“Capacity Building and Strengthening Institutional Arrangement”

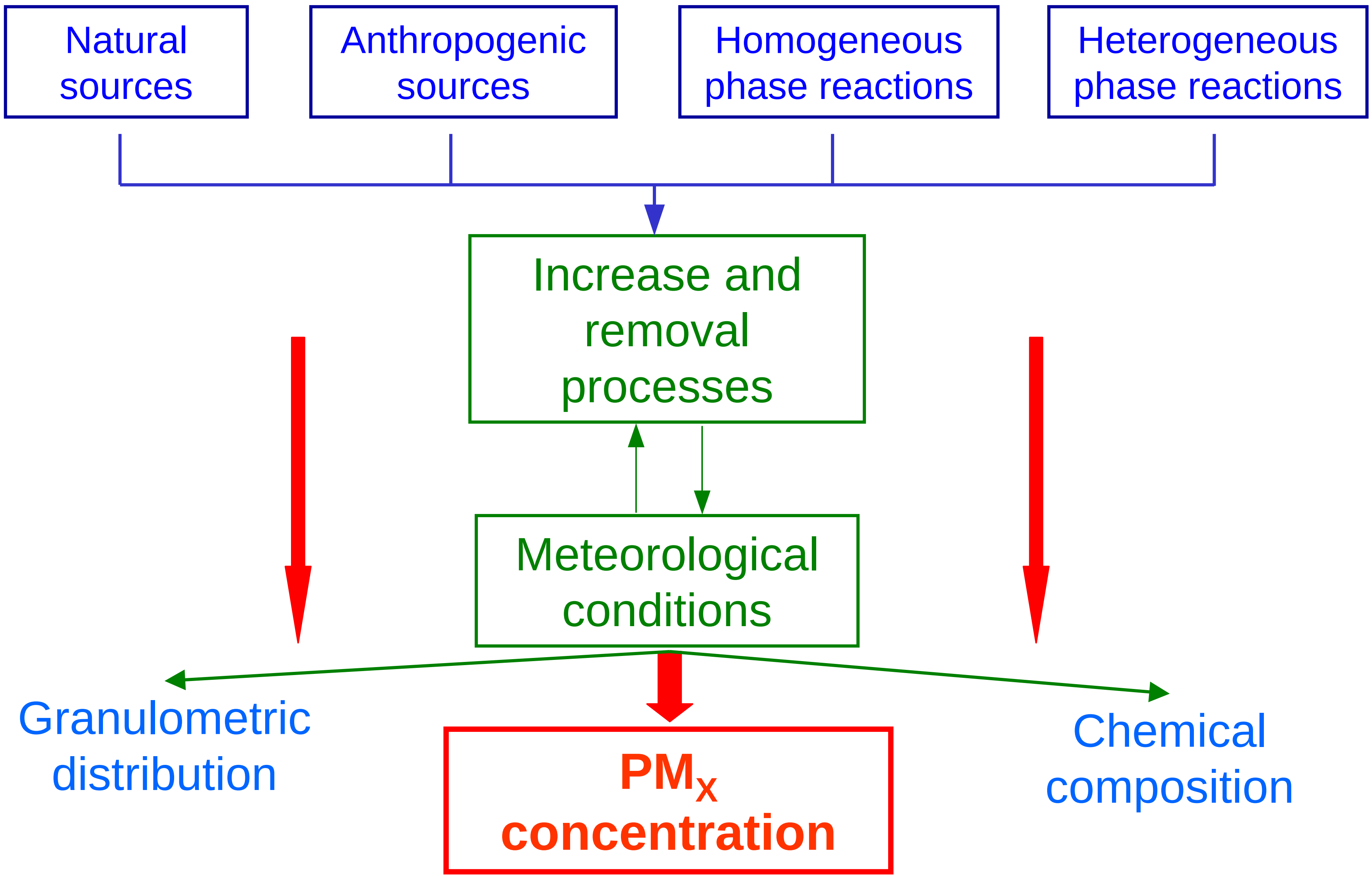
Analysis and sampling of air and air pollution

Evaluation of pollutants

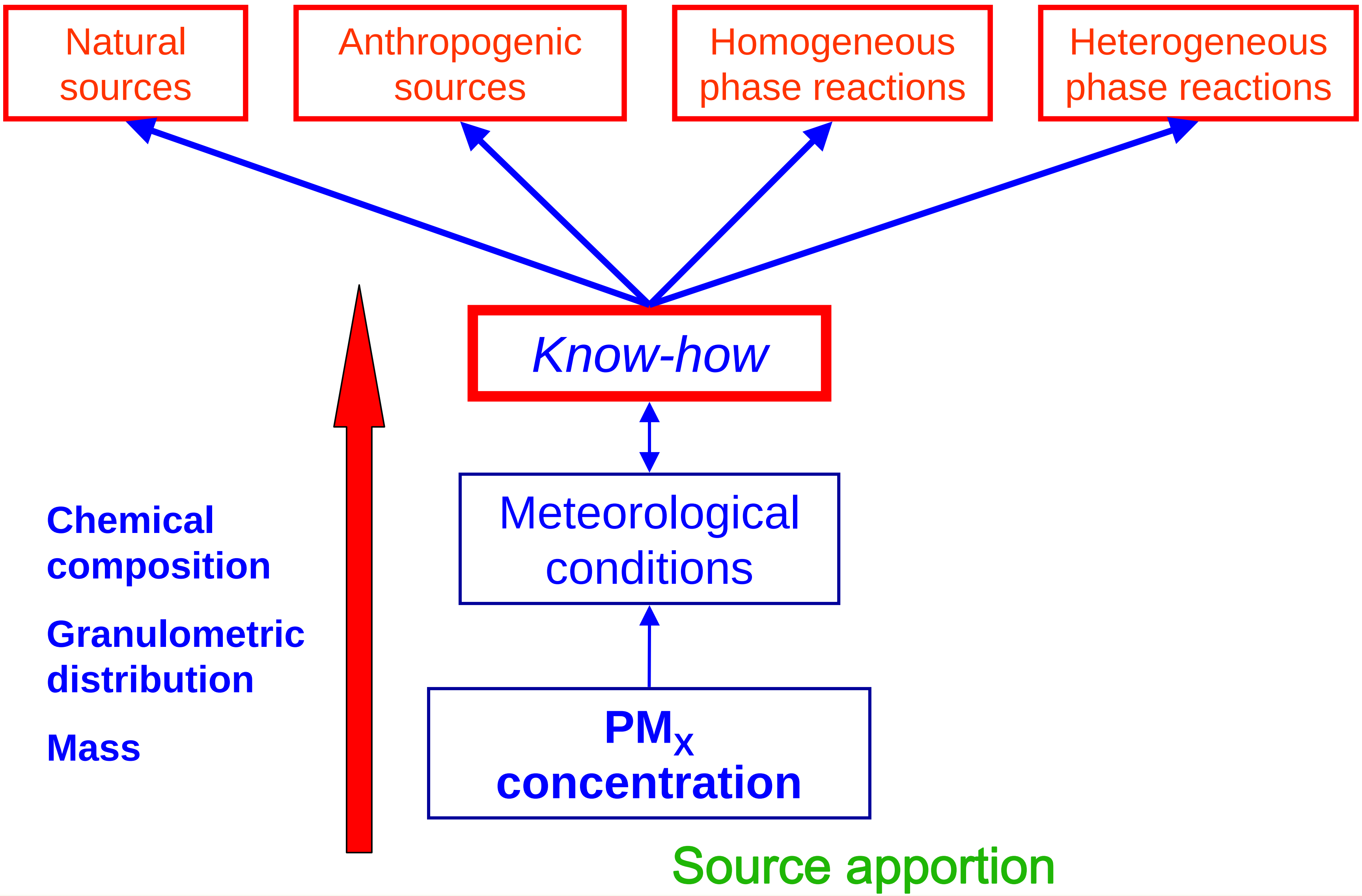
Mr. Alessandro Di Menno Di Bucchianico

APAT

Agency for Environmental Protection and Technical Service

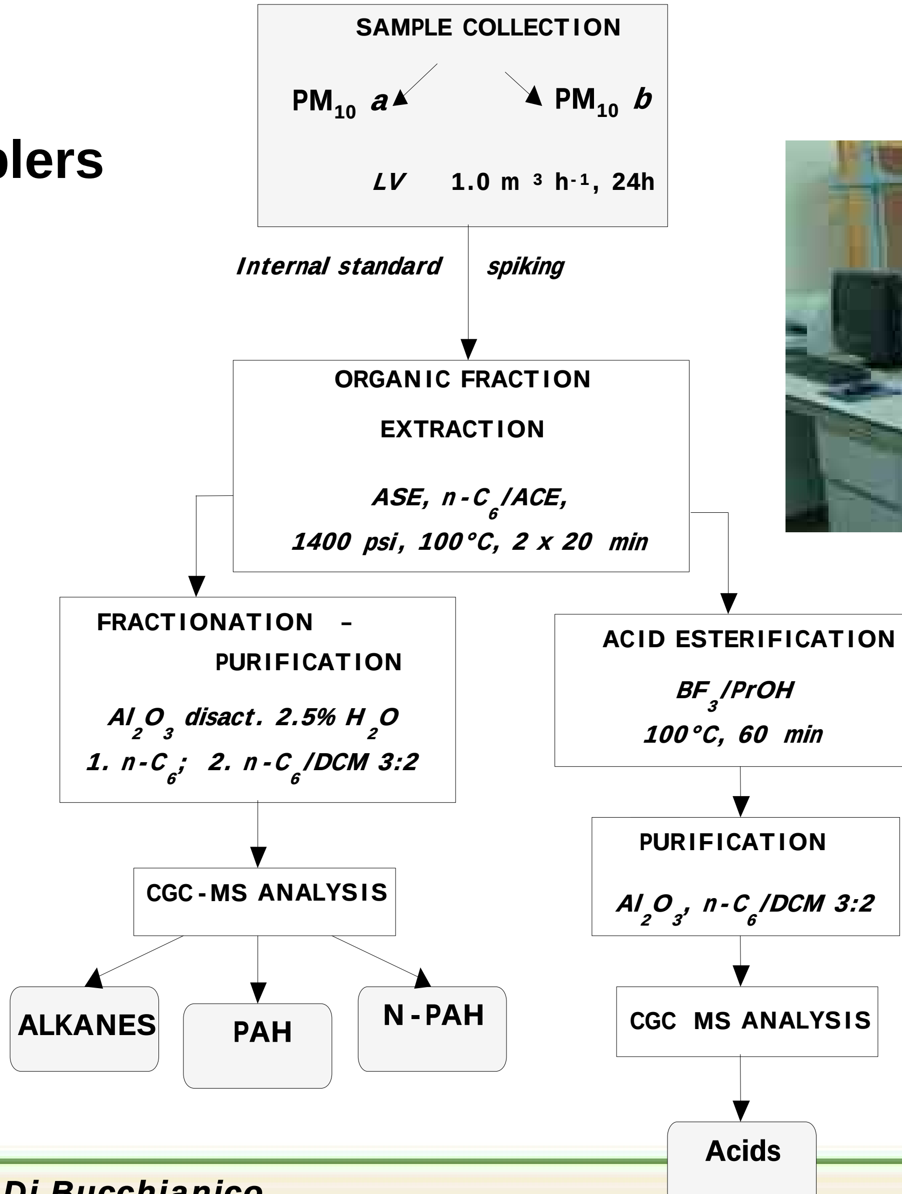


PM_X in the environment

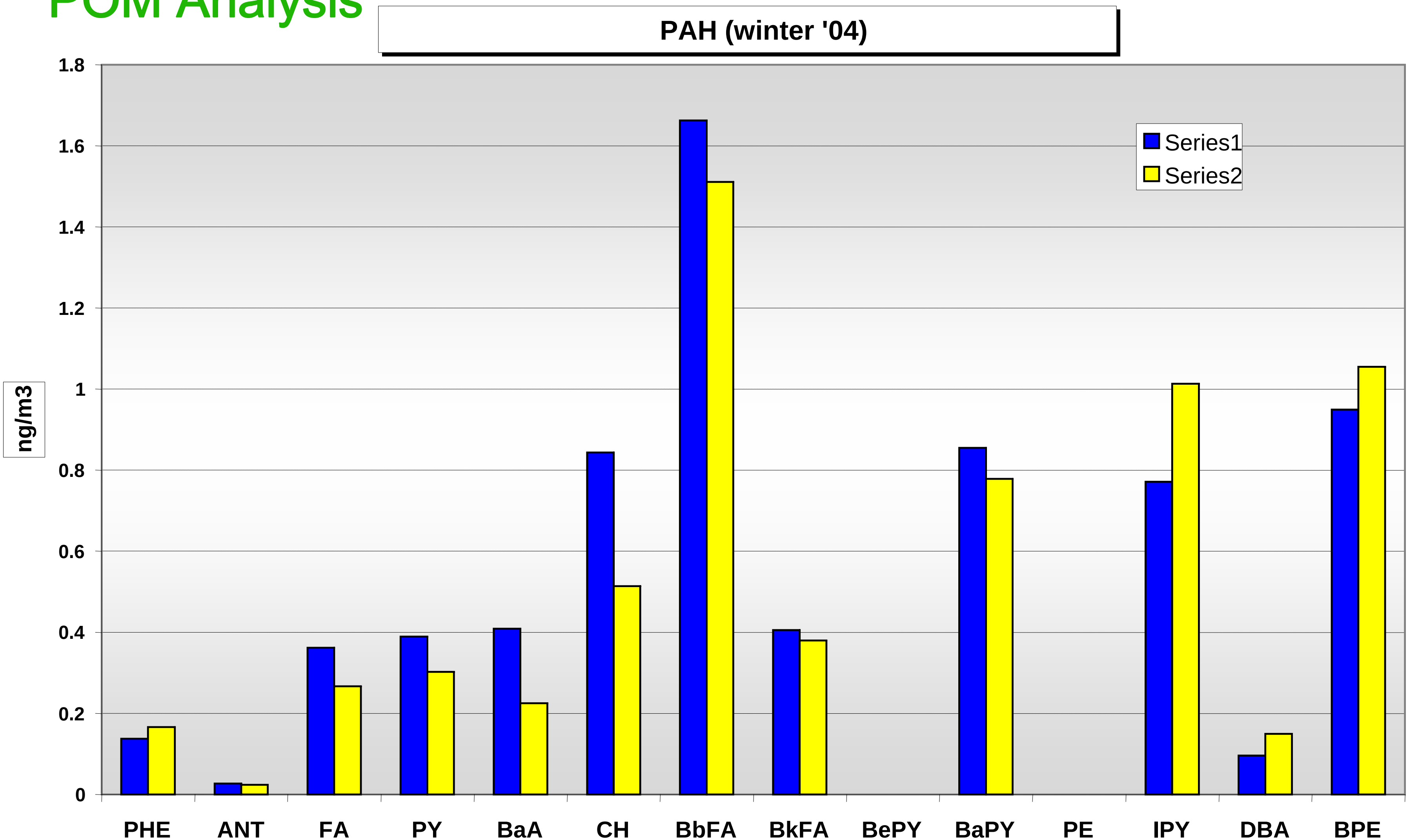

Natural sources
Anthropogenic sources
Homogeneous phase reactions
Heterogeneous phase reactions
Know-how
Meteorological conditions
Chemical composition
Granulometric distribution
Mass
PMX concentration
Source apportion

Analytical Procedure adopted for POM Analysis

co-located samplers

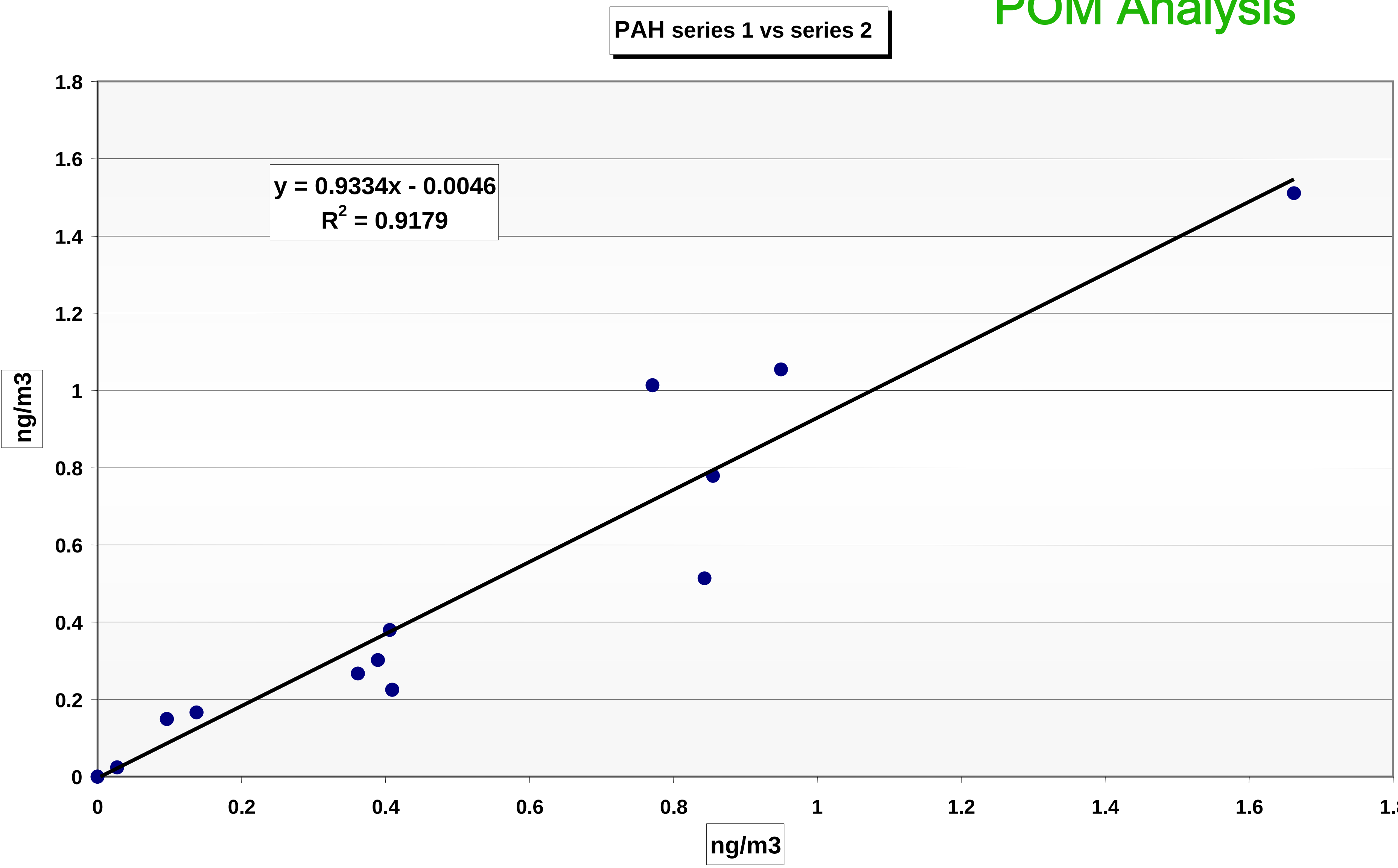


POM Analysis

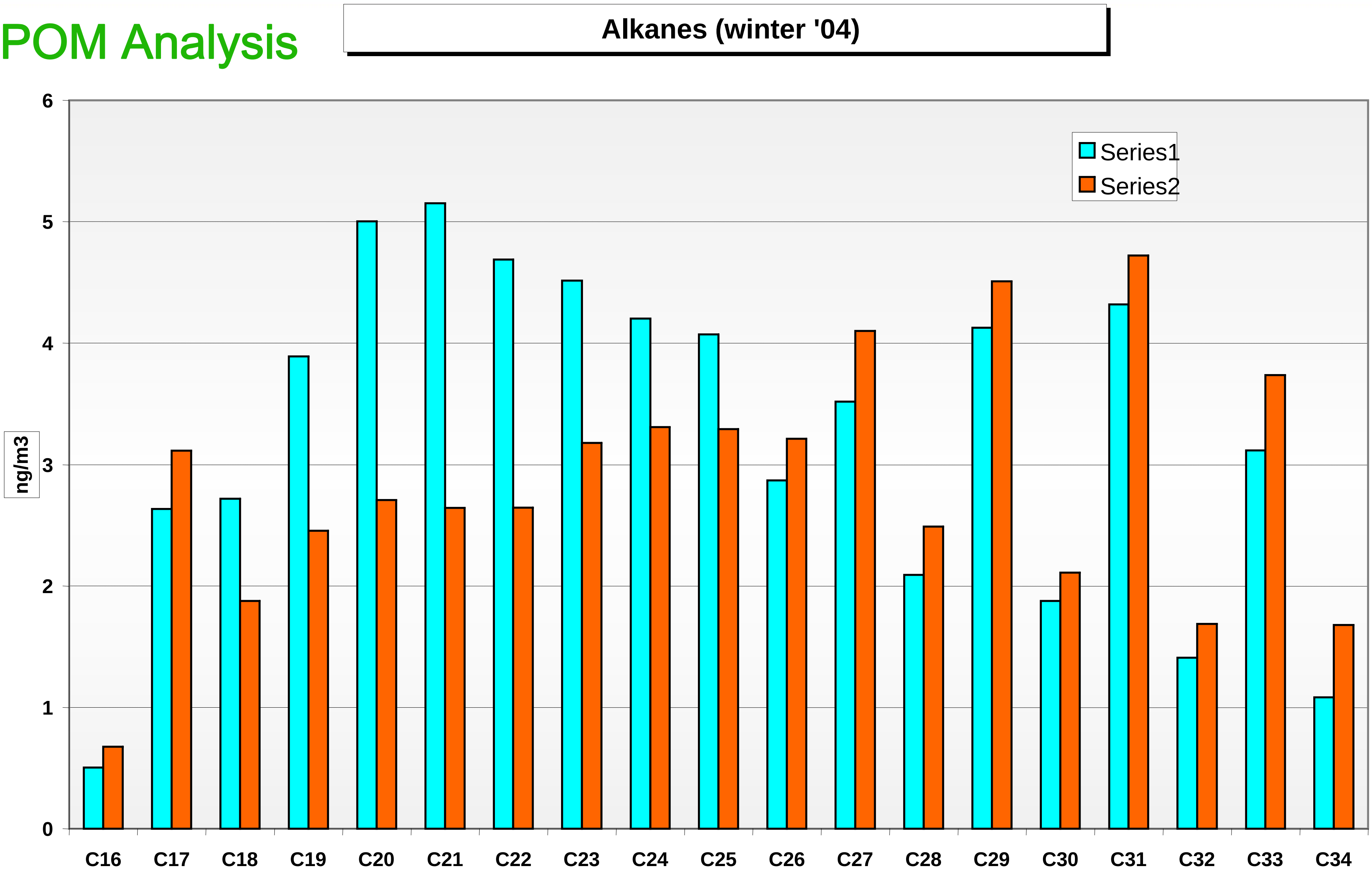


benzo(a)pyrene approximately a 0.8 ng/m^3

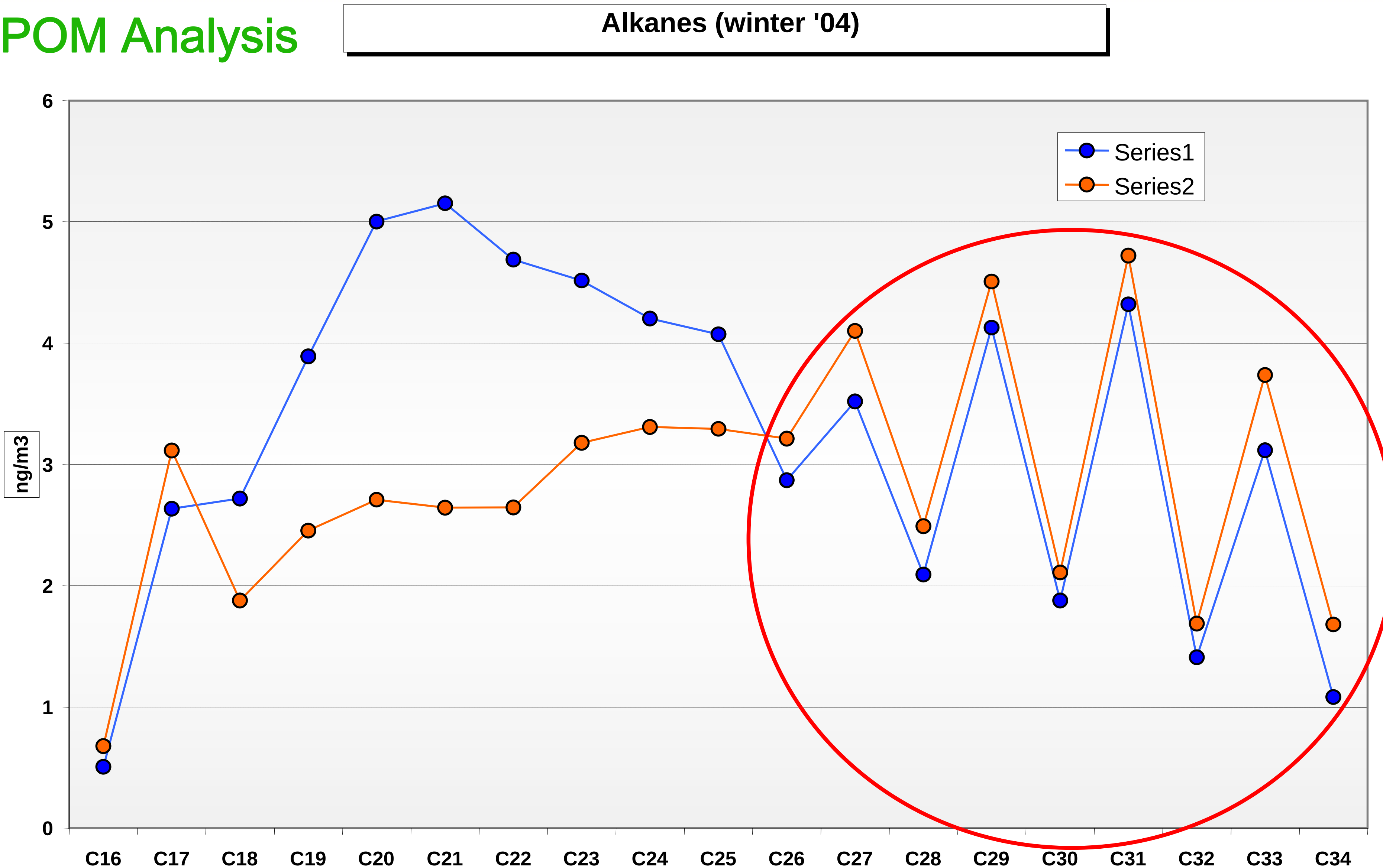
POM Analysis



POM Analysis

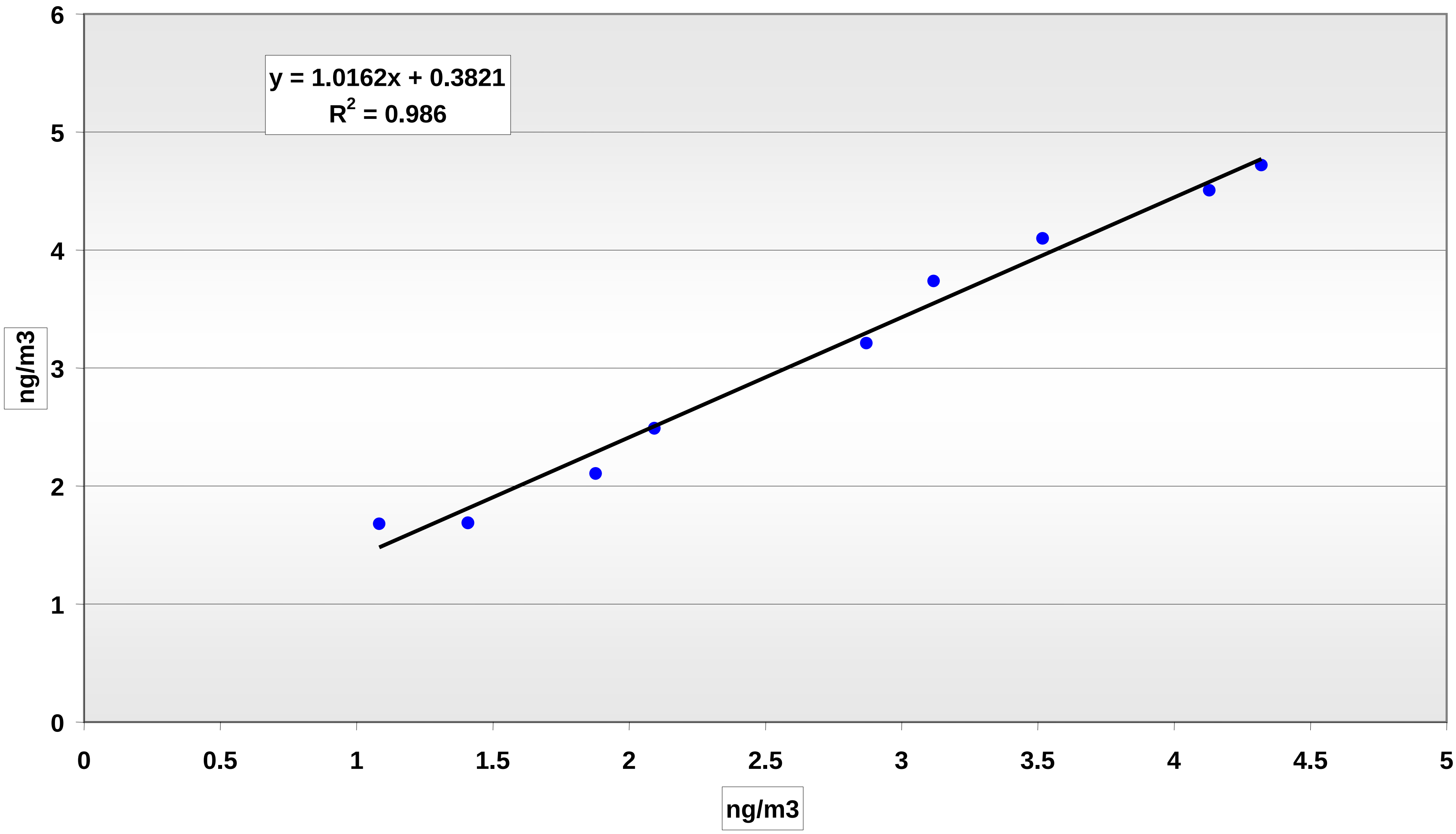


POM Analysis



POM Analysis

ALKANES series 1 vs series 2



POM Analysis - Diagnostic ratios

SET	1		2		3		4		5	
Sampling line	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
[FA]/[PY]	1.24	1.25	1.77	1.18	1.69	n.ev.	1.43	1.41	1.72	1.99
[BaA]/[CHR]	0.43	0.59	1.06	0.37	0.66	n.ev.	0.35	0.40	0.43	0.61
[BaPY]/[BePY]	0.76	1.03	0.30	0.79	0.37	n.ev.	0.54	0.57	0.42	0.80
[IPY]/[BPE]	1.25	1.35	1.12	1.50	1.13	n.ev.	n.ev.	1.13	1.34	1.25
[CHR]/[BePY]	1.15	0.80	5.04	1.13	0.98	n.ev.	0.97	0.80	1.27	1.74
[BPE]/[BePY]	1.72	3.92	0.99	0.34	1.65	n.ev.	n.ev.	2.49	1.89	2.73

RAPPORTI DIAGNOSTICI PER GLI IPA CALCOLATI PER I 5 SET DI FILTRI SULLE 2 LINE DI PRELIEVO

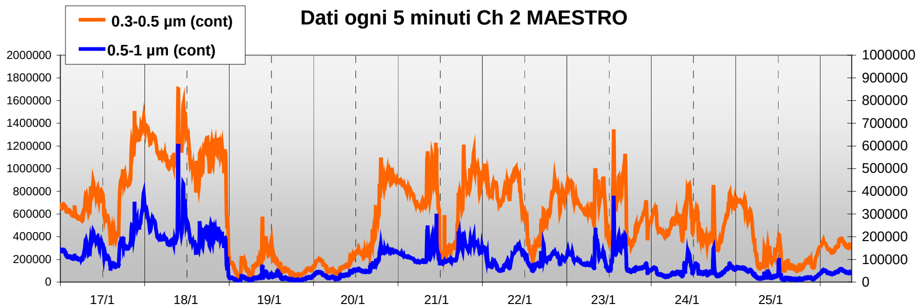
POM Analysis - Diagnostic ratios

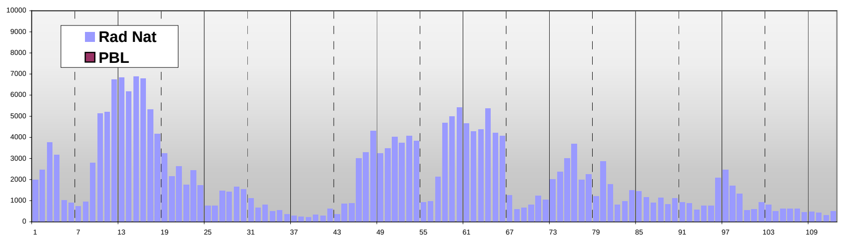
Source	wood burning	cooking	carbon grill	coke emissions	waste burning	domestic heating	power stations	paved roads
PHE/ANT	3,0	4,0	9,0	3,0		4,0	6,0	3,6
FA/PY	1,9	1,1	0,9	1,2		2,3	1,1	0,5
BaA/CHR	1,1	2,5	0,4	1,2		0,6	0,5	0,4
BaPY/BePY	0,7	0,5	0,3	1,5		1,3	1,5	1,0
IPY/BPE	1,3		0,7	1,0		0,9	0,7	
BaPY/BPE	0,8		4,0	2,0	0,4	2,0		
MPH/PH				1,0			<1	2,0
CPAH/TPAH	0,5			1,0	0,8			

Source	ave. Vehicles	gasoline fuelled	diesel engined	used lubri. Oil	new lubri. Oil
PHE/ANT	6,7	5,2	8,2		
FA/PY	0,7	0,7	1,2	0,6	0,2
BaA/CHR	0,5	0,2	1,0	0,6	0,2
BaPY/BePY	0,7	0,9	0,4	0,7	
IPY/BPE	0,8	0,2	1,4	0,7	
BaPY/BPE	1,4	0,3	1,3	2,7	
MPH/PH	>>1	>1	>>1		
CPAH/TPAH	0,6				

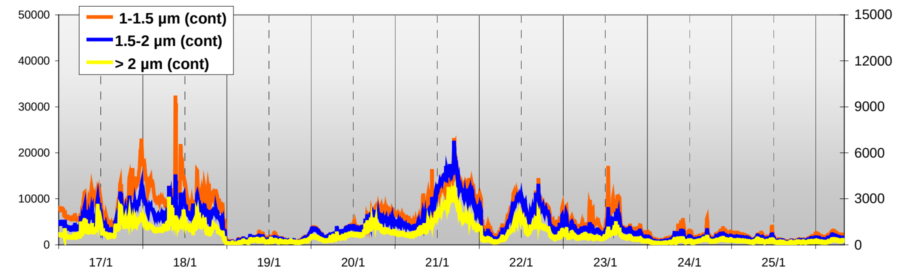
OPC data from 17/1/05 to 25/1/05

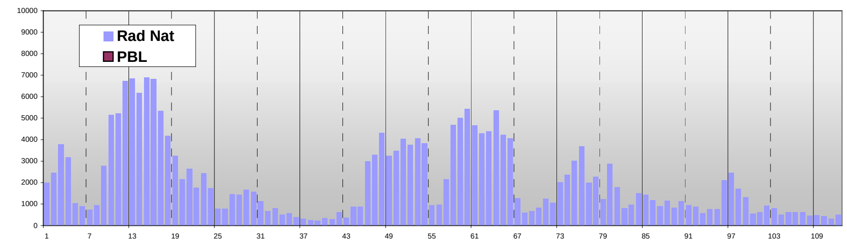
Dati ogni 5 minuti Ch 2 MAESTRO



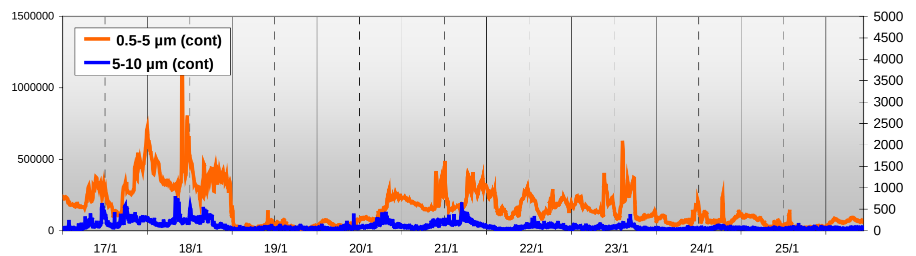


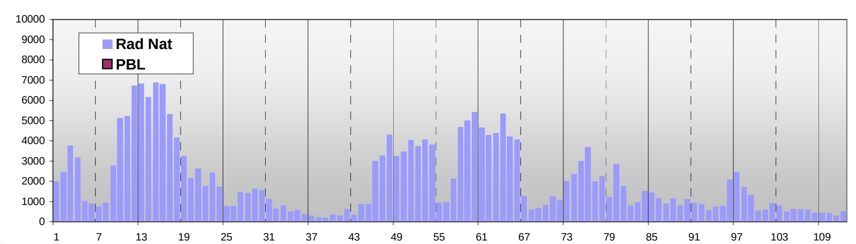
Dati ogni 5 minuti Ch 2





Dati CLIMET



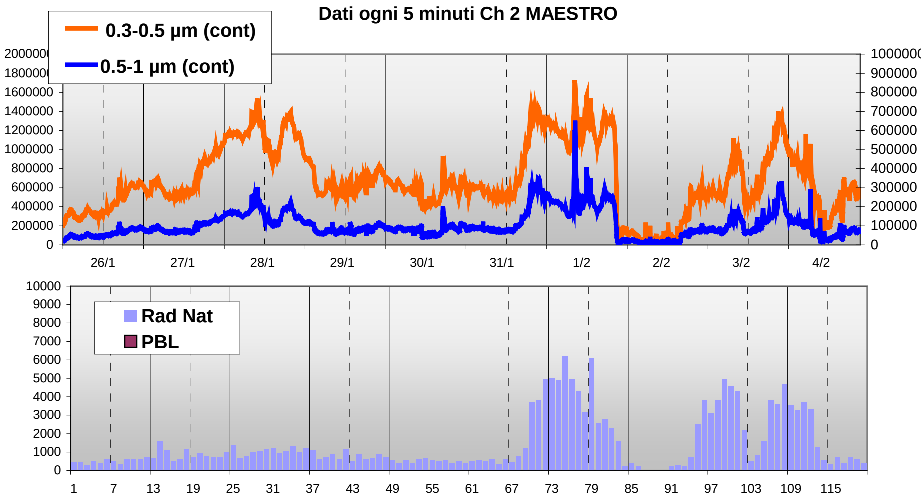


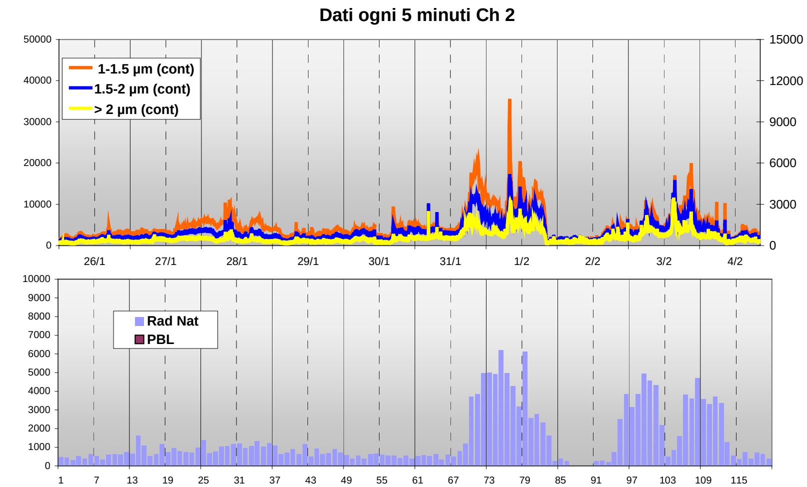
Optical

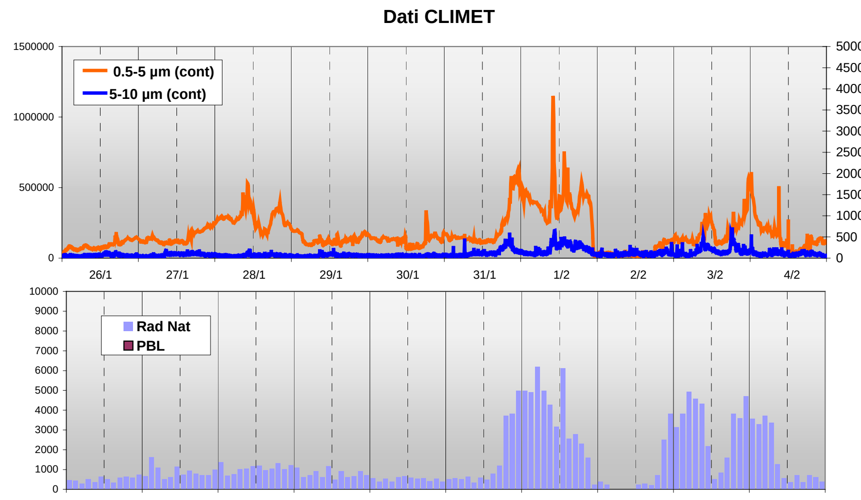
Particle

Counter

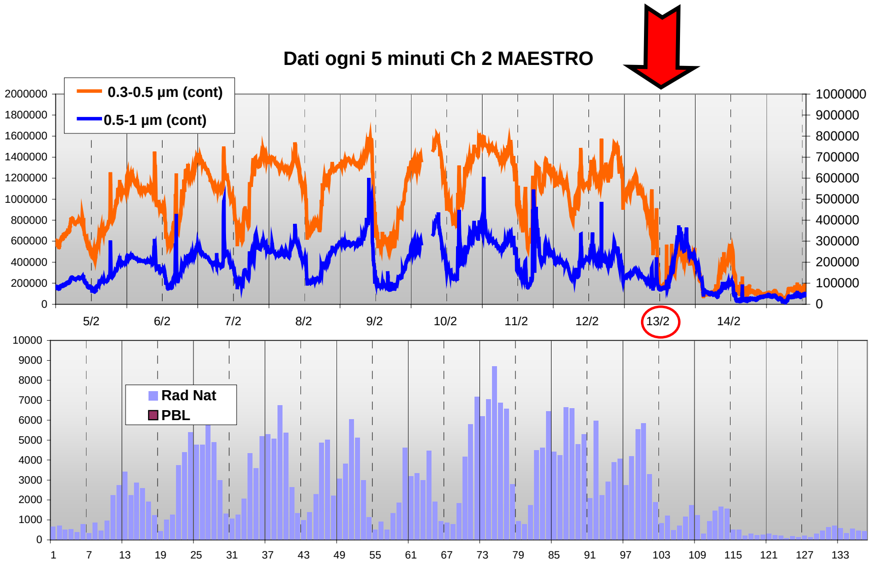
OPC data from 26/1/05 to 4/2/05

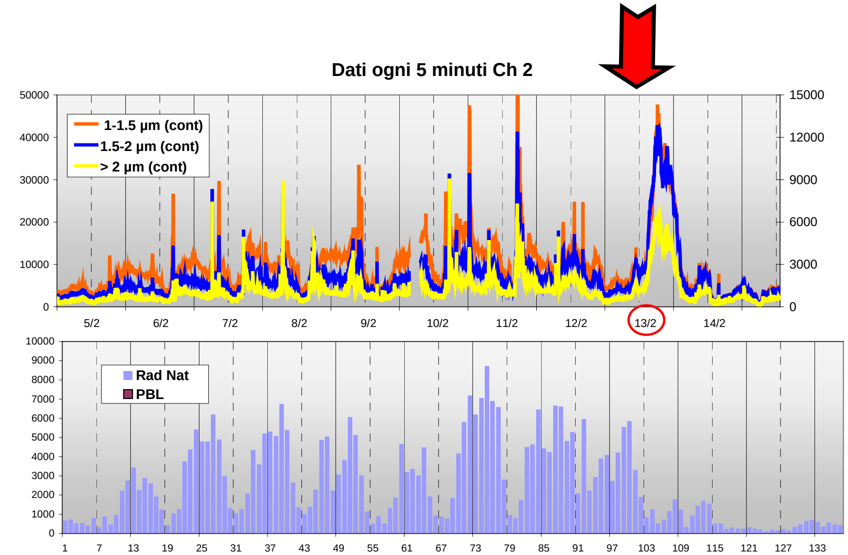


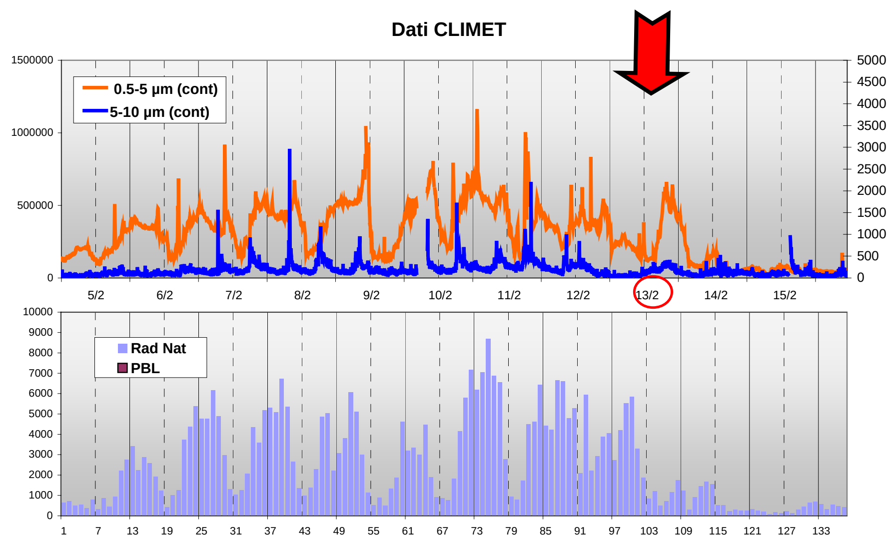




OPC data from 5/2/05 to 15/2/05

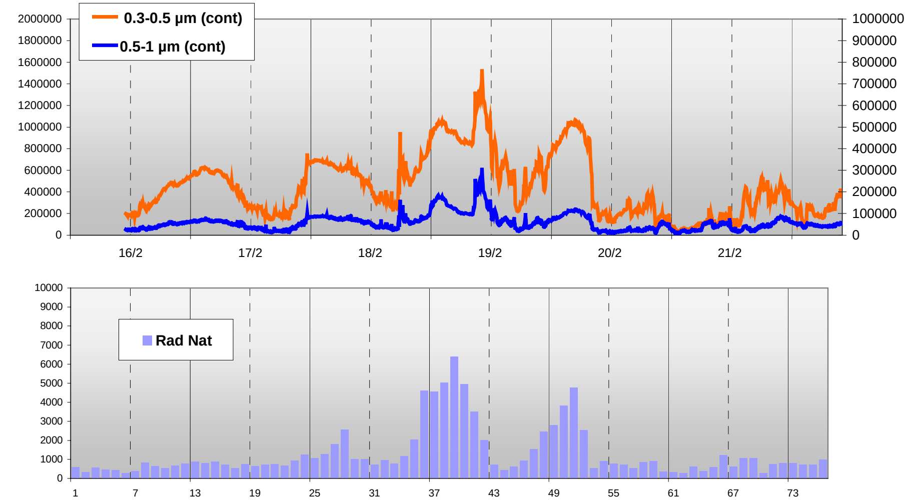




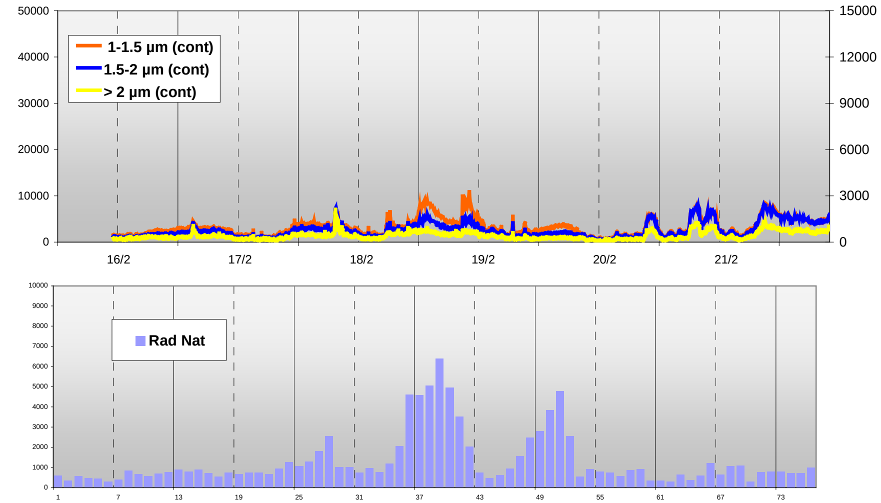


OPC data from 16/2/05 to 21/2/05

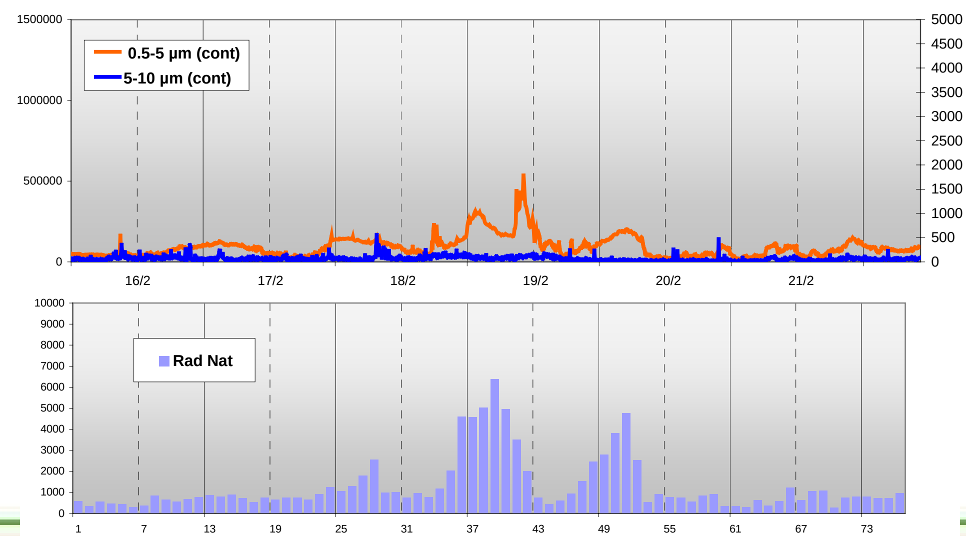
Dati ogni 5 minuti Ch 2 MAESTRO



Dati ogni 5 minuti Ch 2

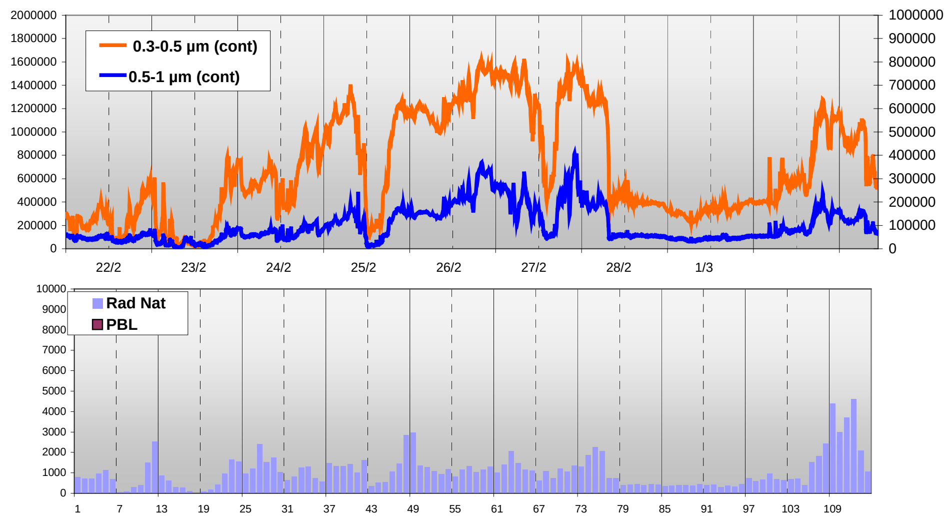


Dati CLIMET

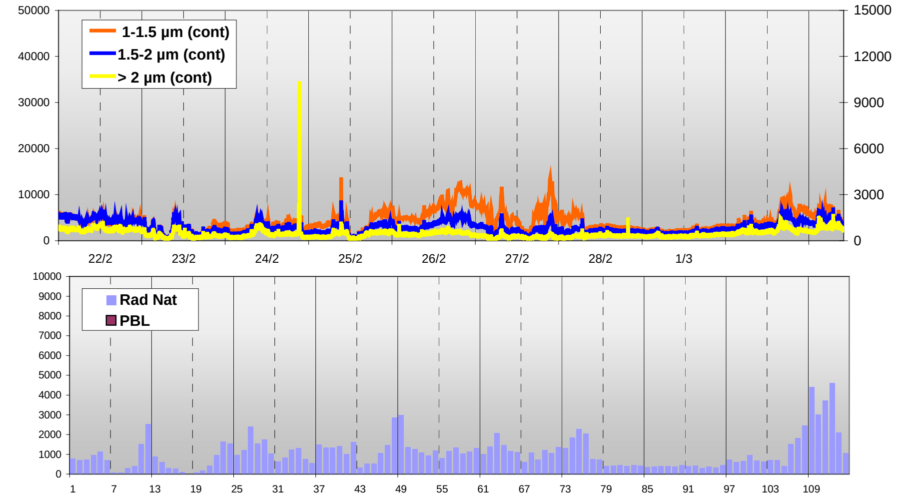


OPC data from 22/2/05 to 28/2/05

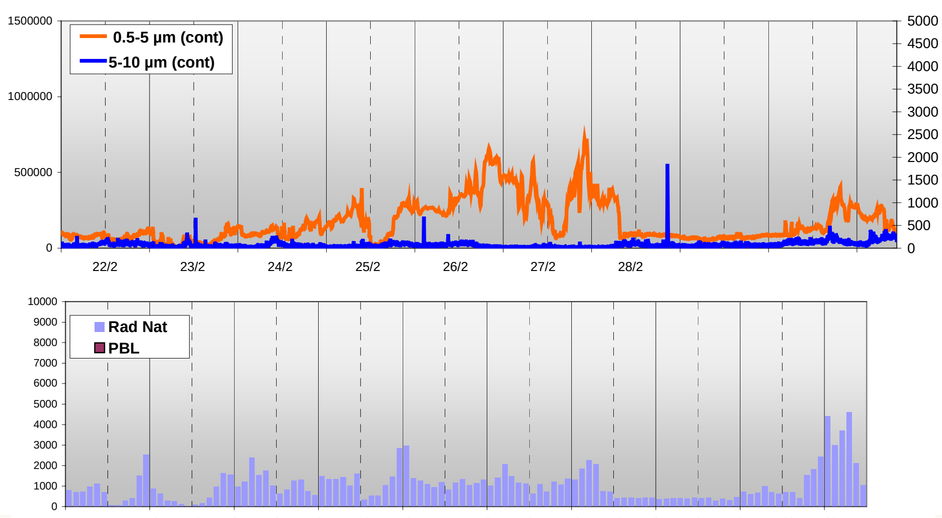
Dati ogni 5 minuti Ch 2 MAESTRO



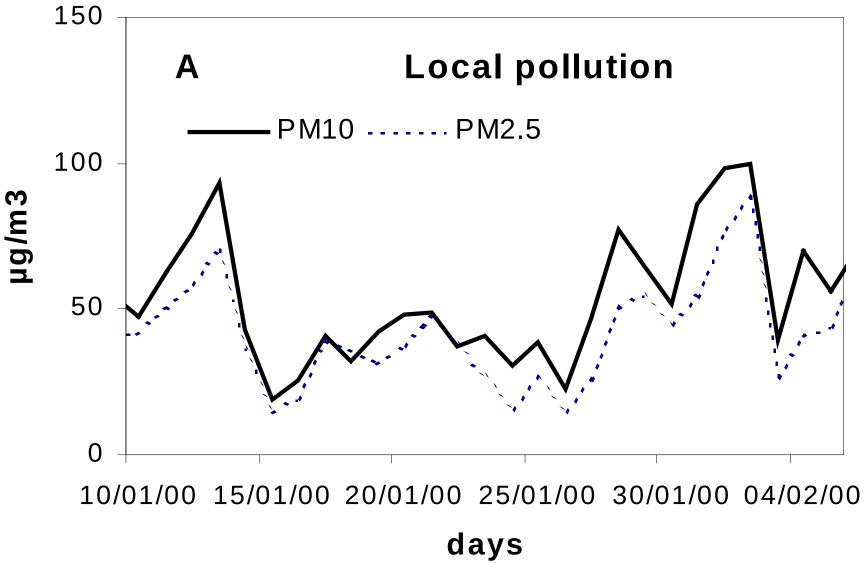
Dati ogni 5 minuti Ch 2

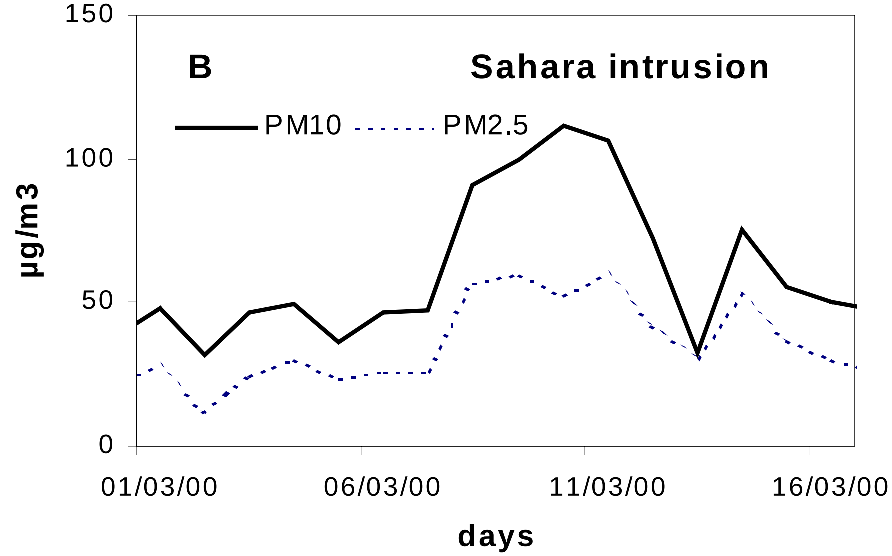


Dati CLIMET



Natural sources of particulate matter





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

Natural sources of particulate matter

Main components of natural particles from Sahara and Europe (%)

	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	

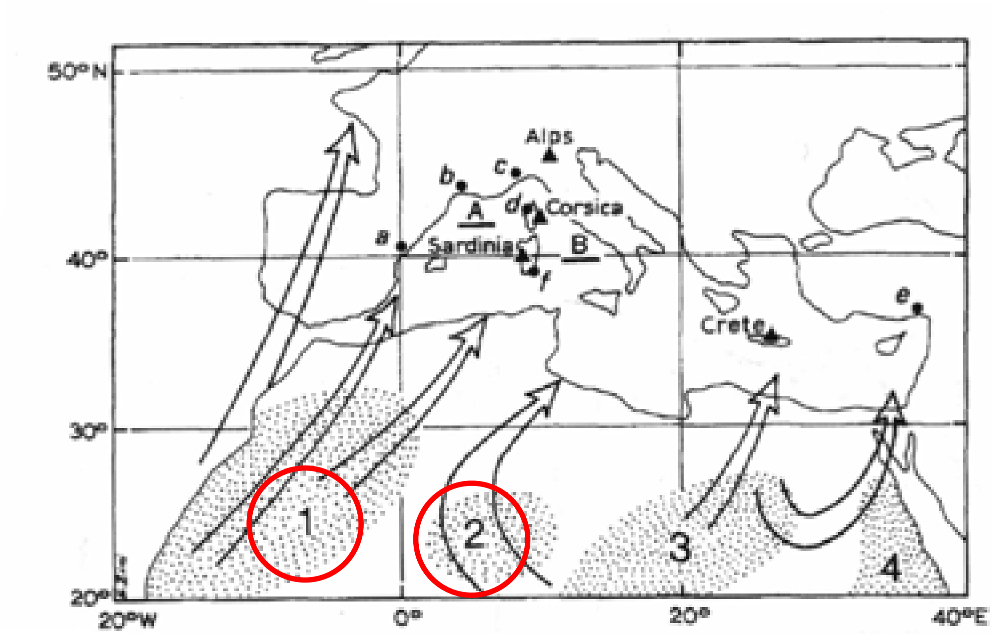
Natural sources of particulate matter

Characteristic dimension of particulate matter

Site	Dimensions (μm)	% < 2 μm
Kano, Nigeria	8,9-74,3	2,3-32,0
Tanezrouft, central Sahara	72,0	9,4
Maghreb	5,0-40,0	-
Crete	8,0-30,0	-
Spain	4,0-30,0	-
Sal Island (Capo Verde)	11,9-18,6	-
Germany (W)	2,2-16,0	-
Creata (2)	4,0-16,0	15-45
Mopti, Mali	16,8	-
Genoa, Italy	14,6	-
Francia (SW)	4,0-12,7	-
France (Sud)	8,0-11,0	-
Mediterraneo centrale	2,0-8,0	-
Paris, France	8,0	-
Alps, Switzerland	4,5	-
Barbados	3,2	-
Bermuda	2,0-2,3	-
Ghana	1,16	-
USA (continental)	< 1,0	-

Natural sources of particulate matter

Saharan dust event: in Italy few episodes per year (specially from zone 1 or 2)



Detection of natural events due to long range transport of mineral dust such as Sahara air mass intrusions

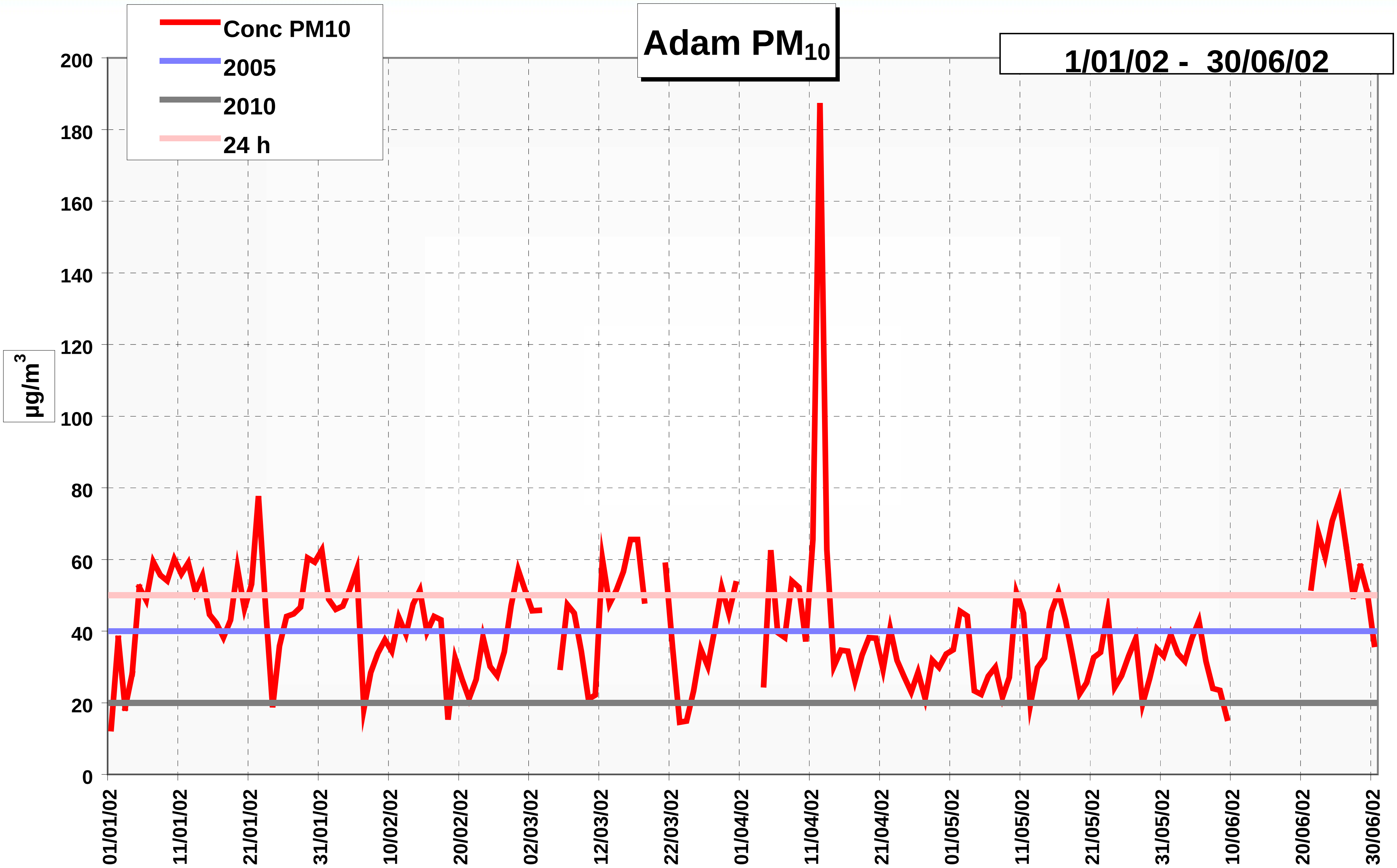
1- Identify particulate peaks in the PM_{10} time series.

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 PM10 levels.

4- meteorological and backwards trajectory analysis.

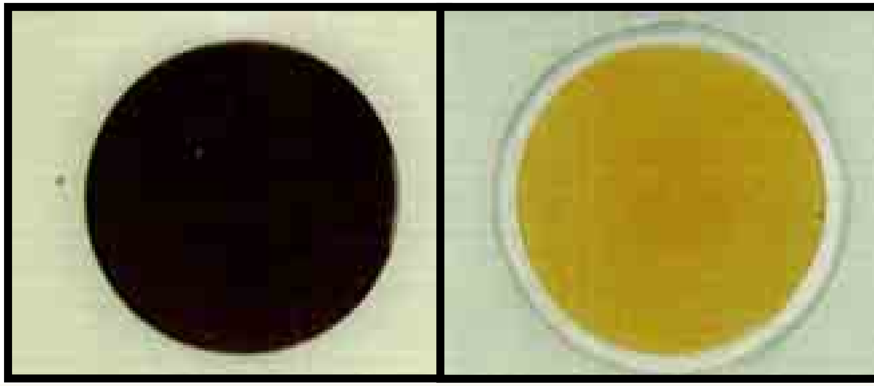
5- Chemical analysis of PM_{10} samples.


Conc PM10
2005
2010
24 h
Adam PM10
1/01/02 - 30/06/02
μg/m3
200
180
160
140
120
100
80
60
40
20
0
01/01/02
11/01/02
21/01/02
31/01/02
10/02/02
20/02/02
02/03/02
12/03/02
22/03/02
01/04/02
11/04/02
21/04/02
01/05/02
11/05/02
21/05/02
31/05/02
10/06/02
20/06/02
30/06/02

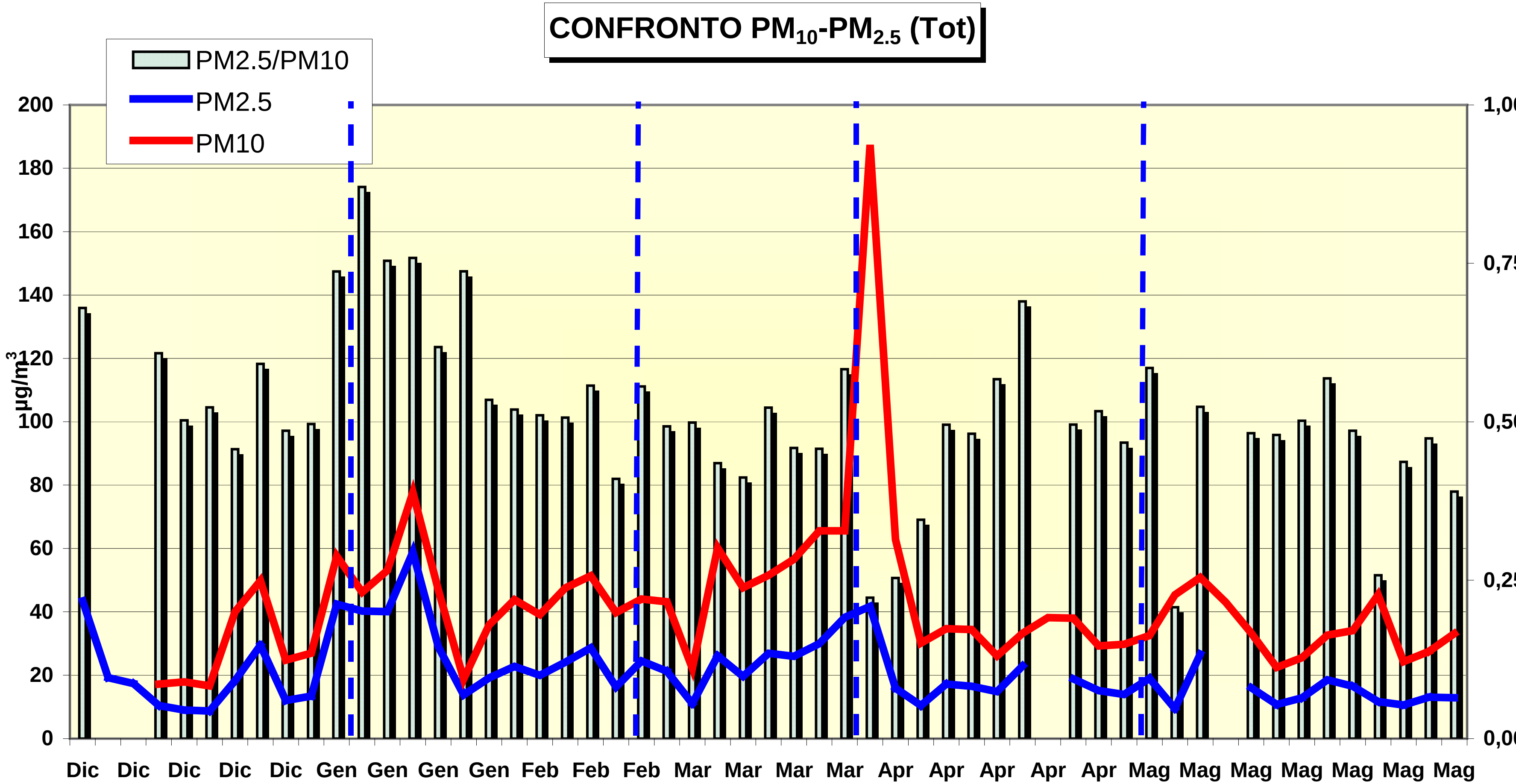
Saharan dust event (April 2002)

11 APRIL | 12 APRIL | 13 APRIL | 14 APRIL

FINE | COARSE



Saharan dust event (April 2002)



$PM_{2.5}/PM_{10}$ mean ratio: **0,50**

$PM_{2.5}/PM_{10}$ ratio 4/02: **0,22**

Saharan dust event

World Wide Web free databases

TOMS

Total **O**zone **M**apping **S**pectrometer (Nasa):
Aerosol Index (A I)

UV aerosol absorption (340 and 380 nm)

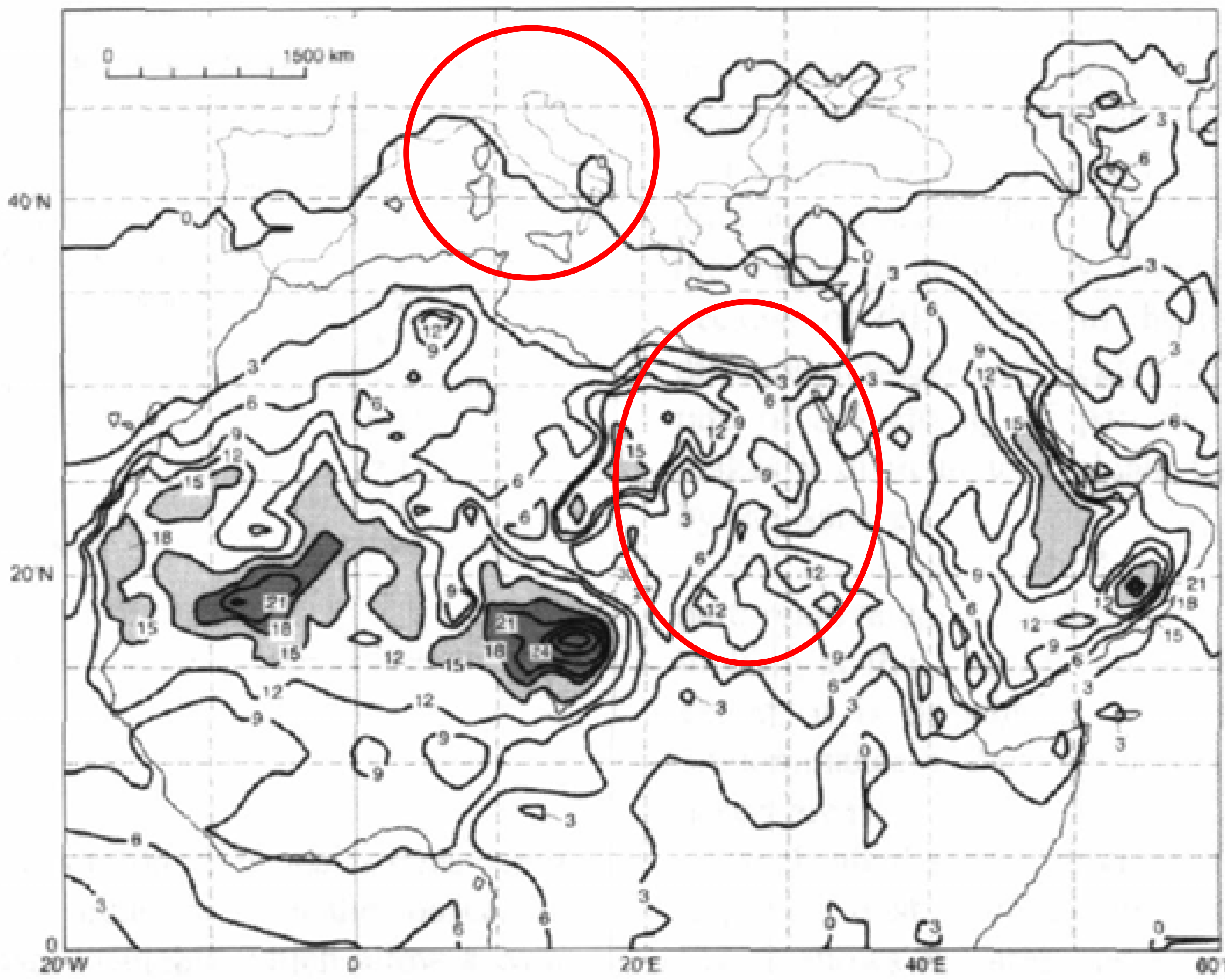
ICoD Models

Euro-Mediterranean Centre on **I**nsular **Co**astal **D**ynamics

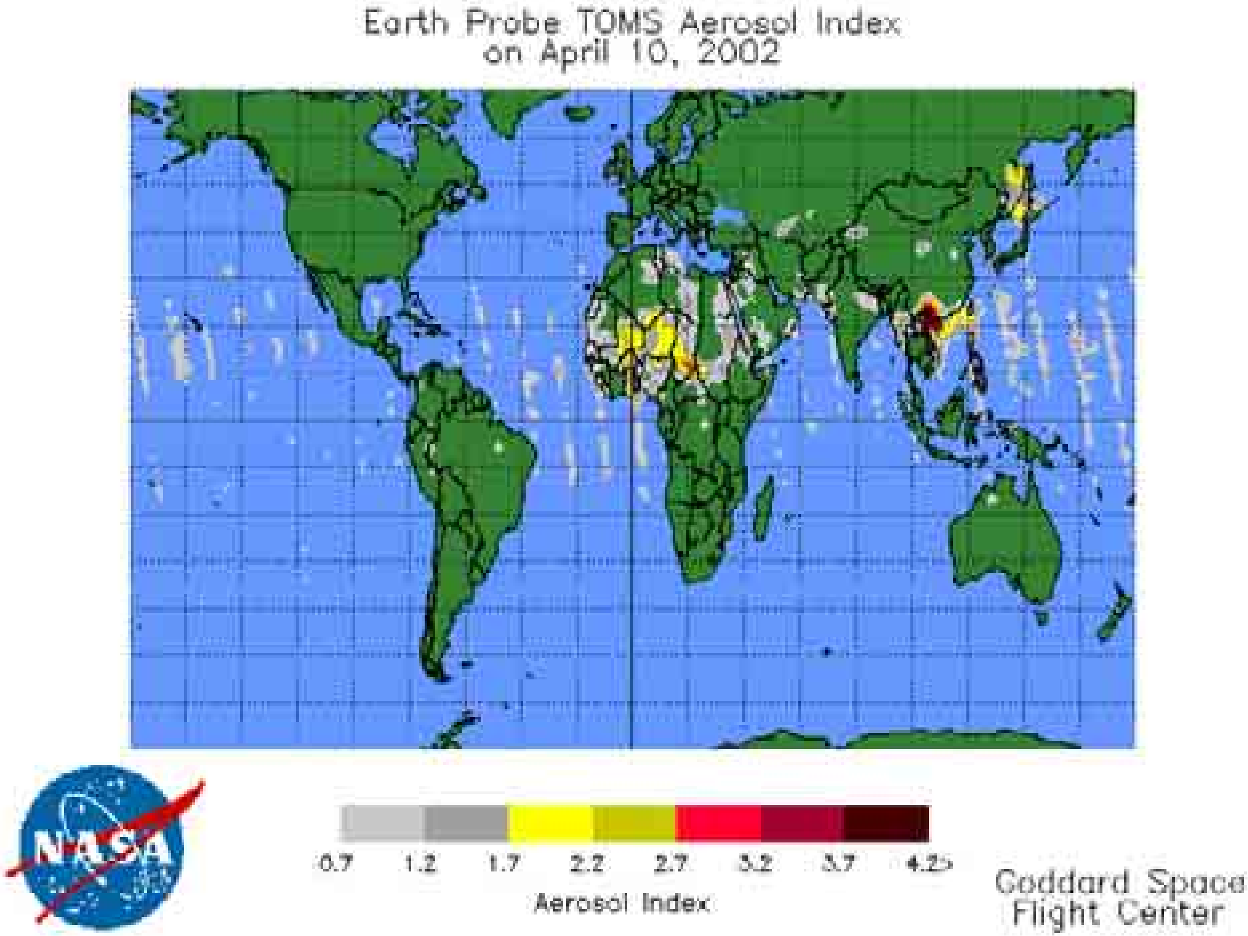
72 h forecast:
height, sea-level, vertical profiles

TOMS DATA

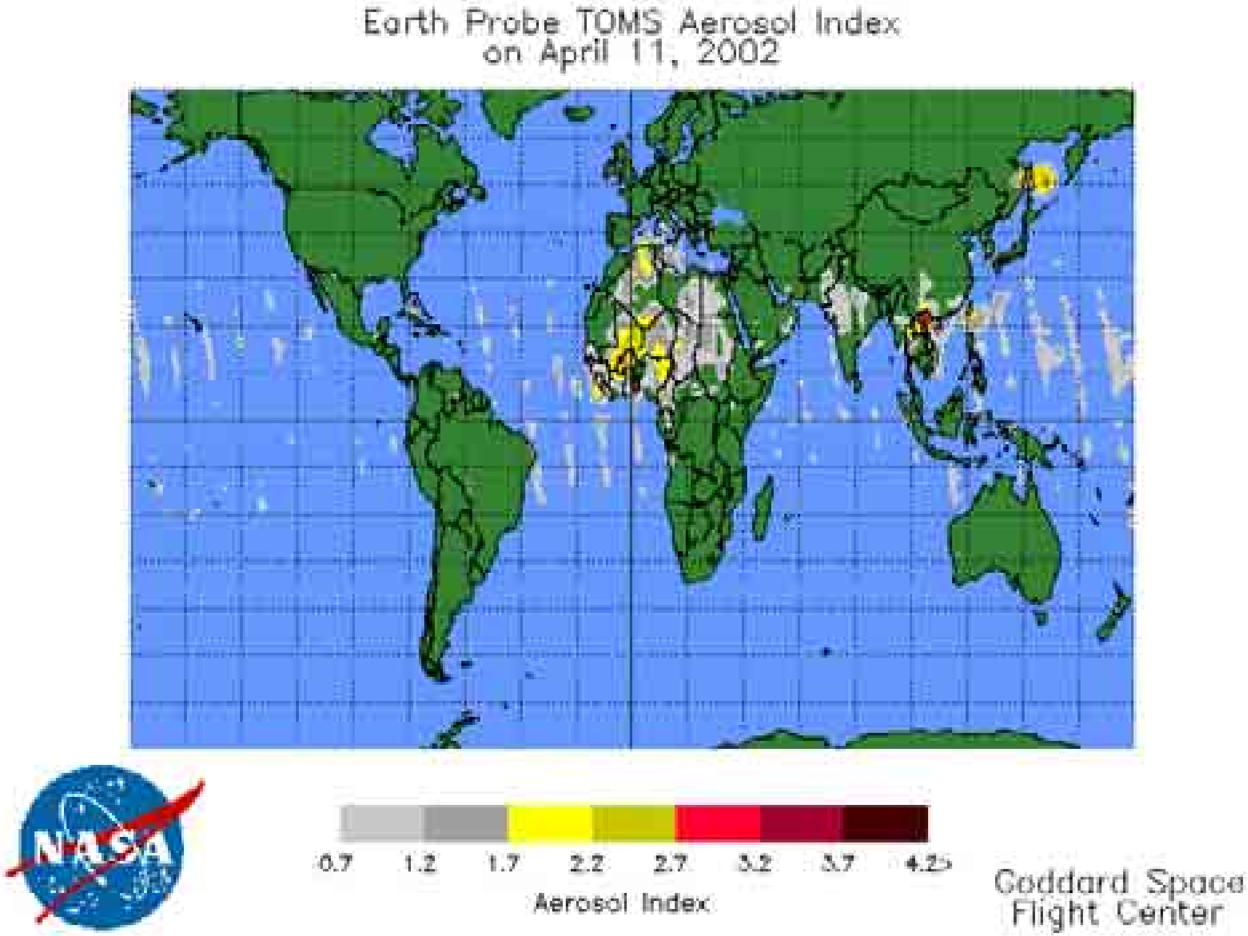
Annual mean **AI** index



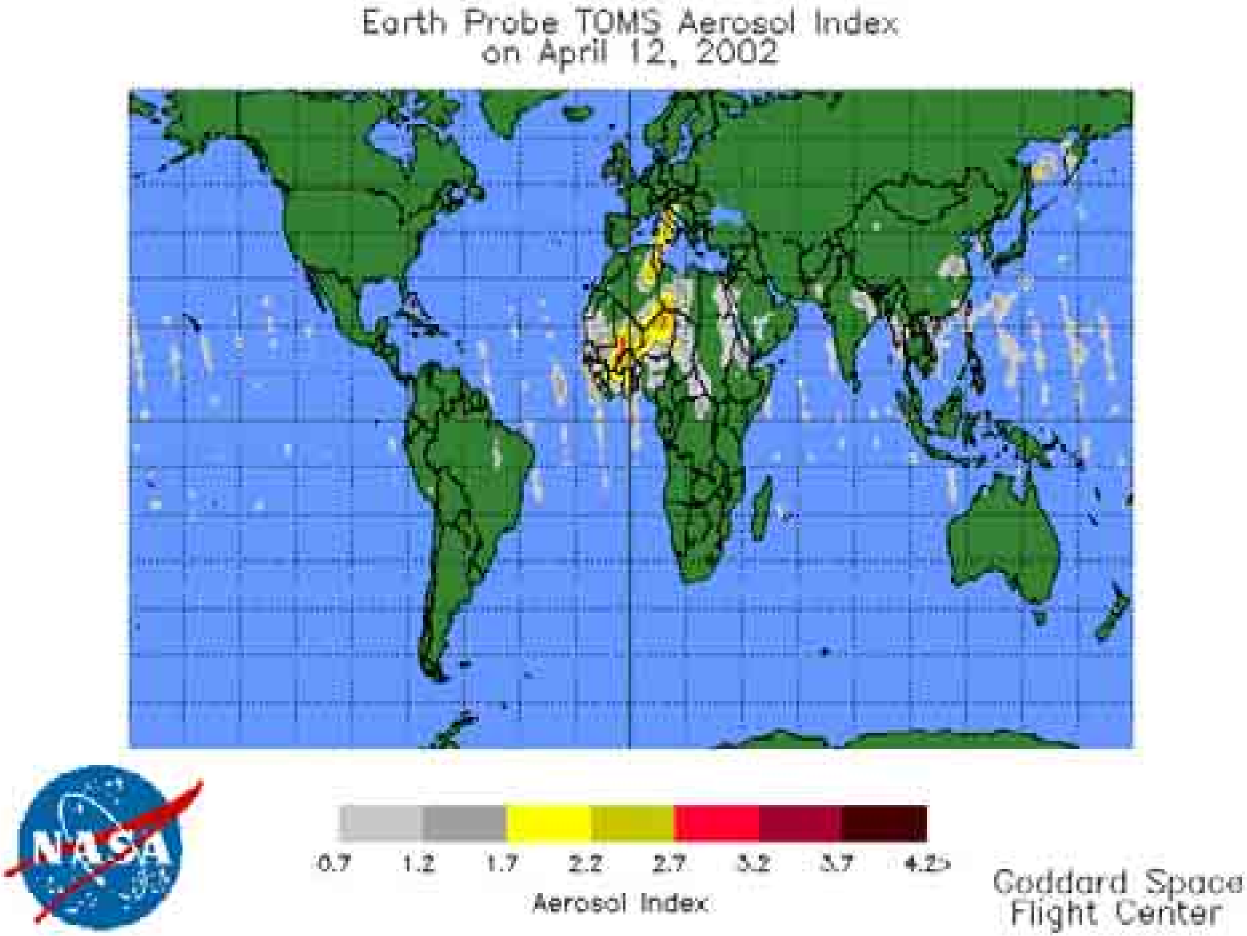
Saharan dust event (April 2002)



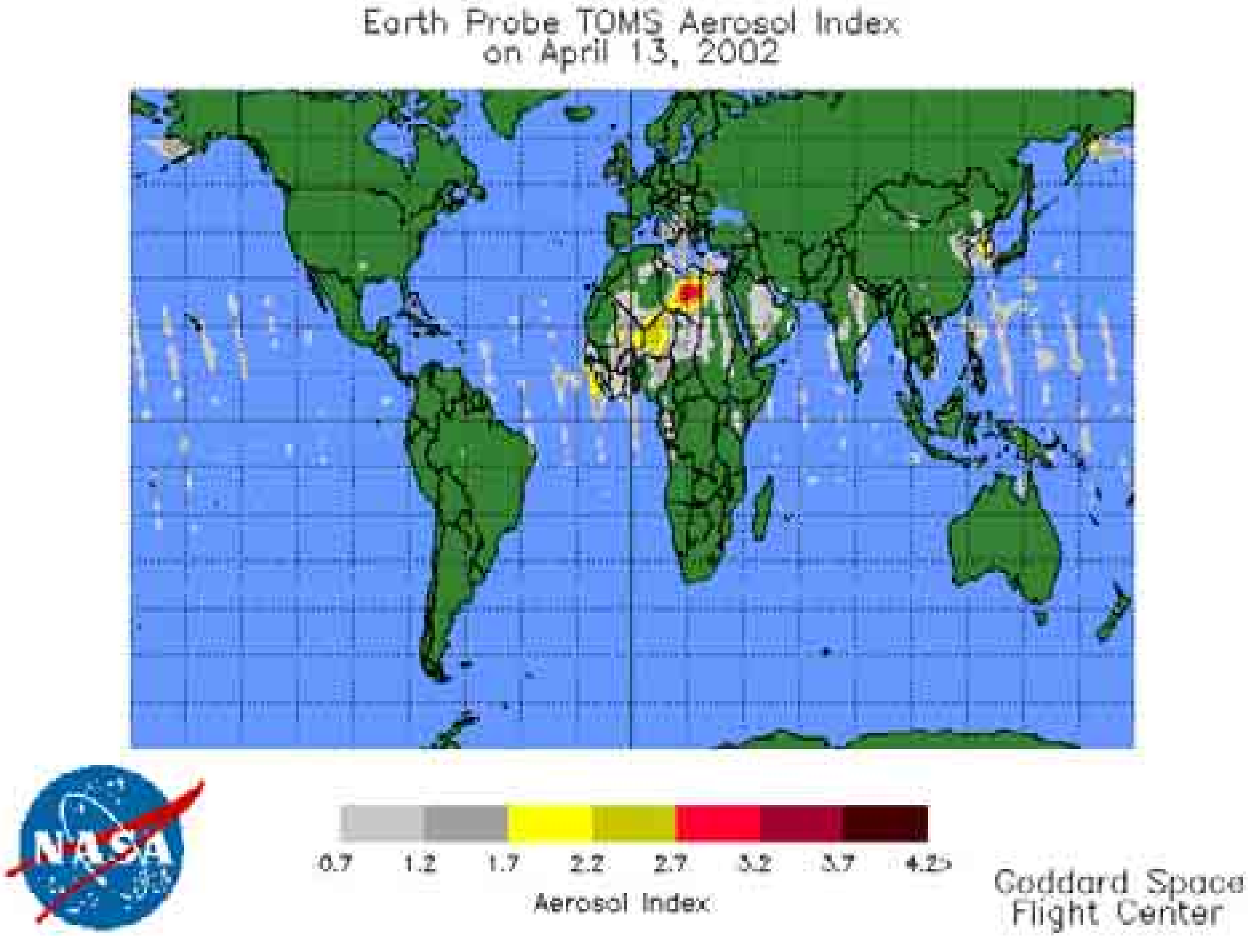
Saharan dust event (April 2002)



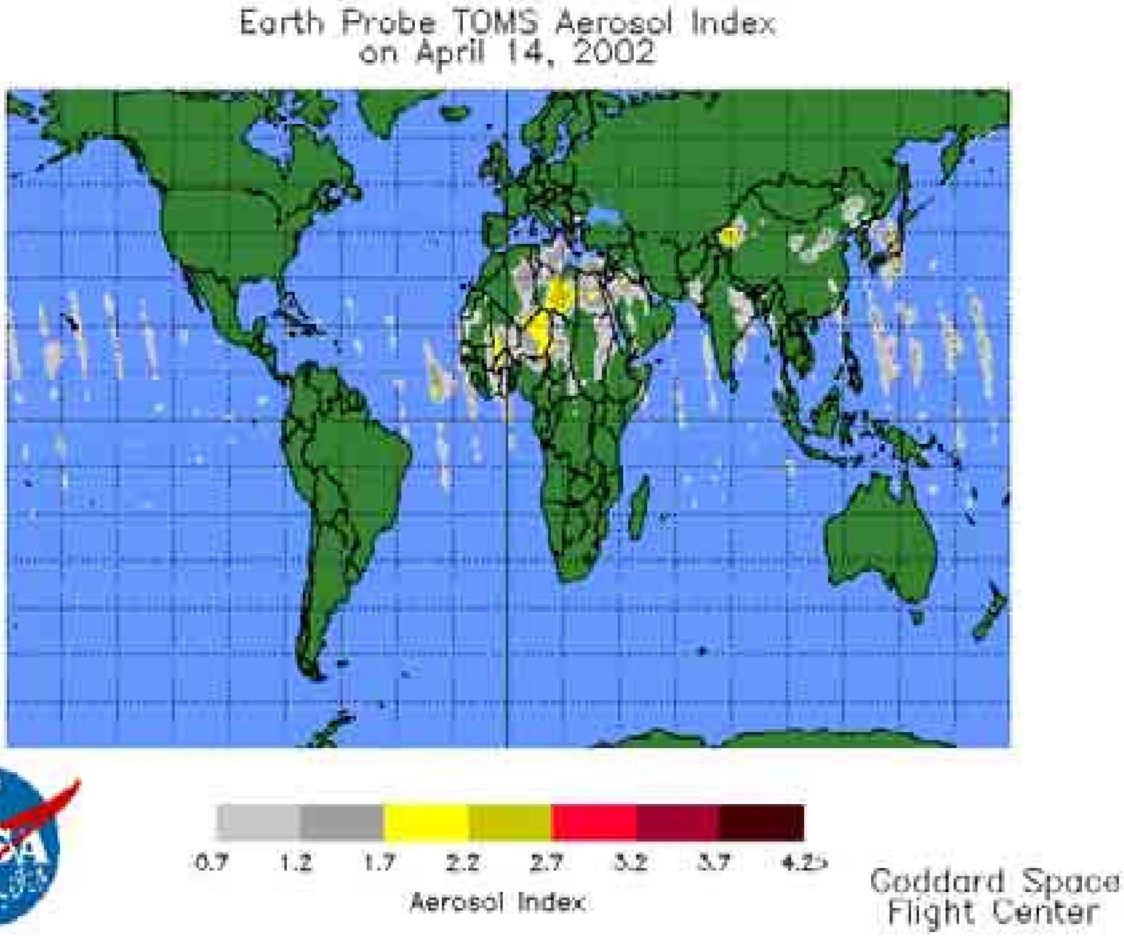
Saharan dust event (April 2002)



Saharan dust event (April 2002)

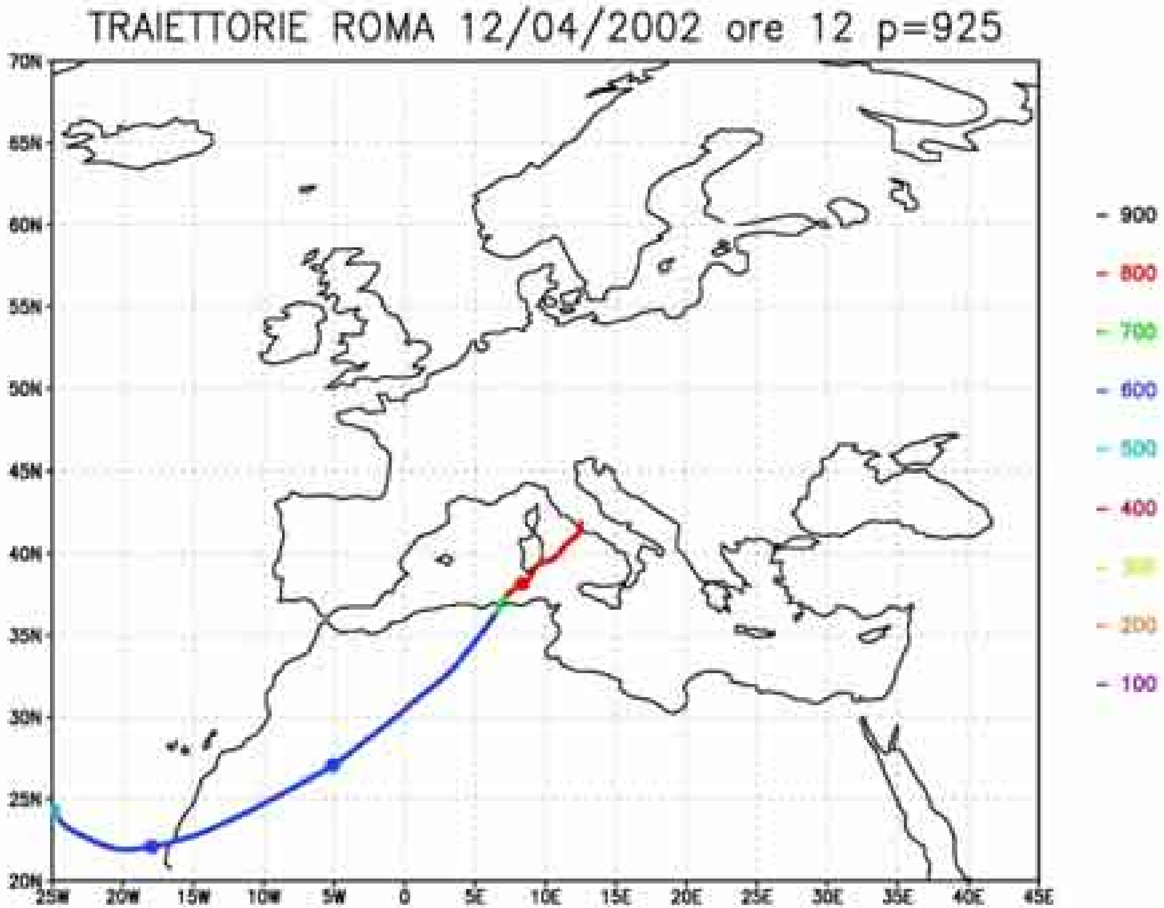


Saharan dust event (April 2002)



Saharan dust event (April 2002)

BACK-TRAJECTORIES MODEL



Saharan dust event (April 2002)

Chemical analysis of PM_{10} samples

Hydro-soluble ions:

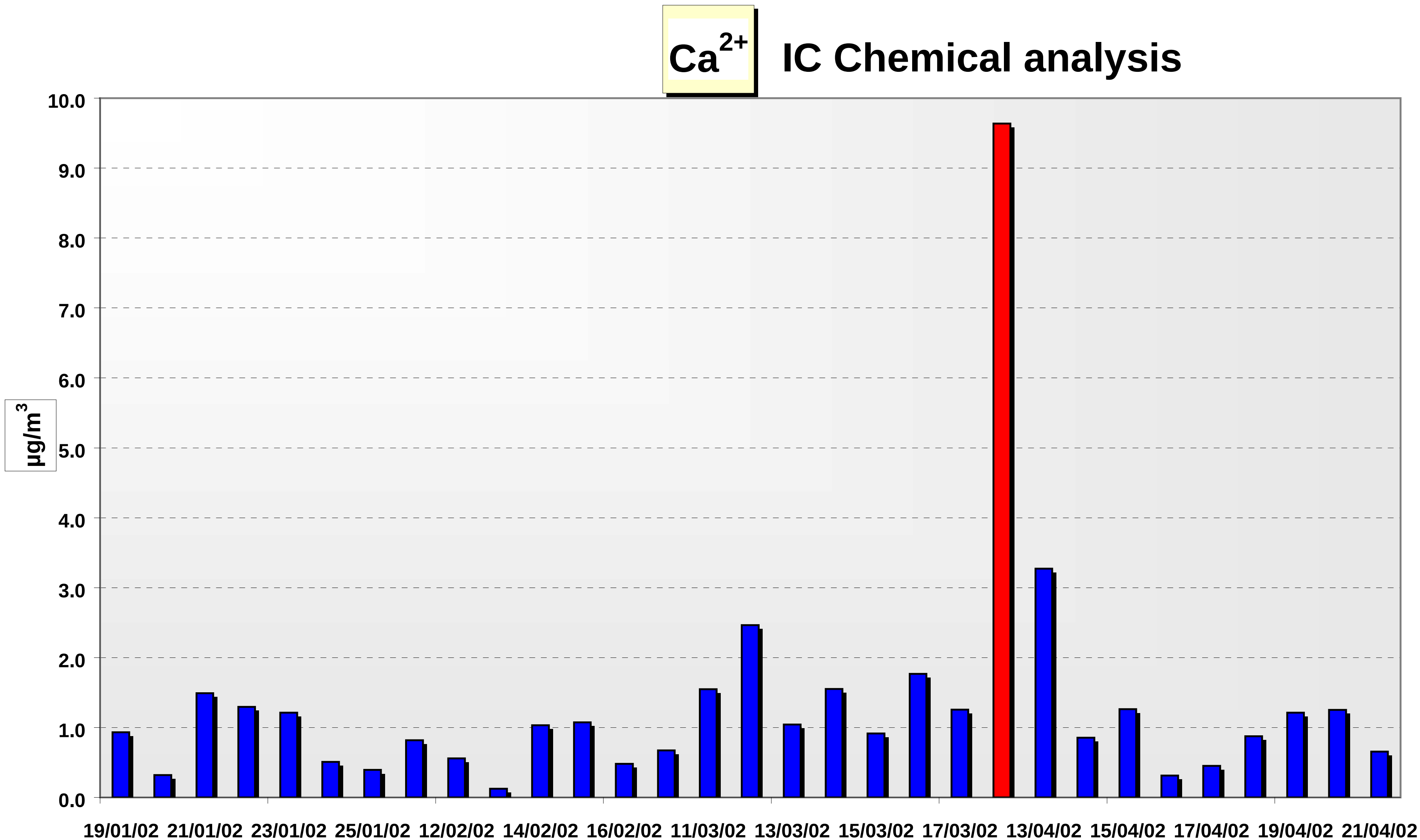
Anions: Cl^-, NO_2^-, NO_3^-, SO_4^{2-}

Cations: Na^+, NH_4^+, K^+, Mg_2^+, Ca_2^+

Metals:

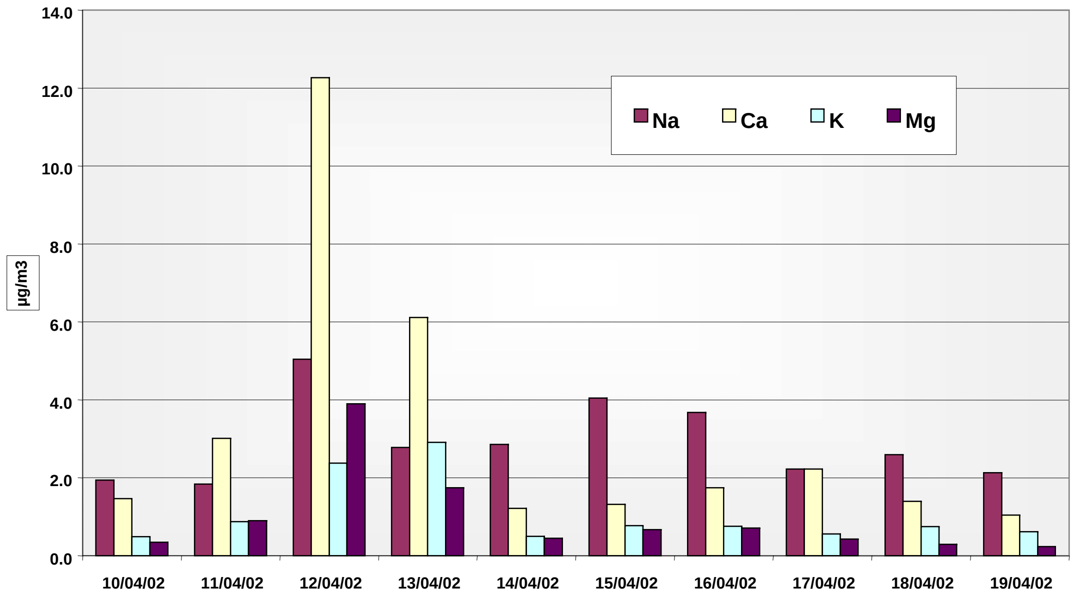
Si, Na, Al, Ca, K, Mg, Ti, P, Fe, Sr, Ba, Pb, Zn, Cu, Mn, V, Cr, Ni

Saharan dust event (April 2002)



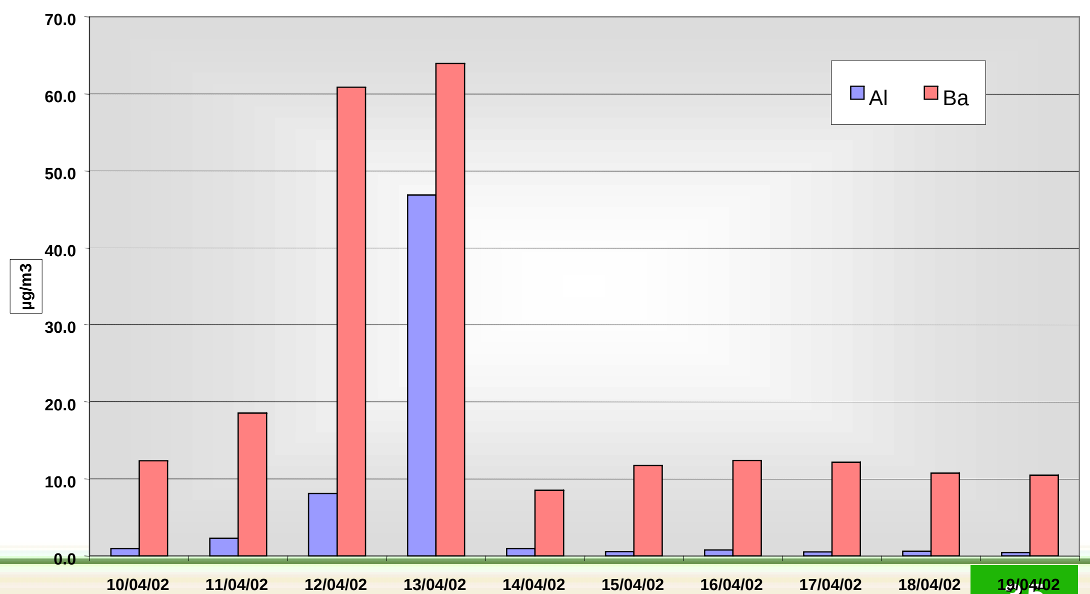
Saharan dust event (April 2002)

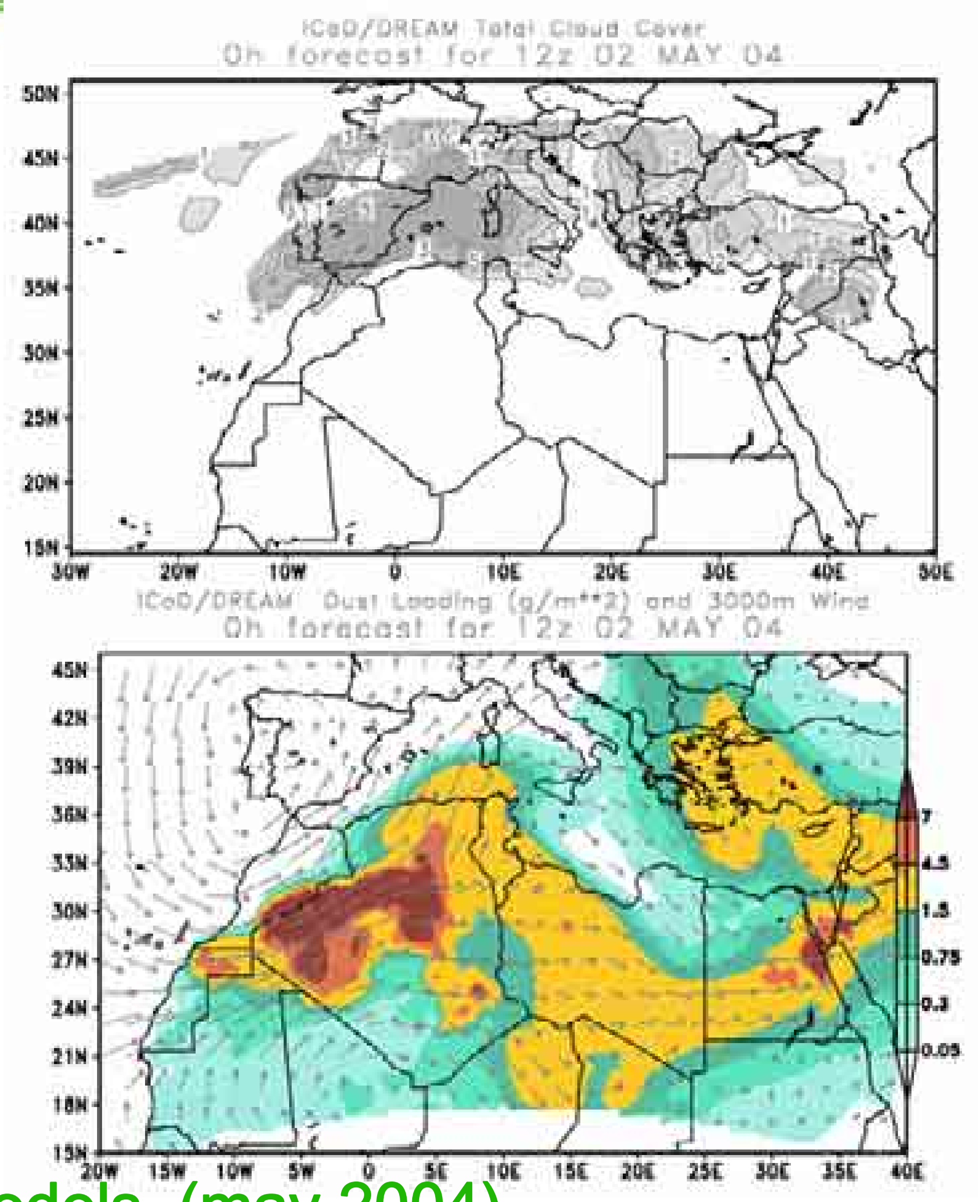
Air concentration



ICP-MS analysis

Air concentration

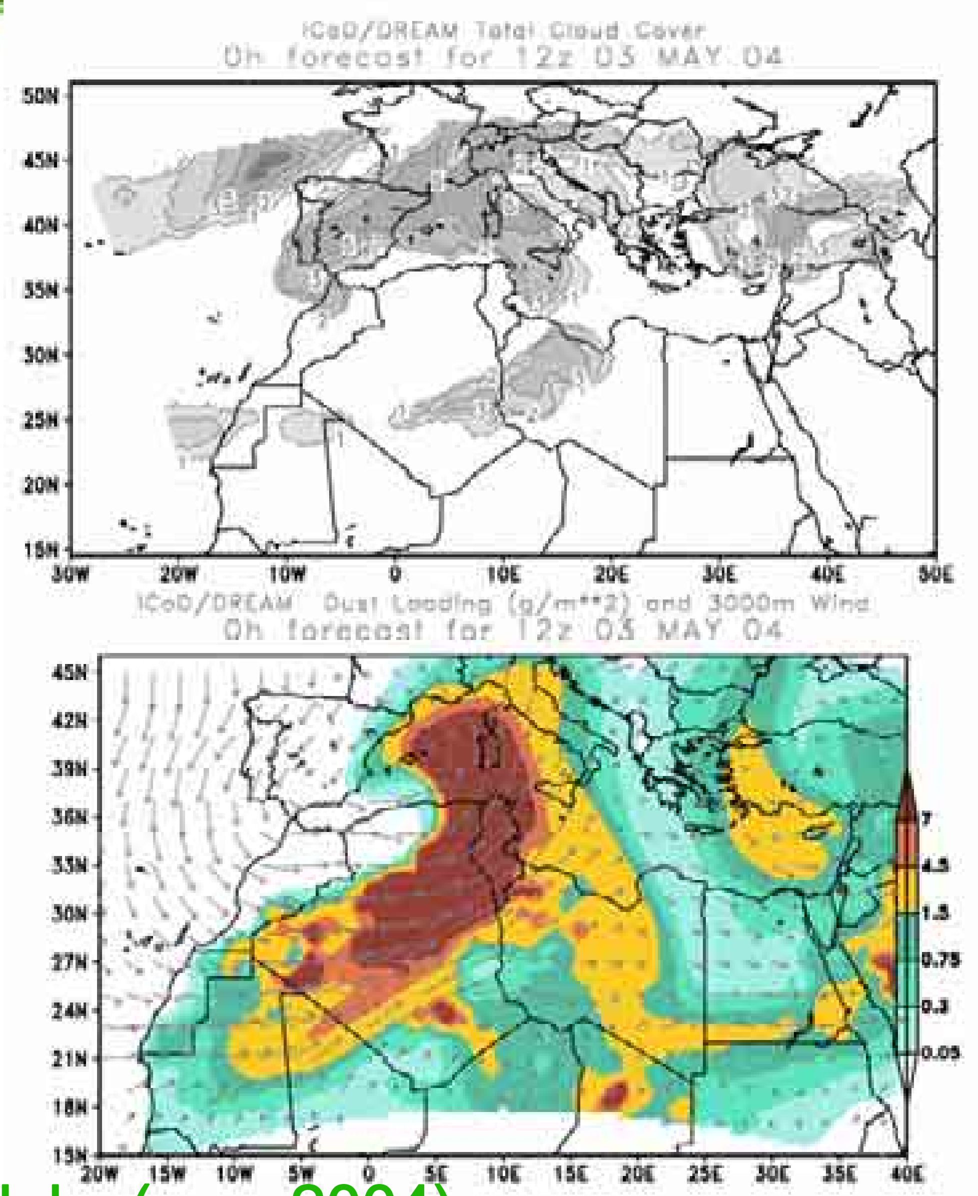




3.000 m

1

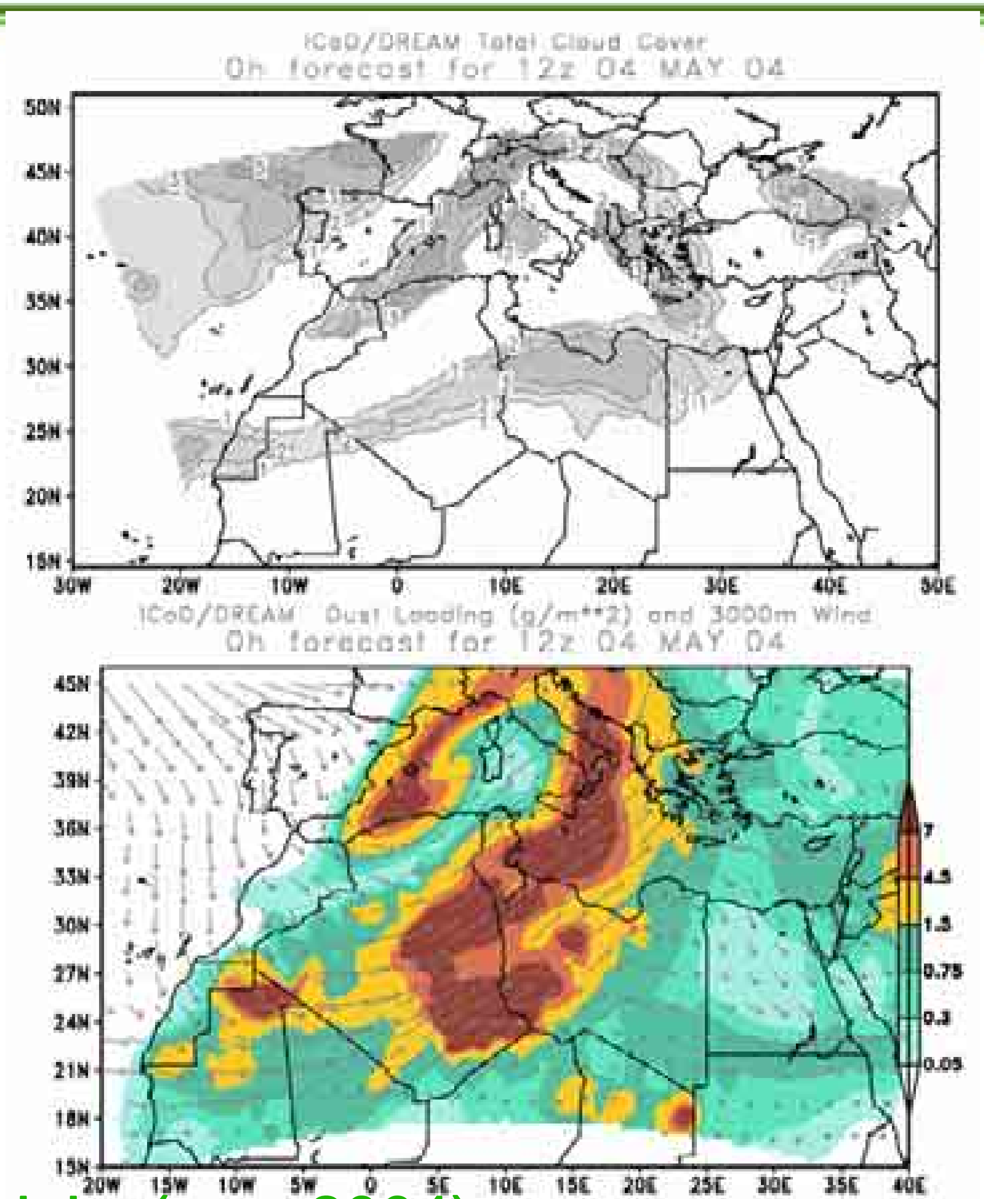
ICoD models (may 2004)



3.000 m

2

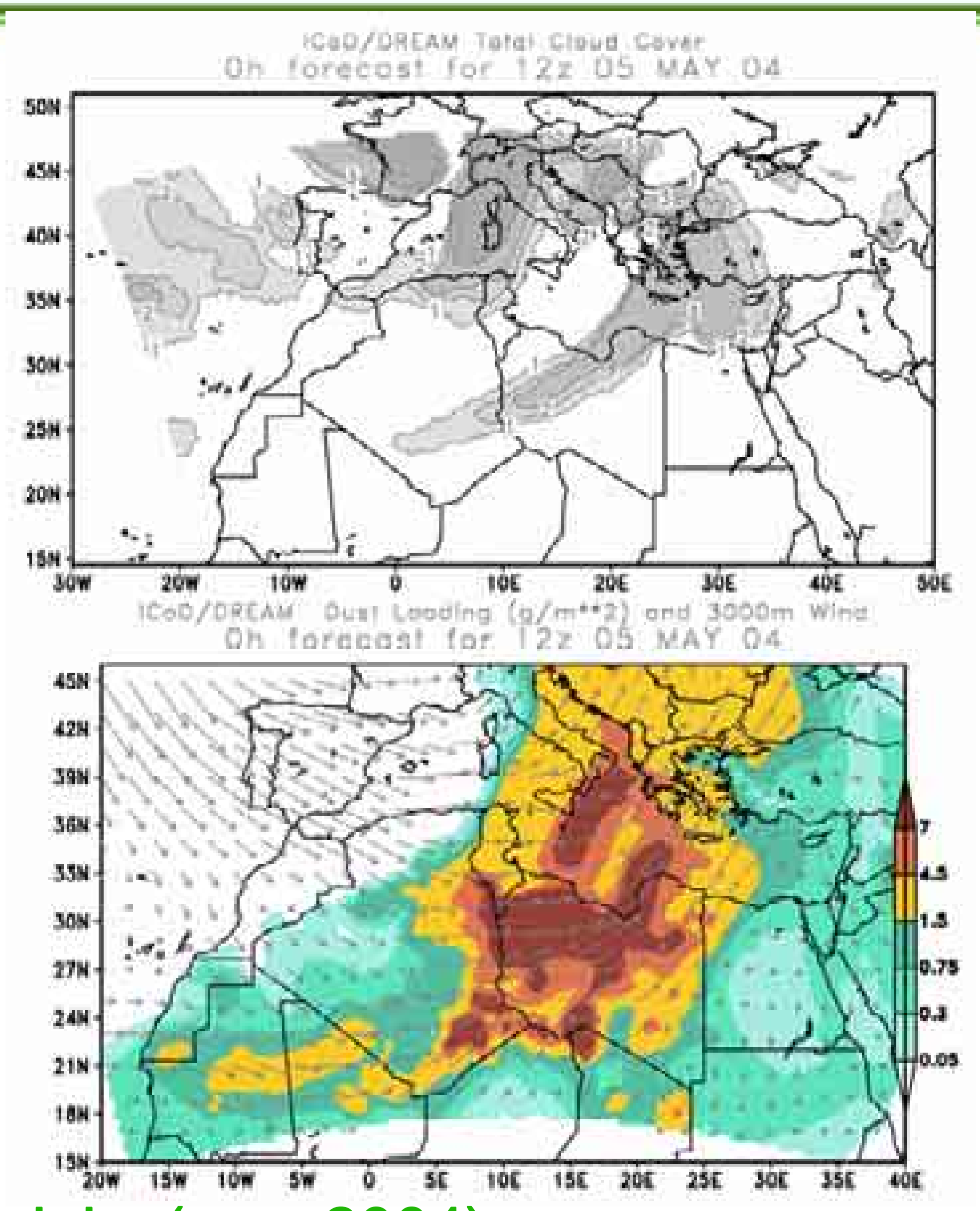
ICoD models (may 2004)



3.000 m

3

ICoD models (may 2004)



3.000 m

4

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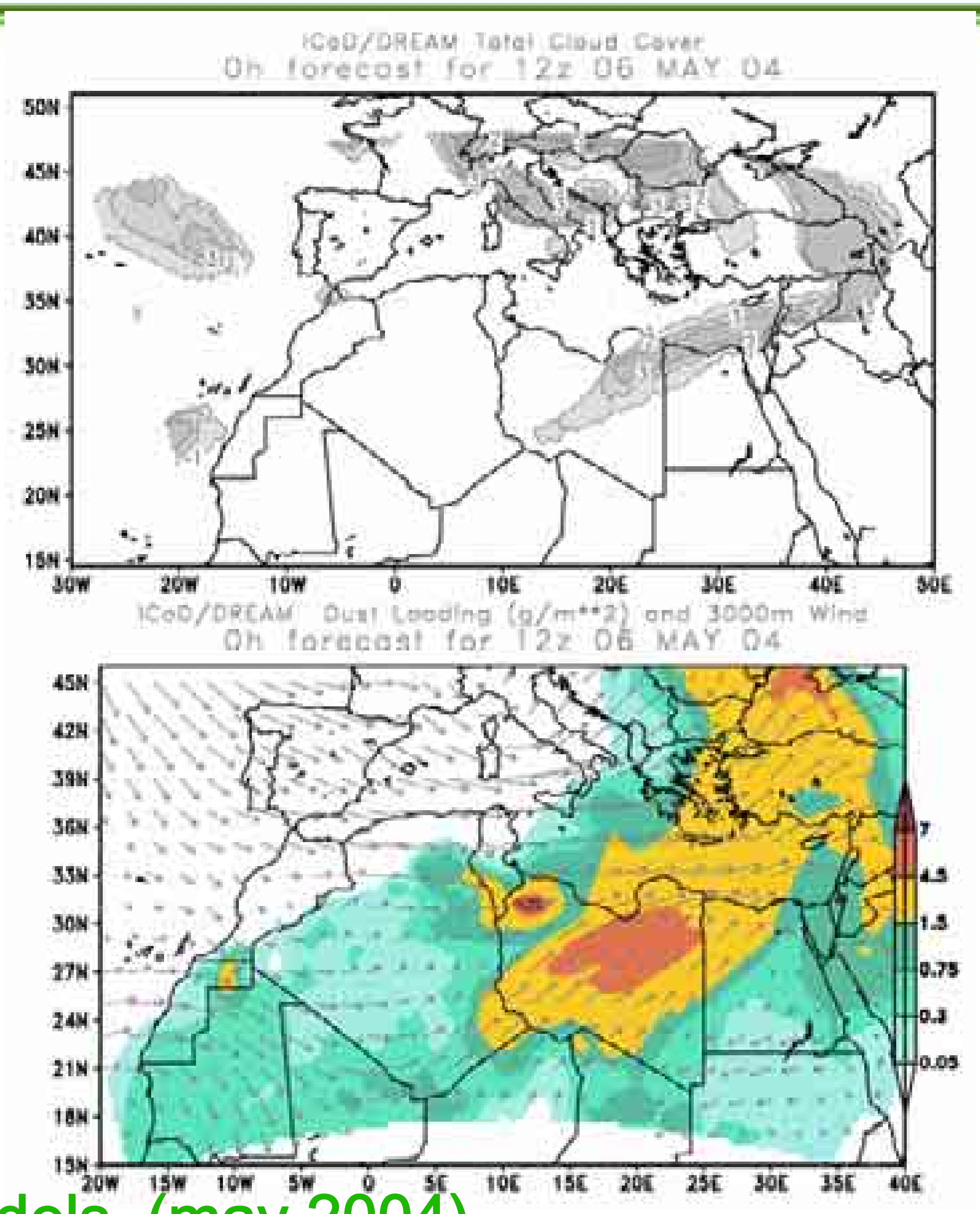
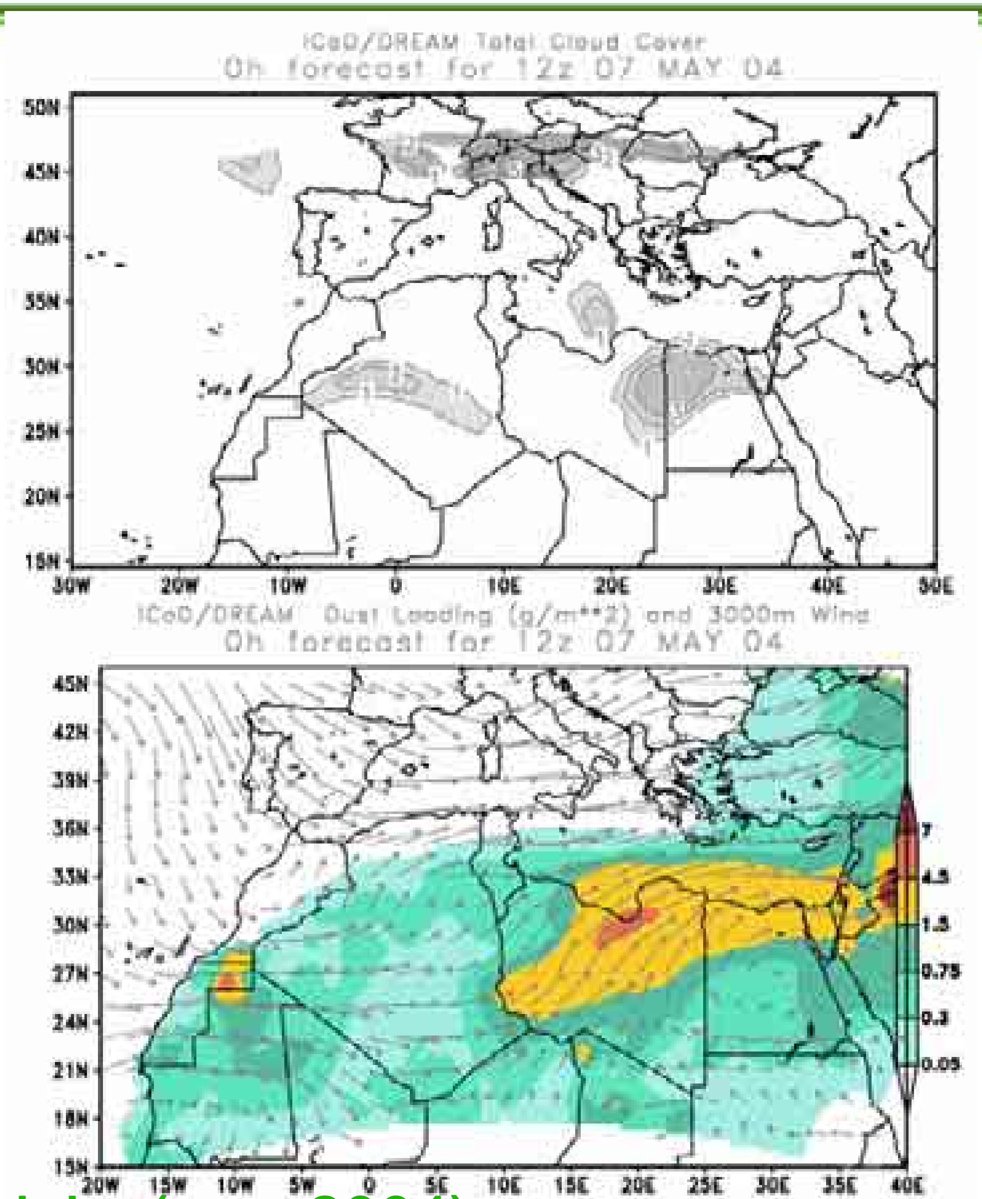


3.000 m

5

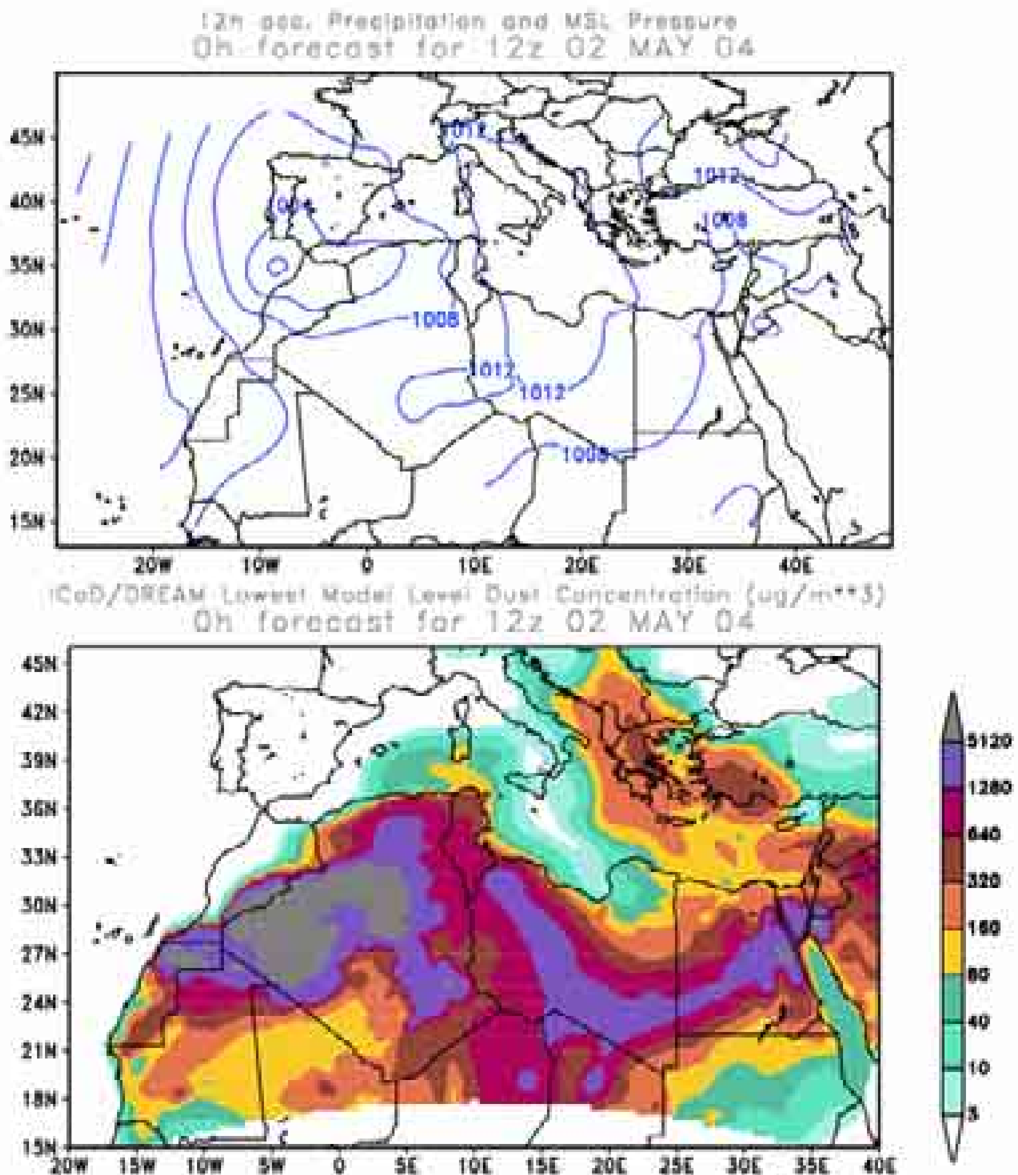
ICoD models (may 2004)



3.000 m

6

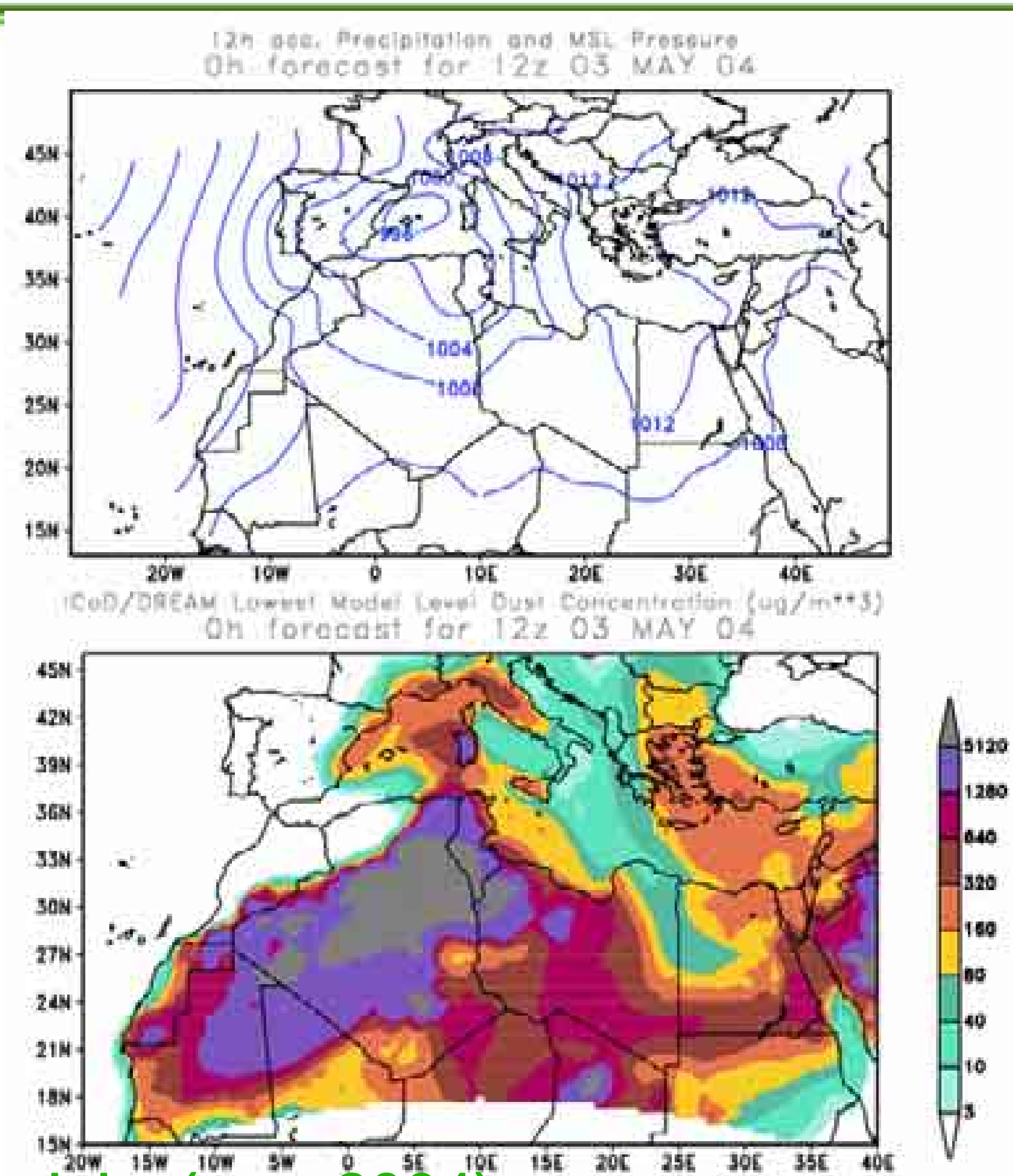
ICoD models (may 2004)



Sea-level

1

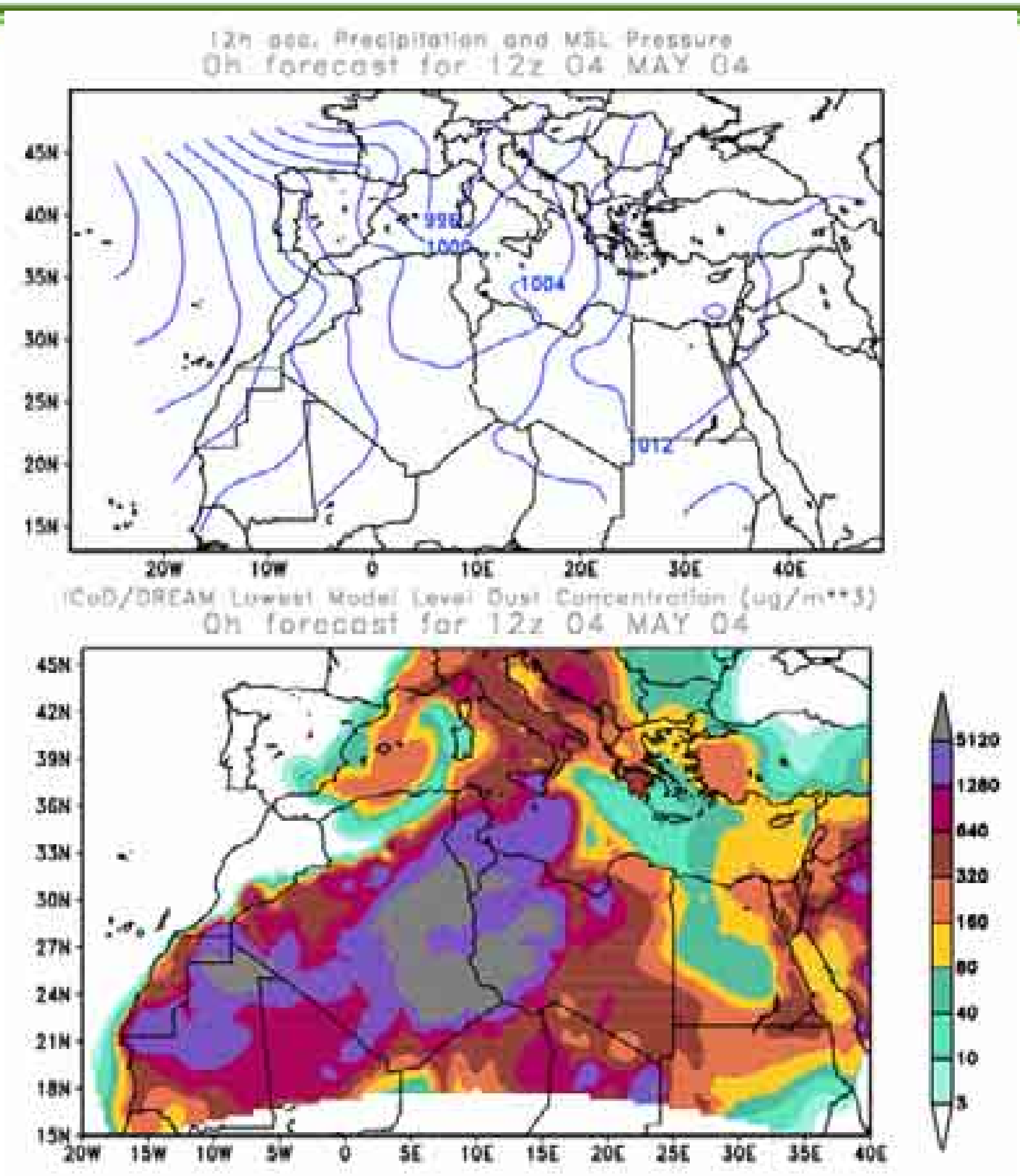
ICoD models (may 2004)



Sea-level

2

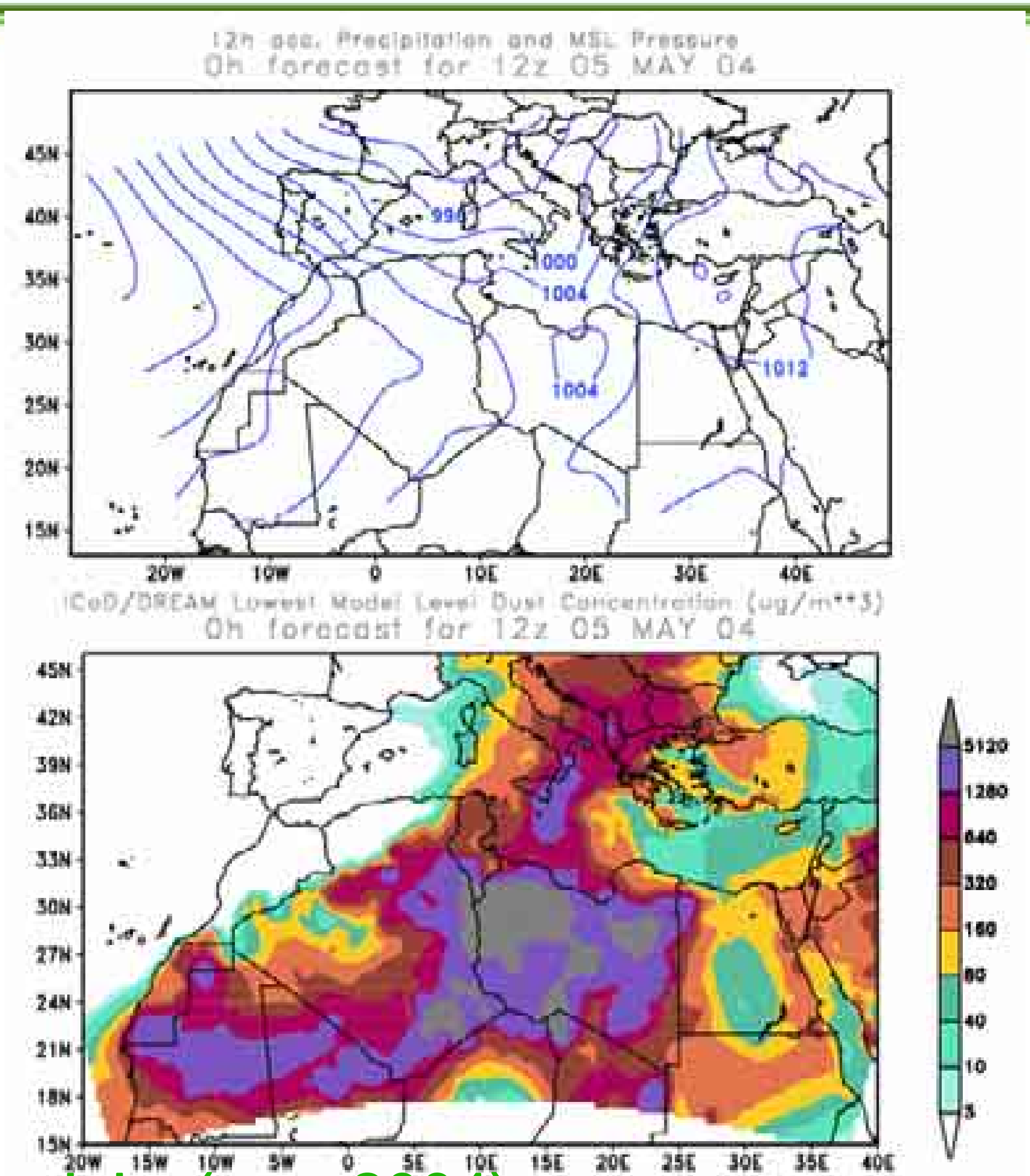
ICoD models (may 2004)



Sea-level

3

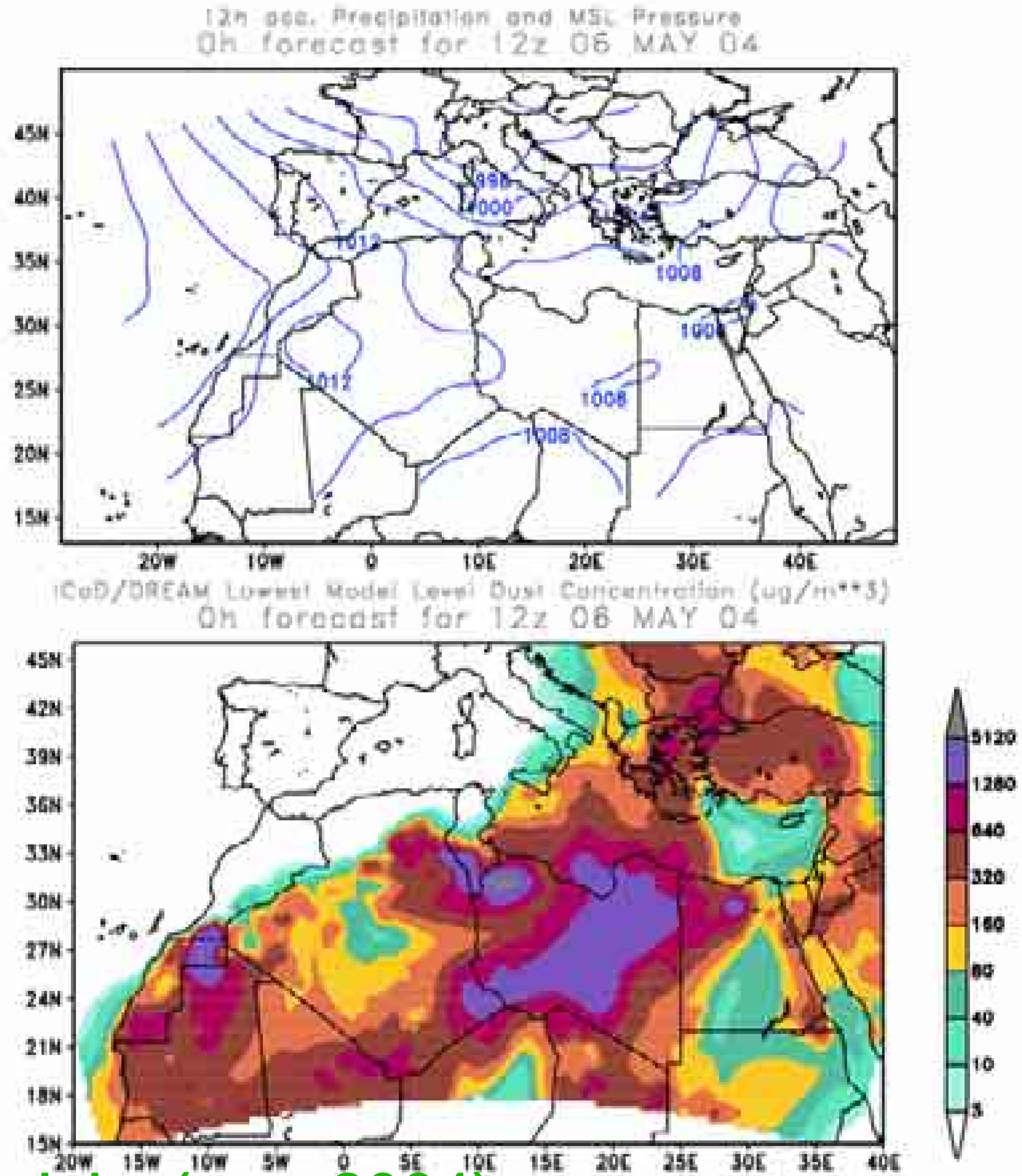
ICoD models (may 2004)



Sea-level

4

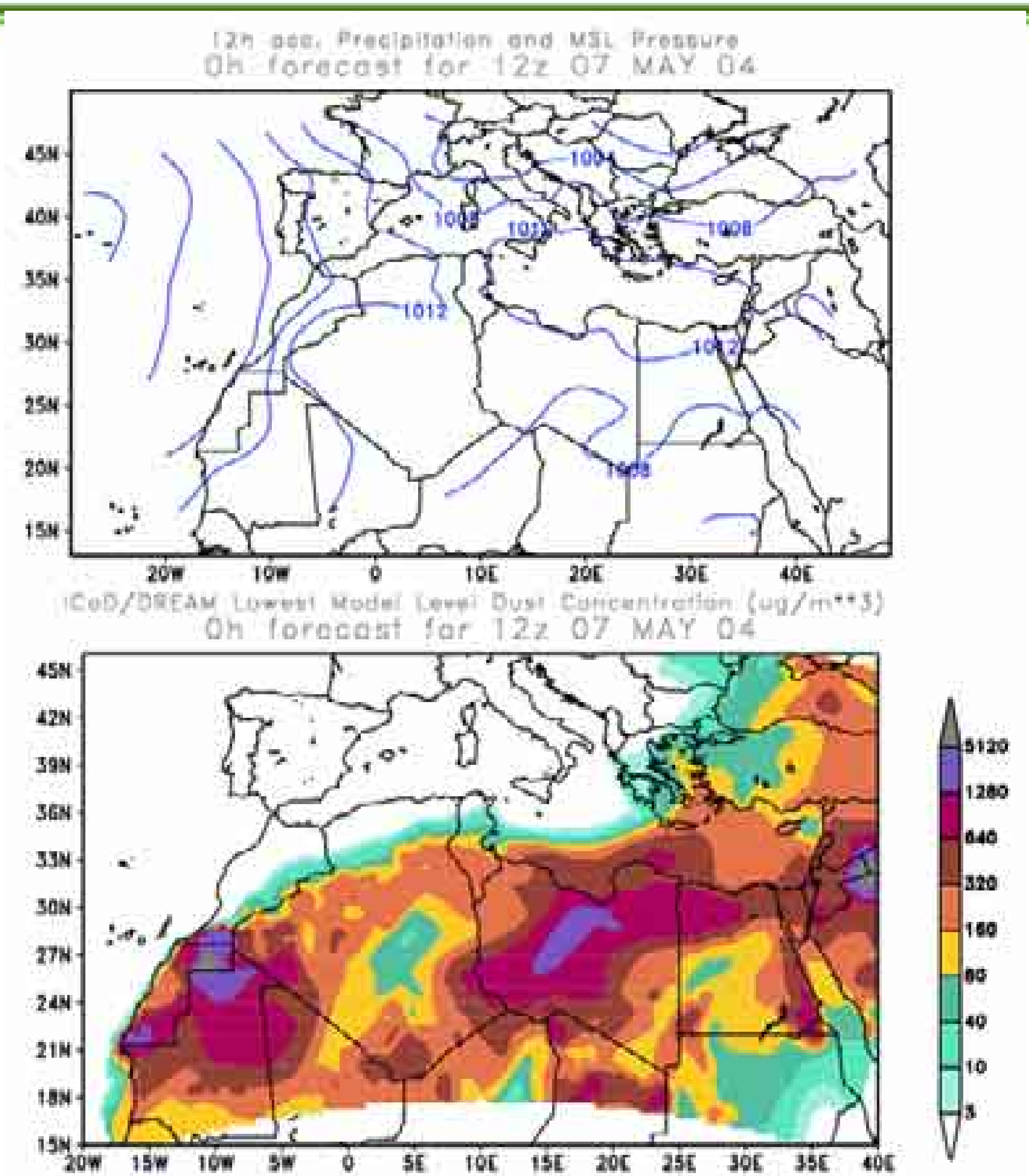
ICoD models (may 2004)



Sea-level

5

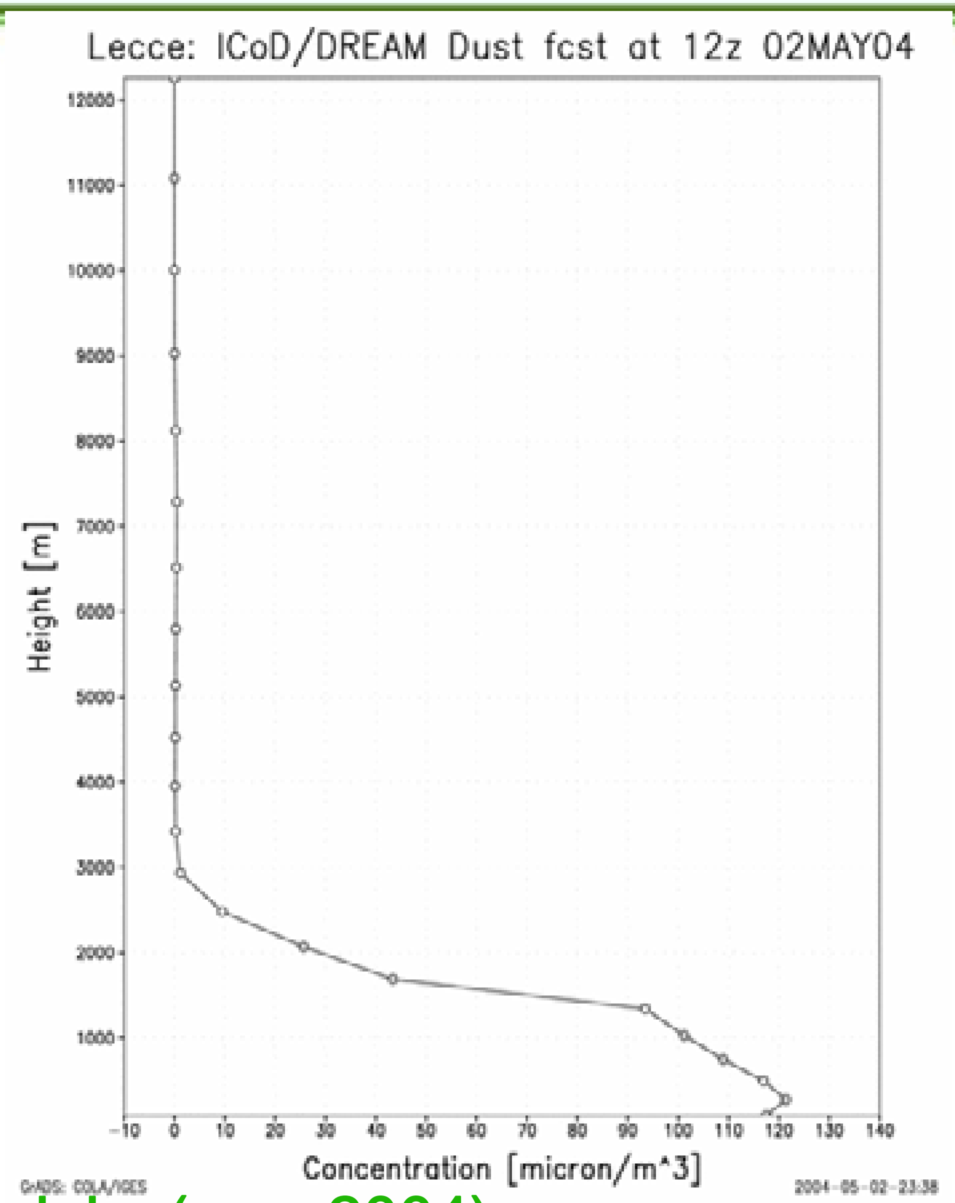
ICoD models (may 2004)



Sea-level

6

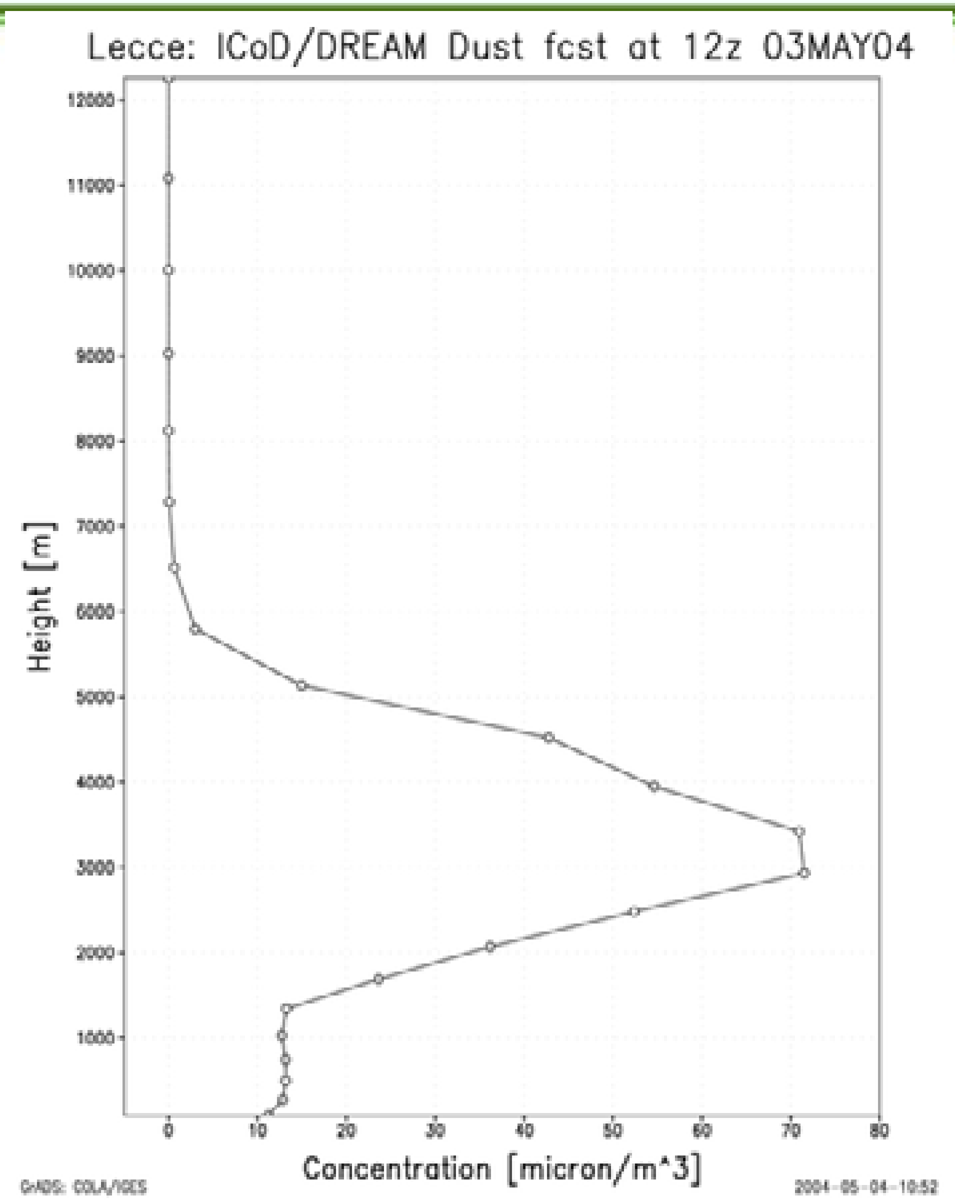
ICoD models (may 2004)



vertical profile

1

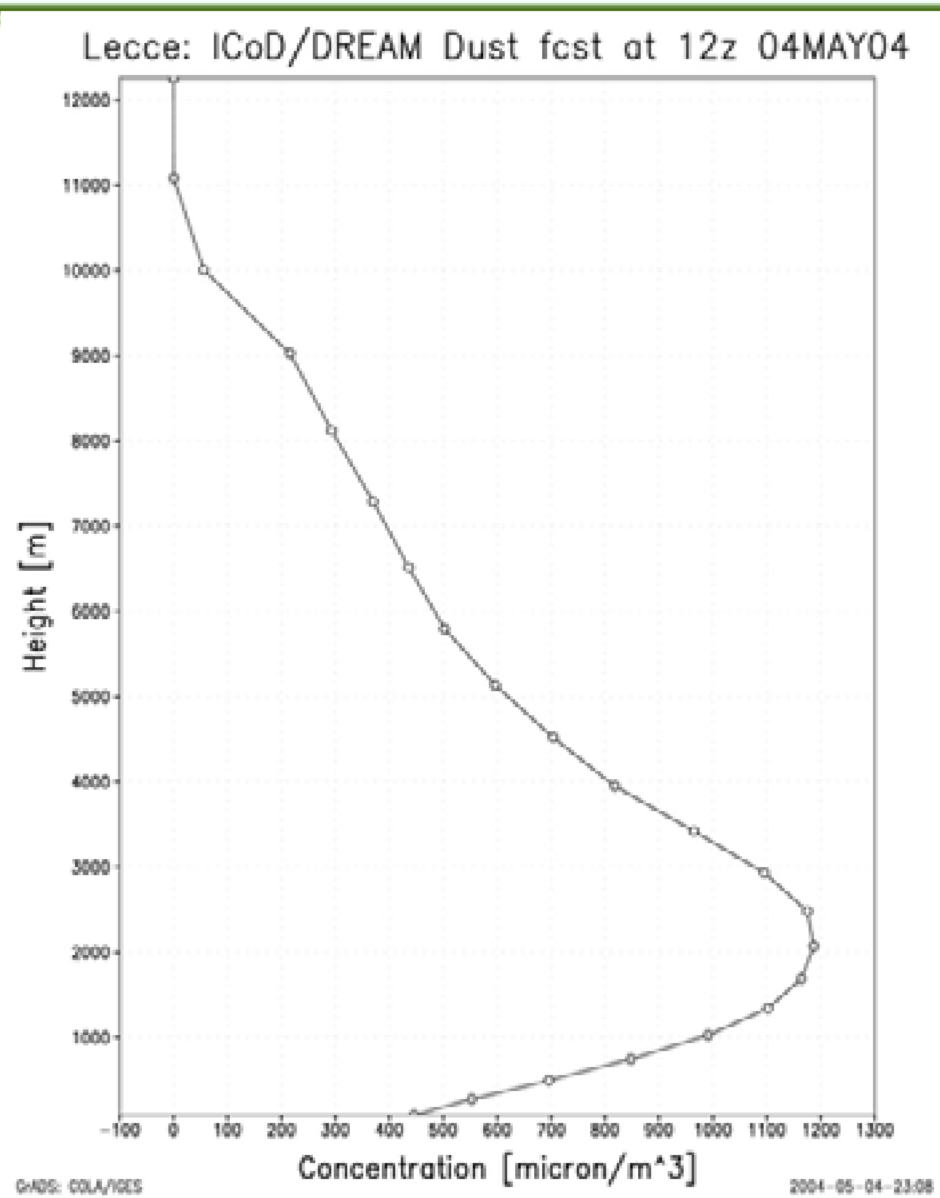
ICoD models (may 2004)



vertical profile

2

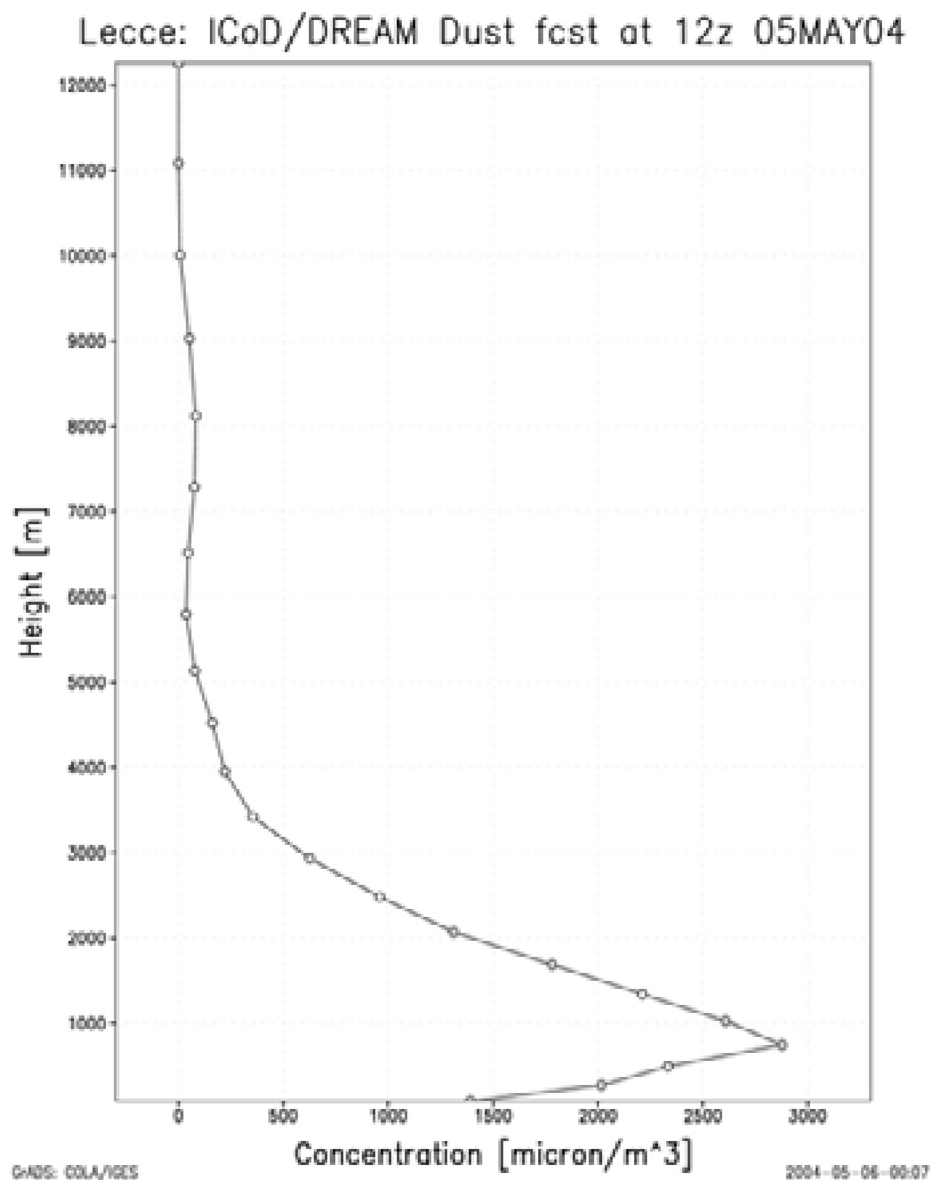
ICoD models (may 2004)



vertical profile

3

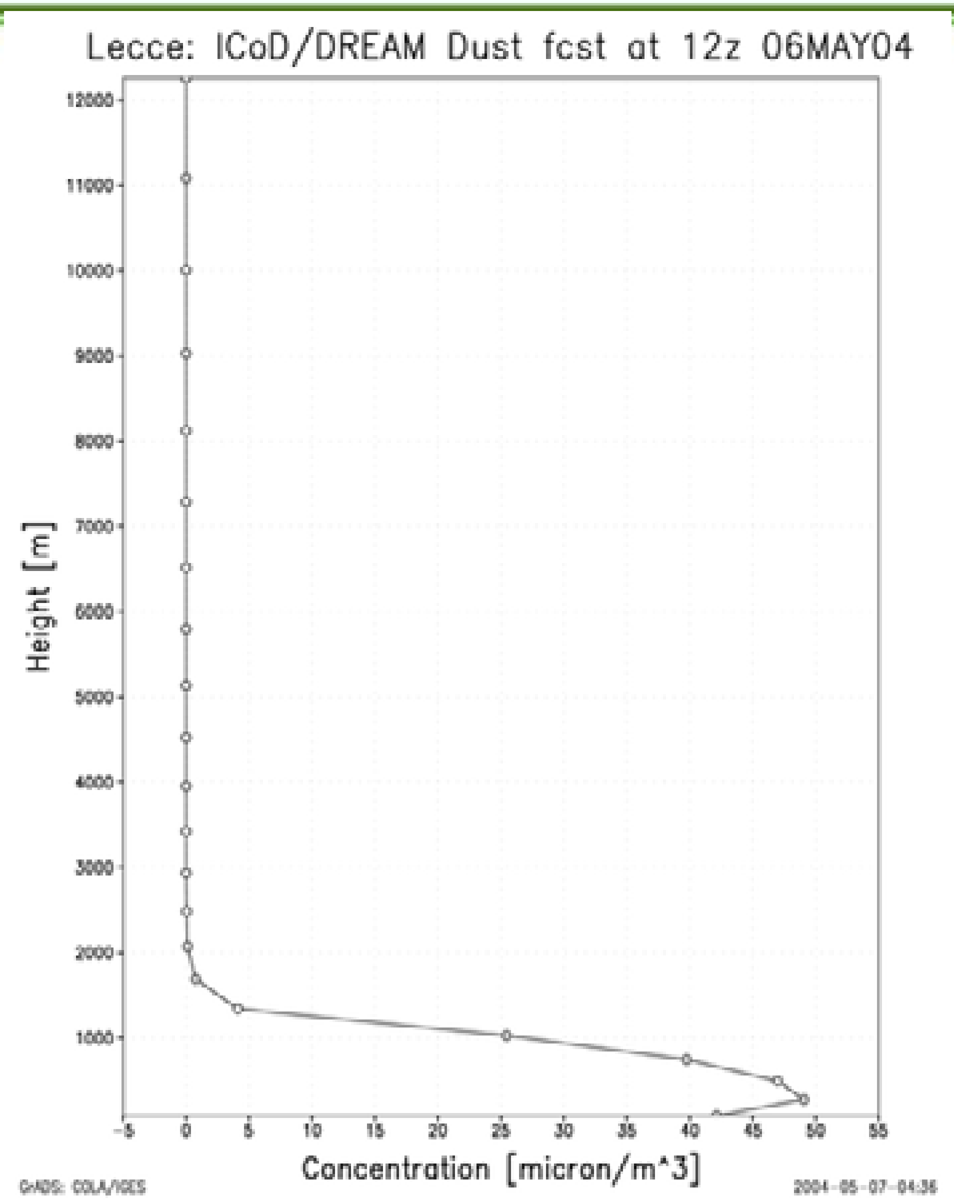
ICoD models (may 2004)



vertical profile

4

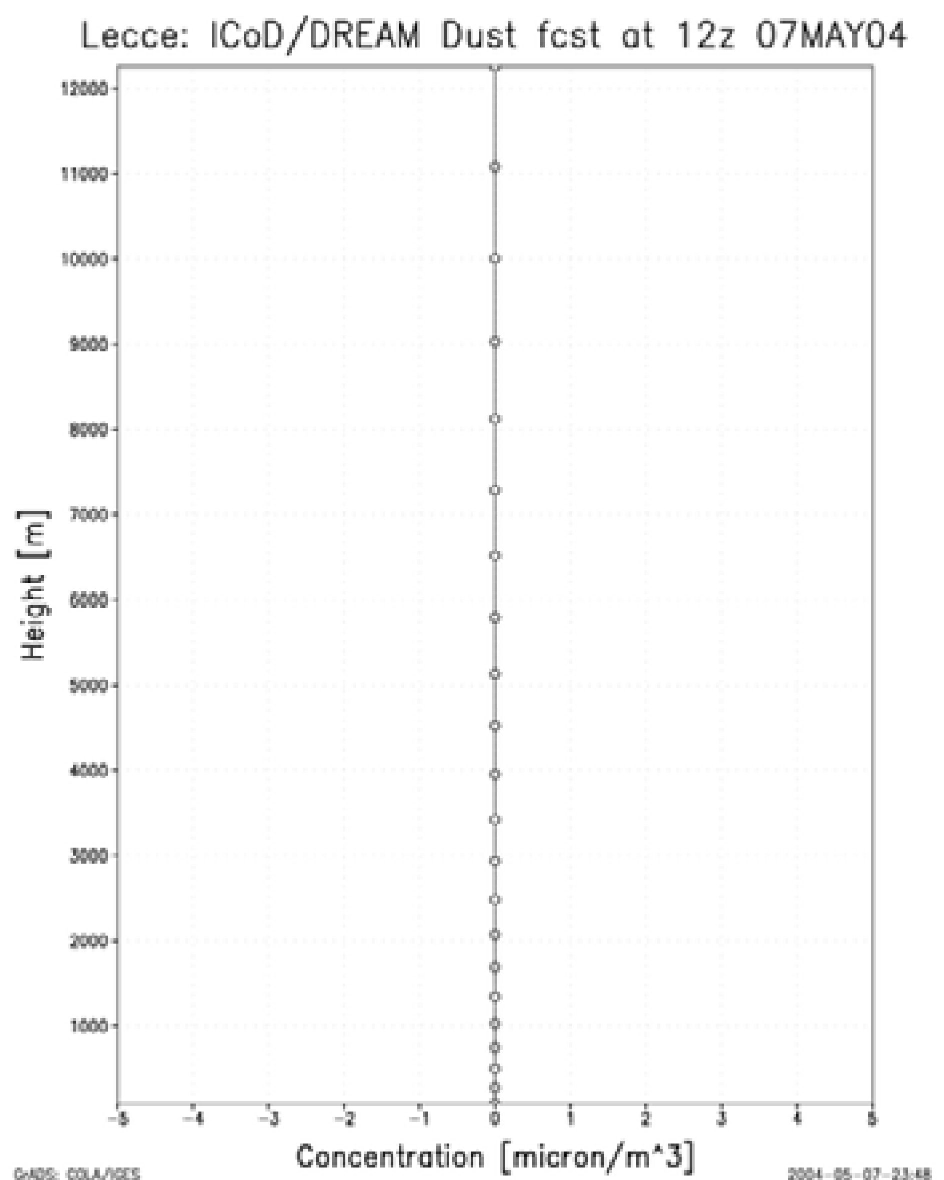
ICoD models (may 2004)



vertical profile

5

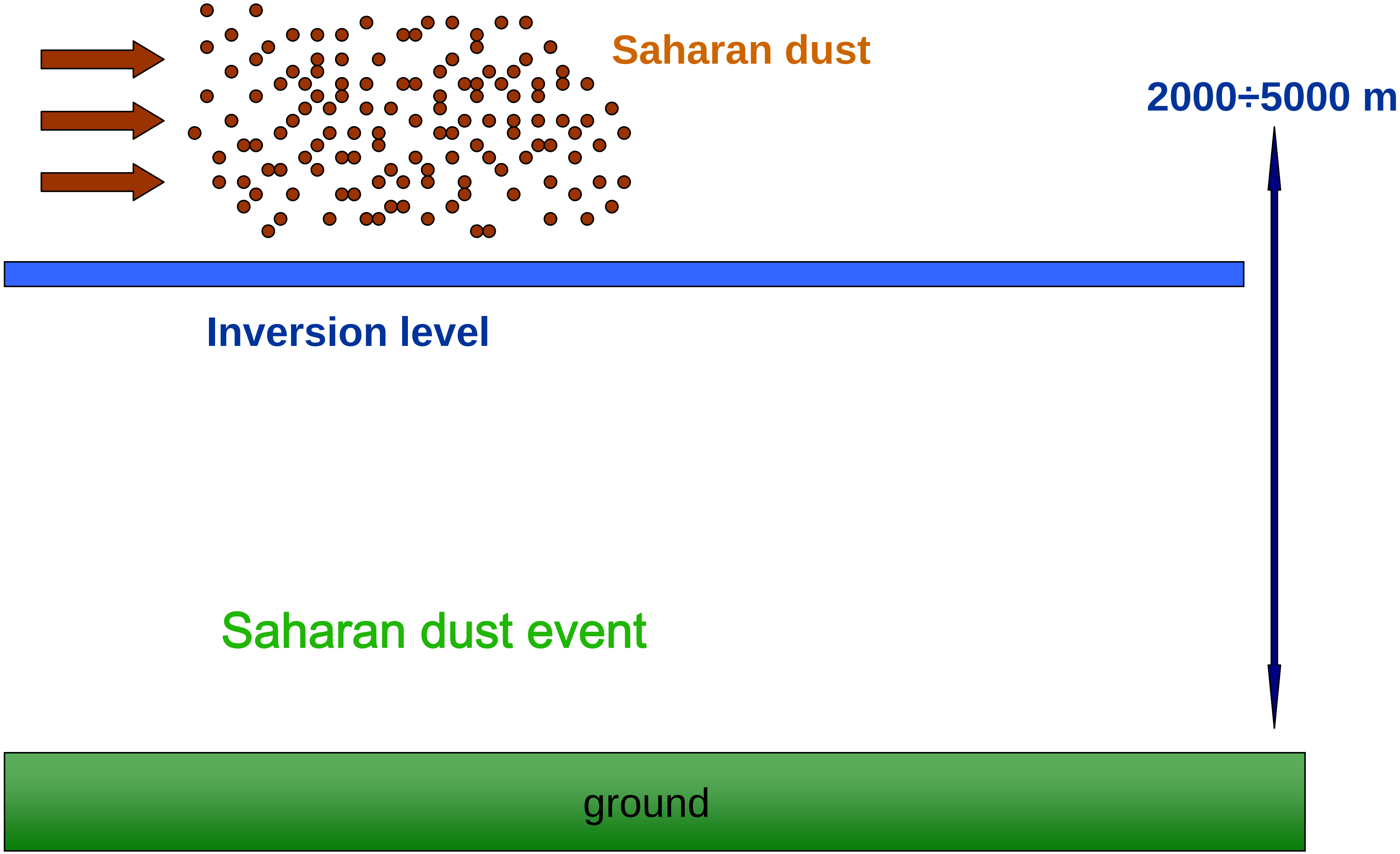
ICoD models (may 2004)

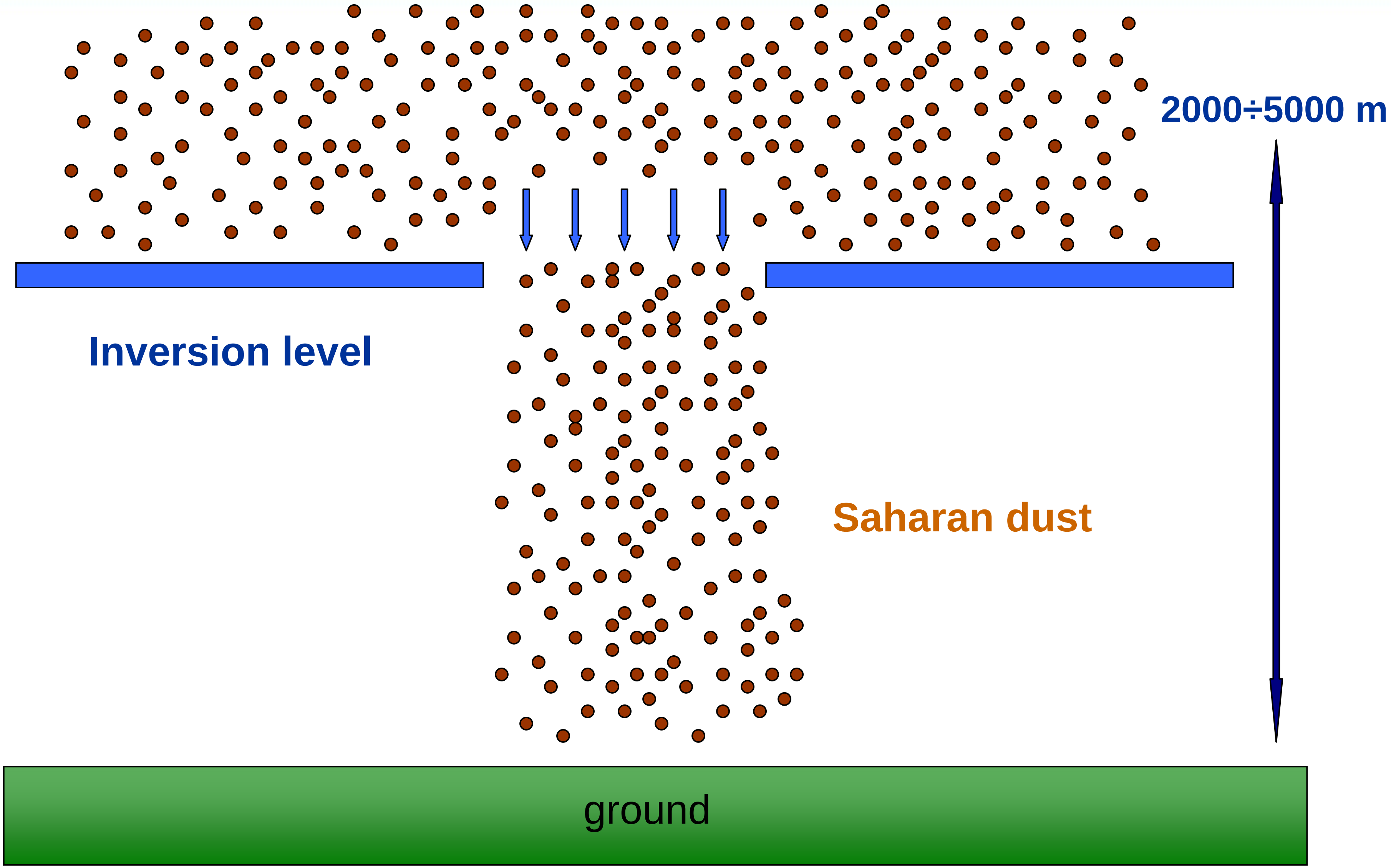


vertical profile

6

ICoD models (may 2004)


Saharan dust
2000÷5000 m
Inversion level
Saharan dust event
ground



Saharan dust event

THE GREAT BOOK OF NATURE

Galileo Galilei

"*Philosophy is written in this enormous book which is continually open before our eyes (I mean the universe), but it cannot be understood unless one first understands the language and recognises the characters with which it is written. It is written in a mathematical language, and its characters are triangles, circles, and other geometric figures.*

Without knowledge of this medium it is impossible to understand a single word of it; without this knowledge it is like wandering hopelessly through a dark labyrinth."

from *Il saggiatore* (The Assayer) 1623