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Chemical mass balance modelling for the source estimation of high PM2.5 concentrations in Milan, Northern Italy

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INTRODUCTION

In Europe, the recent Air Quality Directive (2008/30/CE) establishes an annually averaged PM2.5 concentration of 25 μg m^{-3}, which will be the legal limit value from 2015 onwards. With the aim of designing effective PM2.5 reduction strategies, information on the strength of impacting sources is required.

SAMPLING SITES

Daily low volume gravimetric sampling (2006-09) at a:

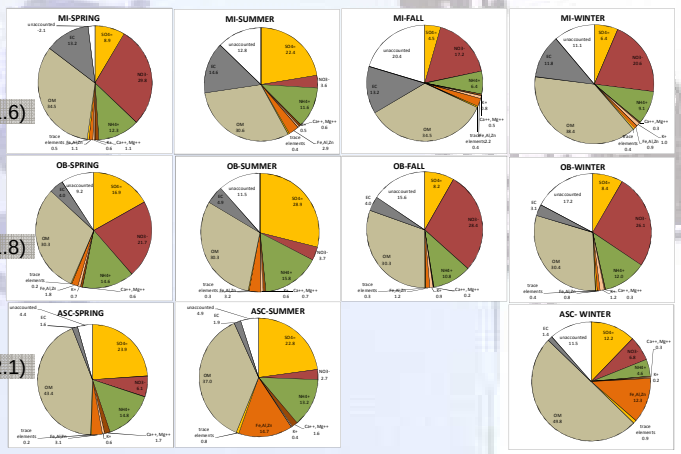
urban site, **Milano (MI)**
rural site, **Oasi Le Bine (OB)**
remote mountain site, **Alpe S. Colombano (ASC)**

CHEMICAL COMPOSITION OF PM2.5

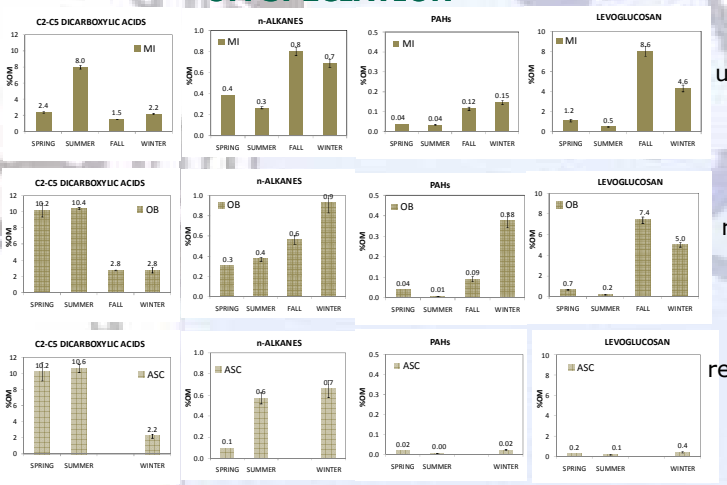
urban
OM (OC ×1.6)

rural
OM (OC ×1.8)

remote
OM (OC ×2.1)



OM SPECIATION



THE SOURCE APPORTIONMENT STUDY

Receptor model :
Chemical Mass Balance CMB
(CMB 8.2 EPA)

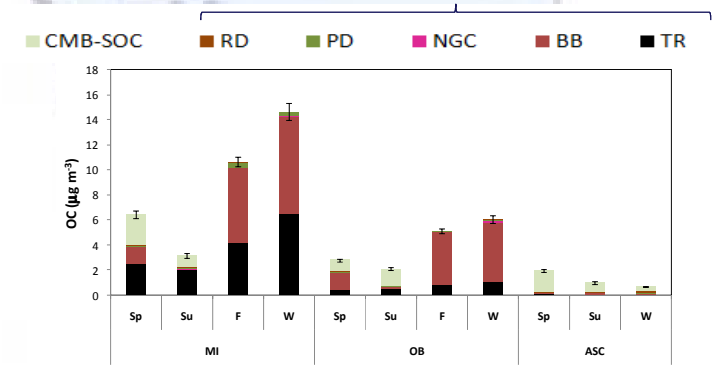
5 primary sources:
- traffic TR
- biomass burning BB
- natural gas combustion NGC
- resuspension ROAD DUST RD
- plant debris PD

13 fitting species:
* EC
* elements: Al, Fe, Pb, Si
* 8 trace organic markers: levoglucosan, PAHs (BbF, BkF, BeP, IcdP, BghiP), *n*-alkanes (C29, C31)

Result-1 OC source estimation

secondary organic carbon (SOC):
CMB-SOC = Total OC – CMB-POC

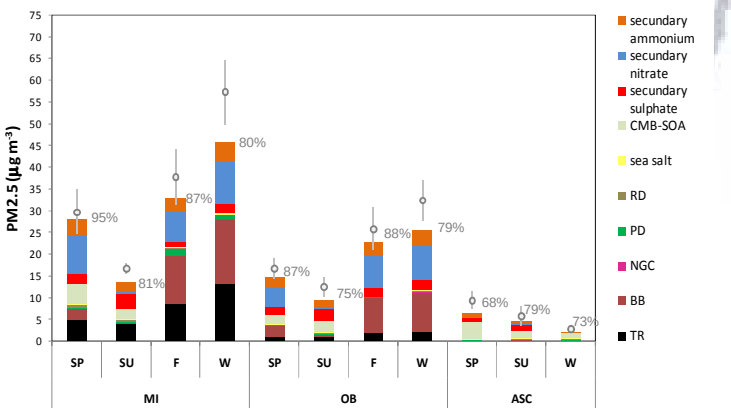
primary organic carbon (POC) : CMB-POC



The **TR** contribuition to [OC] was 40-60% at the MI urban site (all seasons)
The seasonal contribution of **BB** sources to [OC] was 70-80% during fall(F) and winter(W) at OB rural site

Result-2 PM.5 source estimation

secondary organic aerosol (SOA):
CMB-SOA = ambient OM – CMB-POM



70-95% of PM2.5 concentration was apportioned by sources
At the urban and the rural site:
45-65% of PM2.5 from primary sources in F-W
65-75% of PM2.5 from secondary sources in SP-SU
At the ASC remote site:
60-90% of PM2.5 from secondary sources (SOA: 30-40%)

CONCLUSION

The contribution of major pollution sources to ambient PM2.5 at three sites in Northern Italy were estimated by CMB model. In Milan, TR was the strongest primary source (17-24%) for PM2.5, together with secondary inorganic and organic aerosol (21-54%) and BB including residential heating (1-30%).

See for reference:

Perrone MG et al. , 2012 "Sources of high PM2.5 concentrations in Milan, Northern Italy: Molecular Marker data and CMB modelling" Science of the Total Environment 414, 343-345