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An Analysis of Meteorological Factors for High Daily PM_{10} Concentration in Busan via Statistics and Numerical Modeling

Minkyung Kim, Woogon Do, EunchulYoo, PyungjongYoo and Gigon Kim
Busan Metropolitan City Institute of Health & Environment, 120, Hambakbong-ro 140beon-gil, Buk-gu, Busan Metropolitan city, 616-842, Republic of Korea

Extended Abstract

The high concentration of PM_{10} has become a major ambient environmental problem in Korea. The concentration of PM_{10} is influenced by the emission of air pollutants and meteorological factors(Unal et al., 2011). So the Analysis of meteorological factors is essential for understanding high PM_{10} concentration in specific areas.

This study analyzed daily PM_{10} concentration excluding the yellow dust and rainy days in Busan, a coastal city in Korea, during 2004-2013 using statistics methods. We performed the T-test, the one way analysis of variance(ANOVA) test, the Welch and Brown-Forsythe robust tests in SPSS for equality of means as previously shown (Mutlu et al., 2012). The purpose of statistics was to determine if the means in the meteorological factors differ when grouped by the daily PM_{10} concentrations. The groups of PM_{10} concentration were divided according to 5-quantiles, quartiles and 95-quantiles.

The mean concentration of PM_{10} in Busan during 2004-2013 excluding the yellow dust and rainy days was 53 ㎍/㎥, more than the Korean air quality annual PM_{10} standard of 50 ㎍/㎥. On days with high PM10 concentration, the daily mean surface wind speed, the planetary boundary layer height, the sea-level pressure, and the daily mean middle and low cloud amount were found to be low. And the daily mean surface temperature, the daily mean surface relative humidity and the daily mean dew-point temperature were high. The west and south winds blew on the ground and the west wind blew strongly on the 850 hPa.

To know the feature of meteorological elements for high PM_{10} days, we classified high PM_{10} days into three clusters with regard to air mass backward trajectory using the Hybrid Single Particle Lagrangian Integrated Trajectory(Hysplit). Meteorological factors for each cluster were analyzed with the statistics methods such as the one way of variance. The group of the trajectory around north eastern China was largest proportion (50%) among high PM10 days. The distribution of atmospheric pressures were investigated by each group.

For detailed meteorology, WRF/SMOKE/CMAQ was used for the highest daily PM10 concentration from each cluster. The Weather Research and Forecasting(WRF) is meteorological model and the Community Multiscale Air Quality(CMAQ) is the chemistry and transport model. The Sparse Matrix Operator Kernel Emissions(SMOKE) is also used for emissions data processing. In this study the Intergrated Process Rate methodology in CMAQ was used to obtain quantitative information about the different atmospheric processes affecting particle formation as previously shown (Liu et al., 2010). The results of analysis indicated that horizontal and vertical transport were major factors in PM_{10} production. Distribution of PM_{10} concentration and meteorological factors were also investigated using WRF/SMOKE/CMAQ.

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