Bioinformatics infrastructure for the analysis of the relationships between particulate matter and human health

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Motivation

Epidemiological studies have shown that increased mortality is associated with increased atmospheric particulate, quantified in a plus of 0.5% to mortality rate every 10 µg/m3 PM10 increment. These results are confirmed by numerous studies suggesting that the relationship between particulate and mortality is not affected by statistical errors. Atmospheric particulate is a complex mix of mineral and organic particles with size, chemical / physical composition and morphology that vary significantly over time and place. It is now clear that the composition of the particles influences the toxicity of atmospheric particulate and that the current legislation which relies on limit values (50 µg/m3 of PM10 not to be exceeded for 35 days per year and the annual average of 40 µg / m3) is inadequate. We begin to discuss the replacement of the term limit with risk that is of which particulate matter that produce damages which are the real threshold values for a proper definition of risk for human health.

Methods

In this work we present the implementation of an infrastructure for the acquisition, analysis and visualization of atmospheric data coming from different data sources. The system main features are the following: 1.Sampling campaigns of atmospheric particulate PMx (PM0.4, PM1, PM2.5, PM10) are lead in Lombardy Region during the annual period. Granulometrical fractions are subdivided and analyzed according to chemical and toxicological point of view. Using multivariate analysis techniques, the existent relationships between the answers of various cellular toxicology assays and the chemical composition of each sample, are been explored. 2.Importing air quality data, in particular the Particulate Matter, from ARPA (Agenzia Regionale per la Protezione dell'Ambiente della Lombardia) monitoring station, satellite data of NASA Earth and Water platform, MM5 modelling data for the simulation of meteorological conditions. 3.Geo-referencing all the imported data and normalization into a common spatial grid that includes the Lombardy 4.A pipeline for analyzing the data in order to evaluate the air quality in

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the region of interest. 5.Visualization of the data in a map using the API provided by Google

Results

Actually, risk map regarding the PMx doesn't exist: the concentrations are determined experimentally on the ground, the spatialization is performed using models, the satellite data are represented by AOD values but not ground PMx. A bioinformatics platform is proposed to manage a risk assessment from the levels of PMx concentration and toxicity obtained from data sampling ground and spatialized for the Lombardy Region through satellite Figure1. Figure 1: A screen-shot from web interface of the infrastructure. It represents a Geo-referencing map showing the AOD values and the ARPA monitoring stations for PM10. The toxicity data obtained from exposure of human lung alveolar cell line A549 to round sampling PMx allow to build a qualitative/quantitative relationship for the PMx exposure risk assessment. Subsequently, the risk data is spatialized on a grid of 10 x 10 km on the Lombardy region using the concentration PMx data extrapolated from geo-referenced AOD satellite data. The spatialized risk maps, in this case on the Lombardy Region level, are an innovative tool in the air quality and human health related issues management.

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Supplementary information

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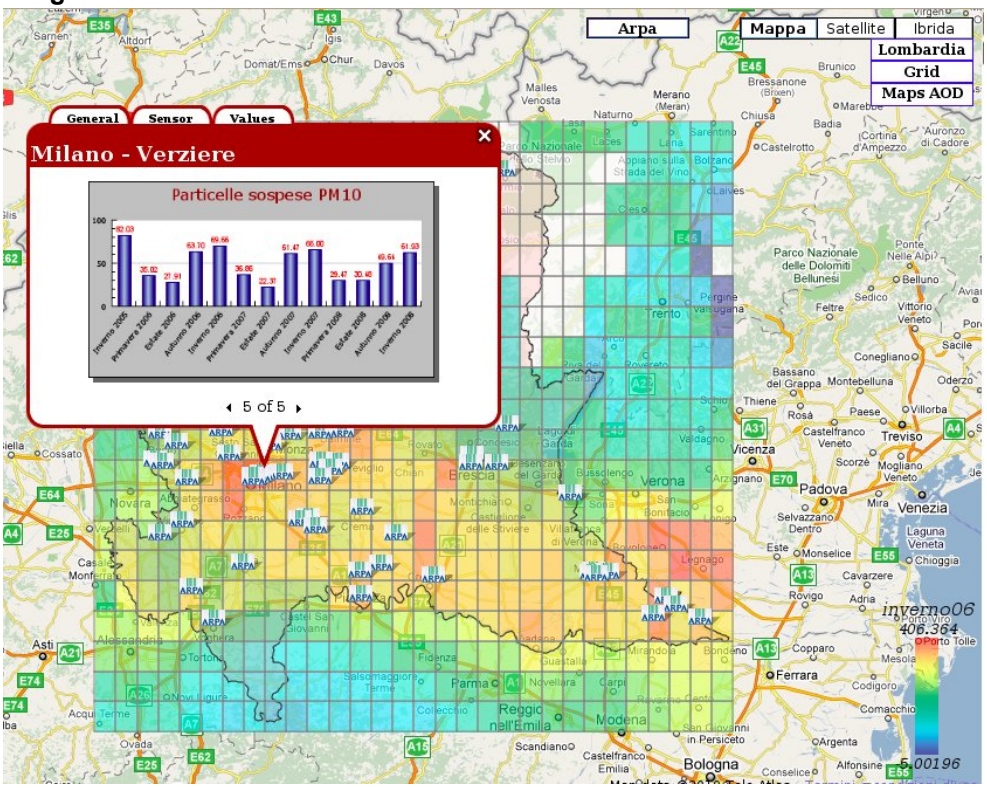
Image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