Flight Scientist Report 2019/09/07 CAMP2EX Lear N474KA Flight LR1A joint with NASA P-3 SF7
Crew: Darryl Hugaboom, Joe LeRosso, Roelof Beuintjes, Ted Fisher, Sarah Woods

Objectives: 1) Sample shallow convection and deeper NE of Luzon and sortie with NASA P-3. Cloud flight to W-NW of Luzon, between Chinese wall and coast. P3 will depart 1st, scope area to determine are of research. Lear will transit high, descend to cloud base and work clouds while P3 butterflies above for remote sensing.

Flight Plan: Depart Clark, head N to convection identified on Imagery. Conduct convection modules for remote and in situ sensing. Coordinate with P-3 jet during this period.

Instrument Configuration:
NCAR 2D-S was not operated for this flight due to computer issues on integration.
New Nevzorov controller box installed
Optics cleaned and purged instruments
1st flight after re-integration of equipment
Xchat connectivity issues. Flight Scientist no able to communicate via xchat and issues with MTS.

T 28.3 degC	Td 25.7 degC	Alt: 544 ft
Ta 27.2	RH 66.8 %	CPC: 10500 n/cm3
P 884 mb	Pa 994 mbar	

When in fishing mode for CPI:
4 pixels 2D-S (40 um)
20 pixels CPI (46 um)

Drizzly while fueling, taxi, takeoff. Overcast and a bit hazy with rain showers in the vicinity of Clark.
00:22 UTC taxi

Takeoff:	00:48:47 (UTC) 08:48 (local)
00:49:19	1298 Ft 23degC into cloud
~00:50	Some precip on climbout
	Multiple cloud layers and some low level some Fractostratus
00:52:17	15.6 C, 6619 ft, into solid cloud layer, small drops
	CPC stabilizing
00:53:24	Precip 7035 ft, 15.1 C while en-route to P3
00:59:	Note: Low-level stratus deck, some breaks in the direction that we're headed, occasional convection popping through, larger system in direction we're heading. Alto stratus and Ci layers above
	P3 operating at 18kft
	Clouds were penetrated while ascending and the tops of the lower SC and Cu clouds around 8600ft with bases around 1000ft. Climbing to 13kft.
01:13:25	Cloud top are below us and descending to the tops from 13kft.

01:16:40	9.3 C, 11.5kft pen turret near top, lot of moisture, little bumpy small & moderate drops, Tops ~ 14kft
01:18:06	Light precipitation below layer cloud: 11.2C, 10.4kft, also seen on windscreen
01:19:49	Penetration smaller turret, 11.6 C 10.2 kft, tops ~12.5kft, tad bumpy, some large drops, lots of small drops
01:20	Descend to Cloud Base, penetrating clouds as we are descending Joining up at southern end of track established with P3
01:20:52	11.8C 9.3kft couple pens on descent, tad bumpy, some small & mod drops Cloud Top: 11.5 – 12.2kft
01:21:40	Penetration: 13.5C, 9kft back in, some updraft, large drops
01:22:28	13.2C, Penetration: 8.3kft pen, large drops, precipitation, lots of moisture Tops: 12.5-13 kft.
01:23:10	Penetration: 7.7kft, 14.1 C, broad droplet spectra on these passes, very bimodal at times
01:23	On westbound track heading north on P3 track
01:24	In precipitation of larger cloud more mature cloud
01:25	Penetration of mature cumulus cloud. 19.9C 4kft Solid Cloud Bases at 4kft, but still broken fractostratus and stratocumulus below Little white-capping on sea surface
01:27:33	Penetrations through low-level scud at 2kft above water, but there is still lower clouds.
01:28:00	Penetration through scud clouds at 1.9kft, 24.5C
01:29	1400kft, 25C Cloud Base above water
01:29:32	23.7C, 1.8kft, Penetration through lowest clouds, descending to 1kft over water
01:30:26	Penetrations through scud, 24.5C, 1.56kft Cloud Bases are down to 1kft over ocean, but very fluffy, and not solid bases.
01:32:46	Climb to penetration slightly through more solid clouds slightly above Cloud Base, 24.9C 1.5kft
01:33:15	1.6kft, Cloud Base penetration then turned to do another penetration at 2.1kft Continue weaving around to penetrate near Cloud bases ~1kft above CB
01:34:32	Penetration in little more solid cumulus 22.1C, 2.8kft, small drops
01:35:15	21.6, 2.8kft, Penetration near top of shallow cumulus, small drops Nothing in area that's towering to higher levels except closer to shore. 3kft 21.7 C
01:36:00	Penetration slightly higher in a growing cloud P3 is at 19kft penetrating higher cloud layer
01:38:14	19.7C 4.6kft, Penetration through growing turret, lot of small drops, couple moderate (drizzle) ones near exit edge. There is also a Stratocumulus layer around 5 kft. In maybe two layers. Turning left to penetrate turret growing into stratocumulus layer
01:40:49	Penetration target turret: 18.1C 5kft, slight echo, mostly small drizzle drops
01:41:34	In light to moderate precipitation 18.3C 4.8kft. Turn left to penetrate a couple of newly growing turrets.
01:42:44	19.45C 4.6kft, 1st turret: low updraft, small drops, 2nd turret: weaker updraft, small drops

01:44:45	Enter turret 19.3C 4.5kft, little turbulent, small drops. Did a sharp left to penetrate other turrets
01:46:24	20.2C, 3.9kft pen 1 short, small drops
01:46:49	Penetration, slight bump with scud behind main penetration. Head for a little larger buildup growing through some scud before
01:47:59	20.1C, 4.2kft penetration with some larger drops a swell as small drops
01:48:29	19.8C 4.1kft. another penetration
01:49:29	194C, 4.5kft penetration with slight bump and lot of small drops
	Climbing to 10kft
01:50:00	Penetration. Precipitation, large drops 18.3C, 5kft
01:52:00	P3 heading to Way Point 6 (WP6), and we are turning to head that way at 9.4kft, 12.4C
01:56:00	See layer of clouds ahead, about 1kft below, We will porpoise through the clouds.
01:58:28	12.4C, 8.8kft going into top of stratocu cloud, small to moderate drops, growing larger.
01:59:25	Climbing a bit in layer to porpoise 8.7kft, 12.2C
01:59:57	Out of layer, resume climbing to 10-12kft
020100	P3 still at 18kft steady, Now 2 mins out from WP6. We estimate Lear to be 1hr more on station
02:06:00	Lear climbing above P3: to 19kft and above. Cloud fields look relatively similar in our vicinity
02:12:00	Climbing to 19kft in right turns
02:13:00	Restarting Hawk2DS GUI. Setting up to penetrate cloud tops 20.5kft, 2 turrets in a row
02:16:22	-6.3C 18.9kft, small & moderate size drops, ice near edges (cols), supercooled liquid, bumpy. 2nd turret taller than 1st, shorter duration, mostly liquid.
	Cloud ahead: top well above 21kft, Roelof request higher pen
02:24:00	-10.3C, 21kft, pen turret with top about 24kft. Liquid, small drops, ice, bumpy, plates, aggregates, columns. Ops request work clouds below P3. Coordinating with P3 pilots.
02:26:00	Longer penetration of outflow from system, -9.2C, 20.9kft, mod drops, ice,
02:27:14	Begin descending, bumpy, liquid, -7C, 18.8kft, heading for 11kft
	Following P3 and continue descent to 11kft for profile through clouds
	Slow left turn, no clouds on descent though
02:31:59	9.7C 11.1kft penetration cloud, rain and small drops, following in trail of P3.
02:33:05	Begin slow descent to CB
02:33:34	In cloud 10.3C 10.0kft
02:35:44	Rain on windscreen 7.5kft, 14.4C, small to mod drops
02:36:00	In cloud, all small drops, 16C, 6.2kft
023924	Continue descending, 20C, 4.1kft, small drops, mod drops, extensive clouds, pretty smooth
024028	penetrating a puffy cu 21.4 3kft
02:41	Nearing CB, rain below
	CPC not working well on this flight
	Cloud base around 2.3kft
02:41:50	In patchy rain shaft

02:43:16	Continue into stronger rain shaft 23.5C 2kft
02:47:35	23.6C, 2kft pen stronger rainshaft with low hanging scud, descending to get below cloud
02:47:58	24.3C, 1.6kft, light rain
	Penetrating one more rain shaft, then reverse course to stay with P3
02:49:12	24.5C, 1.6kft, light rain, small drops, just below variable CB, few lg drops
02:49:54	Into heavier rain, 24.4C, 1.6kft
02:50	Course reversal and begin climbing to 16kft
02:56:20	Into cloud layer at 8.4kft, 12.9C, small drops
02:58	drops on windscreen, 10kft, 10.8C
	P3 at 18kft, 30min or less left for Lear on station
03:07:50	2.4C, 15kft, penetrating turbulent clouds
03:09:29	14.9, 2.2C, slightly bumpy pen of turret, large drops. Visibility below cloud limited by Haze
	Sat com check, success. Climbing to 16kft and above with P3 coming below us.
	Penetrating tops ~19 for 1st turret, one behind is ~23-25kft, more mature, maybe dying
03:17:52	0.4C, 15.9kft, tad bumpy, slight left turn, small to mod drops
03:19:25	Ice fallout from higher clouds after turret pass
	Penetrations in 1st small, tops 16.5kft, 2nd tops 19-20kft, 3rd, tops 19kft
03:22:02	pen 1st small, short turret, small-mod drops, -0.1C, 16.1kft
03:23:01,	-.1C, 15.9 small drops, ice, gruapel, decaying cloud
03:23:27,	0C, 16kft, younger turret pen, good updraft, small and large drops, downdraft just before exit
03:24:03	Lear RTB, trying to penetrate clouds en route back
03:30:51	tops: 14kft pen 8C, very bumpy, over land, small drops
03:33:37	bumpy pen 9C, 10.2kft, very bumpy – airborne in cabin
03:37:49	continued penetration 10.5C, 10.1kft
03:42:43	18C, 4.9kft, some continued pens en route
03:52:41	Land Clark

Figures

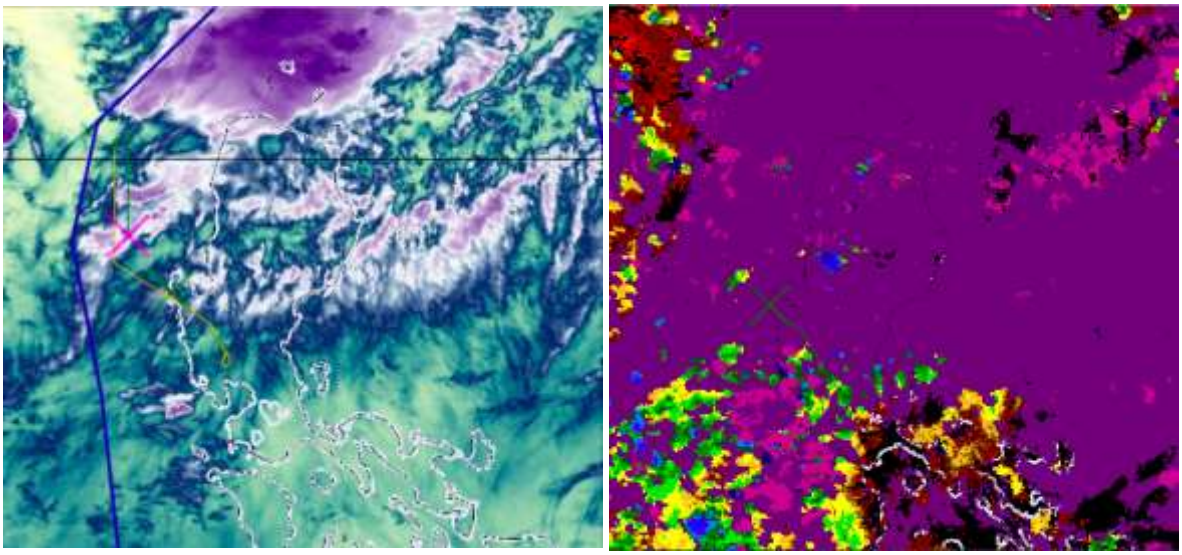

Figure 1. Infrared (7.3µm) image *(left)* and cloud top heights *(right)* from AHI at 00:50UTC. Lear location (green cross) after takeoff with P3 location (pink cross).

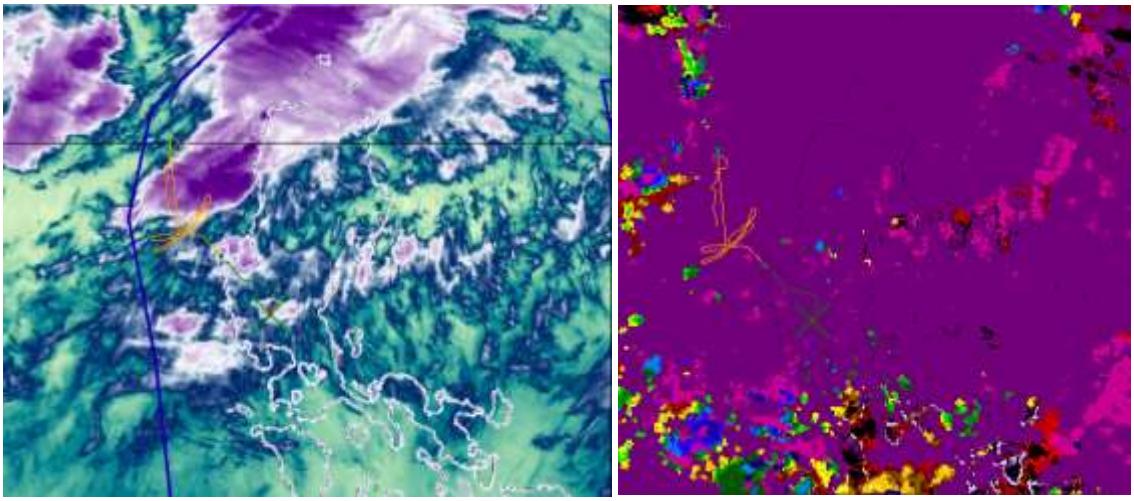

Figure 2. Infrared (7.3µm) image *(left)* and cloud top heights *(right)* from AHI at 03:30UTC. Lear location (green cross) with Lear sampling flight path (yellow line). Higher cloud top heights observed in the sampling region. P3 also sampling the same area at this time.

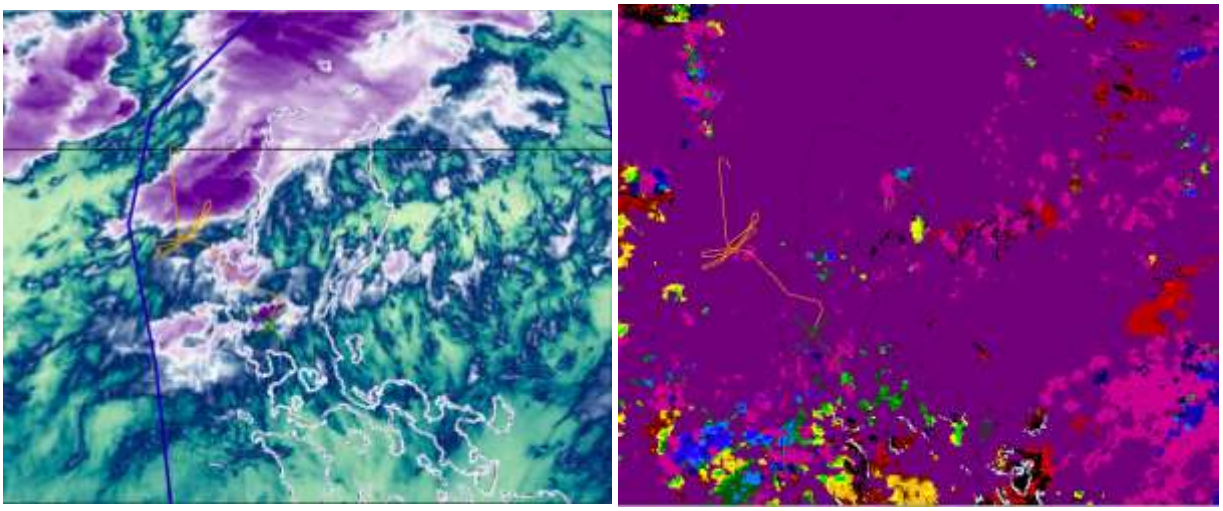

Figure 3. Infrared (7.3µm) image *(left)* and cloud top heights *(right)* from AHI at 03:50UTC when Lear about to land. Lear location (green cross) with research flight path (yellow line).