The effect of the photomineralization mechanism on ambient organic aerosols' cloud condensation nuclei and ice nucleation abilities

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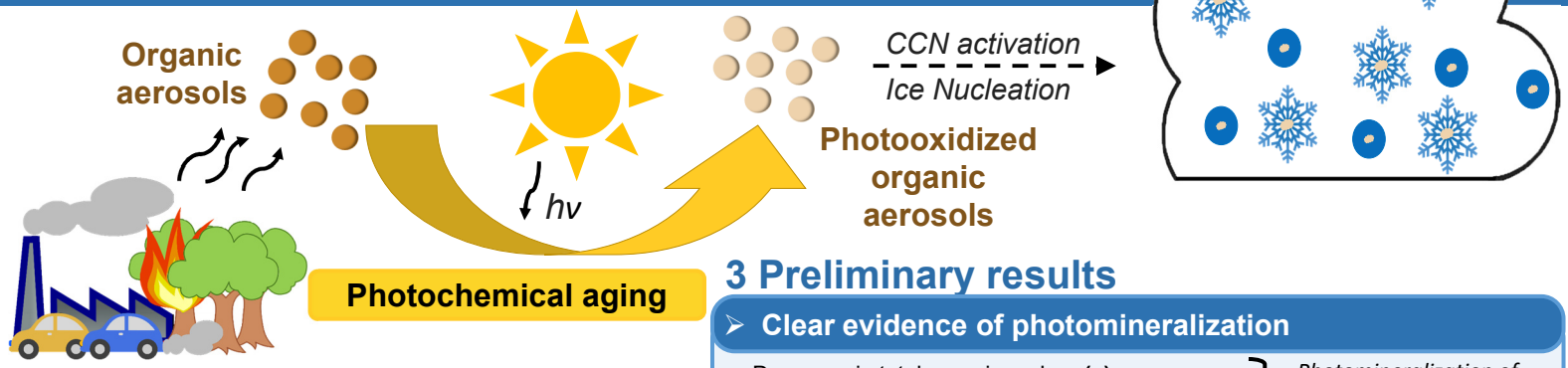


1 Research Question

- During their lifetime of days to weeks in the atmosphere, organic aerosols are exposed to sunlight and thus undergo **atmospheric processing** through **photochemistry**.
- Natural dissolved organic matter (DOM), previously used as a proxy for organic aerosols, **increases** in **Cloud Condensation Nuclei (CCN)** ability and **decreases** in **Ice Nucleation (IN)** ability during UVB irradiation.[1]
- By altering the ice-to-water ratio in mixed-phase clouds, photochemical processing of organic aerosols can therefore influence **aerosol-cloud radiative effects.**
- However, the extension of this mechanism to real ambient organic aerosols **rather than DOM** remains uncertain, with implications for its parameterization in climate models.

➢ **What is the effect of photochemical aging on the cloud-forming properties of lab-generated vs. ambient organic aerosols?**

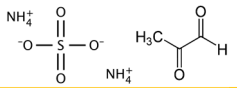
2 Experiments

Ambient aerosols

Firewood smoke sampling with *Coriolis μ* air sampler

Lab-generated aerosols

Ammonium sulfate-methylglyoxal



6 X UVB bulbs
8 hours

Photoreactor

≈ 1.5 days in the atmosphere

Analytical chemistry instruments
- Changes in total organic carbon
- Production of organic acids and CO/CO_2
- Changes in optical properties, pH, conductivity

Cloud Condensation Nuclei Chamber (CCNC)
«How well do the aerosols activate cloud droplets?»

Freezing Ice Nuclei Counter (FINC) [2]
«How well do the aerosols nucleate ice?»

3 Preliminary results

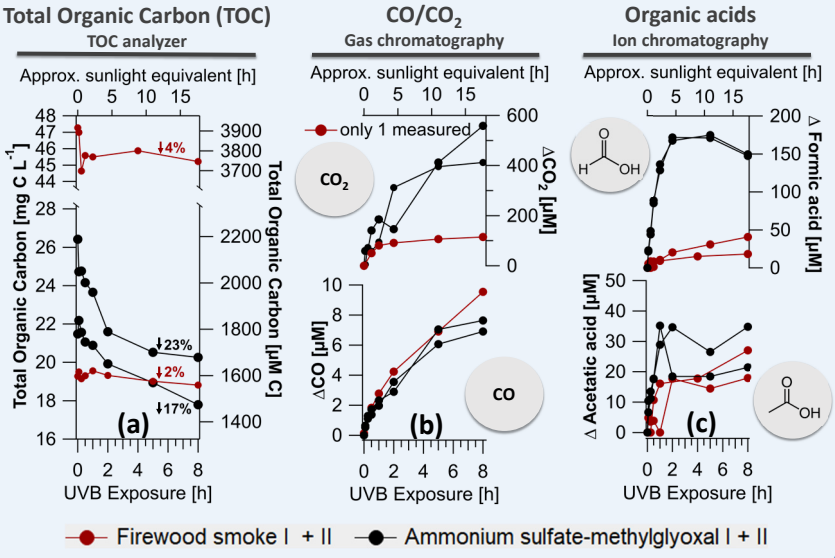
➢ Clear evidence of photomineralization

- Decrease in total organic carbon **(a)**
- Production of CO, CO_2 **(b)** and organic acids **(c)**

} *Photomineralization of organic matter*

- Photobleaching (loss of absorptivity)

➢ Wood smoke aerosols appeared to be **more resistant to photodegradation** than ammonium sulfate-methylglyoxal.

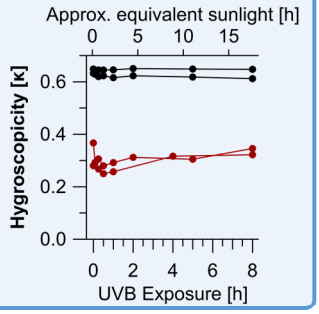


➢ Effect on CCN and IN abilities unclear thus far

No clear changes in **CCN abilities** observed

- ➢ CCN abilities of ammonium sulfate-methylglyoxal appeared to be dominated by the salts with a negligible impact from chemistry changes in the organic fraction.
- ➢ Further experiments will be conducted with wood smoke aerosols, employing longer timescales of photochemical aging.

The effect on **IN abilities** is a work in progress.



4 Outlook

- The results thus far suggest that the mechanisms by which CCN abilities of organic aerosols are altered by photochemical processing differ between ambient organic aerosols and laboratory-generated organic aerosols & DOM.
- Further work is planned to investigate the effect on IN abilities, and to probe the effect of photochemical aging on CCN abilities at longer timescales than studied thus far.

References:

[1] Borduas-Dedekind et al., *Atmos. Chem. Phys.*, 2019

[2] Miller & Brennan et al., *Atmos Meas. Tech.*, 2020. Manuscript in preparation.

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