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

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Keywords: PM2.5, AOD, Remote sensing, health effects of aerosols
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A methodological approach was performed to quantify health hazard associated to PM2.5 pollution levels. The method was developed for a study of risk quantification applied to an area in the Northern Italy, which is one of the most industrialized and populated region of West Europe, and it is characterized by high atmospheric aerosol pollution levels.

Risk attributable to PM2.5 was assessed by combining the distribution of exposure with a factor that describes the exposure-response association.

PM2.5 exposure was assessed by integrating daily data from local ground-based experimental measures of PM2.5 concentration (μg $m^{-3}$, from the local environmental agency, ARPA), meteorological parameters (the height of the mixing layer, Hmix, simulated by MM5) and satellite observations for aerosol optical depth (AOD, from MODIS Terra-Aqua NASA platforms), during the three years 2006-2008. Thus, maps of satellite-based PM2.5 concentrations over Northern Italy were derived, which have the advantage of reconstructing PM2.5 exposure over the whole area with a good spatial resolution (10*10 km) (Di Nicolantonio W., 2009).

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

A risk index RI*ij* based on the *i*-biological response associated to the *j*- PM2.5 sample (a certain site in a certain season) was calculated as

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

where a*ij* and b*ij* are the slope and y-intercept of the dose-response linear function; D*j* *i*s the *j*-dose exposure derived by the mean *j*-PM2.5 atmospheric concentration.; 1 is the control value . Thus, RI*ij* is an estimate of the relative increase of risk compared to a *zero* PM2.5 dose exposure.

Two values of risk index where calculated for each *j*-PM2.5 sample: RIcit*j* and RIgen*j*, which were calculated by biological responses that evaluated respectively the citotoxicity (MTT and LDH) and the genotoxicity (COMET assay) of PM2.5 samples.

The final risk index RIj attributed to the *j*-PM2.5 sample is

$$(2)\quad RIj = (RIcitj + RIgenj)/\max(RIcitj + RIgenj)$$

and it has value ranging from 0 to 1, where 1 is the maximum risk index, max(RIcit*j*+RIgen*j*), calculated for the *j*-PM2.5 samples.

Risk maps (Figure 1) for the Northern Italy were derived by the satellite-based PM2.5 monthly concentrations maps. The risk maps were obtained by converting the *j*-PM2.5 monthly concentration at a certain site in the corresponding RIj as described in (1) and (2). The specific dose-response linear function associated to each site (classified as urban, rural or remote) and season was used.

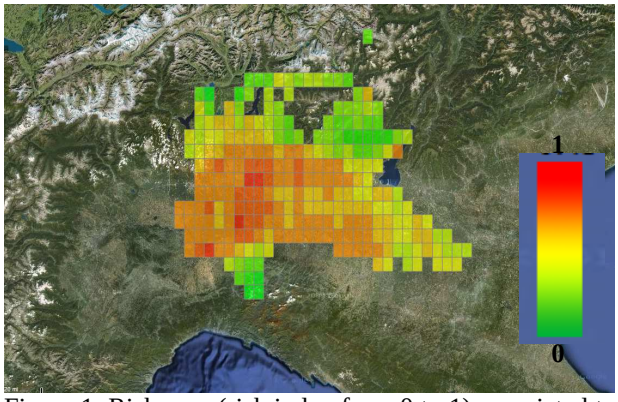

Figure 1. Risk map (risk index from 0 to 1) associated to monthly PM2.5 pollution levels in the Northern Italy (e.g. October 2007: fall season)

This work was supported by QUISAT project (ASI-Agenzia Spaziale Italiana) and VESPA project (Lombardy Region)

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