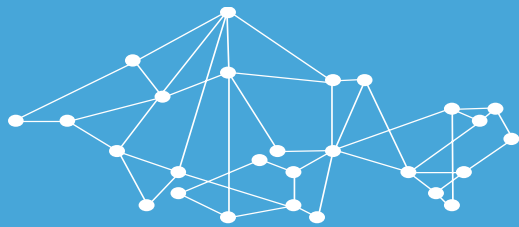# FAIRMODE
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WG8:
SPATIAL REPRESENTATIVENESS, EXCEEDANCE SITUATION INDICATORS & MONITORING NETWORK DESIGN

FAIRMODE TECHNICAL MEETING, 5TH OCT, ATHENS

LEONOR TARRASON & MATT ROSS-JONES
5 OCTOBER 2023

Main aims of the session

» Gather feedback on the current guidance document & need for further improvements

» Agree on key open issues needing further work

» Agree on a schedule for further testing & exercises within WG8

» Discuss a first outline of the chapter on spatial representativeness and network design in the technical guidance on air quality modelling (to be developed within a Commission service contract, SR9)

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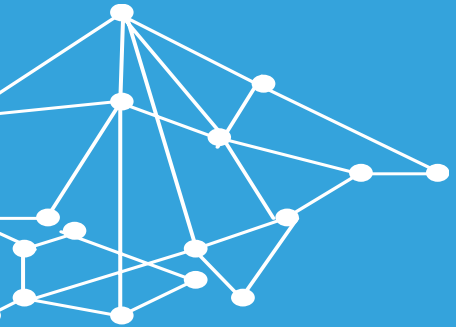
Spatial Representativeness

Where do we stand?

» Proposed recipe for defining spatial representativeness areas of monitoring stations:
https://fairmode.jrc.ec.europa.eu/document/fairmode/WG8/WG8_Guidance_Document_VS3.pdf

» Increased role for SR info in the proposed revision of the AQD

   » Will potentially become applicable in approx 2.5 years

» Development of technical guidance on modelling including a chapter on spatial representativeness & network design.

   » First draft spring 2024, final document early 2025

FAIRMODE WG8 – Guidance Document on the estimation of Spatial Representativeness and of Exceedance Situation Indicators

Authors: Stijn Janssen, Leonor Tarrason, Matthew Ross-Jones on behalf of the WG8 community
Version 3: including output of the discussion during the Technical Meeting in Oslo, 18 October 2022
Date: 21/02/2023

This Guidance Document summarizes the recent work of the FAIRMODE WG8 community. It provides recommendations for the estimation of Spatial Representativeness of monitoring stations and the estimation of the Exceedance Situation Indicators, both relevant parameters when reporting under the Ambient Air Quality Directives (AAQD). Note that this guidance focuses on the methodologies to be used for estimation of these parameters and provides recommendations on their estimation. In its current version, this guidance does not identify the best ways of reporting those methodologies and their results under the Implementing Provisions on Reporting (IPR).

The recommendations on spatial representativeness have to some extent been taken into account in the EC proposal for the new AAQD. The recommendations on the Exceedance Situation Indicators can serve as a basis for the upcoming review of the IPR.

I. Recommendations on Spatial Representativeness estimation

Context

The assessment of the spatial representativeness (SR) of monitoring stations has been discussed within the air quality community for a long time. SR is an essential indicator of any sampling point location and relevant for further interpretation of its measurement data in the context of the EU AAQD. It also plays a crucial role in the characterization of exceedance situations, the evaluation of modelling results and in the design and evaluation of the monitoring network. Therefore, SR is requested to be reported under the IPR and the related e-Reporting system under Data Flow D.

FAIRMODE has been involved in the discussion of SR assessment since the early days, given the potential role of modelling in this assessment process and the relevance of SR in any process where observations from monitoring stations are combined with modelling (validation, data fusion or data assimilation...).

For a better understanding of the concept of SR, it is essential to clearly specify the various application domains of SR. These include:

1. Assessment of population exposure based on monitoring data
2. Assessment of exceedance situations based on monitoring data
3. Monitoring network design
4. Use of monitoring data for model validation and data fusion/data assimilation

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Pianura Est

»

When defining the spatial representativeness area the following associated characteristics shall be considered:

(a) the geographical area may include non-contiguous domains but shall be limited in its extension by the borders of the air quality zone under consideration;

(b) if assessed via modelling, a fit-for-purpose modelling system shall be used and modelled concentrations shall be used at station location to prevent systematic model-measurement biases from distorting the assessment;

(c) other metrics than absolute concentrations can be considered (e.g. percentiles);

(d) the tolerance levels and possible cut-offs for the different pollutants may change depending on the station characteristics;

(e) the annual average of the observed pollutant concentration shall be used as the air quality metric for a specific year.

SPATIAL REPRESENTATIVENESS - OPEN ISSUES
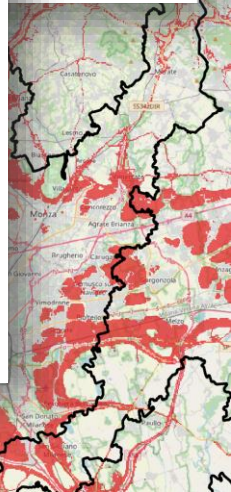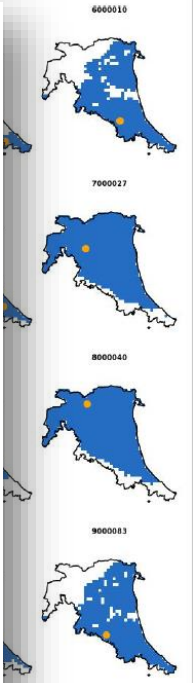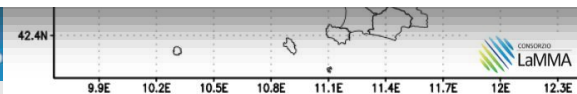
Have we identified all remaining open issues regarding spatial representativeness of measurement stations?

» Tolerance levels
  » Specific levels for different station types (e.g. 10 % for background and 20 % for traffic sites?)
  » Or one single tolerance level for all station types?
  » 2 µg/m^3 as a lower cut-off value or do we need pollutant-specific cut-offs?
  » Need for further similarity criteria? E.g. for percentiles, for sources?

» SR area limited by the AQ zone – is this OK even for regional background stations?

» How to handle model bias / correction?

» How often should the SR area be reviewed (every 5 years?) and how should it be reported?

» What to do when you don't have results from a fit-for-purpose model? Need for further guidance on lower tier methods?

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Draft checklist for further testing & presentation of results

- » Country / Zone / City
- » Measurement station & description (station type, inlet height, other characteristics that may be relevant/important)
- » Pollutant
- » Year
- » Type of model (e.g. Gaussian, OSPM, Lagrangian, CFD, etc.)
- » Model scale / resolution
- » Bias adjustment? (data fusion / data assimilation)

- » Results:
    - » SR area with different tolerance levels (10 or 15 % for background stations, 15 or 20 % for hotspot/traffic stations)
    - » SR area with different lower cut-offs
        - » 1 or 2 µg/m^3 for PM2.5
        - » 2 or 4 µg/m^3 for NO_2
        - » 2, 4 or 6 µg/m^3 for ozone
        - » Input on relevant cut-offs for SO_2, Benzene, CO, B(a)P & metals?
    - » SR area for annual mean vs relevant percentile
    - » Annual variation in SR areas
    - » Impact of applying bias correction on SR area?

- » Comments on scale of gaps in existing monitoring networks with different criteria (i.e. how large are the areas in a city / zone that are not covered by the SR areas of the zone's measurement stations?)

- » Other important comments for consideration (e.g. source-related issues)

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Important with further testing in as many zones as possible across the EU during the autumn / winter

» Online workshops 14th Dec (10:00 – 12:00) & in one in January

» Opportunity to present results of further testing
  » Focus on testing the open issues
  » Increased focus on urban stations, particularly hotspots
  » Also industry and residential heating
  » NO_2, PM2.5, PM10 and O_3 are key, but SO_2, benzene, CO, B(a)P and metals also important
  » Examples from lower tier methods welcome!

» Feedback structured according to the proposed checklist
» Please indicate your willingness to take part in this activity!

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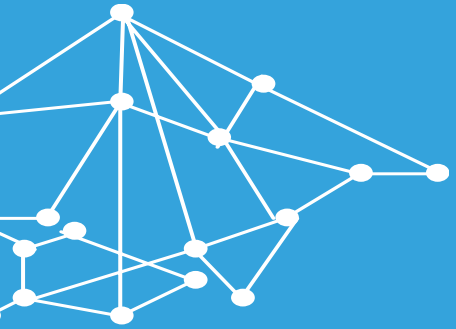
Exceedance Indicators

Where do we stand?

- Proposal for a 2 staged approach:
  - **Exceedance <u>Flagging</u> Indicator (EFI)**: qualitative indicator to flag the severity of the exceedance (compliance purpose) → year X+1
  - **Exceedance <u>Situation</u> Indicator (ESI)**: quantitative indicator that identifies all the "hot spot areas" in the air quality zone (planning purpose) → year X+2

  Guidance document:
  https://fairmode.jrc.ec.europa.eu/document/fairmode/WG8/WG8_Guidance_Document_VS3.pdf

- On-going natural dust exercise with CAMS
- Exceedance indicators to be included in chapter on assessment in technical guidance on modelling (to be developed 2024 / 2025)

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Is the outline of the current guidance document good enough?

- What is missing from the section on exceedance indicators?
- How can the guidance be improved?

What are the most important issues to focus on in coming activities / testing?
Some examples:

- Check population ranges for the EFI?
- Do we need an EFI for the ecosystem indicator?
- Relevance of the road length indicator?
- Assessment methods for the EFI – available modelling results, SR area, expert judgement?
- How to document and report the assessment methods?

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Ideas for further testing

» First test the EFI using actual reported exceedances from 2022 data

» Then test the ESI using these same exceedances

» Based on the results produce guidelines / best practice on how this information should be produced, documented & reported

» Interest in a dedicated workshop to present results on EFI testing during the winter?
    » Workshop in spring on results from ESI testing?
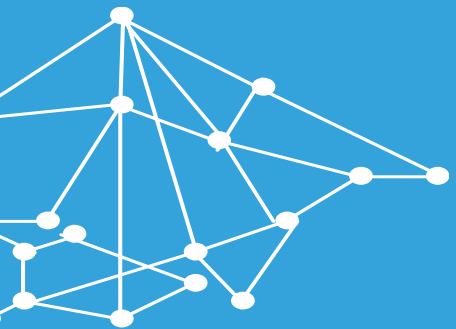
Monitoring network design

• FAIRMODE & AQUILA cooperation 45 participants from 10 countries: **15 presentations sharing experience in two sessions:**

• Austria (1), Germany (1), Ireland (1), Italy (4), the Netherlands (1), Norway (1), Portugal (1), Slovakia (1), Spain (2), Sweden (2)
  - Focused on two domains: country, region/AQ zone
  - Used for PM10 and/or NO2 (some in PM2.5 and O3 in addition)
  - Mostly hourly data, few daily (PM10)

• Useful exercise to
  ✓ Identify inconsistencies in the monitoring sites classification
  ✓ Revise the validity of the current air quality zone definition
  ✓ Evaluate the optimisation of the monitoring network

• Coordinated by Norway(NILU) using the MoNet clustering tool

Results PM_{10}

Large clusters:
• Northern/north-eastern extra-alpine

Results Region 1: Uppsala & Stockholm

Depends on metric, EuD; background stations are in same cluster
--> magnitude similar, but temporal variations influenced by local conditions

Hourly values 2021. Dissimilarity cutoff 30,000

Daily values 2021. Dissimilarity cutoff 4000

Thank you for interest!!
Thank you for your contribution!!

Planned next steps
• Initiation of the elaboration of a Monitoring Network Design Evaluation **Guidebook**
• **Peer review article**
• **Additional exercises** in May/June 2023 to be reported at the next FAIRMODE technical meeting

» **Guidebook** proposed content
- Compilation of experiences in a guidebook form
  - How to evaluate your air quality monitoring network
  - How to use the tool
  - How to interpret the results **(examples from countries)**
  - Protocol for evaluation, Interactive cookbook
    » Streamline a procedure on what to do with the outliers
  - Examples of good practices **(examples from countries)**

Atmosphere
Monitoring

- ✓ Report submitted 30.07.2023 under CAMS National Cooperation Programme for Norway

- ✓ Project coordinated by NEA (Scott Randall) with MET Norway and NILU

- ✓ Can the CAMS regional ENSEMBLE results support monitoring network design in Norway?

- ✓ How can the national uEMEP model results support monitoring network design in Norway ?

- ✓ Example: **Evaluation of the Air Quality Zones**

Atmosphere
Monitoring
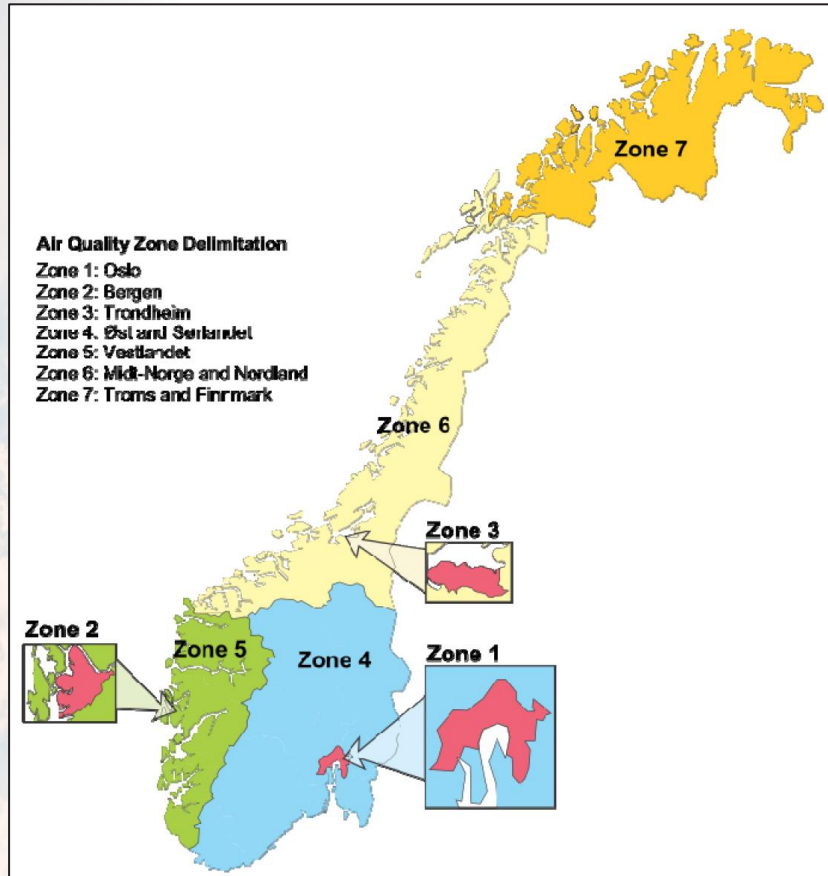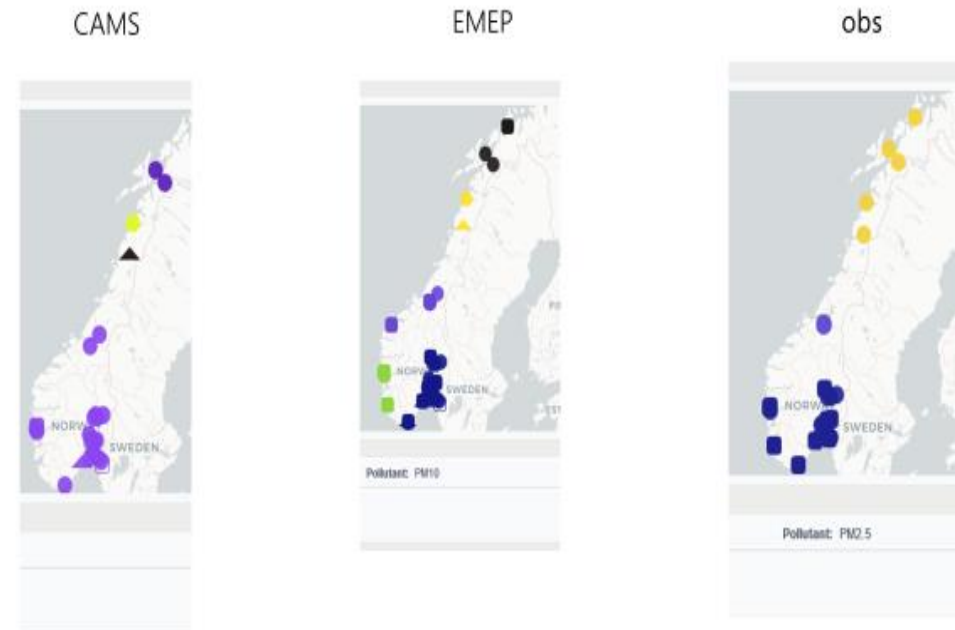
The clustering analysis shows that the current monitoring network does cover different air quality regimes in Norway. Two zones, 6 and 7 may need to be reviewed – new tests with just modelling data recommended

Next steps for the MoNET tool?

» Produce documentation / guidebook on how to use the tool and interpret the results

» How to proceed?

❖ Compilation of experiences so far – Volunteers?

❖ Further testing to identify best practices on the use of models ?

❖ Should we test AQZ with modelling results as done in Norway?

❖ Links to SR9 Guidance on monitoring design

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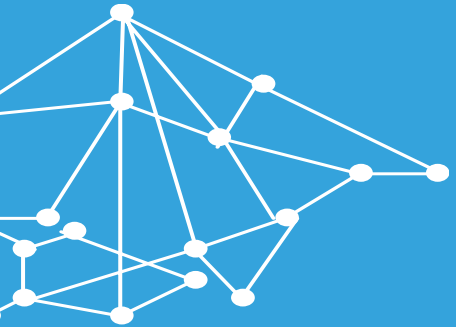
Development of technical guidance document

What further guidance is needed regarding network design and spatial representativeness?

» Lack of up-to-date EU guidance on network design. References to national guidance in MS are welcome!

» How do MS currently design and review monitoring networks?
  » Is modelling data used? If so, how?

» FAIRMODE guidance on SR as a basis for the technical guidance on SR?
  » What is missing from the current FAIRMODE document and how could it be improved?
  » Need for a separate FAIRMODE document (for modellers) and a cookbook-style technical guidance document?

CHAPTER 3 – Spatial Representativeness

- **Importance of SR under the (revised) AAQD**

- **SR methodology / recipe**
  - TIER-ed approach
  - Key criteria for SR areas
  - Specific requirement per station type (RB, UB & hotspot/traffic sites) → needed, useful?

- **Application areas of SR**
  - pop exposure, exceedance indicators, model validation, network design, interpretation of real-time monitoring data

- **Monitoring network design**
  - Link with SR area and other assessment methods (indicative measurements, sensors)
  - Identification of hot spots
  - Identification of redundancies in network
  - MoNET tool – using models and meaurements

- **Exceedance situation estimation (area, road length, pop in exceedance)**
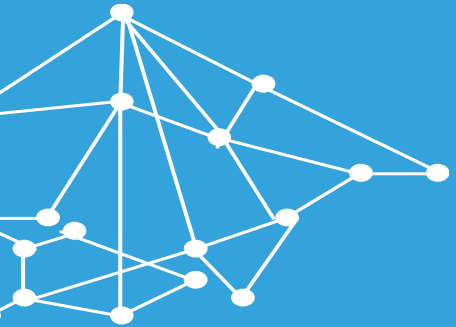 - Assessment methods
  - Role of natural sources/contributions

- **Population exposure**

Feedback @
https://ec.europa.eu/eusurvey/runner/MODGUI

Thank you!

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