

PACE-PAX research flight report 2024/09/06

Compiled by Kirk Knobelspiesse, Brian Cairns, Ivona Cetinic, Bridget Seegers, Michael Ondrusek, 2024/09/09 DRAFT

Reviewed by Samuel LeBlanc

Coordinated TO + ER2 + RS + RB + PACE operations. TO double sortie to Santa Barbara channel (Shearwater) and USC_SeaPRISM/Blissfully latter aligned with PACE overpass. ER2 overflies all in mostly cloud free conditions, including operations further north near a fire. PACE track along partly cloudy Sierra Nevada mts and over ocean near USC_SeaPRISM/Blissfully. TO RTB after refueling in Camarillo, with an intercept of smoke aerosol along return track over the Diablo mountain range.

ER-2/HSRL coolenol issue resolved. ER-2/PICARD lost some of last leg for unknown data issues. TO Humidifier not operational, no f(RH). 1st day of Shearwater operations, late departure and some instruments not yet operational.

ER-2

Takeoff: 17:03, Landing: 23:06, Duration: 6.1

Instrument status: HSRL issue from previous flight resolved. PRISM lost last data leg, issue under investigation. All other instrments good.

Mission Scientist: Kirk Knobelspiesse

Pilot: Kirt Stallings, Mobile Pilot: James 'Coach' Nelson

Twin Otter

First sortie

Takeoff: 17:16, Landing: 22:16, Duration: 5

Instrument status: humidifier nonfunctional, no f(rh)

Second sortie

Takeoff: 23:15, Landing: 01:04 (2024/09/07), Duration: 2

Instrument status: humidifier nonfunctional, no f(rh). PCASP off to prevent overheating.

Mission Scientist: Anthony Bucholtz

Manifest: Bryce Kujat (pilot), Jeff Martin (pilot), Luke Ziemba (QNC), Anthony Bucholtz (QNC)

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

R/V Shearwater

Departure: 20:00, Return 00:19 (09/07/2024), Duration 4.3

Mission Scientist: Michael Ondrusek

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

R/V Blissfully

Departure: 15:11, Return: 01:35 (09/07/24), Duration: 7.3

Instrument status: nominal

Captain/Mission Scientist: Bridget Seegers

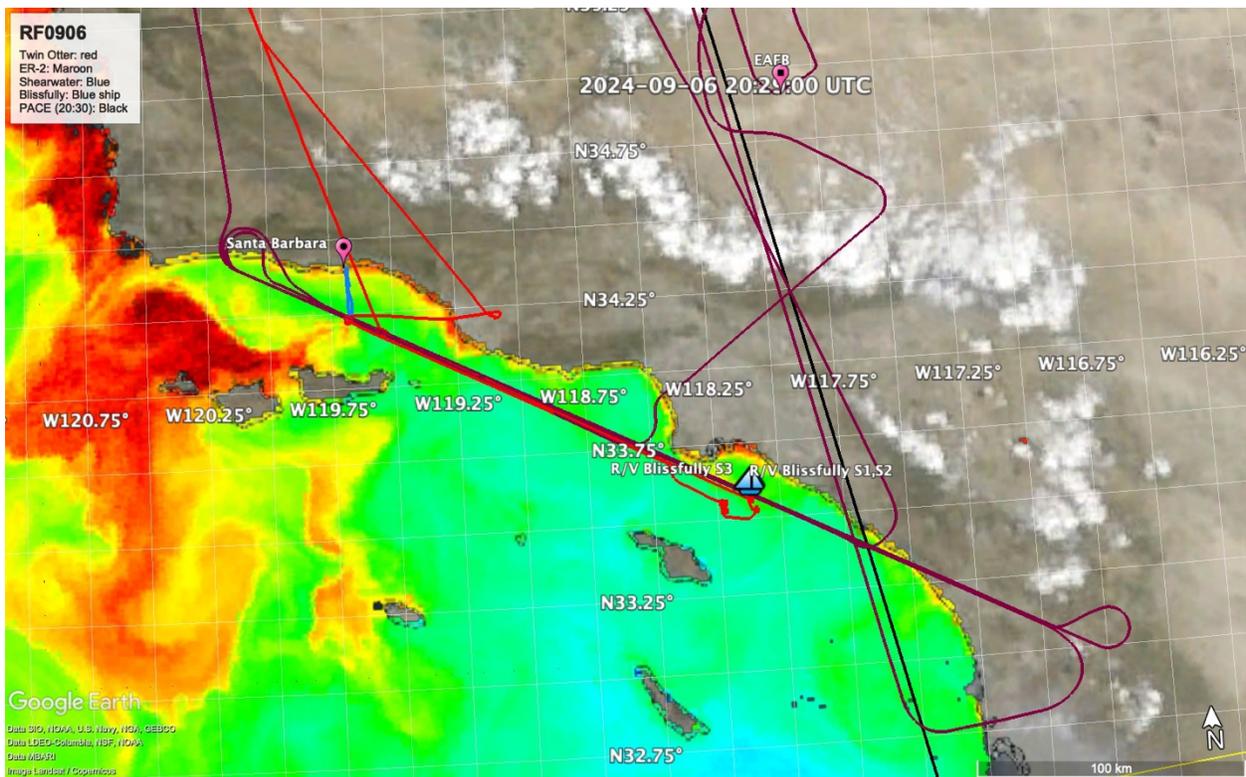
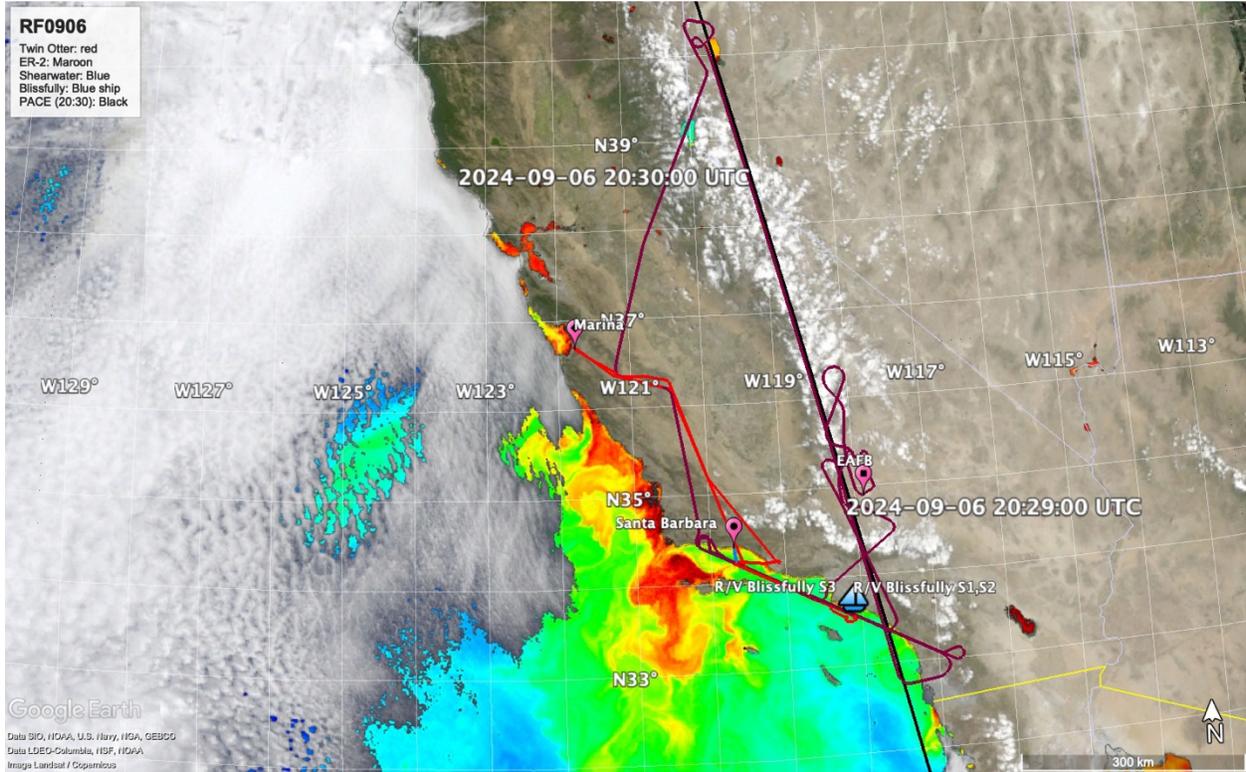
[See end for full R/V Blissfully report](#)

PACE

Overpass: 20:30

Orbit track along Sierra Nevada mountains, East of Los Angeles, then over ocean by USC_SeaPRISM site.

Overall image summary



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>

Validation Traceability Matrix itemized objectives

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

Time	Platform	VTM(hrs)	
15:11	RB		Departure
17:03	ER2		Takeoff
17:16	TO		Takeoff (sortie 1)
18:01	ER2, RB	1b(1.0), 1c(0.5)	ER-2 over RB and USC_SeaPRISM AERONET-OC AOD(510)=0.15. Partly cloudy
18:36	ER2, TO	1d(1.0)	ER-2 overfly TO line, although ER-2 is late by ~20 min.
18:51	ER2	1d(0.5)	ER-2 overflight of Turlock_CA AERONET site AOD(500)=0.19
19:11	ER2	1d(0.5),6h(0.5)	ER-2 overflight of U. Nevada Reno CA AERONET site AOD(500)=0.18, over pyramid lake
19:47	ER2	6h(0.5)	ER-2 overfly of Mono lake turbid waters, within 1h from PACE
19:51	ER2	1d(0.5)	ER-2 overflight of Mammoth CUES AERONET site AOD(500)=0.12, possible cloud
20:00	RS		Departure
20:18	ER2	1d(1.0),1e(1.0), 3b(1.0),3c(1.0), 6f(1.0)	Over land section in PACE-OHS swath, mostly cloud free but with broken clouds in sections
20:30	ER2	1b(1.0),1c(1.0), 3a(1.0)	Over ocean section in PACE-OHS swath., Cloud free. Ocean params partially satisfied with HSRL2
20:30	RB	1b(1.0),1c(0.5), 3a(1.0)	RB + USC_SeaPRISM AERONET-OC AOD(510)=0.13 in PACE-OHS swath
20:30	PACE		Overpass
20:37	ER2	1c(0.5),6b(0.5),6k(0.5)	ER2 over AERONET (La_Jolla) AOD(500nm) ~0,4
20:55	ER2, RB	1b(0.5), 1c(0.5)	ER2 overfly R/V Blissfully & USC_SeaPRISM AERONET-OC, AOD(510)=0.12
20:56	ER2, TO,RB	1c(1.5)	ER2 overfly TO as it is doing a spiral down over USC_SeaPRISM and RV Blissfully
20:58	ER2	1f(2.0), 4b(2.0)	Much of this line has significant sunglint
21:03	ER2, RS	1b(1.0), 1c(1.0)	ER-2 over R/V Shearwater
21:27	ER2, RB	1b(1.0), 1c(1.0)	ER-2 over R/V Blissfully and USC_SeaPRISM AERONET-OC
21:42	ER2, RS, TO	1b(1.0), 1c(2.5)	ER-2 over R/V Shearwater and Twin Otter spiral
22:01	ER2, RS	1b(1.0), 1c(1.0)	ER-2 over R/V Shearwater
22:16	TO		Landing (sortie 1)
22:32	ER2	1d(0.5)	ER-2 over CalTech AERONET, AOD(500)=0.13
23:06	ER2		Landing
23:15	TO		Takeoff (sortie 2)

23:40	TO		Transiting back along same path as L1, within the smoke aerosol layer
00:19	RS		Return
00:30	TO		Again in smoke layer on transit back
01:04	TO		Landing (sortie 2)
01:35	RB		Return

PACE-OHS: within PACE OCI, HARP2 and SPEXone swath

SPP: Solar Principal Plane

ER2: ER-2

TO: Twin Otter

RS: R/V Shearwater

RB: R/V Blissfully

Assessment:

- 14.9% of objectives satisfied. Most successful day of operations thus far.
- Value of bringing TO down to Southern California shown, although we should note that a spiral of TO over an ocean asset without a satellite or ER-2 overpass has little value.
- Top remaining objectives: PACE aerosol in narrow swath (3a,b), EarthCARE (3d,3e) and cloud validation (1e)

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%	55.6%	0.0%	28.1%	20.1%	6.4	
	b	Ocean radiometric parameters	10	8.0	14.5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	83.7%	1.6	
	c	Aerosol parameters over the ocean	12	8.0	11.8	0.0%	0.0%	6.1%	0.0%	64.4%	0.0%	6.5%	77.0%	2.8	
	d	Aerosol parameters over land	12	8.0	21.0	39.3%	24.4%	8.0%	0.0%	8.8%	0.0%	12.1%	92.7%	0.9	
	e	Cloud parameters	12	8.0	7.0	0.0%	0.0%	39.3%	0.0%	0.0%	0.0%	19.0%	58.3%	5.0	
	f	Ocean surface parameters	1	8.0	2.0	0.0%	0.0%	0.0%	0.0%	0.0%	22.1%	0.0%	22.1%	0.8	
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%	8.8	
	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	2.5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	46.5%	46.5%	4.3	
	e	Cloud parameters (EarthCARE)	8	4.0	0.5	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	11.8%	11.8%	7.1	
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	2.0	0.0%	0.0%	0.0%	0.0%	63.2%	0.0%	0.0%	63.2%	2.2	
	c	Validate large reflectances with low polarization	6	2.0	2.0	22.1%	0.0%	30.6%	0.0%	0.0%	0.0%	10.4%	63.2%	2.2	
	d	Diversity 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	
	e	High aerosol loads over land	4	2.0	1.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	39.3%	39.3%	2.4	
6. Focus on specific processes or phenomena	a	High aerosol loads over ocean	4	2.0	1.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	39.3%	39.3%	2.4	
	b	Multiple aerosol layers	1	2.0	4.1	0.0%	87.3%	0.0%	0.0%	0.0%	0.0%	0.0%	87.3%	0.1	
	c	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	
	d	Aerosol above liquid phase cloud	4	2.0	3.5	22.1%	0.0%	0.0%	0.0%	0.0%	60.5%	0.0%	82.6%	0.7	
	e	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	
	f	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	
	g	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	
	h	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	
	i	Smoke aerosols over ocean	1	2.0	1.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	39.3%	0.6	
	k	Smoke aerosols over ocean	1	2.0	1.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	39.3%	0.6	
total:			150	98	79.3	0.057	0.025	0.071	0.000	0.149	0.031	0.092	0.427		
					prior to this week					total					
					ER-2 flight hours	1.9	2.8	0	4.7	0	6.1	0	5.3	0	18.9
					TO flight hours	0	2.4	3.4	3.8	0	7	3.9	1.7	0	22.2
					Shearwater days	0	0	0	0	1	0	1	0	2	
					PACE-PAX overall objectives satisfied:	0.427									

ER-2/MVIS images

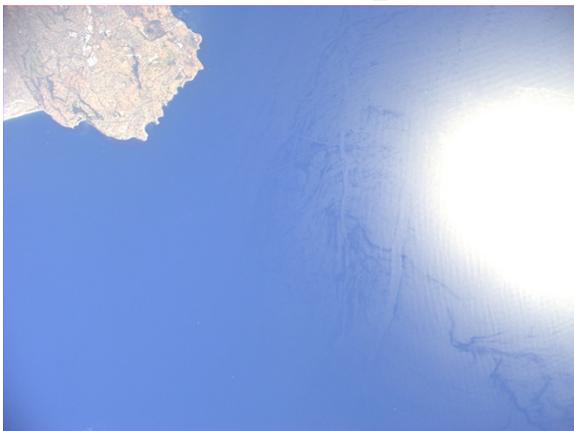
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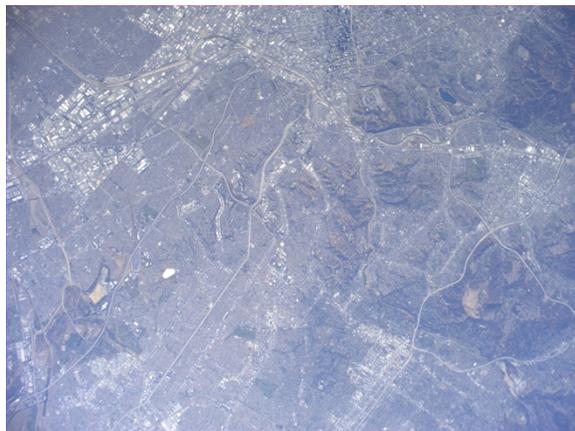
20:30:00 PACE overpass



20:56:00 ER2+TO+RB+USC_SeaPRISM



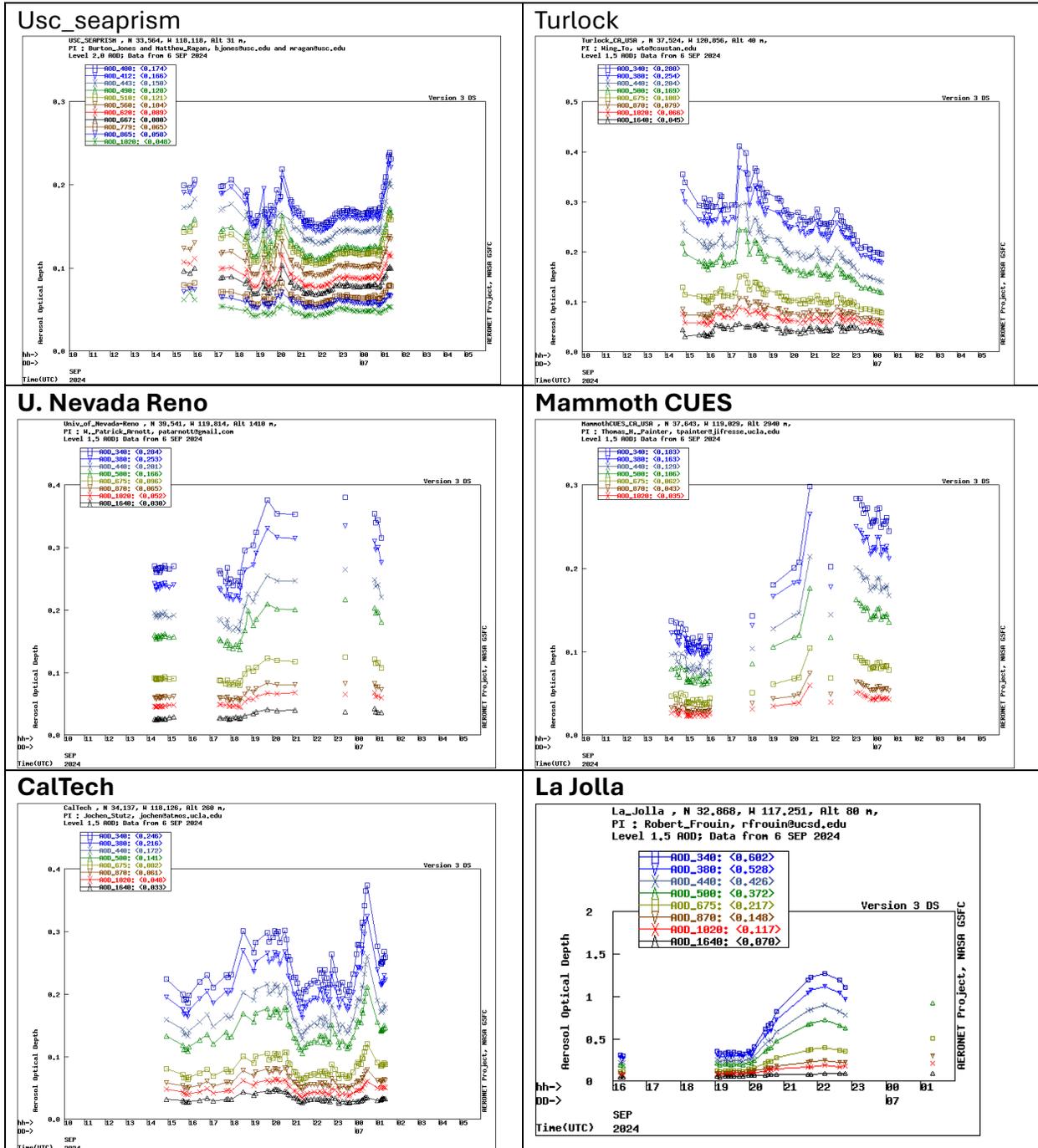
22:32 ER-2 over CalTech Aeronet



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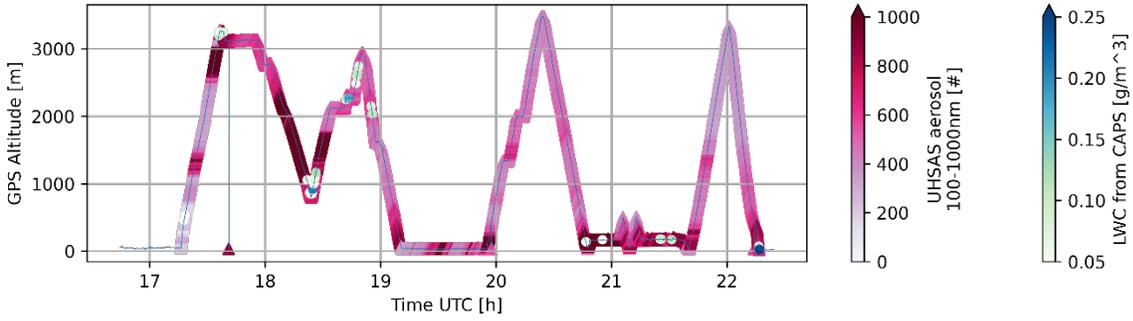
<https://www-air.larc.nasa.gov/missions/pacepax/index.html>

AERONET quicklooks

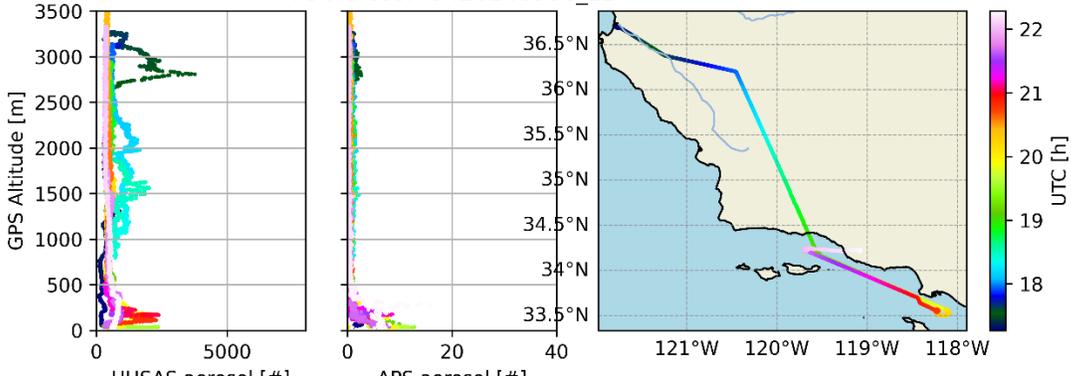


TO Quicklooks

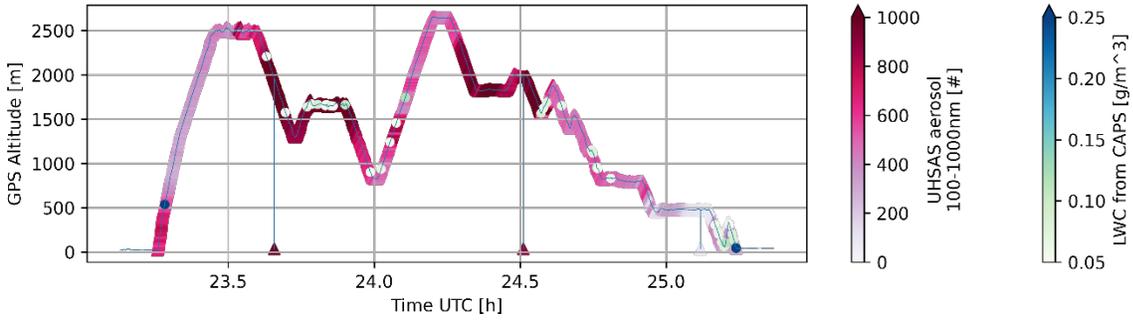
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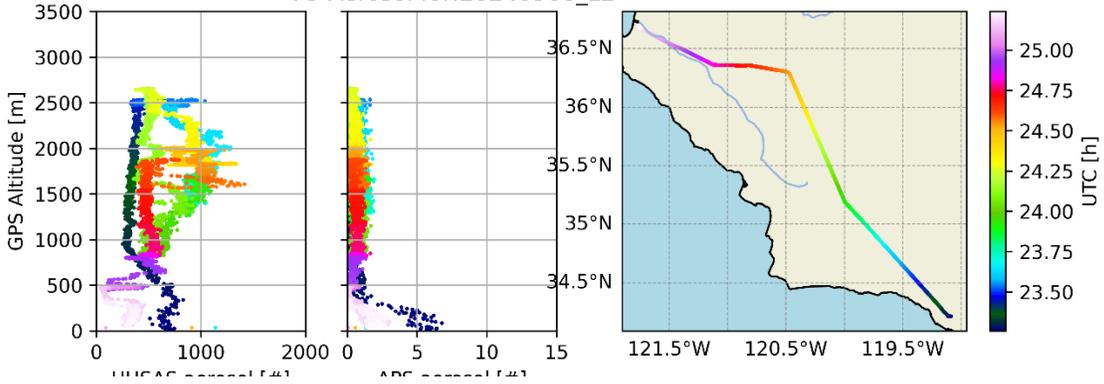
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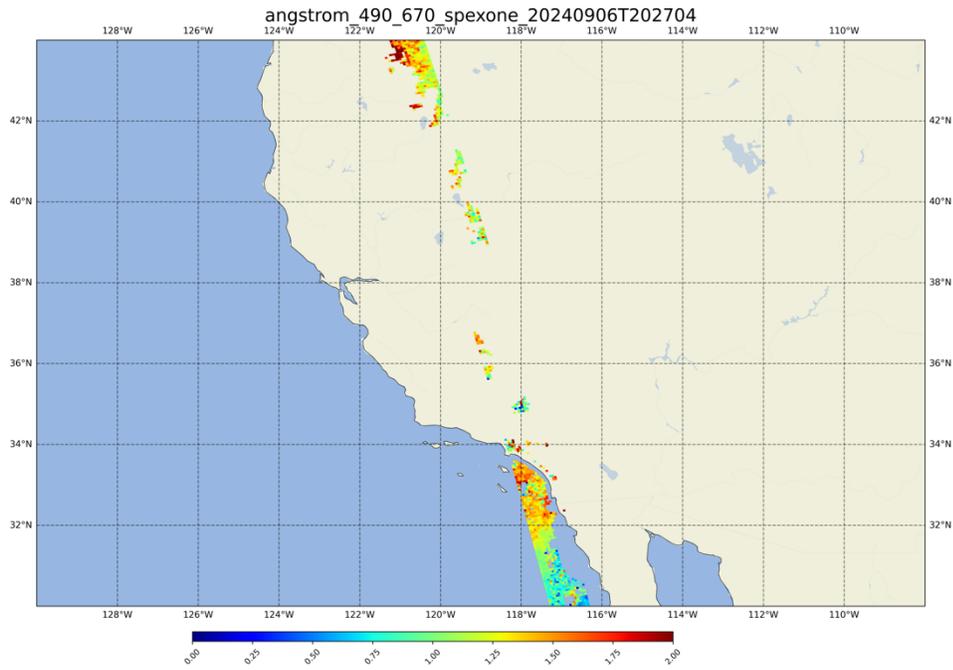
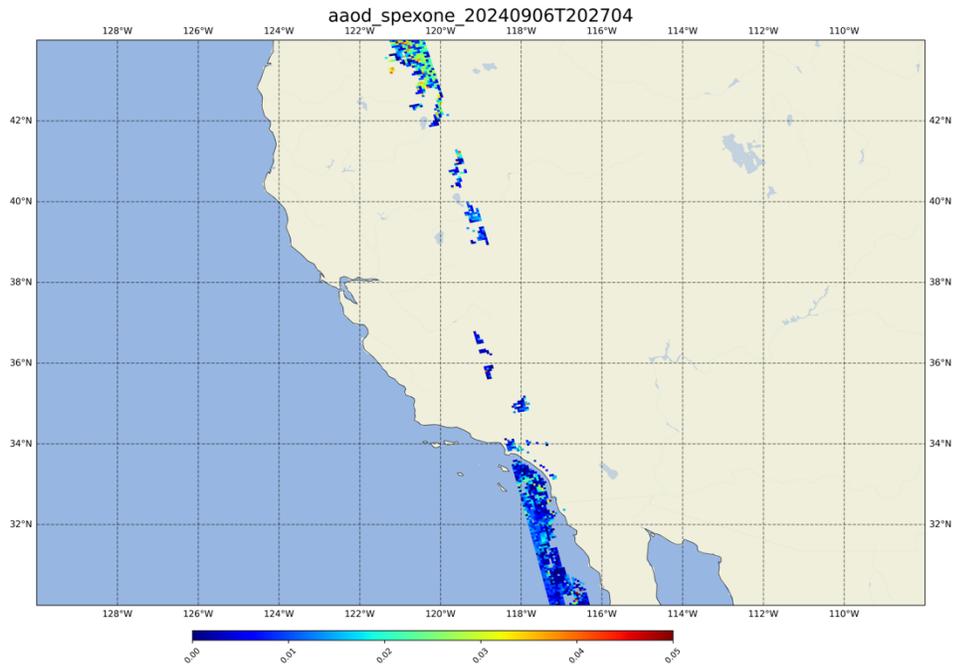
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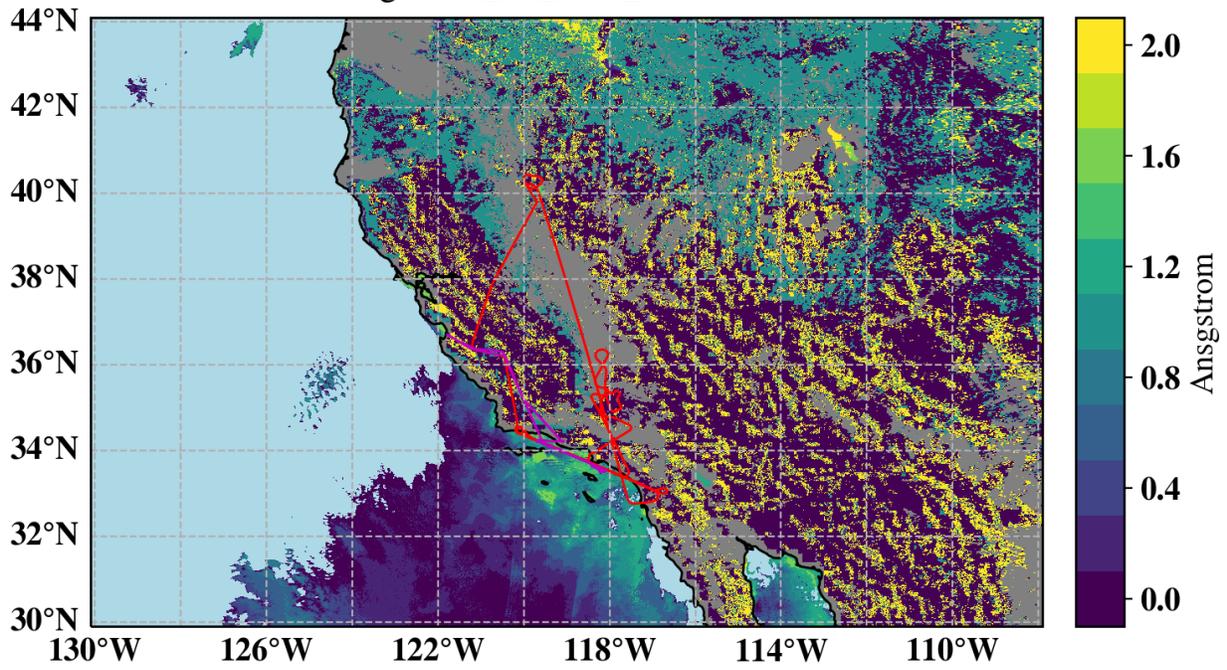
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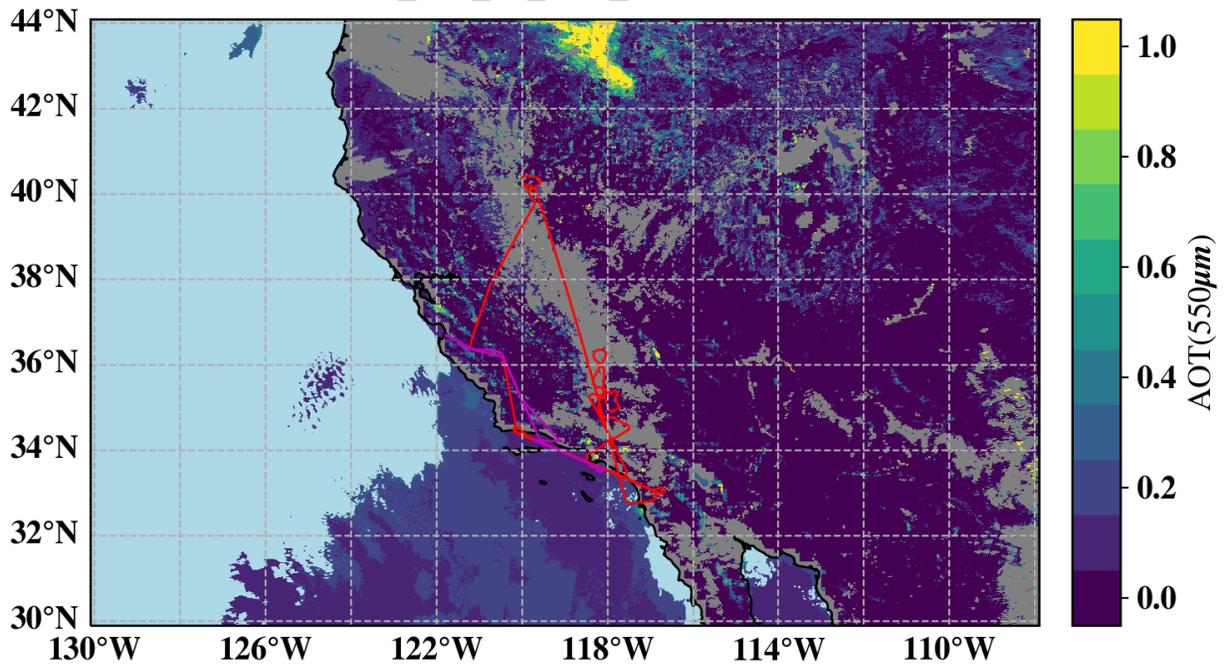
PACE Satellite products



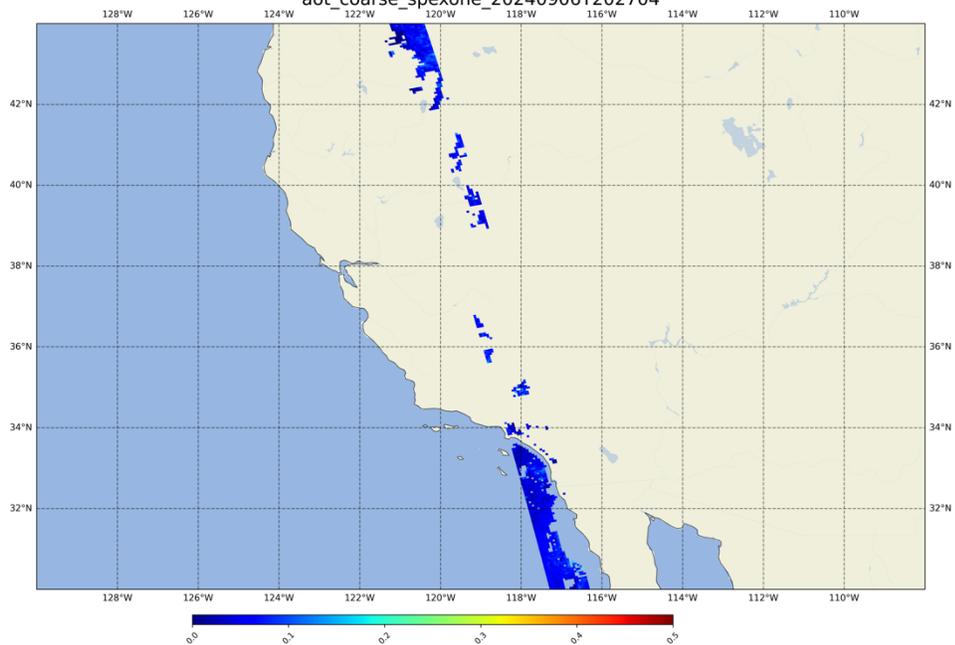
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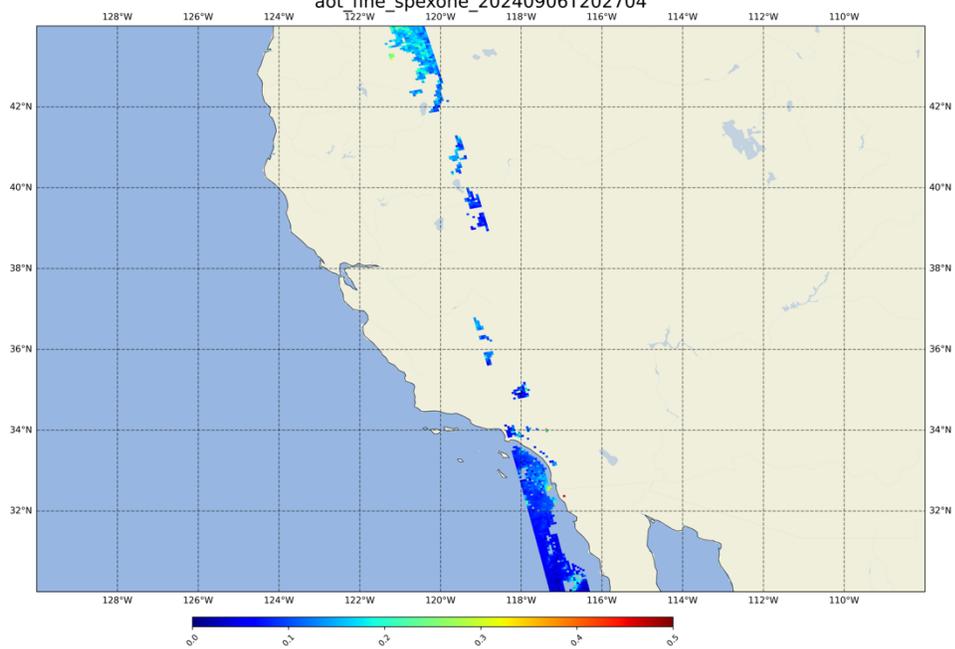
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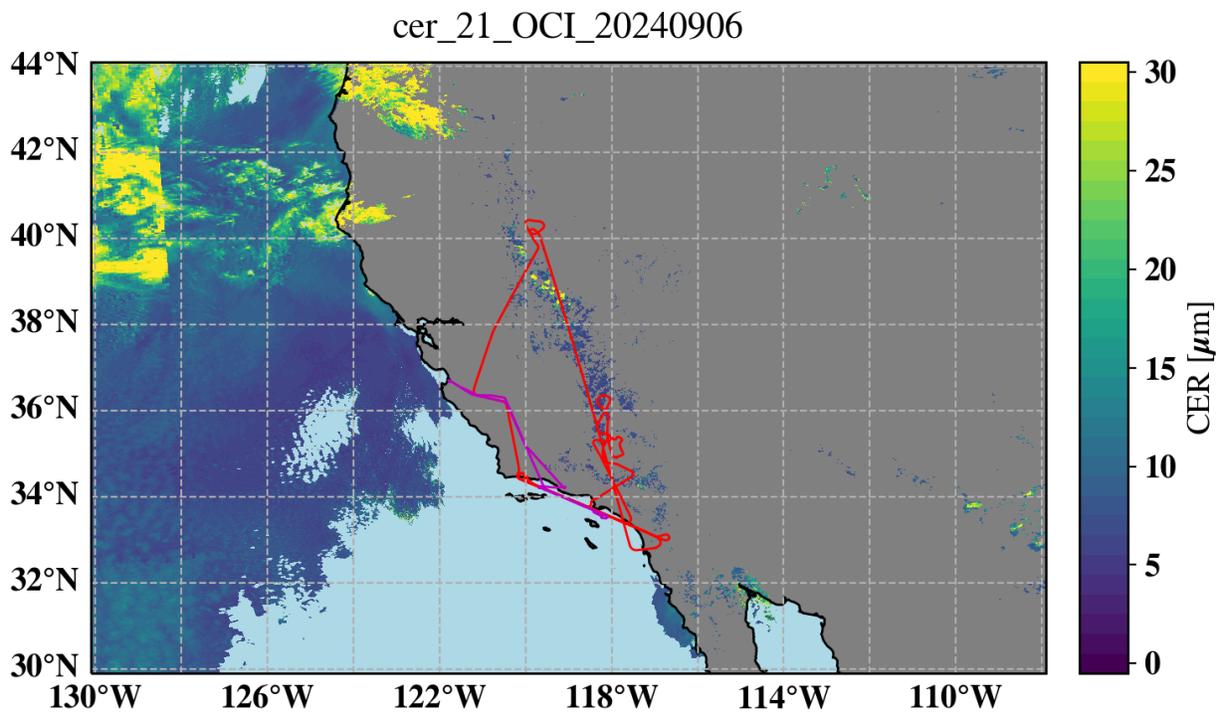
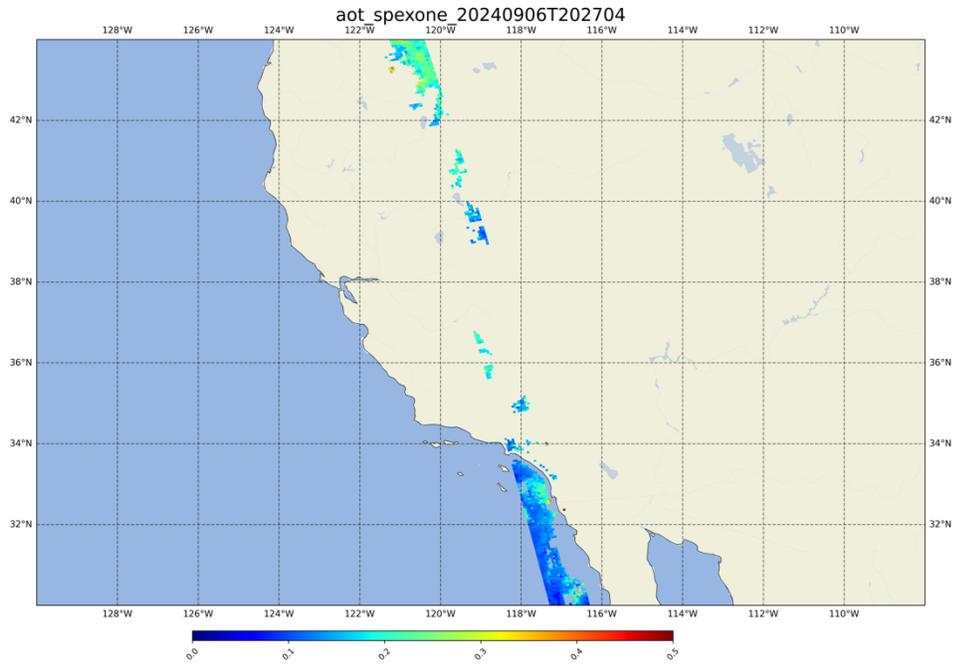


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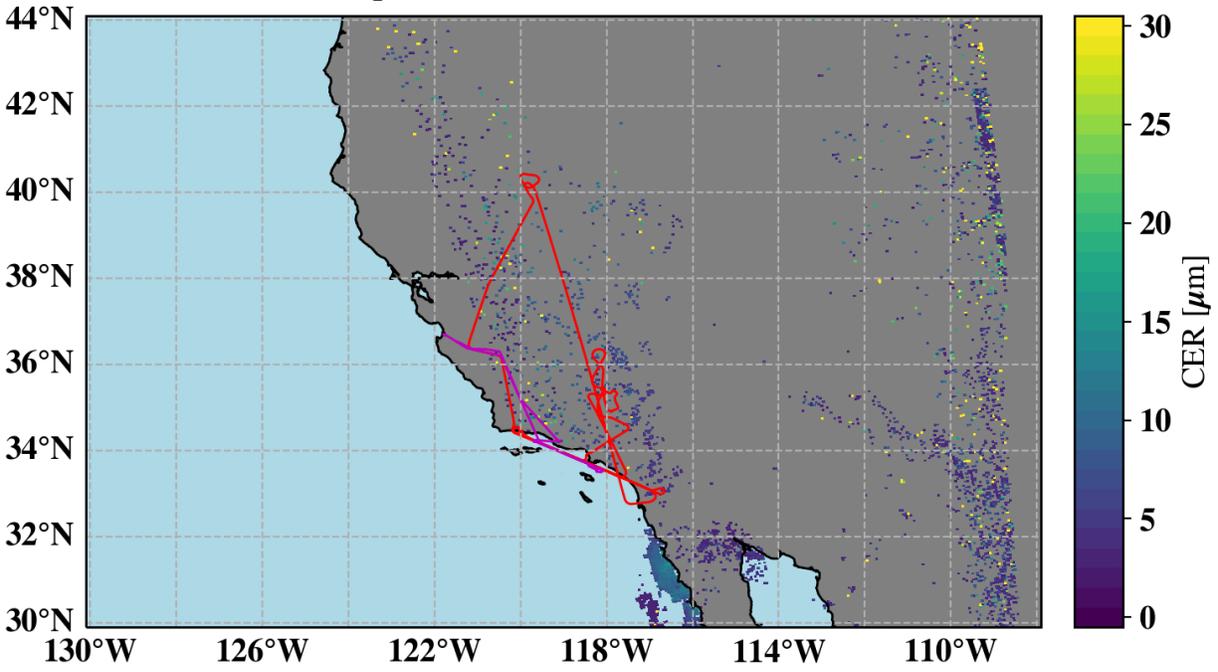


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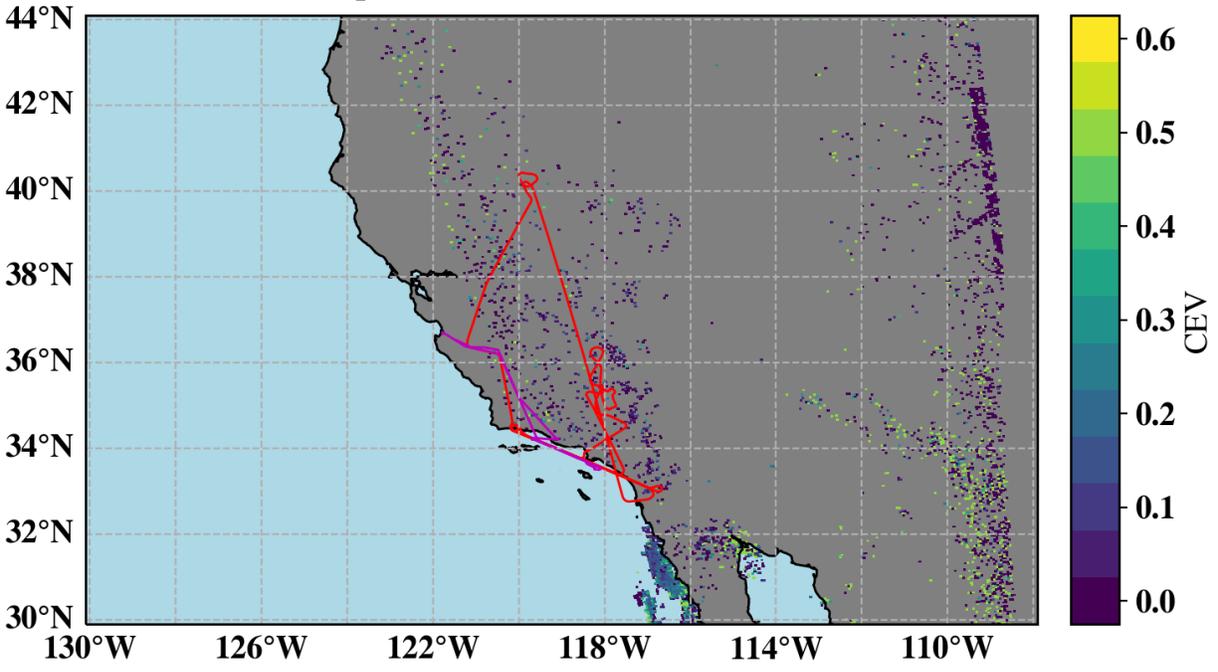


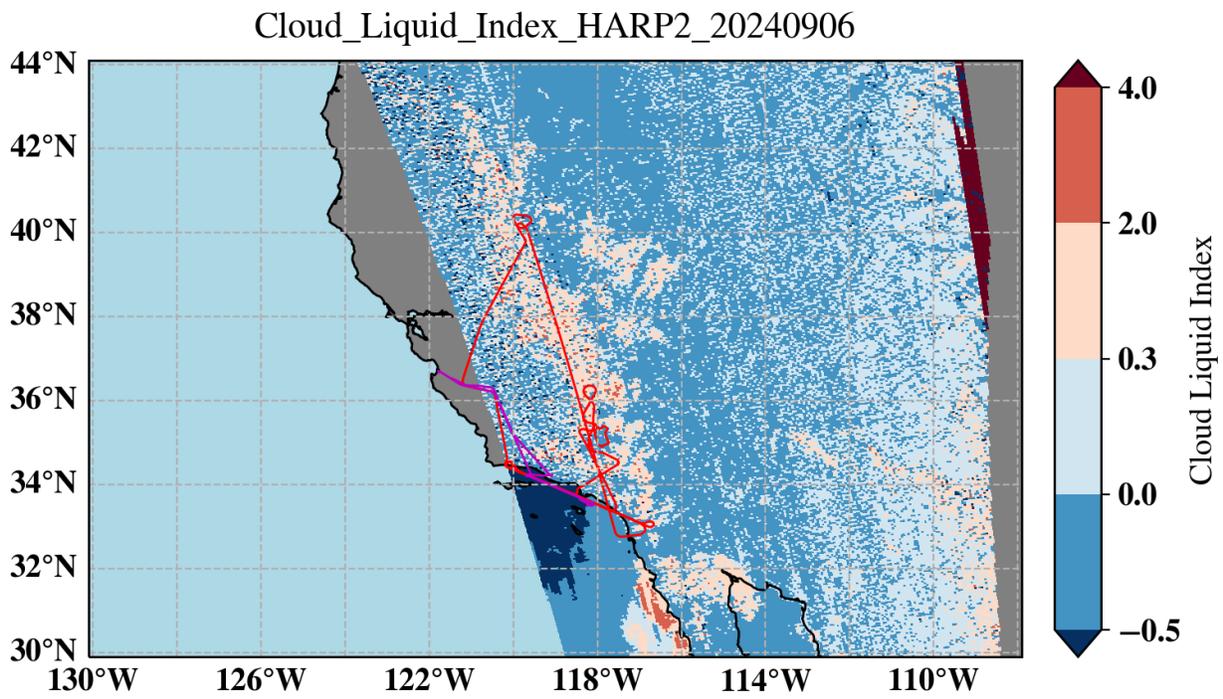
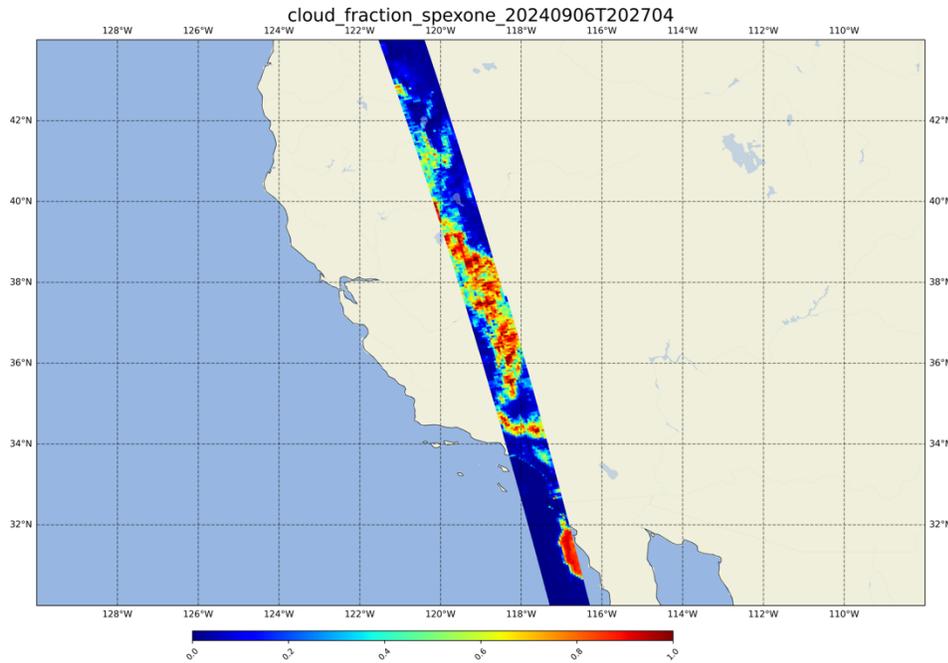


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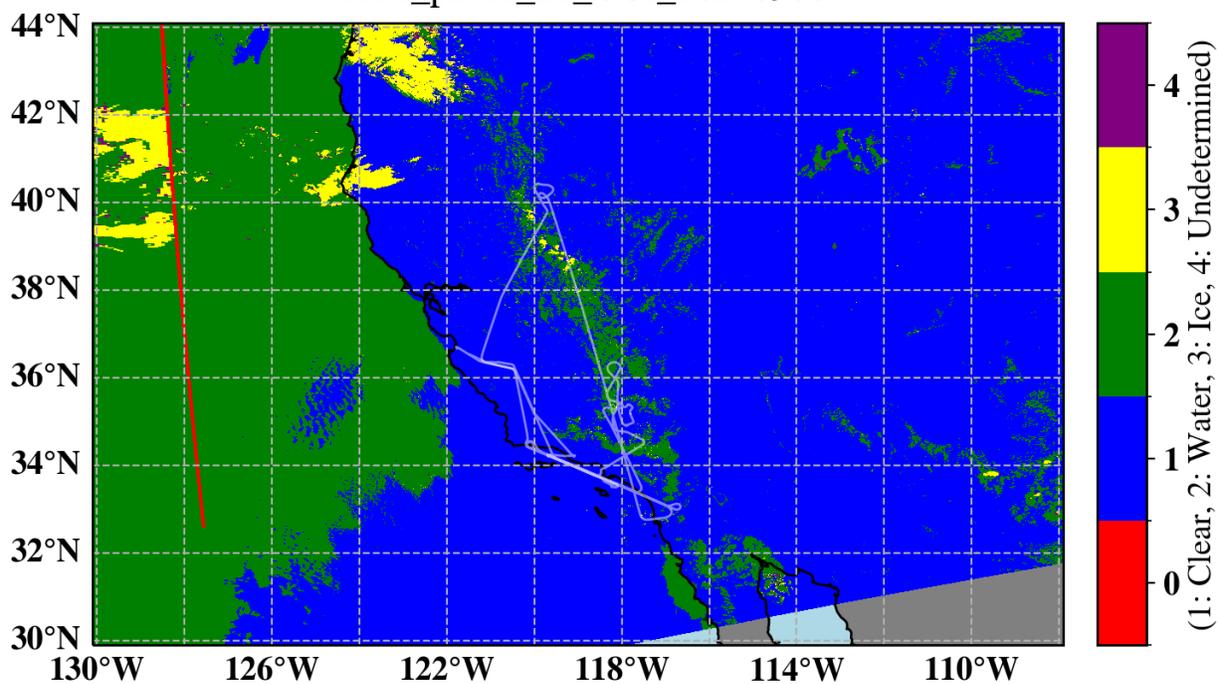


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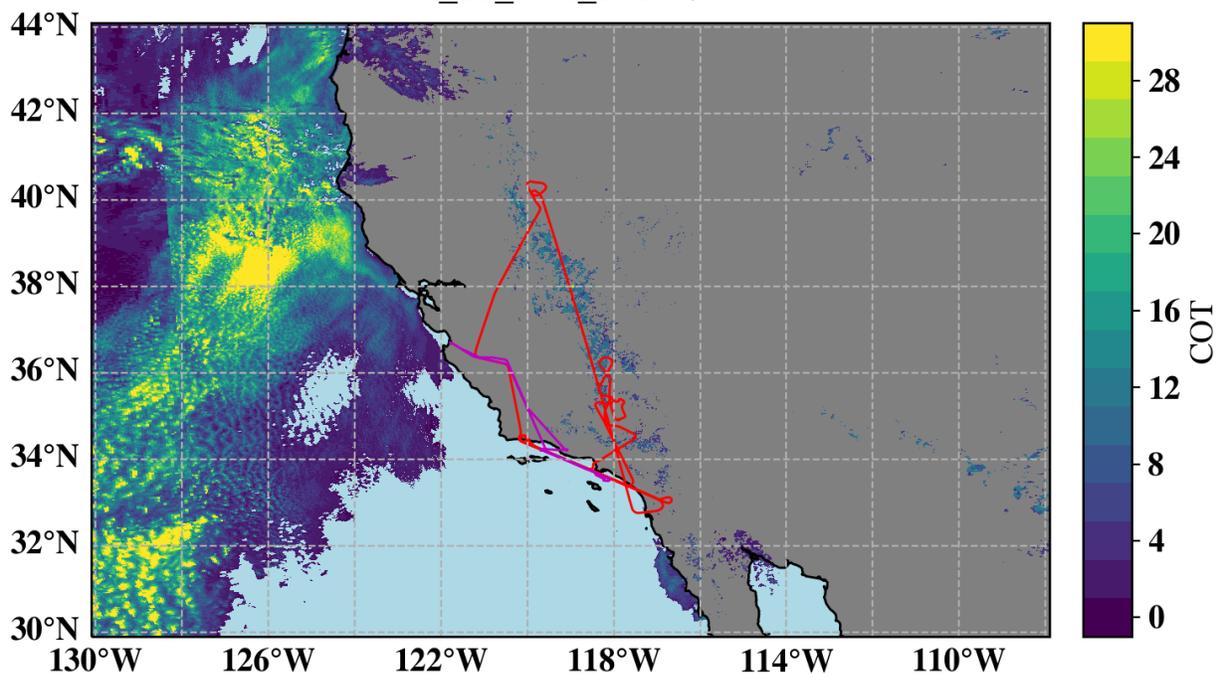




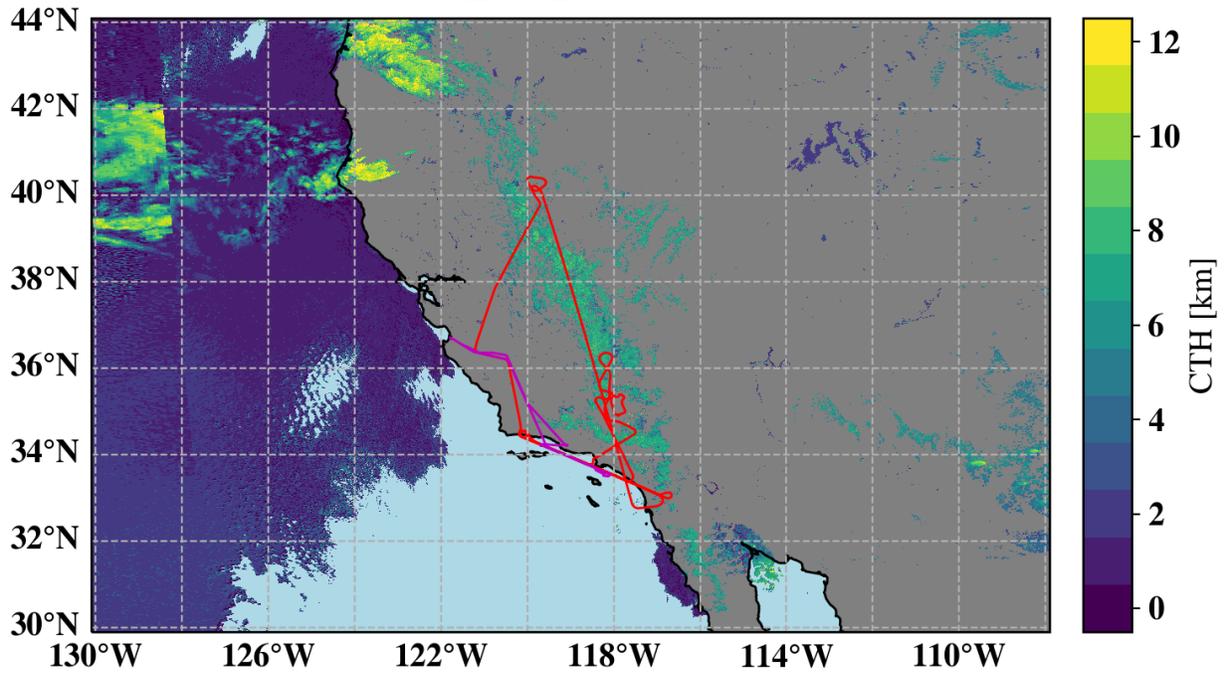
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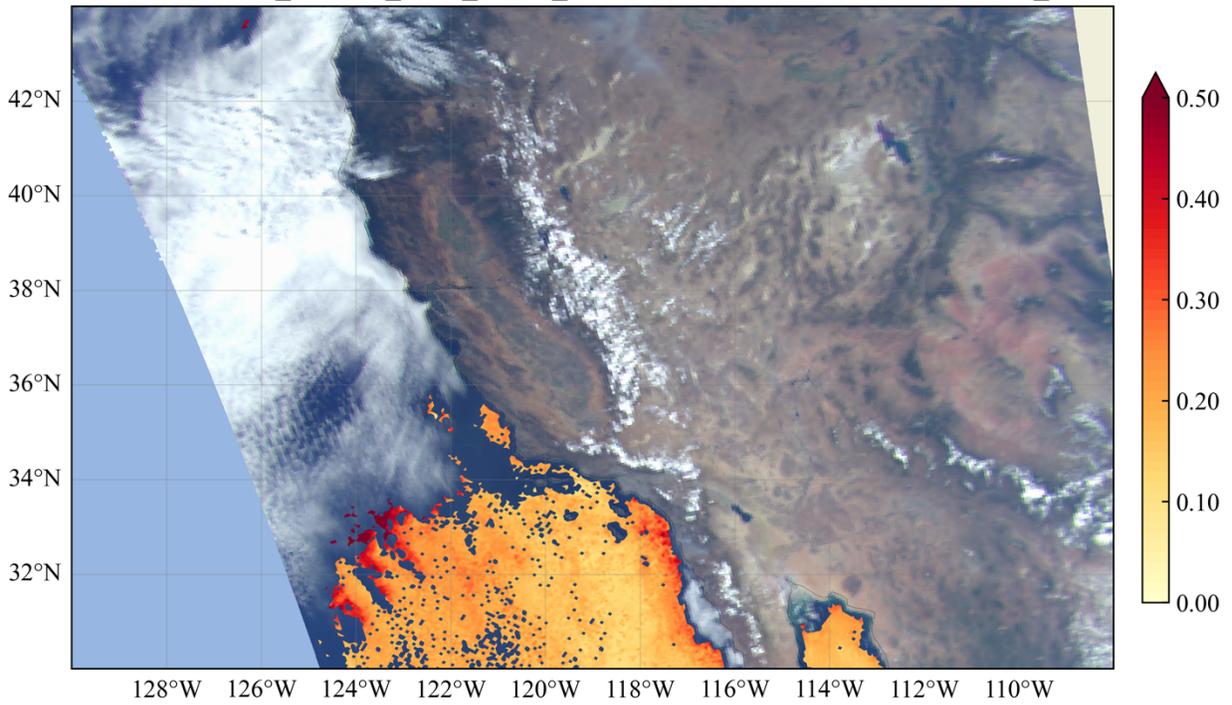
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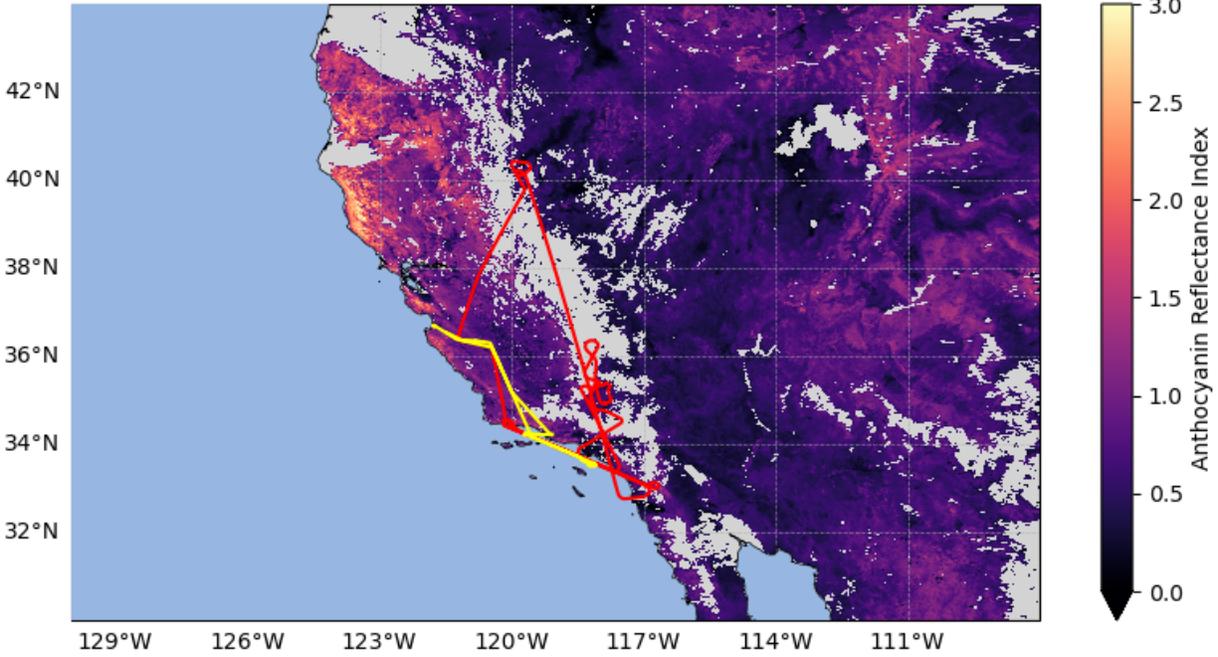
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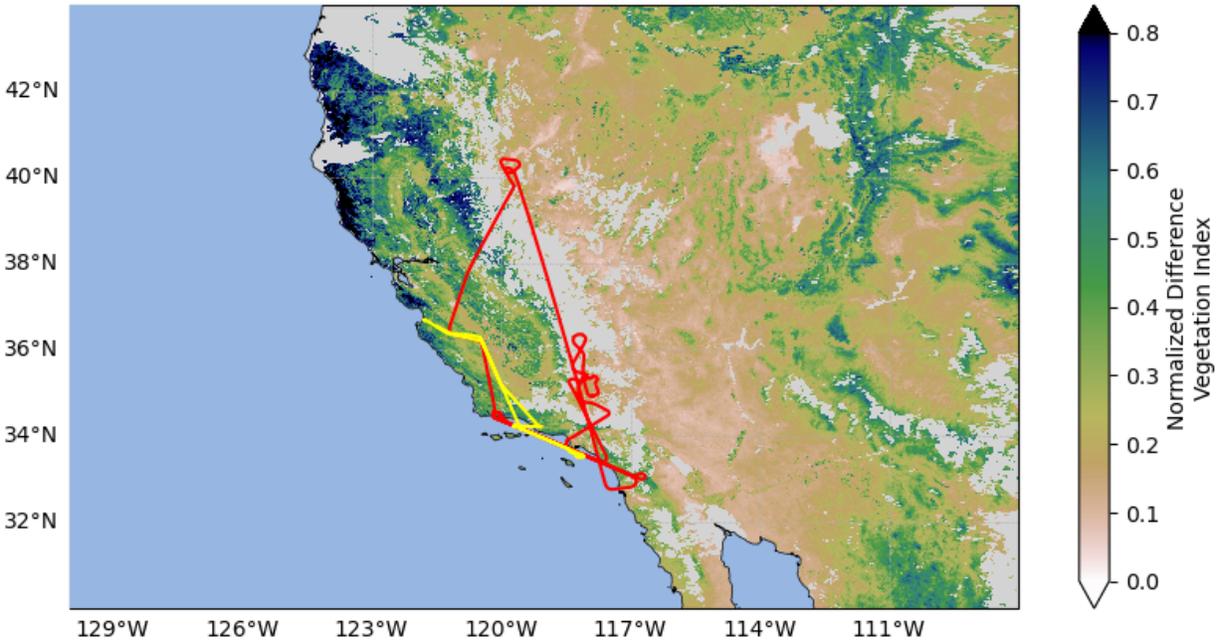
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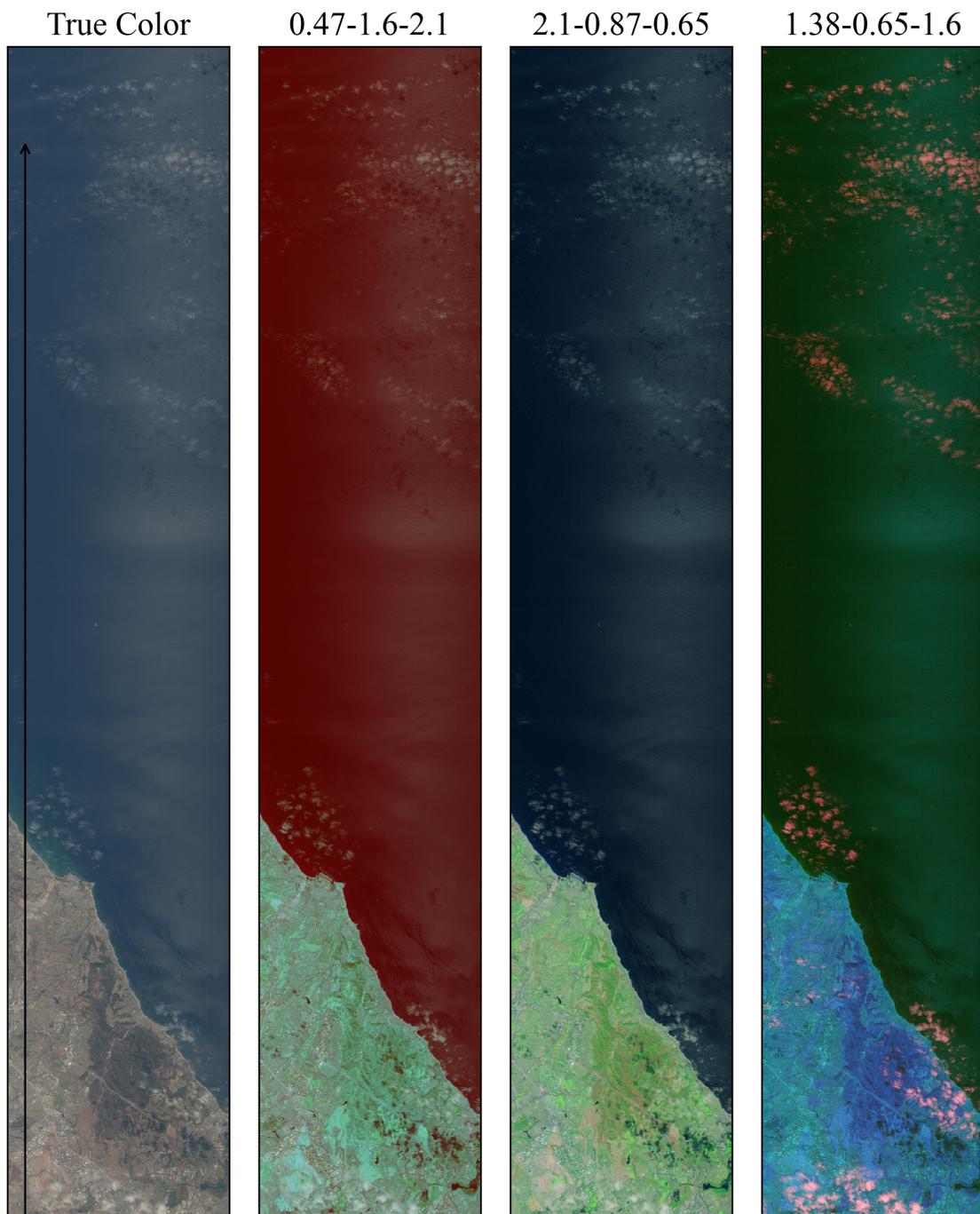
OCI mARI with ER2/Twin Otter Flight Tracks, 2024-09-06



OCI NDVI with ER2/Twin Otter Flight Tracks, 2024-09-06

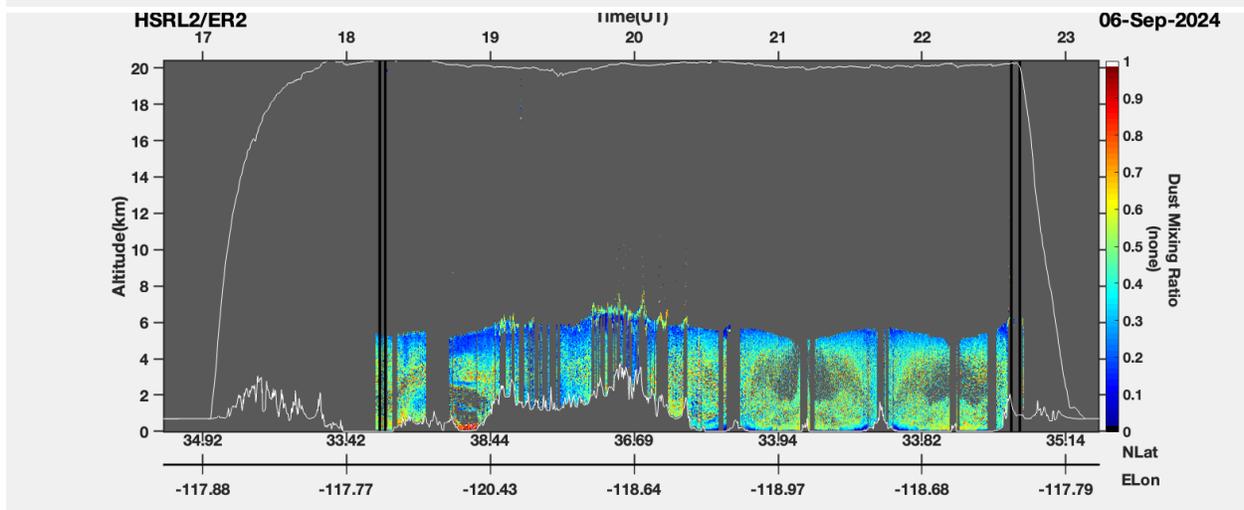
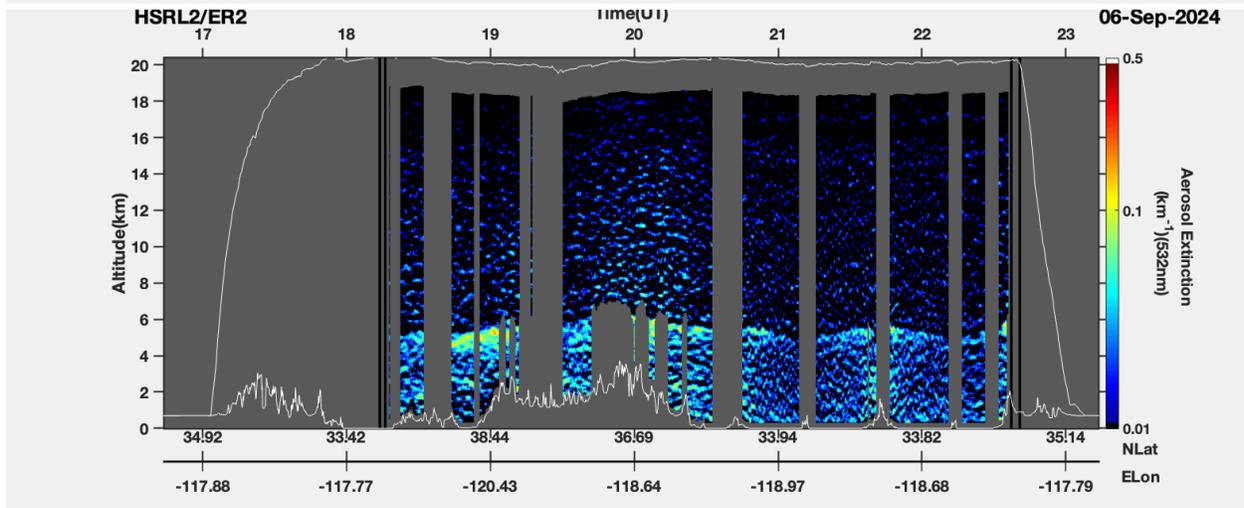
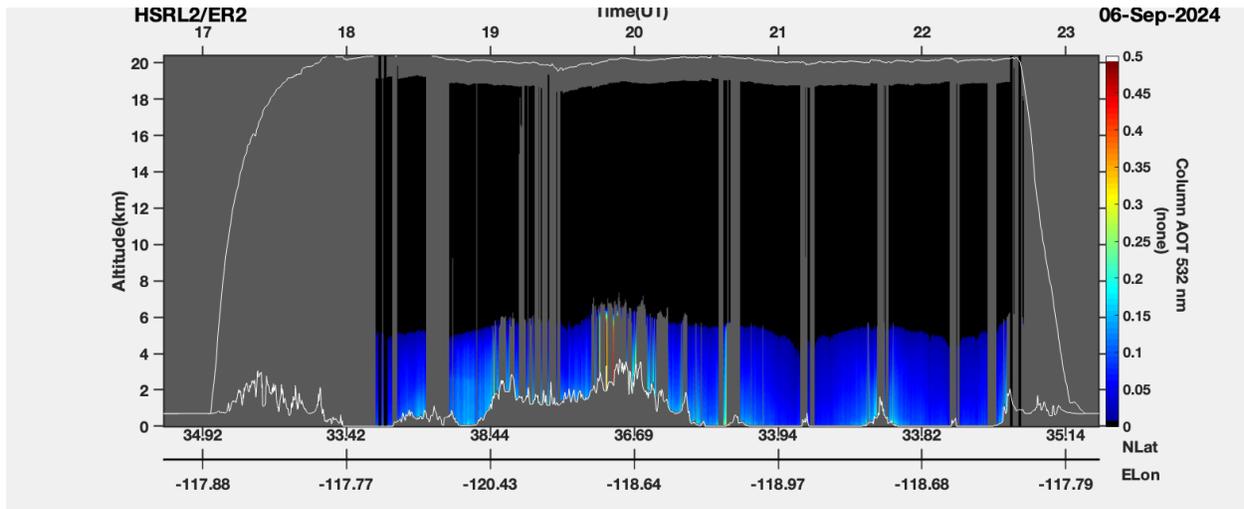


PACE-PAX quicklooks



PICARD end of PACE track line. More PICARD quicklooks here:
https://asapdata.arc.nasa.gov/picard/data/flt_html/24622.html

ER2 / HSRL quicklooks



Twin otter flight report

PACE-PAX Research Flight report 2024/09/06

Double-Sortie Twin Otter Flight

Manifest:

Bryce Kujat (pilot)

Jeff Martin (pilot)

Luke Ziembra (QNC)

Anthony Bucholtz (QNC)

Launch 1:

Take off: 10:16:15 (17:16:15 UTC) Marina Airport (OAR)

Landing: 15:16:54 (22:16:54 UTC) Camarillo Airport (CMA)

Duration = 5.0 hrs.

Objectives: Profiles of aerosol scattering and absorption coefficients and size distributions together with scattering (polarized) phase functions above the SeaPRISM site and the RV Shearwater. Characterization of microphysical properties of smoke from the Boon fire.

Summary: Out of aerosol quickly after takeoff with 4 Mm^{-1} scattering coefficient at 2 kft. Aerosol layer at 4.2 kft with 25 Mm^{-1} scattering coefficient, then clean passing through 8 kft during ascent out of Marina. Smoke layer at 9 kft with 120 Mm^{-1} scattering coefficient near (northwest of) the Boon fire, then at the top of the smoke layer at 9.5 kft with 20 Mm^{-1} scattering coefficient. See picture of smoke at 11:04 local time (18:04 UTC). Temporary flight restriction (TFR) did not allow sampling below 9.5 kft in fire area. Descended past (south of) the TFR with scattering coefficients of 10 Mm^{-1} at 8 kft then 35 Mm^{-1} at 7 kft in an aerosol layer. The slant column at 18:08 UTC relevant for ER-2 lidar comparison.

After flying high over a ridge, observed multiple aerosol layers on the way to coast with scattering coefficient of 50 M^{-1} at 4.8 kft. In line descent to minimum safe altitude at the Shearwater waypoint, although the Shearwater was not yet in position. Scattering coefficient of 30 Mm^{-1} at 100 ft and boundary layer cloud free. Very shallow marine boundary layer (MBL) topped by sharp temperature inversion. Transit to the SeaPRISM site at the top of the MBL (at 100 ft) with scattering coefficient varying between 30-50 Mm^{-1} . Aerosol size distribution appeared quite broad with mix of sea salt and pollution and a scattering Angstrom exponent of 0.5. Started spiral up at SeaPRISM site at 12:55 local time (19:55 UTC) in a cloud free area with an aerosol layer at 500 ft and decreasing scattering through 2 kft. Not allowed to climb above 4 kft at SeaPRISM site (by ATC) so spiral continued where airspace allowed; first to the SE and then closer to Catalina Island. Immediately spiraled down without re-positioning during PACE overflight at 20:29 UTC. Reverse heading track done mostly at 500 ft altitude. ER-2 overflies at 13:56 local time (20:56 UTC). Aerosol at 500 ft was very different from that at 100 ft with smaller particles (scattering Angstrom exponent 1.8). Small porpoise maneuver at 21:03 UTC between 1500 ft and 100 ft to profile the MBL structure and contrast the surface and elevated aerosol properties. Cargo ship on nose at 21:07; no obvious emissions sampled. Overflight of the RV Shearwater (see picture below) at 14:42 local time (21:42 UTC) followed by spiral up to 10 kft and transit to land at Camarillo Airport (CMA) for re-fueling. Spiral ended at 14:54 local time (21:54 UTC) and ER2 flew over at 15:08 local time (22:08 UTC). During landing, observed VERY thick dust just east of the airfield that seemed to be trapped by surrounding mountains; 100 Mm^{-1} scattering sampling just at the edge of this dust plume. Sampled dust during taxi to FBO after landing.

Launch 2:

Take off: 16:15:28 (23:15:28 UTC) Camarillo Airport (CMA)

Landing: 18:14:22 (25:14:22 UTC) Marina Airport (OAR)

Duration = 2.0 hrs.

Objectives: Measurements of aerosol scattering and absorption coefficients and size distributions together with scattering (polarized) phase functions of smoke emissions from Boon Fire in Central California. Ferry aircraft home.

Summary: 7.5 kft altitude over mountains at 23:36 UTC. Porpoise maneuvers when possible, with 25 Mm^{-1} scattering at 6 kft; 10 Mm^{-1} at 7.5kft. Altered flight path to be clear of the TFR, north and east of previous turn-point. Descended to 5.5 kft (lowest safe altitude) around fire region at 24:20 UTC, but did not find any obvious smoke emissions in the area. Smoke was presumably trapped in valley and not able to be sampled. Descended into Salinas Valley at 24:49 UTC, but conditions

were very clean: 3 Mm^{-1} scattering at 1.0 kft at 25:10. Performed missed approach at 25:12:05 UTC for tower comparison at $\sim 14 \text{ Mm}^{-1}$ scattering.

LARGE humidifier not functioning during flight, therefore no $f(\text{RH})$ data will be archived. PCASP was turned off for second sortie to prevent overheating. All other instruments functioned nominally.



Smoke near the Boon fire at 11:04 local time taken by Luke Ziembra from the CIRPAS Twin Otter.



Picture of the CIRPAS Twin Otter about to start spiral up at the SeaPRISM site. Taken by Bridget Seegers on the RV Blissfully at 13:16 local time.



Picture of the RV Shearwater taken from the CIRPAS Twin Otter by Luke Ziemba at 14:42 local time.

R/V Blissfully report

PACE-PAX R/V Blissfully day report

Date: 09/06/2024

Creator: Bridget Seegers

Cruise ID: RF0906-RB

Sailed out: 15:11

Back in port: 01:35 09/07/2024

Today, the ship accomplished....

Collection of vertical radiometry profiles and discrete sample collection (HPLC + ap) on three stations in proximity of SeaPRISM site. Each station has three sets of 5 HyperPro profiles to 20m and a single deep cast to 60m. Each station discrete water samples include triplicate HPLC + ap and duplicate community composition Lugol's preserved and paraformaldehyde samples for flow cytometry.

Station 1:

- arrival 17:17, 33° 33.74' N, 118° 7.18' W with patchy sky
- ER-2 overflight 18:02



Station 2:

- Location same as station 1 17:17, 33° 33.74' N, 118° 7.18' W
- arrival 19:10, patchy sky
- Twin otter overflight 19:56



- PACE overpass @ 20:29
- ER-2 overpass @ 21:27

Station 3:
to 33° 34.12' N 118° 6.96' W

- arrival 21:22 , blue clear sky



Tomorrow,

the R/V Blissfully will not sail.

Ship plans through the next 3 days...

Sail on the next ER-2 flight day

System Status...

All operational, no time for microtops measurements.

Group Status...

Spirit is high.

R/V Shearwater report

PACE-PAX R/V Shearwater day report

Date: 09/06/2024

Creator: Michael Ondrusek

Cruise ID: RF0906-RS

Sailed out: 1300 PT/ 2000 UTC

Back in port: 1719 PT/ 0019 UTC 09/07/2024

Today, the ship occupied two stations. The first station was approximately 10 nm of shore and the second one was 4 nm offshore.

Station 1: 34.22472° -119.67931° ~2100 UTC

Station 2: 34.34414° -119.67253° ~2300 UTC

At each station we collected radiometry data with one hyperpro profiling, one floating and with C-OPS. Seawater was also collected for laboratory analysis. The flow through system was not operating yet.

Flyovers were observed from the twin otter and ER2 while collecting data on the first station. The twin otter conducted an ascending spiral over the ship, and there were 3 overflights of the ER-2.

Tomorrow, the survey ship will remain in port to work on equipment.

In upcoming days - ship plans to sample off Santa Barbara on 0908, 0909, and 0910

System Status:

Depth sensor on one hyperpro was not operating. Sent for a new cable to be delivered next week.

Issues with flow through water system.

Group Status: All groups were operating as expected. Joaquim Goes participated on the days activities