CAMS – FAIRMODE WG8 Joint evaluation exercise

The joint CAMS-FAIRMODE natural dust exercise: advances so far

Atmosphere Monitoring

Leonor Tarrasón, NILU

7th CAMS Policy User Workshop, Athens, 4th October 2023

The joint CAMS- FAIRMODE WG8 Exercise

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- CAMS-FAIRMODE assessment of methods to identify natural pollution exceedances due to dust
- Started in April 2023
- CAMS team: L. Tarrason, P. Hamer, A.M. Fjæraa, S. Tsyro, R. Timmermans, A. Colette and B. Raux
- FAIRMODE chairs: Leonor Tarrason and Matthew Ross-Jones

- **40 participants**
  - **14 countries**: **Austria, Belgium, Bulgaria, Croatia, Cyprus, France, Hungary, Italy, Malta, Norway, Poland, Portugal, Spain and Turkey**
  - **ECMWF, WMO and EEA** follow closely this exercise

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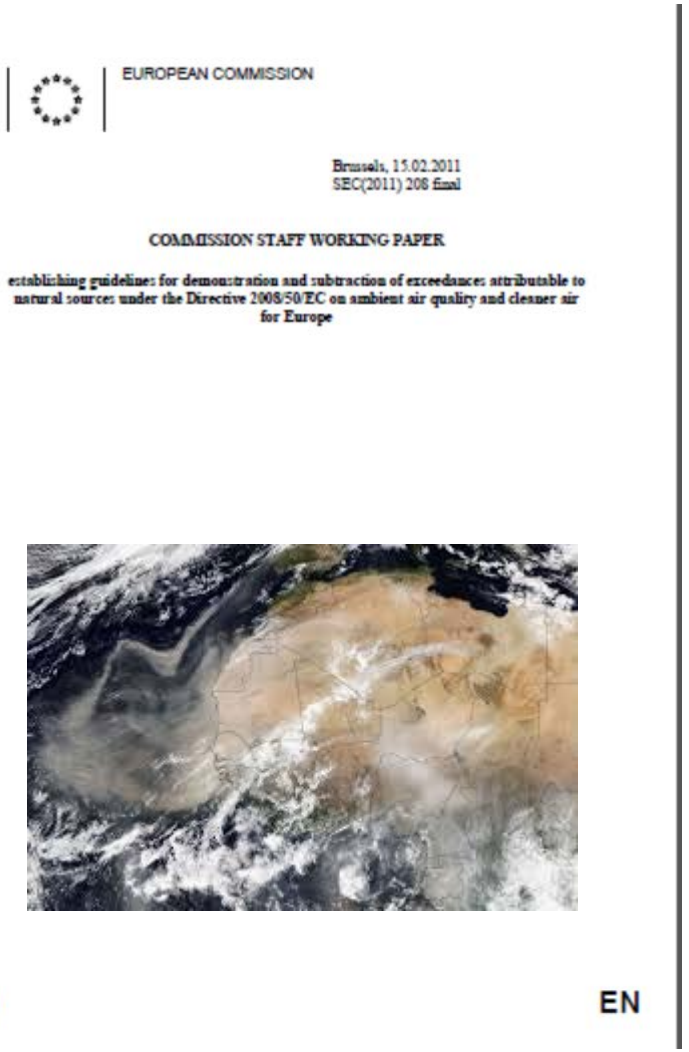
CONTEXT : EVALUATION OF EXCEEDANCES – DEDUCTION OF NATURAL CONTRIBUTIONS

- Under the AAQD, Article 20, Member States are requested to identify zones where exceedances of limit values are attributable to natural sources. Now in Article 16 of the revised version of the AAQD proposed by the European Commission.

- Member States are to follow the current guidelines in COM(208)/2011 if there are to deduce the contribution of natural dust to measured exceedances to limit values.

- The current official guidance is from 2011. New modelling and measuring methods have been developed since then such as the Saharan dust information regularly provided by CAMS

- Identification of best practices for exceedance evaluation at the core of FAIRMODE WG8 activities



EUROPEAN COMMISSION

Brussels, 15.02.2011
SEC(2011) 208 final

COMMISSION STAFF WORKING PAPER

establishing guidelines for demonstration and subtraction of exceedances attributable to natural sources under the Directive 2008/50/EC on ambient air quality and cleaner air for Europe

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Natural Dust contribution to exceedances of limit value

Purpose of this common CAMS - FAIRMODE WG8 exercise

- Identify **best practices** for use of CAMS modelling dust products when deducing natural contribution from exceedances in the context of the AAQD
- Prepare **recommendations for the inclusion** of reference to **CAMS dust products** in a possible revision of the guidelines for the deduction of natural contributions to exceedances

- Increase the awareness on the existing CAMS dust products
- Promote the use of CAMS dust products for the exceedance analysis
- Compile experiences of use of CAMS dust products for exceedance analysis
- Provide recommendations for the evolution and documentation of the CAMS dust products valuable for exceedance evaluation and analysis

Procedure

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- Participants are asked to
  - **Select** a given exceedance episode in **2022**
  - **Identify the natural dust contribution** for the given situation by using their own usual methodology - analysis of deduction of Saharan dust as usual
  - **Carry out an additional evaluation** using some specific CAMS products
  - **Compare the two methodologies** in a common template presentation
  - **Share experience** with other participants in the exercise
  - **Help developing best practices and recommendations** on the use of CAMS modelling dust products for deducing natural dust contribution from exceedances to limit values in the context of the AAQD

➢ **Comparison with current methodologies**

➢ **Not for compliance reporting in this first round**

Natural dust episodes selection

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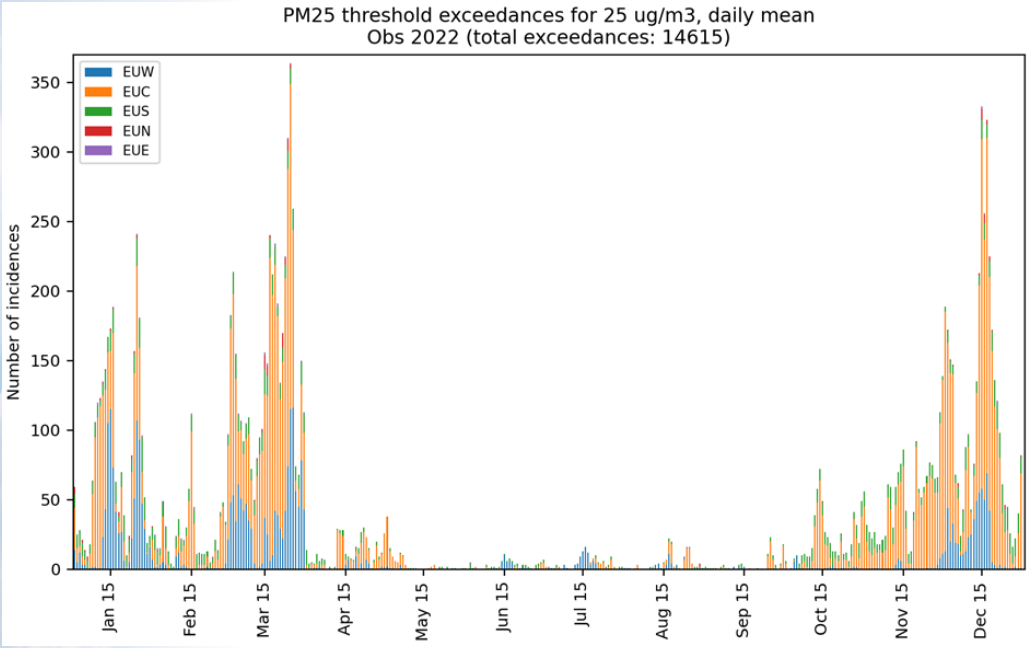
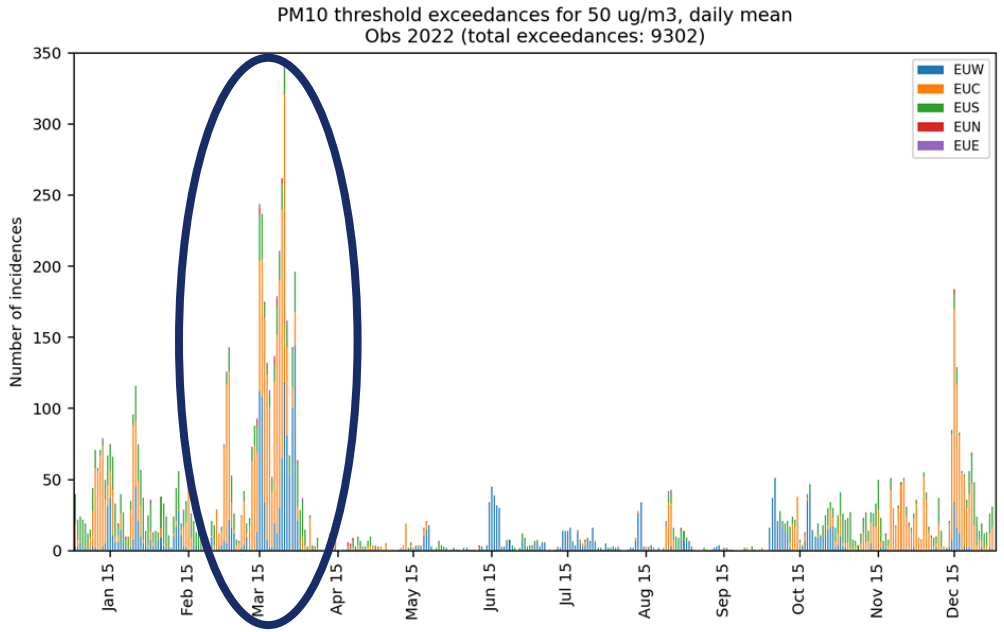
- Overview of exceedances of PM2.5 and PM10 in in **2022.**





- ✓ The target year is 2022
- ✓ But ewe allow flexibility on the choice of the actual episode as the exceedance situation of interest may be different in different countries/areas.

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CAMS dust products shared

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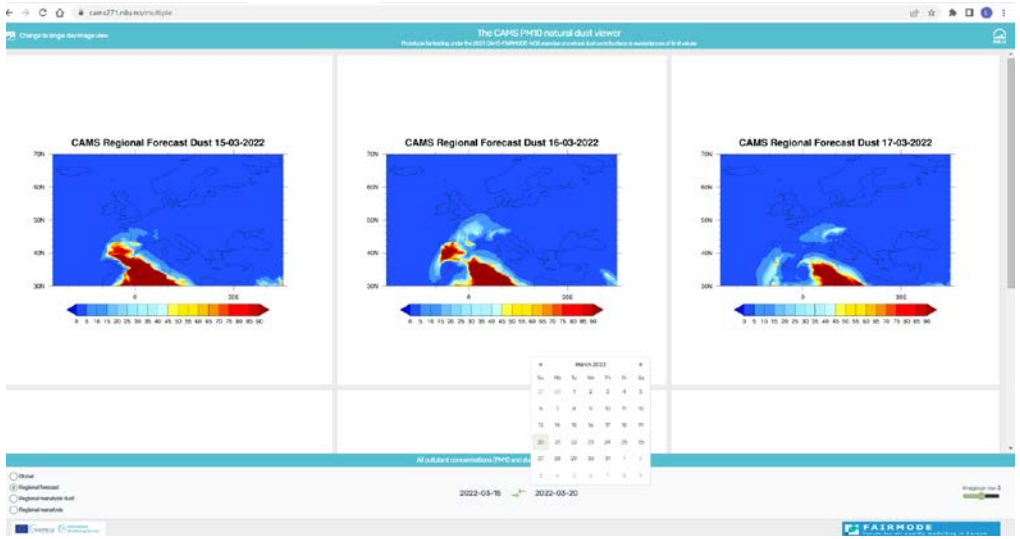
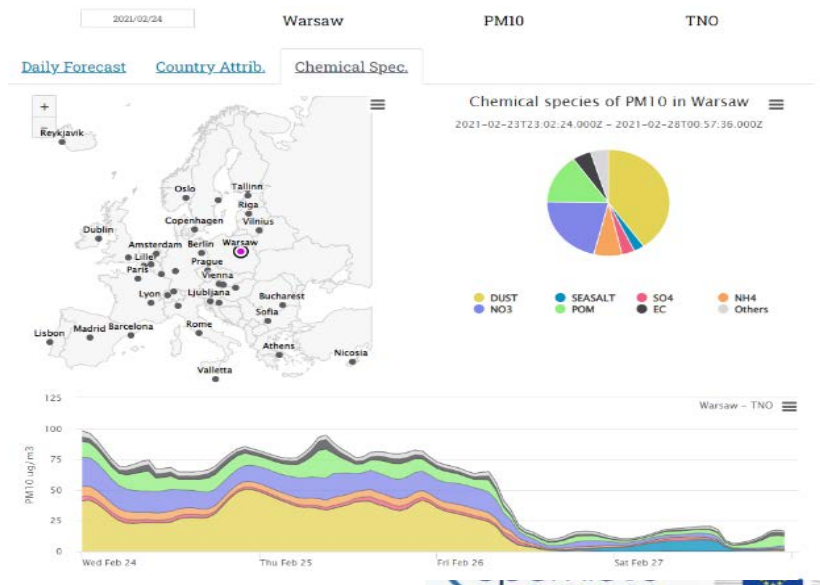
CAMS data products shared are

- CAMS regional Interim **reanalysis data** for PM10 and PM2.5 (hourly data)
- CAMS **regional dust forecast** (hourly data)
- CAMS **SR data for natural dust** for the selected episode in European cities (hourly data)
- CAMS **chemical speciation** data for the selected episode in European cities (hourly data)

✓ No constraints on how to use the CAMS data in the evaluation and secure flexibility





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1) Daily Data viewer – https://cams271.nilu.no

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CAMS2-71

cams271.nilu.no

Change to multi day image view

The CAMS PM10 natural dust viewer

Prototype for testing under the 2023 CAMS-FAIRMODE-WG6 exercise on natural dust contributions to exceedances of limit values

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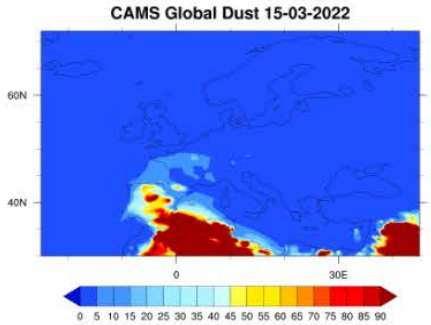
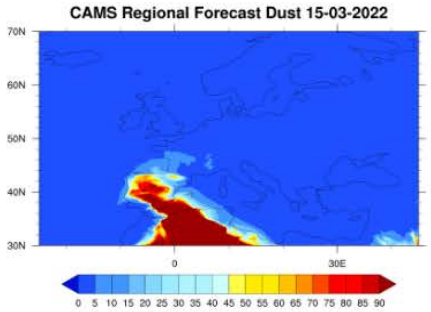
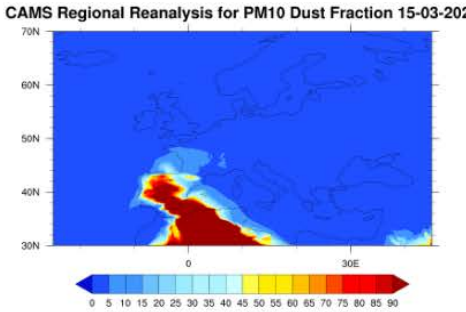
CAMS global ensemble (3) and AOD data assimilation



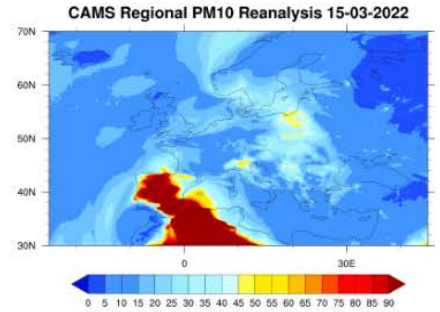
CAMS regional ensemble (9) Forecast – No data assimilation



CAMS regional ensemble (9) and surface PM10 data assimilation – Dust fraction



CAMS regional ensemble (9) and surface PM10 data assimilation – All

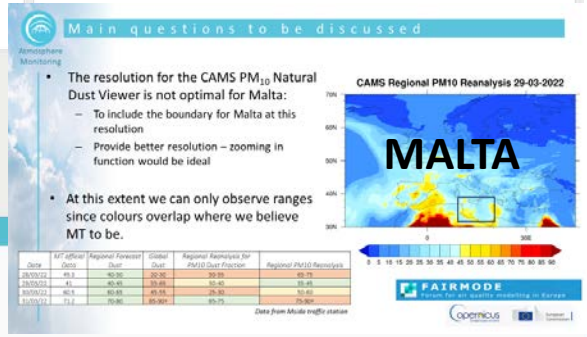


Link to the viewer https://cams271.nilu.no

All pollutant concentrations (PM10 and dust) are in units of ug.m-3

- Global
- Regional forecast
- Regional reanalysis dust
- Regional reanalysis

2022-03-15
(Click for calendar)



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2) Hourly Chemical speciation data

- **ON-LINE HOURLY CAMS PM10 chemical speciation data** including specifically desert dust from the EMEP and LOTOS-EUROS forecast model for the whole year 2022 in selected (about 50) European cities (hourly data)

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3) Hourly data at EEAs stations

- **HOURLY observations of PM_{10} and $PM_{2.5}$** for the whole year 2022 at EEA selected stations - 2022 E2a (Up-to-date) and E1a (2021
- **HOURLY CAMS regional Interim reanalysis** data for **PM10, PM2.5 and Dust** fraction in PM10 for the whole year 2022 at same EEA selected stations
- **HOURLY CAMS regional NRT forecast** data for **PM10, PM2.5 and Dust f**raction in PM10 for the whole year 2022 at same EEA selected stations
- **DAILY MEAN** averages at selected stations

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Natural Dust contribution – CAMS method

PORTUGAL

- Proposed methodology using CAMS dust products

- $dust\ component = (1 - \frac{PM10_{CAMS} - PM10_{obs}}{PM10_{CAMS}}) \times DUST10_{CAMS}$

			current method P40		CAMS based method	
		PM10 obs (µg.m^{-3})	dust component (µg.m^{-3})	PM10 after dust deduction (µg.m^{-3})	dust component (µg.m^{-3})	PM10 after dust deduction (µg.m^{-3})
SCO	15 mar	423.3	416.2	7.1	349.6	73.7
	16 mar	266.8	259.6	7.1	222.5	44.2
FRN	15 mar	293.8	290.4	3.4	203.7	90.0
	16 mar	582.7	579.3	3.4	375.4	207.3
CHA	15 mar	216.8	206.9	10.0	137.6	79.2
	16 mar	215.5	205.5	10.0	131.7	83.8
CER	16 mar	173.3	166.0	7.3	110.0	63.3
	17 mar	115.7	109.7	6.0	67.5	48.2

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Contributions so far – 10 countries

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20th June 2023 – First interpretation webinar

- **Bulgaria** (Emilia Georgieva and Hristina Kirova, National Institute of Meteorology and Hydrology-Bulgaria)
- **Hungary** (Anita Tóth, Hungarian Meteorological Service)
- **Italy - Tuscany** (Guglielmo Tanganelli and Francesca Guarneri, ARPAT)
- **Italy** (Francesca Barnaba, Cnr-isac, Andrea Bolignano, Enea, and Giorgio Cattani, Ispra).
- **Malta** (Ariana Schembri and Ruth Borg, ERA)
- **Poland** (Joanna Strużewska, IOS, Poland)
- **Portugal** (Carla Gama, University of Aveiro)
- **Portugal** (Joana Monjardino, FCT NOVA, Portugal)

4th October 2023 – 2nd interpretation workshop

- **Austria** (Wolfgang Spangl, UBA-Vienaydrology-Bulgaria)
- **France** (Laure Malherbe and Laurent Latenois, INERIS)
- **Italy** (Francesca Barnaba, Cnr-isac, Andrea Bolignano, Enea, and Giorgio Cattani, Ispra).
- **Malta** (Ariana Schembri and Ruth Borg, ERA)
- **Poland** (Pawel Durka, Joanna Strużewska, IOS)
- **Spain** (Noemi Perez, CSIC)

Belgium, Croatia, Cyprus and Turkey not yet contributing

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Timeline

April 2023 to March 2024

- ✓ **13th April 2023 –** Initial webinar to agree on the exercise set-up and distribute the CAMS data and information to be made available and the template format for the evaluation exercise.
- ✓ **20th June 2023 –** First interpretation webinar to gather experiences from participants.
- ✓ **4th October 2023 –** Second interpretation workshop to share experiences and identify lessons learnt.
- ❑ **Feb/March 2024 –** Summary of conclusions and lessons learnt. This is planned as a presentation under WG8 in the FAIRMODE Plenary which is to back to CAMS Policy User Workshop in 2024

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Natural Dust contribution – Current method

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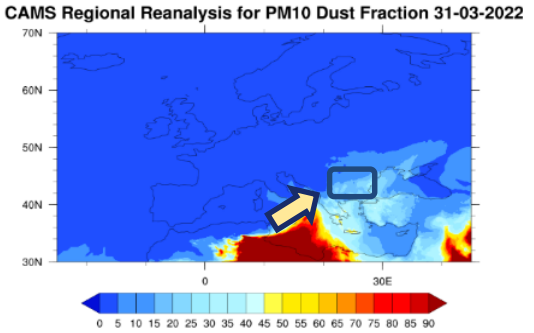
- Current methodology **1.episode: 29.03-01.04.2022**
- **– based on time series of PM10obs** :

a) For days identified with DUST: **PERC50** with time window ±3 days out of dust period

b) Dust_contr_PM10obs = PM10obs – PERC50

c) PM10corr = PM10obs - Dust_contr_PM10obs



- **Current calculated natural dust contribution, 1.episode: 29.03-01.04.2022**

Date/ MEAN (µgm-3) for stat. with EXC	PM10 value before correction	Calculated PM10 dust contribution – Current method	PM10 value after deduction of dust contribution	Stations with EXC – before	Stations with EXC - after
29/03/2022	**60.71**	**1.76**	**58.95**	10	9
30/03/2022	**56.36**	**16.27**	**40.09**	11	4
31/03/2022	**58.88**	**26.53**	**32.35**	22	0
01/04/2022	**67.85**	**39.08**	**29.23**	22	0
Avg.	**60.95**	**20.91**	**40.16**	**SumEx 65**	**SumEx 13**

- **Before: Number of exceedances 65 at 31 stations; After: 13 exceed. at 11 stations**

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CAMS dust products to be used

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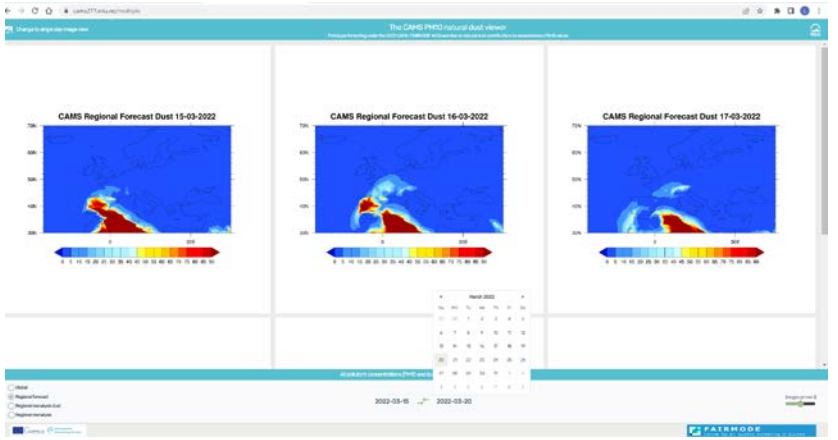
No constraints on how to use the CAMS data in the evaluation

✓ Is this OK ? YES – allow flexibility



1. Use the dust component of the **CAMS regional ensemble** over Europe as basis to document the presence of a Saharan dust in the place and time of the observed PM_{10} exceedance.
   a. The use of the CAMS regional ensemble is preferable over the use of any of the single models in the source-allocation service because its robustness in comparison with observations.
   b. The use of the dust component of CAMS regional ensemble is preferable over the use of the dust product from the CAMS global aerosol system because of increased resolution and consistent use of observations over Europe with other products of the CAMS regional ensemble.
2. Calculate the bias of the CAMS regional ensemble PM_{10} concentrations with respect to observations - Δ
   a. Use the total regional ensemble values as a whole.
   b. We could assume that the same bias (Δ)applies both to the total PM_{10} concentration as to the PM_{10} dust contribution.
3. Identify the contribution of the dust component in the CAMS regional ensemble for the place and time of the observed PM10 exceedance. This value is the CAMS dust component ($PM_{10\ dust}$)
   a. This value is not recommended to the one to be subtracted from the observations because there is a possible bias in the CAMS model calculations.
4. Correct the CAMS dust component for possible bias and use the corrected value for deducting the natural Saharan dust contribution to the observed exceedance concentrations

This means that the PM_{10} dust correction will actually be equal to

$$PM_{10\ CAMScorrection} = (1-\Delta)\ PM_{10\ dust}$$

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