Saharan dust contribution to PM_{10} in Italy

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Air quality legislation and identification of African dust episodes over Europe

EARLY EUROPEAN DIRECTIVES ON PARTICULATE MATTER

Until the year 1999, monitoring of PM levels was based on the determination of the levels of black smoke (**BS**) and total suspended particles (**TSP**): **European Directives 80/779/CEE** and **89/427/CEE** (In Italy an annual **target value** for PM_{10} was introduced in the **25/11/1994 Ministerial Decree**).

COUNCIL DIRECTIVE 1999/30/EC

Article 2 (**Definitions)** 'natural events' shall mean volcanic eruptions, seismic activities, geothermal activities, wild-land fires, highwind events or the atmospheric resuspension or transport of natural particles from dry regions.

Article 5 **(Particulate matter)** Where the limit values for PM_{10} are exceeded owing to concentrations of PM_{10} in ambient air due to natural events […] Member States shall inform the Commission […] providing the necessary justification to demonstrate that such exceedances are due to natural events. Member States shall be obliged to implement action plans […] only where the limit values […] are exceeded owing to causes other than natural events.

COUNCIL DIRECTIVE 2008/50/EC

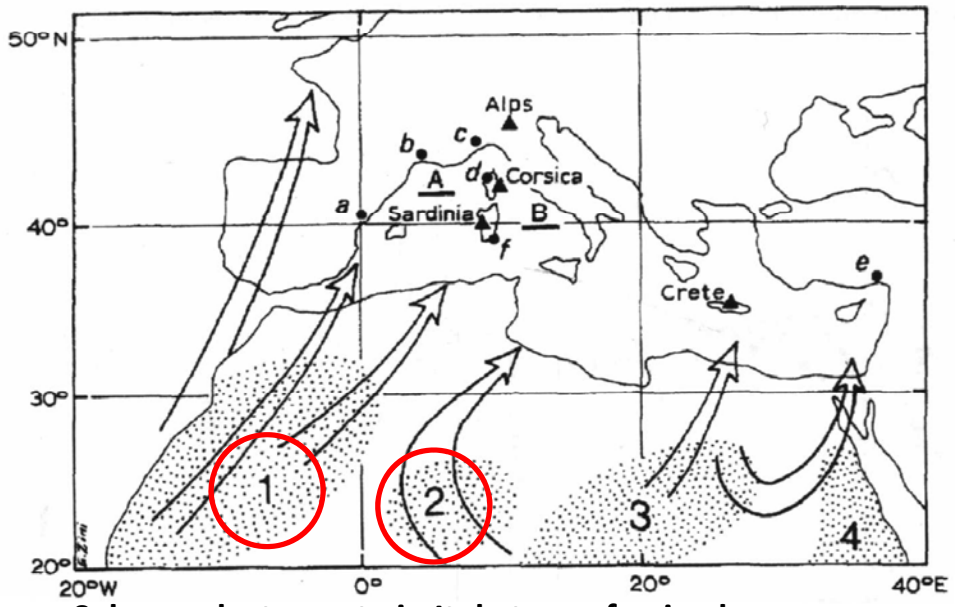
(15) Contributions from natural sources can be assessed but cannot be controlled. Where natural contributions to pollutants in ambient air can be determined with sufficient certainty, and where exceedances are due in whole or in part to these natural contributions, these may […] be subtracted when assessing compliance with air quality limit values.

Article 2 (**Definitions)** 'contributions from natural sources' shall mean emissions of pollutants not caused directly or indirectly by human activities, including natural events such as volcanic eruptions[…] or transport of natural particles from dry regions.

EC SEC(2011) 208 (18/2/2011) 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

Natural sources of particulate matter

Main components of natural particles from Sahara are: calcite, dolomite, iron oxides, quartz and clay minerals

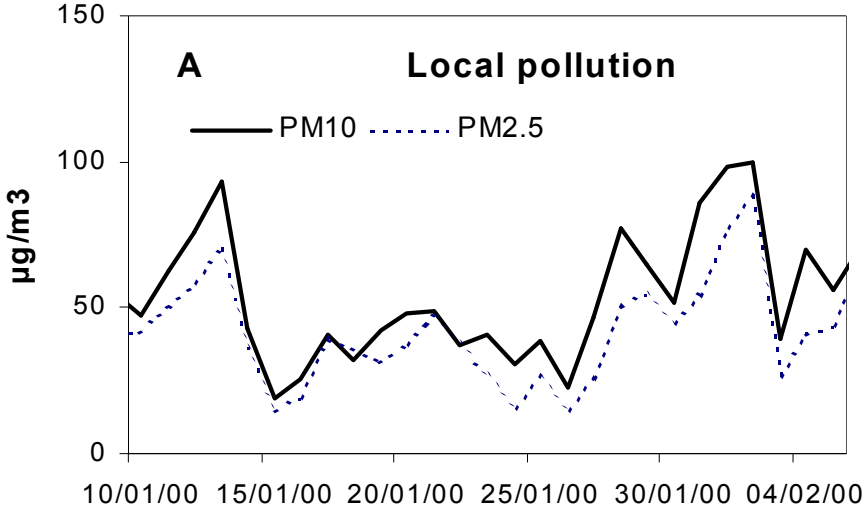


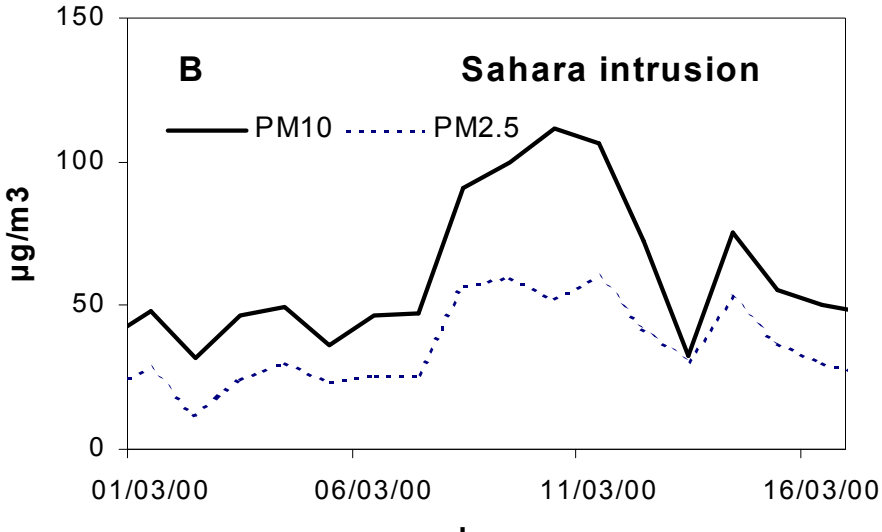
Saharan dust event: in Italy tens of episodes per year

(specially from zone 1 or 2)

	SAHARA	EUROPE
SiO_2	60.95	56.49
Al_2O_3	11.02	13.91
Fe_2O_3	4.05	6.37
FeO		
MgO	0.76	3.08
CaO	2.31	8.60
Na_2O	1.39	1.14
K_2O	2.81	2.63
TiO_2	0.82	1.04
P_2O_5	0.20	0.24
MnO	0.09	
SO_3		
CO_2	5.26	
H_2O	8.75	

Average composition of natural particles (%)





Evaluation of $PM_{2.5}/PM_{10}$ ratio during a Saharan dust event

Previous method for detection of natural events due to long range transport of mineral dust such as Sahara air mass intrusions

1- Identify particulate peaks in the PM_{10} time series.

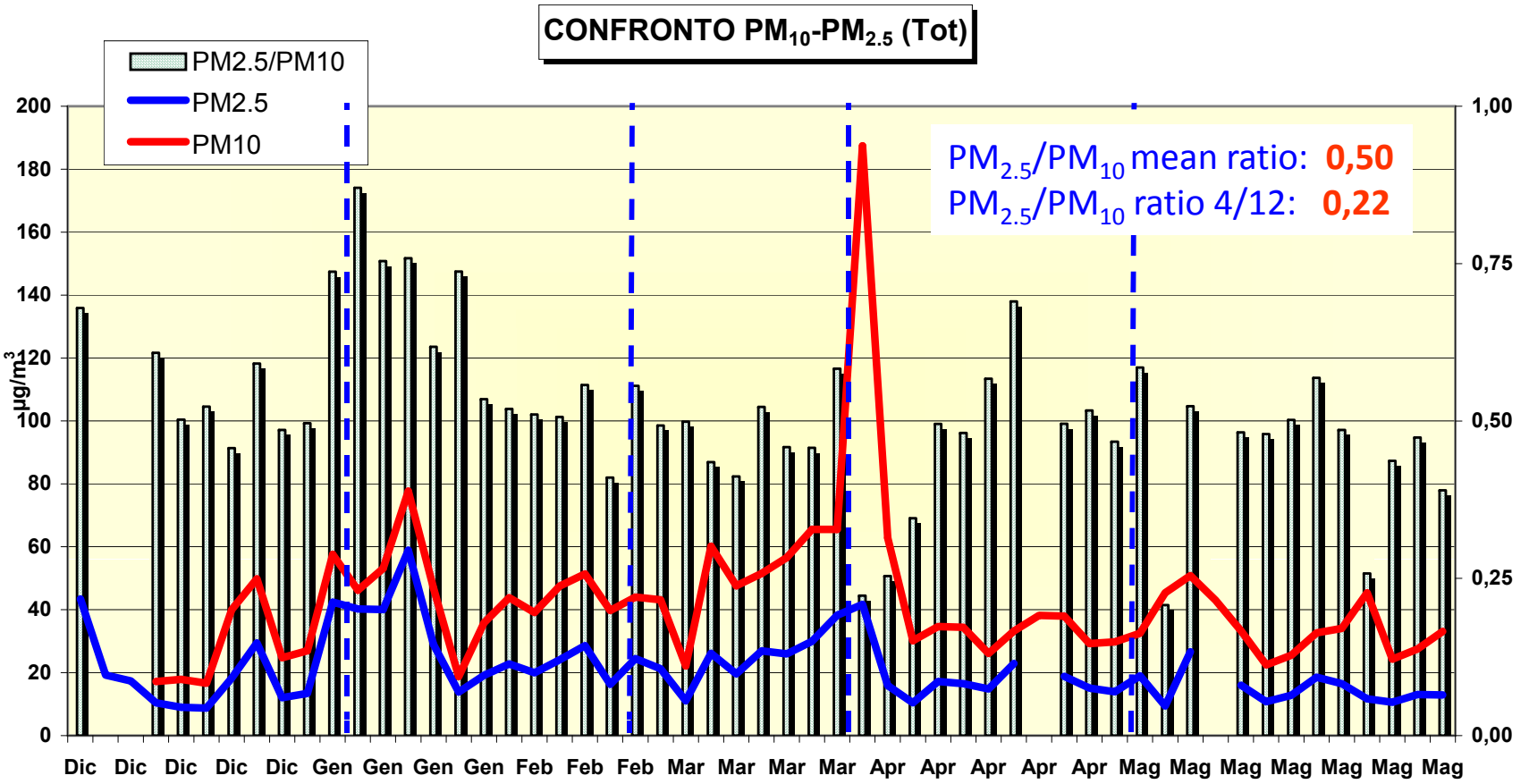
2- Evaluation of $PM_{2.5}/PM_{10}$ mass concentration ratio.

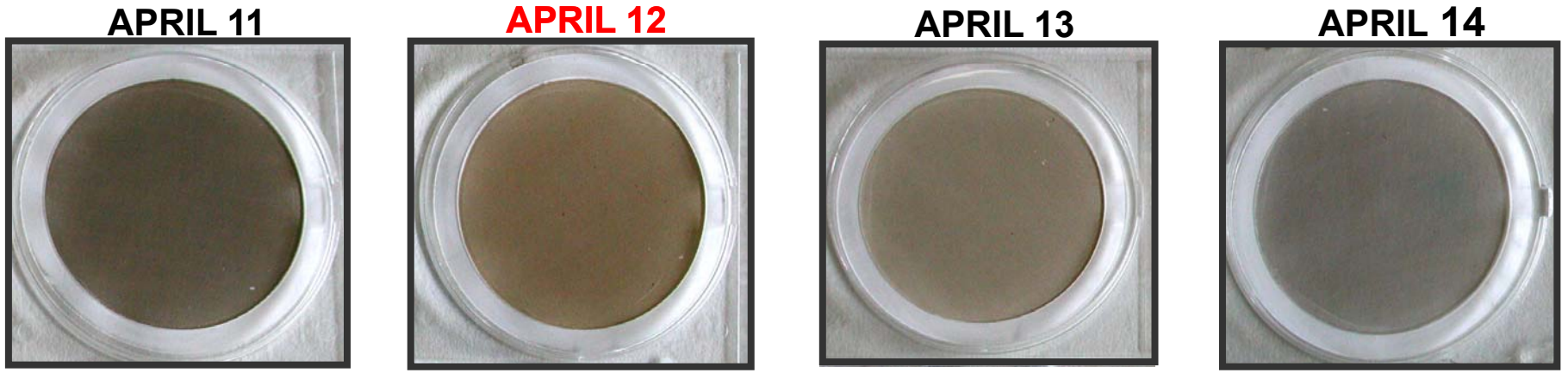
3- A daily collection of the results of the **TOMS** (Total Ozone Mapping Spectrometer) measurements of aerosol index and of the SKIRON model has to be performed to evaluate the possible Sahara/Sahel influence on the PM_{10} levels.

4- meteorological and backwards trajectory analysis.

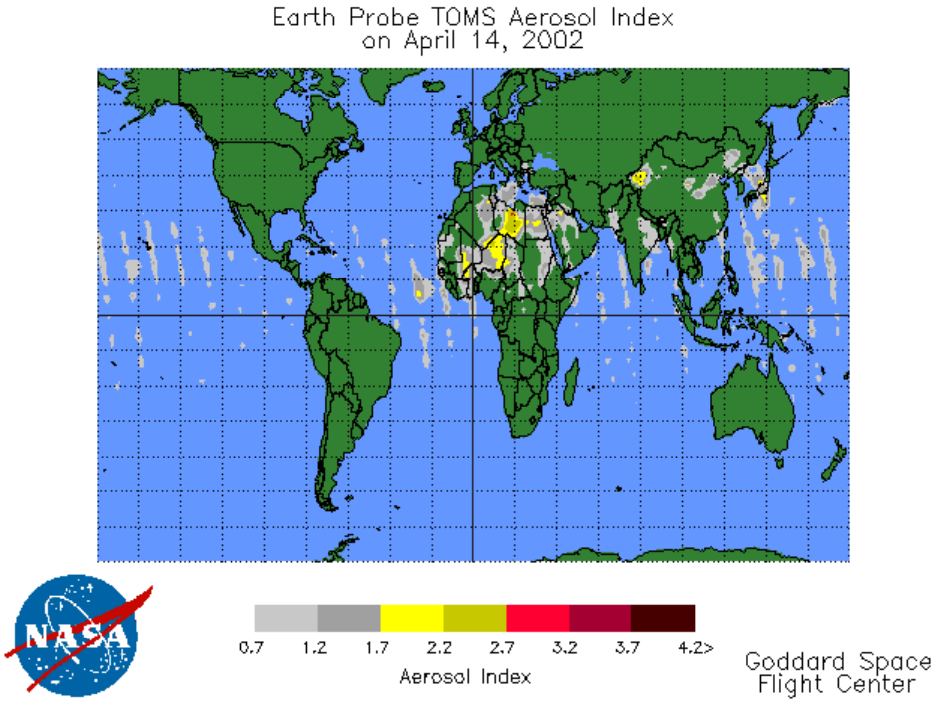
5- Chemical analysis of PM_{10} samples.

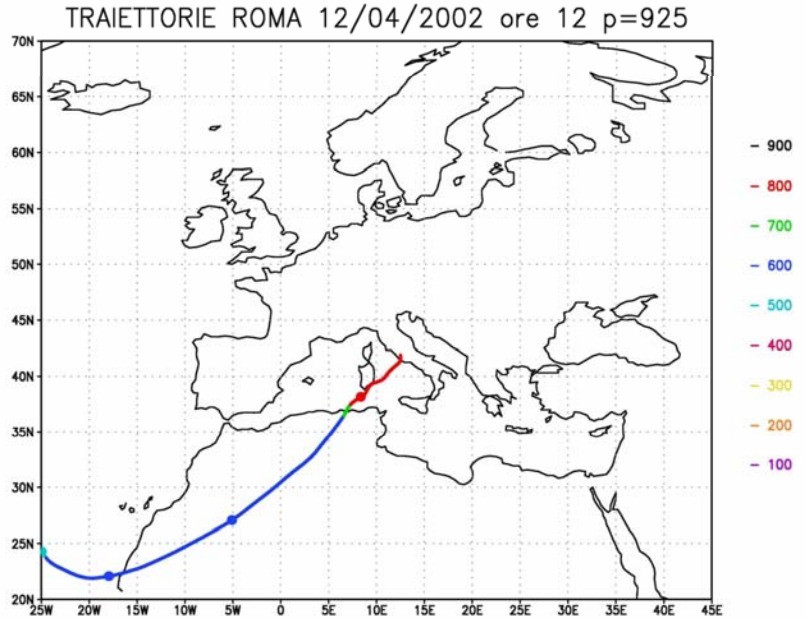
Saharan dust event - April 2002 *Montelibretti* (Rome)





Saharan dust event - April 2002





TOMS Total Ozone Mapping Spectrometer

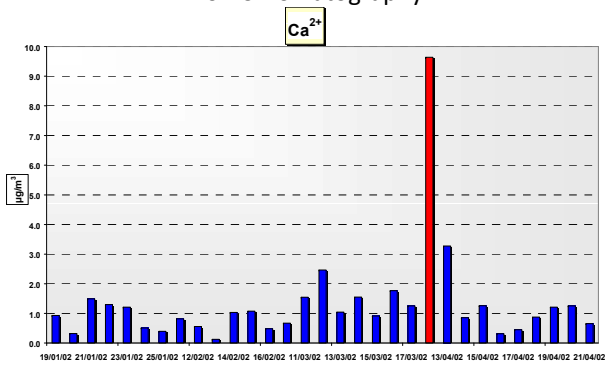
Aerosol Index (A I) UV aerosol absorption (340 and 380 nm)

BACK-TRAJECTORIES

Elemental analysis

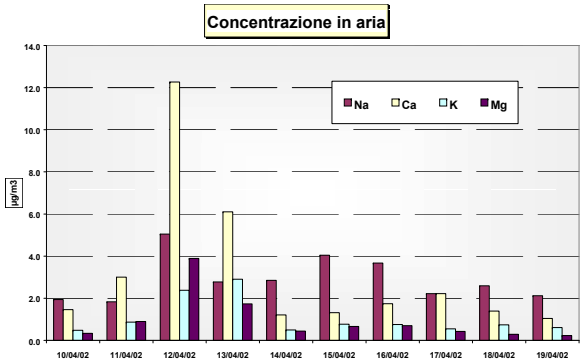
IC analysis

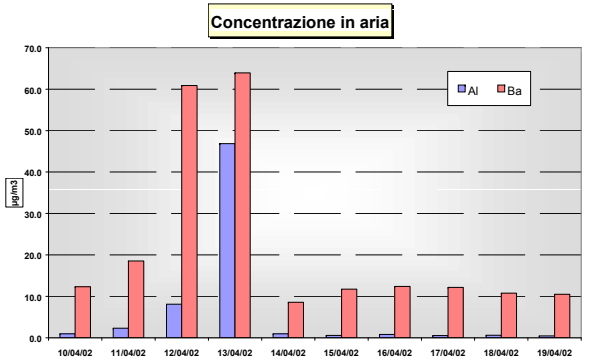
Ion Chromatography



ICP-MS analysis

Inductively Coupled Plasma Mass Spectrometry





Current method for for demonstration and subtraction of exceedances attributable to natural sources

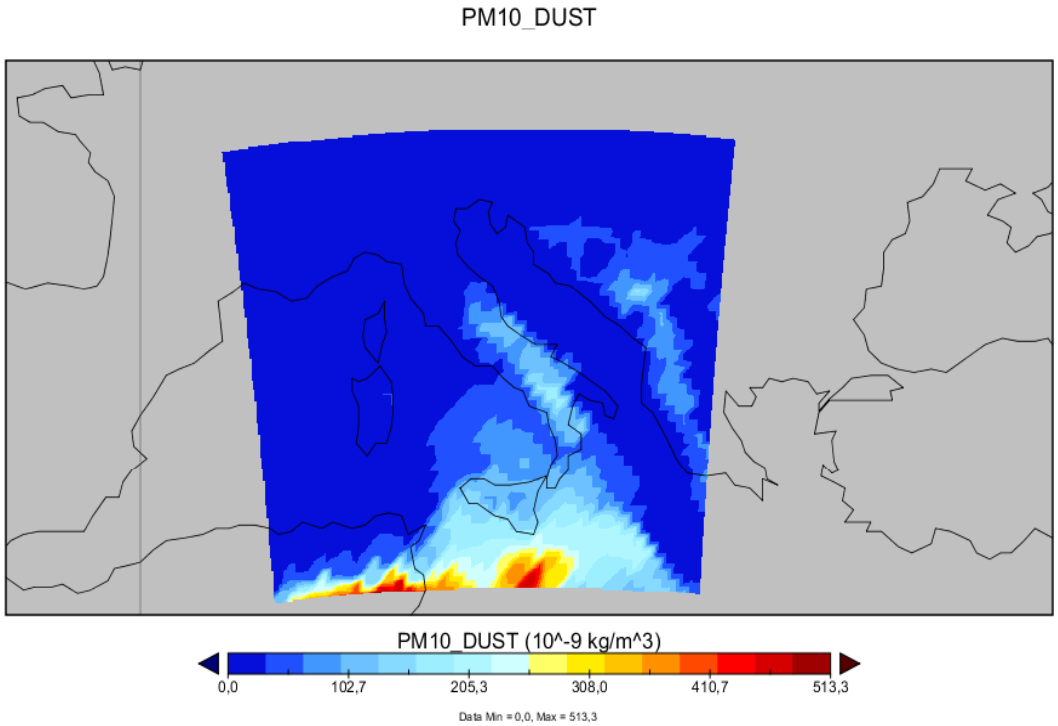
1 - Identifying Saharan dust outbreak episodes;

2 - selection of regional background reference stations;

3 - quantifying Saharan dust contribution in reference stations and daily PM_{10} concentration in stations belonging to regional zones in exceedance;

4 - subtraction of exceedances attributable to natural sources under the Directive 2008/50/EC.

1 - Identifying Saharan dust outbreak episodes

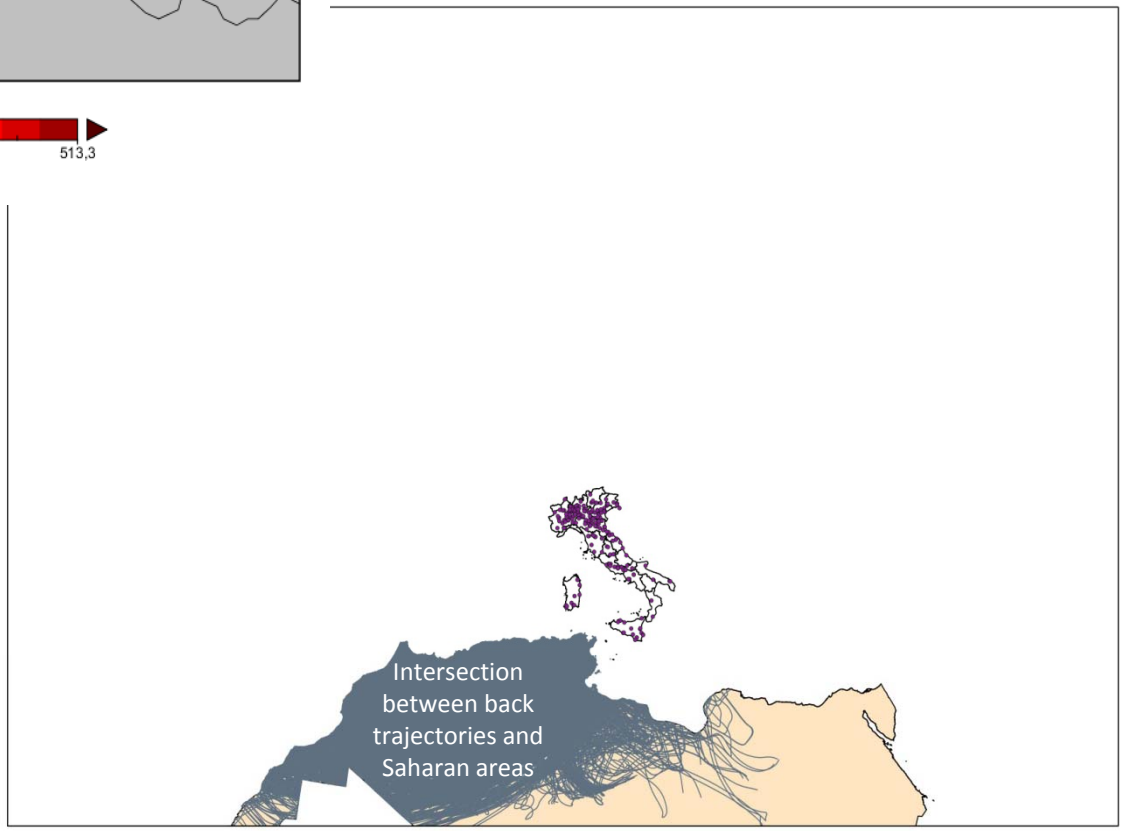


BSC-DREAM forecast

Re-analysed dust concentration data at surface level on a 30x30 km^2 grid

Hysplit on-line tool

Back trajectories at three levels: 750 m, 1500 m, 2500 m



2 - Selection of regional background reference stations

Six criteria that allowed a univocal selection of a reference station for a given area were applied:

1. the maximum overlap between the days of event identified in the Candidate Reference Station (CRS) and the urban station (US) that exceeds the daily EC limit value;

2. the maximum correlation between the data series from the CRS and the considered US;

3. the minimum distance between CRS station and US;

4. the minimum difference in the mean sea level between CRS and US;

5. the maximum data coverage;

6. the minimum midspread (interquartile range).

A different choice of the reference station will significantly change the final evaluation of the Saharan contribution to the number of days that exceeds the EC limit value and if the spatial representativeness of the reference station is low, the real number of episodes is underestimated.

3 - Quantifying Saharan dust contribution in reference stations and PM10 concentration w/o SD events

Station with PM10 exceedances | **Reference station**

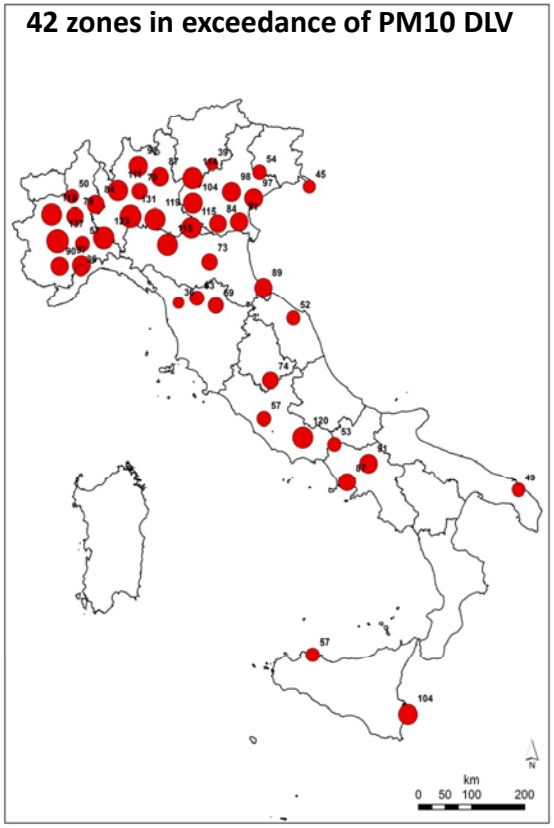
DAY	Rome - C.SO_FRANCIA	C.SO FRANCIA Dream_episodes	Rome - CASTEL_DI_GUIDO	CASTEL DI GUIDO Dream_episodes	Quantification of saharan dust contribution (30_Prc)	Quantification of saharan dust contribution (40_Prc)	Quantification of saharan dust contribution (50_Prc)	Quantification of saharan dust contribution (Avrg)	C. FRANCIA PM10 Quantification30	C. FRANCIA PM10 Quantification40	C. FRANCIA PM10 Quantification50	C. FRANCIA PM10 QuantificationA
03/03/2012	57		35		0,0	0,0	0,0	0,0	57,0	57,0	57,0	57,0
04/03/2012	53		39		0,0	0,0	0,0	0,0	53,0	53,0	53,0	53,0
05/03/2012	44		30		0,0	0,0	0,0	0,0	44,0	44,0	44,0	44,0
06/03/2012	38		20		0,0	0,0	0,0	0,0	38,0	38,0	38,0	38,0
07/03/2012	55		21		0,0	0,0	0,0	0,0	55,0	55,0	55,0	55,0
08/03/2012			34		0,0	0,0	0,0	0,0				
09/03/2012			25		0,0	0,0	0,0	0,0				
10/03/2012	21	1,2	20	0,9	0,0	0,0	0,0	0,0	21,0	21,0	21,0	21,0
11/03/2012	25		16		0,0	0,0	0,0	0,0	25,0	25,0	25,0	25,0
12/03/2012	30		17		0,0	0,0	0,0	0,0	30,0	30,0	30,0	30,0
13/03/2012	29		17		0,0	0,0	0,0	0,0	29,0	29,0	29,0	29,0
14/03/2012	37		21		0,0	0,0	0,0	0,0	37,0	37,0	37,0	37,0
15/03/2012	56		38		0,0	0,0	0,0	0,0	56,0	56,0	56,0	56,0
16/03/2012	60		46		0,0	0,0	0,0	0,0	60,0	60,0	60,0	60,0
17/03/2012	49		35		0,0	0,0	0,0	0,0	49,0	49,0	49,0	49,0
18/03/2012	**31**	**4,5**	**22**	**1,2**	**0,0**	**0,0**	**0,0**	**0,0**	**31,0**	**31,0**	**31,0**	**31,0**
19/03/2012	**43**	**11,1**	**28**	**4,9**	**3,7**	**1,8**	**0,0**	**0,0**	**39,3**	**41,2**	**43,0**	**43,0**
20/03/2012	**48**	**12,4**	**34**	**7,4**	**10,0**	**9,0**	**4,0**	**5,9**	**38,0**	**39,0**	**44,0**	**42,1**
21/03/2012	**54**	**8,4**	**46**	**8,5**	**22,9**	**21,0**	**16,5**	**18,0**	**31,1**	**33,0**	**37,5**	**36,0**
22/03/2012	64		53	2,6	28,6	27,4	22,0	24,6	35,4	36,6	42,0	39,4
23/03/2012	**61**	**3,9**	**53**	**3,4**	**28,0**	**25,6**	**22,0**	**24,2**	**33,0**	**35,4**	**39,0**	**36,8**
24/03/2012	**50**	**5,4**	**47**	**6,3**	**22,9**	**22,0**	**17,5**	**19,3**	**27,1**	**28,0**	**32,5**	**30,7**
25/03/2012	42		31		0,0	0,0	0,0	0,0	42,0	42,0	42,0	42,0
26/03/2012	46		32		0,0	0,0	0,0	0,0	46,0	46,0	46,0	46,0
27/03/2012	36		24		0,0	0,0	0,0	0,0	36,0	36,0	36,0	36,0
28/03/2012	48		32		0,0	0,0	0,0	0,0	48,0	48,0	48,0	48,0
29/03/2012	51		34		0,0	0,0	0,0	0,0	51,0	51,0	51,0	51,0
30/03/2012	48		33		0,0	0,0	0,0	0,0	48,0	48,0	48,0	48,0
31/03/2012	44		31		0,0	0,0	0,0	0,0	44,0	44,0	44,0	44,0
01/04/2012	36		28		0,0	0,0	0,0	0,0	36,0	36,0	36,0	36,0
02/04/2012	37		25		0,0	0,0	0,0	0,0	37,0	37,0	37,0	37,0
03/04/2012	37	2,1	27	1	12,6	10,4	7,5	5,9	24,4	26,6	29,5	31,2
04/04/2012	47	29,4	36	7	23,0	20,0	17,0	15,3	24,0	27,0	30,0	31,7
05/04/2012	61	41	41	20,5	28,0	25,6	23,0	20,8	33,0	35,4	38,0	40,2
06/04/2012	33	15	25	21,2	12,0	10,0	8,0	5,0	21,0	23,0	25,0	28,0
07/04/2012	32	3,3	18	4	5,0	2,8	1,5	0,0	27,0	29,2	30,5	32,0
08/04/2012	16		13		0,0	0,0	0,0	0,0	16,0	16,0	16,0	16,0

[µg/m^3]

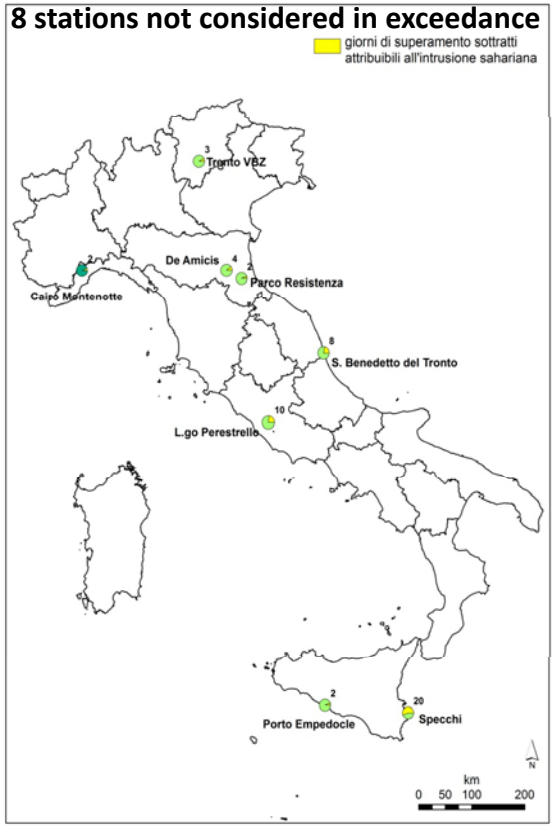
4 - Subtraction of exceedances attributable to natural sources under the Directive 2008/50/EC

Italian regions	2012					
	Saharan dust episodes		Episodes with estimated dust > 0 [µg/m^3]		Dust concentraziotn average value [µg/m^3]	
	Min	Max	Min	Max	Min	Max
Northwest Italy	32	43	18	30	4	21
Northeast Italy	35	62	25	38	10	18
Central Italy	54	77	34	48	7	18
Southern and insular Italy	90	151	53	102	5	12

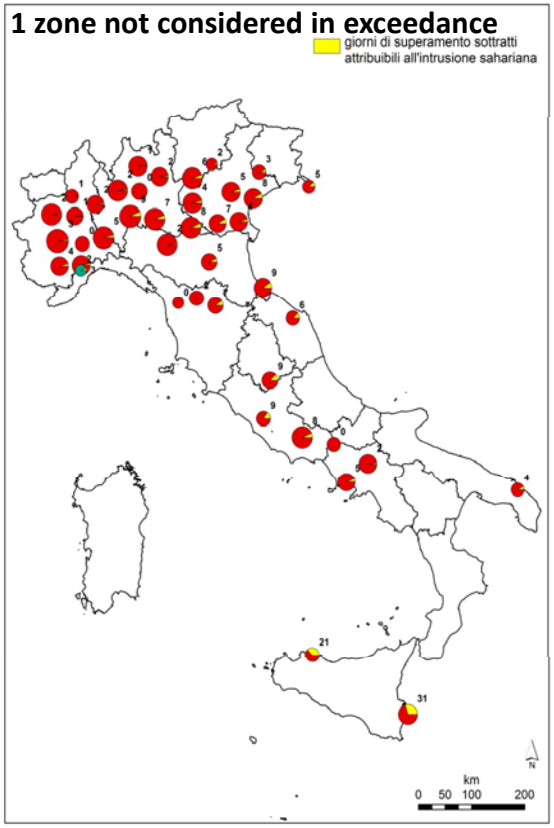
42 zones in exceedance of PM10 DLV



8 stations not considered in exceedance



1 zone not considered in exceedance



Reliability and limitations of the European guidelines

Rural background stations

SPAIN

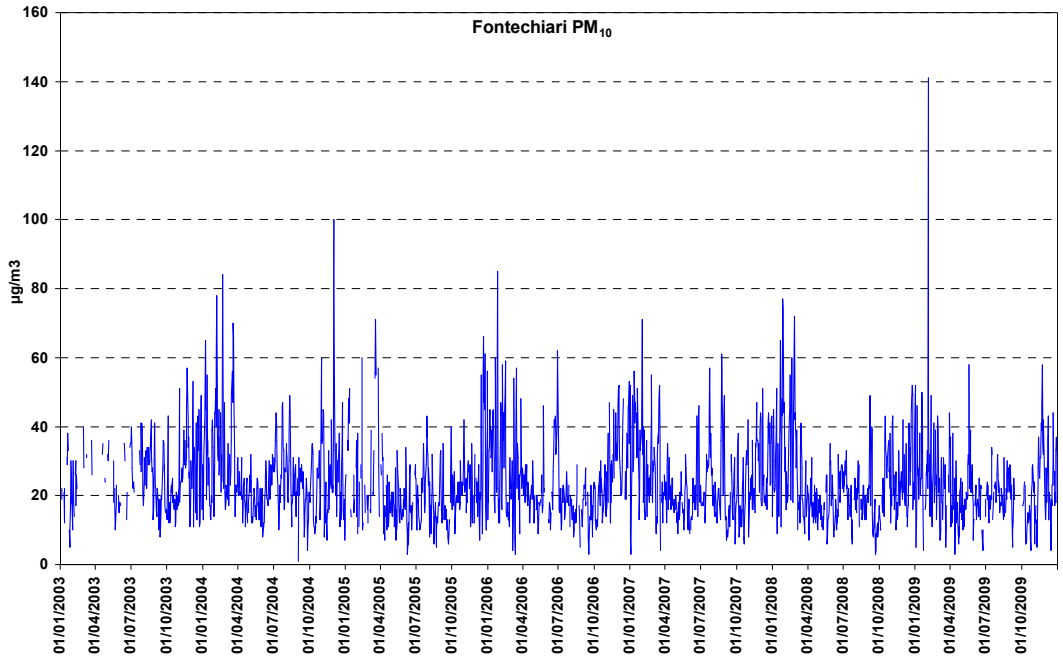
- Background stations from air quality monitoring networks
- EMEP stations with real time measurements
- EMEP stations with gravimetric measurements

Background stations network used for detection of African episodes.

ITALY

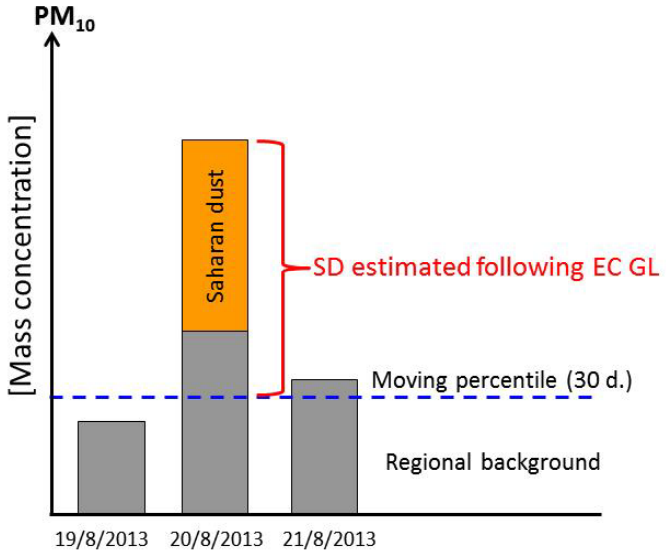
○ **Rural background stations with PM_{10} monitor**

Possible overestimation of Saharan contribution to PM_{10} following the EC GL

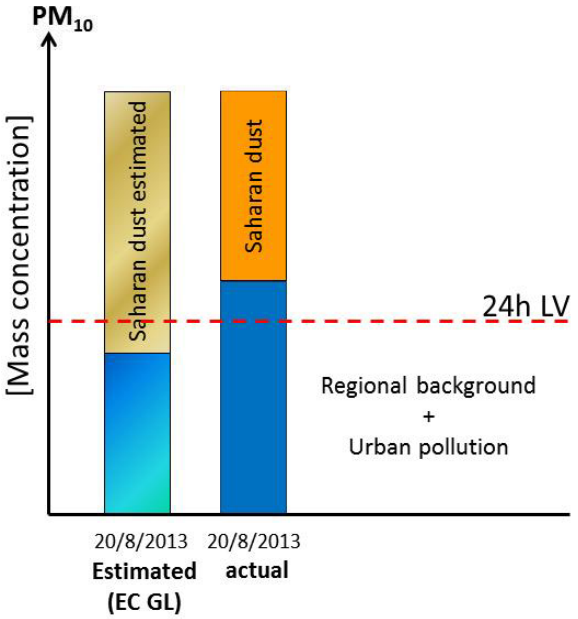


Fontechiari (Lazio)
R-B station

Regional Background station



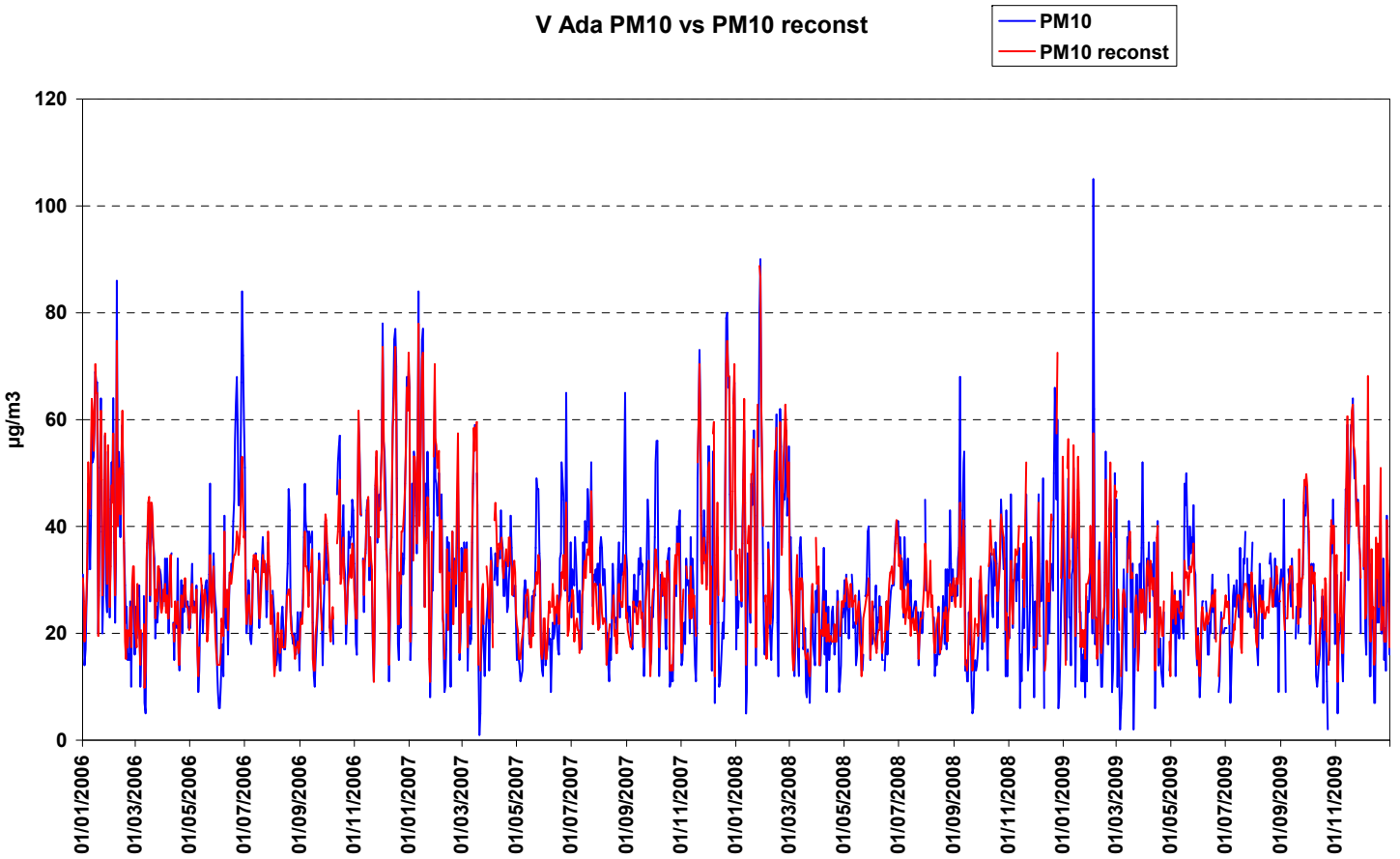
Urban station

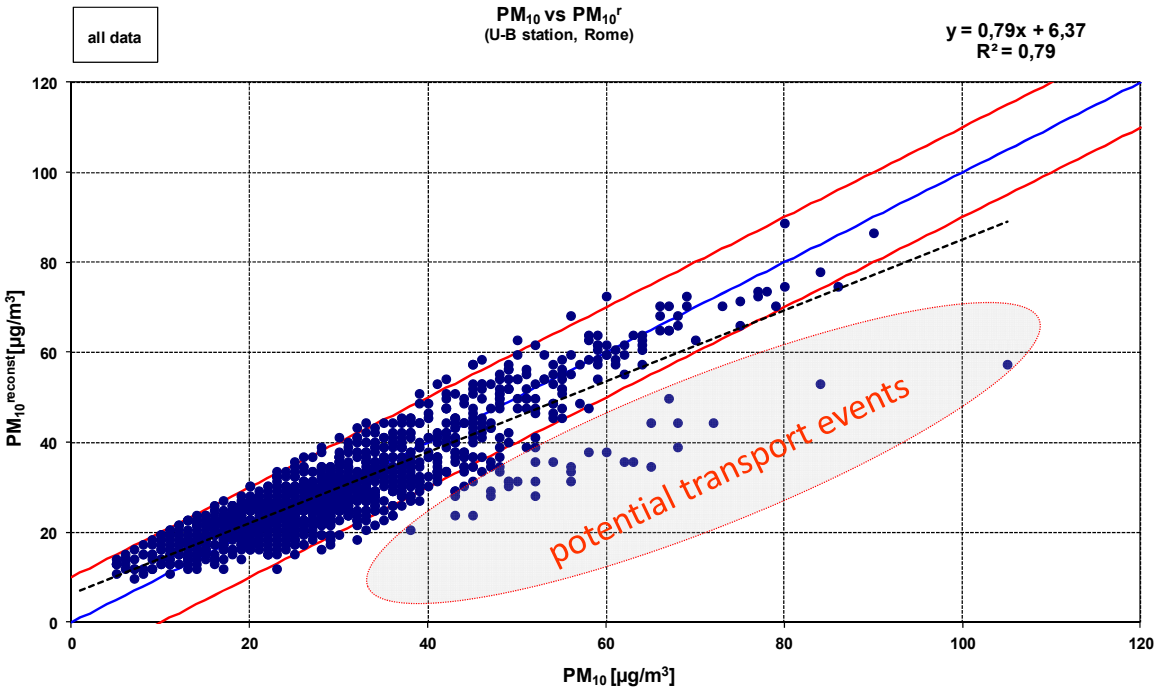


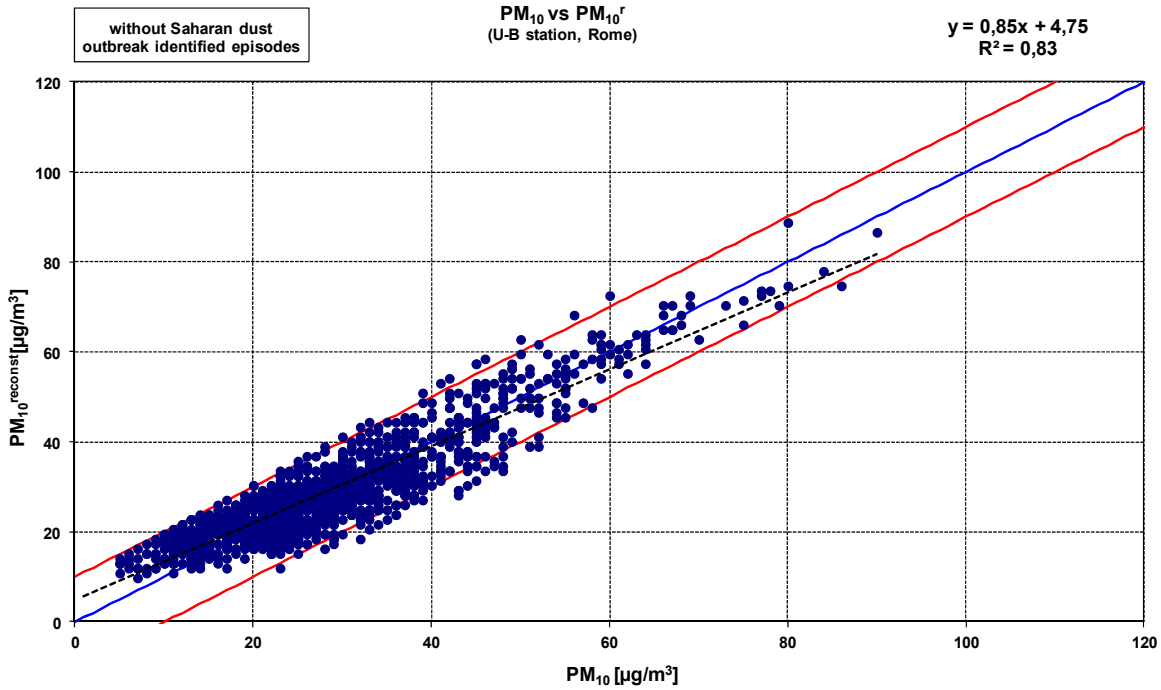
An alternative approach

Simple or multiple regression

- $[PM_{10}]_{w/o\ SD\ episodes} = a[PM_{2.5}] + b$;
- $[PM_{10}]_{w/o\ SD\ episodes} = a[PM_{2.5}] + b[CO] + c[NO] + d[C_6H_6] + f$







Potential transport events vs Dream forecast

V. Ada	PM10	PM10r	Dream	Note
20/06/2006	56	35	Si	
21/06/2006	63	36	Si	
22/06/2006	68	39	Si	
23/06/2006	58	38	Si	
27/06/2006	67	50	Si	
28/06/2006	84	53	Si	
29/06/2006	72	44	Si	
30/06/2006	60	38	Si	
19/08/2006	47	28	Si	
23/05/2007	49	31	Si	
24/05/2007	47	29	Si	
20/06/2007	52	31	Si	
21/06/2007	49	30	Si	
25/06/2007	65	44	Si	
05/07/2007	38	21	No	
29/08/2007	49	31	-	no Dream data
30/08/2007	65	35	-	no Dream data
03/10/2007	52	36	Si	
04/10/2007	56	34	Si	
05/10/2007	56	31	Si	
07/09/2008	68	44	Si	
11/09/2008	52	41	Si	
12/09/2008	54	36	Si	
29/10/2008	43	24	Si	
03/02/2009	105	57	Si	
04/02/2009	62	36	Si	
30/03/2009	52	28	Si	
18/05/2009	50	31	Si	
04/09/2009	45	24	No	

A	H	I	J	K	L	V	W	X	Y	Z	AC	AD	AE	AF	AG	AJ	AK	AL	AM	AN
	¥ Ada	¥ Ada	¥ Ada	y-1,0819x+8,7057	Diff PM10-PM10	Cipro	Cipro	Cipro	y-1,1462x+10,105	Diff PM10-PM10	C Francia	C Francia	Frncia	y-1,2247x+12,381	Diff PM10-PM10	Arenula	Arenula	Arnla	y-1,2821x+11,758	Diff PM10-PM10
data	PM10	PM2.5	2.5/10	PM10 reconst		PM10	PM2.5	2.5/10	PM10 reconst		PM10	PM2.5	2.5/10	PM10 reconst		PM10	PM2.5	2.5/10	PM10 reconst	
06/08/2008		15		25	-25	26	14	0.54	26	0	32	18		34	-2	40	14	0.35	30	10
07/08/2008		17		27	-27	27	13	0.48	25	2	31	18		34	-3	37	17	0.37	31	12
08/08/2008		13		23	-23	26	12	0.46	24	2	30	14		30	0	37	16	0.43	32	5
09/08/2008	23	9	0.39	18	5	27	8	0.30	19	8	33	13	0.39	28	5	36	8	0.22	22	14
10/08/2008	12	7	0.58	16	-4	17	7	0.41	18	-1	16	8	0.50	22	-6	21	10	0.48	25	-4
11/08/2008	16	10	0.63	20	-4	18	11	0.61	23	-5	24	14	0.58	30	-6	35	10	0.29	25	10
12/08/2008	14	12	0.86	22	-8	17	12	0.71	24	-7	34	17	0.50	33	1	28	11	0.39	26	2
13/08/2008	16	13	0.81	23	-7	19	11	0.58	23	-4	30	16	0.53	32	-2		0		12	-12
14/08/2008	25	14	0.56	24	1	25	13	0.52	25	0	29	14	0.48	30	-1	39				
15/08/2008	16	10	0.63	20	-4	25	9	0.36	20	5	33	13	0.39	28	5	15	8	0.53	22	-7
16/08/2008	18	7	0.39	16	2	21	6	0.29	17	4	24	7	0.29	21	3		8		22	-22
17/08/2008	17	9	0.53	18	-1	17	8	0.47	19	-2	22	10	0.45	25	-3		8		22	-22
18/08/2008	20	11	0.55	21	-1	14	10	0.71	22	-8	24	14	0.58	30	-6		12		27	-27
19/08/2008	27	12	0.44	22	5	14	11	0.79	23	-9	30	15	0.50	31	-1	25	9	0.36	23	2
20/08/2008	24	14	0.58	24	0	18	10	0.56	22	-4	29	14	0.48	30	-1	27	11	0.41	26	1
21/08/2008	18	13	0.72	23	-5	24	11	0.46	23	1	37	15	0.41	31	6	29	16	0.55	32	-3
22/08/2008	32	15	0.47	25	7	26	16	0.62	28	-2	31	15	0.48	31	0	54	17	0.31	34	20
23/08/2008	17	12	0.71	22	-5	26	12	0.46	24	2	31	14	0.45	30	1	13	11	0.85	26	-13
24/08/2008	32	9	0.28	18	14	25	7	0.28	18	7	28	9	0.32	23	5	35	10	0.29	25	10
25/08/2008	29	14	0.48	24	5	31	12	0.39	24	7	35	15	0.43	31	4	38	14	0.37	30	8
26/08/2008	30	15	0.50	25	5	22	13	0.59	25	-3	30	15	0.50	31	-1	33	15	0.45	31	2
27/08/2008	43	19	0.44	29	14						36	20	0.56	37		39	19	0.49	36	
28/08/2008	33	17	0.52	27	6						35	20	0.57	37		34	15	0.44	31	
29/08/2008	26	17	0.65	27	-1						35	19	0.54	36		36	21	0.58	39	
30/08/2008	32	19	0.59	29	3	29	19	0.66	32	-3	35	20	0.57	37	-2	40	26	0.65	45	-5
31/08/2008	27	20	0.74	30	-3	25	17	0.68	30	-5	33	20	0.61	37	-4	34	22	0.65	40	-6
01/09/2008	29	16	0.55	26	3	27	16	0.59	28	-1	39	20	0.51	37	2	35	20	0.57	37	-2
02/09/2008	26	15	0.58	25	1	24	21	0.88	34	-10	35	19	0.54	36	-1	36	20	0.56	37	-1
03/09/2008	30	20	0.67	30	0	27	18	0.67	31	-4	38	19	0.50	36	2					
04/09/2008	27	19	0.70	29	-2	27	16	0.59	28	-1	36	19	0.53	36	0	40	21	0.53	39	1
05/09/2008	34	19	0.56	29	5	29	19	0.66	32	-3	42	22	0.52	39	3	40	20	0.50	37	3
06/09/2008	36	23	0.64	34	2	43	15	0.35	27	16	48	19	0.40	36	12	53	30	0.57	50	3
07/09/2008	68	33	0.49	44	24	44	14	0.32	26	18	54	18	0.33	34	20	59	25	0.42	44	15
08/09/2008	33	15	0.45	25	8	27	13	0.48	25	2	47	18	0.38	34	13	36	16	0.44	32	4
09/09/2008	32	19	0.59	29	3	28	12	0.43	24	4	38	18	0.47	34	4	34	18	0.53	35	-1
10/09/2008	43	27	0.63	38	5	38	20	0.53	33	5	55	25	0.45	43	12	54	33	0.61	54	0
11/09/2008	52	30	0.58	41	11	52	23	0.44	36	16	60	25	0.42	43	17	59	35	0.59	57	2
12/09/2008	54	25	0.46	36	18	53	21	0.40	34	19	62	22	0.35	39	23	64	33	0.52	54	10
13/09/2008	12	5	0.38	14	-1	22	5	0.23	16	6	34	10	0.29	25	9	29	10	0.34	25	4
14/09/2008	15	5	0.33	14	1	20	6	0.30	17	3	37	8	0.30	22	5	21	7	0.33	21	0
15/09/2008	11	4	0.36	13	-2	10	6	0.60	17	-7	18	8	0.44	22	-4	16	8	0.50	22	-6
16/09/2008	11	6	0.55	15	-4	6	6	1.00	17	-11	18	11	0.61	26	-8	14	7	0.50	21	-7
17/09/2008	24	10	0.42	20	4	9					26	17	0.65	33		16	12	0.75	27	
18/09/2008	18	15	0.83	25	-7	15	13	0.87	25	-10	35	25	0.71	43	-8					
19/09/2008	25	20	0.80	30	-5	24	20	0.83	33	-9	40	26	0.65	44	-4	33	20	0.61	37	-4
20/09/2008	10	10	1.00	20	-10	15	9	0.60	20	-5	23	10	0.43	25	-2	17	11	0.65	26	-9
21/09/2008	5	4	0.80	13	-8	11	4	0.36	15	-4	20	7	0.35	21	-1	11	6	0.55	19	-8
22/09/2008	6	6	1.00	15	-9	13	6	0.46	17	-4	19	9	0.47	23	-4	14	8	0.57	22	-8
23/09/2008	14	10	0.71	20	-6	19	11	0.58	23	-4	28	15	0.54	31	-3	20	12	0.60	27	-7
24/09/2008	15	13	0.87	23	-8	20	12	0.60	24	-4	27	16	0.59	32	-5	22	17	0.77	34	-12
25/09/2008	13					17	12	0.71	24		26	16	0.62	32		20	15	0.75	31	
26/09/2008	14	12	0.86	22	-8	13	11	0.85	23	-10	24	14	0.58	30	-6	18	12	0.67	27	-9
27/09/2008	17	10	0.59	20	-3	8	7	0.88	18	-10	18	12	0.67	27	-9	18	10	0.56	25	-7
28/09/2008	20	12	0.60	22	-2	13	11	0.85	23	-10	29	15	0.52	31	-2	21	13	0.62	28	-7
29/09/2008	30	18	0.60	28	2	24	18	0.75	31	-7	37	21	0.57	38	-1					
30/09/2008	25	22	0.88	33	-8	46	18	0.39	31	15	43	22	0.51	39	4	35	21	0.60	39	-4
01/10/2008	21	17	0.81	27	-6						40	21	0.53	38		34	22	0.65	40	
02/10/2008	17	15	0.88	25	-8	33	14	0.42	26	7	40	17	0.43	33	7	33	17	0.52	34	-1
03/10/2008	21	9	0.43	18	3	27	11	0.41	23	4	35	14	0.40	30	5	26	12	0.46	27	-1
04/10/2008	22	9	0.41	18	4		11		23	-23	32	15	0.47	31	1	21	9	0.43	23	-2
05/10/2008	24	13	0.54	23	1	19	14	0.74	26	-7	27	16	0.59	32	-5	25	15	0.60	31	-6
06/10/2008	27	17	0.63	27	0	23	17	0.74	30	-7	36	21	0.58	38	-2	30	17	0.57	34	-4
07/10/2008	20	17	0.85	27	-7	27	17	0.63	30	-3	37	21	0.57	38	-1	35	19	0.54	36	-1

Copernicus Atmosphere Monitoring Service (CAMS) and remote sensing of particulate pollution from space

Satellite observations are a crucial input to the **MACC-II** systems in order to produce services in NRT and in delayed-mode.

Satellite observations assimilated in the global NRT MACC-II system

Instrum.	Satellite	Space Agency	Data Provider	Species	Status*
MODIS	EOS-Aqua, -Terra	NASA	NASA	AOD, FRP	A
MLS	EOS-Aura	NASA		O_3 profile	A
OMI	EOS-Aura	NASA	KNMI	O_3, NO_2, SO_2	A
SBUV-2	NOAA-16, 17, 18, 19	NOAA	NOAA	O_3 profile	A
IASI	METOP-A	EUMETSAT/CNES	ULB/LATMOS	CO	A
MOPITT	EOS-Terra	NASA	NCAR	CO	A
GOME-2	METOP-A, -B	EUMETSAT/ESA	DLR	O_3	A
GOME-2	METOP-A, -B	EUMETSAT/ESA	DLR	NO_2, SO_2	M
IASI	METOP-B	EUMETSAT/CNES	ULB/LATMOS	CO	M
SEVIRI	METEOSAT	EUMETSAT	LandSAF	O_3, FRP	M
Imager	GOES-11, -12	NOAA	UCAR	FRP radiances	M
CALIOP	CALIPSO	NASA		lidar backscat.	P
OMPS	Suomi NPP	NASA		O_3	P
IASI	METOP-A, -B	EUMETSAT/CNES	EUMETSAT	O_3 radiances	P
Imager	MTSAT-2	JMA	JMA	FRP radiances	P
VIIRS	Suomi NPP	NASA		AOD, FRP	P
SEVIRI	MSG	EUMETSAT	ICARE	AOD	P

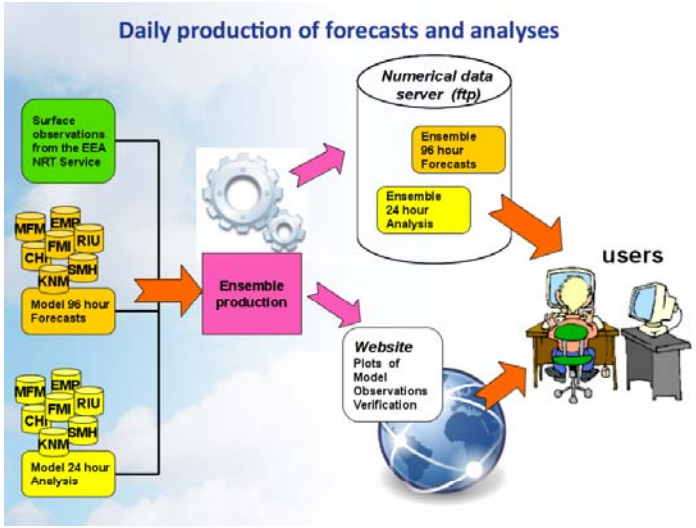
* A = Active assimilation; M = passive monitoring ; P = implementation is planned.

MACC III products (daily over Europe)

- Ensemble analyses and forecasts : 4-days forecasts of ozone (**O_3**), nitrogen dioxide (**NO_2**), sulphur dioxide (SO_2), carbon monoxide (**CO**), particulate matters with size below 10 mm (**PM10**) and below 2.5 mm (**PM2.5**) at surface, at 500m, 1000m and 3000m altitude.
- EPSgrams: 4-days forecasts of **O_3, NO_2, SO_2** and **PM10** at the location of **41 major European cities** and their uncertainty via EPSgrams plots.
- Individual analyses: Hourly analyses at surface for the past 24 hours from the 7 production.
- Individual forecasts: 4-days forecasts of **O_3, NO_2, SO_2, CO, PM10** and **PM2.5** at surface, at 500m, 1000m and 3000m altitude on an hourly basis from the seven models.
- RAQ near real time observations: hourly observations **O_3, NO_2, SO_2, CO, PM10** for the day before, collected from the EEA NRT service.
- Verification of the forecasts and analyses against European surface station observations for **O_3, NO_2, SO_2, CO** and **PM10**: maps and statistical indicators.
- Zooms over Mediterranean areas from the MACC Ensemble and from higher horizontal resolution models over Spain and Greece

These data are available in a large European domain at the resolution 0.1x0.1° in Netcdf or Grib-Edition2 format.

The products available in Nearly Real Time (NRT) for **today** and the **past 4 days** are :
- Each day, model forecasts until 96h by 1h-step, and hourly analyses of the day before.
- Products are available at the **vertical levels** : **surface, 50, 250, 500, 1000, 2000, 3000, 5000 meters**.
- The pollutant parameters are **O3, CO,NO2, SO2, PM2.5**, **PM10, NO, NH3, NMVOC**, and **PANs** and **birch pollen** (during pollen season, from 1st of March until 30 June).



Possibly useful MACC products for air quality

To best describe the relationship between the optical thickness and columnar aerosol concentrations in the soil particle will be useful to have **AOD data** at frequency of 550 nm, on a grid of **1 km x 1 km** centered on Italy, all the days of the year.

EC-LIFE project DIAPASON

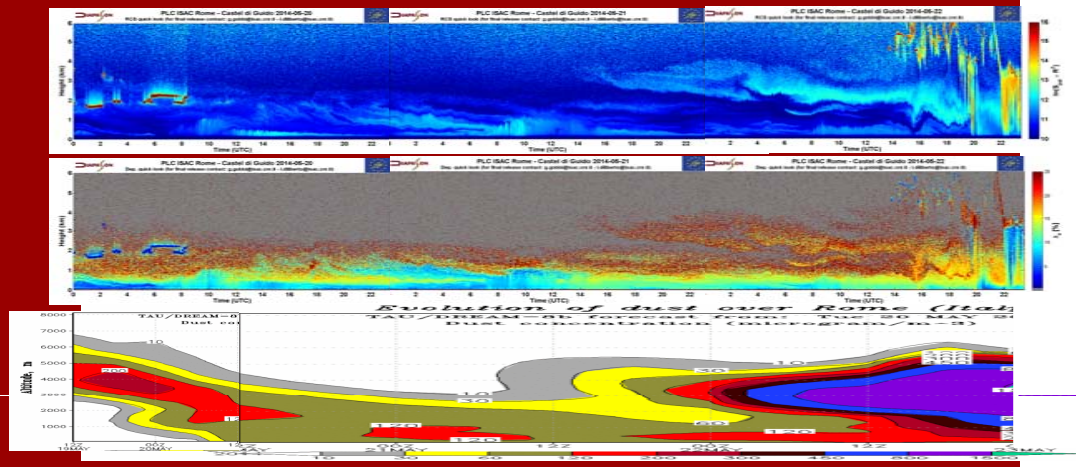
(Desert dust Impact on Air quality through model-Predictions and Advanced Sensors ObservatioNs)

www.diapason-life.eu

LIFE+10 ENV/IT/391

DIAPASON:

- Aims at improving the analysis and observational tools suggested by the EC Directive 2008/50/EC and relevant Guidelines (2011) to assess desert dust contribution to PM ;
- Is a "Networking Partner" of MACC (ECMWF, Reading, UK) and employs Model Dust-Forecasts as a "co-flag" to identify Saharan dust advections;
- Developed and networked automated "Polarization Lidar-Ceilometers, PLCs" to certify the presence of Saharan dust advections over a region.

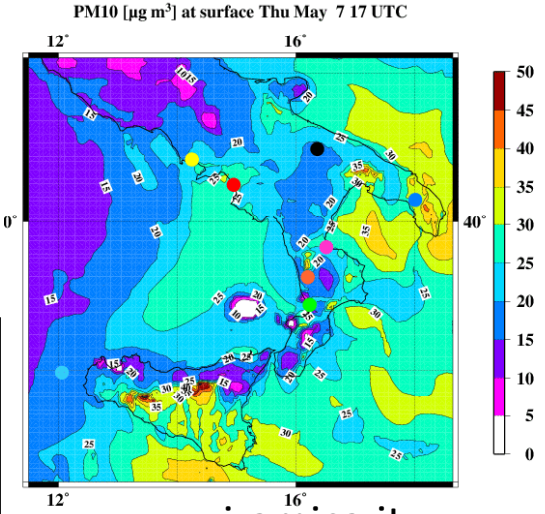


INFRASTRUTTURA DI ALTA TECNOLOGIA
PER IL MONITORAGGIO INTEGRATO CLIMATICO-AMBIENTALE

I-AMICA
INFRASTRUTTURA DI ALTA TECNOLOGIA PER IL MONITORAGGIO INTEGRATO CLIMATICO-AMBIENTALE

I-AMICA project has reinforced the observational activities in Convergence Regions (i.e. southern Italy).

A task of this project deals with the detection of <u>Saharan dust episodes</u> and their impact on PM_{10} levels by using eulerian modeling system, ground based measurements and satellite data.



www.i-amica.it

MACC products (i.e. Boundary Conditions) can improve the modeling simulations performed by using WRF-CHIMERE

At the moment are available for CHIMERE 2014

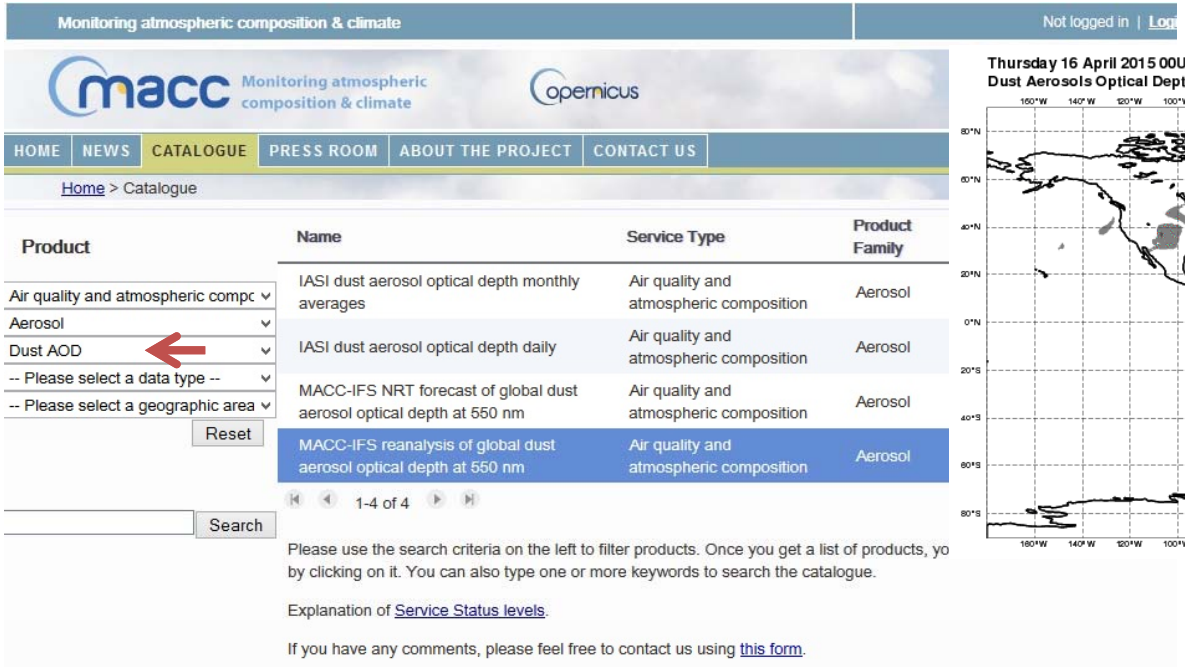
GOCART **<u>monthly</u>**

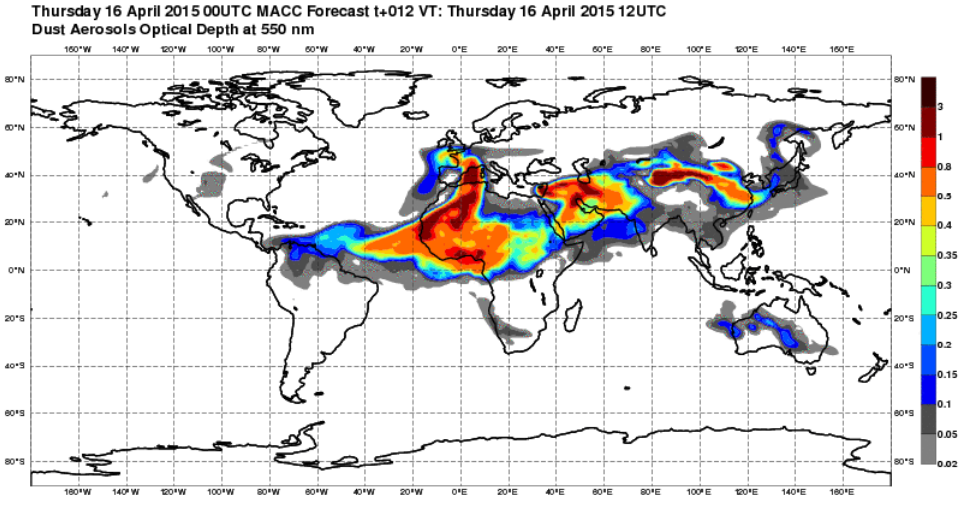
LMDz-INCA **<u>monthly</u>**

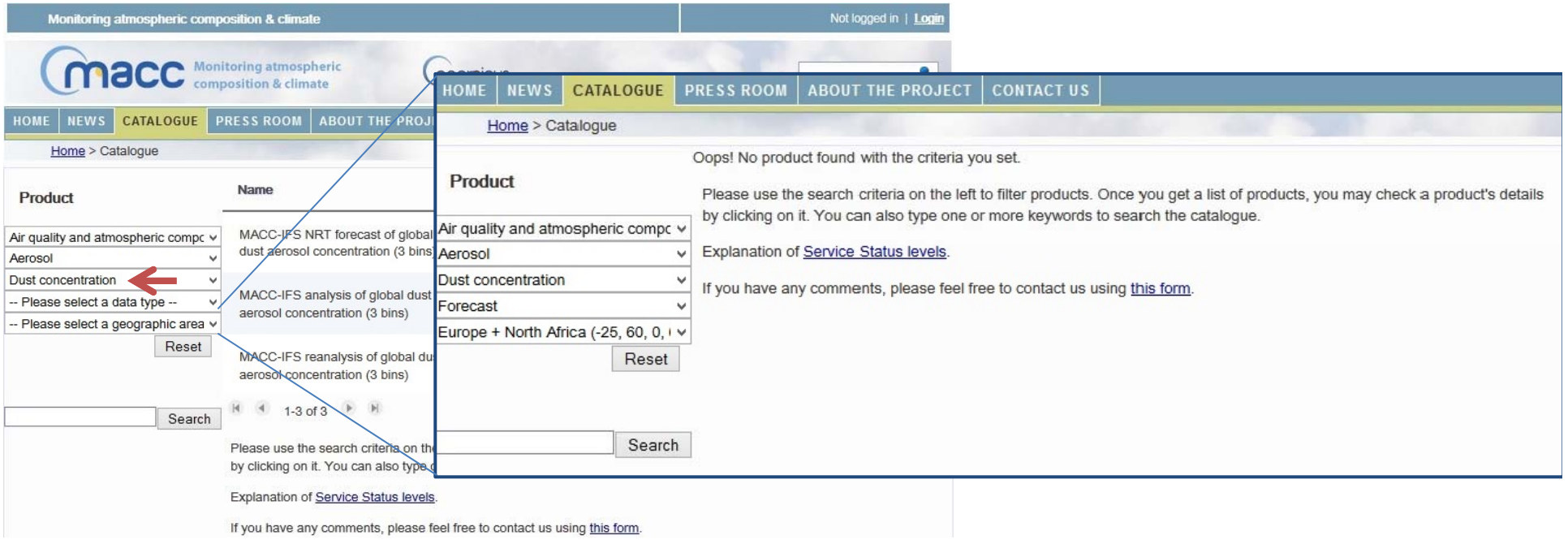
MACC **<u>monthly</u>**

It would be useful make available also MACC <u>hourly</u> only DUST and or other species as well for a better simulation of aerosols and gas levels even during a Saharan dust episodes

MACC III products







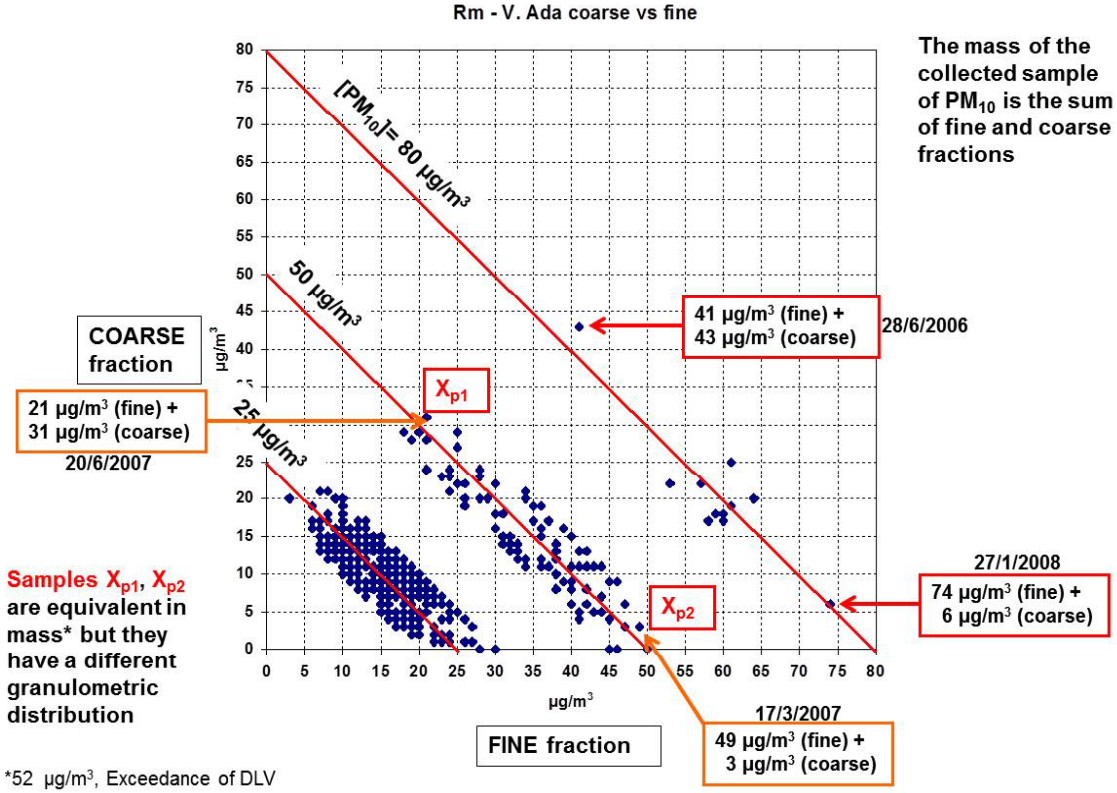
Use of AOD to assess ground-based concentrations

$PM_{2.5}$/AOD relationships AOD is correlated with ground-based $PM_{2.5}$ mass. Assuming **cloud-free skies, well-mixed boundary layer of height (*H*) with no overlying aerosols, and aerosols that have similar optical properties**.

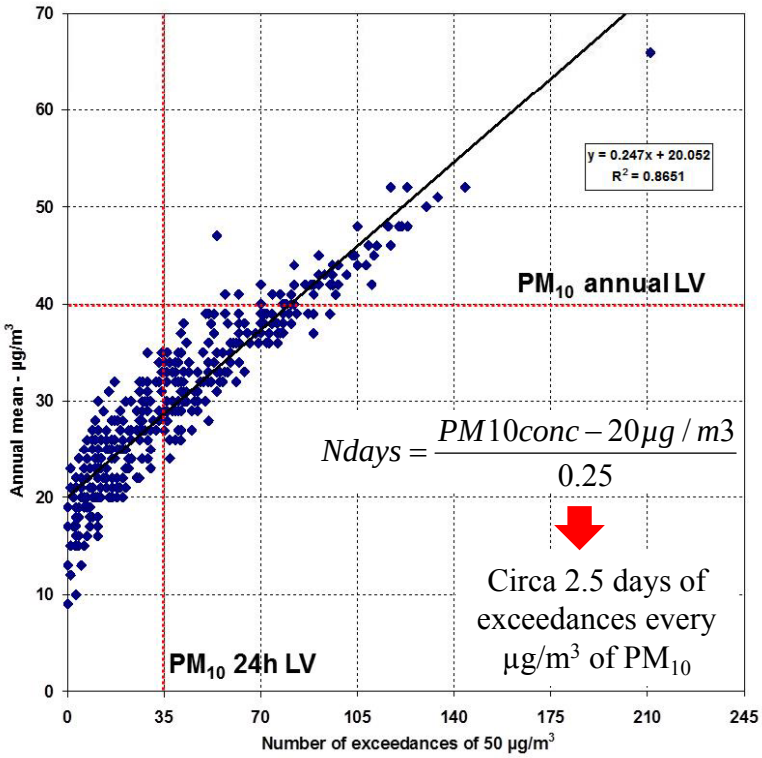
Aerosols provide a difficult challenge because the **intrinsic** (or microphysical) property of the pollutant is not constant. For aerosols, the **composition, sizes, indices of refraction, and hydration properties are not constant**.

Not only do the **extrinsic properties** (i.e., the number of particles per cubic meter, the height of the mixed layer, the profile, etc.) have to be known, but also the $PM_{2.5}$ (or PM_{10}) intrinsic property differences (composition, size distribution, density, indices of refraction, hygroscopicity).

Equivalence between particulate matter samples



PM_{10} in Italy: concentrations and EC LV (2008)



Conclusions

- At the present time, no satellite measurements have been used to quantitatively address Air Quality standards.

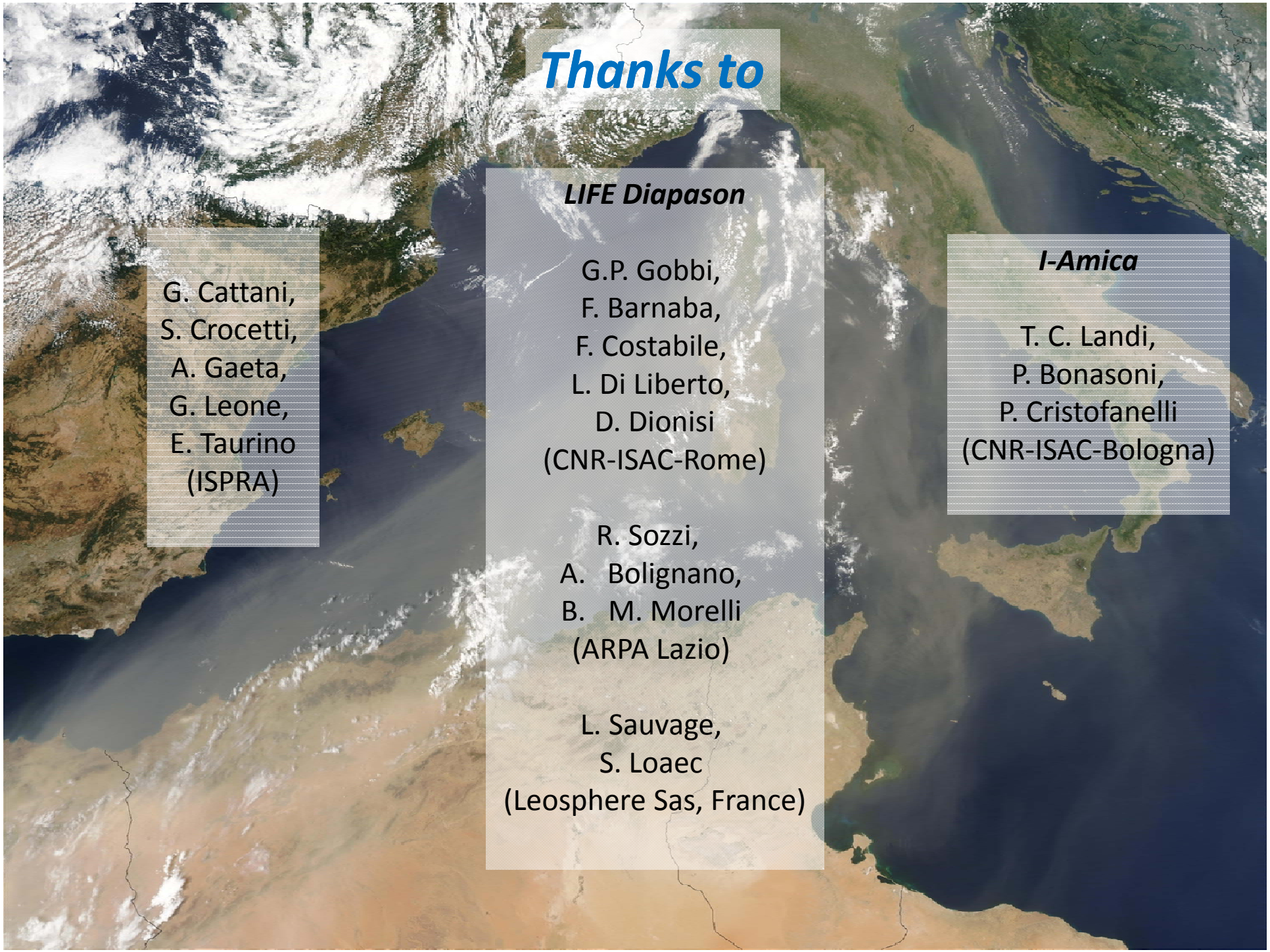
- Precision in measuring is fundamental: i.e for AOD is **20%**, and the relationship to **PM2.5** is **at best 30%**. **This is not currently sufficient for regulatory use**.

- A spatial resolution of **10 km^2** is **coarse compared with that needed for estimating human exposure conditions**.

- The primary regulatory option for these producs is the identification of **natural events** like wildfires or dust storms.

- There are portions of Italy that have no continuous monitors and most of the AQ monitors are urban-based. Satellite imagery coupled with ground information is useful for **qualitatively assessing PM** and **filling in the gaps** where there are no ground monitors or minimal coverage.

- Ground-based measurements, models, and satellite measurements should be viewed as a system, each component of which is necessary to better understand air quality. Combining multiple measurements and models improves the understanding of the measurement and improves the precision.



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