



# University of Wyoming DMIMS 2006

May16 - June30 2006

*Photo courtesy of Vanda Grubisic, DRI*

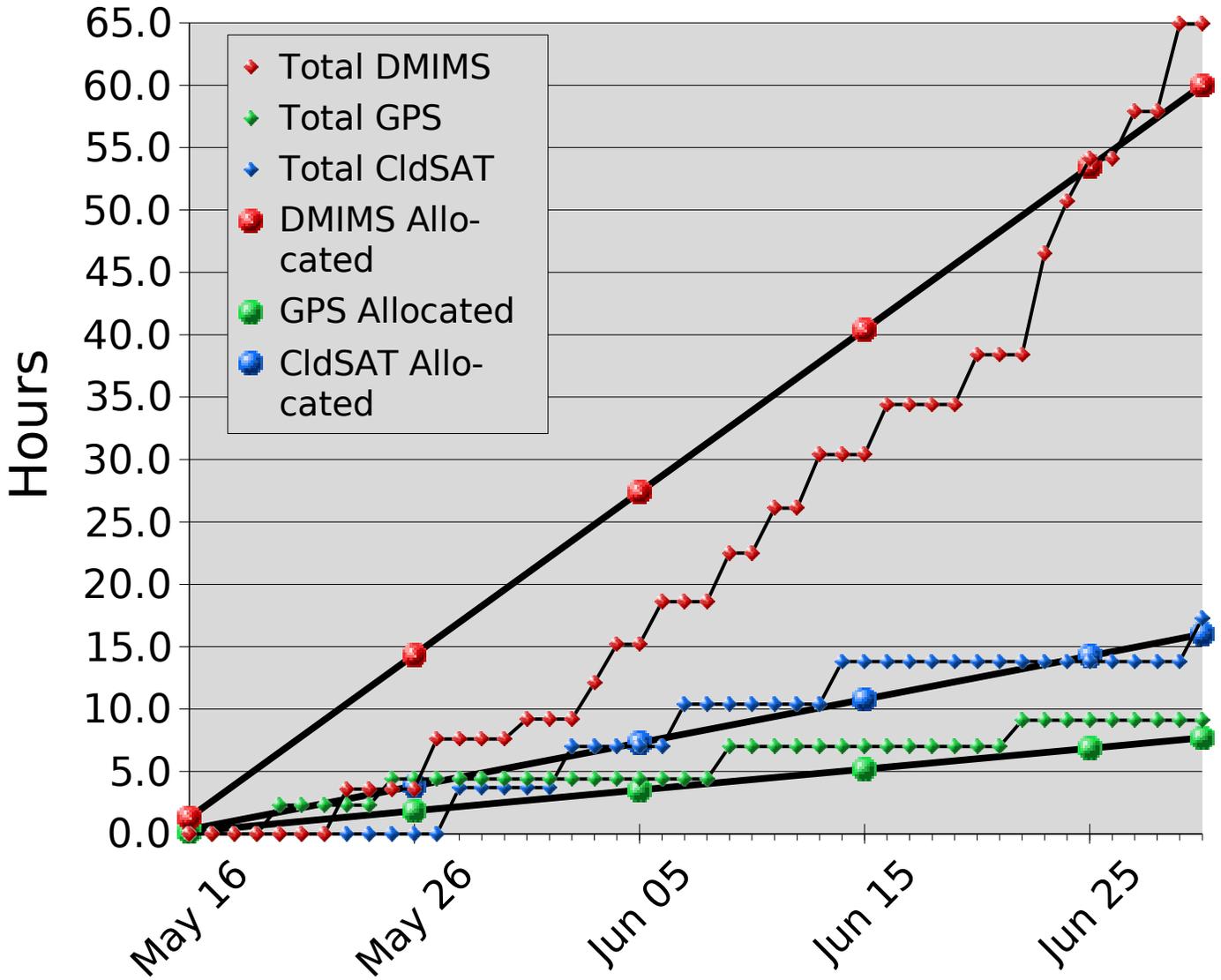
- [Contacts](#)
- [Flight Data](#)
- [WCR Data](#)
- [Plot of Flight Hours](#)
- [FAA Letter of Agreement](#)
- [Aerosol Soundings](#)
- [Temperature/Dewpoint Soundings](#)

Date	Flight # (* .kml)	Status	Times (UTC)	Hours	Reports	Graphs/Images
Aug 29	2006	Reprocessed 20060623a, shortened beginning of file to avoid bad IRS values.				
Jul 12	2006	Reprocessed data to version dmims06_qc2				
Jun 30	<a href="#">Flt 27</a>	CloudSat overpass	1957-2320	3.5 (CloudSat)		
Jun 29	<a href="#">Flt 26</a>		2300-0216	3.4 (DMIMS)	<a href="#">dleon_fltnotes</a>	
Jun 29	<a href="#">Flt 25</a>		1731-2103	3.6 (DMIMS)	<a href="#">dleon_fltnotes</a>	
Jun 27	<a href="#">Flt 24</a>	MODIS overpass	1832-2212	3.8 (DMIMS)	<a href="#">rwood_fltnotes</a>	
Jun 25	<a href="#">Flt 23</a>	CTD flight PVM values elevated 1832-1957, wet?	1700-2017	3.4 (DMIMS)		

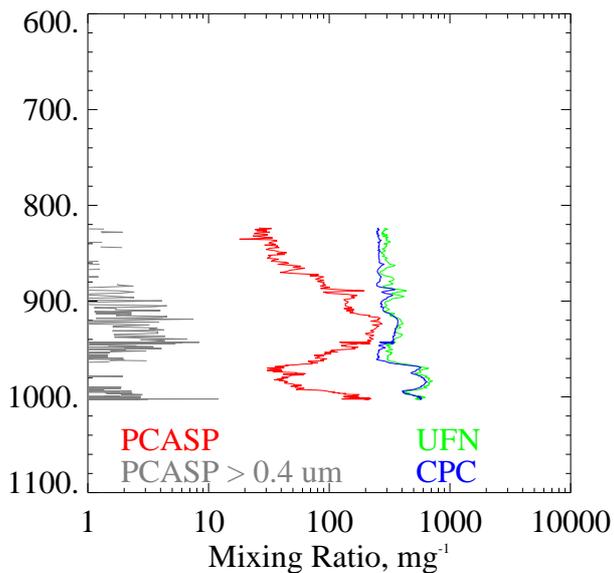
Jun 24	<a href="#">Flt 22</a>	CTD flight	1630-2032	4.2 (DMIMS)		
Jun 23	<a href="#">Flt 21</a>	CTD flight The UFN would not initialize, too hot? No data.	2047-2358	3.3 (DMIMS)		
Jun 23	<a href="#">Flt 20</a>	CTD flight	1501-1940	4.8 (DMIMS)		
Jun 22	<a href="#">Flt 19</a>	GPS flight	2144-2343	2.1 (GPS)		
Jun 20	<a href="#">Flt 18</a>	ASTER overpass flight One second data glitch at 18:12:53 on all IP cards except IP429, IPALT1, and IPALT2.	1656-2045	4.0 (DMIMS)	<a href="#">dleon_fltnotes</a>	
Jun 19		Flight scrubbed after DIGIO1 failed to come up. Moved the IPRALT1 IP module from slot C to slot A. Installed new vxWorks code.				
Jun 16	<a href="#">Flt 17</a>	Set zero and span on PVM prior to flight. Radar repeatedly faulted early in flight. First part of flight was a CloudSat overpass.	2103-0056	4.0 (DMIMS)	<a href="#">rwood_fltnotes</a>	
Jun 14	<a href="#">Flt 16</a>	Problems with CCN after rewetting pads at 2053.	2018-2336	3.4 (CloudSat)	<a href="#">bgeerts_fltnotes</a>	
Jun 13	<a href="#">Flt 15</a>		1705-2121	4.3 (DMIMS)	<a href="#">rwood_fltnotes</a>	
Jun 11	<a href="#">Flt 14</a>	PVM still has baseline shifts	1814-2140	3.6 (DMIMS)	<a href="#">jsnider_fltnotes</a>	
Jun 09	<a href="#">Flt 13</a>	GPS flight.	2203-0110	2.6 (GPS)	<a href="#">drahn_fltnotes</a>	
Jun 09	<a href="#">Flt 12</a>	Airconditioner not cooling, Don C found that the low pressure switch had blown.	1647-2032	3.9 (DMIMS)	<a href="#">jsnider_fltnotes</a>	
Jun 07	<a href="#">Flt 11</a> <a href="#">A B</a>	CloudSAT overpass, PCASP looks too high entire flight (??) 2 files, data system hangs ~2200	1957-2316	3.4 (CloudSAT)	<a href="#">jfrench_fltnotes</a>	
Jun 06	<a href="#">Flt 10</a>	Stratus clouds late in day, clouds weak, refilled CPC before flight	2243-0147	3.4 (DMIMS)	<a href="#">jfrench_fltnotes</a>	
Jun 04	<a href="#">Flt 9</a>	MODIS box W of Arcata, air conditioner not working, recover in Medford 2 files, 'a'--in hangar, leak test, 'b'--flight	1800-2055	3.1 (DMIMS)	<a href="#">jsnider_fltnotes</a> <a href="#">jfrench_fltnotes</a>	
Jun 03	<a href="#">Flt 8</a>	targeting stratus SW of Arcata, too hot on ferry, aborted flight because of heat	1749-2034	2.9 (DMIMS)	<a href="#">jsnider_fltnotes</a> <a href="#">jfrench_fltnotes</a>	
Jun 02	<a href="#">Flt 7</a>	CloudSAT overpass northeast of Redding	1956-2310	3.3 (CloudSAT)	<a href="#">jsnider_fltnotes</a> <a href="#">jfrench_fltnotes</a>	
May 31	<a href="#">Flt 6</a>	Rainy system moving in; wanted to test PVM, PVM having problems	1604-1734	1.6 (DMIMS)	<a href="#">jsnider_fltnotes</a> <a href="#">jfrench_fltnotes</a>	

May 28	<a href="#">Flt 5</a>	CloudSAT, Aster/MODIS over flight, documented 1 drizzle cell	1752-2133	3.7 (CloudSAT)	<a href="#">jsnider_fltnotes</a> <a href="#">jfrench_fltnotes</a>	<a href="#">Pic1</a> <a href="#">Pic2</a> <a href="#">Pic3</a>
May 27	<a href="#">Flt 4</a>	DMIMS, documented 2 drizzle cells, PVM was having problems	1908-2304	4.0 (DMIMS)	<a href="#">jsnider_fltnotes</a> <a href="#">jfrench_fltnotes</a>	<a href="#">Pic1</a> <a href="#">Pic2</a> <a href="#">Pic3</a> <a href="#">Pic4</a> <a href="#">Pic5</a> <a href="#">Pic6</a> <a href="#">Graph1</a>
May 25	<a href="#">Flt 3</a>	GPS, sawtooth legs, 100 ft flux runs	1922-2118	2.1 (GPS)	<a href="#">jsnider_fltnotes</a> <a href="#">jfrench_fltnotes</a>	
May 23	<a href="#">Flt 2 A</a> <a href="#">B</a>	2 data files, lines of clouds/cells oriented N-S	1813-2022	3.6 (DMIMS)	<a href="#">jsnider_fltnotes</a> <a href="#">jfrench_fltnotes</a>	<a href="#">Graph1</a>
May 20	<a href="#">Flt 1</a>	no known problems, no radar, GPS flight	1813-2022	2.3 (GPS)	<a href="#">jsnider_fltnotes</a>	
May 16	<a href="#">Test FLT2</a>	no known problems	2010-2112	2.1 (test)	<a href="#">jsnider_fltnotes</a> <a href="#">jfrench_fltnotes</a>	<a href="#">Pic1</a> <a href="#">Pic2</a> <a href="#">Pic3</a> <a href="#">Pic4</a> <a href="#">Pic5</a> <a href="#">Pic6</a>
May 9	<a href="#">Test FLT1</a>	OneDC setup incorrectly	1631-1755	1.5 (test)		
Total Research Hours				64.9 of 60.0 DMIMS 17.3 of 16 CloudSAT 9.1 of 7.7 GPS		

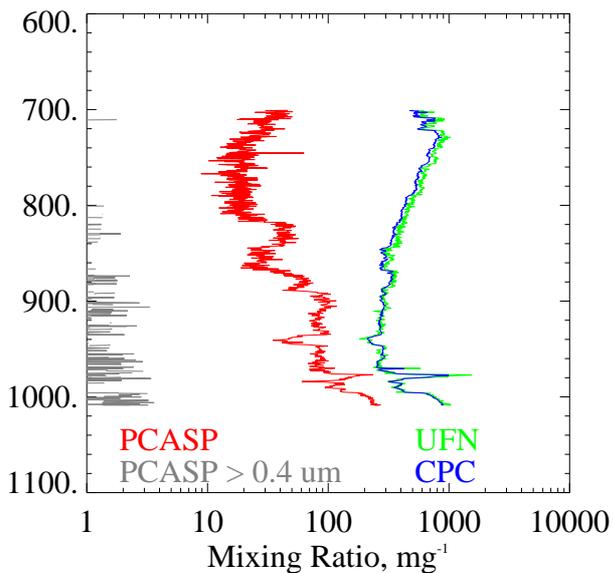
# DMIMS06 Flight Hours



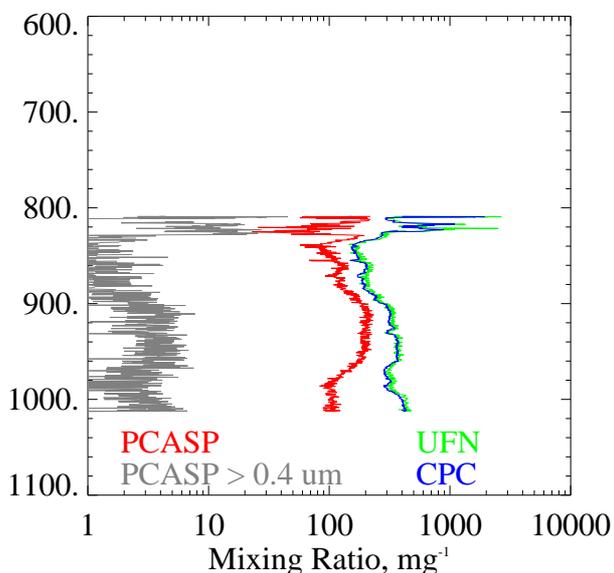
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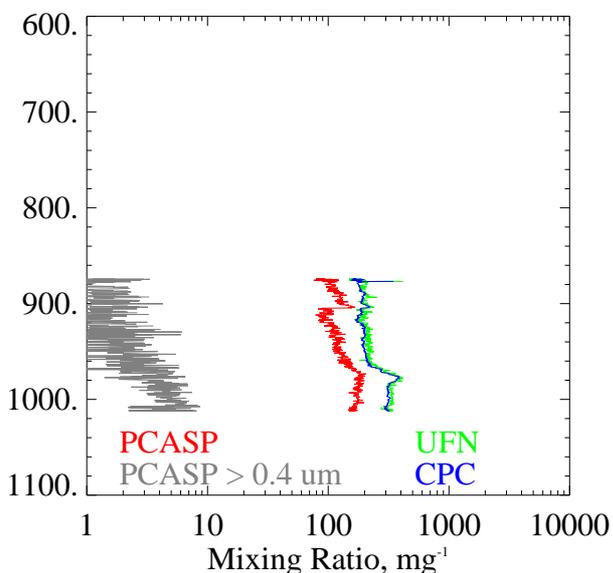
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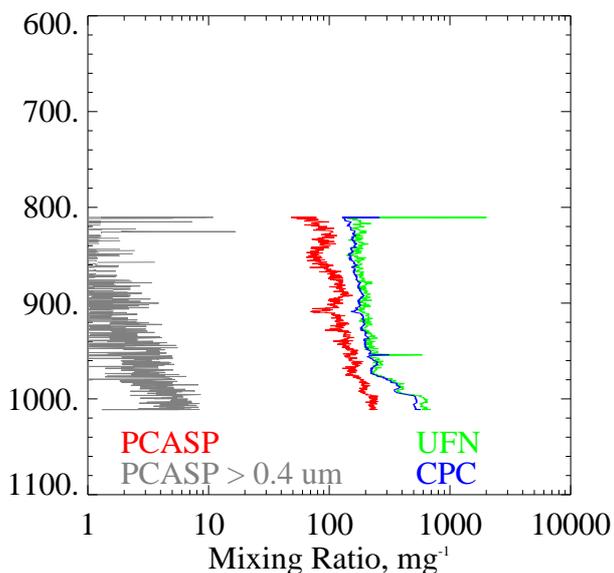
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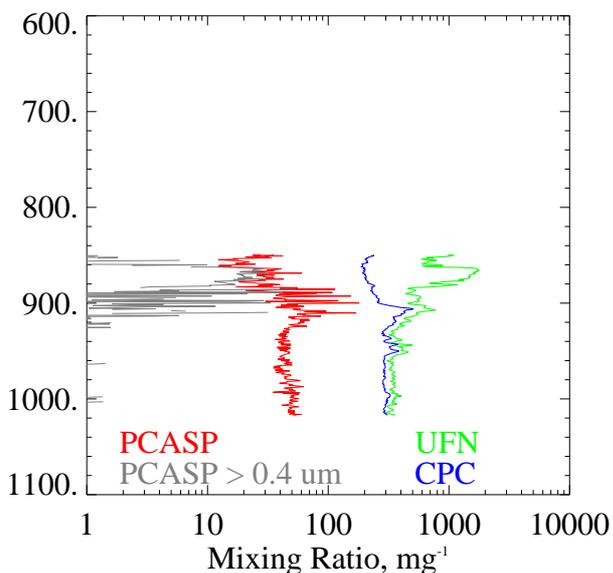
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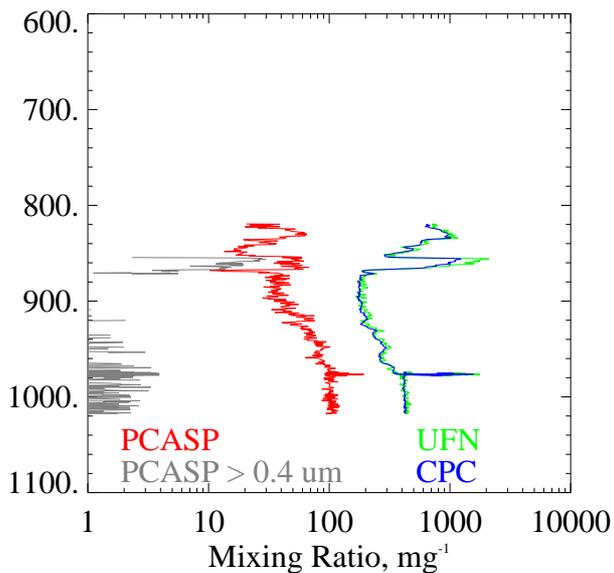
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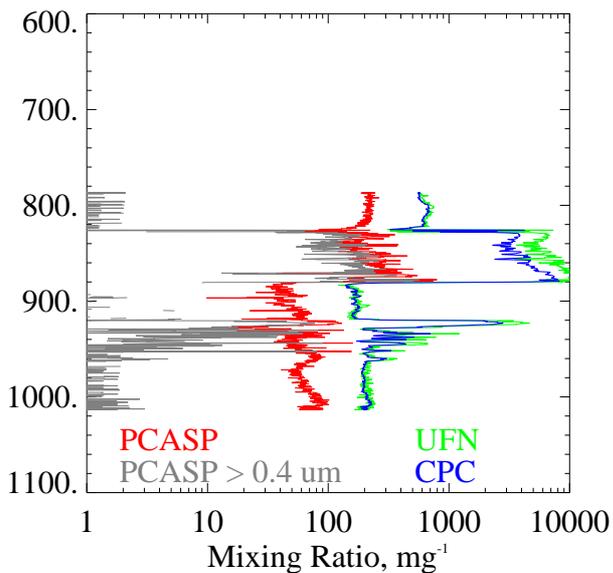
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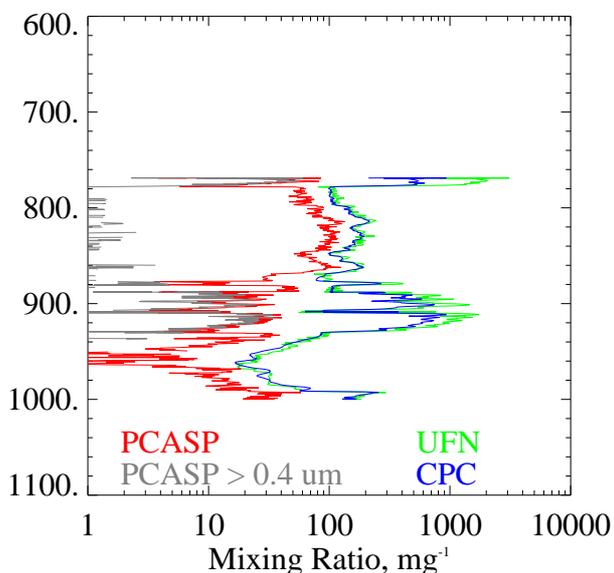
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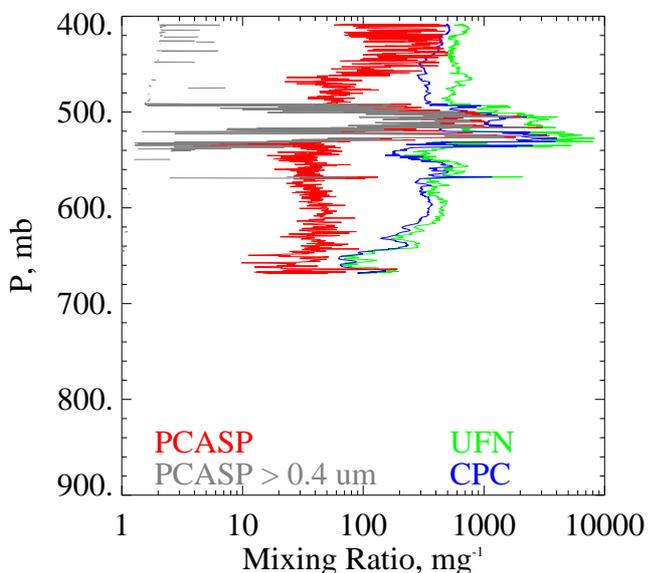
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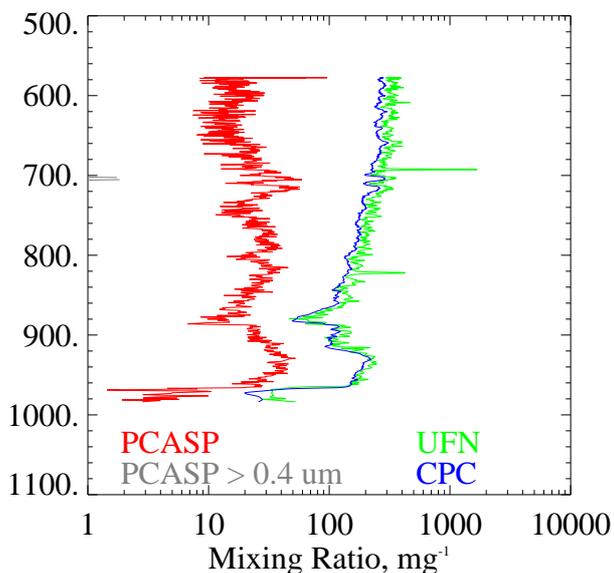
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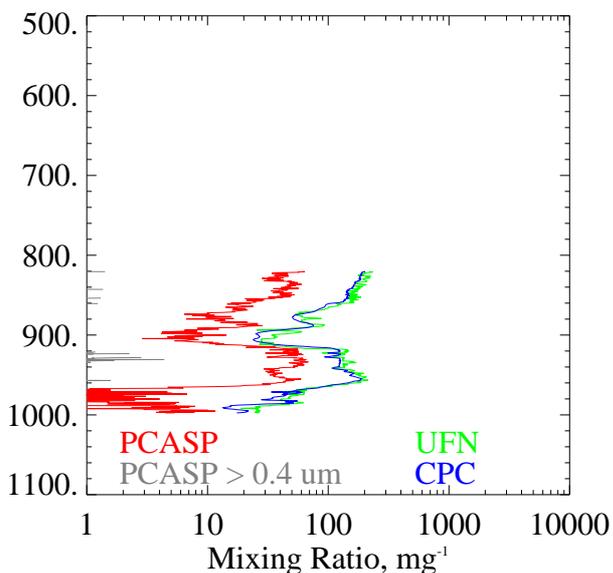
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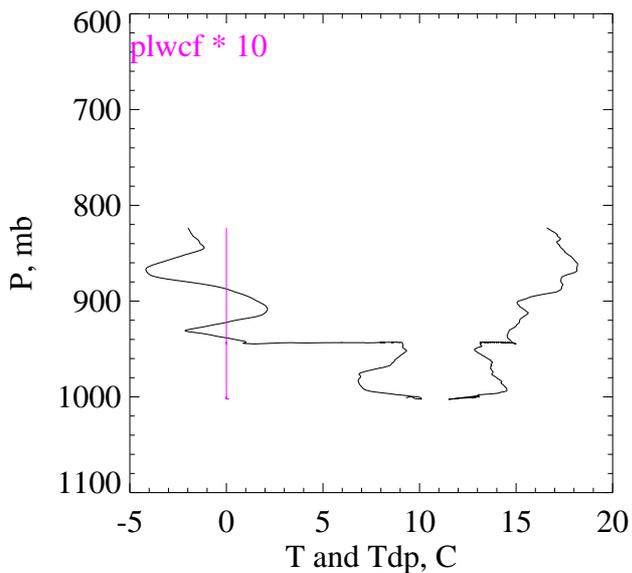
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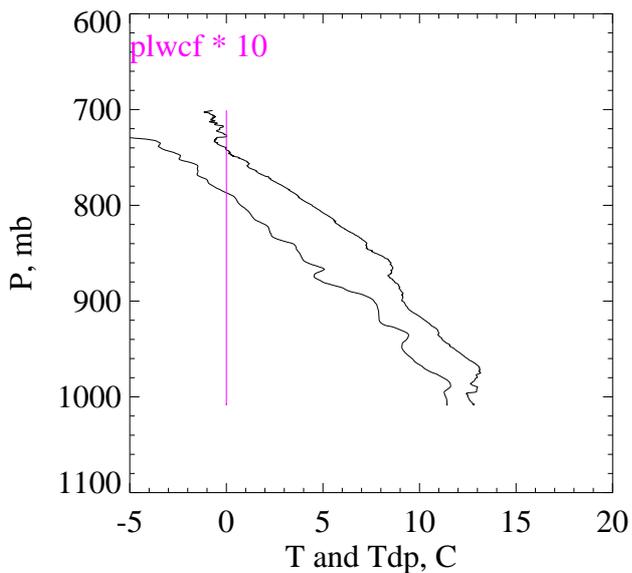
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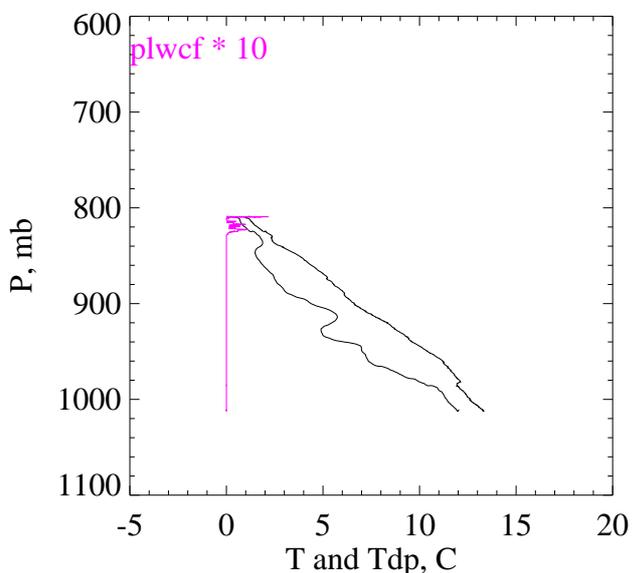
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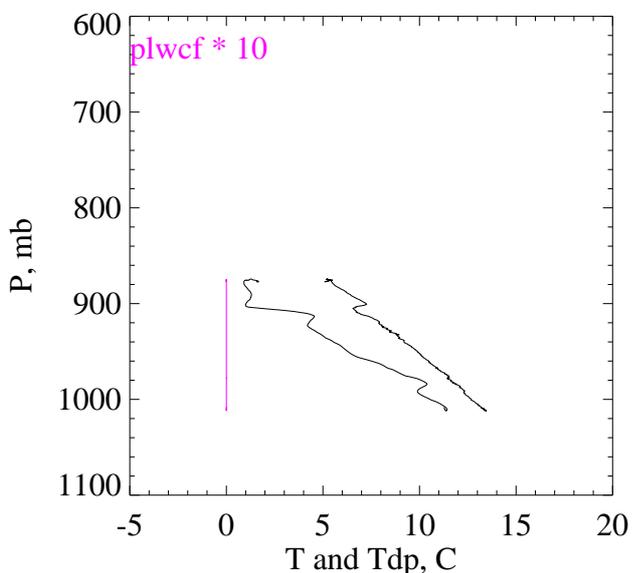
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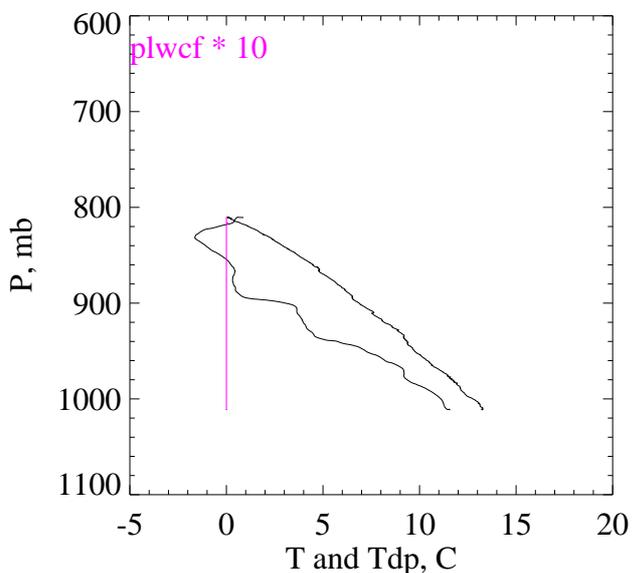
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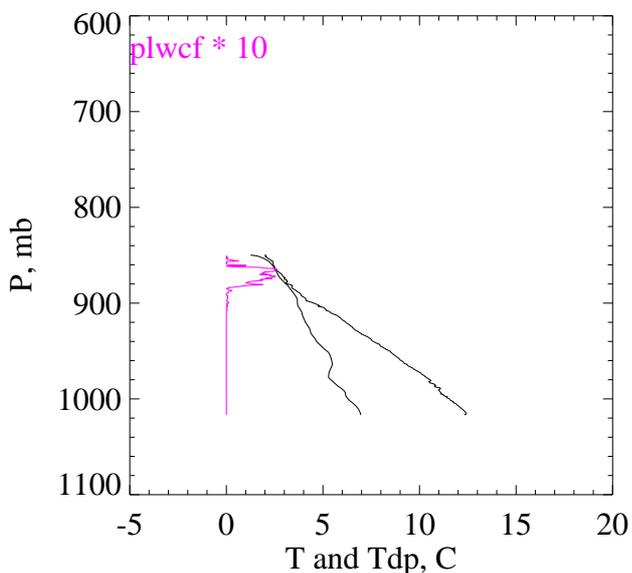
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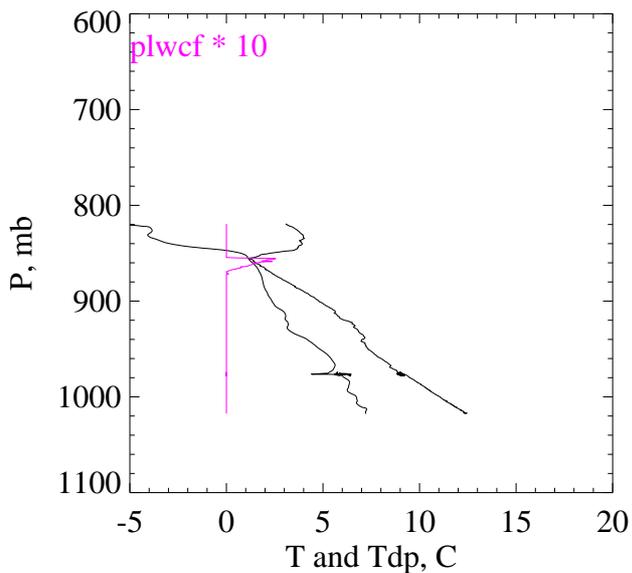
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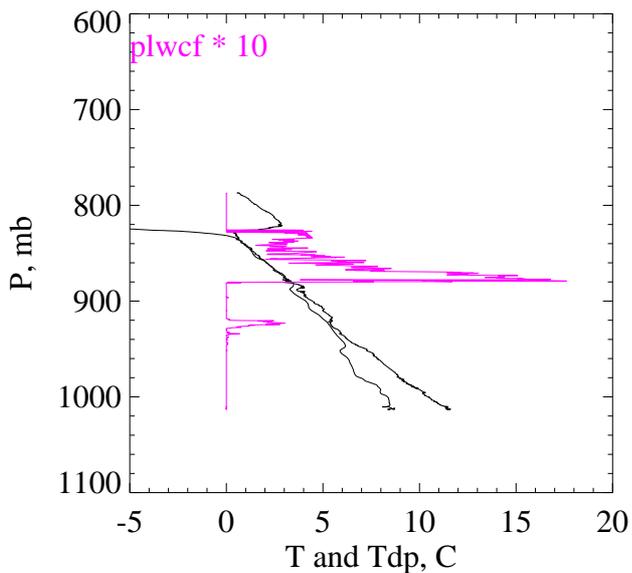
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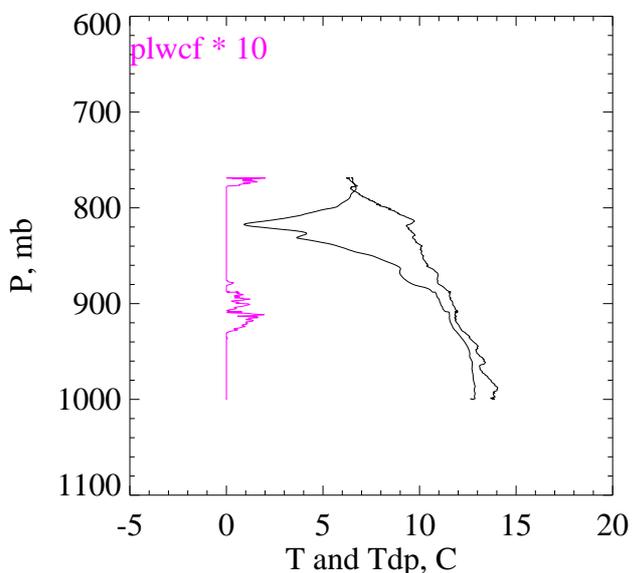
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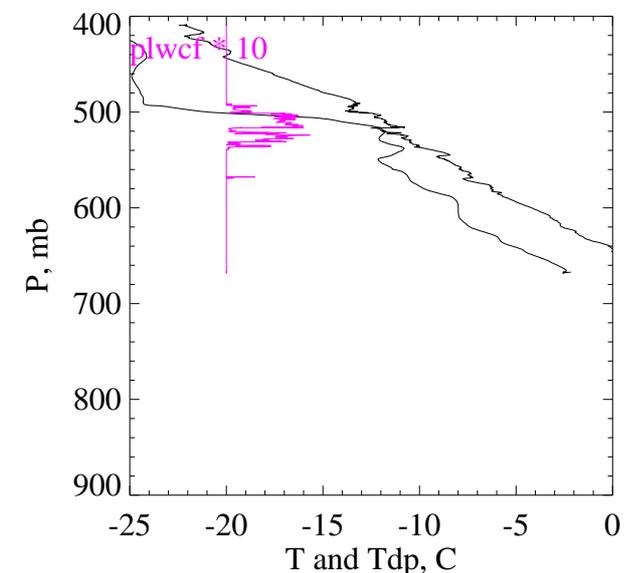
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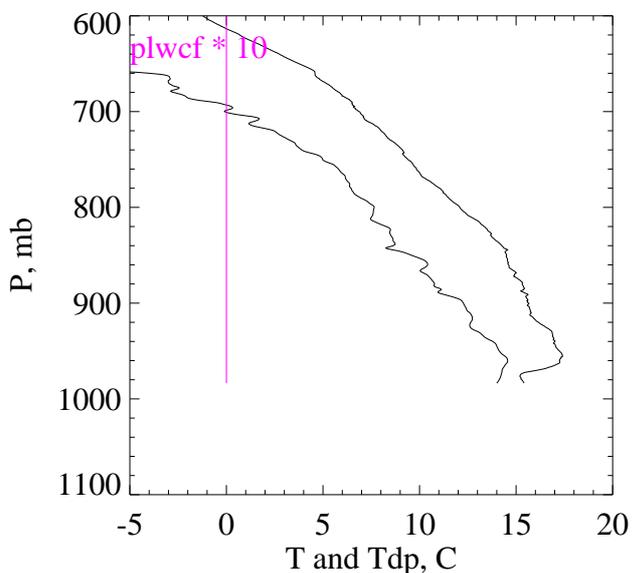
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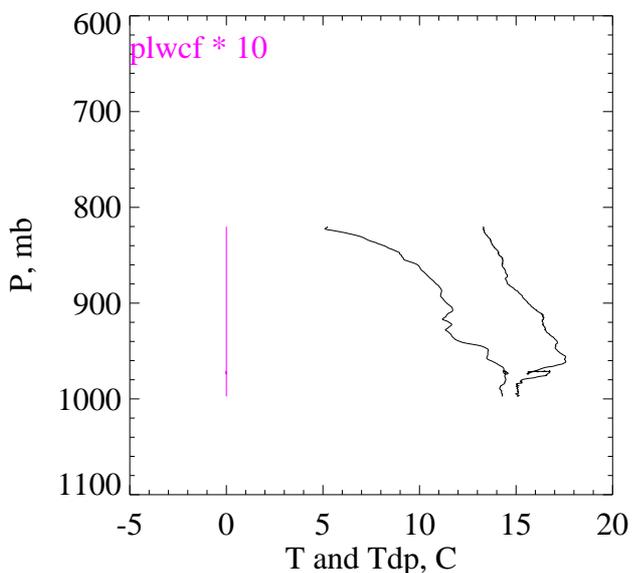
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Date: June 29<sup>th</sup> 2006

## **Second Cloud/Drizzle flight of the day in "Stratocane"**

*Flight scientist – Rob Wood*

Takeoff: 23:00 UTC, Arcata

Landing: 02:16 UTC, Arcata

23:00 Take off. Transit to waypoint 39.5°N, 126°W.

23:06 Transit to waypoint. Essentially same structure as last flight, so won't bore the reader with superfluity.

23:26 First signs of drizzle on radar (OK, so I will discuss something about the transit if drizzle is involved).

23:48 Almost at waypoint and located elevated cloud tops. Lo and behold, the drizzle is profuse below. Set pointer at 39.98°N, 126.03°W. PCASP 250 cm<sup>-3</sup> above cloud.

23:50 Turn and descend for run to NE in cloud layer at 3000 ft. FSSP 100 cm<sup>-3</sup>. Cloud tops 3200 ft.

23:52 Started run. Winds 4 m s<sup>-1</sup>/160°. In solid cloud at 3000 ft. Drizzle on windshield. FSSP climbs to 200 cm<sup>-3</sup> in cell center. LWC as high as 1.1 g m<sup>-3</sup>. Bumpy through cell center at 23:56.

23:59 Turning 90/270 back to pointer at same level. Almost out of tops at NE end.

00:00 Start run at 3000 ft to SW. FSSP increases from 100 cm<sup>-3</sup> at cell edge to over 250 cm<sup>-3</sup> and sometimes higher, at cell center. This general behavior is repeated throughout flight.

00:05 Descending to 500 ft with 90/270 and run to SW. Sea calm. Base of upper layer 2000 ft, lower layer 1300 ft. Can see the portentous wall-cloud ahead. A harbinger of drizzle to come for the seafarer, wary of the dangers of stratocane transits in his flimsy vessel. PCASP 200-250 cm<sup>-3</sup> in surface leg. Puts to bed the idea that you need really clean clouds to get significant drizzle. Very interesting wind shifts (with some bumps) at low levels. Clear convergence into cell.

00:18 Turn quick for turn back to pointer. Scud is not in prominence. Instead there appears to be a lower level sheet.

00:28 Turned for 3<sup>rd</sup> run back to pointer at 300 ft. PCASP almost doubled under cell from around 100 to 200 cm<sup>-3</sup>. Lower concentrations to SW.

00:35 90/270 and climb for run at 2000 ft. PCASP high at surface (300 cm<sup>-3</sup>). First cloud layer at 1100 ft. Main bases around 2000 ft, but variable.

00:37 Start run at 2000 ft. FSSP increasing from 100 to over 300 cm<sup>-3</sup> in cell center.

00:45 Left turn back for run to N at 2000ft. Some cumulus (wall clouds?) but not penetrating upper deck. Second cell core entered about 6 km to NNE of first at 00:52.

00:53 Turn and climb to 2500 ft for run to SSW. 90/270 turn.

01:04 Turned fast to L for run back at 2500 ft.

01:10 Turning 90/270 with descent to 300 ft. Enter lower cloud layers at 1400 ft. Cell center appears now to be S of pointer. Possible propagation?

01:21 Profiling up to 3500 ft through cloud main bases 2300 ft. Very thin here. Tops 3100 ft. Tops very uniform visually. Climbing to 3800 ft to remain above cloud. Most active cell now appears to be 1-2 miles to NE of center point.

For run in cloud the linear relationship between cloud liquid water content and cloud droplet concentration was observed. Similar to first flight. Evidence of drizzle removal, or simply of mesoscale cell dynamics and mixing?

01:30 End of cell sampling. Transit home

02:16 Landed.

Date: June 29<sup>th</sup> 2006

**Cloud/Drizzle flight with ASTER/MODIS overpass at 19:20 in "Stratocane"**

*Flight scientist – Rob Wood*

Takeoff: 17:30 UTC, Arcata

Landing: 21:03 UTC, Arcata

- 17:30 Take off. Fog bases 400 ft. Transit out to drizzle cells and ASTER box in *stratocane* (Term used by Bruce Albrecht to describe cyclonic low cloud system centered on 38°N, 127°W)
- 17:32 Transit at 3000ft to waypoint at 39.5°N, 126°W. Complete stratus coverage below. Cloud tops at 2000ft but rising to SW. Interesting polluted then clean layers, with rift structure with little cloud to S.
- 17:41 Entering dry air. Seeing increased drizzle below. PCASP around 100 cm<sup>-3</sup>.
- 18:02 Descend into cloud to check out at 2300 ft. Cloud tops 2400 ft. FSSP 150 cm<sup>-3</sup> Strong inversion (15 K).
- 18:14 Climbing above cloud to survey cloud tops. Locate drizzle cell. PCASP 270 cm<sup>-3</sup> above cloud.
- 18:32 Descending into drizzle cell. Cloud cover extensive, no breaks, some cells peaking up above main cloud deck. Strong drizzle. Pointer set.
- 18:36 Turning and descending to 300 ft for run back through pointer. Bases 1500 ft with scud below. Lots of drizzle. What may most aptly be described as wall cloud (see photographs) ahead of main drizzle cell. Seas quite calm. Winds 120°/5 m s<sup>-1</sup>. PCASP concentration 180 cm<sup>-3</sup>. Strong drizzle cells everywhere.
- 18:45 Quick turn to left for run back to E at surface
- 18:53 Climbing for run at cloudbase 1700 ft. Scud visible below. PCASP drops as we climb above surface layer to 30 cm<sup>-3</sup> at 1500 ft. Similar behavior to the case on the 13<sup>th</sup> June with high aerosol in the SML and lower in outflow layer.
- 18:56 Run at cloudbase. FSSP 100 cm<sup>-3</sup>. Drizzle. Quite bumpy at times. Entered cell with high liquid water content. FSSP peaks at 100-150 cm<sup>-3</sup>. PCASP at W end much higher than at E end.
- 19:05 Turn quick for run back at 1500 ft. Clouds thinning and starting to break at edge of cell. PCASP dropping out of cloud from edge to center. As low as 20-30 cm<sup>-3</sup> near cell center out of cloud.
- 19:11 Climb to cloud layer at 2400 ft, turn 90/270 for run back to E. Can see sun. FSSP 50 cm<sup>-3</sup> in main cloud deck at 2550 ft.
- 19:14 Started run to E. FSSP around 50 cm<sup>-3</sup>. In cloud tops. LWC increasing to cell center as is FSSP which peaks around 120 cm<sup>-3</sup> at center. FSSP number concentration curiously linearly related the LWC.
- 19:20 Turning back for run to W through pointer at 2500 ft. Reset pointer based upon side-radar.
- 19:27 Run to E at same level. FSSP curiously peaking at cell center along with LWC. This is a typical signature of today's cells.
- 19:32 Turn and climb for run above cloud. Cloud tops at 2800 ft. PCASP above 300-500 cm<sup>-3</sup> above cloud. Inversion strength 9 K.

19:41 Descend below cloud for run at 300 ft. Cloud base 1900 ft. Wall cloud again visible.

19:45 Run at 300 ft to NE. PCASP  $150 \text{ cm}^{-3}$ . Cloud base lower below cell.

19:49 Turn back to SW for run back at 300ft. Clouds breaking at Eastern end.

19:56 Sounding to above cloud 3500 ft. FSSP reaches as high as  $200 \text{ cm}^{-3}$  in cell center. Tops 2700 ft.

19:59 End sounding. Dropping back to 1500 ft for run to NE at cloud base. Through thinner cloud on descent. FSSP around  $100 \text{ cm}^{-3}$ .

20:01 PCASP  $100 \text{ cm}^{-3}$  at western end. PCASP drops to  $60 \text{ cm}^{-3}$  nearer cell below cloud. Bumpy through cell. PCASP remaining low and then suddenly drops to around  $20 \text{ cm}^{-3}$ . Holds steady until second cell at 20:08. Jeff: study this leg. It is similar to what we saw (albeit not with  $2 \text{ cm}^{-3}$  on June 13<sup>th</sup> case).

20:08 Continuing run back as part of transit home. Enter cloud on occasion.

20:35 Cloud tops have dropped around 1000 ft over half an hour.

21:03 Landed

Date: June 27<sup>th</sup> 2006

**Cloud/Drizzle flight with MODIS overpass at 19:30**

*Flight scientist – Rob Wood*

Takeoff: 18:32 UTC, Arcata

Landing: 22:12 UTC, Arcata

- 18:32           Climb to 3kft and transit to intermediate waypoint at 42°N,125.5°W before heading to 42°N,127.5°W  
Light winds near coast, few whitecaps.  
Fog to N, cleared mostly. Scattered cumulus at 3000 ft, mid-level cloud above  
PCASP 500 cm<sup>-3</sup> near coast, hazy, polluted. CPC high (several thousand)
- 18:40           Level off at 3000 ft  
Coastal fog below, clearing to NW
- 18:48           Passing under midlevel cloud at 5-6 km. Virga  
CPC falling. Some thin low cloud (Cu Hu) below, with edge of haze layer visible ahead
- 19:00           Sharp transition to clean airmass ahead. PCASP down to 40 cm<sup>-3</sup>. Drying out at flight level
- 19:05           CPC/PCASP increases somewhat into airmass to be sampled. Wind speed 20 m s<sup>-1</sup> out of the north. Strong whitecapping at surface.  
Cloud tops below at 1500 ft, patchy, but becoming more extensive ahead.
- 19:15           Turning W at 42°N onto E-W track. Aerosol concentration remaining steady  
PCASP 175 cm<sup>-3</sup>, CPC=450 cm<sup>-3</sup>.
- 19:28           Dropping down to cloud level to sample clouds. Cloud tops 1400ft, strong inversion (8 K). Continuing descent to 500ft. PCASP 150 cm<sup>-3</sup> below cloud.
- 19:34           Level at 1000ft. FSSP around 125-150 cm<sup>-3</sup> in cloud, LWC<sub>max</sub> around 0.3-0.4 g kg<sup>-1</sup>
- 19:34           Strong whitecapping. MBL winds consistently 15-18 m s<sup>-1</sup> out of the north. Some shear turbulence.
- 19:35           Mesoscale variability in crosswind direction clearly evident. Scales of roughly 10 km.
- 19:54           Set pointer at 1000 ft at 42°N, 127.5°W. Will return to advected pointer throughout.
- 19:59           About 15 miles W of pointer, 90/270 turn back to E and descend to 300 ft run. PCASP around 140 cm<sup>-3</sup>. Run back quite bumpy. Winds 16-18 m s<sup>-1</sup> out of the north
- 20:15           East end of leg. Climb with 90/270 for run to W above cloud at 1750 ft.
- 20:18           Climbing shortly after start to 1900 ft to remain above cloud. Cloud base 700 ft, Cloud top 1400 ft. PCASP 20-40 cm<sup>-3</sup> immediately above cloud. Water vapor mixing ratio around 5-6 g kg<sup>-1</sup>. Winds above MBL not strongly different from those in the MBL
- 20:32           Start descent for porpoising legs back to E. MBL well mixed and with consistent LWC maximum of 0.3-0.4 g m<sup>-3</sup>. FSSP showed some interesting mesoscale variability from one profile to next, possibly consistent with subcloud aerosol variability. Wind speed remaining high all along run.

- 20:48 End of run, but continuing to porpoise back to intermediate waypoint for transit back to airport. Cloud noticeably more extensive than during transit out.
- 21:14 End of porpoise. Slow climb to cruise level 5000 ft for transit home. PCASP remaining low above cloud. All aerosol exhibiting only weak gradients. Clear haze layers in evidence near coast. The clear-polluted edge is now much closer to the coast than it was before.
- 21:44 Cloud layer below almost completely gone. Edge of polluted layer at 21:46 with jump of PCASP from 200 to 600 cm<sup>-3</sup>. Visibly hazy. Wind speed dropped at flight level to 10 m s<sup>-1</sup> out of N. Midlevel clouds ahead.
- 21:50 Interesting gravity wave coast-parallel cloud lines (not MBL rolls). Profile into Arcata shows a very stably stratified layer below 3000 ft with no clear inversion.
- 22:12 Landed to S.

Flight Scientists Notes – DMIMS06 20060620  
Crew: Cooksey, Leon, Oolman, Pokharel

ASTER overpass @ 19:26:40.

Basic plan: Ferry out to the site of the ASTER scene and try to find a region of cloud that is likely to be advected into the box during the overpass time. Satellite images prior to the flight show clouds starting fairly far offshore. Based on previous experience the clouds at our latitude appear likely to burn off or collapse during the day (even the earliest visible satellite images show breaks in the clouds for the target region).

Conditions of the flight evolved more or less as expected until we reached the western edge of the ASTER observation region. At this point it became evident that we were too far upwind of the region since the BL winds at this longitude were only about half of what we observed closer to the coast. We then turned southward in order to find a region of stronger cloud within the ASTER observation region. At this point the flight started to unravel as the clouds in this region were much weaker than before and frequently did not show up on the radar. After some attempts to find a suitable area to focus on we started working across a boundary in the cloud layer that was marked by very thin clouds with a lower cloud top on one side and deeper, brighter cloud on the other. After a few passes in and below cloud we decided that this was not a good region to focus on due to the weakness of the radar echoes and apparent lack of structure in the cloud layer.

An attempt was made to find a better region within the area covered by the ASTER scene, however this too was unsuccessful and shortly after the overpass time we decided to return to Arcata at low levels in order to (hopefully) get some good aerosol data for Jeff Snider. Windspeeds along the coast were similar to those observed on the ferry out (20+m/s).

Looking at satellite images after the flight revealed that some cloud remained near where we were working, but that the region of the cloud field that we were working in was eroding rapidly during the time that we were on station.

As a final note, I was informed that for an unknown reason, the ASTER data acquisition that had dictated the timing and location of our flight had not actually been acquired.

Points for future flights: As noted by others it is very difficult to see the visible satellite imagery on the front display. For this reason, either the person in the forth seat should be in a position to make suggestions regarding where to go or somebody on the ground should be available to

contact for help in flight planning.

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Literal flight notes:

164850 Engines running. Pictures of front display.  
165155 Taxiing, waiting for incoming plane to land  
165610 Takeoff. (Note from Larry: Chilled mirror wrong)  
165731 Over shallow clouds next to coast.  
165847 (Larry to Binod) Nadir port door open, ultrafine CPC on.  
165956 Slight bumpiness @ 2750 (zft)  
170156 Clouds on the horizon  
170432 Haze layers to S.  
170531 Some whitecaps on ocean  
170609 Haze above, clouds below.  
170719 End of climb.. return to 1000 ft.  
171000 Estimate from Don: clouds are ~50nmi out.  
171305 start of light turbulence  
171442 Top of boundary layer is at ~1500ft (zft)  
171537 winds 23 m/s @ 354 deg true  
171629 Clouds look stronger to S.  
171800 (Larry) Lots of aerosol.  
172022 Descend to ~500ft. Increased turbulence.  
172130 Haze increasing  
172537 Request to Binod to get satellite image  
172758 End of the 1<sup>st</sup> sequence on the CCN. To be followed by a quick  
sounding  
173508 Approaching cloud.  
173529 Ship off to the north (small ?)  
174015 Encountering cloud- tops at 2500ft. Some echoes on radar.  
Looks worse to west.  
174419 Climb to 6kft to get a better view,  
174419 Some higher cloud tops to the north. Additional cloud (haze ?)  
layer above stratus ahead.  
175307 Descend to 4800 to keep sfc within radar recorded range.  
175424 Well defined haze layer above cloud (pictures).  
175704 (Larry) BL depth 2700 ft.  
175726 Coming over cloud  
175945 Echoes to +5dBZ in cloud layer.  
180302 Echoes broken, clouds dimmer below.  
180508 (Larry) Puttins in a file break for the WCR.  
180800 North of box. Will try to to pick region based on the echoes,  
cloud tops.  
181317 (Larry) Time gap at home.  
181344 Rift between clouds, brightness difference.  
181425 Haze layers above cloud.  
181746 Approaching rift. Will descend into it and try to fly return leg

under cloud.

182028 Descending for under cloud leg.  
182056 Cld top at 2971 zft.  
182248 Winds lighter ~12 m/s (20kts).  
182500 ~ 1hr to overpass. Echoes getting stronger.  
183000 Turning to go S, through the box (current track would be too close to N. end of box at the overpass time)

184020 Climbing back on top of cloud layer to find a better spot to work.

184151 Climbing through break in the cloud

184301 Top of the cloud layer

184437 Above cloud but no echoes.

184750 Turning and heading to stronger- looking clouds.

184930 Aerosol layer above

185038 Approaching rift next to brighter clouds.

185306 Edge of cloud layer

185914 90- 270 turn and drop into cloud.

190140 In cloud. Lwc ~0.5 g/m<sup>3</sup> FSSP 100/cm<sup>3</sup>

190347 @cloud top. In and out of cloud. FSSP conc @ ~100

190508 above cloud

190901 Re- entering cloud ~100m lower

191215 Not working well (flight strategy) Will climb above cloud and try to find something better.

191624 Above cloud. Well- defined haze layer to N.

193850 End of spiral descent. Head for home low down.

194525 ATC problems current altitude 6- 10kft

194844 Haze layers above

195000 No cloud below.

195430 Got clearance. Descending to ~300ft.

195650 Top of inversion @ (?) (Larry)

195743 Spike in aerosol concentration.

201144 Sounding to ~500 ft above BL.

201642 Descending after sounding. Aerosol layer above.

203217 End of low- level leg. Climb out and head to Arcata.

204736 At hangar.

Date: June 16<sup>th</sup> 2006

**Drizzle flight with Aqua/Cloudsat overpass at 21:32 UTC**

*Flight scientist – Rob Wood*

Takeoff: 21:02 UTC, Arcata

Landing: 00:56 UTC, Arcata

21:02 Climb to 3kft and locate Cloudsat overpass line  
Light winds near coast, few whitecaps  
Cloud layer, base 1.6 kft, top 2.1 kft, max LWC=0.3 g/kg  
PCASP 70 cm<sup>-3</sup> near coast

21:07 Level off at 3000 ft  
Multiple stratus layers ahead around 3-5 kft with fog/low stratus near sfc

21:09 Turning to NNW onto Cloudsat path

21:11 Patchy fog/stratus below, some rolls.

21:12 Broken/thinning Sc above at 3600 ft  
Climb to level of upper layer at 4200 ft

21:20 In-cloud straight at 4200 ft, FSSP 50 cm<sup>-3</sup>, LWC 0.1 g/kg

21:25 Climbing to 4900 ft to remain in cloud, weak inversion above

21:27 Levelled off, very few wisps of scattered cloud above

21:29 Drop 300 ft to 4600 ft as cloud layers change below.  
Clear multilayered radar returns, some drizzle, 0 dBz

21:32 Waypoint set. Continuing along run to NNW at 4600 ft

21:40 Turning 90/270 to run SSE through air-relative waypoint

21:40 Start porpoise run 500 ft/min from top to cloudbase around 2400 ft then  
back up to 5000'. In center of layers very low PCASP concentration of 1-2  
/cm<sup>3</sup>

21:56 Turning 90/270 for final run back NNW at 5000 ft

21:58 In and above cloud tops. Descend a little mid-run to remain in tops. Strong  
gradient in cloud top lower to N

22:09 END OF CLOUDSAT COMPARISON

22:09 Head W to locate drizzle cells at 4500 ft

22:20 Cross stratus edge. Clear slot for 40 miles, then stratus beyond. Becoming  
polluted and visibly hazy. Haze layers visible to N

22:28 Bands of stratus visible ahead. Tops 3500 ft

22:34 Enter cell at edge of clear region. 8/8 stratocumulus beyond at 2000-3000 ft.  
Only weak returns so progress further into sheet

22:42 Climb to survey. Homogeneous stratocumulus, well-capped. Back down into  
cloud at 2500 ft

22:43 Set pointer (126°25', 42°23') in center of drizzle cell located using radar. 0  
dBZ returns probably not reaching surface

22:50 Return to waypoint at 2500 ft. Some drizzle on windshield at cloudbase  
2300 ft. PCASP concentrations higher on E side, lower on W.

23:00 Descend into clear air at 300 ft. Run back to waypoint at 300 ft with CCN  
cycling through supersaturations. More polluted at E end. The drizzle cell has  
lower cloud bases. PCASP around 70 /cm<sup>3</sup> decreasing to 50 /cm<sup>3</sup> at W end

23:10 Reverse run to E at cloud level, 2400 ft. Scud/cumulus below but not penetrating stratocumulus

23:16 Turn and climb to 3000 ft. FSSP has interesting structure through cell with low values (20-30 /cm<sup>3</sup>) in cell center, highest values to E (70 /cm<sup>3</sup>) and intermediate values to W (40 /cm<sup>3</sup>).

23:19 Run skimming cloud top at 3500 ft.

23:32 2000 ft run back near cloud base. PCASP at E end around 80-90 /cm<sup>3</sup>

23:40 END OF DRIZZLE CELL SAMPLING

Climb out. Inversion 5-6 K, quite strong hydrolapse

00:26 Going to investigate near-coastal returns. Some interesting cloud structures bunched up around Cape Mendocino. Echo returns around 0 dBZ.

00:56 LANDED

Mission report 061406  
Crew Cooksey, Geerts, Oolman Pokharel

About 65 min ferry to cloudsat leg

Slight change in flight plan. Designated southern point not attempted due to MOA B. Point displaced north 17 nm hopefully close enough to cloudsat track. Northern end will be adjusted up north accordingly.

**212735** : start of Cloudsat leg northbound, porpoising, start with descent from 10 kft to 0.7 kft

213400 Some waves in stratus below present, oriented normal to track

213800: at 2000 ft: IDC droplets

213930: min altitude, back up

2143: up to 3500 ft, above stratus, descend again

214420 Overpass time during a descent leg between 3500 and 700 ft in cloud, some drizzle on windshield, cloud top 3000 ft, base 1000 ft – looks like typical very stratified stratus to me, no vertical cloud edges

2147: min altitude, back up; next a long ascent to 10300 ft. Three cloud layers are traversed: the marine stratus, a weak echo band near 800 mb, and a very thin water cloud (even weaker echo) near 700 mb. The ascent ends just above this cloud. Note that this clouds peters out to the north, as should be obvious in WCR data. I don't see that highest cloud layer again as far north as I can see.

**220000** end of southbound Cloudsat leg; 90- 270 turn

**220200** Backtrack to the south – we ended up looping around some 7 km to the east before returning to the track to the pointer (miscommunication). We then started drifting to the east from the geographically fixed track, but apparently the drift was very little. So after some time we calculated that the southern point should have drifted some 9 nm east of its position when we first crossed it, and the pilot then aimed for that displaced point. Altogether the return track is far from straight. This should give some sense of cross- cloudsat- track variability. Fortunately there appears to be very little variability!

221330 decided on 2400 ft as good in- cloud flight level

Summary of 2400 ft southbound leg: I cannot see any blue sky above nor any ocean below ... for the entire leg southbound. This stratus appears remarkably uniform along this leg at 2400 ft, and echoes are generally weak (few - IDC drops noted). Marine stratus did thin out to the south.

**223930** – end of southbound leg

First a short westbound leg to gain altitude and talk to ATC, then ferry back to ACV.

Date: June 13<sup>th</sup> 2006

**Drizzle flight with Terra/ASTER overpass**

*Flight scientist – Rob Wood*

Takeoff: 17:06 UTC, Arcata

Landing: 21:21 UTC, Arcata

17:06 Climb to 6kft for transit to 127.5°W, 41°N  
Light winds near coast, almost no whitecaps  
Cloud layer, base 4 kft, top 5.6 kft  
CDC 50-70 cm<sup>-3</sup> near coast  
Some drizzle on windshield  
Midlevel cloud layers above around 8-10 kft with some visible precip to N  
Transit below midlevel cloud  
Broken stratus below

17:12 Smooth transit at 6 kft

17:26 Edge of midlevel cloud above to E, mainly clear above ahead

17:30 Elevated particle counts, 150 on PCASP  
Evidence of drizzle cells with tops elevated above stratocumulus

17:35 Rapid drop in particles (PCASP to approx. 20 cm<sup>-3</sup>) seemingly collocated with visible rift edge  
Some elevated cloud layers at flight level (6 kft)

17:47 Entered polluted airmass at 6 kft

17:55 Continued polluted airmass, clouds looking more classically stratocumulus.  
Decide to return E to clean airmass

18:05 Crossed polluted-clean boundary, PCASP 15 cm<sup>-3</sup>. Lots of halo-type clouds around cell centers. Classic open cellular structures? Cloud tops 4500 ft.  
Calm sea surface

18:08 Descent into area with interesting drizzle cell visible

18:10 200ft PCASP 60 cm<sup>-3</sup> with clear stratification through the MBL (around 10-20 cm<sup>-3</sup> near top)

18:11 Level run toward cell center – clear drizzle reaching surface in a cell.

18:18 Drizzle on windshield. Cell marked

18:23 Return run at 200 ft through cell center at 18:27

18:30 Return run at 200 ft through cell center at 18:31. Heaviest drizzle I've ever seen on windshield. Radar around 20 dBZ. Stratus fractus below main bases. Second drizzle cell encountered. Evidence of linear cells.

18:36 2500' More runs under cell

18:58-19:09 3500' runs through cell. Bumpy through center of clouds.

19:09 Heading for center of ASTER box (40.8-41.2°N, 125.2-125.8°W)  
PCASP concentration very low. Cloud tops quite variable  
Multilayer clouds in MBL, some drizzle

19:16 Located drizzle cell within ASTER box. Marker set.

19:17 PCASP 20-40 cm<sup>-3</sup>

19:26 Climb to 4500 ft. PCASP much lower on E side of cell. MBL top at 4500 ft

19:29 In cloud top at 4500 ft. Main cell with tops around 5000 ft. LWC as high as 1 g kg<sup>-1</sup>. FSSP concentration 60 cm<sup>-3</sup>

19:34 Return leg at 4500 ft.  
19:36-19:56 Runs at 3500 ft. Mid-level cloud with virga (photo at 19:39)  
19:59 Descending to 200 ft.  
20:04 Drizzle at surface. PCASP  $70 \text{ cm}^{-3}$ .  
20:10 Profile up to 6000 ft in clear air  
20:12 Stratus fractus at 1200 ft. Boundary layer stratified: thermally, moisture, and aerosol. MBL top 4500 ft. Some mid level cloud to W. Above drizzle cell center at 20:23. PCASP  $20 \text{ cm}^{-3}$ , CPC 80-100  $\text{cm}^{-3}$ .  
20:28 Descending to 4000 ft for runs through cell. Weak inversion (3 K). Very little moisture jump. Into cell 20:30  
20:35 Second run at 4000 ft  
20:39 Third run at 3000 ft  
20:41 Return through cell. Cloud bases at around 3000 ft. Stratus fractus/Cu-Hu below. PCASP 30-40  $\text{cm}^{-3}$   
20:47 Run back at 3000 ft. Drizzle on windshield at 20:50  
20:54 Final run back at 3000 ft.  
20:58 Climbing to 5000'. High ultrafine aerosol concentrations in thin (cloud detrainment level) layer around MBL top.  
21:02 Descending for ferry back to Arcata. Very low PCASP ( $10 \text{ cm}^{-3}$ ), CN ( $70 \text{ cm}^{-3}$ ), no elevated UFC. Stratocumulus aloft, sometimes broken. Drizzle cells to W and S. Is this a POC?  
21:08 PCASP rising gently  
21:09 Sudden rise in PCASP (continental airmass?) to  $70 \text{ cm}^{-3}$ , also CPC.  
21:21 Land, Arcata.

20060611

Jeff Snider

Crew: Cooksey, Snider, Oolman, Rahn

1841 – sounding from 10000 ft agl at 500 ft / min, near top of sounding there are lower aerosol concentrations compared to Friday's (6/9) flight.

However, concentrations increased dramatically around 6000 ft agl

1845 – approaching the hole (dark feature in the visible satellite image) from the east. Beyond the hole there are deeper clouds on the NW horizon. Pictures of this.

1848 – heading to the north during descent because the WCR is showing thin clouds near the eastern bdry of the hole. Noticed and commented on turbulence in the free troposphere as we approached the MBL from above.

1905 – 1940 (approximate) – working drizzle cell to the east of the hole.

Targeted this by looking for punctuations in the cloud tops, directing Don to one that was nearby. There are several punctuating tops visible in this area from altitudes higher than 4000 ft agl. Concentrations on the CPC exceeding  $2000 \text{ cm}^{-3}$  (up to  $2400 \text{ cm}^{-3}$ ) in the above-cloud regime. After descending into cloud observed cloud droplet concentrations of  $150 \text{ cm}^{-3}$

1944 – descending into cloud, to 1900 ft agl, low cloud below, scud. Only a few white caps. Targeted the feature that we worked (from above) by doing a 90/270, realigning with track and getting a visual fix on the most pronounced punctuation of cloud top, then descending to 1900 ft agl.

2003 – 2023 descending to 200 ft agl, 90/270 turn, three passes of same driz feature

2023 – climbing out of MBL

2035 – 2045 – sounding into the hole. Several pictures of this regions, clouds of various type with Cu penetrating into stratus seen illuminated with sun coming in through the hole. Also, the eastern edge of the hole most impressive with several layers of stratus and bases sloping downward to the east.

2100 – heading to north to intercept the line to Arcata. At 500 – 600 ft agl, WCR in the up-looking mode, lower cloud thinned completely and a layer then formed at about 400 m above us, this then thickened. Using CCN in seven point mode, 0.2, 0.4, 0.8, 1.6 %.

2105 – CCN(1.6) and CCN(0.2) reasonably consistent with targets of CPC and PCASP, respectively. Wind magnitude is 11 m/s

2112 – lots of boat (ship) and tugboat/barge traffic (at least four of these), some evidence of a hit on the CPC and UFN but it is also cloudy here (murky) so that could be shattering artifact. Passed under drizzle this is presumed to be the N-to-S feature evident in the satellite, approximately 50 miles off the coast. Could this be a region of concentrated ship traffic?

2123 – PCASP concentration and FLWC anticorrelated

20060609

Crew – Cooksey, Rahn, Oolman, Geerts

Synopsis – Second flight of the day. GPS flight with north/south legs over Cape Mendocino, and a set of west/east isobaric to the south of the cape. Fair skies with just a few scattered clouds just to the north of the cape, increasing towards the end of the flight.

2238 – Take off

2243 – Starting 4500' leg (Leg 1).  $S = 1.6\%$

2257 – CCN rewetted

2303 – End of Leg 1. Restart CCN with  $S=1.6\%$ . Climbing to 5500'.

2306 – Start Leg 2.

2327 – Leg 2 ends.

2328 - Some difficulty with CCN, reset. Concentrations seemed high enough, set  $S = 0.2\%$ .

2332 – Start Leg 3, continuing at 5500'.

2348 – End Leg 3, Delayed descent due to air traffic.

2352 – Start descending spiral.

~2358 – Start Leg 4, 800' (~986mb)

Above the boundary layer for the first third, then moved into it.

Wind max observed to be near 26 m/s

0013 – End Leg 4

0019 – Begin Leg 5 Redundant ( $S = 1.6$ ) Observations repeated. Obvious difference in sea state between Shelter Cove and farther offshore.

0027 – End Leg 5.

0030 – Start sawtooth, ascending at 600 ft/min

0102 – End of Leg 6 after descended to 2000' and headed back to Arcata.

0107 – Pump off

0110 – Landing

0115 – System Off.

20060609

Rightseat notes – Jeff Snider

Crew – Cooksey, Snider, Oolman and Rahn

Synopsis – Stratocumulus approximately 100 nm to WSW of Arcata. Fix at 39 N / 127 S. Expect things to erode around noon (LT), other option is brighter N-to-S feature to the NW of fix

1643 – Taxi

1650 (approximate) – TO

Seastate – larger white caps compared to previous days, winds are NW and speeds at 15 m/s. Took pictures of sea.

1740 (approximate, during ferry at 10000 ft agl) – haze layer ahead, PCASP showing concentrations up to 400 cm<sup>-3</sup> and accumulation mode with mode size around 300 nm. Took pictures of haze layer

1744 – Cloud top 2500 ft, turning WCR on

1750 – Descent sounding, cloud base at 1900 ft

1756 – start of 15 min aerosol leg at 150 ft agl, CCN in 0.4, 0.8, 1.6, 0.8, 0.4 % mode

1811 – end of aerosol leg

1820 (approximate) – WCR in DD/DS, in-cloud leg

UFCPC liquid light is on

UFCPC saturator light is on

1845 (approximate) – targeting cloud number 2, this time with WCR in DD/U mode.

Flying the pointer

1900-1915 900 ft aerosol leg below second cloud. We went to the NW approximately 10 min, targeted highest feature. CCN sequence 0.4, 0.8, 1.6, 0.8, 0.4 %

1921 – we need to get back to Arcata

1928 – Added water to CCN, alternating between 0.2% and 1.6% as we head back to Arcata and pass through the haze layer at 9000 ft agl

1950 – S=0.2% measurements, and comparison to total PCASP concentration, indicates that the haze aerosol are not efficient CCN (CCN concentrations are lower than cumulative PCASP concentration).

2027 – Fly over of paper mill on the spit west of Eureka

## **DMIMS06: 20060607a & 20060607b**

### **Flight 11**

Flight notes: System Scientist (3<sup>rd</sup> seat)

#### Crew:

Pilot: Kevin Fagerstrom  
Flt Scientist: Bart Geerts  
System Scientist: Jeff French  
4<sup>th</sup> Seat: Dave Rahn

#### Pre-flight:

Attempting to coordinate with CloudSAT overpass, stratus are marginal and weakening as the day wears on.

In order to ensure radar is working and not overheated during time of overpass, limit use of radar on ferry to overpass line

Wx: overcast, winds: 290@10 kts, T=14/Td=12C

#### Flight:

Wheels up 1957 UTC (all times hereafter are in UTC)

2001: on climb out through cloud, DMT looks questionable

2020: nearing line, over some stratus and transition to broken stratus

2021: **radar file** 20-21-22 dual down, short file as we fly over transition area, also want to get idea of echo strengths

2025: stop radar

2034: **radar file** 20-34-39 up/dual down

2035: on leg, north bound, sawtooth, bases~2400', tops~3300'

2037: note: DMT appears to be working fine

2120: end leg, 90/270 turn

2122: **radar file** 21-22-28 up/dual down, southbound at 2500 ft, just above cloud base (??)

2123: spikes in UFN, CPC, CCN ship just to our NE at this time (off of left wing)

2159: stop radar, T~103

2200: 90/270 turn, continue leg northbound

2205: data system hangs

2214: **radar file** 21-14-58 up/dual down

2235: stopped radar

2316: wheels down

#### Post-flight/impressions

Data system hung for no apparent reason

PCASP concentrations high by order of magnitude entire flight (before flight dessicant was changed). It was found after flight that tube holding dessicant was leaking, causing for incorrect measurement of sample flow.

## **DMIMS06: 20060606a**

### **Flight 10**

Flight notes: System Scientist (3<sup>rd</sup> seat)

#### Crew:

Pilot: Kevin Fagerstrom  
Flt Scientist: Jeff Snider  
System Scientist: Jeff French  
4<sup>th</sup> Seat: Dave Rahn

#### Pre-flight:

Kevin returned from Medford in AM after part was changed for air conditioner. Plan was to fly early in day but flight delayed several times because of instrument issues (below). By late in day, clouds were dissipating

Filled CPC with butanol before flight, expected this to be ~1 hour job, but took most of day because valve on CPC bulkhead was broken.

Wx: overcast, winds: 310@11 kts, T=17/Td=13C

#### Flight:

Wheels up 2243 UTC (all times hereafter are in UTC)

2248: level off at 6 kft, ferry west

2249: **radar file** 22-49-10 dual down, increased # of range gates to see surface

2258: drop down to 4 kft, stratus very weak, get closer to see them with radar

2259: **radar file** 22-59-20 dual down, 'standard dmims' mode

2313: stopped radar, did descent sounding on west side of stratus deck, in clear air (no clouds below), tracked SSE during descent sounding, at bottom of sounding remained at ~100 ft for remainder of ~50 km leg

2326: 180 turn, remain at 100 ft until back at north end

2340: end leg, climb to 4 kft, head back east look for clouds to repeat legs as described above, but this time in clouds

2343: **radar file** 23-43-45 dual down

2349: over some stratus, set up parallel to earlier track (SSE) hold at altitude 3 kft (few hundred feet above cloud top)

0008: spiral descent through clouds to 100 ft, track back N at 100 ft, under clouds

0009: **radar file** 00-09-48 up/side fore

0023: finish leg at 100 ft, ascend to 500 ft and reverse heading for next leg

002720: stopped radar, temperature was getting warm (nearing 103)

0036: turn, ascend into cloud for in-cloud leg

0038: **radar file** 00-38-10 dual side/dual down

0052: end leg, set up for sawtooth leg, stop radar file due to temperature

0054: begin sawtooth

0103: **radar file** 01-03-59 up/dual down

0120: stop radar file (T is high, again....)

013406: buoy overpass  
013640: buoy overpass  
014207: buoy overpass  
014530: buoy overpass (banked)  
0144: **radar file** 01-44-21 up/side fore  
0157: wheels down

#### Post-flight/impressions

Air conditioner seemed to be doing better than in previous couple of flights, when it obviously was not working, however, radar still heating up quickly

Buoy overpass was over eel river buoy, station 46022: <http://www.ndbc.noaa.gov>

20060604

Fagerstrom, Snider, French, Rahn

Synopsis – coordination with ASTER. The overpass is SW of Arcata (over ocean). Snider (second-seat) is suffering from a head cold.

1755 – Engine run up. The Gast pump is off, UFCPC -11 cm<sup>-3</sup>, CPC -2 cm<sup>-3</sup>

1758 – SW bound from Arcata airport

1805 – Aerosol layer observed during climb out, PCASP is greater than 100 cm<sup>-3</sup>, values as large as 300 cm<sup>-3</sup>

1812 – no more haze layer ahead of us now, still tracking SW

1820 to 1828 – UFCPC enhancement is observed

1844 – UFCPC enhancement decreasing

1847 – recently crossed into the ASTER region, starting spiral descent into a hole in the cloud field. The UFCPC, and CPC, increased soon after start of the spiral descent.

Concluded that this increase was not associated with sampling; probably be due to the vertical and horizontal layering of the aerosol field.

1904 – PCASP concentrations decreased near cloud top, at about 2200 ft, cloud base near 900 ft

1911 – start of zig-zag

1916 – zig-zag ascent/descent rates at 500 ft/min

1916 – mark pointer

1937 – in-cloud pass

1942 – passing the pointer point, CCN being set for the pending below-cloud pass 0.4, 0.8, 1.6%

1944 – descending for sub-cloud pass

1950 – taking pictures, at 500 ft agl, ppt

1953 – ppt on wind shield, no apparent effect on CPC signal, FLWC was flat-lined

Seastate – few white caps

2000 – ascent out of MBL, PCASP down to ~5 cm<sup>-3</sup>, CPC and UFCPC enhanced near MBL/FT interface

2004 – S=1.6%

2008 – PCASP enhancement; can see haze layer to the NE now that we are headed for Medford OR

2002 – PCASP is variable, 200 to 50 cm<sup>-3</sup>, CPC and UFCPC are constant. This is interesting, could we be in a region that the haze aerosol is mixing across?

2039 – Crossing coast, UFCPC increasing

2049 – PCASP increasing, then decreasing as we descend into Medford

2101 - Landing

## DMIMS06: 20060604a & 20060604b Flight 9

Flight notes: System Scientist (3<sup>rd</sup> seat)

### Crew:

Pilot: Kevin Fagerstrom  
Flt Scientist: Jeff Snider  
System Scientist: Jeff French  
4<sup>th</sup> Seat: Dave Rahn

### Pre-flight:

2 files, 'a' file is in hangar, only for leak test (trying to keep plane in hangar as long as possible so doesn't heat up); 'b' file is for flight

air conditioner did not work on yesterdays flight, had serious problems with overheating, because of this we plan on limiting time radar is run. Plan on recovering in Medford for repairs to air conditioner

Wx: overcast/mist, winds: 200@07 kts, T=14/Td=14C

### Flight:

Wheels up 1800 UTC (all times hereafter are in UTC)  
1836: **radar file** 18-36-35 up/dual down, longish range  
1848: stop radar, begin descent sounding (spiral) through cloud hole  
1905: cloud top @ 2200 ft, fairly well-defined inversion  
1908: cloud base @ 900 ft  
1910: begin sawtooth from 800 ft to ~2500 ft  
1911: **radar file** 19-10-59 up/dual down  
1914: higher aerosol concentrations in the inversion layer (lower concs above and below inversion)  
1921: end sawtooth, 90-270 turn to begin leg above cloud  
1923: **radar file** 19-23-02 dual down, leg at ~2600 ft  
1933: end leg, 90-270 turn to begin in-cloud leg  
1935: on leg at ~1500 ft  
1935: **radar file** 19-35-12 dual side/dual down  
1944: end leg, end radar file  
1945: 90/270 turn to setup for below cloud leg (~500 ft)  
1945: **radar file** 19-45-31 up/side fore  
1956: end leg, end radar file; climbing out for end mission  
1958: **radar file** 19-58-12 dual down; enroute to Medford  
2002: shutdown radar, T~103  
2100: wheels down

### Post-flight/impressions

Cabin heated up again in flight, recovered in Medford, ended up over-nighting to allow time for part to be shipped.

20060603

Fagerstrom, Gordon, French, Snider

Synopsis – targeting N/S stratiform feature, and broken stratiform region east of the feature, both on line from Arcata to 38 N / 127 W. N/S feature is thought to be a ship track that morphed into two parallel bright bands with broken cloud inbetween.

Cleaned optics and CCN chamber pm 20060602

1700 (approximate) – leak check, done inside hangar

1737 – taxi, 16/14 T/Tdp (Arcata), 20/20 trf/tdp (KA), 26 AERITMP, it has been sunny for past 30 minutes

1748 – have left airport, S=1.6%

1803 – S=2%, looking at sea surface from 15 kft, no white caps

1809 – descent sounding to cloud top

1815 – S=1.6%, we are below a Ci shelf that extends to the south and west of flight track

1830 – S=2%

1834 – climbing back to 6000 ft, now over the open region (referred to as the “POC” region) in DL’s drawing based on satellite pictures. Turning WCR off, too hot in cabin.

1850-UFCPC liquid and saturator lights are off (they were on earlier), temperatures from UFCPC display are 39, 10 and 38 C

1855 – Water into CCN

1904 – sounding, seeing region where CPC is the same as UFCPC near top of sounding (this on the display without the lab-correction, we are doing in the post-flight processing)

1908 – to the south there are deeper clouds, fuzzier near the top

1916 – took pictures out of left-rear and right-rear windows. I commented that we have have crossed the ship track region (again, see DL’s picture in the lab notebook)

1938 – water to CCN, put CCN in 2.0 and 1.6% for below-cloud measurements

1940 – descending, optics light now off on UFCPC. This implies that the optical chamber is over the setpoint temperature.

1950 – Giving up, the WCR is faulting, we are going to climb and get to colder temperatures

2019 – now at 580 mb, reading values from the UFCPC (0.55 cm<sup>-3</sup>, 5.0 cm<sup>-3</sup>, 42, 10, and 44 C)

2022 – descent sounding into Arcata, the UFCPC is at 3000 cm<sup>-3</sup>, the CPC is at 300 cm<sup>-3</sup>, it may be that the UFCPC is hyperactive because the butanol vapor entering the optical chamber is too hot. Alternatively, we could be see an ultrafine mode since we are now over land and on approach into Arcata

Post Flight – ran the UFCPC and CPC with external vacuum. Concentrations were rather large, but the values (9000 cm<sup>-3</sup> for UFCPC and 7000 cm<sup>-3</sup> for CPC) were reasonable with the laboratory calibration of Pokharel and Snider (2006). The lights going out on the saturator and optics mean that those temperatures were larger than the setpoint temperatures by more than 2 C (see 3025A manual). The values produced by UFCPC during this flight could be in error because of these excess temperatures.

## DMIMS06: 20060603a

### Flight 8

Flight notes: System Scientist (3<sup>rd</sup> seat)

#### Crew:

Pilot: Kevin Fagerstrom  
Flt Scientist: Glenn Gordon  
System Scientist: Jeff French  
4<sup>th</sup> Seat: Jeff Snider

#### Pre-flight:

Plan on trying to intercept 'ship track'-type features well to the Southwest. Glenn Gordon is riding right seat so J Snider can ride 4<sup>th</sup> seat to operate CCN.

Wx: scattered low clouds, winds: 230@04 kts, T=16/Td=14C

#### Flight:

Wheels up 1749 UTC (all times hereafter are in UTC)

1752: **radar file** 17-52-47 up/dual down, ferrying out to SW

1809: **radar file** 18-09-26 dual down, ferrying just above clouds (~2500 ft)

1830: still ferrying, getting hot back in cabin, still have a ways to go before we reach the point, radar at ~101F, decide to shut it down while we are ferrying, perhaps T will lower and stabilize by the time we reach the point so I can bring it back up

1845: **radar file** 18-45-10 dual down, radar cooled to about 95-97F, getting close to the point (I think) begin running radar, fly just above cloud tops (~2300 ft??)

1856: over an area that looks on the radar like an open cell (???)

1859: radar T up to 103F again, decide to shut it down

1945: tried to restart radar, T at about 98 F, faults as soon as I start to transmit. I tried shutting down EIA and turning things back on, as soon as I begin transmitting (w/ cpas) it faults.

1945: note cabin is getting too hot, data system up to 110 F, UFN not working because T up to 140

1950: decide to RTB, climb to 15000 ft, hopefully will cool the cabin down

2034: wheels down

#### Post-flight/impressions

Significant problems related to over heating in the cabin. General feeling is air conditioner unit not working at all, need to get that fixed asap. In short term, will likely have to ferry out at high altitudes (perhaps with radar off???) until get near target area to avoid heating up the cabin early.

20060602

Fagerstrom, Parish, French, Snider

1920 (approximate) – leak check at  $S=0.8\%$   
1951 – to end of runway  
1956 – TO  
2001 – below middeck, PCASP  $0\text{ cm}^{-3}$   
2005 – starting CCN at  $S=1.6\%$   
2010 – above middeck (steady climb out)  
2020 –  $S=2\%$   
2046 – 7 point sequence, 0.2, 0.4, 0.8, 1.6%  
2100 – aerosol and CCN maintaining their marine character even at this lower altitude, no LWC or ppt  
2106 – cloud now, FLWC is a good variable for cloud detection in lieu of PVM  
2117 – UFN 200, CPC 140 PCASP  $10\text{ cm}^{-3}$   
2121 –  $S=1.6\%$ , Arcata is 150 miles away from here, I am surprised about the marine (clean) character of the aerosol.  
2133 – PCASP variable at  $35\text{ cm}^{-3}$ , what causes that, mixing from below?  
2141 – water to CCN, increased VDET, compensating for earlier decrease, back to 1.6%  
2145 – UFN event, no ppt or LWC or first look, but then there may have been LWC. It depends on how the analog variable display updates  
2150 – start upward sounding  
2159 – we have a head wind, to  $S=2\%$   
2209 – to  $S=1.6\%$   
2219 – to  $S=2.0\%$   
2222 – Arcata reports  $T/T_{dp} = 15/14$  (later, after landing I observe 16/14 for trf and tdp)  
2231 – wetted top pad,  $S=2\%$   
2238- last 30 min (approximate) UFN enhanced relative to CPC, 600 versus 400.  
2240-interesting transition into cloud top, no 2DC conc, CCN at 2% decreases significantly, UFN and CPC are enhanced  
2245 – PCASP conc =  $0\text{ cm}^{-3}$  for several seconds  
2247 – UFN enhancements, no indication of LWC or 2DC conc., PCASP is near zero  
2250 – same observation as at 2247, between two cloud layers

## **DMIMS06: 20060602a**

### **Flight 7**

Flight notes: System Scientist (3<sup>rd</sup> seat)

#### Crew:

Pilot: Kevin Fagerstrom  
Flt Scientist: Tom Parish  
System Scientist: Jeff French  
4<sup>th</sup> Seat: Jeff Snider

#### Pre-flight:

Plan on trying to intercept a line well to the east for a cloudSAT overpass. Line is oriented N-S and located east of Redding over northern Sierra Nevada.

Mist/lite rain on ground at Arcata, decide to do leak test in hangar and pull out under power.

Wx: mist/overcast low clouds, winds: 180@08 kts, T=16/Td=15C

#### Flight:

Wheels up 1956 UTC (all times hereafter are in UTC)  
2000: climbing to 23000 (ferry altitude)  
2001: **radar file** 20-01-23 wide pulse, working OK  
2003: down looking beam doesn't look right, quit recording for a bit  
2005: **radar file** 20-0-37 try again with wide pulse  
2008: down looking beam goes bad again, stop the file  
2011: **radar file** 20-11-42, back to one of the 'standard' dmims modes and increased the range gates for extended range (at cost of reducing averages)  
2035: well defined waves in vertical velocity, w +/- 2-3 m/s  
2036: thin cirrus above us, but clouds well out of range of radar  
2041: on line, headed north  
2041: **radar file** 20-41-56 up/dual down, 200 gates  
2048: **radar file** 20-48-56 up/dual down, 150 gates  
2050: penetration of fairly large Cb  
2051: radar heavily attenuated in Cb  
2103: **radar file** 21-03-13 up/dual down, 100 gates  
2112: decide to work this area for satellite overpass  
2114: 90-270, head south line, ascend to 14000 ft  
2120: set pointer  
2126: 90-270, back north on line  
2126: **radarfile** 21-26-44 up/dual down  
2128: on track, headed north  
2132: over pointer  
2136: 90-270, set up to do one more leg  
2139: on track, headed south  
214430: at point

2150: RTB

2151: **radar file** 21-51-10

2210: **radar file** 22-10-02

2310: wheels down

Post-flight/impressions

Good flight, managed to intercept line for cloud sat, PVM look hosed right at landing.

20060531 Fagerstrom, Rahn, French, Snider

Synopsis: Check of PVM, aerosol legs, Buoy check (Did not make it to the buoy)

Weather: Wind shift to southerly at Arcata in am, NWS-WSR shows approaching deep system, precipitation at about 50 mile off the coast

1525 – Leak check of aerosol system, CCN at 0.8%

1530 – vacuum cleaner on

1536 – filter on inlet

1538 – moved baseline of CCN up 1 V, CPC = -1 cm<sup>-3</sup>, UFN = -10 cm<sup>-3</sup> (both values from data system)

1556 – Run up

1600 – Taxi, TRF = 17; AERITMP = 24; TROSE = 16 C

1608 – S=1.6%

1610 – climb out, put CCN in 5/4 (diagnostic mode), it started at +7 V

1615 – CCN VDET now at -6 V, starting operation

1620 – in cloud

1633 – FLWC showing no LWC here, there is ppt

1637 – Very (!) low PCASP concentration, ppt on wind shield, CPC ~ 200 cm<sup>-3</sup>, UFN ~ 2000 cm<sup>-3</sup>

1642 – CPC now comparable to UFN, head E

1647 – Return to the W, ppt on wind shield, CCN to 2.0%

1656 – WCR shows ppt above and below, heavier below

1702 – descending into ppt-free air, UFN decreasing

1707 – Water to CCN, there were only 2 screens holding the top plate on, S=1.6%

1722 – ppt on wind shield

1730 – a few minutes of data in clear (ppt-free air close to Arcata), aerosol conc. Typical (PCASP 200, CPC 200, UFN 300)

1738 – power down

## DMIMS06: 20060531a

### Flight 6

Flight notes: System Scientist (3<sup>rd</sup> seat)

#### Crew:

Pilot: Kevin Fagerstrom  
Flt Scientist: Dave Rahn  
System Scientist: Jeff French  
4<sup>th</sup> Seat: Jeff Snider

#### Pre-flight:

Deep upper low off the west coast, bringing in rain and much deeper clouds, not much hope for useful research/stratus flight today, but do want to test PVM

Don and I took apart PVM on May 29 (following flight and problems with probe on 0528 flight). Nothing obviously wrong when we took it apart, we cleaned the optics and reassembled. We did a new 0 span/offset at that time. When fired up this AM, before flight, baseline was very near zero (0.008 g/m<sup>3</sup>)

Run unpressurized today, hopefully will keep cabin from heating up too much

Wx: overcast with high clouds, winds: 170@04 kts, T=14/Td=09C

#### Flight:

Wheels up 1604 UTC (all times hereafter are in UTC)

1609: **radar file** 16-09-47 up/dual down

1613: level off at 10 kft, some small LWCs on way up here, max ~0.5, baseline of PVM not obviously affected

1632: turn 90/270 out here to west over the water, head back east towards home, descend to 7500 ft

1632: **radar file** 16-32-47 up/dual down

1636: at 7500 ft, finished turning back east, bright band evident on radar from couple thousand ft above us

1646: Snider seeing some interesting stuff on aerosol, decide to turn back west for short run repeat run

1653: finished short run, turn to east, plan to look for rain free area on WCR and then descend to lower altitude

1701: turn to north, about 30 nmi. Out from Arcata to give us more space, begin to descend

1703: lump on PVM, looks like baseline is beginning to wander

1706: 180 turn to south descend to a thin stratus deck.

1707: **radar file** 17-07-04 up/dual down

1708: PVM baseline not looking good

1712: **radar file** 17-12-20 up/side fore

1723: RTB

1734: wheels down

Post-flight/impressions

PVM still having problems, high LWC's and descending from colder to warmer regions (with higher H<sub>2</sub>O vapor) seems to be worse. Not sure what to do with it at this point....

20060528 Fagerstrom, Snider, French, Lukens

Synopsis: ASTER/TERRA overpass and drizzle cells at 127 W, 39 N

Weather: Persisting northerly flow for last 48 hr. Stratocumulus.

1715 – leak check. Different procedure today for CCN. Leak check at lower supersaturation (0.8%), running CCN in diagnostic mode during climb out.

1812 – ferry at 7000 ft. The climb out was good for all aerosol (except CCN) and thermodynamics

1815 – haze layer ahead, one half hour later we did not see it (still heading west).  
S=1.6% on CCN

1830 – descent sounding, droplet concentration 30 cm<sup>-3</sup>, 2DC to as large as 10 L-1

1843 (1) - crosswind leg at 120 ft agl, sea state = very few white caps.

1852 (2) – 1000 ft agl, some drizzle

1904 (3) – above cloud, there is evidence of a particle conc. Enhancement here (PCASP and CPCs), but this may be the contrast between MBL (prior) and above-cloud aerosol. Lukens says that the CO<sub>2</sub> is enhanced.

1911 (4) – above cloud, dwelling for satellite

1915 (5) – still above cloud, we are approaching the westward extent of the box that we need to stay in to be visible by the satellite.

1923 – reconfigured WCR to dual side / dual down. Descending to 4900 ft

1926 (1) – first leg advecting with the wind (earlier) we were on a wind-relative track for the satellite

1938 (2) – back to pointer

1940 – reset pointer

1943 (3) – descending to 3000 ft, WCR now DD/U, near cloud base

1955 (4) – 1000 ft aerosol leg

2001 – climbing to do zig/zag leg

2014 – end zig/zag leg

2021 (1) – above-cloud

2025 (2) – again

~2030 (3) – down to 4.5 kft, DD/U on WCR

2035 (4) – repeat at 4.5 kft

2041 (5) – 90/270 turn, 4000 ft

2047 (6) – roset to 4000 ft

~2050 – 0.4, 0.8, 1.6, 0.8, 0.4 % supersaturation at 1000 ft, aerosol run

2100 – climbing to talk with center

2108 – cabin equalized with ambient pressure

2120 – crossed behind ship steaming south, saw the plume on PCASP, CPC, UFN

## DMIMS06: 20060528a

### Flight 5

Flight notes: System Scientist (3<sup>rd</sup> seat)

#### Crew:

Pilot: Kevin Fagerstrom  
Flt Scientist: Jeff Snider  
System Scientist: Jeff French  
4<sup>th</sup> Seat: Don Lukens

#### Pre-flight:

CloudSAT/DMIMS flight, will try get to target region for satellite overpass and work box, if time left, will target drizzle cells

Radar faulted a couple of times on ground at startup, after ~10 minutes of playing got it started.

PVM acted up yesterday. When we put away last night baseline had restored to zero. On startup this AM, baseline was around ~0.1 g/m<sup>3</sup>, let run on ground for ~1.5 hours, baseline finally went back to zero, I expect problems with PVM on today's flight.

Wx: overcast, winds: 280@06 kts, T=13/Td=08C

#### Flight:

Wheels up 1758 UTC (all times hereafter are in UTC)  
1803: climb out and level at 7000 ft  
1803: **radar file** 18-03-59 dual down w/ incr, range (30 m gate spacing)  
1827: start descent sounding at NE corner of box, wind at cloud top ~300 deg.  
1827: **radar file** 18-27-10 up/dual down  
1832: just after entering cloud, PVM baseline jumps up, pretty bad rest of flight  
1843: set up on low level leg  
1850: turn, climb to 1700 ft (??) near cloud base  
190030: turn, turn climb to cloud top  
1902: **radar file** 19-02-38 dual down  
1905: PVM baseline returns to zero just after we ascend thru cloud top, colder/drier (??)  
1914: turn and repeat above cloud top leg  
1923: turn and go into cloud, at top ~5100 ft  
1924: **radar file** 19-24-41 dual side/dual down  
1935: turn and descend, middle of cloud ~4000 ft  
1944: turn, descend to 3000 ft  
1944: **radar file** 19-44-55 up/dual down  
1951: turn descend to 1000 ft for aerosol runs  
2001: turn and begin sawtooth from cloud base to just above cloud top  
2001: **radar file** 20-01-12 up/dual down  
2015: end sawtooth legs

2015: end satellite stuff, above clouds, begin looking for drizzle cells  
2015: **radar file** 20-15-48 dual down

BEGIN drizzle cell 1  
202115: mark drizzle cell  
202515: pass over drizzle cell second time  
2027: **radar file** 20-27-33 up/dual down  
203120: pass ~4500 ft, just below top  
203450: pass ~4500 ft  
204035: pass ~4000 ft  
2044 (?): pass ~4000 ft  
2046: descend to 1000 ft for aerosol run  
2047: **radar file** 20-47-37 up/dual down  
END drizzle cell 1

2059: RTB at 700 ft  
2124: shutdown radar, severe clear  
2133 wheels down

#### Post-flight/impressions

PVM causing problems almost entire flight. After flight, decision is disassemble and clean optics before next flight

Started getting hot in cabin during low-level ferry back. Radar Temperature up to ~103, decided to de-pressurize cabin and see if that would help cooling, seemed to make big difference and cabin T (and radar T) both dropped. Had some discussion after flight that we may begin to operate un-pressurized for remainder of project.







20060527 Jeff Snider

Crew: Fagerstrom, Snider, French, Lukens

Synopsis: Drizzle cells at 128 W, 41 N

Weather: NW flow associated with anticyclone ~1000 km off the Southern CA coast, a cyclone to the W

1745 – leak check

1857 – run up

1905 – TO

1942 – aerosol pump off

194230 – aerosol pump on

194630 – flushing CCN chamber in diagnostic mode, pump pres 250 mb

194838 – stopped diagnostic mode (CCN)

2006 – CCN chamber opened manually, suspecting leaking valve #1 in CCN, this would explain the intrusion of cabin air into the CPC and UFN. CCN is OK, putting in new pad, the original pad fell off twice, maybe we are making the pad too wet?

2012 – 2015 (1, 2) pass over driz cell at 5500 ft

2020 – 2023 (3) – 500 ft lower, now clipping cloud top, this will be the sequence stepping down into the cloud, the turns are 180 degree so we are hitting the cell at angular differences of about 30 degree

2028 (4)

2032 (5)

2036 (6)

2040 (7)

2044 (8) – CCN run below cloud base

2050 (9) – CCN run below cloud base

2053 – climbing to make side-dual WCR run

2058 (10) – near cloud top, there is drizzle/rain on the wind shield and sun

2101 (11) – again, down 500 ft

2102 – climbing to look for another cell, cloud top at 5100 ft

2105 – 2110, looking for another cell, the field is very smooth, punctuated by towers extending a few hundred ft about the stratiform cloud top. At least 6 tops visible from front wind shield

2113 (1) – working this cell as the previous one, CCN has been up in 0.4, 0.8, 1.6, 0.8, 0.4% supersaturation

2115 (2) – 500 ft lower

2119 (3) –

2124 (4) – droplet concentration 100 to 120  $\text{cm}^{-3}$

2126 (5) –

2129 (6) –

2133 (7) – at cloud base

2137 (8) –

2140 (9) – CCN leg, rain on wind shield

2145 (10) – heading east, CCN leg

2153 – water added to CCN, changing to  $S=1.6\%$

2156 – descent to 120 ft msl, wind speeds are 8 m/s; direction is 300 degree; some white caps

2201 – climb to 1000 ft, problems with PVM, similar to what we say on the May 23

2210 – lowering baseline on CCN

2212 – climbing, though cloud

2224 – straight leg data with  $S=1.6\%$ , 1000 ft, no ppt, below cloud

2233 – CCN to 2.0%

2238 – plume event, no evidence of hydrometeors on the probes or on the WCR

2240 – Rain, taking picture out north-facing window (track is toward the east), another “plume” event but this one is associated with ppt, not cloud droplets (we are below cloud base)

2257 – sounding

225930 – crossing coastline

~2202 – landing with aerosol gear on, CCN at 2.0%

## DMIMS06: 20060527a

### Flight 4

Flight notes: System Scientist (3<sup>rd</sup> seat)

#### Crew:

Pilot: Kevin Fagerstrom  
Flt Scientist: Jeff Snider  
System Scientist: Jeff French  
4<sup>th</sup> Seat: Don Lukens

#### Pre-flight:

DMIMS dedicate flight, will try to target drizzle cells

Radar started with no problems on ground

#### Flight:

Wheels up 1908 UTC (all times hereafter are in UTC)

1917: Ferry out at 6 kft, problems with aerosol stuff, CCN keeps blowing top pad, lots of particles in both CPCs → latter seems correlated with when Don opens CCN chamber... possible valve stuck open(??); finally decide to power down/power back up CCN, seems to fix problem with CPCs, pads no longer blowing off(????)

1919: **radar file** 19-19-49 up/dual down for ferry flight

1956: **radar file** 19-56-27 up/dual down

2003: very thin stratus deck below King Air, approaching starting point, looking for drizzle cells

2009: **radar file** 20-09-29 dual down

BEGIN drizzle cell 1

2012: (??) over drizzle cell, mark as main target

2016: (??) 2<sup>nd</sup> pass over drizzle cell, looks good, make one more pass over, then begin lower alt passes

202017: 3<sup>rd</sup> pass over drizzle cell, drizzle/precip extends to surface, stratus around drizzle cell ~300 m deep

2021: **radar file** 20-21-57, up/dual down

2023: set up for pass in cloud, near top

202330: pass ~4700 ft

202730: pass ~3800 ft, reset pointer

203215: pass ~3300 ft

203615: pass ~2800 ft

203945: pass ~2300 ft

204345: pass below cloud ~1300 ft

205010: last pass below cloud, appears that cell is well into decaying stage (??)

2054: **radar file** 20-54-57, dual size/dual down, try to pass cell on edge, near top

205720: *OOPS*, switch mirror to side looking

205830: through cell ~4700 ft

2059: Dons Sardines stinking up cabin!!!!

2101: pass ~4300 ft  
END drizzle cell 1

2104: begin looking for new cell  
2104: **radar file 21-04-03** dual down

BEGIN drizzle cell 2  
211230: pass over broad cell ~5500 ft  
2114: **radar file 21-14-17** up/dual down  
211545: pass ~4700 ft  
211930: pass ~4200 ft  
212254: pass ~3700 ft  
212545: pass ~3200 ft  
212915: pass ~2700 ft  
213300: pass ~2200 ft  
213645: pass ~1700 ft  
214015: pass below base at 900 ft  
214915: 2<sup>nd</sup> pass below base, 900 ft  
END drizzle cell 2

2153: head back to line will do one low-level run for CCN  
2155: **radar file 21-15-19** up/side fore  
2157: 500 ft run for CCN  
2202: end run, RTB at ~1000 ft

2304 wheels down

#### Post-flight/impressions

Problems with CCN at beginning of flight, likely this fed into problems with both CPCs, it looked like when CCN chamber was open that CPCs were sucking cabin air which may indicate stuck valve on CCN(?); not sure. No problems on ground, before flight, with leak test etc. Everything worked after shutting down CCN and starting back up.

PVM started acting up early to middle of flight. Baseline began to drift to about 0.2 g/m<sup>3</sup> after going through water clouds. The sensitivity (scale) did not seem to be affected. Once on ground, Don let it run for several hours and baseline eventually went back to zero...water inside???







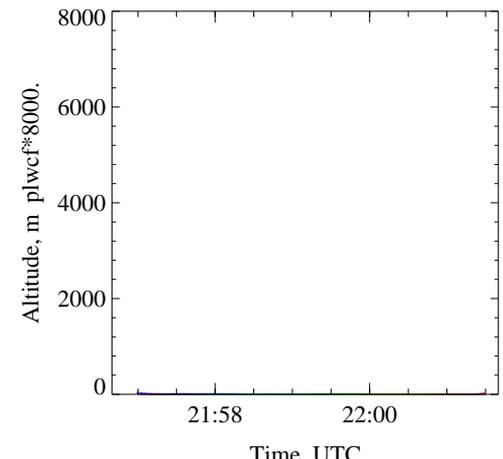
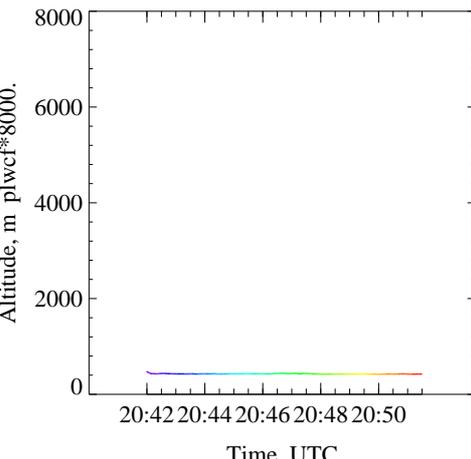
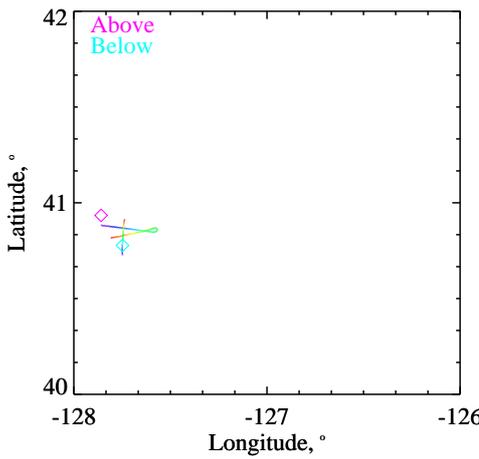
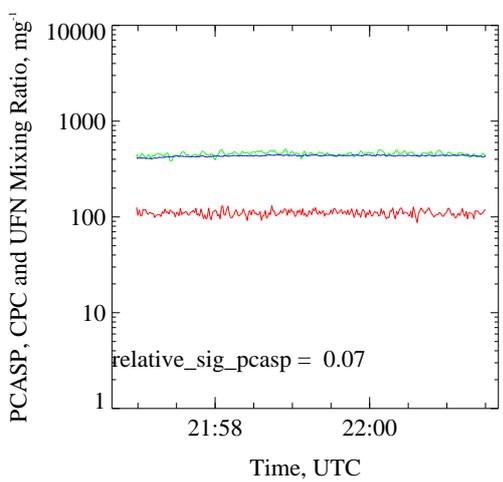
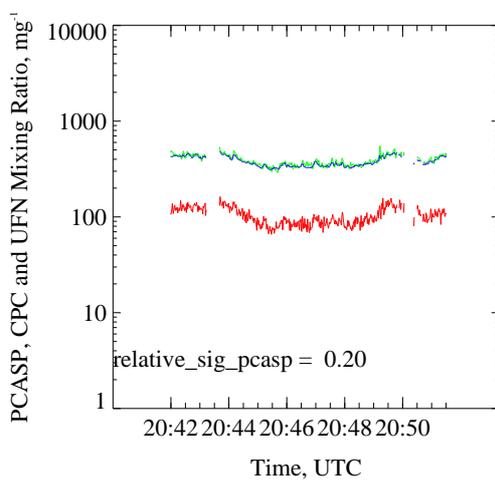
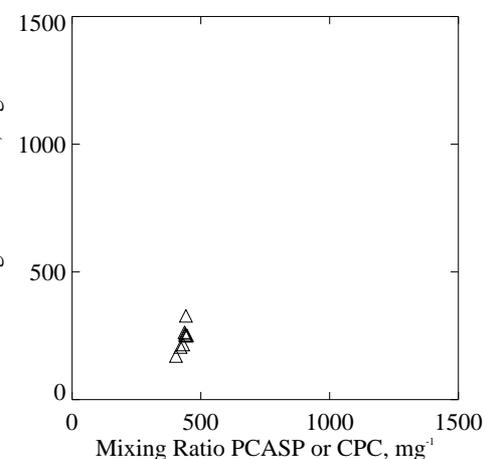
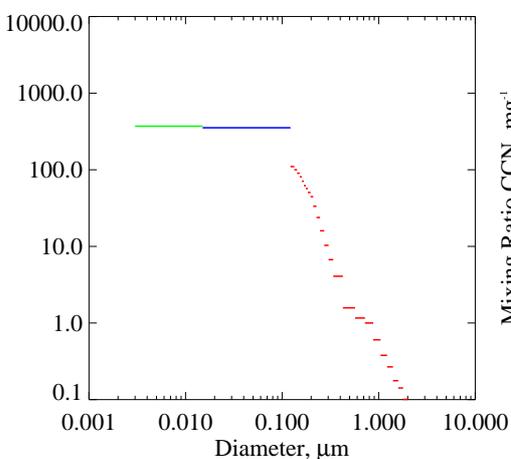
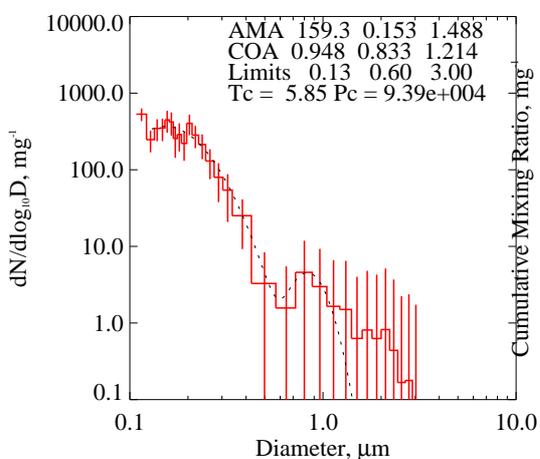
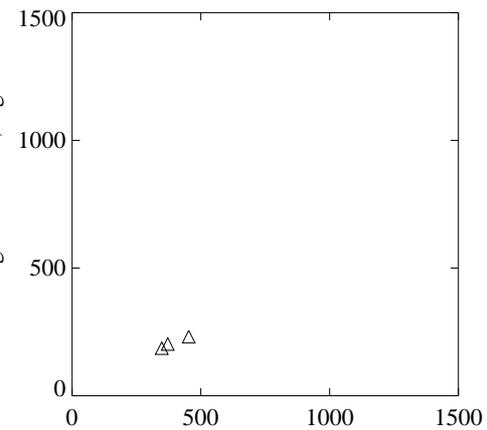
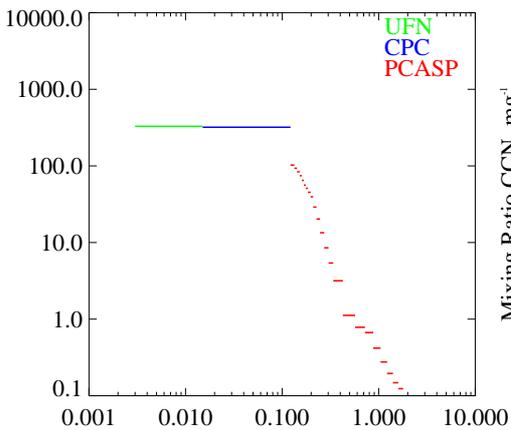
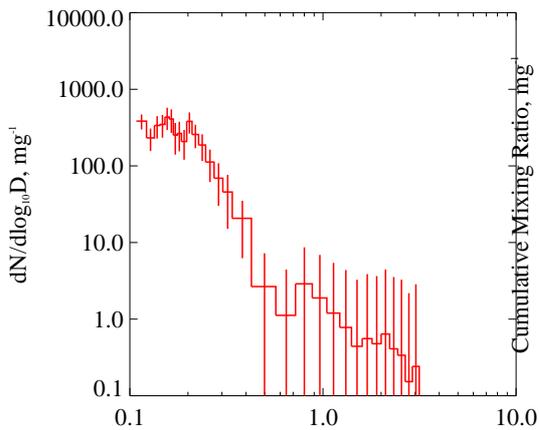






c:\jeff\ccn\_process\out\20060527a\_204200\_205130\_215700\_220130.ps

- CPC vs CCN at  $S_{nom} = 2.0\%$
- △ CPC vs CCN at  $S_{nom} = 1.6\%$
- ◇ PCASP vs CCN at  $S_{nom} = 0.2\%$



20060525 Jeff Snider

Crew: Fagerstrom, Rahn, French, Snider

Synopsis: Checking flows into CPC-1 with TSI4100 meter. There are no screens or screen holders in the sample line.

Weather: Sfc winds could be either north or south depending on position of anticyclone SW and cyclone to NW

1851 – No vacuum, TSIFLOW 1.01 slpm (4<sup>th</sup> seat display)

1853 – Vacuum on, filter on, TSIFLOW 0.94, AERIMF 69, CPC -1.2, UFNCPC -7, CCN looks good

1914 – Run up

1932 – S=1.6%, descending, foggy below

1937 – leg start, above lower cloud, northbound

1947 – S=2.0%

1952 – start second leg, sea state no white caps, wind speeds are less than 5 m/s, no low cloud here, adding water to CCN

2025 – S=1.6%

2030 – descending and seeing shattering artifact on PCASP

2042 – S=1.6% added water, starting 100 ft run, no white caps here

2044 – Plume, but no evidence of a boat, no ppt or cloud

2054 – S=2.0%, returning along same 100 ft ground track (upwind)

2059 – Same plume feature, only on the CPC and UFN, no plume feature on the PCASP

2103 – Starting sounding

2107 – clouds

2110 – no cloud, visual of airport, TSIFLOW 0.97 slpm, after shutting of aerosol pump it is 0.01 slpm

## DMIMS06: 20060525a

### Flight 3

Flight notes: System Scientist (3<sup>rd</sup> seat)

#### Crew:

Pilot: Kevin Fagerstrom  
Flt Scientist: Dave Rahn  
System Scientist: Jeff French  
4<sup>th</sup> Seat: Jeff Snider

#### Pre-flight:

GPS flight, low priority on any clouds/radar data

Radar continued to fault on ground, decided to leave off during takeoff and try to get going during flight.

Wx: clr, wind 230 @ 07 kts, T=16/Td=09

#### Flight:

Wheels up 1922 UTC (all times hereafter are in UTC)  
1925: try to get radar going, put beam voltage down and start radiating; seemed to work with no fault, over next 10 minutes slowly increase beam voltage, no faults  
1932: **radar file** 19-33-24 up/dualdown  
1935: setting up for run at 1 kft, first run to the north ~30 nmi. Length  
193630: begin leg 1, tracking N, wind ~220, clouds broken/scattered throughout most of run  
1947: end leg 1, 90-270 skid turn to minimize roll in attempt to not lose satellites  
1949: **radar file** ??-??-?? up/dualdown with longer range  
195230: begin leg 2, tracking S at 1 kft  
2007 end leg 2, turn to set up for sawtooth runs  
2011: begin leg 3, tracking N, 500→2000 ft alt. Sawtooth pattern  
2021: end leg 3, set up for leg 4  
2021: **radar file** 20-21-35 up/dualdown  
2028: begin leg 4, tracking S, sawtooth as in leg 3  
2038: end leg 4, set up for in/out of wind at 100 ft  
2041: **radar file** 20-41-33 up/side fore  
2042: begin leg 5, 100 ft, heading 220-230, wind 160@2 m/s  
2052: end leg, turn 180  
205330: begin leg 6, 100 ft, hdg 48  
210330: end leg 6  
2105: RTB, **radar file** 21-05-46 up/dualdown  
2118: wheels down at Arcata

#### Post-flight/impressions

Instruments operated with no known problems

20060523 Jeff Snider

Crew: Fagerstrom, Snider, French, Lukens

Weather: Low is NW of Arcata, we planned to go to 41/128.5 but hifreq radio did not test out, so target was 41/126, still saying well SE of the low. Objective is to get aerosol data in the vertical (soundings) look for existence of ultrafine particles. WCR used in ferry for stratus and for convection in dual-down-up and dual-side modes. Clouds were S-to-N oriented lines of cumuli. Alto cumulus with tops at ~8000 ft, perhaps even some Cs above that.

1700 (approximate), leak check of aerosol system before running the tug, then the tug was turned on. CCN set at S=1.6% and then to S=0.2% (nominal)

1744 waiting for ATC, trf 15C

Note: LICOR flows: inlet = 80 slpm, instrument = 8 slpm (flowi)

Copilot altimeter 220 ft, 3002, zft = 118 ft

Deice heat is on

1759 – takeoff, drizzly stuff ends at 3000 ft, there is a deck above that, we will level off at 6000 ft

1803 – level at 6000 ft, trf 4 C

1810 – to S=1.6%, drops registering on 2DC up to full range of display (800 um), most are in the 200 – 300 um range

1813 – WCR report, stratus below, patchier mid-level stratus above

1828 – pointer set, we will return do a sounding below the point, now passing to west of overhanging above-cloud edge then will return to the point

1847 - End sounding at sea surface

~1900 – adding water to CCN

1908 – Sounding start, spike in CCN operating at S=1.6%, what's with that? Later DL finds that the upper pad detached (see comment at 1949)

1922 – aligned to fly downwind along convection, 2000 ft

192327 – realtime crashed

~1930 – restarting the DAQ, there will be two kingair files for this flight

1936 – 4000 ft pass along same line of convection, heading same direction as 2000 ft pass (S to N)

1939 – lots of rain on wind screen, big shattering artifact in PCASP

1942 – climbing to 6000 ft

1949 – top pad of CCN came off in climb, was it loose and causing the spike at 1908?  
Dual side pass

1957 – back to dual down / up mode, over the top of convection (N to S track)

2004 – start sounding downward, PCASP 130, CPC 200, UFN 250

2026 – enhanced UFN/CPC ratio in lower 500 ft of sounding, also CCN @  $S=1.6\%$  showing an enhancement. Less overcast here compared to first sounding. Where are the small particles sourcing from?

~2100 – CCN running at  $S=0.2\%$ , lots of drizzle, rain, very little signal from CCN

2122 – Aerosol pump off, nadir door shut

## DMIMS06: 20060523a & 20060523b Flight 2

Flight notes: System Scientist (3<sup>rd</sup> seat)

### Crew:

Pilot: Kevin Fagerstrom  
Flt Scientist: Jeff Snider  
System Scientist: Jeff French  
4<sup>th</sup> Seat: Don Lukens

### Pre-flight:

Raining/drizzle at hangar during preflight, decide to leak test inside hangar, begin recording data inside, pull out under power, start INS once outside

PVM was turned on until just before engine start

Wx: 3700 ft overcast with lite rain/mist, wind 290 @ 04 kts, T=13/Td=13

Delay by ATC at end of runway ~15 minutes, until 1755

### Flight:

Wheels up 1758 UTC (all times hereafter are in UTC)

1800: **radar file** 18-00-46 up/dualdown (long range), on climb out of Arcata headed west....

1809: break out of clouds briefly

1828: small clear area, flying about 6 ft, clear to surface, set ptr in middle then pass through (rather) weak clouds (don't show on radar)

1831: 90-270 and return to hit ptr at 6 kft

1831: **radar file** 18-31-44 up/dualdown (long range)

1835: through cloud, descend for aerosol sounding in clear 'pocket'

1840: completed descent, head further west, look for better defined clouds/cells around 126.5 west

1857: pass through heavy rain cell

1907: no better clouds apparent out west, turn around and do an aerosol sounding

1908: **radar file** 19-07-58 up/dualdown (long range)

1917: finish aerosol sounding

1918: turn back east, decide to try to work cu convection that passed through at 1857

1921: lined up with line of cu cells (oriented n-s with wind) at 2000 ft.

1921: **radar file** 19-21-18 up/dualdown (long range)

1923: near end of line, display froze unable to 'unfreeze' display restart data logger, lose ~ 3 minutes of flight data

1935: **radar file** 19-35-48 up/dualdown (long range) new data file after starting restarting data logger and cpas

194130: pass back through center at 4 kft

194230: out, turn and ascend to 6 kft

194848: out, setup for outside run (looking in from side) at 6 kft

1950: **radar file** 19-50-59 dual side

195430: passing cloud to right of king air, nice returns on radar

195730: turning at start new radar file for pass through cloud at 6 kft

1958: **radar file** 19-58-26 up/dualdown (long range)

200130: complete pass, descend outside of cloud for aerosol sounding on south side  
(intake????) of line

Long lines at 100 ft for aerosol measurements, clear skies above

2033: stop radar file after several minutes of clear

2036: **radar file** 20-36-34 up/dualdown (long range)

204130: **radar file** 20-41-46 dual side

2042: file outside of well formed cu line looking in with radar in dual size, nice returns

2051: end cu work, return to Arcata

2100: **radar file (???)** up/dualdown

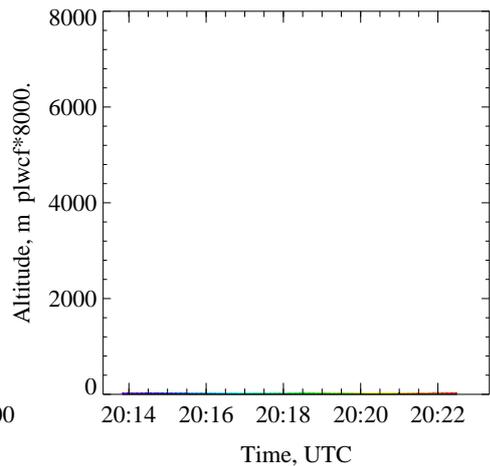
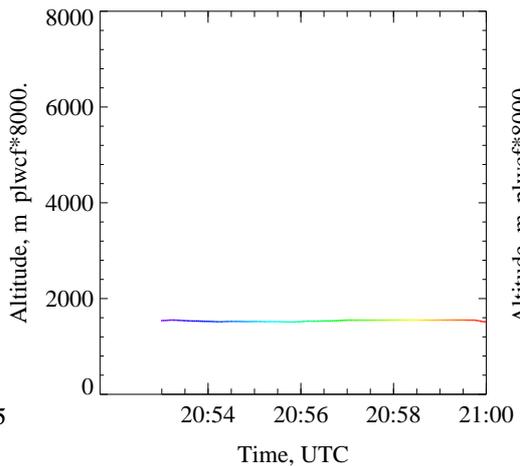
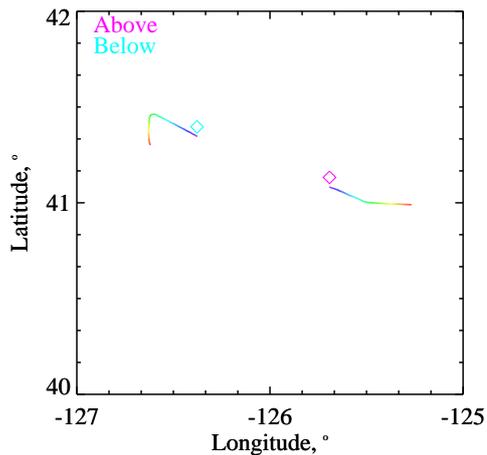
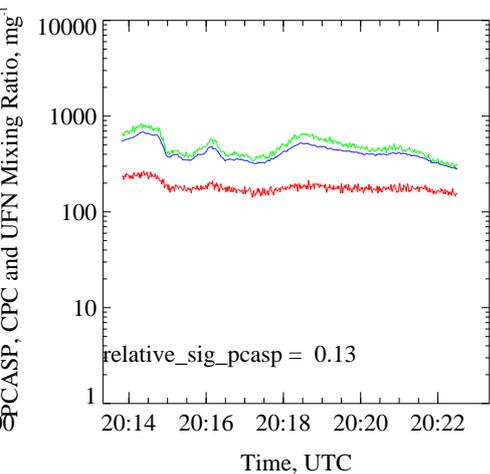
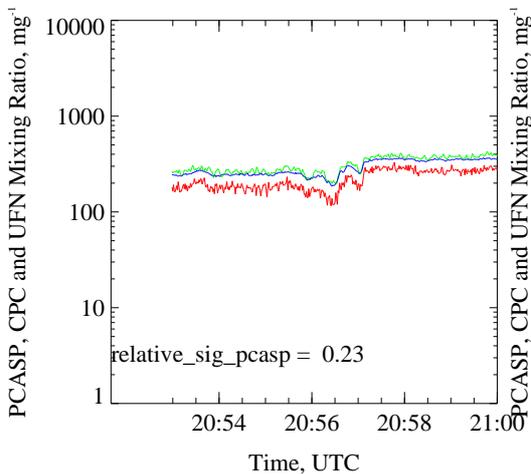
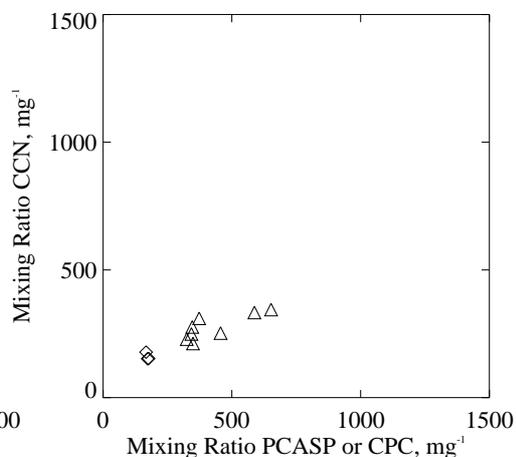
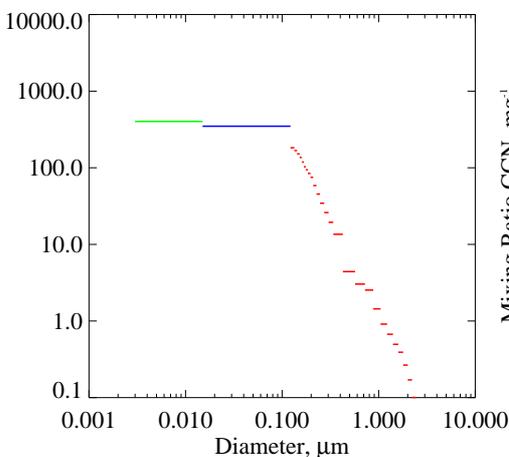
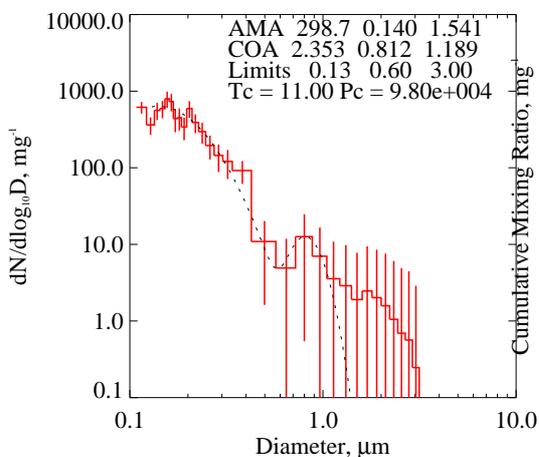
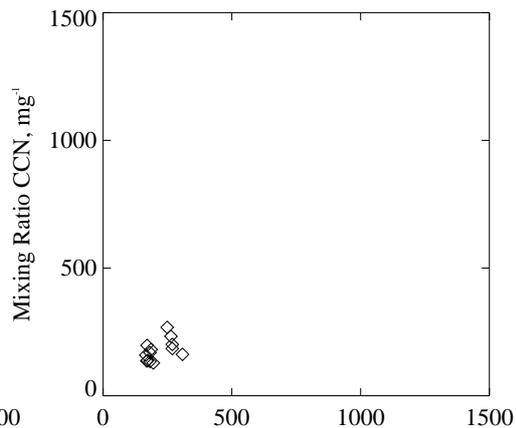
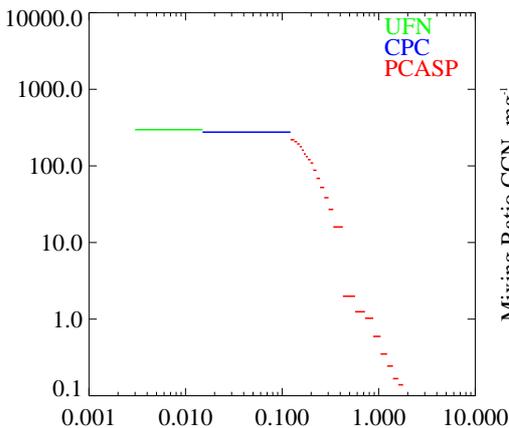
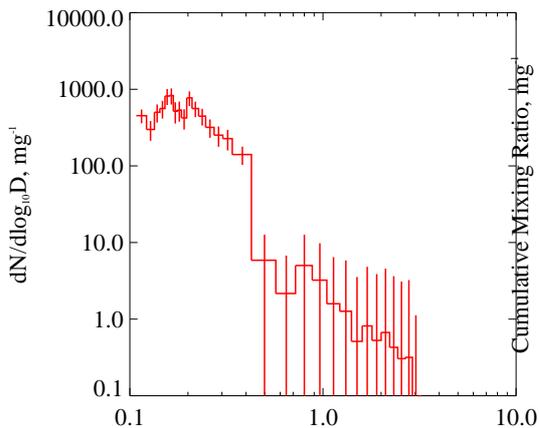
2131: wheels down at Arcata

#### Post-flight/impressions

Longish lines of clouds organized due to strong southerly winds associated with very strong low pressure system off coast. Some organized cu structures, not apparent what is driving force behind their growth/development/maintenance. Cu's extend to ~6000 ft, at times penetrating into larger stratus deck that ranges from 6-8 kft (??)

c:\jeff\ccn\_process\out\20060523b\_205300\_210000\_201350\_202230.ps

□ CPC vs CCN at  $S_{nom} = 2.0\%$   
 △ CPC vs CCN at  $S_{nom} = 1.6\%$   
 ◇ PCASP vs CCN at  $S_{nom} = 0.2\%$



20060520 Notes      Jeff Snider

Fagerstrom, Parish, Wex, Snider

Pre-flight leak check of the aerosol system, a problem getting the CCN VDET to settle down, worked after putting DTEMP to 10 C. The optics were cleaned in the pm, day before

1804 Run up

1811 Taxi, pcaspflow = 1.8

1821 already gone, 2000 to 4000 on UFN, ~100 cm<sup>-3</sup> on pcasp and CCN @0.2%; windspeed near seasurface is 20 m/s but few white caps (noticeably fewer than 05/16) and only moderate swell.

1831 still heading west, crossed behind relatively large ship that was heading south. Nothing evident on the UFN or CPC, apparently the plume had not yet had a chance to mix to our level.

1836 Returning back to the east, level turn, we are in a fog / low cloud now, concentrations on the CPC increasing to several thousand

1842 HWSPD 20 m/s

1852 headed back to east winds are 180 degree / 15 m/s

1855 another interesting feature in sea surface, a long line of with white patches of foam (?) delineating two water masses (?), could these be capillary waves.

1905 S = 1.6 %, it was 0.2%

1918 particle detectors seeing what may be the ship track

1926 Scud off left (right?) wing at just a few 100 meters off the sea

1934 Wind speed is decreasing now that we are in the wake of Cape Mendocino

1940 Scud clouds again, off left wing

1948 Seeing the ship track again, more diffuse, but with dual-plume structure

1959 S=1.6%

2000 weak inversion at 4000 ft, we are going east again, climbing over the water

2025 At hangar, running system for GPS data

20060516 Notes      Jeff Snider

Preflight:

Removed the TSI4100 flow meter and diffusion screens used during 20060515 flight

1950 UTC - Leak check with vacuum cleaner and HEPA filter on Rogers inlet

UFN as low as  $0.2 \text{ cm}^{-3}$  on front display, DAQ  $\sim$  negative  $2 \text{ cm}^{-3}$

CCN108 @ 1.2% nominal supersaturation 6 to  $20 \text{ cm}^{-3}$

CPC 3010 negative  $1 \text{ cm}^{-3}$  on DAQ

Plan is to ascend to 6000 ft then descend to cloud top, then return below (or in) cloud, checking the pointer on return. Fog came in at about 11 am (LT), the satellite shows it extending to 50 km off shore

2005 UTC – Run up, cabin temperatures 79/83 °F (Air and DAQ), T/Tdp 13/10 °C, visibility a few miles. No drizzle.

2010 – CCN at 0.2% showing concentrations comparable to PCASP and the two CPC's, these results for above-cloud measurements

2017 – descending to 4000 ft, adjusting AERIMF to 170 slpm, had to open it since the starting flow was 150 slpm

2020 (approximately) have reached the edge of the cloud/fog seen in the satellite (heading west), now descending into the fog layer. The sea surface showing a few white patches and there is a material on the surface, could be algae. It is striated along the wind direction. Still running 0.2% on the CCN

No time recorded – ascending above the fog layer, returning to the airport. Pictures were taken during this return leg, three exposures each. After checking, it seems that a few notches down from 0 is a good exposure for the cloud scenes.

<http://wx.met.nps.navy.mil/~hale/MM5/>

<http://www.goes.noaa.gov/>

[http://www.nrlmry.navy.mil/sat-bin/epac\\_westcoast.cgi](http://www.nrlmry.navy.mil/sat-bin/epac_westcoast.cgi)

Jeffs,

The Terra/ASTER overpass for May 19th will occur at 19:26:30 UTC at the latitude of Arcata.

I have attached the email that describes the centerline of the ASTER observations for the 1st three cases.

Following Leon's description I get the corners of the box to be (in decimal not deg/min/sec):

126.114, 41.1947

125.399, 41.1947

127.746, 33.1856

128.416, 33.1856

I would tend to work just a bit south of Arcata (~40n) and, barring obvious evidence of linear organization I would probably use ~E-W legs. I would suggest alternating between above cloud legs, near cloud-top legs and porpoising through the cloud layer. My first thought would be to do this on a fixed ground track prior to the overpass, and allow the aircraft to drift with the BL winds afterwards.

Obviously, all this depends on the appearance of appropriate clouds which do not look very promising at the moment. Hopefully, I'll be able to think about this some more and be back in communication prior to the 19th.

Good luck. Now all we need is the clouds.

cheers  
dave

**DMIMS06: 20060516a**  
**Test Flight 2 (in Arcata)**

Flight notes: System Scientist (3<sup>rd</sup> seat)

Crew:

Pilot: Kevin Fagerstrom  
Flt Scientist: Perry Wechsler  
System Scientist: Jeff French  
4<sup>th</sup> Seat: Jeff Snider

Pre-flight:

Arrived in Arcata 20060515; very thin, shallow clouds over ocean, do not expect to see much, but use as 'shakedown' flight in preparation for operations in DMIMS06

Flight:

Wheels up 2009 UTC (all times hereafter are in UTC)  
2012: begin heading west over water, first up to 5000 ft, then down to about 2000 ft, so we have some hope of seeing clouds with the radar  
2013: radar file #1, 20-12-59, up/dualdown mode, clouds marginal (at best)  
2027: reach far western boundary, clouds dissipating out here, descend to 500 ft (in clouds) practice hitting pointers  
2031: radar file #2, 20-30-23, side/dualdown, again clouds remain marginal  
2032-2041: set and hit ptrs for practice, nothing particularly interesting in the data, PMS probes look OK, clouds very marginal for radar  
2046: RTB, remain side/dualdown, return at 500 ft until closer to the coast  
2050: pop up in alt as approaching coast  
2051: radar file #3, 20-52-58, up/dualdown to get more data  
2115: wheels down

Post-flight/impressions

Clouds too weak for detection by radar

No known instrument problems during flight











