# A methodological approach to quantify health hazard from PM2.5 pollution levels in the Northern Italy

M. G. Perrone[1], L. Ferrero[1], M. Moscatelli[1], A.Orro[2], G. Sangiorgi[1], P. D'Ursi[2], M. Milanesi[2] and E. Bolzacchini[1]

[1]POLARIS Research Center, University of Milano Bicocca, P.zza della Scienza 1, 20126 Milan, Italy
[2]Institute for Biomedical Technologies ITB-CNR, Via F.lli Cervi, 93, 20900 Segrate (MI), Italy

contact author: grazia.perrone@uimib.it

## INTRODUCTION

A methodological approach was performed to quantify health hazard associated to PM2.5 pollution levels.
The method was applied to an area (the Lombardy Region) in the Northern Italy, which is one of the most populated region of West Europe, and it is characterized by high atmospheric aerosol pollution levels.

## PM2.5 CONCENTRATION MAPS

PM2.5 exposure was assessed by integrating daily data from local ground-based experimental measures of PM concentrations (μg $m^{-3}$), satellite observations for aerosol optical depth AOD, and the height of the mixing layer Hmix (Di Nicolantonio et al., 2009) Maps of satellite-based PM2.5 daily concentrations over the Northern Italy were derived (years 2006-2008), and they were used to estimate PM2.5 exposure in the area with a spatial resolution of 10*10km

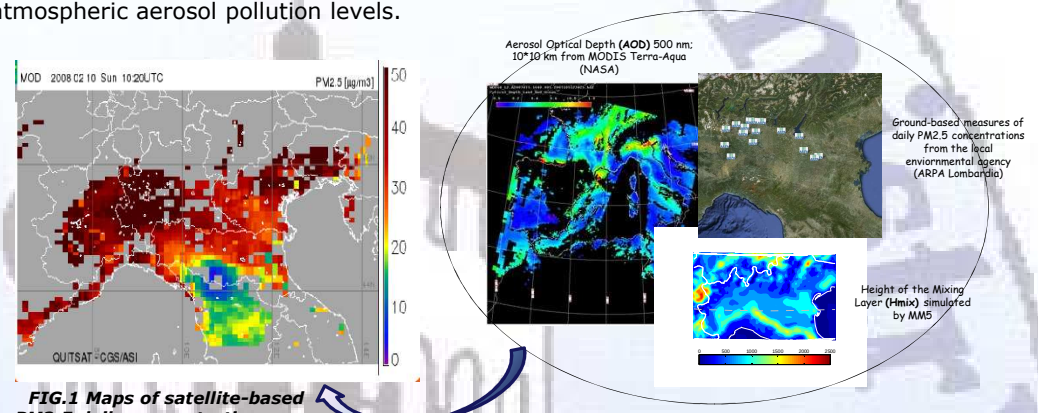


***FIG.1 Maps of satellite-based PM2.5 daily concentrations over the Northern Italy***

## RISK INDEX

The risk R*ij* associated to the *j*-PM2.5 sample (PM2.5 from a certain site and season) based on *the i*-biological response was calculated as

(1) $Rij = |(aij \times Dj + bij)-1|$

where a*ij* and b*ij* are the slope and the y-intercept of the dose-response linear function; D*j* is the *j*-dose exposure derived by the mean *j*-PM2.5 atmospheric concentration (μg $m^{-3}$); 1 is the control level. R*ji* is an estimate of the risk increase compared with a zero PM2.5 dose exposure.

Two risks where calculated for each j-PM2.5 sample: **Rcit*j*** and **Rgen*j***, which where calculated by biological responses that evaluated respectively the citotoxicity (1-MTT and LDH) and the genotoxicity (COMET assay) of PM2.5 samples.

A final **risk index RIj** was attributed to each j-PM2.5 sample:

(2) $RIj = (RIcit+RIgen)/max(RIcit+RIgen)$

**RIj** ranges from 0 to 1, and 1 is the maximum calculated RI, max(RIcit+RIgen).

## EXPOSURE-RESPONSE ASSOCIATIONS

The exposure-response association was evaluated by considering biological effects of PM2.5, derived by *in-vitro* tests. Biological responses were evaluated for PM2.5 collected in an urban, a rural and a remote site in the Lombardy Region along the four seasons (Perrone et al., 2010).
Thus, PM2.5 dose-dependent linear functions of the tested biological responses were derived for each site in each season.

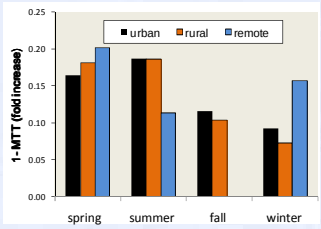


***FIG.2. Cell viability reduction (1-MTT) when particles were added to A549 cells at the isoconcentration of 6 μg $cm^{-2}$***

## RISK MAPS

Risk maps associated to monthly PM2.5 pollution levels for the Lombardy Region where derived by the satellite-based PM2.5 monthly concentrations maps, by substituting the *j*-PM2.5 monthly concentration at a certain site with the corresponding RIj calculated from (2). The specific dose-response linear function associated to each site (classified as urban, rural or remote) and season was used in the calculation.

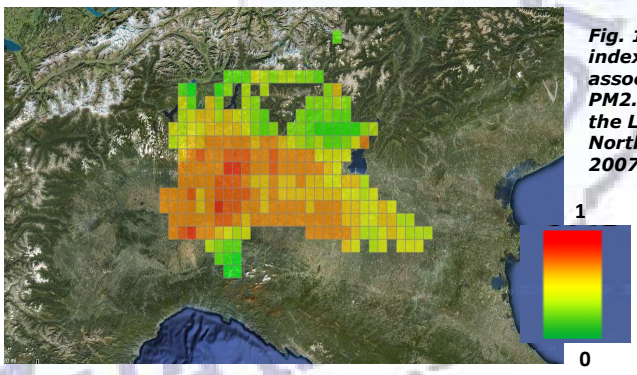


***Fig. 1 Risk map (risk index RI from 0 to 1) associated to monthly PM2.5 pollution levels in the Lombardy Region, North Italy (October 2007)***

## CONCLUSION

The calculated risk index RI was higher in the period November-February at both urban and rural sites; this is mainly due to the high PM2.5 atmospheric concentrations measured in that months for the Northern Italy.

**References**

Di Nicolantonio W., Cacciari A., Tomasi C., 2009. Particulate Matter at Surface: Northern Italy Monitoring Based on Satellite Remote Sensing, Meterological Fields, and *in situ* Samplings. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol.2, n.4, 284-292.

Perrone M.G., Larsen B., Gualtieri M., Ferrero L., Sangiorgi G., De Gennaro G., Udisti R., Bolzacchini E., Camatini M. (2010). PM2.5 and PM1 from urban, rural and remote sites in North of Italy; different contributing sources and biological effects. Poster P1F3, IAC 2010, Helsinki, Aug 29- Sept 3 2010.

***ACKNOWLEDGMENTS.*** *This work was supported by QUITSAT project (ASI-Agenzia Spaziale Italiana) and VESPA project (Lombardy Region)*