FAIRMODE WG2 Update

QA/QC of AQ assessment applications

P. Thunis and L. Tarrasón

Paris Plenary meeting, Monday 26th February 2024

Agenda WG2

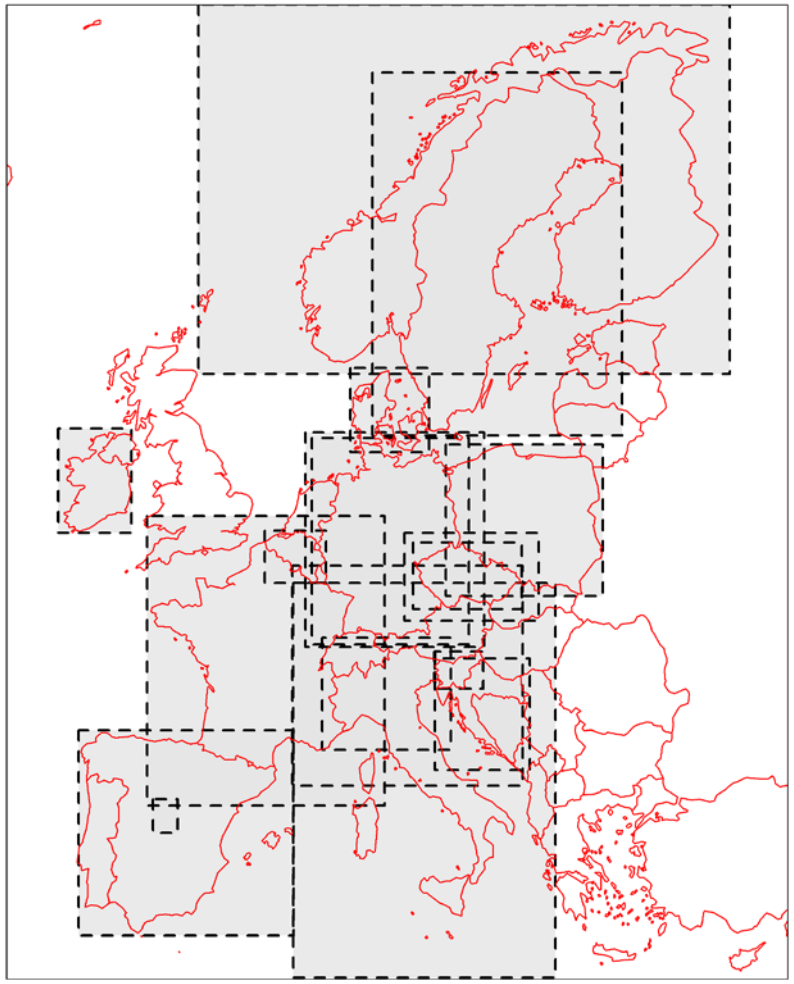
- Status of the composite mapping exercise
- Discussion
  - (I) AQUILA-based, AAQD, FAIRMODE: Which MQI should we use?
  - (II) CEN WG43 databank of datasets: How can FAIRMODE contribute further?
  - (III) Composite mapping MQI exercise: Proposed next steps

Composite mapping exercise

Status

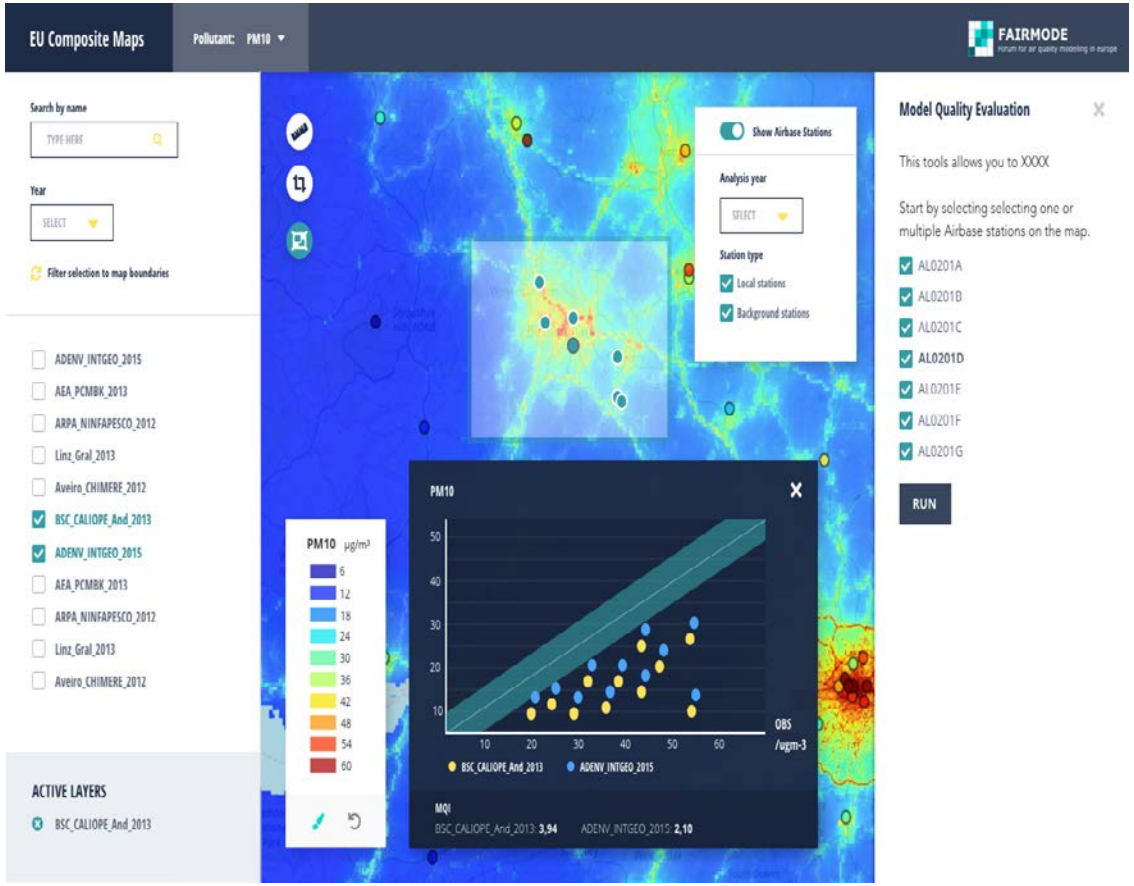
European Commission

Composite mapping exercise



- **Participants so far (20)**: HR, IT, SP, AT, PL, DE (3), CZ (2), DK, SI, FR, SE, NO, IE, PT, BE + Po-Valley, Madrid region,
- **Model spatial resolutions:** from 10 km to 10 meters.
- Most of deliveries include underlying **emissions**

Flexible interface: on-the-fly MQI



- Available for NO_2, PM_{10}, $PM_{2.5}$ and O_3
- Available for many years
- Only possible for the annual MQI, based on hourly, daily and 8h daily maximum values for NO2, PM10/2.5 and O3, respectively.
- Calculates FAIRMODEs MQI values based on user-defined:
  - Set of AIRBASE stations by classification
  - Geographical area (from NUTS3, AQ zone, to country)
  - Optional number of stations – it is possible to remove specific stations
  - AQUILA-based vs FAIRMODE vs AAQD formulations

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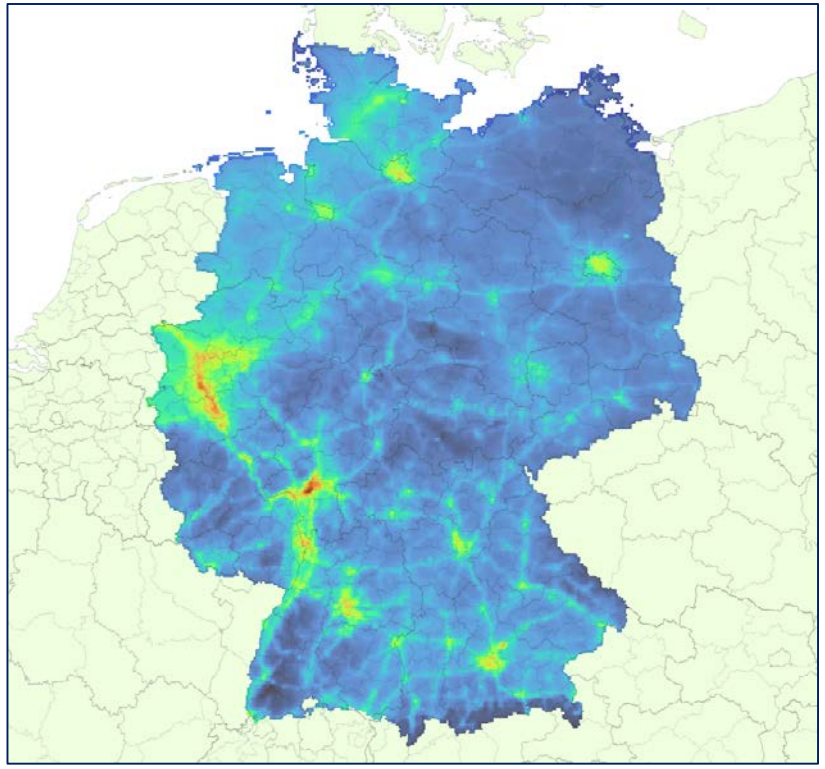
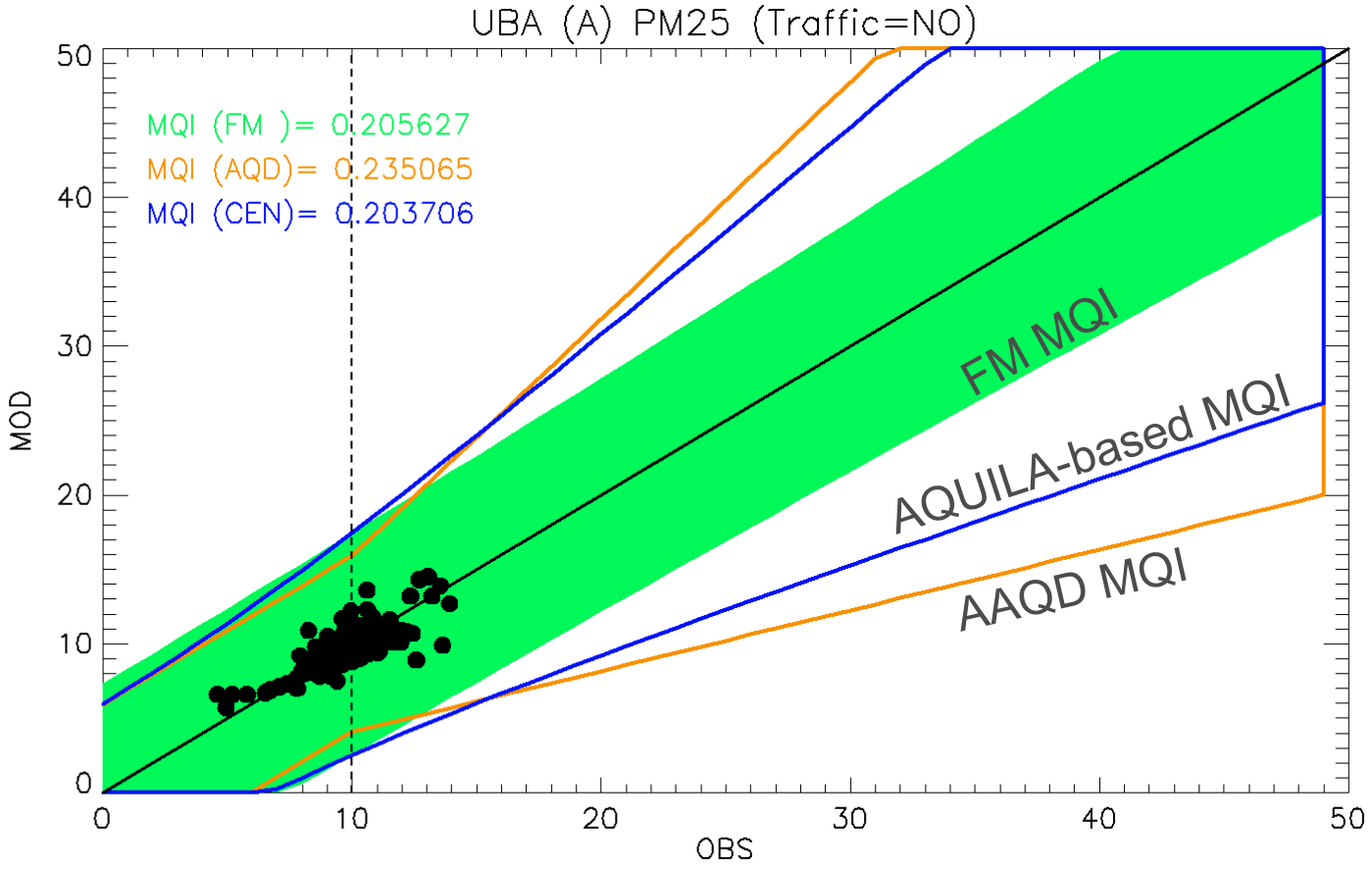
Flexible interface: Manual results!





Spatial resolution: 2 km.
Pollutants: NO2, O3, PM10, PM2.5.
Data assimilation: Yes/No
Year: 2019

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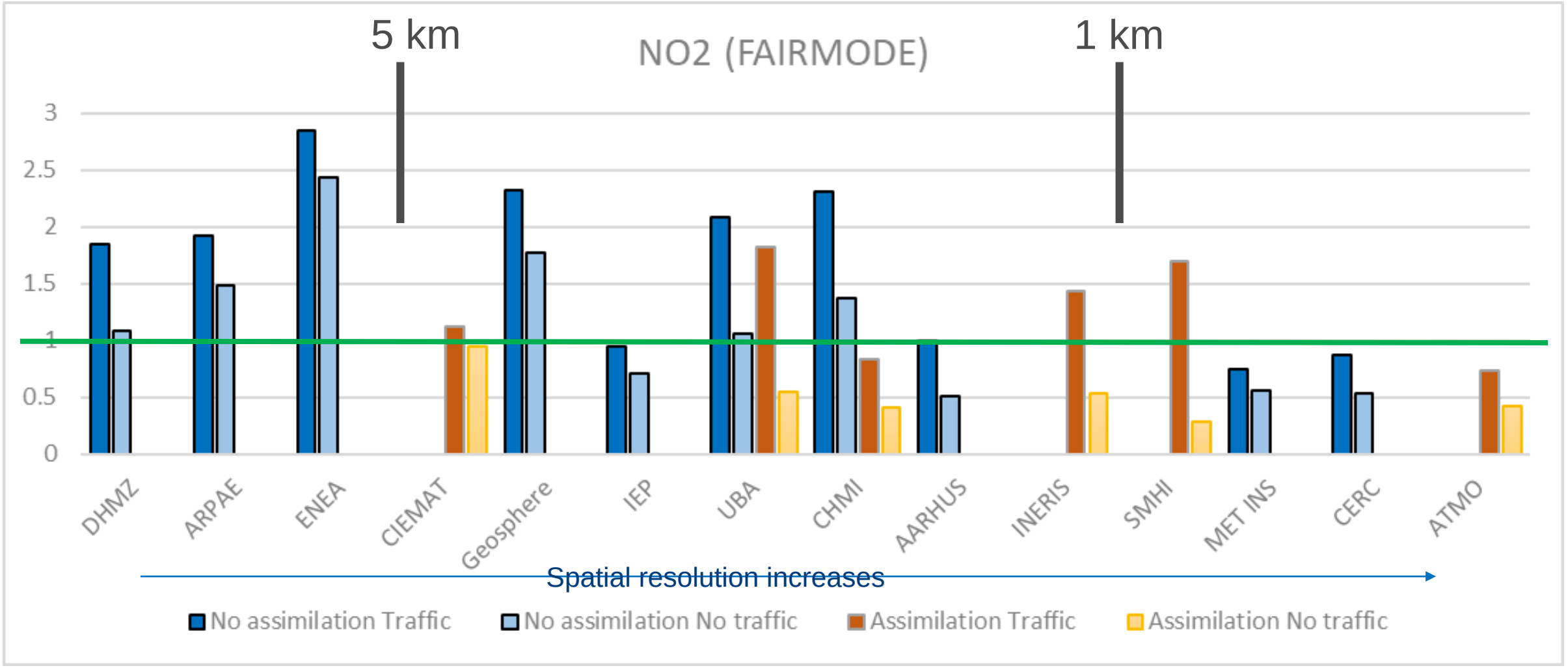
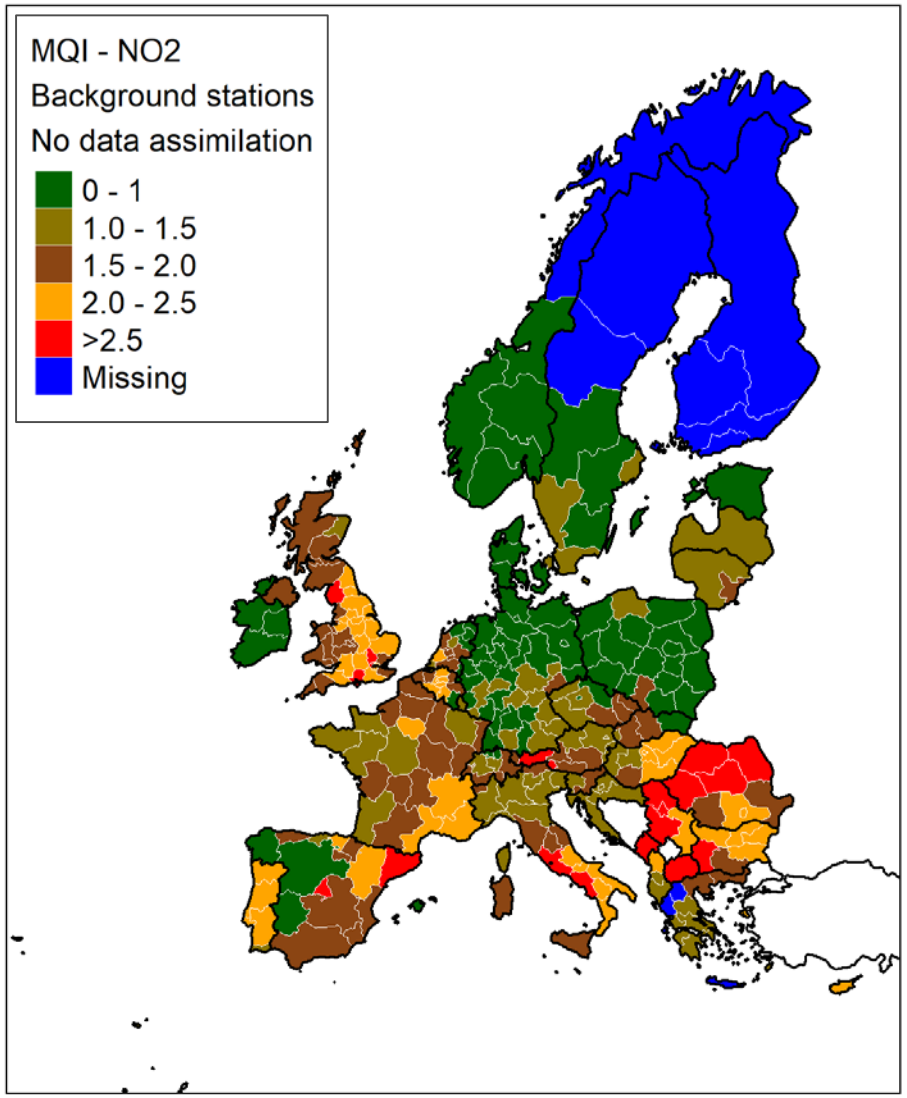
Preliminary analysis



Fixed interface – MQI Map



- Available for NO_2, PM_{10}, $PM_{2.5}$ and O_3
- Available for **2019 only**
- Calculates MQI for all modelling results covering a given geographical area and select best performing model
- **Map of the MQI value**
- Options:
  - Geographical area (from NUTS3, AQ zone, to country)
  - AQUILA-based, FAIRMODE and AAQD formulations of the MQI

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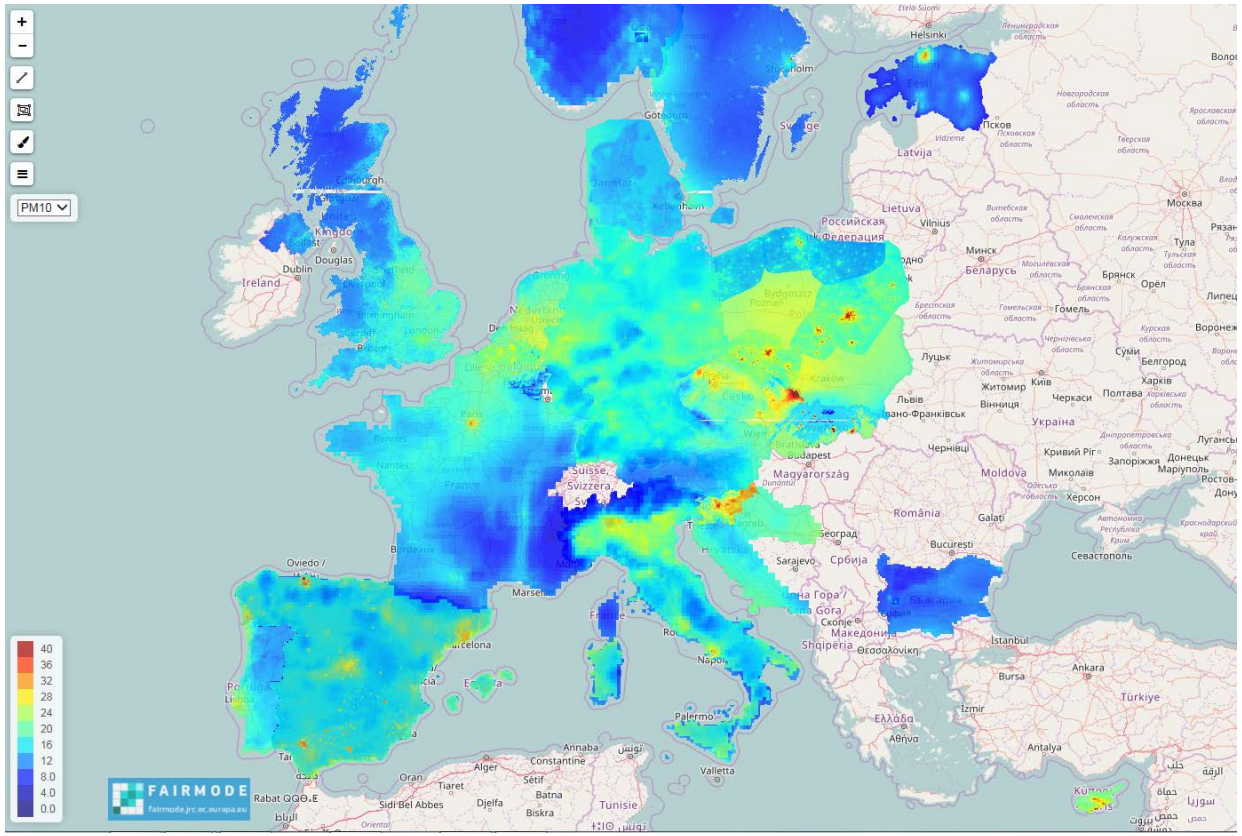
Fixed interface – Concentration Map



- Available for NO_2, PM_{10}, $PM_{2.5}$ and O_3
- Available for **2019 only**
- Calculates MQI for all modelling results covering a given geographical area and select best performing model
- **Map of gridded concentrations**
- Options:
  - Geographical area (from NUTS3, AQ zone, to country)
  - AQUILA-based, FAIRMODE and AAQD formulations of the MQI

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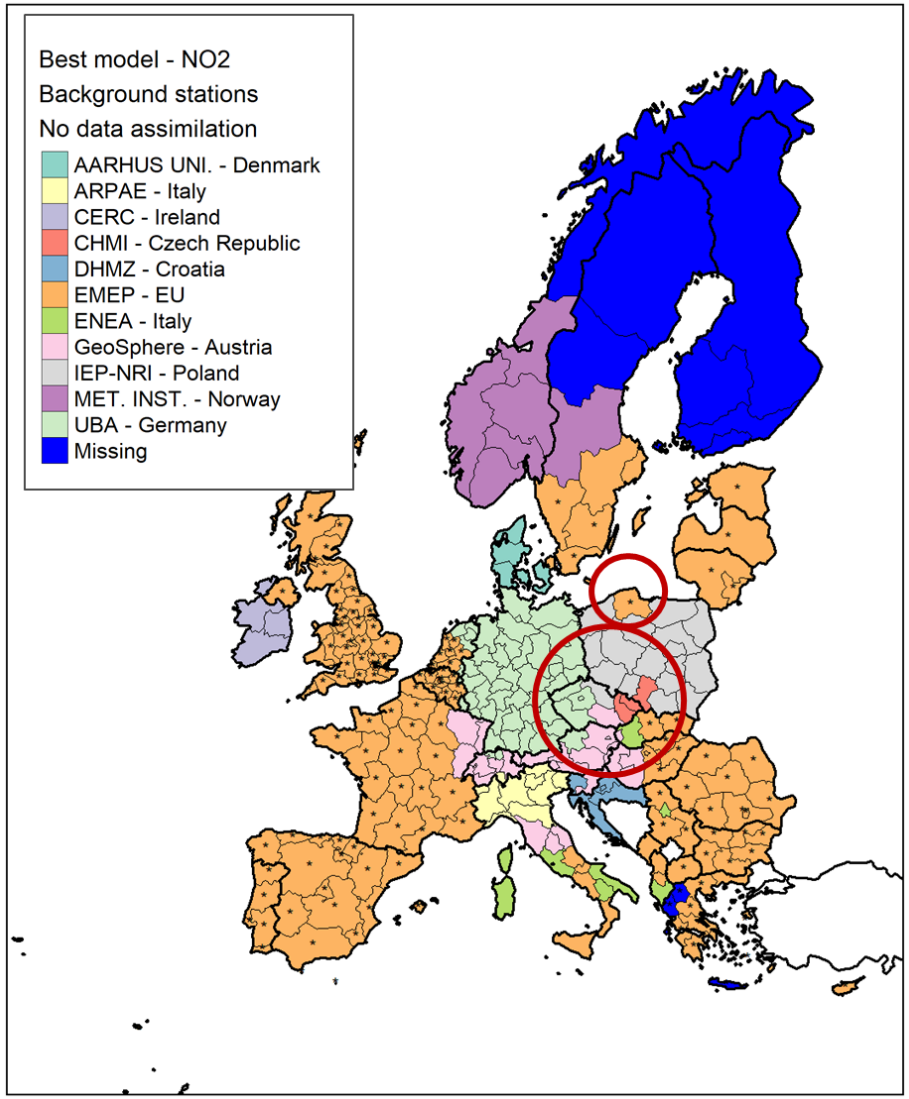
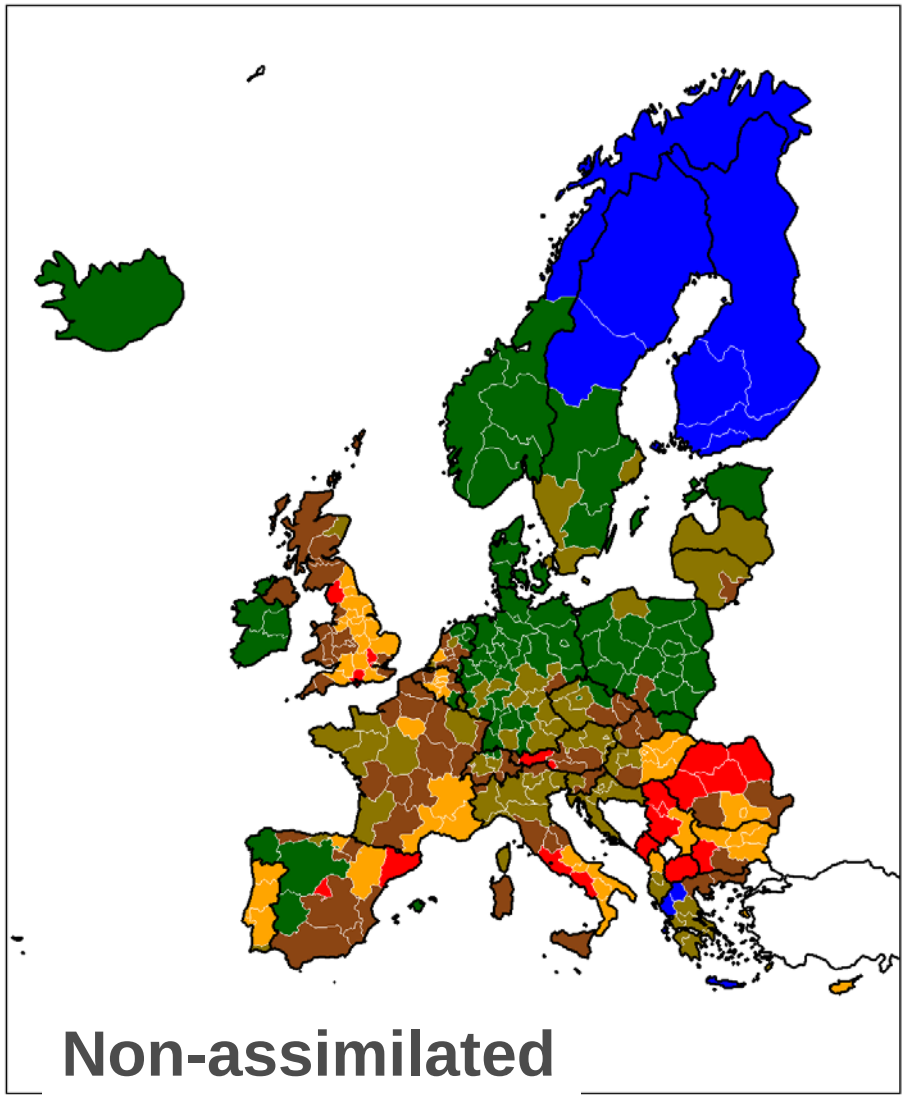
Fixed interface – Best model map



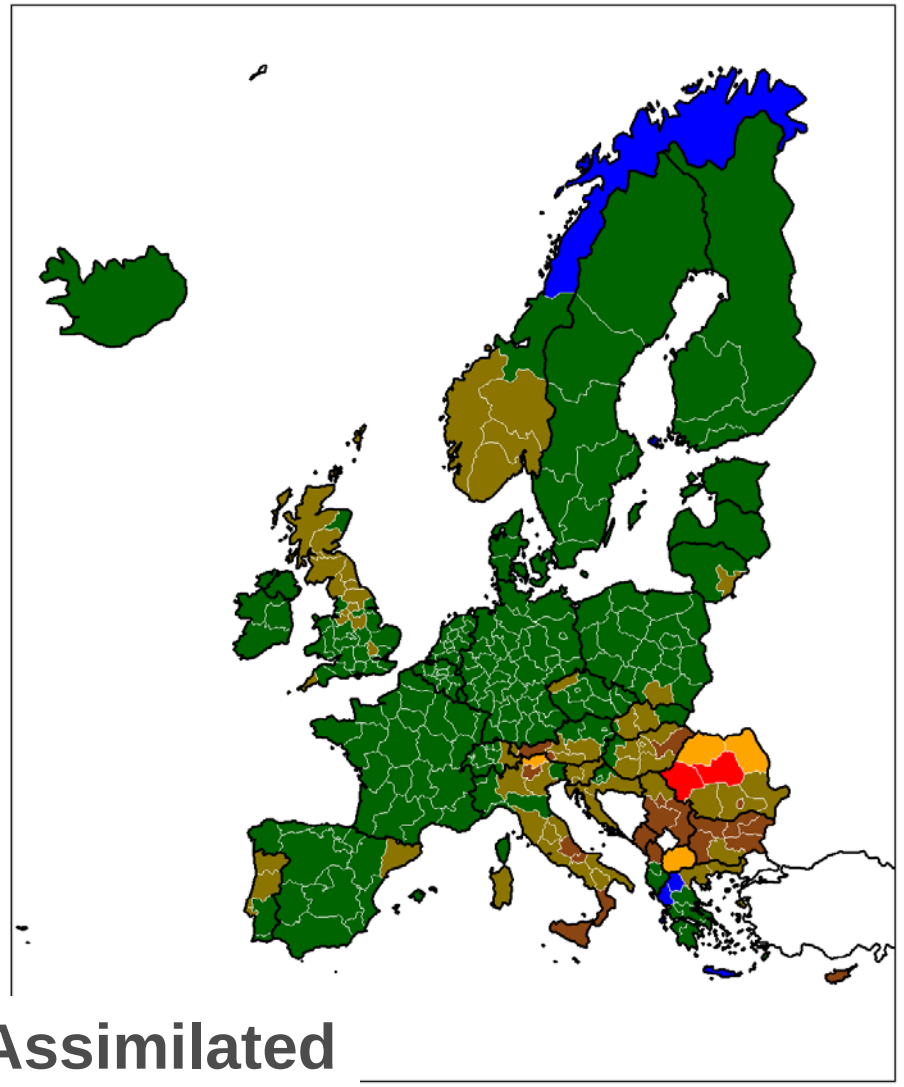
- Available for NO_2, PM_{10}, $PM_{2.5}$ and O_3
- Available for **2019 only**
- Calculates MQI for all modelling results covering a given geographical area and select best performing model
- **Map of best model**
- Options:
  - Geographical area (from NUTS3, AQ zone, to country)
  - AQUILA-based, FAIRMODE and AAQD formulations of the MQI

Fixed interface: **MQI** map - manual results!



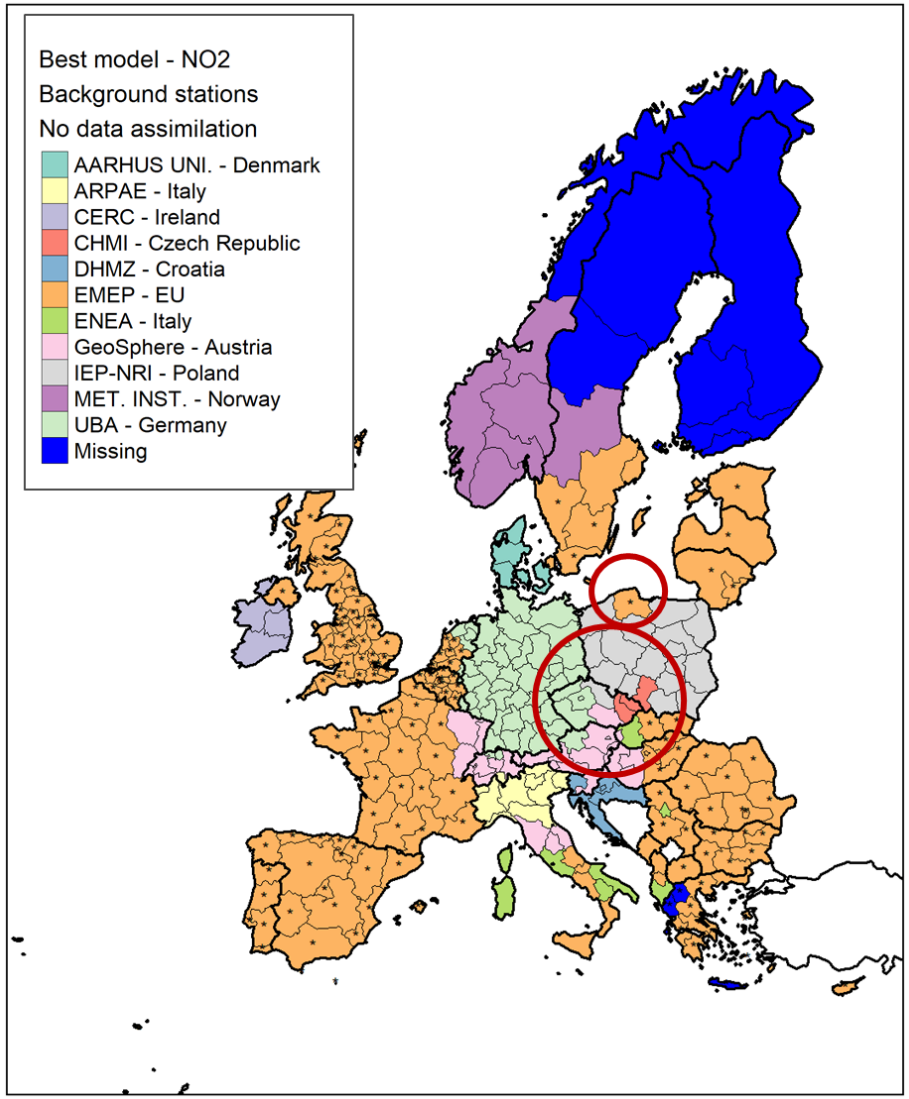
MQI - NO2
Background stations
No data assimilation
0 - 1
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
>2.5
Missing

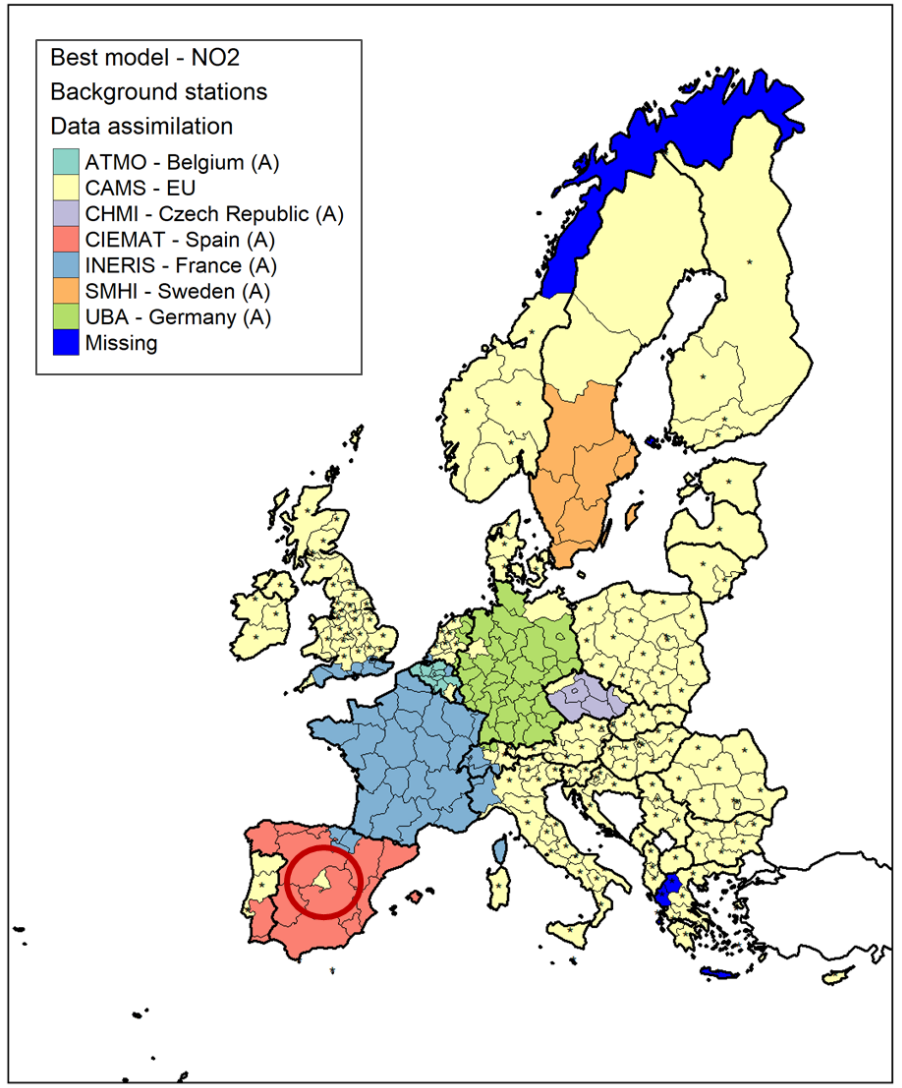
Non-assimilated



Assimilated

Fixed interface: **Model** map - manual results





Planned time schedule

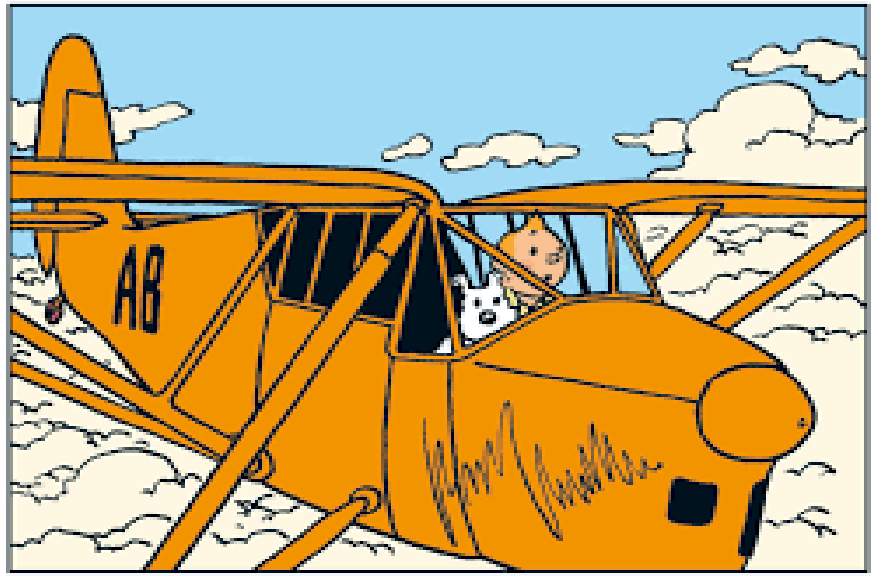
- Interface **Fall 23**
- Interim meeting **December 23**
- Results **Plenary meeting 24**

We faced a few technical issues!

Updated time schedule

- Interface **April 2024 (Flexible)**
  June 2024 (Fixed)
- Interim meeting **April 24**
- Results **Technical meeting 24**

Delayed but flying again!



FAIRMODE
Forum for air quality modelling in Europe

Help ?

European Commission
Joint Research Centre

Emissions App

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Concentrations App

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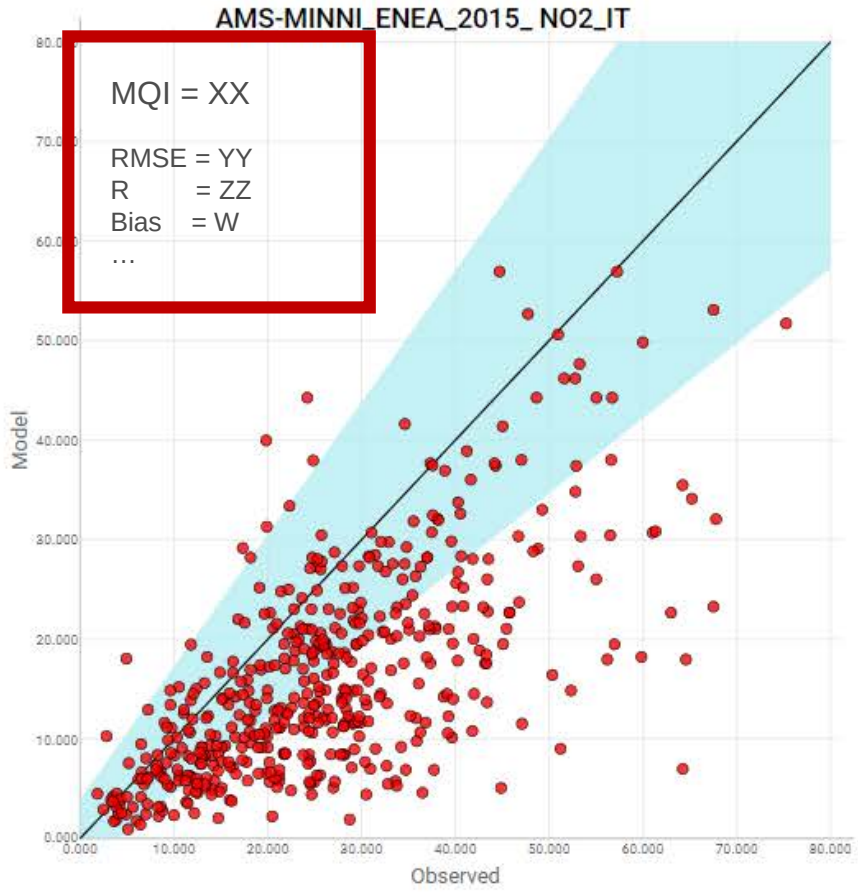
Version: 12/02/2024

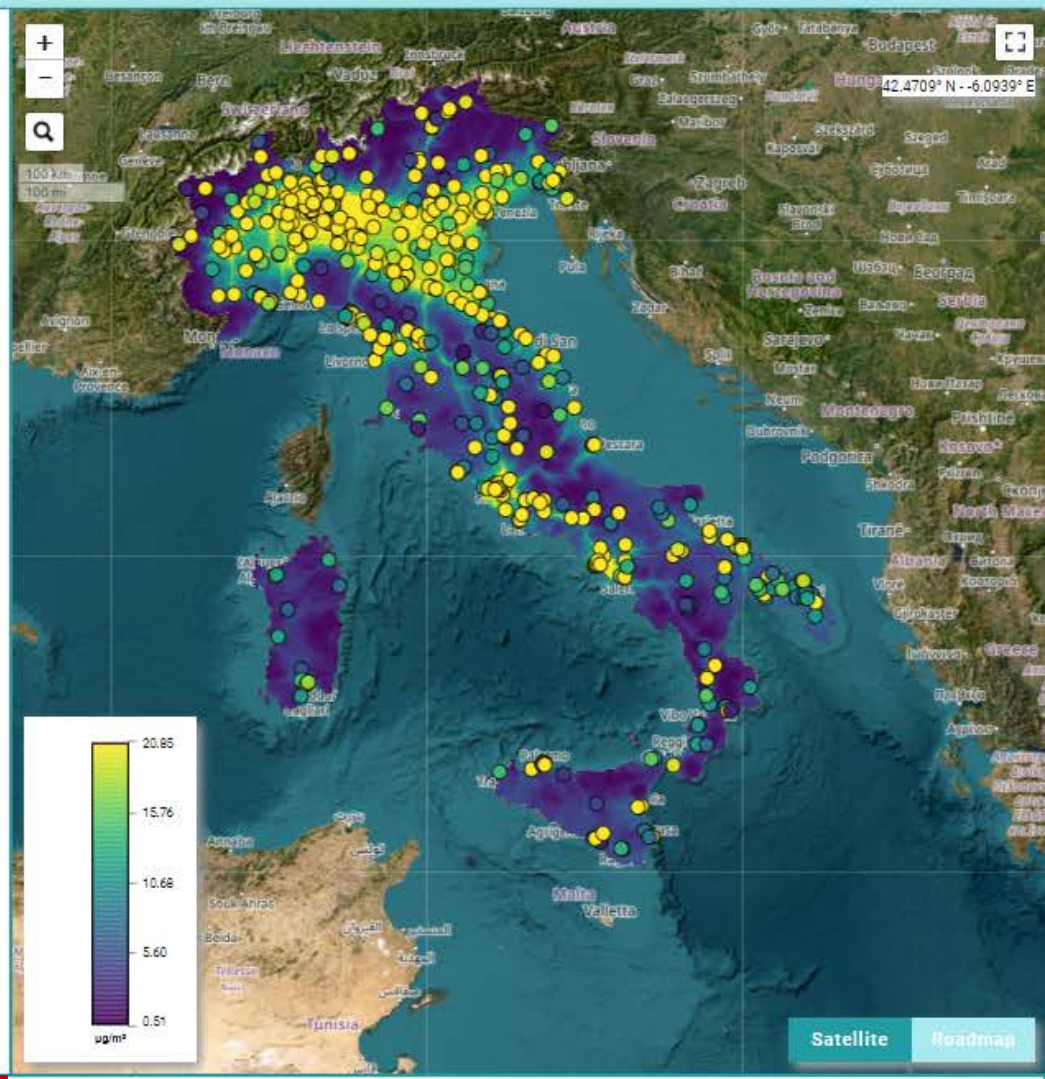
FAIRMODE
Concentrations App
Debug
European Commission

Year: 2015
Model selection
Pollutant: NO2
Detailed model info
Datasets

Comp Map 1
Comp Map 2
Comp Map 3

UBM_ENVS_2015_ NO2_DK
RIVM-GCN_2015_ NO2_NL
ADENV_INGEO_2015_2015_ NO2_LU
AMS-MINNI_ENEA_2015_ NO2_IT
CHIMERE_CIEMAT_2015_ NO2_ES_SPANISH MAINLAN
CHIMERE_CIEMAT_2015_ NO2_ES_SPANISH MAINLAN
DEHM-UBM_ENVS_2015_ NO2_DK
ECOFORECAST_PL_2015_ NO2_PL
EPA_2015_ NO2_IE_DUBLIN
RIO4X4_IRCEL_2015_ NO2_BE
RIO-IFDM_IRCEL_2015_ NO2_BE
SLB_2015_ NO2_SE_STOCKHOLMCOUNTY
SLB_2015_ NO2_SE_STOCKHOLMCOUNTY
ZAMG_2015_ NO2_AT





Stations selection
Selected stations: 498
Types: Background Industrial Traffic
Areas: Rural Suburban Urban
Color mode: Unique color

MQO Selection
FAIRMODE CEN AAQD

Stringency

Interpolation: near
Reverse palette
Family: sequential
Opacity: 100%
Palette: Viridis
Scale: 0.51 20.85

FAIRMODE
Concentrations App
Debug
European Commission

Year: 2015
Model selection
Pollutant: NO2
Detailed model info

Datasets

Comp Map 1
Comp Map 2
Comp Map 3

- UBM_ENVS_2015_ NO2_DK
- RIVM-GCN_2015_ NO2_NL
- ADENV_INGEO_2015_2015_ NO2_LU
- AMS-MINNI_ENEA_2015_ NO2_IT
- CHIMERE_CIEMAT_2015_ NO2_ES_SPANISH MAINLAN
- CHIMERE_CIEMAT_2015_ NO2_ES_SPANISH MAINLAN
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- ECOFORECAST_PL_2015_ NO2_PL
- EPA_2015_ NO2_IE_DUBLIN
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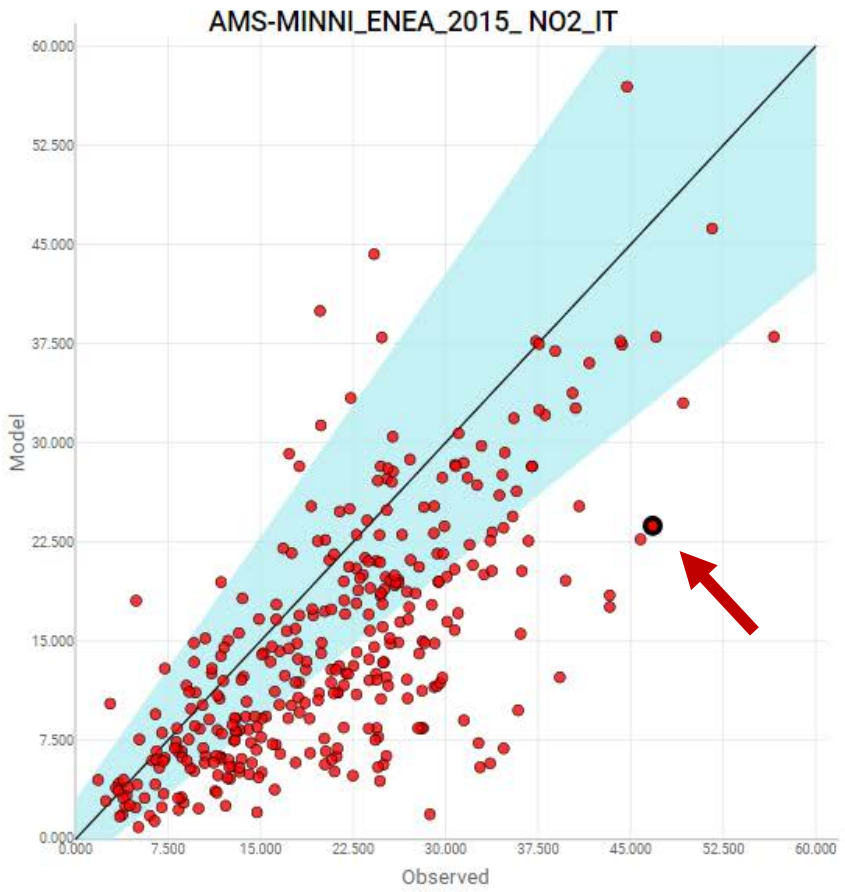
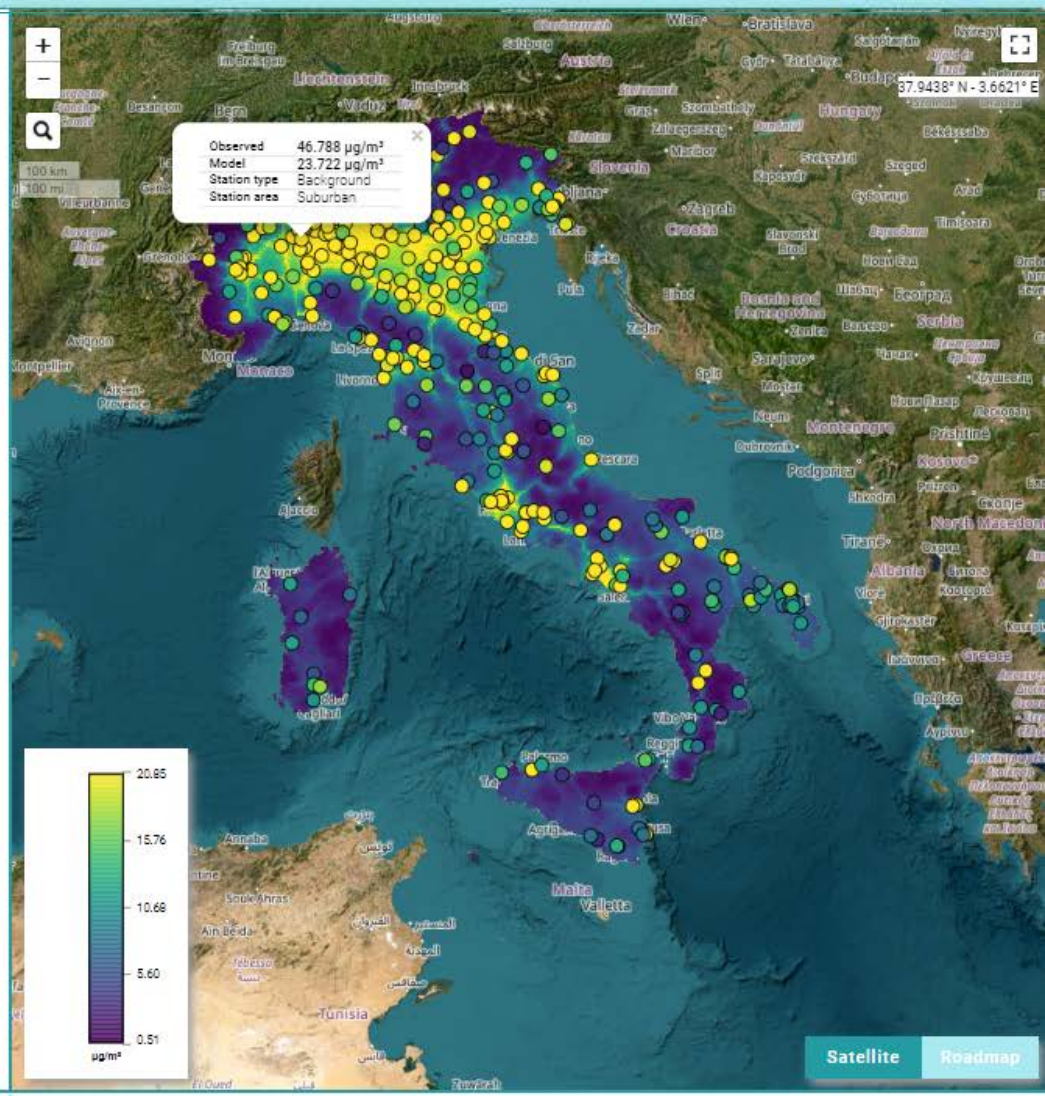
- RIO-IFDM_IRCEL_2015_ NO2_BE
- SLB_2015_ NO2_SE_STOCKHOLMCOUNTY
- SLB_2015_ NO2_SE_STOCKHOLMCOUNTY
- ZAMG_2015_ NO2_AT





Stations selection

Types: Background | Industrial | Traffic

Areas: Rural | Suburban | Urban

Selected stations: 350

Color mode: Unique color

MQO Selection

FAIRMODE | CEN | AAQD

Stringency

Interpolation: near
Reverse palette
Family: sequential
Opacity: 100%
Palette: Viridis
Scale: 0.51 – 20.85

Discussion (I)

How to deal with the three different definitions of the MQI?

CEN, FAIRMODE, AAQD: all based on similar principles

1. Basic formulation:

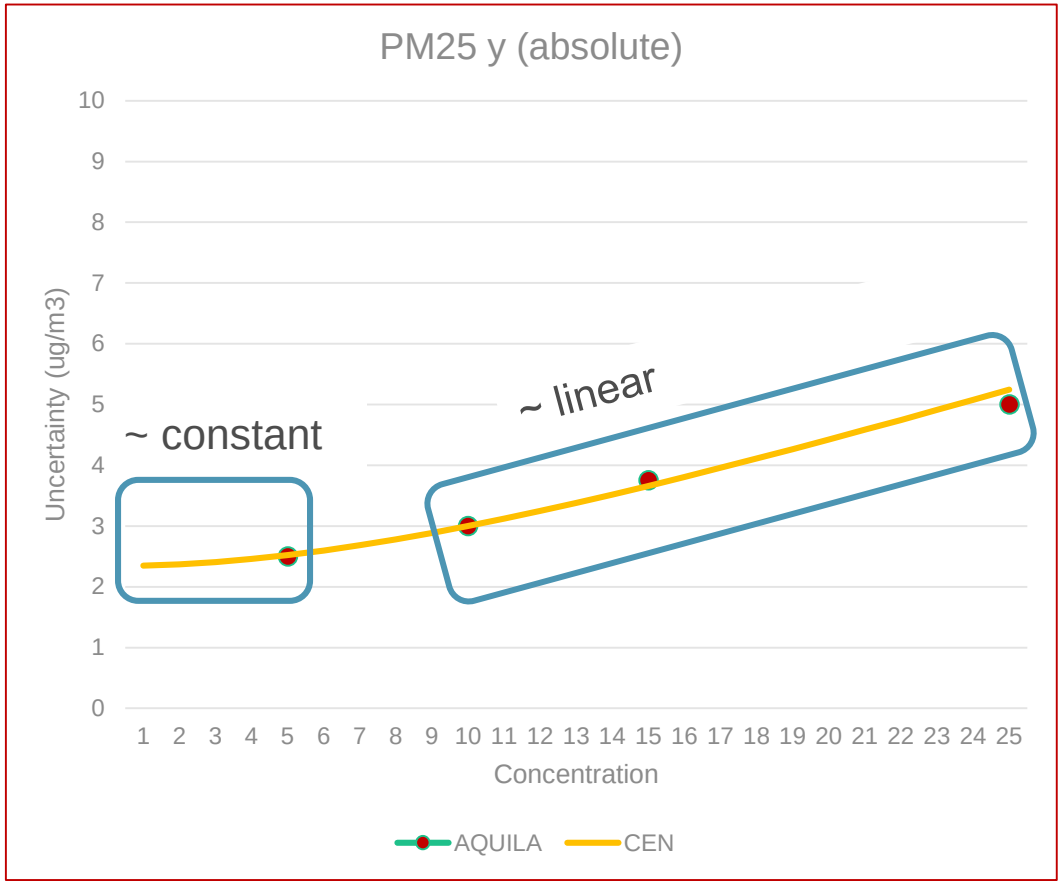
$$MQI = \frac{|M-O|}{\beta\, f(U)} \text{ and } MQO: MQI \leq 1$$

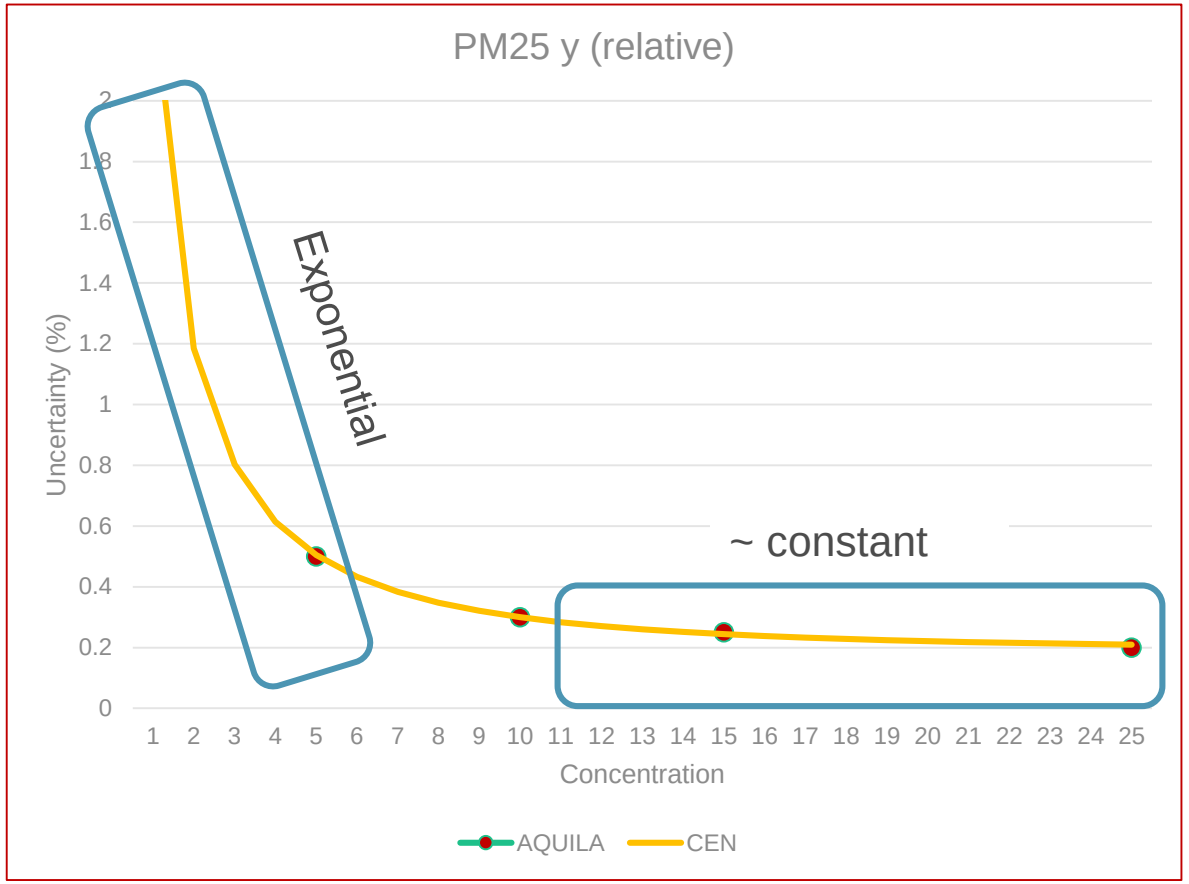
2. The measurement uncertainty (U) is decomposed into two components: one proportional to the concentration (U_p) and one non-proportional (U_{np})

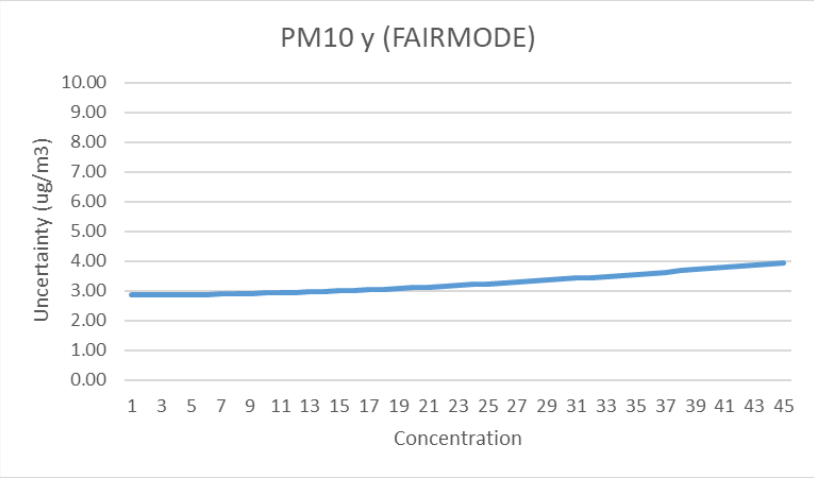
$$U^2 = U_p^2 + U_{np}^2$$

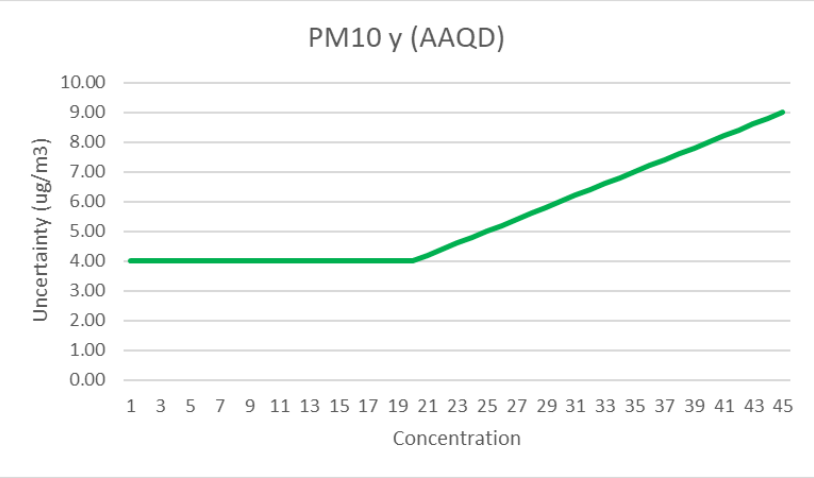
3. The proportional component (U_p) is found to be linear

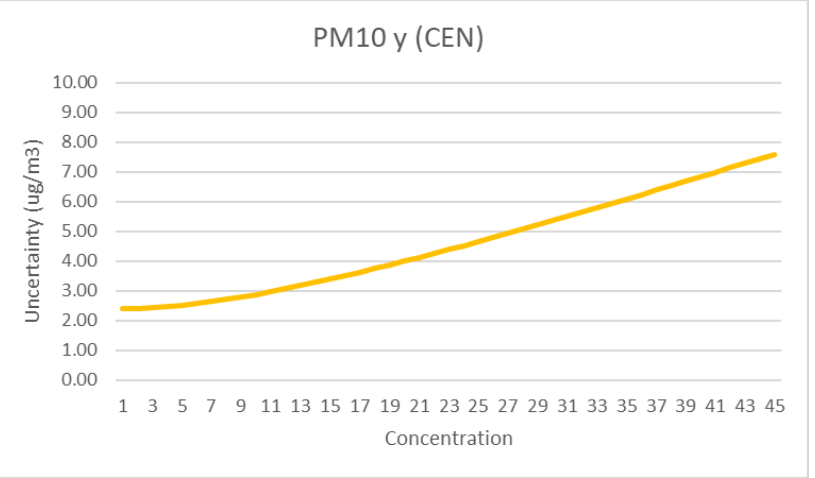
Typical uncertainty curve



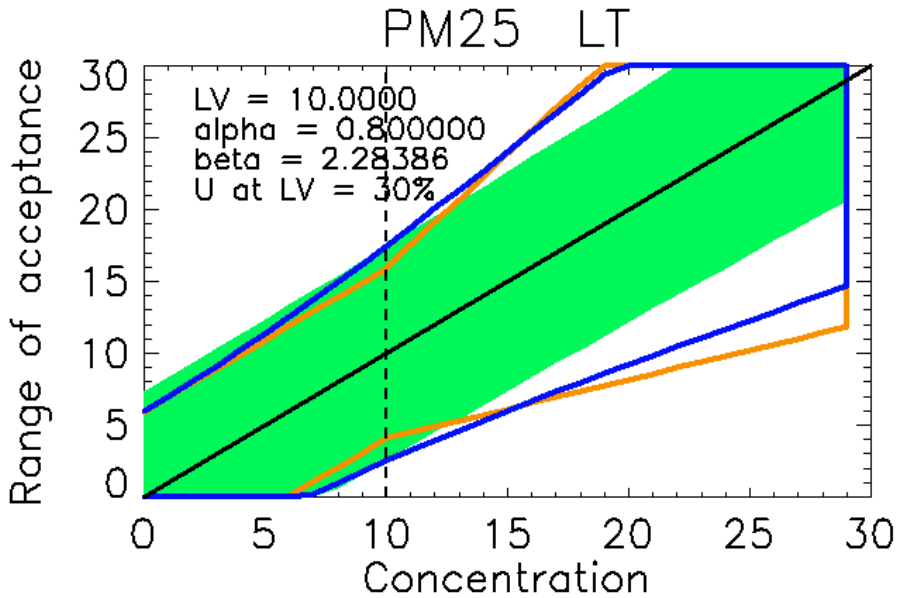


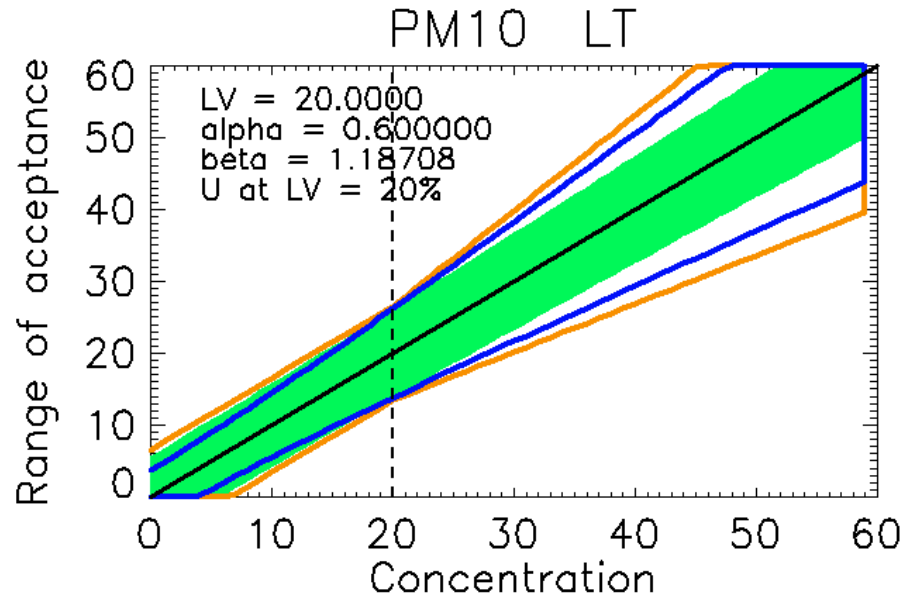


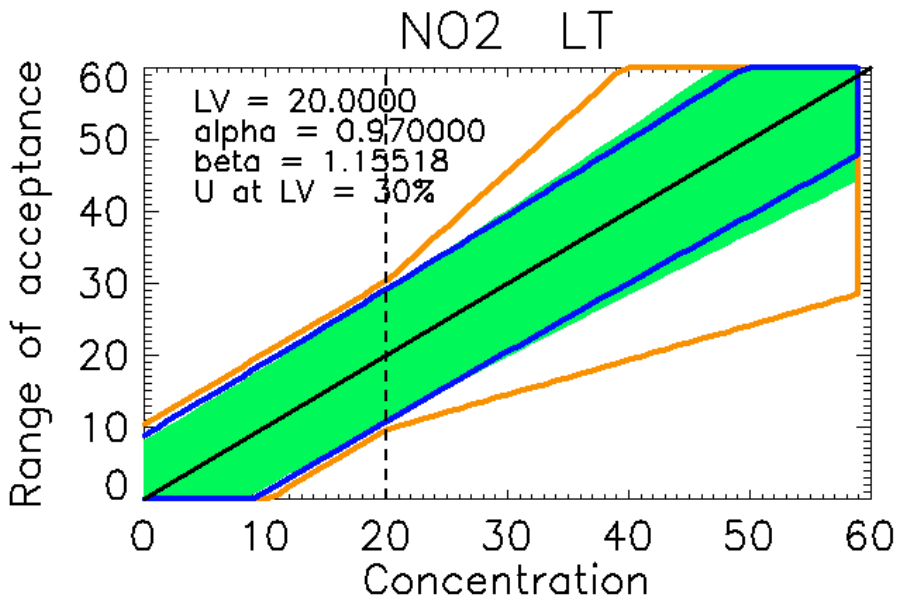


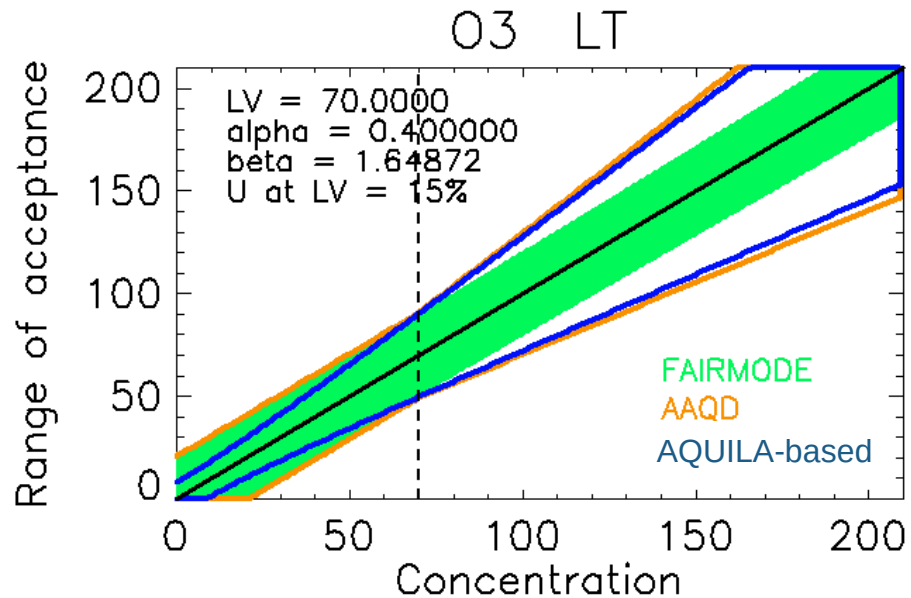


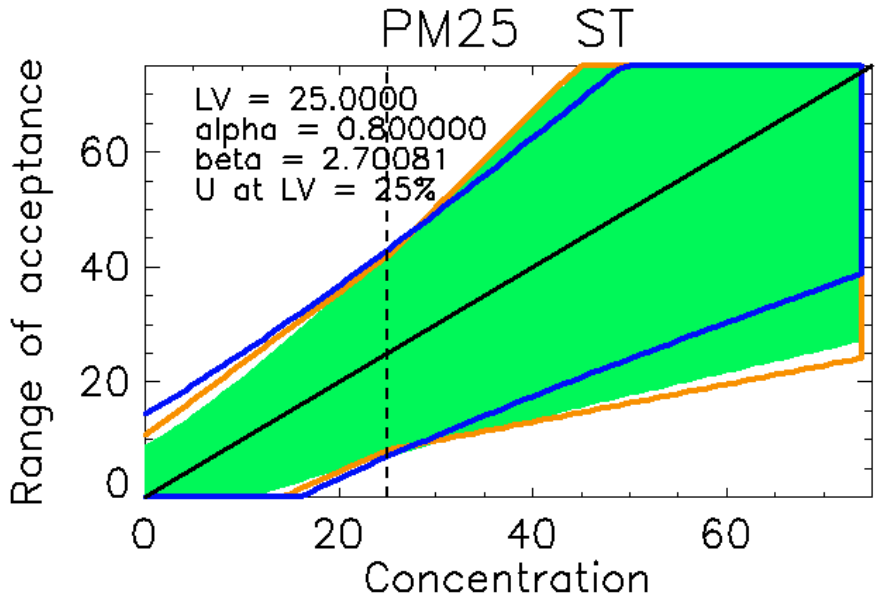
		FAIRMODE	AAQD 2022	AQUILA-based
Measurement Uncertainty	Basis	Actual measurements inter-comparisons (2010)	Maximum allowed measurement uncertainties (DQO) (AQUILA)	
	Coverage	All concentration range	LV (2022)	All concentration range
	Function	Best-fit U_p/U_{np} function (expressed at LV 2008)	Simple step-wise around LV 2022	Best-fit U_p/U_{np} function (expressed inLV 2022)
Pollutant coverage		NO2, PM10, PM2.5, O3	All AAQD pollutants and time-averages	
Status		Available and stable		Available and evolving
Stringency	At LV 2022		~ FAIRMODE	= FAIRMODE
	Other level		≤ FAIRMODE	Variable

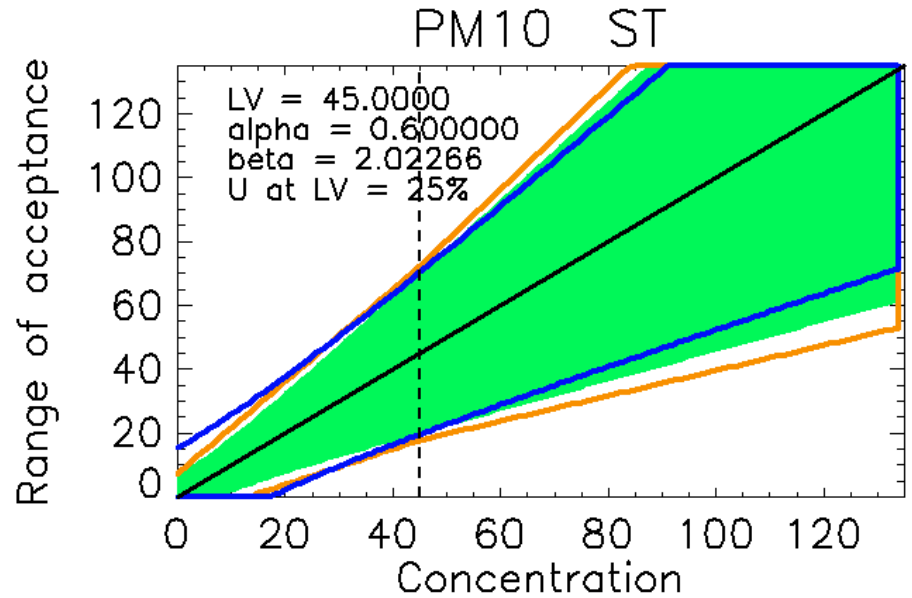


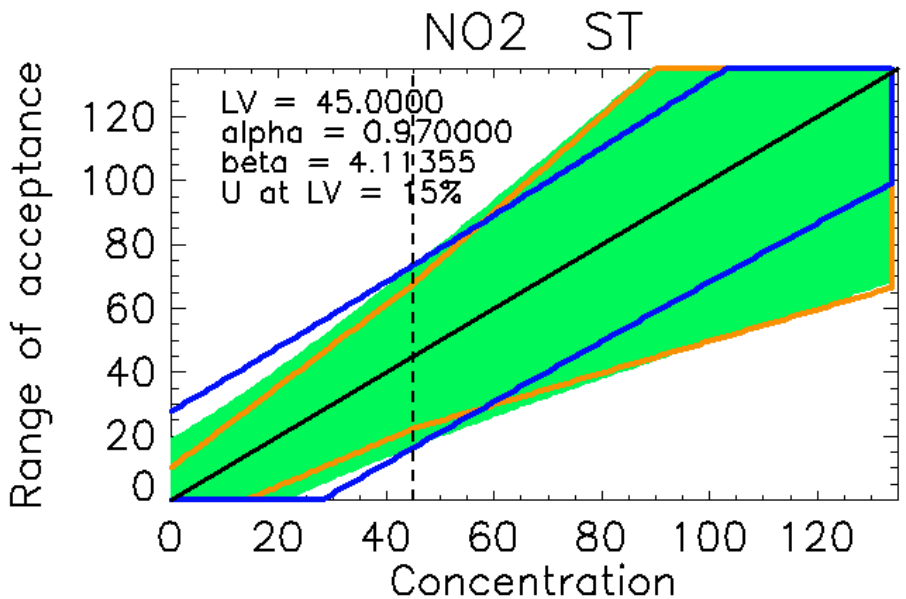


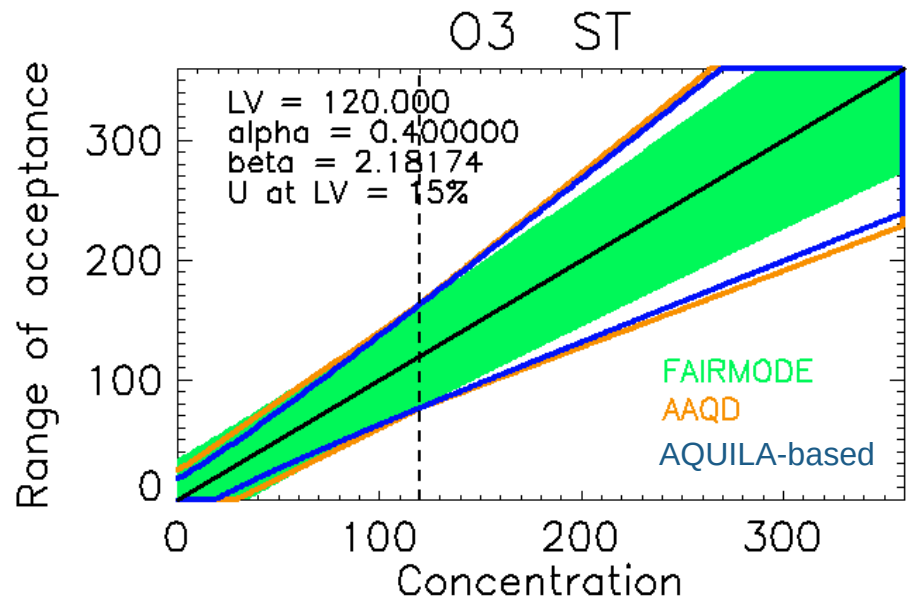












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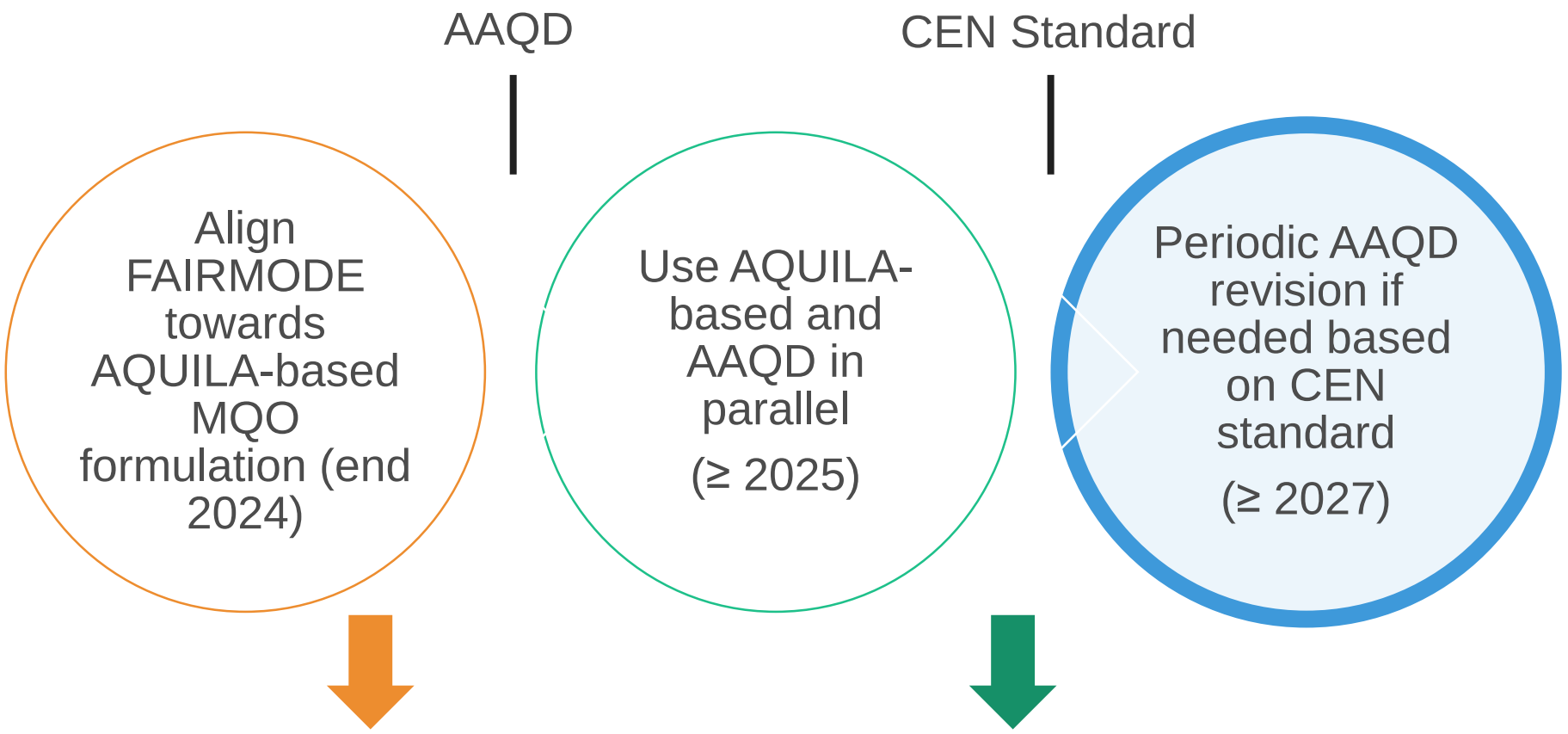
Proposed approach



- **Do you agree with that the ultimate goal is an alignment ?**
- **Do you agree for FAIRMODE to use CEN and AAQD in parallel?**
- **Is the proposed timeframe reasonable?**

European Commission

Discussion (II)

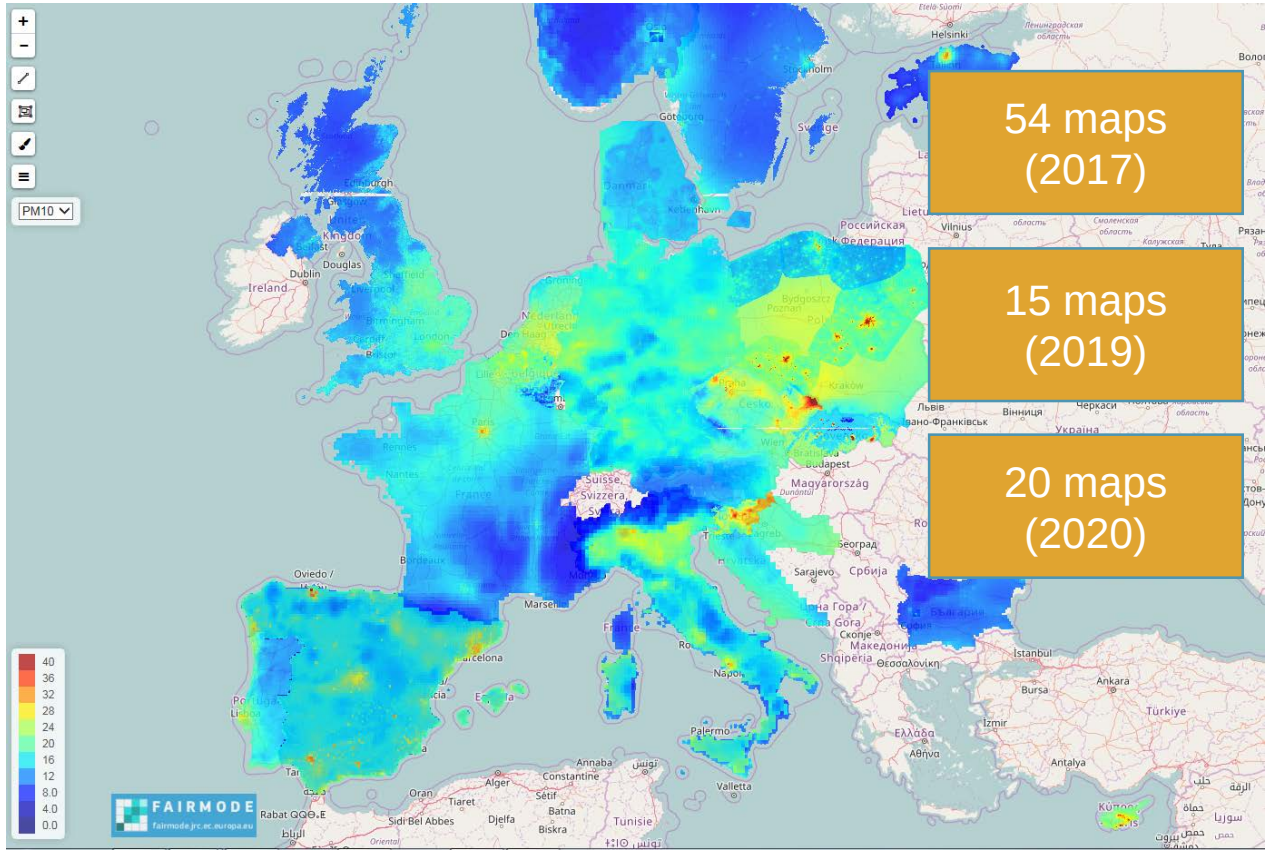
CEN WG43 databank of datasets: How can FAIRMODE contribute?

Need for a database of modelling dataset in the context of CEN WG264/43

- To test the robustness of the MQO formulation on practical case and assess a meaningful level of stringency
- To ensure that the fail/pass MQO test allows distinguishing fit-for-purpose modelling applications

- Datasets should ideally cover all scales (local, regional, country), all possible pollutants, with various spatial resolutions, at high (day/hour) and low (annual) frequencies.

What we have so far…



- Only for annual averages
- Not for all pollutants

⇨ Call for hourly/daily frequency data

- Data-assimilated included but no info on stations used

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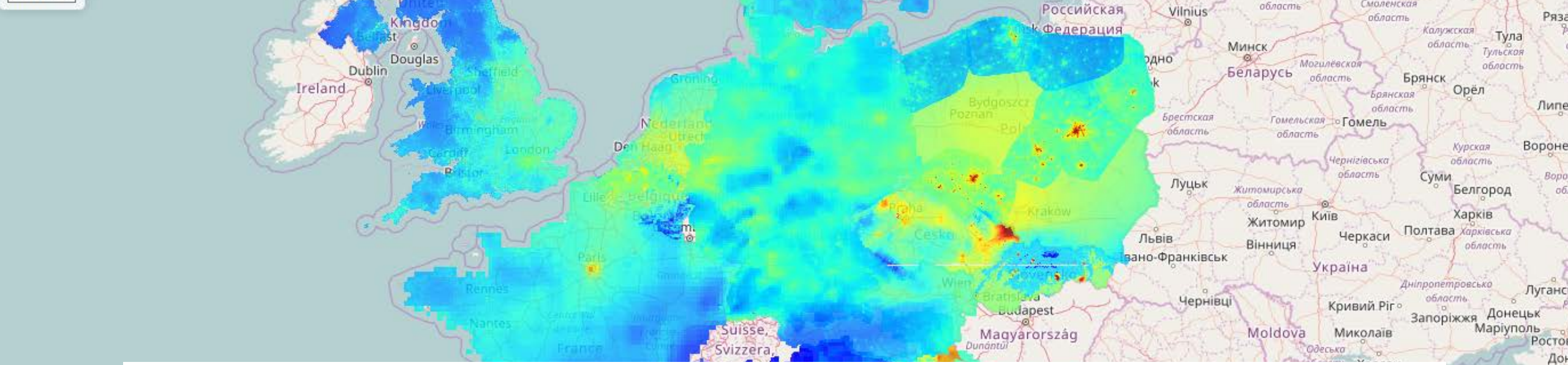
Other datasets

- POMI (2008) – Po Valley – regional modelling – 4 models (H/D)
- Scale dependency (2012) – EU – regional modelling – 5 models (H/D)
- Eurodelta (2010) – EU – regional modelling – 6 models (H/D)
- CityDelta (2003) – various cities – urban modelling – 20 models (H/D)
- “Private” user’s datasets



How can FAIRMODE contribute further ?

- **Can the data compiled by FAIRMODE under WG2 of the composite mapping exercise be used for CEN WG43 purposes?**
- **Is there a need for a consent procedure by data providers or can we adopt a bulk consent?**

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Discussion (III)

Next phases of the WG2 composite mapping exercise

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WG2 composite mapping exercise

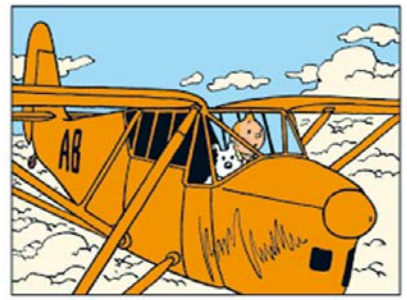
Proposed questions to be addressed

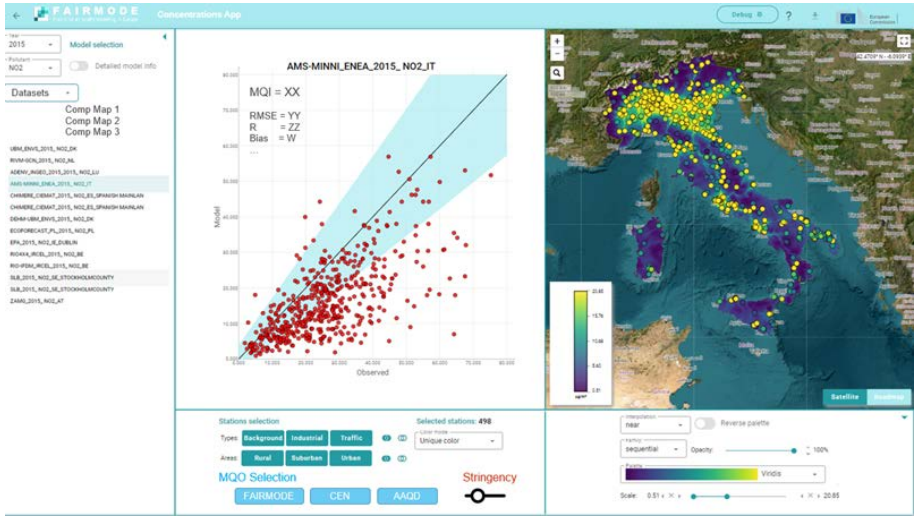
- **Q1 - Does FAIRMODE's on-the-fly MQI fit with own home calculation?**
- Q2 - Are the MQI stringent enough and consistent among pollutants?
- Q3 – Does the fail/pass MQO test ensure a valid distinction between Fit/non-Fit-for-purpose modelling applications ?
- Q4 – How to proceed when models use data-fusion & data assimilation?

Common to CEN WG43

Updated time schedule – ready to fly!

- Interface — **April 2024 (Flexible)**, **June 2024 (Fixed)**
- Interim meeting — **April 24**
- Results — **Technical meeting 24**





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WG2 composite mapping exercise (so far)

- **Participants so far**: HR, IT, SP, AT, PL, DE (3), CZ (2), DK, SI, FR, SE, NO, IE, PT, BE + Po-Valley, Madrid region,
- **Model spatial resolutions:** from 10 km to 10 meters.
- **Emission information:** Most of deliveries include underlying emissions but not all. Can those who delivered only concentrations so far, deliver emissions as well (BE, CZ, FR, ES, SE)?
- **Data assimilated results**: Can those who delivered only data-assimilated results, deliver raw results as well (CHMI, CIEMAT, INERIS, SMHI, ATMO)?

WG2 composite mapping exercise – Q1

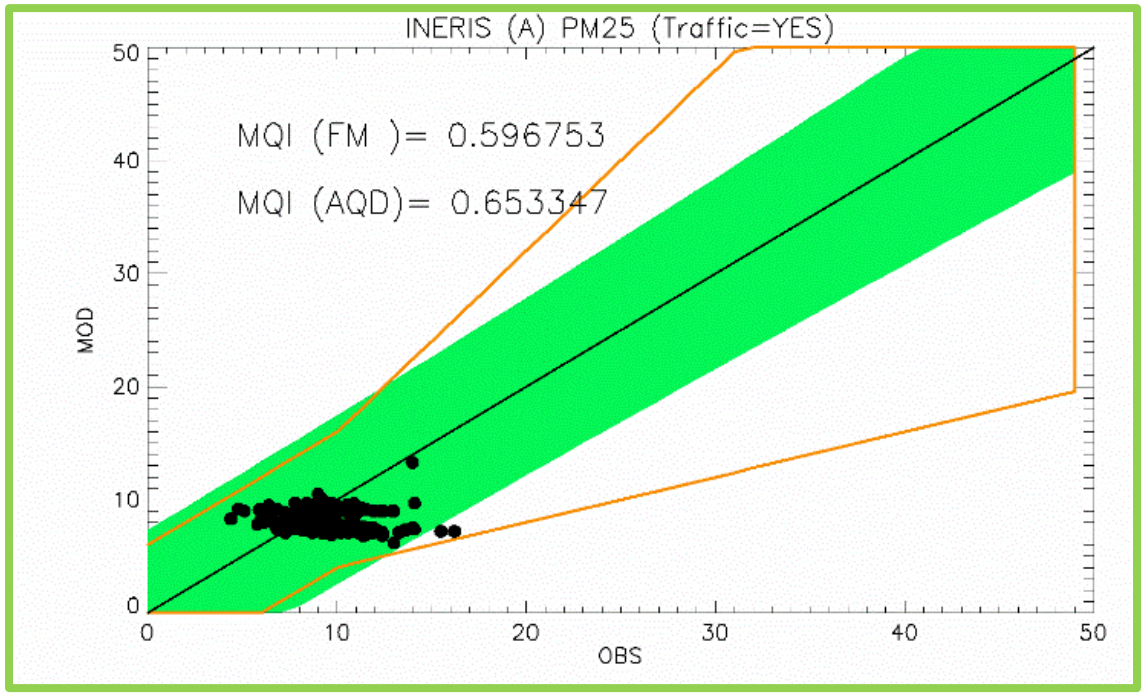
In this initial stage – the purpose of the exercise is to understand the robustness of the MQI results in the common FAIRMODE platform

Q1 Does FAIRMODE's on-the-fly MQI fit with own home calculation?

1. Choose and document the data and stations you want to use for the MQI analysis
2. Compare FAIRMODEs on-the-fly MQI with own home calculation
3. Carry out ONE analysis of your choice
   - Check robustness of your MQI with respect to the number of stations
   - Check robustness of your MQI with respect to aggregation area (NUTS3 vs. NUTS2 vs. country)
   - Check robustness of your MQI across pollutants
   - Compare your MQI with others MQI – if beaten by CAMS – analyse the emission data
   - Check MQI ability to assess specific modelling purpose
4. Report back to us

Q2 - Are the MQI stringent enough and consistent among pollutants?

Based on wrong submission, results still pass the MQO for PM2.5. Should it be so or is the PM25 MQI too flexible?

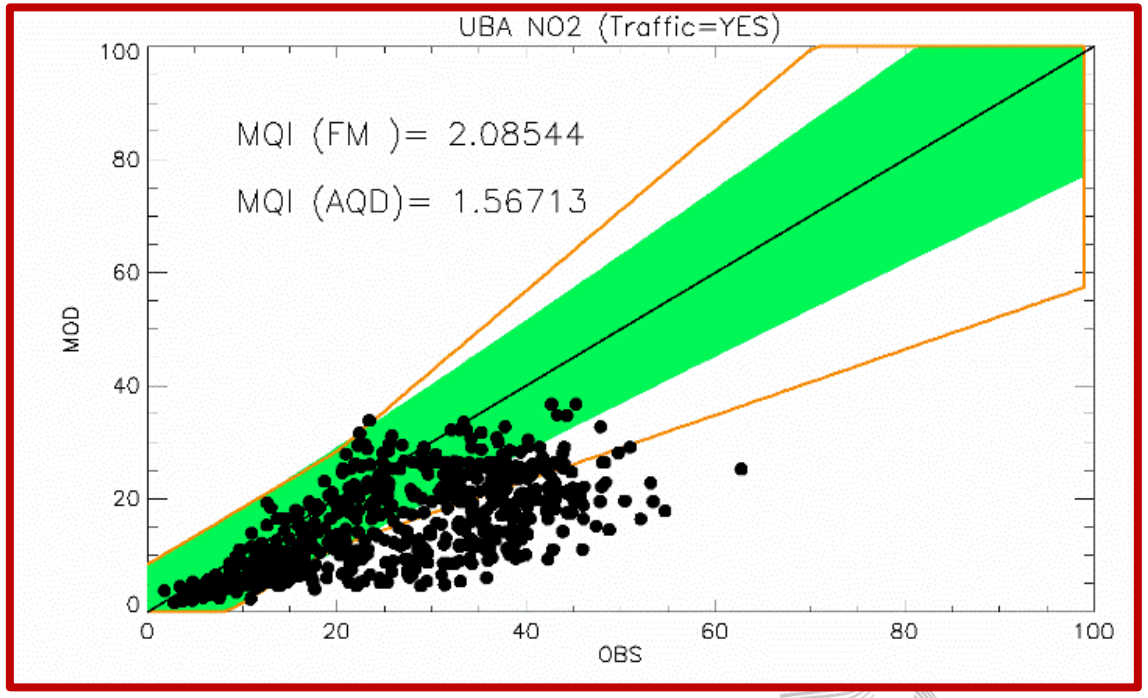


- ***Should Q2 be included in the initial WG2 composite mapping exercise or should this be postponed for 2025?***
- It would be valuable to test the robustness of the MQO formulation with respect to a meaningful level of stringency.
- Participants could be asked to carry out a series of tests to propose and reflect on the optimal stringency factor per component.

Q3 - Does the fail/pass MQO test ensure a valid distinction between Fit vs non-Fit-for-purpose modelling applications ?

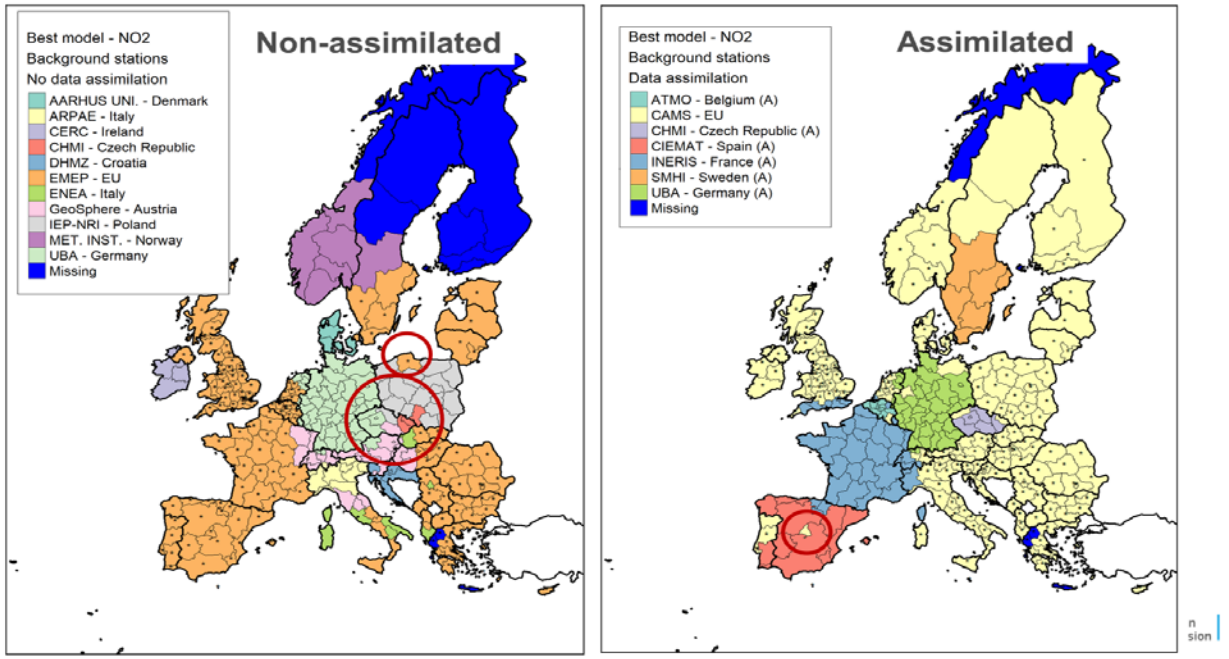
- ***Should Q3 be included in the initial WG2 composite mapping exercise or should this be postponed for 2025?***
- Can the participants identify situation when the modelling applications are not classified as expected in terms of the fail/ pass of the MQO?
- Participants could be asked to reflect on the stringency factor.

For NO2, we would expect the MQO to fail on traffic stations when large resolution modeling is used. Does this always happen?



Q4 - How to proceed when models use data-fusion & data assimilation?

- Information on stations used for assimilation is needed
- Can we apply the “leave one out” approach?
- How to deal with the fact that different models used different station datasets for assimilation/validation?
- Should there be a different stringency criteria for data assimilation model in the platform?



Discussion – Summary of questions

- **Do you agree to focus on Q1 for the 2024 composite mapping exercise in WG2?**
- **Should Q2 and Q3 be included in the initial WG2 composite mapping exercise or should these be postponed to 2025?**
- **How do you suggest we should deal with Q4?**

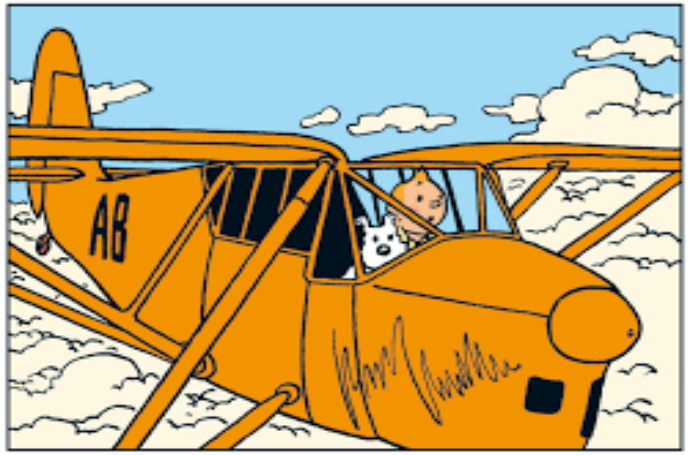
Proposed questions to be addressed

- **Q1 - Does FAIRMODE's on-the-fly MQI fit with own home calculation?**
- Q2 - Are the MQI stringent enough and consistent among pollutants?
- Q3 – Does the fail/pass MQO test ensure a valid distinction between Fit/non-Fit-for-purpose modelling applications ?
- Q4 – How to proceed when models use data-fusion & data assimilation?

Next meeting for participants on the WG2 composite mapping exercise

- Interim meeting **Thursday 18th April 24 from 10:00 to 12:00 CET**

  - **Presentation of the MQI interface**
  - **Questions to be addressed in 2024**
  - **Time schedule for contributions**



Thank-you

European Commission