Seasonal variation of PAHs in fine particulate aerosols at Cheju, Korea: Implications for combustion sources

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A monitoring study of atmospheric blackcarbon (BC) as well as organic carbon (OC) is being conducted in the Asia-Pacific rim region, aiming to estimate the potential (both chemical and climatic) impact of Asian originated air pollutants to the atmospheric constituents, over the North Pacific Ocean. Through the monitoring at the Jeju Island, Korea, both of carbon species have revealed their seasonal trends with considerable elevation in winter to spring seasons and minor maxima in mid-summer. However, it was not clear weather the observed fluctuations in the atmospheric carbon species are stem from a single combustion source. In the present study, we analyzed three- to seven rings polycyclic aromatic hydrocarbons (PAHs). The obtained PAHs compositions including some marker compounds such as retene were used to discriminate combustion sources of airborne carbonaceous particles.

On the declive (1100m a.s.l.) of Mt. Harura, Jeju Island, Korea, located about 100 km south of the toe of Korean Peninsula, fine aerosols (PM2.5) have been collected on quartz fiber filters with the time resolution of 10-15 days since 1999. A quarter to half portion of each filter was spiked with surrogate and Soxhlet extracted with DCM. Then the extract was analyzed for PAHs by using a capirally-GC/MS after purification through silica gel column chromatography.

Sum of 3-7 rings PAHs concentrations (T-PAHs) ranging 48-580pg/m3 showed seasonal variation similar to BC. That is, T-PAHs become highest in winter-spring period ranging from 85-560pg/m3 and a small, but distinctive maximum was found in mid-summer. The ratio of sum of 3-4 ring PAHs to that of 5-7 ring PAHs (LMW/HMW ratio) varied widely from 0.65 to 11 with the highest value in the summer. This trend cannot be explained by the simple partitioning between gas/particulate phases, as high vapor pressure of low molecular weight PAHs relative to high molecular weight species will lower the LMW/HMW ratio with increasing atmospheric temperature. In addition, the relative concentrations of Retene, a molecular marker for wood combustion, to low molecular weight PAHs varied widely in the summer (0.03-0.3) whereas it was quite stable at low values (0.01-0.03) in winter-spring period suggesting contributions from wood combustion in mid-summer. In conclusion, our results indicate that combustion sources that contribute to atmospheric carbonaceous species (i.e., PAHs and, presumably, BC) in the mid-summer differ from those in winter-spring period.