

# PACE-PAX research report 2024/09/20

Compiled by Kirk Knobelspiesse, Ivona Cetinić, Brian Cairns, Michael Ondrusek,  
2024/09/28

Reviewed by Samuel LeBlanc

Planned ER2 +Shearwater and ER2+TO operations offshore in southern California (Shearwater) and in cloudy conditions near the Monterey Bay (TO). PACE track inland (20:20). Unfortunately ER-2 flight scrubbed due to NASA-wide grounding of all ER-2's due to potential engine issue. Inspection showed no issue, to aircraft ready for next day. TO operations modified to be a short flight at the time of PACE overpass.

## ER-2

ER-2 flight scrubbed due to fleetwide grounding of ER-2's for potential engine issue. Inspected and resolved to be ready for flight next day.

## Twin Otter

Take off: 12:17:48 (19:17:48 UTC) Marina Airport (OAR)

Landing: 15:43:17 (21:25:33 UTC) Marina Airport (OAR)

Duration = 2.1 hrs

Manifest: Bryce Kujat (pilot), Jeff Martin (pilot) , Michael Shook (QNC), Francesca Gallo (QNC), Edward Winstead (QNC)

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

## R/V Shearwater

Mission Scientist: Michael Ondrusek

Sailed out: 15:54 UTC

Back in port: 22:56 UTC

[See end for full R/V Shearwater report](#)

## R/V Blissfully

Operations concluded

## PACE

Overpass at 20:20, east along California/Nevada border

## EarthCARE

Far from operations area, not targeted

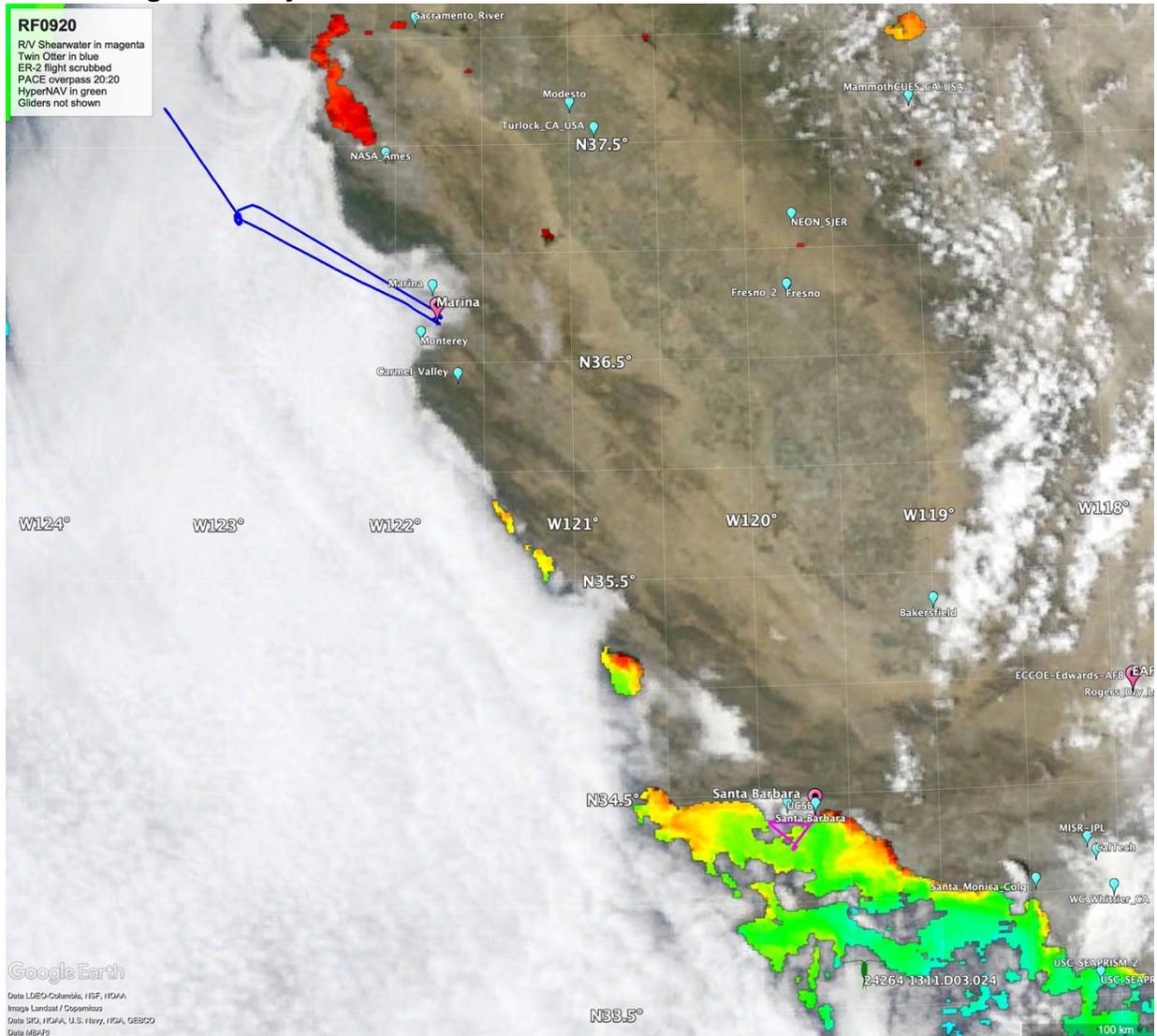
## Gliders

Operational

## HyperNAV

Operational

## Overall image summary



Note: not shown is the PACE tracks outside of range

### Validation Traceability Matrix itemized objectives

VTM elements in **black** satisfied, **blue** partially satisfied, **red** to be confirmed

Time UTC	Platform	VTM(hrs)	
15:54	RS		Shearwater departs
16:50	RS		Arrives on station 25. Planned ER-2 overpass scrubbed. Departure 17:13. Partly cloudy.
18:01	RS		Arrives on station 26. Planned ER-2 overpass scrubbed. Departure 19:38. Mostly cloudy.
19:17	TO		Takeoff from Marina
19:47	TO	1e(3), 6e(1.5*0.5)	Begin operations: spiral down outside ADIZ line, then porpoising NW from there, turn and return at 20:33, concluding at 20:56. Within PACE-O swath, aerosol above clouds.
20:20	PACE		PACE overpass (east of operations region)

20:23	RS	1b(2), 1c(2)	Arrives on station 27. PACE-O overpass. Mostly clear. Departure 21:47
21:25	TO		Landed Marina
23:15	RS		Shearwater back in port

PACE-O: within swath of PACE's OCI instrument

PACE-OH: within swath of PACE's OCI and HARP2 instruments

PACE-OHS: within swath of PACE's OCI, SPEXone and HARP2 instruments

TO: Twin Otter

RB: R/V Blissfully

RS: R/V Shearwater

### Assessment:

- 0.8% of objectives observed, as expected with no ER-2 operations.
- Top remaining objectives (score above 6.0): PACE aerosol in narrow swath (3a,b)

PACE-PAX progress tracking														
Validation objectives	ID	Measurement objectives	Importance, w	Observation time, h (hours)	Total observed (hours)	Fractional success 9/16	Fractional success 9/17	Fractional success 9/18	Fractional success 9/19	Fractional success 9/20	Fractional success 9/21	Fractional success 9/22	Total success	Remaining score
1. Validate new retrieval properties	a	Land surface parameters	8	2.0	4.0	0.0%	39.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.338	0.5
	b	Ocean radiometric parameters	10	8.0	17.0	0.0%	2.0%	0.5%	0.4%	0.1%	0.0%	0.0%	0.395	0.0
	c	Aerosol parameters over the ocean	12	8.0	12.0	0.0%	4.1%	1.1%	1.2%	0.6%	0.0%	0.0%	0.580	0.2
	d	Aerosol parameters over land	12	8.0	4.5	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.998	0.0
	e	Cloud parameters	12	8.0	3.0	0.0%	0.0%	0.0%	0.0%	9.5%	0.0%	0.0%	0.790	2.5
	f	Ocean surface parameters	1	8.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	1.0
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%	0.0%	0.354	6.5
	b	Aerosol parameters over land (PACE)	10	8.0	2.0	0.0%	17.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.403	6.0
	c	Cloud parameters (PACE)	5	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.713	1.4
	d	Aerosol parameters (EarthCARE)	8	4.0	4.5	0.0%	28.2%	3.0%	7.9%	0.0%	0.0%	0.0%	0.826	1.4
	e	Cloud parameters (EarthCARE)	8	4.0	1.0	0.0%	19.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.313	5.5
	f	Ocean surface parameters	1	8.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	1.0
4. Validate radiometric and polarimetric properties	a	Validate large reflectances	6	2.0	4.0	0.0%	49.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.923	0.5
	b	Validate large reflectances with high polarization	6	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.393	3.6
	c	Validate large reflectances with low polarization	6	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.777	1.3
	d	Overfly vicarious calibration sites	6	4.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.268	4.4
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%	0.0%	1.000	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%	0.0%	0.393	2.4
	c	Multiple aerosol layers	1	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.000	0.0
	d	Aerosol under thin cirrus	2	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	2.0
	e	Aerosol above liquid phase cloud	4	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.826	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%	0.528	1.9
	g	Dust aerosols over ocean	4	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.430	2.3
	h	Aerosol and ocean parameters over turbid waters	2	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.790	0.4
	i	Aerosol and ocean parameters over biologically productive waters	4	2.0	5.0	0.0%	86.5%	5.3%	0.0%	0.0%	0.0%	0.0%	0.918	0.3
	k	Smoke aerosols over ocean	1	2.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.713	0.3
	total:			150	98	57.0	0.0%	10.6%	0.3%	0.5%	0.8%	0.0%	0.699	
				ER-2 flight hours	15.8	0	0	0	0	0	0	0	0	15.8
				TO flight hours	11.2	0	0	0	0	0	0	0	0	11.2
				Shearwater days	4	0	0	0	0	0	0	0	0	4
PACE-PAX overall objectives satisfied:					0.699									

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>

## R/V Shearwater photos

**Station #25** 34° 15.188', -119° 48.275' , arrival 16:50 UTC → departure 17:13 UTC

Arrival photo:



Departure photo (departure location - 34° 15.302', -119° 48.158')



**Station #26** 34° 16.681' N, - 119° 40.640', arrival 18:01 UTC → departure 19:38 UTC

Arrival photo:



Departure photo: (34° 22.557', 119° 56.966')



**Station #27** 34° 21.636', 119° 43.193', arrival 20:23 UTC → departure 21:47 UTC

PACE overpass at 20:21

Arrival photo:



Departure photo: (34° 21.887', - 119° 43.463')



## Twin Otter photos



Cloud top over Salinas after taking off at 19:19UTC (~1600ft) ; photo taken by Francesca Gallo.



Below cloud while porpoising north parallel to the ADIZ line at 20:20 UTC at ~600ft (Sca ~25Mm<sup>-1</sup>); photo taken by Francesca Gallo.

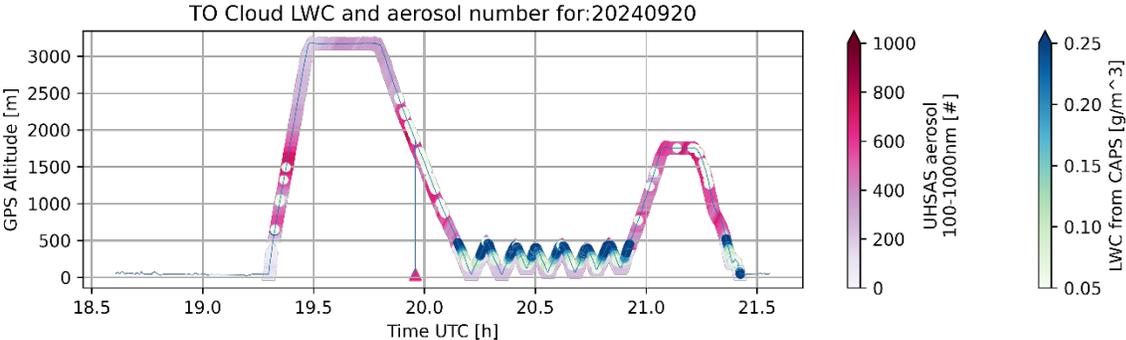


Approaching Marina Airport at 21:23 UTC; photo taken by Francesca Gallo.

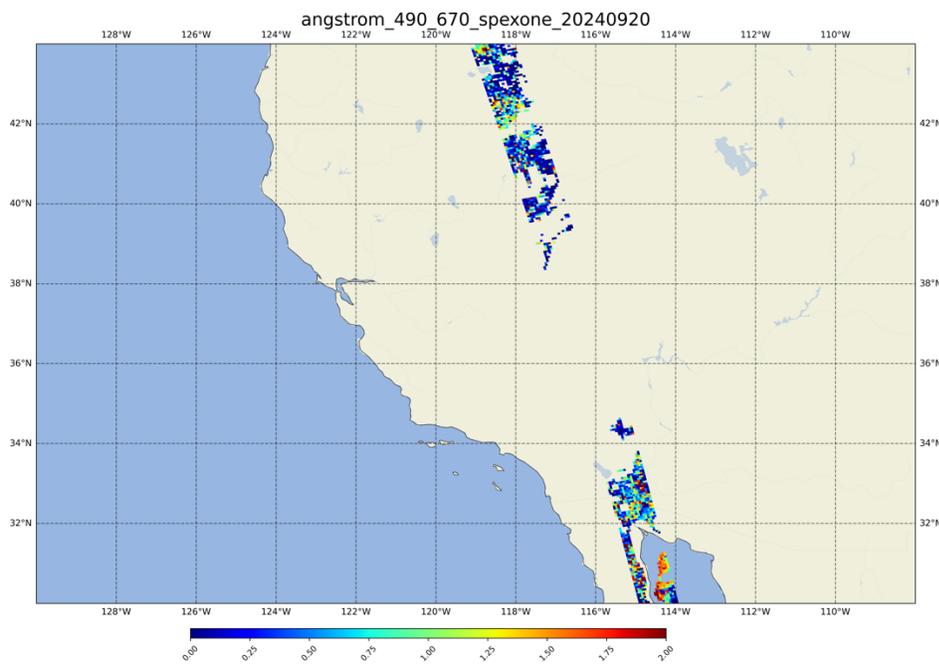
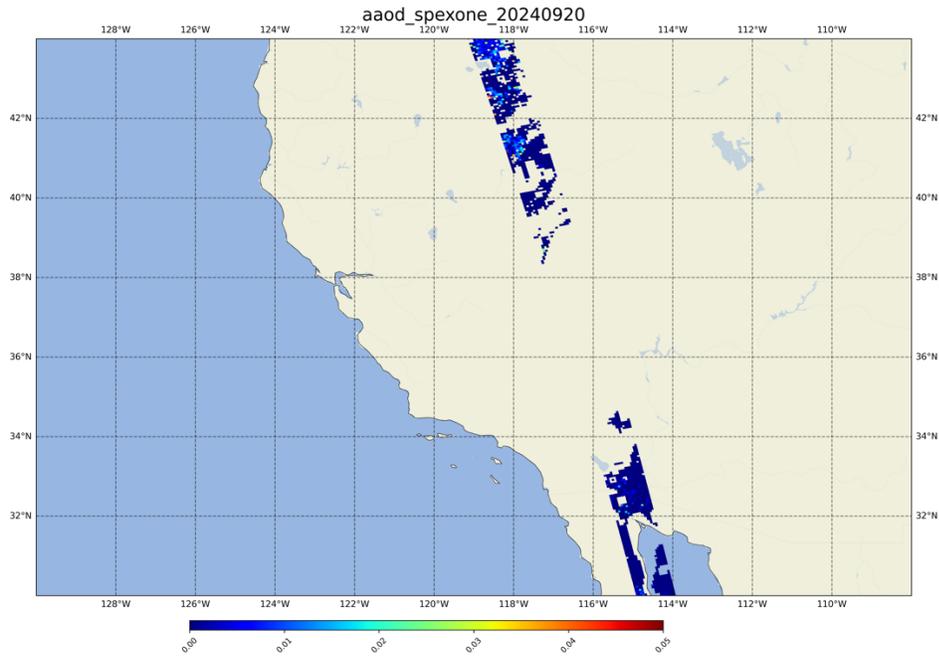


Landing at Marina Airport at 21:25:33 UTC; photo taken by Francesca Gallo.

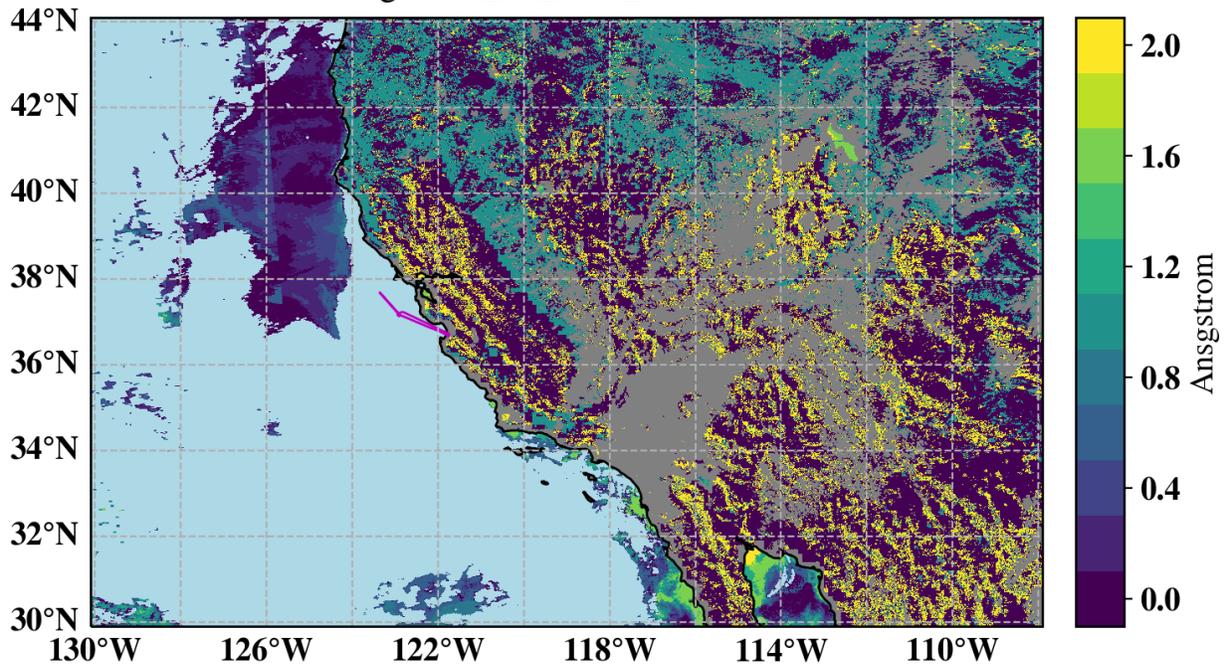
Twin Otter quicklook (Cloud liquid water content (LWC) and aerosol number from UHSAS)



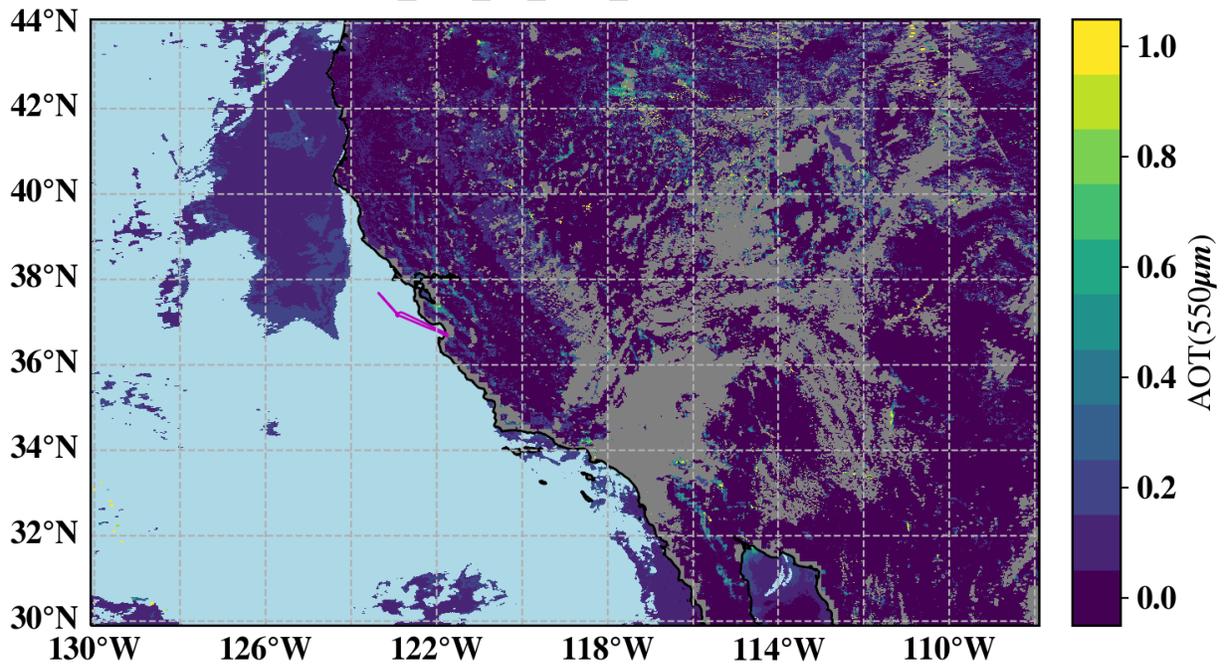
# PACE quicklooks



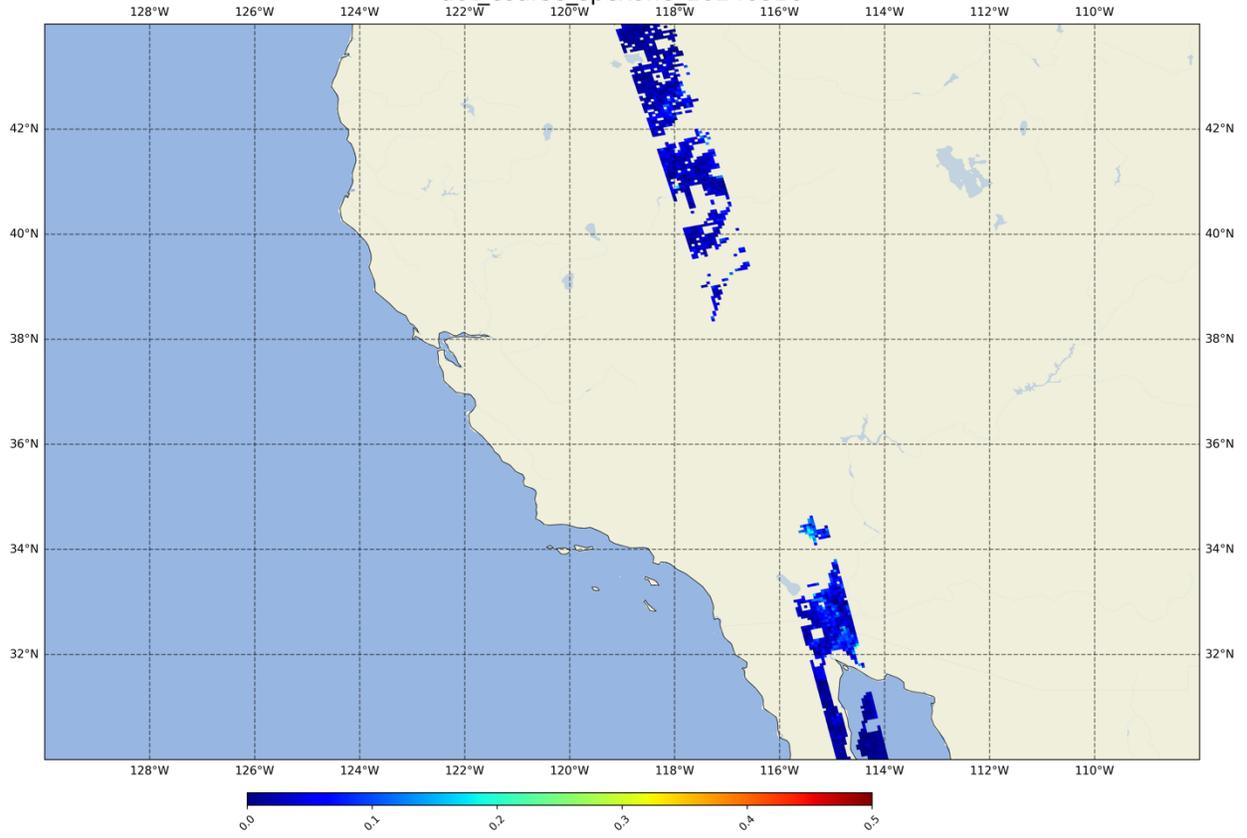
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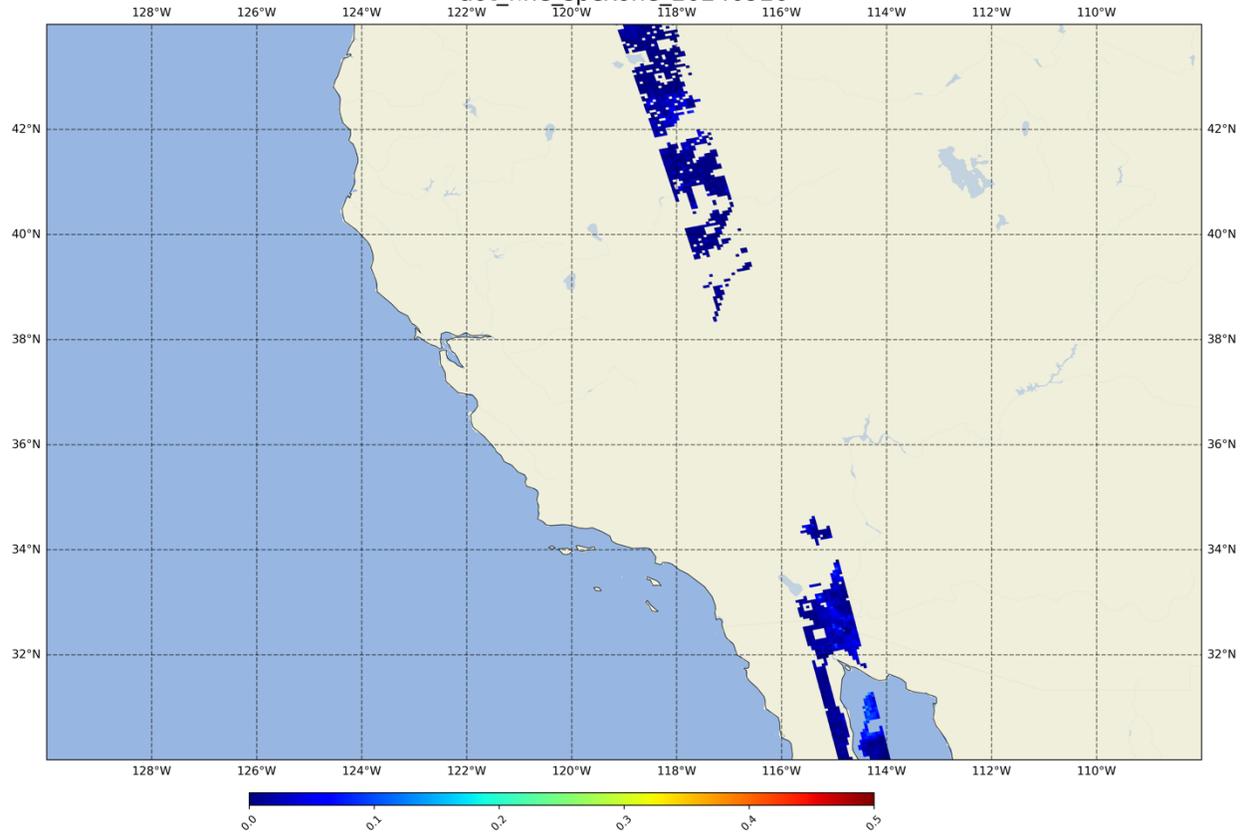
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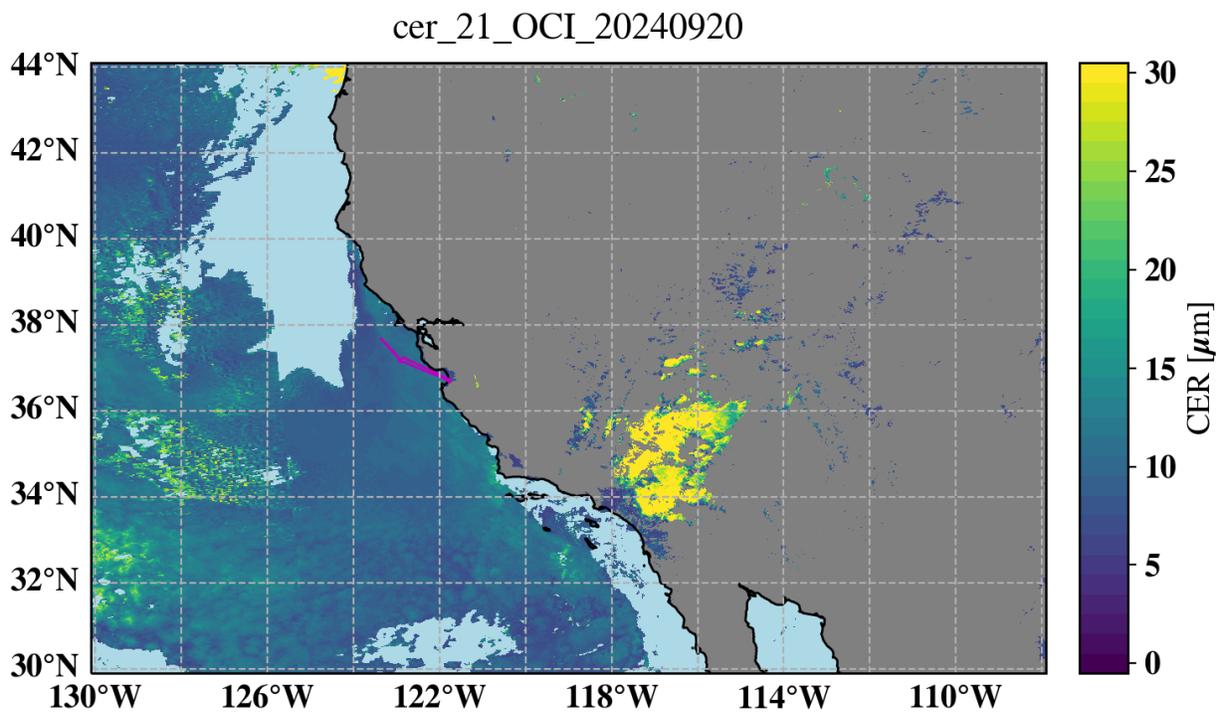
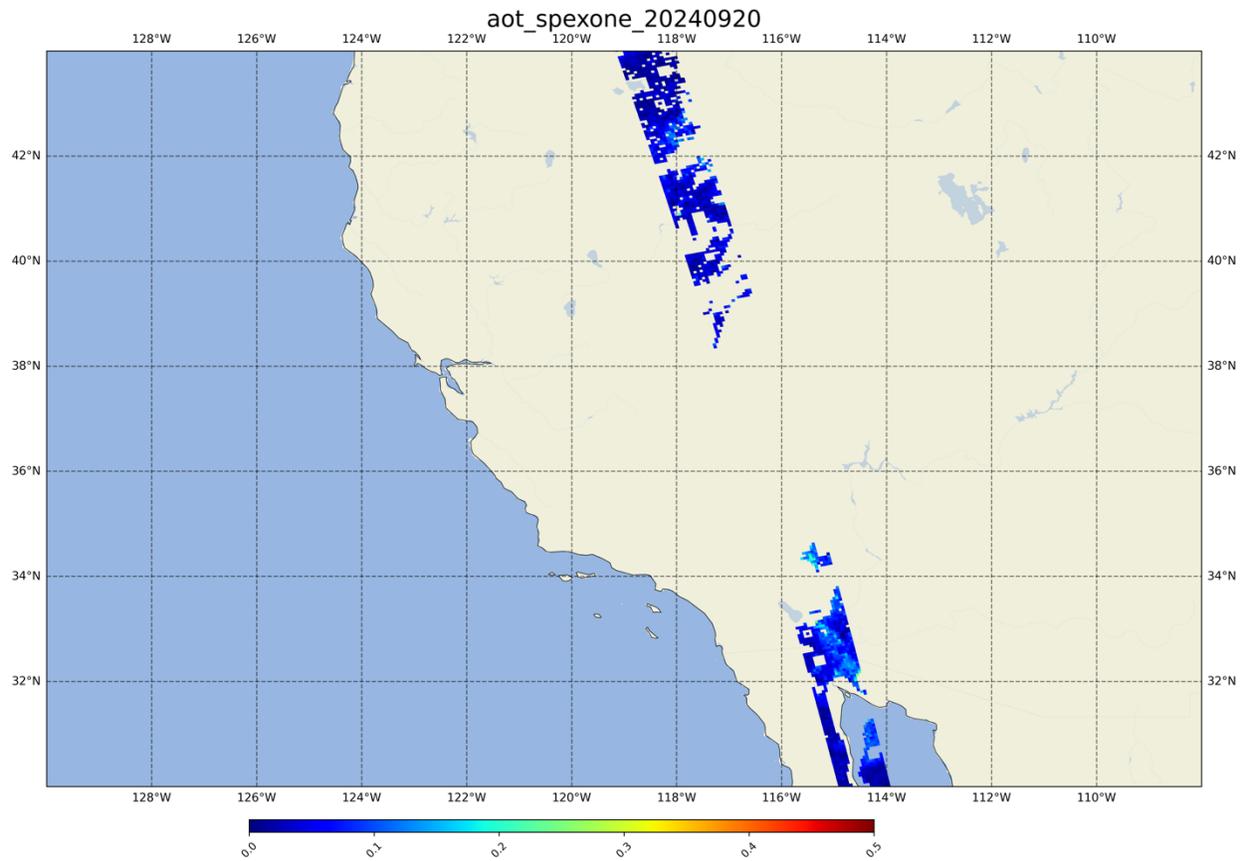


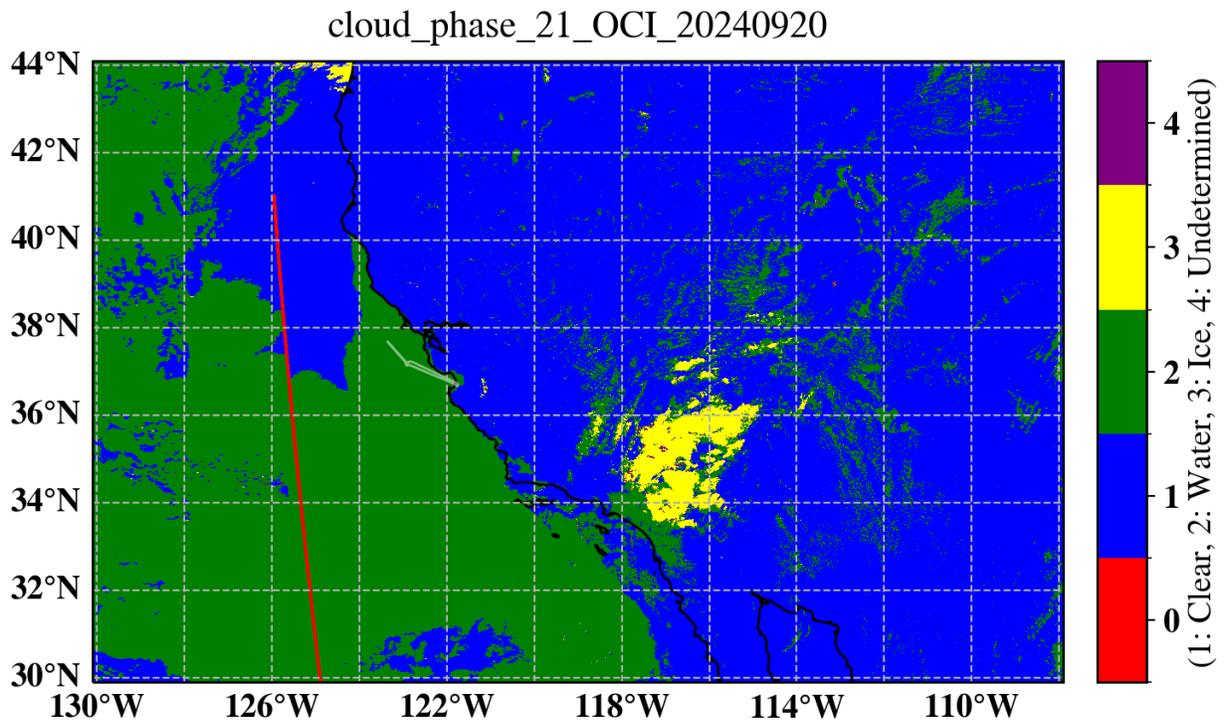
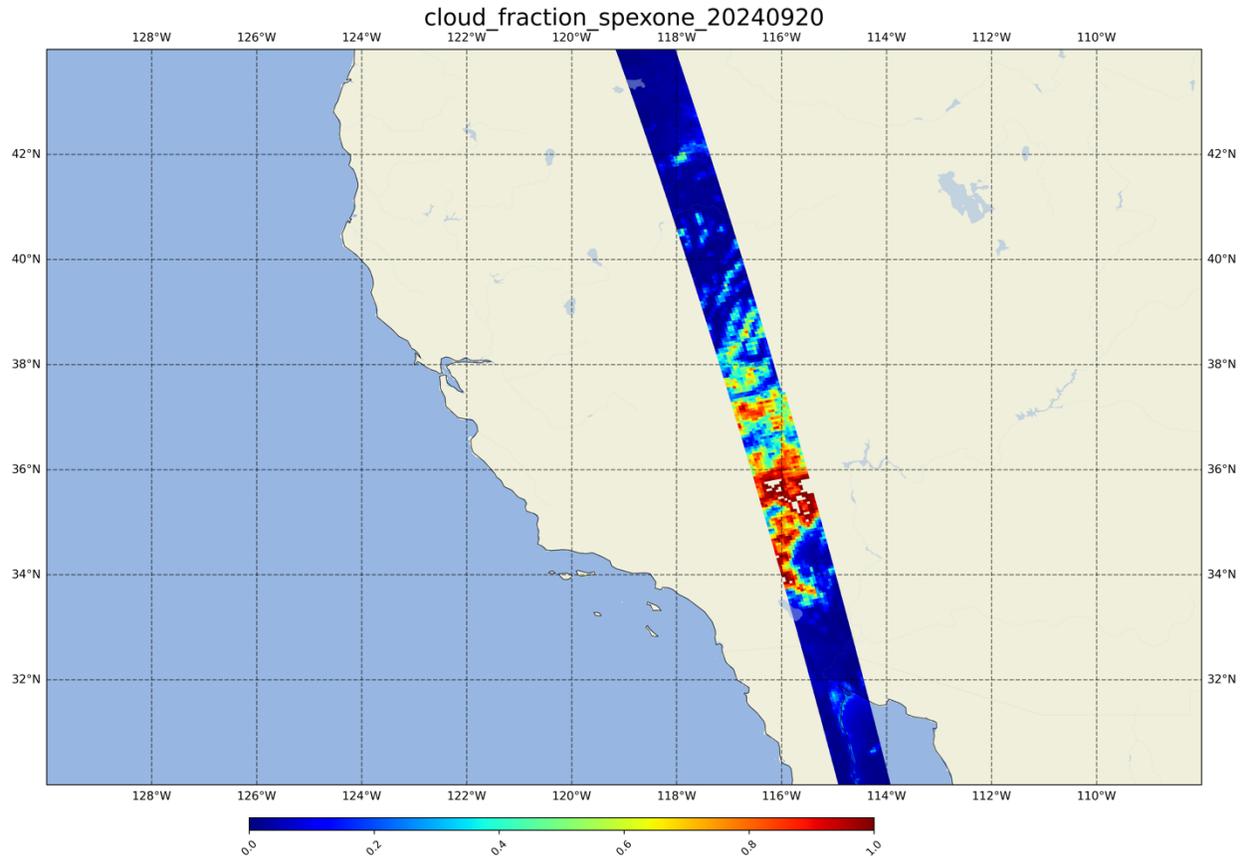
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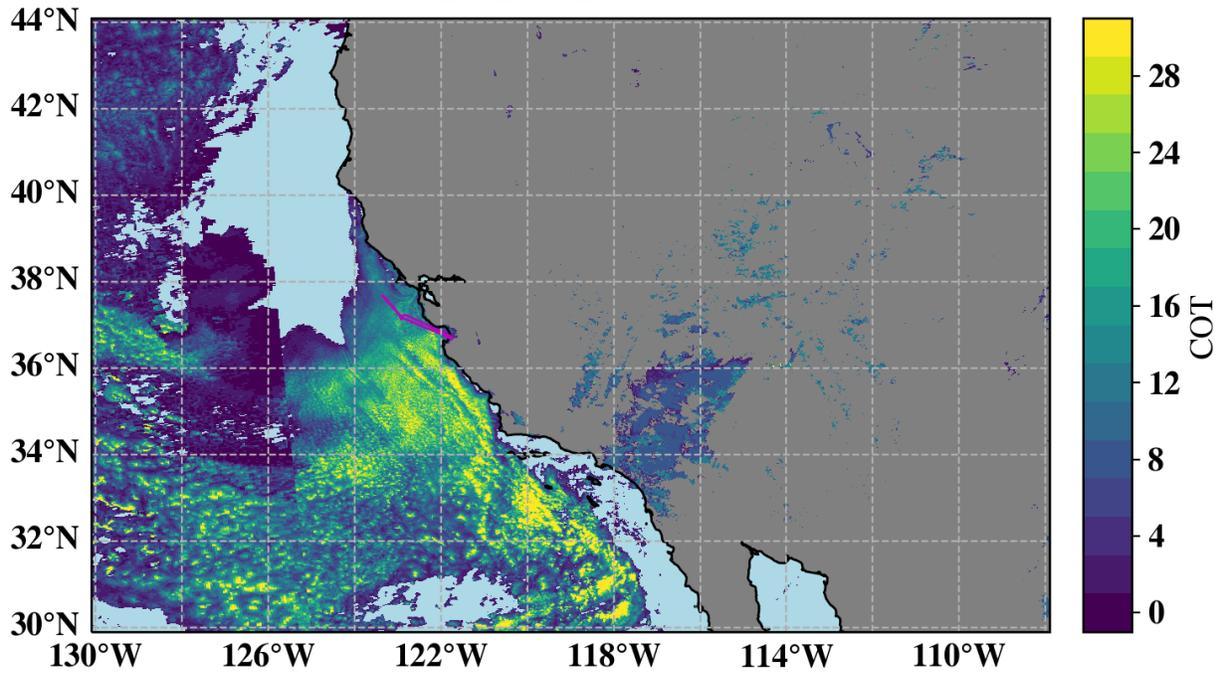
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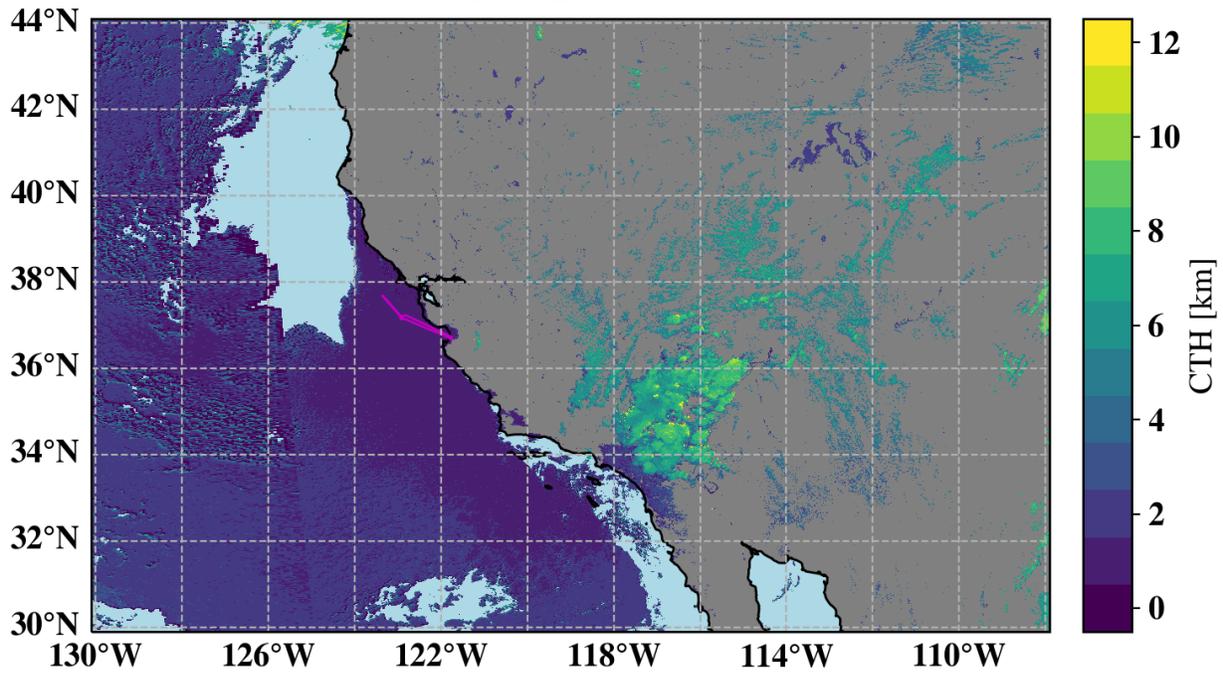




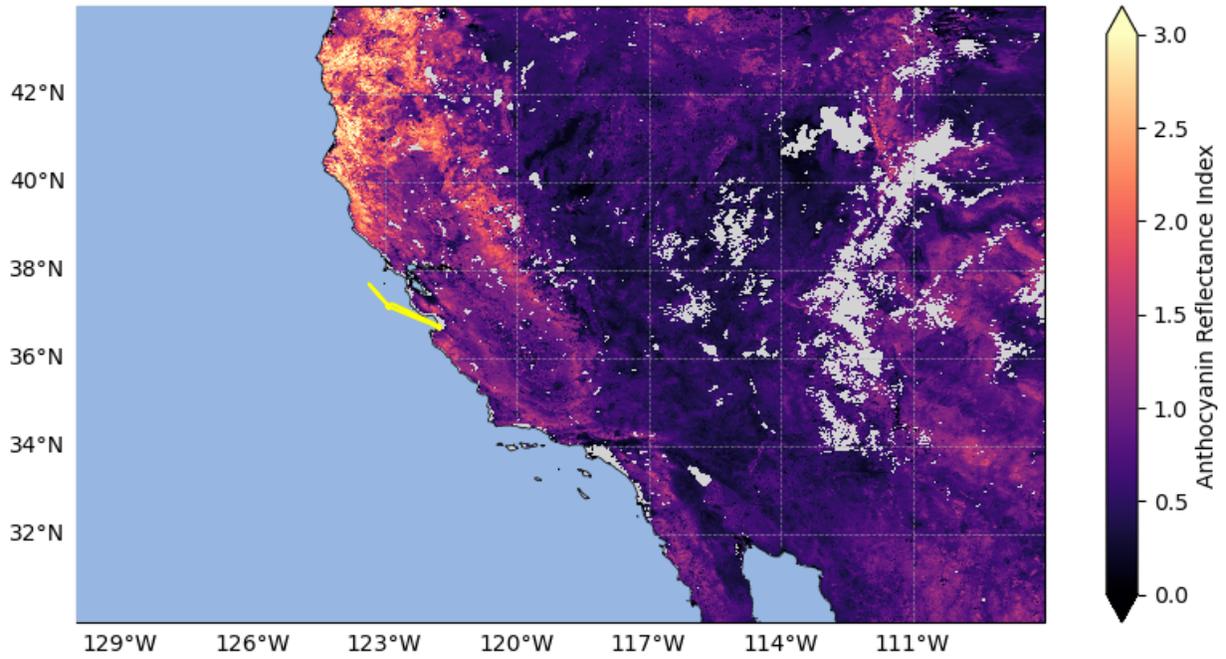
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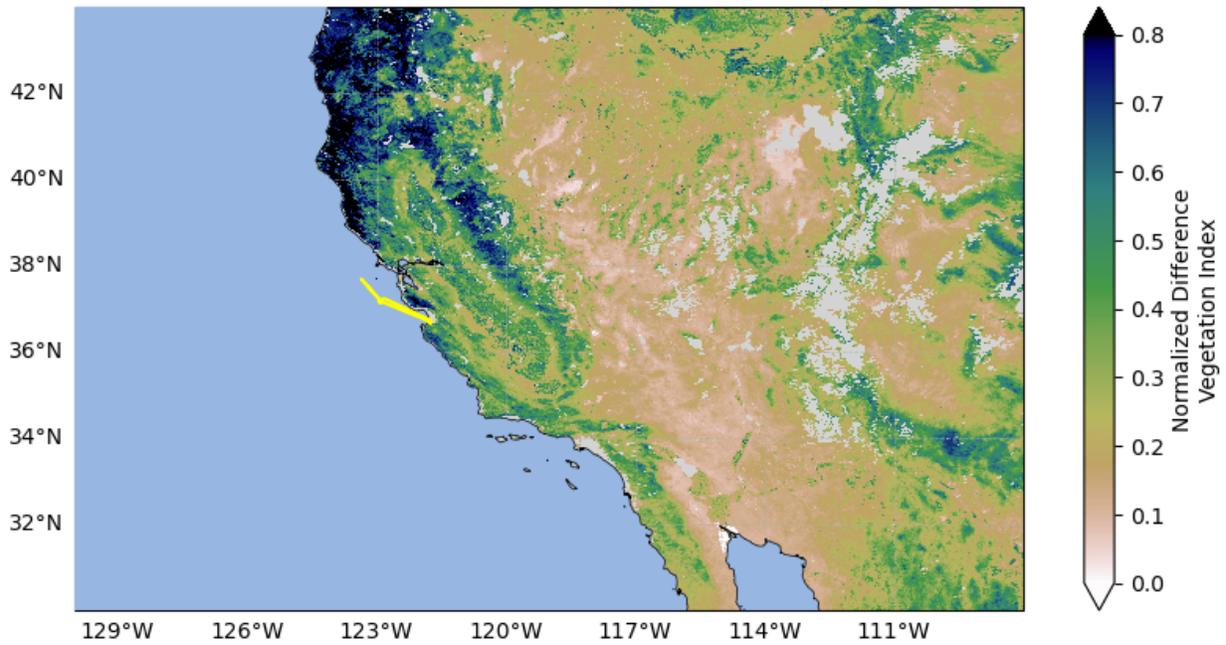
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OCI mARI with Twin Otter Flight Track, 2024-09-20



OCI NDVI with Twin Otter Flight Track, 2024-09-20



## Twin Otter report

# PACE-PAX Research Flight report 2024-09-20

## Twin Otter Flight

### Manifest:

Bryce Kujat (pilot)

Jeff Martin (pilot)

Michael Shook (QNC)

Francesca Gallo (QNC)

Edward Winstead (QNC)

Note: This was a planned ER2 underflight, but the ER2 scrubbed.

Take off: 12:17:48 (19:17:48 UTC) Marina Airport (OAR)

Landing: 15:43:17 (21:25:33 UTC) Marina Airport (OAR)

Duration = 2.1 hrs

Objectives: Cloud microphysics under PACE. Perform a full altitude extent spiral profile down to minimum altitude just past the ADIZ line, then porpoise through the marine stratus to obtain cloud microphysics statistics for ~30 minutes before and after the PACE overpass time. After completing the porpoising, ascend to cross the ADIZ line, then return to Marina Airport.

### Summary:

After taking off, we ascended in line to 10 kft. Once we leveled off, conditions were fairly clean, with green scattering coefficient  $\sim 4\text{Mm}^{-1}$  and a few supermicron particles. We crossed the ADIZ line near PIRAT and began a spiral descent to 100 ft around 19:47 UTC. During the descent, we observed a gradual increase in scattering coefficient up to about  $10\text{Mm}^{-1}$  at around 7.5 kft, before decreasing back down to around  $5\text{Mm}^{-1}$  at about 4.5 kft. The cloud top during the spiral was about 1.5 kft with a cloud base at around 500 ft, and a Liquid Water Content (LWC) at cloud top around  $0.3\text{g/m}^3$ . With no point or track requirement for the PACE underpass, we decided to porpoise north

parallel to the ADIZ line. Due to the focus on microphysics and the minimal extinction above cloud top, we chose to sample for ~10 secs. above and below cloud during the porpoises. Cloud top height descended from ~1500 ft at the south end of our track to ~1250 ft at the north end; cloud bases were quite ragged, with bases ranging from ~500 ft at the south end to ~200 ft at the north end. Cloud top LWC remained fairly constant at around ~0.35g/m<sup>3</sup> and up to 0.4g/m<sup>3</sup>, with LWC decreasing with altitude (LWC ~0.25g/m<sup>3</sup> at 1.0 kft, ~0.12 ~0.25g/m<sup>3</sup> at ~800 ft, and ~0.18 ~0.25g/m<sup>3</sup> at 650 ft) Several large cargo ships were observed in the area. Above-cloud scattering coefficients were relatively constant at around 10 Mm<sup>-1</sup>, with below-cloud scattering coefficients at around 25 Mm<sup>-1</sup> and higher hygroscopicity. We turned to head back south along the same track around 20:33 UTC, with conditions consistent with previous observations. Porpoising concluded at 20:56 UTC, when we ascended to 4.5 kft to cross the ADIZ line and return to Marina. No missed approaches were possible at the tower due to local weather.



Passing Marina Airport Tower before taking off at 19:41UTC; photo taken by Francesca Gallo.



Cloud top over Salinas after taking off at 19:19UTC (~1600ft) ; photo taken by Francesca Gallo.



Below cloud while porpoising north parallel to the ADIZ line at 20:20 UTC at ~600ft (Sca ~25Mm<sup>-1</sup>); photo taken by Francesca Gallo.



Approaching Marina Airport at 21:23 UTC; photo taken by Francesca Gallo.



Landing at Marina Airport at 21:25:33 UTC; photo taken by Francesca Gallo.

# R/V Shearwater report

## PACE-PAX R/V Shearwater day report

**Date:** 09/20/2024

**Creator:** Michael Ondrusek

**Cruise ID:** RF0920-RS

**Sailed out:** 15:54 UTC

**Back in port:** UTC ()

**Today**, the ship occupied three stations. Note that planned ER-2 overflights were canceled after the departure of R/V Shearwater from the dock.

**Station #25** 34° 15.188', -119° 48.275' , arrival 16:50 UTC → departure 17:13 UTC

Arrival photo:



Departure photo (departure location - 34° 15.302', -119° 48.158')



**Station #26** 34° 16.681' N, - 119° 40.640', arrival 18:01 UTC → departure 19:38 UTC

Arrival photo:



Departure photo: (34° 22.557', 119° 56.966')



**Station #27** 34° 21.636', 119° 43.193', arrival 20:23 UTC → departure 21:47 UTC

PACE overpass at 20:21

Arrival photo:



Departure photo: (34° 21.887', - 119° 43.463')



**Tomorrow**, RV Shearwater will

**Ship plans through the next 3 days...**

**System Status...**

All good

**Group Status...**

All great