Linking in-canopy volatile organic compound reactivity to nocturnal new particle formation

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Atmospheric aerosols play a central role in both air quality and climate change. However, the evaluation of aerosol radiative forcing is still one of the greatest uncertainties in predicting future climate (IPCC, 2013). It is therefore crucial to better assess aerosol sources and related processes. At a global scale, New Particle Formation (NPF) is one of the most important aerosol sources, which could represent half of the Cloud Condensation Nuclei (CCN) rate (Merikanto *et al*., 2009). Several studies have observed NPF, over rural as well as urban areas, mostly during daytime, related to photochemical processes (Kulmala *et al*., 2004). But, only a few studies have reported nocturnal NPF (Lee *et al*., 2008). The origin of these nocturnal events remains sparse, mostly due to the lack of investigations. In addition, the role of biogenic volatile organic compounds (BVOCs) in NPF is still not clearly understood, even if recent advances (Riccobono *et al*., 2014) were proposed. Hence, new studies about NPF and their link with BVOCs are of great interest, especially in locations still poorly investigated.

The Landes forest, located in southwestern France, is one of the largest monospecific forest in Europe (~1 million ha) and composed of 95% of maritime pines (*pinus pinaster*), a large monoterpene emitter, mainly α- and β-pinene, two well-known SOA precursors. Flat, with few anthropogenic inputs, under the direct influence of the Atlantic Ocean with strong photochemical periods, this forest may be considered as an "open-air laboratory". Hence, the Landes forest appears to be one of the best suitable ecosystem to investigate NPF related to BVOCs emissions.

This work is a part of the LANDEX coordinated project, aiming to assess the formation and fate of Secondary Organic Aerosols (SOA) generated from the French Landes forest. To achieve this goal, two preliminary field campaigns have been conducted in summer 2014 and 2015, in order to explore SOA related photochemistry and NPF in this forest. During both campaigns, BVOCs and their corresponding oxidation products were measured in the gas phase using online GC-FID and PTR-TOF-MS. Ozone, nitrogen oxides (NOx) and sulfur dioxide were also monitored. Aerosol size distribution and concentration were measured with a SMPS, whereas quartz fiber filter daily collected particles for off-line chemical analysis. Local meteorology (T, P, RH, solar radiations, wind speed and direction) were characterized, and completed by air mass backward trajectory calculations. The physiologic state of the ecosystem has been evaluated through latent and sensible heat fluxes and CO_2 flux measurements. Ozone deposition was also measured, including its potential reactivity with very reactive BVOCs.

During both preliminary campaigns, night-time NPF have been observed at high frequency rates. Through this presentation, we will focus on the 2015 field campaign, which took place during a strong hydric stress period. This period presented the highest NPF frequency rate (56%) with extremely high monoterpene concentrations. Gas phase oxidation products such as nopinone and pinonaldehyde have been successfully identified thanks to the PTR-TOF-MS. In-canopy monoterpene reactivity with ozone will be discussed in light to nocturnal NPF observation, to assess its potential contribution. Finally, the effect of hydric stress on nocturnal NPF, in the context of global warming, will be evaluated.

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