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A Statistical Method to Estimate $PM_{2.5}$ Concentrations over Europe from Meteorology and Its Application to the Effect of Climate Change

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Atmospheric particulate matter (PM) pollution has become a field of great interest because of its impacts on human health, climate change, and atmospheric visibility. In particular, fine particles with an aerodynamical diameter less than or equal to 2.5 μm ($PM_{2.5}$) are regulated in North America and Europe. It is well-known that PM concentrations depend on meteorology via its effects on the emissions, the kinetics of chemical reactions, the gas/particle partitionning, and the removal of PM from the atmosphere. Therefore, climate change is expected to affect PM concentrations.

First studies of the effect of climate change on air quality have originally been conducted on ozone, whereas the study of its effect on PM concentrations is more recent. However, most of the work pertaining PM has focused so far on the United States. Furthermore, there is currently no strong consensus on the effects of the present and future climate on $PM_{2.5}$ concentrations. Therefore, we propose here a statistical method which estimates $PM_{2.5}$ concentrations over Europe from the meteorology and which can be applied to present and future climates.

In more detail, we apply a multiple linear regression model to understand the relationships between $PM_{2.5}$ concentrations and meteorological variables in Europe. Multiple linear regression predictors include temperature, precipitation, wind speed, and weather types, which are representative of the large-scale atmospheric circulation. We use the results of a 9-year (2000-2008) model simulation as $PM_{2.5}$ *pseudo-observations*. By assuming that the weather types will remain the same in the future (stationarity), we use different model predictions provided by the IPCC to study how the frequency of the weather types will change in the future. The statistical model is used to estimate future $PM_{2.5}$ concentrations that would result from this climate change.