Geophysical Research Abstracts
Vol. 21, EGU2019-1956, 2019
EGU General Assembly 2019

Analysing the relation of NPF events to local environmental factors in northern Europe

Dimitrios Bousiotis (1), Manuel Dall'Osto (2), David C.S. Beddows (1), Francis D. Pope (1), Andreas Massling (3), Roy M. Harrison (1,4)

(1) University of Birmingham, Geography Earth and Environmental Sciences, United Kingdom (dxb595@bham.ac.uk), (2) Institute of Marine Sciences, CSIC, Passeig Marítim de la Barceloneta, 37-49. E-08003, Barcelona, Spain, (3) Aarhus University, Frederiksborgvej 399, P.O. Box 358, DK-4000, Rosklide, Denmark, (4) Department of Environmental Sciences / Centre of Excellence in Environmental Studies, King Abdulaziz University, PO Box 80203, Jeddah, 21589, Saudi Arabia

Ultrafine particles typically make the greatest contribution in the total particle count, especially in urban environments. The sources of ultrafine particles in the atmosphere can either be from primary emissions or new particle formation (NPF) from gaseous precursors. NPF events have different patterns of development depending on the conditions of the area in which they occur. Apart from general meteorological conditions, the local environment also affects their occurrence and development.
In this study, NPF events occurring at sites of close proximity but different characteristics are studied. Thus, rural and urban background along with roadside sites from three different cities in northern Europe (London, Copenhagen and Leipzig) are assessed to not only elucidate the general conditions of these events, but also to determine both the effect of the local environment on NPF events as well as the effect of NPF events on the local environment.
In general, clear atmospheric conditions (strong solar radiation and low relative humidity) and a low condensation sink were found to be the favourable conditions for NPF events in all areas, regardless of the type. Regional events (with an extent of at least 50 km) were found to occur when these conditions were even more prevalent. For areas in close proximity to the sea, marine air masses presented a higher probability of NPF events compared to air masses with continental origin, due their lower condensation sink.
As the sites for each city are in close proximity, the effect of the local environment is studied. A general pattern was found in which the condensation sink increases with the degree of pollution of the site, but this is counteracted by increased particle growth rates at the more polluted location. As a result, while the frequency of NPF events was the highest in the rural sites, growth rates were highest in roadsides in all three cities. Higher growth rates were also found in each site for more polluted incoming air masses compared to cleaner ones. A key finding of this study is that the role of the urban environment in the area of London, leads to an increment of 20% in N16-20nm in the urban background compared to that of the rural area in NPF events occurring at both sites. Urban background sites in this study presented greater variability due to their nature, as local conditions and pollution sources can have a more detrimental effect compared to roadsides (e.g. the nearby port in Copenhagen's urban background site).
Finally, the effect of NPF events on the particle number composition in each site is also studied. It was found that while the urban environment enhances both the formation and growth of particles, the effect of NPF events is reduced on moving from the rural background to the roadside, due to the increased contribution of other sources in the urban environment. NPF events were found to more than double N16-100nm on event days depending on the area, having a significant effect on the aerosol size distribution.