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An assessment of mineral dust impact from China and Mongolia on air quality in the Seoul Metropolitan Area with a full year simulation for 2009

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Asian mineral dust from Gobi Desert, sand desert, Loess Plateau and barren mixed soil in Northern China and Mongolia has a major impact on the air quality in the SMA (Seoul Metropolitan Area). These mineral aerosols increase PM10 concentration over 1000 μg/m3 during the dust storm event and they also increase PM10 background concentrations as the fugitive soil dust during the non-dust period in Korea. The mineral dust modifies the formation mechanism of inorganic aerosols via the chemical interactions with atmospheric gas species. The PM10 prediction by a regional chemical transport model without the dust emission shows an intrinsic tendency to underestimation according to previous studies in this region, especially for the soil originated coarse PM. This is partially due to the uncertainty of fugitive dust emissions.
The US EPA Models-3/CMAQ (Community Multiscale Air Quality model) v5.0 by modifying the fugitive dust module was used to simulate the chemical transport including the mineral aerosols. The Asian Dust Aerosol Model 2 (ADAM2) and Westpal schemes for the dust emission with CMAQ were tested for their applicability in assessing the impact of mineral dust on air quality in the SMA for a full year of 2009. The performance of available dust emission schemes to depict not only the high PM10 concentrations and onset time for the dust storm period but also the level of background PM10 concentration for the non-dust event were evaluated against the surface measurements of and satellite measurements over East Asia. The surface observations were from EANET (Acid Deposition Monitoring NETwork in East Asia), API (Air Pollution Index) monitoring sites in China and the intensive monitoring stations in the SMA.
The results show that the CMAQ predictions of PM10 with ADAM2 and Westpal scheme are relatively in a good agreement with the observations and influence of mineral dusts on the sulfate and nitrate formations is significant when the dust mixes with anthropogenic emissions over China for the dust event periods. They, however, occasionally over-predict the PM10 concentrations during non-dust event periods. It means the dust emission models need further modifications to use as the year round simulations in estimating the background concentrations in the SMA.
Details of modifications of dust emission schemes and annual background PM10 concentrations by the soil fugitive dust in the SMA will be discussed in the presentation.