

Proceeding Paper

Online Ice-Nucleating Particle Measurements in the Southern Great Plains (SGP) Using the Portable Ice Nucleation Experiment (PINE) Chamber [†]

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Abstract: We present our field results of ice-nucleating particle (INP) measurements from the commercialized version of the Portable Ice Nucleation Experiment (PINE) chamber from two different campaigns. Our first field campaign, TxTEST, was conducted at West Texas A&M University (July–August 2019), and the other campaign, ExINP-SGP, was held at the Atmospheric Radiation Measurement (ARM) Southern Great Plains (SGP) site (October–November 2019). In both campaigns, the PINE made semi-autonomous INP measurements at a high-time-resolution of 8 min for individual expansions with continuous temperature scans from –5 to –35 °C in 90 min. The PINE instrument was set to have a minimum detection capability of ~0.3 INPs per liter of air. To complement our online PINE measurements, polycarbonate filter impactor and liquid impinger samples were also collected next to the PINE. Offline droplet-freezing assays were later conducted from the filter and impinger samples for the immersion freezing mode. Our preliminary results suggested that the immersion freezing mode was the dominant ice-nucleation mechanism at the SGP site compared to the deposition mode. We did not find any statistical correlation between cloud condensation nuclei (CCN) and INP concentration during our ExINP-SGP period, suggesting that CCN activation is not a significant prerequisite for ice nucleation at the SGP site. In addition, we analyzed the relationship between various aerosol particle size ranges and INP abundance. At SGP, we found an increase in INPs with the super-micron particles, especially for diameters >2 µm across the entire heterogeneous freezing temperature range examined by PINE. Lastly, we computed a variety of INP parameters, such as, ice nucleation active surface site density, water activity-based freezing, and cumulative INP per liter of air, representing the ambient INPs in the SGP. Our field campaign results demonstrated the PINE’s ability to make remote INP measurements, promising future long-term operations including at isolated locations.

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Supplementary Materials: The following are available online at <https://www.mdpi.com/article/10.3390/ecas2020-08469/s1>.