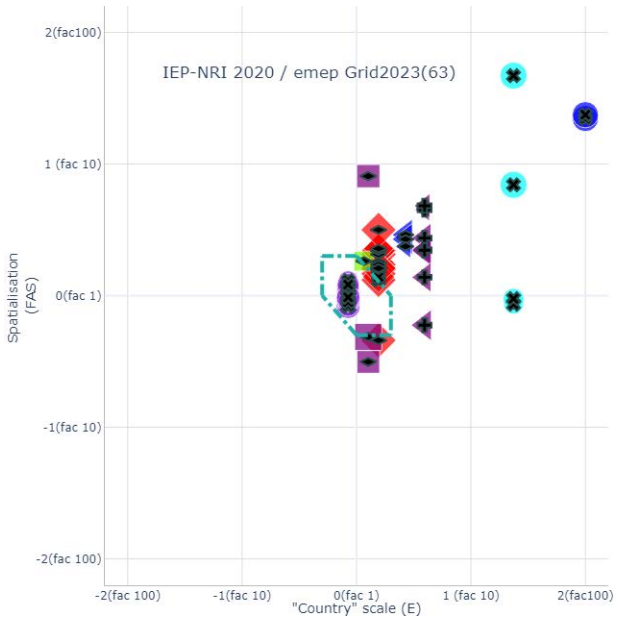
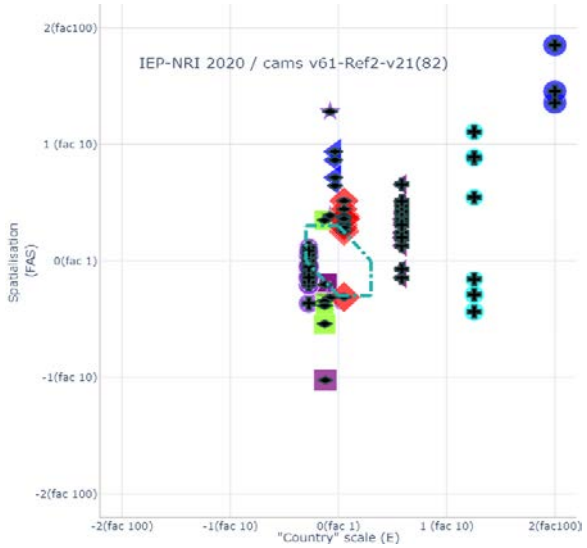
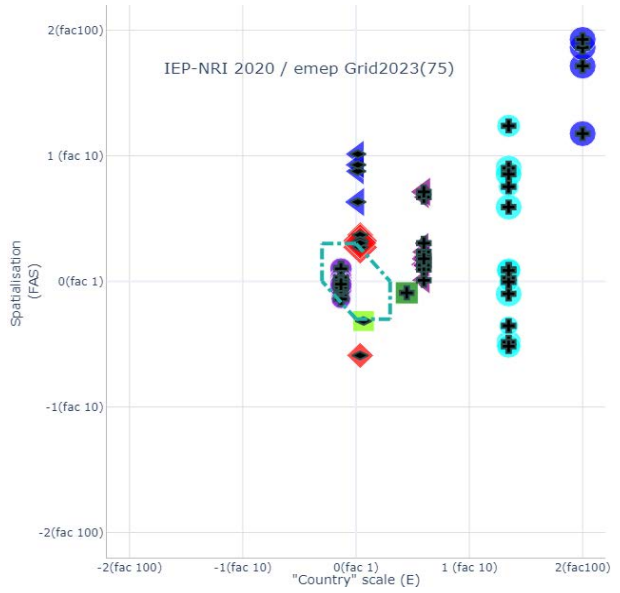
NUST≈FUA

CAMS-REG≈EMEP

	ΧΑΜΣ	ΕΜΕΠ
ΦΥΑ		
ΝΥΣΤ		

Key questions

- Is it possible to explain these inconsistencies?
- Is it possible to solve these inconsistencies?
- Are you stuck at a certain point?
- Need any additional information?

Sector	Pollutant	Explanation
Residential	NMVOC	More detail information in CED (not only fuel consumptions in GNFR C - 1A4bi in country)
Agri	NH3	spatial distribution of data and proxies used in EMEP/CMAS and in CED
Solvent	NMVOC	2D3a - Domestic solvent use including fungicides (not in CED) Entity are not obliged to report NMVOC
Fugitives	NMVOC	1B1a - Fugitive emission from solid fuels: Coal mining and handling Entity are not obliged to report NMVOC
Industry	PMCO	Detail information from Entities (not only census data - EMEP)

What are the main lessons learned?

- CM tool gives a quick answer about notable differences between bottom-up and top-down emission inventories
- Deep knowledge about the national emission indicators/activity data taken into account in reported emissions (EMEP) is needed to understand inconsistencies between top-down and bottom-up approaches.
- There are inconsistencies resulting from different approaches to emission estimation.

Any suggestions to improve the tool?

- Login to app – could it be easier and more available
- In the *All inconsistencies overview* tab, Bottom Plot (FAS, LPT, and LSS) should have the same order as for *Priority inconsistencies* (LPT, LSS and FAS). Also, abbreviations could be explained in this tab.
- For the *Priority inconsistencies* in FAS plot, all areas (FUA and NUTS) should be visible, perhaps with a scrollbar on the left-hand side. Additionally, clicking on each bar representing an area should provide a zoomed-in view or highlight that specific area on the map.
- Changing from NUTS/FUA should not change the inventory that was taken previously
- Exporting to a shapefile or other spatial formats with all statistics from the CSV file would be beneficial.
- Diamond diagram PNG export
  - add FUA/NUTS
  - add legend (Pollutant/sector)
  - name of the exported plot

Krajowy Ośrodek Bilansowania
i Zarządzania Emisjami
Instytut Ochrony Środowiska
Państwowy Instytut Badawczy

Thank you for your attention

Karol Szymankiewicz
Zespół Zarządzania Krajową Bazą
National Database Management Unit

karol.szymankiewicz@kobize.pl
tel. +48 22 5696 536

KOBiZE
The National Centre for Emissions Management
The Institute of Environmental Protection – National Research Institute

WG7 – Compilation of high resolution emission inventories

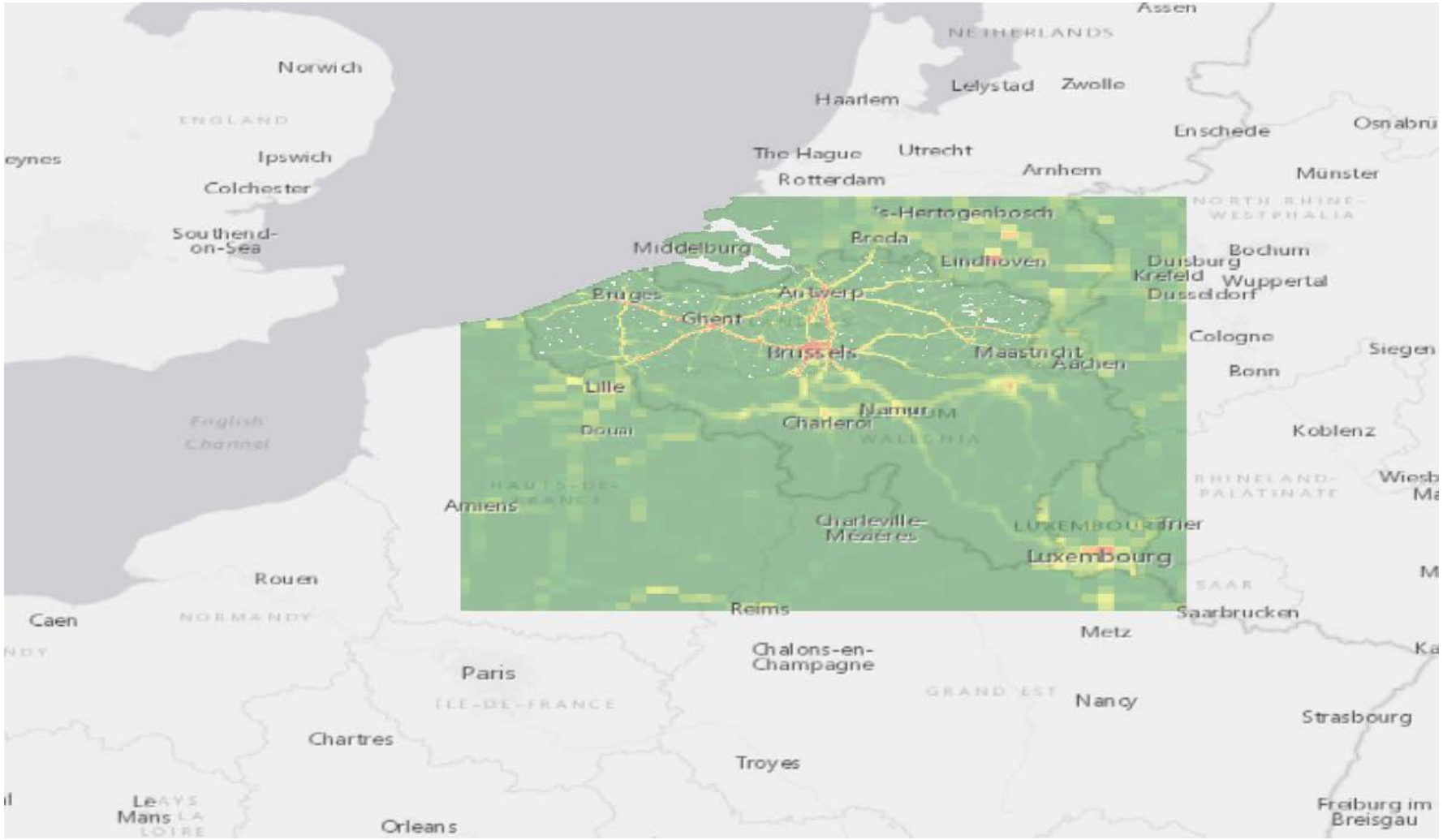
Belgium

Peter Viaene, VITO (responsible for the work)
Jorge Sousa, VITO (just the messanger)

vito

vito.be

Emission MAPper (EMAP) emission inventory for Belgium



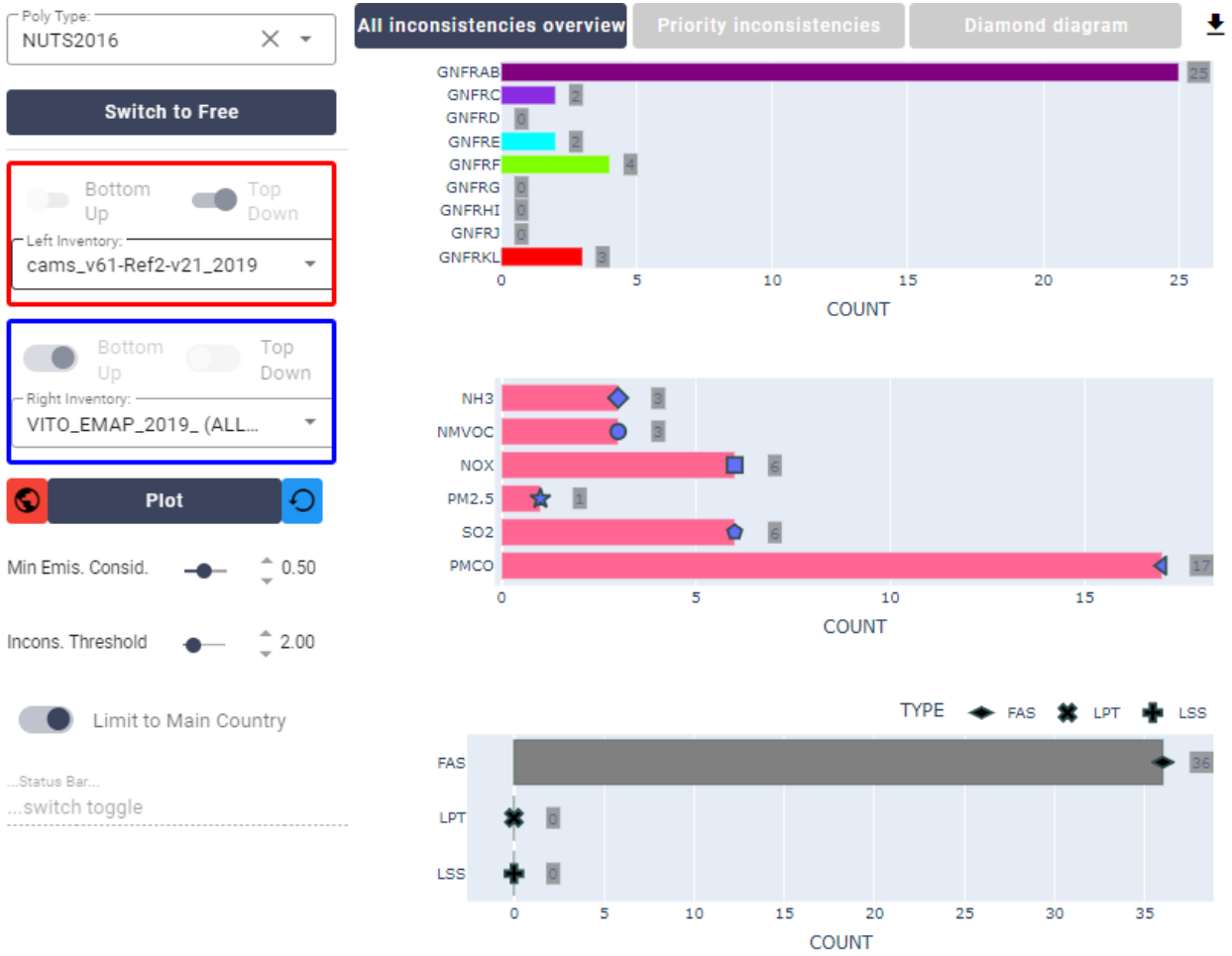
Available for different resolutions for use in AQ modelling

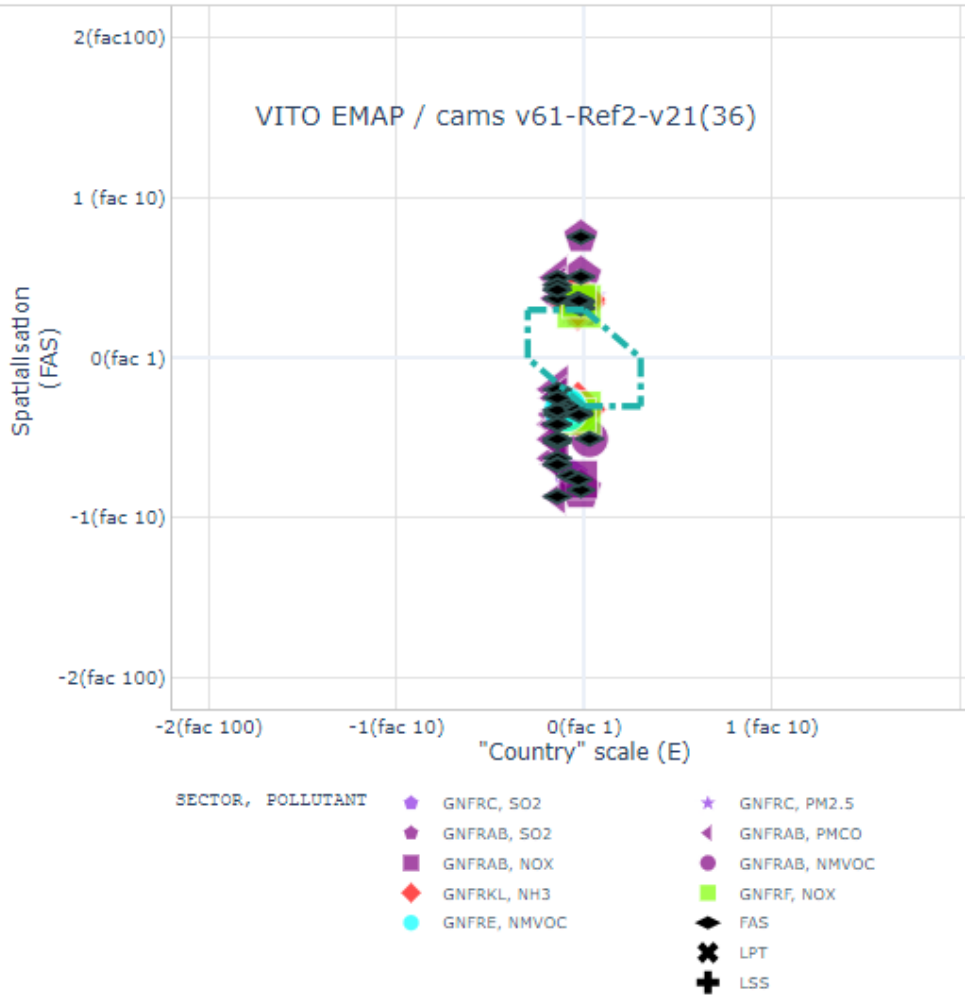
Example to the left:
0.014° x 0.0089°
for Chimere
NOx GNFR F

6 pollutants
9 sectors
=> 54 tif

Main inconsistencies found?

CAMS vs EMAP





Main inconsistencies found?

These inconsistencies are expected …

NO differences:
Emission totals (LPT) + Emission total per sectors (LSS) are consistent between CAMS and VITO EMAP

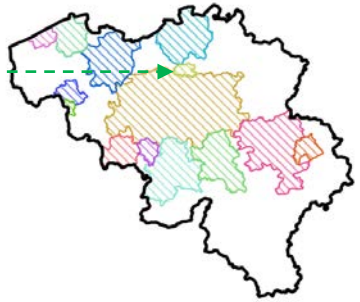
Differences in spatial distribution (FAS) due to differences in the point emission source data

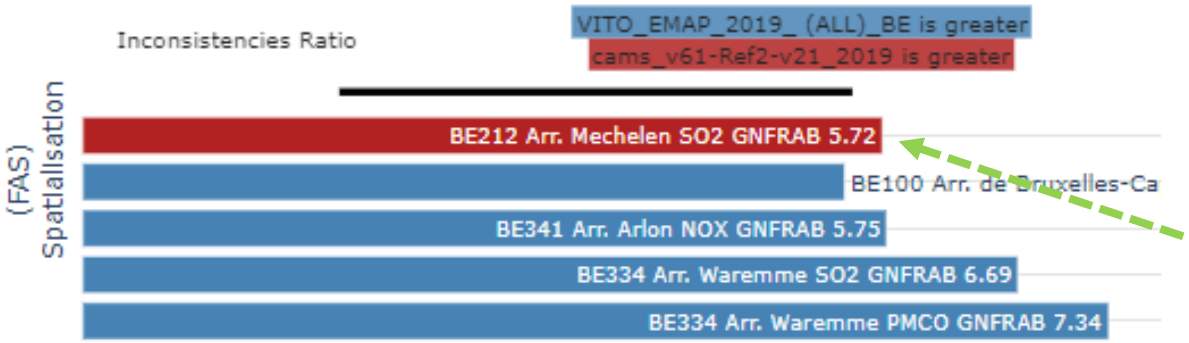
Inconsistencies the same for FUA and NUTS?

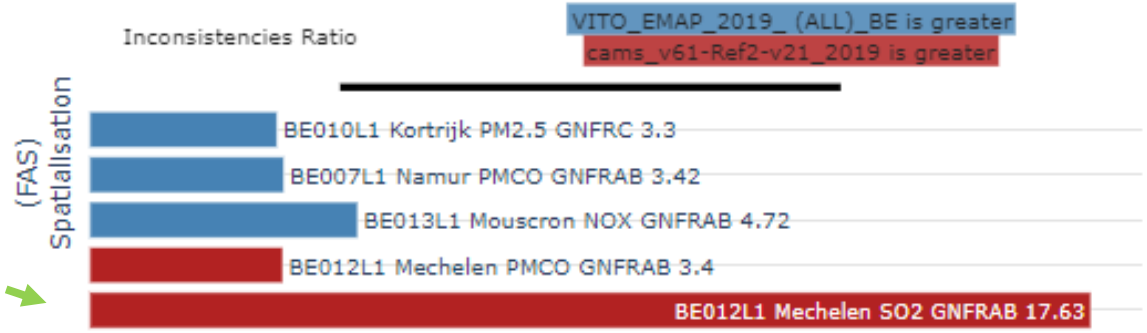
CAMS vs EMAP

NUTS

FUA



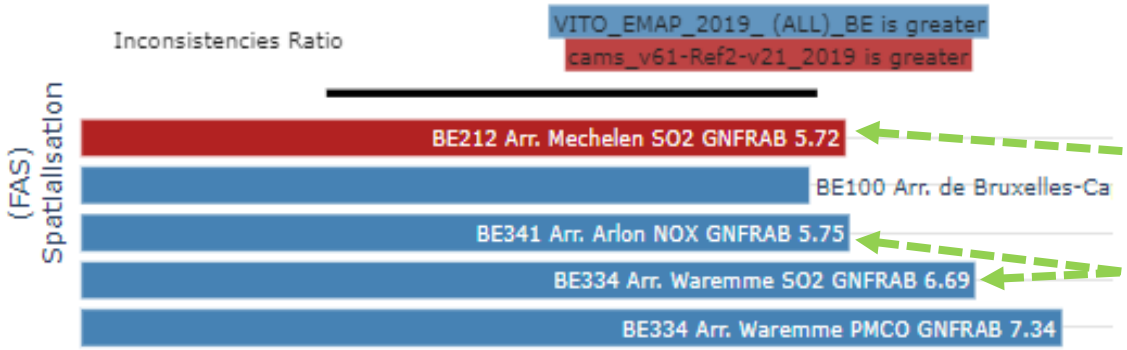




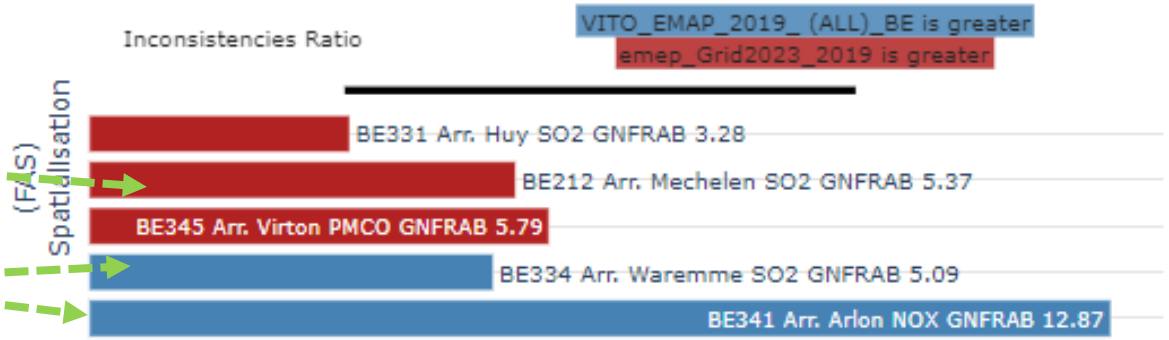
- All major inconsistencies in both cases due to spatial distribution (FAS)
- Only one of these inconsistencies in common between the FUA and NUTS but the size is different for this ‘common’ inconsistency.

Inconsistencies with EMAP the same for EMEP and CAMS?

EMAP_VITO vs CAMS_v61-ref2 v21 _2019

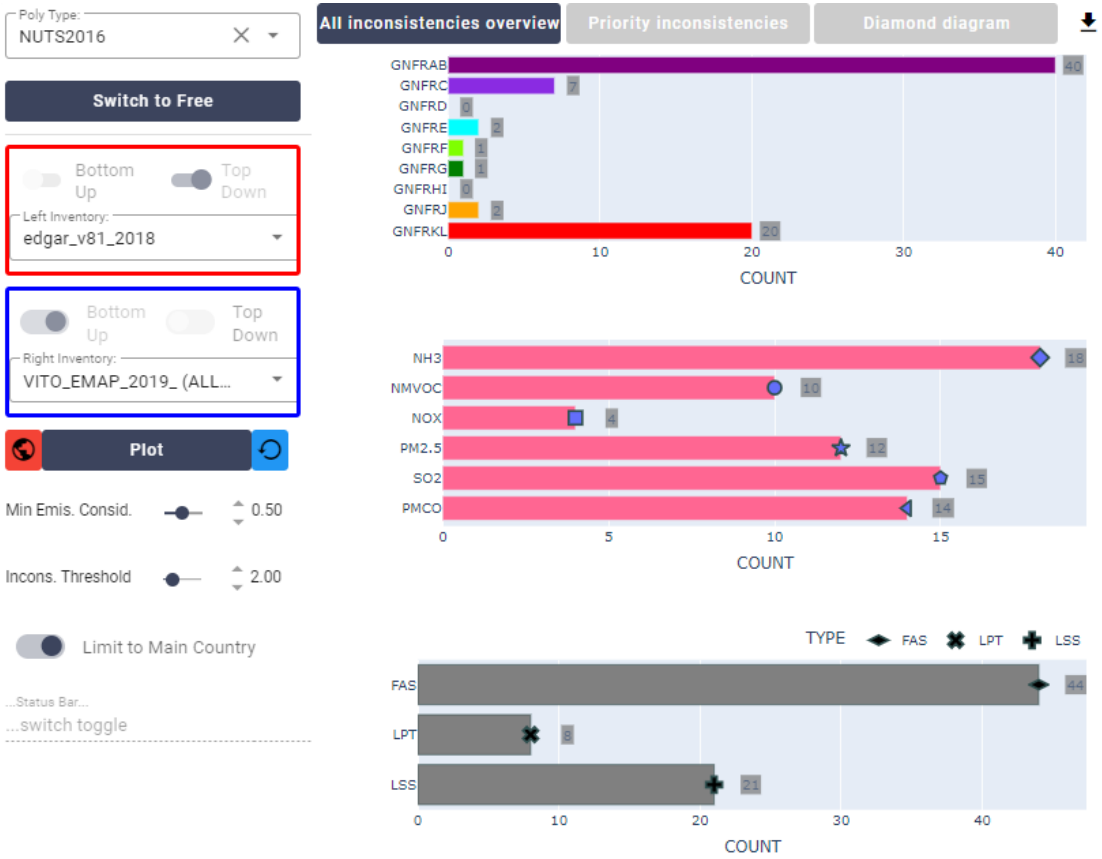


EMAP_VITO vs EMEP_Grid2023_2019



- All major inconsistencies in both cases due to spatial distribution
- 3 out of 5 of these inconsistencies in common between EMEP and CAMS

Inconsistencies the same for EDGARv81 2018?



Edgar_2018 vs EMAP_VITO

- Quite different results: not only spatial distribution (FAS) but also distribution over sectors (LSS) and country total (LPT)
- Different year, 2018 instead of 2019, but can this explain these differences?

CONCLUSIONS

Inconsistencies between NUTS and FUA?

These are related to the FAS and quite different but this is not that surprising given de different areal disaggregation for NUTS and FUA.

Inconsistencies between EMAP and … ?

- For **CAMS / EMEP** the results are rather similar and the only inconsistencies are related to the spatial distribution (point sources)

- For **EDGAR** results are different both in terms of totals, sector distribution and spatial distribution

WG 7 exercise
SI

Petra Dolšak-Lavrič, ARSO
Don Ciglenečki, ARSO

ARSO_2016 vs. Edgar-v61-2016

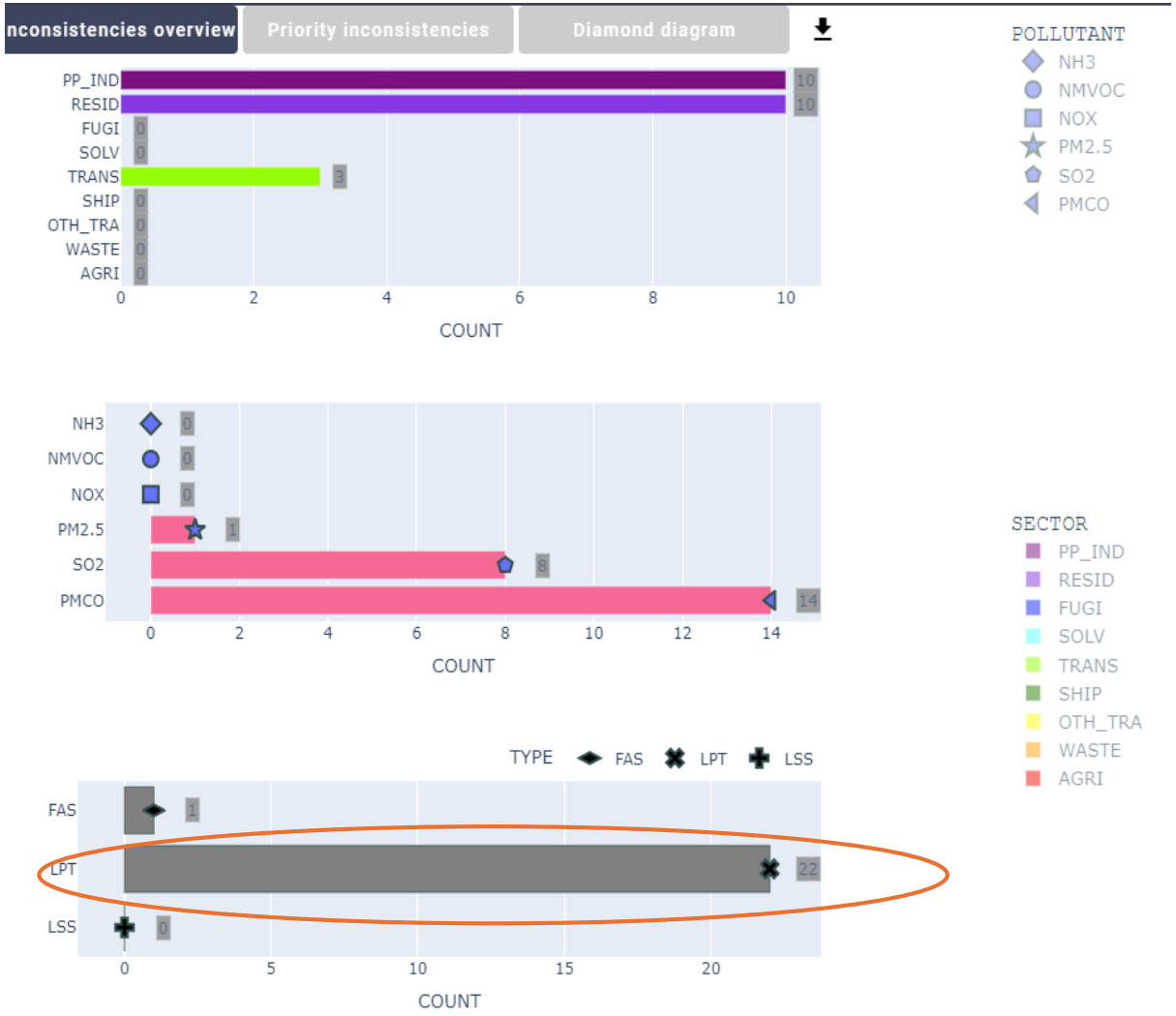
ARSO_2016 vs. cams_v51_2016

REPUBLIC OF SLOVENIA
MINISTRY OF THE ENVIRONMENT, CLIMATE AND ENERGY
SLOVENIAN ENVIRONMENT AGENCY

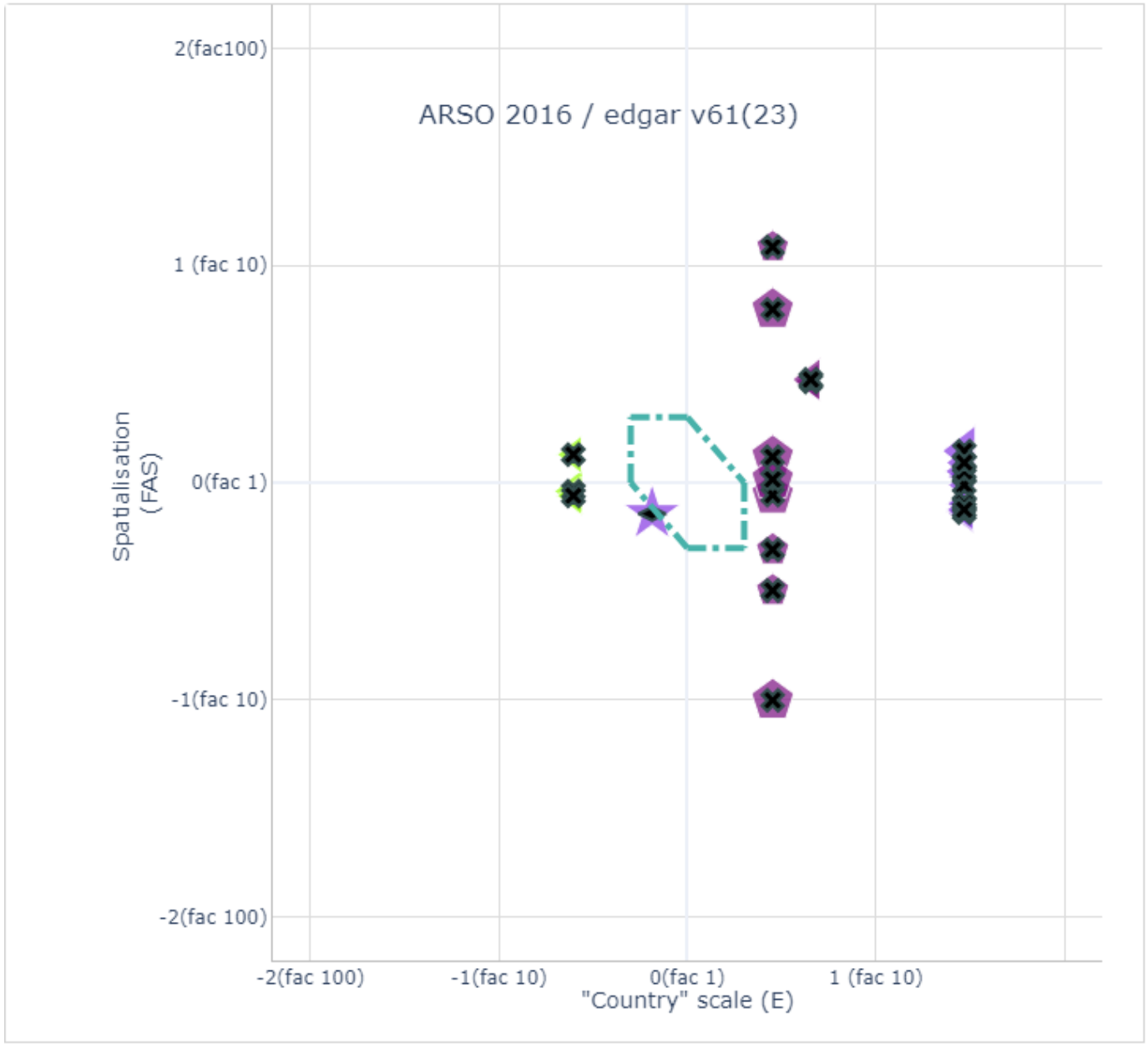
Emission inventories in Slovenia

- Slovenian national emission inventory
  - Regularly reported to CEIP
  - Mostly top-down approach
- ARSO emission inventory
  - At least 25m×25m grid
  - Main focus on SO_x, NO_x, PM, NMVOC and NH_3
  - Updated every two years
  - Mostly bottom-up approach
    - cross-matching different inventoriers to assume heating device and fuel type for each house in Slovenia
    - REMIS base (reports from stack emission measurements) used to assess industrial emissions
    - Traffic counters data used

EDGAR v6.1 vs ARSO_2016



All inconsistencies overview | Priority inconsistencies | Diamond diagram



It appears necessary to review, compare and develop new methodologies and proxies for the spatial disaggregation of emissions from the industrial sector.

EDGAR: The importance of residential and road traffic emissions appears to be systematically estimated as lower (Residential) and higher (Traffic) over urban areas

(Trombetti et al. 2018).

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CAMS v5.1 -2016 vs ARSO_2016

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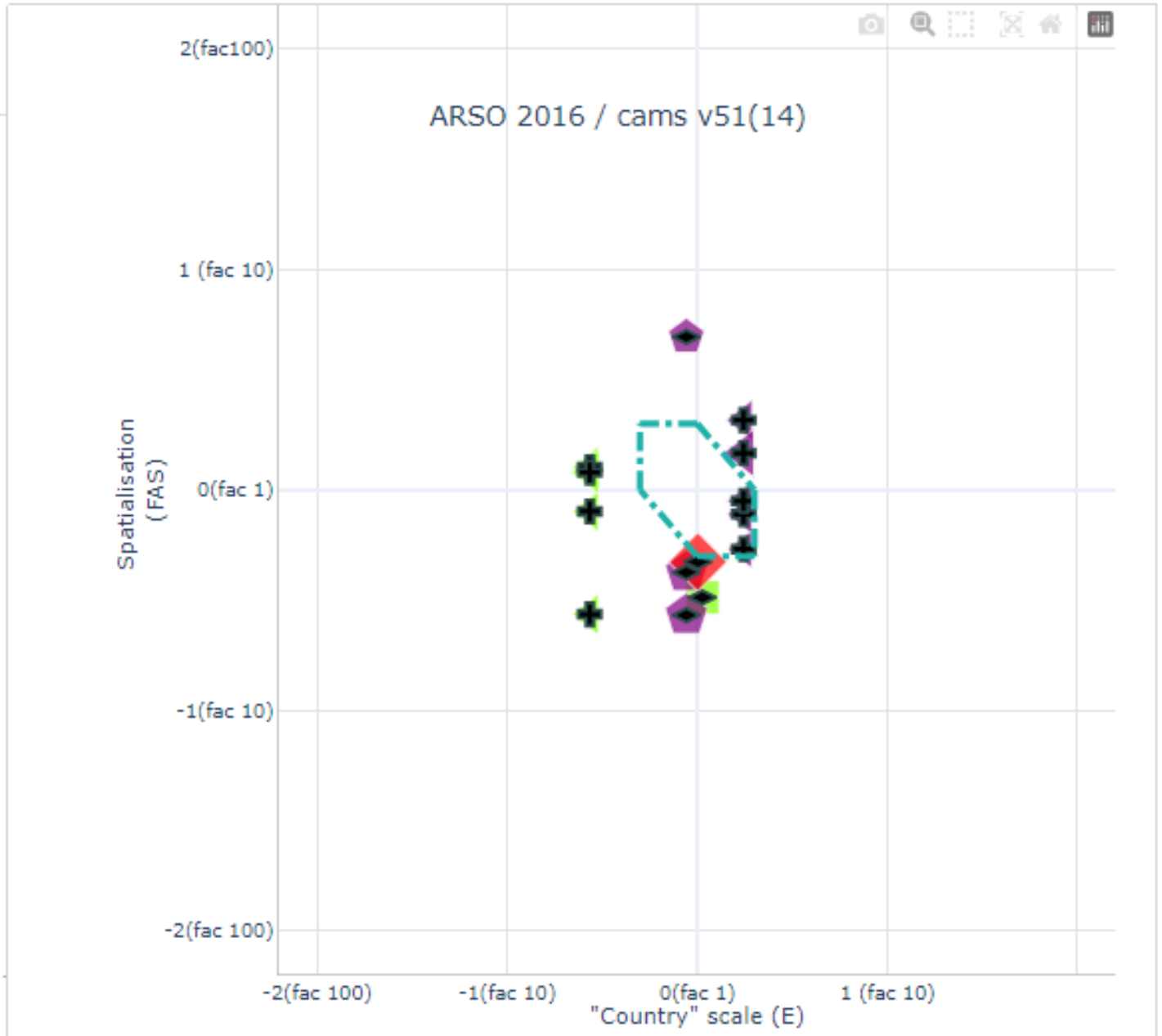
All inconsistencies overview | Priority inconsistencies | Diamond diagram



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

SECTOR
- PP_IND
- RESID
- FUGI
- SOLV
- TRANS
- SHIP
- OTH_TRA
- WASTE
- AGRI

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