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Air pollution by aerosol at the Romanian scale: emissions, atmospheric concentrations and correlations with economic development

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Despite the fact that Romania, the largest country in the southeastern Europe, has gone through many economic, industrial and urbanization transformations in the last 25 years, to the best of our knowledge, a lack of research exists concerning spatio-temporal pattern of air pollutants with high resolution at the country scale and no attention was paid to the relationships between air pollutants and socio-economic indicators.
Therefore, the aim of this research is to answer questions of both scientific and socio-economic importance on the variation of pollution level due to particulate matter (PM) across Romania. First objective is to explore the spatio-temporal pattern of particulates PM10 and PM2.5 (aerosol particles less than 10 and 2.5 μm) at national scale and second objective is to check for correlations between particulate matter mass concentrations and three important statistical indicators: gross domestic product, inhabitants' number, vital statistics-life expectancy.
The research involves the statistical analysis of several PM10 and PM2.5 datasets of emissions (extracted from WebDab of EMEP), collocated high-resolved (daily, by geographical coordinates) atmospheric observations (PM from European air quality database, and aerosol optical depth data from Moderate-Resolution Imaging Spectro-radiometer (MODIS) using MYD04_L2 and MCD19A2) and statistic indicators' information (from database of National Institute of Statistics). Most of timeseries cover the period from 2016 back to 2005, as the first year of a systematic ground-based monitoring in Romania.
Out of 143 ground-based stations operating nowadays at the country scale that reports air pollution data for European Environment Agency, we present here the analysis results from eight urban stations in cities across Romania impacted by different pollution sources, having different level of development, cities with regional role and potential influence at European scale. Our study presents an up-to-date view of spatio-temporal variability of PM air pollution at national scale. The occurrence of lowest and highest mass concentrations (below 25 percentile and above 75 percentile) in the ground measurements were analyzed one by one for the entire year 2016. As result from radar products analysis, lowest PM10 levels seems correlated with the presence of large convective systems and intense rainfall, whereas a superposition between episodic long-range dust transport or fire events and extremely high PM2.5 mass concentrations were not clearly identified. This suggests PM local pollution is mainly caused by local anthropogenic emissions and not by advections from long distances.
At the country scale, both ground-based measurements and satellite data indicate a strong direct correlation (above 0.60) between air pollution level and gross domestic product and inhabitants number; this effect is more pronounced for aerosol fine fraction (0.77); life expectancy was negative correlated with PM pollution, with site-dependent values of the correlation (from -0.20 to -0.67). Insights into the temporal trends were provided by change-point analysis that highlighted the points when the trends suffered significant changes.
Present work points to the strong necessity of additional investigations on the link between air pollution data and economic indicators by development region, in order to help decision takers for abatement pollution strategies at the country scale combined with regional measures.