Charaterizing the N isotopic compositions of ammonium and nitrate in $PM_{2.5}$ in South Korea: seasonal perspective

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We collected $PM_{2.5}$ samples for analyzed $\delta^{13}C$, $\delta^{15}N$-TN, $\delta^{15}N$-NO_3^- and $\delta^{15}N$-NH_4^+ isotope from a rural (Baengnyeong Island), an urban (Seoul) in Korea from 2014 to 2016. In Baengnyeong, $\delta^{13}C$, $\delta^{15}N$-TN, $\delta^{15}N$-NO_3^-, and $\delta^{15}N$-NH_4^+ were −22.6 ± 0.9‰, 8.5 ± 5.2‰, 11.7 ± 2.7‰, and −5.5 ± 4.6‰, respectively in winter and −24.3 ± 0.7‰, 0.6 ± 4.0‰, 0.8 ± 1.9‰, and 9.7 ± 5.7‰, respectively in summer, which showed significant seasonal differences with sinusoidal variation. In Seoul, the isotopic compositions were −23.9 ± 1.3‰, 13.3± 2.7‰, 11.9 ± 2.5‰, and 14.1 ± 4.6‰, respectively in winter and −25.2 ± 0.5‰, 12.2 ± 3.9‰, 5.2 ± 1.7‰, and 14.2 ± 4.8‰, respectively in summer. The isotopic results implied that C, NO_3^-, and NH_4^+ in $PM_{2.5}$ from Baengnyeong were mostly originated from coal combustion during winter heating seasons; the island was heavily influenced by high $PM_{2.5}$ pollution caused by China's winter heating. Whereas, the isotopic values implied that NO_3^-, and NH_4^+ in $PM_{2.5}$ from Seoul were introduced mainly from local vehicle emissions, but during heating seasons, contributions from coal combustion are also important for NO_3^-, but not for NH_4^+. NH_3, the precursor of NH_4^+ in $PM_{2.5}$ in Seoul, is expected to originate mainly from vehicle emissions. The multi-isotope analysis of each component in $PM_{2.5}$, demonstrated here, is identified as a promising tool for tracking the origins of atmospheric aerosols, which helps to develop effective $PM_{2.5}$ control strategies implemented by the international organization in East Asian regions.