

# PACE-PAX research flight report 2024/09/07

## RF0907

Compiled by Kirk Knobelspiesse, Brian Cairns, 2024/09/14 DRAFT

Reviewed by Samuel LeBlanc

Twin Otter only flight out over the ocean to sample forecasted (smoke) aerosols above marine stratocumulus clouds west of the Monterey Bay during the PACE overpass (within OCI and HARP2 but not SPEXone swath). GEOS had moderate (AOD 0.1 to 0.2) smoke aerosols from fires in Oregon and Idaho lofted to about 3000m above sea level, the Twin Otter found a smaller amount of aerosols concentrated at cloud top and only existing at small amounts up to 2800m.

### ER-2

No flight

### Twin Otter

Takeoff: 19:13, Landing: 23:04, Duration: 3.9

Instrument status: Dewpoint Temperature sensor was not operational for this flight, while all other instrumentation (including humidifier and f(RH)) operated nominally.

Manifest: Bryce Kujat (pilot) Jeff Martin (pilot)

Luke Ziembra (QNC)

Edward Winstead (QNC)

[See end for full Twin Otter report](#)

### R/V Shearwater

No operations

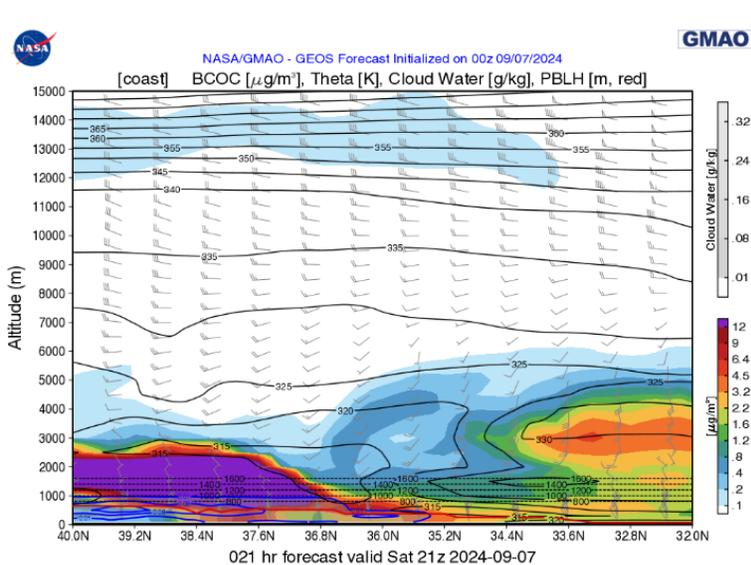
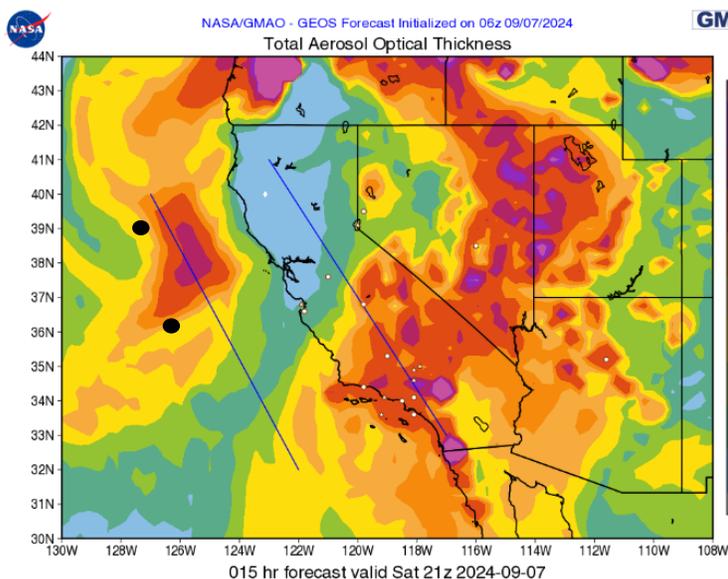
### R/V Blissfully

No operations

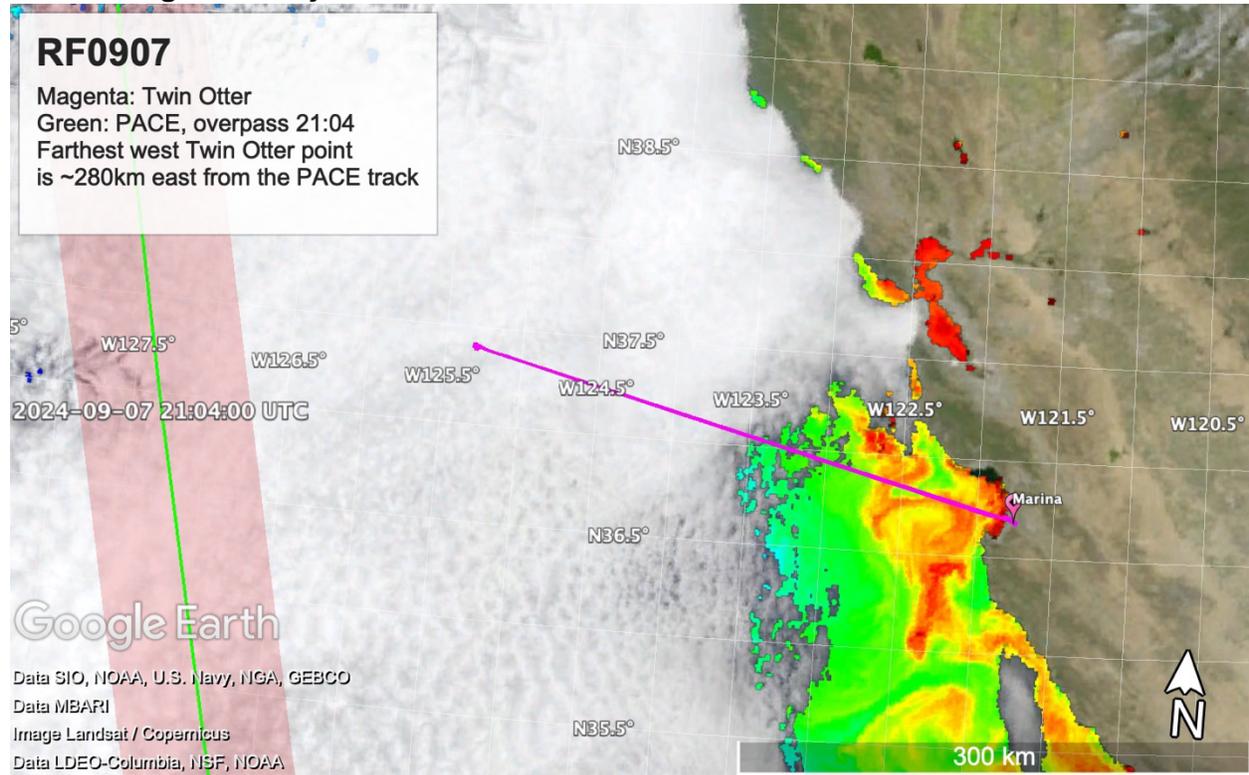
### PACE

Overpass: 21:04

Orbit track along Sierra Nevada mountains



**Overall image summary**



**Validation Traceability Matrix itemized objectives**

VTM elements in **black** satisfied, **blue** partially satisfied and **red** not satisfied

Time	Platform	VTM(hrs)	
19:13	TO		Takeoff
20:58	TO		Start spiral down from clean aerosol region
21:04	TO	1e(3.0), 6e(3.0)	PACE-OH overpass (21:04). Track ~280km west of TO location
<b>21:04</b>	<b>PACE</b>		<b>PACE-OH</b>
22:54	TO		Fly by AERONET Monterey, AOD(500 nm) = 0.03
23:04	TO		Landing

PACE-OH: within PACE OCI, HARP2 but not SPEXone swath

TO: Twin Otter

**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>**

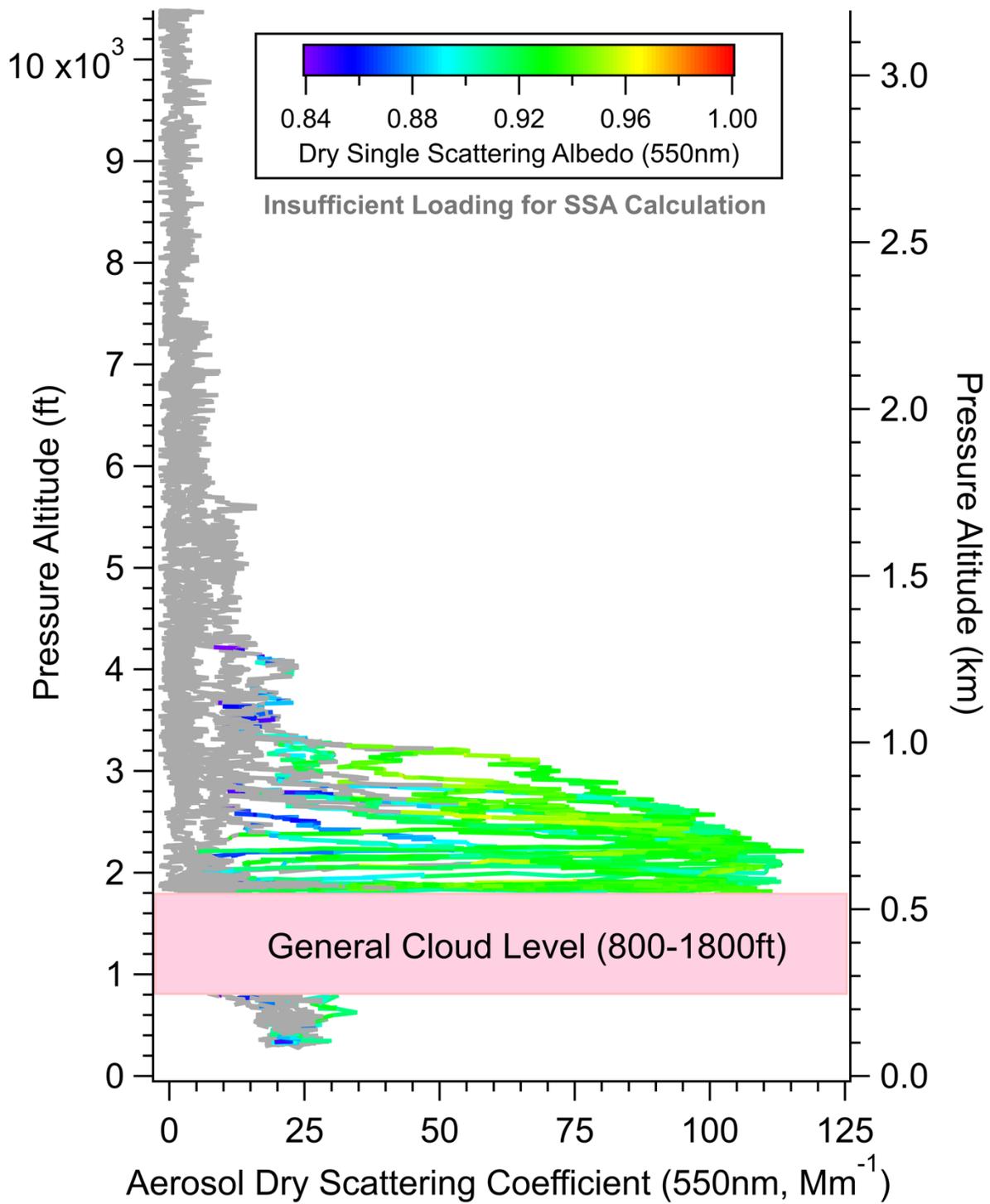
## Assessment:

- 3.1% of objectives satisfied. Reasonable given the limited operations (TO only) and unique nature of aerosol above cloud observations.
- Top remaining objectives: PACE aerosol in narrow swath (3a,b), EarthCARE (3d,3e)

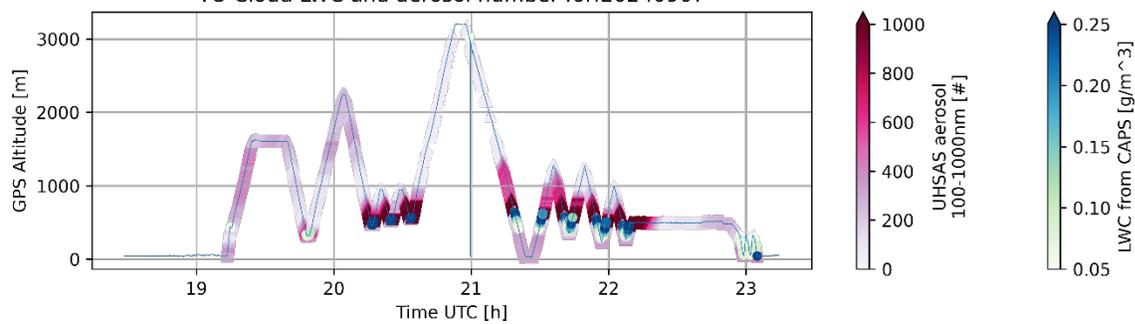
PACE-PAX progress tracking															
Validation objectives	ID	Measurement objectives	Importance, w	Observation time, h (hours)	Total observed (hours)	Fractional success 8/29	Fractional success 9/3	Fractional success 9/4	Fractional success 9/5	Fractional success 9/6	Fractional success 9/7	Fractional success 9/8	Total success	Remaining score	
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%	0.0%	20.1%	6.4	
	b	Ocean radiometric parameters	10	8.0	6.5	0.0%	0.0%	0.0%	0.0%	55.6%	0.0%	0.0%	55.6%	4.4	
	c	Aerosol parameters over the ocean	12	8.0	9.8	0.0%	0.0%	6.1%	0.0%	0.0%	0.0%	0.0%	70.4%	3.5	
	d	Aerosol parameters over land	12	8.0	13.5	39.3%	24.4%	8.0%	0.0%	8.8%	0.0%	0.0%	80.6%	2.3	
	e	Cloud parameters	12	8.0	7.0	0.0%	0.0%	39.3%	0.0%	0.0%	19.0%	0.0%	58.3%	5.0	
	f	Ocean surface parameters	1	8.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0	
3. Validate in a narrow swath	a	Aerosol parameters over the ocean (PACE)	10	8.0	2.0	0.0%	0.0%	0.0%	0.0%	22.1%	0.0%	0.0%	22.1%	7.8	
	b	Aerosol parameters over land (PACE)	10	8.0	1.0	0.0%	0.0%	0.0%	0.0%	11.8%	0.0%	0.0%	11.8%	3.8	
	c	Cloud parameters (PACE)	5	2.0	1.5	0.0%	0.0%	39.3%	0.0%	13.4%	0.0%	0.0%	52.8%	2.4	
	d	Aerosol parameters (EarthCARE)	8	4.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.0	
	e	Cloud parameters (EarthCARE)	8	4.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.0	
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%	0.0%	0.0%	6.0	
	b	Validate large reflectances with high polarization	6	2.0	1.0	0.0%	0.0%	0.0%	0.0%	39.3%	0.0%	0.0%	39.3%	3.6	
	c	Validate large reflectances with low polarization	6	2.0	1.5	22.1%	0.0%	30.6%	0.0%	0.0%	0.0%	0.0%	52.8%	2.8	
	d	Overfly vicarious calibration sites	6	4.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.0	
	a	High aerosol loads over land	4	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.0	
6. Focus on specific processes or phenomena	b	High aerosol loads over ocean	4	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.0	
	c	Multiple aerosol layers	1	2.0	4.5	0.0%	0.0%	87.3%	0.0%	0.0%	0.0%	0.0%	87.3%	0.1	
	d	Aerosol under thin cirrus	2	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.0	
	e	Aerosol above liquid phase cloud	4	2.0	3.5	22.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	82.6%	0.7	
	f	Broken clouds with complex structure	4	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.0	
	g	Dust aerosols over ocean	4	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.0	
	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%	0.0%	22.1%	1.6	
	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%	0.0%	0.0%	4.0	
	k	Smoke aerosols over ocean	1	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0	
	<b>total:</b>			<b>150</b>	<b>98</b>	<b>52.8</b>	<b>5.7%</b>	<b>2.5%</b>	<b>7.1%</b>	<b>0.0%</b>	<b>13.8%</b>	<b>3.1%</b>	<b>0.0%</b>	<b>32.3%</b>	



Stratocumulus cloud deck observed at 20:21 UTC. Note smoke layer possibly visible on north horizon (Photo = Ziembra)



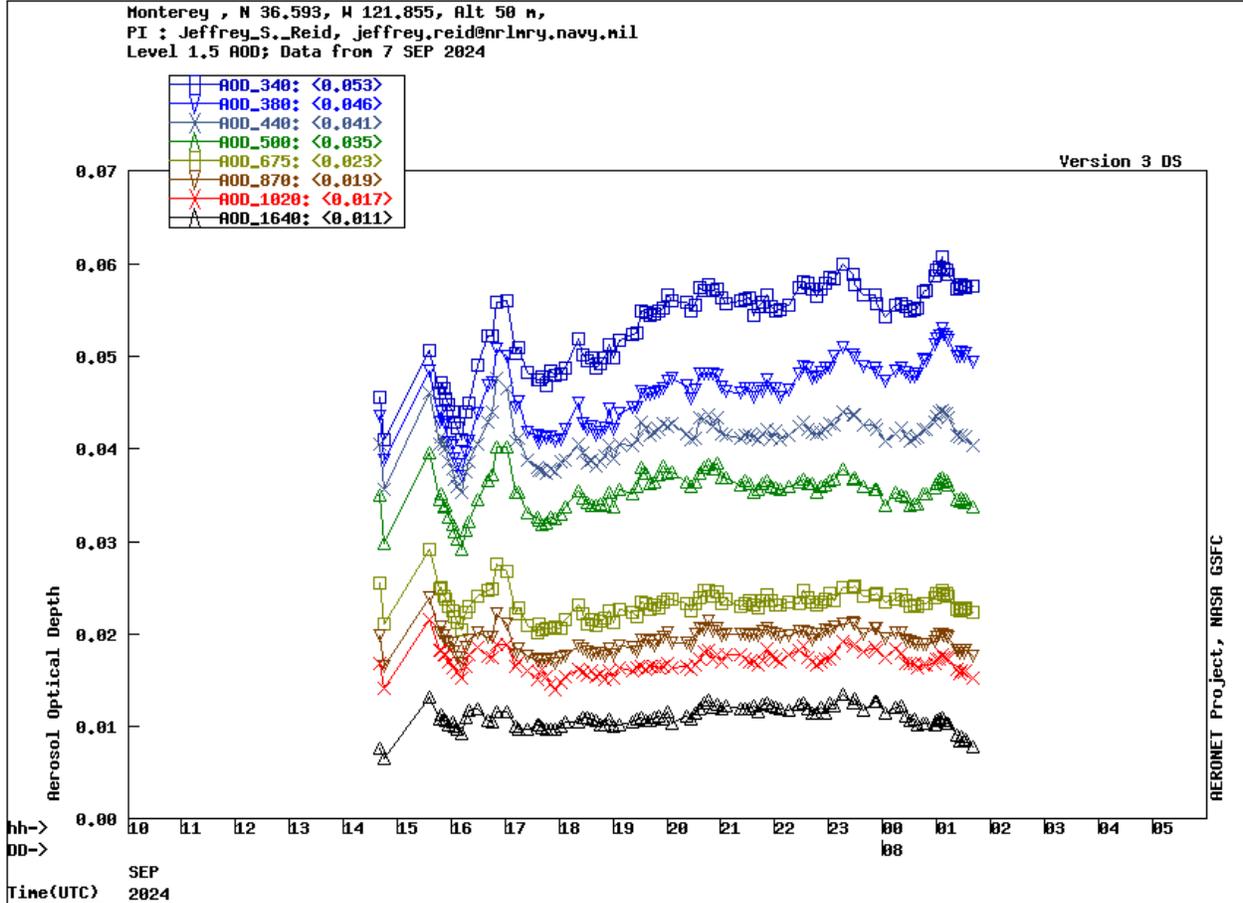
TO Cloud LWC and aerosol number for:20240907





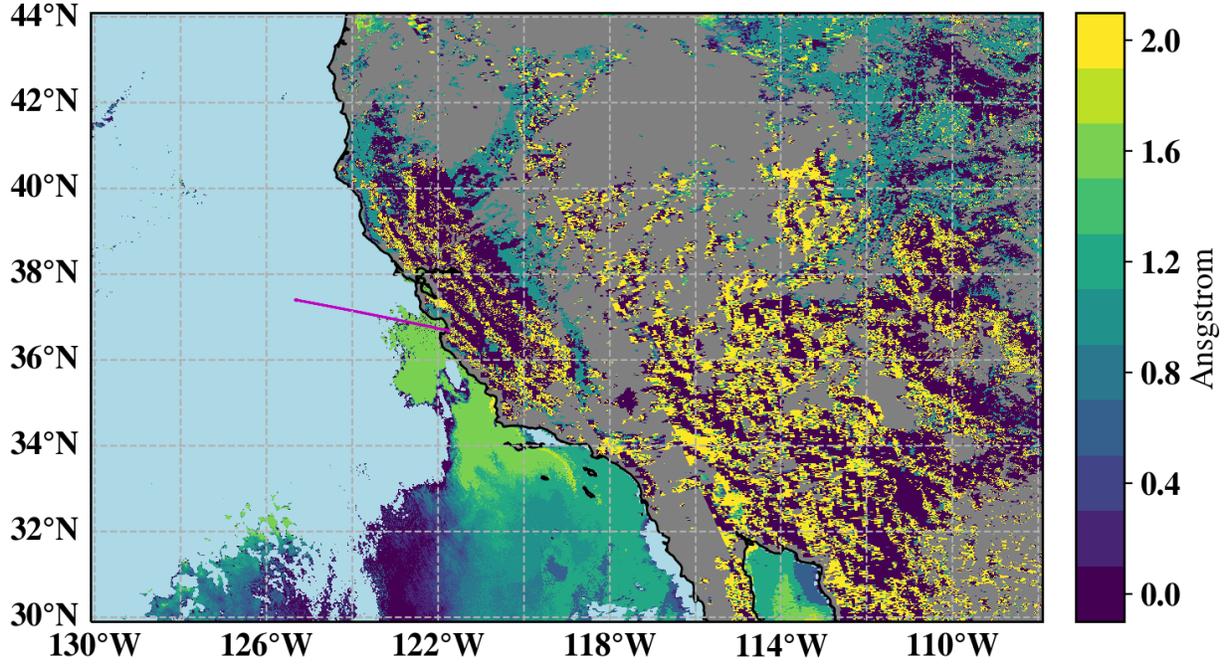
# AERONET

## Monterey

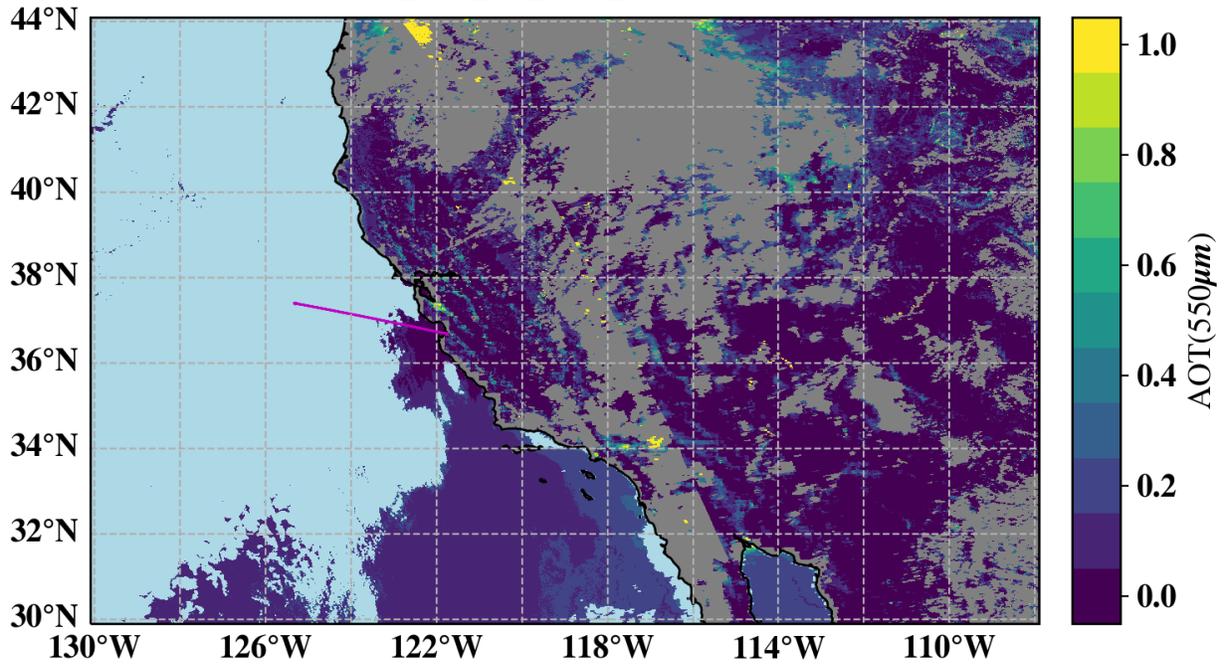


**PACE Satellite products**

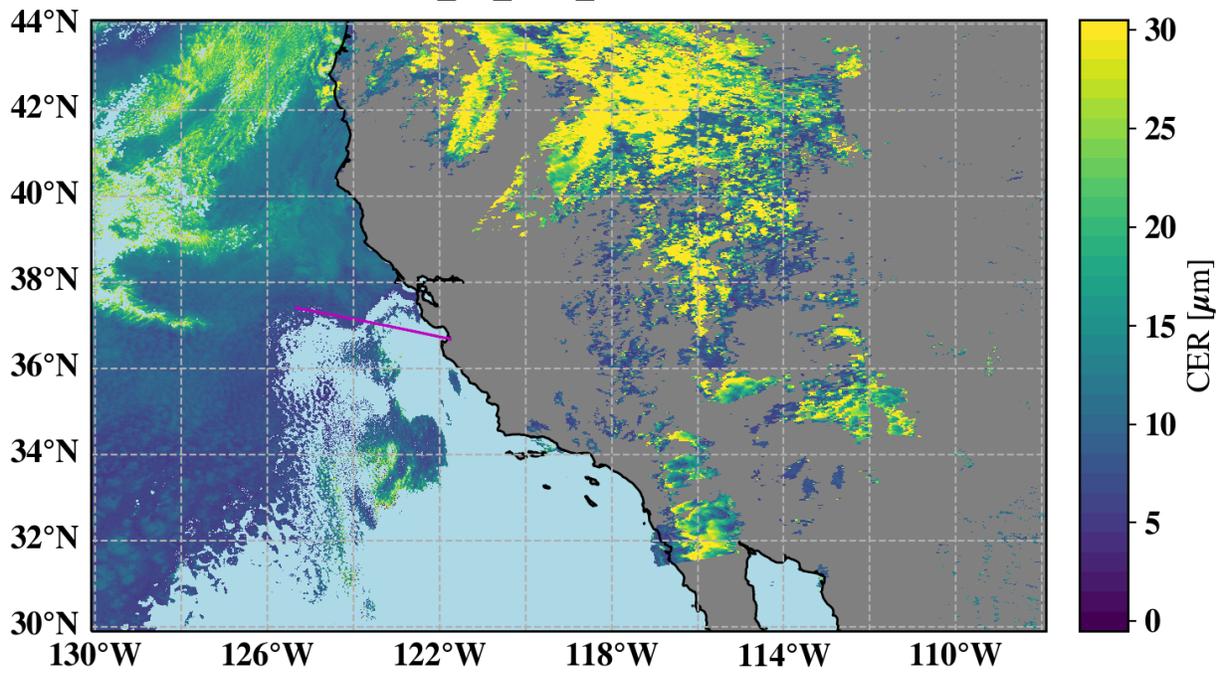
angstrom\_db\_OCI\_20240907



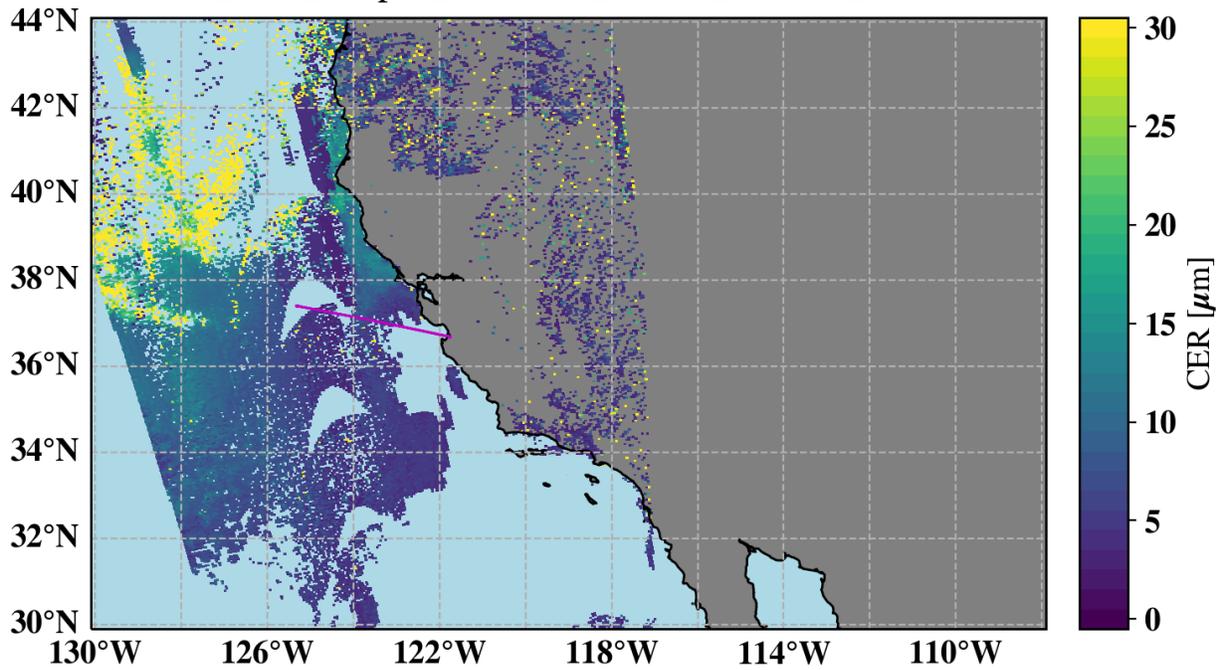
aot\_550\_db\_OCI\_20240907



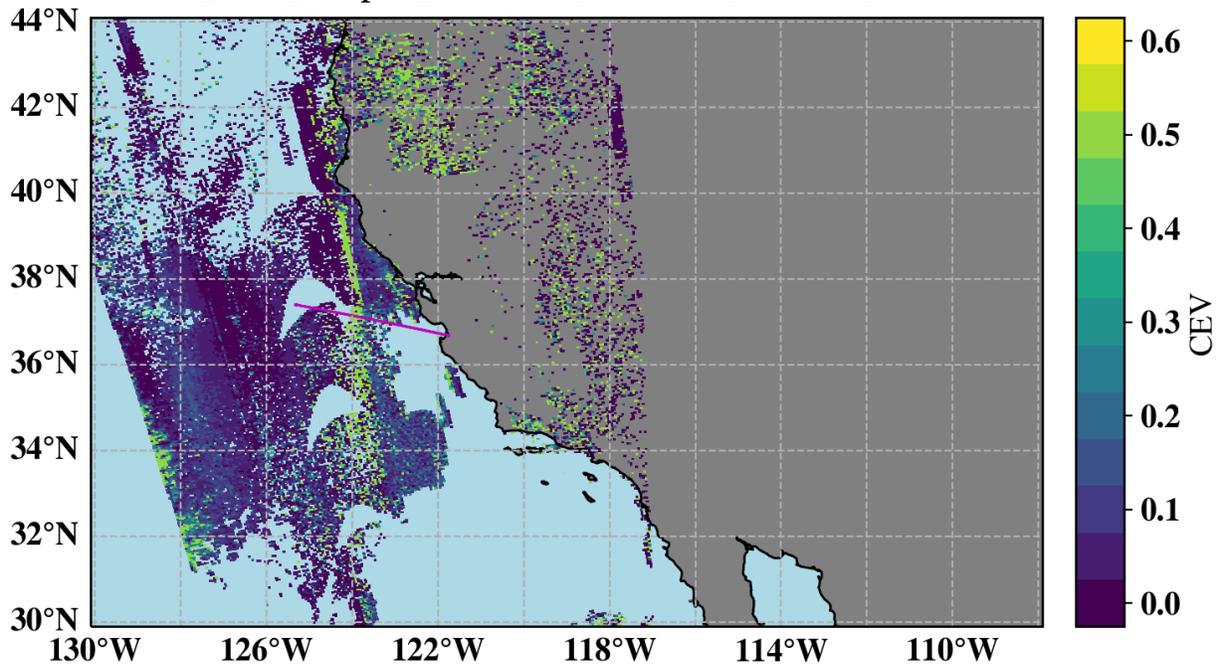
cer\_21\_OCI\_20240907



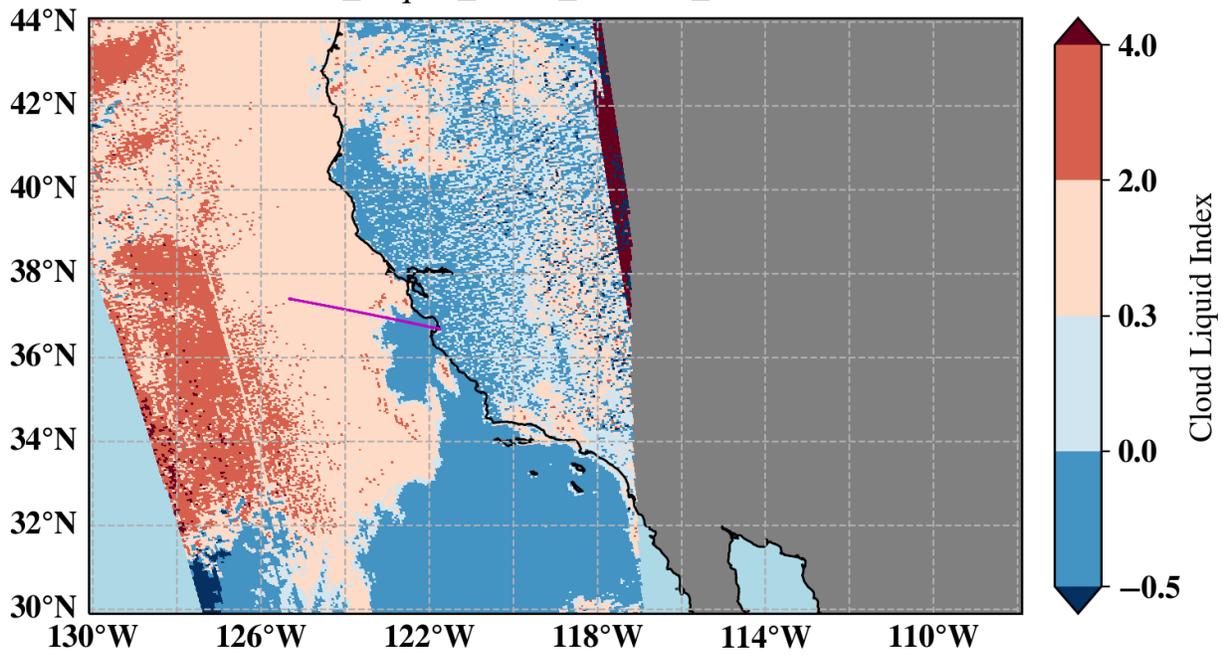
Cloud\_Bow\_Droplet\_Effective\_Radius\_HARP2\_20240907



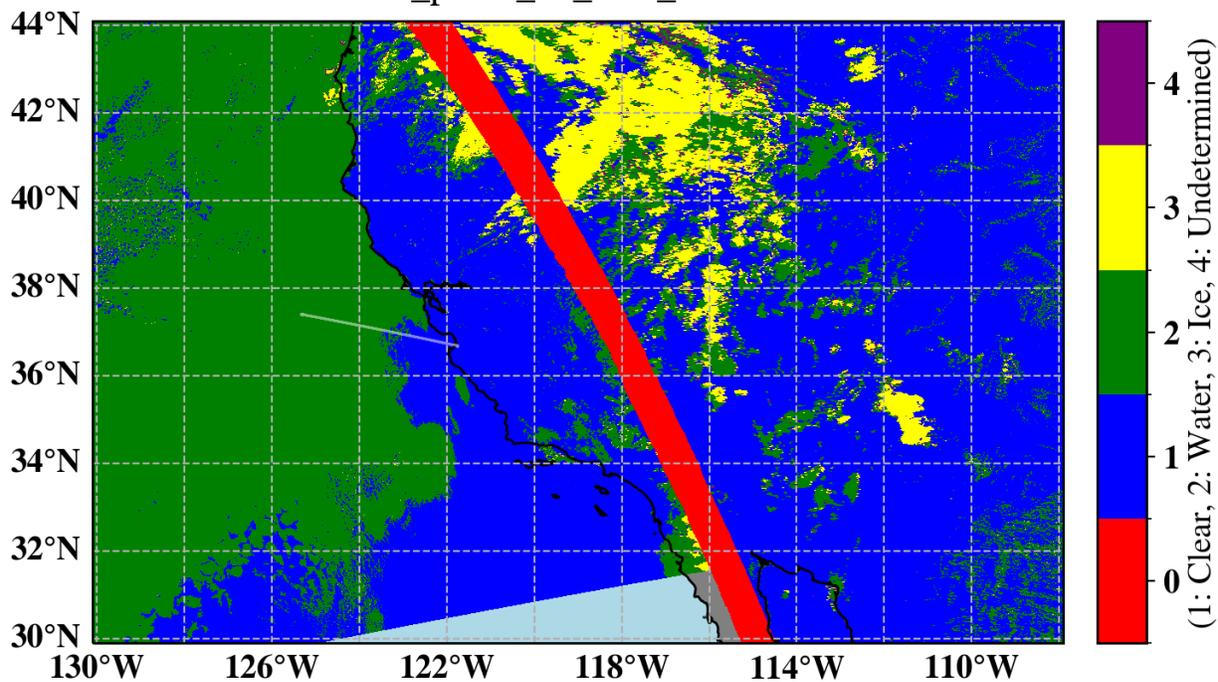
Cloud\_Bow\_Droplet\_Effective\_Variance\_HARP2\_20240907



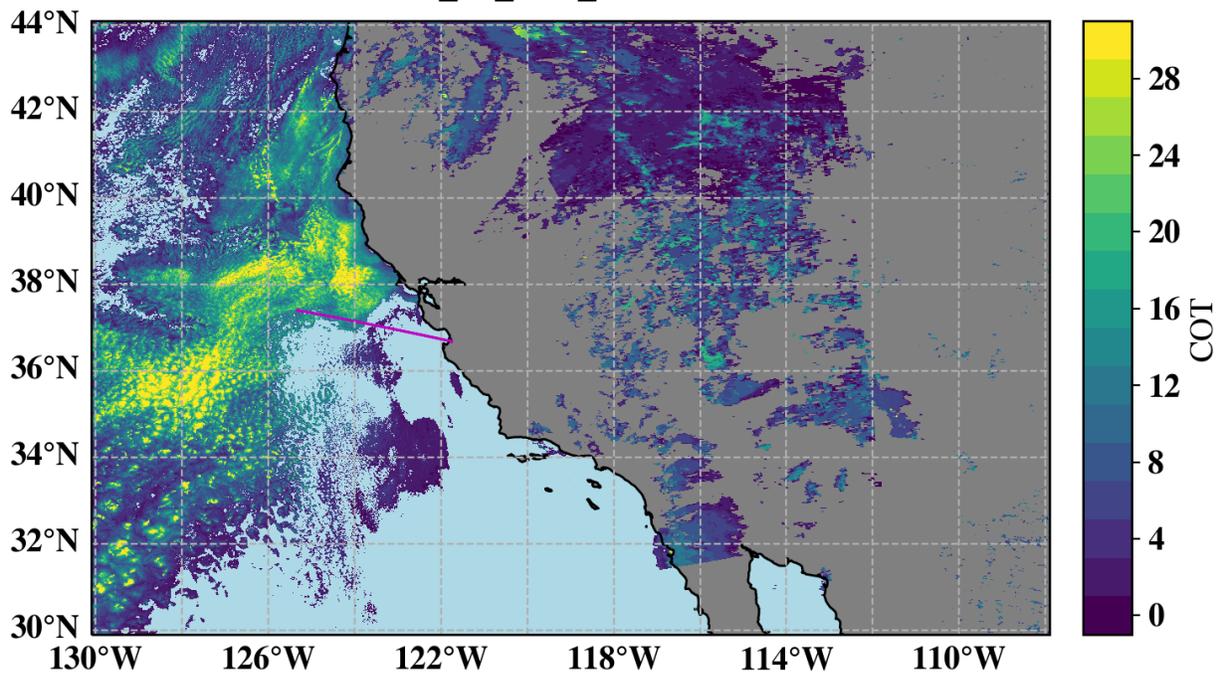
Cloud\_Liquid\_Index\_HARP2\_20240907



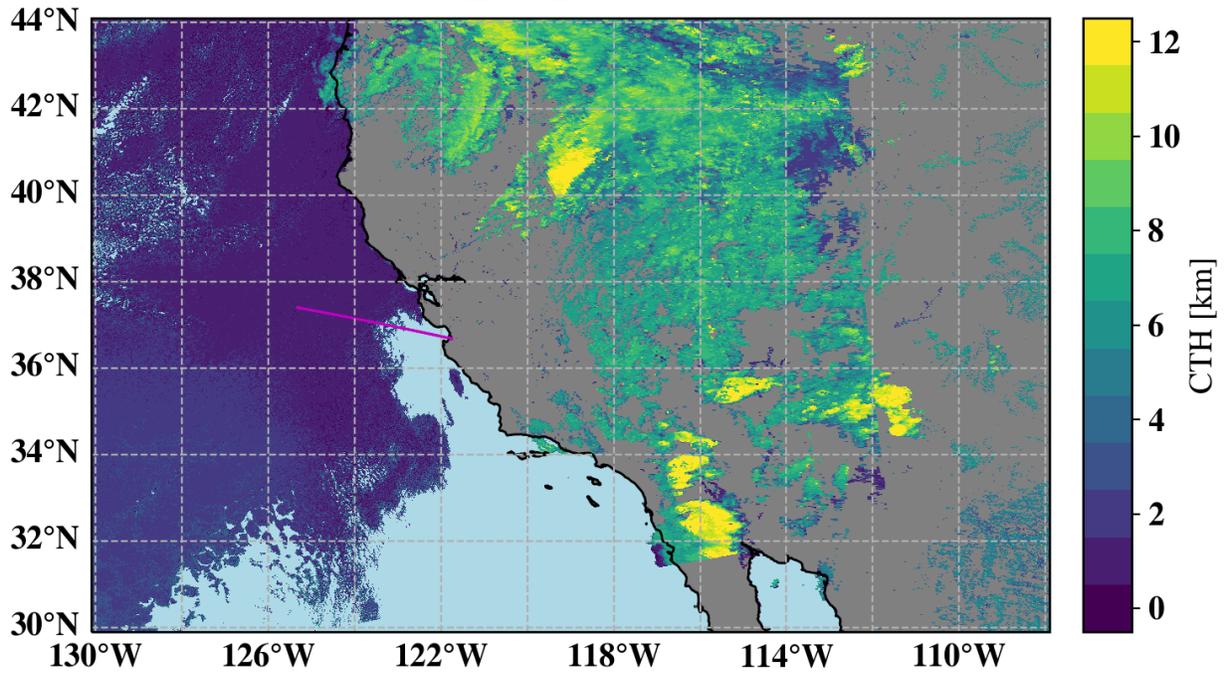
cloud\_phase\_21\_OCI\_20240907



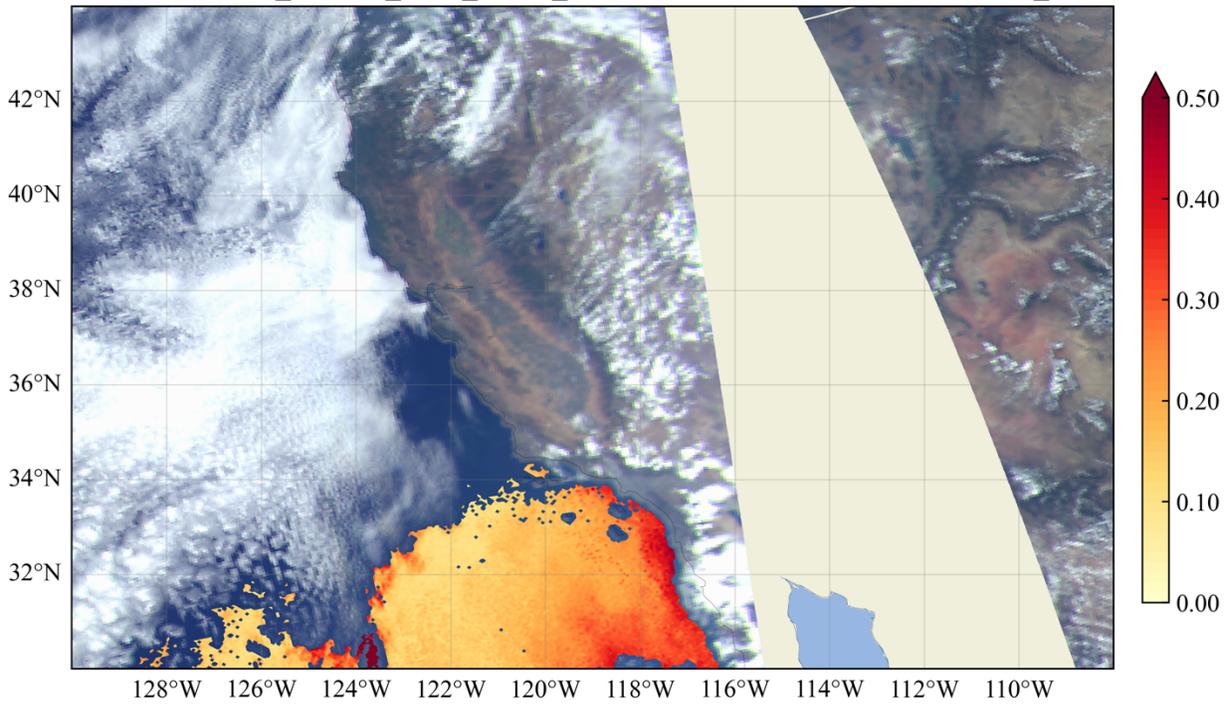
cot\_21\_OCI\_20240907



cth\_OCI\_20240907



FastMAPOL\_HARP2\_AOT\_v3.7.4\_20240907T210127-20240907T192809\_3



## Twin Otter flight report

# PACE-PAX Research Flight report 2024/09/07

## Twin Otter Flight

Manifest:

Bryce Kujat (pilot)

Jeff Martin (pilot)

Luke Ziembra (QNC)

Edward Winstead (QNC)

Take off: 12:13:22 (19:13:22 UTC) Marina Airport (OAR)

Landing: 16:04:55 (23:04:55 UTC) Marina Airport (OAR)

Duration = 3.9 hrs.

Objectives: Profiles of aerosol scattering and absorption coefficients and size distributions together with scattering (polarized) phase functions of transported smoke plume over stratocumulus clouds. Coordinated spiral profile with PACE overpass.

Summary:

Very low and sparse clouds observed over bay at takeoff, mostly clear. 4 Mm<sup>-1</sup> scattering at 2kft at 19:17 UTC. Clouds now below aircraft, and some smoke potentially observed on the NW horizon at 19:31 UTC. Start large porpoises at 19:39 UTC to look for smoke. Cloud tops 1270 ft at 19:47, with 30 Mm<sup>-1</sup> scattering just above cloud top. No smoke in the free troposphere up to 7kft during porpoising. Smoke observed at 20:16 UTC just above cloud top (at 1600 ft), 80 Mm<sup>-1</sup> scattering! Smoke extended up to 2800 ft in a very thin layer. Smoke layer 90 Mm<sup>-1</sup> scattering at 20:24 UTC, LWC 0.5 g/m<sup>3</sup> in underlying cloud. Smoke layer height fairly consistent at 2800 ft at 20:32 UTC. Cloud top at 1830 ft, 80-90 Mm<sup>-1</sup> scattering, 200-250nm diameter smoke particles at 20:33 UTC. Ascending up to 10 kft at 20:44 UTC to setup for PACE spiral, very clean FT above smoke. 20:58 UTC start spiral down; PACE overpass at 21:05 UTC during descent. Clouds here are very uniform, some small gaps but generally filled-in stratocumulus. Aerosol layer top at 4000ft at 21:14, but

fairly diffuse until just above cloud top. Cloud for PACE: top 2100ft, bottom 1300 ft. 20 Mm<sup>-1</sup> scattering below cloud, interesting the particles still look like smoke with AE = 1.5; presumably sea salt is only a minor component. 10°C inversion observed at 2000ft. Continued porpoising eastward, profiling from just-below cloud bottom to above smoke layer (generally 1000ft to 4000ft). Level leg at 1600ft started at 22:11 at 80 Mm<sup>-1</sup> scattering; maintained this altitude until no smoke was present. Observed underlying clouds break up coincident with smoke dissipation. Performed two missed-approaches before landing.

Interesting case with smoke aerosol over stratocumulus clouds. Smoke was fairly concentrated (90 Mm<sup>-1</sup> scattering), but in a very thin layer resulting in low presumed AODs. While the spatial extent of the smoke seemed well represented in forecast models, the predicted vertical extent showed large discrepancies with observations.

Dewpoint Temperature sensor was not operational for this flight, while all other instrumentation (including humidifier and f(RH)) operated nominally.



Sparse clouds (streets?) observed over Monterey Bay at 19:20 UTC (Photo = Ziemba)



Stratocumulus cloud deck observed at 20:21 UTC. Note smoke layer possibly visible on north horizon (Photo = Ziembra)



KOAR airfield and ground-measurement tower location during missed approaches (Photo = Ziemba)