Distribuzione dimensionale, solubilità e rapporti caratteristici delle aree sorgente di marker di polveri sahariane nel PM10 campionato all'isola di Lampedusa

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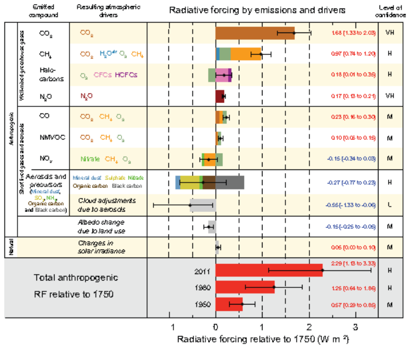
PM2014 - GENOVA

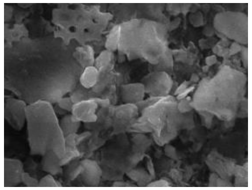
Importance of the study on Saharan dust aerosol

Sahara is the largest source of soil-derived aerosols, with an annual emission estimated to be about 600 Tg yr−1 (D'Almeida, 1986; Marticorena et al, 1997). Dust may also greatly increase the atmospheric levels of PM, adversely affecting air quality.

Mineral aerosols affect the atmospheric radiative balance through scattering, absorption, and emission of radiation (IPCC, 2013; di Sarra et al., 2011); they also affect it indirectly, by acting as cloud condensation nuclei (Levin et al., 1996) and modifying cloud properties.



Dust particles frequently act as reaction surfaces for reactive gases (Dentener et al., 1996; Levin et al., 1996), affecting atmospheric chemical processes.



Mediterranean marine regions are highly influenced by crustal dust deposition, which may provide large amounts of nutrients for phytoplankton (Béthoux et al., 1996; Guerzoni et al., 1999).


NASA/MODIS
35.5°N, 12.6°E

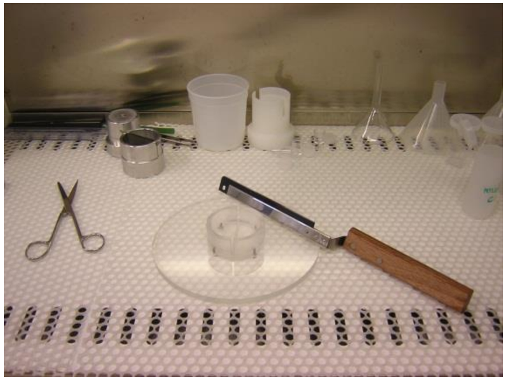
meteorological station and air inlet for
CO_2, CH_4, N_2O, CFCs, HFCs, HCFC measurements

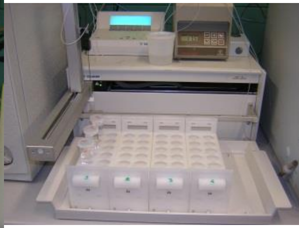
http://www.lampedusa.enea.it/

Aerosol sampling Campaigns

- ✓Jun 04 – Dec 06: PM10 - PM2.5 - PM1 alternatively
- ✓Jan 2007- today: PM10.
- ✓Spr-Sum 06: campaign with 8 stages impactor
- ✓Jan 10: sampling also on quartz filters for EC/OC.

Cuting in clean conditions

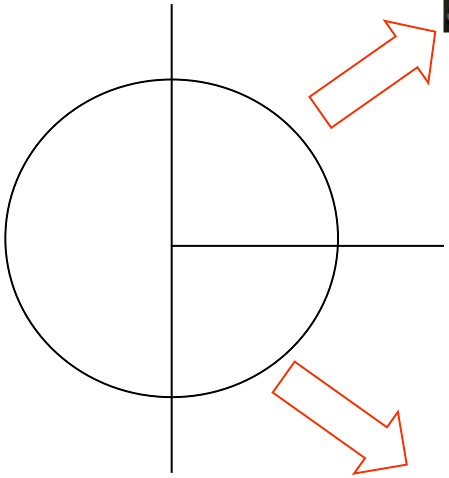




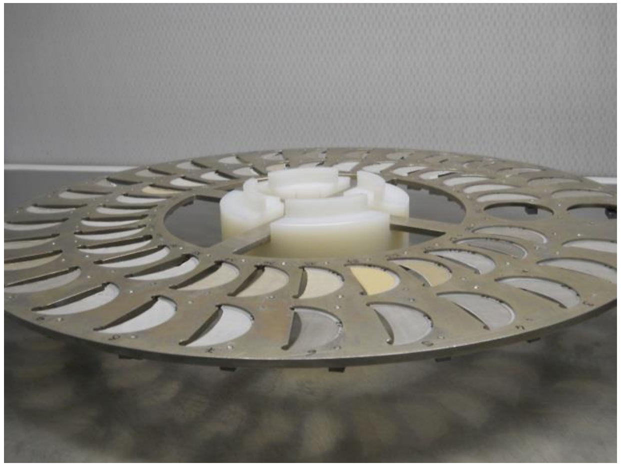
Dept. of Chemistry, Univ. of Florence

Ions Chromatography

Na^{+}, NH_4^{+}, K^{+}, Mg^{2+}, Ca^{2+}, Cl^{-}, NO_3^{-}, SO_4^{2-}, MSA, Ac, For, Gly, Ox



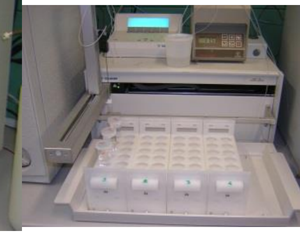
PIXE: elements total content

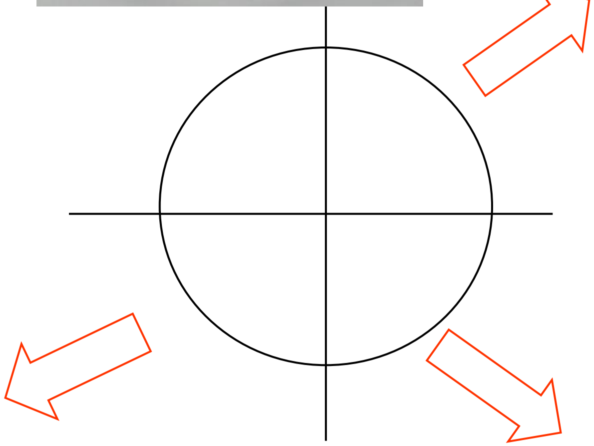


Dept. of Physics and INFN

ICP AES HNO_3 pH1.5

Al, Cd, Ba, Pb, Si, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Mo





Ions Chromatography

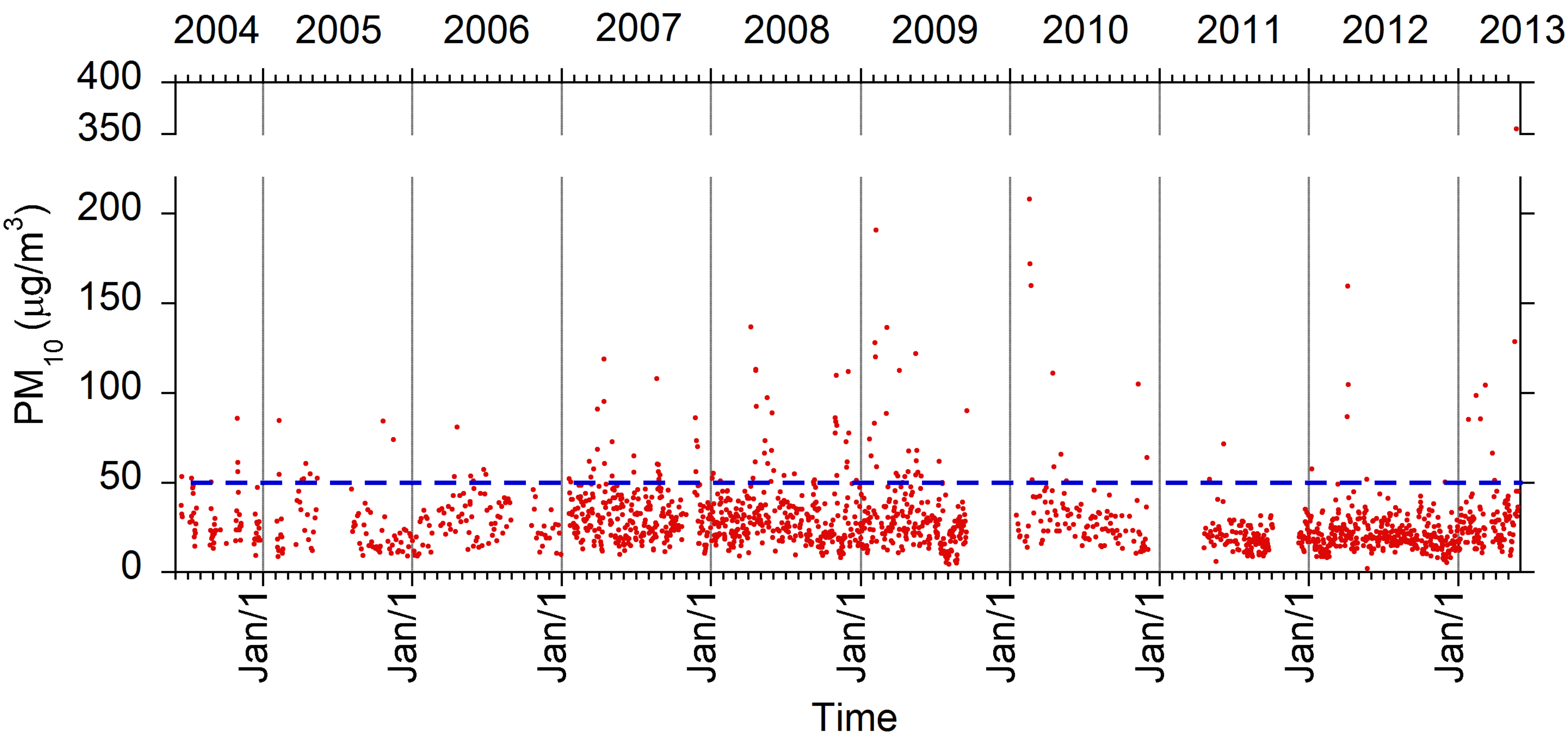
Na^{+}, NH_4^{+}, K^{+}, Mg^{2+}, Ca^{2+}, Cl^{-}, NO_3^{-}, SO_4^{2-}, MSA, Ac, For, Gly, Ox

ICP AES HNO_3-H_2O_2

Al, Cd, Ba, Pb,
Si, Ti, V, Cr, Mn,
Fe, Ni, Cu, Zn,
As, Mo

ICP AES HNO_3
pH1.5

Al, Cd, Ba, Pb,
Si, Ti, V, Cr, Mn,
Fe, Ni, Cu, Zn,
As, Mo



2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
400
350
200
150
100
50
0
PM_{10} (µg/m^3)
Jan/1
Time

Crustal aerosol =

1.89*Al + 2.14*Si + 1.4*nssCa + 2.12*Fe + 1.35*nssNa +

1.66*nssMg + 1.21*nssK +1.67*Ti

tot Na = nssNa + ssNa

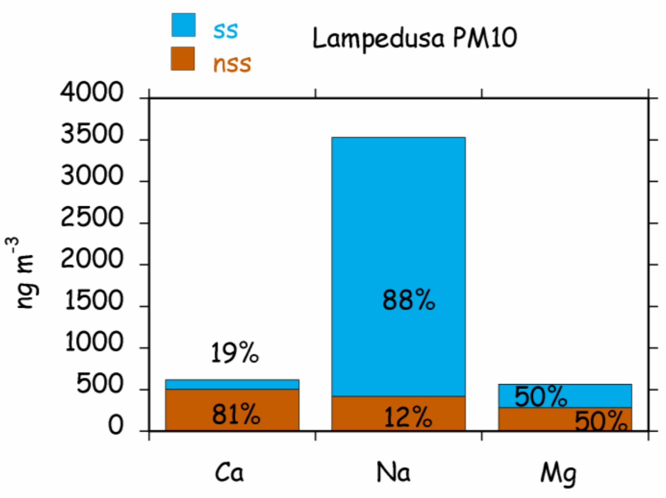
tot Ca = nssCa + ssCa

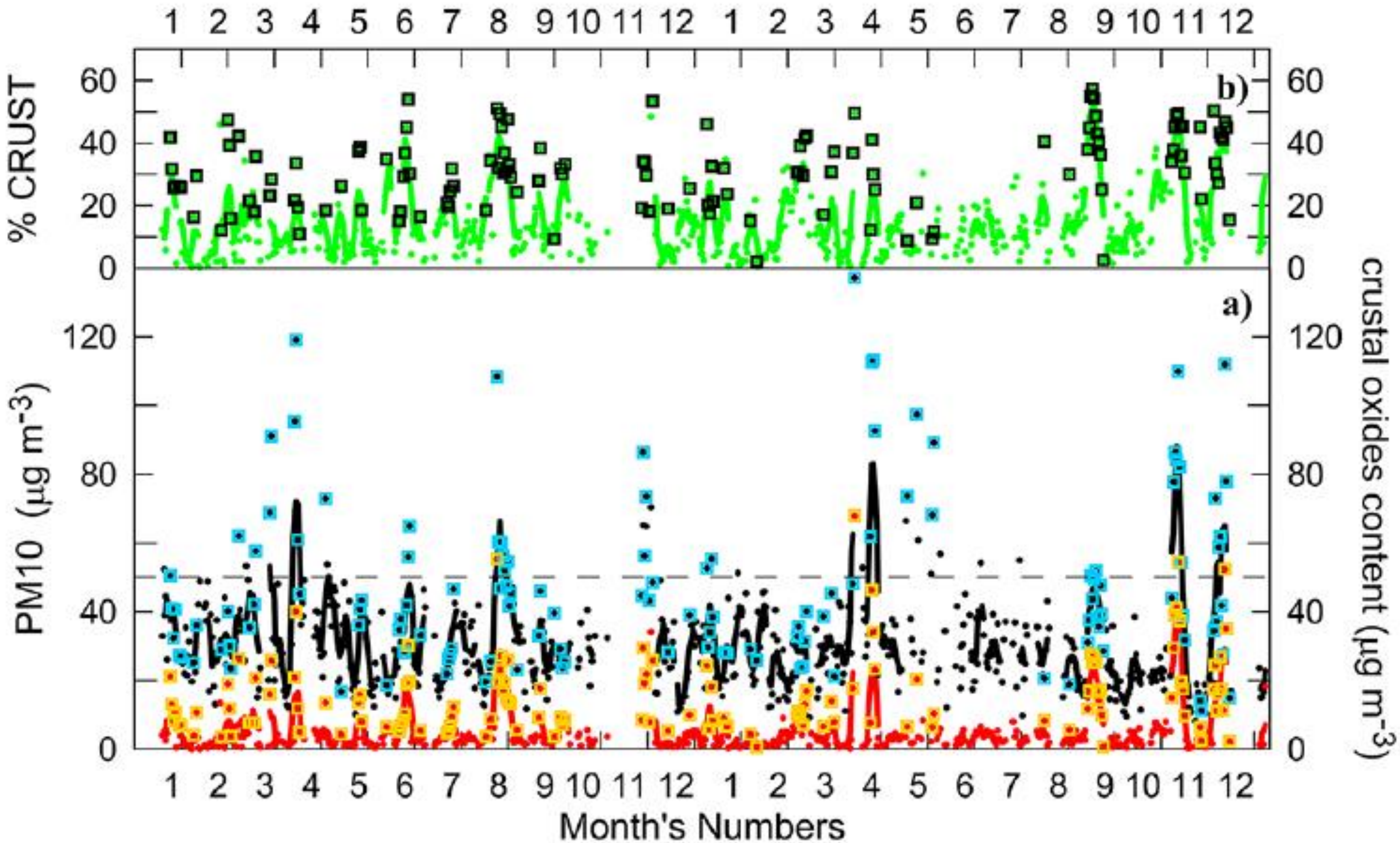
$ssNa = \text{tot Na} - (Na/Ca)_{crust} * nssCa$

$nssCa = \text{tot Ca} - (Ca/Na)_{sea\ water} * ssNa$

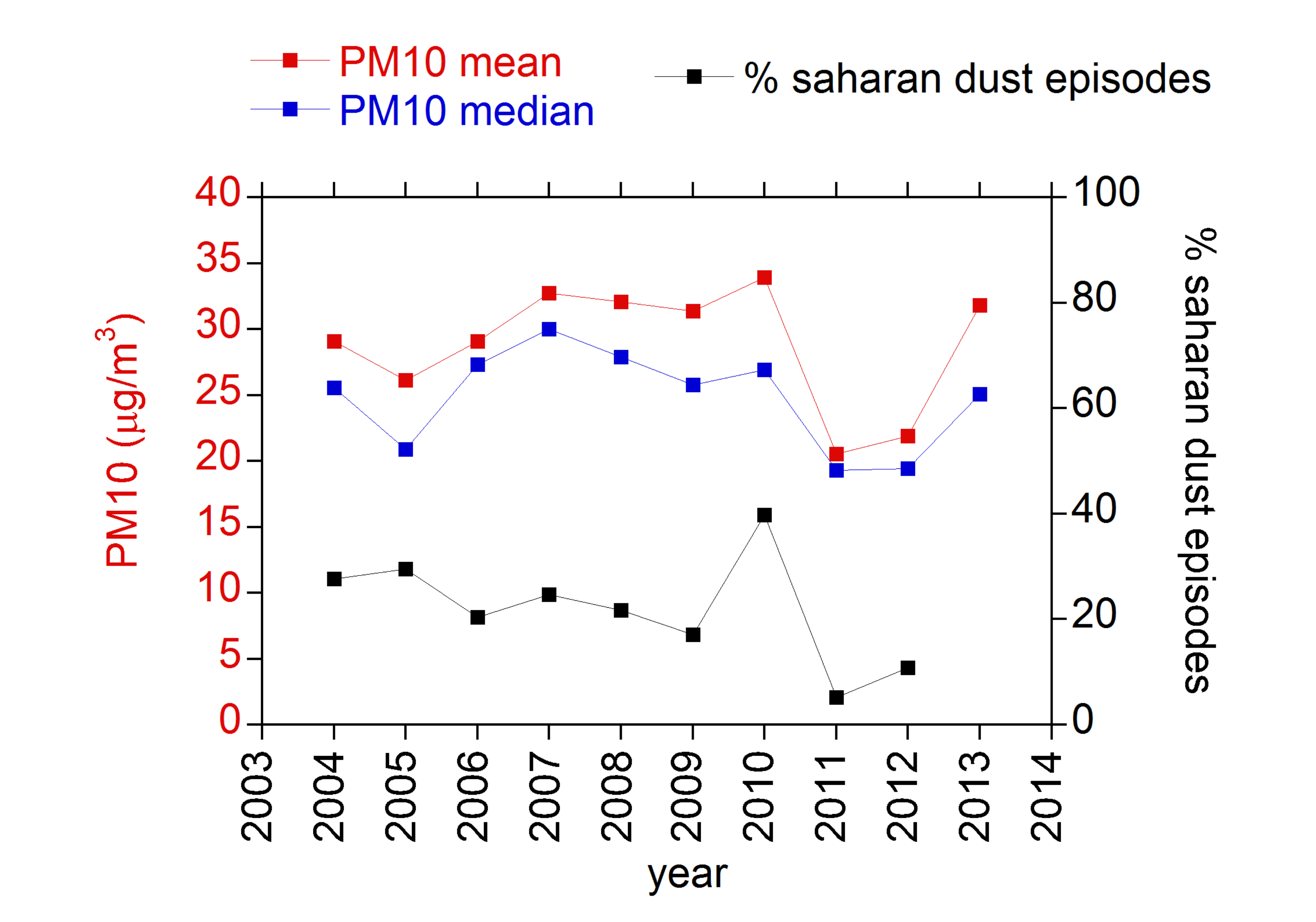
$(Ca/Na)_{sea\ water} = 0.038\ w/w$

$(Na/Ca)_{crust} = 0.569 w/w$





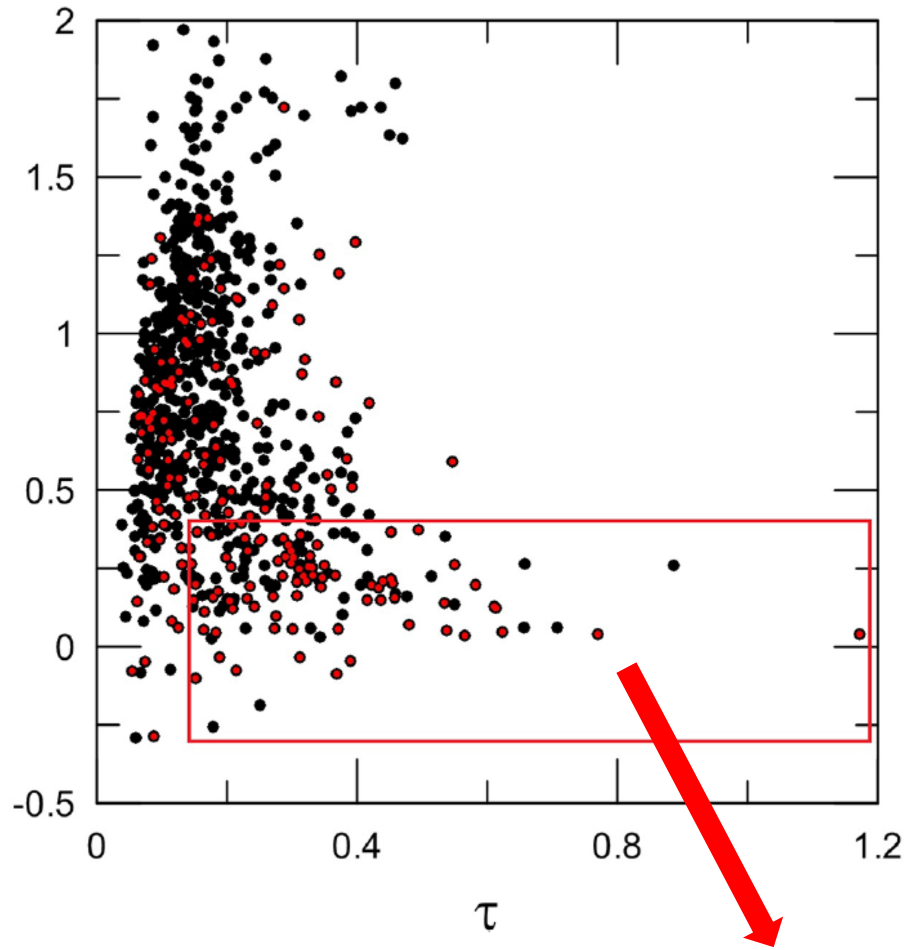
% CRUST
PM10 (µg m-3)
crustal oxides content (µg m-3)
Month's Numbers
a)
b)
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12



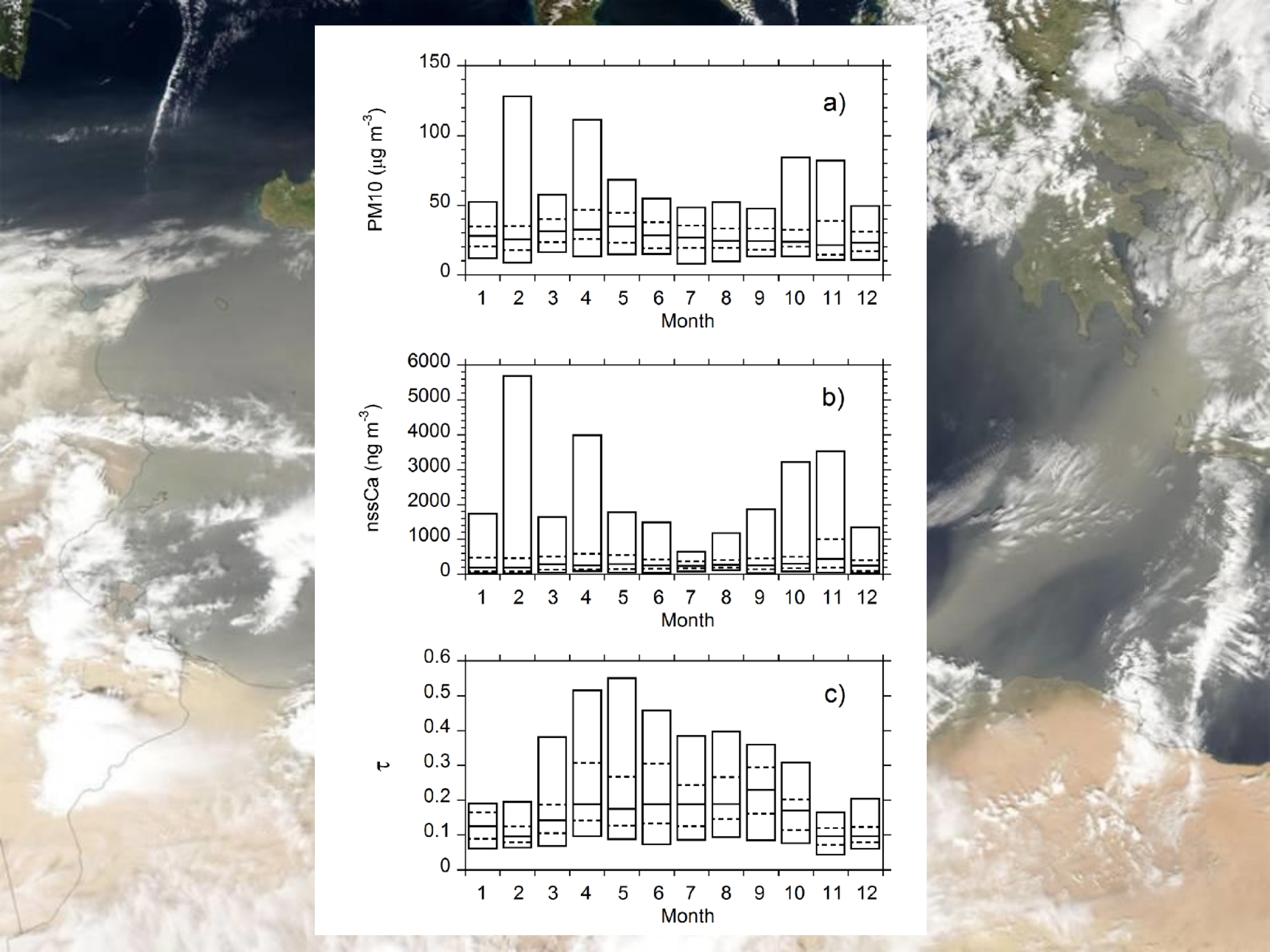
PM10 mean
PM10 median
% saharan dust episodes
PM10 (µg/m3)
% saharan dust episodes
year
0
5
10
15
20
25
30
35
40
0
20
40
60
80
100
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

Eventi sahariani al suolo

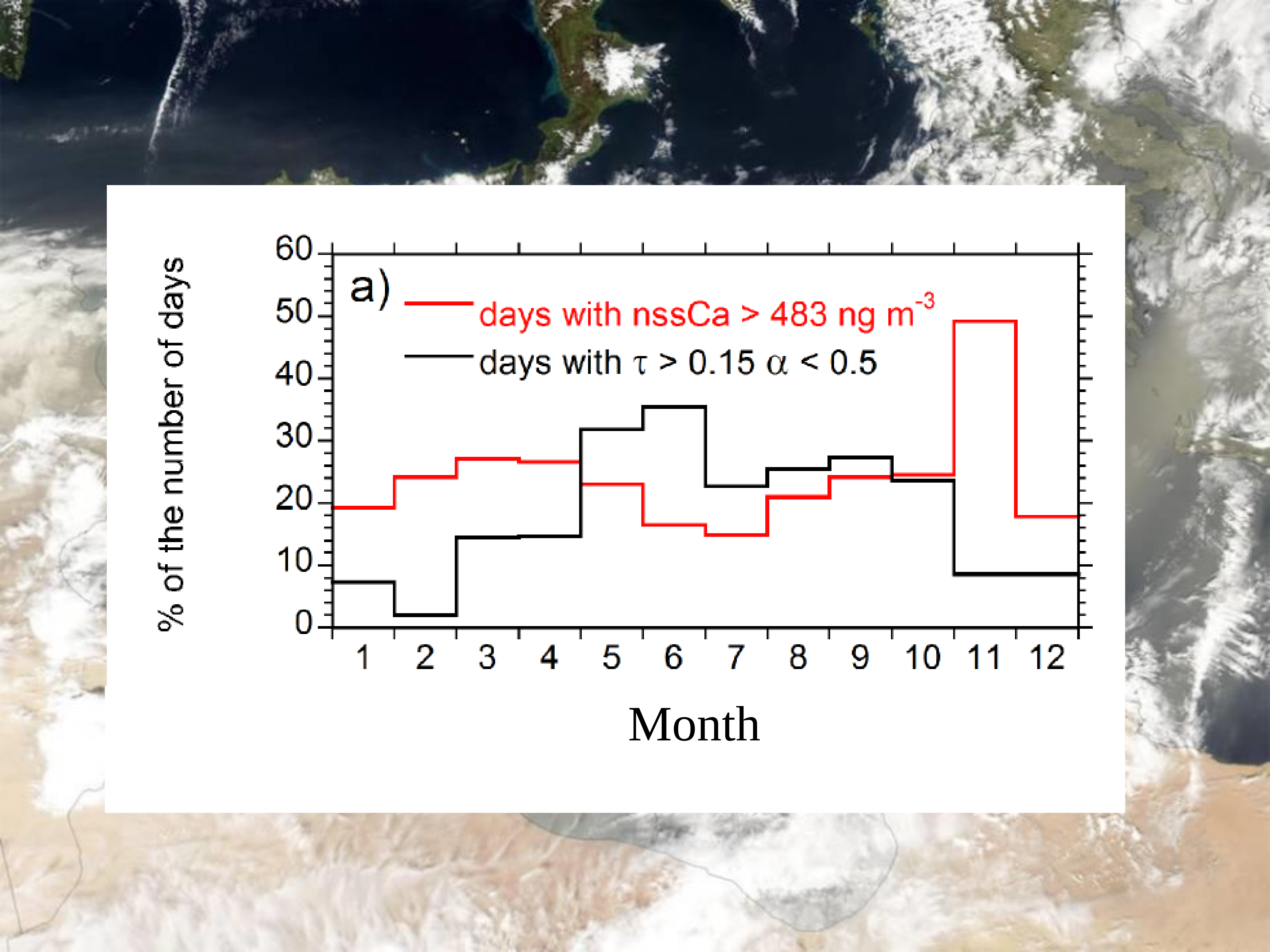
$$\alpha = -\frac{\ln\left(\tau_{415.6}/\tau_{868.7}\right)}{\ln\left(415.6/868.7\right)}$$



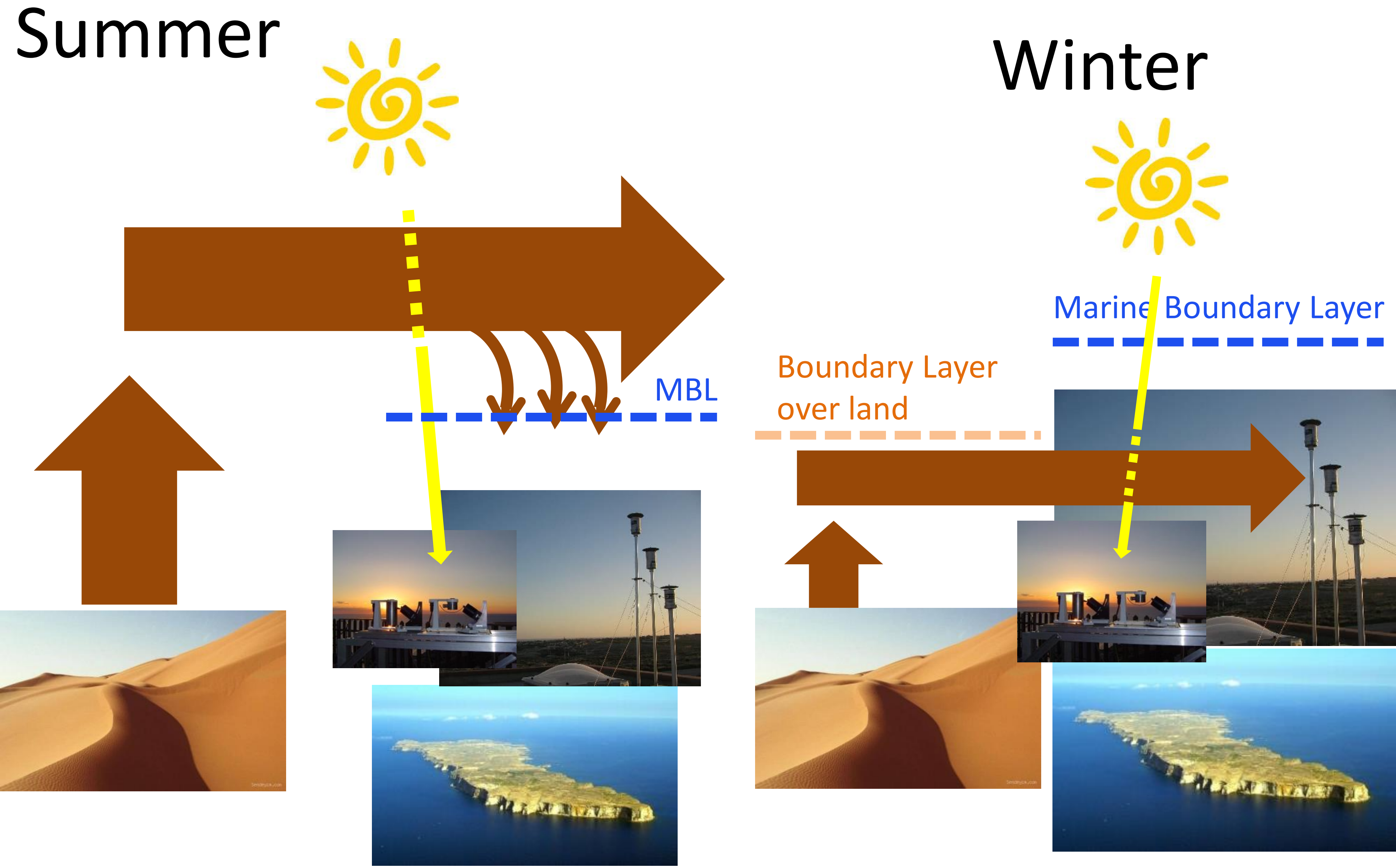
Eventi sahariani
(Pace et al. 2006)



a)
PM10 (μg m-3)
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12
Month
b)
nssCa (ng m-3)
6000
5000
4000
3000
2000
1000
0
1 2 3 4 5 6 7 8 9 10 11 12
Month
c)
τ
0.6
0.5
0.4
0.3
0.2
0.1
0
1 2 3 4 5 6 7 8 9 10 11 12
Month



a)
days with nssCa > 483 ng m-3
days with τ > 0.15 α < 0.5
% of the number of days
0
10
20
30
40
50
60
1
2
3
4
5
6
7
8
9
10
11
12
Month


Summer
Winter
MBL
Boundary Layer
over land
Marine Boundary Layer

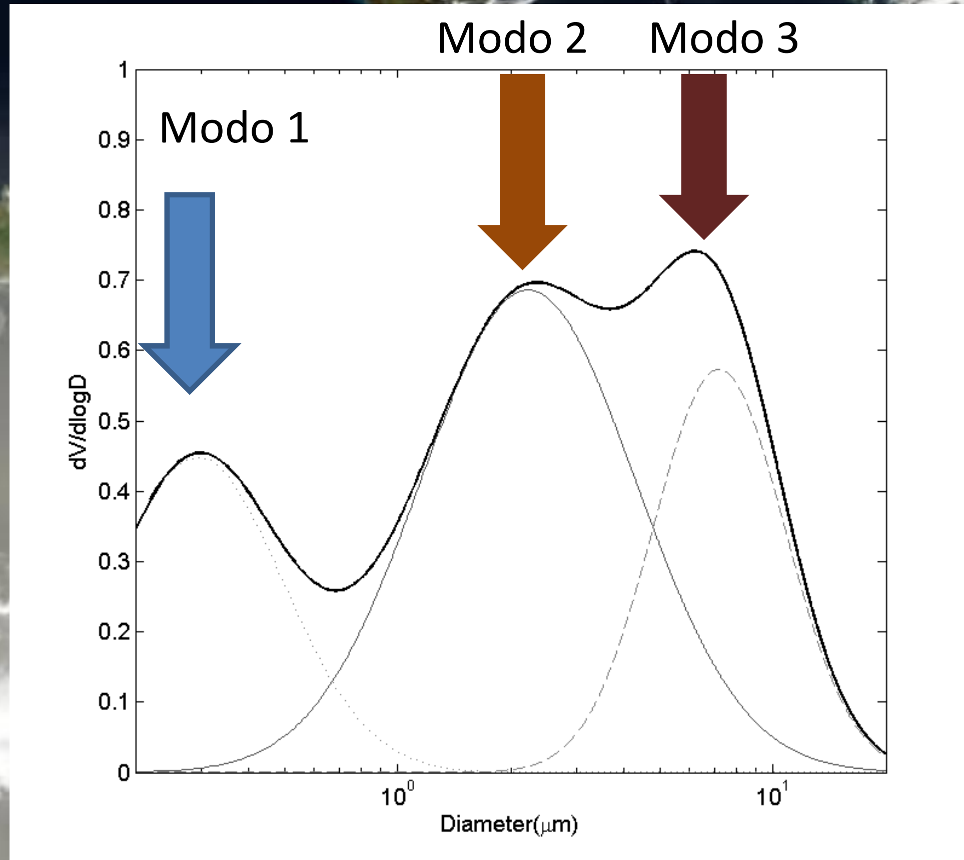
Distribuzione dimensionale e solubilità

PM10 bulk

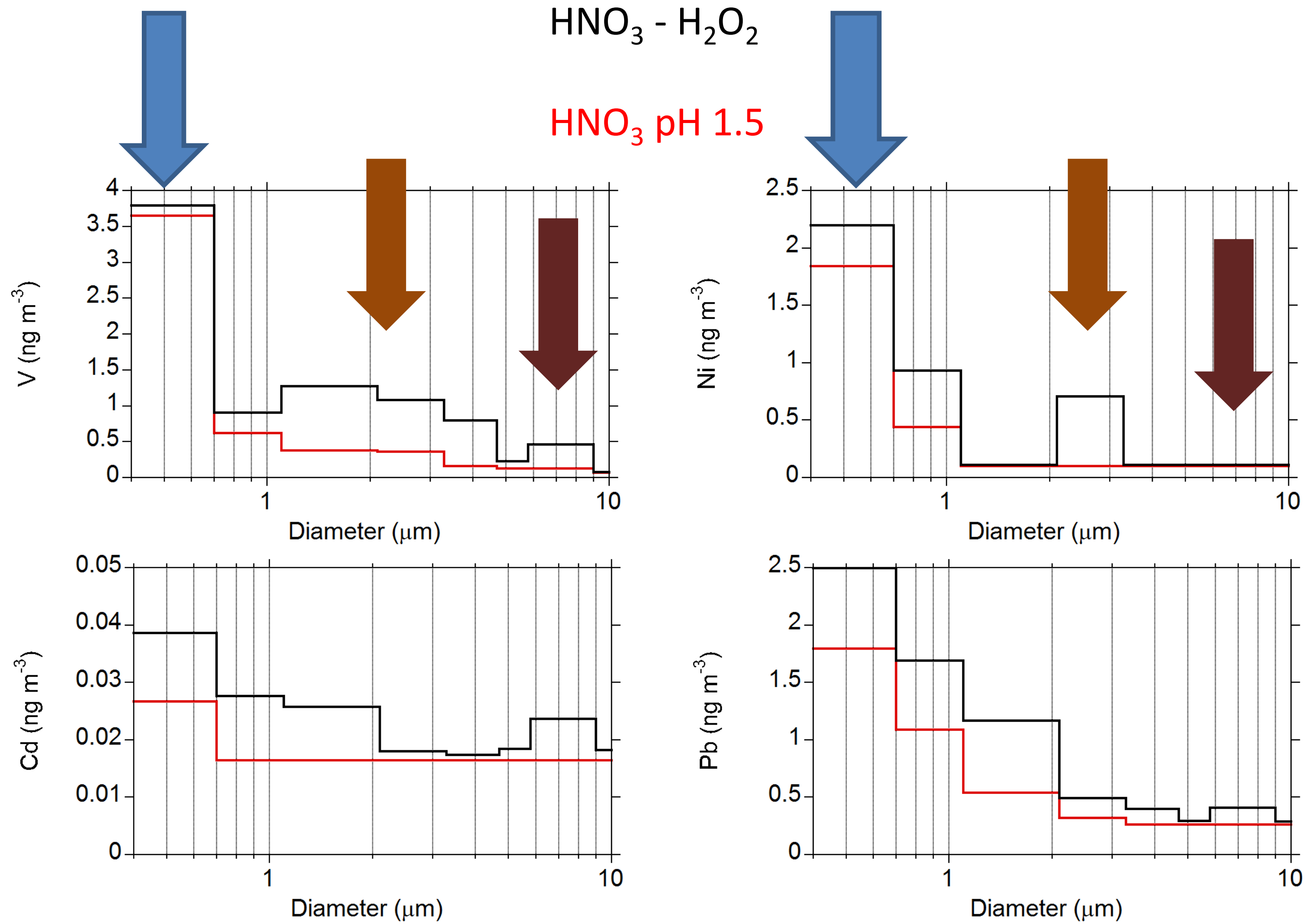
Solubilità HNO_3 pH1.5 %= 100 * $Me_{HNO3\ pH1.5}$/ Me_{PIXE}

	Saharan dust event				Non Saharan dust events			
	Median	Mean	Std dev of the mean	N. valid data	Median	Mean	Std dev of the mean	N. valid data
Al	10.7	12.5	0.8	159	14.8	18.6	0.6	497
Fe	5.9	7.5	0.4	158	13.0	15.3	0.5	499
Ca	75.8	75.2	1.5	163	76.8	76.4	1.0	495
Mg	75.4	73.4	2.5	147	91.7	87.1	1.4	395
K	39.5	40.5	1.3	166	63.7	63.0	0.9	510
Mn	54.6	53.9	1.2	153	54.9	55.2	1.1	330
V	46.6	46.7	2.1	104	66.7	65.1	1.5	295
Ni	50.9	50.7	2.1	136	63.0	61.3	1.3	400
Cr	6.2	6.9	0.5	94	6.0	7.6	0.7	71
Cu	45.7	47.3	1.8	143	53.1	53.6	1.4	397
Pb	62.7	64.8	2.8	84	56.3	56.8	2.0	177

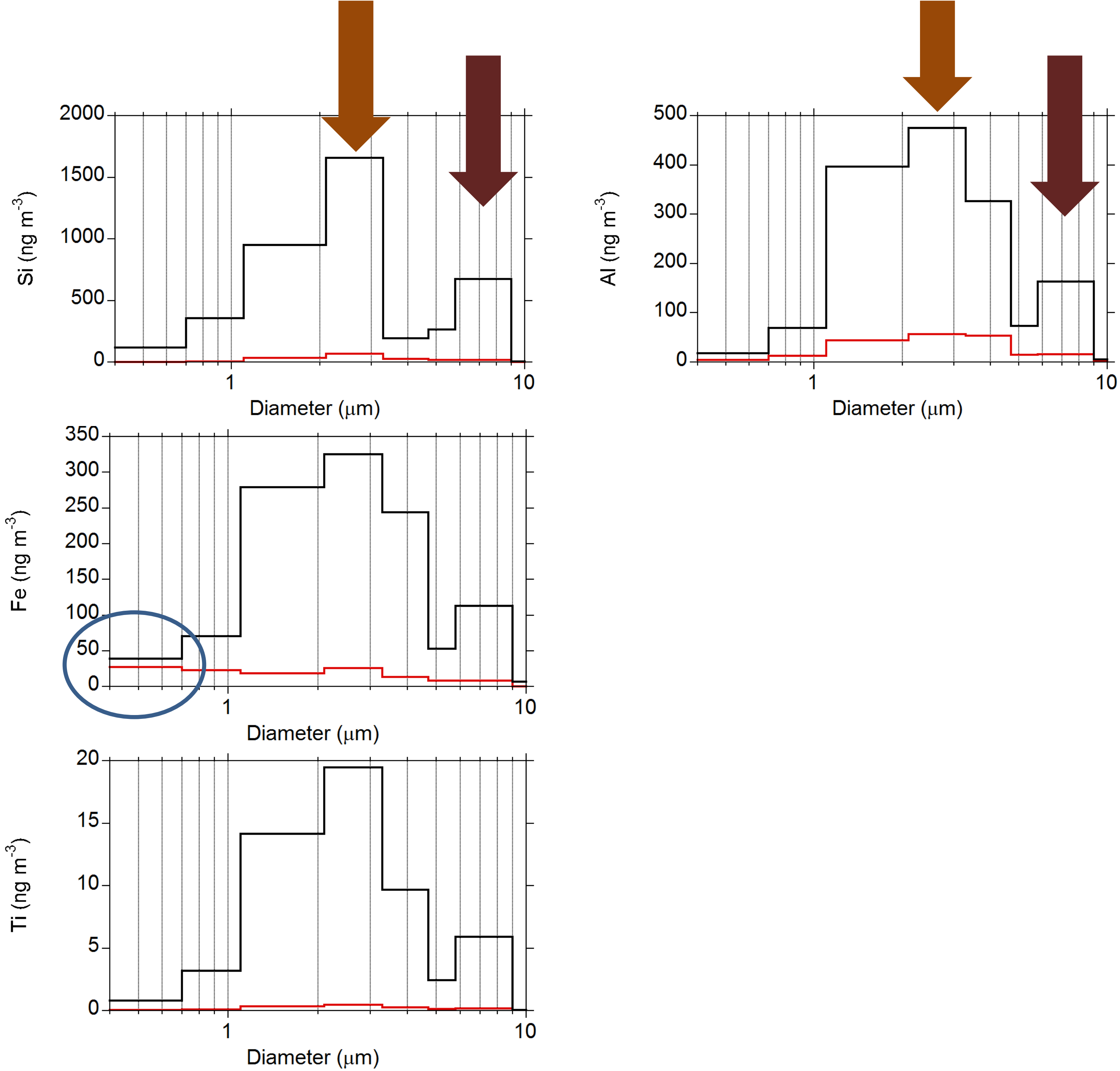
OPC



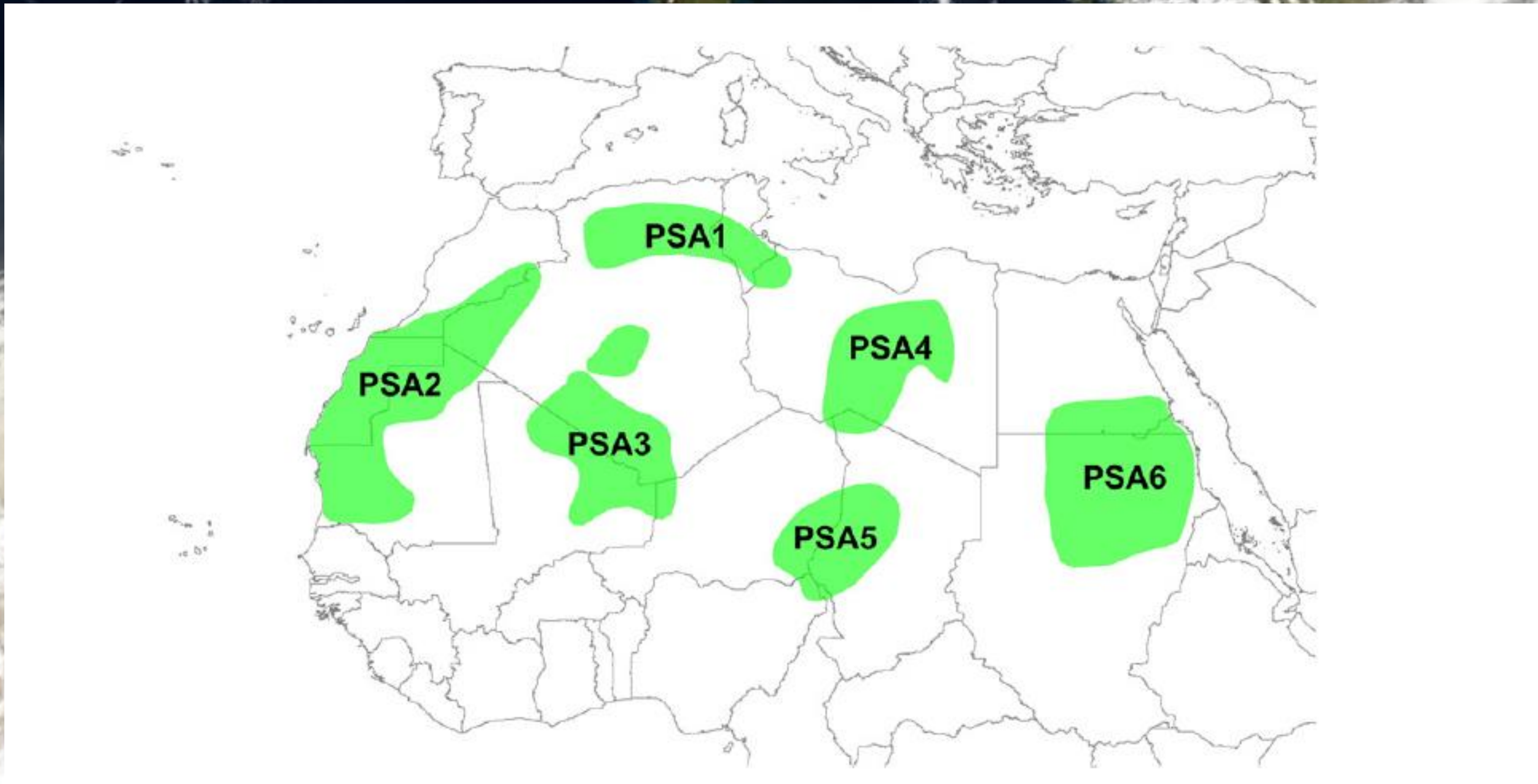
	Dv (μm)	σ	V (%)	N(%)
Mode 1	0.29	1.35	25.6	99.8
Mode 2	2.23	2.02	49.1	1.23×10^{-1}
Mode 3	7.18	1.77	25.3	1.89×10^{-3}

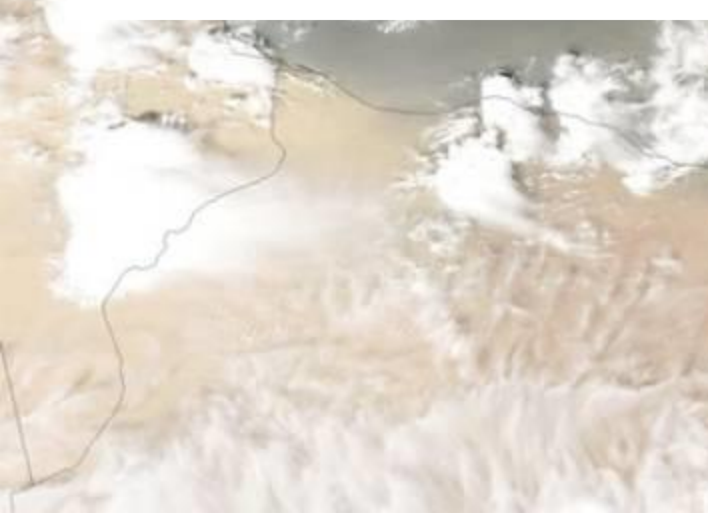


HNO_3 - H_2O_2
HNO_3 pH 1.5
V (ng m^{-3})
Ni (ng m^{-3})
Cd (ng m^{-3})
Pb (ng m^{-3})
Diameter (μm)
Diameter (μm)
Diameter (μm)
Diameter (μm)


Si (ng m^{-3})
2000
1500
1000
500
0
1
10
Diameter (μm)
Al (ng m^{-3})
500
400
300
200
100
0
1
10
Diameter (μm)
Fe (ng m^{-3})
350
300
250
200
150
100
50
0
1
10
Diameter (μm)
Ti (ng m^{-3})
20
15
10
5
0
1
10
Diameter (μm)

Aree Sorgente





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Bulk composition of northern African dust and its source sediments — A compilation

Dirk Scheuvens [a,b,*], Lothar Schütz [b], Konrad Kandler [a,b], Martin Ebert [a], Stephan Weinbruch [a]

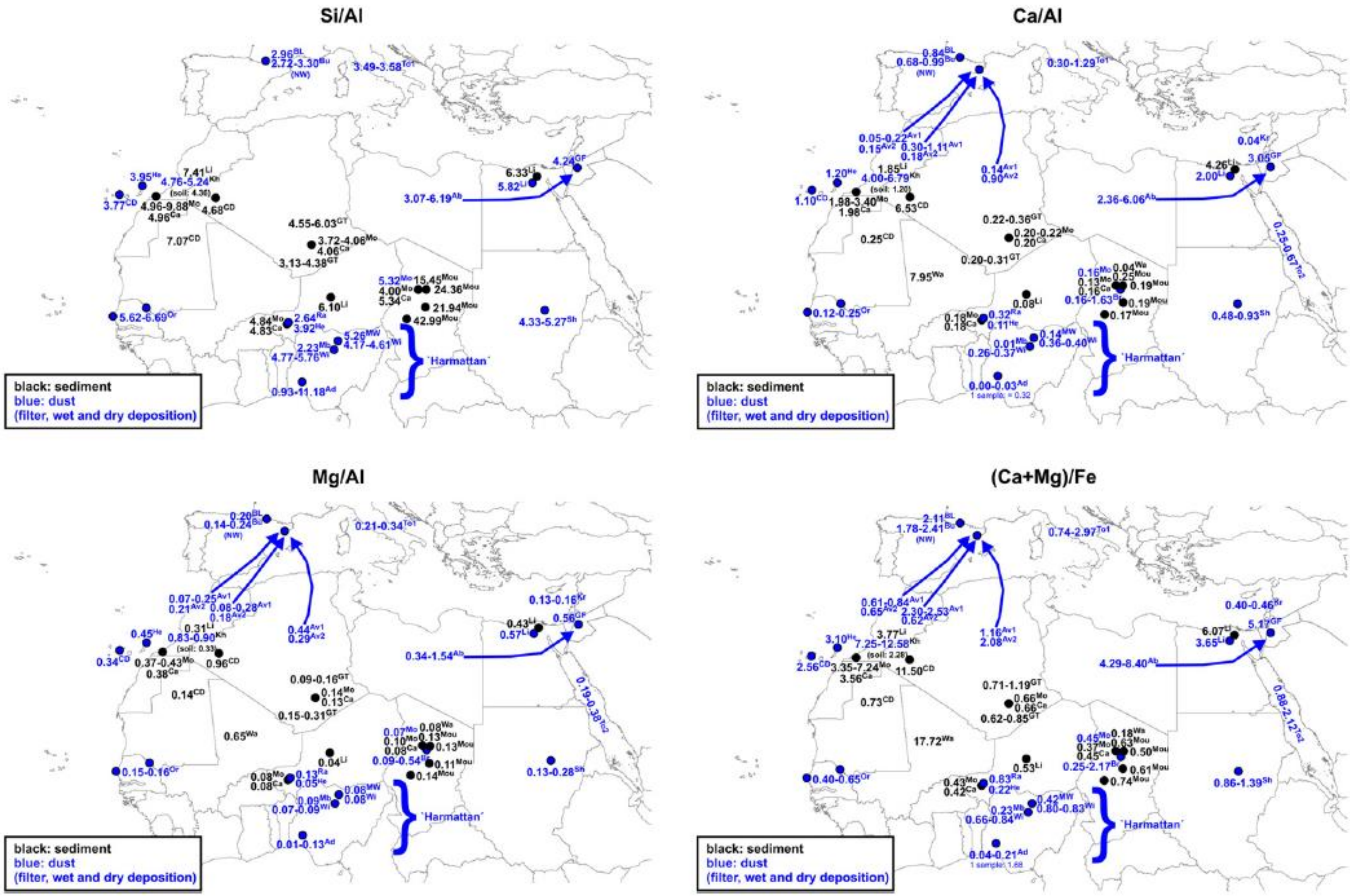


Fig. 2. Maps of northern Africa with elemental ratios of Si/Al, Ca/Al, Mg/Al, and (Ca + Mg)/Fe indices (bulk chemical analyses in wt.%) for dust and sediment samples; arrows show transport directions of mineral dust of selected studies. References: MW: McTainsh and Walker (1982), BL: Bücher and Lucas (1984), To1: Tomadin et al. (1984), Wi: Wilke et al. (1984), Ad: Adedokun et al. (1989), Bu: Bücher (1989), To2: Tomadin et al. (1989), Mb: Møberg et al. (1991), Or: Orange et al. (1993), Sh: Sharif (1995), GF: Ganor and Foner (1996), GT: Guieu and Thomas (1996), He: Herrmann et al. (1996), Av1: Avila et al., 1998, Kr: Krom et al. (1999), Gu: Guieu et al. (2002a), CD: Criado and Dorta (2003), Si: Singer et al. (2003), Kh: Khiri et al. (2004), Li: Linke et al. (2006), Mo: Moreno et al. (2006), Mou: Mounkaila (2006), Av2: Avila et al. (2007), Ca: Castillo et al. (2008), Ra: Rajot et al. (2008), Ab: Abed et al. (2009), Wa: Washington et al. (2009), and Br: Bristow et al. (2010).

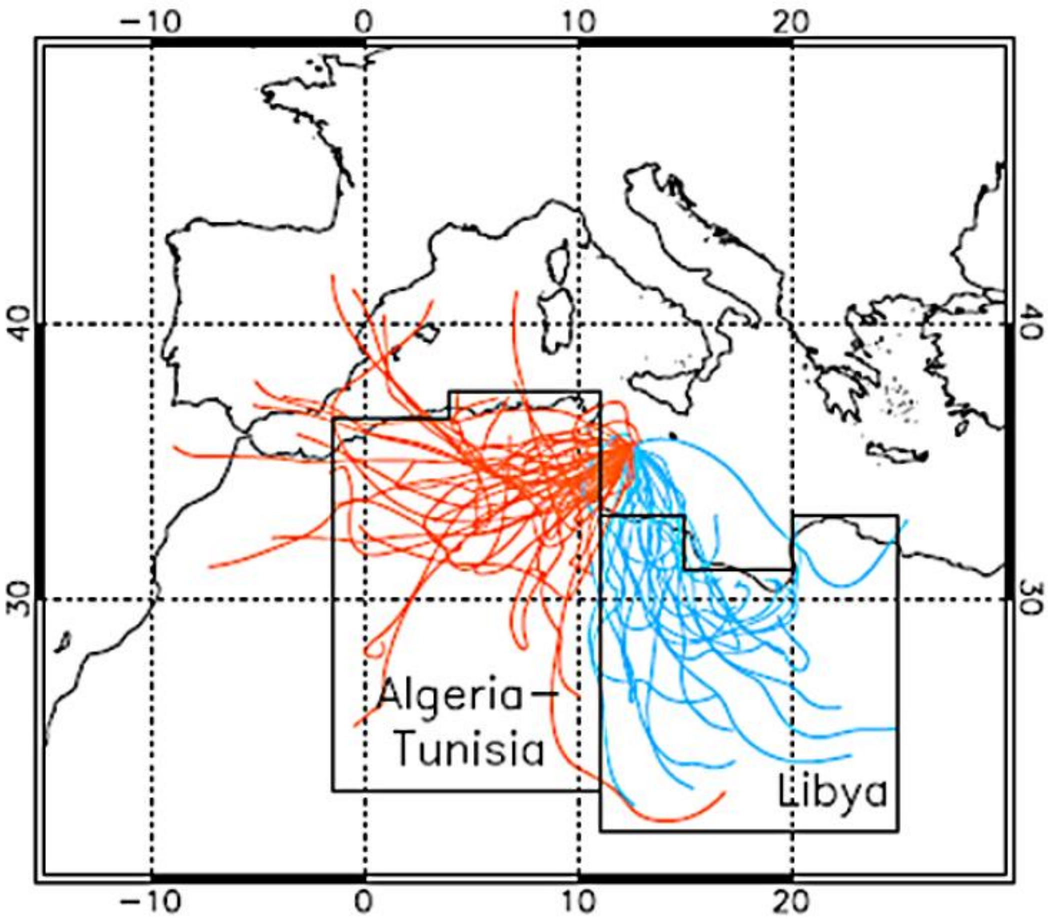
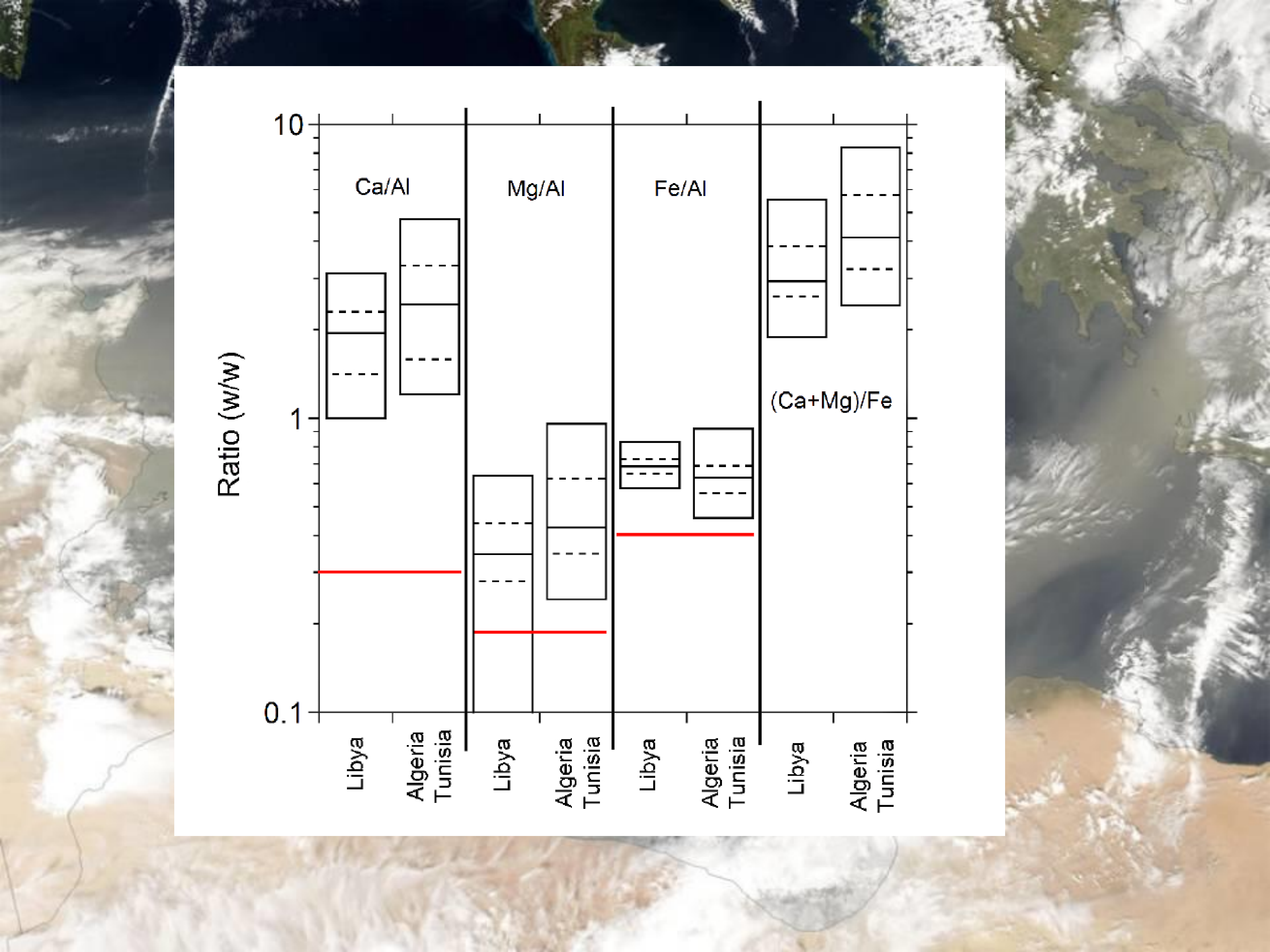
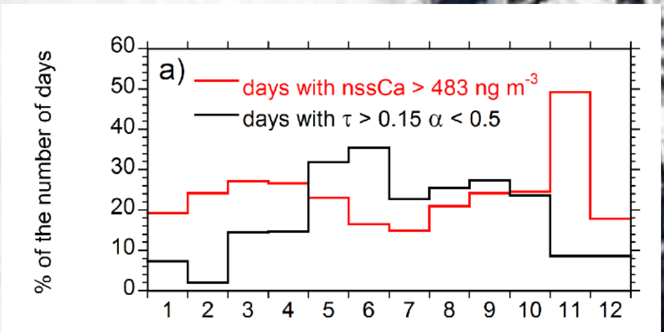
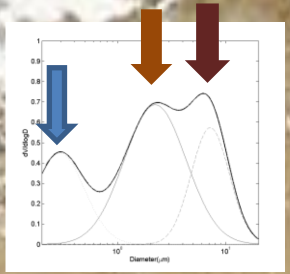


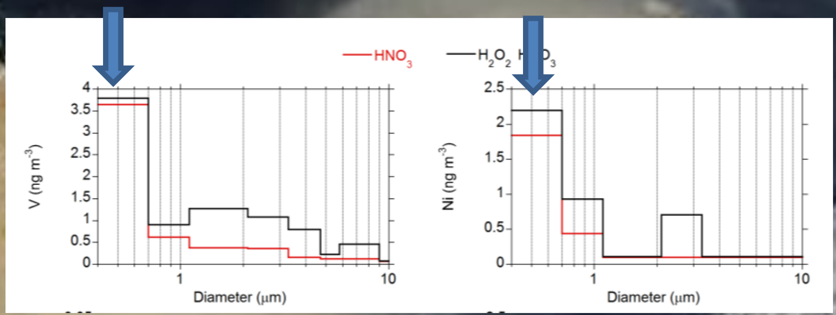
Fig. 7. Dust source regions and back trajectories fulfilling the 50 % permanence criterion for each source region (orange for Algeria–Tunisia and blue for Libya).

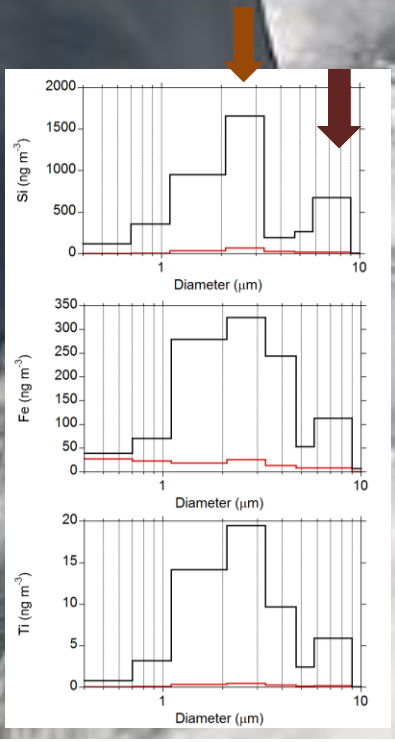

Ratio (w/w)
10
1
0.1
Ca/Al
Mg/Al
Fe/Al
(Ca+Mg)/Fe
Libya
Algeria Tunisia
Libya
Algeria Tunisia
Libya
Algeria Tunisia
Libya
Algeria Tunisia

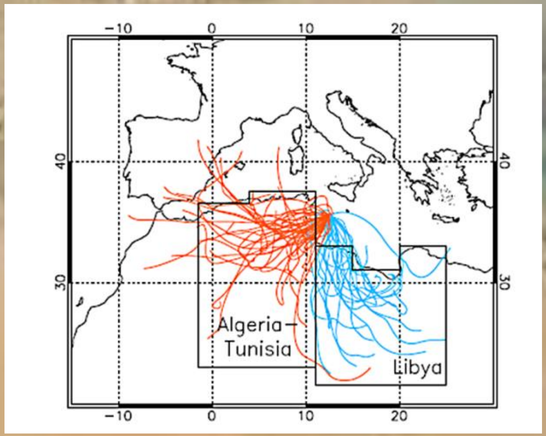
Conclusioni

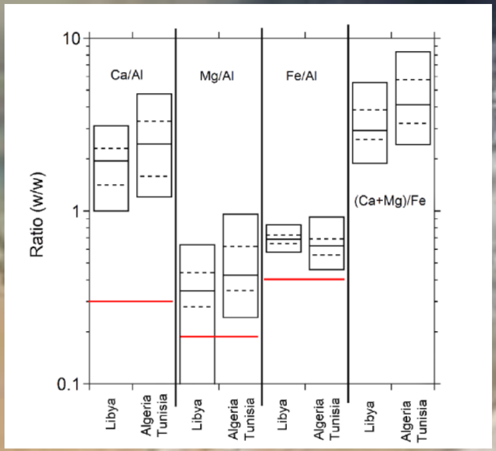












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doi:10.5194/acp-14-2039-2014

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Saharan dust aerosol over the central Mediterranean Sea: PM_{10} chemical composition and concentration versus optical columnar measurements

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