

# DUST EVENTS IN PORTUGAL a modelling perspective

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Universidade de Aveiro



# Dust events in Portugal | papers

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TELLUS

## Properties of dust aerosol particles transported to Portugal from the Sahara desert

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### ABSTRACT

Aerosol properties of mineral particles in the far field of an African desert dust outbreak over the Mediterranean in different layers to Portugal. The measured project Desert Aerosols over Portugal (DAPRO) which was linked to the Saharan Min. The maximum particle mass concentration was about  $150 \mu\text{g m}^{-3}$  and the coarsest  $190 \text{ Mm}^{-1}$  which results in a mass scattering efficiency of  $0.87 \text{ m}^2 \text{ g}^{-1}$ . The aerosol  $\alpha$  0.53 and the lidar ratio was between 45 and 50 in the whole dust loaded column. A-C distributions and polarization features showed different characteristics and results.

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## Aerosols over continental Portugal (1978–1993): their sources and an impact on the regional climate

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Atmospheric Research  
Contents lists available at ScienceDirect  
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## Aerosol radiative effects during two desert dust events August 2012 over the southwestern Iberian Peninsula

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This study provides the first calculated during the two desert dust events over the southwestern Iberian Peninsula in August 2012.



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## Solar and thermal radiative effects during the 2011 extreme desert dust episode over Portugal

A. Valenzuela<sup>a,c,d,\*</sup>, M.J. Costa<sup>b</sup>, J.L. Guerrero-Rascado<sup>c,d</sup>, D. Bortoli<sup>a</sup>, F.J. Olmo<sup>c,d</sup>

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Atmospheric Research

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## Modeling Saharan desert dust radiative effects on clouds

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Atmospheric Chemistry and Physics  
Open Access  
EGU

Atmospheric Pollution Research 6 (2015) 70–81

Atmospheric Pollution Research

www.atmospollutres.com

## Assessing the mineral dust from North Africa over Portugal region using BSC–DREAM8b model

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### ABSTRACT

Over the last decade, air pollution has become a major problem in Portugal mainly due to the high concentrations of particulate matter in the atmosphere, which surpassed the daily limit values. An abundant type of natural atmospheric aerosol is related with the suspension and long-range transport of mineral dust from North Africa deserts. The main objective of this work was to assess the mineral dust over Portugal, namely in what concerns both long-term period (one year) and episode peaks. The BSC–DREAM8b v1.0 model was applied for the entire year of 2011 and the modeled surface concentrations were explored. The annual mean of the simulated dust has a magnitude of  $2\text{--}6 \mu\text{g m}^{-3}$ . The monthly average analysis highlights the largest mineral dust average values in April and May (about  $4 \mu\text{g m}^{-3}$ ) higher than the other months. The influence of the transport of mineral dust from North Africa to Portugal is limited on time



## The vertical distribution of Saharan dust over the western and central Mediterranean through dust modelling and lidar observations

Solar Energy 160 (2016) 94–102

Contents lists available at ScienceDirect

Solar Energy

journal homepage: www.elsevier.com/locate/solener



## Saharan dust transport to Europe and its impact on photovoltaic performance: A case study of soiling in Portugal

Ricardo Conceição<sup>a,\*</sup>, Hugo G. Silva<sup>a</sup>, José Mirão<sup>a</sup>, Michael Gostein<sup>a</sup>, Luís Fialho<sup>a</sup>, Luis Narvarte<sup>b</sup>, Manuel Collares-Pereira<sup>c</sup>

<sup>a</sup> Renewable Energies Chair, University of Évora, Portugal  
<sup>b</sup> Hercules Laboratory, University of Évora, Portugal  
<sup>c</sup> Atmosmeric Inc., TX, United States  
<sup>d</sup> Universidad Politécnica de Madrid, Spain

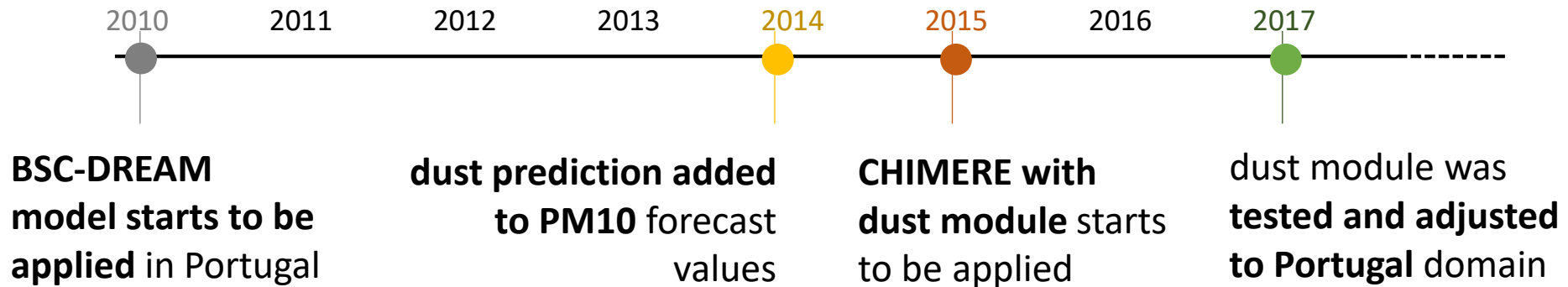
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### ABSTRACT

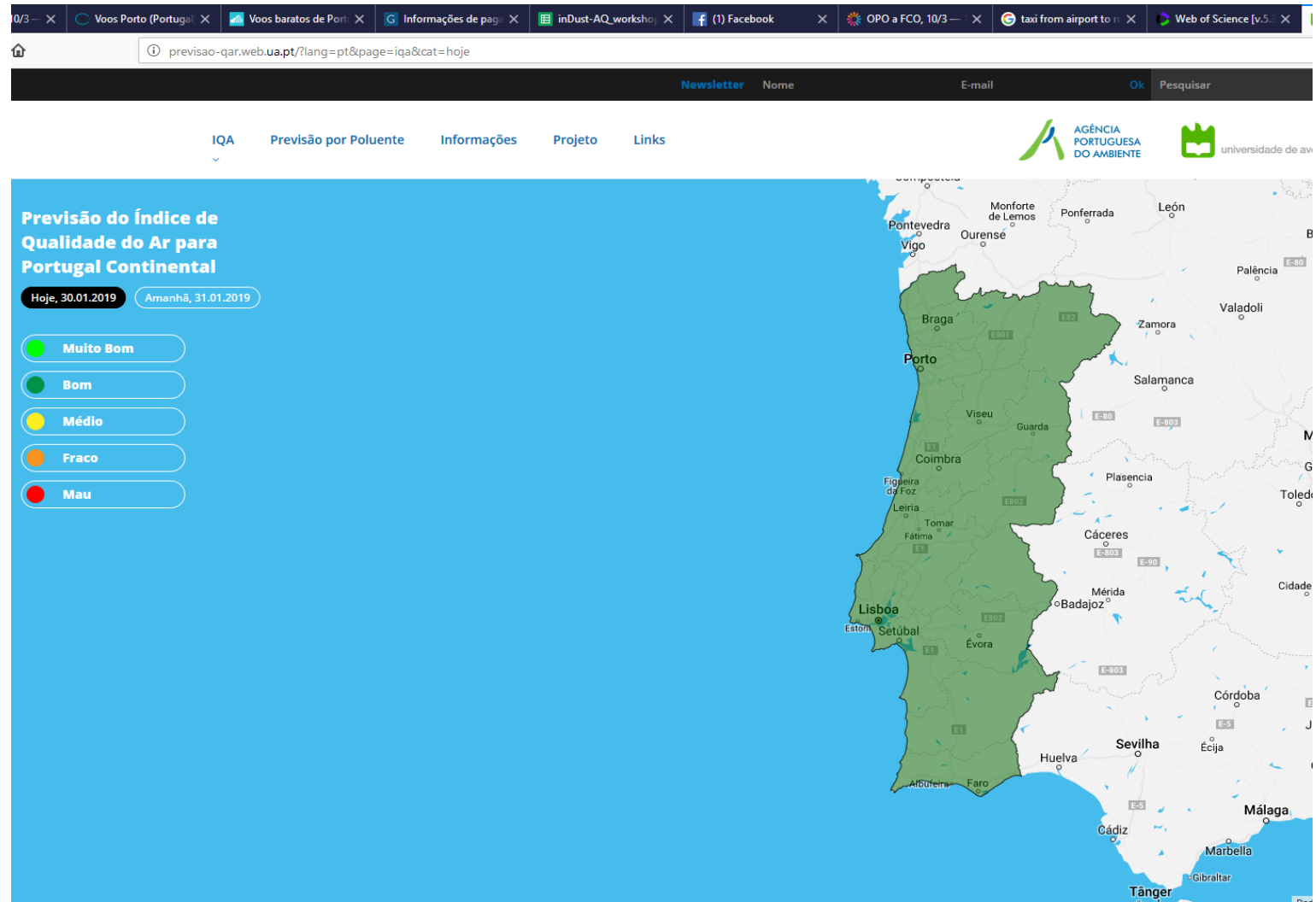
The impact of long range Saharan dust transport, arising from one event in February and other in March 2017, on the performance of photovoltaic flat panels is reported as a case study of soiling. Through satellite images,

# Dust forecast modelling in Portugal timeline

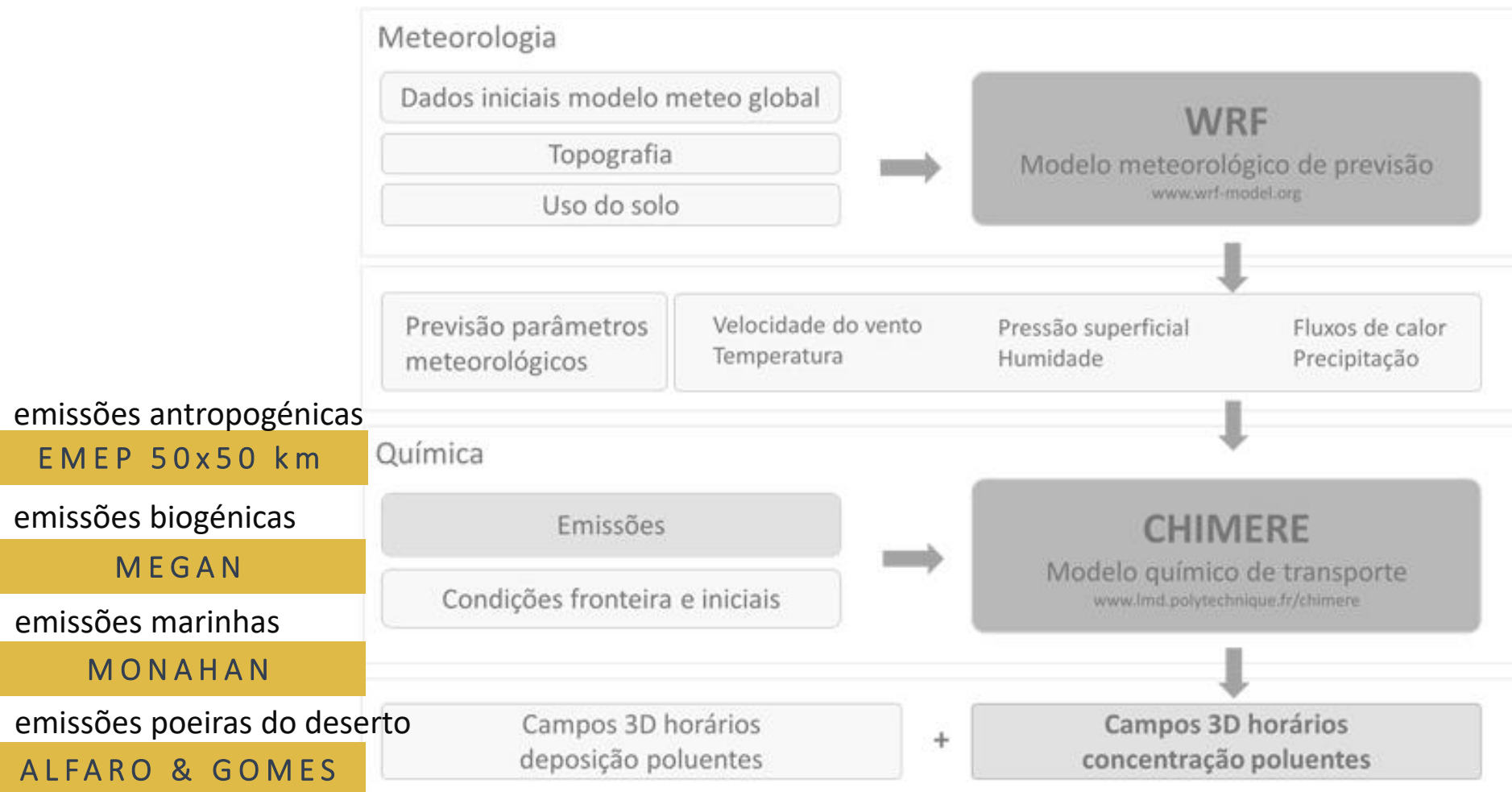


## Forecasting DUST over Portugal

<http://previsao-qar.web.ua.pt/>

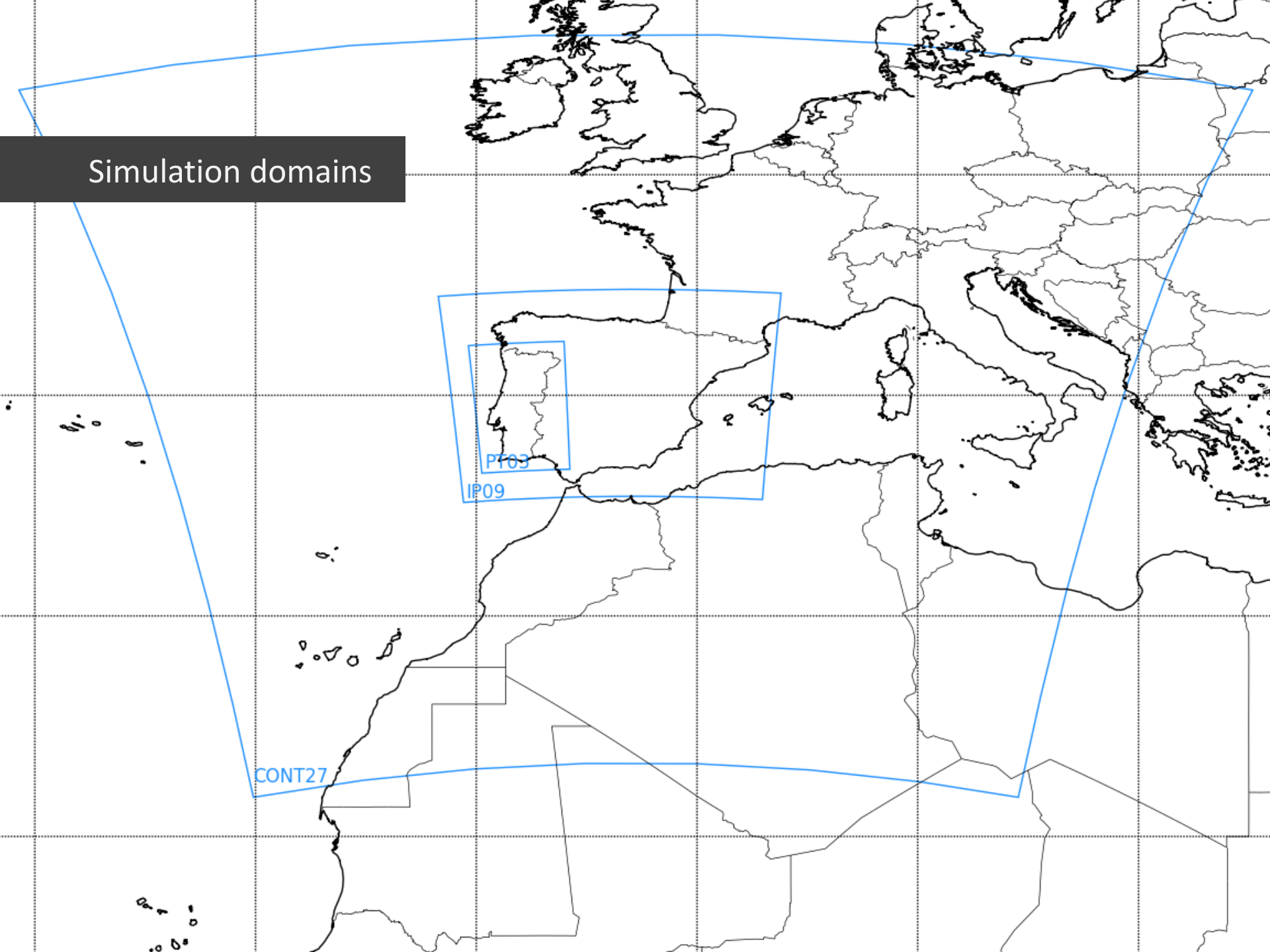


# Dust modelling forecast over Portugal

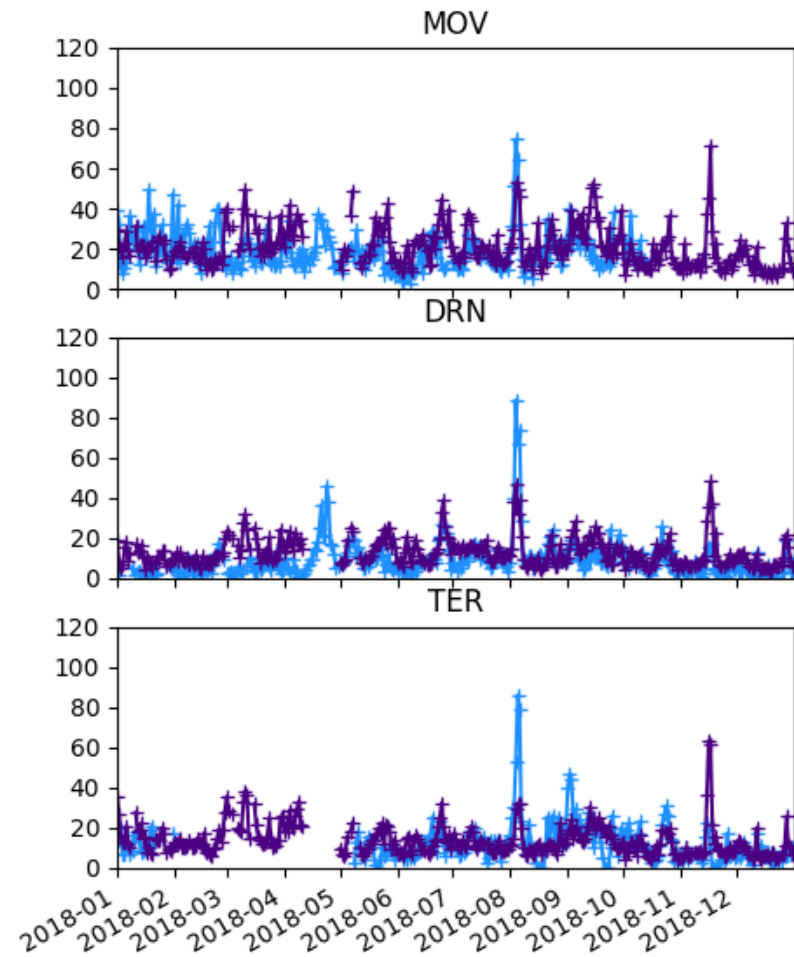
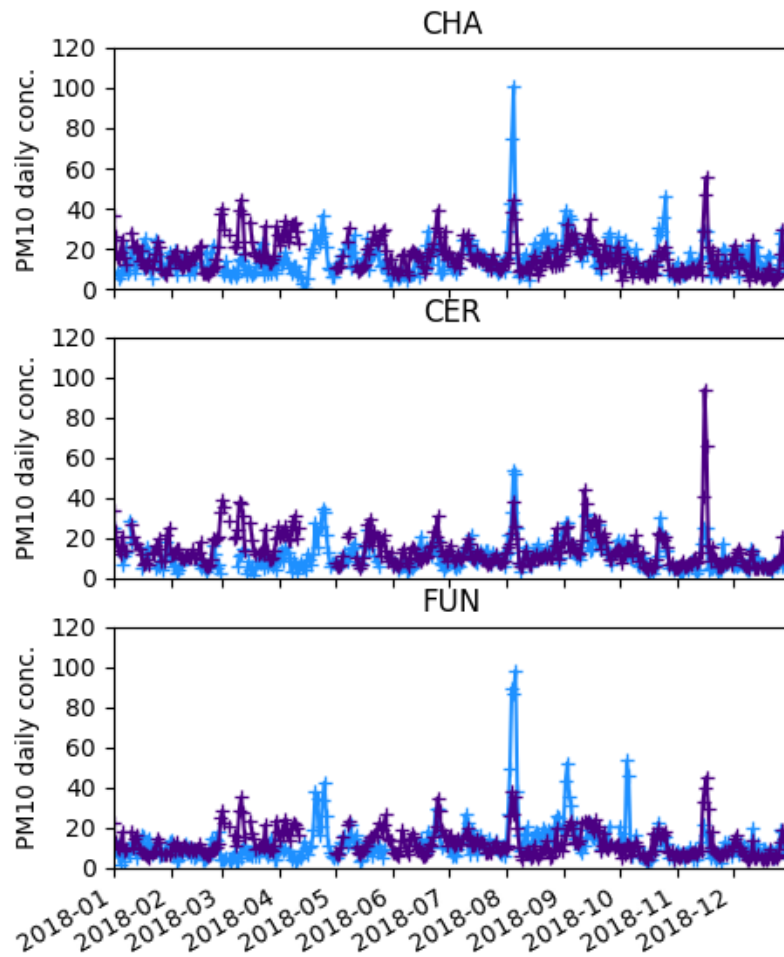




## Simulation domains



# Model validation

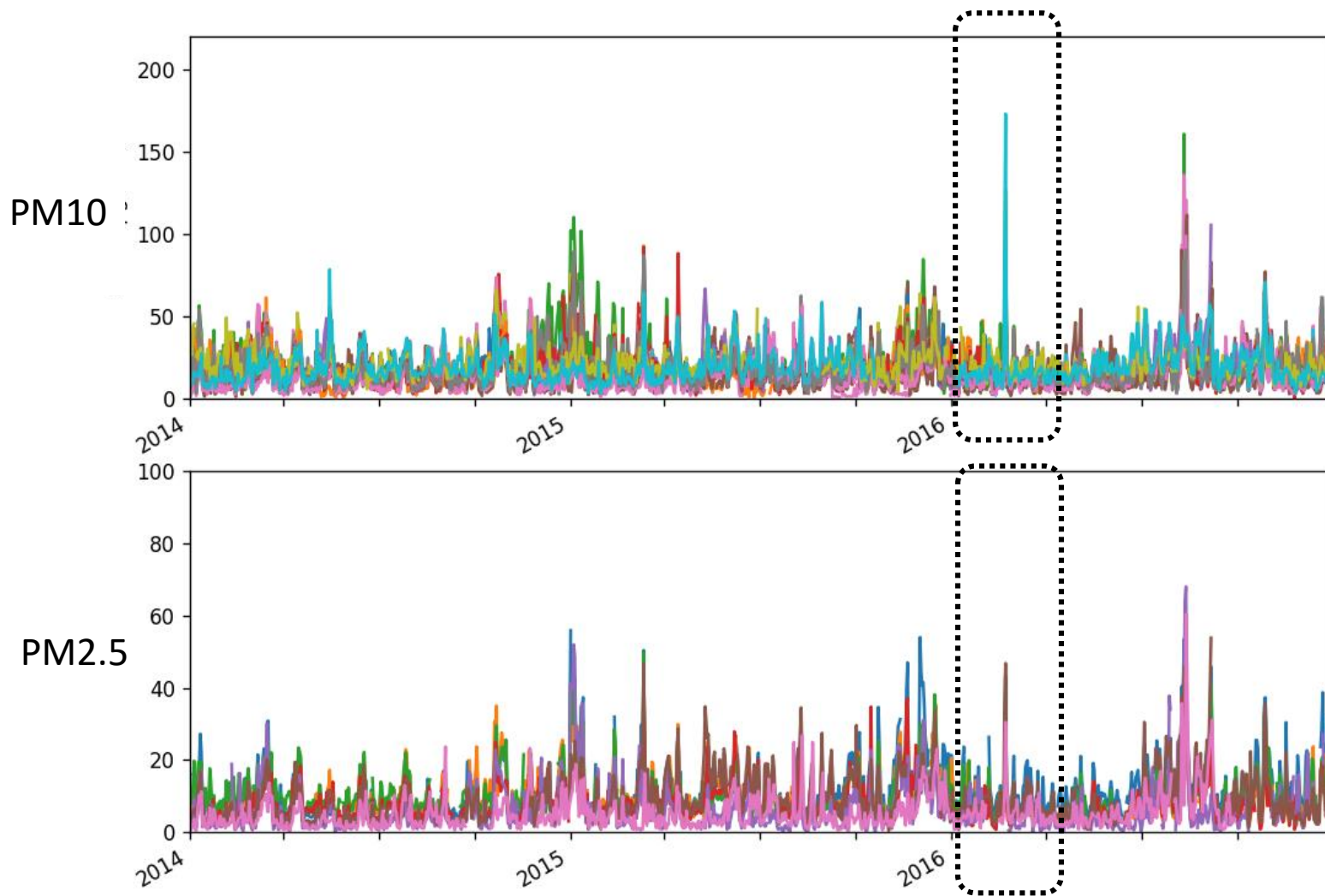


—+— observations  
—+— forecasts

An outlook over the highest dust episode of the last years...

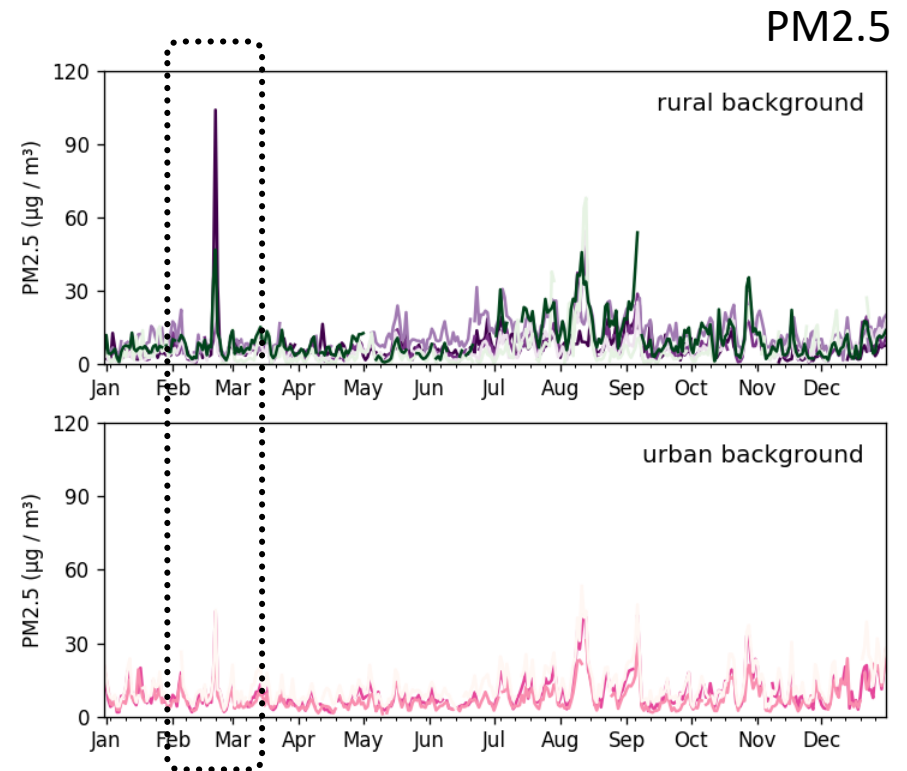
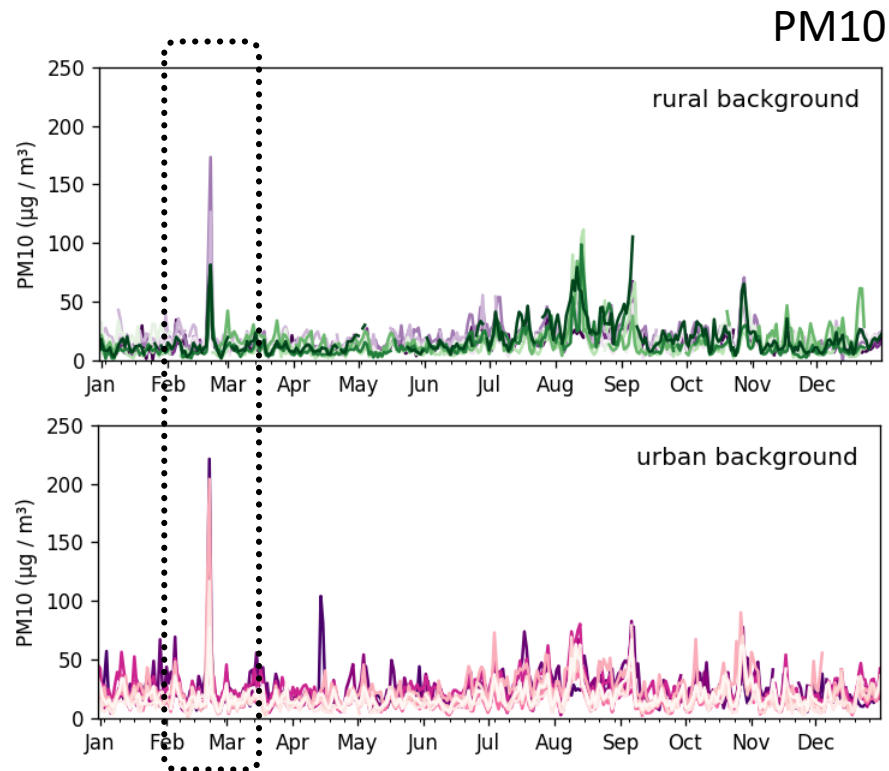


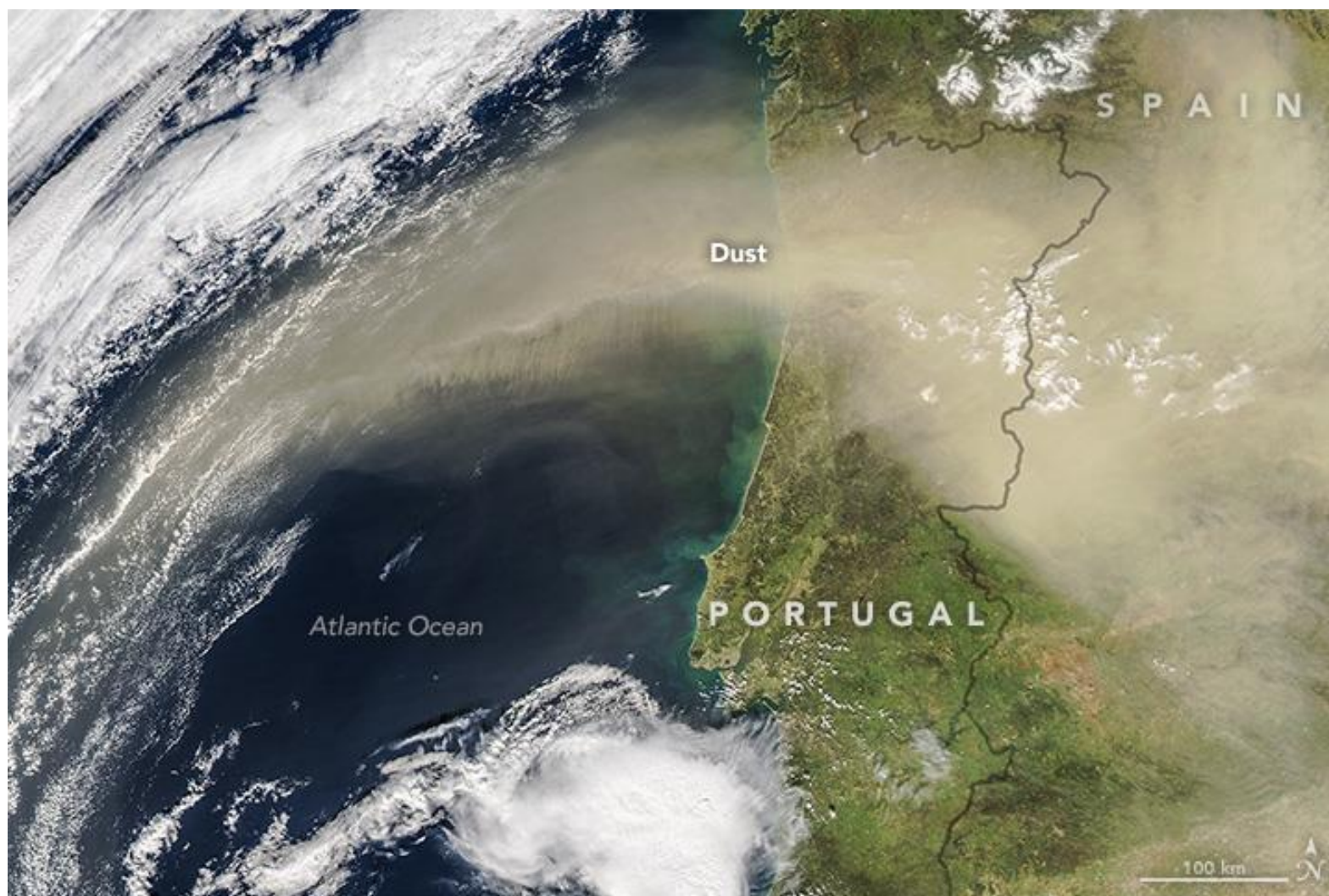
# The highest event over the last years...



21-22 Feb 2016

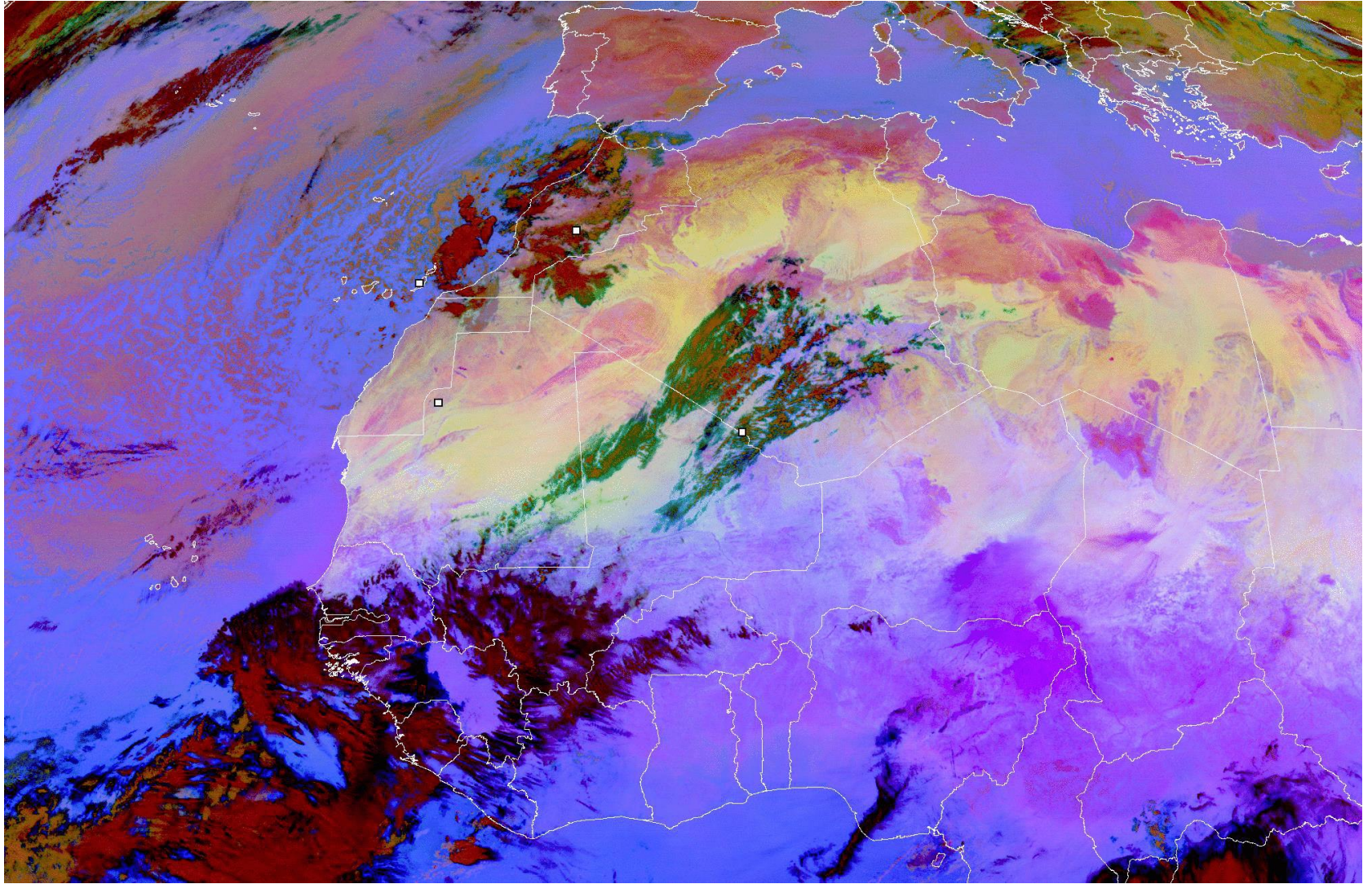
# The dust episode





February 21, 2016 14:00 UTC [Aqua – MODIS]

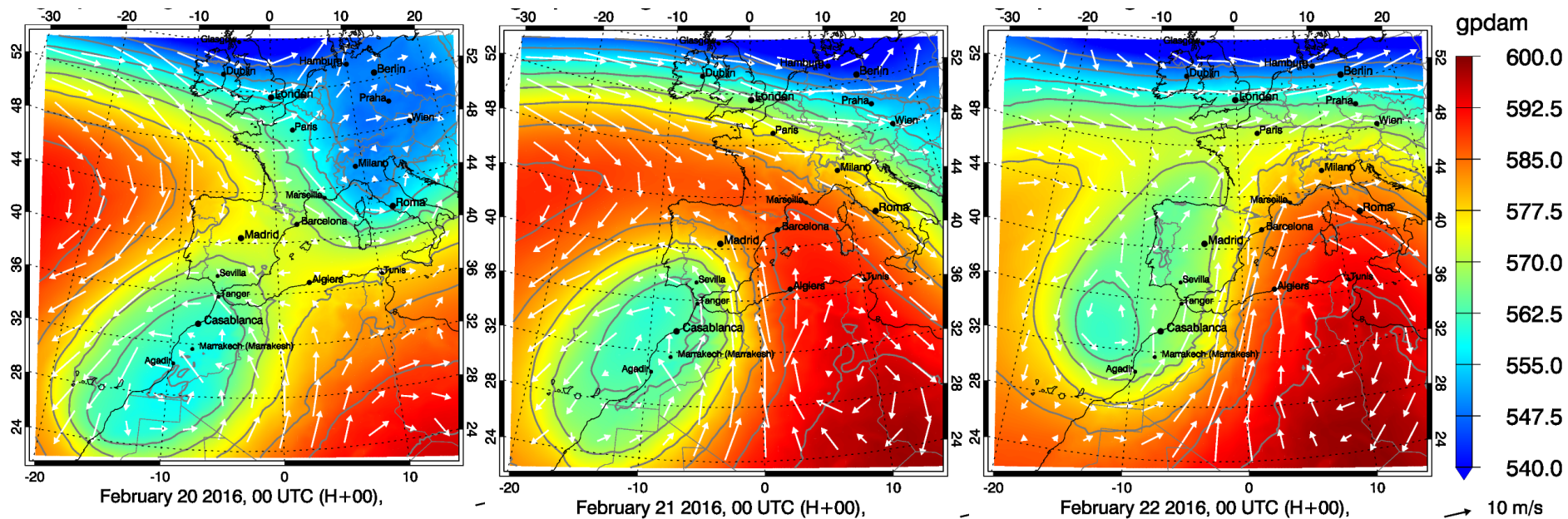






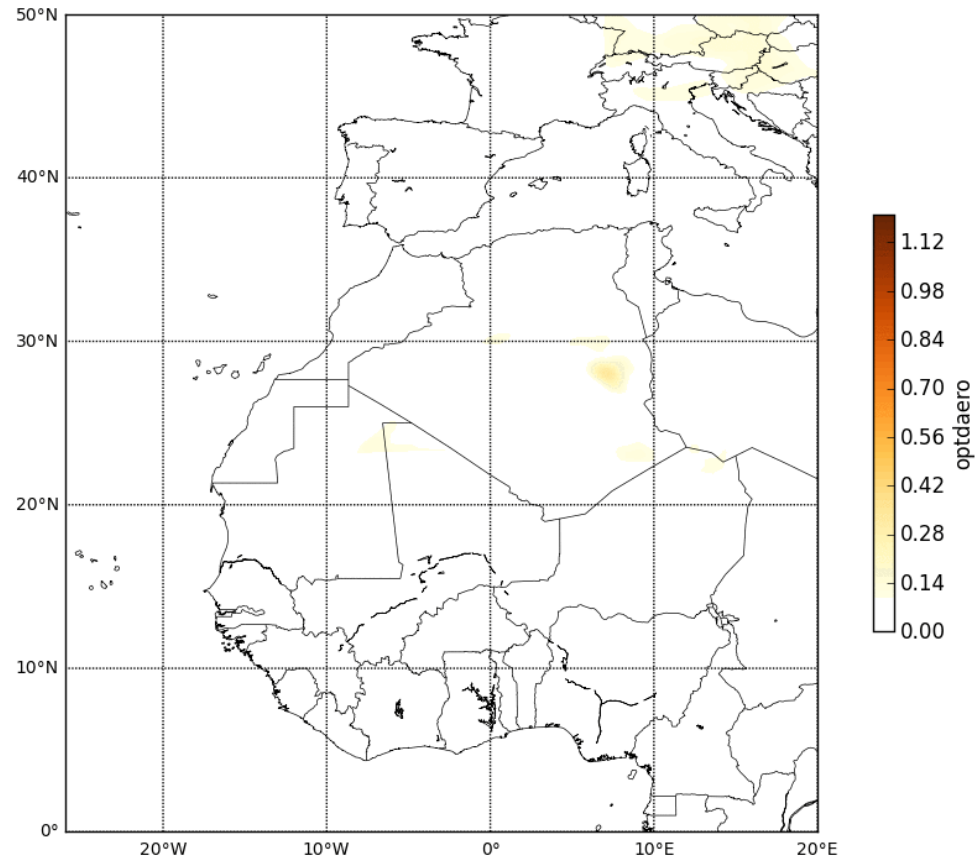
# Meteorological fields [WRF simulation]

geopot. height @ 500 hPa; winds @ 2km



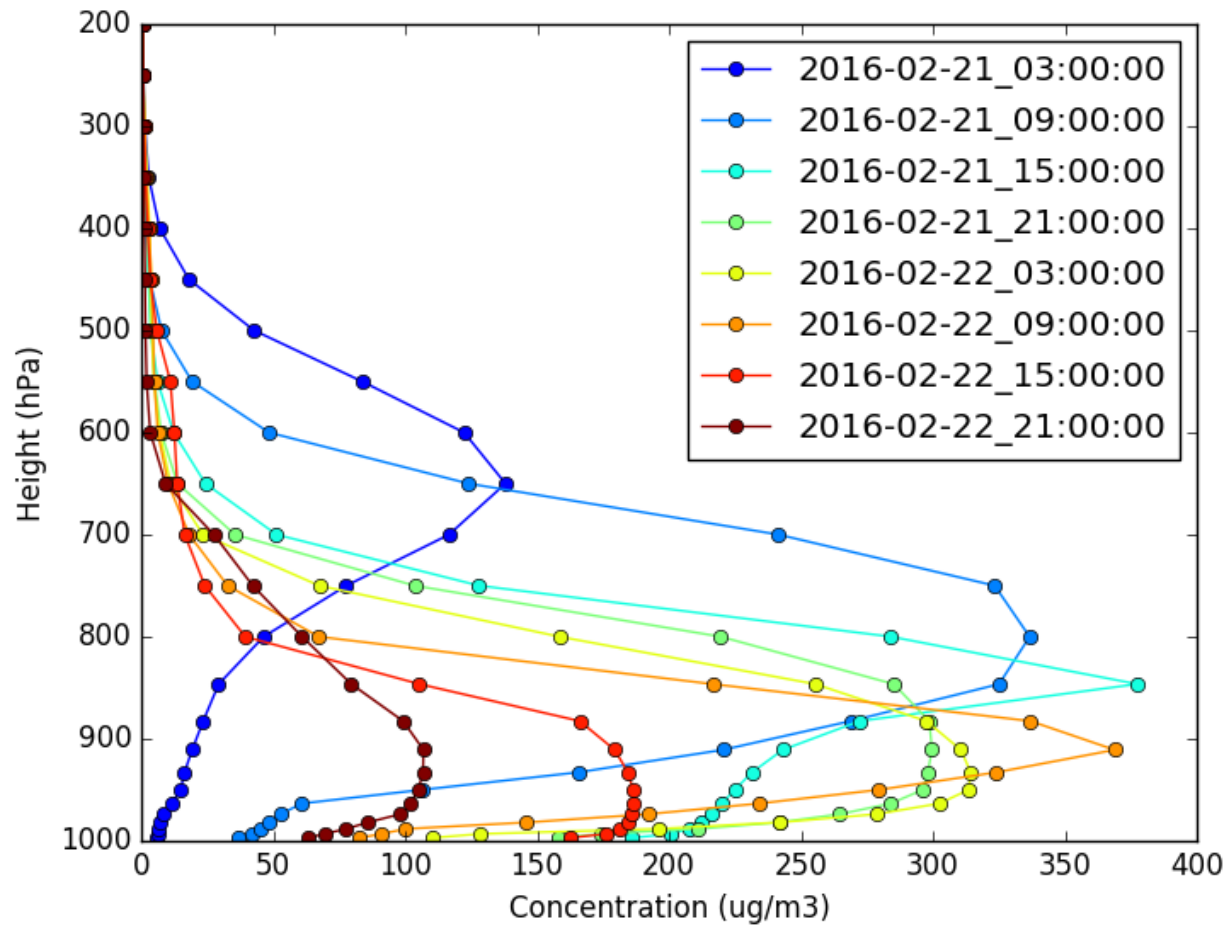
# Aerosol Optical Depth

19.02.2016 12h00 – 23.02.2016 12h00



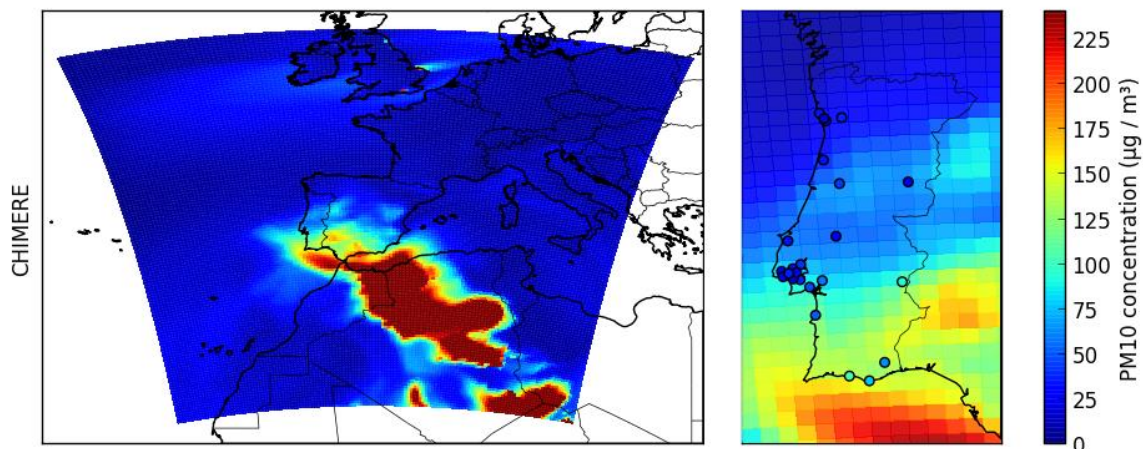


# Vertical profile of dust

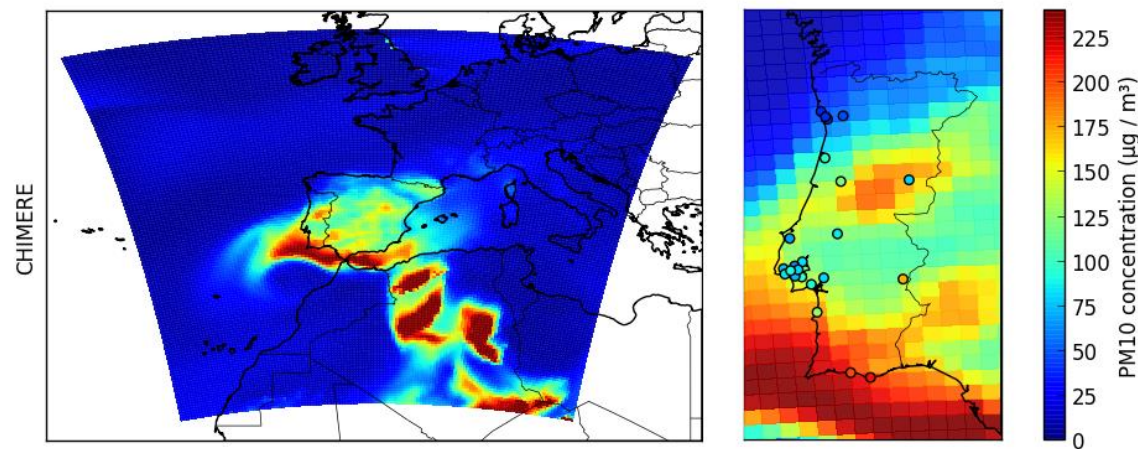


# Air Quality [PM10 concentrations]

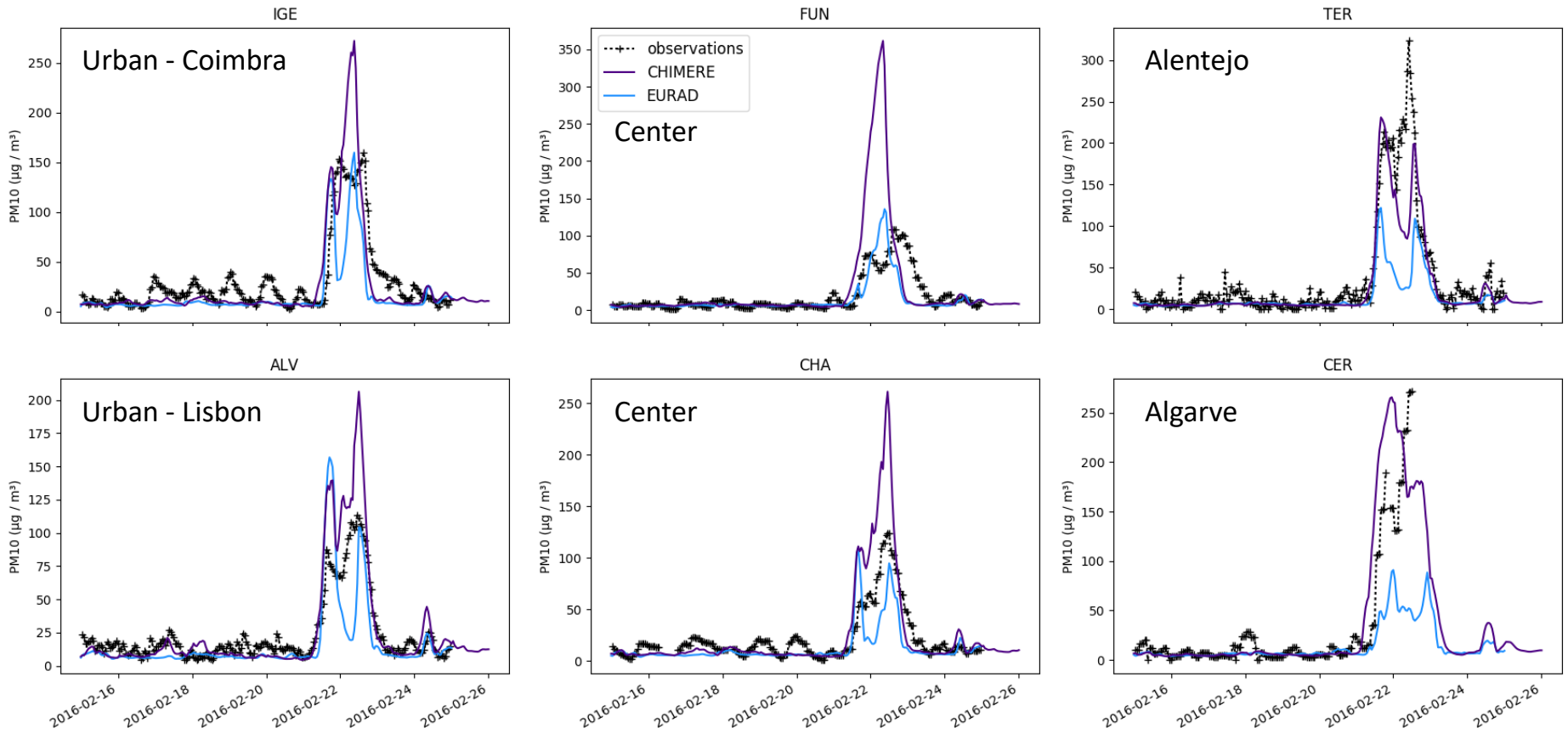
Feb 21



Feb 22

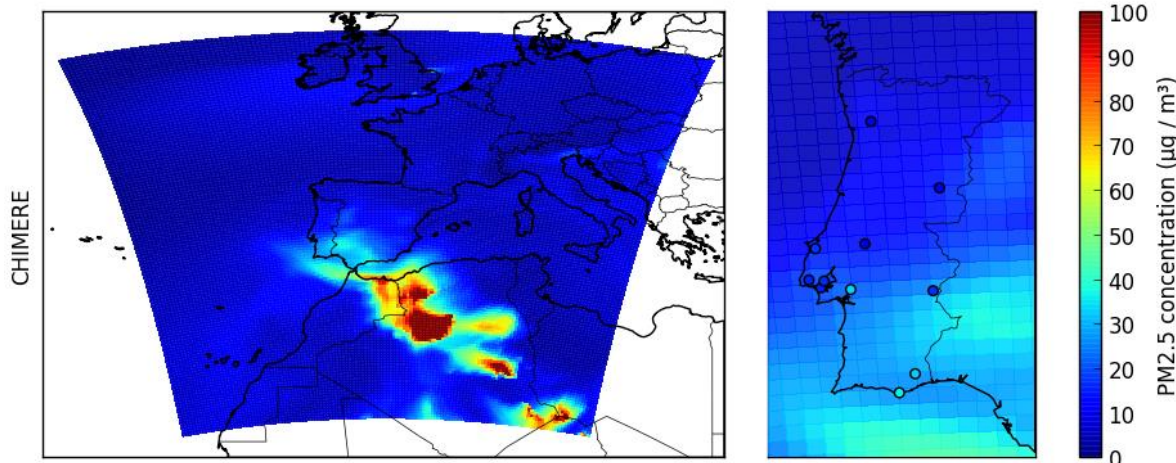


# Air Quality [PM10 concentrations]

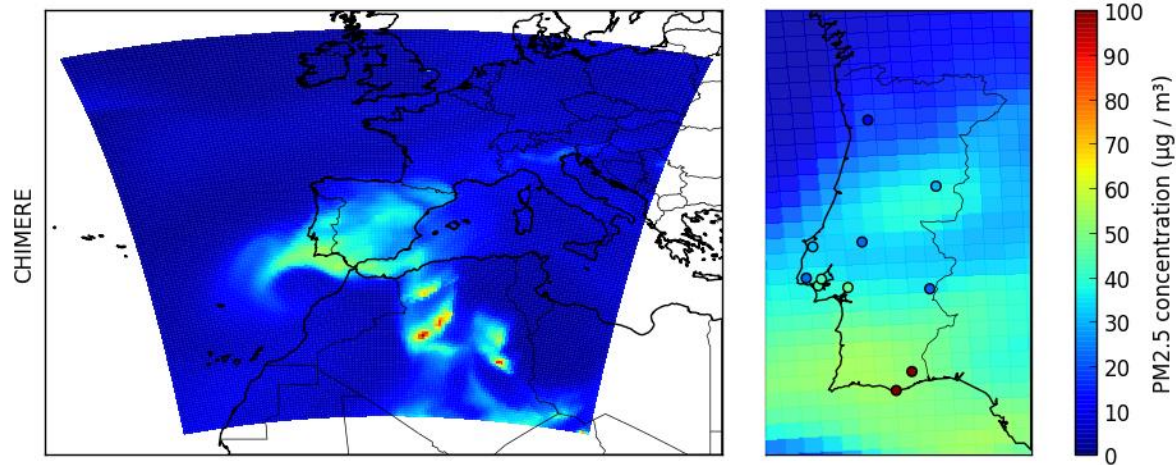


# Air Quality [PM2.5 concentrations]

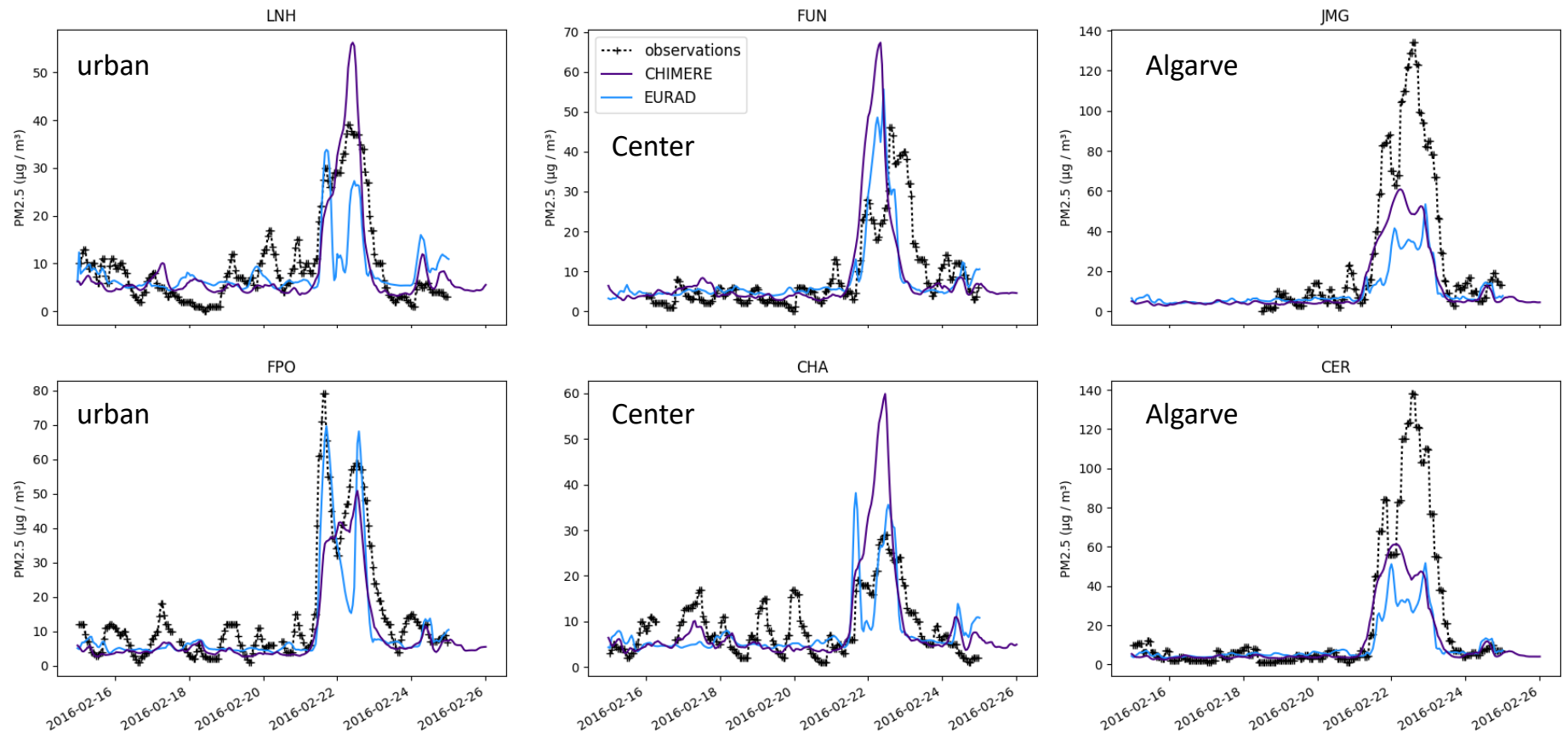
Feb 21



Feb 22



# Air Quality [PM2.5 concentrations]

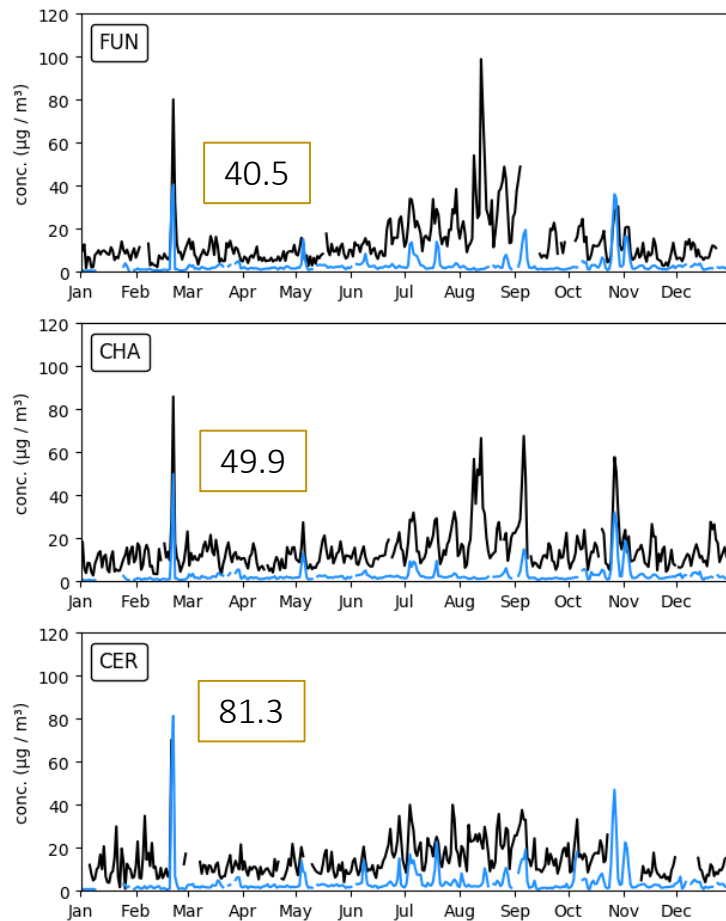


How models could be useful to  
evaluate dust contribution?

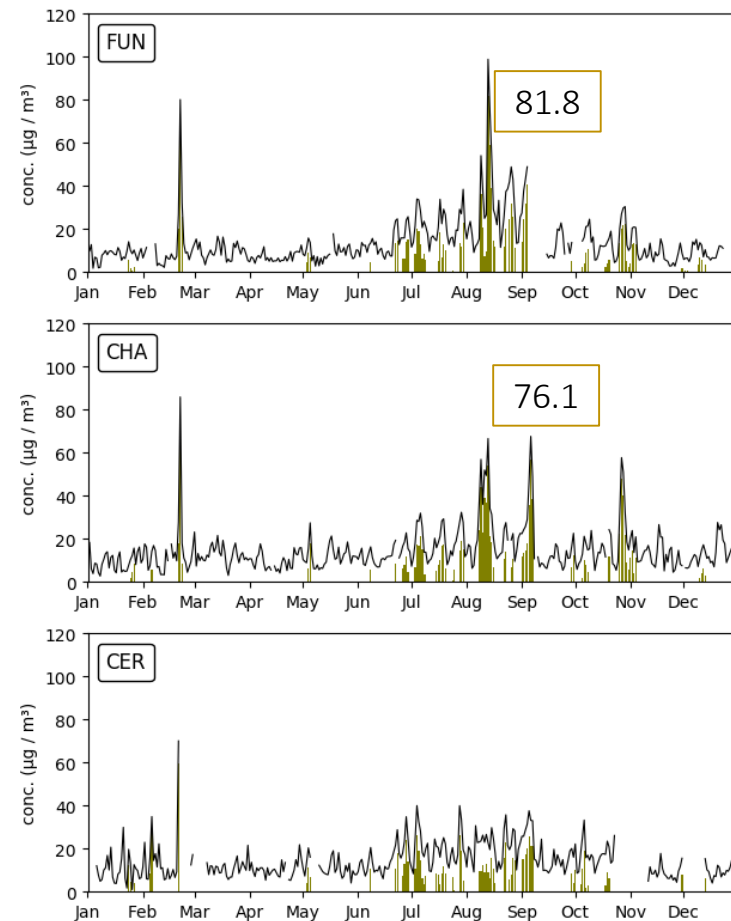


# Modelling approach vs EC Methodology

WRF-CHIMERE

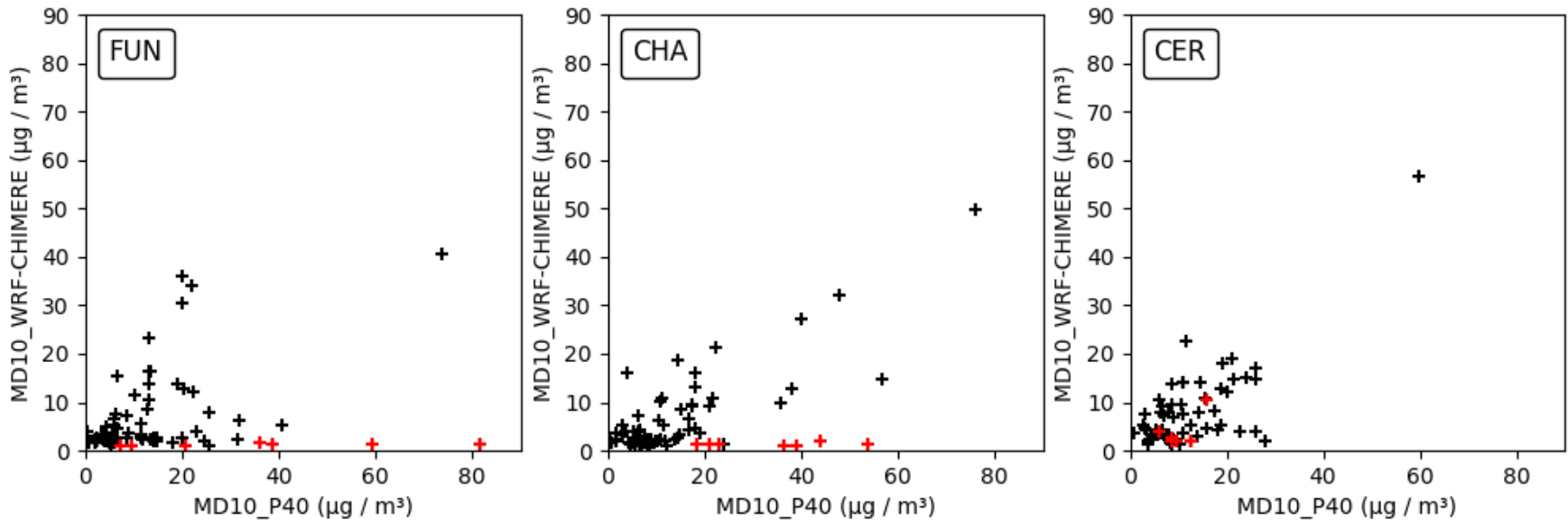


P40



— PM10 (obs) — MD10 (mod)

# Modelling approach vs EC methodology



+ 08 a 15 agosto

There is concordance between the 2 methods,  
but in general dust concentrations estimated by  
WRF-CHIMERE modelling system are inferior to  
the P40 methodology

Forest fires

# Future challenges to modelling dust

- **Satellite + models** instead of satellites vs models!!
- **More accuracy** on dust modelling -> using models to estimate dust contribution to air quality
- **Real alert system** for AQ/dust
- **Dust-AQ-CC**: Dust-air quality-climate change

# Current research...

## How dust episodes can influence ozone peaks?

Ana Ascenso<sup>1</sup>, Florian Couvidat F<sup>2</sup>, Carla Gama<sup>1</sup>, Augustin Colette<sup>2</sup>, Alexandra Monteiro<sup>1</sup>

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<sup>2</sup> INERIS, National Institute for Industrial Environment and Risks, Parc Technologique ALATA, France

Desert dust outbreaks affect air quality in many regions around the world, and the western Mediterranean Countries are an example, where also occurs ozone episodes during summer. This study intends to estimate the influence of dust in the atmosphere on the ozone photochemical production. A summer period, with heat wave and dust event, that occurred last August 2018 over Portugal, is studied using the WRF-CHIMERE modelling system.

This modelling system was applied for the year in analysis, considering three nested domains with horizontal resolutions of 27x27 km<sup>2</sup> (over North Africa and Europe), 9x9 km<sup>2</sup> and 3x3 km<sup>2</sup> (over Portugal). Different runs with the latest CHIMERE model version (recently developed and still in tests) were produced. The idea is to deactivate the process involving dust until we can see no effect of dust onto ozone and therefore to diagnose the importance of each of these processes, namely the formation of coarse nitrate onto dust and heterogeneous reactions; only considering the heterogeneous reactions and also investigating the importance of the processes of coagulation of dust with other particles. The modelling results obtained along these different simulation tests will allow to identify and quantified the importance of each of these processes and to better understand the impact of dust in the atmosphere when there is favourable photochemical conditions for ozone production (Figure 1).

This study will allow to improve knowledge on the main atmospheric chemical processes that should be included (take part) of the air quality models, in particular the ones used for air quality forecast services and prediction of both dust and ozone events.

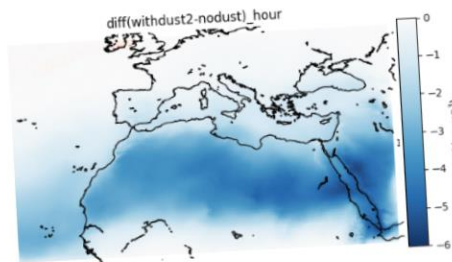


Figure 1. Average spatial differences of hourly ozone concentrations obtained by subtracting the simulation with dust from the simulation without.

Work to be presented at GLOREAM2019 workshop, Sweden

Thank you!