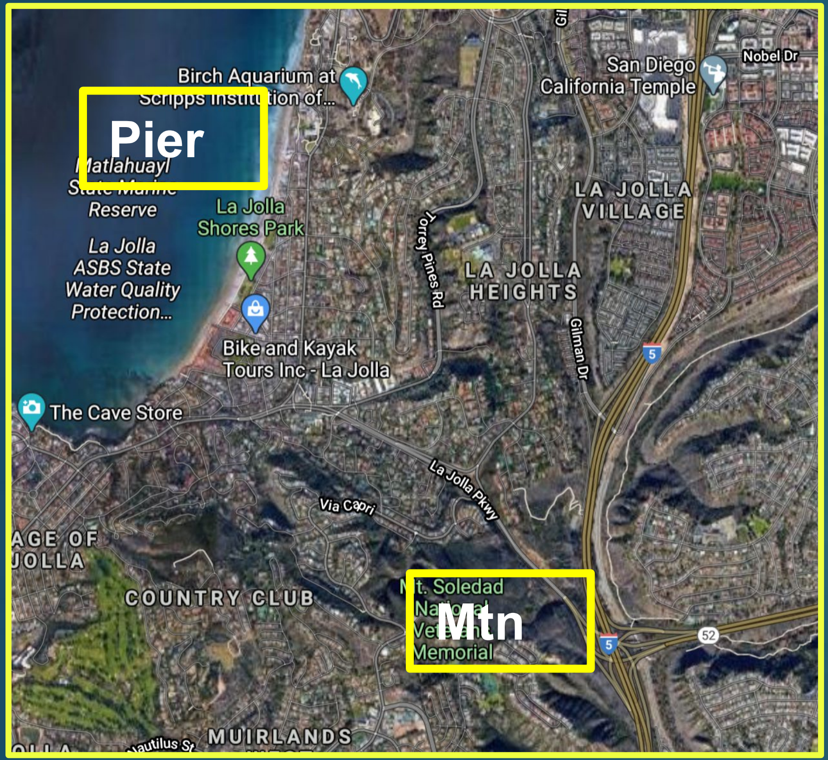
https://www.arm.gov/research/campaigns/amf2

EPCAPE



Eastern Pacific Cloud Aerosol Precipitation Experiment
DOE ARM AMF1 Deployment: February 2023 - February 2024
La Jolla, California: Scripps Pier and Mt. Soledad
Lead Scientist Lynn Russell: lmrussell@ucsd.edu

SUMMARY – Breakout Session 2: EPCAPE
24 October 2022

Interesting history of stratus observations at La Jolla 1923-2021.

Mt. Soledad droplet, residual, and vapor measurements (EnvCanada & Dalhousie).

Mt. Soledad aerosol measurements (NCSU, UCLA, UCI, UCSD).

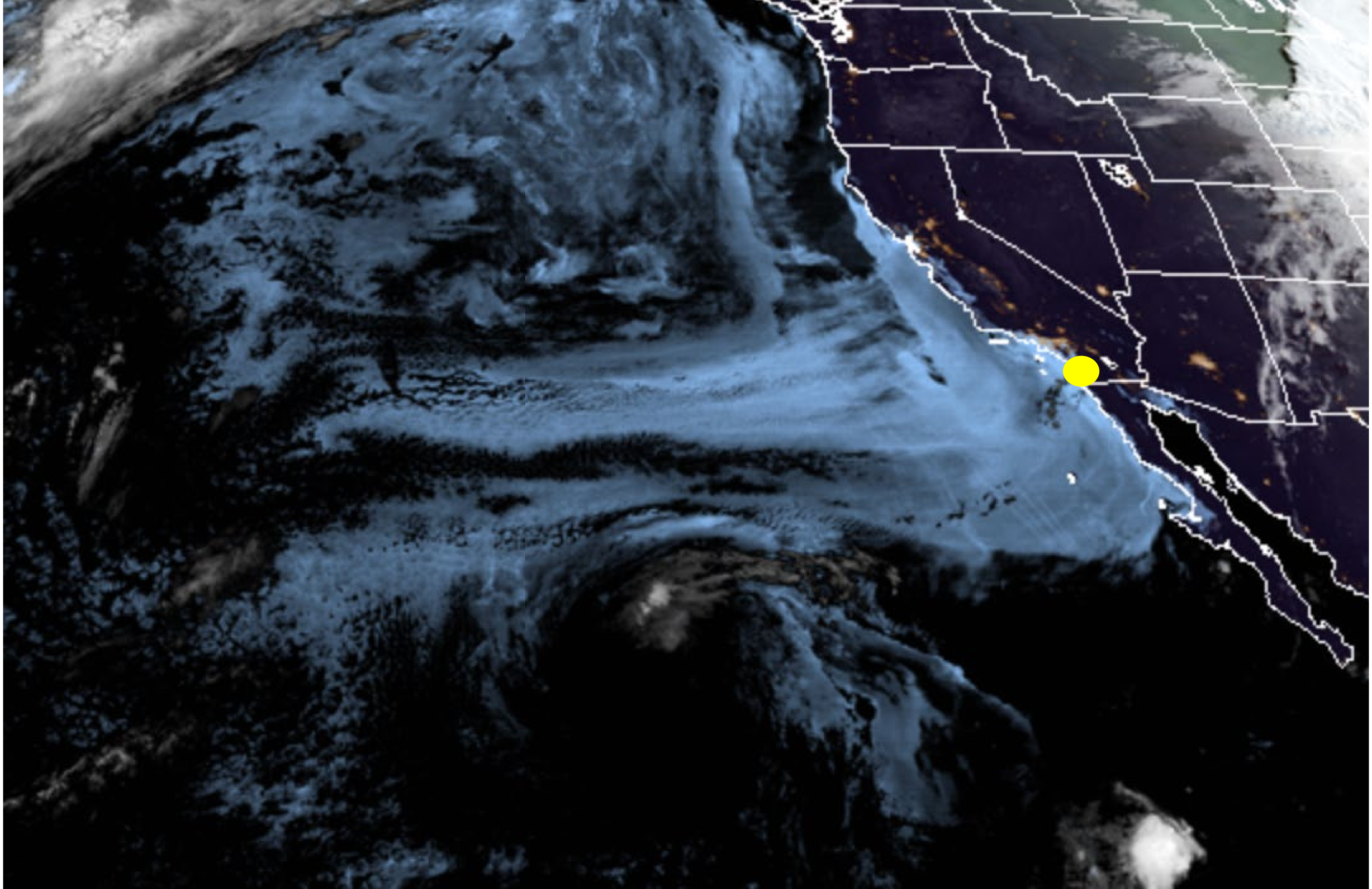
Mt. Soledad CL^2EAAN deployment of aerosol and residual measurements (LANL).

CIRPAS Twin Otter SCILLA deployment in June offshore/upwind (NPS, UCR, Clemson).

ARM VAPs for EPCAPE will be available and upgraded by Translator team.

Modeling opportunities for EPCAPE:

- Multi-scale simultaneous modeling possibilities for clouds and aerosols.
- Expanded instrument records, less turbulent interference than MASRAD.
- LES studies targeting drizzle and drizzle formation.
- Since no DOE airborne studies, no forecasting or modeling is supported yet.
- RFP needed for processing and interpretation of measurements to support modeling.



CVI and Isokinetic Inlet at Mt. Soledad

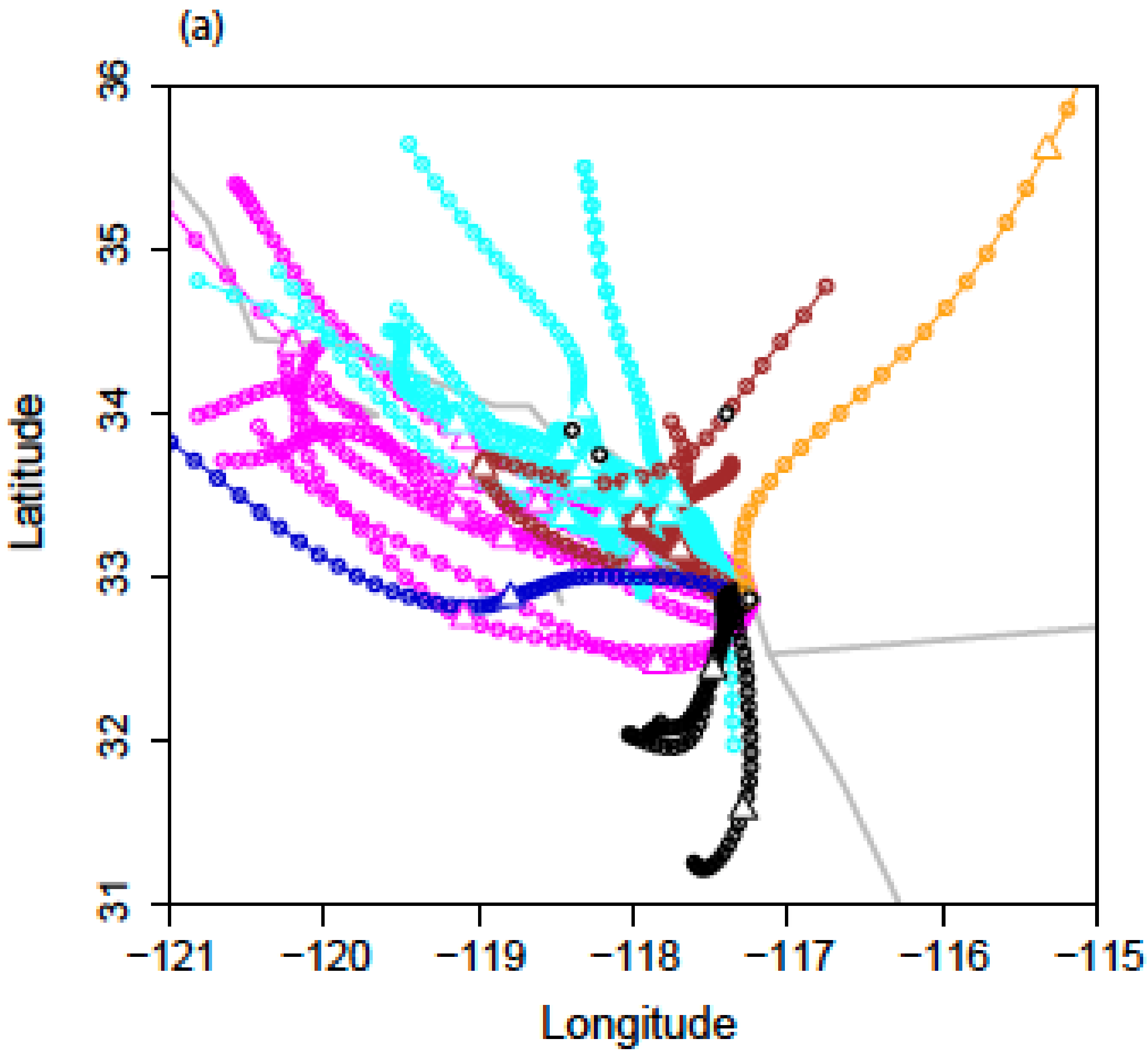
Instrument	Contact	Description	Inlet
Brechtel Counterflow Virtual Impactor (CVI)	Wheeler	Evaporates cloud droplets and provides residual particles to other instruments	N/A
Brechtel Differential Mobility Analyzer (DMA)	Russell	Number distribution of particles (0.02-0.9 um)	Switched
*DMT Cloud Condensation Nuclei (CCN) Counter	Petters	CCN number concentration and supersaturation spectra of particles for 0.07-0.6% supersaturation	Switched
Mini Handix CCN (5)	Petters	CCN number concentration and supersaturation spectra of particles for 0.1-1% supersaturation	Both
Printed Optical Particle Spectrometer (POPS)	Petters	Aerosol number distribution (0.15-3 um)	Switched
TSI Aerodynamic Particle Sizer (APS)	Russell	Number distribution of particles (0.5-10 um)	Isokinetic
Aerodyne High-Resolution Aerosol Mass Spectrometer (HR-AMS) with Event Trigger (ET)	Russell	NR organic, sulfate, nitrate, chloride, ammonium mass fragment concentrations (0.07-0.8 um) every 5 min	Switched
DMT Single-Particle Soot Photometer (SP2)	Wheeler	BC mass and number distribution (0.08-1 um)	Switched
Aerodyne Iodide Chemical Ionization Mass Spectrometer (CIMS)	Liggio	Gas-phase compounds	Switched
Fog Droplet Monitor	Chang	Number size distribution of fog (cloud) droplets	N/A
DMT Photoacoustic Extinctiometer (PAX)	Lee	BC concentration, aerosol light scattering and absorption coefficients	Switched
*Direct-to-Liquid Cloud Droplet OH Burst (DtL-OH)	Paulson	Hydroxyl radical formation by particles using direct-to-liquid sampling and fluorescence	Switched
*Filters for transition metals and OH burst	Paulson	Soluble metals by ICPMS and OH burst	Switched
Filters for FTIR and XRF	Russell	Organic functional group and element concentrations	Both

TDCIMS, UHPLC-HRMS) Smith Chemical composition of ultrafine particles

H/VTDMA Smith Ultrafine particle hygroscopicity and volatility

Where does our air come from?

In August-September (2009), most trajectories to Scripps pier were associated with northwesterlies, many of which passed near the ports of Los Angeles and Long Beach.



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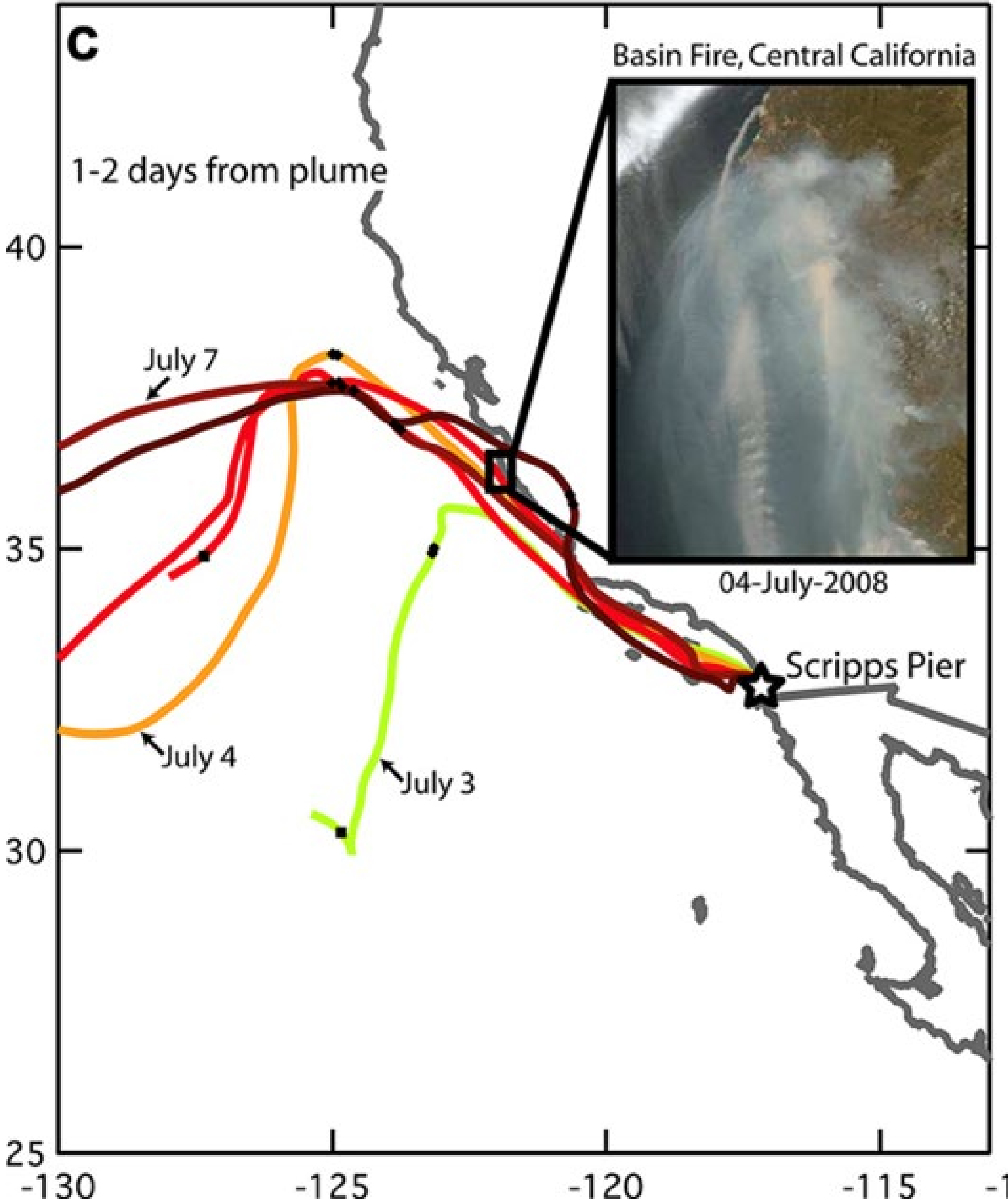
Liu, S., Day, D. A., Shields, J. E., & **Russell**, L. M. (2011). Ozone-driven daytime formation of secondary organic aerosol containing carboxylic acid groups and alkane groups. *Atmospheric Chemistry and Physics*, *11*(16), 8321–8341. https://doi.org/10.5194/acp-11-8321-2011

What about sources further North?

Multi-day transport in July 2008 carried aerosol particles from the northern California coast. Measurements at the pier provided detailed characterization of the aerosol.

Wildfires provide extreme events with visible satellite signatures.



Hawkins, L. N., & **Russell**, L. M. (2010). Oxidation of ketone groups in transported biomass burning aerosol from the 2008 Northern California Lightning Series fires. *Atmospheric Environment*, *44*(34), 4142–4154. https://doi.org/10.1016/j.atmosenv.2010.07.036

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UCSD

EPCAPE

Eastern Pacific Cloud Aerosol Precipitation Experiment

ARM
CLIMATE RESEARCH FACILITY

Lead Scientist: Lynn Russell
Questions? lmrussell@ucsd.edu

Logo by Jeep Maneenoi
(1st-year CS PhD Student)

EXTRA SLIDES

Aerosols!

Large dynamic range of aerosol sources, including frequent transport from LA/LB ports after 12-24 hr transit over ocean, provides a variety of aerosol conditions for investigating aerosol cloud interactions.

Mt. Soledad (at ~250m above sea level) provides the ability to capture different aspects of aerosol and cloud sampling.

Breakout Session 2: EPCAPE
24 October 2022

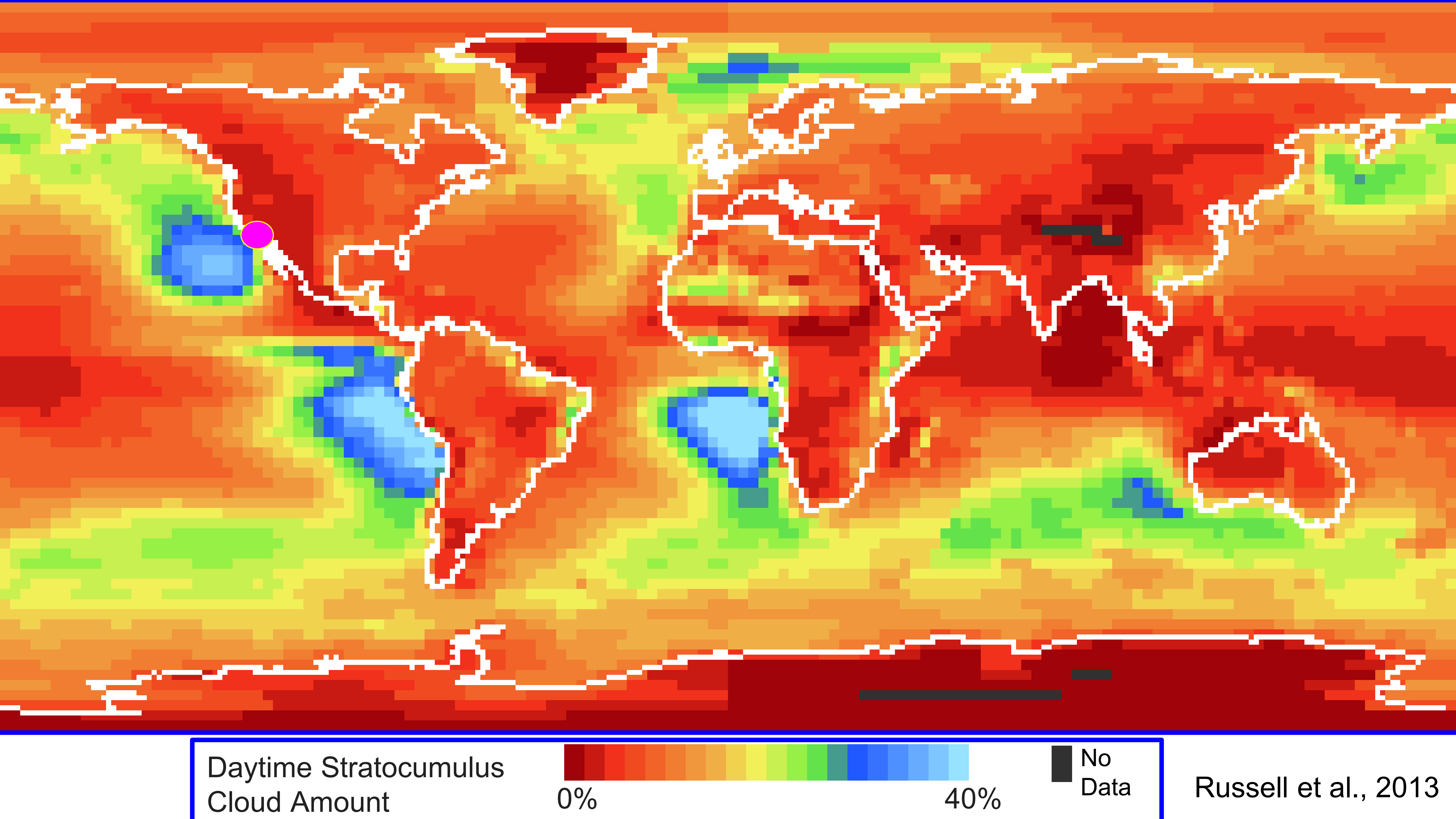
<u>Agenda</u>

4:00	Lynn Russell	Introduction to EPCAPE and Agenda
4:05	Dan Lubin	ARM Cloud and Radiation at EPCAPE (ARM, SIO)
4:15	John Liggio	Mt. Soledad Droplet Measurements (ECCCanada and Dalhousie)
4:25	Markus Petters	Mt. Soledad Aerosol Measurements (NCSU, UCLA, SIO)
4:35	Katie Benedict	Mt. Soledad Aerosol Absorption Measurements (LANL, UCD)
4:45	Mikael Witte	SCILLA Twin Otter Measurements (NPS, UCR, UNM)
4:55	Shaocheng Xie	ARM Translator Products for EPCAPE
5:05	Israel Silber, Mark Miller	Questions and Related Discussions for Intercomparisons and Modeling

EPCAPE Co-Investigators

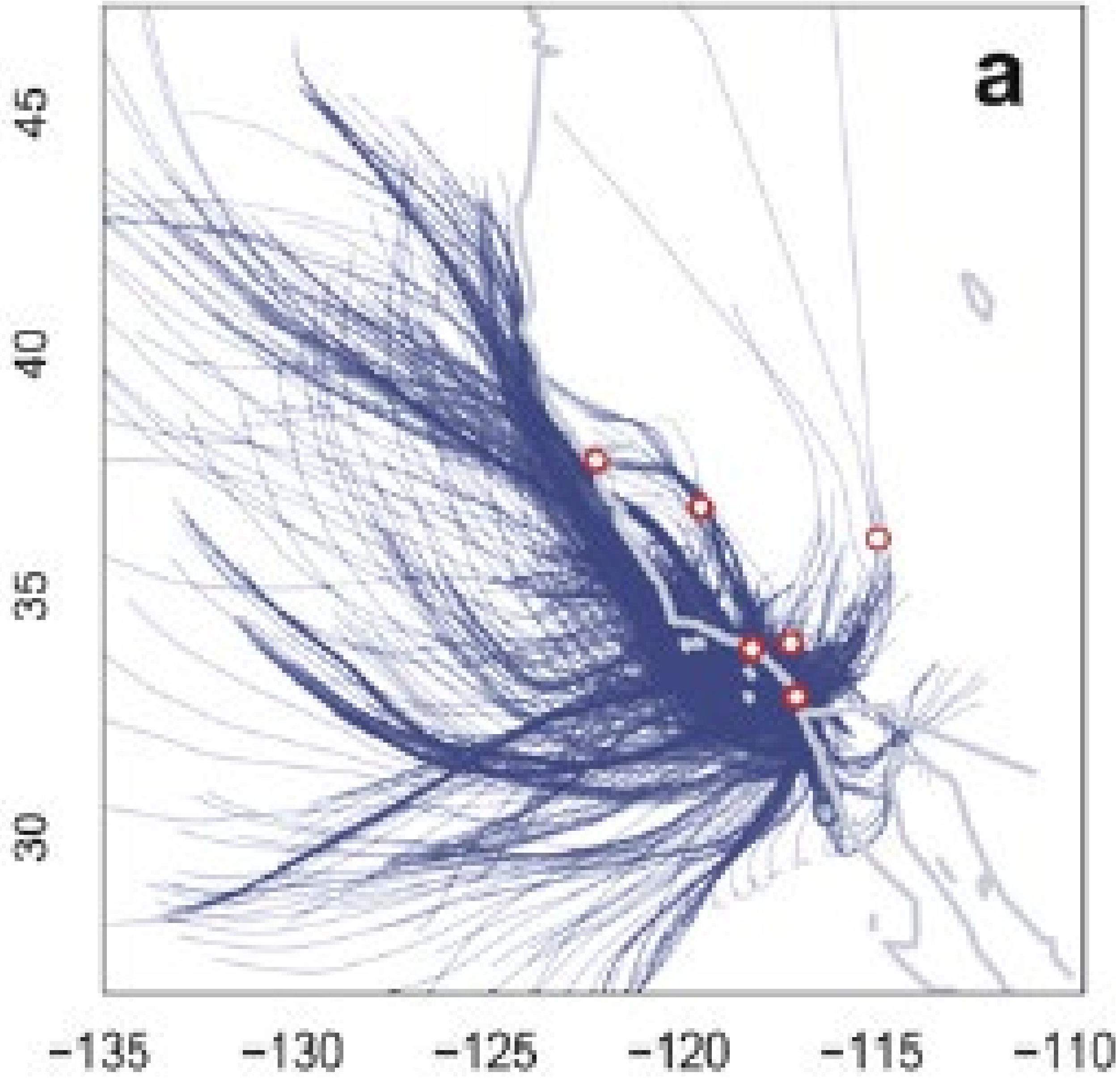
Dan Lubin, Scripps Institution of Oceanography, UCSD
Israel Silber, Pennsylvania State University
Ed Eloranta, University of Wisconsin
Johannes Muelmenstaedt, Pacific Northwest National Laboratory
Susannah Burrows, Pacific Northwest National Laboratory
Allison Aiken, Los Alamos National Laboratory
Die Wang, Brookhaven National Laboratory
Markus Petters, North Carolina State University
Mark Miller, Rutgers University
Andy Ackerman, Goddard Institute of Space Studies
Ann Fridlind, Goddard Institute of Space Studies
Mikael Witte, NPS
Matt Lebsock, JPL/UCLA
David Painemal, Langley Research Center
Rachel Chang, Dalhousie University
John Liggio, Environment and Climate Canada
Michael Wheeler, Environment and Climate Canada

Abigail Williams
Jeep Maneenoi
Amita Stowitts
Christian Pelayo
Jeramy Dedrick
Sourita Saha


Daytime Stratocumulus Cloud Amount
0%
40%
No Data
Russell et al., 2013

What about winds from the East?

In February-March (2009), Scripps pier received frequent air masses from the eastern LA basin (Riverside).



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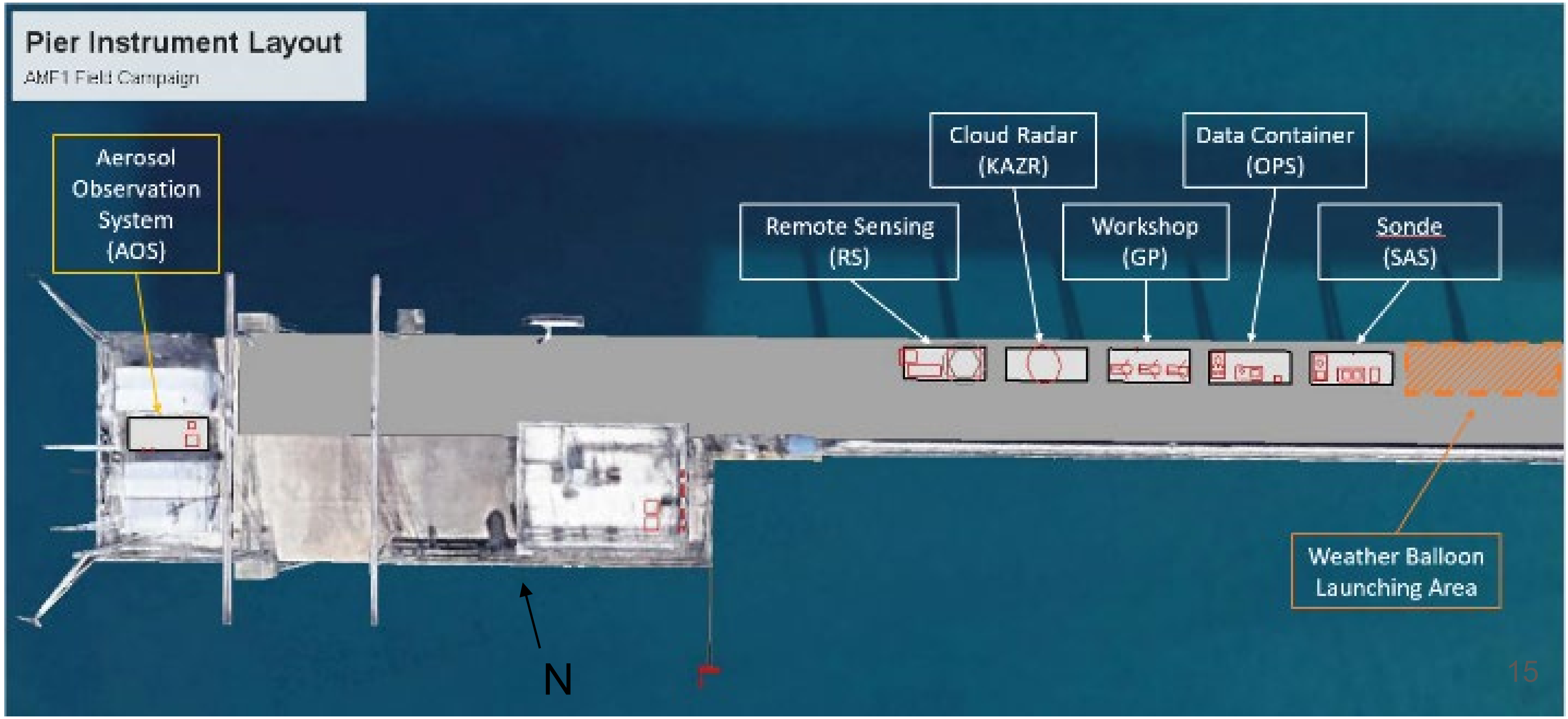
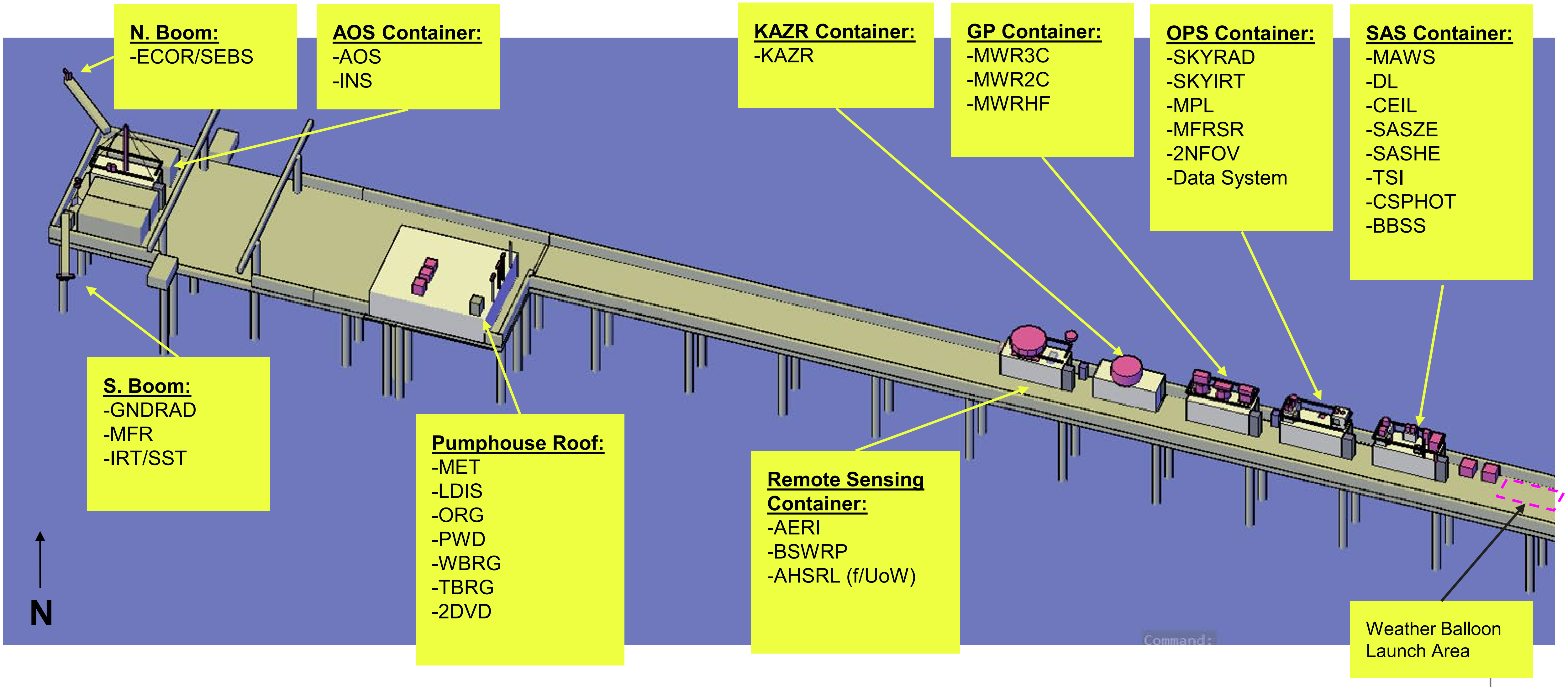
Scripps Pier Measurements

- Scripps Oceanography Research Pier
- Main site for AMF1 facility and Balloon launches
- Shared resource, limited footprint

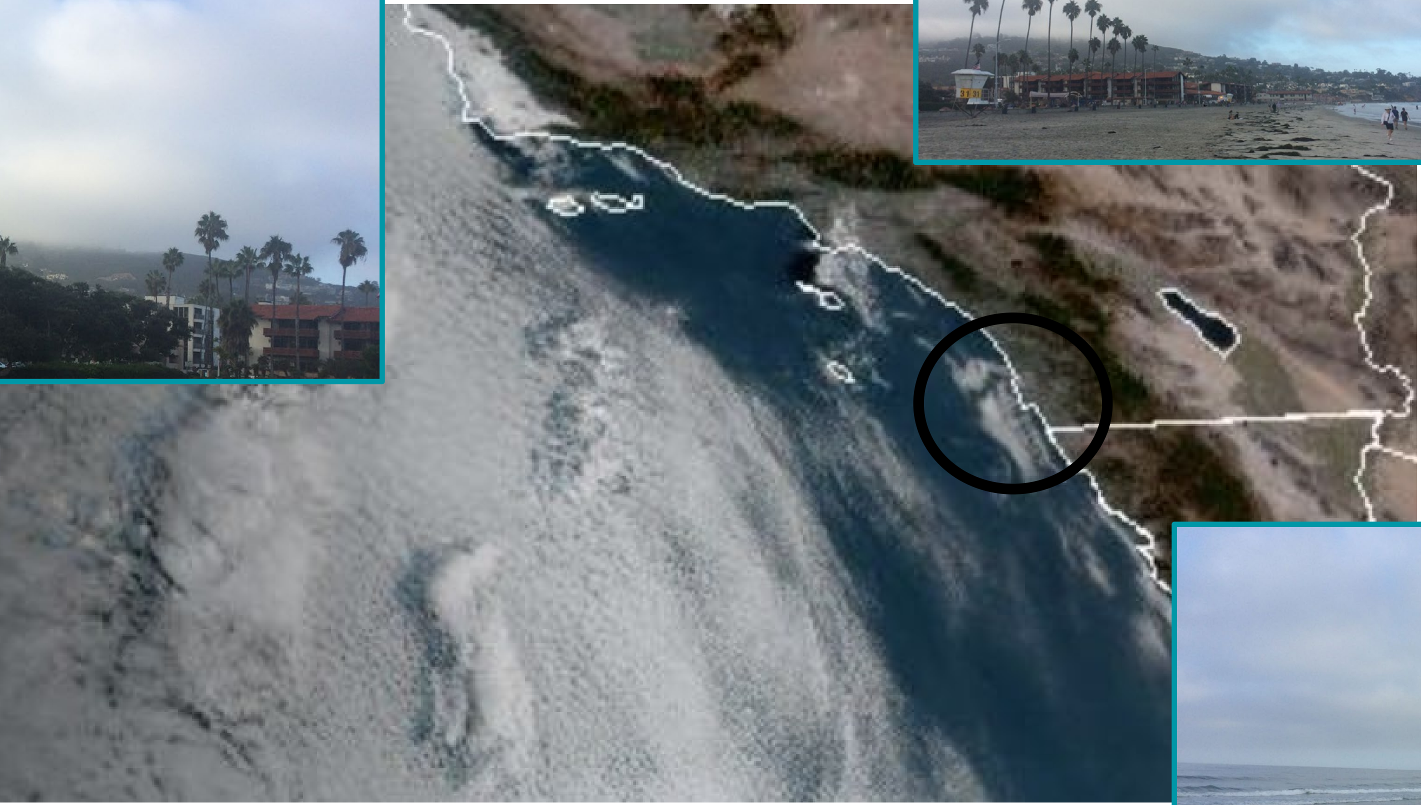


The Detailed Layout



INTENSIVE EPCAPE-Chem April-June: Mt. Soledad site is frequently in cloud in May-June, allowing sampling of droplets and interstitial aerosol.

Broken Clouds on 26 September 2022 at Soledad



https://www.arm.gov/research/campaigns/amf2023epcape

ASR Atmospheric System Research

ARM CLIMATE RESEARCH FACILITY

Eastern Pacific Cloud Aerosol Precipitation Experiment (EPCAPE)

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EPCAPE Eastern Pacific Cloud Aerosol Precipitation Experiment

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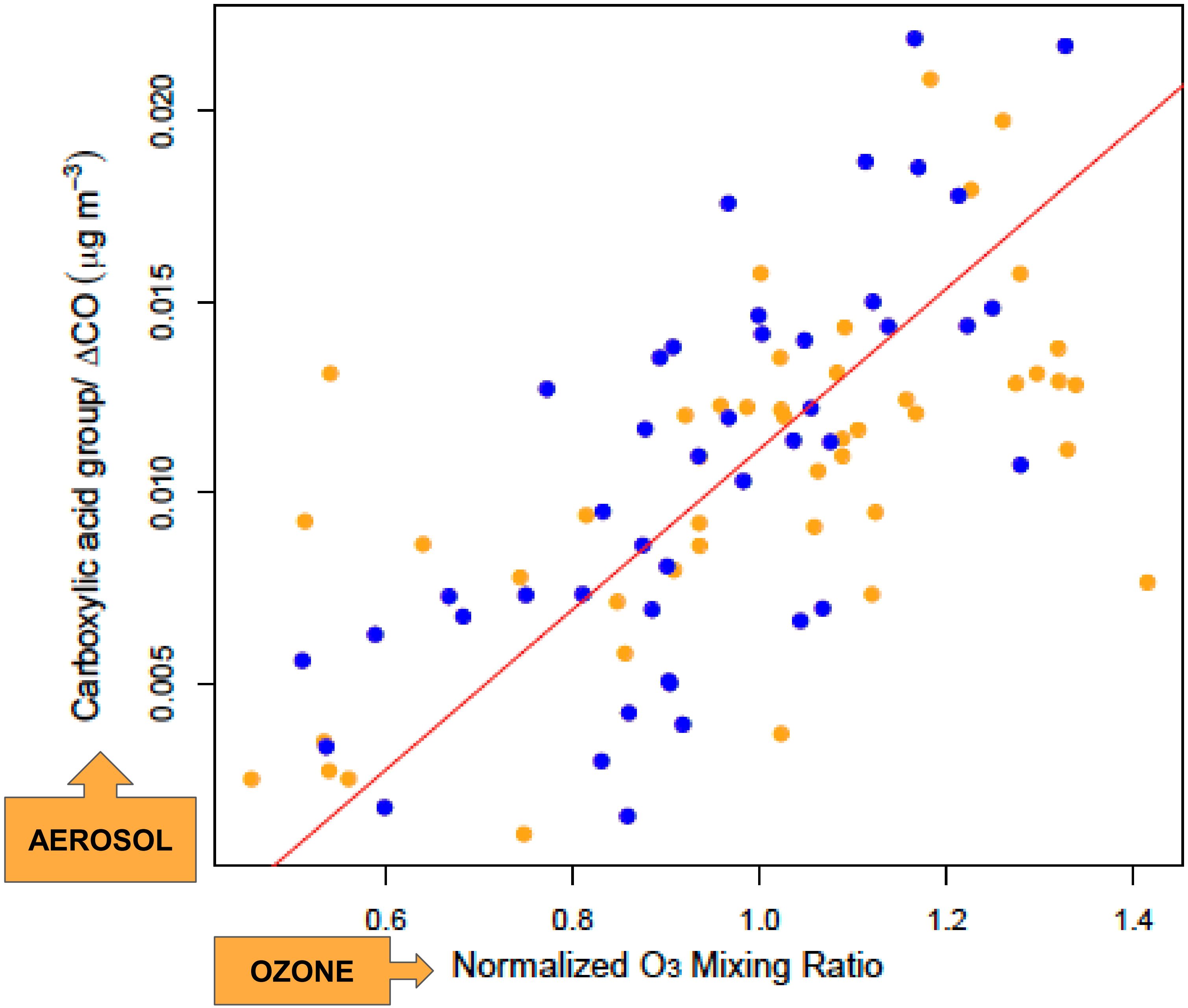
Sunlight makes aerosol over the ocean

- Even though there are few new aerosol sources over the ocean, the aerosol increases.
- Sunlight increases ozone, which oxidizes gaseous emissions to make more aerosol.



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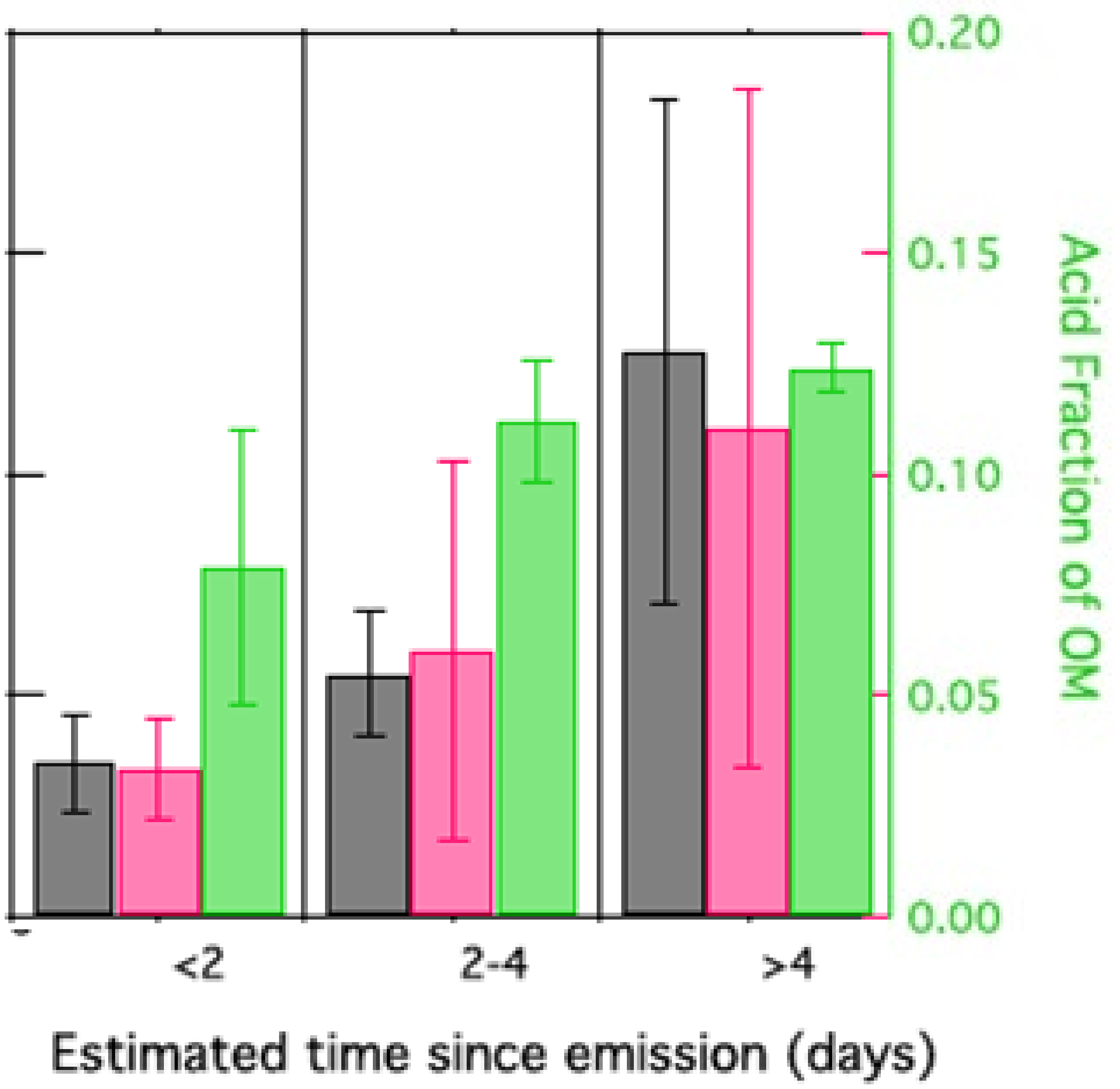
How do Aerosols Change in the Atmosphere?

- As particles are transported from northern California, sunlight and clouds can both add to the aerosol particles.
- For wildfire emissions, the acidic fraction of particles increased with atmospheric processing.



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How do sources affect the chemical composition?

- High nitrate and organic concentrations were associated with combustion emissions from vehicles from eastern Los Angeles basin.

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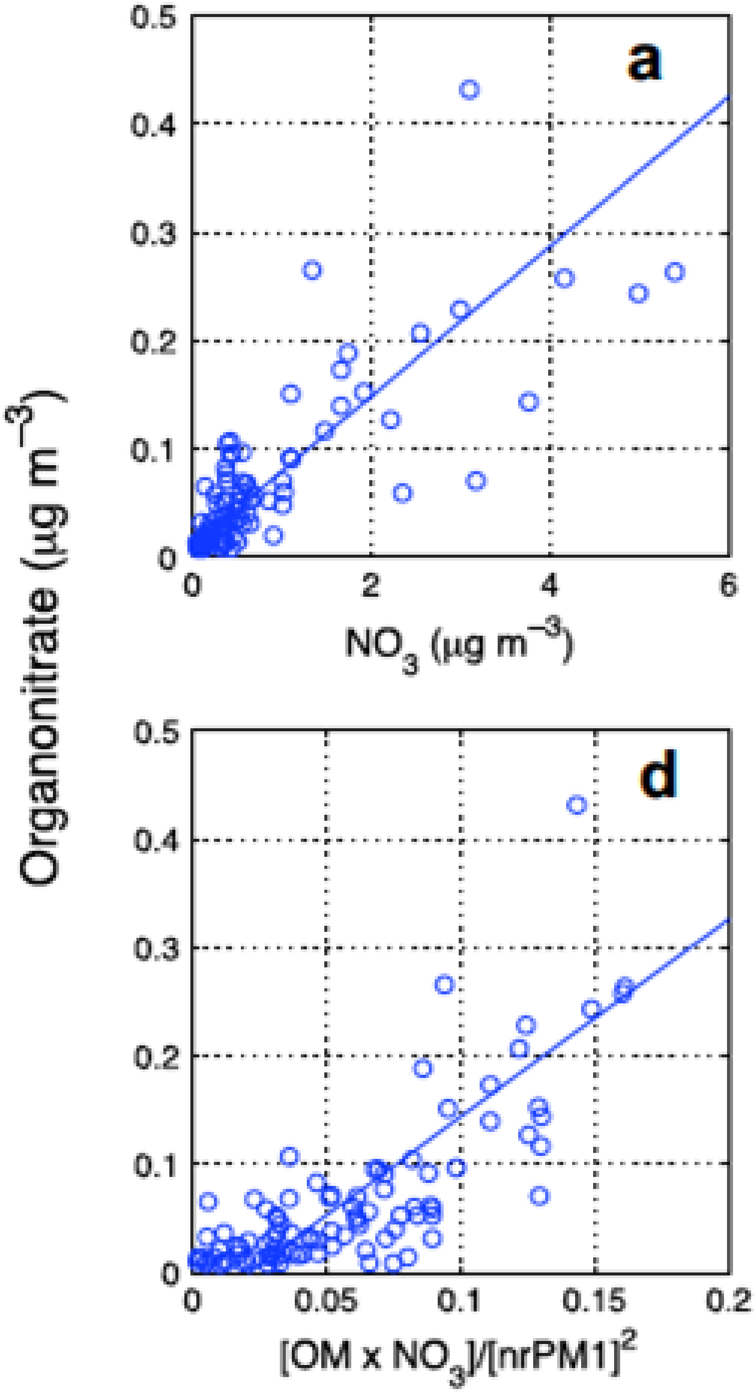
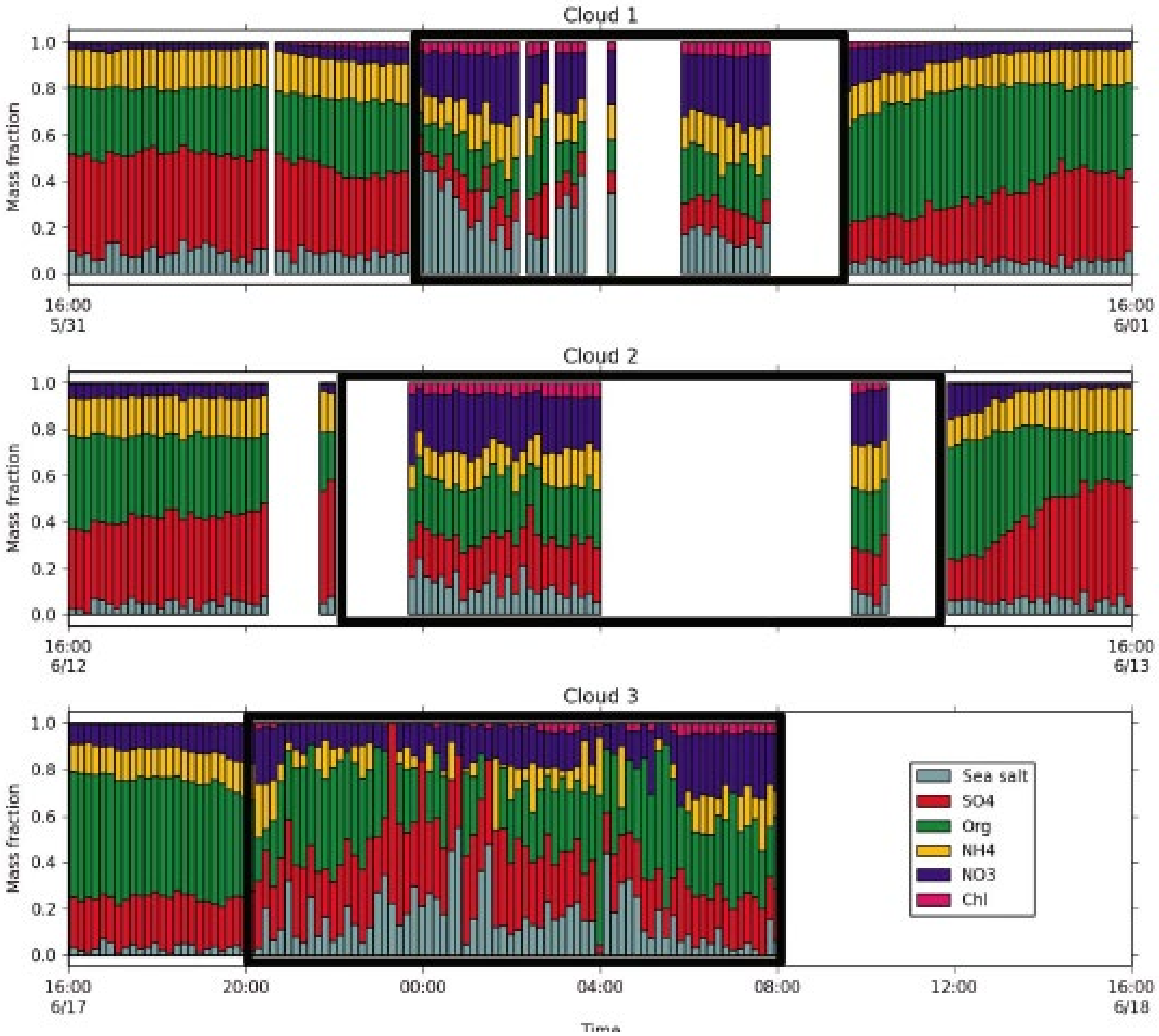


What are aerosol effects **IN clouds?**

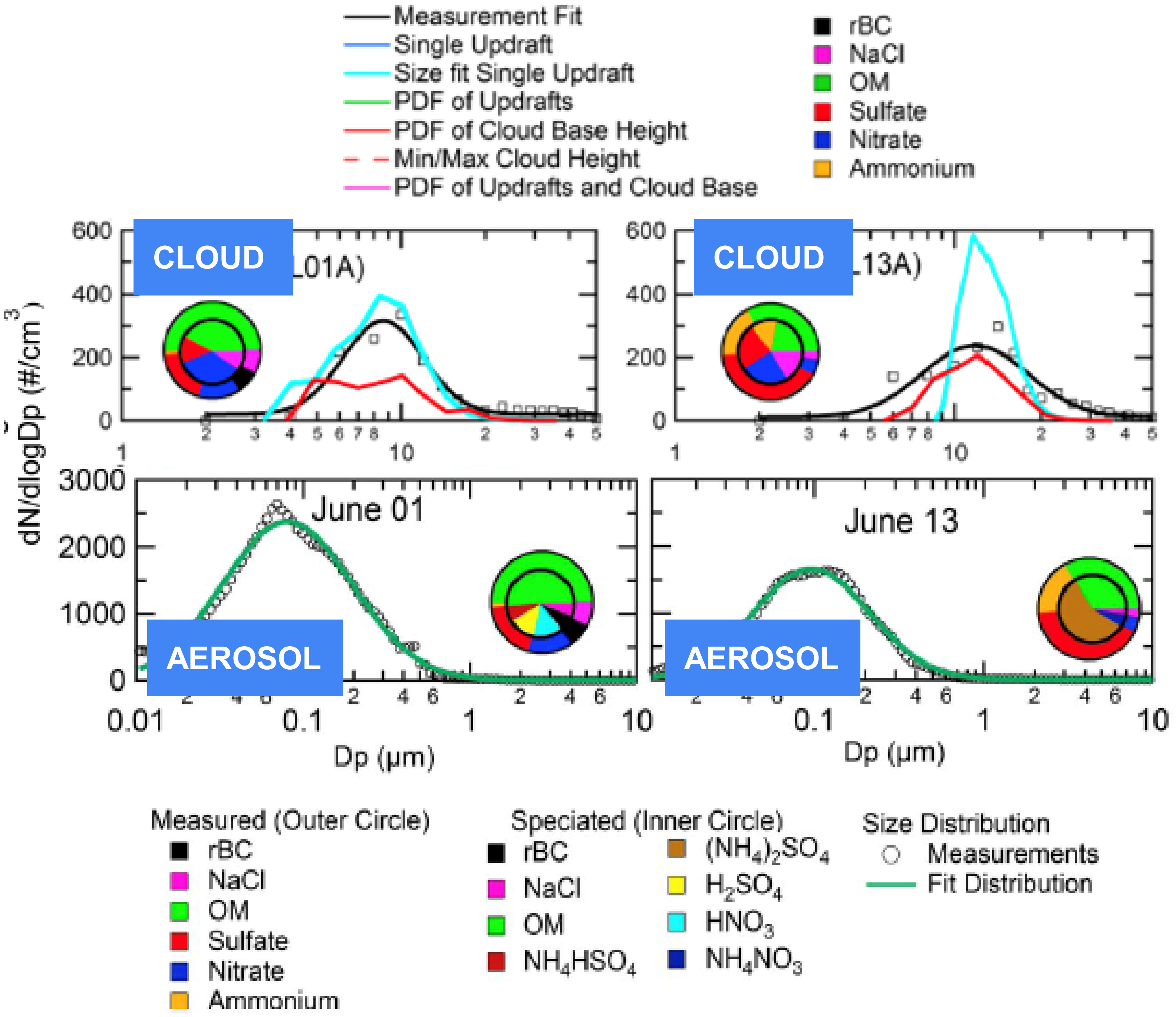
During the “SOLEDAD” Campaign in June 2012, only some aerosol particles were included in cloud droplets, and these had more sea salt than outside of clouds.

Modini, R. L., Frossard, A. A., Ahlm, L., **Russell**, L. M., Corrigan, C. E., Roberts, G. C., Hawkins, L. N., Schroder, J. C., Bertram, A. K., Zhao, R., Lee, A. K. Y., Abbatt, J. P. D., Lin, J., Nenes, A., Wang, Z., Wonaschutz, A., Sorooshian, A., Noone, K. J., Jonsson, H., … Leaitch, W. R. (2015). Primary marine aerosol-cloud interactions off the coast of California. *Journal of Geophysical Research-Atmospheres*, *120*(9), 4282–4303. https://doi.org/10.1002/2014jd022963



What are aerosol effects **ON clouds**?

Aerosols change cloud drop size distributions, affecting how clouds change radiation.



Sanchez, K. J., **Russell**, L. M., Modini, R. L., Frossard, A. A., Ahlm, L., Corrigan, C. E., Roberts, G. C., Hawkins, L. N., Schroder, J. C., Bertram, A. K., Zhao, R., Lee, A. K. Y., Lin, J. J., Nenes, A., Wang, Z., Wonaschutz, A., Sorooshian, A., Noone, K. J., Jonsson, H., … Seinfeld, J. H. (2016). Meteorological and aerosol effects on marine cloud microphysical properties. *Journal of Geophysical Research-Atmospheres*, *121*(8), 4142–4161. https://doi.org/10.1002/2015jd024595

Science Questions for EPCAPE

- What are seasonal differences in clouds and aerosol?
- What controls cloud dissipation at the coast?
- How closely are aerosol and cloud properties linked?