Particle number concentrations and size distributions in Po valley (Northern Italy) during PoAIR **experiment**

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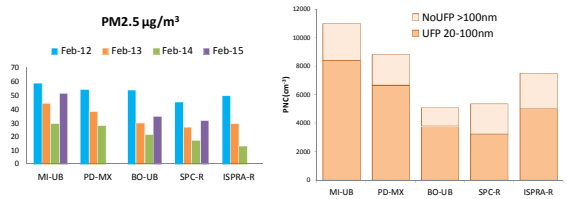
INTRODUCTION

In order to investigate the temporal and spatial variations of particle number concentration (PNC) levels and particle number size distribution (PNSD) in the Po valley area, an intensive multi-site field campaign was conducted during February 2014, called PoAIR experiment. Po valley is a densely populated and heavily industrialized area and it is a well known hot-spot for PM pollution, especially in the cold season, due to the frequent thermal inversion and stagnant meteorological conditions.



Figg. 1a&1b: PM2.5 and UPF&NoUFP - monthly concentrations

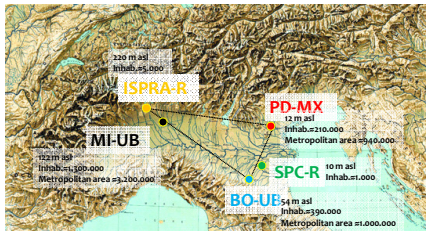


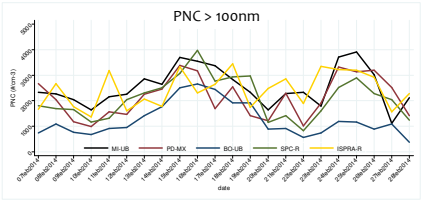
Fig. 2: Po valley and the monitoring sites: two urban background sites, Milano (MI-UB) and Bologna (BO-UB); two rural site, Molinella (SPC-R) and Ispra (ISPRA-R) and one mixed site (urban, industrial and rural) Padova (PD-MX).

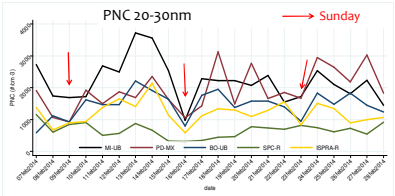
Pearson correlation (r) PM2.5 vs				
Station	>100nm	<100nm	UFP/TOT	NoUFP/TOT
MI-UB	0.90	0.12	76.4%	23.6%
PD-MX	0.85	0.44	75.7%	24.3%
BO-UB	0.96	0.38	74.5%	25.5%
SPC-R	0.80	-0.03	60.2%	39.8%
ISPRA-R	0.69	0.56	66.8%	33.2%

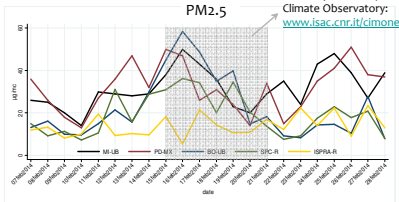
Tab. 1. Correlation PM2.5 *vs* number concentration in two size range (><100nm) and percentage of UFP and NoUFP to the total number particles. Data observed are in agreement with literature values, considering the atypical meteorological conditions of the month and the size range analyzed.
Lonati et al., 2011; Rodriguez et al., 2007; Bigi et al., 2011; Hamed et al., 2005; Rodriguez et al., 2005

METEO

Compared with the typical winter conditions in this area, February 2014 was warmer, more unstable and rainy during the first and last decade and very warm in the middle because of a southern anticylonic configuration thus, particulate matter mass concentration levels were quite low (similar to the other pollutants as number concentration, gasses and PM2.5 chemical compounds).







Figg. 3, 4 and 5: daily trend for particles in different ranges (>100nm and 20-30nm) and for particulate matter PM2.5.

RESULTS & DISCUSSIONS

Urban areas located at north of the Po river appear more impacted in terms of number concentration and mass, in part due to different emission sources and in part due to the orographic and meteorological characteristics. In rural areas, coagulation and condensation processes occurring during the transport of particulate matter from neighboring areas with high aerosol sources play an important role in the determining PNSD.

BO-UB: lower values than other urban stations , probably due to different micrometeorology that is affected by the proximity of the hills;

PD-MX and **MI-UB**: similar values despite the different urbanization;

ISPRA-R: shows an urban/rural mixed behavior. Recent studies identify the site as a background heavily influenced by human emissions (Henne et al., 2010; Sandrini et al., 2014);

SPC-R: clear differences for the smaller particles with respect to the urban stations but similarities for the NoUFP and PM2.5 ($r_{PM\,(SPC\,-\,BO)} = 0.86$) proving a rural and regional background behavior.

This study demonstrate that, in addition to local emission sources, the geographical location, the orography and the micro-meteorology features of each individual sites have to be taken into account in evaluating the different PNC and PNSD, despite the Po Valley is often considered as an accumulation sink where pollutants are mixed homogeneously in the whole region.

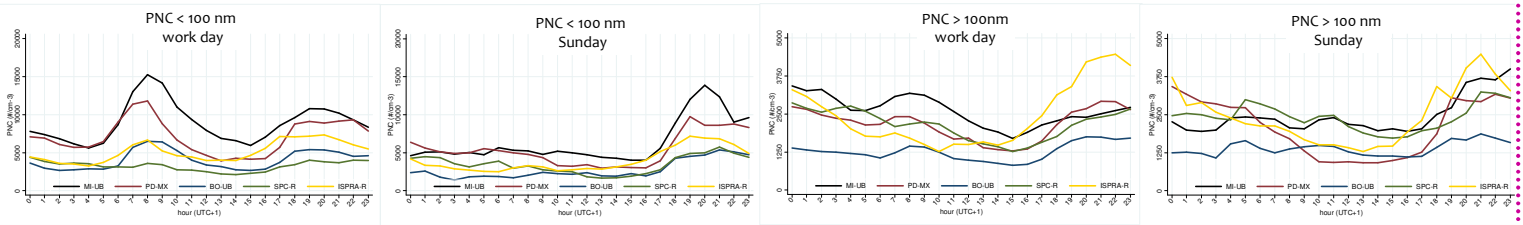
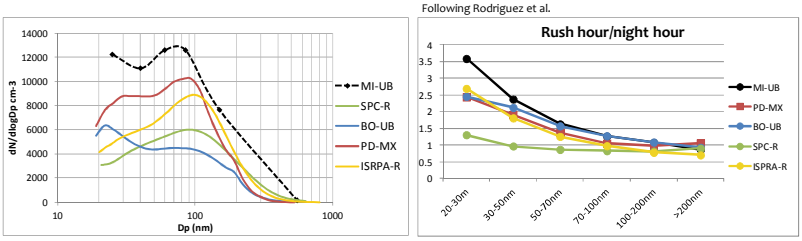


Fig. 1: Diurnal time series for PNC from 20 to 30nm and >100nm and for PM2.5 during work day and Sunday

INSTRUMENTATIONS and DATA PREPARATION

The database was averaged on hourly and daily basis. SMPS data were only used to correct FMPS data following Jeong et. al, 2009. Statistical data analysis was carried out using STATA (Version SE 12.0).

Instruments	Sites	Range distributions	Time resolution	Channels	Brand
Differential Mobility Particle Sizer (DMPS)	ISPRA-R	10-800 nm	-	45	-
Ultrafine Particle Moniter (UPM)	**MI-UB**	20-1000 nm	30 min	6	TSI 3031
Fast Mobility Particle Sizer (FMPS)	**PD-MX**	5.6-560 nm	1 min	32	TSI 3091
Twin-Differential Mobility Particle Sizer (t-DMPS)	SPC-R	3-600 nm	1 omin	119	TSI 3091
Scanning Mobility Particle Sizer (SMPS) e FMPS	BO-UB	3-600 nm 5.6-560 nm	5 min 1min	148 32	TSI 3093 TSI 3091



Figg. 6&7: monthly size distribution and "morning rush hour to night hour" ratio of number concentration in several size ranges

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