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Photochemical aging of secondary organic aerosols: effects on hygroscopic growth and CCN activation

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Plant emitted volatile organic carbons (VOCs) are a major precursor of secondary organic aerosols (SOA), an important constituent of atmospheric aerosols. The precursors are oxidized via ozonolysis, photooxidation, or by NO3 and form aerosol particles. Due to further oxidation of the organic matter the composition of the SOA may age with time. This will also change the hygroscopic growth (HG) and cloud condensation nuclei (CCN) activation of the particles.

In this study we generated and aged SOA in the SAPHIR chamber at the Research Centre Juelich under near atmospheric conditions: natural sunlight, low precursor and O3 concentrations, and long reaction times. As precursor we used a mixture of 5 monoterpenes (MT) or 5 MT with 2 sesquiterpenes which had been identified as major constituents of plant emissions in previous experiments. Concentrations ranged between 4 and 100 ppb MT and the total reaction time was 36h. HG was measured at RH=10-97% by a Hygroscopic Tandem Differential Analyser (HTDMA, FZ Juelich) and at RH=97-99% by the Leipzig Aerosol Cloud Interaction Simulator (LACIS-mobile, IfT Leipzig). The agreement between HTDMA and LACIS-mobile data was generally good. CCN properties were measured with a continuous flow CCN Counter from DMT.

SOA particles generated on a sunny day were more hygroscopic and had a lower activation diameter (Dcrit) than SOA formed under cloudy conditions. With aging it became more hygroscopic and Dcrit decreased. Sunlight enhanced this effect. But the change in HG and Dcrit due to aging was less than the difference between SOA generated under different conditions (i.e. sunny or cloudy). We did not observe a dependence of the HG on the precursor concentration.