CAMS – FAIRMODE WG8 Joint evaluation exercise

The joint CAMS-FAIRMODE natural dust exercise and perspective for Iceland and arctic regions

Atmosphere Monitoring

Leonor Tarrasón, NILU on behalf of the whole group

FAIRMODE Plenary meeting 27th February 2024

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The joint CAMS- FAIRMODE WG8 Exercise

- 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

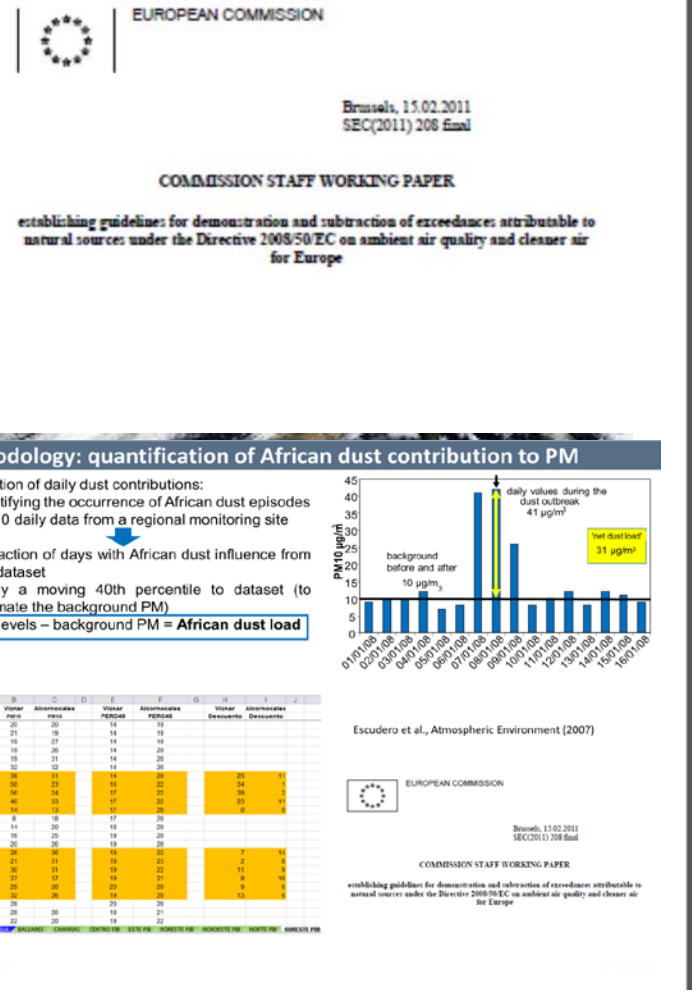
CONTEXT : EVALUATION OF EXCEEDANCES – DEDUCTION OF NATURAL CONTRIBUTIONS

- 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

Methodology: quantification of African dust contribution to PM

Calculation of daily dust contributions:
- Identifying the occurrence of African dust episodes
- PM10 daily data from a regional monitoring site
- Extraction of days with African dust influence from the dataset
- Apply a moving 40th percentile to dataset (to estimate the background PM)
- PM levels – background PM = **African dust load**

daily values during the dust outbreak
41 µg/m³
'net dust load'
31 µg/m³
background before and after
10 µg/m³
PM10 µg/m³

Escudero et al., Atmospheric Environment (2007)

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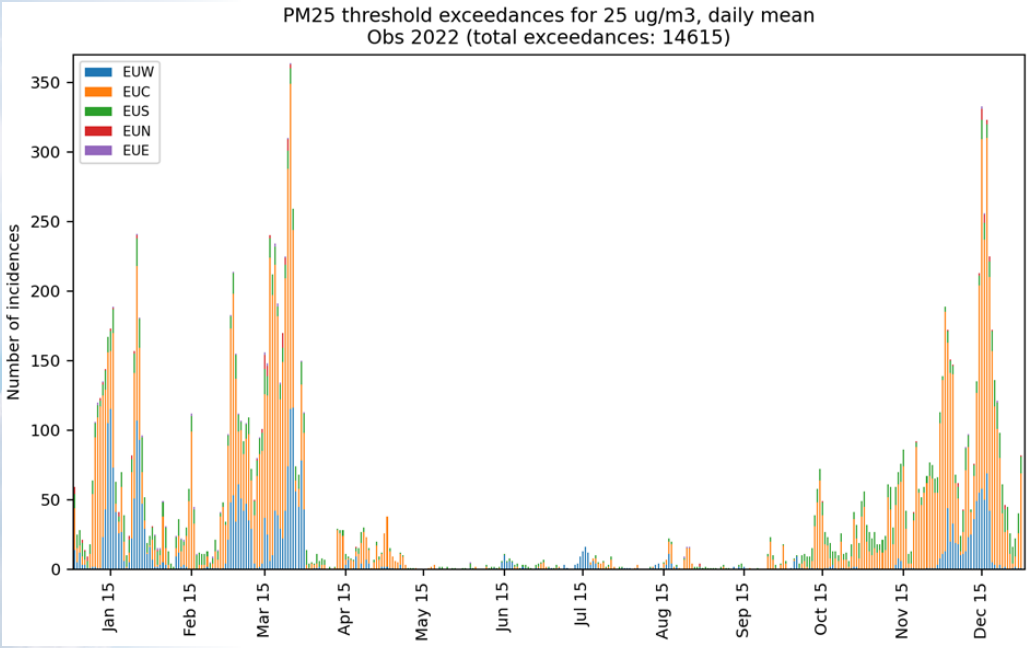
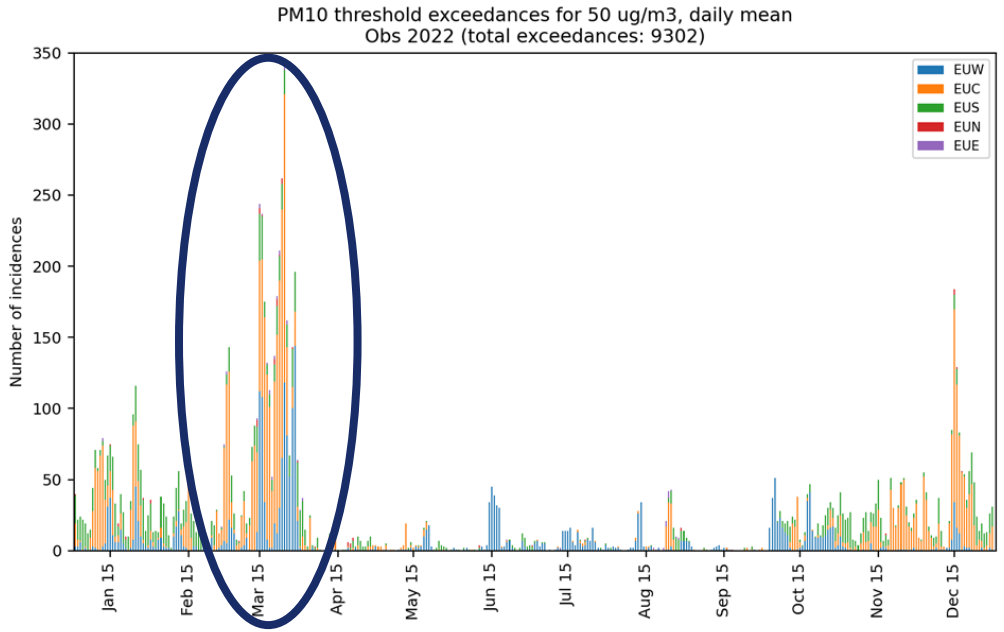
- Overview of exceedances of PM2.5 and PM10 in in **2022.**





- ✓ 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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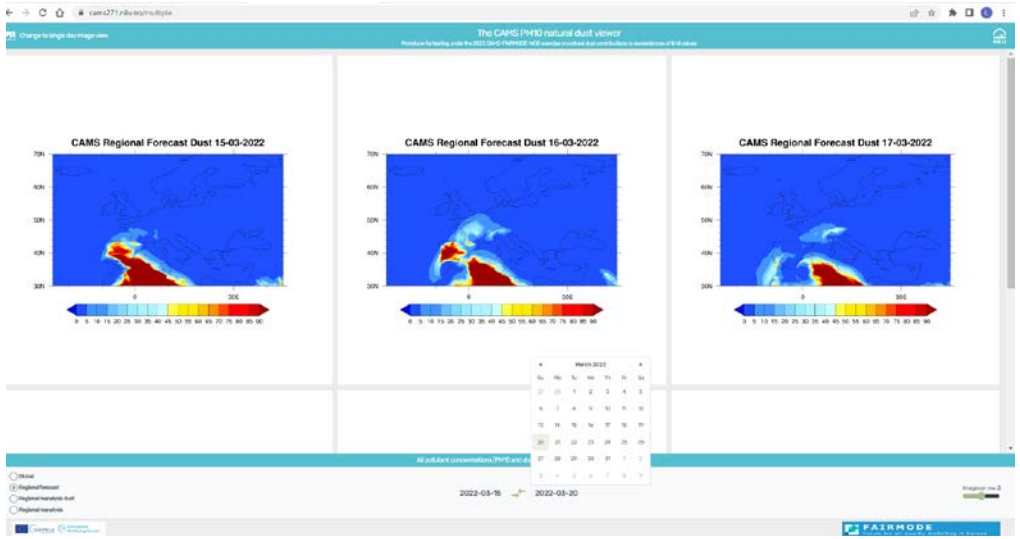
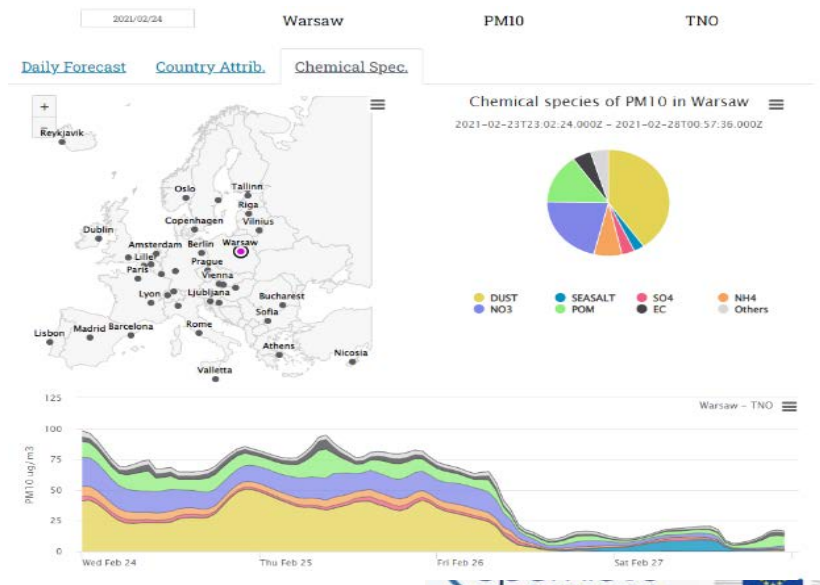
CAMS data products shared are

- 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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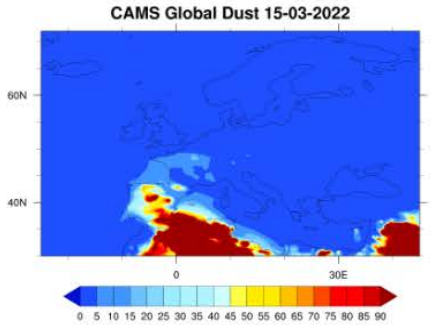
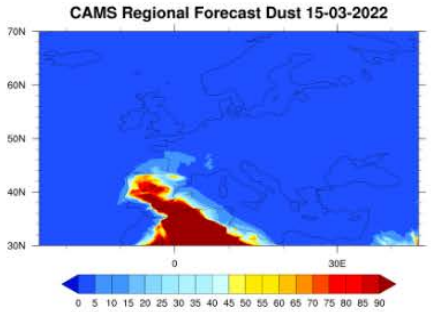
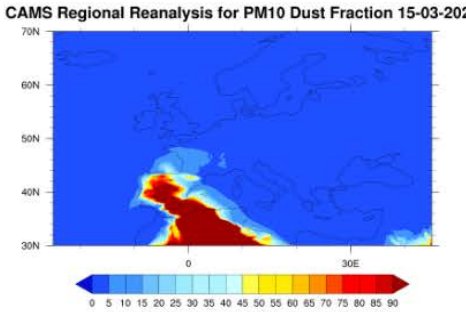
CAMS global ensemble (3) and AOD data assimilation



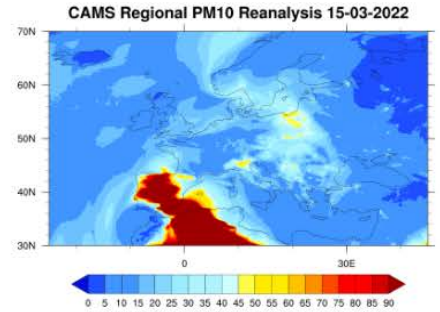
CAMS regional ensemble (9) Forecast – No data assimilation



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



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

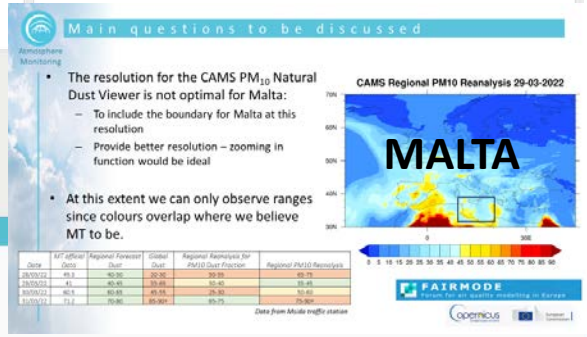


Link to the viewer https://cams271.nilu.no

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

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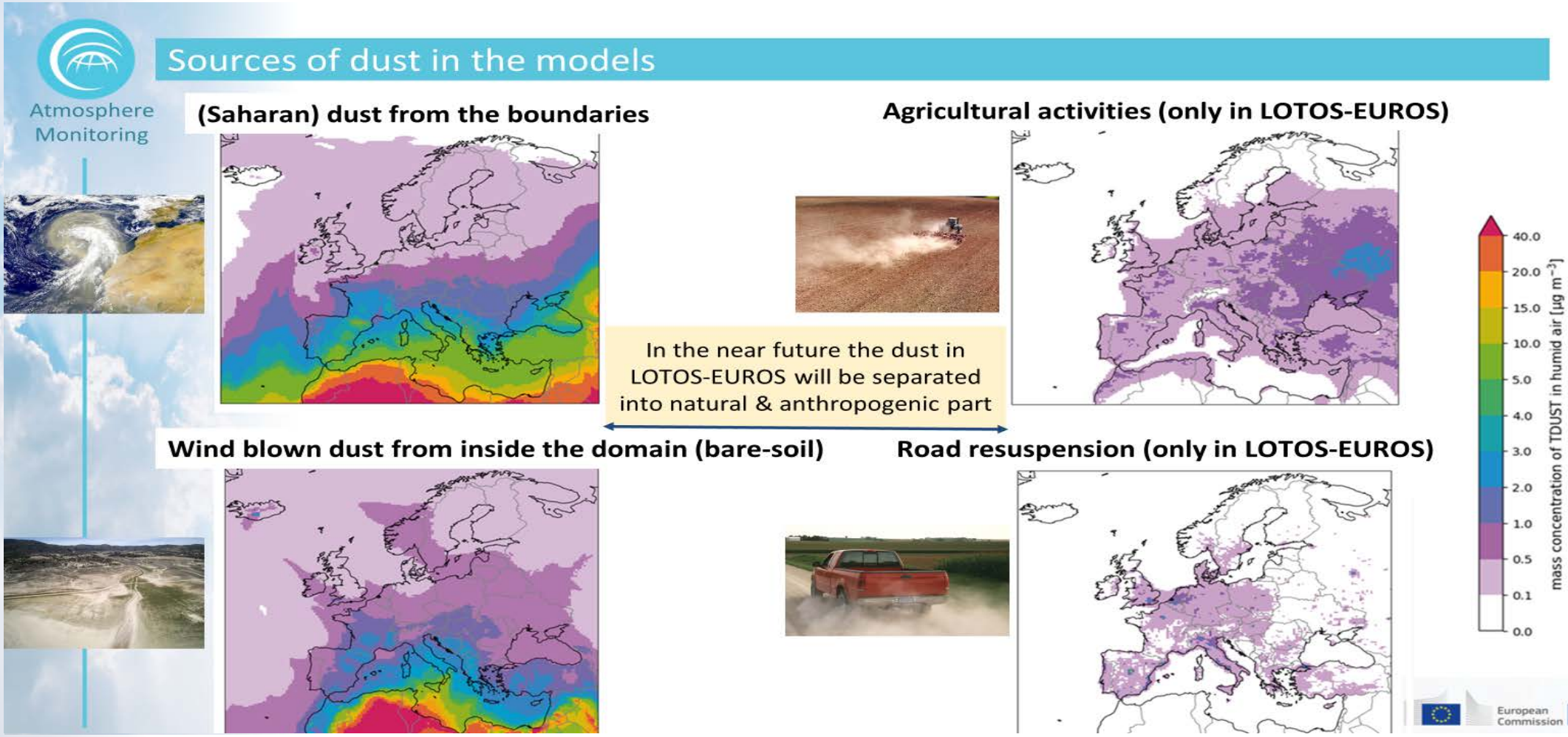
- **ON-LINE HOURLY CAMS PM10 chemical speciation data** including specifically desert dust from the EMEP and LOTOS-EUROS forecast model for the whole year 2022 in selected (about 50) European cities (hourly data)



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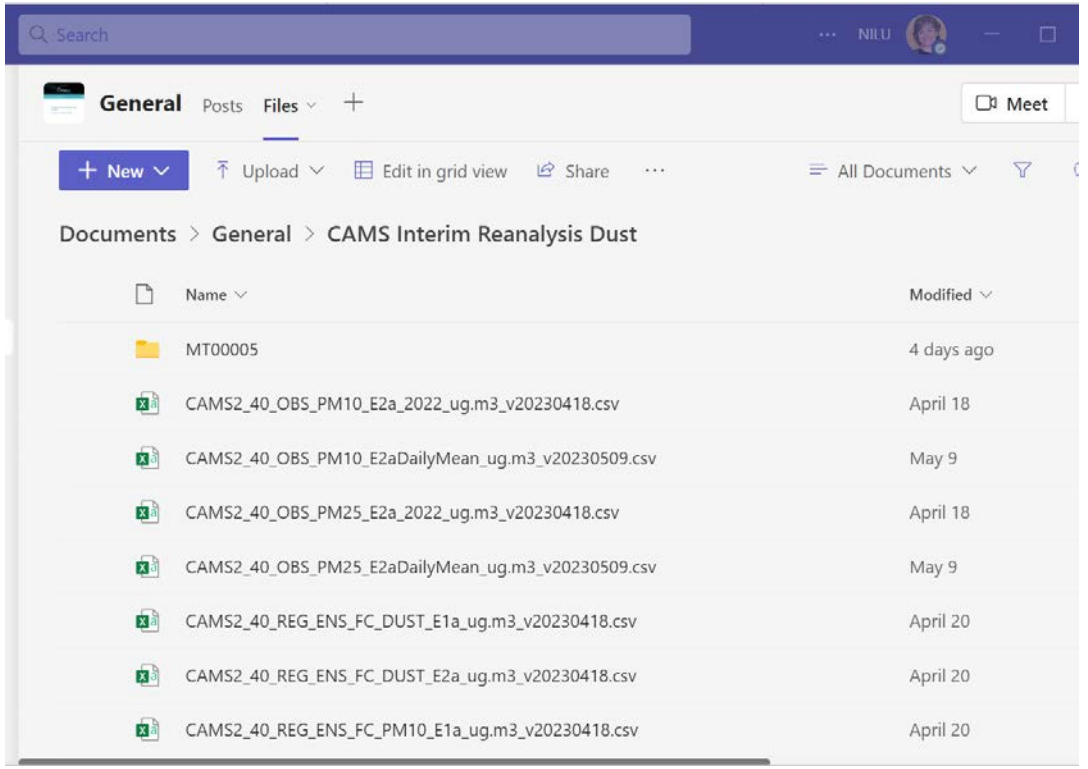
3) Hourly data at EEAs stations

- **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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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-Viena)
- **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, possible contribution from **Iceland on HLD**

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Lessons learned so far (I)

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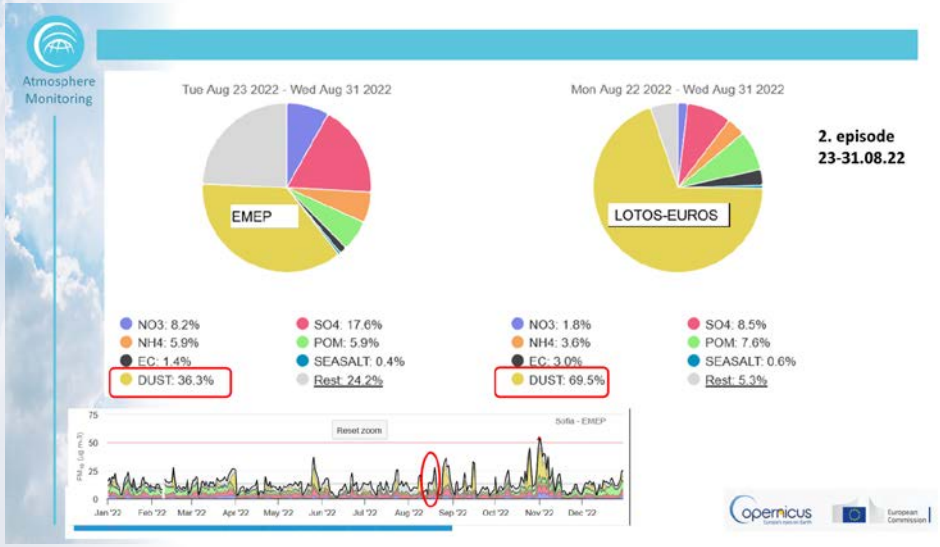
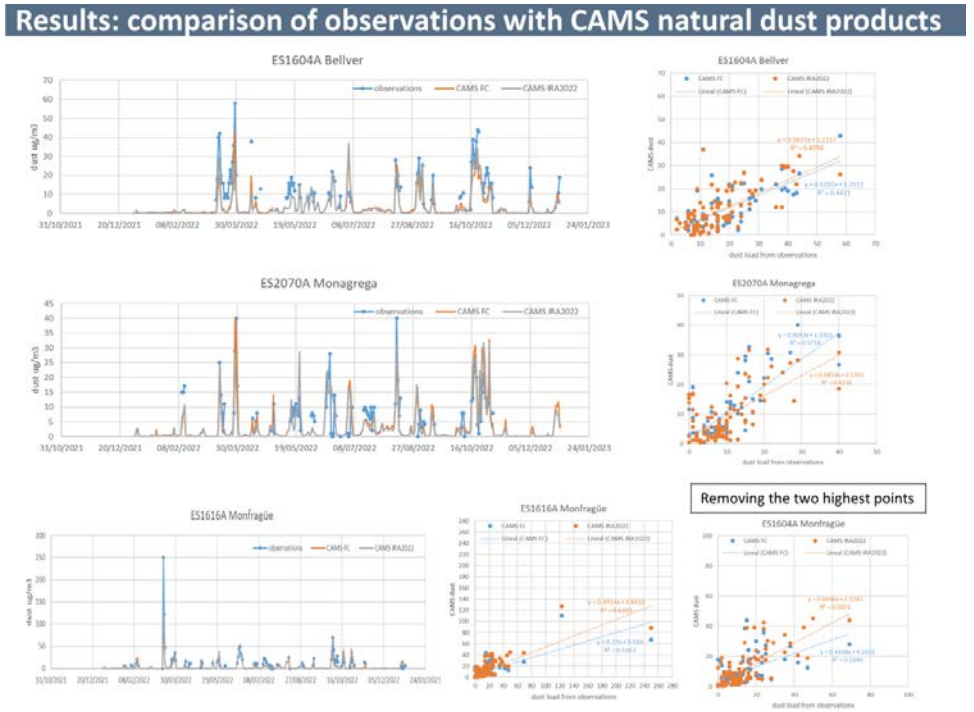
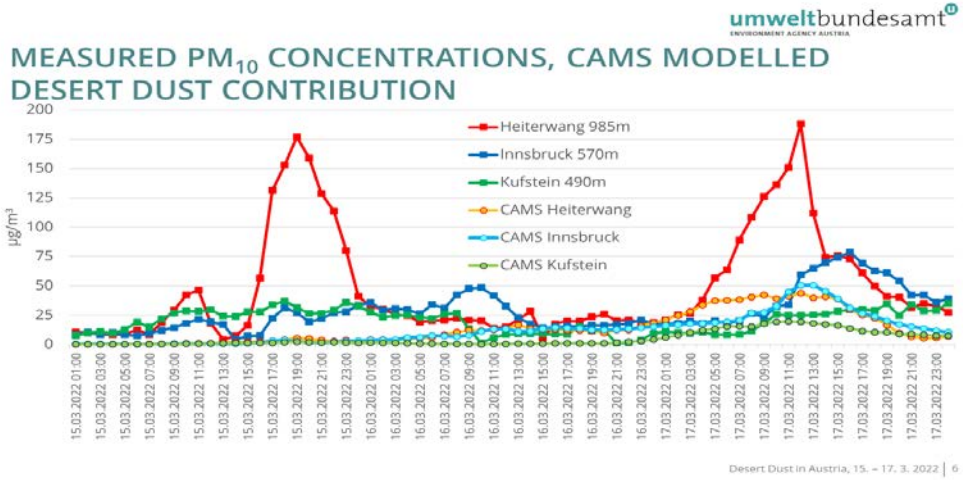
- ✓ IRA results from CAMS with in better agreememt with observations than FC and global model
- ✓ Still large differences in the performance of CAMS in different areas
- ✓ Chemical composition data from CAMS shows large differences between models – maybe use as indication of dust episode – not for quantification







Lessons learned so far (II)

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- ✓ Best approaches based on bias corrections instead of direct use of the CAMS PM10 dust products
- ✓ Links to DIAPASON methodology worth investigating further (fed with CAMS RIA and with Lidar data)
- ✓ Combined use of in-situ dust measurements highly recommended

Portugal

- Proposed methodology using CAMS dust products

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

		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			
	17 mar	115.7	109			

Malta

Malta has applied three different methodologies:

1) Assumption that the DUST data is made up of Saharan dust only without the inclusion of anthropogenic dust (resuspension), agricultural dust, etc.

$$PM_{NDD} = PM_{10}total - PM_{10}DUST$$

2) Estimating the share of natural dust in the FC and IRA using actual monitored Saharan dust fractions by dividing the monitored Saharan dust by Malta's monitored total PM_{10}, apply that % share to the IRA/FC PM_{10} total and subtracting the estimated Saharan dust fraction.

$$PM_{ratio} = (MT_{Sahara}/MT\_PM_{10}total)$$

$$PM_{NDD} = PM_{10}total - PM_{ratio}$$

3) Calculating a bias between Malta monitored data vs PM_{10} total and deducting that same bias from the PM_{10} total.

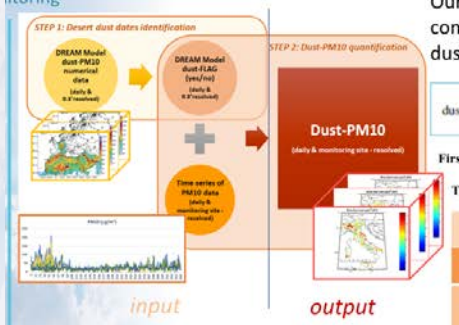
$$PM_{BIAS} = MT\_PM_{10}total - PM_{10}total$$

$$PM_{NDD} = PM_{10}total - PM_{BIAS}$$

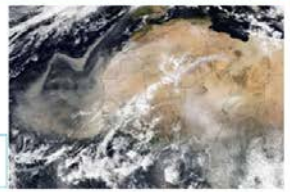
Italy

Explain the dust deduction methodology currently used: DIAPASON

Our method is a modification of the EC-Methodology combining **modelled** dust-PM10 fields (only to flag dust presence) and **PM10 measurements**



$$dust\text{-}PM10_{MS}(dust\ day) = \Delta PM10 = PM10_{MS}(dust\ day) - \langle PM10_{MS}(out\text{-}of\text{-}dust) \rangle$$



First difference: run over ALL sites, not only over RB sites

Third difference: fully automatic, no supervision needed

The second is that the out-of-dust reference value is computed using the 50th percentile over a shorter temporal window of ±3 days from the dust-affected dates.

In our original methodology, we used the **BSC Dream8bV2** (no more available)

*For this exercise we used the **BSC NMMB model***

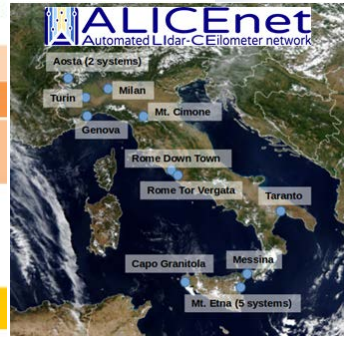
***Acknowledgement: NMMB data were provided by** the WMO Barcelona Dust Regional Center and the partners of the Sand and Dust Storm Warning Advisory and Assessment System **(SDS-WAS)** for Northern Africa, the Middle East and Europe.*

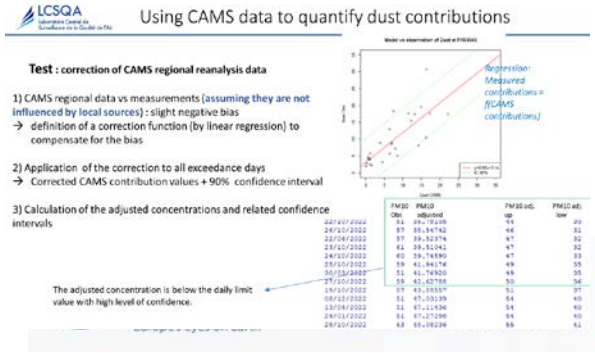
IMPORTANT:

1) We use <u>daily average</u> PM10 values (modelled and measured), as this is the metric currently legislated by EC
2) What do we obtain: <u>daily and site resolved dust-PM10</u>

For the requested exercise we also run the methodology using CAMS

France





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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. Dedicated session under WG8 in the FAIRMODE Plenary which is to back to CAMS Policy User Workshop in Paris, 27th February (TODAY!) - Final review meeting March 2024

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Questions for discusion

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Our purpose

- ✓ 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

➢ Have we fulfilled our purpose?

➢ What are your expectations on this inter-comparison summary report?

- **Is it possible to agree on best practices at this stage?**
- **Is it possible to make recommendations for the inclusion of CAMS products in the calculation of natural contributions to exceedances**
- ***How should your contributions be included ?***

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Next steps

- **Final meeting Thursday 21st March 2024 from 10-12:00**

  - ***Agree on best practices at this stage***
  - ***Summarise recommendations for the evolution and documentation of the CAMS dust products***
  - ***Summarise recommendations for the use of CAMS products when* calculating natural contributions to exceedances**

  - **Agree on the form of the final report**
  - **Discuss outlook for possible next stages**

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Thank you !

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