

# PACE-PAX research flight report 2024/09/04

Compiled by Kirk Knobelspiesse, Brian Cairns, 2024/09/07

Reviewed by Samuel LeBlanc

Coordinated TO + ER2 flight including an underpass of PACE over a marine stratocumulus covered ocean in the SPEXone swath for the ER2, followed by coordination with the Twin Otter offshore. Some overflight of aeronet in central valley with ER-2 as well.

Delay of takeoff for ER-2 due to fueling issue, this was mitigated by delaying TO takeoff slightly and cutting short a segment in the ER-2. Coordination still happened as planned. TO instruments nominal, ER-2 had major problem with HSRL (no data due to cooling issue) and minor problems with PICARD (overheating, resolvable with reconfigured settings).

## *Twin Otter*

Objectives: Profiles of aerosol scattering and absorption coefficients and size distributions together with scattering (polarized) phase functions above CEOBS site and over marine stratocumulus clouds.

Extensive profiles of marine cloud microphysical properties and liquid water content for validation of cloud remote sensing retrievals.

Summary: Cloud top after take-off at 900 ft. At 1500 ft scattering coefficient was 10-15  $\text{Mm}^{-1}$ . Profile done at CEOBS with scattering coefficient down to zero at 4500 ft through 10000 ft. Top of spiral reached at 12:38 local time (19:38 UTC) then inline descent to do porpoise maneuvers in cloud region west of Marina. Cloud top reached at 1000 ft. Orbit maneuver performed at 20:05 for overpass timing. Extensive porpoising performed, profiling at 500 ft/min with 10-second level legs in clear air above and below clouds. Cloud bases initially at 400 ft altitude, tops at 1100 ft. Continued porpoising before and after the PACE overpass time of 13:59 local time (20:59 UTC). LWC observed 0.25-0.4  $\text{g/m}^3$ . Aerosol scattering initially  $\sim 10 \text{ Mm}^{-1}$  both below and above cloud layer, nearly zero  $\text{Mm}^{-1}$  in-cloud (presumably due to cloud scavenging or activation). At the west side of flight track, cloud bases/tops increased in height to  $\sim 1000/1500\text{ft}$ , and below-cloud aerosol scattering increased to 20  $\text{Mm}^{-1}$ . At 20:40 UTC, inserted orbit maneuver for coordination timing. Spiral maneuver performed at 21:12 UTC (up and down), with aerosol scattering extending to just below 5000 ft altitude. Aircraft in porpoising maneuver during ER2 overpass at 15:08 local time (22:08 UTC). Spiral up at PIRAT waypoint for ATC communications, then start transit back to KOAR. Descended to 2000 ft on the way back to land at Marina to see if there were any aerosols present, but very little observed ( $\sim 5 \text{ Mm}^{-1}$  scattering). Missed approach at Marina tower was planned, but aborted due to cloud cover.

Clouds were ideal for PACE validation with overcast conditions and peak liquid water content of 0.4  $\text{g/m}^3$  indicative of relatively thick, opaque, clouds and relatively large droplets. Cloud altitude increased from East to West with base of 400 ft and top at 1100 ft in the East and base of 1000 ft and top at 1500 ft in the West. All instrumentation performed nominally for the full flight.

## **ER-2**

Takeoff: 18:34

Landing: 23:15

Duration: 4.7

Instrument status: HSRL: coolenol pump failed, no data gathered. PICARD: overheating, some loss of data. SPEXairborne: data transmission issue resulting in loss of ¼ data. All other instruments operated successfully.

Mission Scientist: Kirk Knobelspiesse

Pilot: James Nelson (Coach)

Mobile Pilot: Tim Williams

### Twin Otter

Take off: 12:10:49 (19:10:49 UTC)

Landing: 15:56:27 (22:56:27 UTC)

Duration = 3.8 hrs

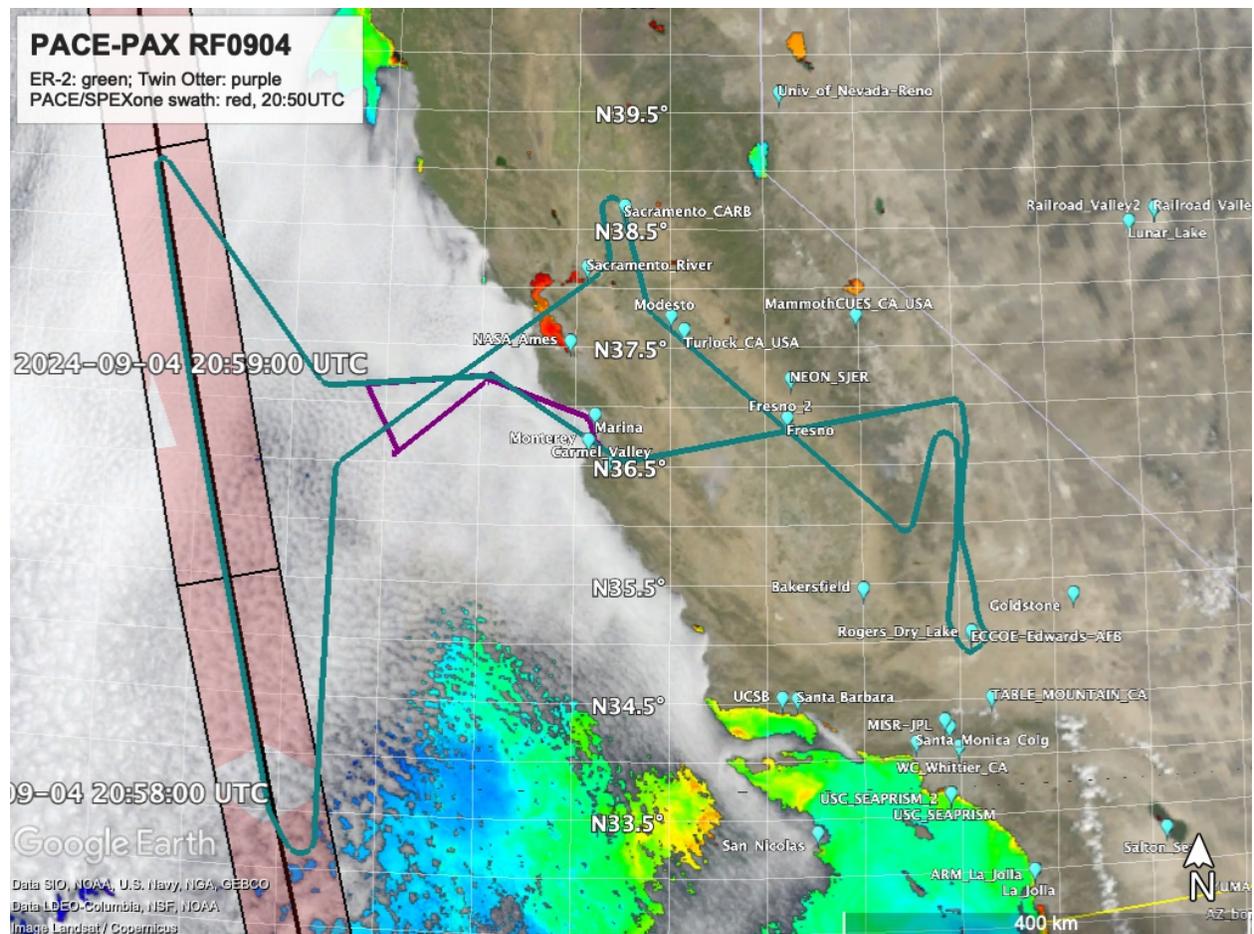
Instrument status: nominal

Manifest: Bryce Kujat (pilot), Jeff Martin (pilot), Luke Ziemba (QNC), Michael Shook (QNC)

### PACE

Overpass: 20:59

Orbit track west offshore



All times are in UTC, VTM elements in **black** satisfied, **blue** partially satisfied and **red** not satisfied.

Time	Platform	VTM	
18:34	ER2		Takeoff
19:10	TO		Takeoff
19:18	ER2	1d	Overfly Fresno_2 AERONET. AOT=0.11
19:26	ER2	1d	Overfly Turlock AERONET. AOT=0.08
19:29	ER2	1d	Overfly Modesto AERONET. AOT=0.07
19:38	TO	1e	Top of spiral at CEOBS site and begin porpoise in clouds
19:38	ER2	1d	Overfly Sacramento CARB AERONET, AOT=0.13
19:47	ER2	1b, 1c, 6h	Sacramento River AERONET-OC, AOT=0.05
20:43	ER2		Start PACE-OHS line
20:59	ER2, TO	1e, 3c, 4c	PACE underpass 20:59. 1e for TO & ER-2, ER-2 only for other VTM elements
<b>21:00</b>	<b>PACE</b>		<b>PACE overpass</b>
21:32	ER2		End PACE-OHS line
22:08	ER2, TO	1e	Coordination between ER-2 and Twin Otter, while the latter is porpoising in clouds
22:18	ER2, Marina	1d, 6g	Overfly Marina Airport aerosol tower measurements (APS volume for particles greater than 1000 nm at 11 $\mu\text{m}^3/\text{cm}^3$ )
22:34	ER2	1d	Overfly Fresno AERONET. AOT=0.10
23:28	TO		Land

SPP: Solar Principal Plane

PACE-OHS: PACE track withing swaths of OCI, HARP2 and SPEXone

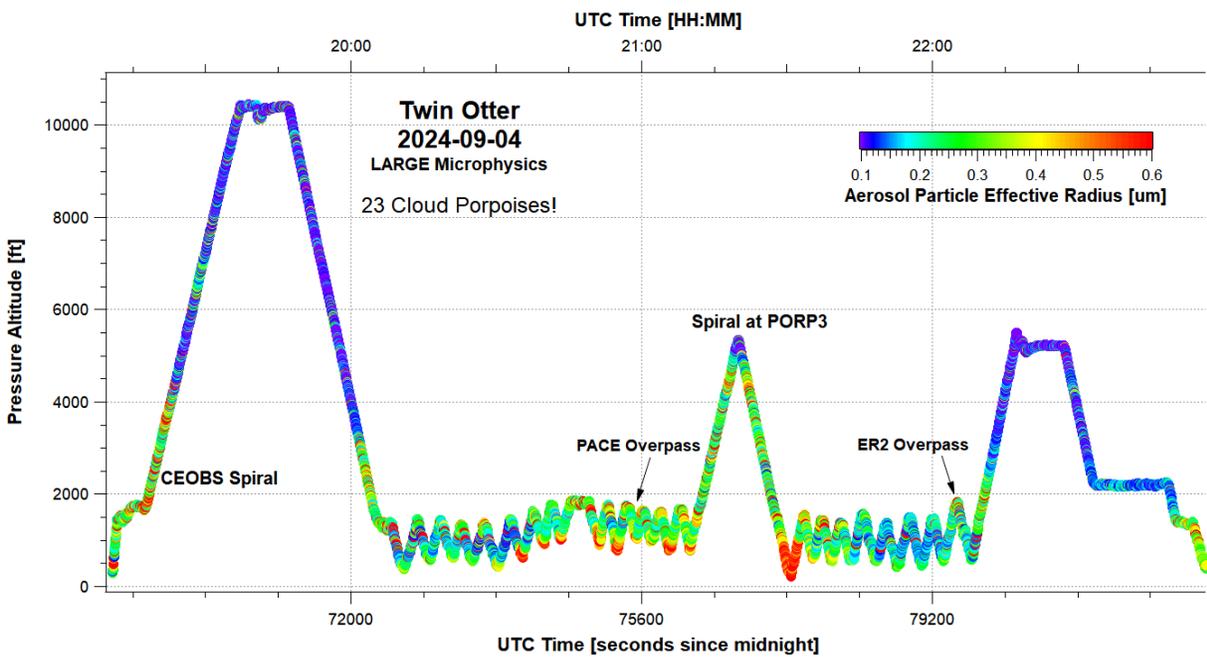
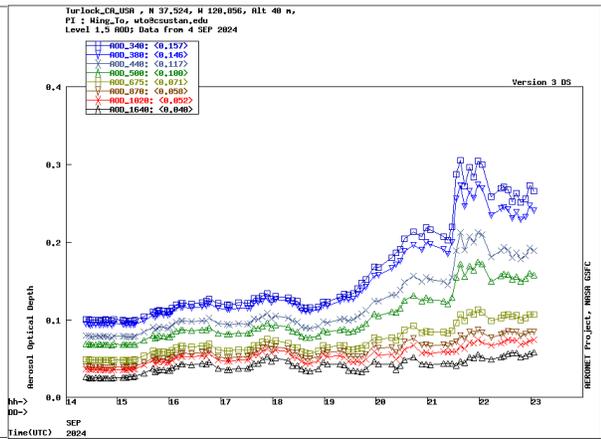
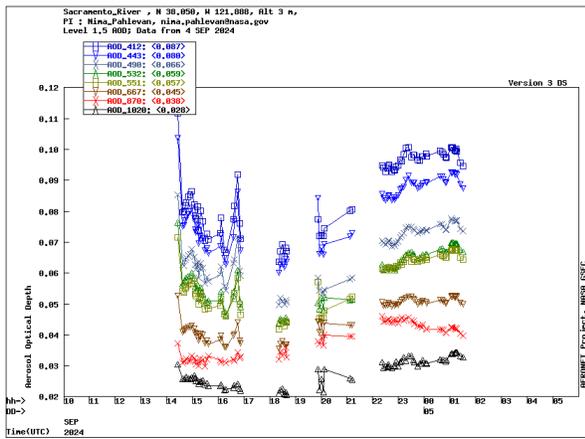
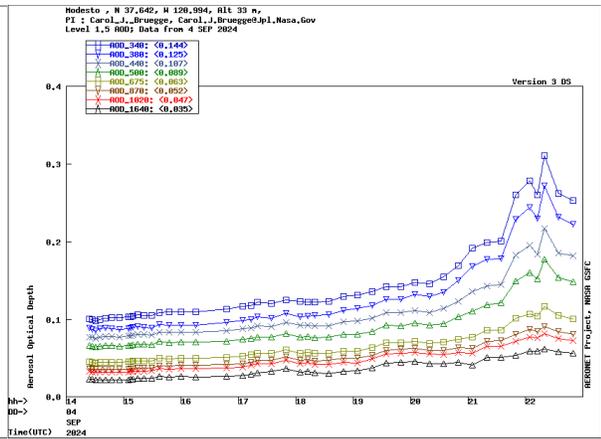
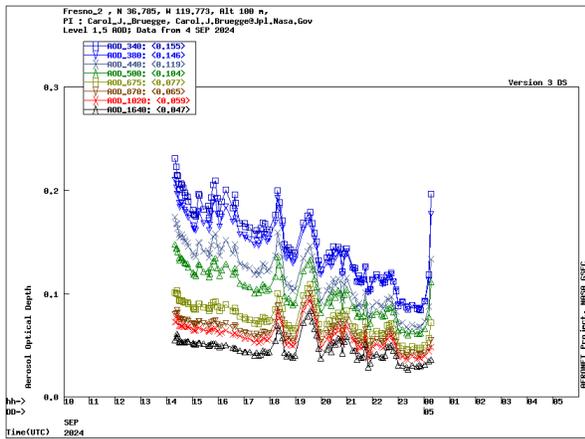
**Assessment:**

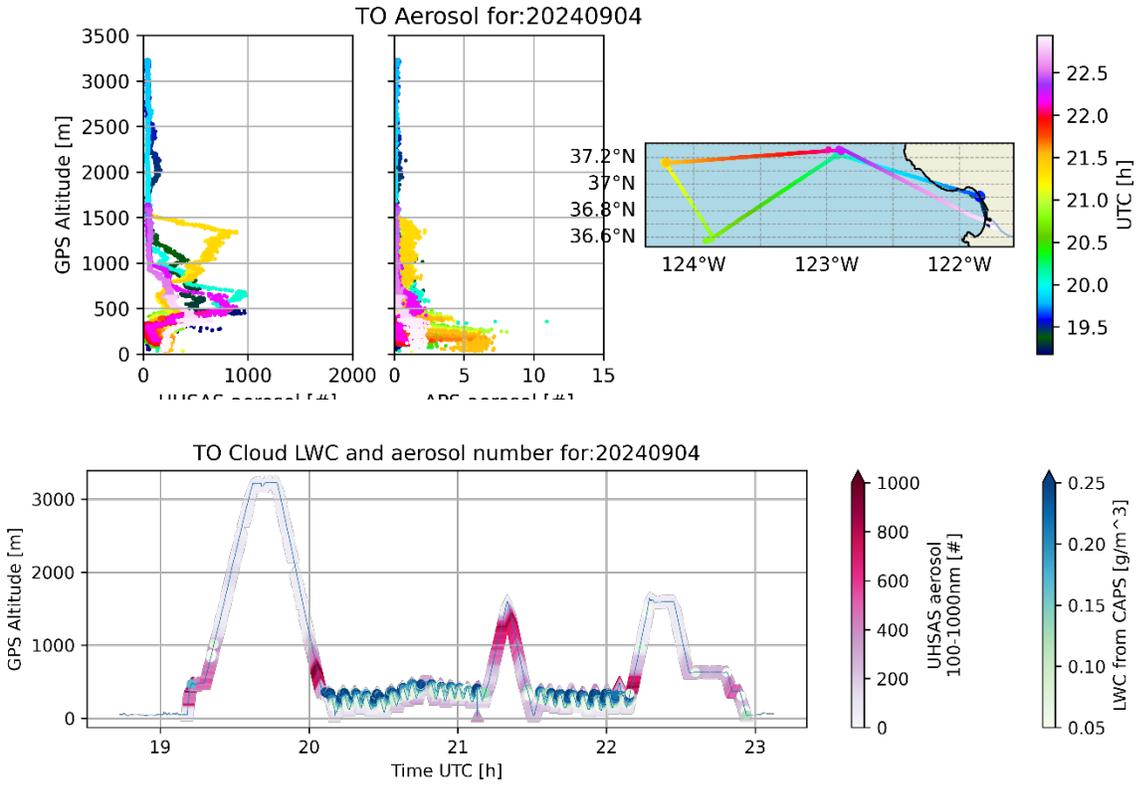
- 7.1% objectives satisfied for cloud flight. Coordination worked well, even with delayed start of ER-2

PACE-PAX progress tracking												
Validation objectives	ID	Measurement objectives	Importance, w	Observation time, h (hours)	Total observed (hours)	Fractional success 8/29	Fractional success 9/3	Fractional success 9/4	Fractional success 9/5	Fractional success 9/6	Fractional success 9/7	
1. Validate new retrieval properties	a	Land surface parameters	8	2.0	0.5	20.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
	b	Ocean radiometric parameters	10	8.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	c	Aerosol parameters over the ocean	12	8.0	0.5	0.0%	0.0%	6.1%	0.0%	0.0%	0.0%	
	d	Aerosol parameters over land	12	8.0	10.5	39.3%	24.4%	8.0%	0.0%	0.0%	0.0%	
	e	Cloud parameters	12	8.0	4.0	0.0%	0.0%	39.3%	0.0%	0.0%	0.0%	
	f	Ocean surface parameters	1	8.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
3. Validate in a narrow swath	a	Aerosol parameters over the ocean (PACE)	10	8.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	b	Aerosol parameters over land (PACE)	10	8.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	c	Cloud parameters (PACE)	5	2.0	1.0	0.0%	0.0%	39.3%	0.0%	0.0%	0.0%	
	d	Aerosol parameters (EarthCARE)	8	4.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	e	Cloud parameters (EarthCARE)	8	4.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
4. Validate radiometric and polarimetric properties	a	Validate large reflectances	6	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	b	Validate large reflectances with high polarization	6	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	c	Validate large reflectances with low polarization	6	2.0	1.5	22.1%	0.0%	30.6%	0.0%	0.0%	0.0%	
	d	Overfly vicarious calibration sites	6	4.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
6. Focus on specific processes or phenomena	a	High aerosol loads over land	4	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	b	High aerosol loads over ocean	4	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	c	Multiple aerosol layers	1	2.0	4.5	0.0%	87.3%	0.0%	0.0%	0.0%	0.0%	
	d	Aerosol under thin cirrus	2	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	e	Aerosol above liquid phase cloud	4	2.0	0.5	22.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
	f	Broken clouds with complex structure	4	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	g	Dust aerosols over ocean	4	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	h	Aerosol and ocean parameters over turbid waters	2	2.0	0.5	0.0%	0.0%	22.1%	0.0%	0.0%	0.0%	
	i	Aerosol and ocean parameters over biologically productive waters	4	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	k	Smoke aerosols over ocean	1	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	<b>total:</b>			150	98	23.5	5.7%	2.5%	7.1%	0.0%	0.0%	0.0%
					prior to this week							
					ER-2 flight hours	1.3	2.8	0	4.7	0	0	0
					TO flight hours	0	2.4	3.4	3.8	0	0	0
					Shearwater days	0	0	0	0	0	0	0
					PACE-PAX overall objectives satisfied: 15.3%							

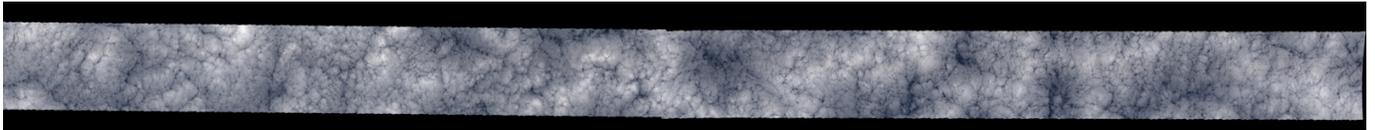
**Note: images and data presented in this report are preliminary, and not for publication, presentation, or scientific use. The PACE-PAX data archive is:**

**<https://www-air.larc.nasa.gov/missions/pacepax/index.html>**



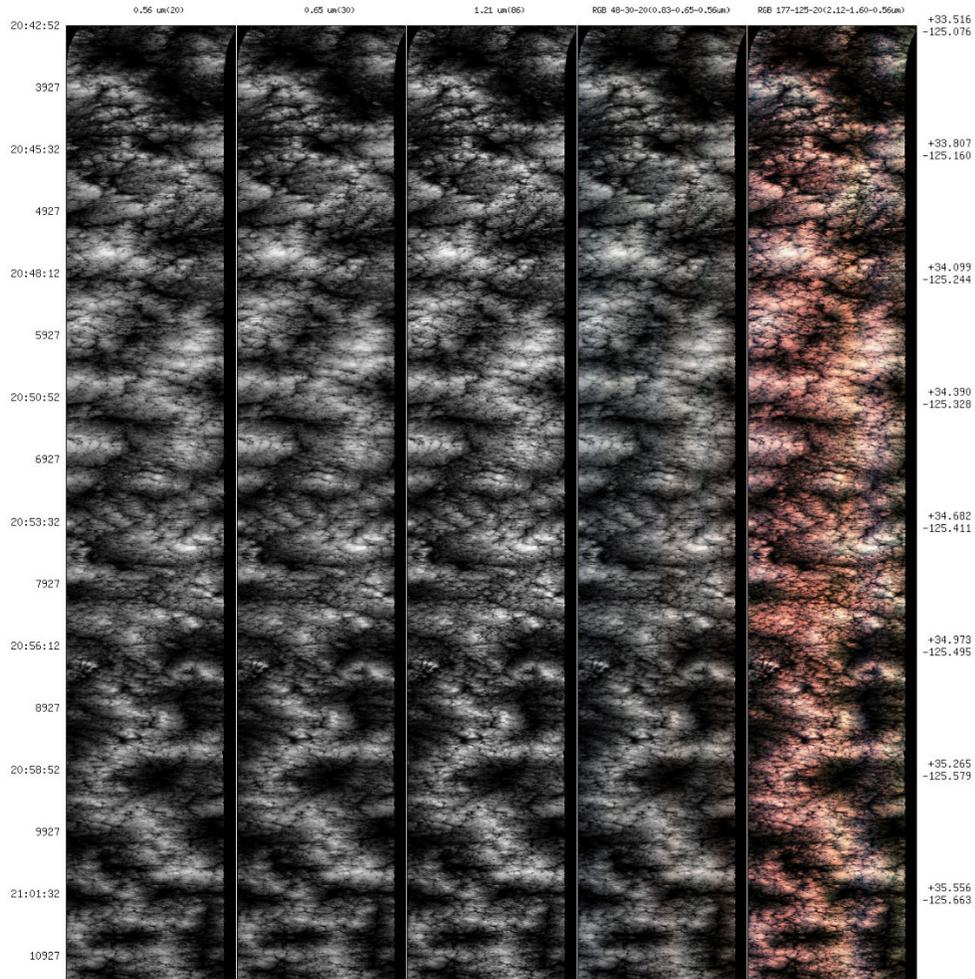


**A portion of the PRISM quicklook along the PACE overpass line (left: south, right: north)**

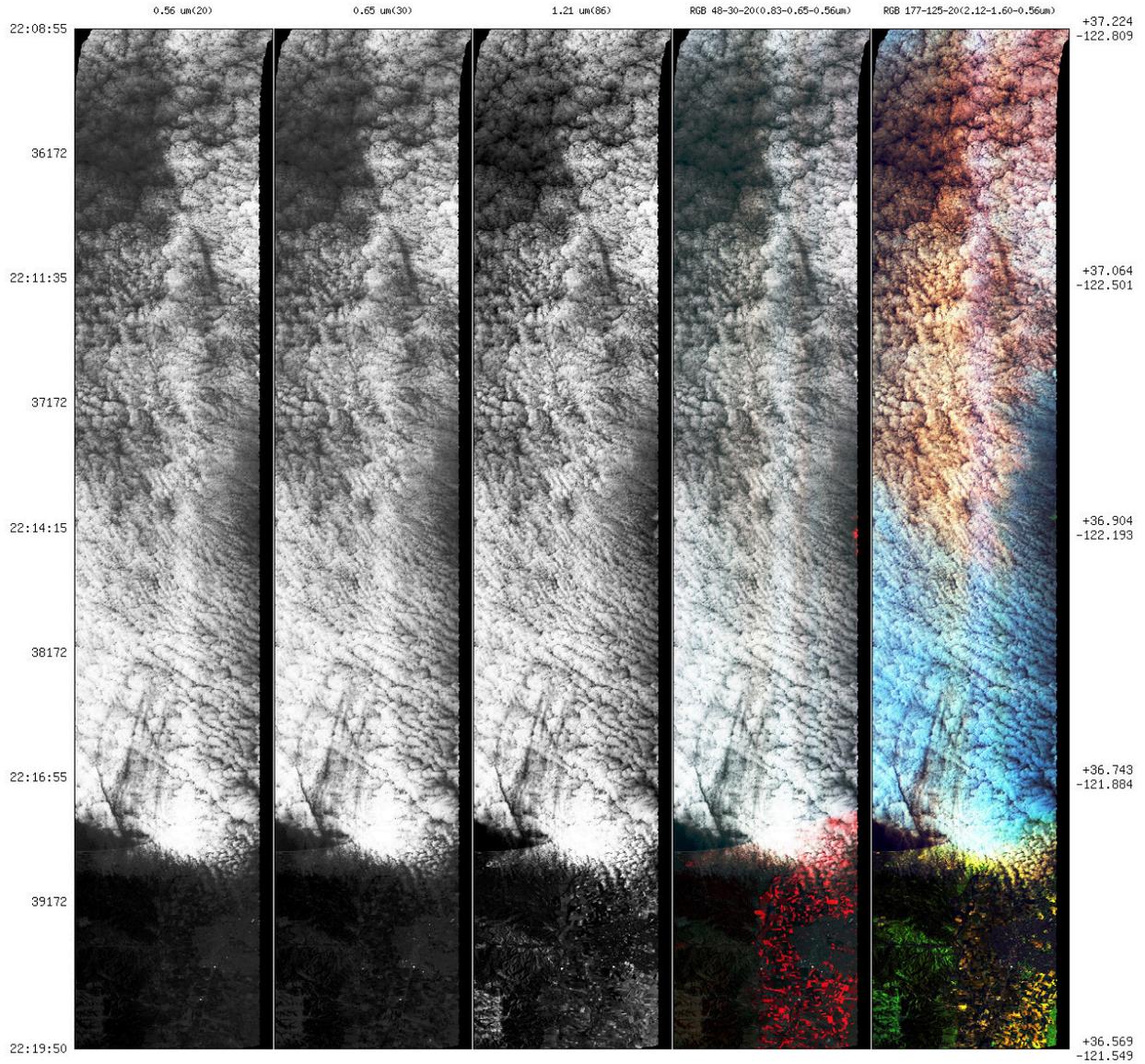


**A portion of the PICARD quicklook along the PACE overpass line. More quicklooks at: [https://asapdata.arc.nasa.gov/picard/data/flt\\_html/24623.html](https://asapdata.arc.nasa.gov/picard/data/flt_html/24623.html)**

Pushbroom Imager for Cloud and Aerosol Research and Development  
Level-0 Quicklooks  
4 Sep 2024  
Flight# 24-623 Track# 3 of 7

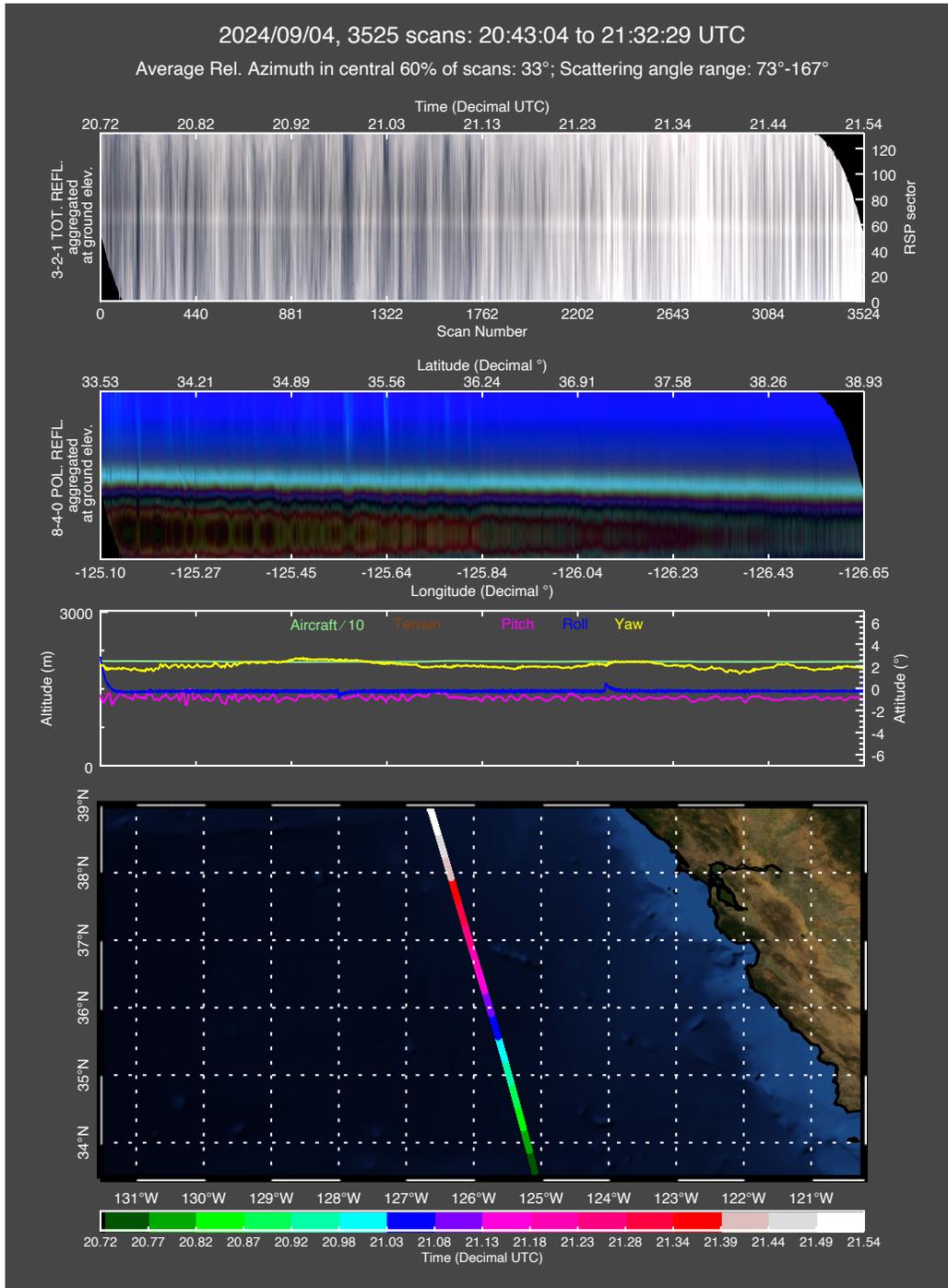


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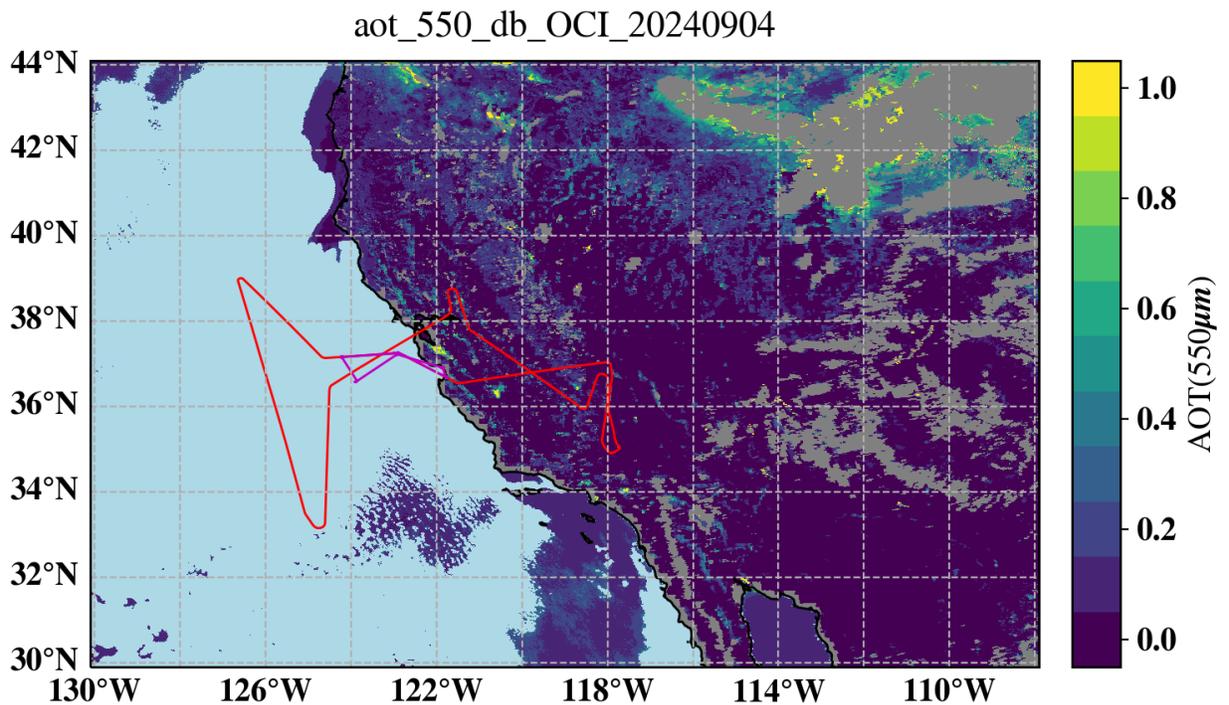
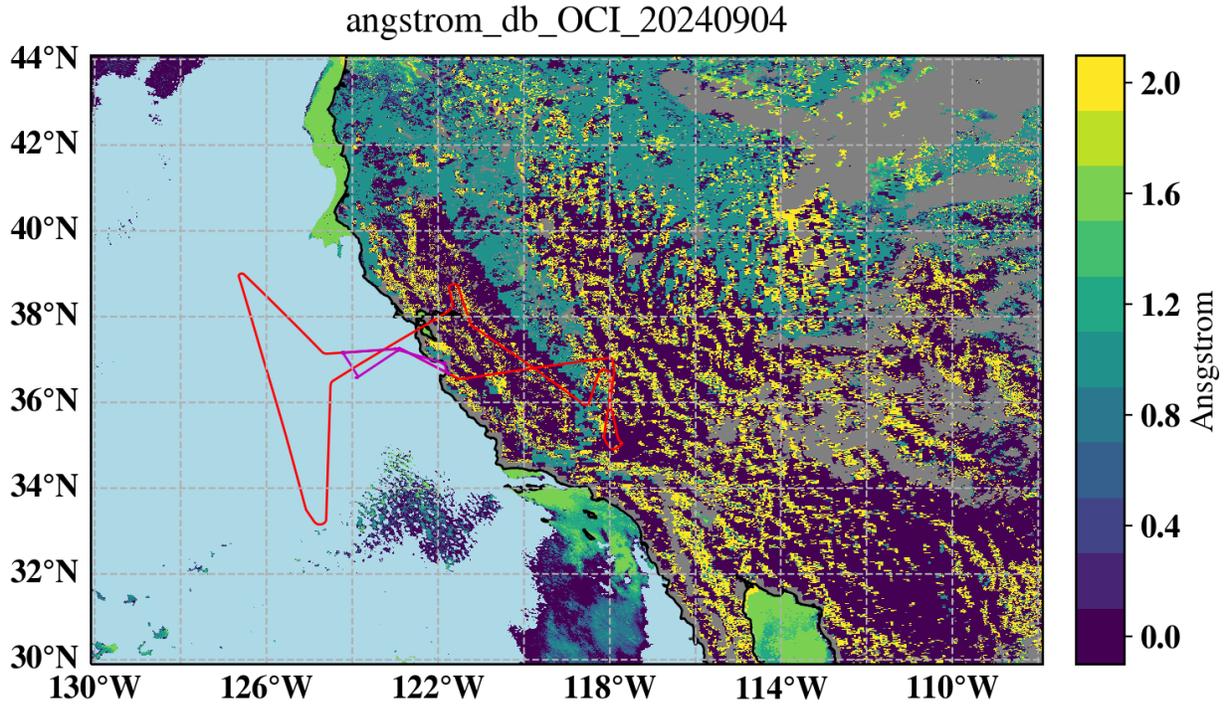
**Over the Marina airport, at the south edge of marine stratocumulus**

RSP quicklook along the PACE satellite track. More quicklooks: <https://data.giss.nasa.gov/pub/rsp/data/PACEPAX/quicklooks/>

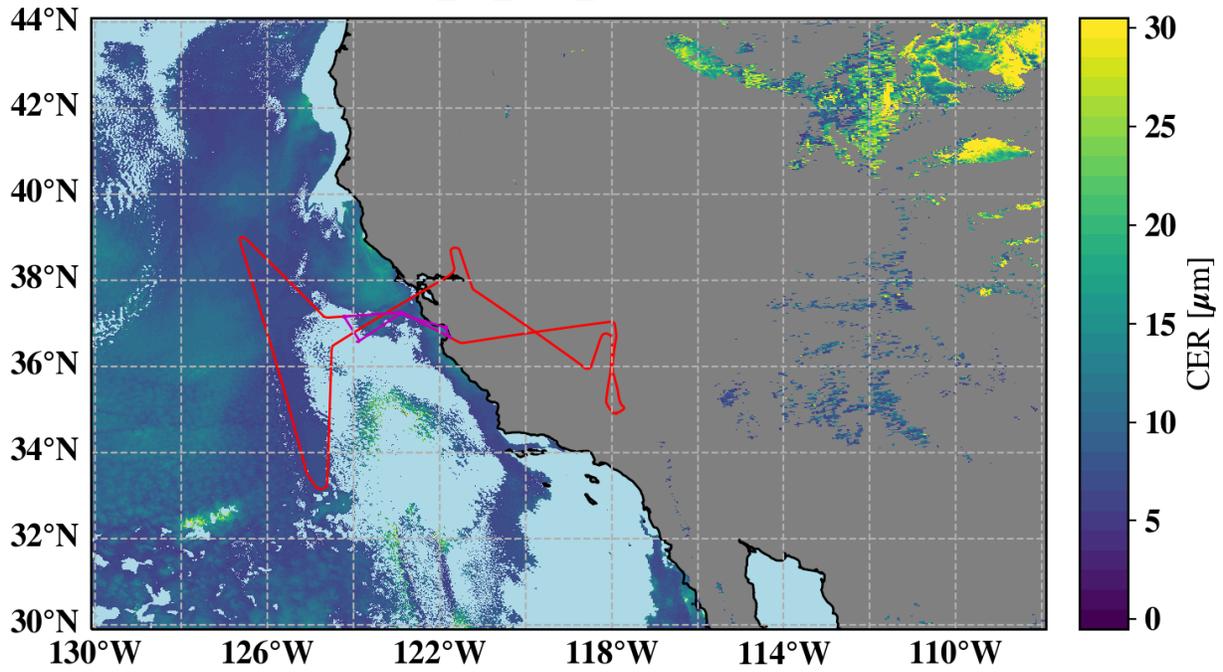


### PACE satellite quicklooks

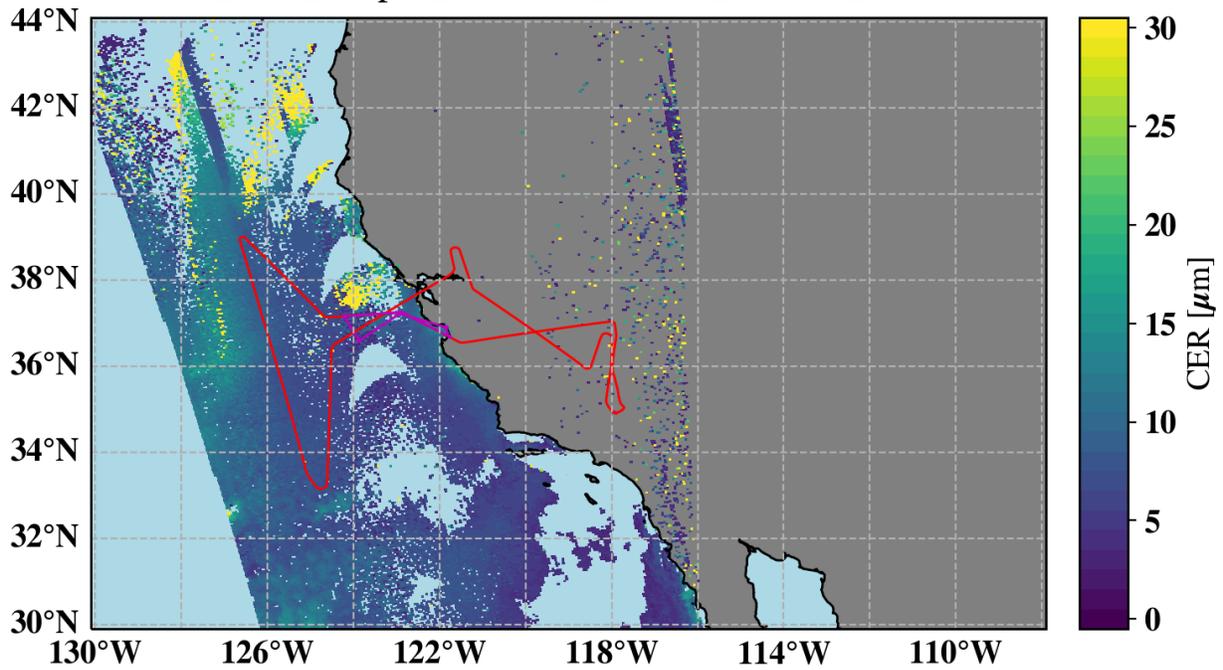
*Note: PACE quicklooks contain unreleased data with unverified quality. They are intended for qualitative purposes only and are not for distribution.*



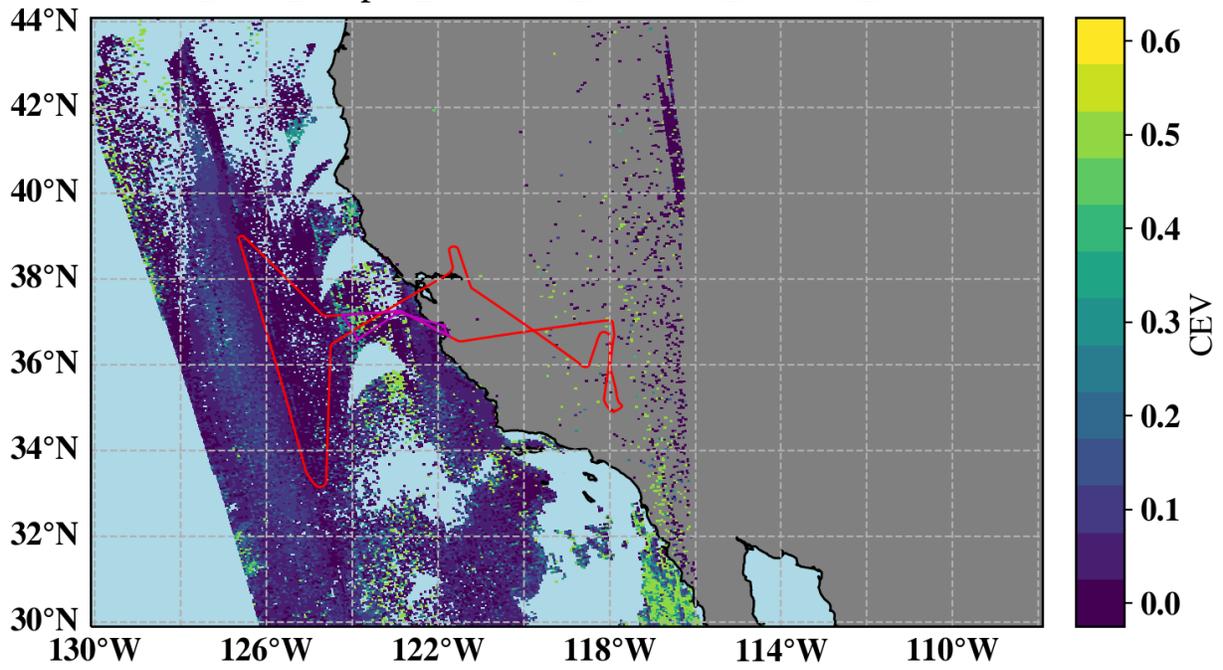
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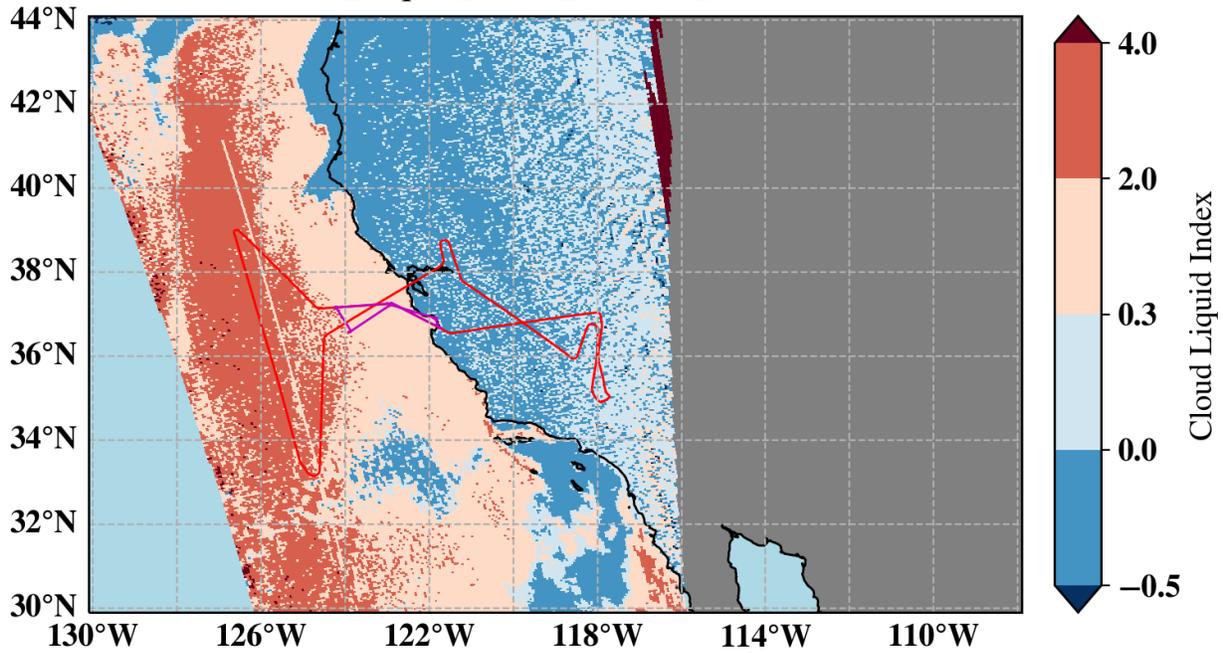
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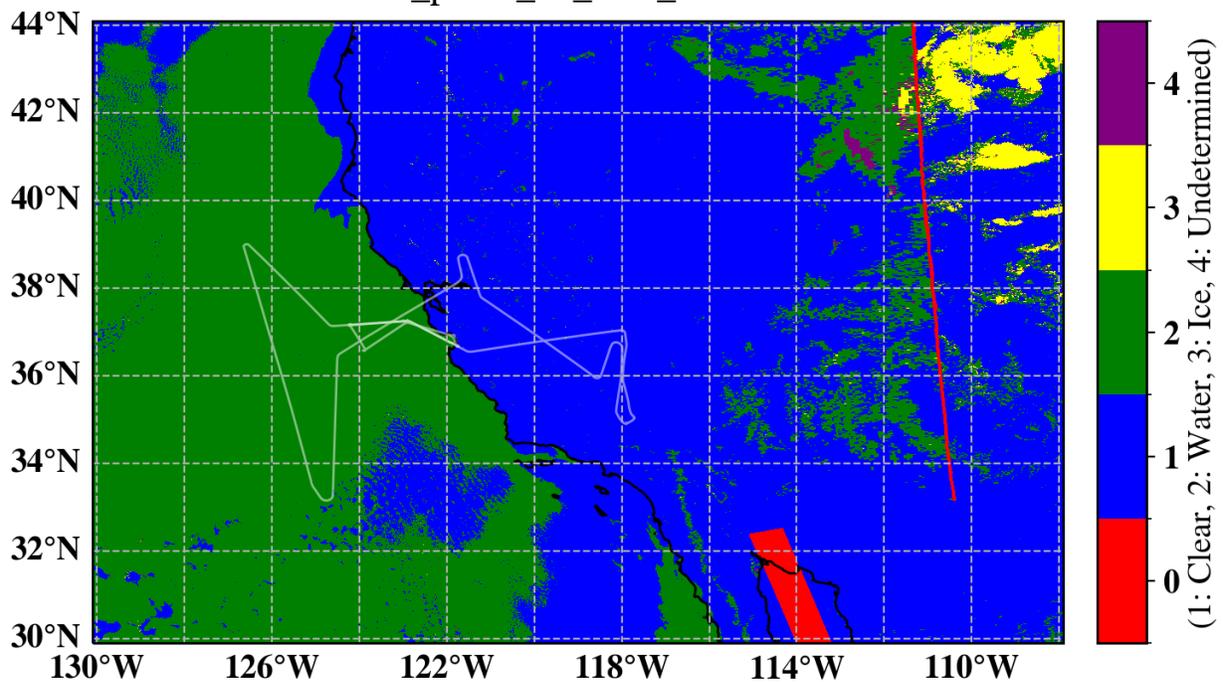
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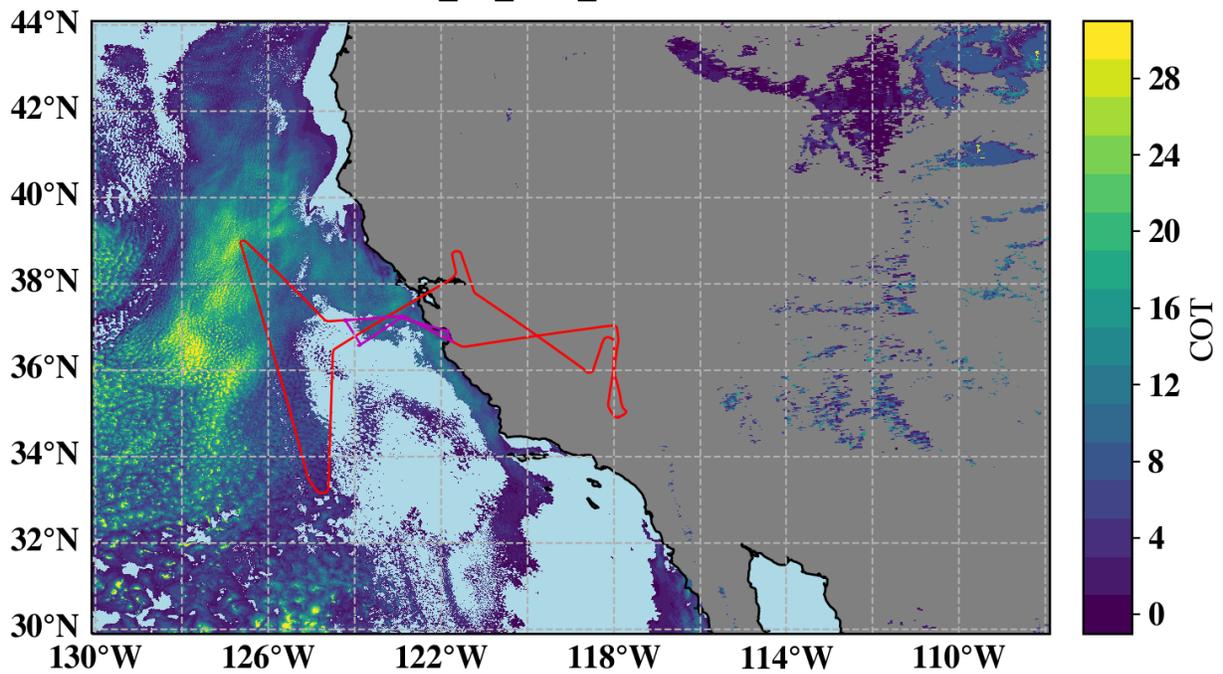
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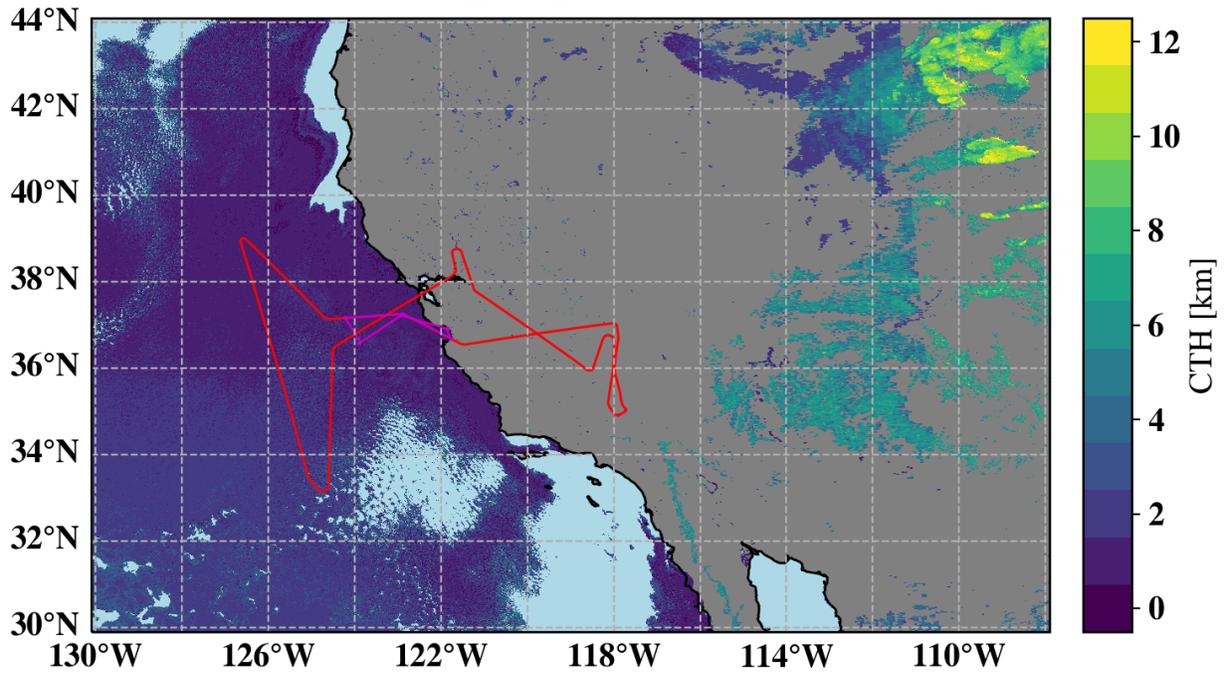
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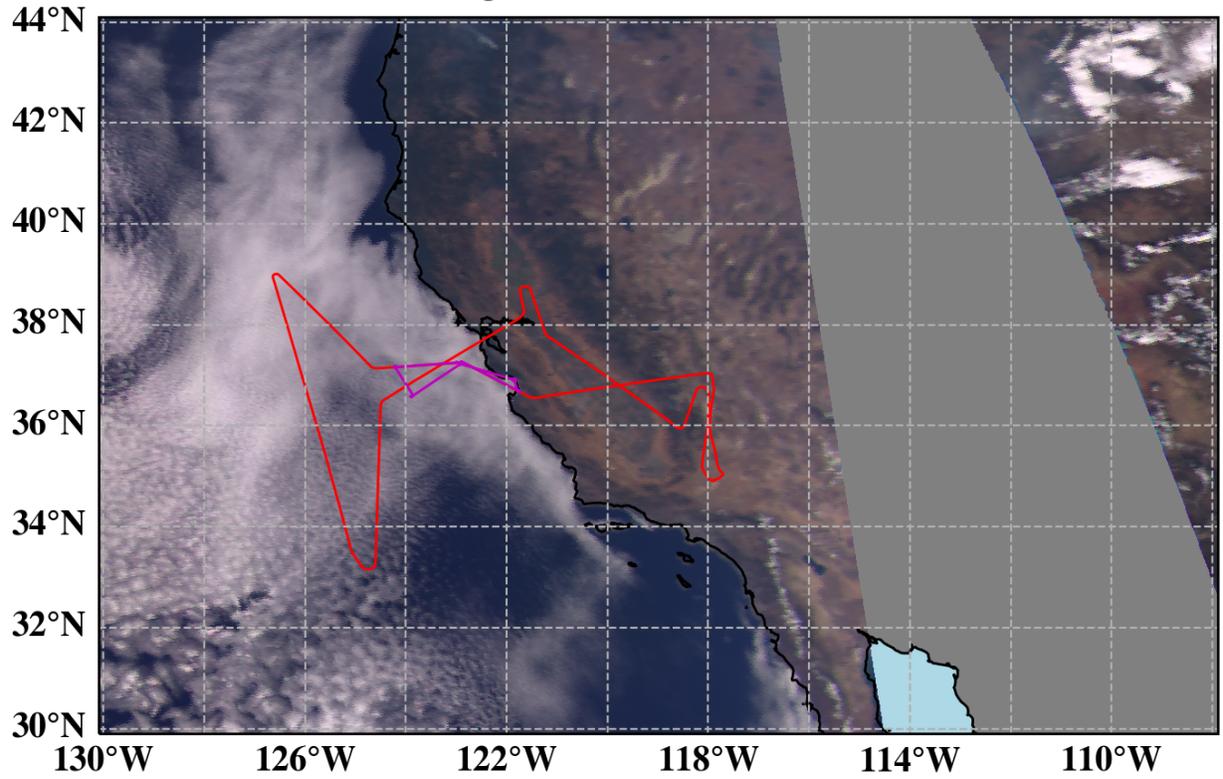
cot\_21\_OCI\_20240904



cth\_OCI\_20240904



rgb\_HARP2\_20240904



# PACE-PAX Research Flight report 2024/09/04

## Twin Otter Flight

Manifest:

Bryce Kujat (pilot)

Jeff Martin (pilot)

Luke Ziembra (QNC)

Michael Shook (QNC)

Take off: 12:10:49 (19:10:49 UTC)

Landing: 15:56:27 (22:56:27 UTC)

Duration = 3.8 hrs.

Objectives: Profiles of aerosol scattering and absorption coefficients and size distributions together with scattering (polarized) phase functions above CEOBS site and over marine stratocumulus clouds. Extensive profiles of marine cloud microphysical properties and liquid water content for validation of cloud remote sensing retrievals.

Summary: Cloud top after take-off at 900 ft. At 1500 ft scattering coefficient was  $10\text{-}15 \text{ Mm}^{-1}$ . Profile done at CEOBS with scattering coefficient down to zero at 4500 ft through 10000 ft. Top of spiral reached at 12:38 local time (19:38 UTC) then inline descent to do porpoise maneuvers in cloud region west of Marina. Cloud top reached at 1000 ft. Orbit maneuver performed at 20:05 for overpass timing. Extensive porpoising performed, profiling at 500 ft/min with 10-second level legs in clear air above and below clouds. Cloud bases initially at 400 ft altitude, tops at 1100 ft. Continued porpoising before and after the PACE overpass time of 13:59 local time (20:59 UTC). LWC observed  $0.25\text{-}0.4 \text{ g/m}^3$ . Aerosol scattering initially  $\sim 10 \text{ Mm}^{-1}$  both below and above cloud layer, nearly zero  $\text{Mm}^{-1}$  in-cloud (presumably due to cloud scavenging or activation). At the west side of flight track, cloud bases/tops increased in height to  $\sim 1000/1500\text{ft}$ , and below-cloud aerosol scattering increased to  $20 \text{ Mm}^{-1}$ . At 20:40 UTC, inserted orbit maneuver for coordination timing. Spiral maneuver performed at 21:12 UTC (up and down), with aerosol scattering extending to just below 5000 ft altitude. Aircraft in porpoising maneuver during ER2 overpass at 15:08 local time (22:08 UTC). Spiral up at PIRAT waypoint for ATC communications, then start transit back to KOAR.

Descended to 2000 ft on the way back to land at Marina to see if there were any aerosols present, but very little observed ( $\sim 5 \text{ Mm}^{-1}$  scattering). Missed approach at Marina tower was planned, but aborted due to cloud cover.

Clouds were ideal for PACE validation with overcast conditions and peak liquid water content of  $0.4 \text{ g/m}^3$  indicative of relatively thick, opaque, clouds and relatively large droplets. Cloud altitude increased from East to West with base of 400 ft and top at 1100 ft in the East and base of 1000 ft and top at 1500 ft in the West. All instrumentation performed nominally for the full flight.