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Chemical coupling between acid gases and water-soluble inorganic ions in size-segregated aerosols during Arabian Dust in Beirut

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In the proximity of the Eastern Mediterranean region, the combination of two large desert areas; Arabian and African, with heavy oil industry and high insolation during summer delineate a unique location of atmospheric processes in the region. Once emitted, dust particles can be transported over long distances and/or remain suspended in the atmosphere for several days. The so-called remnant dust episodes in Beirut originate from both African and Arabian deserts. In this study, the gas and particle transformations and gas-to-particle conversion during Arabian-dust (Ar-D) events are assessed. The increase in primary and secondary gas concentrations during Ar-D days is ascribed to three contributing factors; (i) the regional-long-range transport (LRT), (ii) the drop in the average solar radiation leading to a slow primary-to-secondary conversion and secondary gas photo-degradation, and (iii) the enhancement of the recirculation and accumulation of the main pollutants during dusty days. In parallel, a respective mass increase by 137, 149 and 13% in the coarse (CPM), accumulation (ACC) and ultrafine (UF) fractions was measured and an increase in particle volume distribution was mostly noticed for particles ranging in sizes between 2.25 and 5 μm. This lead to major changes in the inorganic chemical composition of all particle sizes. In particular, the enhanced presence of several types of nitrate and sulfate salts in the accumulation mode confirms that remnant dust episodes offer a favorable environment for gas-to-particle conversion and particle chemical transformations and growth.