inDust WEBINAR

5 MAY 2021
15:00 - 16:00 CET

IS IT ONLY MINERAL DUST THAT MATTERS FOR HEALTH EFFECTS DURING DESERT DUST EPISODES? FROM METHODOLOGICAL ISSUES TO THE HEALTH EFFECTS

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Outline

- **Major patterns of desert dust and impact on air quality**
- **Impact of dust outbreaks on PM levels procedure for the detection and quantification of natural dust contributions**
- **Examples of applications of the method**
- **Health effects (focus on Europe, Spain, Barcelona)**
- **Final considerations**

Dust sources, emissions and transport

- **Global MASS of mineral dust aerosols:** **16 Mega (10^6)-tons**

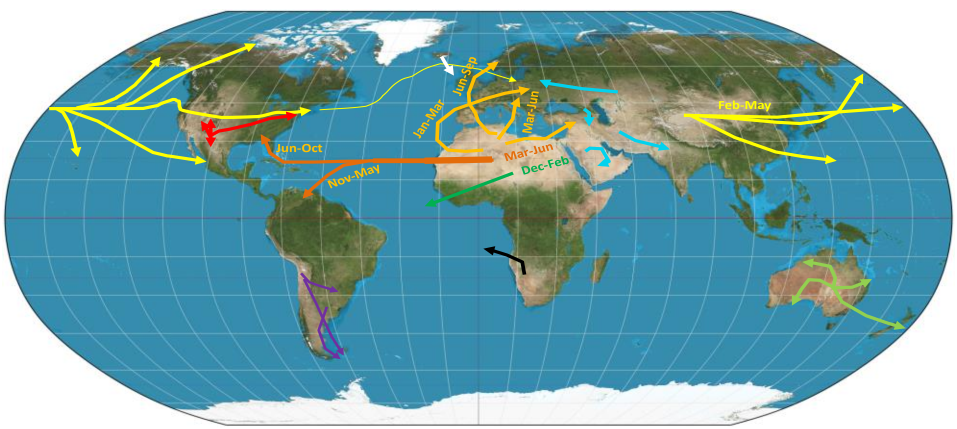
Emissions **1200-1600 Mt/yr**

- **N-Africa** **790-840 Mt/yr**
- **Gobi** **140-220 Mt/yr**
- **C. Asia, E. Australia, Atacama and South Africa** **10- 60 Mt/yr each**
- **S. US-N. Mexico** **2- 60 Mt/yr**

Prospero J.M., 2002. Rev. Geophys 40(1):1002
Ginoux P. et al., 2012. Rev Geophys 50:1–36
Washington R. et al., 2003. Ann Assoc Am Geogr 93(2):297–313

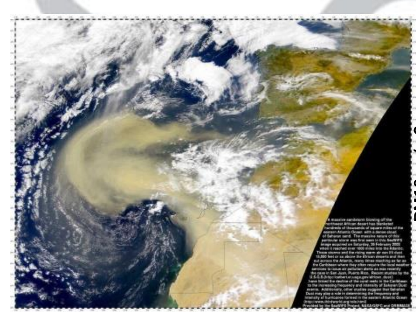
Huneeus N. et al., 2011. Atmos Chem Phys 11(15):7781–816
Ginoux P. et al., 2010. J Geophys Res Atmos 2010;115(5):1–10
Varga G., 2012. Hungarian Geogr Bull 61(4):275–98

Atmospheric transport

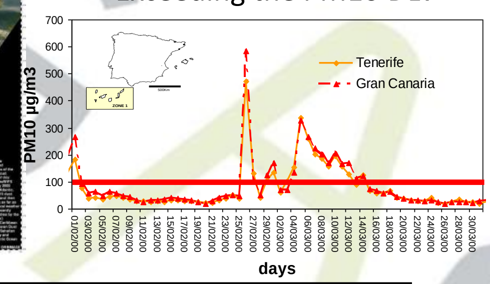


Duration

Atmospheric life time, hours- weeks
Duration, hours to several weeks



25/02 to 17/03/2000
Exceeding the PM10 DLV



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Modified from Griffin DW., 2007. Clin Microbiol Rev;20(3):459–77.

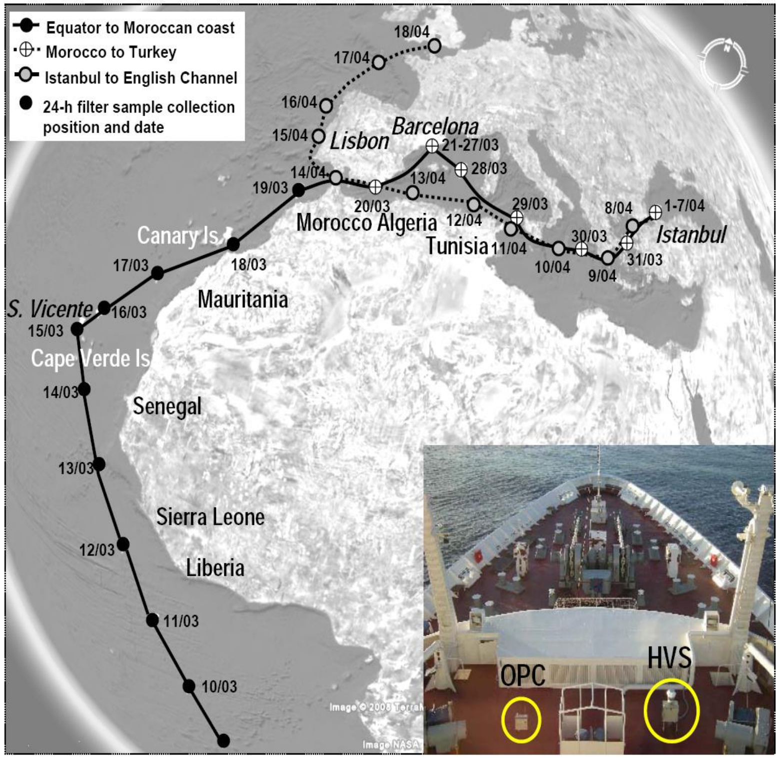
PM composition during dust episodes

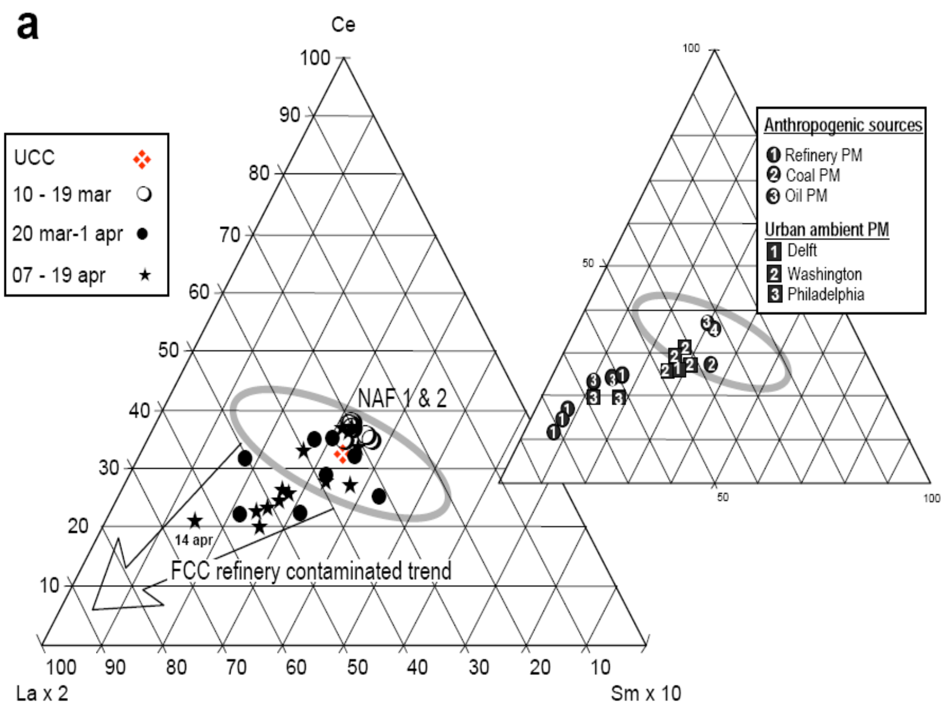
*Minerals typically present in desert dust. Asterisks indicate abundance: ***** very high to * low.*

Silicates & aluminium-silicates	Silicates	Quartz	SiO_2 (mineral grains or diatomea fragments)	*****
	Clay minerals	Kaolinite	$Al_2Si_2O_5(OH)_4$	****
		Illite	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$	****
		Chlorite	$((MgFe)_5Al)(AlSi_3)O_{10}(OH)_8$	***
		Palygorskite	$(Mg,Al_2Si_4O_{10}(OH)\cdot 4(H_2O)$	***
		Montmorillonite	$(Na,Ca)_{0.33}(Al,Mg)_2(Si_4O_{10})(OH)_2\cdot nH_2O$	***
	Feldspars	Albite	$NaAlSi_3O_8$	**
		Anorthite	$CaAl_2Si_2O_8$	**
		Microcline/orthocl.	$KAlSi_3O_8$	**
	Other silicate	Zircon	$ZrSiO_4$	*
		Hornblende	$Ca_2(Mg,Fe,Al)_5(Al, Si)_8O_{22}(OH)_2$	*
Carbonates	Ca &Mg Carb.	Calcite	$CaCO_3$	****
		Dolomite	$(CaMg)_2CO_3$	**
Oxides	Iron oxides	Hematite	Fe_2O_3	**
		Magnetite	Fe_3O_4	*
		Goethite	α-FeO(OH)	**
	Other oxides	Anatase & rutile	TiO_2	*
Salts	Chlorides	Halite	NaCl	*
	Sulphates	Gypsum	$CaSO_4.2H_2O$	**
		Thenardite	Na_2SO_4	*
		Epsomite	$MgSO_4$	*
Phosphates		Apatite	$Ca_5(PO_4)_3(F,Cl,OH)$	*

Querol X., et al., 20219 Environment International

PM composition during dust episodes



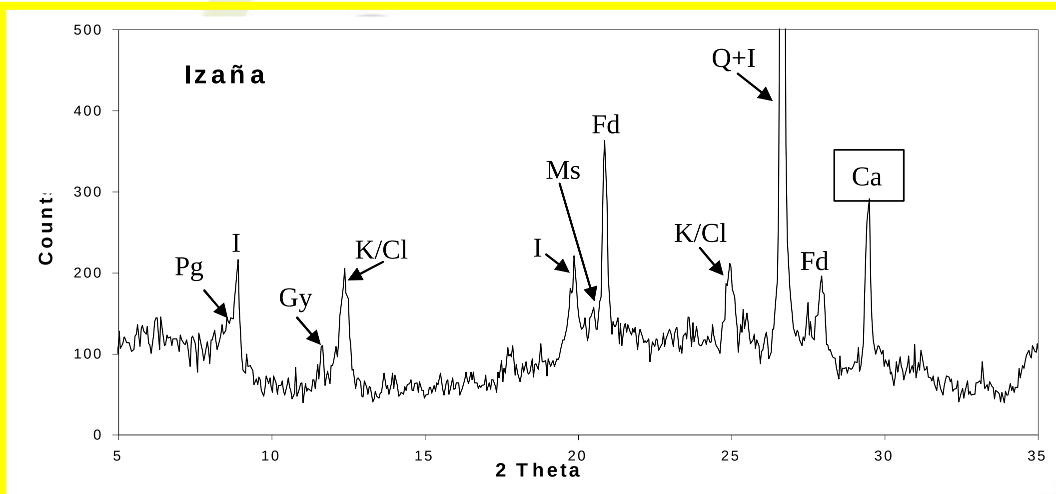


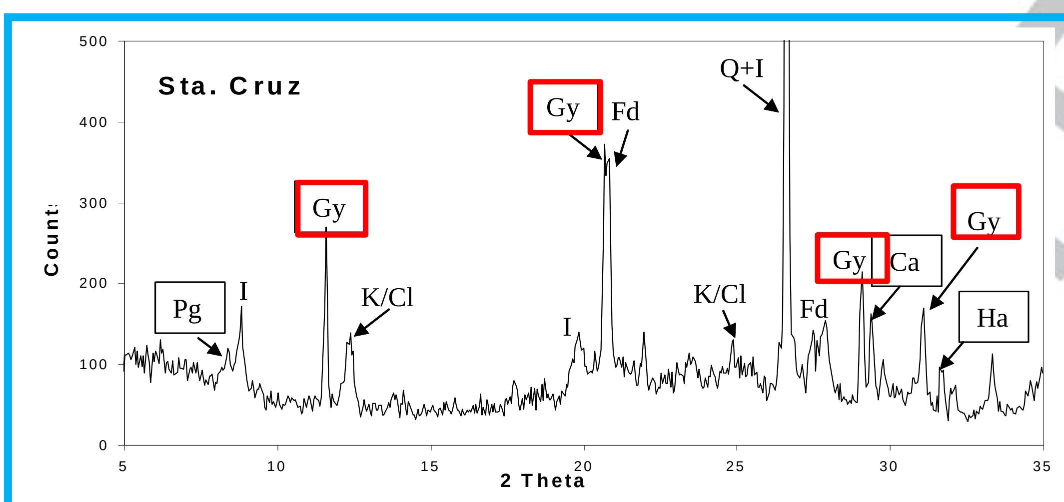
Moreno et al., 2008, Atmos Ennv.

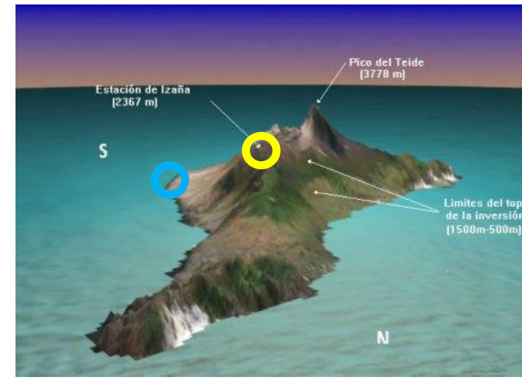
PM composition during dust episodes

Mineralogical characterisation by XRD

Alastuey et al., 2004. Atmospheric Environment







Fd:	Feldspars
Ca:	Calcite
Q:	Quartz
Ha:	Halite
Gy:	Gypsum
Ms:	Mascagnite
Clays	
Pg:	Palygorskite
I:	Illite
K:	Kaolinite
Cl:	Clinochlore

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PM composition during dust episodes

1996-1997, Fungi and bacteria from Africa to the Caribbean with soil dust

Prospero et al., 2005, Aerobiologia

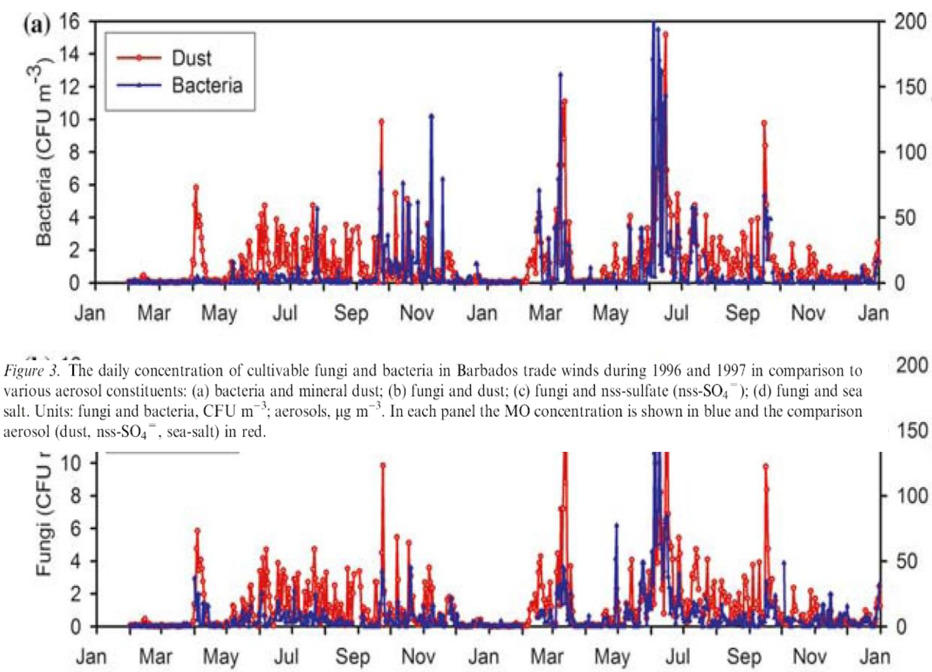
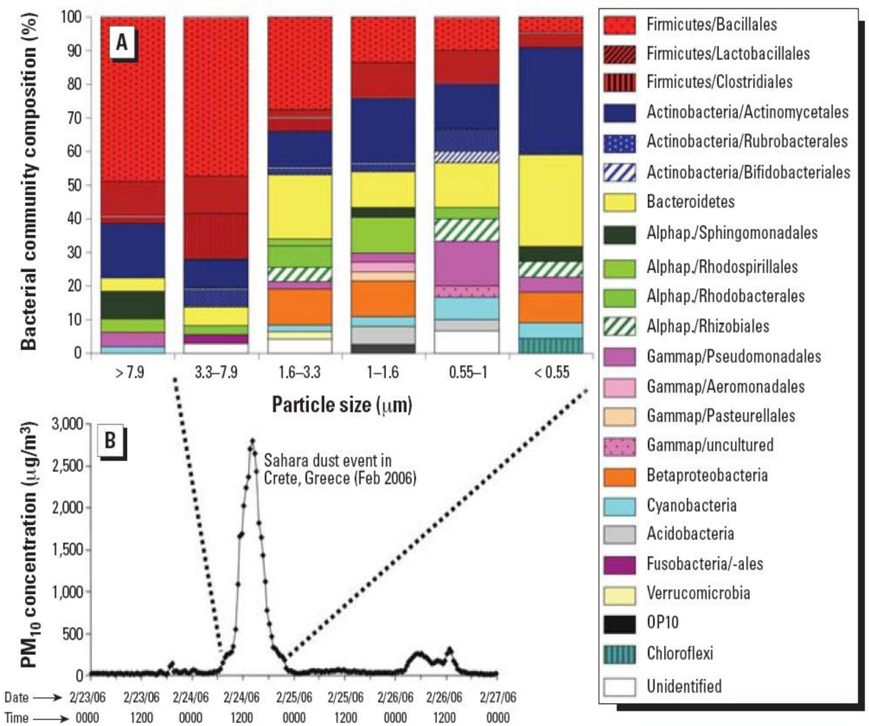


Figure 3. The daily concentration of cultivable fungi and bacteria in Barbados trade winds during 1996 and 1997 in comparison to various aerosol constituents: (a) bacteria and mineral dust; (b) fungi and dust; (c) fungi and nss-sulfate (nss-$SO_4^{=}$); (d) fungi and sea salt. Units: fungi and bacteria, CFU m^{-3}; aerosols, μg m^{-3}. In each panel the MO concentration is shown in blue and the comparison aerosol (dust, nss-$SO_4^{=}$, sea-salt) in red.

Microorganisms and pathogens from Africa to the Eastern Mediterranean, 24-26/02/2006

Polymenakou P.N. et al., 2008, Environmental Health Prespectives

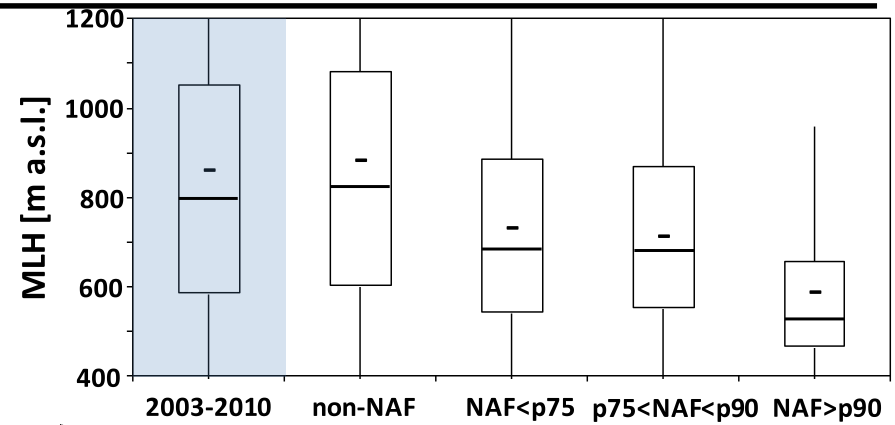


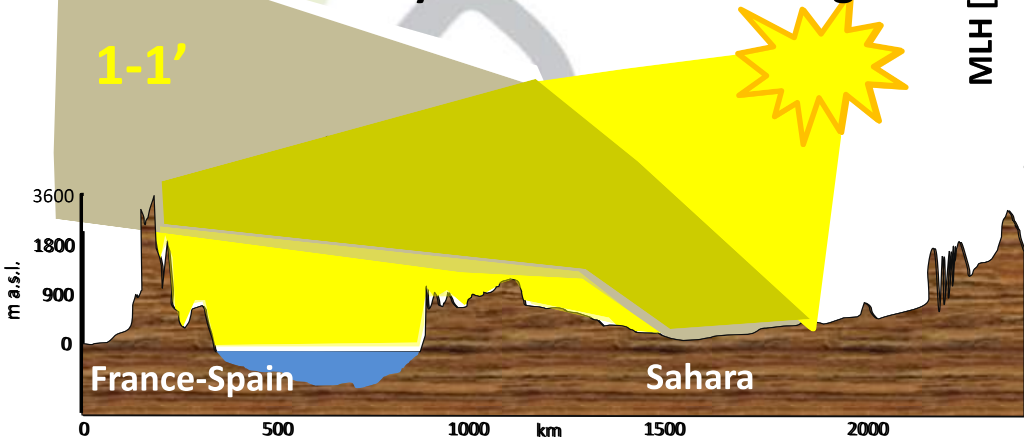
igure 2. Analysis of dust particles from the Sahara dust event by bacterial community composition and by PM_{10} concentration at different time points. (*A*) Bacterial community composition in particles of different sizes. (*B*) PM_{10} concentrations during the Sahara dust event. Abbreviations: Alphap., Alphaproteobacteria; Gammap, Gammaproteobacteria.

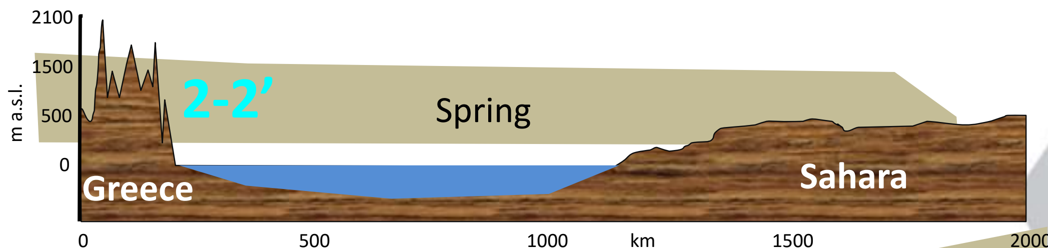
PM composition during dust episodes

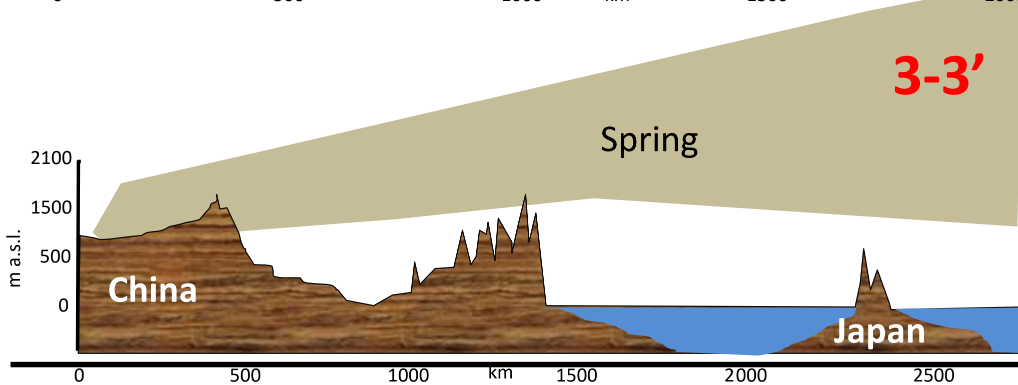
Pandolfi et al., 2014, STOTEN

BARCELONA 2003 – 2010: 2513 MLH days from radiosounding









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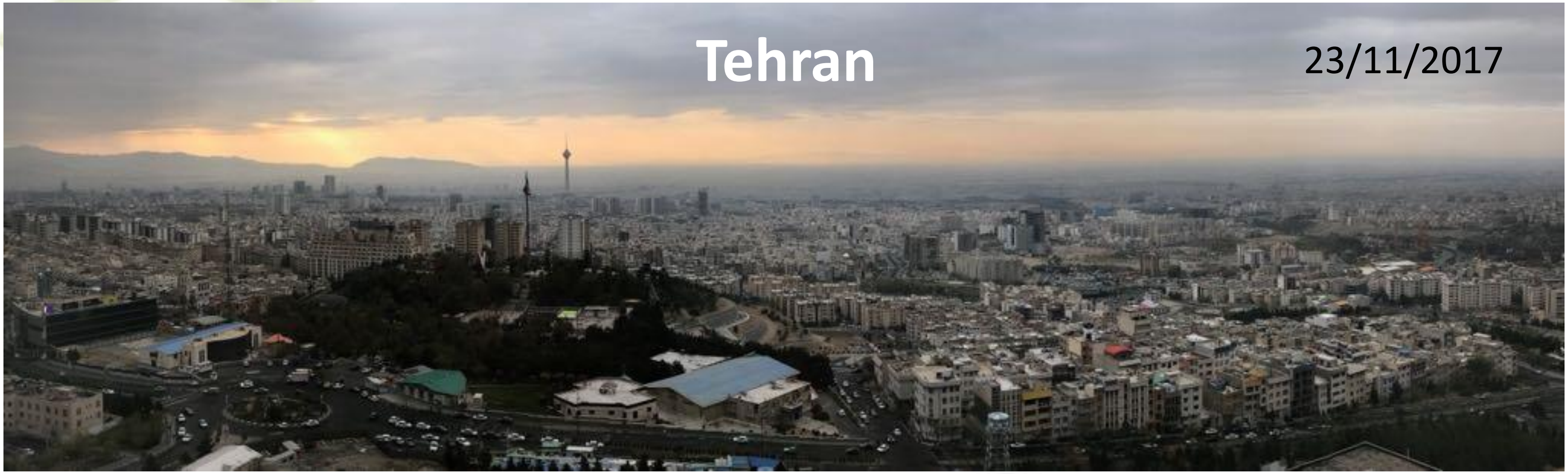
PM composition during dust episodes

Querol X., et al., 20219 Environment International

Increased PM concentrations during dust outbreaks

- Obviously the transport of mineral matter from desert dust
- The co-transport of anthropogenic pollutants with dust, both emitted at the source areas or entrained during dust transport
- The accumulation of locally emitted anthropogenic PM pollutants by:
  - A relatively thin mixing layer height accumulate local pollutants
  - Dust favouring the formation of secondary pollutants (such as nssSO_4^{2-})
  - Because frequency is higher in spring/summer: higher secondary PM pollutants
- Considering also bioaerosols
- These might strongly vary from one region to other

Impact of dust outbreaks on air quality



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Impact of dust outbreaks on air quality

- PM10 and PM2.5 vary widely during desert dust episodes according the regions and episodes in the same region
- PM size might also vary a lot

Mori et al., 2003 (TSP)	up to 6700 µg/m³	8h	Inner Mongolia (China)
	up to 1500 µg/m³	6h	Beijing (China) 95% coarse
	up to 230 µg/m³	24h	Japan remote island 64% coarse
Aryal R, 2012 (PM10)	up to 11800 µg/m³	1h	Sydney, Australia
Krasnov H, et al., 2014 (PM10)	up to 2000 µg/m³	24h	Beer-Sheva, Negev, Israel
Viana et al., 2002 (PM10)	up to 675 µg/m³	24h	Canary Islands, Spain
Sotoudeheian et al., 2016 (PM10)	up to 650 µg/m³	24h	Central Iran cities
Achilleos et al., 2014 (PM10)	up to 470 µg/m³	24 h	Nicosia, Cyprus
Querol et al., 2009 (PM10)	up to 250 µ/m³	24h	Mainland Spain remote sites

Querol et al., 1998, Spain — **1 yr: PM10 exceedances can be largely attributed to dust outbreaks**

Querol et al., 2009; Pey et al., 2011: Mediterranean region

17 to 37% of the days are affected by dust transport
9 to 43% of the annual ambient PM10 levels at remote sites
1 to 8 µg/m³ of the annual PM10 averages
25-30%. of dust days receive daily dust of 25 µg/m³ in PM10
10% in Northwestern Mediterranean

Krasnov H,et al., 2014: Beer Sheva, Israel

10% of the dust days exceed 71 µg/m³ PM10
122 µg/m³ PM10 daily net dust to PM10 during dust days

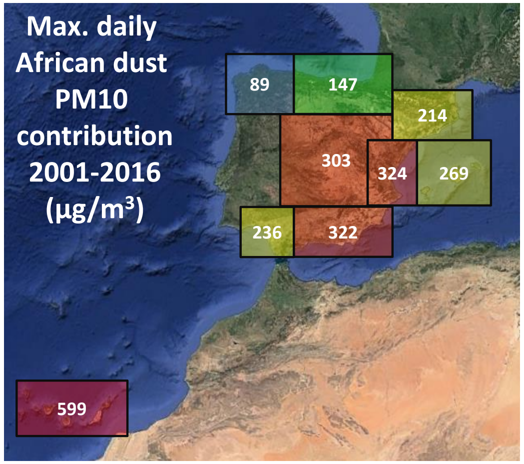
Prospero et al., 2005: Barbados

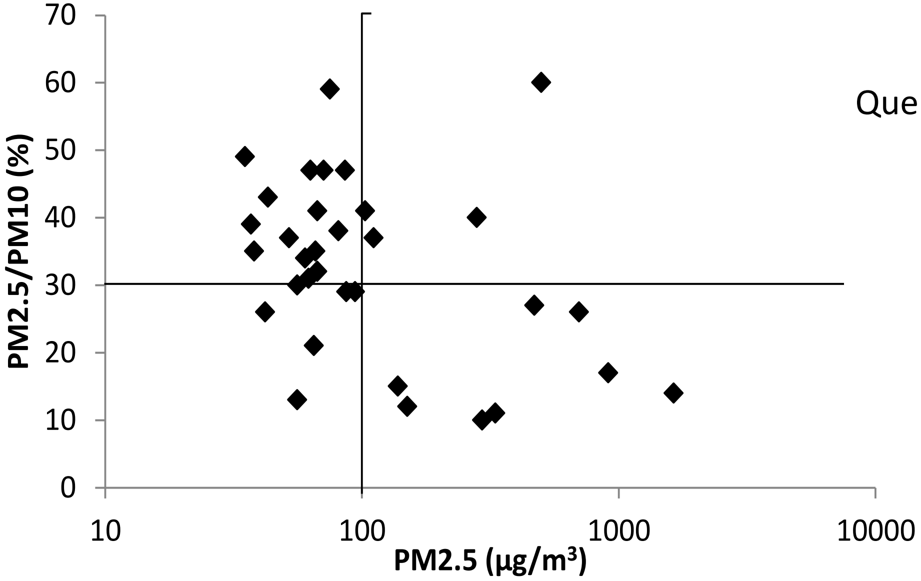
35 days recorded dust contributions >50 µg/m³, 7 days >100 µg/m³.

Impact of dust outbreaks on air quality

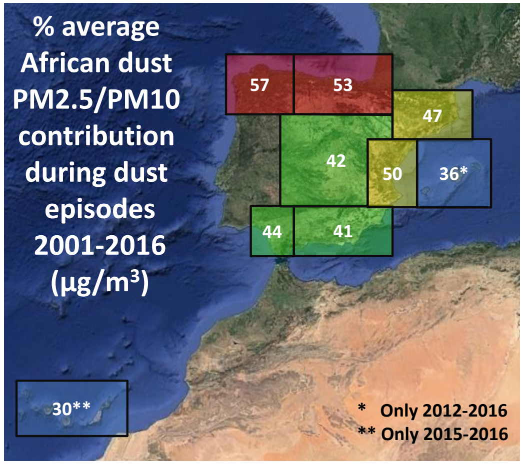
Goudie A.S. , 2014. Env Int 63:101–13

Region	PM10 mg/m3	PM2.5 mg/m3
Southern Europe	150-2,500	43-86
Eastern Asia	134-3,006	63-700
Australia	266-15,366	
Western Africa	312-5,000	42-1,368
North America	123-65,112	
Midde the East	700-5,619	





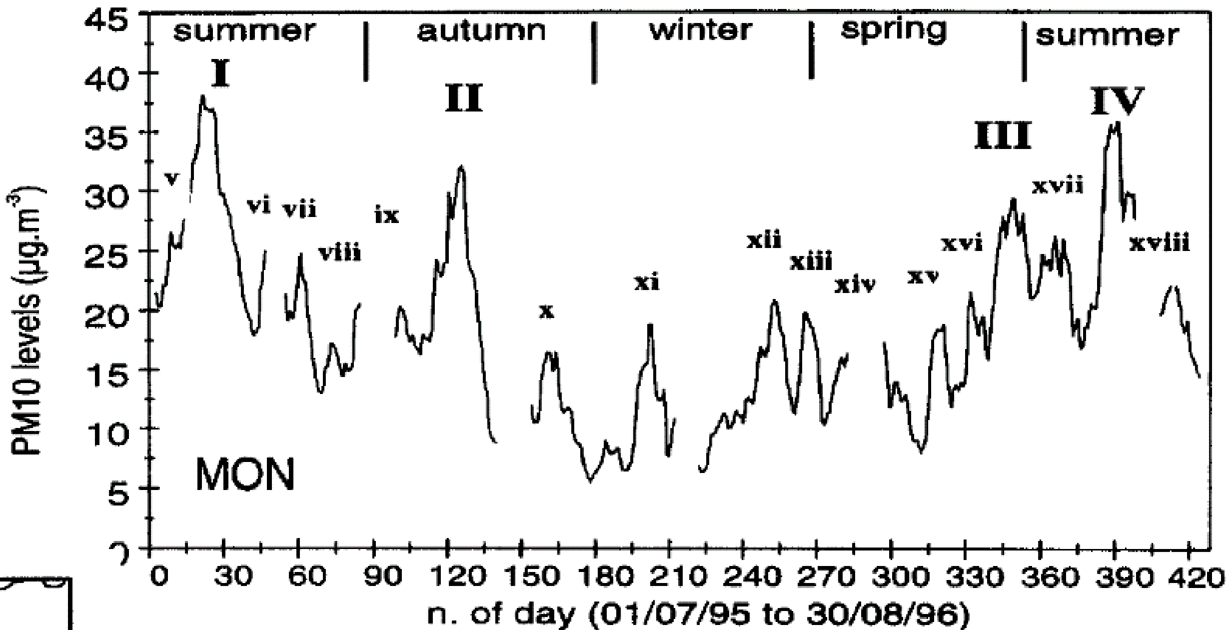
Querol et al., 2019, STOTEN



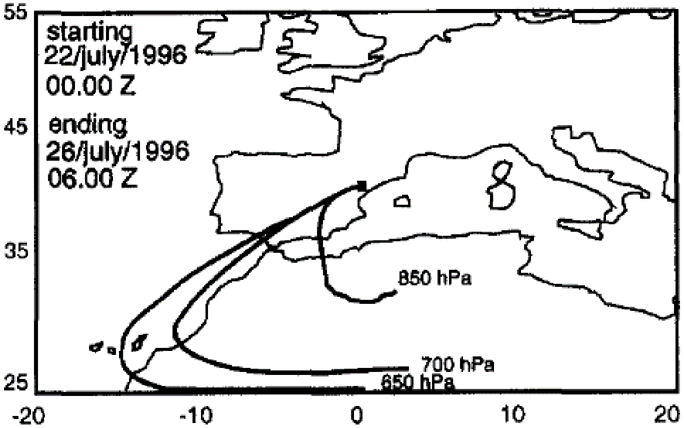
Data obtained from:

- *Goudie A.S., 2014; max. conc. over the world,*
- *Jayaratne et al.* (79) *dust storm in Brisbane,*
- *Engelbrecht et al.* (73) *annual mean conc. Middle East*

Impact of dust outbreaks on air quality



Querol et al., 1998a, Atmos. Environ.



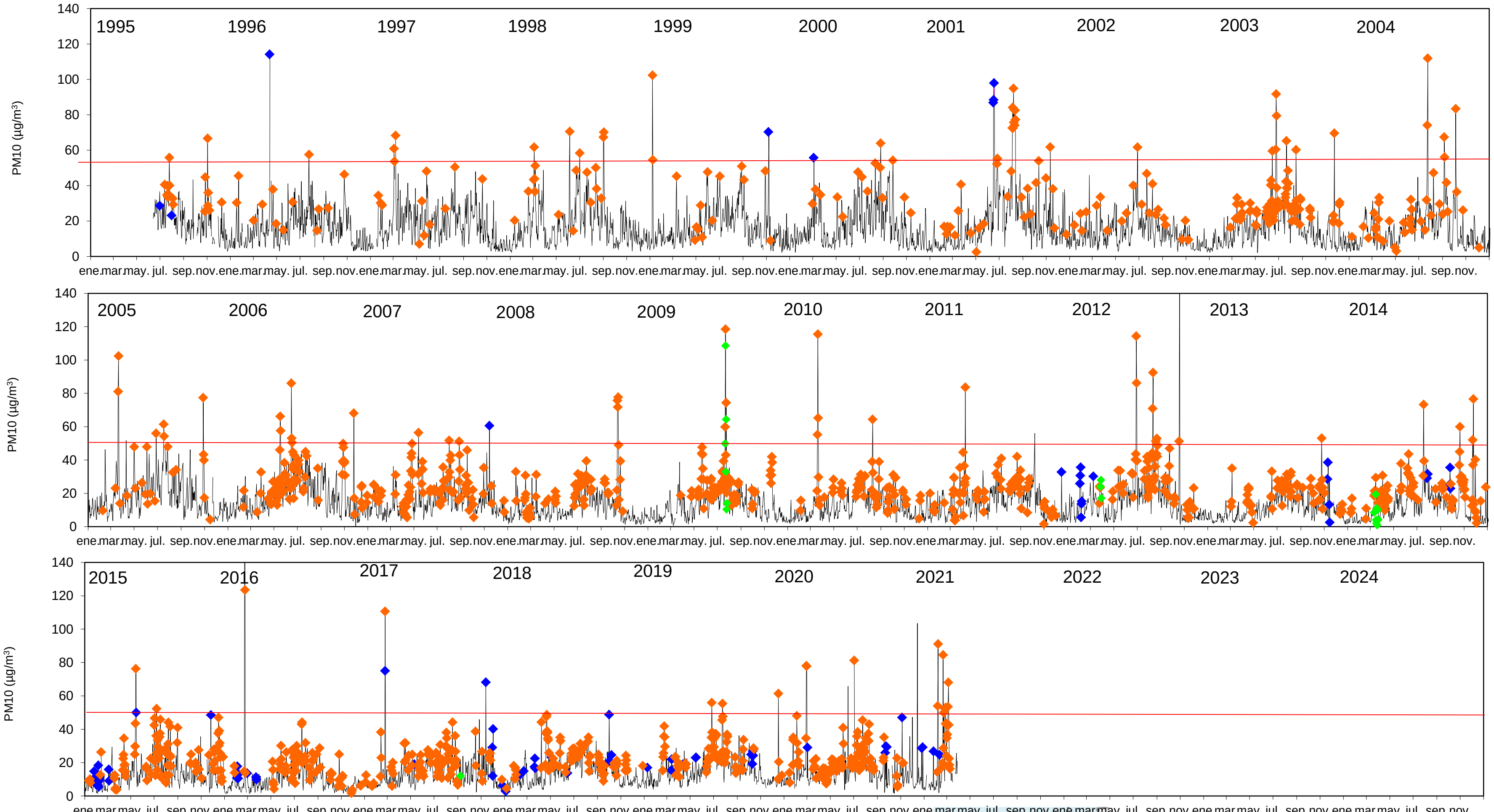
PM10 EU AQ standards can not be attained (in rural areas NE Spain) due to African dust outbreaks

Basis of including dust episodes in 1999/30/CE

Impact of dust outbreaks on air quality

African dust, regional background NE Spain

Daily PM10 (µg/m³)



Daily limit value PM_{10} 2008/50/CE (50 µg m^{-3})

97 out of 110 exceedances registered in near 26 years are caused by African dust outbreaks

- **African dust outbreaks**
- **Local dust from Monegros**
- **Forest fires**

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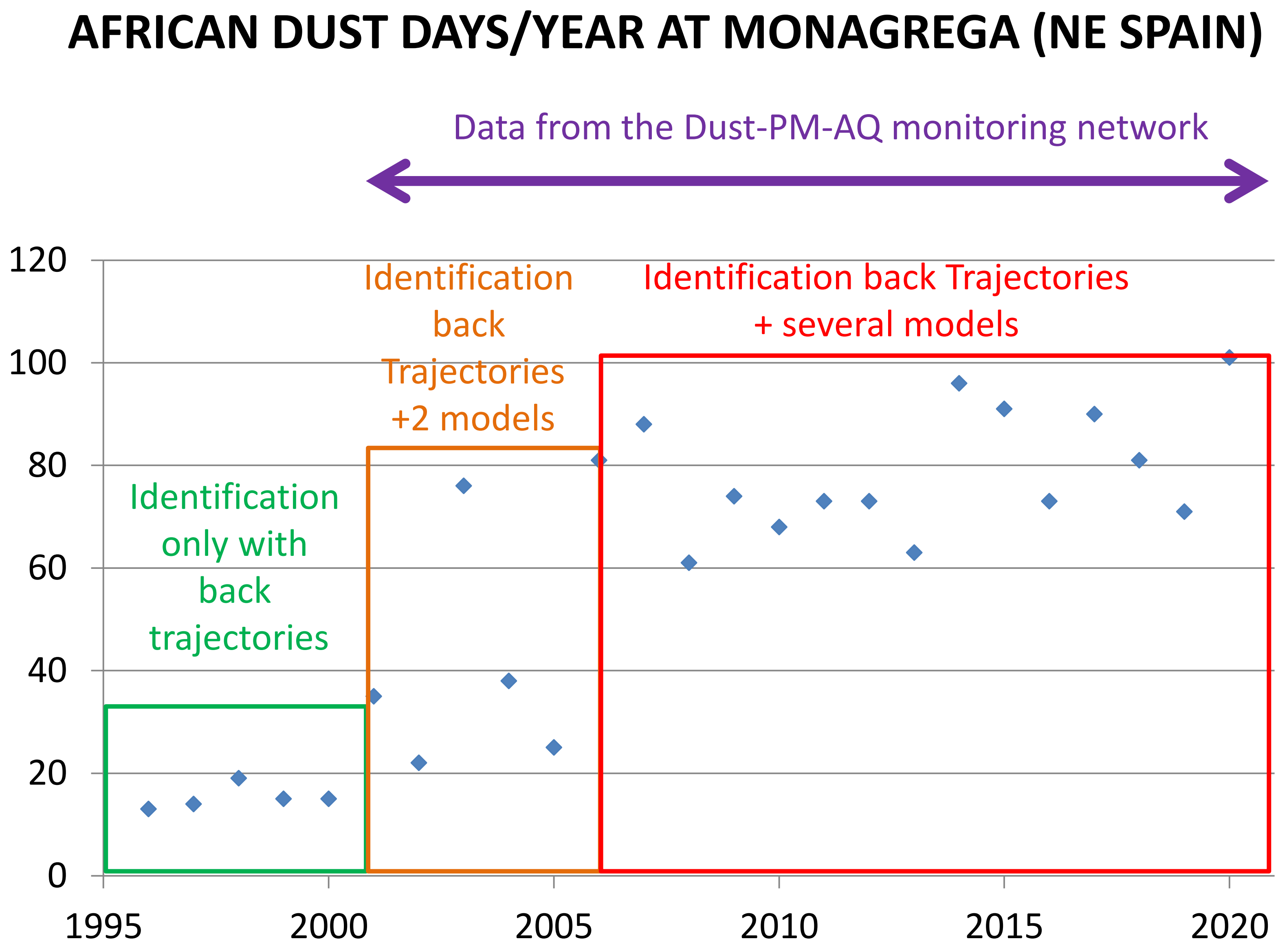

AFRICAN DUST DAYS/YEAR AT MONAGREGA (NE SPAIN)
Data from the Dust-PM-AQ monitoring network
Identification only with back trajectories
Identification back Trajectories +2 models
Identification back Trajectories + several models
0
20
40
60
80
100
120
1995
2000
2005
2010
2015
2020

Method to quantify dust and anthropogenic PM

http://ec.europa.eu/environment/air/quality/legislation/pdf/sec_2011_0208.pdf

EUROPEAN COMMISSION

Brussels, 15.02.2011
SEC(2011) 208 final

COMMISSION STAFF WORKING PAPER

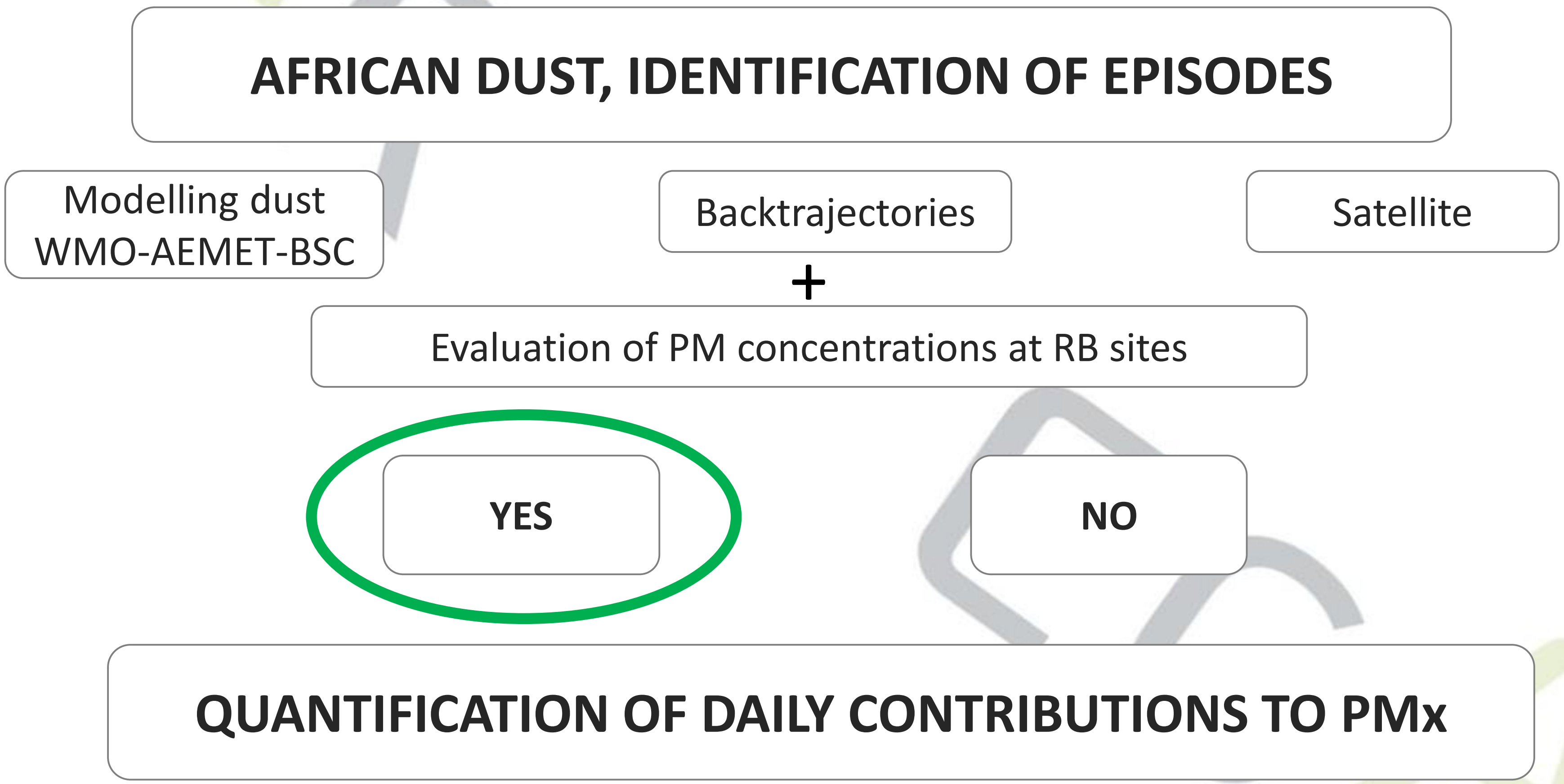
establishing guidelines for demonstration and subtraction of exceedances attributable to natural sources under the Directive 2008/50/EC on ambient air quality and cleaner air for Europe

4.1. Methodology for the determination of re-suspended and transported Saharan dust

The following describes a procedure to determine the African origin of the exceedances of the daily mean concentration of 50µg/m^3. The procedure is based on a method developed in Spain and Portugal (Querol et al., 2006) for application in both countries[10]. It focuses on the daily limit value; discounting the contributions by re-suspended and transported natural Saharan dust episodes in the calculation of the annual average of PM_{10} may however also have a

Method to quantify dust and anthropogenic PM

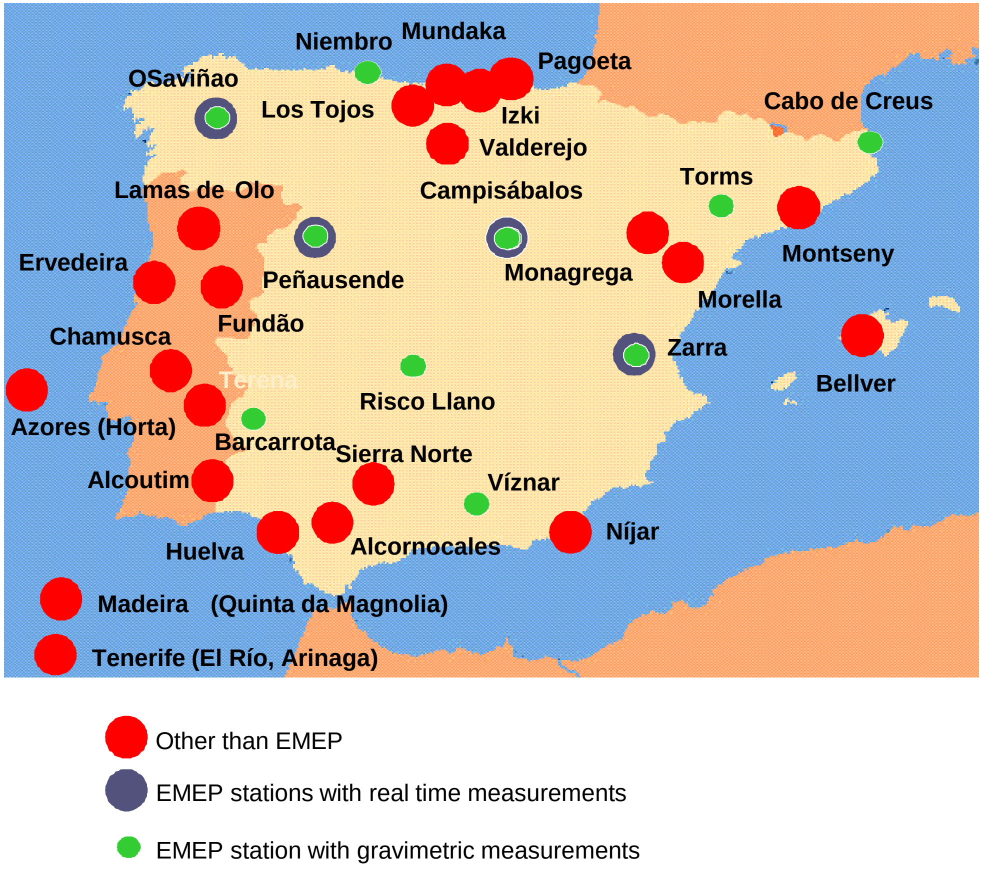
The percentile method

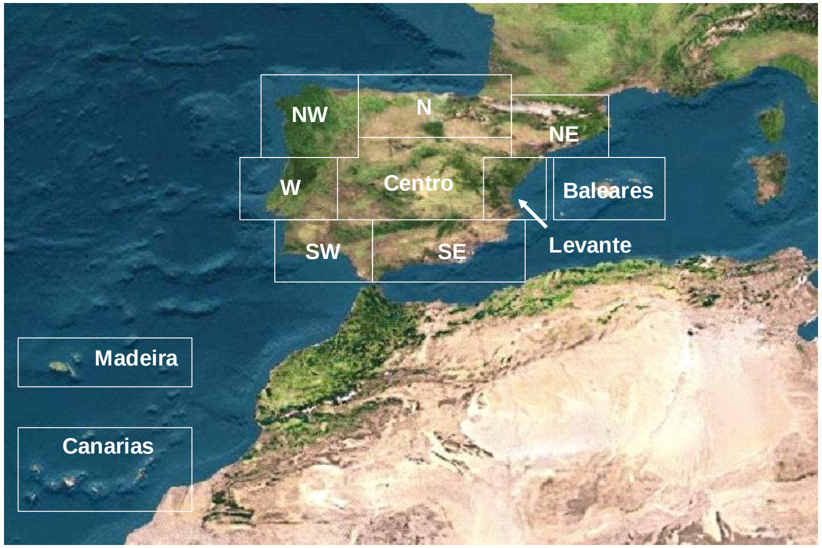


Method to quantify dust and anthropogenic PM

Reporting on episodes

Impact on surface PMx concentrations: experimental





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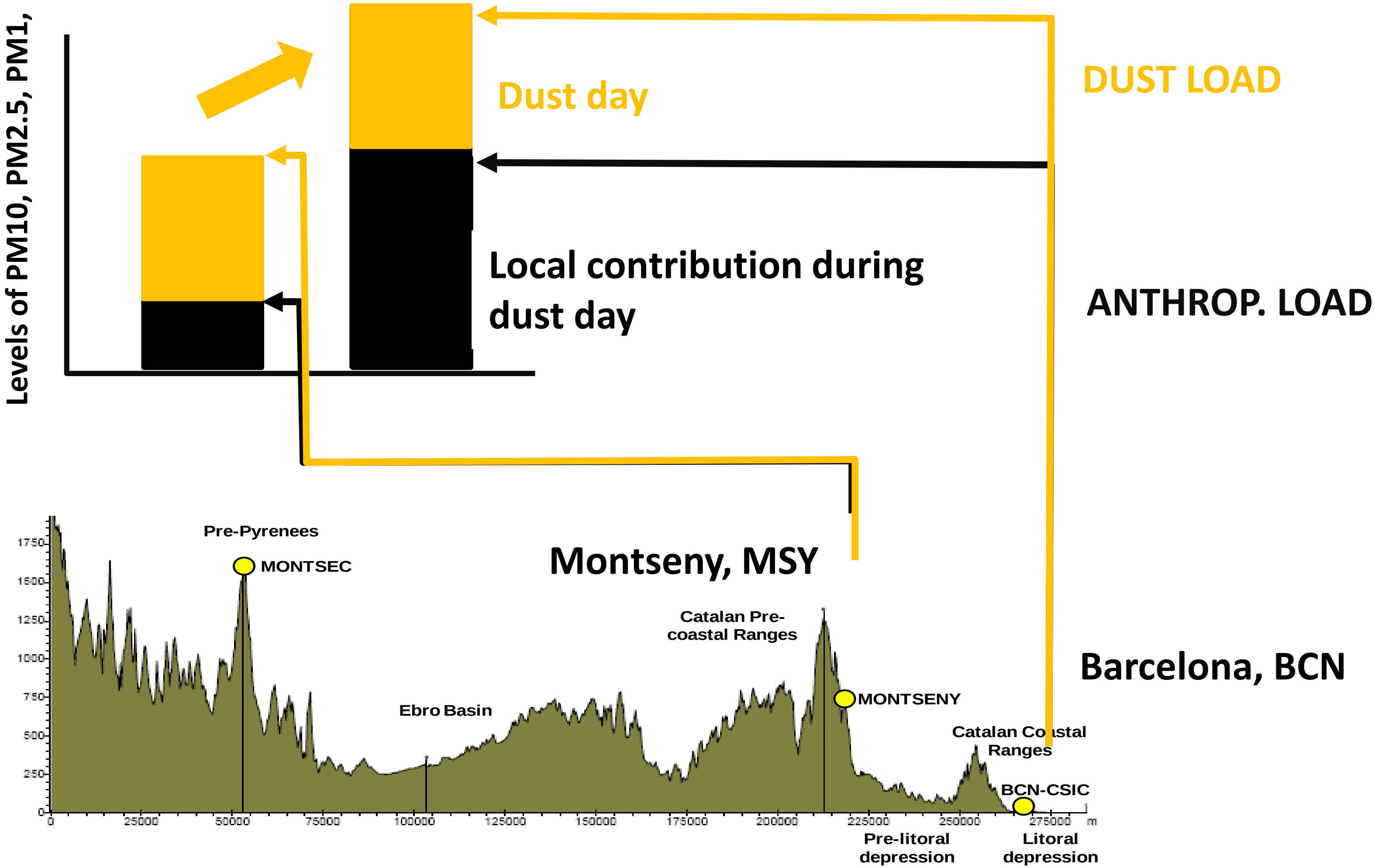
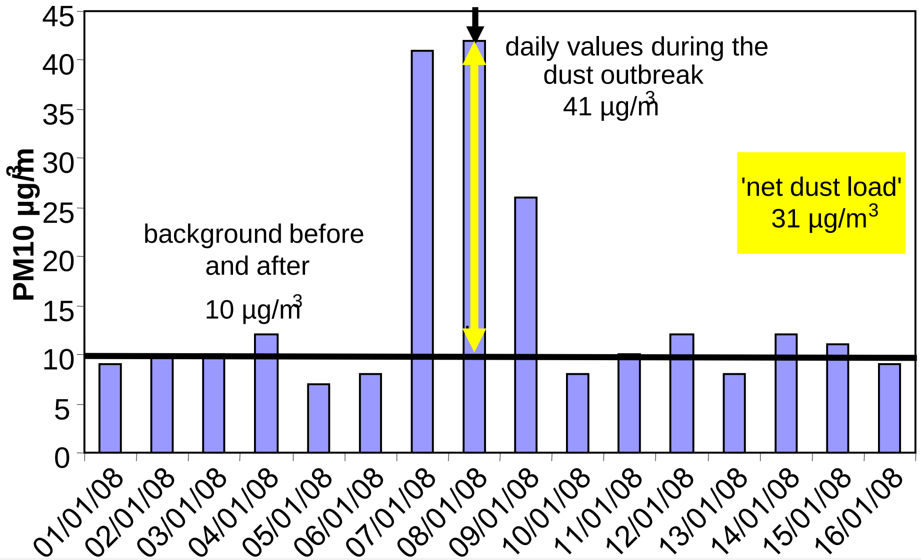
Method to quantify dust and anthropogenic PM

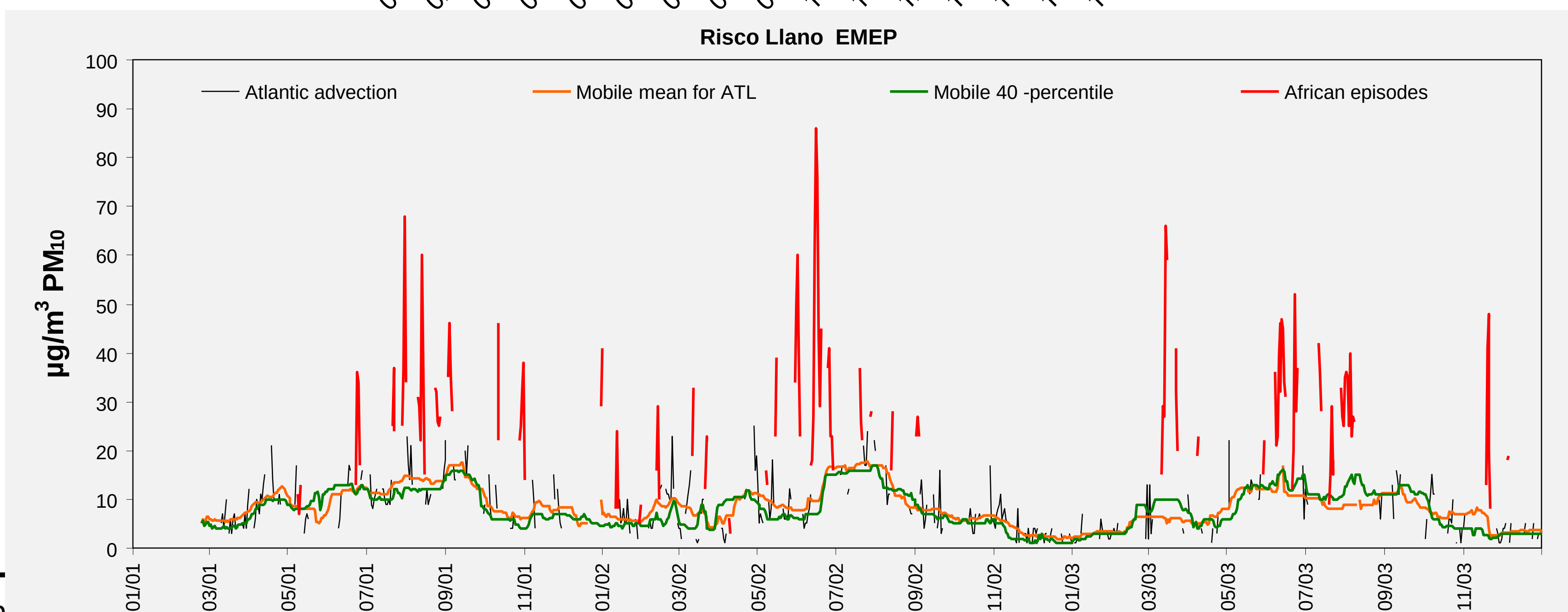


- Hourly UFP, BC, PM10, PM2.5 and PM1 2009-2016 simultaneously
- 1/3 day sampling and speciation PM10, PM2.5 and PM1

Method to quantify dust and anthropogenic PM

The quantitative approach

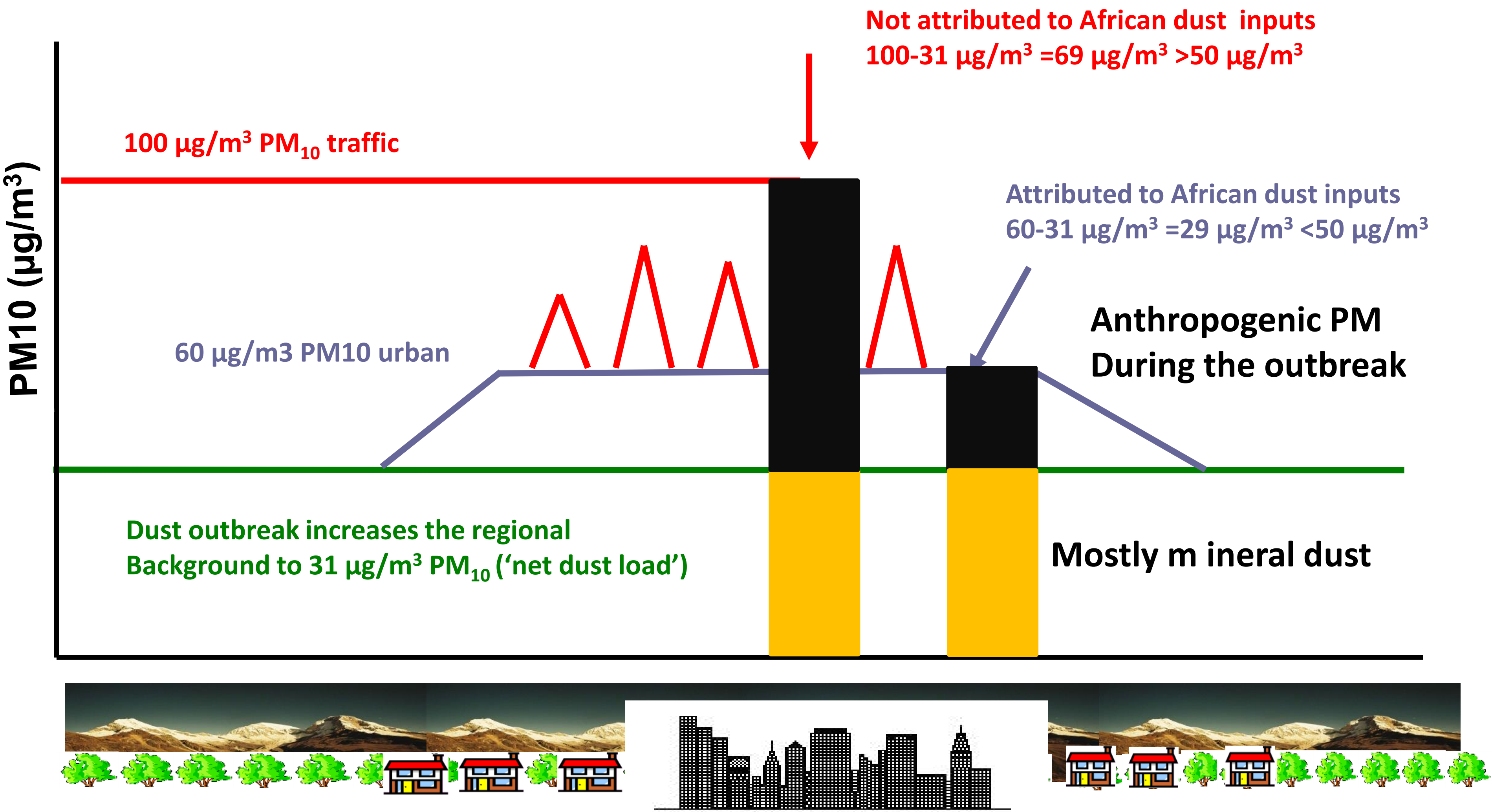




Method to quantify dust and anthropogenic PM

Determining the anthropogenic and natural contributions to PM in an urban site

EXAMPLE



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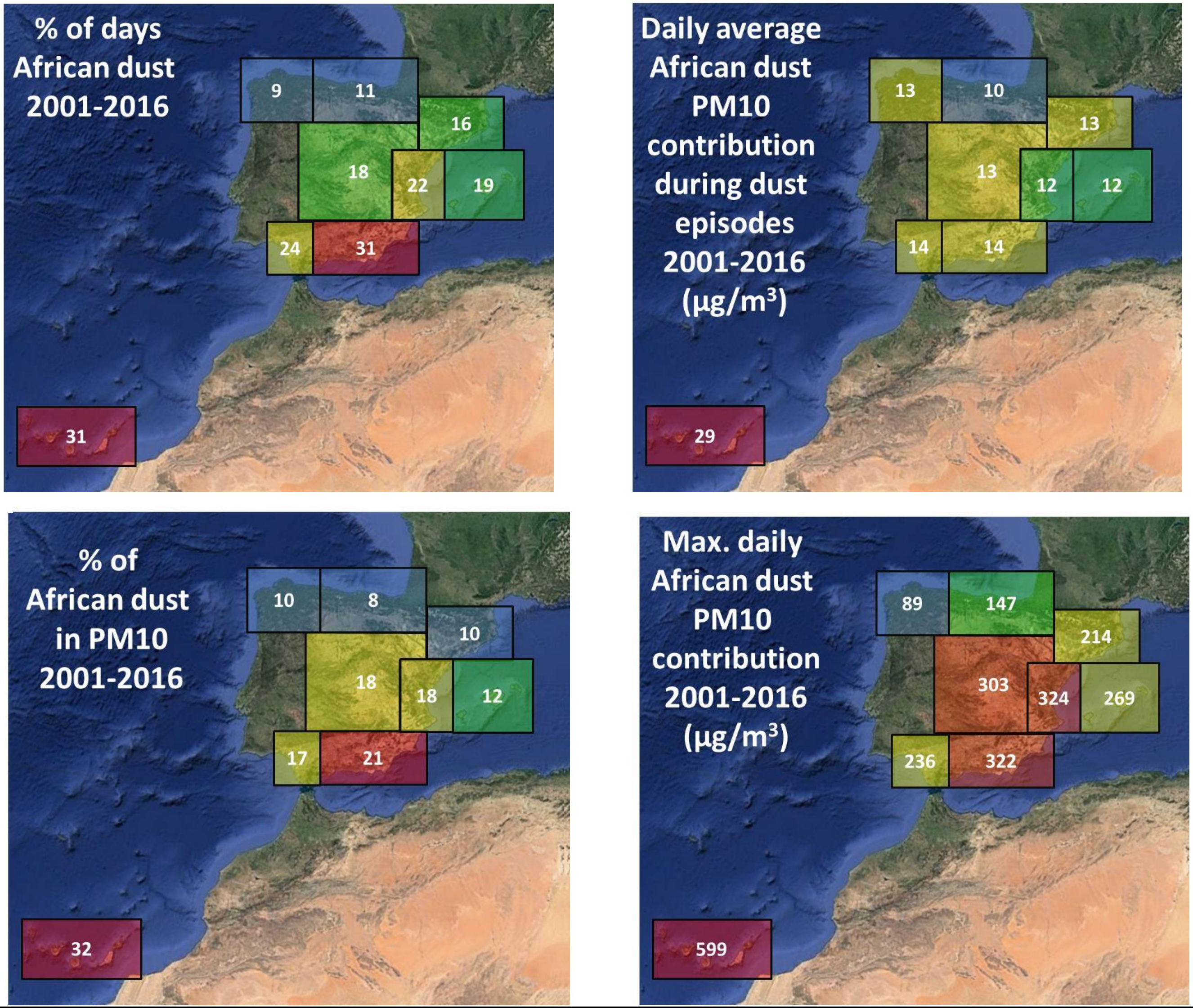
Method to quantify dust and anthropogenic PM

Querol et al., 2019, STOTEN



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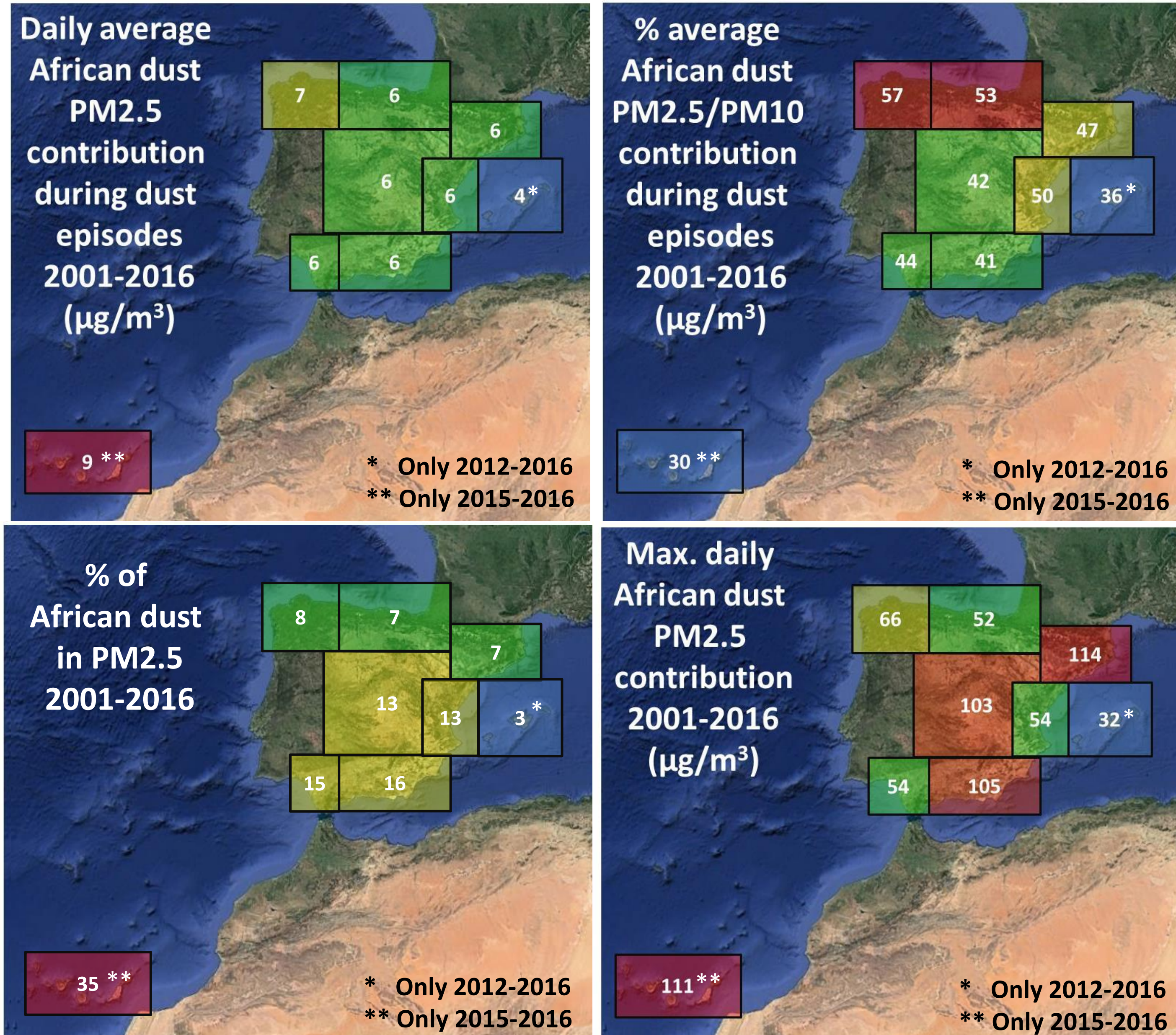
Method to quantify dust and anthropogenic PM

Querol et al., 2019, STOTEN



Health effects of desert dust in Europe

No long term effects available!!!!!

Short-term effects on mortality

Tobías A. et al BMJ, 2019

		African dust as effect modiffier of								As risk exposure
		$PM_{10-2.5}$	PM_{10}	$PM_{10-2.5}$	PM_{10}	$PM_{10-2.5}$	PM_{10}	$PM_{10-2.5}$	PM_{10}	
City (C.)	(Yr. Pub.)	All natural		CVD/Circ.		Cerebrovascular		Respiratory		Respiratory
Barcelona (SP)	(2008, 2012)	✓		✓	✓	✗		✗		
Madrid (SP)	(2010, 2012)	✓	✓		✓				✗	
Rome (IT)	(2011)	✓	✓	✓	✓	✗	✗	✗	✗	
Emilia-Romagna (IT)	(2011)		✗		✗				✗	✓
Athens (GR)	(2011)		✗		✗				✗	
Nicosia (CY)	(2013)		✗		✓				✗	

Divergence of results because:

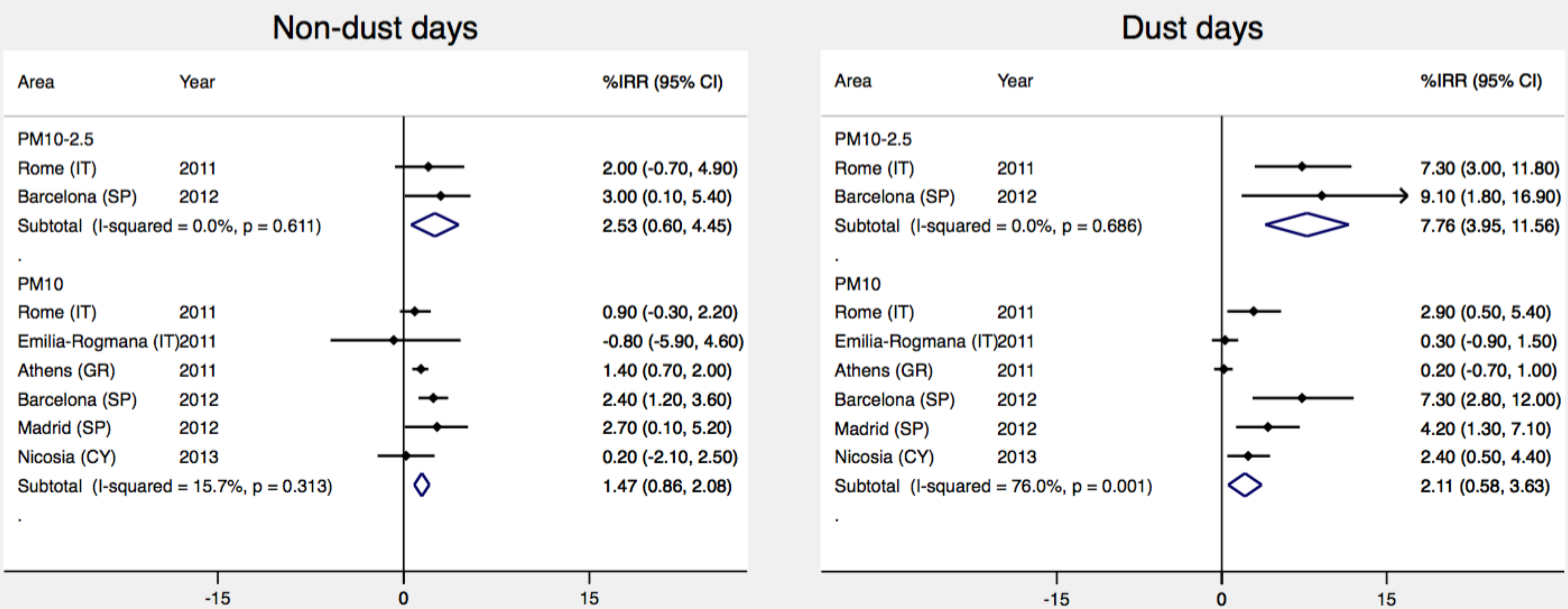
- **Different methods for exposure to dust were used**
- **Different phenomenology of dust episodes**

Health effects of desert dust in Europe

Short-term effects on mortality

Tobías A. et al BMJ, 2019

Meta-analysis of published risks of cardiovascular mortality for an increase of 10 μg/m^3 PM during Saharan and non-Saharan dust days in Southern Europe



Health effects of desert dust in Barcelona

Data for Barcelona 2003-2004

Pérez L., et al (2008)Epidemiology: November 2008 - Volume 19 - Issue 6 - p 800-807

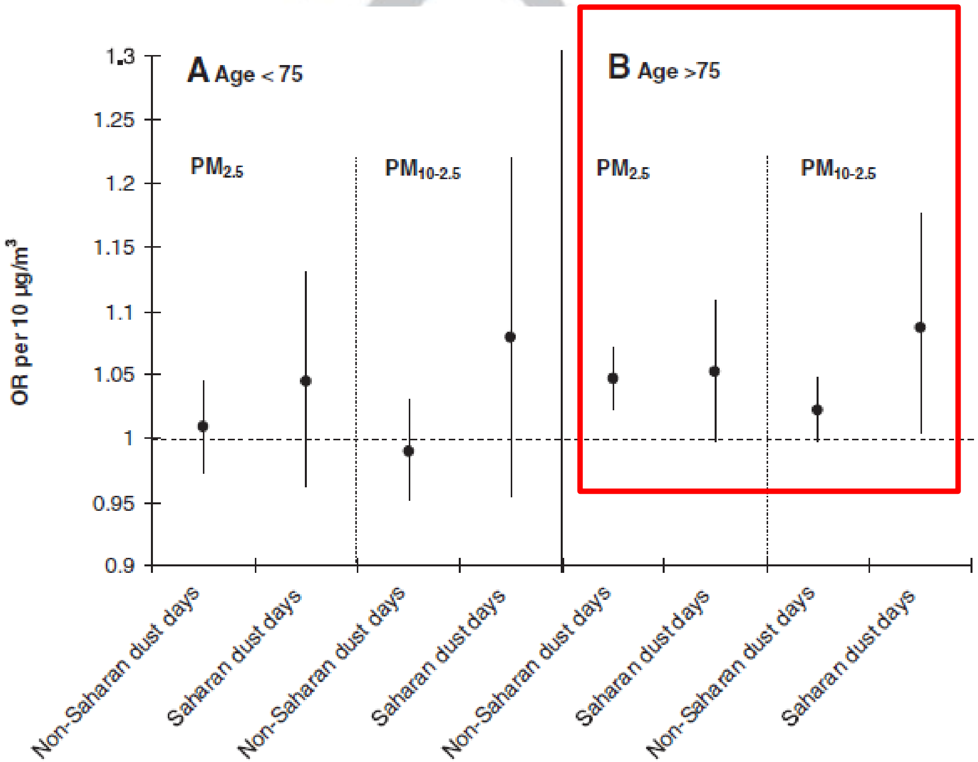


TABLE 2. Odds Ratio for the Association of Daily Exposure to $PM_{2.5}$ and $PM_{10-2.5}$ With Total Mortality, With Effect Modification by Age and Saharan Dust Days (Lag 1)

	OR per 10 $\mu g/m^3$ (95% CI)	
Variables	$PM_{2.5}$	$PM_{10-2.5}$
All	1.032 (1.015, 1.05)	1.016 (0.996, 1.036)
By age (yrs)		
<75	1.015 (0.983, 1.049)	0.996 (0.96, 1.033)
>75	1.049 (1.027, 1.071)	1.019 (0.995, 1.043)
P for interaction	0.10	0.31
By Saharan dust days		
Non-Saharan dust days	1.035 (1.016, 1.055)	1.013 (0.992, 1.034)
Saharan dust days	1.05 (1.005, 1.097)	1.084 (1.015, 1.158)
P for interaction	0.56	0.05
By age (years) and Saharan dust days		
<75		
Non-Saharan dust days	1.009 (0.973, 1.045)	0.99 (0.952, 1.03)
Saharan dust days	1.044 (0.963, 1.131)	1.079 (0.954, 1.219)
P for interaction	0.44	0.19
>75		
Non-Saharan dust days	1.047 (1.023, 1.071)	1.022 (0.997, 1.048)
Saharan dust days	1.052 (0.998, 1.108)	1.087 (1.005, 1.176)
P for interaction	0.86	0.14

All models adjusted for flu week, holiday, 2003 heat wave period, and 4-day average temperature and humidity.

Two-pollutant model. Additionally adjusted by the other particle size.

Health effects of desert dust in Barcelona

Data for Barcelona 2003-2007

Pérez L., et al., 2012. Environment International 48 (2012) 150–155

Table 2
Odds ratio (OR) for an increase by interquartile range (IQR) of particulate matter fractions, and its 95% confidence interval (95% CI), for the association with cause-specific mortality during Saharan and non-dust days.

Models	Mortality	Non-Saharan dust days IQR	OR	(95% CI)	Saharan dust days IQR	OR	(95% CI)	p for interaction
Single pollutant	Cardiovascular (lag 1)							
	PM_1	11.6	1.030	(1.006, 1.054)*	8.7	1.036	(0.972, 1.105)	0.6804
	$PM_{2.5-1}$	5.3	1.055	(1.023, 1.089)*	7.0	1.093	(1.018, 1.173)*	0.6433
	$PM_{10-2.5}$	11.0	1.041	(1.018, 1.066)*	9.4	1.097	(1.029, 1.169)*	0.0814
	Respiratory (lag 2)							
	PM_1	11.6	1.032	(0.993, 1.072)	8.7	1.017	(0.920, 1.125)	0.9036
	$PM_{2.5-1}$	5.3	1.067	(1.011, 1.126)*	7.0	1.110	(0.983, 1.254)**	0.7737
	$PM_{10-2.5}$	11.0	1.053	(1.014, 1.094)*	9.4	1.033	(0.923, 1.156)	0.8361
	Cerebrovascular (lag 1)	11.6	1.030	(0.983, 1.079)	8.7	1.046	(0.929, 1.178)	0.7079
	PM_1	11.6	1.030	(0.983, 1.079)	8.7	1.046	(0.929, 1.178)	0.7079
	$PM_{2.5-1}$	5.3	1.049	(0.987, 1.116)	7.0	1.002	(0.871, 1.153)	0.4385
	$PM_{10-2.5}$	11.0	1.039	(0.993, 1.087)**	9.4	1.081	(0.959, 1.219)	0.4698
Three pollutants	Cardiovascular (lag 1)							
	PM_1	11.6	1.018	(0.992, 1.044)	8.7	1.029	(0.964, 1.099)	0.6460
	$PM_{2.5-1}$	5.3	1.024	(0.985, 1.064)	7.0	1.074	(0.998, 1.156)**	0.3478
	$PM_{10-2.5}$	11.0	1.033	(1.006, 1.060)*	9.4	1.085	(1.017, 1.158)*	0.1111
	Respiratory (lag 2)							
	PM_1	11.6	1.019	(0.977, 1.062)	8.7	0.992	(0.895, 1.101)	0.6844
	$PM_{2.5-1}$	5.3	1.029	(0.965, 1.098)	7.0	1.109	(0.978, 1.257)**	0.3687
	$PM_{10-2.5}$	11.0	1.044	(1.001, 1.089)*	9.4	1.010	(0.901, 1.133)	0.6596
	Cerebrovascular (lag 1)							
	PM_1	11.6	1.020	(0.969, 1.074)	8.7	1.052	(0.931, 1.189)	0.5693
	$PM_{2.5-1}$	5.3	1.016	(0.942, 1.097)	7.0	0.982	(0.849, 1.135)	0.6397
	$PM_{10-2.5}$	11.0	1.030	(0.978, 1.084)	9.4	1.087	(0.961, 1.229)	0.3714

* $p<0.05$.
** $p<0.1$.

Health effects of desert dust in Barcelona

Data for Barcelona 2003-2007 KEY FINDINGS FOR US!!!!!!!

Pérez et al., Epidemiology, 2012

Epidemiology • Volume 23, Number 5, September 2012

TABLE. Levels of PM_{10} and Percentage Increase in Risk of Cardiovascular Mortality 10 $\mu g/m^3$ During Non-Saharan Dust Days (Contributing Total PM_{10} Levels) and Saharan Dust Days (Contributing Local and Saharan Contributions to PM_{10} Levels)

	Mean (sd)	Minimum	Percentiles 25	Percentiles 50	Percentiles 75	Maximum	Short-term Effects Lag	Short-term Effects %IR (95% CI)
Non-Saharan dust days (n = 1317)								
PM_{10}	38.6 (15.7)	7.0	27.0	35.9	47.1	107.6	Lag 0	1.1 (−0.1 to 2.4)
							Lag 1	2.8 (1.6 to 4.1)
							Lag 2	1.7 (0.5 to 2.9)
							Lag 3	0.3 (−0.9 to 1.6)
Saharan dust days (n = 145)								
Local contributions to PM_{10}	27.7 (10.7)	0.0	20.6	27.5	34.6	53.0	Lag 0	4.9 (−0.3 to 10.3)
							Lag 1	9.7 (4.3 to 15.3)
							Lag 2	6.3 (1.1 to 11.8)
							Lag 3	7.3 (2.0 to 12.8)
Saharan contributions to PM_{10}	16.5 (12.0)	0.0	8.0	13.0	23.0	57.0	Lag 0	3.0 (−1.5 to 7.6)
							Lag 1	4.0 (−0.4 to 8.7)
							Lag 2	2.2 (−2.2 to 6.8)
							Lag 3	3.5 (−1.0 to 8.1)

Local PM_{10} during non-NAF days

Local PM_{10} during NAF days

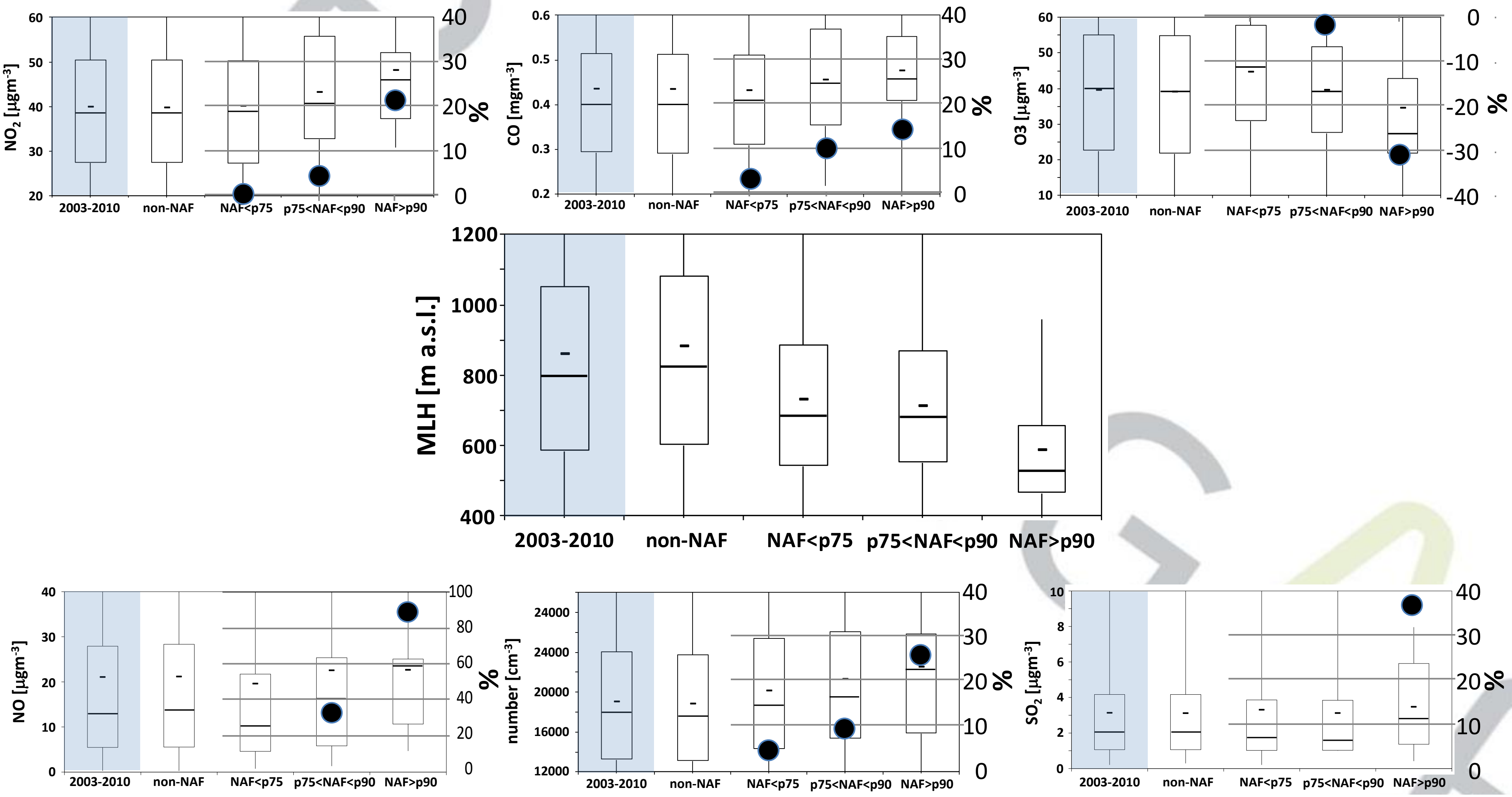
Sahara PM_{10} during NAF days

Health effects of desert dust in Barcelona

Pandolfi et al., 2014, STOTEN

BARCELONA 2003 – 2010: 2513 MLH days from radiosounding at 12:00 UTC

- Effects of Saharan dust outbreaks on MLH
- Effects of MLH oscillation on air quality during Saharan dust outbreaks

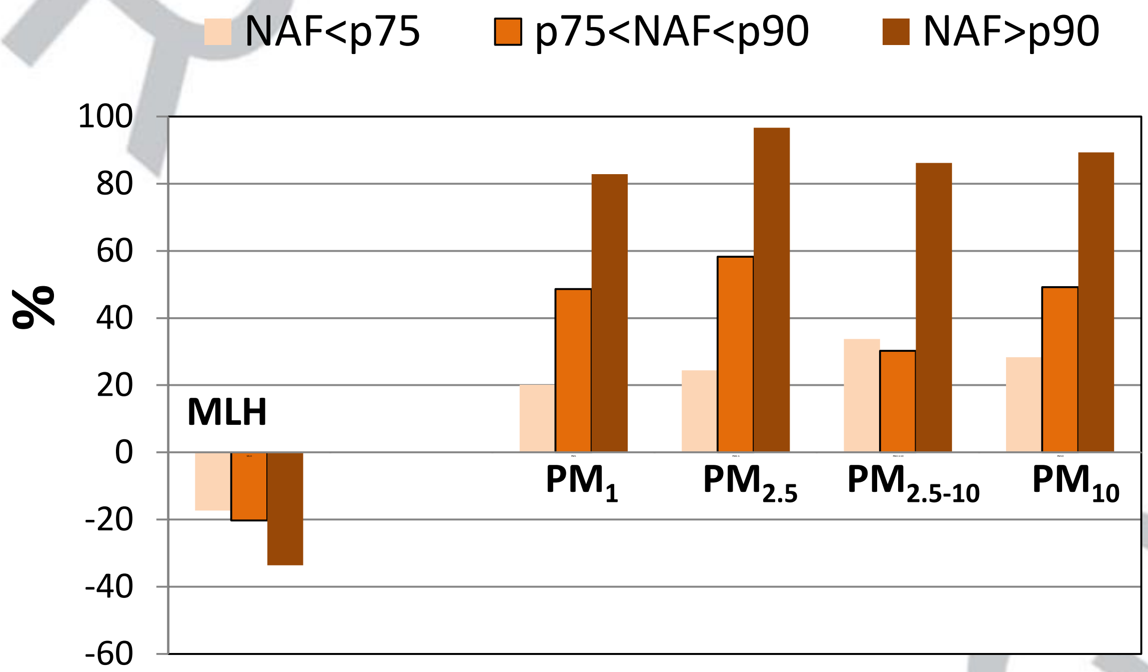


Health effects of desert dust in Barcelona

Pandolfi et al., 2014, STOTEN

BARCELONA 2003 – 2010

Relative decrease [%] of MLH and relative increases [%] of PMx concentrations during different NAF episodes intensities compared to non-NAF days

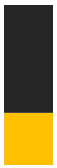


Comparison >p90NAF with no-NAF

PM1>81%

Local contribution >30-50%

African dust



PM10 >85%

Local contribution

African dust

Health effects of desert dust in Barcelona

Pandolfi et al., 2014, STOTEN

BARCELONA 2003 – 2010

Effect of MLH oscillations on health during Saharan dust outbreaks

Pandolfi et al., STOTEN, 2014

Higher toxicity of PM during dust episodes

TABLE. Levels of PM_{10} and Percentage Increase in Risk of Cardiovascular Mortality 10 $\mu g/m^3$ During Non-Saharan Dust Days (Contributing Total PM_{10} Levels) and Saharan Dust Days (Contributing Local and Saharan Contributions to PM_{10} Levels)

	Mean (sd)	Minimum	Percentiles 25	50	75	Maximum	Short-term Effects Lag	%IR (95% CI)
Non-Saharan dust days (n = 1317)								
PM_{10}	38.6 (15.7)	7.0	27.0	35.9	47.1	107.6	Lag 0	1.1 (−0.1 to 2.4)
							Lag 1	2.8 (1.6 to 4.1)
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Local contributions to PM_{10}	27.7 (10.7)	0.0	20.6	27.5	34.6	53.0	Lag 0	4.9 (−0.3 to 10.3)
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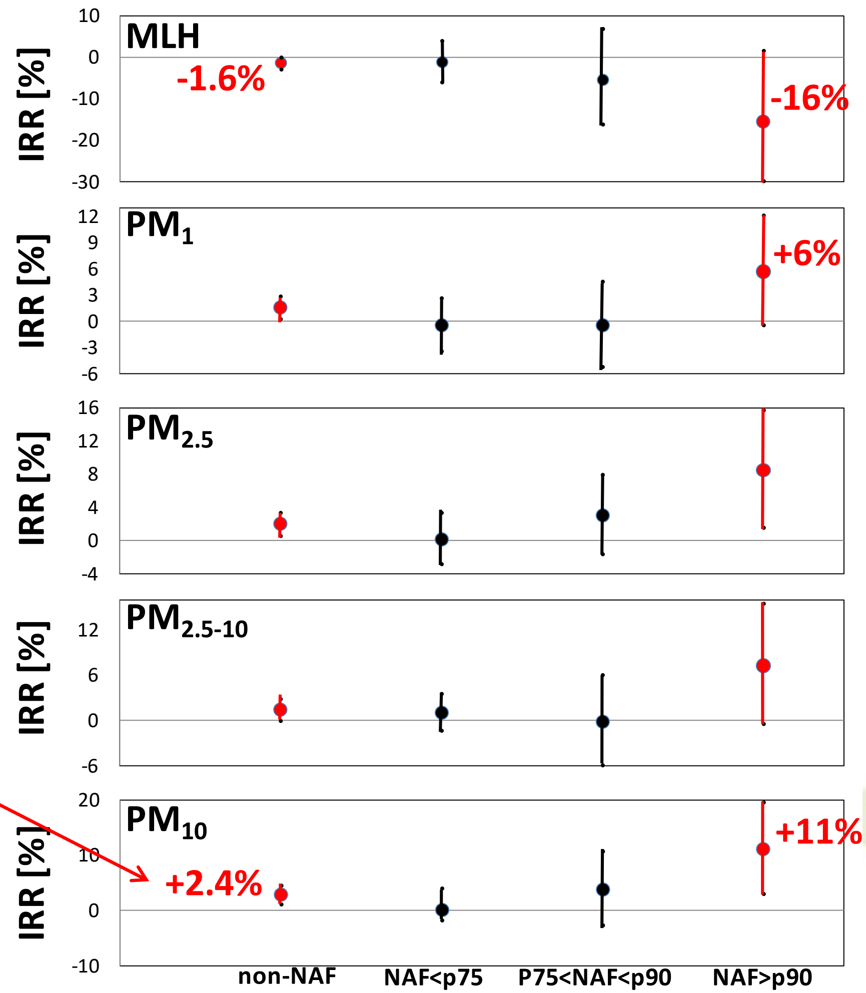
Saharan contributions to PM_{10}	16.5 (12.0)	0.0	8.0	13.0	23.0	57.0	Lag 0	3.0 (−1.5 to 7.6)
							Lag 1	4.0 (−0.4 to 8.7)
							Lag 2	2.2 (−2.2 to 6.8)
							Lag 3	3.5 (−1.0 to 8.1)

non-NAF days; Local PM_{10}

NAF days; Local PM_{10}

NAF days; dust PM_{10}

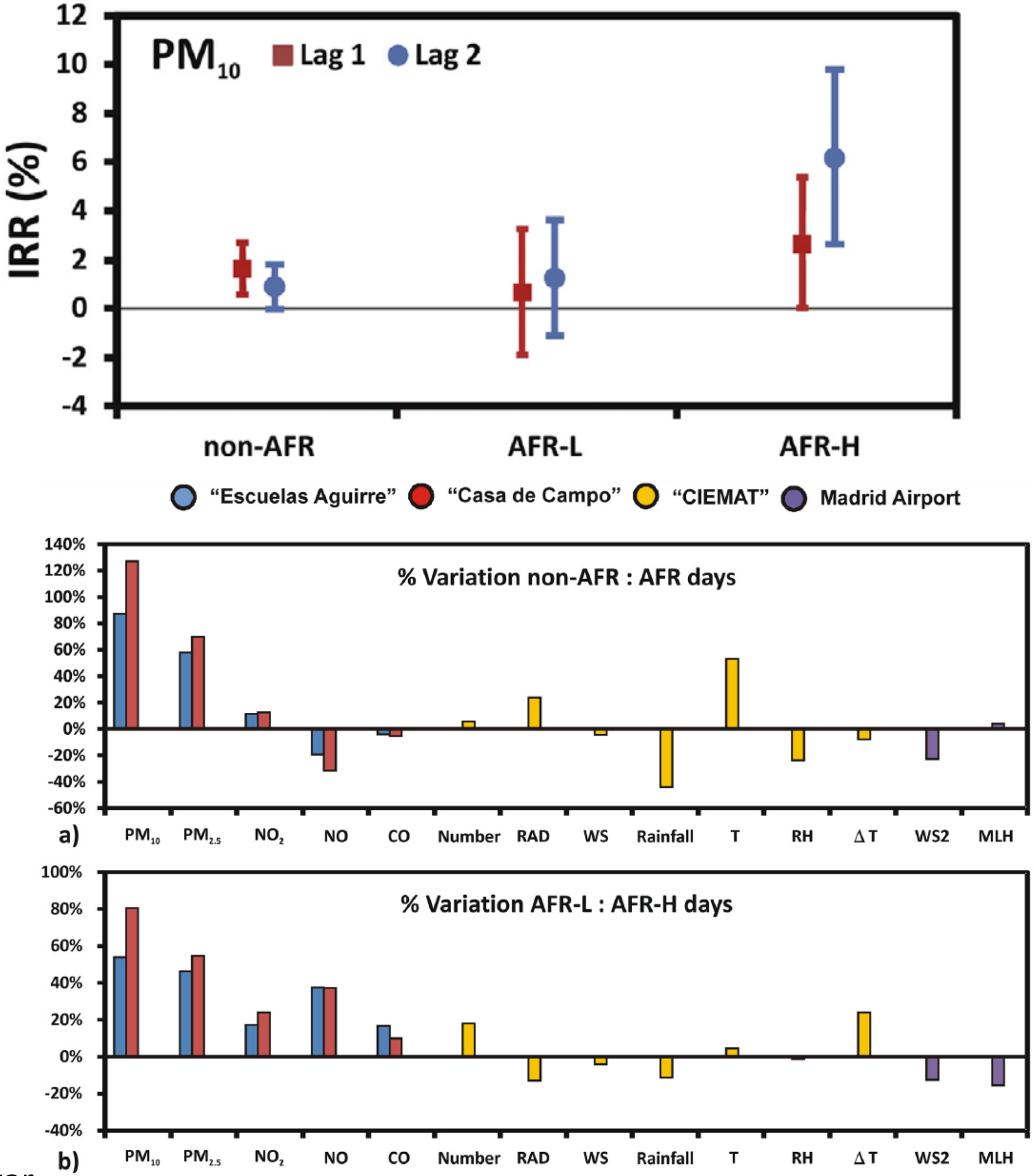
Barcelona (2003-2007) *Perez et al., 2012*



Health effects of desert dust in Madrid

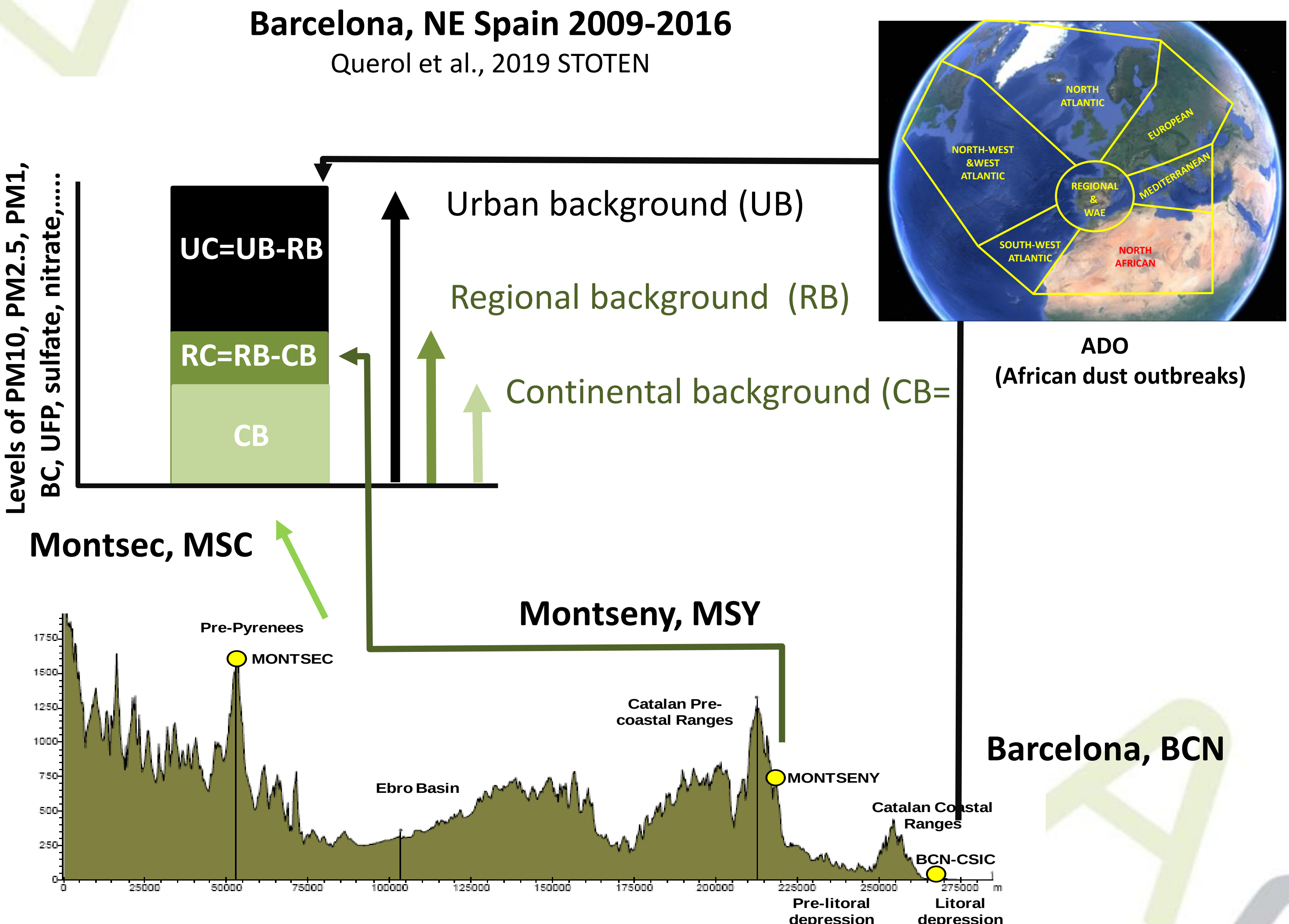
Madrid 2011-2014

Salvador P. et al., 2019. Atmospheric Research 226 (2019) 208–218



http://idaea.csic.es/egar

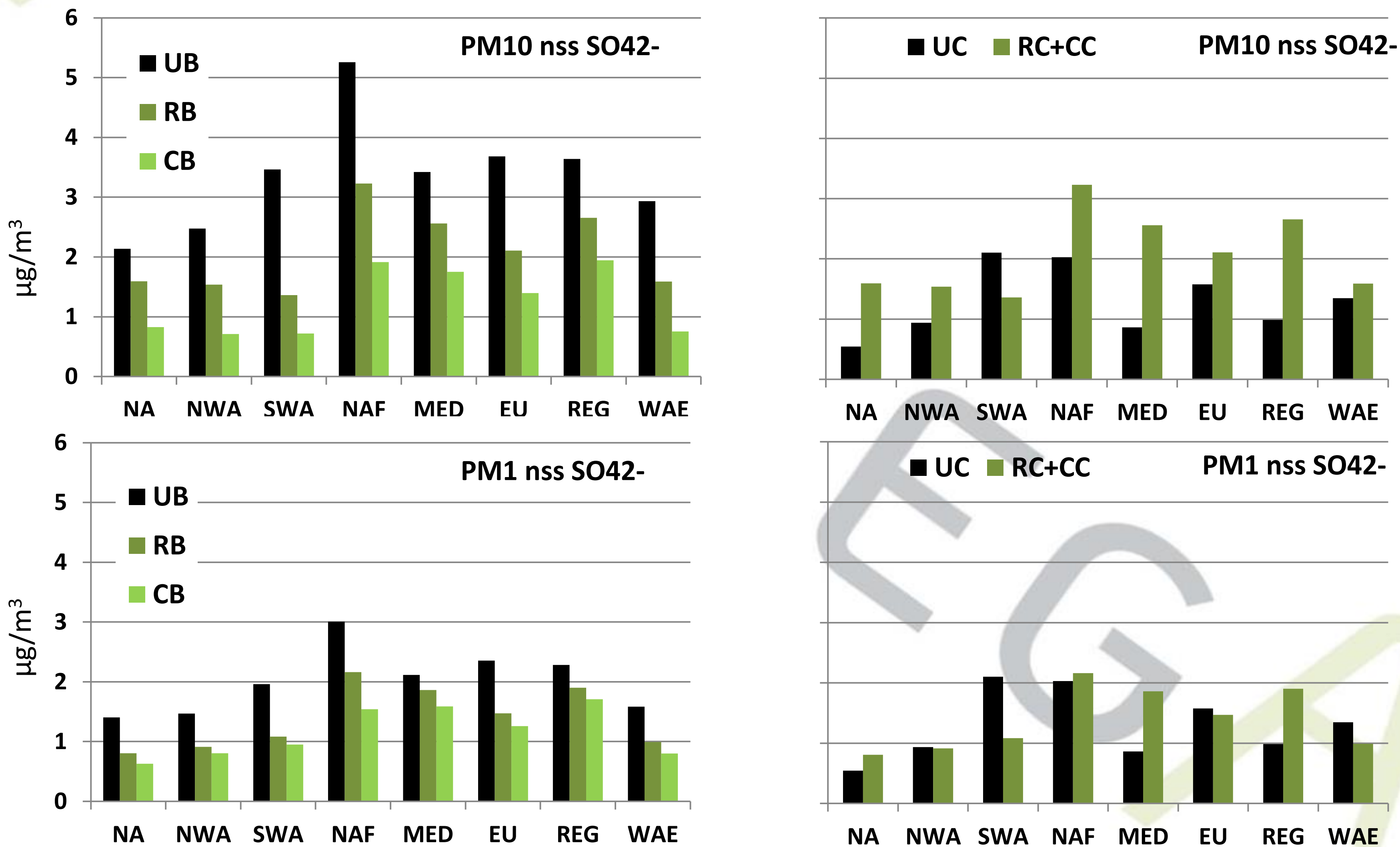
Why PM might be more toxic during dust outbreaks?



Why PM might be more toxic during dust outbreaks?

Barcelona, NE Spain 2009-2016

Querol et al., 2019 STOTEN

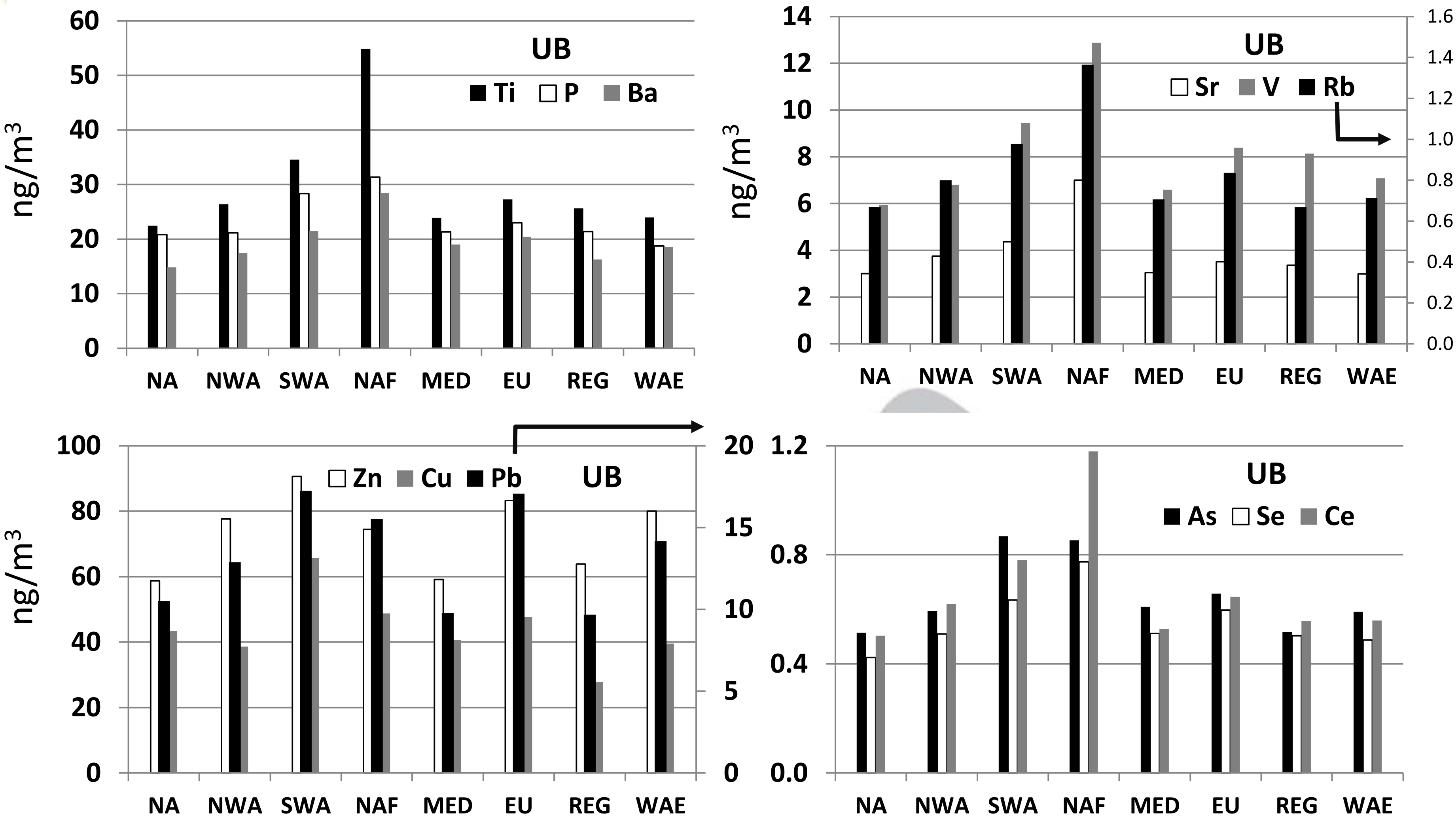


http://idaea.csic.es/egar

Why PM might be more toxic during dust outbreaks?

Barcelona, NE Spain 2009-2016

Querol et al., 2019 STOTEN



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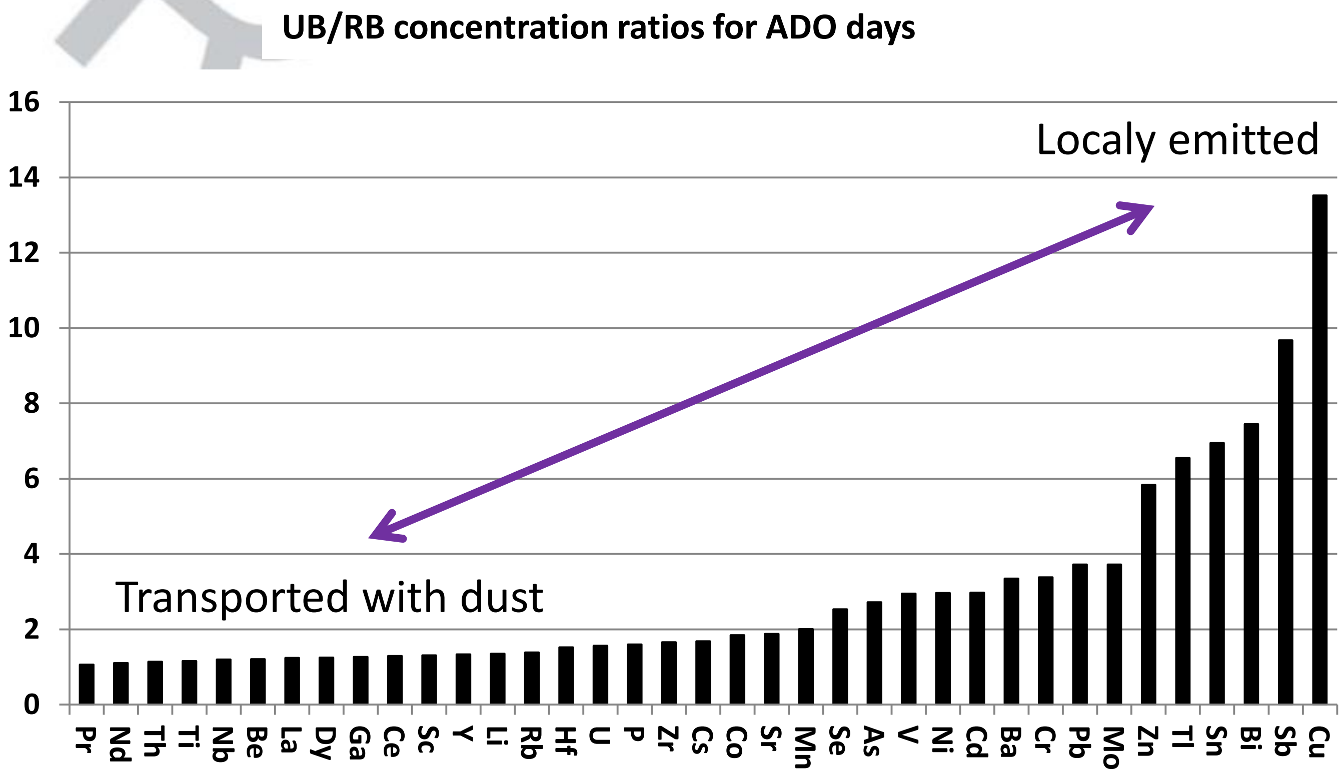
Why PM might be more toxic during dust outbreaks?

Barcelona, NE Spain 2009-2016

Querol et al., 2019 STOTEN

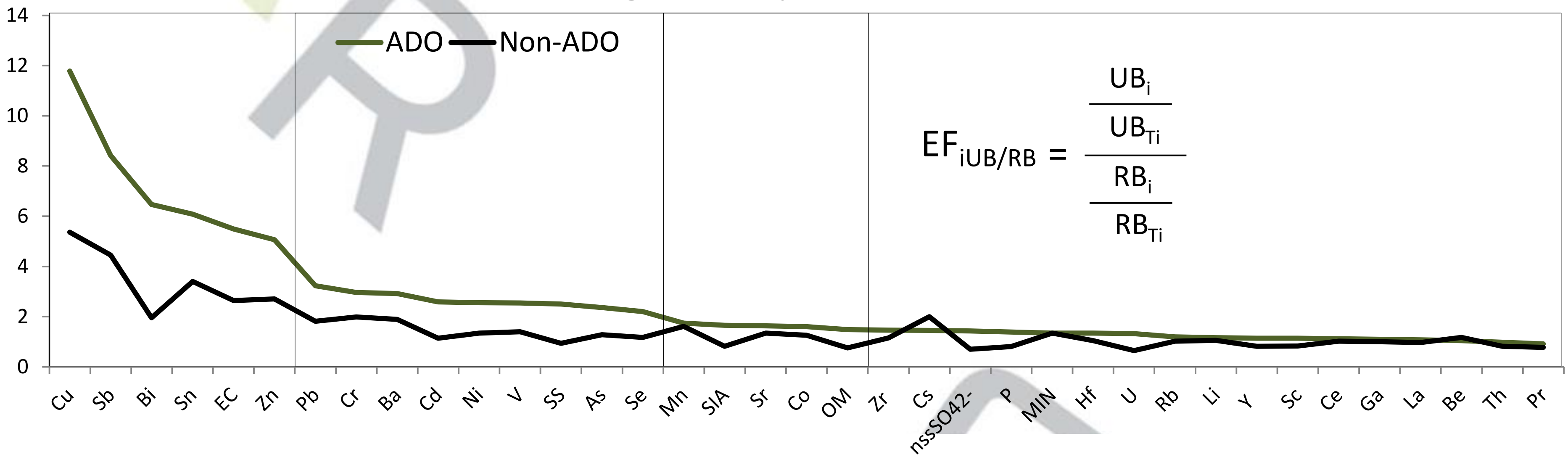


Why PM might be more toxic during dust outbreaks?

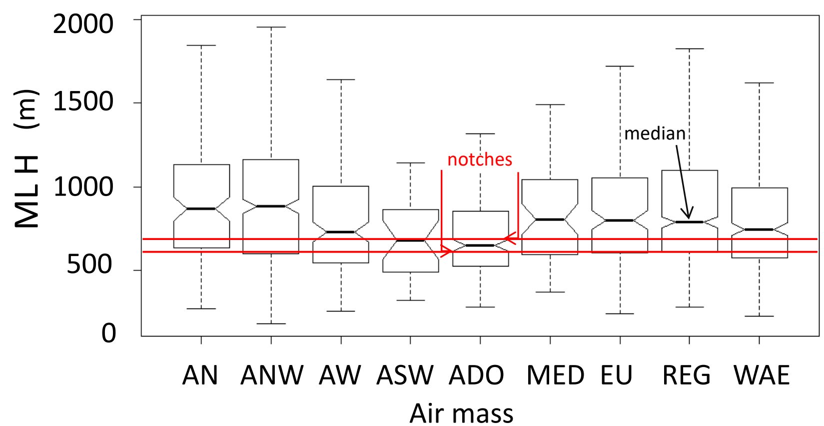
Barcelona, NE Spain 2009-2016

Querol et al., 2019 STOTEN

Enrichment of PM components in the urban background compared with the regional bacground during ADOs compared with non-ADOs



$$EF_{iUB/RB} = \frac{\frac{UB_i}{UB_{Ti}}}{\frac{RB_i}{RB_{Ti}}}$$



Final considerations (1)

- African dust outbreaks highly influence PM10, PM2.5 and PM1 levels over Spain
- The degree of impact widely varies according the distance to North Africa
- Levels of mineral dust markedly increase during these outbreaks, **but it is only dust that maters**, because levels of PM1, specially those of sulfate and metals also increase relatively when compared with other air mass transport origins
- Probably is the PBL height that decreases during African dust events and this results in the concentration of pollutants
- For African dust outbreaks a statistically significant associations of PM10 and increase of premature mortality have been found, but this relation is driven mostly by the anthropogenic load of PM10 more than by African mineral dust
- **These results apply to the Western Mediterranean, not necessarily to other areas affected by dust outbreaks**

Final considerations (2)

Major questions still not replied

What causes health effects?

- Temperature increase
- Dust
- Non-dust fraction
- Microorganisms
- Mixed anthropogenic PM
- Other

Why in some studies we find health outcomes and not in others?

- **Do methods yield same outputs concerning PM contributions?**
- A temperature increase much pronounced in some regions
- Microorganisms
- Different source or mix (with anthropogenic PM)
- Other

Need for harmonization of study designs and exposure control

How might we reduce population exposure to PM during dust outbreaks?

- Abate resuspension after episodes
- Decrease emissions of local pollutants
- Informing sensible population (How? When?)
- Other ???

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Laura Pérez
Nino Kuenzli

Thank you very much for your attention!!!

Sara Basart & Carlos Pérez García-Pando

inDust

GOBIERNO DE ESPAÑA | VICEPRESIDENCIA CUARTA DEL GOBIERNO | MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

GOBIERNO DE ESPAÑA | MINISTERIO DE CIENCIA E INNOVACIÓN

World Health Organization

Life

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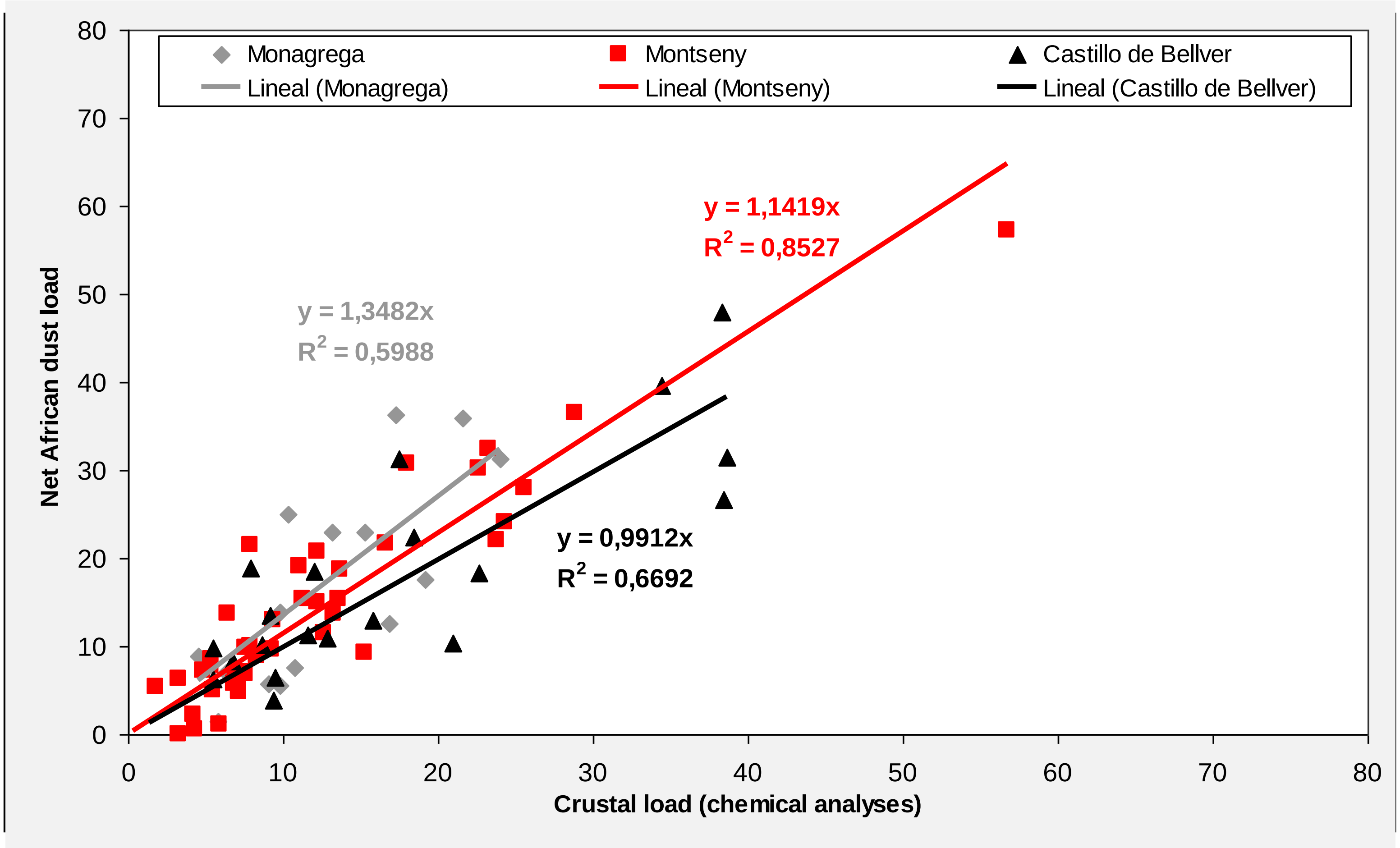
Method to quantify dust and anthropogenic PM

Validation of the procedure by chemical analysis of PM10



Method to quantify dust and anthropogenic PM

Dirección General de Calidad y Evaluación Ambiental

Reporting on episodes

ENERO 2008

ENERO 2008						
	CANARIAS	SUROESTE	SURESTE	LEVANTE	CENTRO	NOROESTE
COMBUSTIÓN BIOMASA						
EUROPEO SULFATOS						
AFRICANOS	19-29	23	23	22-23	22-24	22-23

FEBRERO 2008

FEBRERO 2008						
	CANARIAS	SUROESTE	SURESTE	LEVANTE	CENTRO	NOROESTE
COMBUSTIÓN BIOMASA						
EUROPEO SULFATOS						
AFRICANOS	6-12 21-23 27-29	12-19 22-28	13-20 22-28	14-20 24-29	14-17 26-27	14-17 23-26

MAYO 2008

MAYO 2008						
	CANARIAS	SUROESTE	SURESTE	LEVANTE	CENTRO	NOROESTE
COMBUSTIÓN BIOMASA						
EUROPEO SULFATOS						
AFRICANOS		2-6	2-6	3-6	2-6	3-6

MARZO 2008

MARZO 2008									
	CANARIAS	SUROESTE	SURESTE	LEVANTE	CENTRO	NOROESTE	NORTE	NORESTE	BALEARES
COMBUSTIÓN BIOMASA									
EUROPEO SULFATOS									
AFRICANOS	5 13-16	2-3 15	1-3 14-16	1-3 14-15	14-15			15	1-3

ABRIL 2008

ABRIL 2008									
	CANARIAS	SUROESTE	SURESTE	LEVANTE	CENTRO	NOROESTE	NORTE	NORESTE	BALEARES
COMBUSTIÓN BIOMASA									
EUROPEO SULFATOS									
AFRICANOS	2-5 14-15 24-29	7 16-17	7 16	7 16	7 16	7 16	16	16-17 27-28	16-17 28

MAYO 2008

MAYO 2008									
	CANARIAS	SUROESTE	SURESTE	LEVANTE	CENTRO	NOROESTE	NORTE	NORESTE	BALEARES
COMBUSTIÓN BIOMASA									
EUROPEO SULFATOS									
AFRICANOS		2-6	2-6	3-6	2-6	3-6	3-6	2-6	2-6