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EPCAPE – Proton Transfer Reaction Mass Spectrometer Field Campaign Report

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Acronyms and Abbreviations

ARM	Atmospheric Radiation Measurement
EPCAPE	Eastern Pacific Cloud Aerosol Precipitation Experiment
EPCAPE-PTRMS	EPCAPE – Proton Transfer Reaction Mass Spectrometer campaign
EPCAPE-UPP	EPCAPE – Ultrafine Particle Properties campaign
PTR-ToF-MS	proton transfer reaction time-of-flight mass spectrometer
VOC	volatile organic compound

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1.0 Summary

The Eastern Pacific Cloud Aerosol Precipitation Experiment – Proton Transfer Reaction Mass Spectrometer (EPCAPE-PTRMS) campaign was created in response to the urgent need expressed by EPCAPE co-investigators for measurements of volatile organic compounds (VOCs) during the EPCAPE intensive operational period. A proton transfer reaction time-of-flight mass spectrometer (PTR-ToF-MS, model 8000, Ionicon Analytik) was deployed to Mt. Soledad, San Diego, California, on 15 May 2023 for the measurement of VOCs. The instrument was installed in the same Atmospheric Radiation Measurement (ARM) user facility guest container that the Smith group used for the EPCAPE – Ultrafine Particle Properties (EPCAPE-UPP) campaign. The Smith group provided the sample inlet and operated and maintained the instrument. A complete VOC mass spectrum was recorded every 10 sec, continuously. Calibrations using a traceable VOC mixture were performed onsite at the end of the campaign. Measurements ended on 15 June 2023.

The campaign generated raw and processed data of high-resolution mass spectra. One-minute-averaged data will be archived in the ARM Data Center, but one-second data is available from the principal investigator by request.

2.0 Results

2.1 Setup and Operation

Ambient air was sampled via a ¼-inch unheated Teflon line approximately 3 m in length spanning from the instrument to the handrail on the roof of the guest instrument container. A fine mesh covered the inlet to prevent insect intrusion and a water trap was located inside the container to protect the instrument from water condensation. On May 30 an unexpected site-wide power outage lasted several minutes and exceeded the timespan of our uninterruptible power supply. When power was restored, the PTRMS ran erratically for several days as a result of various hardware problems until June 2. There appears to be a one-day interval around May 31 when things were running well, but in general that period is characterized by lack of data and data spikes.

2.2 Data Analysis

Real-time analysis of the concentration of VOCs was performed using a PTRMS. Samples were collected continuously, with spectra being taken every second. Data analysis involved assigning detected mass-to-charge (m/z) peaks to specific compounds. PTRMS-Viewer, software that was provided by the instrument manufacturer, was used to do this. The software compared peaks present in the sample to the theoretical mass-to-charge ratios of various compounds. This, plus an examination of the isotope ratios of suspected compounds, allowed for peak identification. The concentration of identified VOCs in the atmosphere was then calculated, using standard analysis procedure (Taipale et al. 2008). Quantification was confirmed by performing measurements of a multicomponent VOC standard directly before and after the campaign (Apel-Riemer Environmental Inc., Miami, Florida, USA).

2.3 Results

In total, we identified and quantified 60 different VOCs during the measurement period. This has allowed us to explore differences in atmospheric composition between in-cloud and out-of-cloud periods. Table 1 shows some of the detected VOCs that were observed at higher concentrations during cloudy periods. Measurements such as these will provide important details on the impact of cloud events on atmospheric composition. Figure 1 shows representative time series of benzene (C_6H_6), and acetaldehyde (C_2H_4O).

Table 1. Average concentration of detected VOCs during cloudy periods compare to non-cloudy periods.

VOC	C(in-cloud) [ppb]	C(out-of-cloud) [ppb]
C_4H_8O	0.3	0.22
C_3H_6	0.41	0.38
C_3H_6O	1.87	1.48
C_6H_6	0.087	0.067
C_7H_8	0.106	0.067

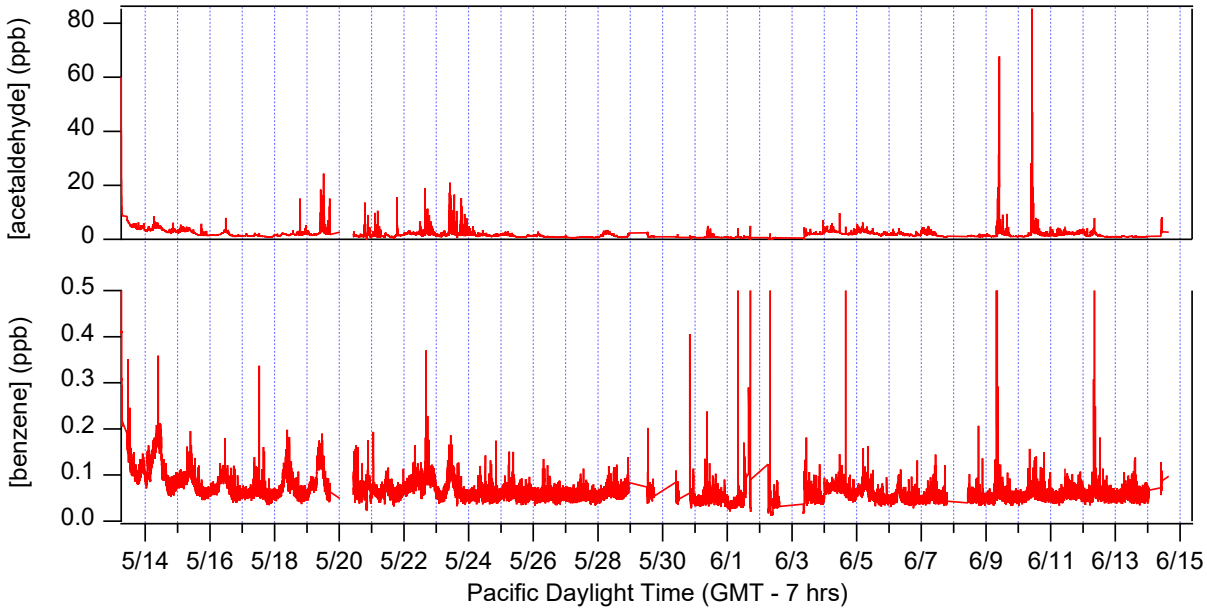

Figure 1. Time series of the mixing ratio of acetaldehyde, benzene (C_6H_6).

3.0 Publications and References

3.1 Presentations

Kapp, A, PS Bauer, M Dam, AE Thomas, J Wakeen, and JN Smith. 2024 "Marine and Anthropogenic Effects on Ultrafine Aerosol Composition during the Eastern Pacific Cloud Aerosol Precipitation Experiment." Presented at the Annual Meeting of the American Association for Aerosol Research. Albuquerque, New Mexico.

3.2 References

Taipale, R, TM Ruuskanen, J Rinne, MK Kajos, H Hakola, T Pohja, and M Kulmala. 2008. "Technical Note: Quantitative long-term measurements of VOC concentrations by PTR-MS – measurement, calibration, and volume mixing ratio calculation methods." *Atmospheric Chemistry and Physics* 8(22): 6681–6698, https://doi.org/10.5194/acp-8-6681-2008

4.0 Lessons Learned

We would like to acknowledge the hard work of the ARM site support staff for a smooth campaign. We would especially like to express our appreciation to Daniel for going above and beyond to help us.

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