Geophysical Research Abstracts
Vol. 12, EGU2010-9467, 2010
EGU General Assembly 2010

The Effect of Pollution on Newly-Formed Particle Composition in Boreal Forest

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The geographical extent of the tropical, temperate and boreal forests is about 30% of the Earth's land surface. Those forests are located around the world in different climate zones effecting widely on atmospheric composition via new particle formation. The Boreal forests solely cover one third of the forests extent and are one of the largest vegetation environments, forming a circumpolar band throughout the northern hemisphere continents, with a high potential to affect climate processes [1]. In order to more fully understand the possible climatic effects of the forests, the properties of secondary organic aerosols (SOA) in varying conditions (e.g. a change in meteorological parameters or in the concentrations of biogenic and antropogenic trace gases) need to be better known. In this study, we applied the UFO-TDMA (ultrafine organic tandem differential mobility analyzer [2]) and the UFH-TDMA (ultrafine hygroscopicity tandem differential mobility analyzer [3]) methods parallel to shed light on the evolution of the nucleation and Aitken mode particle compositions (via physic-chemical properties) at a virgin boreal forest site in varying conditions. The measurements were carried out at Hyytiälä forest station in Northern Europe (Finland) during 15 spring nucleation events. We also carried out a statistical analysis using linear correlations in order to explain the variability in the composition behaviour of the particles during multiple nucleation events. The overall results show a clear anthropogenic influence on the nucleation and Aitken mode particle compositions during the events. The SO2/MTOP and NOx/MTOP (MTOP, monoterpene oxidation products) ratios explain most strongly the variation in the nucleation mode composition during clean and pollution-affected events, suggesting also the importance of organic sulfur compounds, in addition to other sulfur, nitrogen and organic compounds, in particle formation, composition and properties. During the cleanest events, MTOP explain significantly the time behaviour of the 10 nm particle composition with an estimated organic fraction of over 95%.

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