Characterization of new particles formation events at Izaña Mountain Observatory (Tenerife, Canary Islands): formation, growth rates and influencing atmospheric parameters

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We present a study of new particle formation events in the low free troposphere over Tenerife (Canary Islands). The study is based on 4 years (2008-2011) observations of particle number size distribution in the Izaña Global Atmospheric Watch Observatory. This site is placed at 2400 meters above the sea level. The site remains almost permanently above the marine stratocumulus layer typical of the subtropical oceans. The low troposphere is strongly inhibited, in such a way that the 'dry' troposphere is separated from the 'humid' marine boundary layer by the subtropical inversion layer (linked to trade winds). The study data set includes particle size distribution, measured with a Scanning Mobility Particle Sizer (10 – 500 nm), reactive gases (NOx, SO_2, O_3 and CO), meteorological parameters and radiation. The objective of this study is to identify the context in which New Particle Formation (NPF) events occur.

Ultrafine particle (<100 nm) concentrations showed a strong diurnal evolution, with a maximum during daylight. This evolution was prompted by the development of buoyant slope winds, which also resulted in increases in the concentrations of water vapour, reactive gases and nanoparticles (3 – 10 nm; Rodríguez et al., 2009). We observe that, in most of cases, the increases in the ultrafine particles were associated with burst in the nucleation mode particles (< 20 nm). In many cases these burst were followed by a subsequent particle growth up to diameters within the range 50 – 100 nm, resulting in New Particle Formation (i.e. banana type, Fig.1).

These NFP episodes were observed with any wind direction, being also associated with the arrival of polluted air from below due to the action of upslope winds. The frequency of NPF events showed a significant variability, within the range 2 - 14 events / year. The events are more frequent in summer. Growth rates of nucleation particles (diameter < 25 nm; Dal Maso et al., 2005) typically exhibits values within the range 1 - 5 $nm \cdot h^{-1}$. The frequency of NPF events, as well as the growth and formation rates is somewhat lower than those observed in the polluted continental boundary layer (Kulmala et al., 2004). This is attribute to the much lower concentrations of gas phase precursors in this free troposphere site (e.g. SO_2 concentrations are ~ tends to hundreds of ppt during daylight).

A day-to-day event classification was performed. Different subgroups were segregated, and the parameters that may influence on the NPF formation were studied.

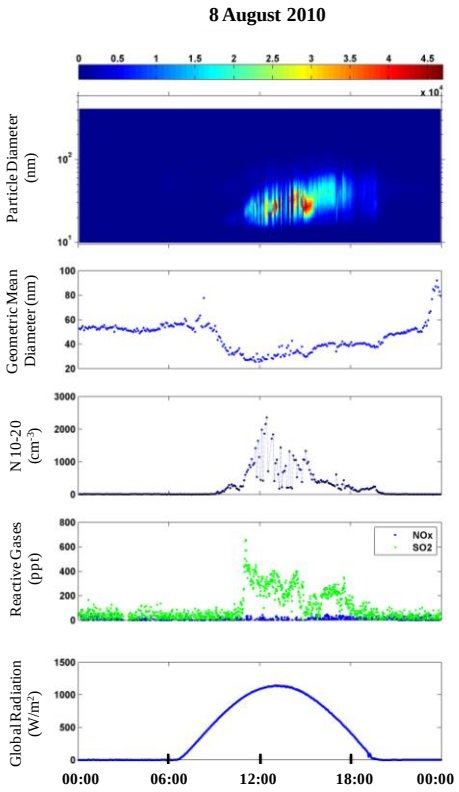

Figure 1. NPF and its comparison with atmospheric parameters

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