

RIPEG

RIVELATORE PER IL
MONITORAGGIO IN TEMPO REALE
DEL PARTICOLATO ULTRAFINE E
DI GAS INQUINANTI IN AREE URBANE



COMPETITIVITÀ
DINAMISMO
INNOVAZIONE
QUALITÀ



REGIONE TOSCANA



REPUBBLICA ITALIANA



UNIONE EUROPEA

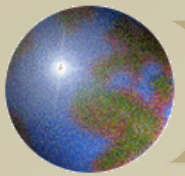


Studio e monitoraggio della qualità dell'aria in Toscana

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STUDIO DEL PARTICOLATO

- **Comprendere i processi atmosferici**
- **Valutare il livello di inquinamento**
- **Identificare sorgenti e processi di trasporto**

- **effetti sull'ambiente e sulla salute**
- **fenomeni di trasporto e rimozione**
- **origine (sorgenti)**



**dimensioni e
composizione**

È importante determinare la concentrazione e la composizione delle diverse frazioni granulometriche e come esse variano nel tempo e nello spazio

Progetto PATOS - Siti di campionamento



Sei siti in Toscana, rappresentativi di aree di differente tipologia (differenti fonti emissive e topografia)

Sub-urban background

urban background

Progetto PEGASO - SITO DI CAMPIONAMENTO

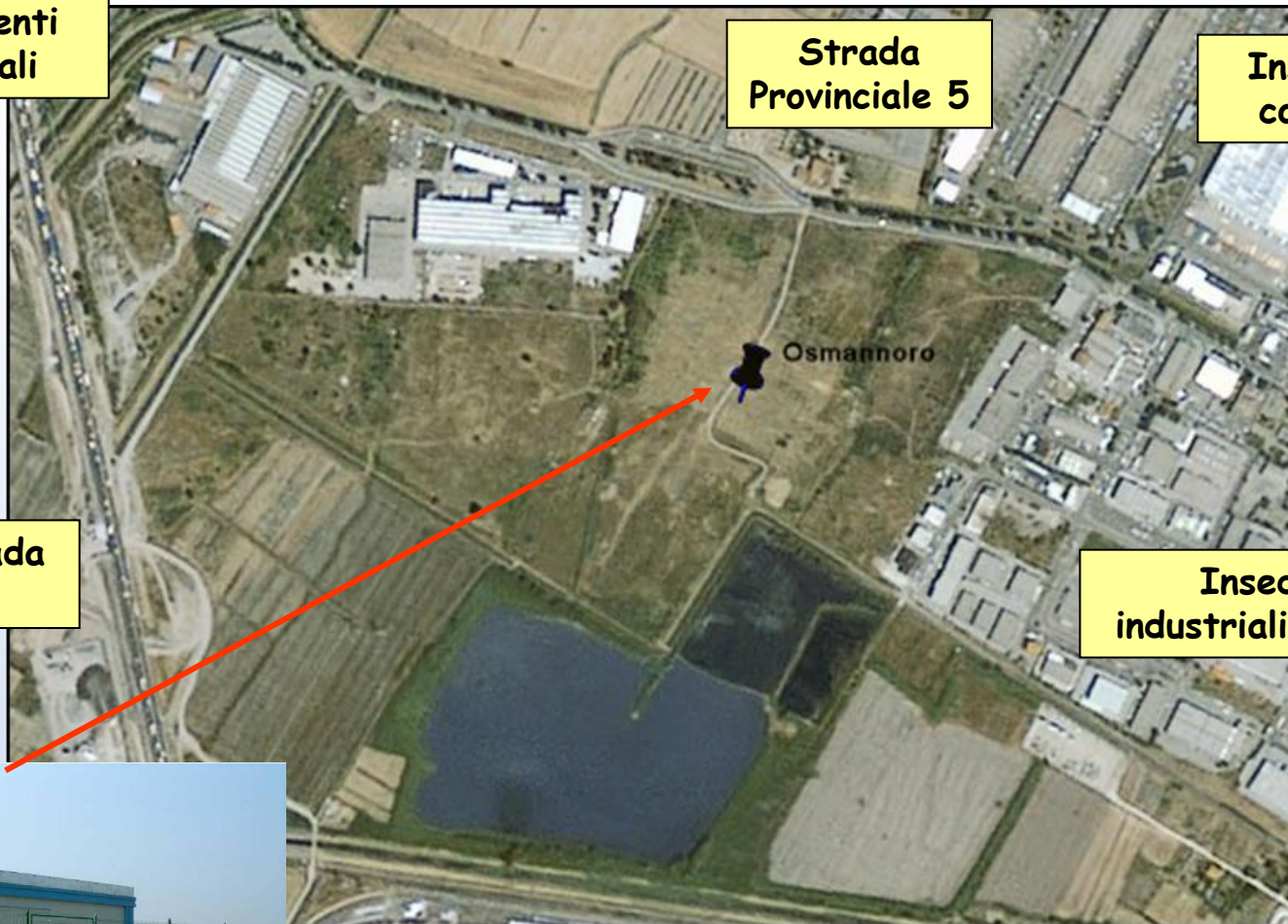
Insedimenti Industriali

Strada Provinciale 5

Insedimenti commerciali

Autostrada A1

Insedimenti industriali/commerciali



Strada Statale 66



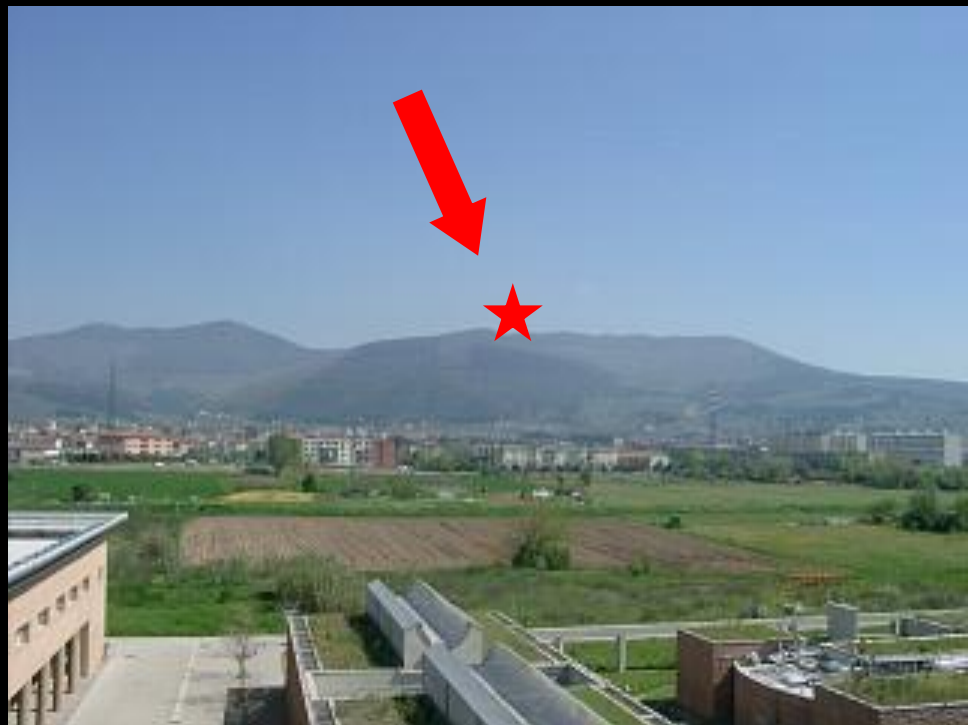
Studi pilota aerosol Sesto F.no

PASF-2: PM_{2.5} Lug 05 - Mar 07

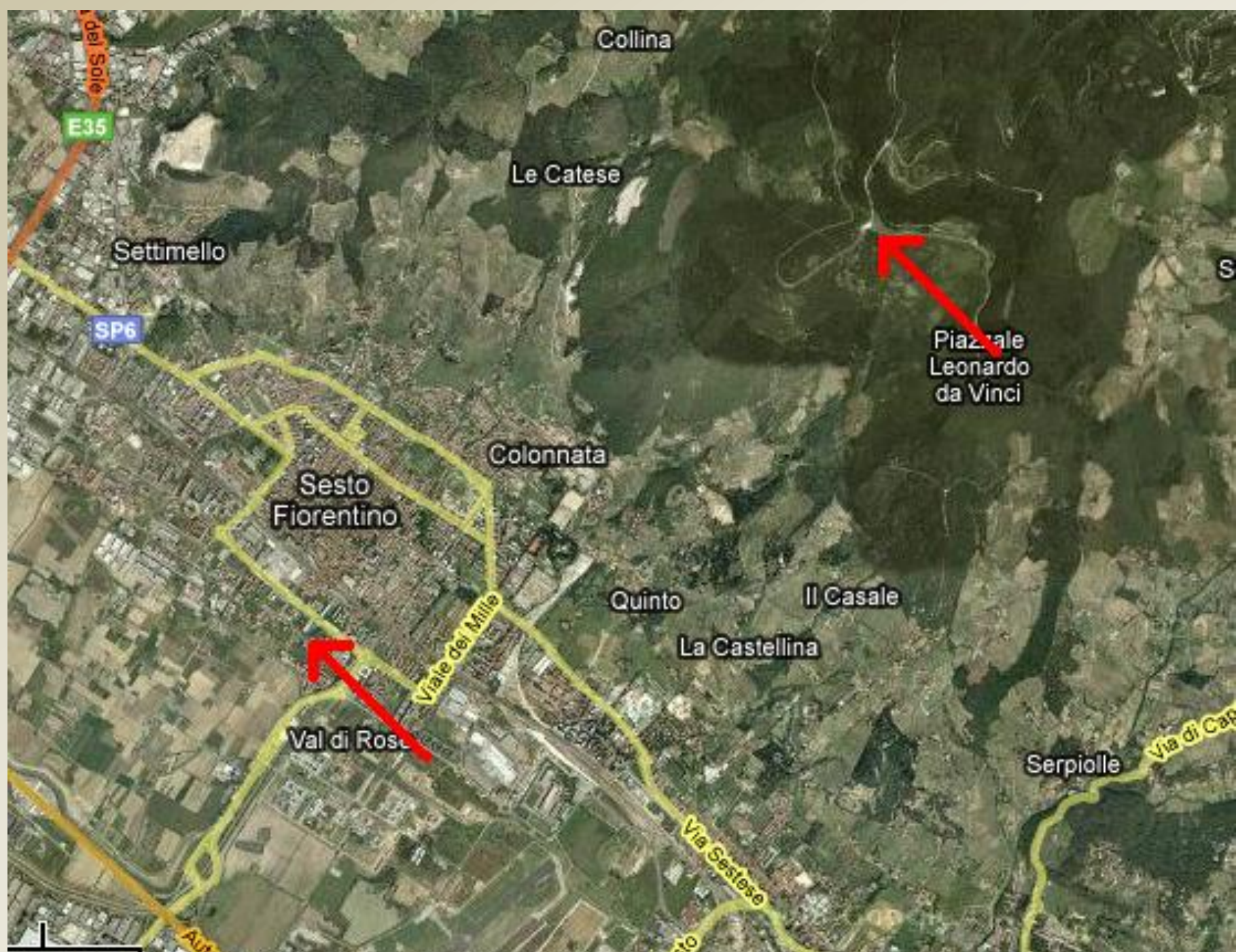
PASF-3: PM₁ Mar 07 - Mag 08

PASF-4: PM_{2.5} Set 08 - Oggi

- Area a basso livello di antropizzazione utilizzata come riferimento: Monte Morello (700 m slm)
- Centro urbano di Sesto Fiorentino



Strato Inversione - PBL: Radon

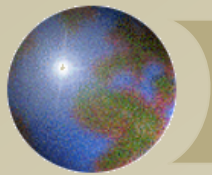


Villa San Lorenzo - Sesto F.no



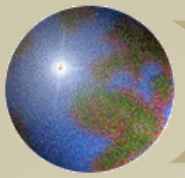
8 km distanza in linea d'aria ma 750 m slm
Fonte dei Seppi - Monte Morello





Anthropic Sources

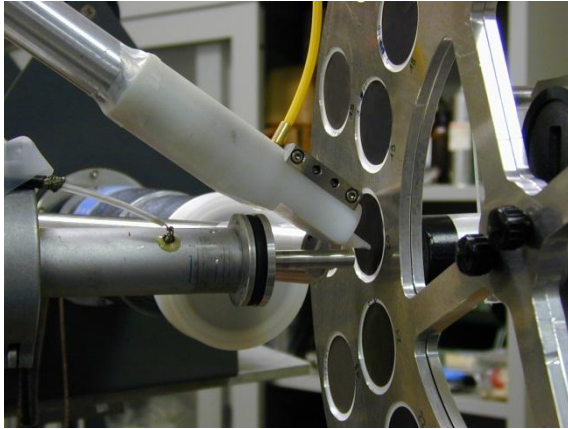
- ➔ **Bio-mass burning:**
K, formate, acetate, glycolate, EC-OC.
Anthropic activity - Forest fires
- ➔ **Industrial processes:**
Metals, Organics, EC-OC
Anthropic activity
- ➔ **Secondary Aerosol:**
 **NO_3^- , SO_4^{2-} , NH_4^+ , Organic Carbon (OC),
surfactant (MBAS-LAS).**
Anthropic activity - Biogenic activity



Aerosol Environmental Markers

- Atmospheric Dust: Ca^{2+} , insoluble dust particles
Atmospheric circulation - Hydrological cycles (source area aridity, wet atmospheric scavenging)
- Sea Spray: Na^+ (and, partially, Cl^- and Mg^{2+})
Sea ice extension
Atmospheric circulation modes
- Marine Biological activity: MSA (nssSO_4^{2-} and NH_4^+)
Negative Feedback on climate (CCN formation and uptake of CO_2). Oceanic fertilization
- Volcanic Activity: nssSO_4^{2-} (not biogenic), HF, HCl
Climate forcing
Stratospheric and tropospheric transport

Metodi di analisi per lo studio della composizione chimica: Filtri in Teflon

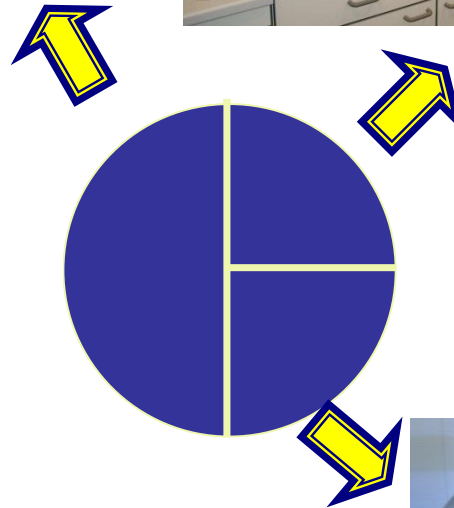


**Particle Induced
X-ray Emission
(PIXE)**
Concentrazioni
elementali ($Z > 10$)



**Cromatografia
ionica:**

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



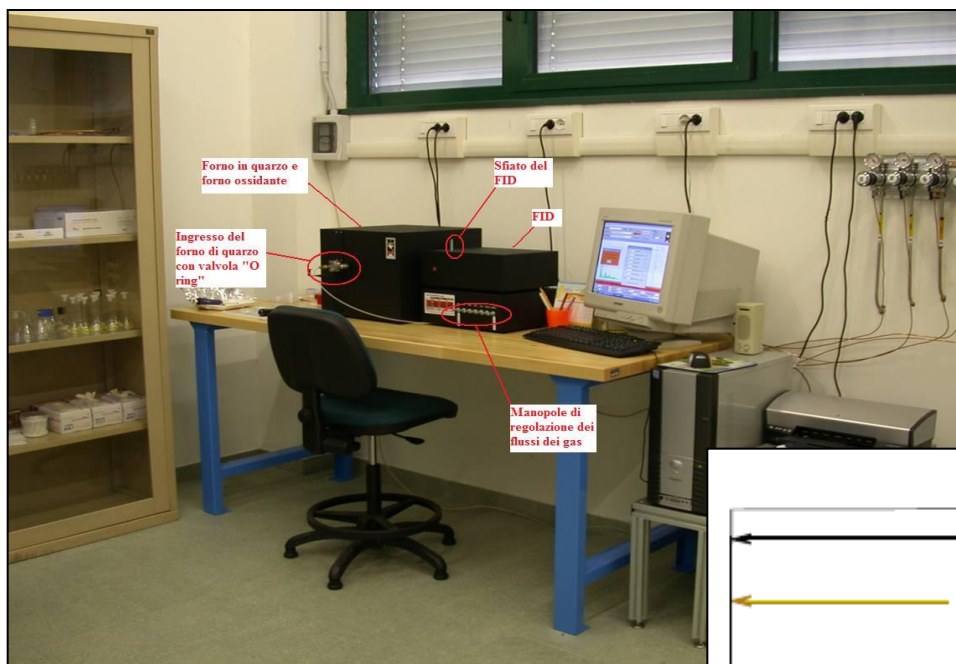
HR-ICP-MS:
Componente solubile
di alcuni metalli



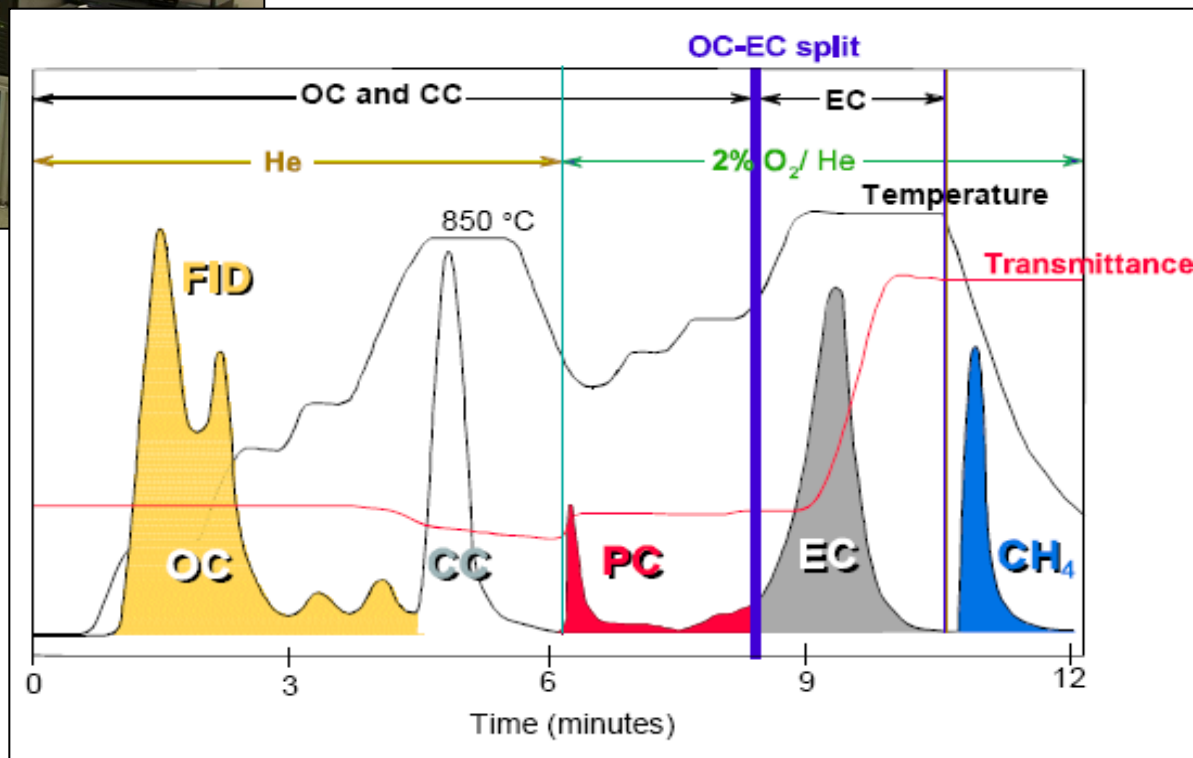
Al, Fe, Mn,
Cu, Cd, V, Ni,
Cr, Pb, Mo,
As, Hg, Zn

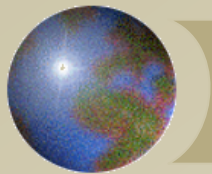
Medium Volume Quartz Filters: EC/OC INFN-Firenze

Analizzatore Termo-Ottico SUNSET



Organic Carbon (OC)
Elemental Carbon (EC)
separated by the
NIOSH protocol





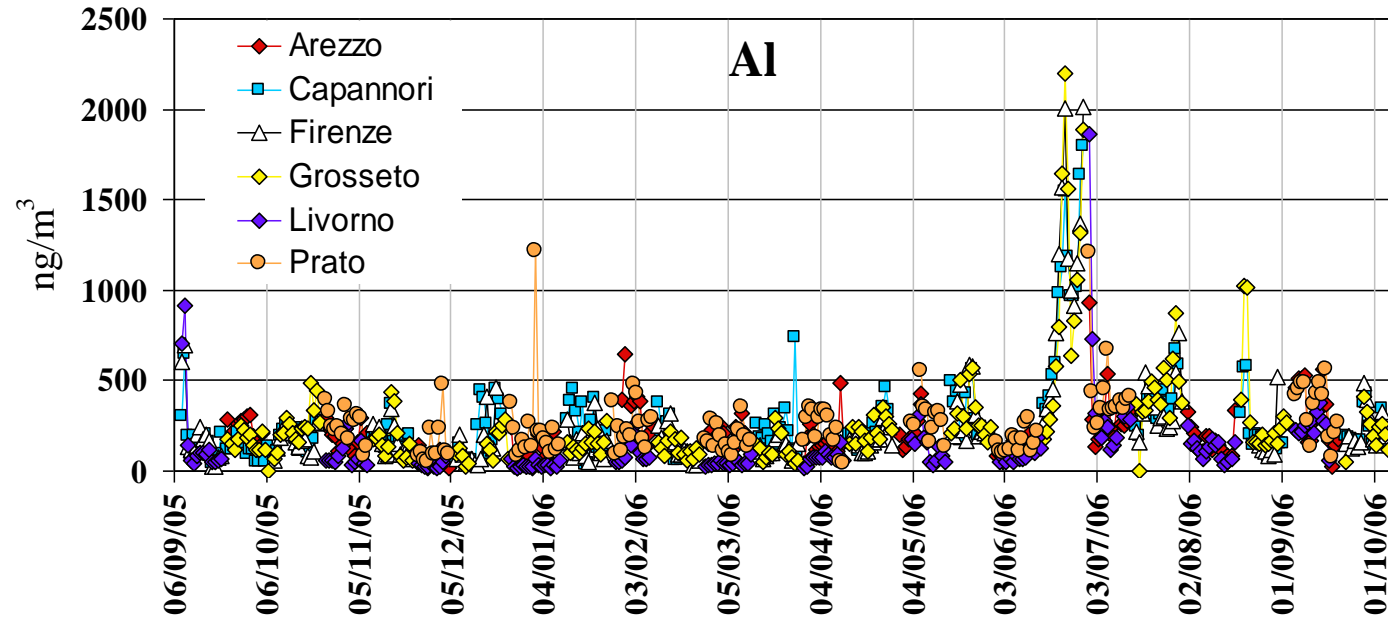
Progetti PATOS 1 e 2

Il rischio sanitario del particolato dipende dalla composizione chimica, dalle dimensioni e dalle caratteristiche di superficie delle particelle.

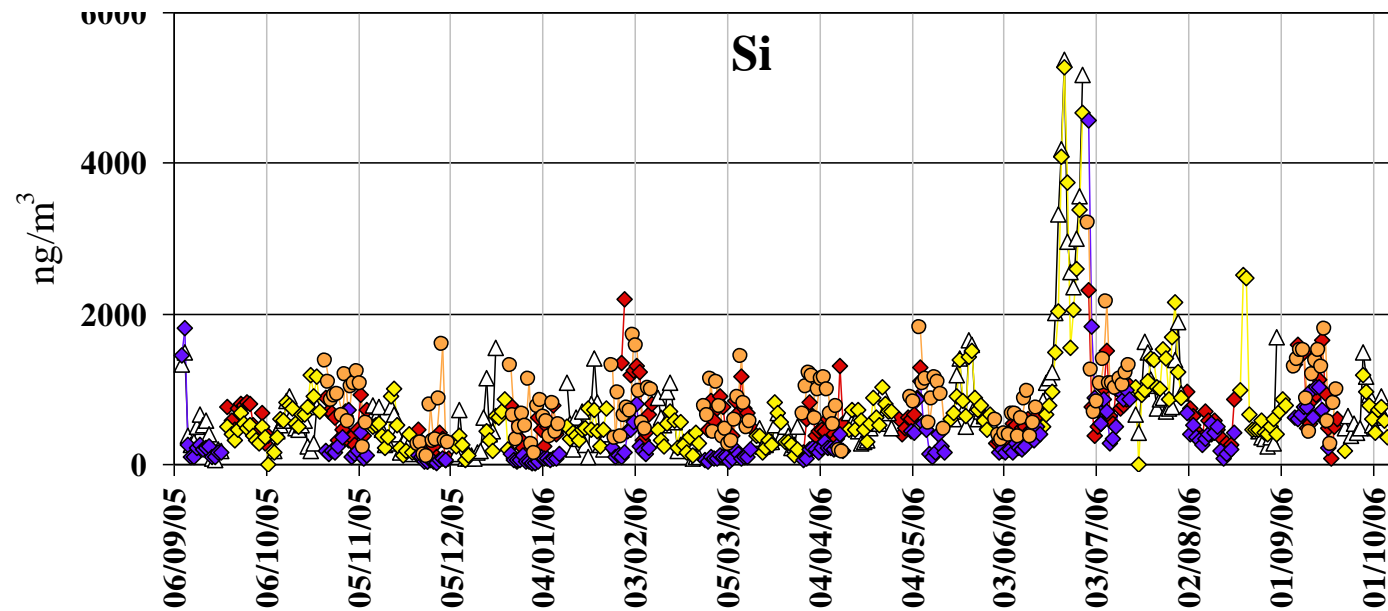
Obiettivi:

- Composizioni chimica del PM10 e del PM2.5
- Valutazione dei valori di fondo del PM10
- Misura delle conc. di metalli nel PM10 (Decr.152/2007)
- Quantificazione componente secondaria PM10 e PM2.5
- Identificazione delle sorgenti emissive e valutazione del loro contributo al PM10 e al PM2.5
- Influenza delle condizioni meteo su PM10 e PM2.5

Soil-dust component

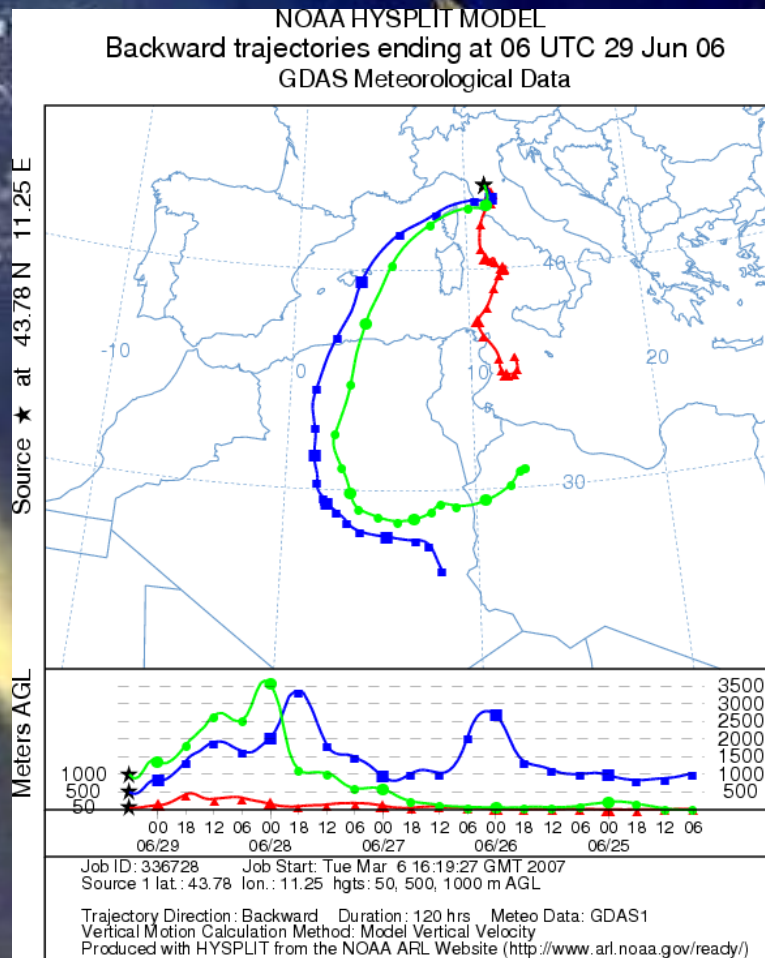
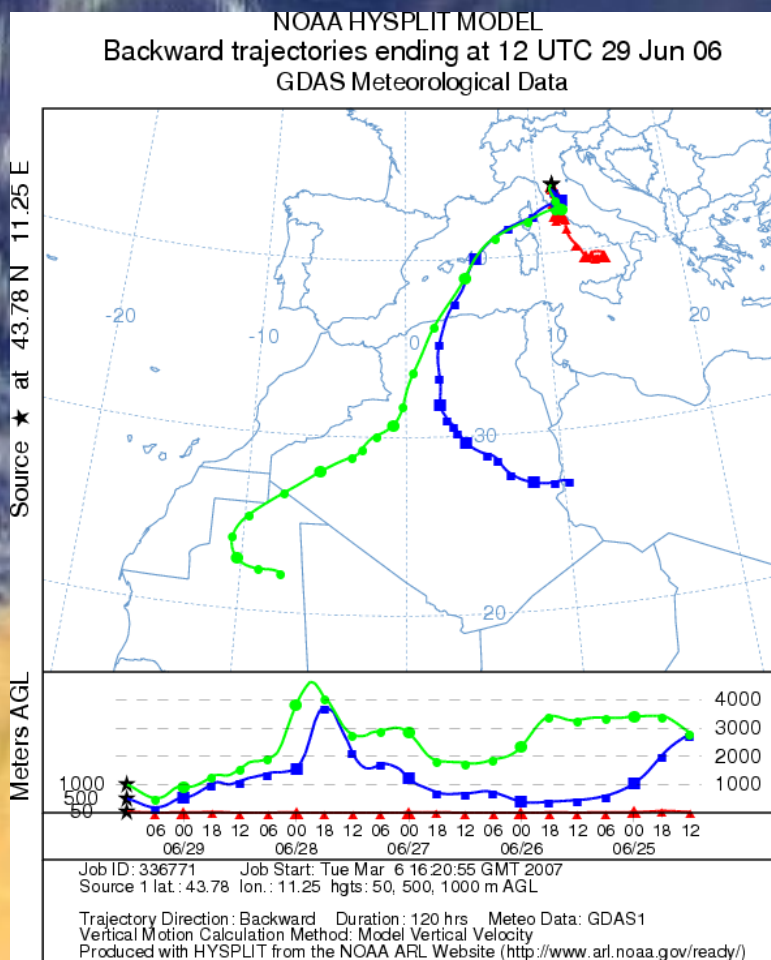


Al



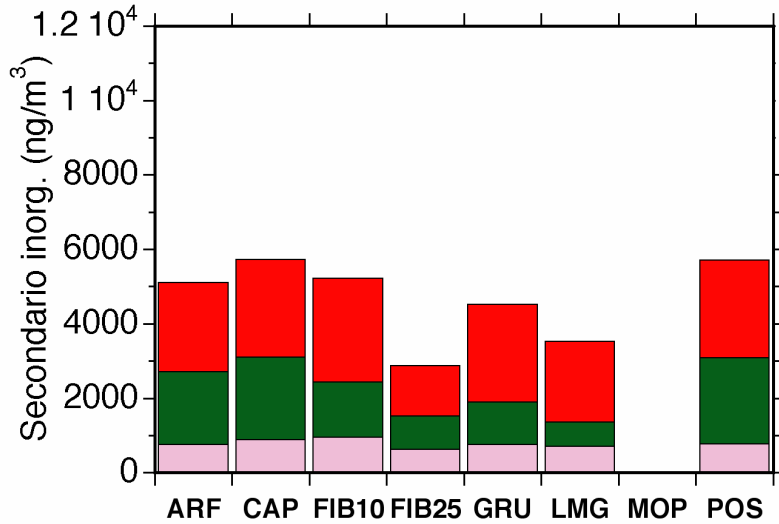
Si

Retro-traiettorie

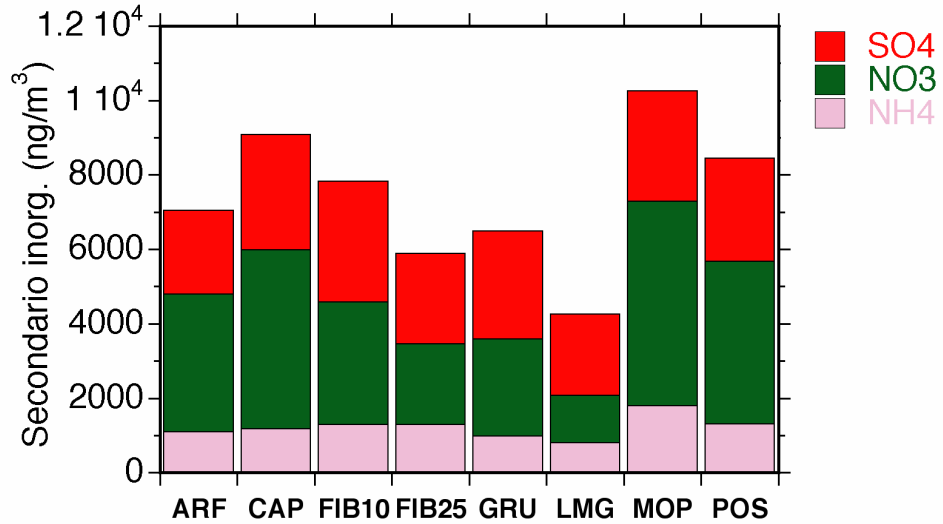


Particolato secondario inorganico

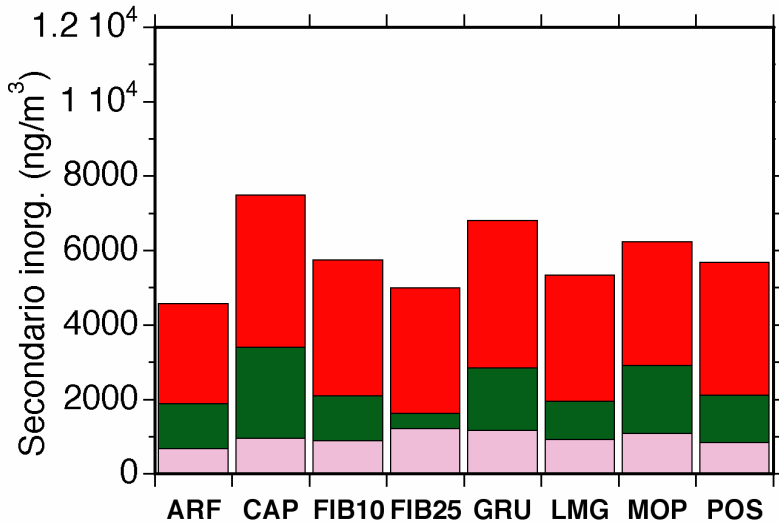
Media autunno



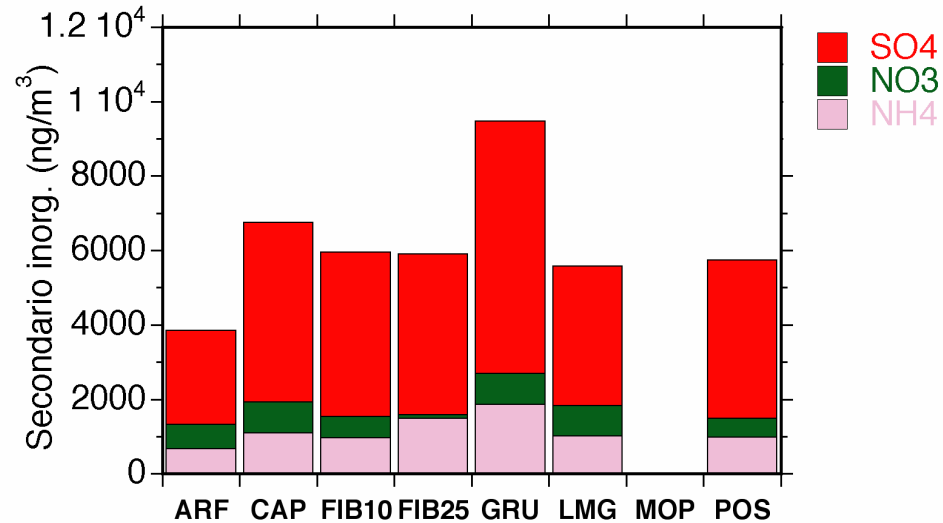
Media inverno



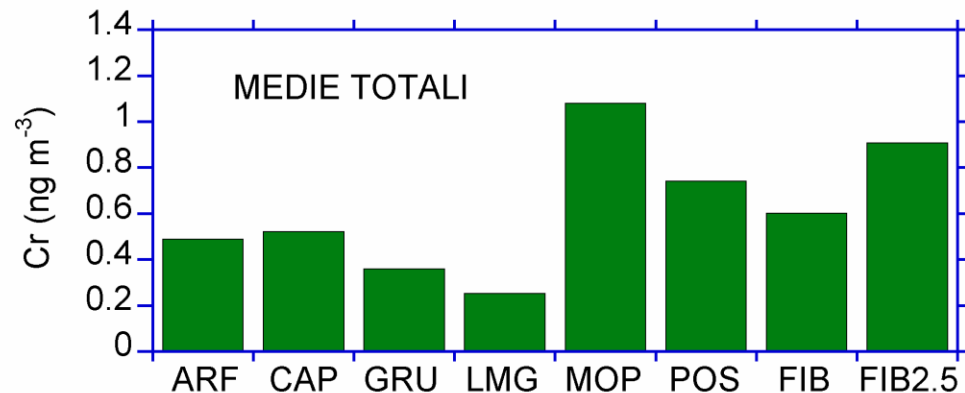
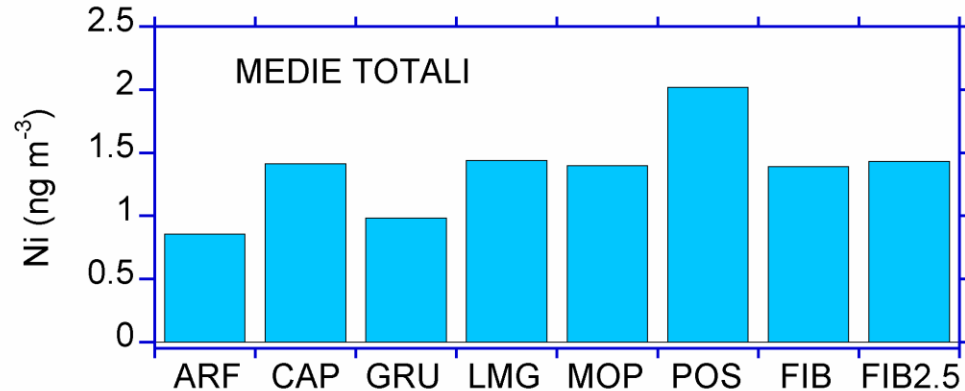
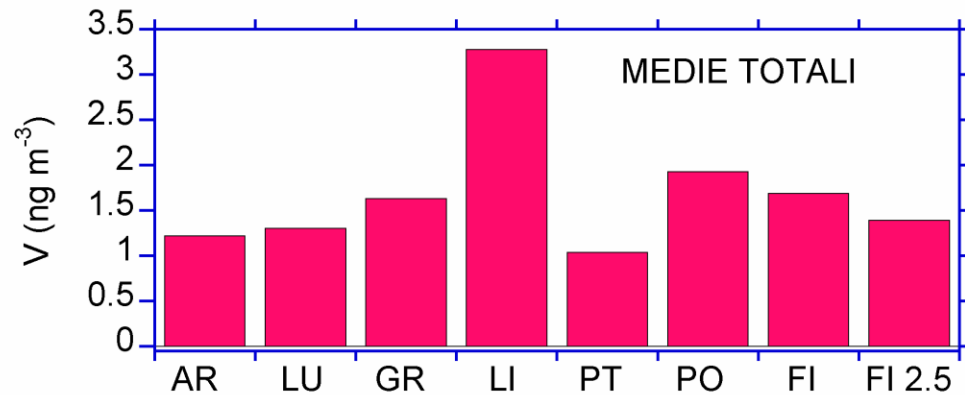
Media primavera



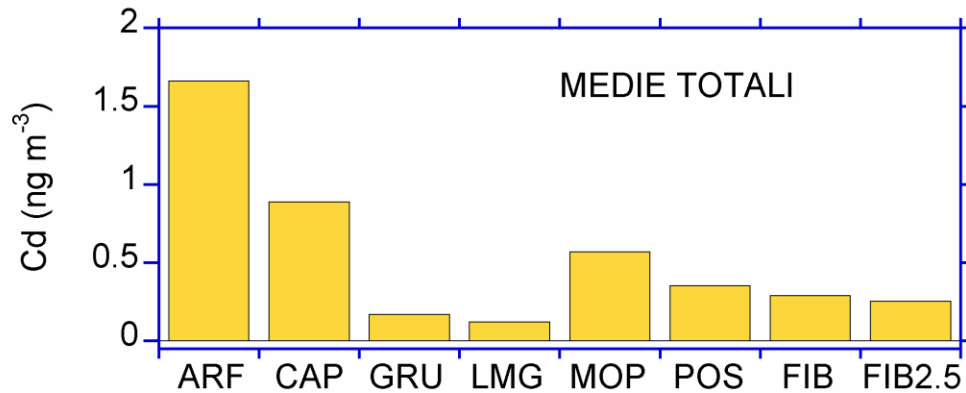
Media estate



Direttiva 2004/107/CE Valori Obiettivo 2013

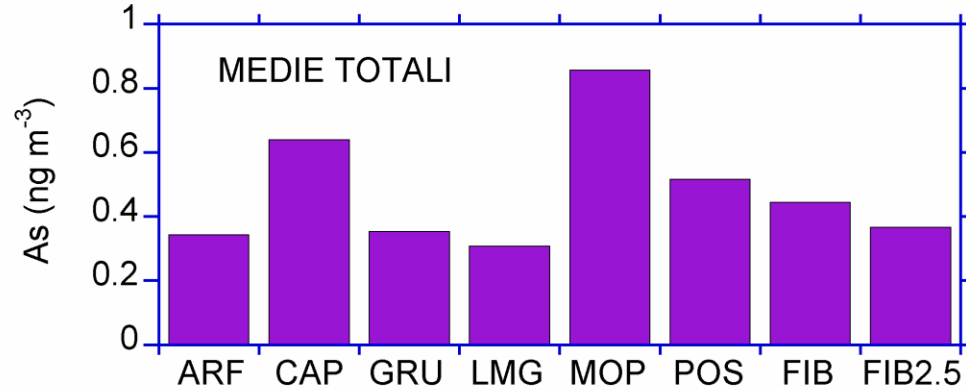


Nichel
20 ng/m^3



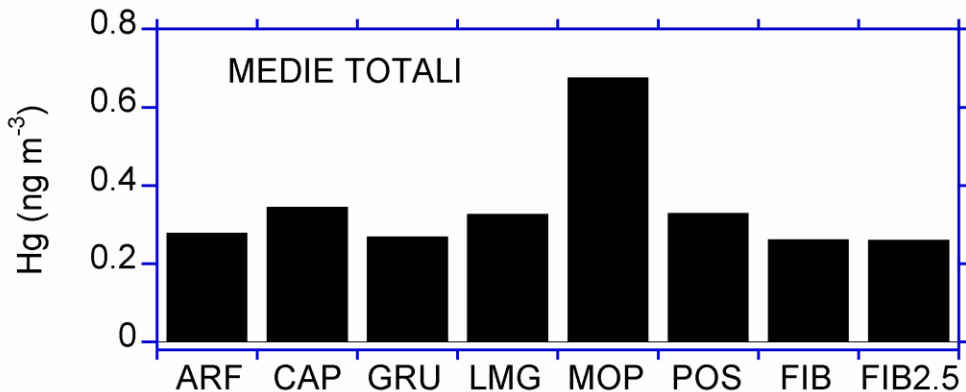
Cadmio

5 ng/m³



Arsenico

6 ng/m³

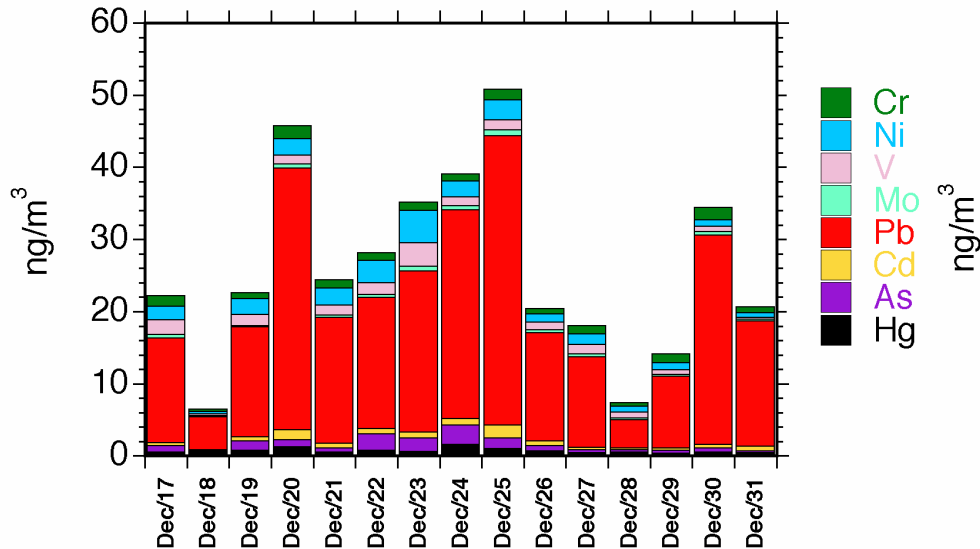


Mercurio

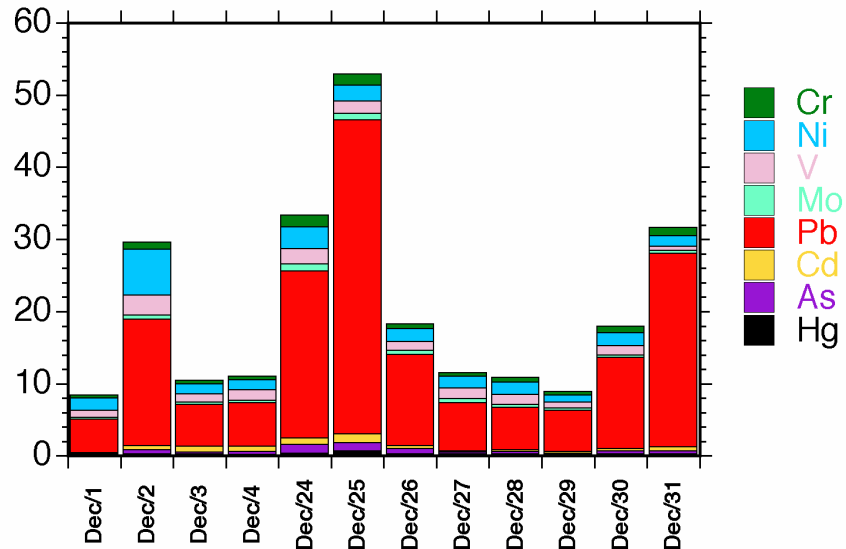
**Definire metodi
e criteri**

Metalli di prevalente origine antropica

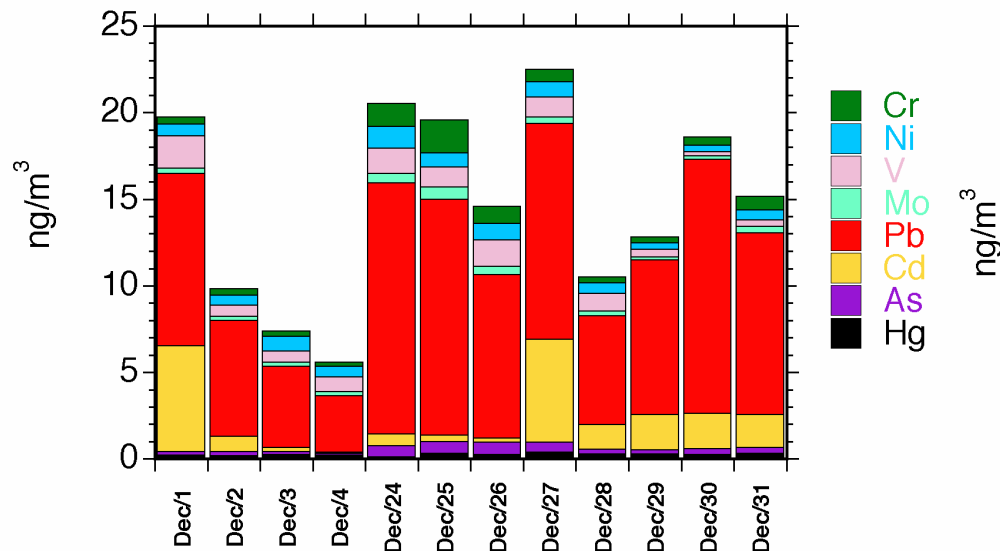
Montale PM10 - Dicembre 2005



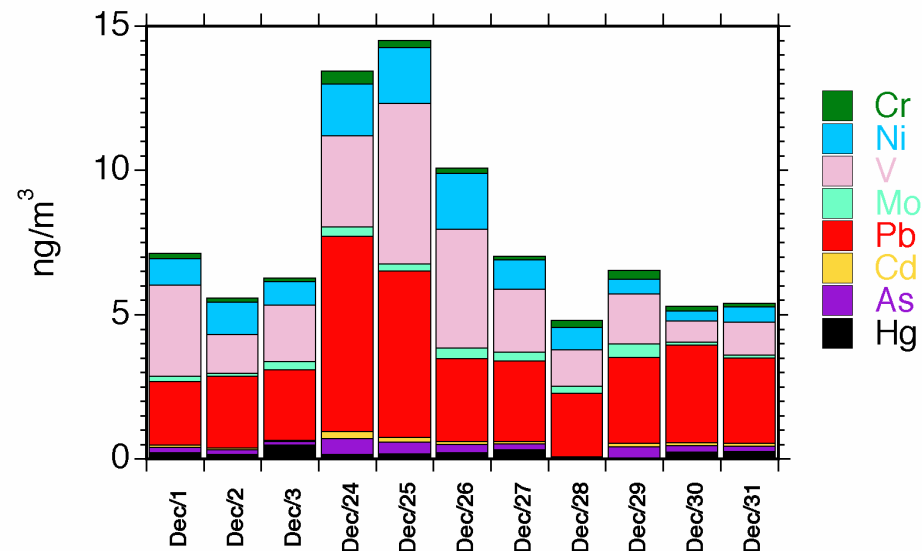
Prato PM10 - Dicembre 2005



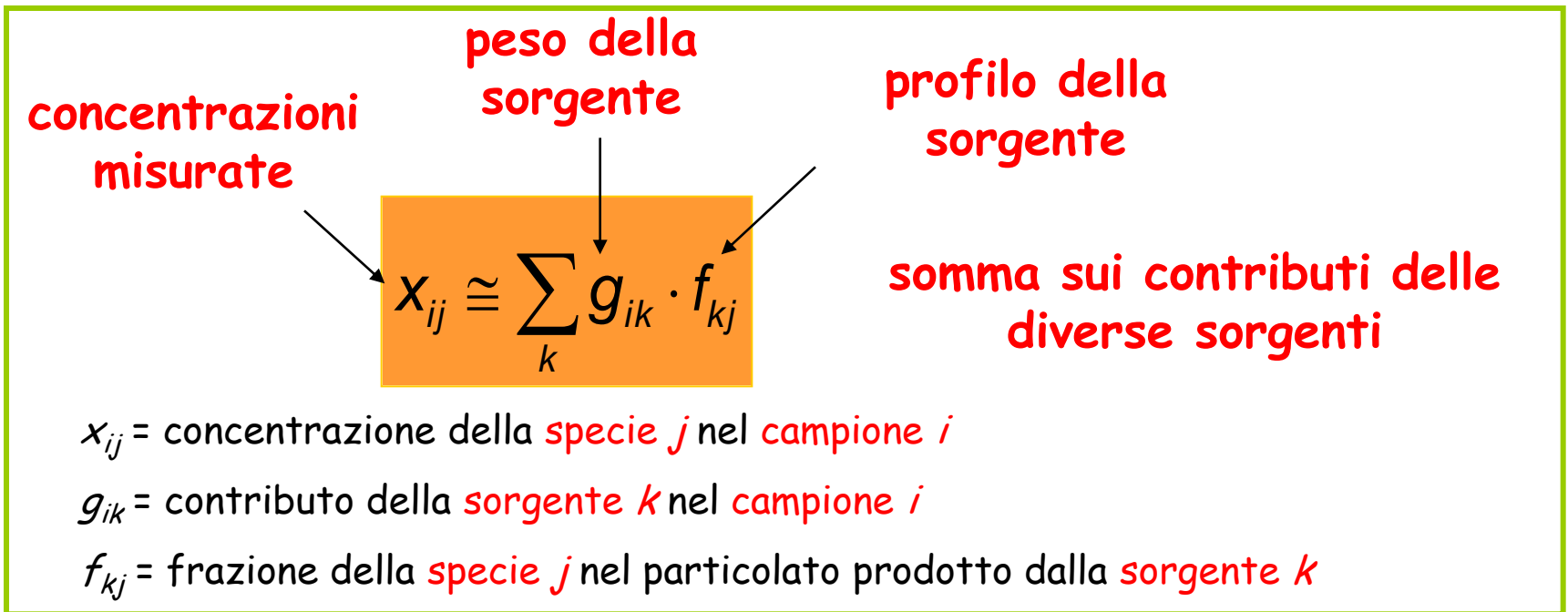
Arezzo PM10 - Dicembre 2005



Livorno PM10 - Dicembre 2005



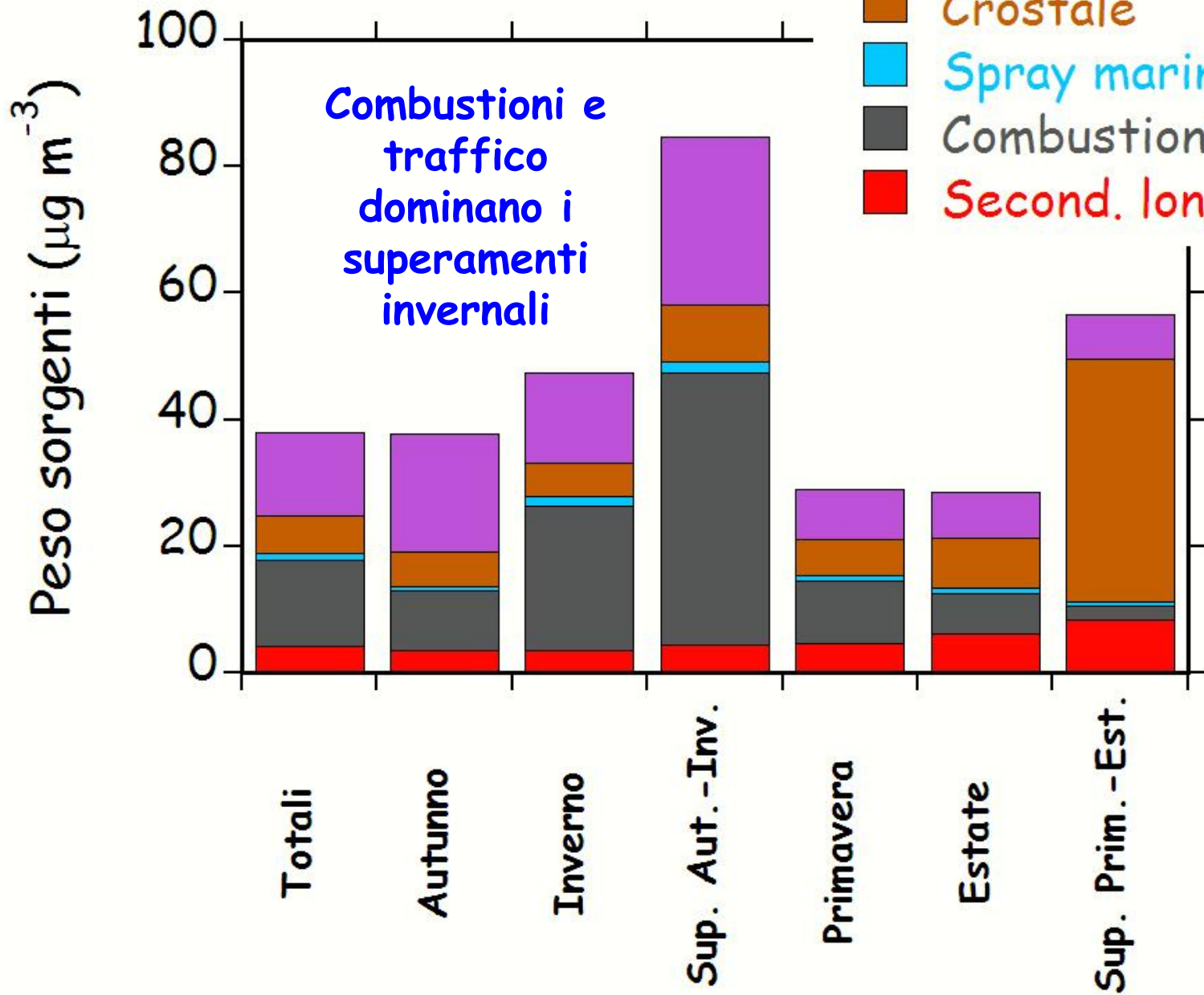
Modelli a recettore



Modelli utilizzati:

- **Absolute Principal Component Factor Analysis (APCFA)** [Swietlicki, Thurstone, Heidam]
- **Positive Matrix Factorisation (PMF)** [Paatero, Hopke]
vantaggi: G e F positivi, dati pesati con loro incertezze

VSL - PM10

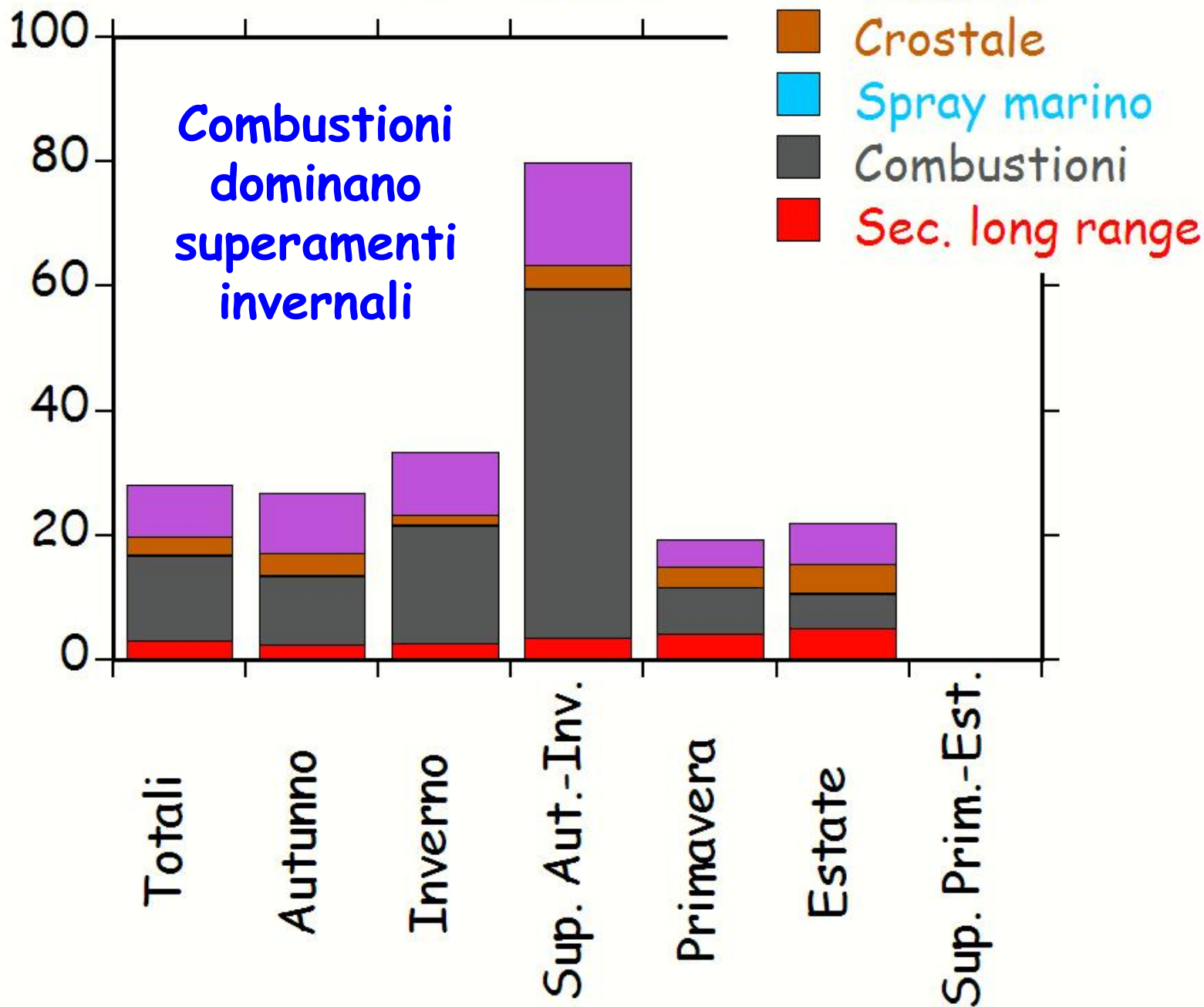


Combustioni e traffico dominano i superamenti invernali

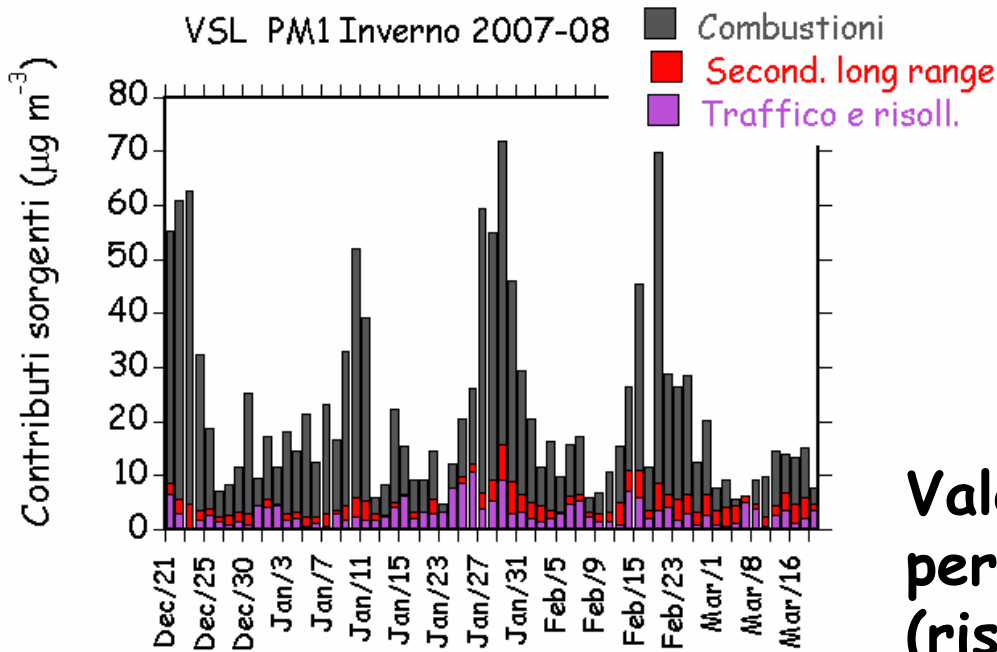
Il contributo crostale domina i superamenti estivi

VSL - PM2.5

Peso sorgenti ($\mu\text{g m}^{-3}$)



Villa San Lorenzo

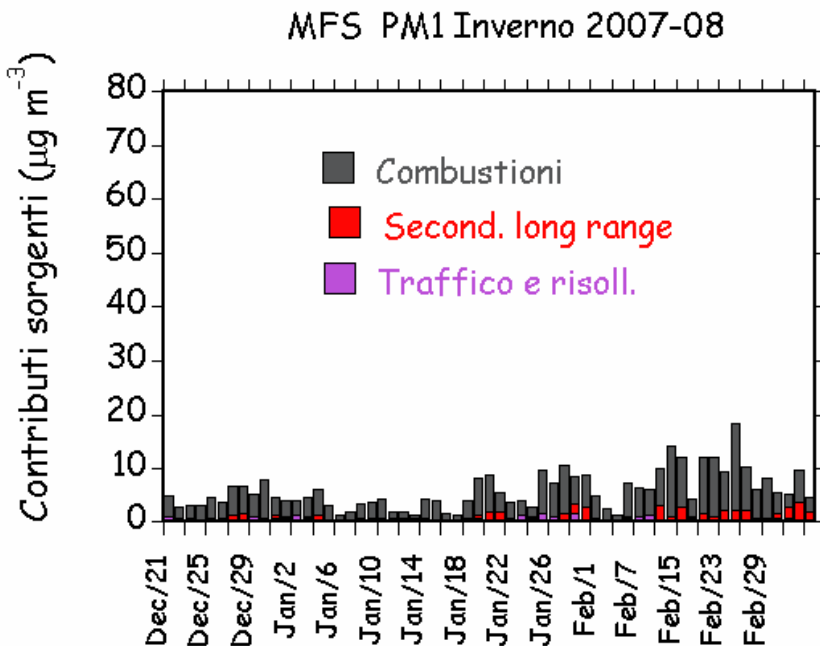


PM1

In inverno

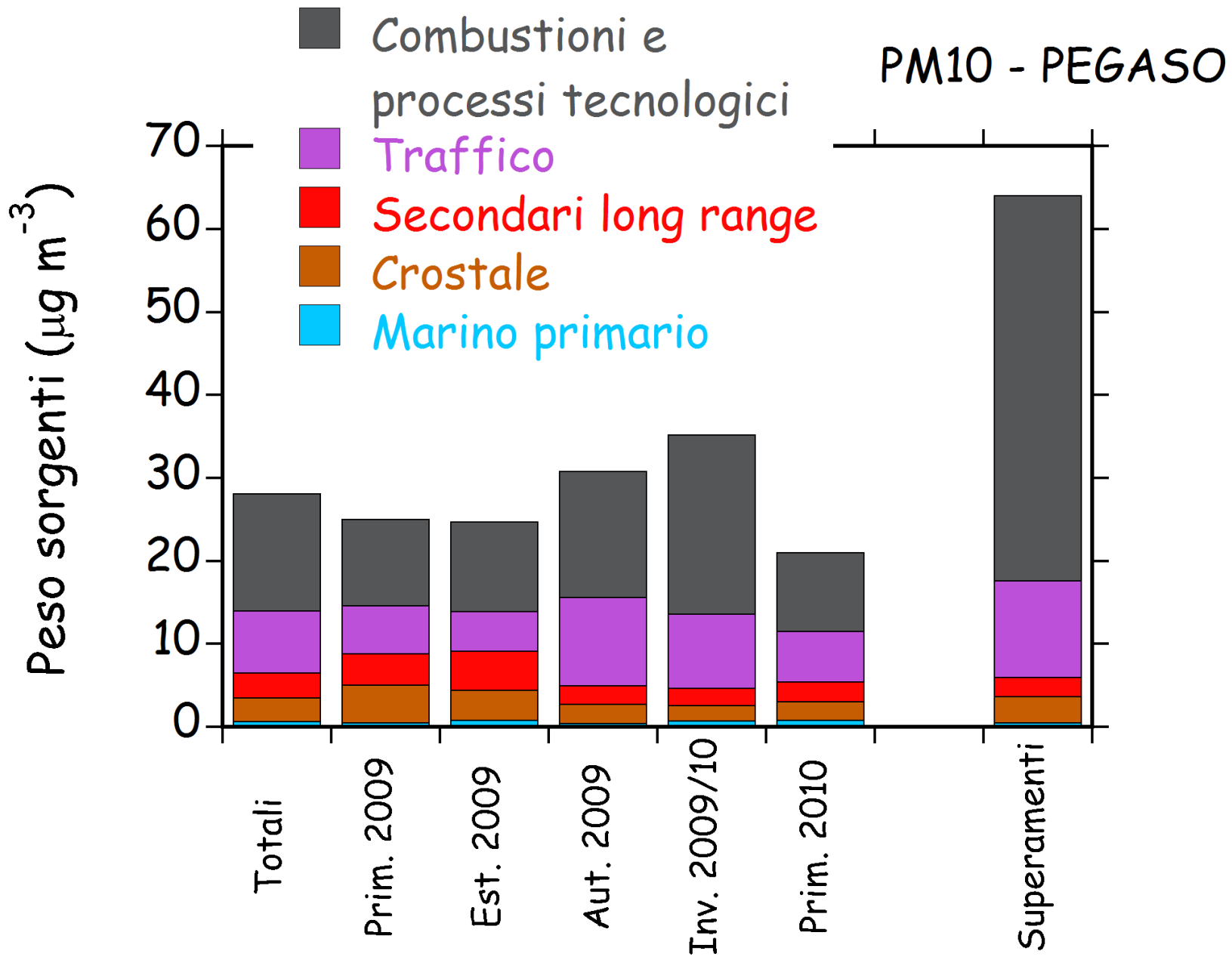
Valori molto piu' alti per l'abitato di Sesto (riscaldamento - strati di inversione termica)

Monte Morello



Sorgente prevalente:

Combustioni



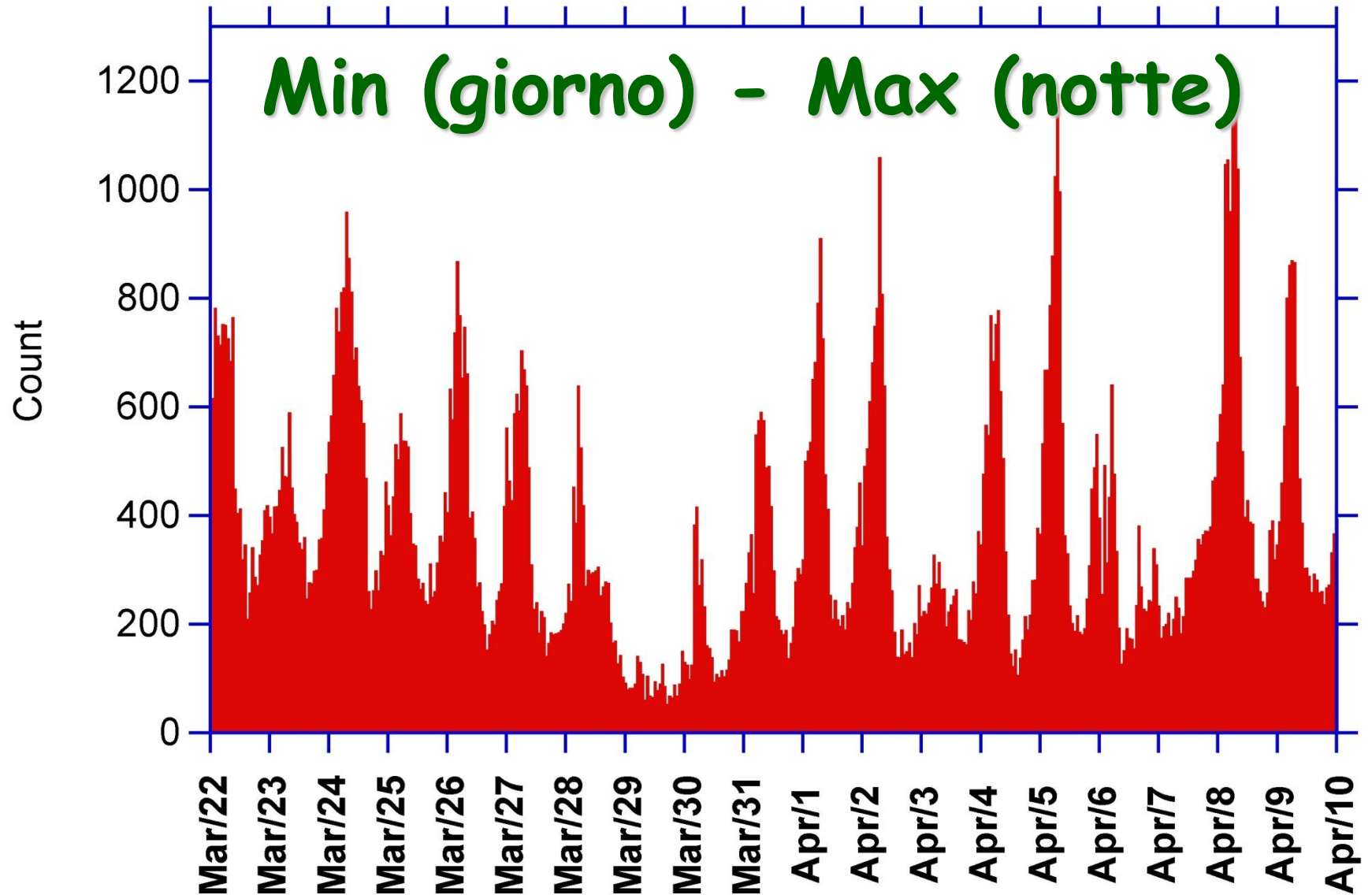
Misure di radon
Villa San Lorenzo
Set05 - Nov06

PBL

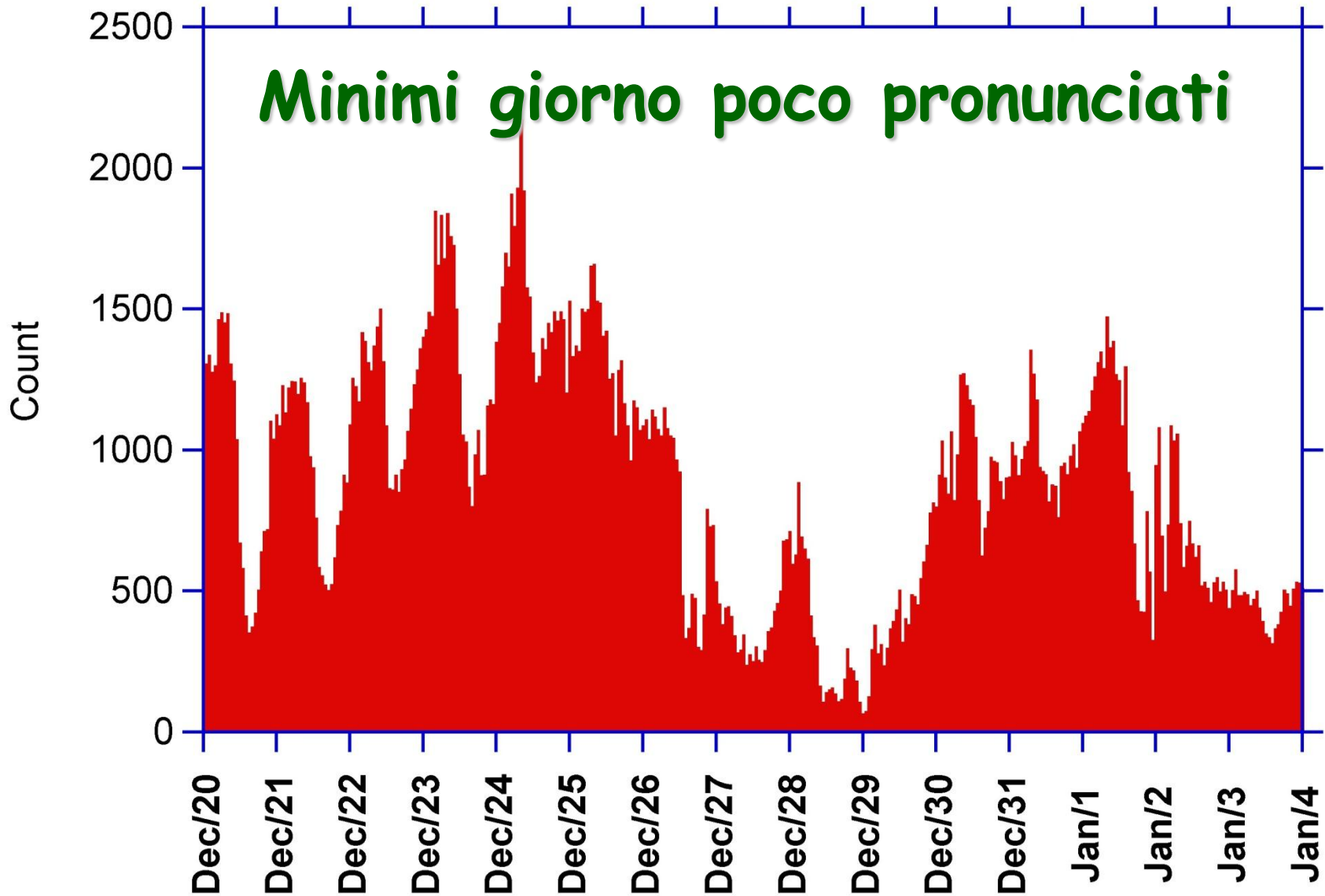


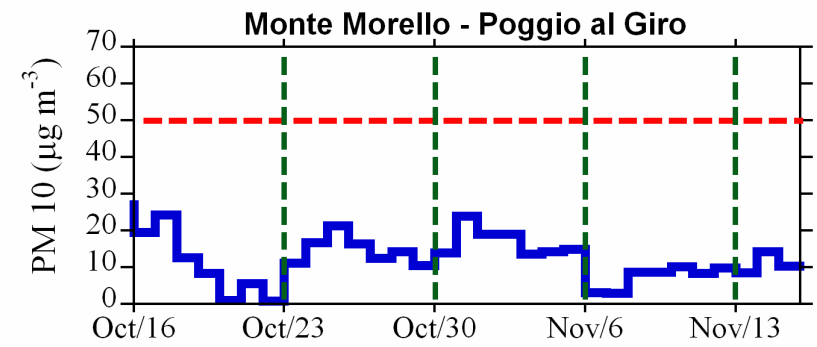
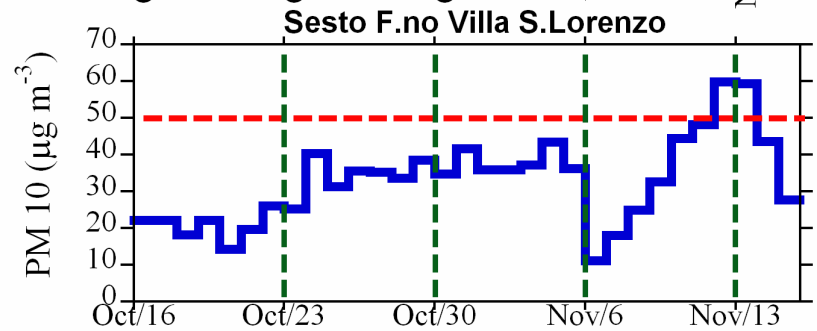
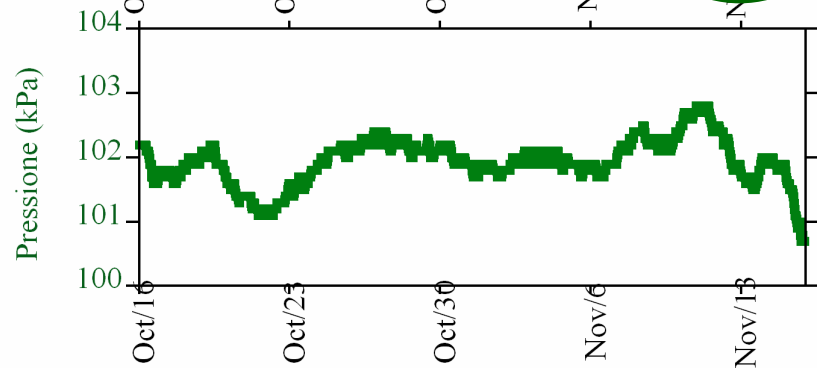
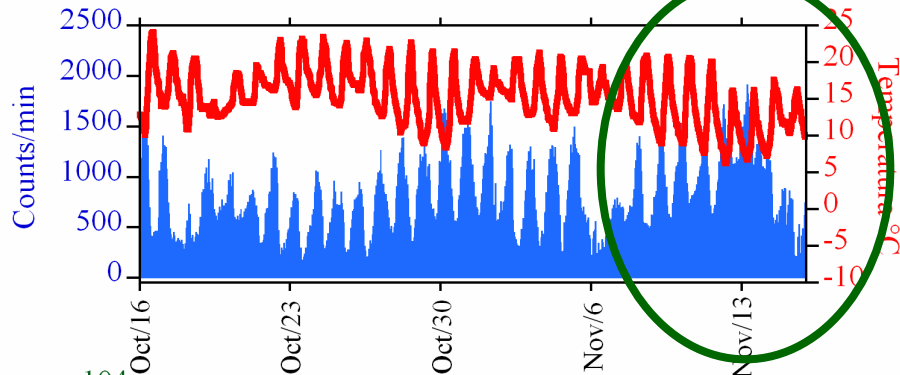
Effetto dell'altezza dello strato di
rimescolamento

Libera circolazione atmosferica



Formazione strato di inversione





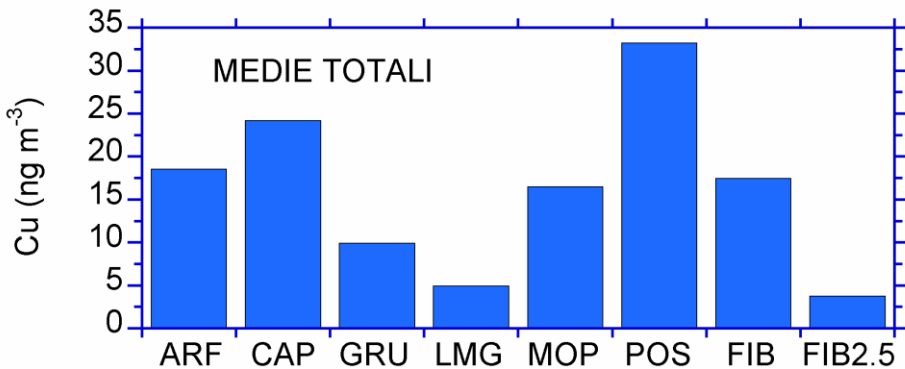
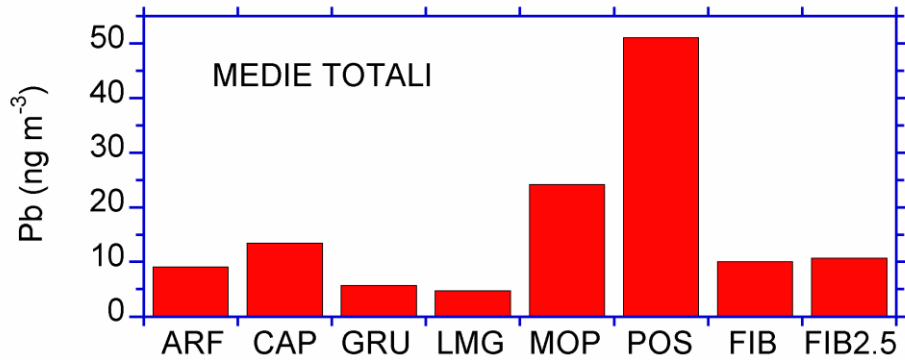
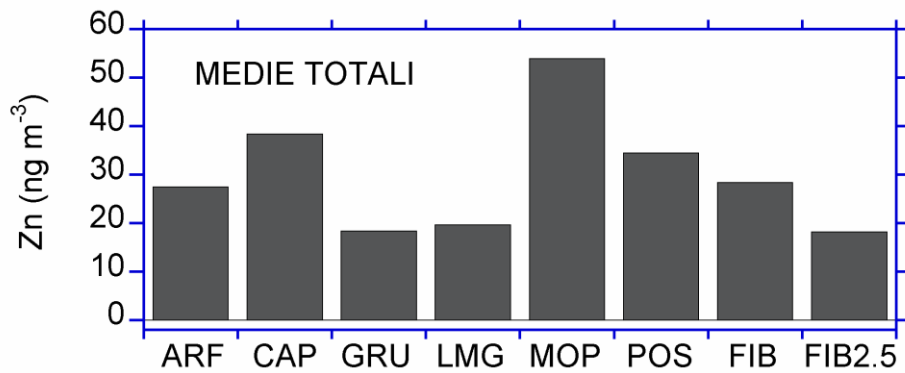
Scarsa
circolazione
atmosferica
verticale
(strato invers.
termica suolo)

Superamenti
Centro urbano

Valori bassi
Stazione rifer.
(700 m s.l.m.)



Grazie per l'attenzione !



Piombo
DM 60 del
02-04-02
500 ng/m³

Sesto F.no - Villa San Lorenzo

Campagna PASF-2

