Spatial Extend of New Particle Events over the Mediterranean basin from multiple ground-based stations and aircraft measurements

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Over the last two decades, new particle formation (NPF), i.e. the formation from the gas-phase of new 1 nm particle clusters followed by their growth to the 10-50 nm size range, has been extensively observed in the atmosphere (Kulmala et al, 2004). The characteristics of the NPF events reported so far are highly variable in term of frequency and intensity (Maninen 2010,Yli Juuti 2011), according to the geographical location and time of the year. It is thus necessary to describe the occurrence and characteristics of NPF over a large variety of environments, and assess to what spatial extend these characteristics can be applied to. In particular, in the Mediterranean area which is exposed to higher radiation compared to the rest of Europe, but also to large amount of preexisting primary particles (dust and pollution aerosols), the question of the spatial extend of NPF observed so far (Pikridas et al, 2012; Kalivitis et al, 2015) is crucial both for climate and air quality concerns.

In this work, we use aerosol size distribution measurements performed simultaneously at Ersa, Corsica and Finokalia, Crete over a one-year period for analyzing the occurrence of NPF events. The geographical location of these two sites, as well as the extended sampling period allow us to assess the large spatial and temporal variability of atmospheric nucleation. Globally, Finokalia and Ersa show similar seasonalities in the monthly average nucleation frequencies, growth rates, and nucleation rates although the two stations are located more than 1000 km away from each other.

During an intensive sampling period (July 3rd to August 12th 2013) aerosol size distribution measurements are also available from a ground based station on the island of Mallorca as well as aboard the French research aircraft, the ATR-42.

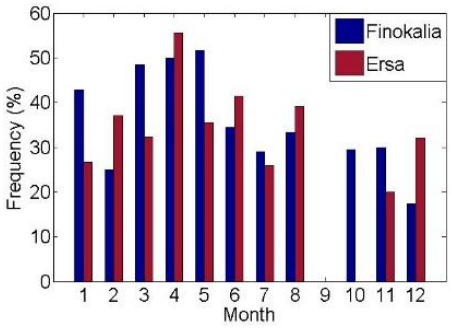

Figure 1: Comparison of the monthly mean seasonal frequency of NPF occurrence at the two ground-based stations Finokalia and Ersa.

This unique combination of stationary and mobile measurements provides us with detailed insights into the horizontal and vertical development of the NPF process on the daily scale. During the intensive sampling period, nucleation events occurred both at Ersa and Mallorca over delimited time slots of several days, but different features were observed at Finokalia. The results highlight that the spatial extent of the NFP events over the Mediterranean Sea might be as large as several hundreds of km, mainly determined by synoptic conditions, but still featuring local characteristics.

References

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