PACE-PAX research report 2024/09/27

Compiled by Kirk Knobelspiesse, Ivona Cetinić, Brian Cairns, Michael Ondrusek, 2024/10/06
Reviewed by Samuel LeBlanc
Last coordination between ER-2 and Twin Otter. ER-2 on PACE track. For the first time, overflights of R/V Rachel Carson in the Monterey Bay (PACE PVST PI Clarissa Anderson).

ER-2
Take off: 17:56
Landing: 00:26
Duration: 6.4 hrs
Pilot: Dean Neeley, mobile: Kirt Stallings
All instruments operated successfully

Twin Otter
Take off: 20:27
Landing: 23:31
Duration = 3.1 hrs
Manifest: Bryce Kujat (pilot), Jeff Martin (pilot) , Michael Shook (QNC), Elizabeth Wilk (QNC), Edward Winstead (QNC)
See end for full Twin Otter report

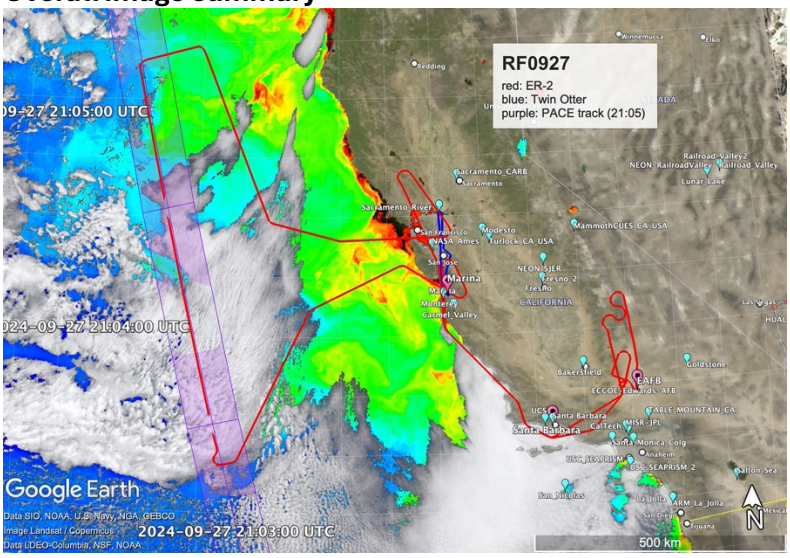
R/V Shearwater
Operations concluded

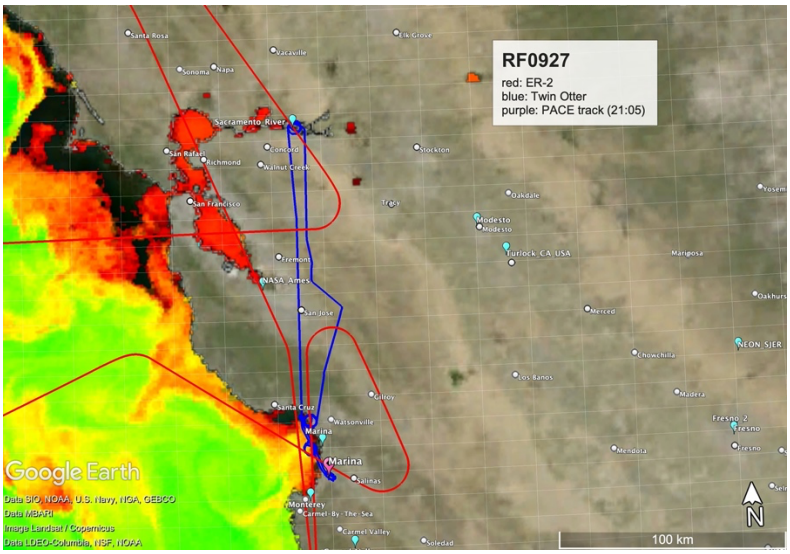
PACE
21:04, offshore California

EarthCARE
Not targeted

Gliders
Operational

Overall image summary





Validation Traceability Matrix itemized objectives

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

Time UTC	Platform	VTM(hrs)	
17:56	ER2		ER-2 takeoff
18:54	ER2, gliders		ER-2 overflies gliders. Cloudy
19:18	ER2	1d(0.5)	ER-2 overflies Monterey AERONET site. AOT(500)=0.05
19:22	ER2	1d(0.5)	ER-2 overflies CEOBS site. AERONET instrument not functional, but lidar, etc. are.
19:36	ER2, RC	1b(1.0), 1c(1.0), 6i(1.0)	ER-2 over R/V Rachel Carson in biologically productive Monterey Bay conditions
20:27	TO		Twin Otter takeoff
20:30	ER2, PACE-OHS	1b(1.0), 1c(1.0), 1e(2.0), 3a(1.0), 3c(2.0), 6f(2.0)	Begins ~ 1 hour PACE track. Roughly 2/3 cloudy, 1/3 cloud free. Ends at 21:21
20:39	TO, PACE-OH	1b(1.5), 1c(1.5), 6i(1.5), 6c(1.5)	Twin Otter spiral over R/V Rachel Carson (PACE overpass). Top of spiral at 21:09, multiple aerosol layers

21:01	RS		Rachel Carson begins optical profiles
21:04	**PACE**		**PACE overpass, offshore California**
21:40	ER2	1c(1.0)	Begin ER2 cloud free segment in PACE-OH swath
21:43	TO	1c(1.5), 6c(1.5), 6h(1.5)	Start of spiral down over Sacramento_River AERONET-OC site. ER-2 overpass after spiral (22:38), multiple aerosol layer.
22:38	ER2	1b(0.5), 1c(0.5), 6h(0.5)	Over Sacramento_River AERONET-OC site. AOT(490)=0.05
22:50	TO	1d(1.5), 1c(1.5*0.5)	Twin Otter begins CEOBS spiral with ER-2 overhead(23:07). Cloud free. Partially above water.
23:01	ER2	1d(0.5)	ER-2 over NASA Ames AERONET site, AOD(500)=0.05
23:16	ER2	4c(0.5)	ER-2 return over cloudy (marine strato-cumulus) coast.
23:31	TO		Twin Otter landed
23:36	ER2, gliders	4c(0.5)	ER-2 over gliders, but cloudy
24:23	ER2		ER-2 lands

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:

- 0.019 of objectives observed. Successful coordination between ER-2, R/V Rachel Carson and TO, plus underpass of PACE.
- No scores above 6.0. Largest is still PACE aerosol in narrow swath over ocean (3a) at 5.7

PACE-PAX progress tracking

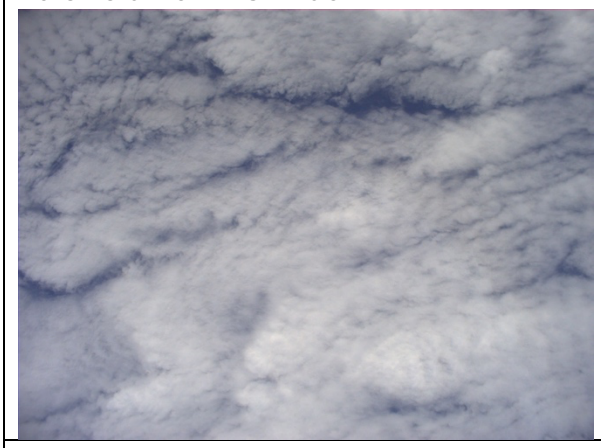
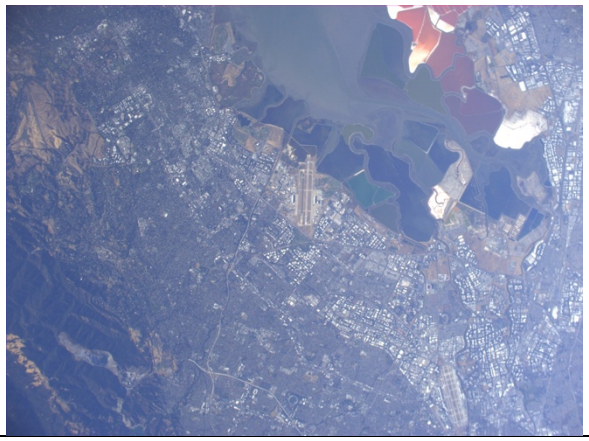
Validation objectives	ID	Measurement objectives	Importance, w	Observation time, h (hours)	Total observed (hours)	Fractional success 9/23	Fractional success 9/24	Fractional success 9/25	Fractional success 9/26	Fractional success 9/27	Fractional success 9/29	Fractional success 9/30	Total success	Remaining score
1. Validate new retrieval properties	a	Land surface parameters	8	2.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.971	0.2
	b	Ocean radiometric parameters	10	8.0	12.0	0.000	0.000	0.000	0.003	0.001	0.000	0.000	0.999	0.0
	c	Aerosol parameters over the ocean	12	8.0	14.5	0.000	0.000	0.000	0.014	0.003	0.000	0.000	0.997	0.0
	d	Aerosol parameters over land	12	8.0	16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.0
	e	Cloud parameters	12	8.0	6.8	0.058	0.025	0.000	0.000	0.023	0.000	0.000	0.920	1.0
	f	Ocean surface parameters	1	8.0	1.5	0.000	0.000	0.000	0.133	0.000	0.000	0.000	0.354	0.6
3. Validate in a narrow swath	a	Aerosol parameters over the ocean (PACE)	10	8.0	1.0	0.000	0.000	0.000	0.000	0.076	0.000	0.000	0.430	5.7
	b	Aerosol parameters over land (PACE)	10	8.0	4.0	0.132	0.000	0.000	0.103	0.000	0.000	0.000	0.638	3.6
	c	Cloud parameters (PACE)	5	2.0	2.0	0.000	0.000	0.000	0.000	0.181	0.000	0.000	0.895	0.5
	d	Aerosol parameters (EarthCARE)	8	4.0	3.0	0.038	0.000	0.000	0.053	0.000	0.000	0.000	0.918	0.7
	e	Cloud parameters (EarthCARE)	8	4.0	2.5	0.152	0.167	0.000	0.000	0.000	0.000	0.000	0.632	2.9
4. Validate radiometric and polarimetric properties	a	Validate large reflectances	6	2.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.953	0.3
	b	Validate large reflectances with high polarization	6	2.0	1.5	0.000	0.000	0.000	0.194	0.000	0.000	0.000	0.826	1.0
	c	Validate large reflectances with low polarization	6	2.0	1.5	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.970	0.2
	d	Overfly vicarious calibration sites	6	4.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.268	4.4
6. Focus on specific processes or phenomena	a	High aerosol loads over land	4	2.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.0
	b	High aerosol loads over ocean	4	2.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.393	2.4
	c	Multiple aerosol layers	1	2.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.0
	d	Aerosol under thin cirrus	2	2.0	3.5	0.826	0.000	0.000	0.000	0.000	0.000	0.000	0.826	0.3
	e	Aerosol above liquid phase cloud	4	2.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.826	0.7
	f	Broken clouds with complex structure	4	2.0	3.0	0.186	0.000	0.000	0.000	0.181	0.000	0.000	0.895	0.4
	g	Dust aerosols over ocean	4	2.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.430	2.3
	h	Aerosol and ocean parameters over turbid waters	2	2.0	1.0	0.000	0.000	0.000	0.046	0.036	0.000	0.000	0.873	0.3
	i	Aerosol and ocean parameters over biologically productive waters	4	2.0	4.0	0.000	0.000	0.000	0.043	0.028	0.000	0.000	0.989	0.0
	k	Smoke aerosols over ocean	1	2.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.713	0.3
		total:	150	98	77.8	0.041	0.011	0.000	0.021	0.019	0.000	0.000	0.812	
														total
				ER-2 flight hours		2.8	0	0	0	0	0	0	0	2.8
				TO flight hours		2.5	0	0	0	0	0	0	0	2.5
				Shearwater days		0	0	0	0	0	0	0	0	0

PACE-PAX overall objectives satisfied: 0.812

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

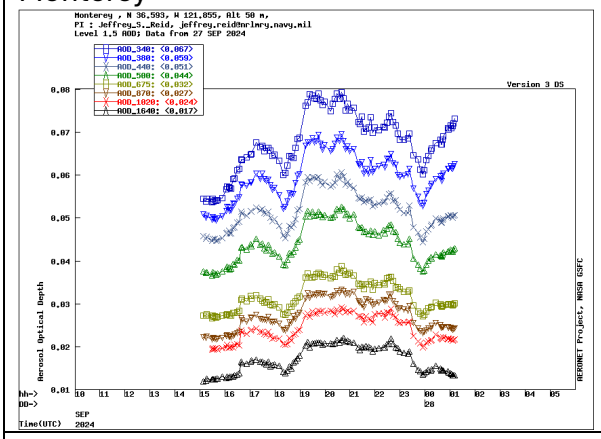
https://www-air.larc.nasa.gov/missions/pacepax/index.html

MVIS imagery

19:22 CEOBS site 	19:36 R/V Rachel Carson 
20:32 start of PACE track 	21:21 end of PACE track 
22:38:30 Sacramento_River AERONET-OC 	23:01:30 NASA_Ames AERONET 

AERONET plots

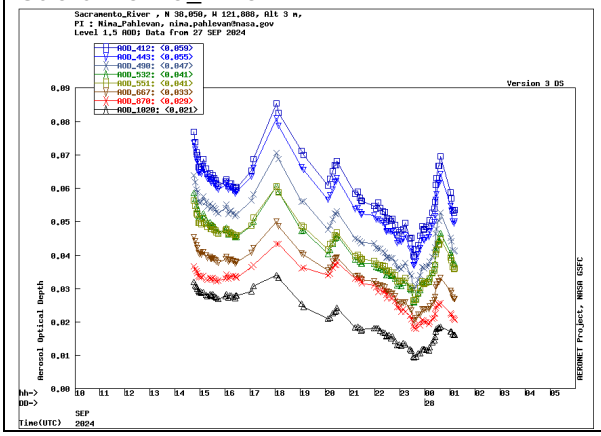
Monterey



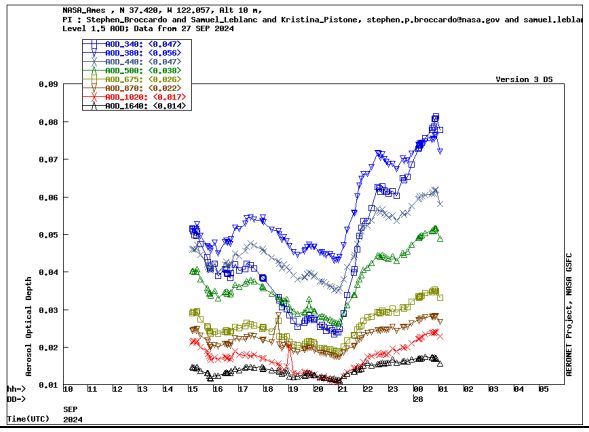
NRL_CEOBS_MBAYCAUSA

Not operational

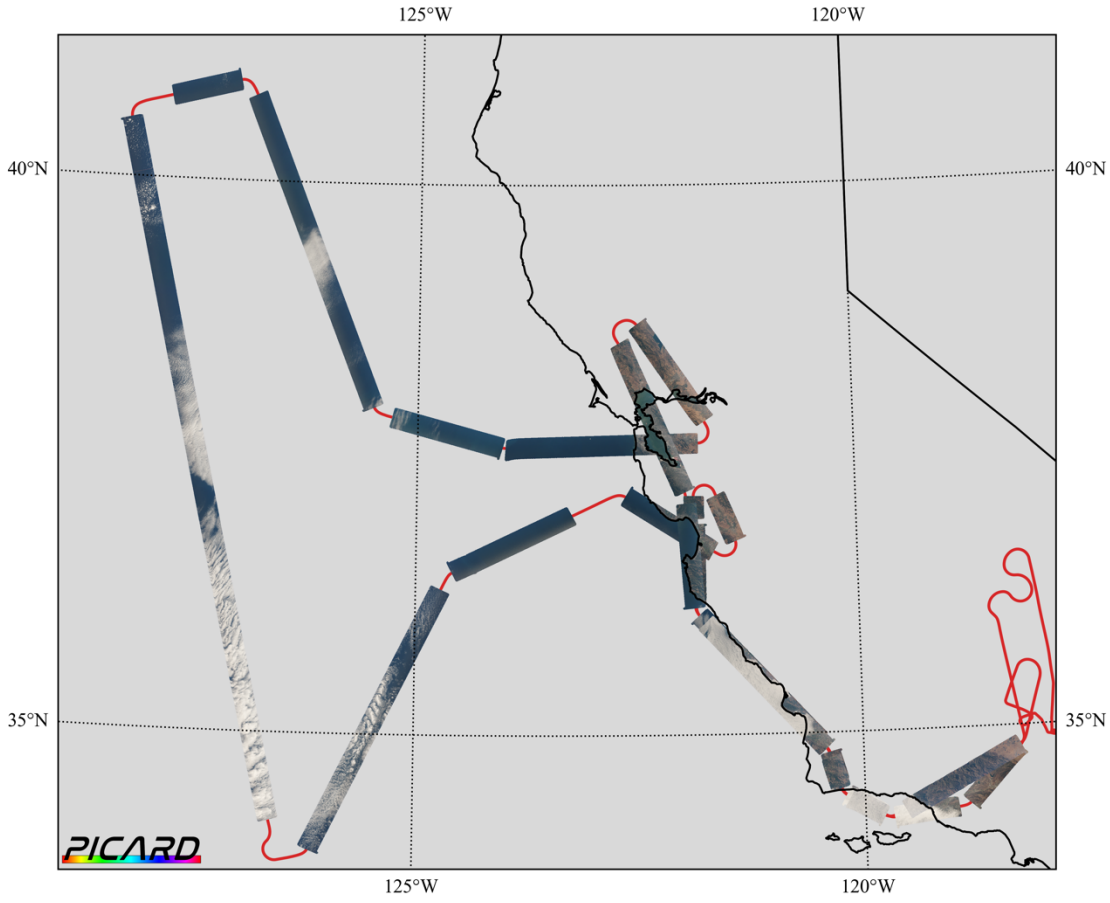
Sacramento_River



NASA_Ames

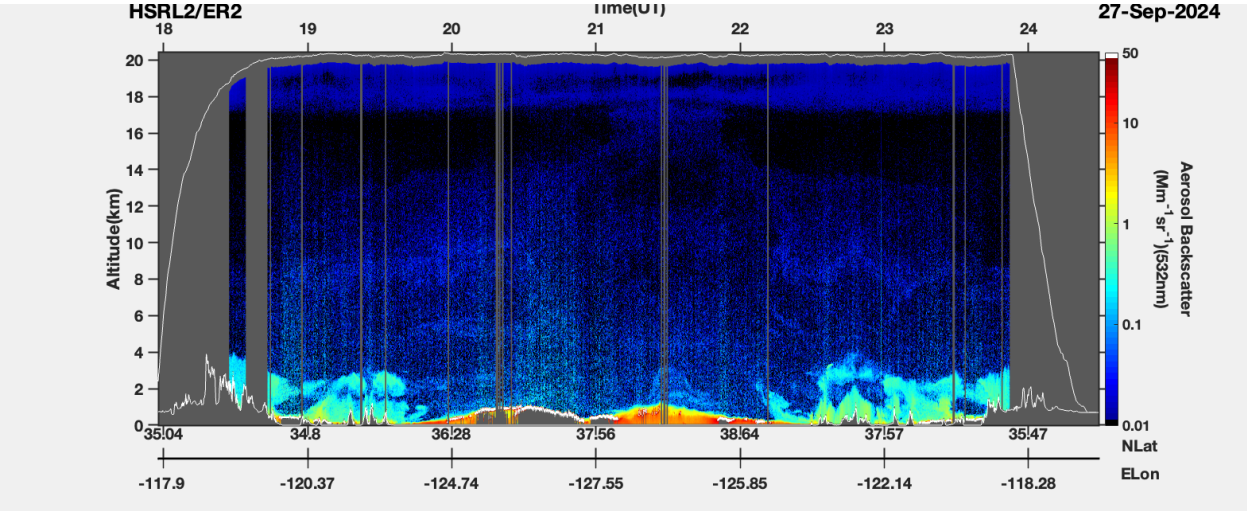


PICARD quicklooks

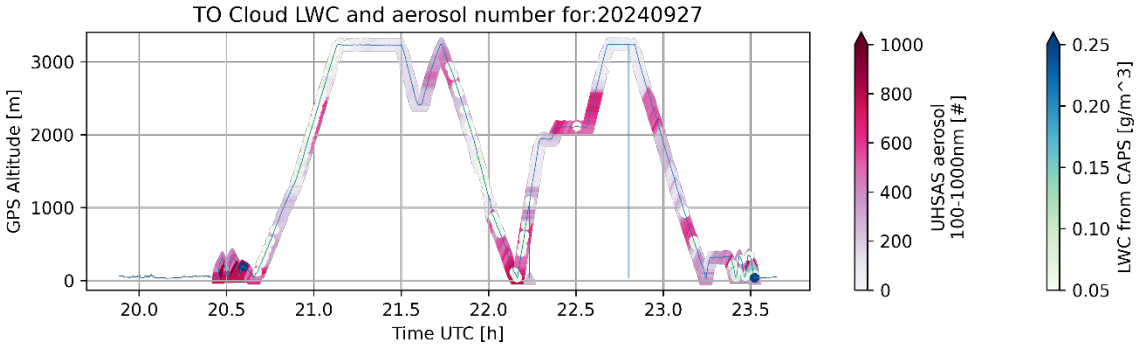


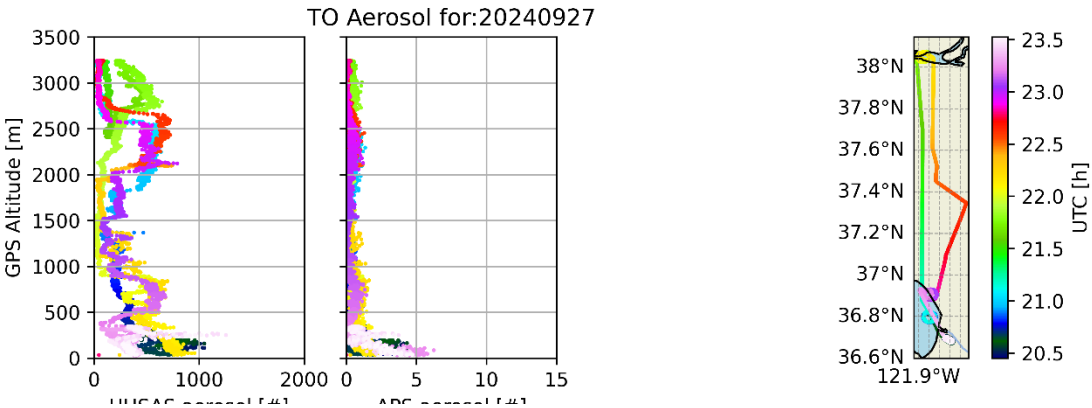
Pushbroom Imager for Cloud and Aerosol Research and Development
PACE-PAX, NASA Armstrong Flight Research Center
27 September 2024

HSRL quicklooks

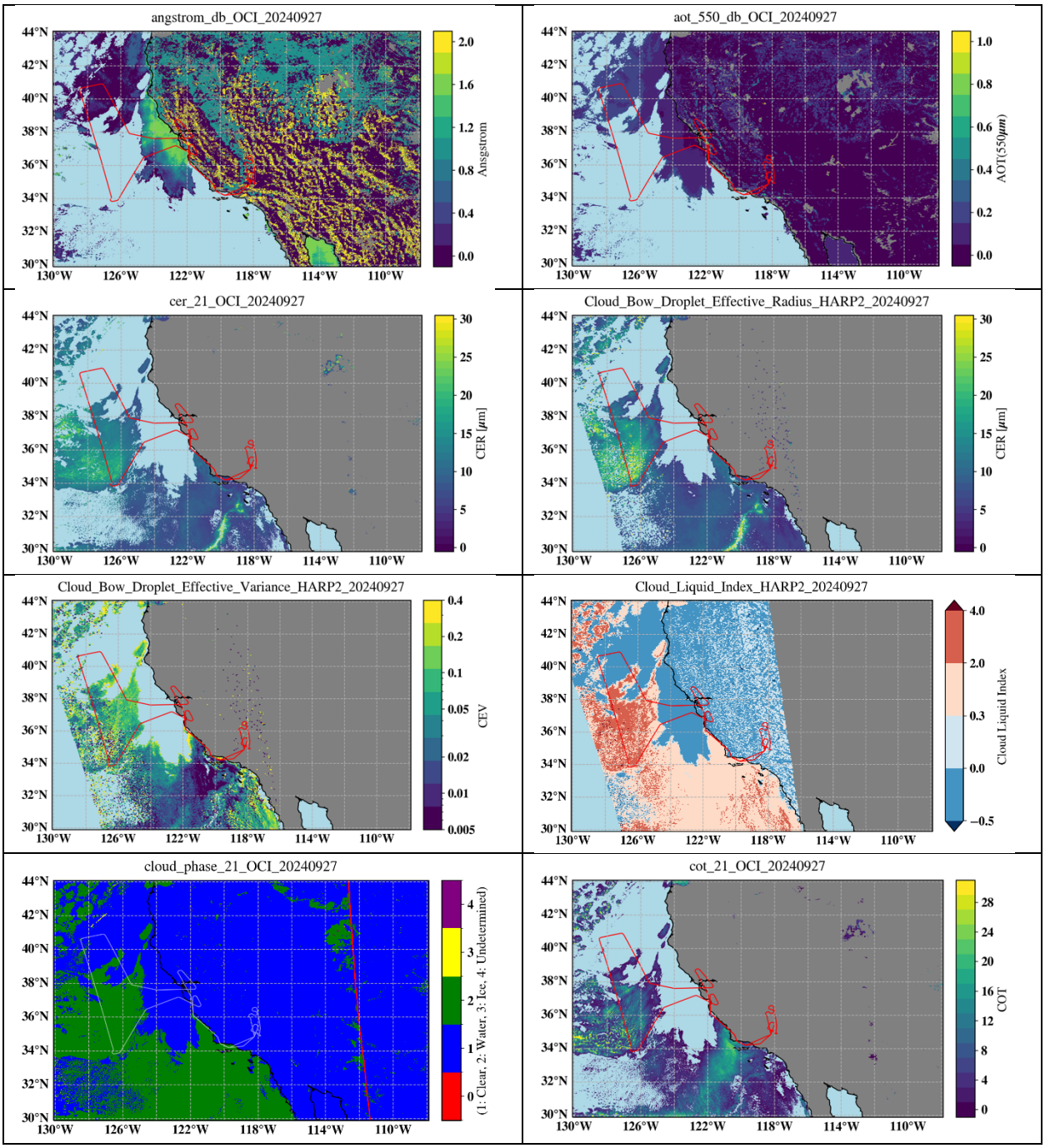


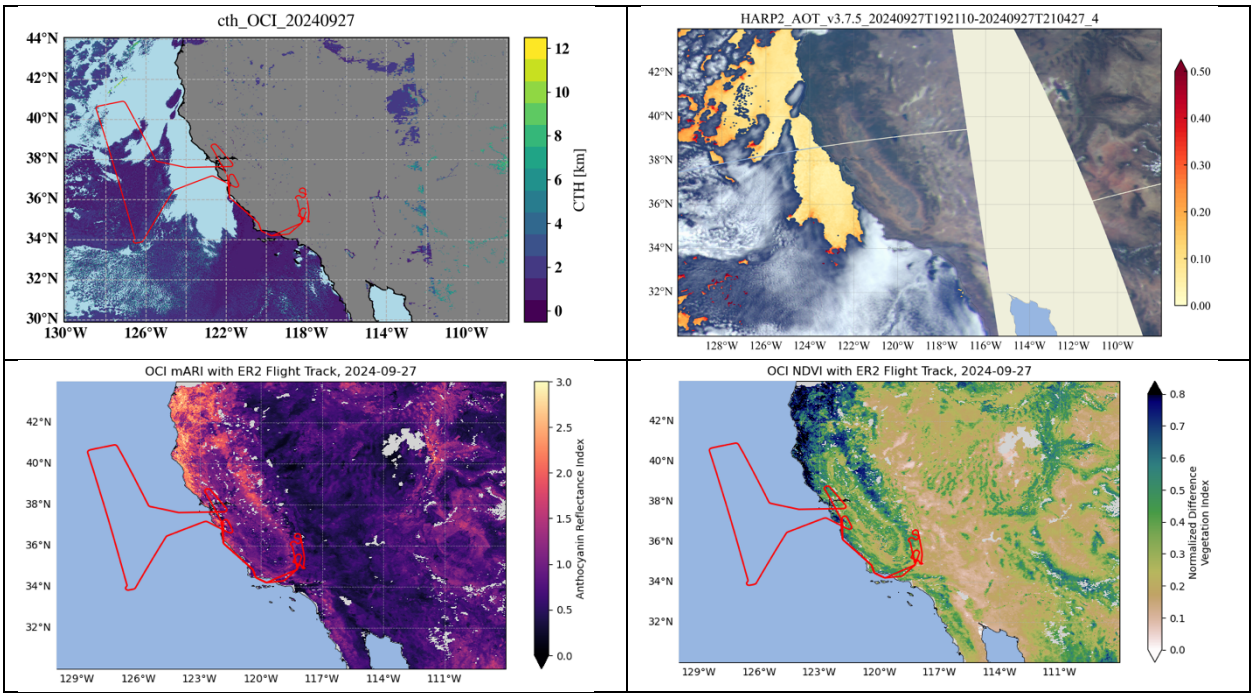
TO Quicklooks





PACE quicklooks




cth_OCI_20240927
CTH [km]
HARP2_AOT_v3.7.5_20240927T192110-20240927T210427_4
OCI mARI with ER2 Flight Track, 2024-09-27
Anthocyanin Reflectance Index
OCI NDVI with ER2 Flight Track, 2024-09-27
Normalized Difference Vegetation Index

PACE-PAX Research Flight report 2024-09-27

Twin Otter Flight

Manifest:

Bryce Kujat (pilot)

Jeff Martin (pilot)

Michael Shook (QNC)

Elizabeth Wilk (QNC)

Edward Winstead (QNC)

Note: This flight had coordination with the ER-2.

Take off: 13:27:07 (20:27:07 UTC) Marina Airport (OAR)

Landing: 16:31:24 (23:31:24 UTC) Marina Airport (OAR)

Duration = 3.1 hrs

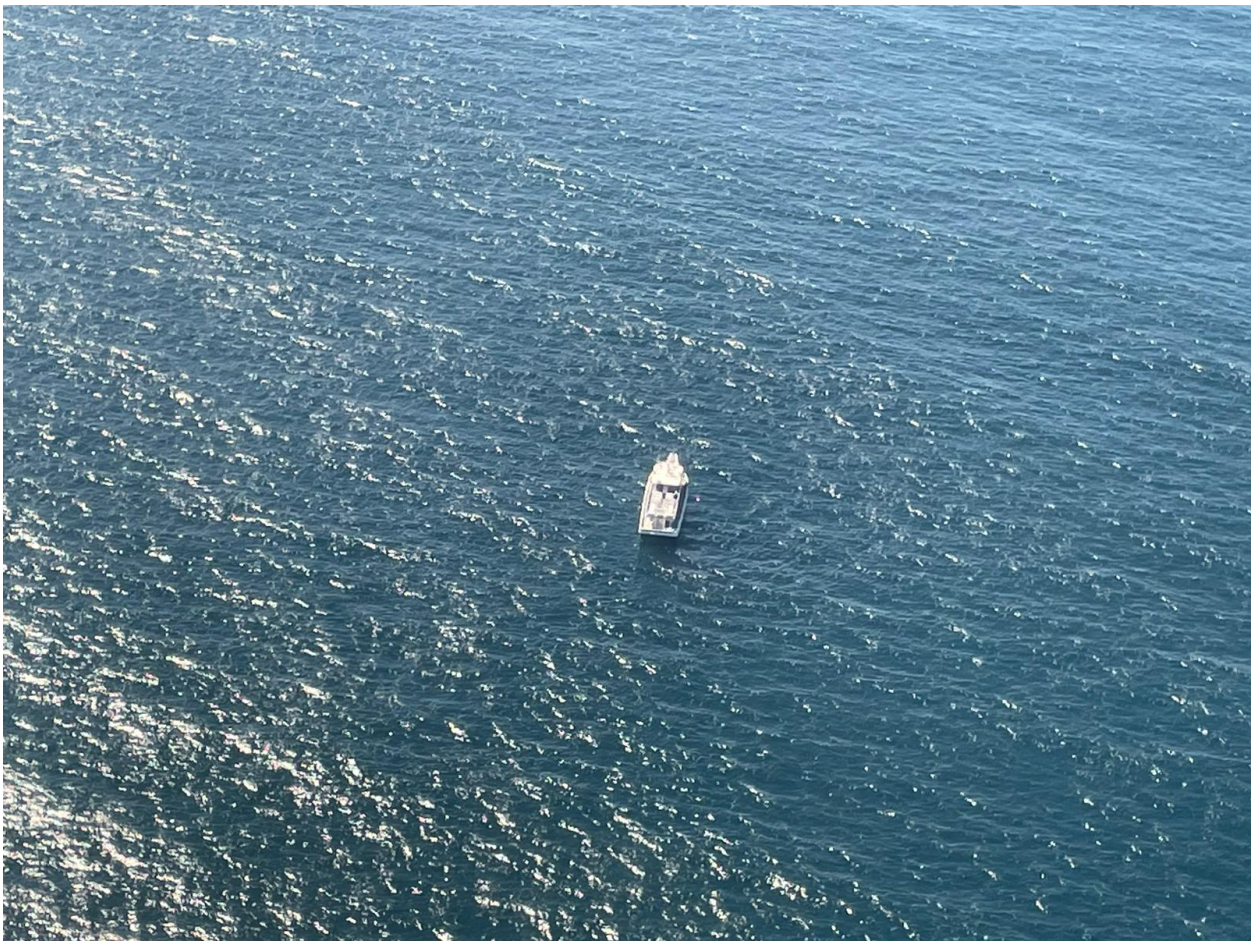
Objectives: Perform low approaches at Marina after takeoff. Transit out to the R/V Rachel Carson in the Monterey Bay and spiral up over it during the PACE overpass at 21:05 UTC. Spiral down over the Sacramento River AERONET site under the future ER-2 flight track. In-line ascent to CEOBS, then spiral down during the ER-2 overpass at about 23:08 UTC. If possible, perform low approaches at Marina prior to landing.

Summary: After taking off, we performed two low approaches at the Marina airport. Green scattering coefficient was 25-30Mm^{-1} in the boundary layer, and some coarse mode particles were measured by the APS. The boundary layer height was estimated at 550 ft. During the low approaches, the PI-Neph experienced two restarts, but remained stable the rest of the flight. We then transited at 500 ft to the R/V Rachel Carson in the Monterey Bay, at approximately 36° 47.82'N, 121° 50.83W, and began our spiral up at 20:39:20 UTC. Initially we climbed at slower than our normal 500 ft/minute to insure we would still be in the spiral at the PACE overpass time. The water appeared red near the coast at Moss Landing (potential "red tide"/harmful algal bloom).

Scattering coefficient in the profile was low and variable, starting at 7-15Mm^{-1} near the surface, then a layer with close to 0Mm^{-1} and 700 particles/cm^3, then a layer of 8Mm^{-1}, then clean again near the top. We completed the spiral at 21:09 UTC and headed to the Sacramento River AERONET location at 10kft.

Conditions were very clean during this transit, with scattering coefficient near zero. At 21:30 UTC we descended to 7500 ft to try and sample an aerosol layer we could see visually on the right-hand side of the aircraft, but no significant increase was observed, so we started climbing back to 10kft at 21:37 UTC to reach the spiral top. At 21:44 UTC, we started the Sacramento River spiral from 10 kft. The boundary layer height was estimated at 2900 ft. We completed the profile at 100 ft at 22:10 UTC and began an in-line ascent to the south. During the spiral and in-line ascent, conditions remained fairly clean (scattering coefficient 10Mm-1 or less). Some different aerosol populations were observed (e.g., particle number concentration increased while scattering remained the same), but nothing was distinct or identifiable.

As we transited south towards CEOBS, we were vectored and controlled in altitude several times by ATC near San Jose. We arrived at CEOBS and started our spiral down from 10kft at 22:50 UTC. Again, scattering was variable but minimal in most of the profile, and more potential red tide was observed in this area. The ER-2 passed over the location at about 23:07 UTC. The temperature profile indicated that the marine layer was about 500 ft deep, and scattering coefficient had jumped to 20Mm^{-1} at 250 ft. We completed the spiral around 23:19 UTC and climbed to 1000 ft towards Marina. We performed two low passes at Marina, where scattering coefficient was about 17Mm^{-1}.

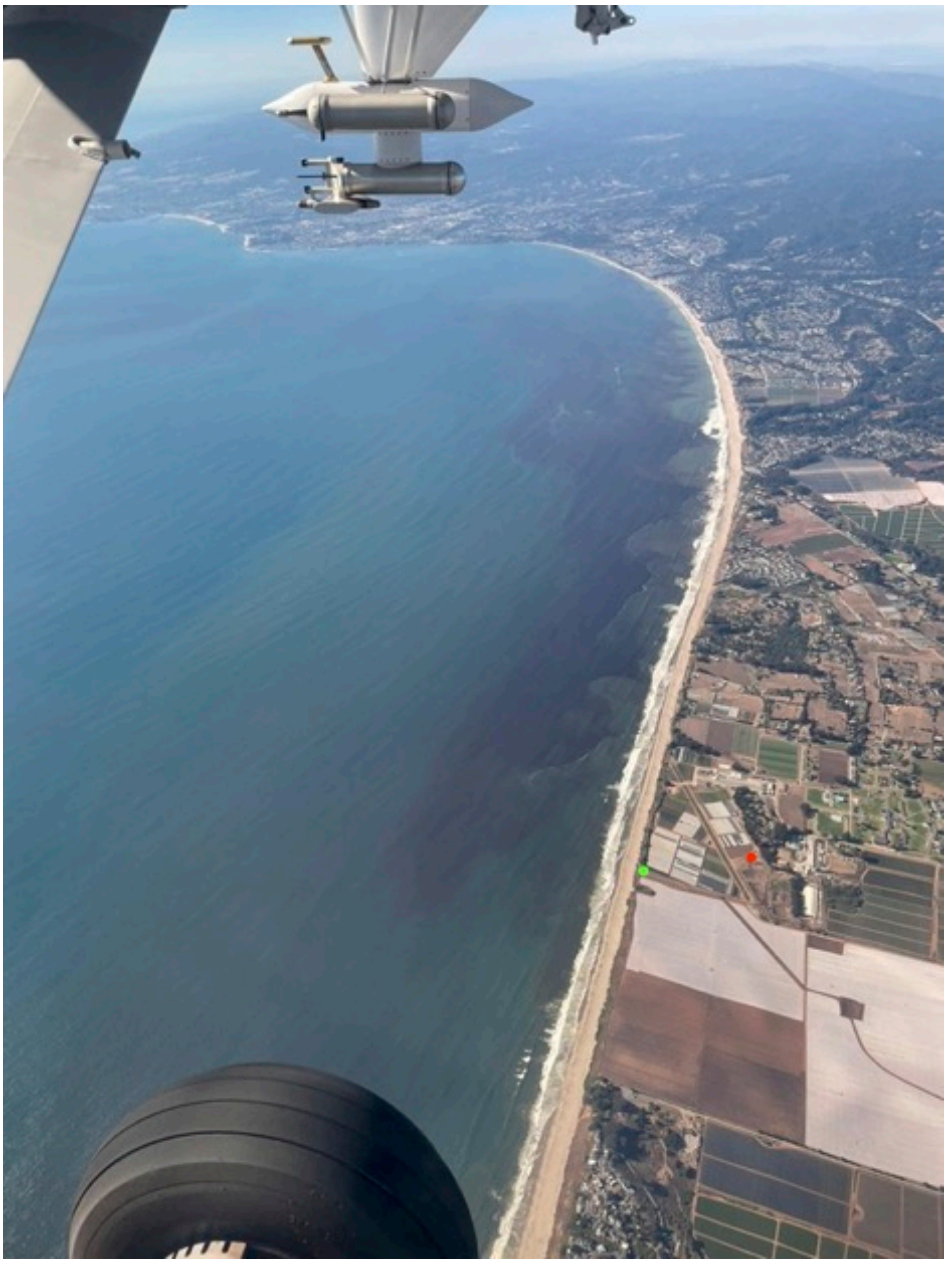


The R/V Rachel Carson; photo by Eddie Winstead

Red tide near Moss Landing; photo by Michael Shook

Sacramento River Aeronet spiral location; photo by Eddie Winstead

Red tide near CEOBS; photo by Eddie Winstead



Red tide near CEOBS. CEOBS primary site is marked by a red circle and the secondary site where a wind profiler is located is marked by a green circle; photo by Eddie Winstead