



FAIRMODE

Forum for air quality modelling in Europe



WG3 Source Apportionment

19-21 June 2017

Spatial Source Apportionment A case study for the Milan urban area

Nicola Pepe, Guido Pirovano

Alessandra Balzarini, Maurizio Riva, Anna Toppetti



POLITECNICO
MILANO 1863

Source Apportionment

S1



S2



S3



Natural Sources

CAMx/PSAT

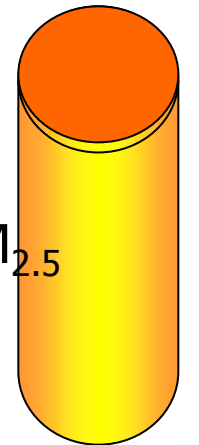
$$\frac{\partial c_l}{\partial t} = -\nabla_H \cdot V_H c_l + \left[\frac{\partial(c_l \eta)}{\partial z} - c_l \frac{\partial^2 h}{\partial z^2 \partial t} \right] + \nabla \cdot \rho K \nabla (c_l / \rho)$$

$$+ \left. \frac{\partial c_l}{\partial t} \right|_{Emission} + \left. \frac{\partial c_l}{\partial t} \right|_{Chemistry} + \left. \frac{\partial c_l}{\partial t} \right|_{Removal}$$

SA

CTM

PM_{2.5}

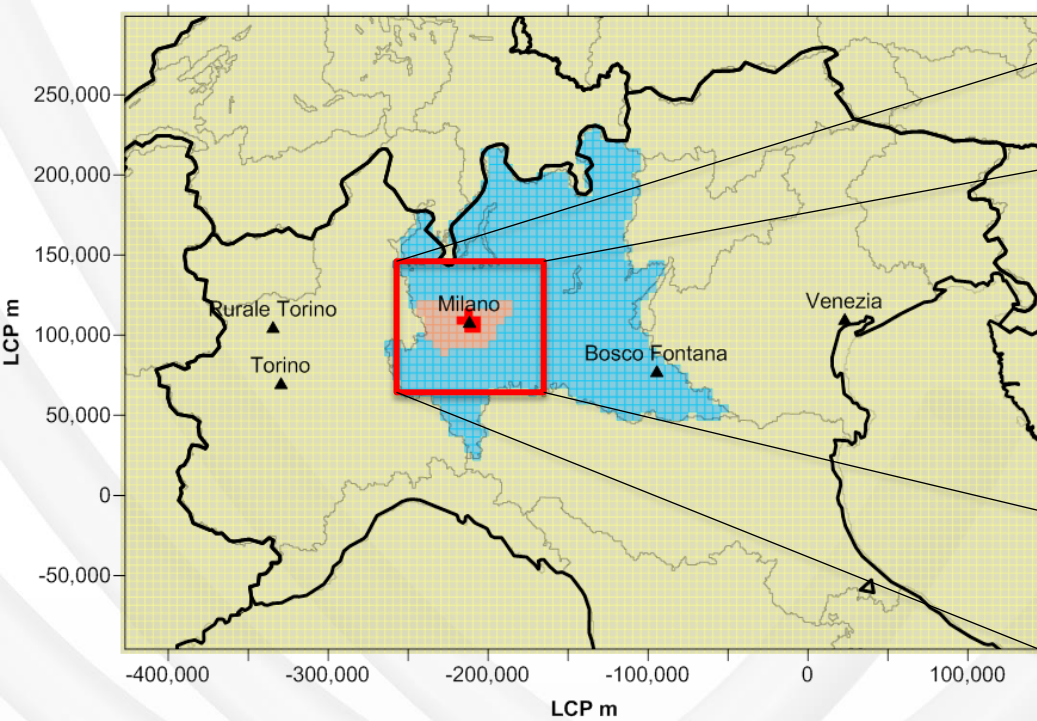


PM_{2.5}

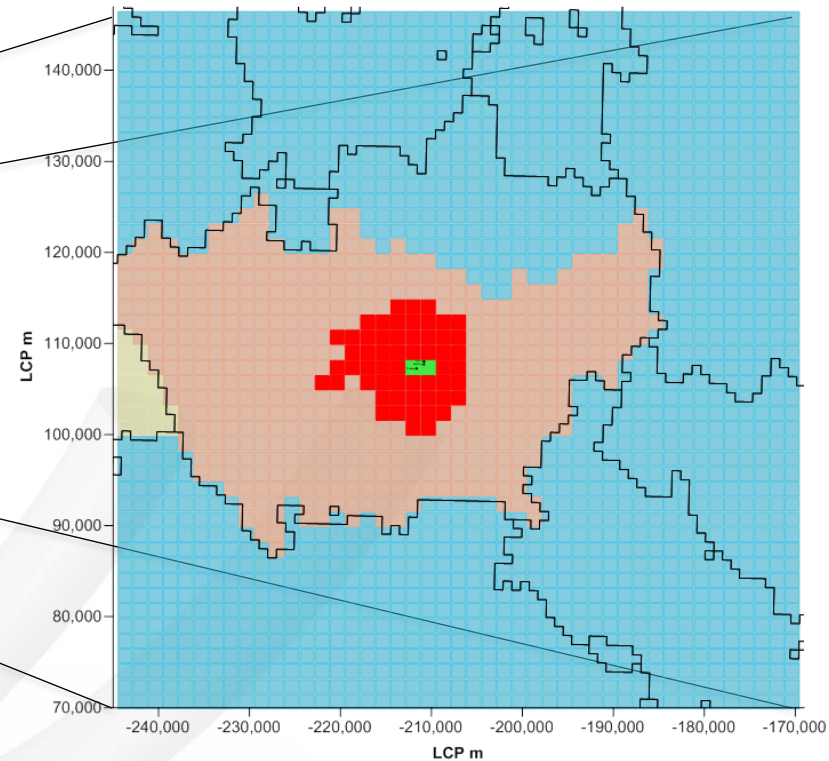
Meteorological model

Model domain – Po Valley and Milan urban area

Source regions “tagging”



Resolution = 5 km



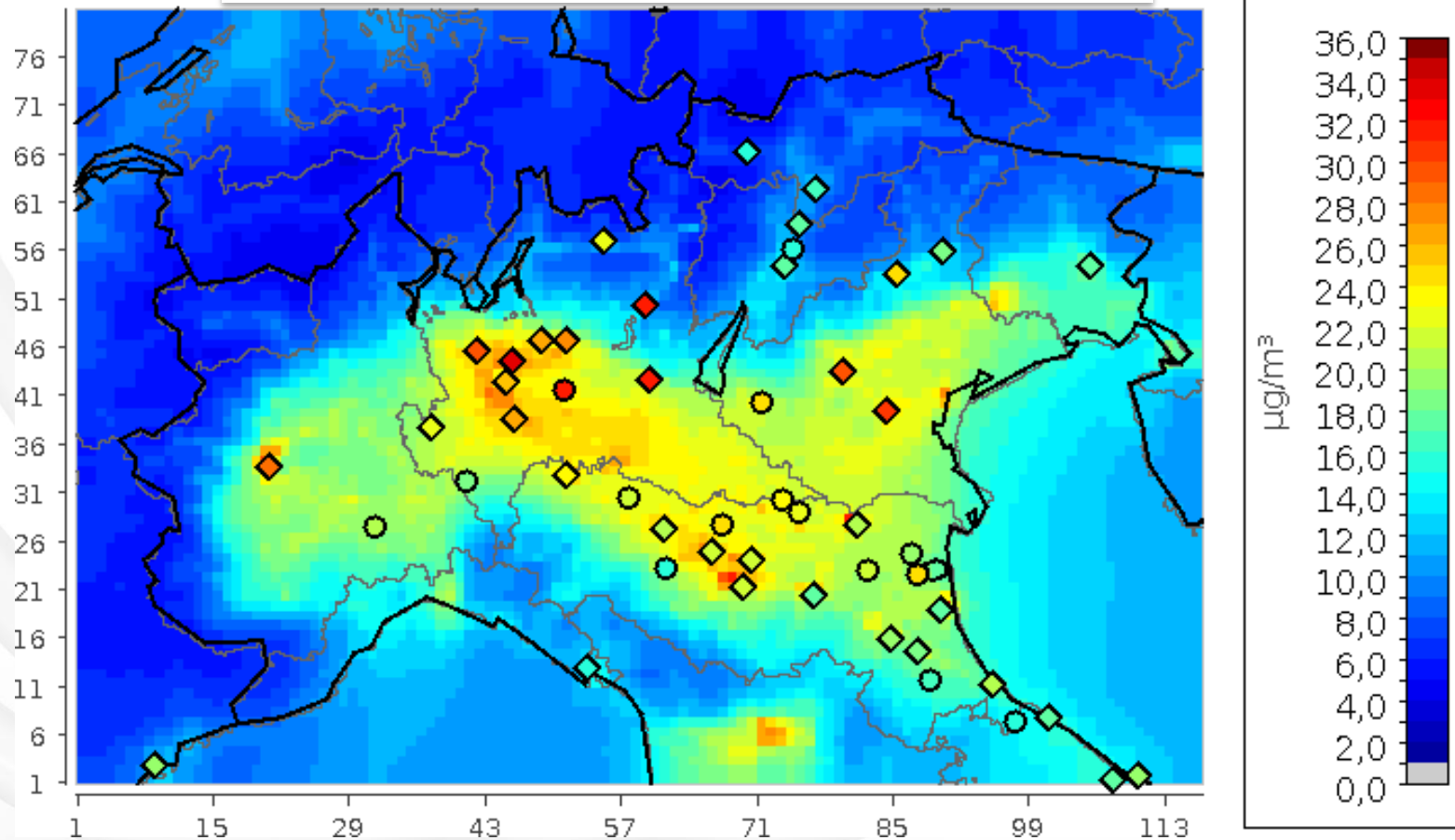
Resolution = 1,7 km

Source categories “tagging”

| | |
|--------|---|
| | |
| 01 ELE | Power plants |
| 01 OTH | Energy production (other than power plants) |
| 02 BIO | Biomass burning for residential and commercial heating |
| 02 OTH | Residential and commercial heating (other fuels) |
| 07 AUT | Road transport (Cars) |
| 07 LEG | Road Transport (Light duty vehicles) |
| 07 PES | Road transport (Heavy duty vehicles) |
| 07 MOT | Mopeds and motorbikes |
| 11 NAT | Natural sources |
| EMEP | Transboundary sources |
| OTHER | Other sources (including agriculture) |

Base Case – Yearly mean concentration

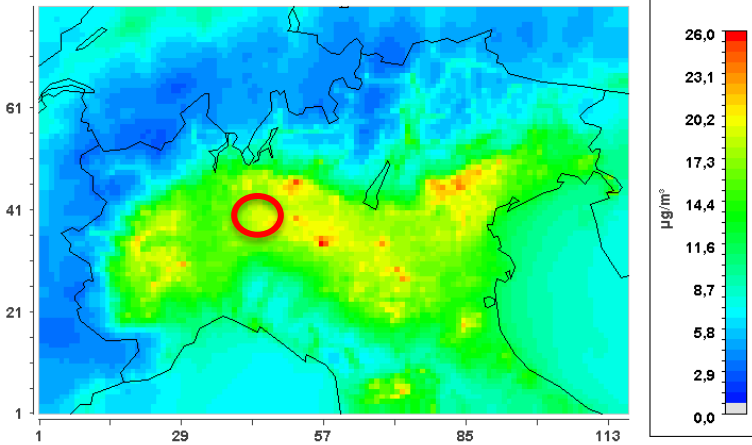
PM2.5



Grid analysis

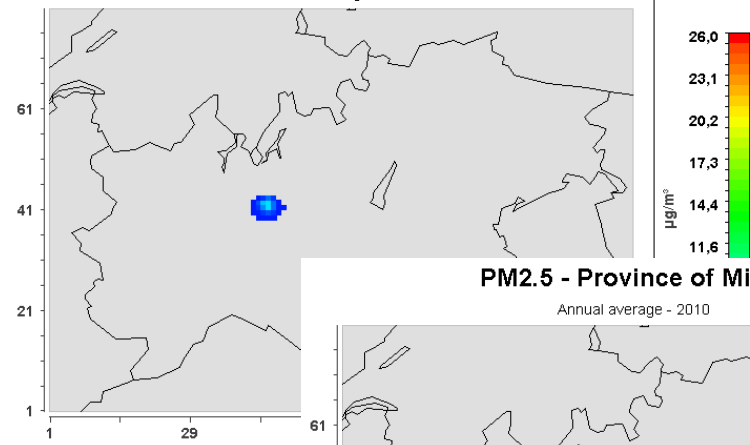
PM_{2.5} yearly mean – Source regions contribution

Annual average - 2010



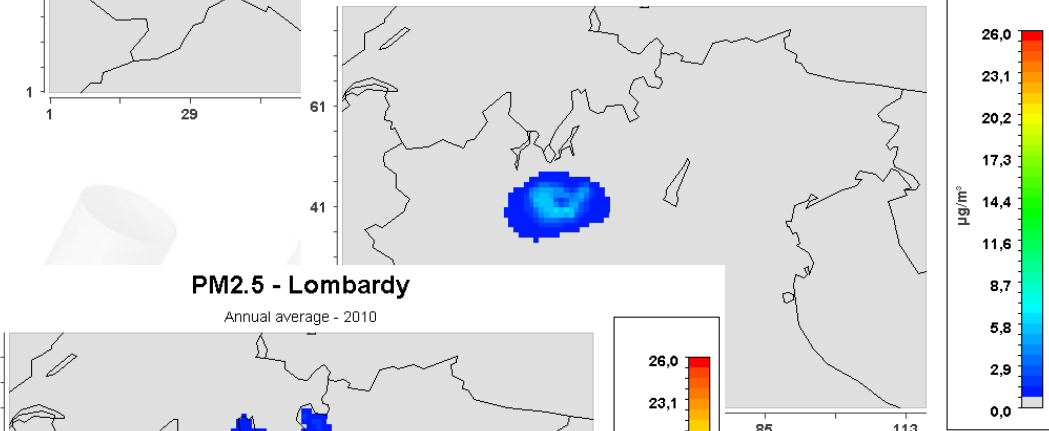
PM_{2.5} - Milan

Annual average - 2010



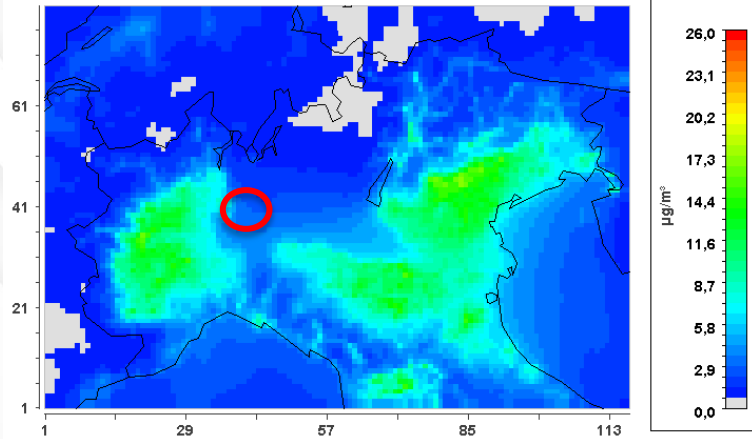
PM_{2.5} - Province of Milan

Annual average - 2010



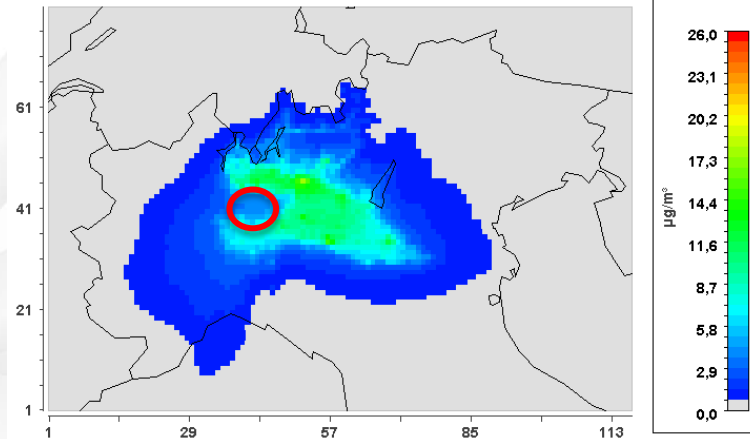
PM_{2.5} - Po Valley

Annual average - 2010



PM_{2.5} - Lombardy

Annual average - 2010

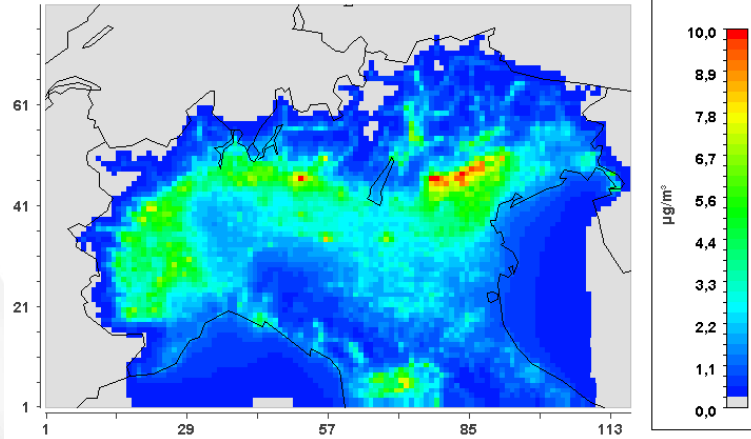


Grid analysis

PM_{2.5} yearly mean – Source categories contribution

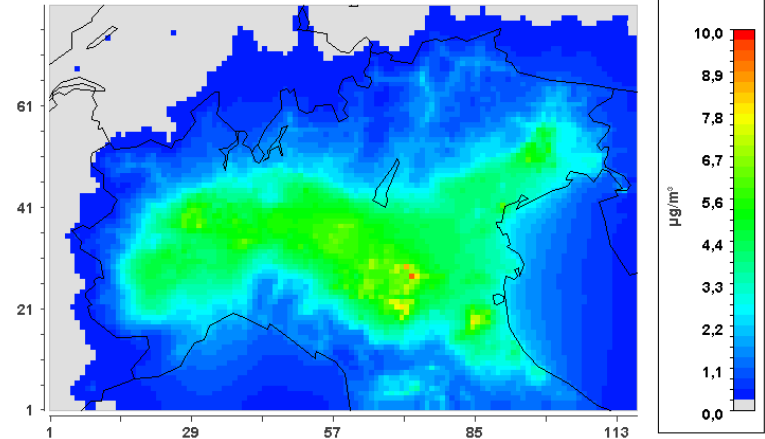
PM2.5 - 02 BIO

Annual average - 2010



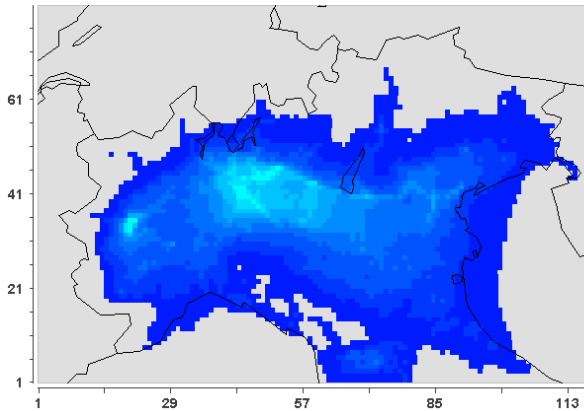
PM2.5 - 0TH

Annual average - 2010



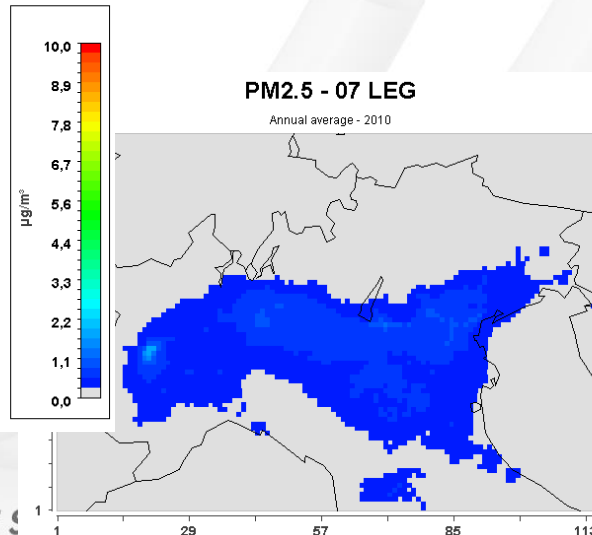
PM2.5 - 07 AUT

Annual average - 2010



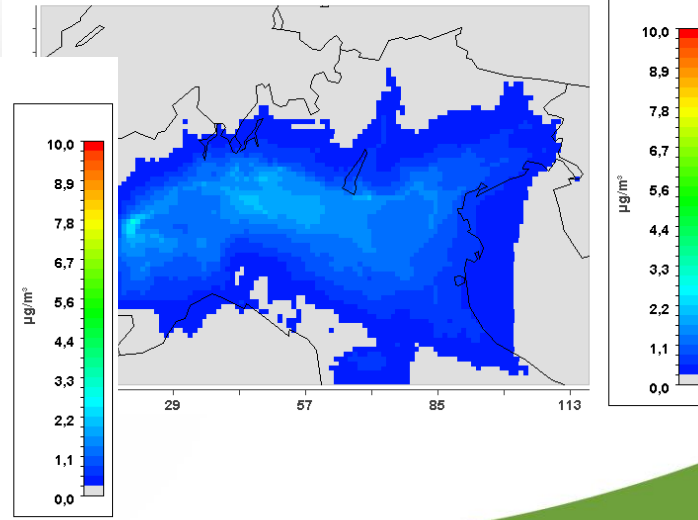
PM2.5 - 07 LEG

Annual average - 2010



PM2.5 - 07 PES

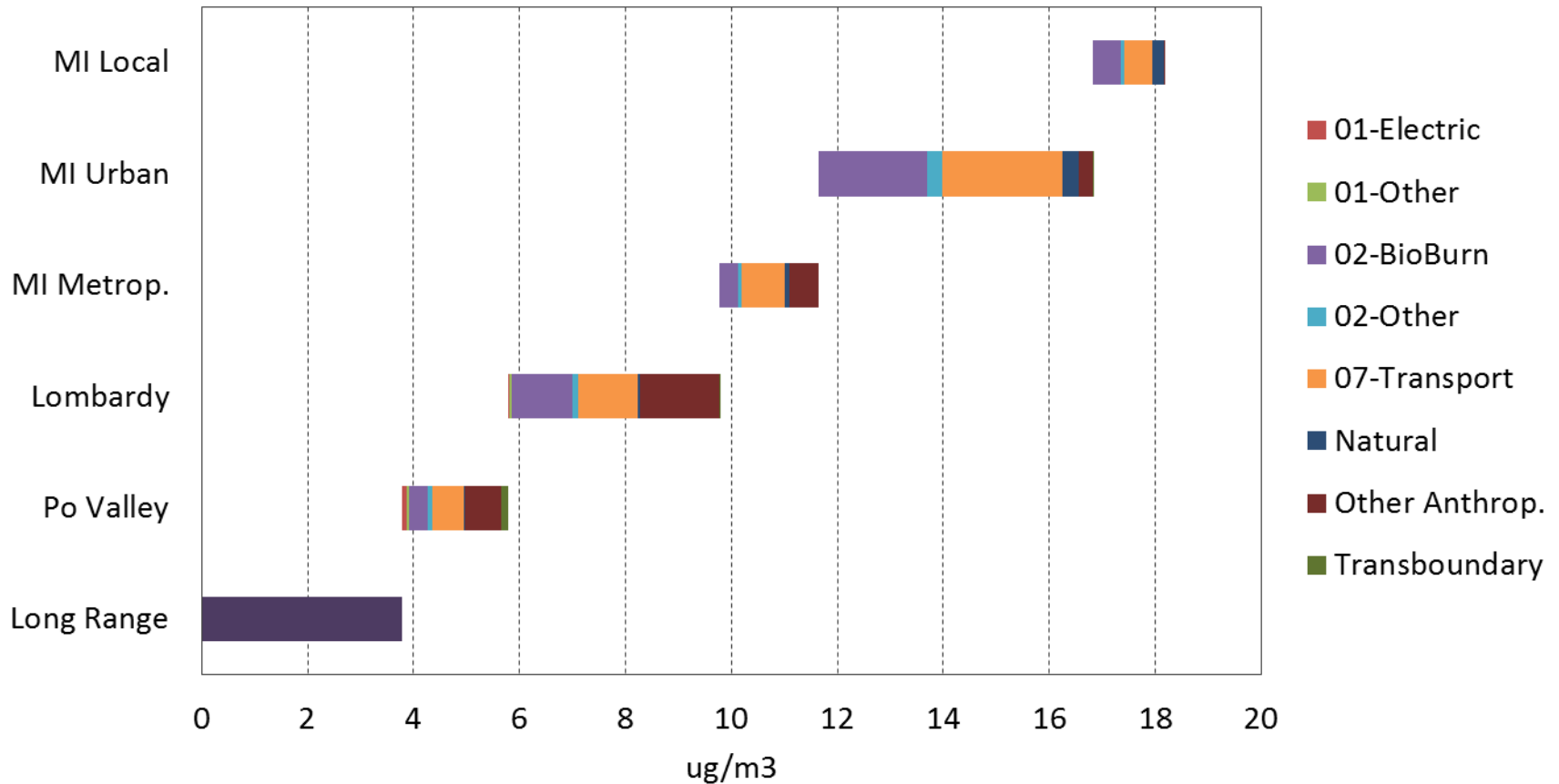
Annual average - 2010



Receptor analysis

PM_{2.5} yearly mean – Source regions/categories contribution

PM_{2.5} - Duomo (CAMx)

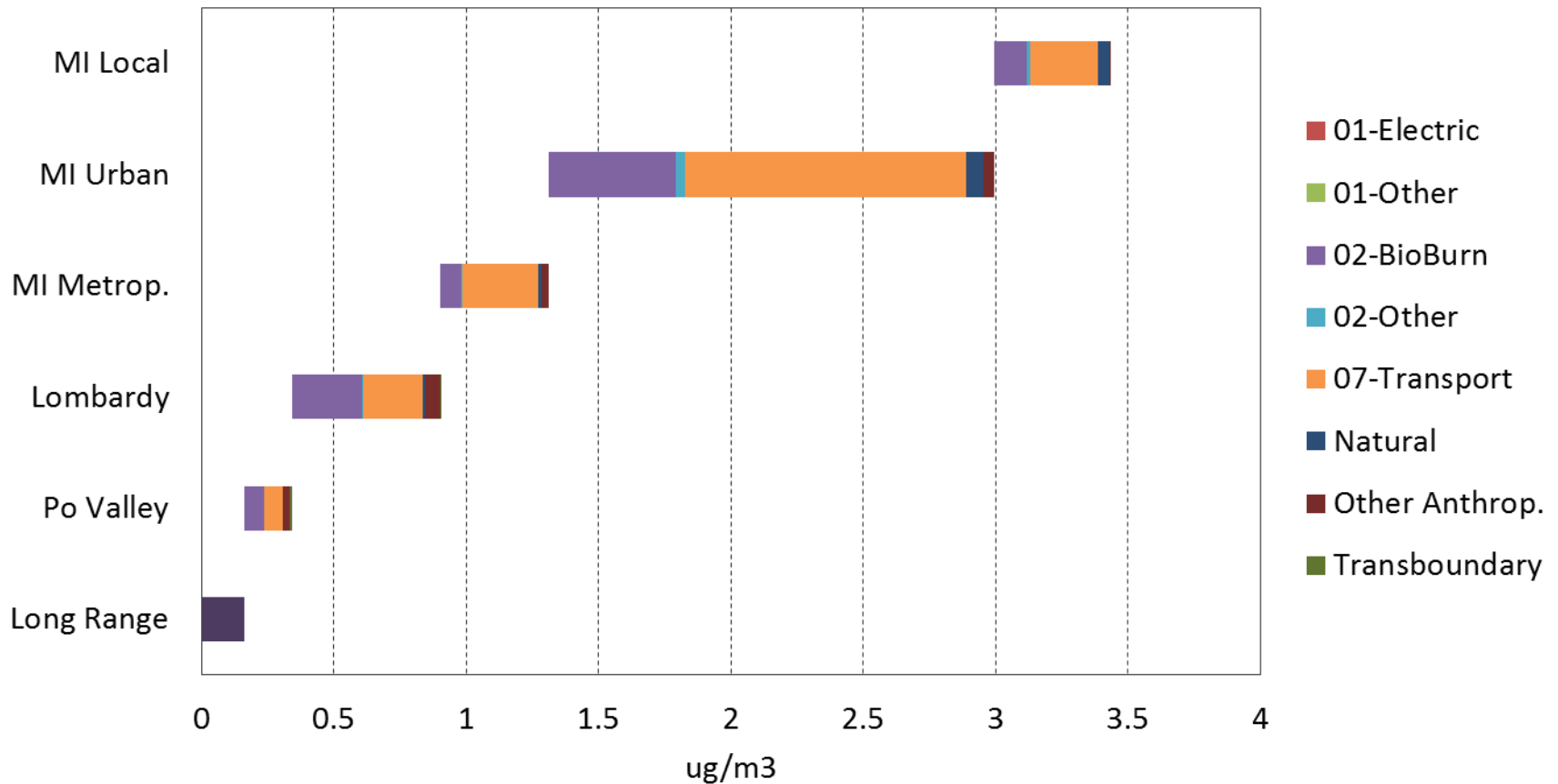


Receptor analysis

EC yearly mean – Source regions/categories contribution



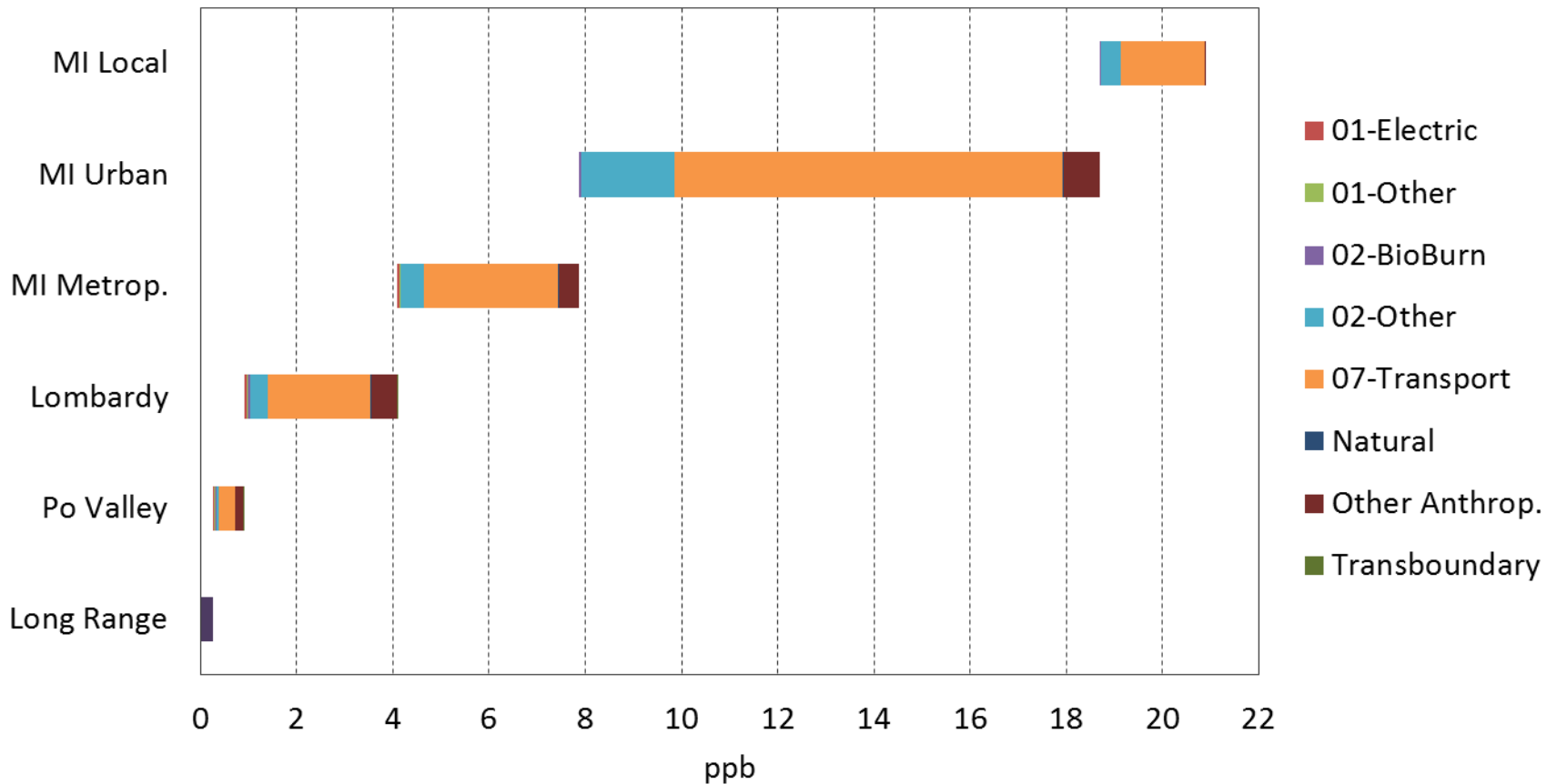
EC - Duomo (CAMx)



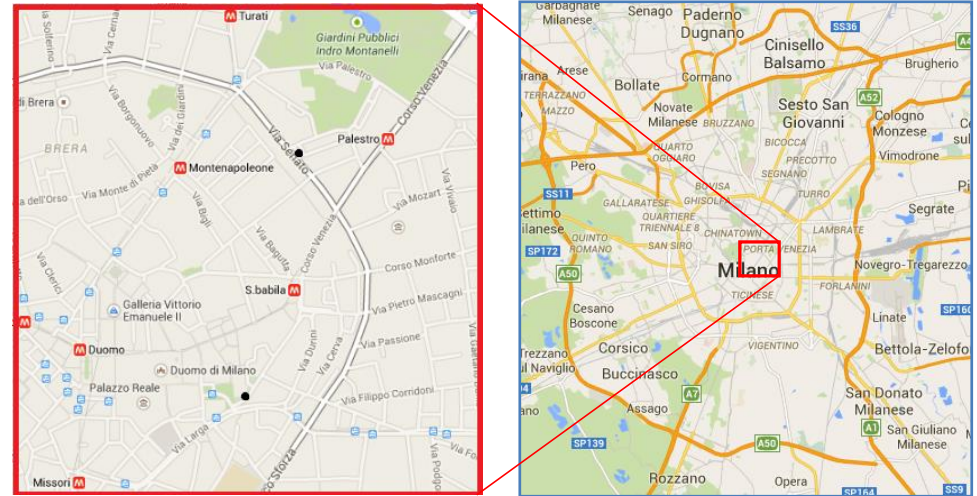
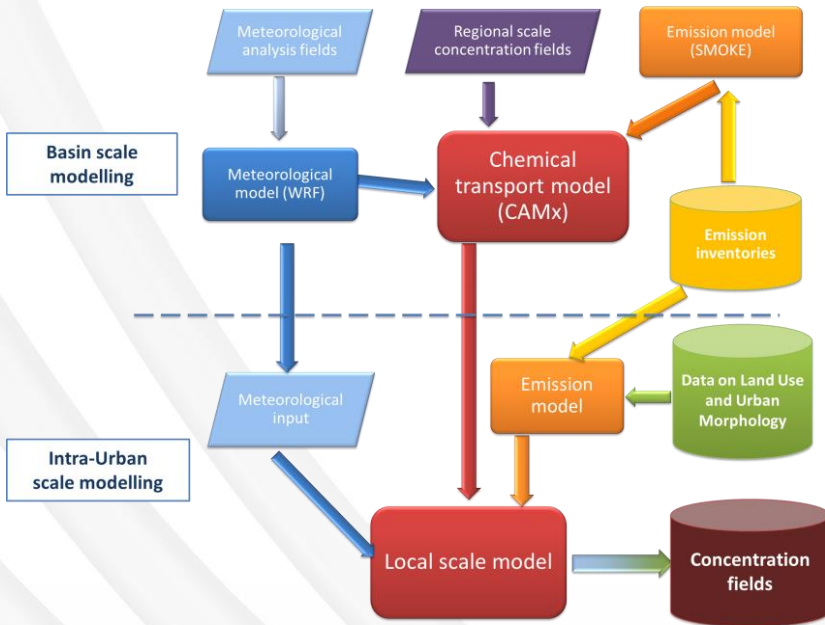
Receptor analysis

NO₂ yearly mean – Source regions/categories contribution

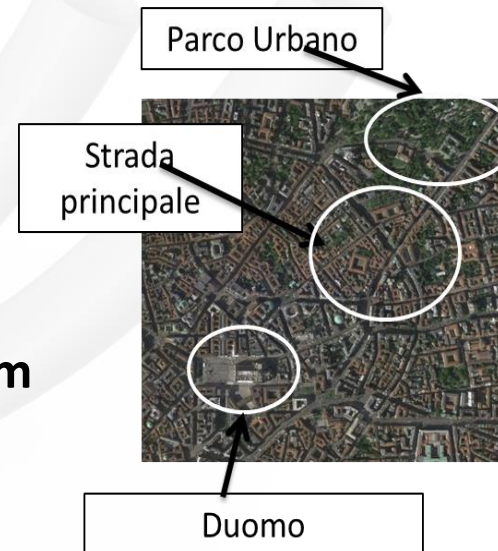
NO₂ - Duomo (CAMx)



Hybrid modelling system



Resolution = 20 m

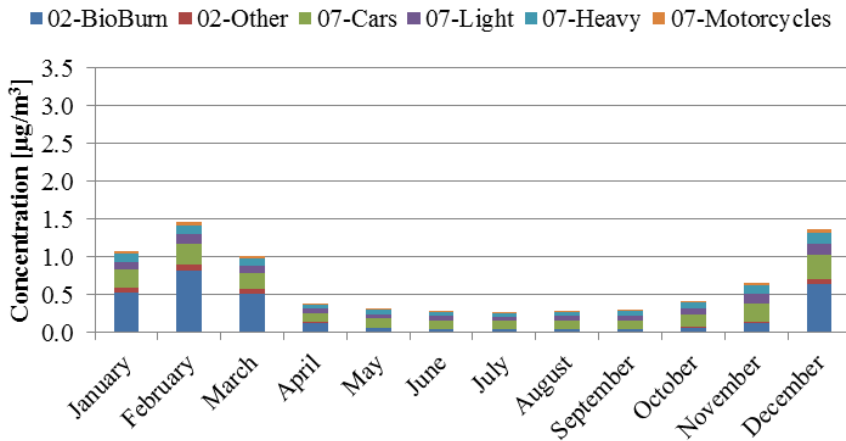


Receptor analysis at Urban scale

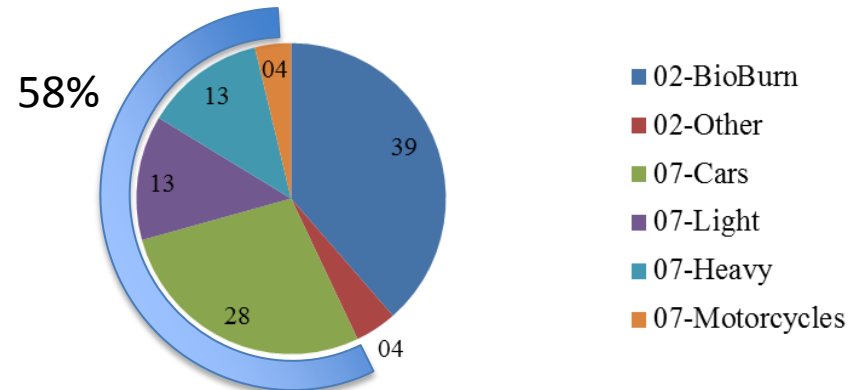


PM_{2.5} monthly mean – Local source categories contribution

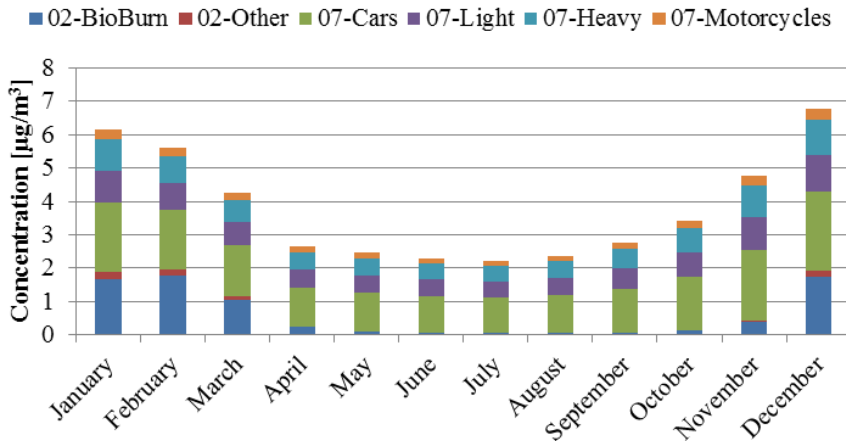
Monthly contributions - PM_{2.5} - Park site



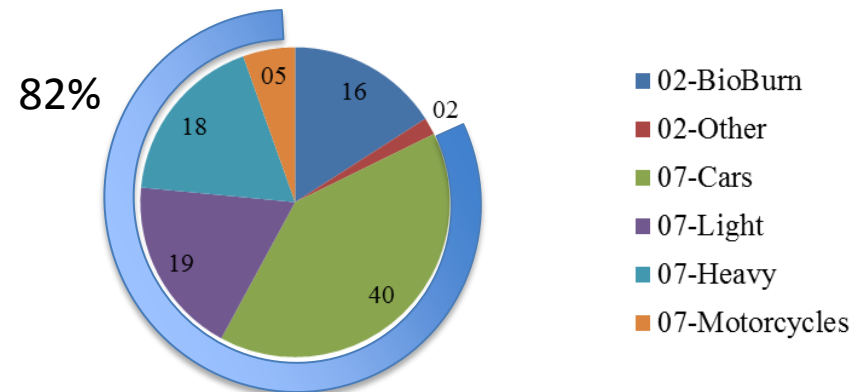
PM_{2.5} percentage distribution Year - Park site



Monthly contributions - PM_{2.5} - Traffic site



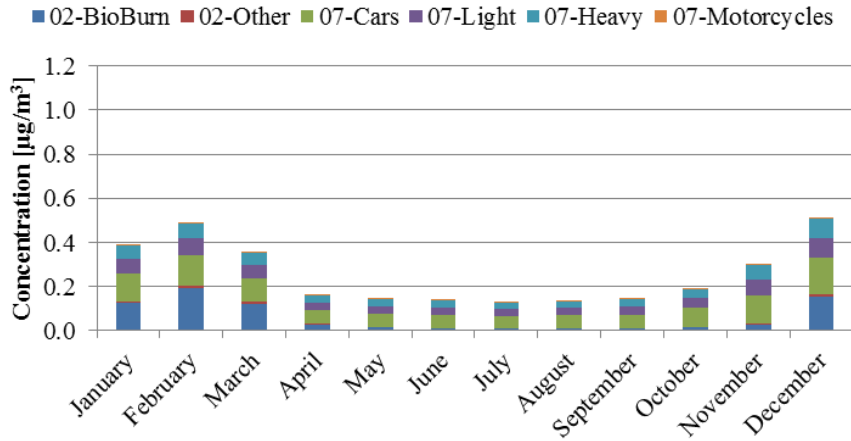
PM_{2.5} percentage distribution Year - Traffic site



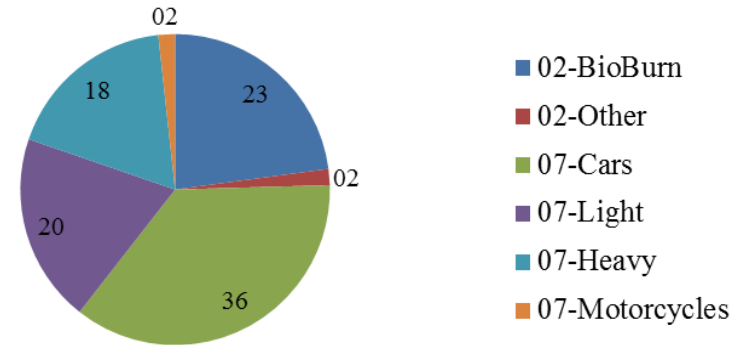
Receptor analysis at Urban scale

EC monthly mean – Local source categories contribution

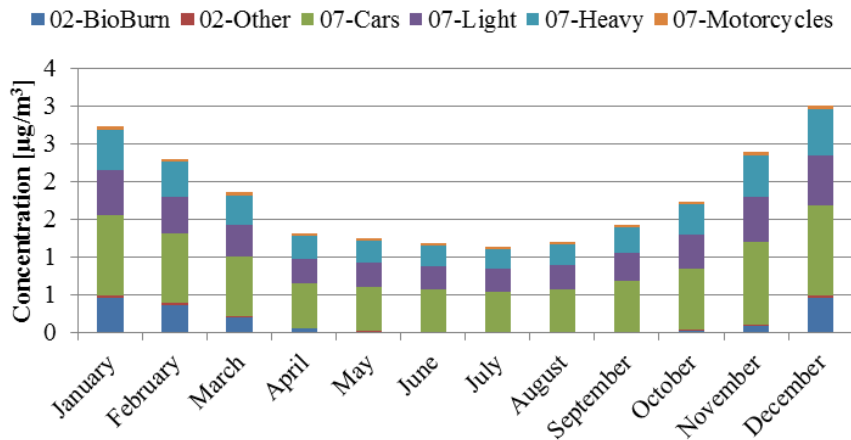
Monthly contributions - EC - Park site



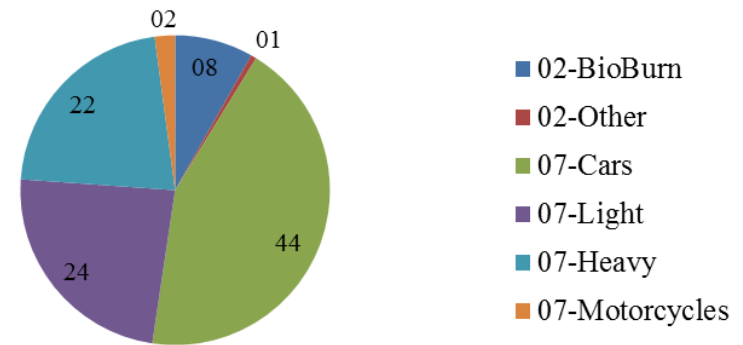
EC percentage distribution Year - Park site



Monthly contributions - EC -Traffic site



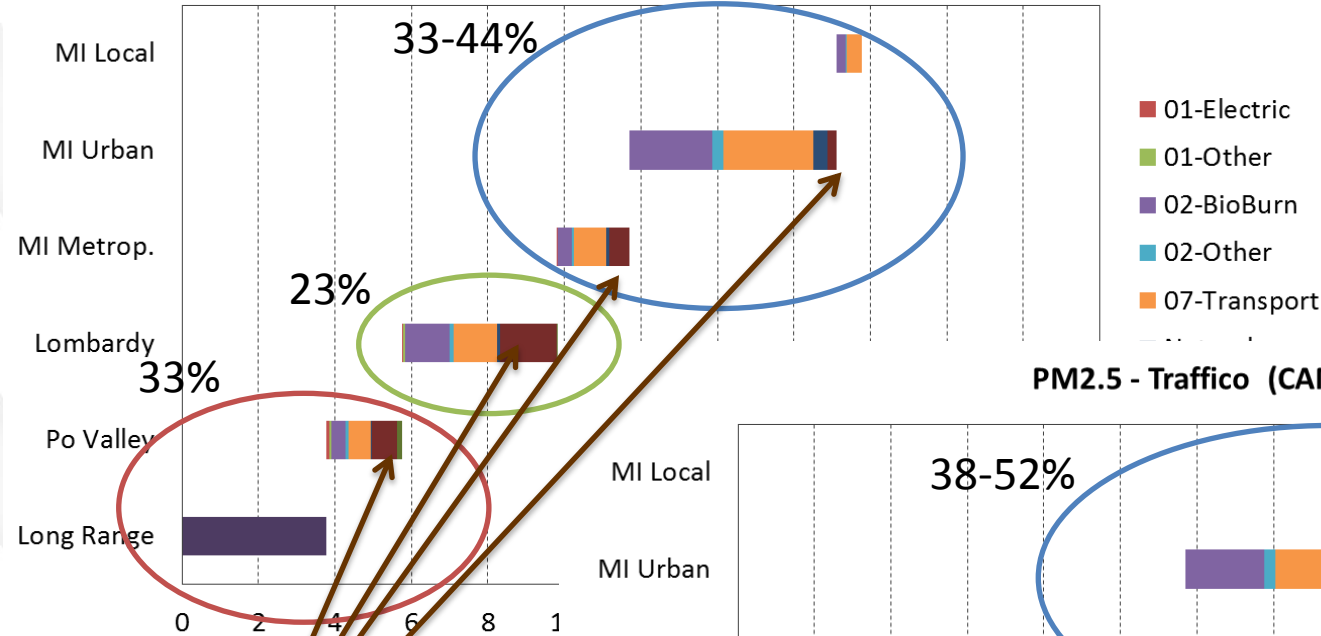
EC percentage distribution Year - Traffic site



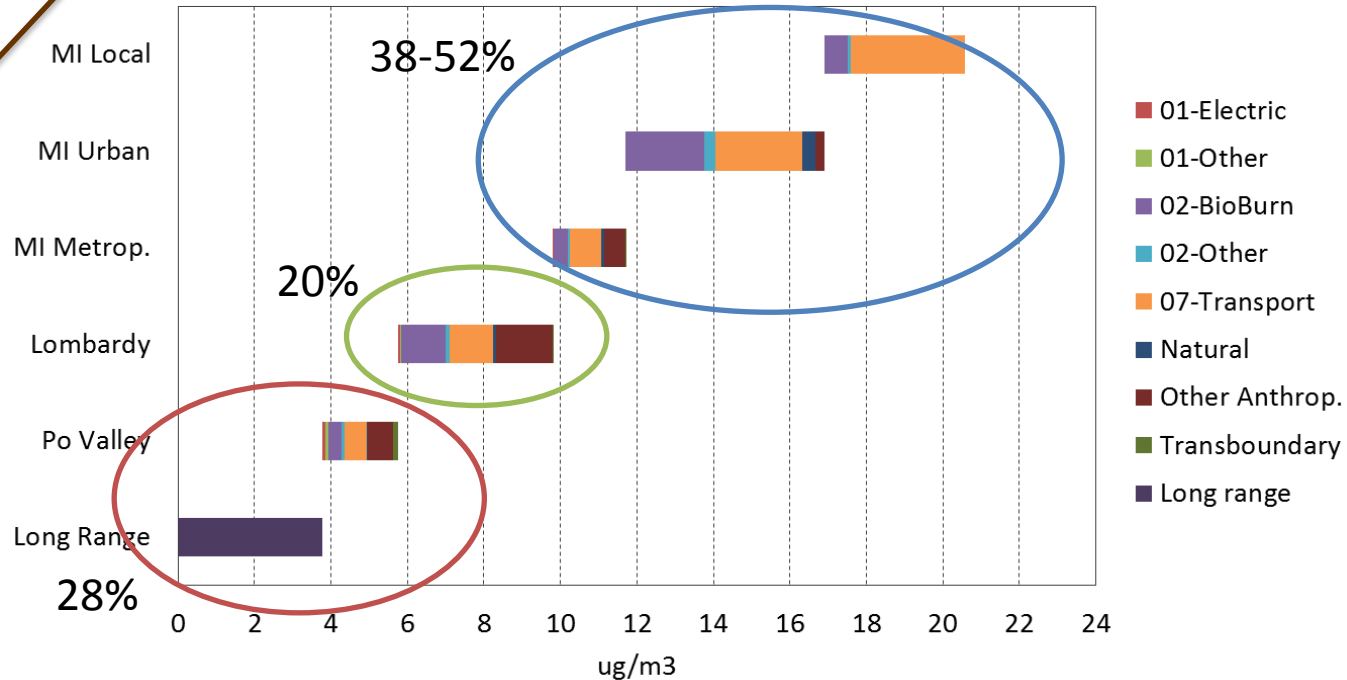
Multi scale Receptor analysis

PM_{2.5} Yearly mean – Source regions/categories contribution

PM_{2.5} - Parco (CAMx-HMS)



PM_{2.5} - Traffico (CAMx-HMS)

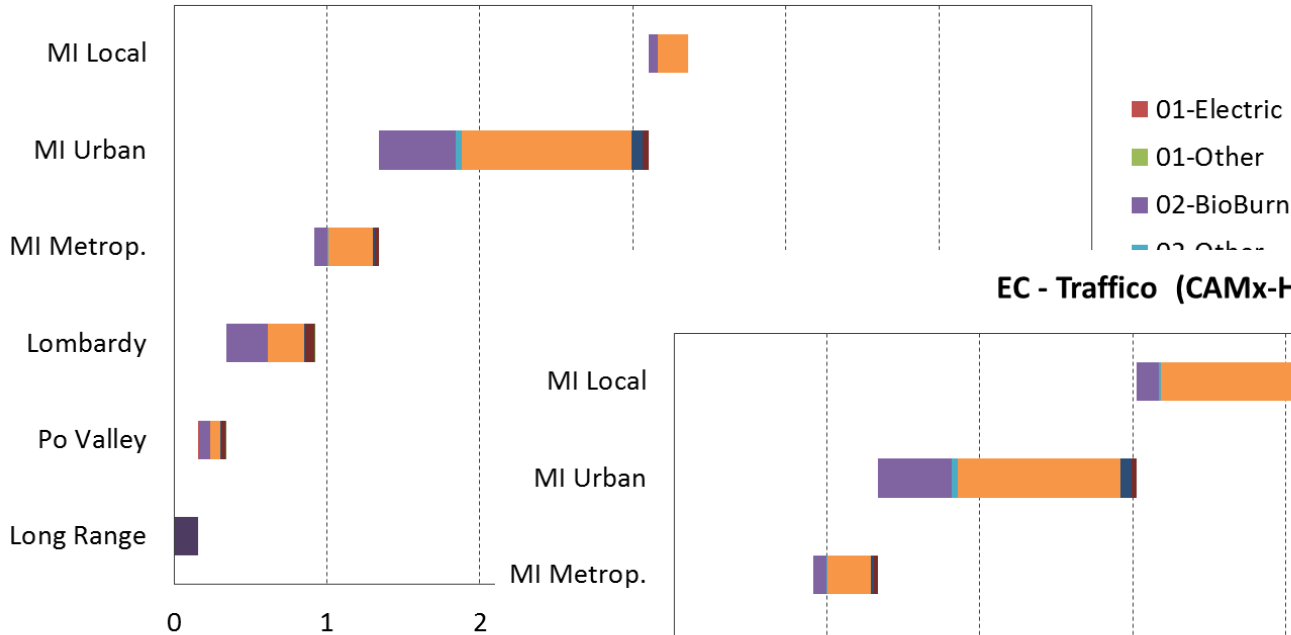


Agriculture

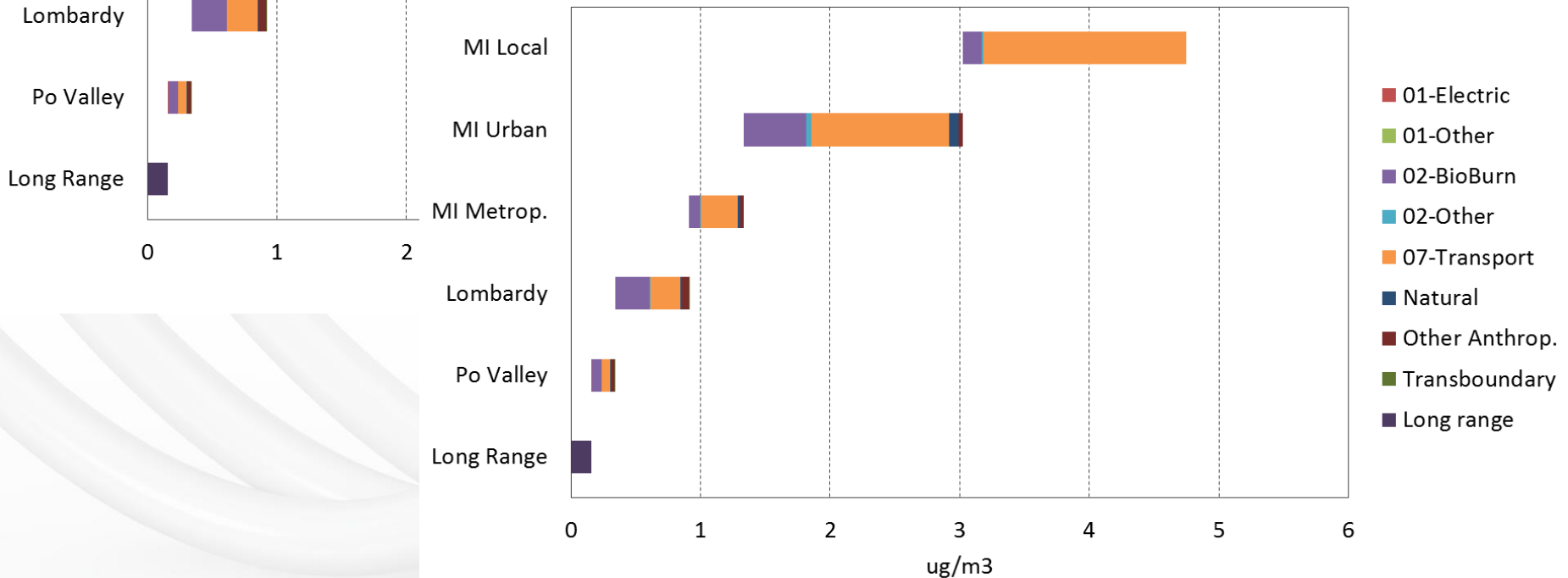
Multi scale Receptor analysis

EC Yearly mean – Source regions/categories contribution

EC - Parco (CAMx-HMS)



EC - Traffico (CAMx-HMS)



Thanks

guido.pirovano@rse-web.it