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Investigating the washing effects of precipitation on translocation of pollutants from particulate matter to surface by characterizing seasonal variations of rainwater quality in South Korea

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The washing process of precipitation on the ambient particulate matter (PM) can affect the chemical characteristics of rainwater and its effects on the surface environment. In this study, we investigated the seasonal characteristics of rainwater quality (pH, electrical conductivity (EC), water-soluble ions) to identify the effects of ambient PM on the surface ecosystem by rainfall intensity. The concentrations of $PM_{2.5}$ (≤ 2.5 μm in diameter) and PM_{10} (≤ 10 μm in diameter) were measured by an automatic weather system (AWS), and daily average data were used from March to August 2020 in Busan, South Korea. Rainwater samples (50 mL) were collected in Spring (March-May) and Summer (June-August) for each season of 5 precipitation events. We found that the average concentration of PM_{10} in Spring and Summer was 33.9 μg/m^3 and 27.7 μg/m^3, respectively. The average concentration of $PM_{2.5}$ was 13.6 μg/m^3 in the Spring and 12.3 μg/m^3 in the Summer. From rainwater quality analysis, the value of EC in Spring was 143 μS/cm, and the average concentrations of cations (Na^+, Mg^{2+}, K^+, Ca^{2+}, and NH_4^+) and anions (Cl^-, NO_3^-, and SO_4^{2-}) were 18.8 and 28.3 mg/L, respectively. In Summer, the value of EC is 44.3 μS/cm, and the average concentrations of cations and anions were 11.3 and 8.8 mg/L. Furthermore, the pH of rainwater in Spring and Summer was 4.3 and 4.6, respectively, indicating that the acidity and concentration of ions in Spring rainwater are relatively high with the concentrations of PM. Interestingly, however, the correlation coefficient between PM levels and the rainwater quality was higher in Summer, especially with correlation coefficients of pH ($r = 0.72$), NH_4^+ ($r = 0.98$), and K^+ ($r = 0.53$). Our results from this study indicate that precipitation plays a significant role in the translocation of pollutants from the atmosphere to the surface when rainfall intensity is strong (i.e., Summer), whereas other meteorological factors (e.g., wind and humidity) combine to affect this function when it is weak.