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EPCAPE Pier Filters Field Campaign Report

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Acronyms and Abbreviations

ACSM	aerosol chemical speciation monitor
ARM	Atmospheric Radiation Measurement
ASR	Atmospheric System Research
CE	collection efficiency
EPCAPE	Eastern Pacific Cloud Aerosol Precipitation Experiment
FAIR	Findable, Accessible, Interoperable, and Reusable
FTIR	Fourier transform infrared spectroscopy
LPM	liters per minute
PST	Pacific Standard Time
XRF	X-ray fluorescence spectrometry

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1.0 Summary

The focus of the Eastern Pacific Cloud Aerosol Precipitation Experiment (EPCAPE) is to characterize the extent, radiative properties, aerosol interactions, and precipitation characteristics of stratocumulus clouds in the Eastern Pacific across all four seasons at a coastal location, the Scripps Pier and the Scripps Mt. Soledad sites in La Jolla, California. An important enhancement to this study will be the collection of simultaneous in-cloud aerosol and droplet measurements to investigate the differences in these cloud properties during regional polluted and clean marine conditions.

A focus of EPCAPE is characterizing the annual changes in aerosol composition and sources, and weekly filters were proposed to provide trace organic groups for source identification for 12 months during the campaign. With U.S. Department of Energy Atmospheric System Research (ASR) support and Atmospheric Radiation Measurement (ARM) user facility approval, daily filters were collected to enhance the time resolution. All filters collected were analyzed by Fourier transform infrared spectroscopy (FTIR), and two filters per week were submitted for X-ray fluorescence spectrometry (XRF) analyses. These results are posted as a principal investigator product to a Findable, Accessible, Interoperable, and Reusable (FAIR)-compliant archive (https://library.ucsd.edu/dc/collection/bb0898306q; https://library.ucsd.edu/dc/object/bb8578550m). The filters are stored frozen for other potential analyses. The results have been used to identify refractory chemical components, chemical tracers, and other events as part of publications now in preparation.

2.0 Results

During EPCAPE, filter samples were collected daily at Scripps Pier from 1900 to 1800 PST (local time) using an inlet situated approximately 14 m above mean sea level on 37 mm Teflon filters (Pall Corp., Ann Arbor, Michigan). These filters were positioned downstream of a 1-mm sharp-cut cyclone (SCC 2.229 PM1, BGI Inc., Waltham, Massachusetts) within the same container as the Aerosol Observing System on the Scripps Pier. Each filter set maintained a flow rate of approximately 10 LPM using a single flow meter and flow controller (Alicat Scientific, Tucson, Arizona). Samples were transported back to the laboratory and kept frozen in air-tight bags during storage (Russell et al. 2009, Day et al. 2010).

All 365 filters were analyzed by FTIR for organic functional groups (Figure 1). Concentrations are reported for filters with three or more organic functional groups above detection limit, based on standard deviation and minimum observable peak, no instrument maintenance issues, and above a 3 m^3 sampling volume threshold (Maria et al. 2003, Gilardoni et al. 2007, Russell et al. 2009). Hydrates were present in filters between October and January and were removed by dehydration (Frossard et al. 2014).

A subset of 104 of the filters collected (Figure 2) were sent to Chester Labnet (Tigard, Oregon) for XRF analysis providing concentrations of elements, including Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Br, Rb, Sr, Zr, Ag, Pb, and Ba (Maria et al. 2003, Gilardoni et al. 2007, Russell et al. 2009). Sea salt particle concentrations were determined as XRF Na ($\mu g/m^3$)×1.47 + XRF Cl ($\mu g/m^3$) (Bates et al. 2012, Frossard et al. 2014, Quinn et al. 2019, Saliba et al. 2020). The mass of dust was calculated from XRF metal concentrations, assuming dust consists of $MgCO_3$, Al_2O_3, SiO_2, K_2O, $CaCO_3$, TiO_2, Fe_2O_3, MnO, and BaO after excluding the mass associated with sea salt (Usher et al. 2003, Liu et al. 2018).

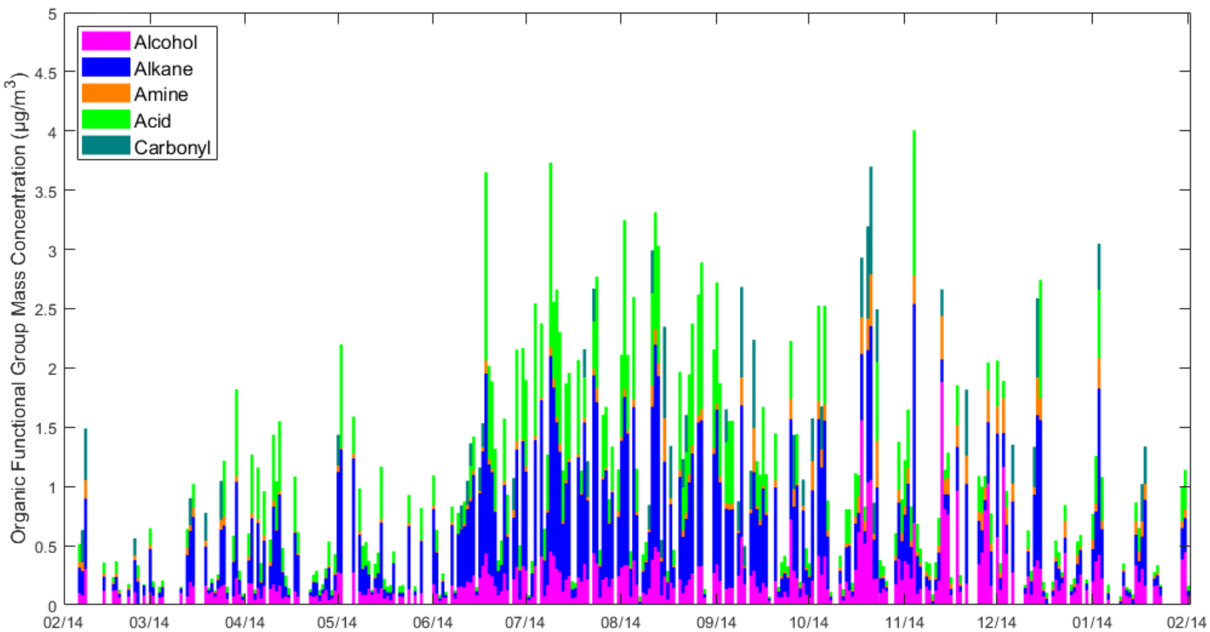

Figure 1. Time series of 23-hour FTIR non-volatile organic functional groups mass concentration for <1 µm filters at Scripps Pier during EPCAPE.

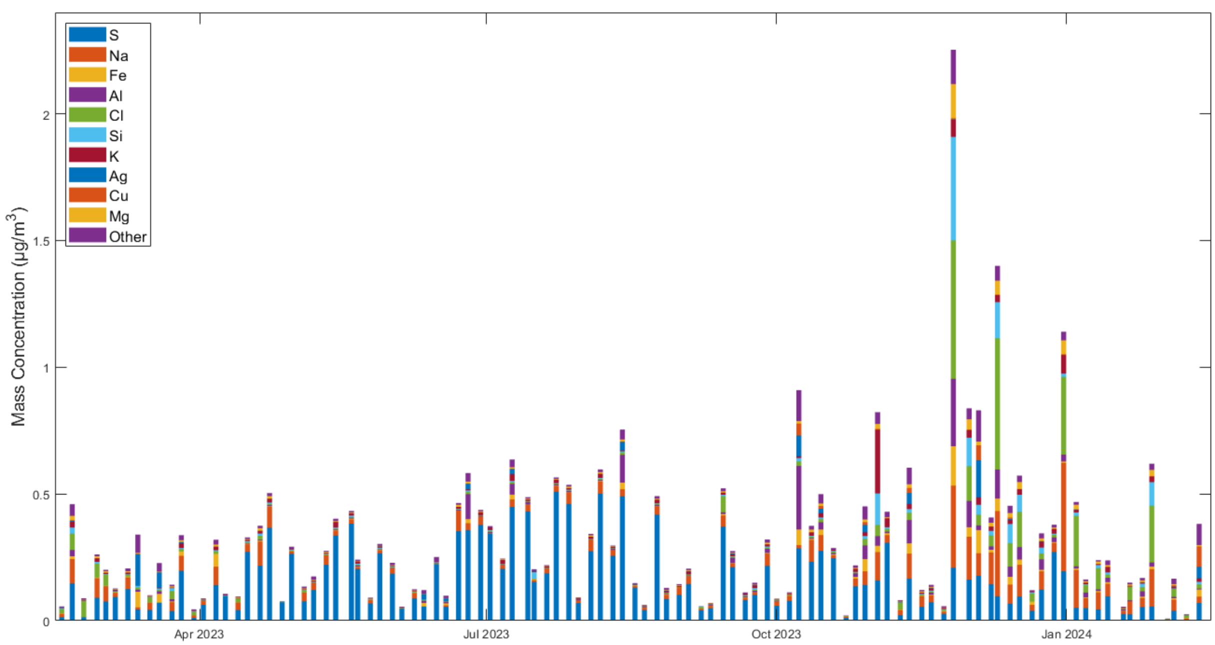

Figure 2. Time series of 23-hour XRF elemental mass concentration for <1 µm filters at Scripps Pier.

The organic and elemental concentrations from FTIR and XRF have already been used to calculate the refractory components of the submicron composition at Scripps Pier, including the dust and sea salt. This calculation has supported the evaluation of the collection efficiency (CE) of the aerosol chemical speciation monitor (ACSM) as well as of the composition-based hygroscopicity ("kappa") of particles.

3.0 Publications and References

3.1 Published Data Sets

Maneenoi, N, C Pelayo, and LM Russell. 2024. Filter Organic and Elemental Composition of Submicron Aerosol Particles and Particle Number Concentration at Scripps Pier during EPCAPE 2023-24 . In Aerosol Microphysics and Chemical Measurements at Mt. Soledad and Scripps Pier during the Eastern Pacific Cloud Aerosol Precipitation Experiment (EPCAPE) from February 2023 to February 2024. University of California, San Diego Library Digital Collections. https://doi.org/10.6075/J03778XV

Russell, LM, S Han, AS Williams, V Berta, JL Dedrick, C Pelayo, N Maneenoi, M Petters, E Ravichandran, R Chang, A Kapp, JN Smith, M Wheeler, J Wentzell, and J Liggio. 2023. Aerosol Microphysics and Chemical Measurements at Mt. Soledad and Scripps Pier during the Eastern Pacific Cloud Aerosol Precipitation Experiment (EPCAPE) from February 2023 to February 2024. University of California, San Diego Library Digital Collections. https://doi.org/10.6075/J0NG4QT4

3.2 Conference Presentations

Han, S, A Williams, V Berta, JL Dedrick, C Pelayo, N Maneenoi, and L Russell. 2023. "Aerosol Organic and Inorganic Composition on Sunny and Cloudy Days during EPCAPE." Presented at the American Association for Aerosol Research Annual Meeting. Portland, Oregon. Status = PUBLISHED; Acknowledgement of FederalSupport = Yes

Maneenoi, N, LM Russell, C Pelayo, and AJ Sedlacek. 2023. "Correlation between Black Carbon and Aerosol Organic Functional Groups from Primary Vehicle Emissions in Coastal Regions during EPCAPE." Presented at the American Geophysical Union Annual Meeting. San Francisco, California. Status = PUBLISHED; Acknowledgement of Federal Support= Yes

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Maria, SF, LM Russell, BJ Turpin, and RJ Porcja. 2002. "FTIR measurements of functional groups and organic mass in aerosol samples over the Caribbean." *Atmospheric Environment* 36(33): 5185–5196, https://doi.org/10.1016/A1352-2310(02)00654-4

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4.0 Lessons Learned

ARM support for this campaign was excellent. There was good communication to address and document the minor maintenance issues that occurred, and support from technical staff was always available.

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