ISEE2016 Abstracts on Supersite Project

S-033: Supersite Project: Physical and chemical characteristics of atmospheric aerosols.

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More than three years of atmospheric aerosol measurements have been made during Supersite project, in five different sites in the Po valley (I), to better understand its chemical composition, mass closure, size distribution and source apportionment.

The sampling have been made for the following fractions of Particulate Matter: PM1, PM2.5 and PM0.05-0,14; 0.14-0,42; 0.42-1.2; 1.2-3.5; 3.5-10, 3-600 nm particle size distributions, 280nm – 10µm particle number.

Chemical analysis of different fractions of PM have been made for the following species: ions, metals, elemental and organic carbon, organic acids, sugars, phenols, polycyclic aromatic hydrocarbon, nitro and oxy polycyclic aromatic hydrocarbons, alkanes.

Several outcome show:

the significant contribution of ammonium salts that indicate the importance of the emissions of some agriculture activities;

the presence of Nickel and Vanadium, tracer of ship emissions that suggest a long range transport, probably due to the ship sailing in the seas around Italian peninsula;

a signal rich of metals, but not of elemental carbon, that seems to be associated to different industrial emissions or, in general, to emissions of different productive activities.

The main results prove that:

the major sources of aerosols are road traffic, biomass burning, agriculture, long range transport and industries;

the primary and secondary organic matter from biomass burning and traffic vehicles is the principal component of PM2.5 and PM1.

The set of results emphasize the importance of taking into account actions on all these sources to improve air quality in the Po valley.

S-034: Supersite Project: Toxicological profiles of atmospheric aerosol. - Annamaria Colacci, Center for Environmental Toxicology, ARPAE Emilia-Romagna, Italy, acolacci@arpa.emr.it, Maria Grazia Mascolo, Monica Vaccari, Stefania Perdichizzi, Cristina Zanzi, Francesca Rotondo, Stefania Serra, Laura Polacchini, Sandro Grilli.

In recent years, a shift from in vivo costly and time-consuming animal studies to short term in vitro assays, supported by omics technologies, has been proposed as a model to provide reliable toxicity prediction for single chemical and relevant information to assess the hazard and risk of complex mixtures.

Among omics techniques, transcriptomics is a powerful tool to assess the impact of exposure to complex mixtures. It allows the identification of the metabolic signaling and regulatory networks in cells exposed to the mixture, providing at the same time information for the mechanism of action and for predicting the final adverse outcome. The global gene modulation caused by complex mixtures, such as cigarette smoking, diesel exhaust and urban dust, have been intensively investigated, giving more insight into their effects on toxicological relevant endpoints.

This approach would be useful to investigate the exposure at low concentrations of multiple chemicals in environmental media and to support the identification of key events through the pathway leading to adverse outcomes. Airborne particulate matter could be regarded as the prototypical example of the environmental complex mixtures.

Within the Supersite project, we applied an integrated approach, including in vitro tests and toxicogenomics, to highlight the effects of air particulate matter on toxicological relevant endpoints and to identify the key events at molecular and cellular level.

Several cell lines were used in this study. Each cell model was chosen for its ability to highlight specific key events or endpoints related to adverse outcomes. Cells were exposed to extracts of PM2.5 and PM1 samples, which had been collected in an urban background site.

Results gave evidence for the modulation of genes playing a key role mainly in immune diseases and reproduction toxicity, suggesting that the pathway-based toxicity approach we used could support the prediction of risk from environmental exposures.

S-035: Supersite Project: Epidemiological findings on short-term and long-term effects

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Introduction:

Multi-city time-series and long-term cohort studies showed associations between PM2.5 and health outcomes. However, it is not well clear the role of specific PM components.

One of the main goals of Supersite Project was to identify PM2.5 components and sources responsible for short- and long-term health effects

Methods:

Four study areas in the Po valley of Italy with corresponding measurements sites were considered for detailed data collection and epidemiological analyses. Three years of daily environmental data were associated with mortality and hospitalizations using time-series approach in a pooled analysis. Missing data in three sites were reconstructed by multiple imputation approach using daily measurements from a main site and site-specific environmental and meteorological daily data. Survival analyses were used to analyze a retrospective cohort of residents in the period 2001-2013. Residential exposure to PM components was estimated on a monthly basis by kriging and back extrapolation.

Results:

We recruited more than 2 million subjects (66% in the 2 urban areas, 13% and 21% in the rural and coastal area). Short-term effects analyses showed associations mainly with respiratory diseases and different components, and consistent associations with natural mortality when considering source apportionment data (in particular traffic and biomass burning). Multiple imputation allowed a more precise estimation but with a generally slight decrease in the extent of associations. Retrospective cohorts considered more than 20 million of person/years, with ongoing analyses on mortality, hospitalization and reproductive outcomes.

Conclusions:

Associations of components and sources of PM2.5 and health outcomes showed peculiar patterns when considering mortality and morbidity. Results of ongoing long-term associations could help in the interpretation of this aspect.

P2-099: Short-term effects of fine particle components on daily mortality and hospitalization in the Emilia-Romagna region: Results from Supersite Project - Simone Giannini, Centre for Environment and Health, ARPAE Emilia-Romagna, Italy, simone.giannini.7@gmail.com, Andrea Ranzi, Serena Broccoli, Stefano Zauli-Sajani, Marta Ottone, Francesco Forastiere, Dimitri Bacco, Isabella Ricciardelli, Silvia Candela, Paola Angelini, Paolo Lauriola.

Introduction: Particulate matter is a complex mixture of chemical constituents that potentially affect health. We evaluated short-term effects of PM2.5 components on daily mortality and morbidity in a population living in Po Valley.

Methods: Within the "Supersite" project, we measured particle metrics and PM2.5 components over 3 years (2012-2014) in 4 sites (3 in urban areas, 1 in rural area). Measurements data was available daily at the main site (Bologna) and every three days at the satellite sites. Short-term effects of each components were estimated using pooled analysis at single lags. Cumulative lags were considered only after multiple imputation of missing data at the satellite sites. Poisson regression models were used, adjusting for seasonality, meteorology, influenza epidemics, holidays and population summer decrease. Daily cause-specific mortality and hospital admissions were collected by Regional Health Information Systems. Results were expressed as percent changes in outcomes for an interquartile range increase in pollutant concentrations.

Results: Natural mortality was associated with Ca2+ (lag 1), K+ (lag 2), and Fe (lags 3-4) and the strongest association was for Ca2+ (2.68%;95%CI:0.54,4.87). For cardiovascular mortality the strongest association was for K (lag 2: 3.24%;95%CI:0.01,6.56). Respiratory morbidity was associated with PM2.5 at every lag (lag 3: 2.66%;95%CI:1.34,4.00). Similar results was observed for organic carbon, 3.34% increase at lag 3 (95%CI:1.13,5.60), and Pb, 3.23% increase at lag 2 (95%CI:1.22,5.27). Other components associated with this outcome were total carbon, NO3-, SO42-, K, K+, Mn, As. Cardiovascular morbidity was associated at lag 3 with PM2.5, NO3-.

Conclusions: Respiratory outcomes resulted more associated with chemical components, with clearest association for the hospitalization. Some components, like potassium and calcium ions, Organic and Total Carbon, iron, seems to play a major role in association with health outcomes.

P2-021: Health effects of fine particle sources and dimensional fractions: a 3-year time-series study in an urban area of Northern Italy - Andrea Ranzi, Centre for Environment and Health, ARPAE Emilia-Romagna, Italy, aranzi@arpa.emr.it, Simone Giannini, Elisa Stivanello, Fabiana Scotto, Arianna Trentini, Stefano Zauli-Sajani, Marta Ottone, Laura Bonvicini, Ferdinando Luberto, Paola Angelini, Paolo Lauriola.

Introduction: Short-term exposure to fine particle mass has been associated with acute effects on health, but few studies examined source-specific exposure and role of size-segregated particle distribution. Within Supersite project we investigated the association between exposure to sources or fraction of particulate and health outcomes in the city of Bologna.

Methods: A daily series of chemical profile and fraction of particulate data has been collected for the period 2012-2014. Source apportionment methods were applied to identify specific sources of pollution. Particles number concentration (PNC) was converted into surface of particles, or collapsed into nucleation, Aitken and accumulation mode. The association of these daily data with mortality and morbidity was studied using Poisson regression models, adjusted by seasonality, meteorology, holidays, influenza epidemics and population summer decrease. Both single and mediated lags were examined. The effect estimates are expressed as percent changes in the number of cases per interquartile range increase of pollutant.

Results: 6 major sources were identified: traffic, industry, biomass burning, oil combustion, secondary nitrates and sulphates. Traffic and biomass burning showed significant associations with natural deaths at lags 3,4 (lag 4: 3.52%;95%CI:1.18;5.91) and lag 1,2,3 (lag 3: 3.50%;95%CI:0.82;6.25) respectively. Cardiovascular (CV) morbidity was associated only with nucleation at lag 3 (6.39%,95%CI:1.81;11.19). Respiratory (Resp) morbidity was variously associated with all sources, with stronger effects with industry (lag 0-1:4.81%,95%CI:1.50;8.23), and an association was observed also with accumulation at lag 6.

Conclusions: Particulate emission sources were consistently associated with respiratory diseases, while specific sources (traffic and biomass burning) were associated with natural mortality. PNC analyses suggested associations between smallest and biggest particles and CV and Resp outcomes respectively.

P3-312

Using multiple imputation to treat missingness in air pollution time series

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Introduction: Missing values are common in daily air pollution time series. They can be due to instrument failures, errors in reporting measurements or can be planned by design. Missing values are usually filled in by single imputation, while, with few exceptions, Multiple Imputation (MI) is not adopted in this field, despite it has better properties and brings to more reliable results. In this work, we used MI within the Supersite Project, a project focused to provide detailed measurements of chemical, physical and toxicological parameters in the atmosphere of the Emilia-Romagna region, Italy.

Methods: MI was performed according to an iterative procedure suitable for large data sets, based on partitioning the whole set of missing values in several blocks characterized by monotone missing data pattern. Separately for each block, missing values were imputed by sampling from the posterior predictive distribution of each variable, conditioning on a large number of covariates. We selected these covariates from all the available information by applying an ElasticNet algorithm, after having constrained the predictive model to contain lagged values of the outcome variable as well as seasonality terms.

Results: MI was performed on time series data arising from monitors located in Bologna, Parma, Rimini and San Pietro Capofiume. The percentage of missing values was heterogeneous depending on the site and on the measured parameter, reaching in some case the 95%. The algorithm detected 8 blocks involving more than 50 missing values and many other small patterns. We generated 10 different imputed data sets to be used for future analyses.

Conclusions: MI is a useful tool to treat missingness in air pollution time series. In our application, due to the large amount of missing values, a careful evaluation of the imputed data should be performed, by checking the coherence of relevant quantities after imputation and implementing ad hoc validation methods.