

## Vertical profile of air pollutant concentrations in proximity of a high rise building

S. Marchesi<sup>1</sup>, S. Zauli Sajani<sup>1</sup>, D. Bacco<sup>2</sup>, S. Ferrari<sup>2</sup>, C. Maccone<sup>2</sup>, I. Ricciardelli<sup>2</sup>, F. Scotto<sup>2</sup>, S. Rovelli<sup>3</sup> and G. De Gennaro<sup>4</sup>

<sup>1</sup>Regional Centre for Environment and Health, ARPA Emilia-Romagna, Modena, 41121, Italy

<sup>2</sup>Regional Centre for Urban Areas, ARPA Emilia-Romagna, Bologna, 40138, Italy

<sup>3</sup>Department of Science and High Technology, University of Insubria, Como, 22100, Italy

<sup>4</sup>Department of Chemistry, University of Bari, Bari, 70126, Italy

Keywords: human exposure, air pollution, vertical profile, urban environment.

Presenting author email: [smarchesi@arpa.emr.it](mailto:smarchesi@arpa.emr.it)

Many epidemiological studies pointed out significant associations between fine particle concentrations (particularly, PM<sub>2.5</sub>) and the increase in both respiratory and cardiovascular hospitalization (Stafoggia *et al.*, 2013) and mortality (Samoli *et al.*, 2013).

The proper representation of human exposure to particulate matter as well as to the other environmental pollutants is clearly of fundamental importance in epidemiological research.

In this respect, the evaluation of pollutant concentrations inside urban areas is a fundamental aspect to be carefully taken into consideration in the design of epidemiological studies. In fact, human exposure is typically associated with the available monitoring stations located at ground level only, while tall buildings are quite common within the urban fabric and can reach a considerable height.

The main objective of the study is the evaluation of outdoor concentration and distribution of some traffic-related pollutants at different heights from the ground level up to about 60 meters. In literature there is limited information about the description of vertical profiles of particle concentrations and quite inconsistent results in the performed studies (Quang *et al.*, 2012).

The pollutants considered in this work are particulate matter (PM), both PM<sub>2.5</sub> and Ultra-Fine-Particles (UFPs), nitrogen dioxide (NO<sub>2</sub>), benzene (C<sub>6</sub>H<sub>6</sub>) and carbon monoxide (CO).

Different instruments have been used for PM, that is Skypost TCR Tecora samplers for PM<sub>2.5</sub> and FMPS sizers for the estimation of UFPs concentrations, as well as the measurement of particle size distribution. NO<sub>2</sub> and C<sub>6</sub>H<sub>6</sub> have been measured using passive samplers (Radiello), while CO has been measured using Langan T15n samplers.

The instruments have been placed in four small balconies at various floors of the selected building, in particular the 2<sup>nd</sup>, the 5<sup>th</sup>, the 10<sup>th</sup>, and the 16<sup>th</sup>. The building is located in Bologna, the capital city of Emilia-Romagna Region in northern Italy and it is located close to a very busy street. The balconies are along the same side of the building. Additional instruments have been placed in the courtyard of the building having the same orientation with respect to the heavy traffic road.

The complete set of instruments to measure all the above-mentioned pollutants have been placed at 16<sup>th</sup> and 5<sup>th</sup> floor as well as at ground level (FMPS, Skypost, CO sampler, passive samplers). All the instruments

except for FMPS and CO sampler have been placed at the 2<sup>nd</sup> and 10<sup>th</sup> floor.

Two measuring campaigns have been scheduled: the first started last February with a 3 weeks duration in order to properly represent winter conditions of the urban environment, while the second campaign will take place in June (with the same duration) in order to be associated with summer conditions. In particular, high frequency measures of particulate concentration and distribution will be available.

Finally, some meteorological equipments have been placed together with the other measuring devices, namely, an anemometer at 18<sup>th</sup> floor, in order to have an estimate of wind intensity and direction, and a thermogrometer at each floor and at ground level in order to measure temperature and relative humidity at the same heights as air quality parameters.

The experimental design has been set up in order to obtain simultaneous measures of the pollutants at several heights along the vertical. This will allow to create a vertical profile for the pollutants. First results associated to winter campaign indicate that there is nearly a 15% decrease for PM<sub>2.5</sub> concentration throughout the whole height in the vertical. Moreover, the decrease with height is more relevant for UFPs and the results will be presented to give an overview of the vertical outdoor gradients in the urban concentration and distribution of particles.

### Acknowledgements

This research was conducted as part of the SUPERSITO Project, which was supported and financed by Emilia-Romagna Region and Regional Agency for Prevention and Environment under Deliberation Regional Government n. 1971/13.

### References

- Quang T.N., He C., Morawska L., Knibbs L.D., Falk M. (2012) *Atmos. Chem. Phys.* **12**, 5017-5030.
- Samoli E., et al. (2013) *Environ. Health Perspect.*, **121**, 932-938.
- Stafoggia M., et al. (2013) *Environ. Health Perspect.*, **121**, 1026-1033.