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Characterization of Water-Soluble Inorganic Ions and Carbonaceous Aerosols in the Urban Atmosphere in Amman, Jordan

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The Eastern Mediterranean is a unique region for air pollution because it is the crossroads between three continents exchanging air pollution transported between Africa, Asia, and Europe. Here, we investigated urban particulate matter (PM) carbonaceous and water-soluble ions for eleven months in Amman, Jordan. The $PM_{2.5}$ total carbon (TC) annual mean was 7.6±3.6 µg/m^3 (organic carbon (OC) 5.9±2.8 µg/m^3 and elemental carbon (EC) 1.7±1.1 µg/m^3), which was about 16.3% of the $PM_{2.5}$. The PM_{10} TC annual mean was 8.4±3.9 µg/m^3 (OC 6.5 ± 3.1 µg/m^3 and elemental carbon (EC) 11.9±1.1µg/m^3), about 13.3% of the PM_{10}. The $PM_{2.5}$ total water-soluble ions (TI) annual mean was 7.9±1.9 µg/m^3(about 16.9%), and that of the PM_{10} was 10.1±2.8 µg/m^3 (about 16.0%). The minor ions (F^-, NO_2^-, Br^-, and PO_4^{3-}) constituted less than 1% in the PM fractions. The significant fraction was for SO_4^{2-} ($PM_{2.5}$ 4.7±1.6 µg/m^3 (10.0%) and PM_{10} 5.3±1.9 µg/m^3 (8.3%)). The NH_4^+ had higher amounts of $PM_{2.5}$ (1.3±0.6 µg/m3; 2.7%) than that PM_{10} (0.9±0.4 µg/m^3; 1.4%). During sand and dust storm (SDS) events, TC, Cl^-, and NO_3^- were doubled in both $PM_{2.5}$ and PM_{10}, SO_4^{2-} did not increase significantly, and NH_4^+ slightly decreased. Regression analysis revealed: (1) carbonaceous aerosols in Amman come equally from primary and secondary sources, (2) about 50% of the OC came from non-combustion sources, (3) traffic emissions dominate the PM, (4) agricultural sources have a negligible effect, (5) SO_4^{2-} is completely neutralized by NH_4^+ in the $PM_{2.5}$ but there could be additional reactions involved in the PM_{10}, and (6) $(NH_4)_2SO_4$, was the major species formed by $SO_4^{2-}$and NH_4^+ instead of NH_4HSO_4.