EGU2020-13585
https://doi.org/10.5194/egusphere-egu2020-13585
EGU General Assembly 2020

To what extent can the synoptic weather explain high PM2.5 pollution in Seoul?

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The change in PM level is the combined result of meteorological change and emission control. Meteorological change can strengthen or weaken the effectiveness of emission control. We applied an empirical and a statistical method to understand the effect of the meteorological variables on high PM2.5 event. A major meteorological mode associated with synoptic weather pattern that governs the high PM2.5 concentration in Seoul was identified through the empirical synoptic weather pattern classification and principal component analysis and regression. We used 2016-2018 PM2.5 observations from ~110 sites and 1 surface meteorological observation and 1 radiosonde observation within Seoul Metropolitan Area (SMA). Fifty cases with high PM2.5 concentration in SMA were selected in 2016 for the empirical weather pattern classification, and observed PM2.5 and meteorological data during 2017 ~ 2018 for the principal component analysis and regression.

As a result, a total of six synoptic weather patterns were derived, which was in agreement with the dominant meteorological mode of principal component analysis and regression. The dominant meteorological consists of high temperature at 850hPa, high geopotential height at 500hPa, high surface temperature, low wind speed at both surface and 850 hPa. The meteorological modes associated with the six patterns account for more than 90% of all high PM2.5 pollution days. Our results suggest that major synoptic weather modes can be used to easily predict high dust concentration potentials compared to WRF-SMOKE-CMAQ based air quality forecasting models.