

NEW PARTICLE FORMATION AND TRANSPORT OVER CENTRAL GREECE

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ABSTRACT

A significant number of particles with initial sizes around 1 nm is introduced in the atmosphere through homogeneous binary or ternary nucleation ^[1]. These particles then grow to larger sizes through condensation and coagulation. Nanoparticles resulting from new particle formation (NPF) events can strongly affect climate ^[2] and may have an impact on air quality and human health ^[3]. Various efforts have been made to quantify the frequency and the strength of NPF events in Greece. However, uncertainties persist regarding the spatial scale on which they are formed as well as the fate the formed particles. Particle size distributions measured in Patras during the summers of 2020 and 2021 indicated a low nucleation frequency (12%) ^[4]. However, small particles (20-30 nm) appeared frequently (30% of all days) in this area during the afternoon. These particles were attributed to the transport to Patras of particles, formed in an area in Boeotia, 150 km northeast of the site and then transported to the measurement site ^[4].

To further explore these transported events, a field campaign was conducted in July 2023, including simultaneous measurements in Boeotia (two sites, Elateia and Kamena Vourla), the area where NPF is expected to occur, Patras and Athens. These sites were selected to cover potential transport routes of formed particles. Instrumentation included four scanning mobility particle sizers (SMPS) for the measurement of particle size distributions, monitors for the mass concentration of PM_{2.5} an aethalometer for black carbon, and a suite of gas monitors for SO₂, NO_x, NH₃. A particle size magnifier (PSM) was deployed in Elateia measuring nanoparticles with diameter down to 1 nm. Following the standard event classification scheme ^[5], low NPF frequencies were quantified in all four sites during the campaign, the highest being in Elateia (16%). While nucleation mode particles appeared and grew to larger sizes in Boeotia, they were not detected by the PSM or the smallest size channels (<10 nm) of the SMPS, suggesting that they were not formed in situ. Nevertheless, transport of the formed particles from one site to another (depending on the wind direction) was confirmed in at least 3 of the 5 cases with NPF. Furthermore, a sudden and simultaneous appearance of a particle mode in the range of 20-30 nm was observed during July 27. This mode persisted for four days growing to 100 nm and was linked to a transported NPF event induced by emissions from wildfires to the North of the site.

KEYWORDS: New Particle Formation, Particle Transportation, Wildfires, Climate Change

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