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Estimation of surface PM concentration in the Korean peninsula using satellite-based AOD and the multiple regression model

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Atmospheric aerosols, from both natural and anthropogenic, are known to be major air pollutants affecting climate, environment and human health. The importance of monitoring air pollution on the Korean peninsula has been growing due to deteriorating air quality. Recently, there has been an increase in the ground air pollution observation network on the Korean peninsula because of the concern about the serious high concentration particulate matters (PMs) cases. However, these point-based observations are costly and they have limitations in analyzing temporal and spatial changes such as long-range transport of PMs. To overcome these limitations, studies have been progressed to estimate the ground concentration of particulate matter (PM) using satellite-based aerosol optical depth (AOD). The AOD, which represents the integral value of the aerosol extinction coefficient on the atmospheric optical path, and the PM, which collects the air from the ground and measures the concentration, can be expressed empirically. In order to improve the performance of the PM concentration estimation, a vertical correction method using a planetary boundary layer and a humidity correction method considering hygroscopic growth of an aerosol have been used.

In this study, a multiple linear regression model was used to estimate PM2.5 and PM10 (PMs with aerodynamic diameters less than 2.5 and 10 μm, respectively) in the Korean Peninsula. Factors for estimating the PM include the AOD and the altitude of the planetary boundary layer to consider the vertical correction, the hygroscopic growth coefficient for the humidity correction, and the wind speed and surface pressure to take into account the vertical mixing and horizontal diffusion of the aerosol. In addition, seasonal modeling and air pollutants such as ozone, nitrogen dioxide, carbon monoxide, and sulfur dioxide were introduced as factors to improve PMs estimation performance.