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New Particle Formation events over an eastern Mediterranean region – Influence of Secondary Organic Aerosols

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New Particle Formation (NPF) is a crucial process responsible for generating new aerosols in the atmosphere and contributing to nearly half of the cloud condensation nuclei concentration. NPF events have been frequently observed in various environments. Characterizing NPF events and identifying the key chemical species and the responsible mechanism is vital in advancing the knowledge regarding NPF events and their impact on climate and human health.

The Mediterranean region is a “hot spot” for climate change and is expected to undergo significant warming and drying in the 21st century. This semi-arid location is affected by continental, marine, and desert dust airmasses, and intense photochemistry during the dry and hot weather makes this region interesting for NPF. However, studies of NPF over the eastern Mediterranean region are limited and present a significant gap in the understanding of NPF. In this study, the aerosol number size distribution, particulate chemical composition, and gaseous pollutants in Rehovot (31°53"N 34°48"E, a semi-urban site in Israel) were collaboratively monitored from 29 April to 03 May 2021 and 03 May to 11 May 2023, during when a national bonfire festival happened. The present study employs a novel hybrid source apportionment to understand the relationship between particle size distribution and chemical composition.

The source apportionment of organic aerosols (OA) revealed 2 primary factors (Hydrocarbon-like OA and Biomass-burning OA) and 2 secondary factors (MO-OOA (more oxidized oxygenated OA) and LO-OOA (low oxidized oxygenated OA)). Ultrafine particle burst/NPF events were observed during daytime (mostly well-defined nucleation events) and nighttime (without well-defined growth). The daytime events were associated with an enhancement in the sulfuric acid proxy concentrations (~ 3.8×10^{6} molecules cm^{-3}), suggesting the role of gas-phase photochemistry. The results from Hybrid PMF analysis suggested the involvement of multiple components, including sulfate and MO-OOA, in the nucleation and

subsequent particle growth during daytime. Interestingly, nighttime events were associated with the involvement of semi-volatile species (LO-OOA and nitrate) in the growth along with sulfate and more-oxidized organics. This study demonstrates the involvement of organic and inorganic secondary components in the ultrafine particle burst/NPF events observed over a semi-urban, semi-arid location.

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