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Development of a numerical system to improve particulate matter forecasts in South Korea using geostationary satellite-retrieved aerosol optical data over Northeast Asia

Sojin Lee[1], Chul-han Song*[1], Rae Seol Park[1,5], Mi Eun Park[1,6], Kyung man Han[1], Jhoon Kim[2], Myungje Choi[2], Young Sung Ghim[3], Jung-Hun Woo[4]
[1]School of Environmental Science and Engineering, Gwangju Institute of Science and Technology (GIST), Gwangju 500-712, South Korea
[5]Numerical Model Team, Korea Institute of Atmospheric Prediction Systems (KIAPS), Seoul 156-849, South Korea
[2]Asian Dust Research Division, National Institute of Meteorological Research (NIMR), Jeju-do 697-845, South Korea
[6]Department of Atmospheric Sciences, Yonsei University, Seoul 120-749, South Korea
[3]Department of Environmental Science, Hankuk University of Foreign Studies, Yongin 449-791, South Korea
[4]Department of Advanced Technology Fusion, Konkuk University, Seoul 143-701, South Korea

ABSTRACT

To improve short-term particulate matter (PM) forecasts in South Korea, the initial distribution of PM composition, particularly over the upwind regions, is primarily important. To prepare the initial PM composition, the aerosol optical depth (AOD) data retrieved from a geostationary equatorial orbit (GEO) satellite sensor, GOCI (Geostationary Ocean Color Imager) which covers Northeast Asia (113°E–146°E; 25°N–47°N), were used. A spatio-temporal (ST) kriging method was used to better prepare the initial AOD distributions that were converted into the PM composition over Northeast Asia. One of the largest advantages to using the ST-kriging method in this study is that more observed AOD data can be used to prepare the best initial AOD fields. It is demonstrated in this study that the short-term PM forecast system developed with the application of the ST-kriging method can greatly improve PM_{10} predictions in Seoul Metropolitan Area (SMA), when evaluated with ground-based observations. For example, errors and biases of PM_{10} predictions decreased by ~60% and ~70%, respectively, during the first 6 h of short-term PM forecasting, compared with those without the initial PM composition. In addition, The influences of several factors (such as choices of observation operators and control variables) on the performances of the short-term PM forecast were also explored in this study.

Keywords: PM hindcast, geostationary satellite, AOD, spatiotemporal kriging