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Source-receptor relationship of wet and dry depositions of PAHs in Northeast Asia

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The spatial distribution of polycyclic aromatic hydrocarbons (PAHs) deposition by the source-receptor analysis over Northeast Asia was investigated by using an Eulerian regional-scale aerosol chemical model denoted as Regional Air Quality Model 2 for Persistent Organic Pollutants (RAQM2-POP version) at the year of 2005. We confirmed that the simulation was reproduced the PAH concentrations in precipitation based on comparison with observed and simulated concentrations. In this research, the domain was divided into six-source regions (Northern China, NCHN; Central China, CCHN; South China, SCHN; eastern Russia, ERUS; South Korea, SKOR; Japan, JPN) and three-receptor regions (Yellow Sea and East China Sea, ECS; the Sea of Japan, SOJ; northwestern Pacific Ocean, NWP). We focus on benzo[a]pyrene (BaP), which is the most carcinogenic species. The largest emission occurs on CCHN, following SCHN, NCHN, ERUS, SKOR, JPN. In the three Chinese domains and ERUS, the largest contribution to the dry and wet deposition is the domestic origin. In these domains, the wet deposition amount of BaP was 2-16 times larger than those of the dry deposition amount. The total deposition (wet+dry) amount was lower than those of the emission amount. In contrast, the total depositions are larger than the emissions from their own domains in the downwind region (SKOR, JPN), indicating a signature of long-range transport of PAH to the downwind regions.

The relative contributions from the three Chinese domains and ERUS to the downwind region (KOR, JPN) are evaluated. For wet deposition in winter, the relative contribution from NCHN and CCHN (20-69%) are larger, whereas the relative contribution from CCHN, SCHN, RUS (13-57%) are larger in summer. These are controlled by the distribution of precipitation. For dry deposition, the relative contribution from NCHN and CCHN (28-49%) are large in winter season, whereas the relative contribution from the three Chinese domains and ERUS are decrease in summer season, instead of this, relative contribution from its own domain is increased.

In the oceanic receptor region, the relative contributions are strongly influenced to the location as well as the precipitation or wind pattern. In ECS, the relative contribution from CCHN for dry and wet deposition is large in winter (dry 82%; wet 63%) and summer season (dry 78%; wet 89%). In SOJ, the contribution regions are changed to more northern region under the northwesterly wind in comparison with those in ECS: For dry deposition, the relative contribution in winter was large from ERUS (60%), whereas large from ERUS, SKOR, and JPN (19-52%) in summer. The relative contribution of wet deposition was 25-45% from NCHN and CCHN in winter season, whereas 21-41% from CCHN and ERUS in summer.