Clean Air Action and Air Quality Trends in Beijing Megacity

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Air pollution is a top environmental risk in developing megacities. Beijing is one of the most polluted megacities in the world with severe impacts on public health and the economy. To improve air quality, a five-year Clean Air Action Plan with a series of policies and regulations on air pollution control has been implemented in Beijing and neighbouring regions in 2013, leading to a huge improvement in Beijing air quality. However, the effectiveness of those policies from the Action Plan on Beijing air quality improvement is still unidentified specifically because of the significant influence of meteorological conditions on air pollution levels. This work developed a novel machine learning technique based on a random forest algorithm to evaluate the real impact of the Action Plan by normalizing the influence of weather conditions. The long-term trends of six key air pollutants which were measured from 12 national air quality monitoring stations in Beijing over a 5-year period (2013-2017) were analyzed using a Theil-Sen estimator after de-trending weather effects. As a result, this study found a marked decrease in air pollution levels due to emission control with a reduction of 34%, 24%, 17%, 68%, and 33% in PM2.5, PM10, NO_2, SO_2 and CO from 2013 to 2017, respectively. The annual average concentration of fine particles (61 μg m-3) after normalization of meteorological parameters in 2017 was higher than the observed level by 7%, indicating that Beijing could not achieve its PM2.5 target (< 60 μg m-3 in 2017) if not for favourable meteorological conditions in 2017. In addition, our results reveal that the policies in energy re-structuring, particularly in coal combustion reduction were highly effective for decreasing the levels of SO_2 and PM2.5 mass.