Supplement of Atmos. Chem. Phys., 22, 5377–5398, 2022
https://doi.org/10.5194/acp-22-5377-2022-supplement

Atmospheric Chemistry and Physics
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EGU

Supplement of

Micro-spectroscopic and freezing characterization of ice-nucleating particles collected in the marine boundary layer in the eastern North Atlantic

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This Supplement comprises of six figures (S1-S6).

Figure S1: Sampling location on Graciosa Island, Azores, during the Aerosol and Cloud Experiments in the Eastern North Atlantic (ACE-ENA) field campaign (Wood, 2019) and image of ground sampling site (Wang et al., 2021). Airport and access road could impact particle collection. However, the duration of local pollution from airport and access road is relatively short. In addition, these fresh emissions are dominated by nucleation/Aitken mode particles outside of the examined particle and INP sizes.

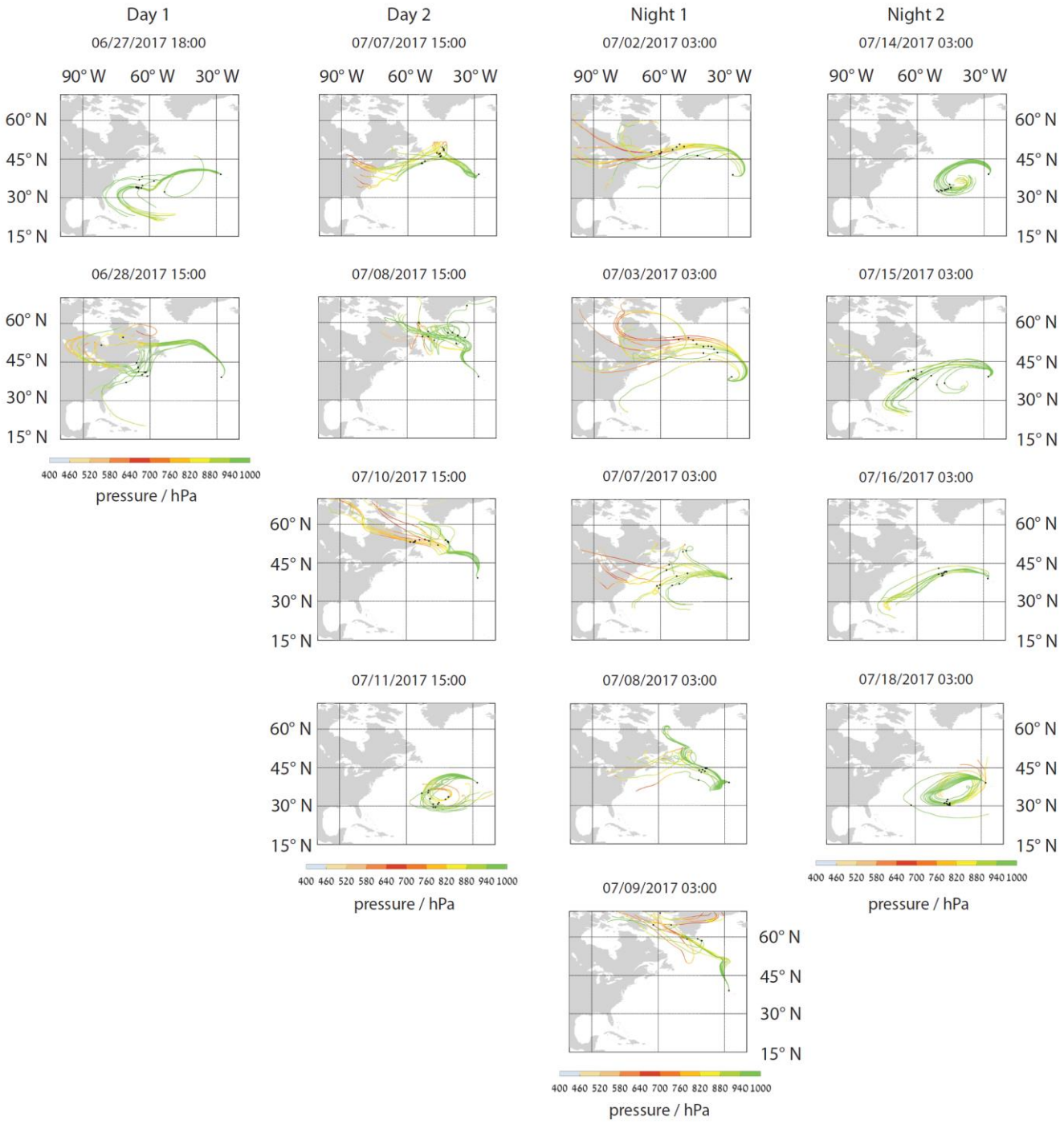


Figure S2: Representative backward trajectories for examined daytime and nighttime samples for corresponding sampling periods. The date in the panel title marks the time from which the 10-day backward trajectories are calculated (black dot), and the additional black dots mark the trajectories' locations 5 days prior to their arrival at the sampling site. The trajectories are colored by their pressure level (hPa).

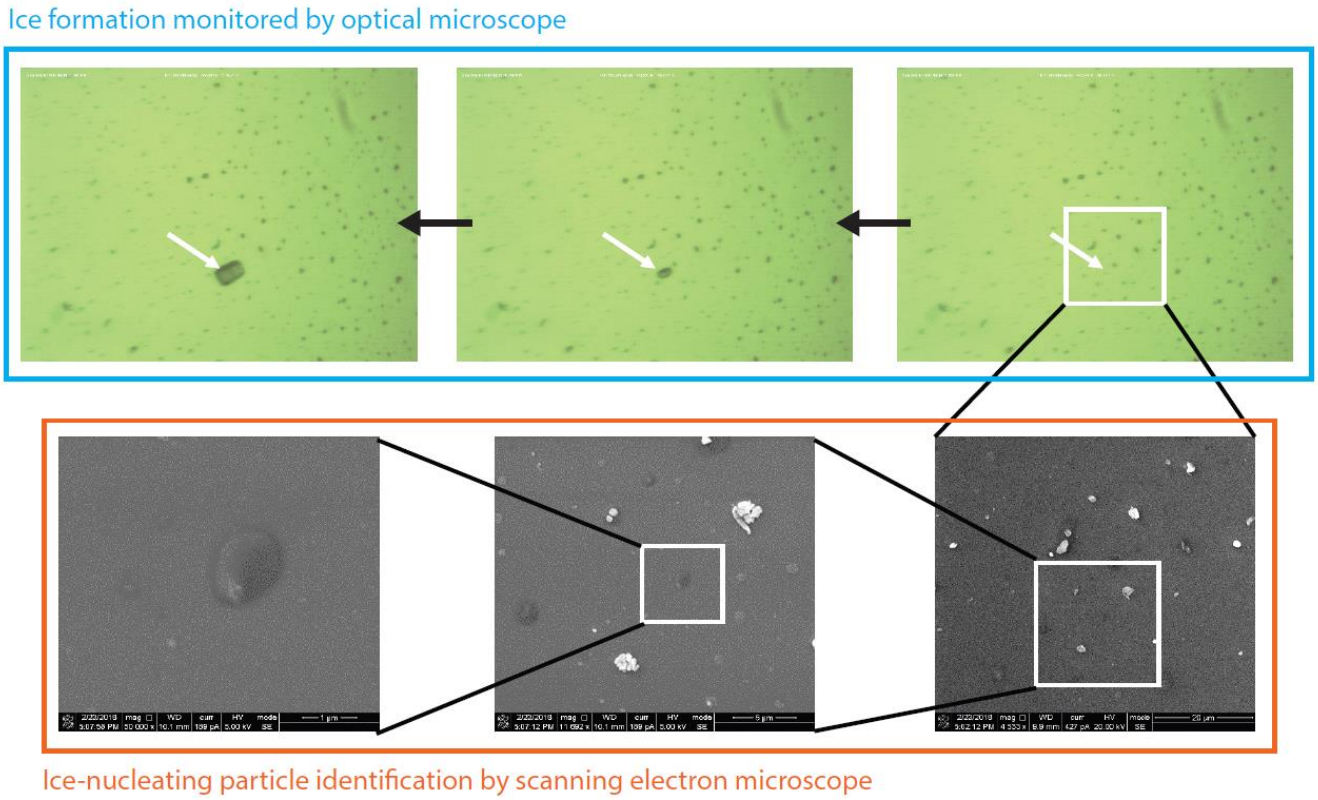
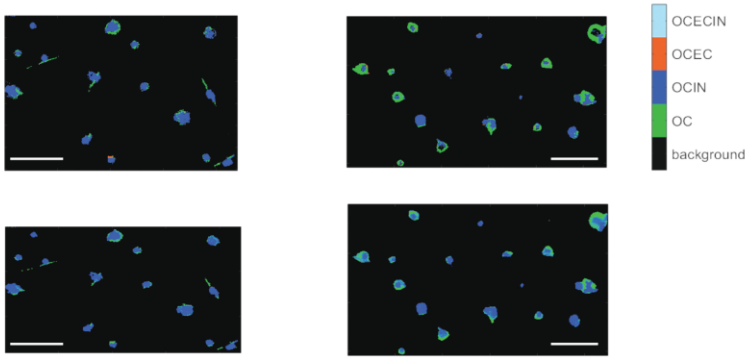
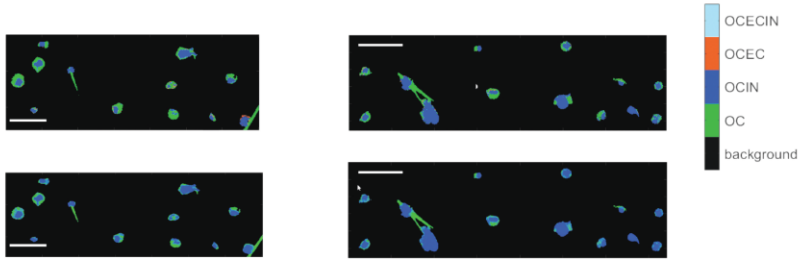


Figure S3: Process of ice-nucleating particle (INP) identification using multi-model instrument approach following Knopf et al. (2014).

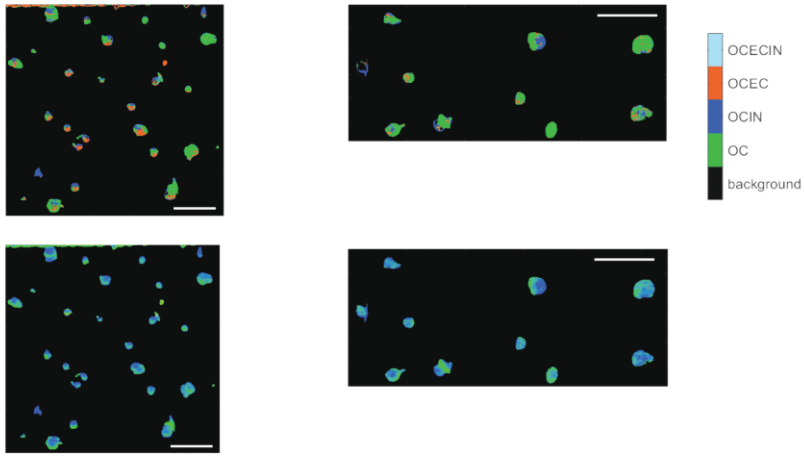
Day 1



Day 2



Night 1



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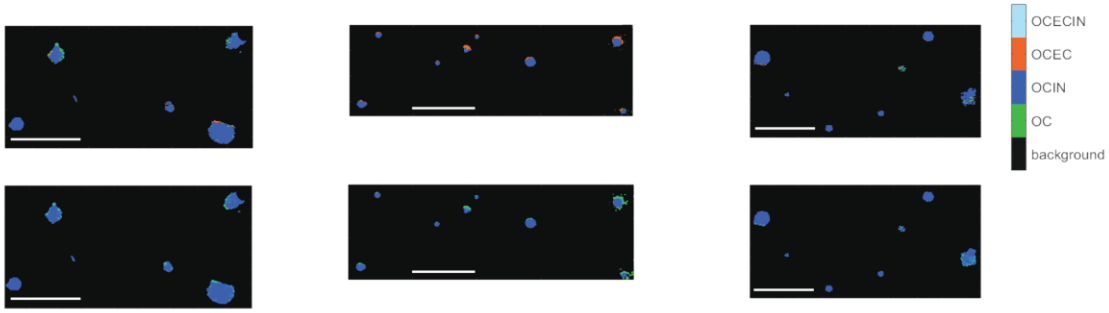
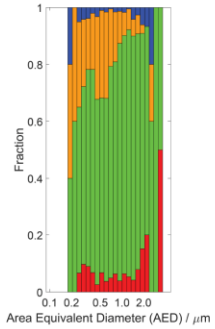
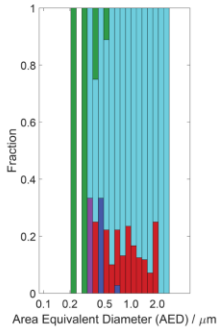


Figure S4: Representative false color particle maps derived by STXM/NEXAFS for the daytime and nighttime samples. The upper panels for each sample provide particle population mixing state where IN - inorganic, EC - elemental carbon, OC - organic carbon. The corresponding lower panels indicate the range in organic volume fraction (OVF) per particle, where organic dominated particles are in green (organic mass is > 80%) and inorganic dominated particles are blue (inorganic mass is > 80%). Scale bar indicates 5 µm.

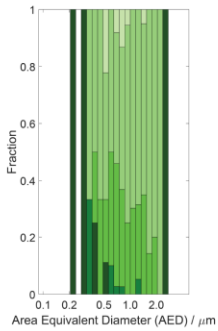
Day 1 SEM - Cluster



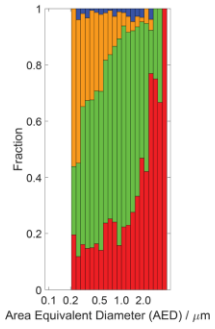
STXM - Mixing State

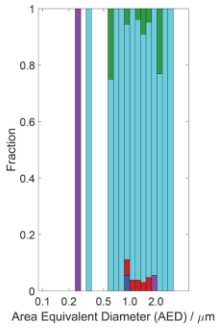


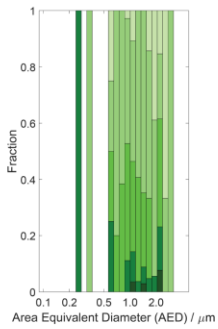
STXM - Organic Volume Fraction



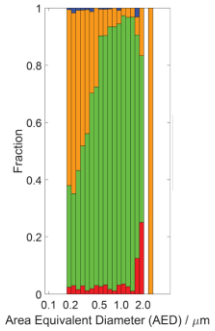
Day 2

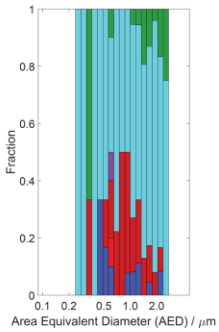


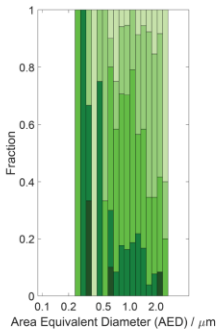




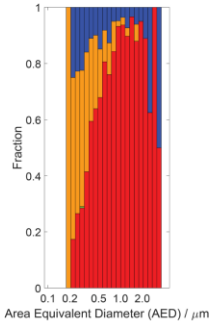
Night 1

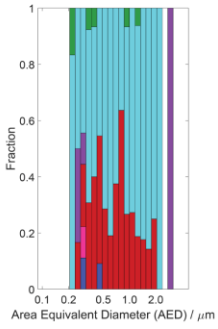


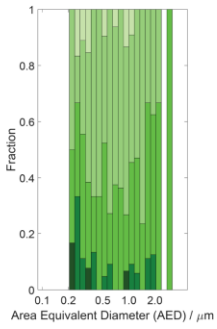




Night 2







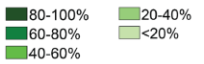


Figure S5: Size-resolved fractional particle composition for particle samples determined by micro-spectroscopic single-particle analysis as a function of area equivalent diameter (AED). From left to right: first column: CCSEM/EDX derived particle-type classes as 'processed sea salt with mineral dust and organic matter', 'sea salt', 'processed sea salt with mineral dust' and 'organic matter with chlorine'. Second column: STXM/NEXAFS derived particle mixing state: IN - inorganic, EC - elemental carbon, OC - organic carbon. Third column: organic volume fraction (OVF).

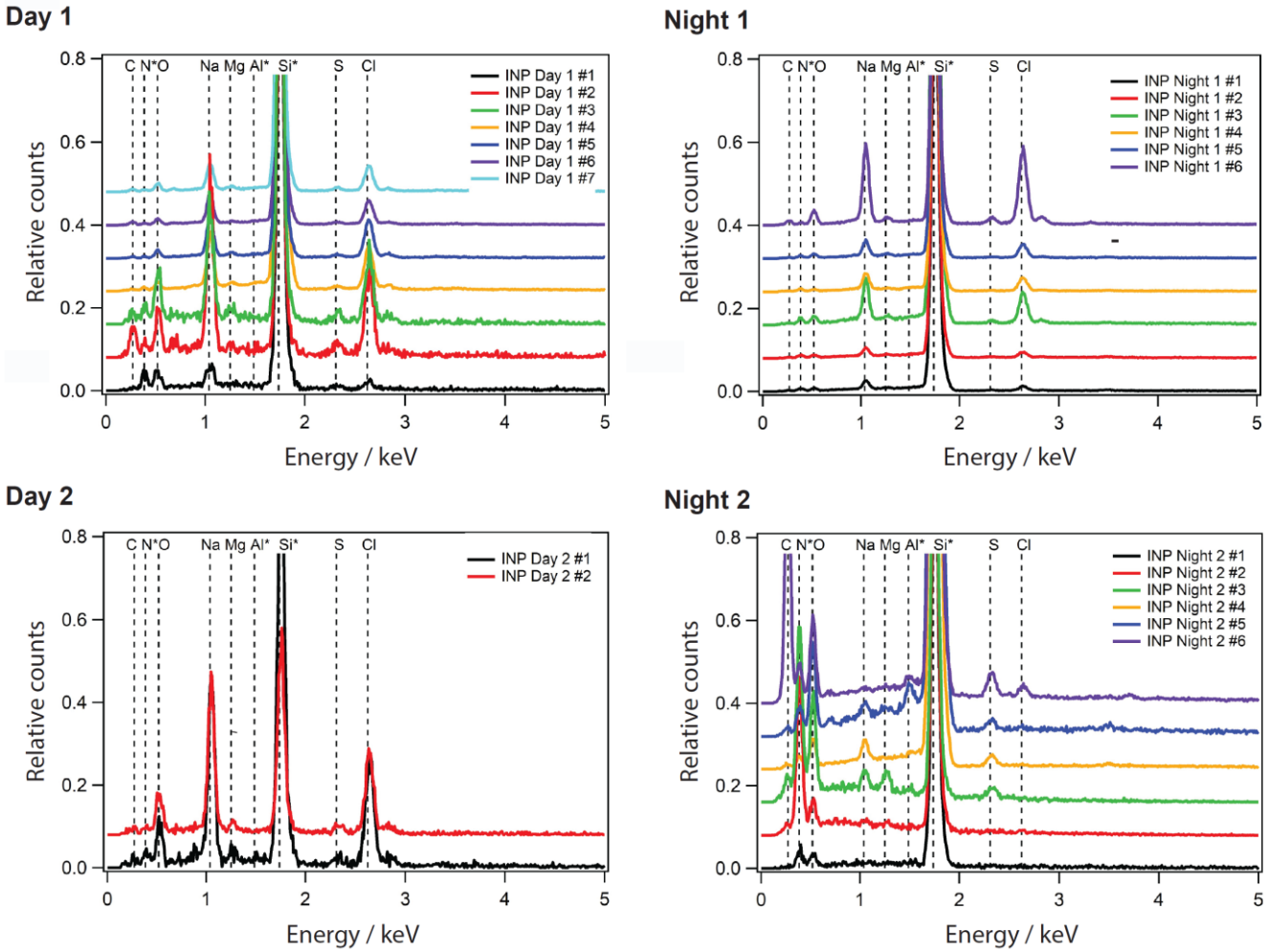


Figure S6: EDX spectra of identified INPs present in daytime and nighttime samples given in Fig. 6 and Table 3. *corresponds to the signal from the substrate (Si_3N_4 coated silicon wafer chips) and the chamber/holder (Al).

References

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