



DUST EVENTS IN PORTUGAL a modelling perspective

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Universidade de Aveiro



Dust events in Portugal | papers

Tellus
Volume 61B, 2009, 618–207–306
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TELLUS

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

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(Manuscript received 7 February 2008; in final form 14 August 2008)

ABSTRACT
Aerosol properties of mineral particles in the air field of an African desert dust outbreak over the Saharan desert over the Mediterranean in different layers to Portugal. The measurements were performed during the project Desert Aerosols over Portugal (DARPO) which was linked to the Saharan Mineral Dust Experiment (SMDEX) which results in a mass scattering efficiency of $0.87 \text{ m}^2 \text{ g}^{-1}$ and the corresponding 0.53 and the lidar ratio was between 45 and 50 in the whole dust loaded column. A comparison of the distributions and refractive indices derived from different instruments and models shows that some minor differences could also be observed. Measurements as well as calculations

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Atmospheric Research
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Aerosol radiative effects during two August 2012 over the Southwestern

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ARTICLE INFO

Article history:
Received 17 July 2014
Received in revised form 6 October 2014
Accepted 7 October 2014
Available online 10 October 2014

ABSTRACT

This study provides a spectral radiative forcing spectrum. For this calculated during two dust events in August 2012 over the Southwestern of Portugal. The properties from the dust were used to simulate the

Atmospheric Environment
Contents lists available at ScienceDirect
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Solar and thermal radiative effects during the 2011 extreme desert dust episode over Portugal

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HIGHLIGHTS

Atmospheric Research
Contents lists available at ScienceDirect
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Modeling Saharan desert dust radiative effects on cloud

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Atmos. Chem. Phys., 15, 6407–6418, 2015
www.atmos-chem-phys.net/15/6407/2015/
doi:10.5194/acp-15-6407-2015
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Atmospheric Chemistry and Physics
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Aerosols over continental Portugal (1978–1993): their source and impact on the regional climate

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Received: 2 September 2014 – Published in Atmos. Chem. Phys. Discuss.: 9 December 2014
Accepted: 10 December 2014 – Final version: 10 December 2014

Solar Energy 160 (2018) 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

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ARTICLE INFO

Keywords:
Solar energy
Saharan desert dust transport
Soiling

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 coming from north Africa was detected, while using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model, the location of the dust were found. Dust accumulated on glass coverings of photovoltaic panels was observed. The annual mean of the simulated dust has a magnitude of $2\text{--}6 \mu\text{g m}^{-3}$. The surface concentrations were assessed. The annual mean of the simulated dust has a magnitude of $2\text{--}6 \mu\text{g m}^{-3}$. The surface concentrations were assessed.

Atmospheric Pollution Research
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journal homepage: www.elsevier.com/locate/apr

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

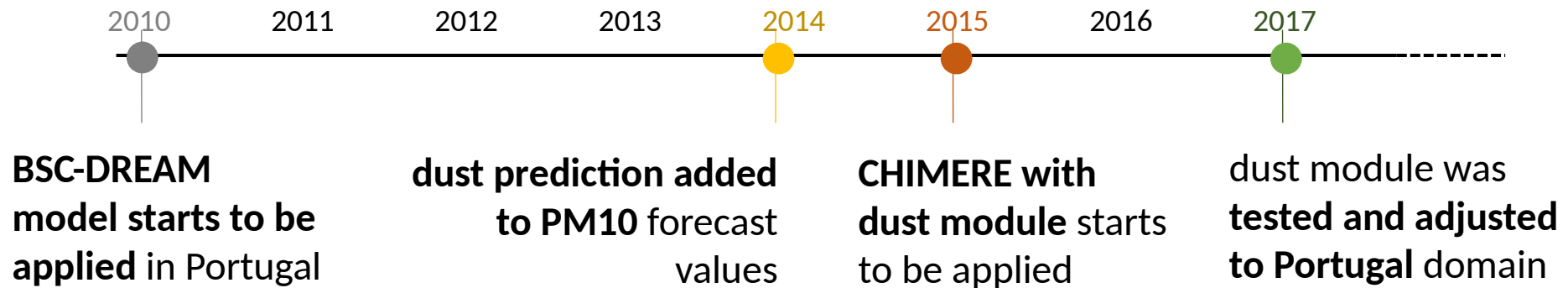
Alexandra Monteiro^a, Ana Patricia Fernandes^a, Carla Gama^a, Carlos Borrego^a, Oxana Tchepel^b
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ABSTRACT

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 peak. The BSC-DREAM8b v1.0 model was applied for the entire year of 2011 and the modelled surface concentrations were assessed. The annual mean of the simulated dust has a magnitude of $2\text{--}6 \mu\text{g m}^{-3}$. The surface concentrations were assessed.

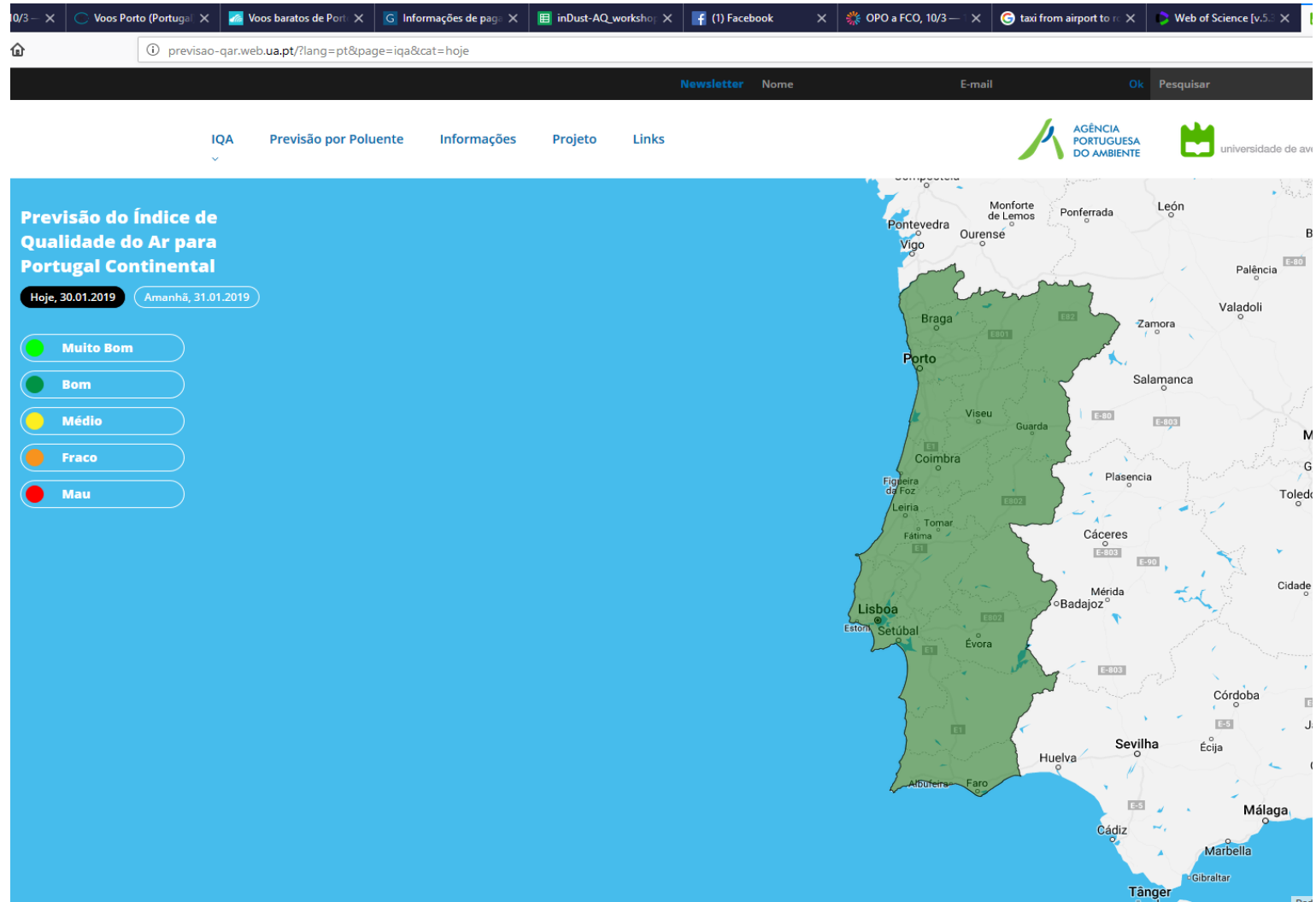
The vertical distribution of Saharan dust over the western and central Mediterranean through dust modelling and lidar observations

Dust forecast modelling in Portugal timeline

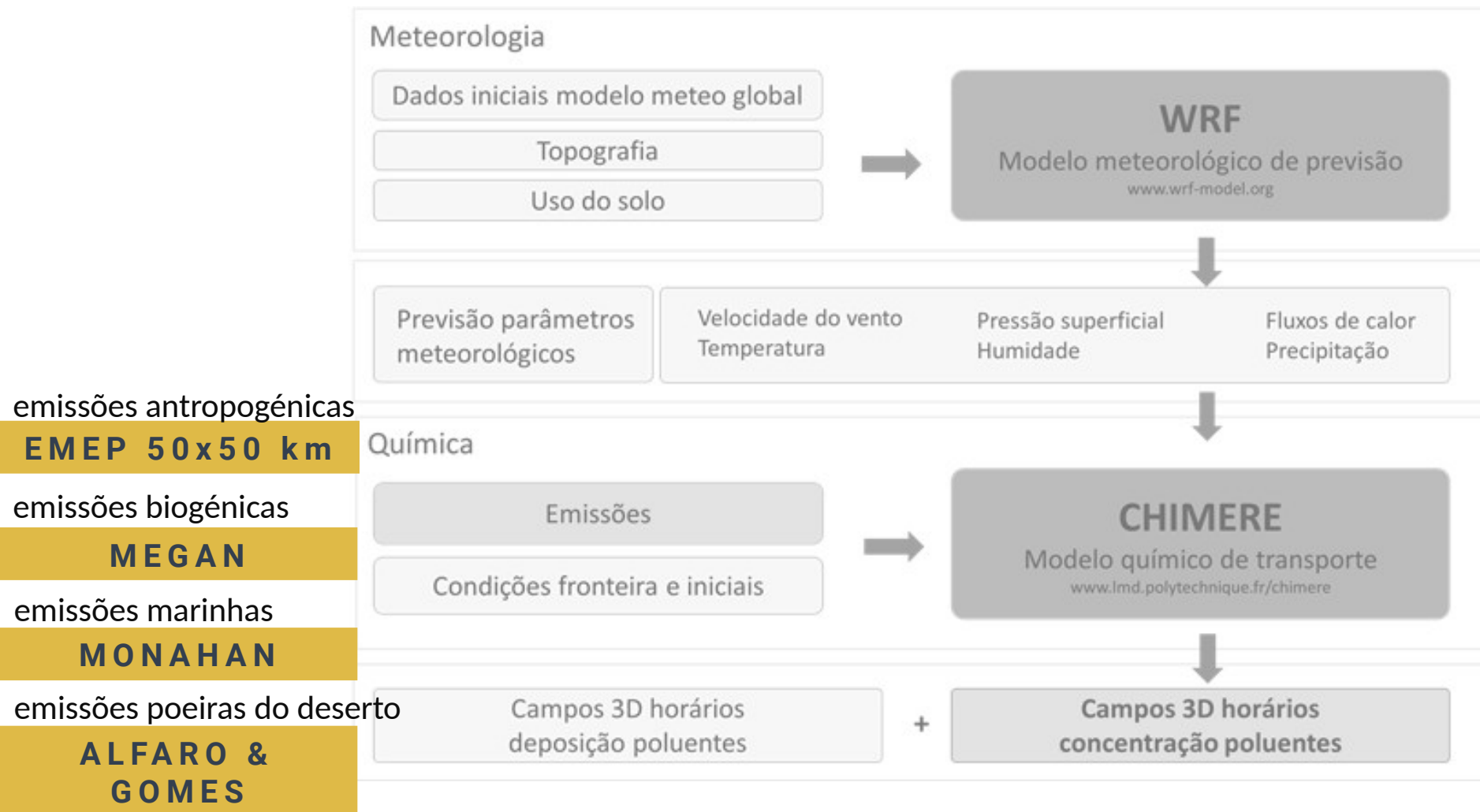


Forecasting DUST over Portugal

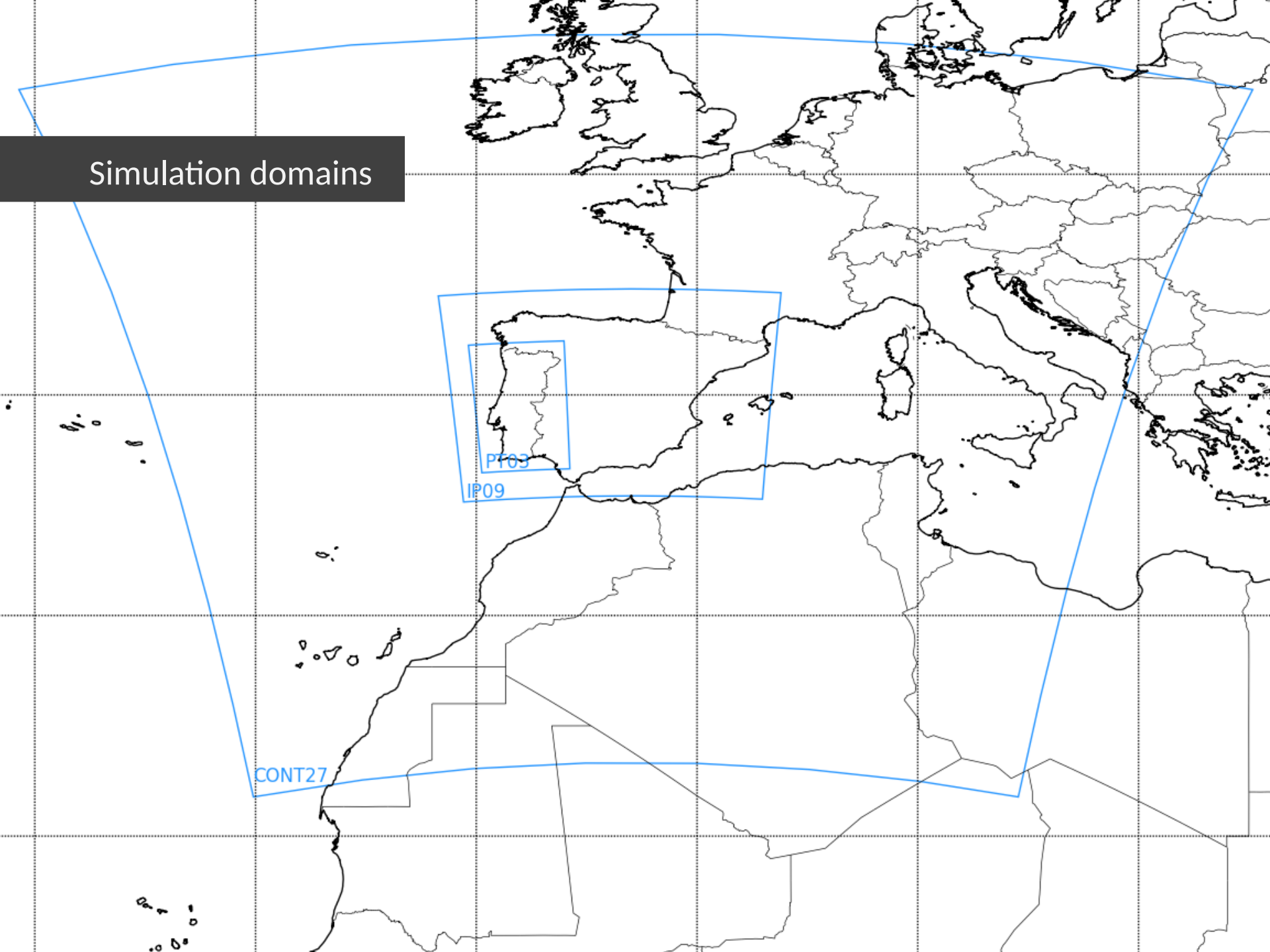
<http://previsao-qar.web.ua.pt/>



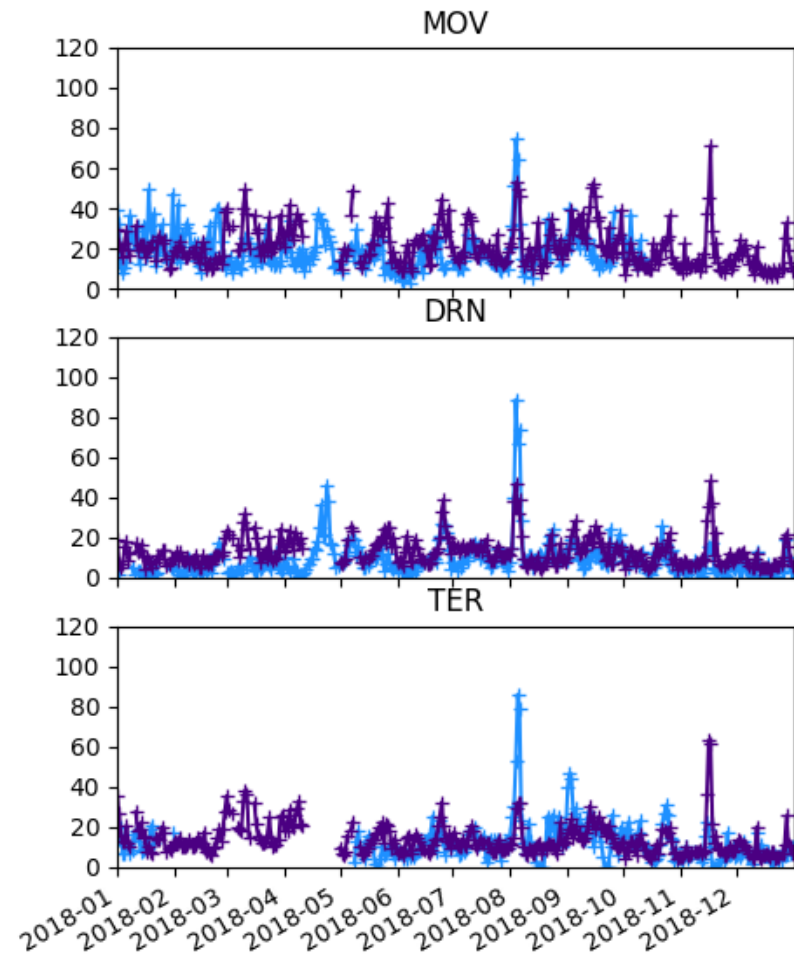
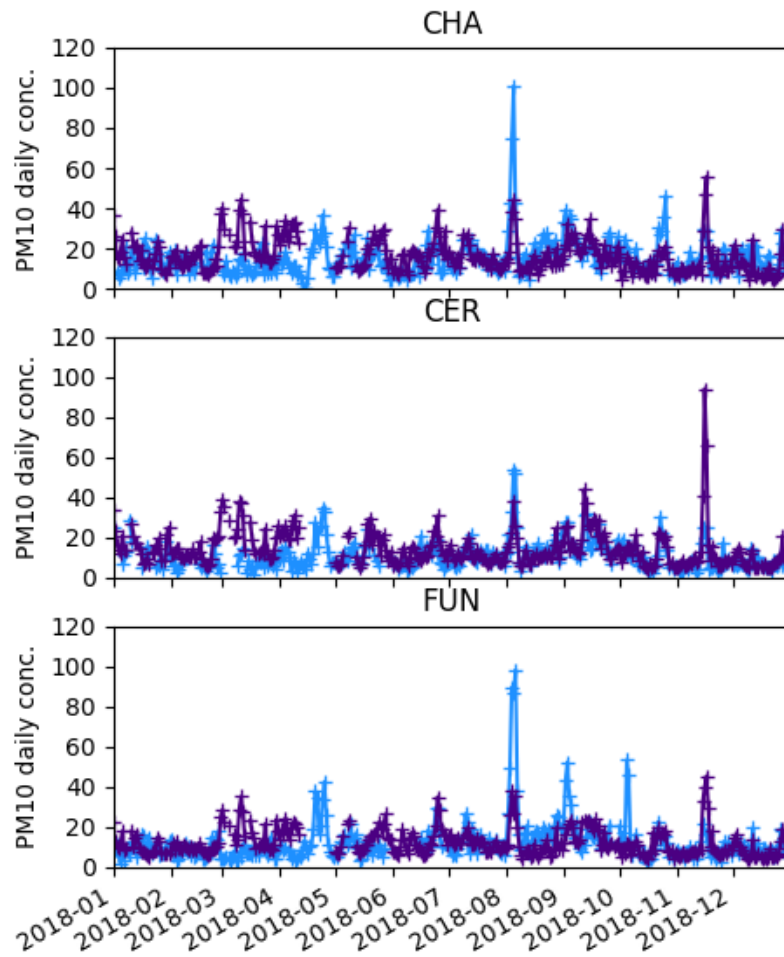
Dust modelling forecast over Portugal



Simulation domains



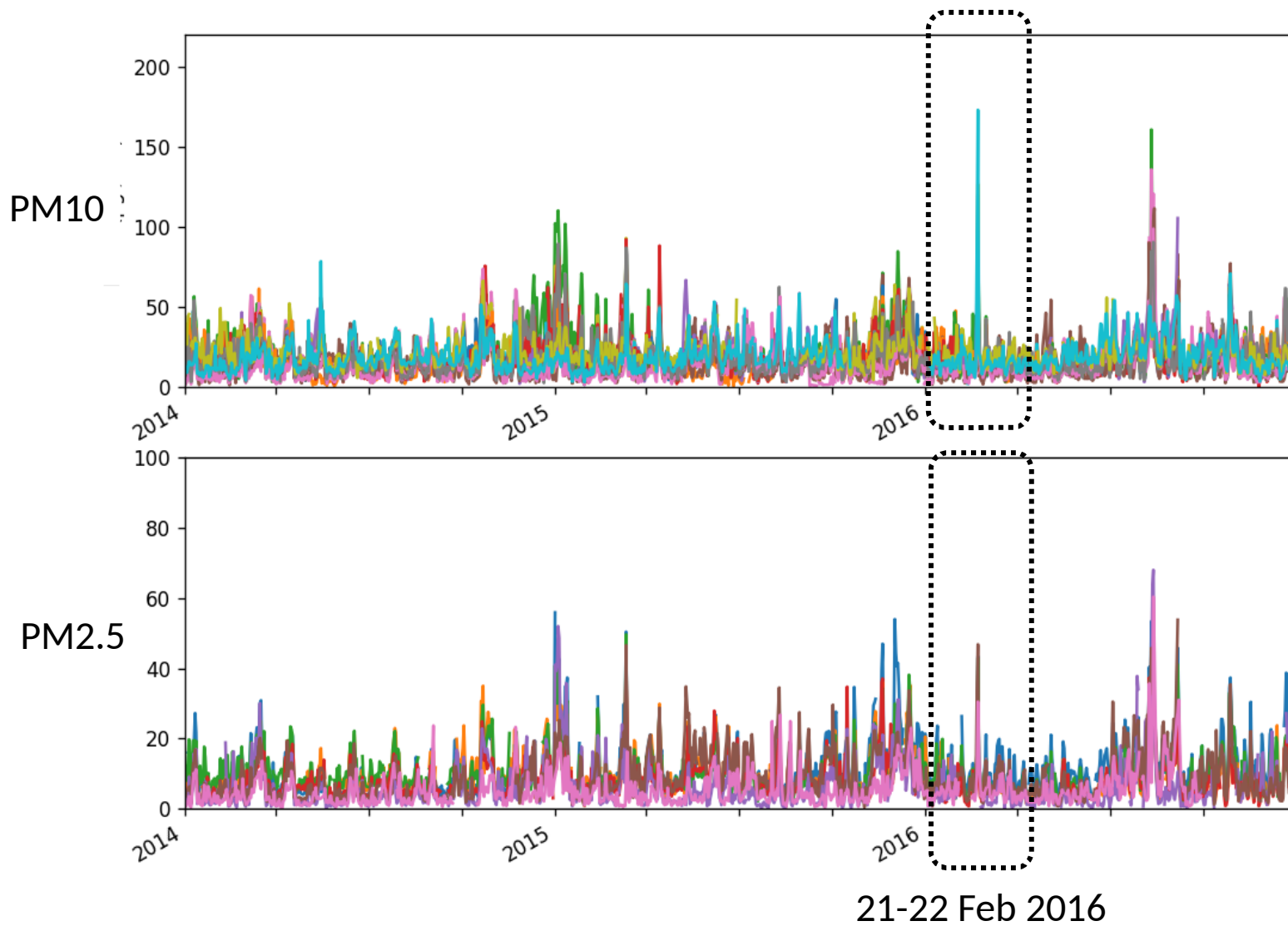
Model validation



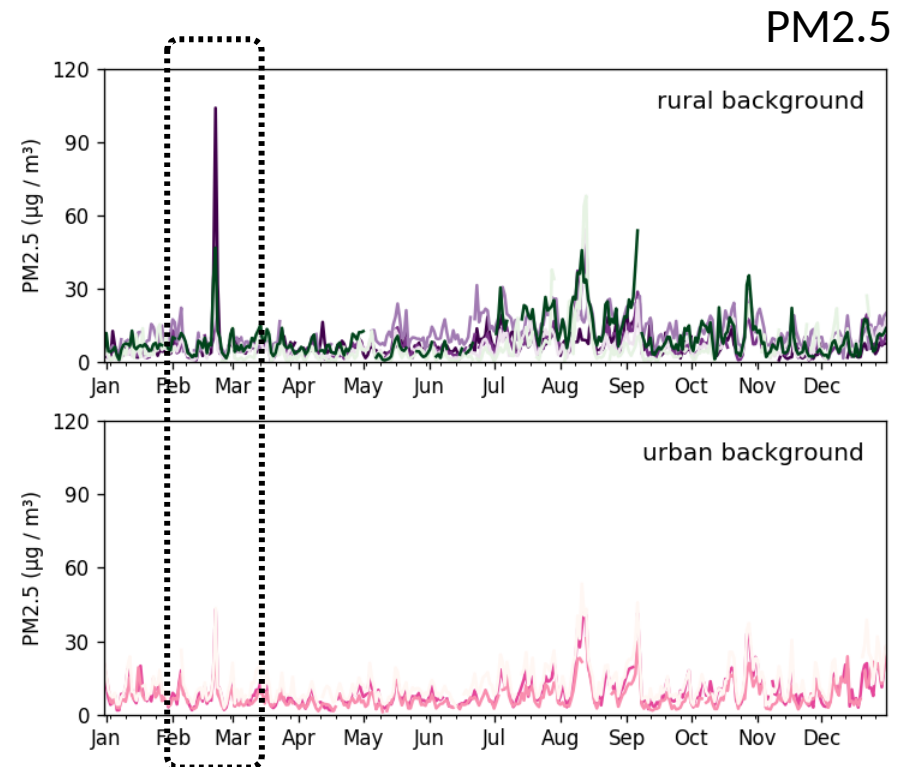
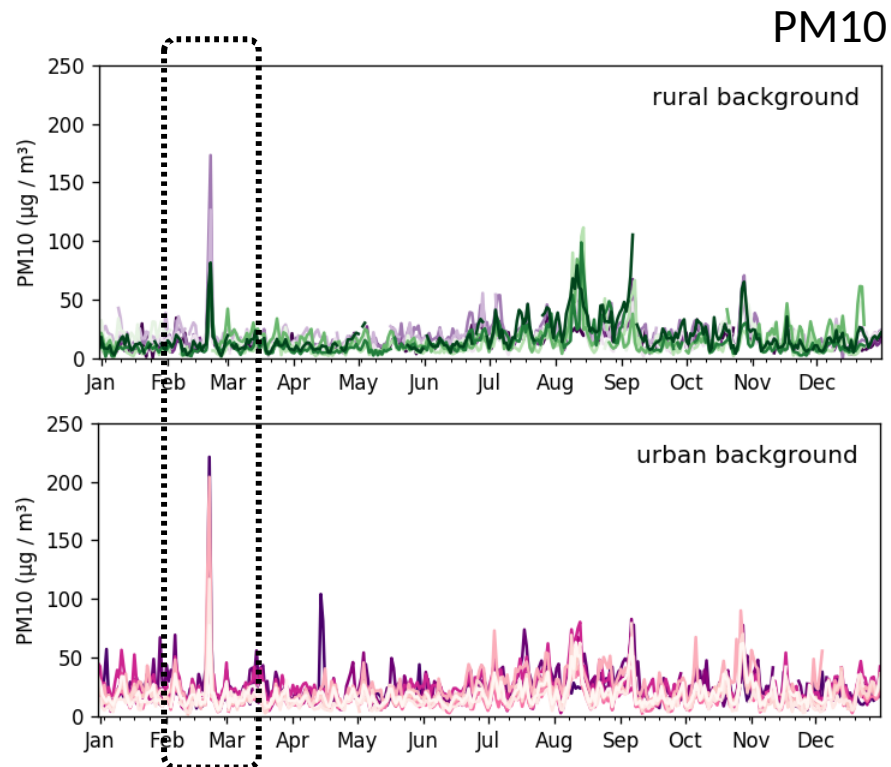
—+— observations
—+— forecasts

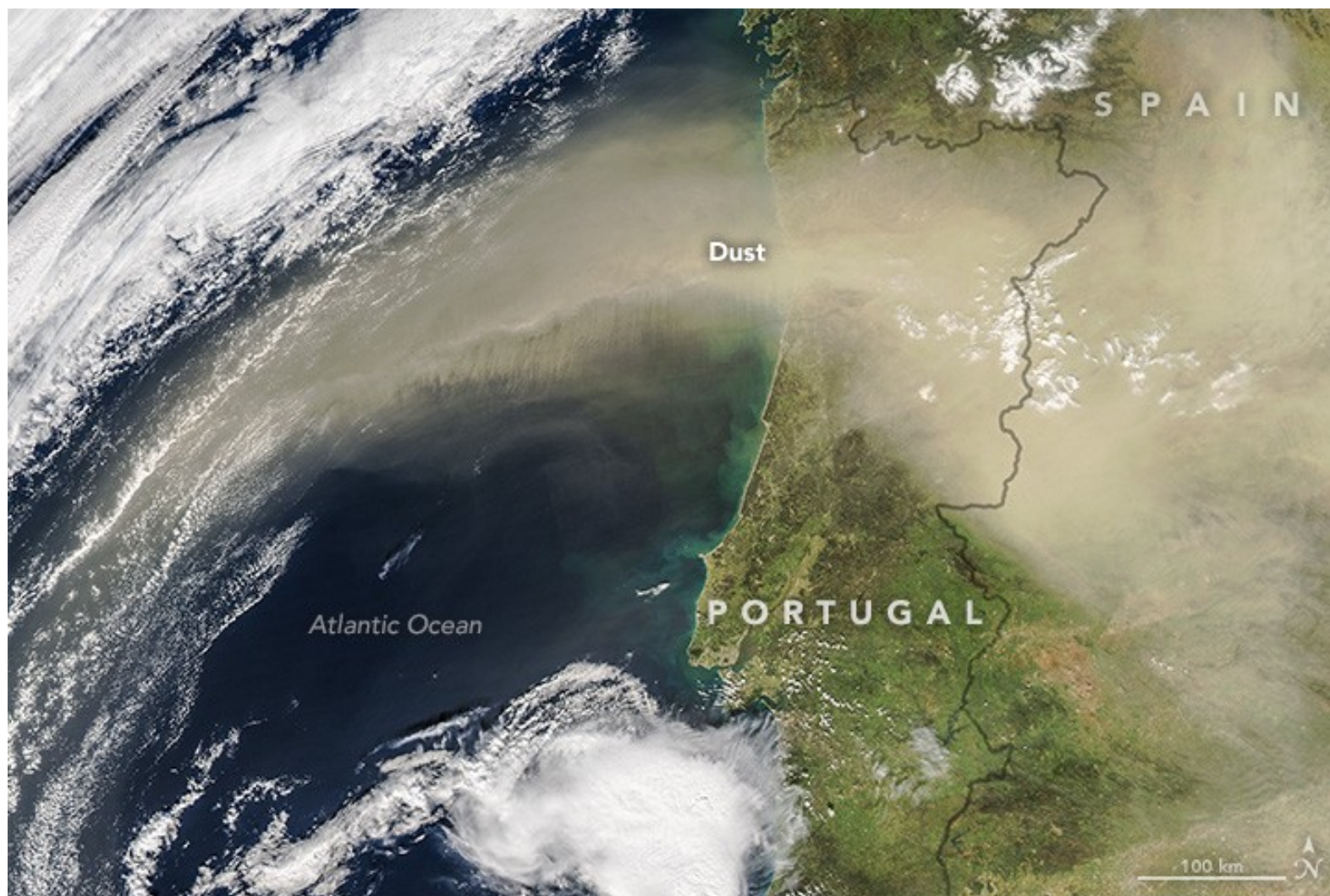
An outlook over the highest dust episode of the last years...

The highest event over the last years...

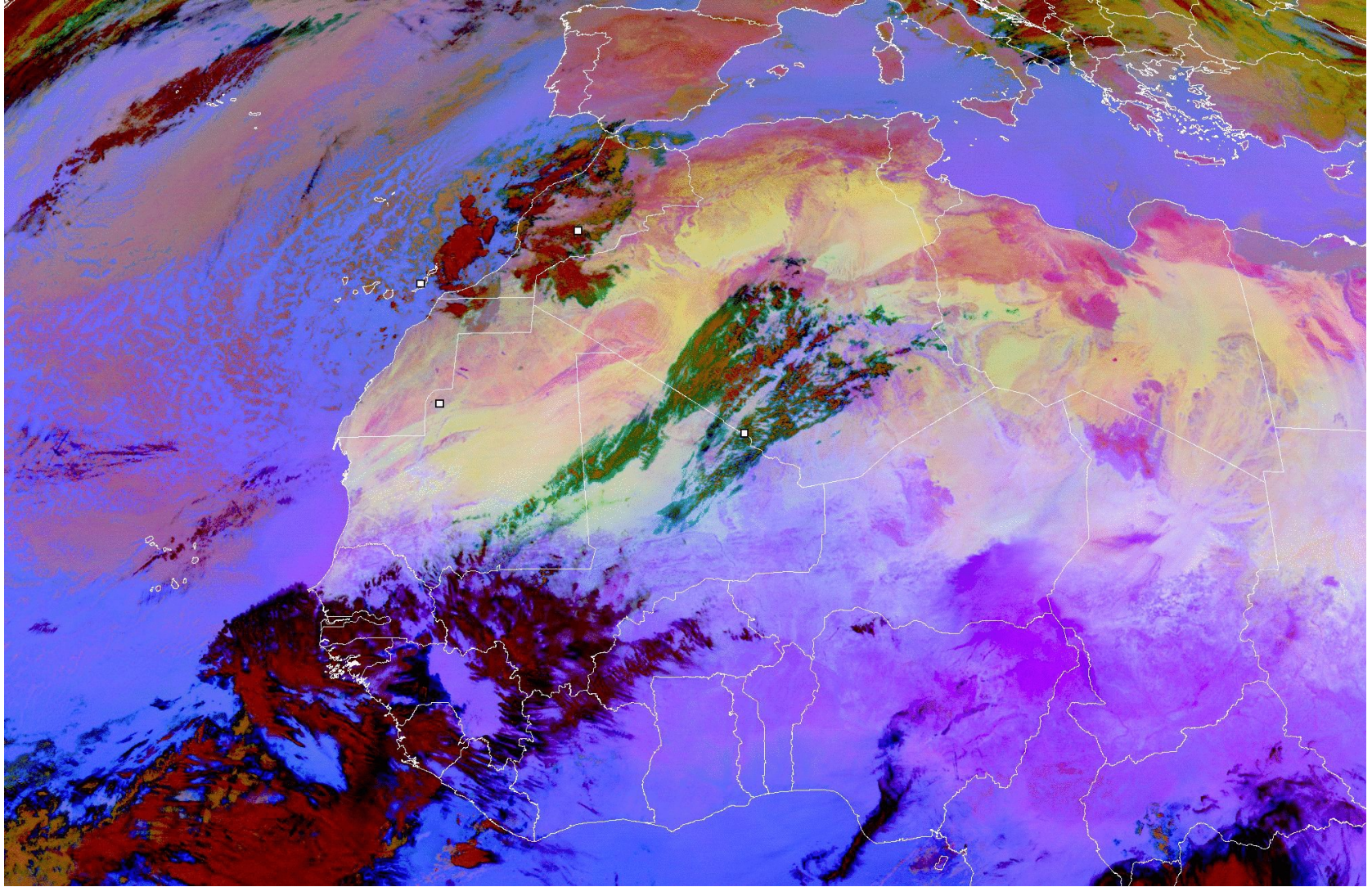


The dust episode



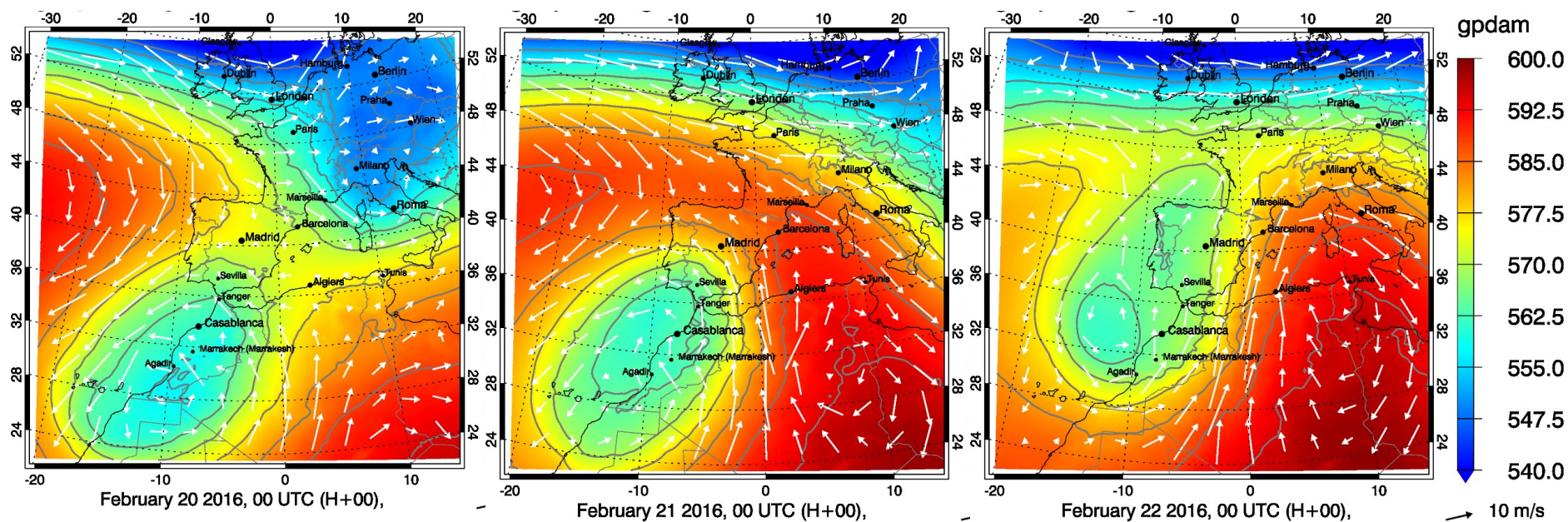


February 21, 2016 14:00 UTC [Aqua - MODIS]



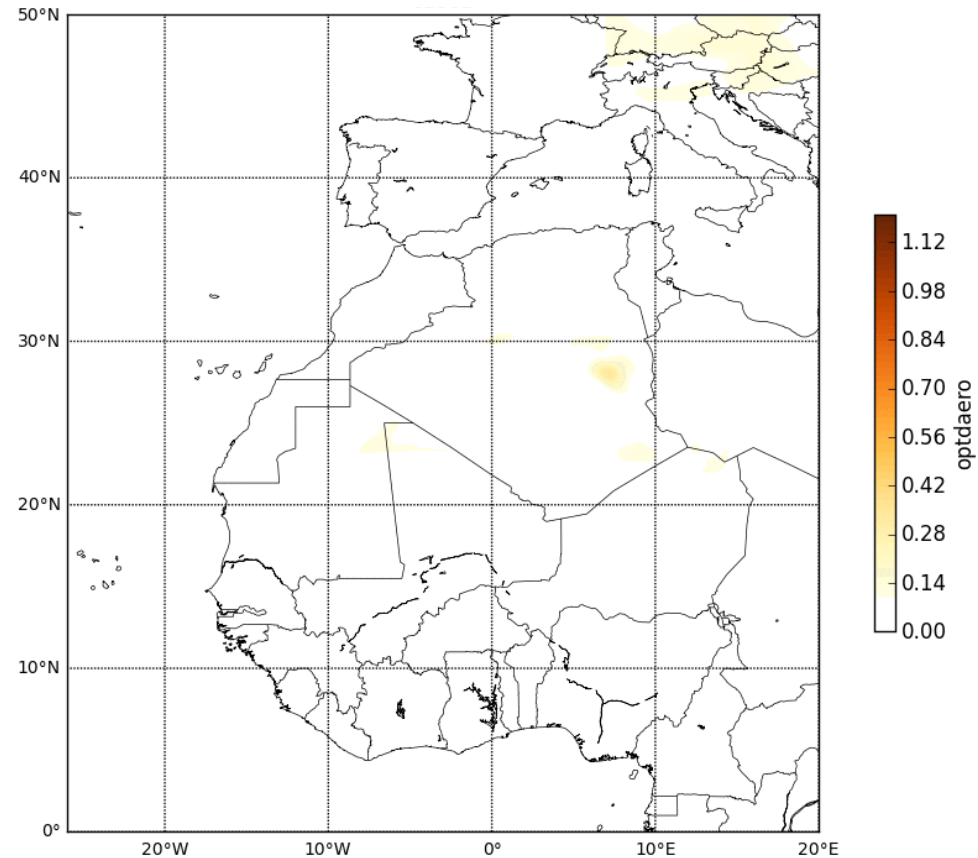
Meteorological fields [WRF simulation]

geopot. height @ 500 hPa; winds @ 2km

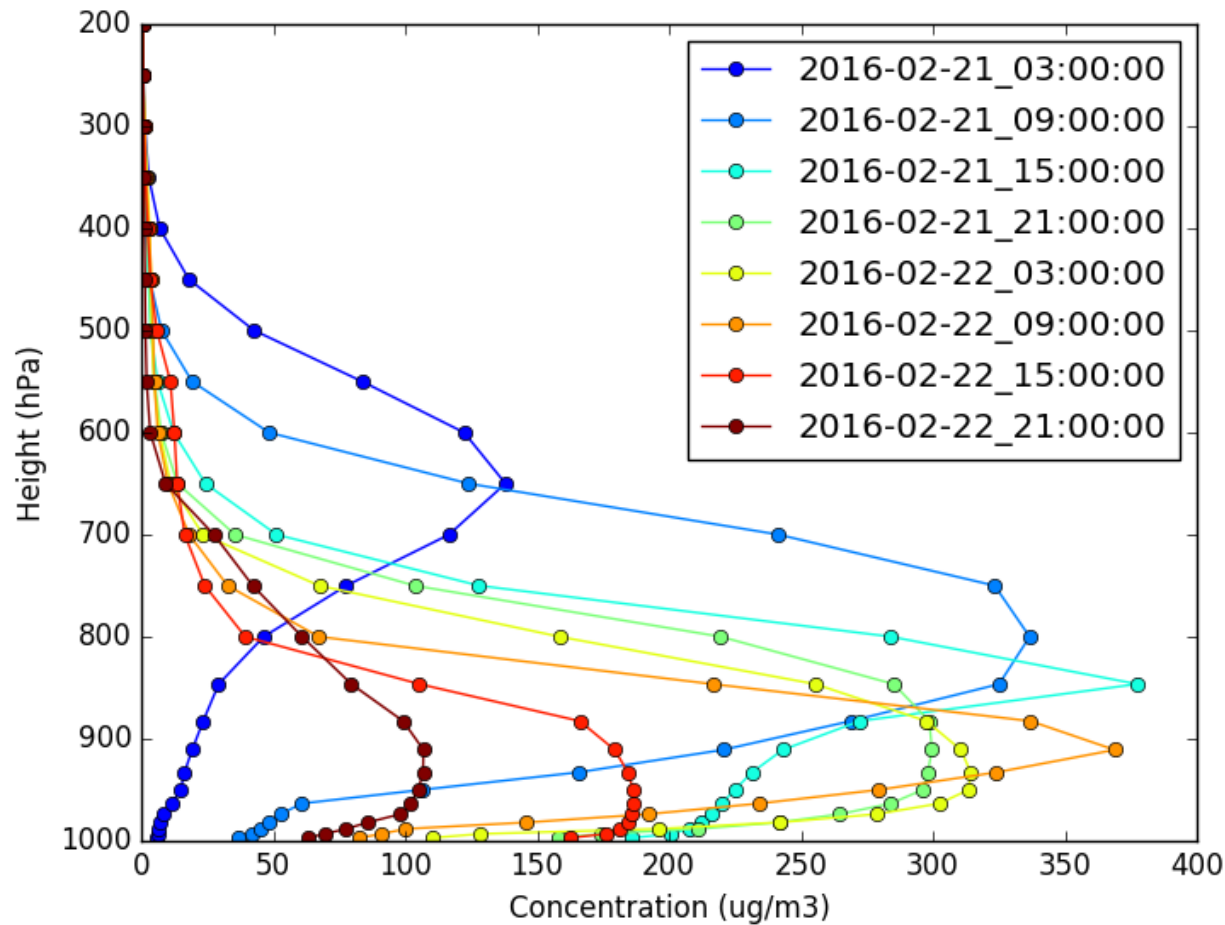


Aerosol Optical Depth

19.02.2016 12h00 - 23.02.2016 12h00

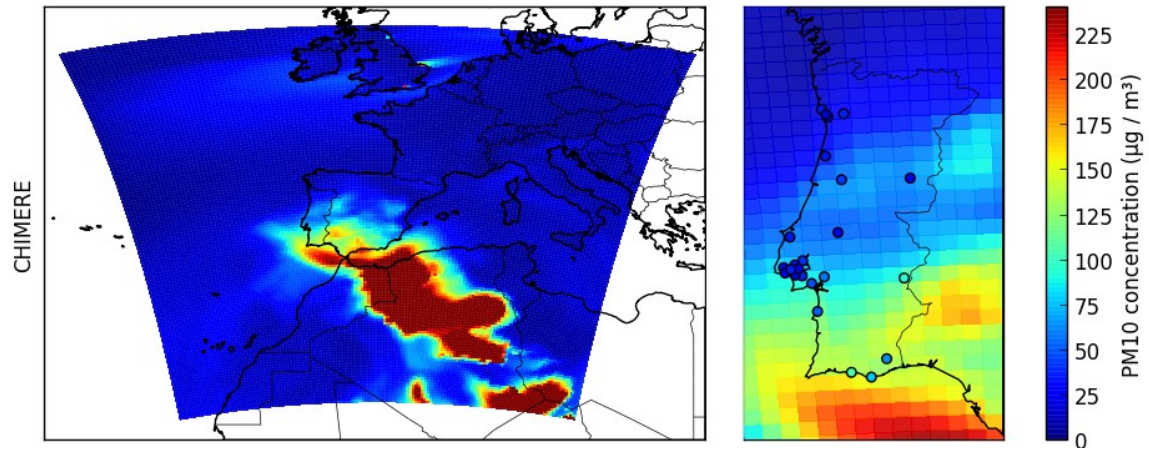


Vertical profile of dust

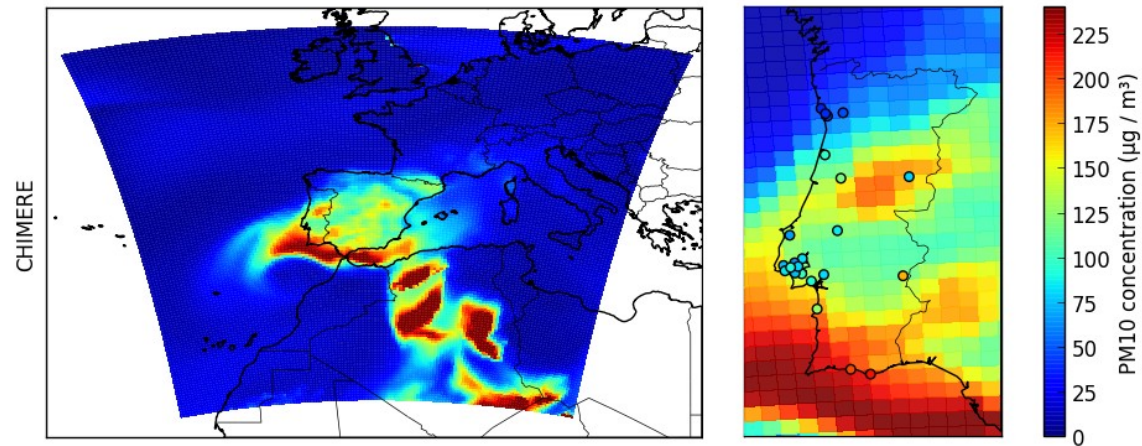


Air Quality [PM10 concentrations]

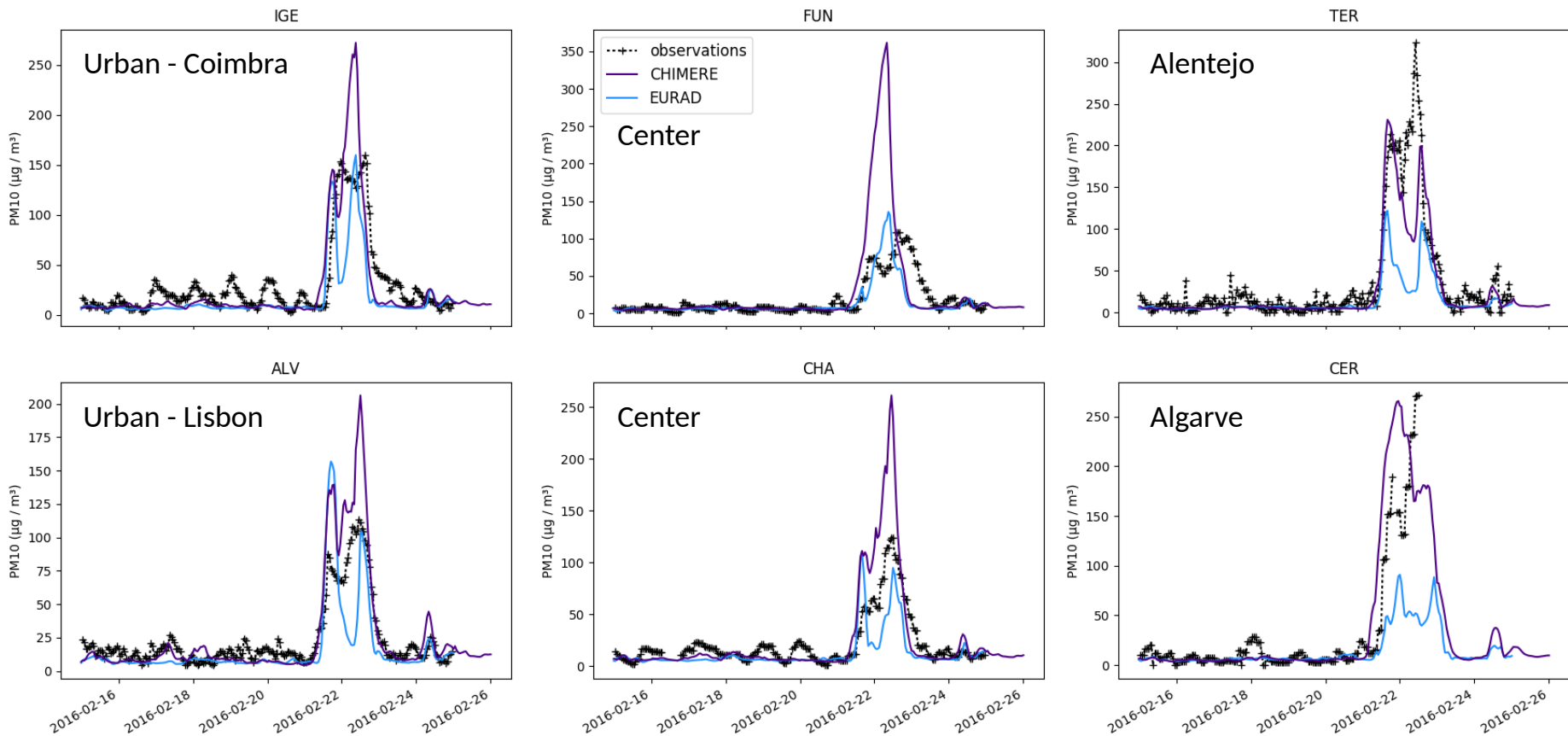
Feb 21



Feb 22

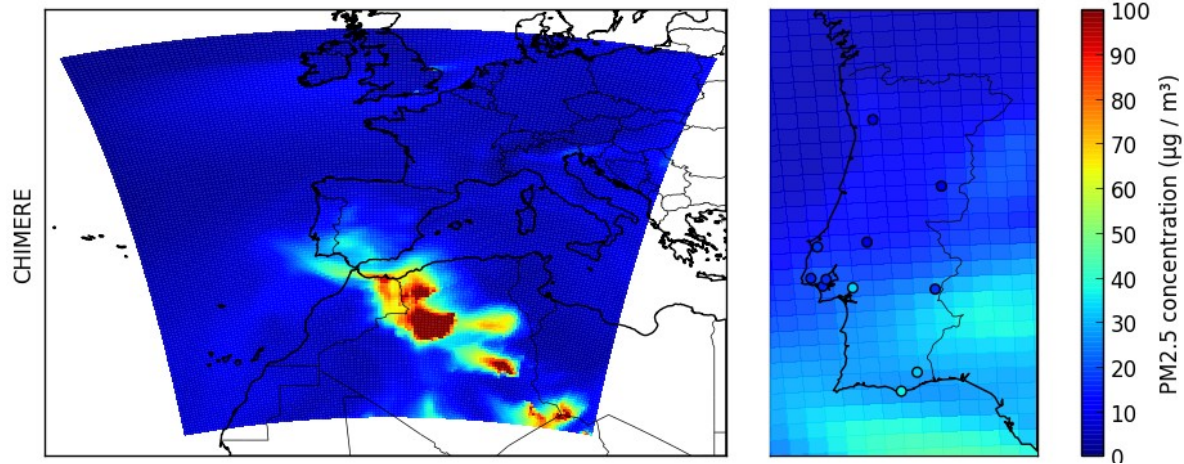


Air Quality [PM10 concentrations]

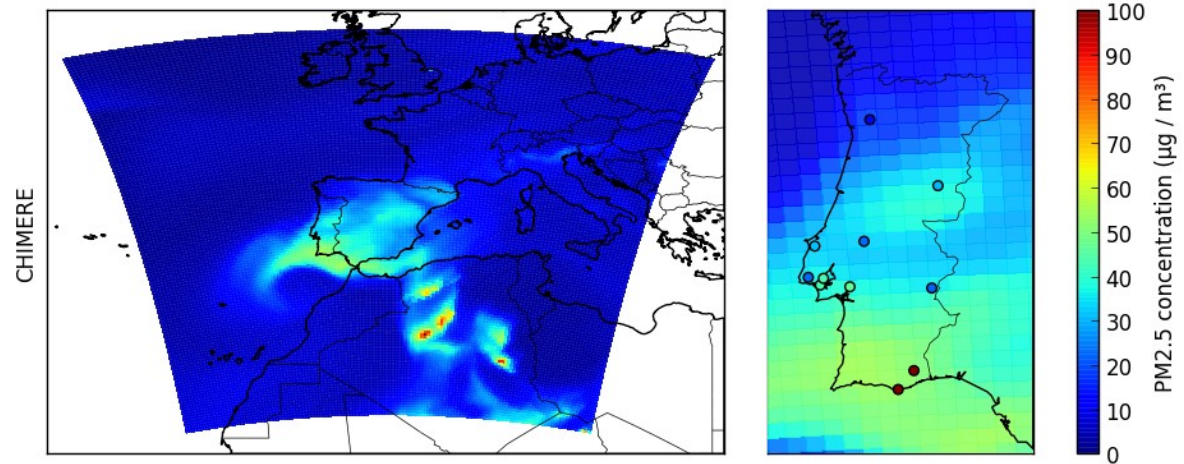


Air Quality [PM2.5 concentrations]

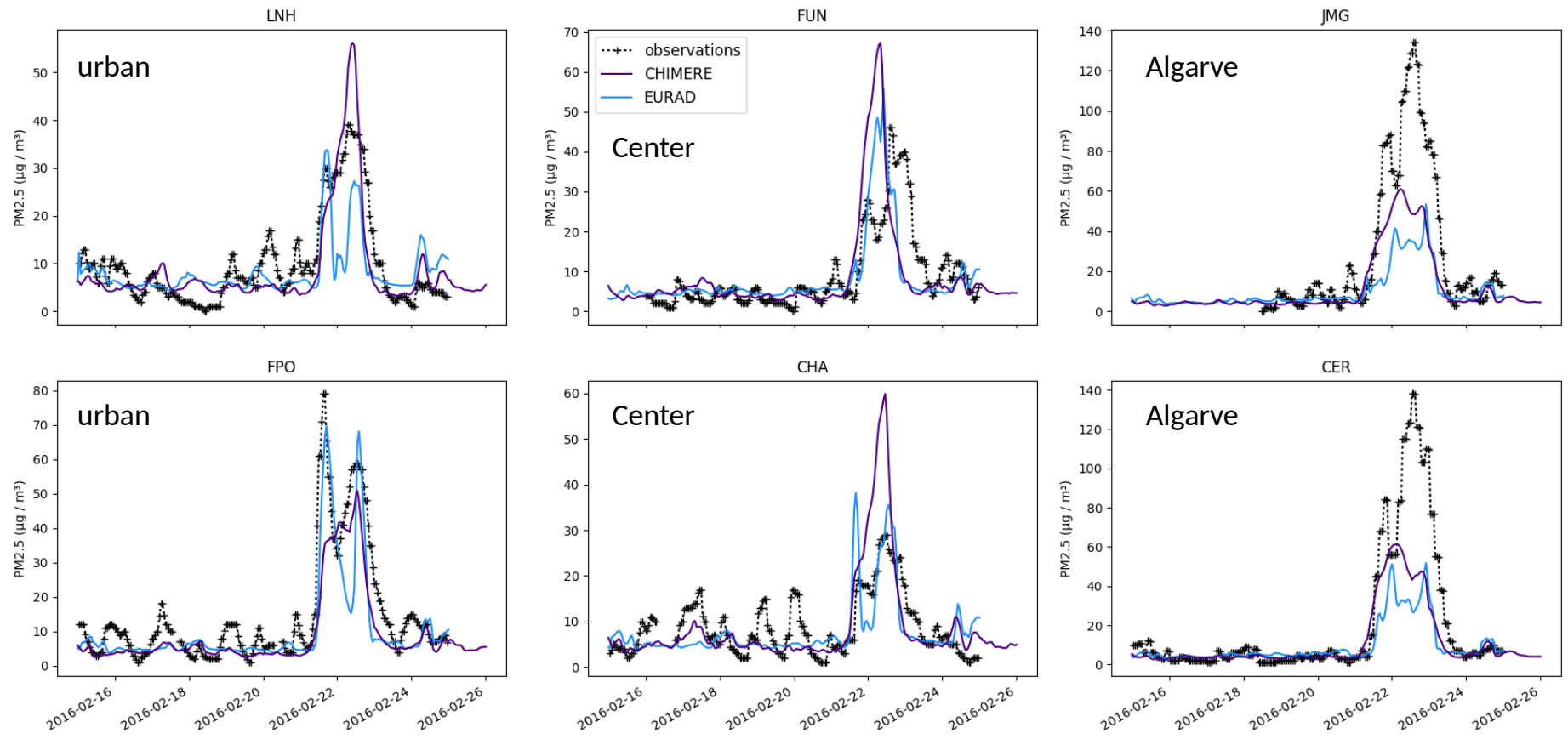
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Feb 22



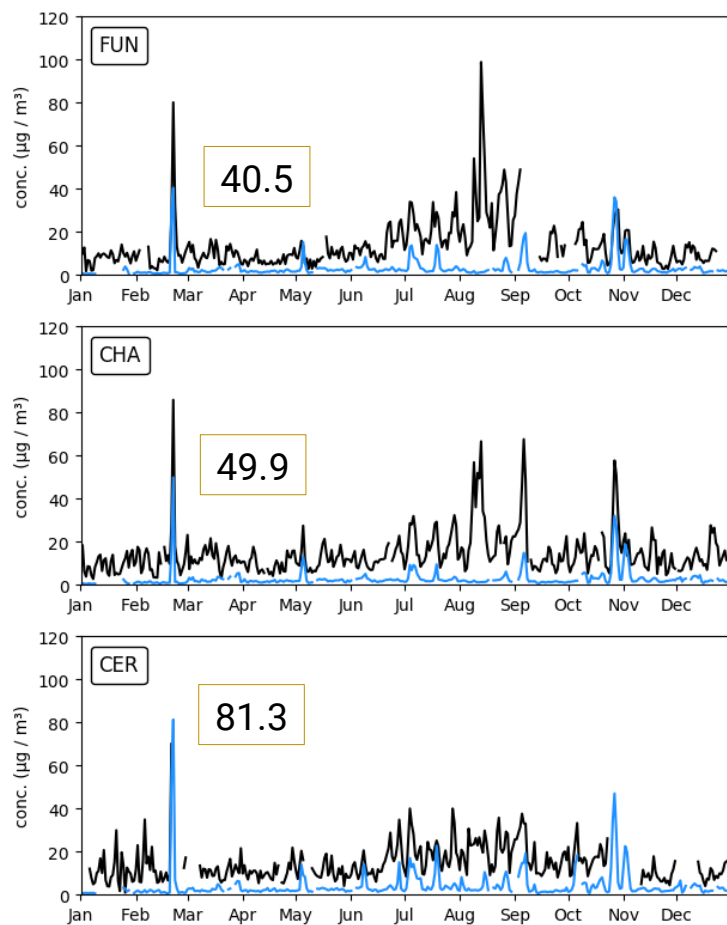
Air Quality [PM2.5 concentrations]



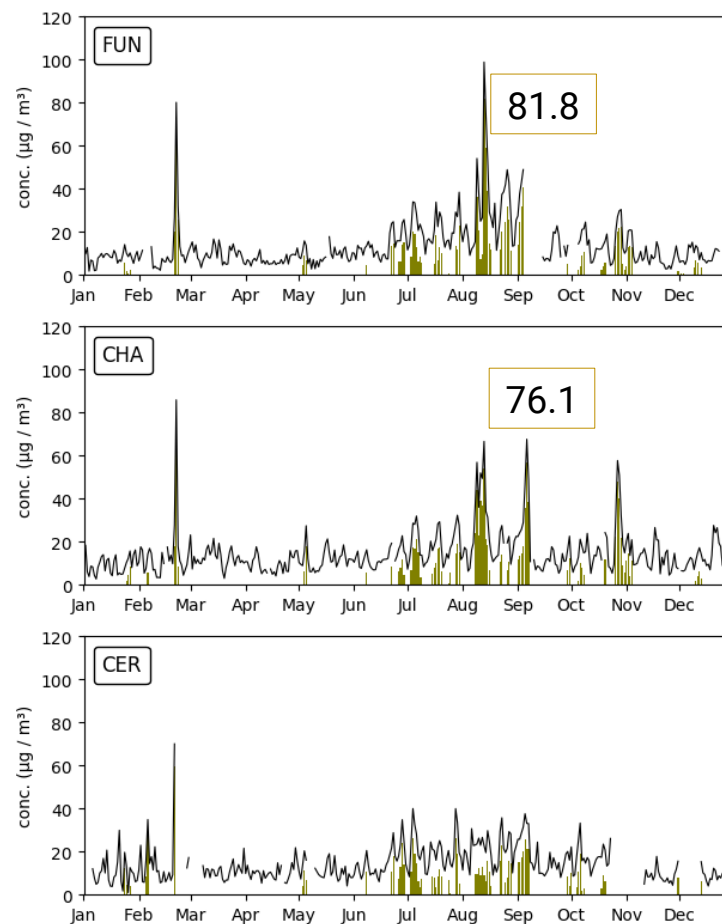
How models could be useful to
evaluate dust contribution?

Modelling approach vs EC Methodology

WRF-CHIMERE

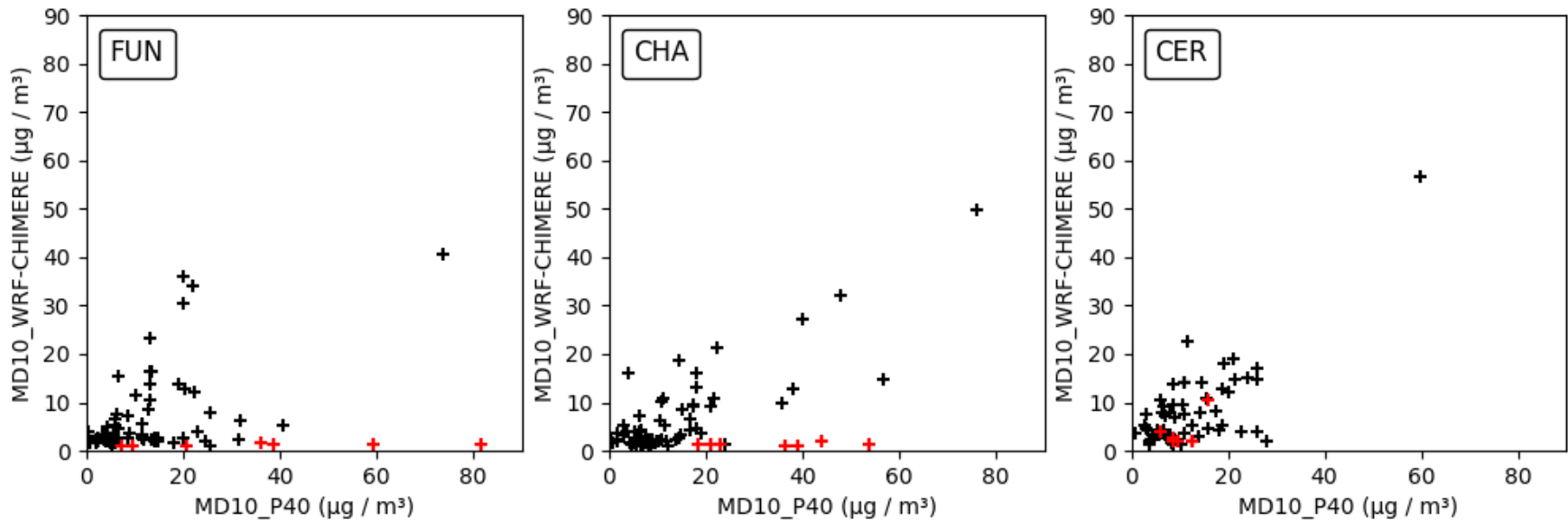


P40



— PM10 (obs) — MD10 (mod)

Modelling approach vs EC methodology



+ 08 a 15 agosto

Forest fires

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

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?

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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 km² (over North Africa and Europe), 9x9 km² and 3x3 km² (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.

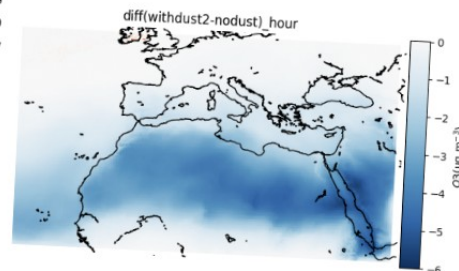


Figure 1. Average spatial differences of hourly ozone concentrations obtained by subtracting the simulation with dust from the simulation without.

Work to be
presented at
GLOREAM2019
workshop, Sweden

Thank you!