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Long-term Annual Variability of PM2.5 in a Suburban Area of Beijing, China

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Air pollution of PM2.5 (particulate matter with the aerodynamic diameter less than 2.5 [U+F06D]m) in Beijing has been drawing growing attention since it is responsible for haze, visibility impairment, regional problems in the context of air complex pollution, and poses increased health risk to the public.
In order to recognize the major factors causing severe pollution of PM2.5, ten-year monitoring data of PM2.5 (from January 2005 to April 2015) in a northwest suburban area of Beijing were collected and the long-term annual variability was analyzed. The data suggested serious regional pollution of PM2.5 in the past ten years with the annual average concentration as high as 100 ug/m3 and evenly spatial distribution within the study area regardless of local emissions. The pollution was greatly affected by wind direction and wind speed. When the northwest wind brought clean air from mountain area into the study area, PM2.5 concentration decreased by 33%, compared with southeast wind bring polluted air mass from industrial areas and downtown areas of Beijing. When wind speed was lower than 5 m/s, wind provided favorable dilution condition and PM2.5 concentration decreased with wind speed (correlation coefficient of -0.49, p = 0.06), while when wind speed exceeded 6 m/s, high wind speed tended to aggravate PM2.5 pollution especially in spring. PM2.5 concentration was also significantly affected by relative humidity positively and by temperature negatively, implying the influences of atmospheric oxidation capacity and vertical mixing on PM2.5 pollution. Analysis of annual PM2.5 concentration and socio-economic data gave light on the long-term influence of control strategies. During 2009 to 2015, the annual concentration of PM2.5 positively correlated with coal consumption (correlation coefficient of 0.970, p = 0.006) and negatively with natural gas consumption (correlation coefficient of -0.922, p = 0.026), supporting the importance of the energy constructure optimization in clean air act. During 2009 to 2012, the annual concentration of PM2.5 was positiveley correlated with population living in rural areas (correlation coefficient of 0.969, p = 0.007), indicating cropstraw burning in rural areas would greatly contributed to PM2.5.

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