A case of CCN formation associated with atmospheric nucleation in eastern Mediterranean

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Quantifying the contribution of atmospheric nucleation processes as source of cloud condensation nuclei (CCN) is an important step towards the understanding of the interactions between aerosols and clouds, and subsequently the radiative forcing of the atmosphere (Kerminen et al., 2012).

During the FRONT (Formation and growth of atmospheric nanoparticles) project both nucleation and growth of atmospheric aerosols are studied, with special emphasis given to the precursor gases driving these processes. Continuous measurements of aerosol and ion size distributions and real time aerosol chemical composition are performed at Finokalia station, Greece.

In Fig. 1 an event of consecutive nucleation days observed at Finokalia is presented. Aerosol size distributions were measured with an SMPS in the size range 10-900nm and real time chemical composition of fine particles was monitored with an ACSM (Aerosol Chemical Speciation Monitor). The onset of new particle formation sequence took place when the origin of the air masses changed from west to north. Back trajectories analysis showed that air mass penetration from higher altitudes resulted to a drastic drop of condensation sink (CS). For the days presented the air mass origin remained the same. There were 4 events of atmospheric nucleation observed. The chemical composition of aerosols showed that the change of air masses origin, except of the drop of CS resulted additionally to a cations/anions (C/A) ratio well above 1. As has been shown in the past (Pikridas et al., 2012) under these conditions nucleation is favored, high C/A ratio is an indication of NH_3 excess in a sulfate rich environment as Finokalia.

Number concentration for particles with D_p<20nm (N_{nuc}) and D_p>100nm (N_{acc}) were calculated, N_{nuc} to demonstrate the nucleation and N_{acc} as representative for CCN number. In previous experiments during summer at Finokalia it was observed that N_{acc} is well correlated to CCN number for supersaturation of 0.2% (not shown). As can be seen in Fig. 1, the variation of N_{acc} follows closely that of sulfate indicating that sulfate is the major species that result to growth to CCN sizes. On the other hand, organic compounds present a weaker correlation to N_{acc}, playing important role though in the determination of CCN number. However, it is expected that the contribution of different species in the growth process changes on annual basis as a subject of the abundance of each species. Future work will provide supplementary information on VOCs and their potential role in the formation and growth processes.

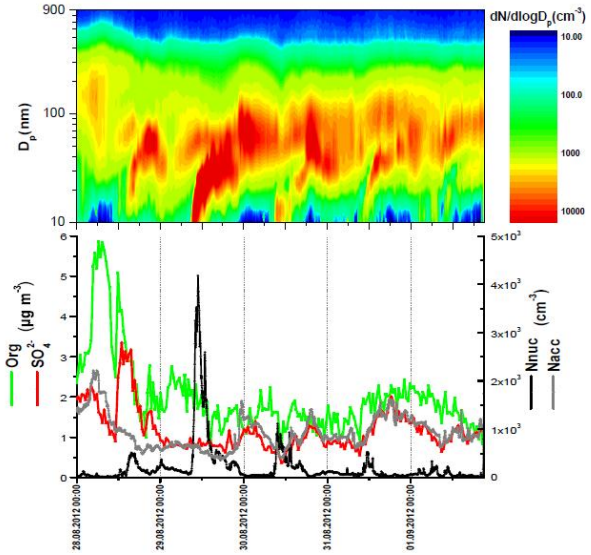

Figure 1. Nucleation events observed at the Finokalia station during the period 28/8-1/9/2012. Upper panel, number size distributions of atmospheric aerosols (D_p 10-900 nm). Lower panel, time series of aerosol chemical composition (major components) and number concentration of nucleation and accumulation mode particles.

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