

PACE-PAX research flight report 2024/09/13

Compiled by Kirk Knobelspiesse, Ivona Cetinić, Michael Ondrusek, Brian Cairns
2024/09/21

Reviewed by Samuel LeBlanc

Focus on Southern California, which has extremely large fires (Bridge, Line and Airport) producing large amounts of smoke. Twin Otter does a double sortie to the Los Angeles Basin. R/V Shearwater, R/V Blissfully and Gliders all collect data offshore, with clouds clearing as the day progresses. PACE overpass (19:36; 21:14) are far from the observation region, but data are collected during overpass for PACE/OCI validation. Additionally, an overpass is made of Railroad Valley in Nevada.

ER-2

Takeoff: 16:41, Landing: 22:57, Duration: 6.3

Instrument status: RSP inoperable, all others good

Pilot: Greg Nelson, mobile pilots Kirt Stallings and Tim Williams

Twin Otter

Sortie 1: takeoff: 15:29, Landing: 19:25, Duration: 3.9 (land Chino CNO)

Sortie 2: takeoff: 20:45, Landing: 00:21, Duration: 3.6

Instrument status: Good, descent into Chino may have been faster than the dewpoint monitor would prescribe, aerosol concentrations may have been too high for some of the particle counters.

Manifest: Bryce Kujat (pilot), Jeff Martin (pilot), Anthony Bucholtz (QNC), Adam Ahern (QNC), Edward Winstead (QNC)

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

R/V Shearwater

Departure: 15:57, Return:23:03, Duration:

Instrument status: good

Captain/Mission Scientist: Michael Ondrusek

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

R/V Blissfully

Departure: 15:59, Return: 01:01 (2024/09/14), Duration: 7.0

Instrument status: good

Captain/Mission Scientist: Bridget Seegers

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

PACE

Overpass at 19:36 (east of target region)

Overpass at 21:14 (west of target region)

EarthCARE

No targeted underpass

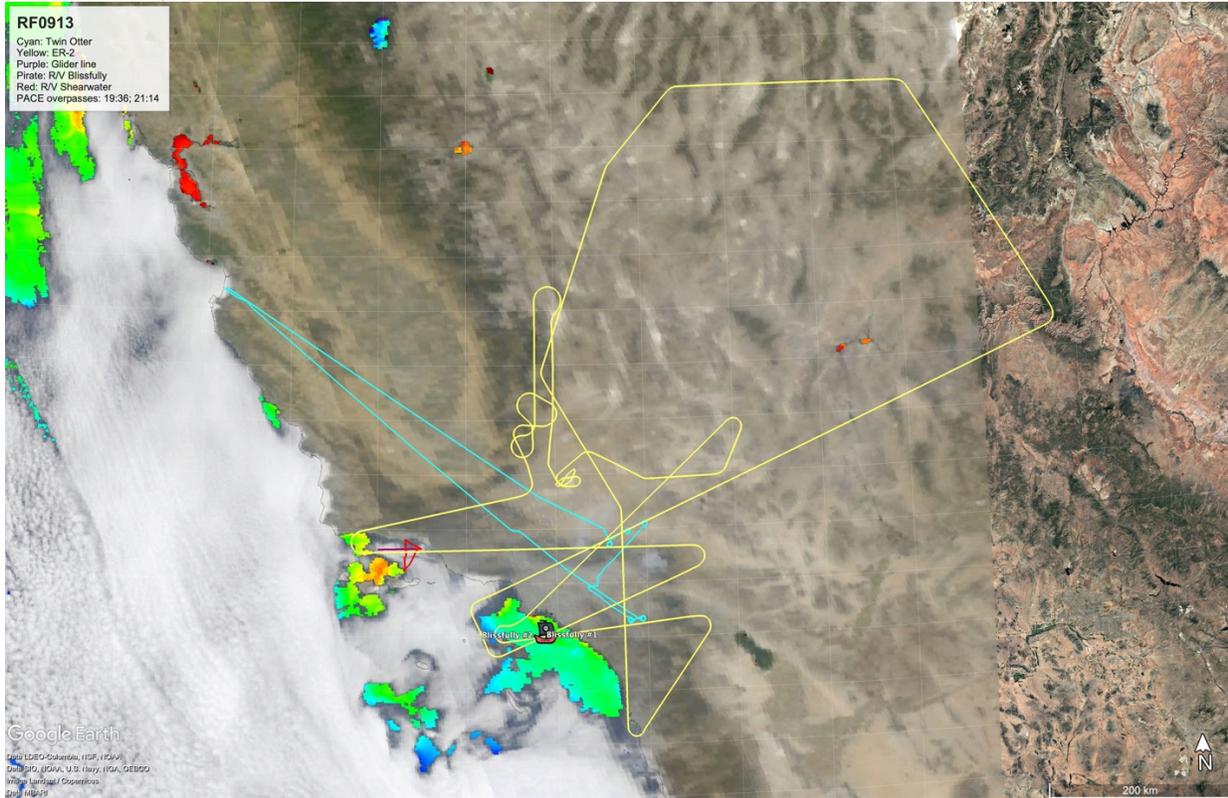
Gliders

Operational

HyperNAV

Operational

Overall image summary



Validation Traceability Matrix itemized objectives

VTM elements in **black** satisfied, **blue** partially satisfied

Time UTC	Platform	VTM(hrs)	
15:29	TO		Takeoff (sortie 1)
15:57	RS		Departure
15:59	RB		Departure
16:41	ER2		Takeoff
18:01	ER2, gliders		ER-2 over gliders, cloudy
18:02	ER2, RS		ER-2 overpass of Shearwater at station 9, cloudy
17:53	ER2, TO	1d(3.0), 6a(3.0), 6c(3.0)	ER-2 overpass of Twin Otter double spiral in smoke east of Bridge fire. TO spiral down 17:39-17:53, up starting at 17:53. At least two distinct smoke layers observed. ER-2 observes this location at 18:18
18:15	ER2		ER-2 overflies Table_Mountain_CA AERONET site. Site is inoperable, possibly destroyed due to fire . Edit: was not destroyed by fire, just not acquiring data.
18:18	ER2, TO	1d(3.0), 6a(3.0), 6c(3.0)	ER-2 overpass of Twin Otter double spiral in second location in smoke east of Bridge fire. Similar to prior spirals, at least two distinct smoke layers observed, but this time even greater loads. ER-2 observes this location at 18:18
18:42	ER2, RB		ER-2 overpass of Blissfully, USC_SeaPRISM. Cloudy.
18:52	ER2, RB	6e(0.5x0.5)	ER-2 overwater (turning) with smoke aerosol over clouds
18:54	ER2	1d(1.0), 6a(1.0), 6c(1.0)	Extremely long leg (to 19:36) over LA basin, Bridge fire and following path of smoke as it is advected east and north

18:58	ER2	1d(1.0), 6a(1.0), 6c(1.0)	ER-2 overfly CalTech AERONET site. AOD(500)=0.48
19:05	ER2, TO	1d(3.0), 6a(3.0), 6c(3.0)	ER-2 overpass of Twin Otter double spiral in third location in smoke east of Bridge fire. ER-2 observes this location at 19:05
19:25	TO		Landing (sortie 1, Chino)
19:36	RS		Shearwater on station 10 from 18:44 to 19:57 during PACE overpass. Partly cloudy, satellite image cloudy
19:36	PACE-O		PACE overpass
19:45	ER2	1d(1.0), 6a(1.0), 6c(1.0)	Start second long leg perpendicular to leg starting at 18:54. Catches other pathway of advected smoke at the time of PACE overpass. Within OCI swath and edge of HARP2 swath. Leg ends at about 20:05
20:18:30	ER2	1a(1.0), 1d(1.0), 4a(1.0), 4c(1.0)	ER2 over Railroad Valley, AERONET AOD(440)=0.05
20:45	TO		Takeoff (sortie 2, Chino)
21:05	ER2	1d(2.0), 6a(2.0), 6c(2.0)	Third long ER2 leg over smoke. This time southward over eastern LA basin with smoke from Bridge and Airport fires, ending at 21:22 near San Diego. Includes PACE overpass at OCI edge.
21:12	ER-2, TO	1d(3.0), 6a(3.0), 6c(3.0)	ER-2 overpass of Twin Otter spiral down in smoke east of Airport fire. Similar double layer structure as observed at other spirals. ER-2 observes this location at 21:40. PACE overpass as well.
21:14	RB	1b(1.5), 1c(1.5), 6k(1.5)	Blissfully sampling adjacent to USC_SeaPRISM site during PACE overpass (OCI only) with cloud-free skies. AOT(490)=0.18, moderate aod, smoke from fires
21:14	RS	1b(1.5), 1c(1.5)	Shearwater on station 11 from 20:45 to 22:01 during PACE overpass. Cloud free
21:14	PACE-O		PACE overpass
21:20	TO		Overfly La_Jolla AERONET site with high AOD(500)=0.22. However, no AERONET measurements after 19:30 due to broken clouds
21:39	ER-2, TO	1d(3.0), 6a(3.0), 6c(3.0)	ER-2 overpass of Twin Otter spiral up in smoke east of Airport fire. Similar double layer structure as observed at other spirals. ER-2 observes this location at 21:39. PACE overpass as well.
21:48	ER2, RB	1b(1.5), 1c(1.5), 6k(1.5)	ER-2 overpass of Blissfully and USC_SeaPRISM. Cloud free skies, AOT(490)=0.19, moderate aod, smoke from fires
21:55	ER2	1d(1.0), 6a(1.0), 6c(1.0)	Final long ER-2 leg starting at Long Beach and heading northeast over smoke from Airport and Bridge fires. End leg at 22:19
21:59	ER2	1d(0.5), 1a(0.5), 1c(0.5)	ER2 overflites WC_Whittier_CA AERONET site, AOD(500)=0.35 high load
22:57	ER2		Landing
00:21	TO		Landing (sortie 2)
	RS		Return
01:01	RB		Return

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

TO: CIRPAS Twin Otter

RB: R/V Blissfully

RS: R/V Shearwater

Assessment:

- 4.9% of objectives satisfied. EXCELLENT observation of smoke from the Bridge, Airport and Line fires – beyond PACE validation this could be the source of a paper or more. Scoring does not reflect the amount of data in this regard – we have maxed out “aerosol parameters over land (1d)”, “High aerosol loads over land (6a)” and “Multiple aerosol layers (6c)”. Also good observation of railroad valley (high reflectance calibration site) and smoke over water.
- Top remaining objectives (score above 6.0): PACE aerosol in narrow swath (3a,b), EarthCARE cloud (3e)

PACE-PAX progress tracking														
Validation objectives	ID	Measurement objectives	Importance, w	Observation time, h (hours)	Total observed (hours)	Fractional success 9/9	Fractional success 9/10	Fractional success 9/11	Fractional success 9/12	Fractional success 9/13	Fractional success 9/14	Fractional success 9/15	Total success	Remaining score
1. Validate new retrieval properties	a	Land surface parameters	8.000	2.000	1.575	0.000	0.048	0.000	0.000	0.295	0.000	0.000	0.545	3.640
	b	Ocean radiometric parameters	10.000	8.000	24.000	0.000	0.036	0.000	0.067	0.010	0.000	0.000	0.950	0.498
	c	Aerosol parameters over the ocean	12.000	8.000	17.875	0.000	0.051	0.000	0.050	0.022	0.000	0.000	0.893	1.285
	d	Aerosol parameters over land	12.000	8.000	45.563	0.000	0.017	0.000	0.023	0.030	0.000	0.000	0.997	0.040
	e	Cloud parameters	12.000	8.000	7.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.583	5.002
	f	Ocean surface parameters	1.000	8.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
3. Validate in a narrow swath	a	Aerosol parameters over the ocean (PACE)	10.000	8.000	3.500	0.000	0.000	0.000	0.133	0.000	0.000	0.000	0.354	6.456
	b	Aerosol parameters over land (PACE)	10.000	8.000	2.125	0.000	0.000	0.000	0.116	0.000	0.000	0.000	0.233	7.667
	c	Cloud parameters (PACE)	5.000	2.000	1.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.528	2.362
	d	Aerosol parameters (EarthCARE)	8.000	4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.465	4.282
	e	Cloud parameters (EarthCARE)	8.000	4.000	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.118	7.080
4. Validate radiometric and polarimetric properties	a	Validate large reflectances	6.000	2.000	1.125	0.000	0.061	0.000	0.000	0.370	0.000	0.000	0.430	3.419
	b	Validate large reflectances with high polarization	6.000	2.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.393	3.639
	c	Validate large reflectances with low polarization	6.000	2.000	3.000	0.000	0.000	0.000	0.000	0.145	0.000	0.000	0.777	1.339
	d	Overfly vicarious calibration sites	6.000	4.000	1.250	0.000	0.268	0.000	0.000	0.000	0.000	0.000	0.268	4.390
6. Focus on specific processes or phenomena	a	High aerosol loads over land	4.000	2.000	20.750	0.000	0.410	0.000	0.000	0.197	0.000	0.000	1.000	0.000
	b	High aerosol loads over ocean	4.000	2.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.393	2.426
	c	Multiple aerosol layers	1.000	2.000	21.625	0.000	0.000	0.000	0.000	0.127	0.000	0.000	1.000	0.000
	d	Aerosol under thin cirrus	2.000	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.000
	e	Aerosol above liquid phase cloud	4.000	2.000	3.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.826	0.695
	f	Broken clouds with complex structure	4.000	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.000
	g	Dust aerosols over ocean	4.000	2.000	1.125	0.000	0.000	0.000	0.430	0.000	0.000	0.000	0.430	2.279
	h	Aerosol and ocean parameters over turbid waters	2.000	2.000	3.125	0.000	0.000	0.000	0.569	0.000	0.000	0.000	0.790	0.419
	i	Aerosol and ocean parameters over biologically productive waters	4.000	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.000
	j	Smoke aerosols over ocean	1.000	2.000	2.500	0.000	0.000	0.000	0.000	0.320	0.000	0.000	0.713	0.287
	total:			150.000	98.000	163.738	0.000	0.034	0.000	0.046	0.049	0.000	0.000	0.545
				ER-2 flight hours	18.900	0.000	4.300	0.000	0.000	6.300	0.000	0.000	0.000	10.600
				TO flight hours	22.200	0.000	0.000	0.000	3.700	7.500	0.000	0.000	0.000	11.200
				Shearwater days	2.000	0.000	1.000	0.000	1.000	1.000	0.000	0.000	0.000	3.000
PACE-PAX overall objectives satisfied:			0.545											

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>

ER-2 MVIS quicklooks

18:02 R/V Shearwater



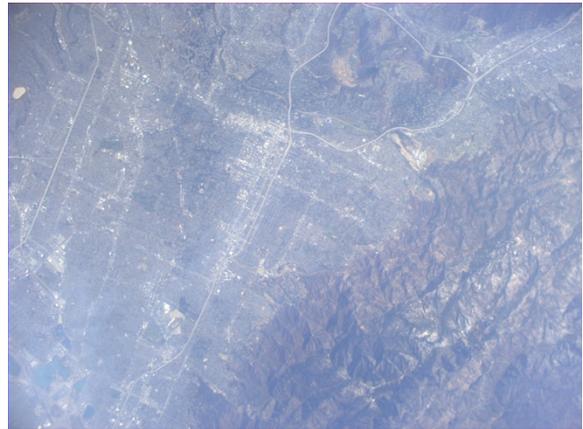
18:18 Bridge fire smoke with Twin Otter



18:42 USC_SeaPRISM; R/V Blissfully



18:57 CalTech AERONET site, smoke



19:05 downwind Bridge fire smoke w. TO



20:18:30 Railroad Valley



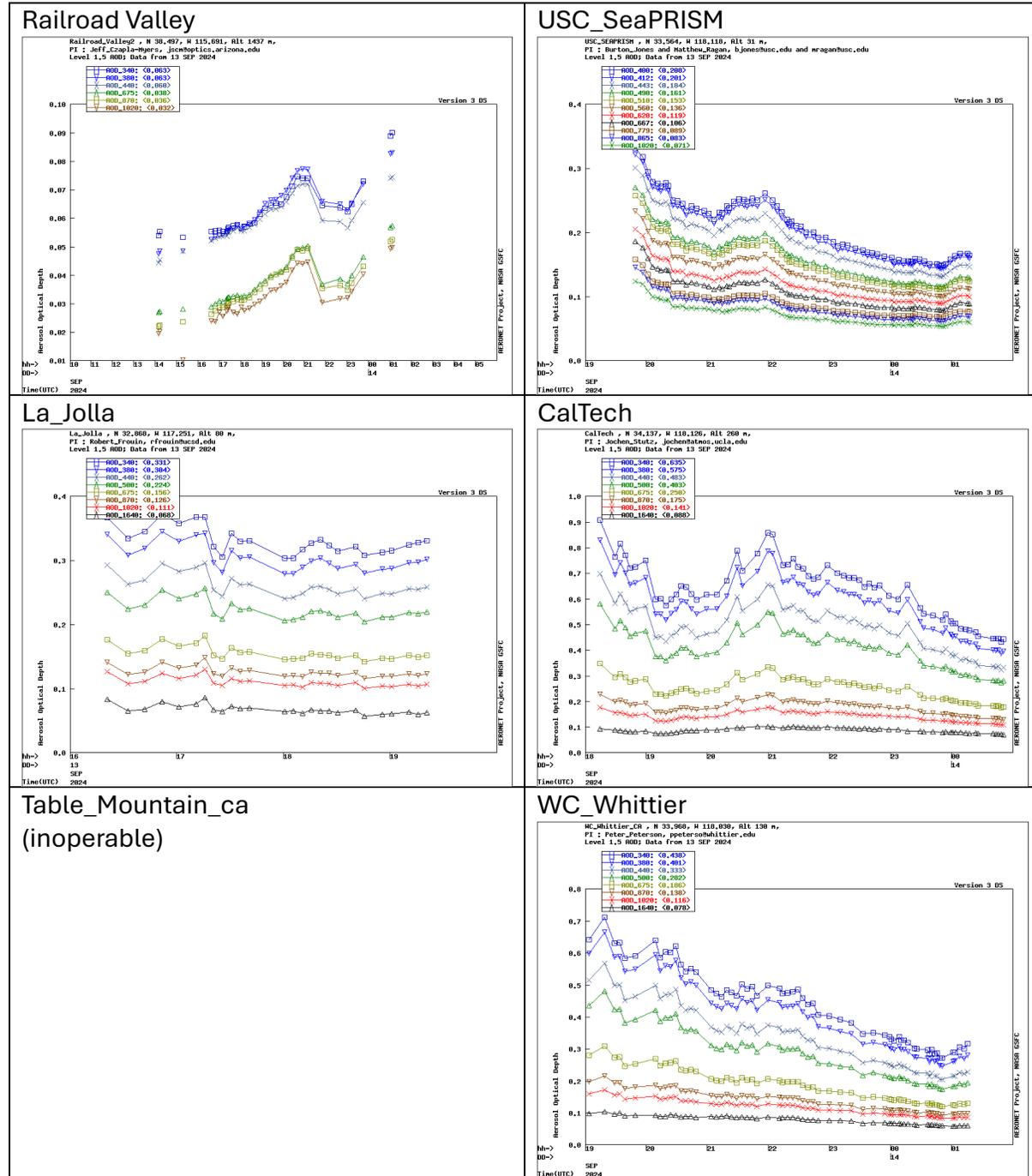
21:21:18 La_Jolla AERONET



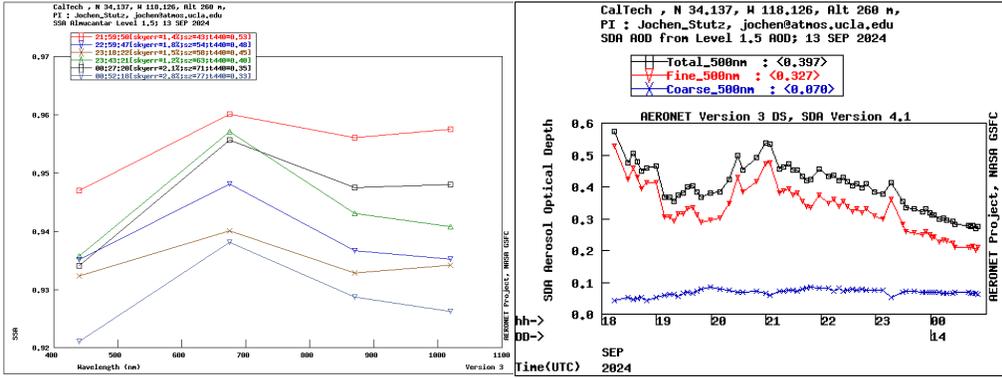
21:48 USC_SeaPRISM; R/V Blissfully



AERONET quicklooks



AERONET retrieval quicklook



Twin Otter photos

Heading into the smoke at 10 kft, 17:21 UTC.
(Photo = Adam Ahern)



View of the Bridge Fire during the first spiral
17:35:29 UTC. LA basin full of smoke.



17:40:40 Two layers of aerosol visible during
descent of first spiral. Photo isn't great, but it was
an observable phenomenon during the spirals.
(Photo = Ahern Ahern)



Distinct aerosol layer visible during spiral
down east of Airport fire at 21:11. (Photo =
Adam Ahern)



Two layers of aerosol visible at 22:50 UTC during
transit back from LA. (Photo = Adam Ahern)



R/V Blissfully photos

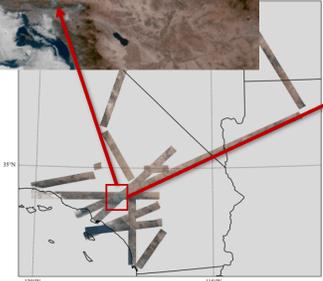
Station 2b (cruise station RB_11) 33.558371°, -118.117538, repeated same location for the ER-2 overpass 21:48 UTC



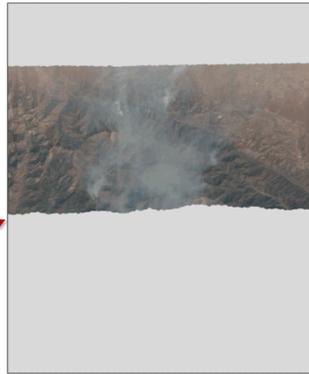
ER-2/PICARD

PICARD Bridge Fire Overpasses, 13 September 2024

Worldview GOES-18 True Color, 1820 UTC



True Color
(469, 548, 665nm)

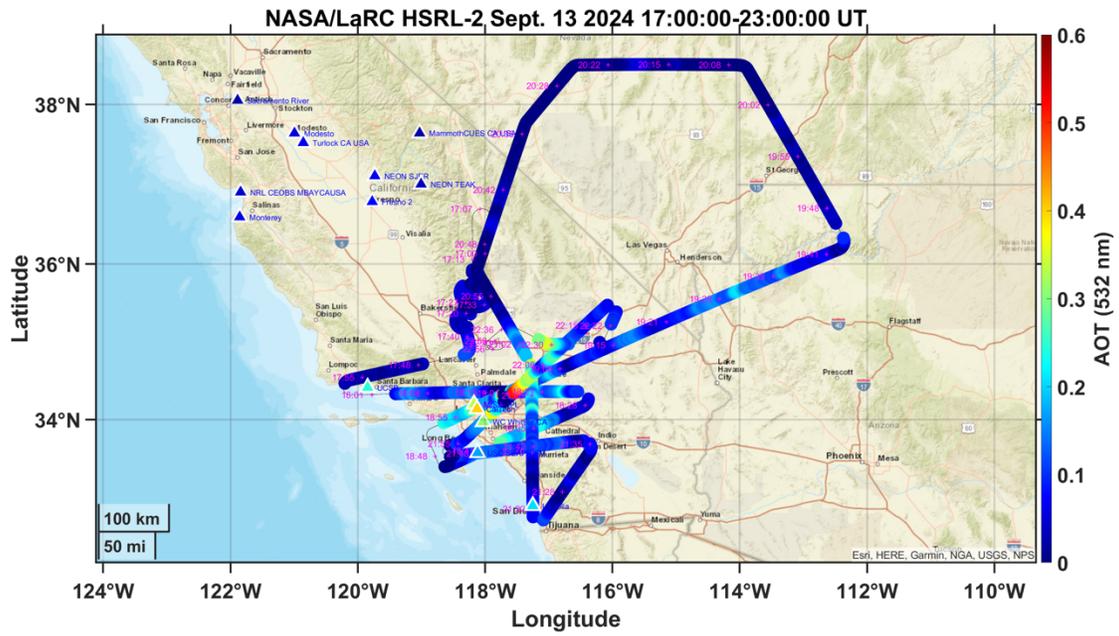
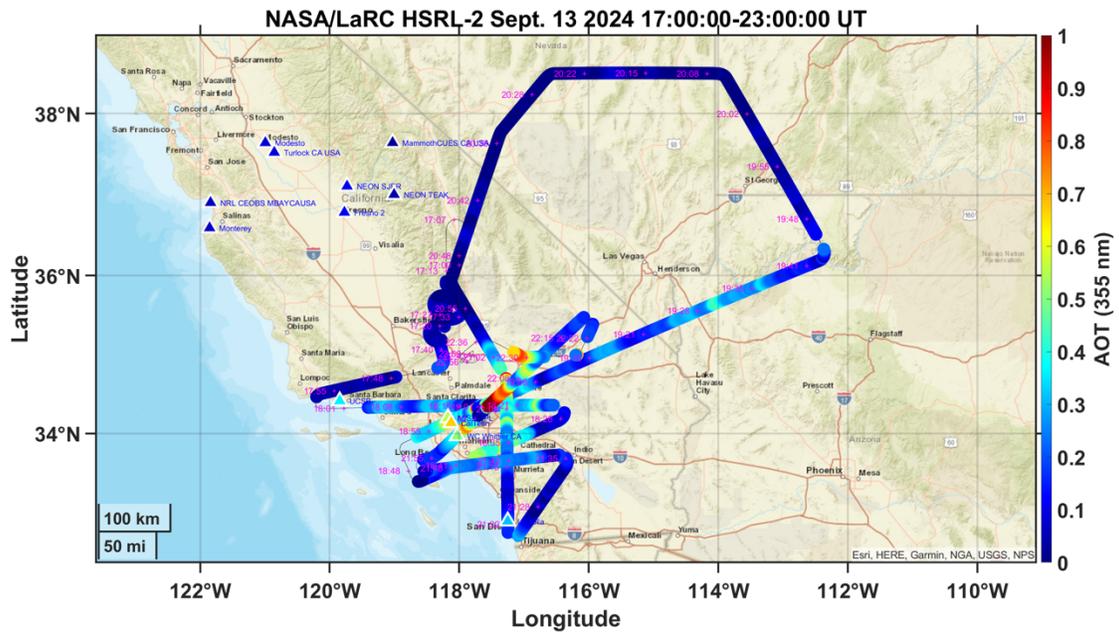


False Color
(2110, 872, 665nm)

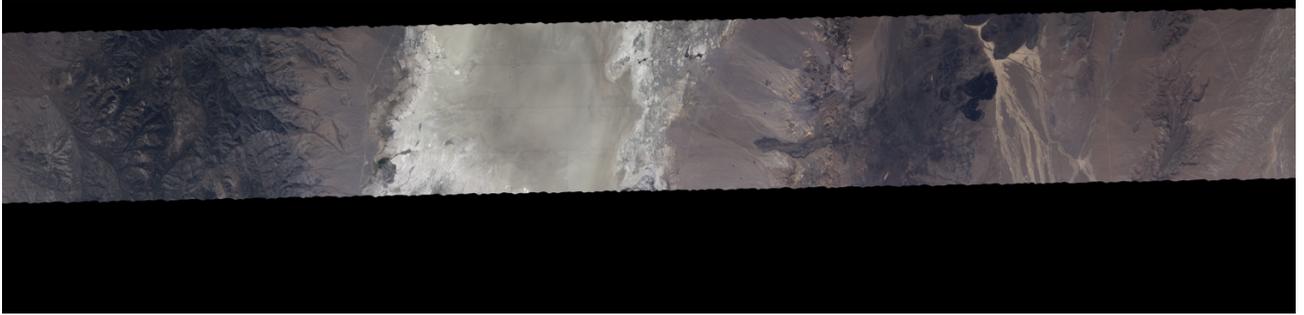


1817 UTC

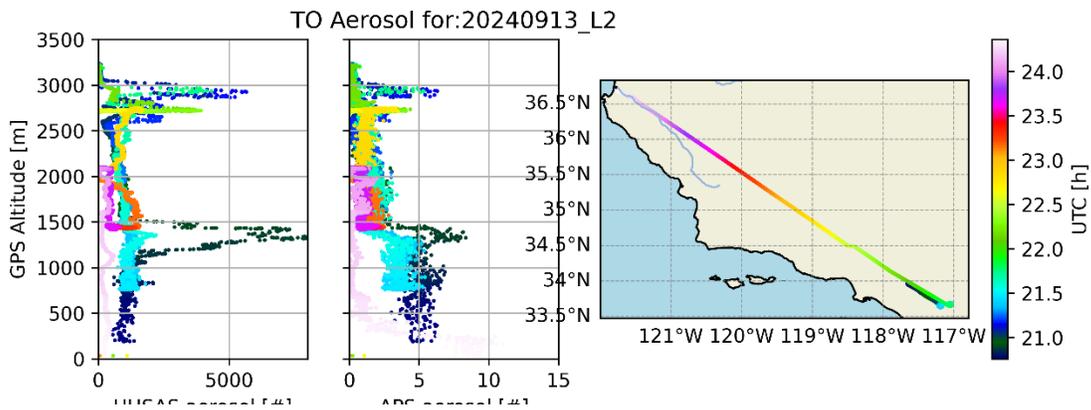
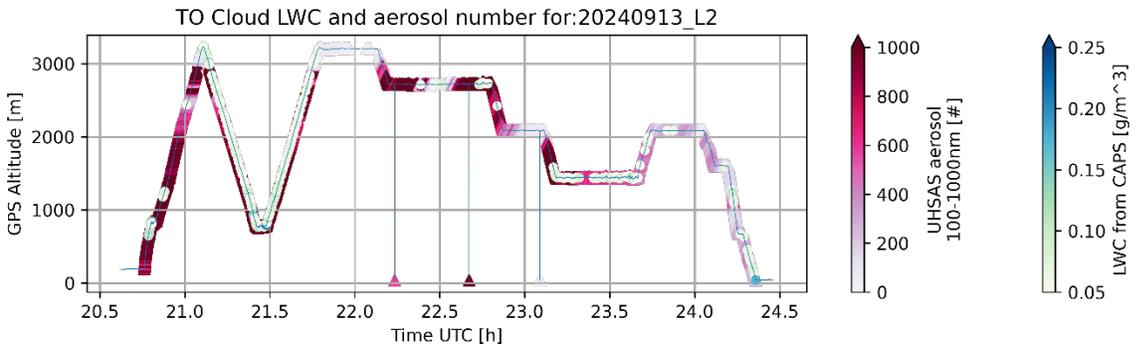
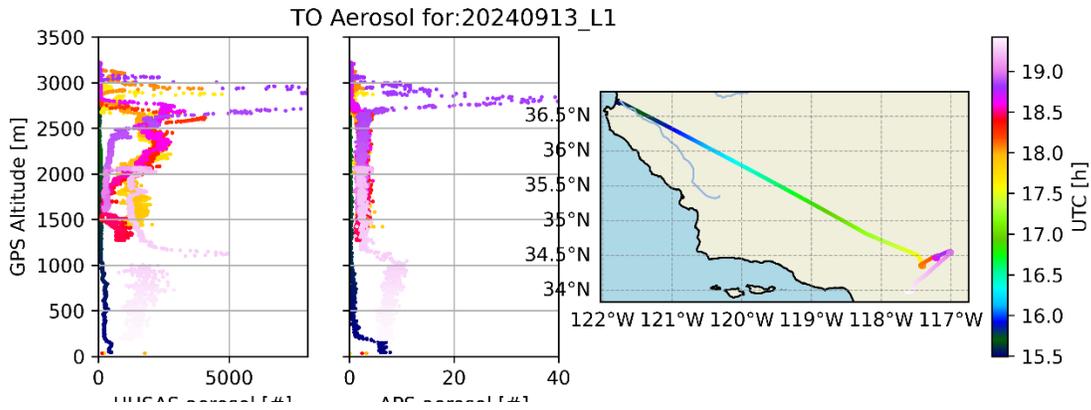
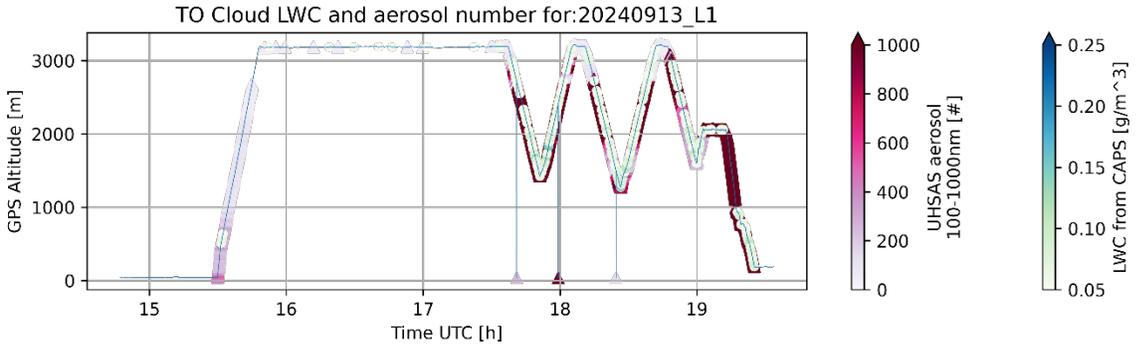
ER-2/HSRL



ER-2/PRISM
Railroad valley(20:19UTC)

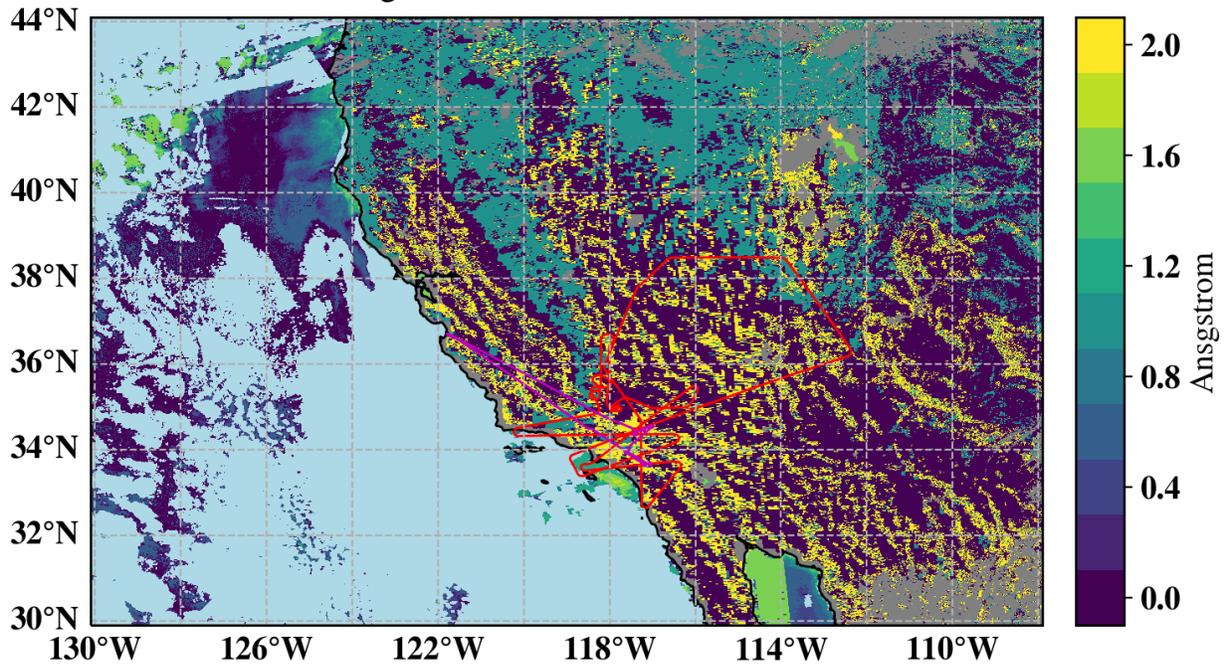


TO Quicklooks

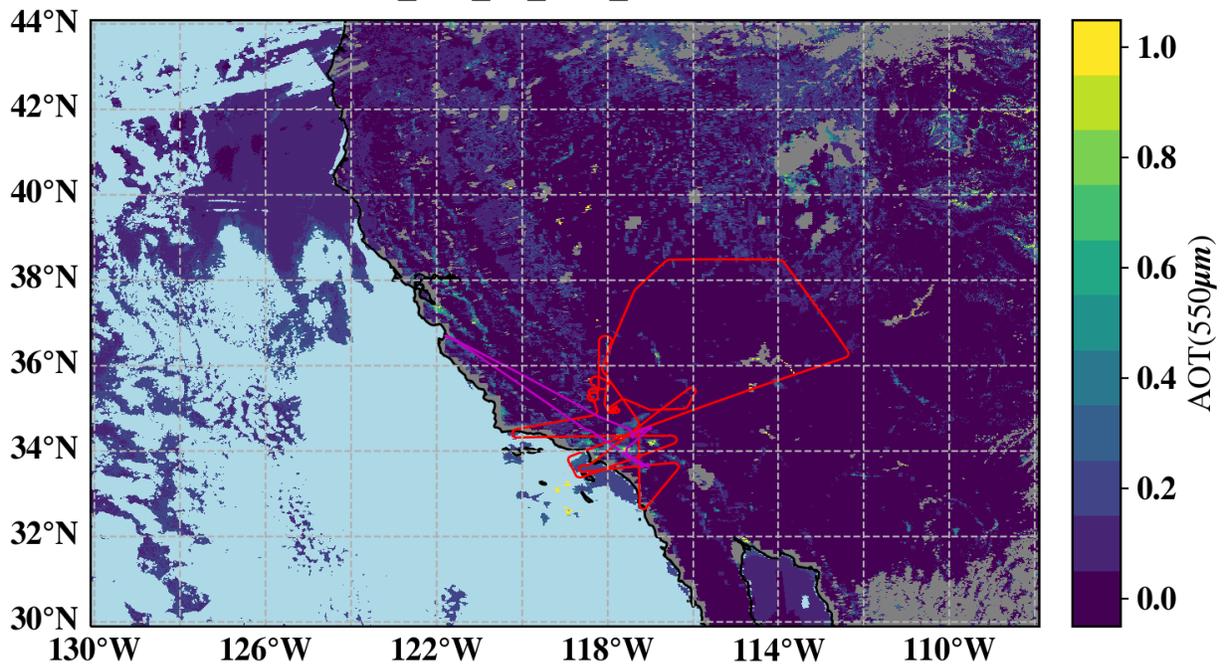


PACE Satellite products

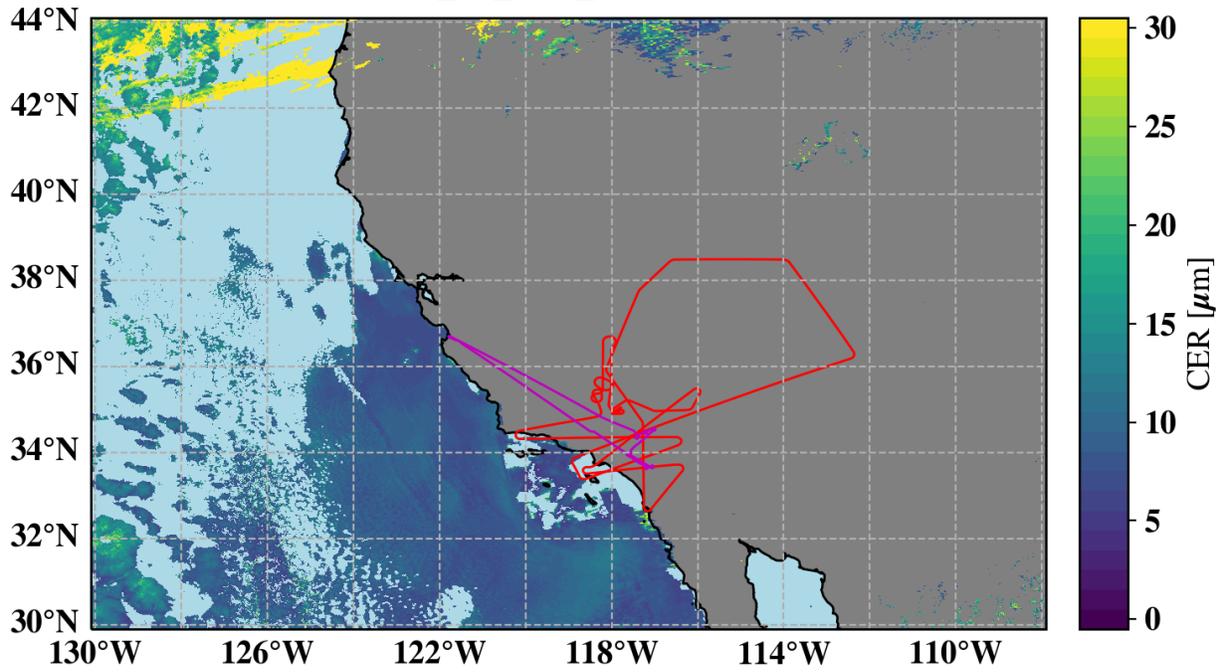
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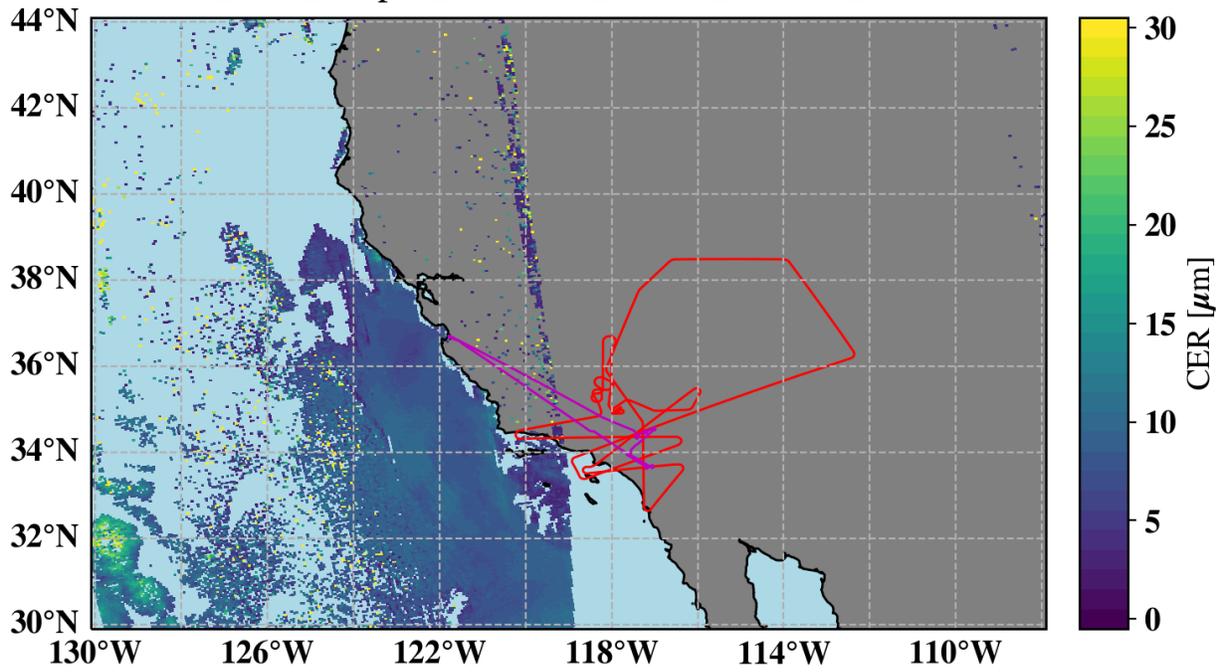
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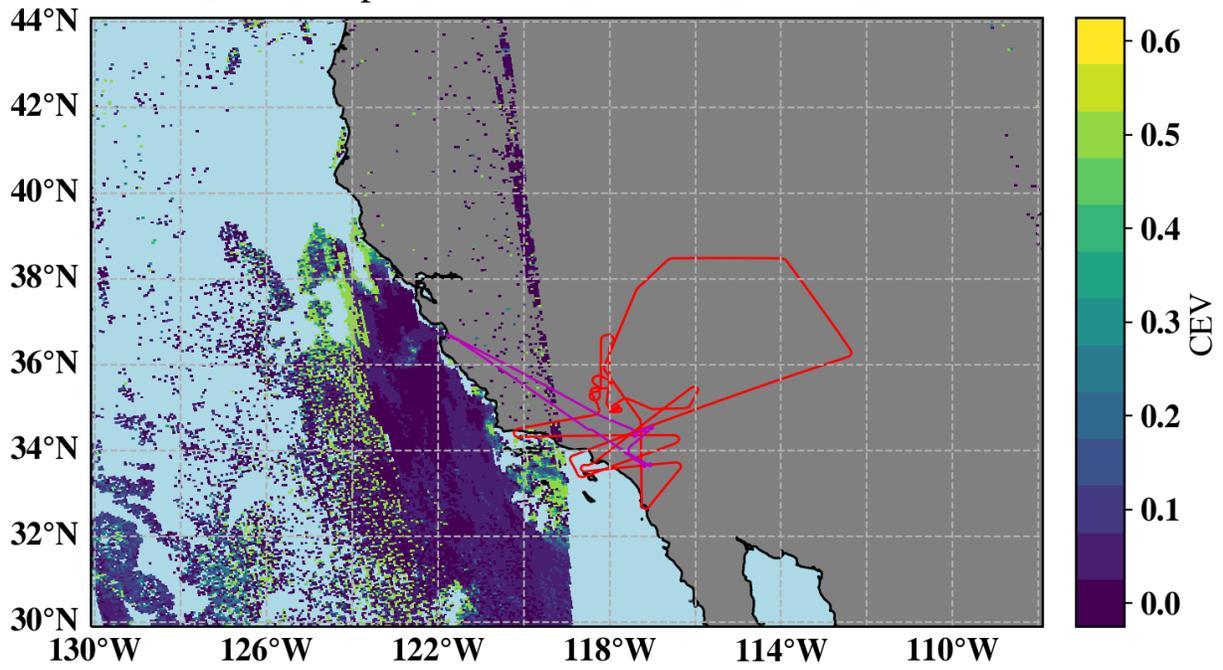
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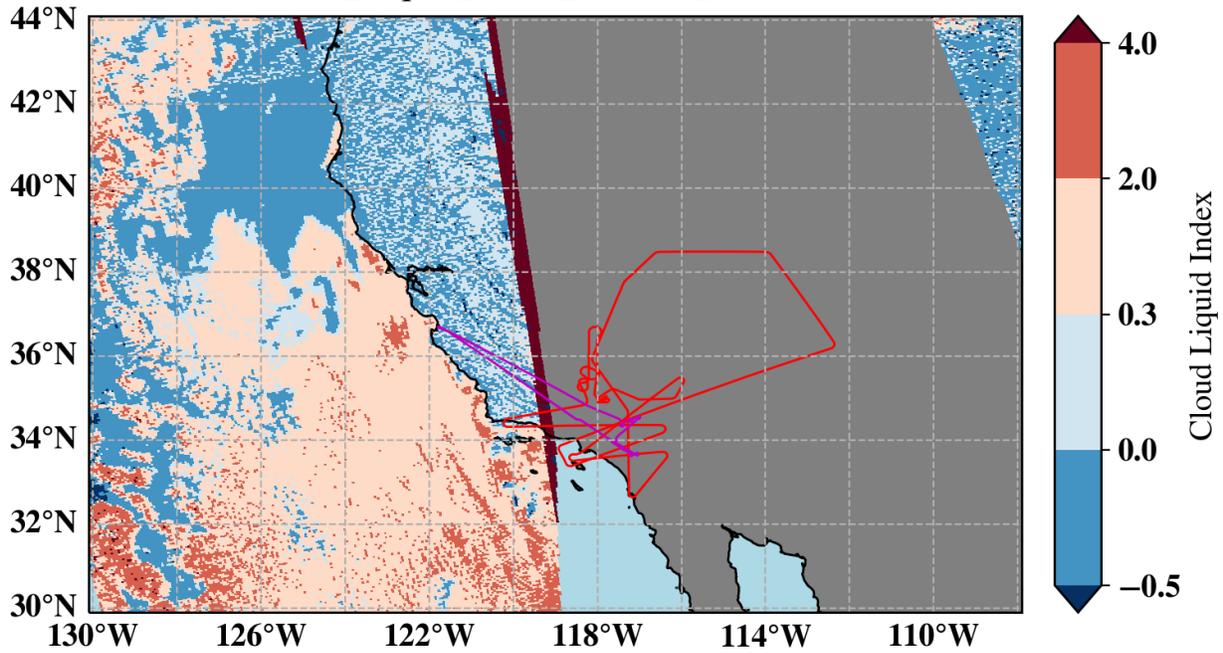
Cloud_Bow_Droplet_Effective_Radius_HARP2_20240913



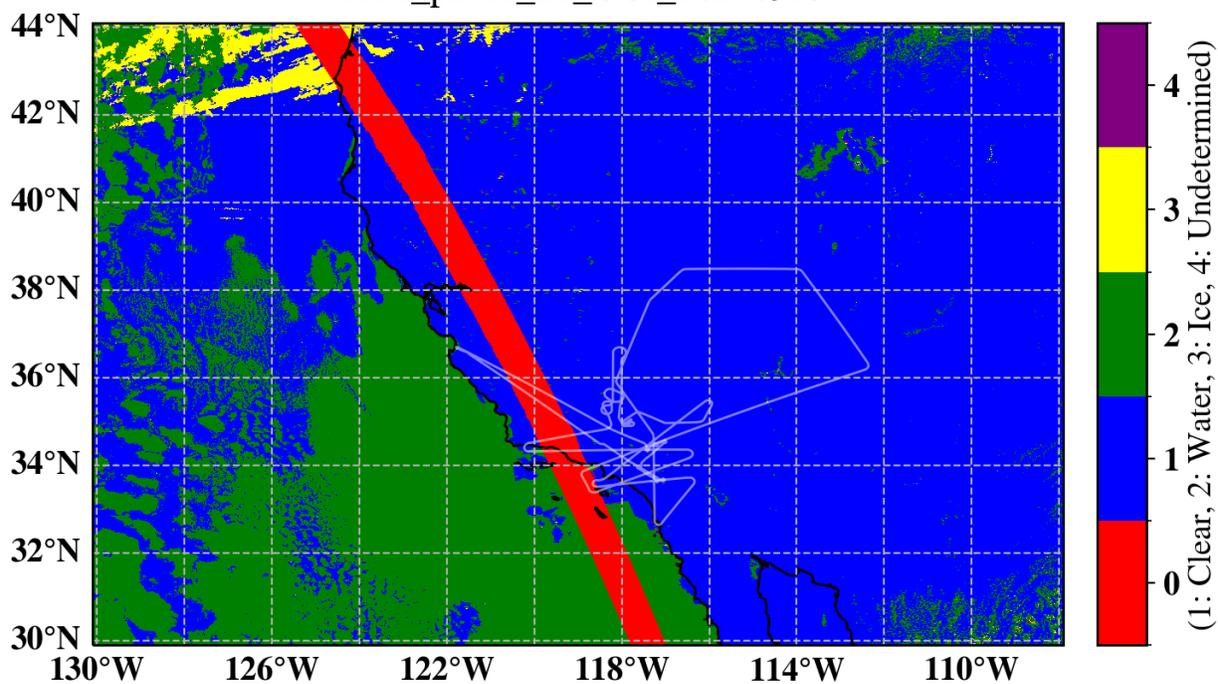
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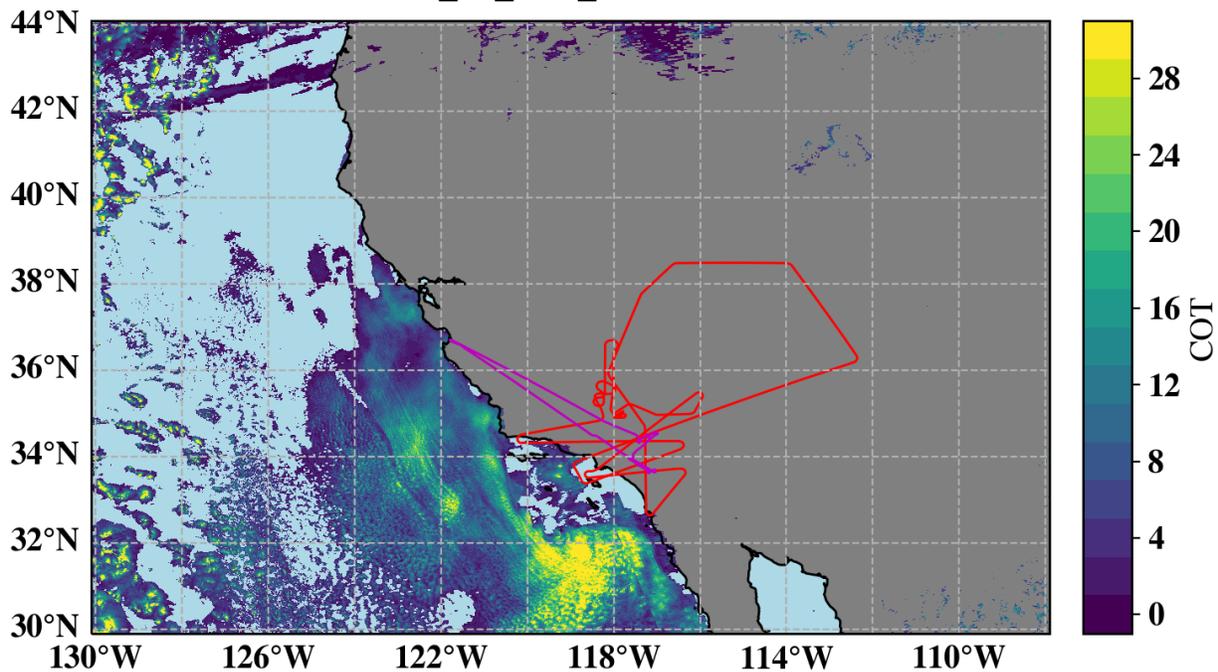
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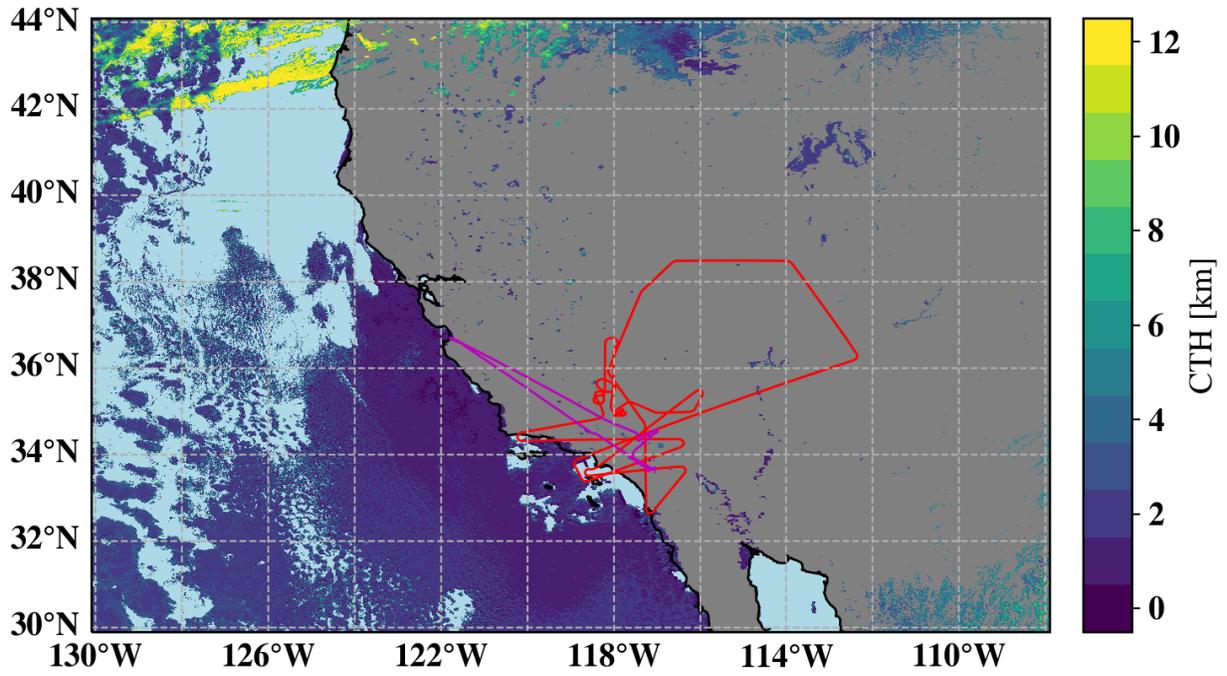
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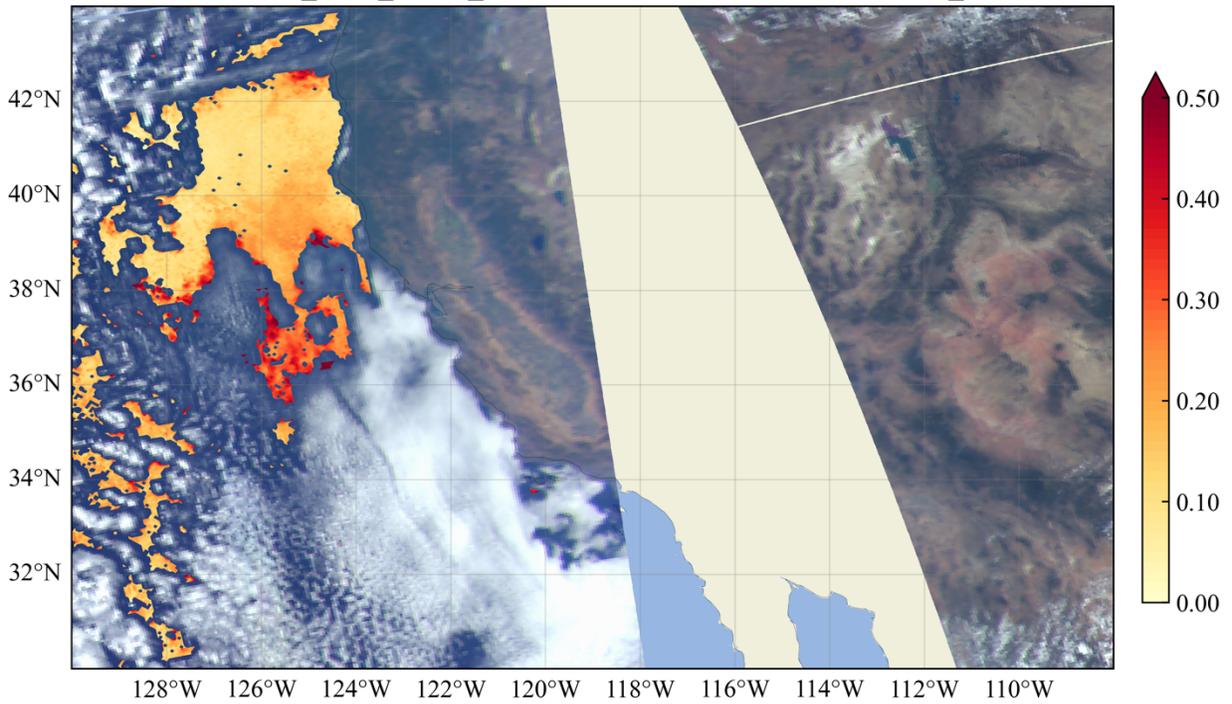
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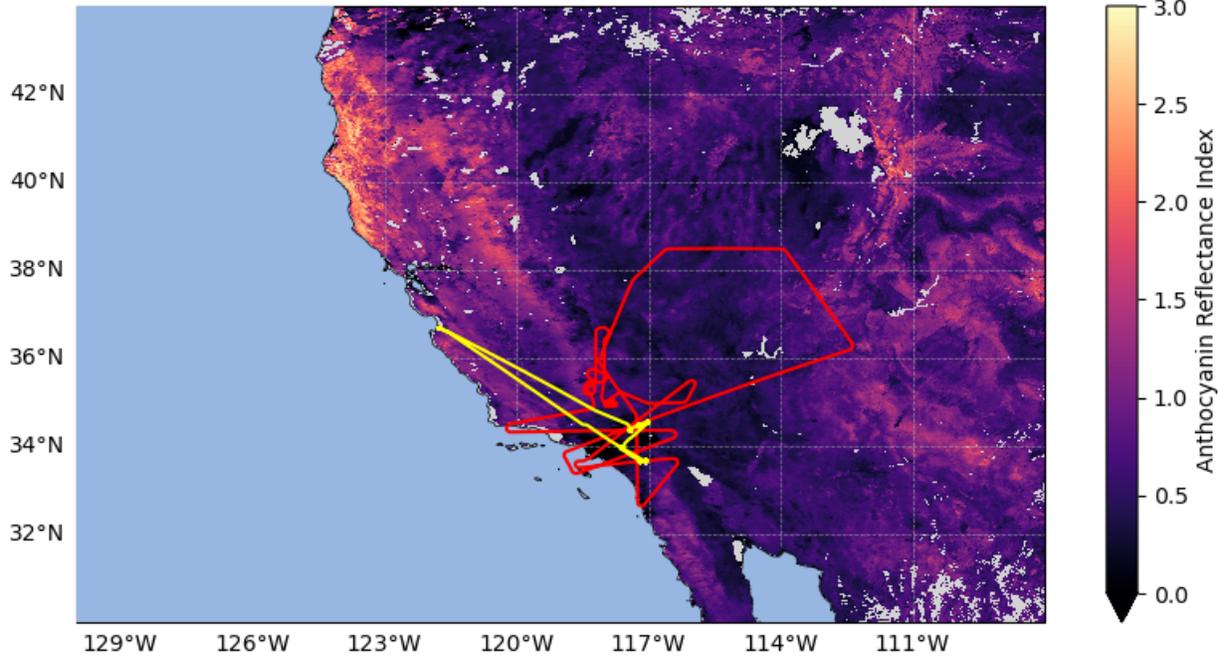
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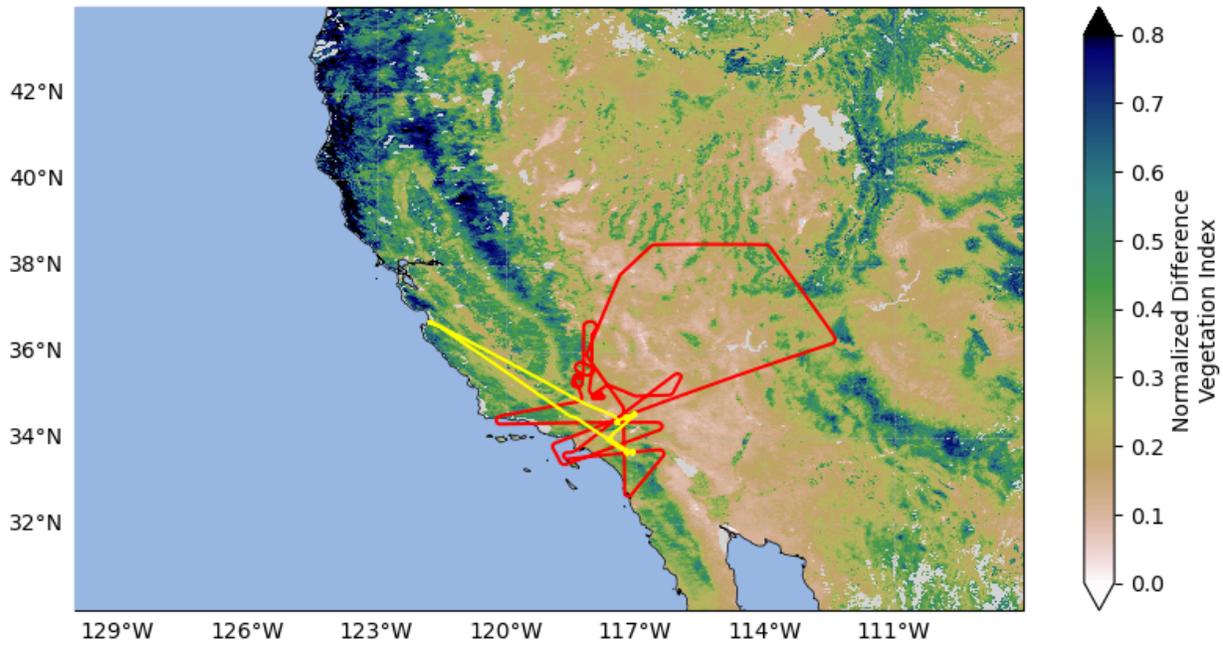
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OCI mARI with ER2/Twin Otter Flight Track, 2024-09-13



OCI NDVI with ER2/Twin Otter Flight Track, 2024-09-13



Twin Otter flight report

PACE-PAX Research Flight report 2024/09/13

Double-Sortie Twin Otter Flight

Manifest:

Bryce Kujat (pilot)

Jeff Martin (pilot)

Anthony Bucholtz (QNC)

Adam Ahern (QNC)

Edward Winstead (QNC)

Launch 1:

Take off: 08:29:51 (15:29:51 UTC) Marina Airport (OAR)

Landing: 12:25:12 (19:25:12 UTC) Chino Airport (CNO)

Duration: 3.9 hrs.

Objectives: Profiles of aerosol scattering and absorption coefficients, and size distributions together with scattering (polarized) phase functions of aged and fresh smoke from wildfires outside of Los Angeles. First flight down to the Los Angeles (LA) area will be made at altitude, allowing for coordination with the ER2 (planned 17:46 UTC) during the first spiral down that is east of the Bridge Fire. Two additional spirals are planned along the ER2 flight track, downwind of the Bridge Fire and north of the Line Fire. After completing spirals, as fuel allows, land in Chino, CA for fuel.

Summary: Takeoff at 15:29:51 UTC with very little aerosol present during the climb out from Marina, CA. Transit to LA at 10 kft was very clean, although dust aerosol was visually identified below in the Central Valley. Smoke from the wildfires becomes visible at 16:10 UTC, with local landmarks showing that the smoke layer was just below San Antonio Mountain which has a height of 10,064 ft. During the first spiral down, we observed three distinct layers of smoke. The first was a

very sharp increase to $\sim 90 \text{ Mm}^{-1}$ of scattering $\sim 9.2 \text{ kft}$, followed by clean air, then another thick layer $\sim 80 \text{ Mm}^{-1}$, which then transitioned into a fairly well mixed boundary layer. The bottom of the spiral was at 4.8 kft due to terrain. Since we were early and had plenty of fuel, we repeated the spiral back up and observed similar structure. We headed to the second planned location a few miles east and spiraled down and then back up. During this second spiral we were overflown by the ER2. We saw similar structure but with much denser smoke at the second spiral, both down and up. We moved slightly further east to waypoint BFIR3 and spiraled down, seeing the highest scattering of the flight at 1100 Mm^{-1} . After spiraling down, we headed to Chino, CA (KCNO) for fuel. Transitioning from the Antelope Valley into the LA basin showed a distinct increase in aerosol loadings, $\sim 124 \text{ Mm}^{-1}$. We landed at KCNO at 19:25:12.

Launch 2:

Take off: 13:45:37 (20:45:37 UTC) Chino Airport (CNO)

Landing: 17:21:35 (24:21:35 UTC) Marina Airport (OAR)

Duration: 3.6

Objectives: Second sortie is planned for coincidence with PACE satellite overpass (21:14 UTC, OCI only) during a spiral down just east of the Airport Fire. A second spiral is planned further east of the Airport Fire with an ER2 overpass. Two passes at the Marina airport tower will be done if time and conditions allow.

Summary: We took off from KCNO at 20:45:37, ascending through significant smoke, with scattering coefficient $\sim 60 \text{ Mm}^{-1}$. We climbed to 10 kft and were directed by ATC to move further east to avoid an active skydiving zone. We observed the same vertical distribution of aerosol as we did east of the mountains, going from $\sim 2 \text{ Mm}^{-1}$ at 10 kft increasing to $\sim 150 \text{ Mm}^{-1}$ at 9.2 kft , clean air, then another layer of better mixed smoke. Bottom of spiral was 2.5 kft , at which point we transited at that altitude to over Diamond Valley Lake and spiraled up. At the top of the spiral we turned back towards Marina and descended to 8.5 kft to try and be in the smoke. Once clear of LA airspace, we descended as low as terrain would allow, including 20 minutes at 4.5 kft when we measured what appeared to be marine inflow characterized by large particles that may have been sea salt. We landed at 24:21:35 (on September, 14th 2024 in UTC time). No passes at the tower were possible due to the presence of fog.

All instruments aboard the Twin Otter were operating nominally throughout both flights, except during the descent into Chino CA which may have been faster than the dewpoint monitor could respond to, and the aerosol concentrations may have been too high for some of the particle counters.



Heading into the smoke at 10 kft, 17:21 UTC; photo taken by Adam Ahern



View of the Bridge Fire during the first spiral 17:35:29 UTC. LA basin full of smoke; photo taken by Adam Ahern



17:40:40 Two layers of aerosol visible during descent of first spiral. Photo isn't great, but it was an observable phenomenon during the spirals; photo taken by Adam Ahern.



Distinct aerosol layer visible during spiral down east of Airport fire at 21:11; photo taken by Adam Ahern.



Two layers of aerosol visible at 22:50 UTC during transit back from LA; photo taken by Adam Ahern.

R/V Shearwater report

PACE-PAX R/V Shearwater day report

Date: 09/13/2024

Creator: Michael Ondrusek

Cruise ID: RF0913-RS

Sailed out: 15:57 UTC (8:57 PST)

Back in port: 23:00 UTC (16:00PST)

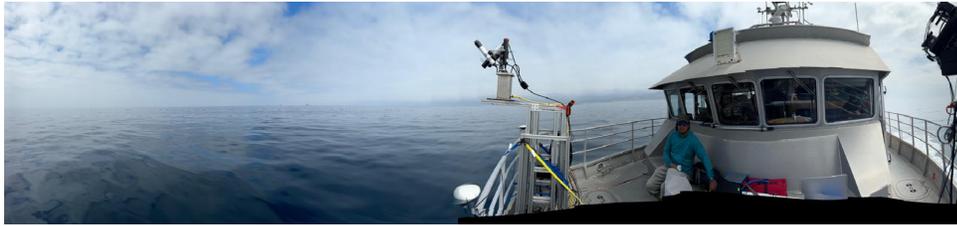
Today, the ship occupied three stations.

Station #9 34.327250, -119.503281 arrival 16:37 UTC (9:37 PST) → departure 18:27 UTC (11:27 PST) occupied station at eastern end of ER2 line. Swell < 1ft. Wind 1 to 3 kts. Completely overcast. IOPs first then profiles with consistent lighting, the polarimagers.

Arrival photo:



Departure photos



Station #10 34.32317, -119.57417, arrival 18:44 UTC (11:44 PST) → departure 19:57 UTC (12:57 PST) 5 Nm west on line. Profiles first, then Polarimager then IOPs. Clouds in and out. Starting to break up.

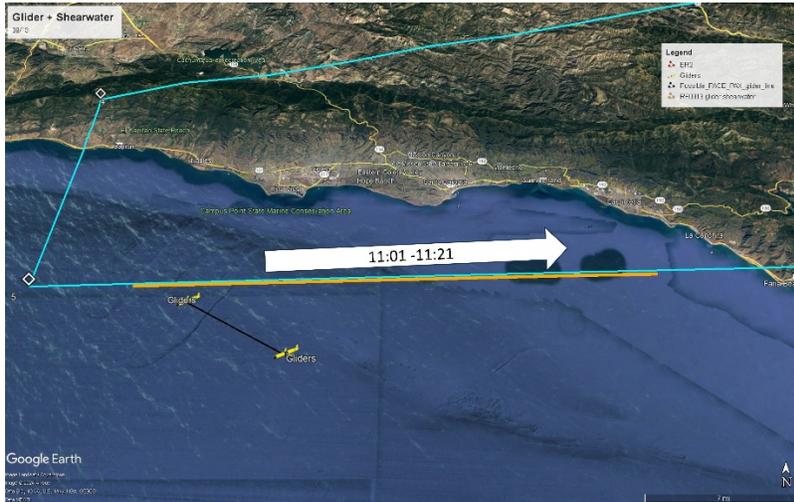
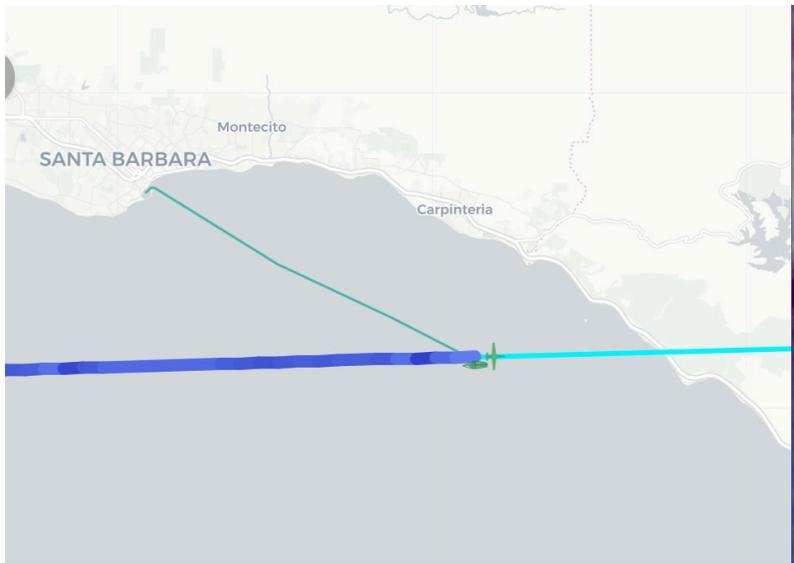


Station #11 34.12268°, -119.70124°, arrival 20:45:40 UTC (13:45 PST) → departure 22:01:40 UTC (15:01 PST) Just North of Santa Cruz between Island and shipping channel. Winds 11.5 kts. Clear sun but some haze. Green water. Did profiles, the polarimager then IOPs.



System Status:

ER-2 overflight at 18:03 UTC (11:03 PST)



Group Status: All's well

R/V Blissfully report

PACE-PAX R/V Blissfully day report

Date: 09/13/2024

Creator: Bridget Seegers

Cruise ID: RF0913-RB

Sailed out: 15:59 UTC

Back in port: 01:01 UTC

Today, the ship accomplished....

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

Station 1 33.563581°, -118.117805° , no sampling because of clouds, ER-2 overflight 18:42 UTC



Initial conditions, sampling delay

Station 2a (cruise station RB_10) 33.558371°, -118.117538, sampling started at 20:14 UTC,
Station 2b (cruise station RB_11) 33.558371°, -118.117538, repeated same location for the ER-
2 overpass 21:48 UTC



Tomorrow, RV Blissfully

Ship plans through the next 3 days...

Sampling in coordination with rest of the experiment

System Status...

All good

No ER-2 overflight

Group Status...

All great