

# Estimation of dust contribution – French experience

## CAMS-FAIRMODE meeting

4 October 2023



Groupement d'intérêt scientifique

## Case study:

Exceedance of the PM10 daily limit value at an urban traffic station in Marseille in 2022

(38 recorded daily exceedances of the 50  $\mu\text{g}/\text{m}^3$  limit value)

- Application of the European methodology\* using CAMS data to identify dust episodes
- Use of CAMS data to quantify dust contributions

\* [http://ec.europa.eu/environment/air/quality/legislation/pdf/sec\\_2011\\_0208.pdf](http://ec.europa.eu/environment/air/quality/legislation/pdf/sec_2011_0208.pdf)

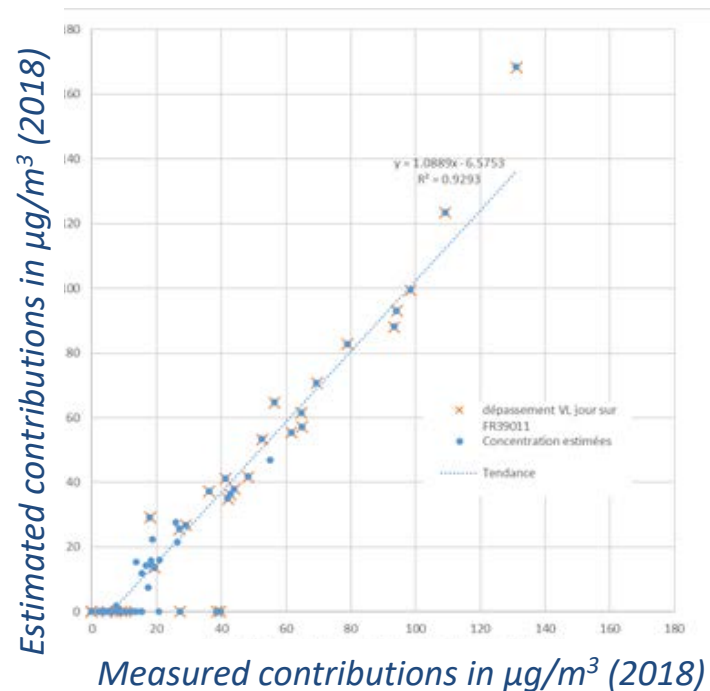
## Prior experience: estimation of dust contributions in Martinique

- Frequent exceedances of PM<sub>10</sub> limit values in the Caribbean region, in particular in Martinique
- The Caribbean region is known to be regularly impacted by the transport of Saharan dust :



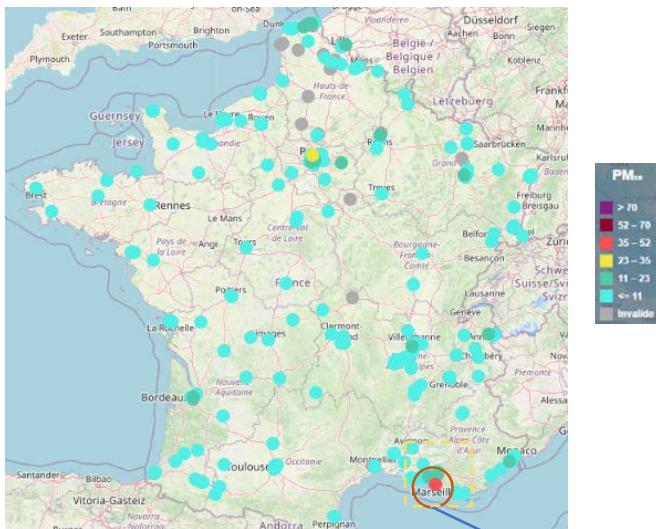
*Hemispherical simulation, CHIMERE model, resolution: 10km , July 2014 (source: Ineris)*

- Validation of the EU methodology (2011 Commission staff working paper) for year 2018 using chemical speciation data from a field monitoring campaign
- Application to other years for which exceedances of PM10 limit values were observed



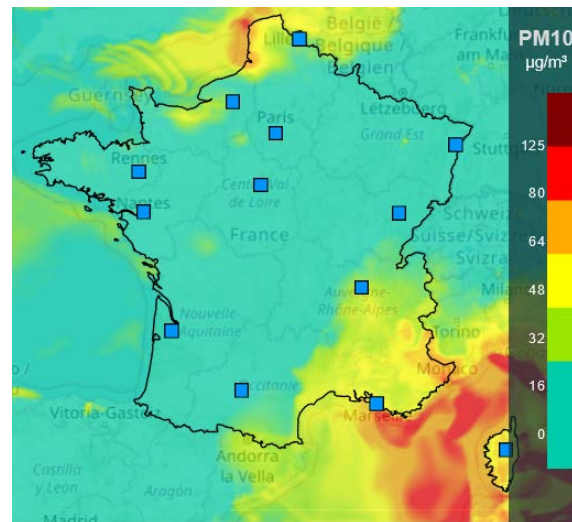
## New case in mainland France:

- Marseille Rabatau (FR03006) urban traffic station
- **38 exceedance days** in 2022



Marseille Rabatau  
(FR03006)  
Traffic - Urban

Saharan dust import may partly contribute to some exceedances :



5 June 2022 – PM10 concentrations - Source: Prev'air

Application of the statistical method described in the Commission Staff Working Paper “establishing *guidelines for demonstration and subtraction of exceedances attributable to natural sources*”

3 steps:

1) Identification of dust episodes

Use of **CAMS global reanalysis data** (extraction of surface *dust* data) (source of data previously used for Martinique)

+ for this study: test of the use of **CAMS regional interim reanalysis data**

2) Quantification of the natural contribution using data from a regional background site (application of a moving median)

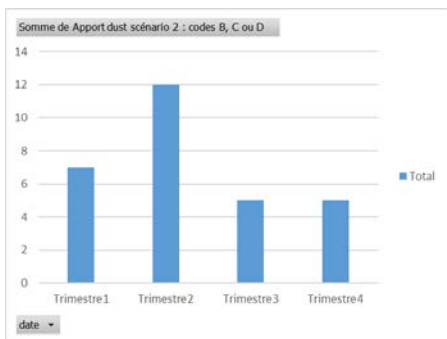
3) Subtraction of the estimated natural contribution for the exceedance days at the station concerned

## Identification of dust episodes with CAMS data

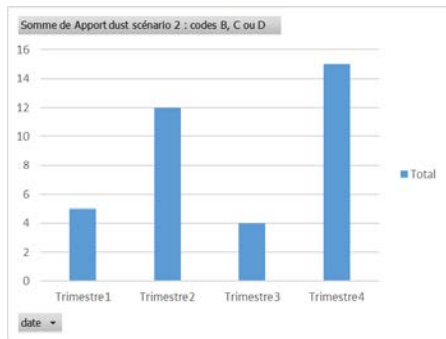
Dust CAMS data were classified in 5 classes for both the global and regional models :

- L : concentrations lower than  $1 \mu\text{g}/\text{m}^3$
- A : concentrations between 1 and  $5 \mu\text{g}/\text{m}^3$
- B : concentrations **between 5 and  $10 \mu\text{g}/\text{m}^3$**
- C : concentrations **between 10 and  $50 \mu\text{g}/\text{m}^3$**
- D : concentrations **upper than  $50 \mu\text{g}/\text{m}^3$**

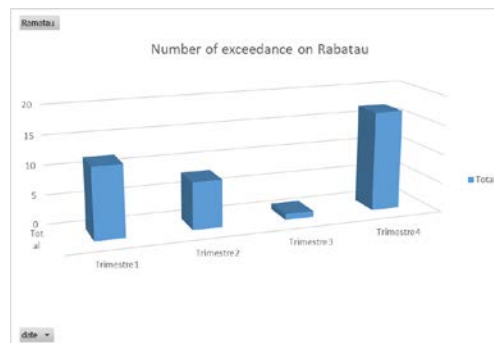
Classes B to D are considered as **dust episodes**.



Dust episodes per quarter with global model



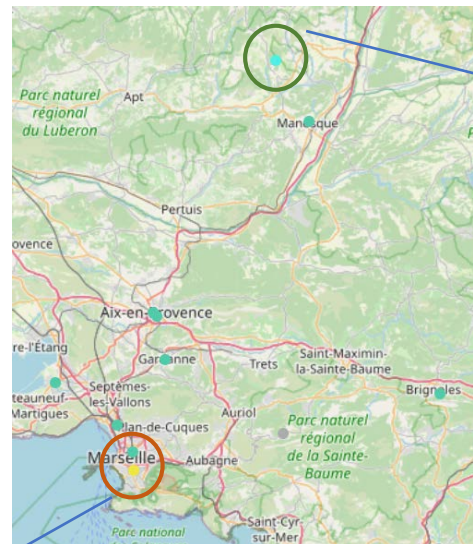
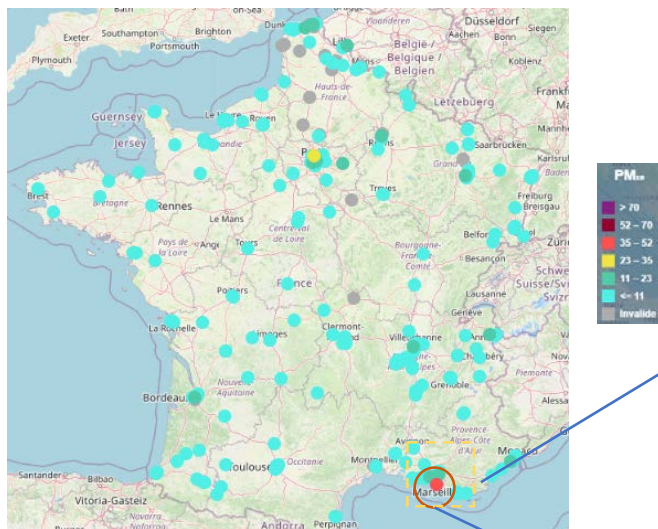
Dust episodes per quarter with regional model



Number of daily exceedances recorded on Rabateau site

# Applying the European methodology

## Background station



Obs Haute-Provence  
(FR24039)  
Background - Rural near  
city

Marseille Rabatau  
(FR03006)  
Traffic - Urban



## Results

Contributions evaluated with the European methodology were compared with available in situ measurements obtained by filter sampling at another station : « Marseille 5 Avenues » (FR03043). **Chemical analysis data were available for 29 days in 2022 including 16 exceedance days.**

Dust contributions were estimated from four components :  $\text{Fe}_2\text{O}_3$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{SiO}_2$  and  $\text{CO}_3$ .

### Limit of the comparison :

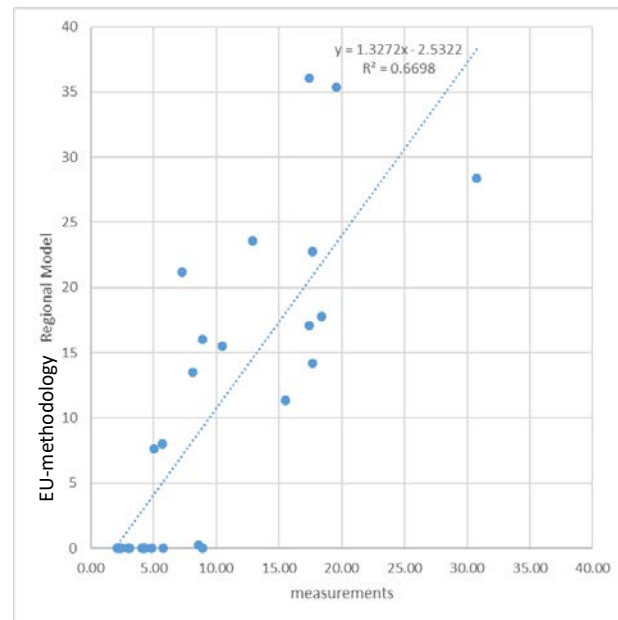
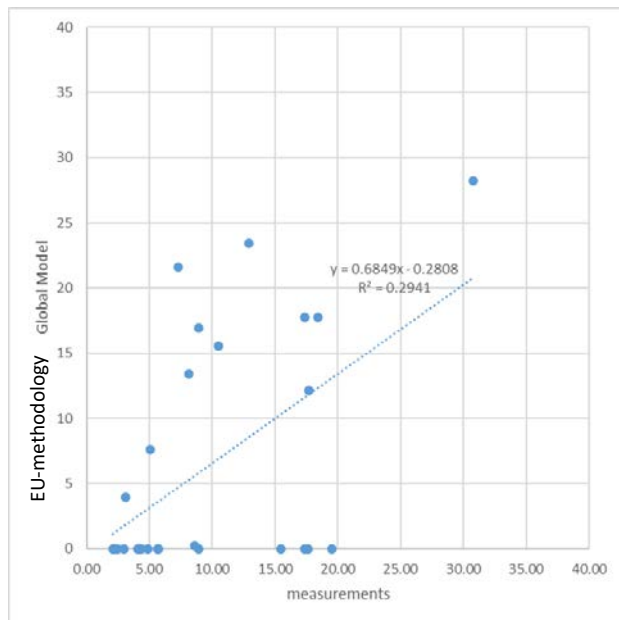
The Marseille 5 avenue station **is not a regional rural background station** : it is an urban background station.

The four species may have other sources: non-exhaust transport; urban development works; local dust, etc...

→ Dust contributions derived from the measurements **may** therefore **overestimate** the natural contributions.



## Results



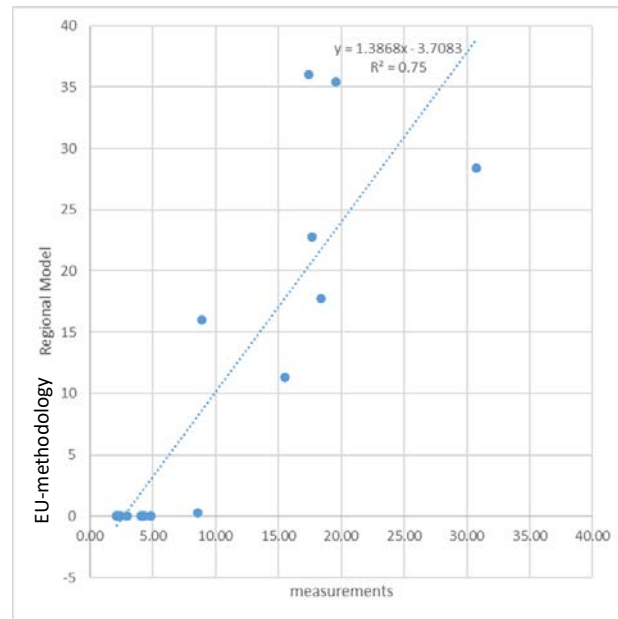
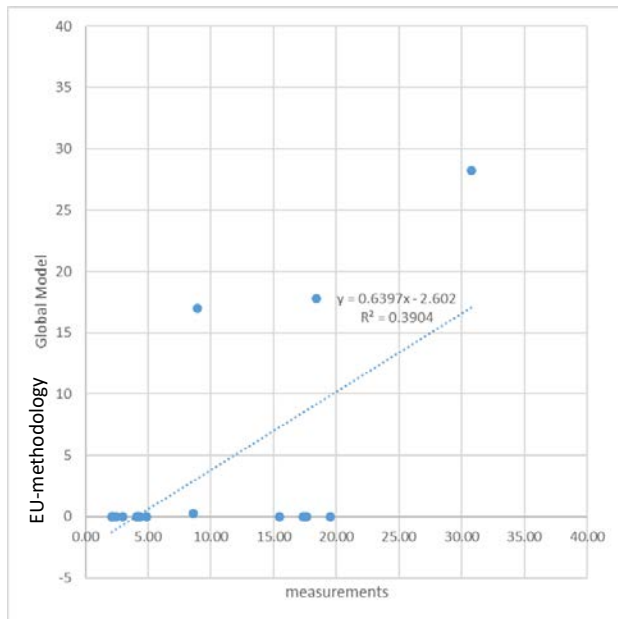
Comparison between

y-axis: the contributions calculated by the EU-methodology using CAMS reanalysis data (left: global; right: regional)

x-axis: the contributions derived from the measurements

**All days with measurements available**

## Results



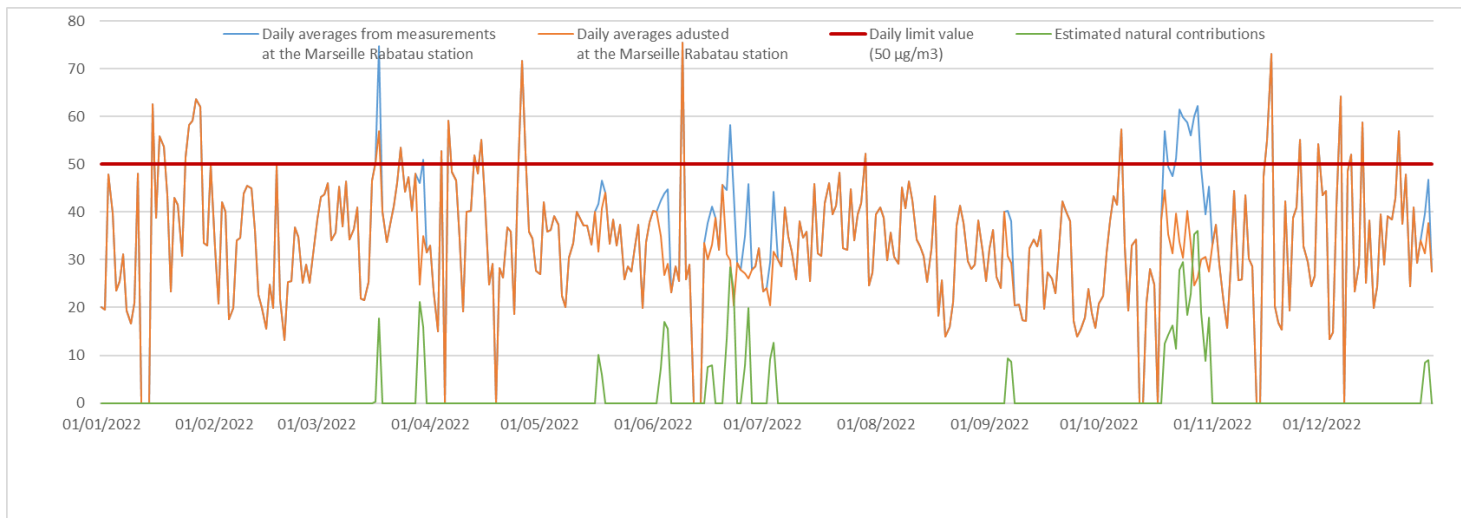
Comparison between the dust contributions

x-axis: derived from the measurements

y-axis: calculated according to the EU-methodology using CAMS reanalysis data (left: global; right: regional)

**Only days with measurements available and on which exceedances were recorded**

## Results

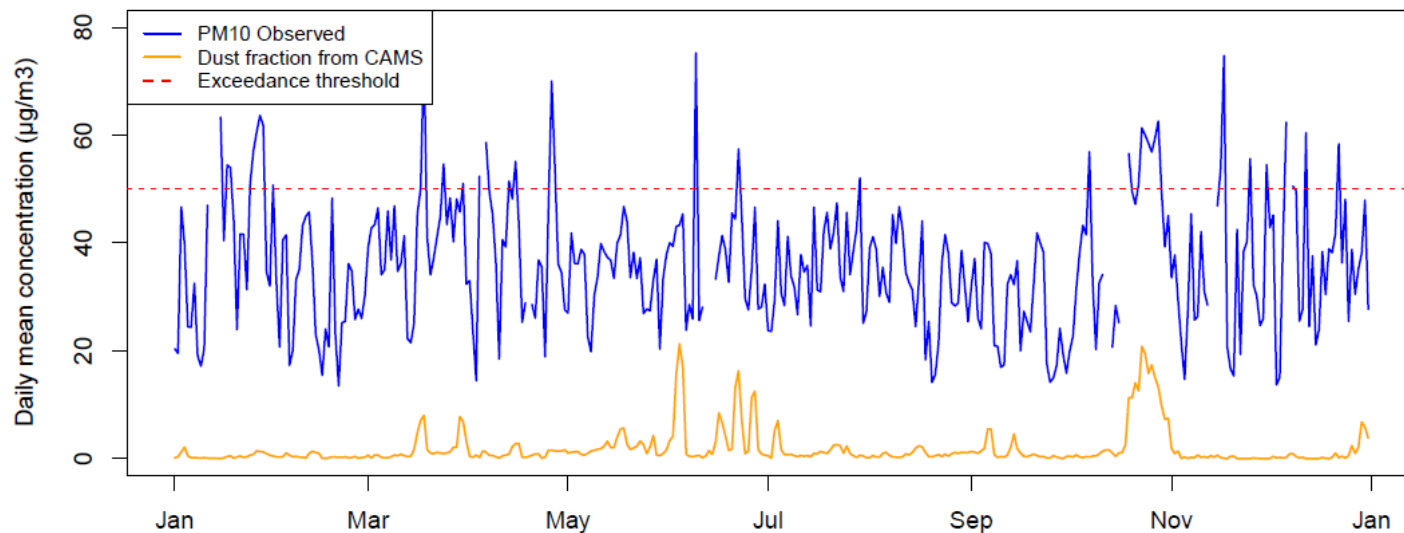


Application of the EU methodology using CAMS regional interim reanalysis data to identify dust episodes

Number of exceedances before adjustment	Number of exceedances – Adjustment through the EU methodology, using CAMS global data to identify episodes.	Number of exceedances – Adjustment through the EU methodology, using CAMS regional data to identify episodes.
38	32	27

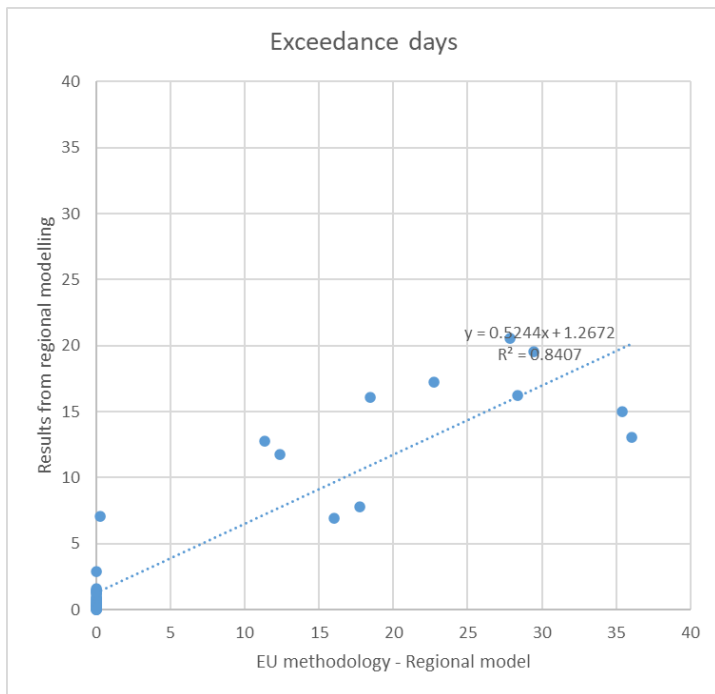
# Using CAMS data to quantify dust contributions

2022 daily mean concentration at station FR03006



In orange: dust contributions from CAMS regional interim reanalysis data

## Comparison with the EU- methodology



Good correlation  
EU methodology: higher  
estimated contributions

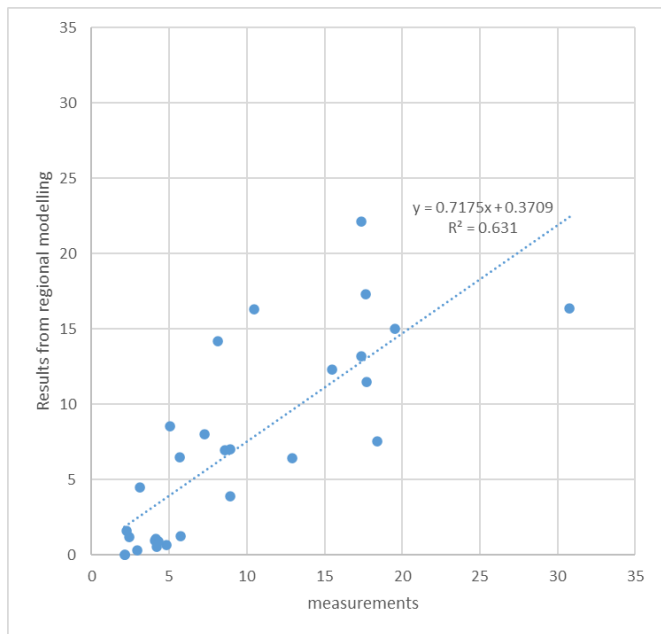
Comparison between the dust contributions

x-axis: calculated according to the EU-methodology using CAMS regional reanalysis data

y-axis: directly obtained from CAMS regional reanalysis data

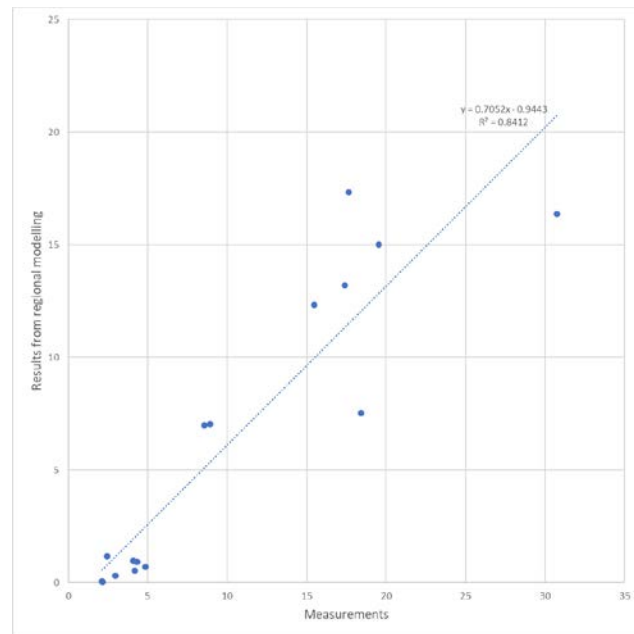
**Only days on which exceedances were recorded**

# Using CAMS data to quantify dust contributions



Contributions directly obtained from **CAMS regional reanalysis data** vs contributions derived from the **measurements**

**All days with measurements available**



Contributions directly obtained from **CAMS regional reanalysis data** vs contributions derived from the **measurements**

**Only days with measurements available and on which exceedances were recorded**

# Using CAMS data to quantify dust contributions

## Test : correction of CAMS regional reanalysis data

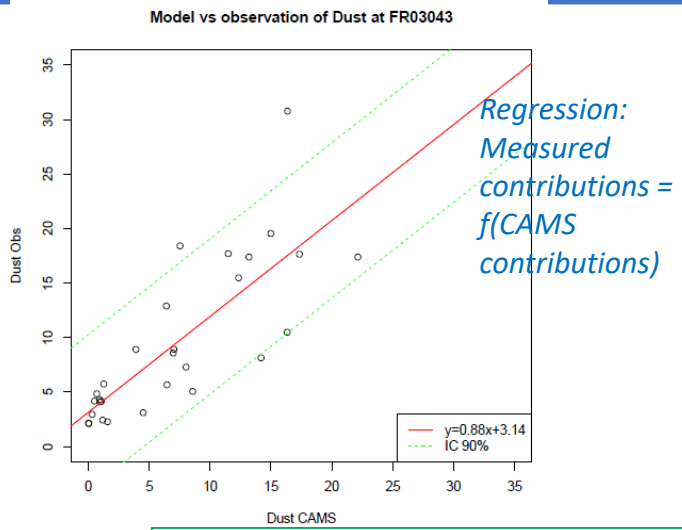
1) CAMS regional data vs measurements (**assuming they are not influenced by local sources**) : slight negative bias

→ definition of a correction function (by linear regression) to compensate for the bias

2) Application of the correction to all exceedance days

→ Corrected CAMS contribution values + 90% confidence interval

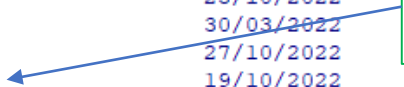
3) Calculation of the adjusted concentrations and related confidence intervals



- 22/10/2022
- 26/10/2022
- 22/06/2022
- 23/10/2022
- 24/10/2022
- 25/10/2022
- 30/03/2022
- 27/10/2022
- 19/10/2022
- 08/12/2022
- 13/04/2022
- 24/01/2022
- 28/10/2022

PM10 Obs	PM10 adjusted	PM10 adj. up	PM10 adj. low
51	36.78105	44	30
57	38.54742	46	31
57	39.52374	47	32
61	39.51041	47	32
60	39.74590	47	33
59	41.94176	49	35
51	41.76920	49	35
59	42.62788	50	36
57	43.88557	51	37
51	47.03139	54	40
51	47.11436	54	40
51	47.27298	54	40
63	48.08236	55	41

The adjusted concentration is below the daily limit value with high level of confidence.






# Using CAMS data to quantify dust contributions

## Number of exceedances

No adjustment	Adjustment through the EU methodology, using CAMS global data to identify episodes	Adjustment through the EU methodology, using CAMS regional data to identify episodes	Adjustment using directly CAMS regional data to quantify the contributions	Adjustment using corrected CAMS regional data to quantify the contributions (with confidence level of 90%)
38	32	27	27	30

  
The 11 subtracted days are  
the same

# Conclusion

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In view of the available measurements of PM composition, the European method seems to overestimate natural contributions. By contrast, as expected, regional CAMS data are below the measured contributions.

Due to a lack of suitable background measurements, it is difficult to really conclude from these results. However, despite the methodological differences between the European method and the use of regional CAMS data, the reduction in the number of exceedance days is identical over the same time periods.

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