

Aircraft Flight Log for the University of Washington, Cloud and Aerosol Research Group

Date 2/10/01	Flight Number 1860	Experimental Observations Continued to sample with a cold-frontal rainband (?) that was sampled on Flt 1859 off Washington Coast. Rainband almost stationary. Good mic and 5-Pe 1 radar measurements (At eastern part of ^{7h} above rainband with more elements merged rainband to east)
Project name IMPROVE - 1		
Engines on time 2148	Engines off time 0225	
Departure airport Hoquiam	Arrival airport Prineville	
Flight Scientist signature P. V. Hobbs		
Pilot signature		
Surface met. & visual obs. at takeoff overcast, no precip		Ac As Cb Cu Ns Sc St
Research crew Hobbs Rahgo Gray Wilson Sutherland Gerry Eric	Equipment failure CPR 1) image not too good. 2) SW out	

Justin David } "Observers"
Stan

UNIVERSITY OF WASHINGTON FLIGHTS FOR IMPROVE
(PHASE I: 4 Jan - 14 Feb)

Date: 10 Feb 2001

UW Flight Number: 1860 (IMPROVE 10P #11)

Goals of Flight: Continue to sample wide cold-fronted rainband off Wash. coast that was sampled on flt 1859

Period of Flight (Engines on to engines off: UTC): 2148-0225 (4.62 hrs)

Locations: West of S-pal rada (at Westport) off

Weather Conditions: Washington coast

Main Accomplishments:

Good microphysical measurement, in almost stationary rainband from ~1.5 to 18 kft. May show effects of ageing on rainband, when compared to flt. 1859.

Approx UCT Time (UTC = local time plus 8 hours)	Activity
2148	Engines on
2153	Take off from Hoquiam
2153-2213	Head west to 470 15' / 125002' at 7 kft
2215-2232	Head east at 1.5 kft (10C)
2233	Turn at easterly point

Flt 1860
12 Feb 2001

Approx UCT Time (UTC = local time plus 8 hours)	Activity
2234 - ?	Head west climbing at 300 ft/min to 3500 ft to 47°15' / 12500'
? - 2258	Head east at 3.5 kft (-2.5°C)
2300 - ?	Head west climbing to 5.5 kft.
2310	Turn
2313 - 2327	Head east at 5.5 kft (-6°C)
2327 - 2329	Turn
2330 - 2341	Head west climbing to 8.5 kft
2341	Turn
2345 - 2358	Head east at 8.5 kft (-12°C)
2358 - 0002	Head Turn
0002 - 0013	Head west climbing to 10.5 kft
0014 - 0016	Turn
0017 - 0026	Head east at 10.5 kft (-15°C)
0026 - 0029	Turn
0030 - 0039	Head west climbing to 13.5 kft
0040 - 0055	Head Head south to (wrong) coordinates. Then returned to original west point location.
0056 - 0108	Head east at 13.5 kft (-22°C). Cirrus fall streaks
0108 - 0111	Turn
0111 - 0121	Head west climbing to 16.5 kft (-29°C)
0122 - 0139	Sampled cirrus near westerly point at 18 kft (-33°C). This cirrus was seeding lower cloud

0139

0122

0225

Land at
Paine

Engines
off

earlier in flight, but had drifted to north.
Head Back to Paine Field
Report prepared by: P. V. Hobbs

Date: 2/10/01

Flight 1860
February 10, 2001
Voice Transcriptions*
IMPROVE-1

PH: This is UW flight 1860, the second flight for the 10 February. On board the same people who were on the previous flight, namely, Hobbs, Rangno, Gray, Wilson; guests Stan, Justin and David; pilots Sutherland, Eric and Jerry. We took off from Hoquiam heading out west to do some more measurements on this same rainband that we looked at on flight 1859.

1:56 PM

GG: The 2-D looks good.

TW: Yes it does.

JR: Peter, Jerry here.

PH: Yes Jerry.

JR: How high do you want to go?

PH: Let's head out at this altitude to our westerly point.

JR: Okay. We'll be at 7,000 ft going out to our westerly point.

PH: Okay.

1:58 PM

PH: Jerry?

2:00 PM

PH: Larry or Jerry?

2:01 PM

* AR = Art Rangno, DL = David Laskin, DS = Don Spurgeon, EC = Eric Cooper (pilot), GG = Grant Gray, JR = Jerry Rhode (pilot), JS = Justin Sharp, LS = Larry Sutherland (pilot), PH = Peter Hobbs, SR = Stan Rose, TW = Tom Wilson

PH: We're heading out to our westerly point given to us by the radar. We're heading out at this stage of 7,000 ft. The 2-D probe is up and HVPS is up. Art's working on the CPI. Larry?

LS: Standby Peter.

2:02 PM

LS: Go ahead Peter.

PH: Let's slowly descent at about 500 ft/min as we head out to our westerly point. When we turn around and come back east, I'd like to be at 1,000 ft.

LS: Okay.

2:03 PM

PH: Lots of noise spikes.

LS: Peter, did you say you wanted a 500 ft/min descent?

PH: Yes Larry. Larry?

2:05 PM

PH: The frequent spikes have now disappeared from the PVM.

LS: Peter, we're only about 3 miles from that point and I'm just out of 5,500 ft at a 500 ft/min rate of descent. Do you just want me to spiral down when we get there?

PH: No. Go a little distance beyond that point and let's go down at 750 ft/min and then you can do a turn and return back through that point eastbound and I can give you an easterly location to head for.

LS: Somebody blocked you out on that, so you're going to have to give it to me again.

PH: We can go beyond that westerly point. Let's descend at 750 ft/min. Then do a turn so that when you come back east bound through our westerly point we're at 1,000 ft. Then we'll continue to head east and, when you're ready, I can give you the easterly endpoint.

LS: Okay. Go ahead and give the point.

PH: It will be at 47°00'/124°22'.

LS: Okay.

2:07 PM

AR: Back there this band is not looking like much. I'm using my sunglasses at 4,500 ft.

PH: We're actually going a bit west of the point we were given in order so we can decrease our altitude at a reasonably slow rate. We'll actually start our research flight proper in this rainband when we're east bound at 1,000 ft.

2:08 PM

PH: Larry?

LS: Go ahead.

PH: If we need to, can we do a full flight?

LS: How many hours do you have to get, Peter?

PH: A total of 6 hr by time we land in Paine Field will use up all our hours. We may not need to do it, but I just want to plan ahead a bit.

LS: Okay. I'd like to cut it a little shorter because that's going to be about 11 hr of flight time for us today, which is quite a bit.

PH: Okay. We'll take that into account.

LS: We have three crewmembers, so we can go a length of ten.

PH: You'd like to keep to more like say 5 hr total?

LS: We had 5 1/2 hr on the last one. So if we keep it to 5 hr total, that will give us 10 1/2 hr.

PH: Okay.

AR: Larry, I don't know if it helps, but the record for our group is 13 1/2 hr. I don't know if you want to go for it, but we could land again in Hoquiam and get another burger.

LS: Maybe not.

PH: That's the last burger you're going to see there, Art, for some time unless you take yourself there from Seattle.

AR: It sounds like that now, doesn't it?

2:10 PM

AR: A little sliver of droplet cloud here near flight level and then it looks like ice pretty much the rest of the way up here at this point, the time 220910. It's position has been evident this whole leg, the pre-first leg. Now we've got higher-level droplet clouds probably at 3,000 ft above aircraft as well as droplet clouds, stratus fractus-type down below the aircraft.

2:12 PM

AR: About to descend into some stratocumulus.

2:13 PM

PH: Larry?

LS: Go ahead.

PH: What altitude do you have there?

LS: 1,500 ft now, Peter.

PH: Okay. You could start to make the turn and head back to our easterly point that I gave you.

LS: Okay.

PH: Still heading down to 1,000 ft as we head east.

LS: I can't get lower than 1,500 ft out here, Peter.

PH: Okay. We'll make it 1,500 ft.

AR: For what it's worth, Peter, I've been able to see the sun the whole leg here even down around 1,500 ft, which of course we didn't have anything near like that when we came out here before. So this thing must really be thinning out.

PH: Wasn't it a bit thicker closer to the coast?

AR: It could have been. I was fiddling around with that CPI thing and didn't catch some of that on the way out here.

2:14 PM

AR: Stan Rose informed me that he could see the sun the whole way. tans-alt 12,070, temperature +1°C indicated.

2:15 PM

PH: We're in our turn to take us back eastward. +1°C here at 1,500 ft, so this will be our precip run.

2:16 PM

PH: Just above cloud base as we head back east at 1,500 ft. Temperature is 1°C.

2:18 PM

AR: No white caps visible. Winds indicated to be 7 knot, 221810.

2:20 PM

AR: The main stratocumulus deck has thinned and lifted in cloud base. We have a separate stratus fractus layer near the surface. Two columns in here.

2:22 PM

AR: Sun is obscured here due to thicker stratocumulus above the aircraft. This is just above 100-200 ft. It looks like we're going to nip some of the lower ones here. It looks to me like this is some sort of organized line of stratocumulus that we're coming into here. The sky continues to darken in here. Of course, the sun is gone. High droplet concentrations of 400/cm³. Liquid water content is 0.5 g/m³ in the ramp zone. Partially obscured.

2:23 PM

PH: In some cumulus here. Liquid water is going up to about 0.4 g/m³. DMT is not tracking the PVM and the FSSP as well as it has been on the earlier flight. Still no J-W, that went out on the last flight.

2:24 PM

PH: Larry?

LS: Go ahead.

PH: I have a westerly point for you.

LS: Okay.

PH: It's 47°15'/125°02'.

LS: Got it.

PH: When we reach our easterly point, we'll do our turnaround and we head back to that westerly point climbing slowly to 3,500 ft over the westerly point.

LS: Okay. A slow climb to 3,500 ft did you say?

PH: Correct. We'll be doing our slow climbs as we head west and we'll be doing our straight-and-level runs as we come back to the east.

LS: Okay. Do you have an idea, Peter, what the mileage is on that leg?

PH: I haven't worked it out, but my guess is that it's about 30-40 miles.

LS: Okay.

AR: Picked up white caps now. Indicating 140 to 150 say at 22 knots.

2:26 PM

PH: Probably more like 20 miles, Larry.

LS: Okay.

AR: That is before white caps indicated to increase toward the coast. We're coming into another enhanced cumulus zone here, uplift zone of continental aerosol, 400/cc droplet concentrations, liquid water 0.4 g/m³, white caps numerous indicating 25-30 knots on the surface.

2:27 PM

AR: The temperature continues to fall on this track from about a little more than +1°C. It's getting down to about +0.5°C or so, the first cold front. Also we're getting more and more snow in the precipitation. We started out with just rain and now we're getting mainly snow.

2:29 PM

AR: We seem to be intersecting the freezing level here at 1,300 ft, about 1,600 ft on the gps.

2:32 PM

LS: Peter, we're going to have to turn it around here now because they've got us limited to within 30 miles of your offshore fix there.

PH: Okay.

2:33 PM

PH: So you're saying, Larry, they don't want us to come closer than what distance from the coast?

LS: Well, they cleared us out to the fix that you gave him and then he insisted that we stay within 30 miles of that. This controller seems to be a bit on the prickly side there about it.

PH: Within 30 miles of land?

LS: What did you say?

PH: He wants us to stay within 30 miles of land?

LS: No, 30 miles of that first fix that you gave us. We can negotiate some other fixes, but right now that's where he wants us.

PH: Okay. I'll keep giving you the points I want and you can work it out with him.

LS: Right.

AR: The turnaround point, lots of white caps down there estimating 20-30 knot winds. We're turning so our winds here are not good. The turnaround point is near the freezing level.

2:34 PM

LS: Peter, we're going to start our climb at about 300-ft a minute here.

PH: Thank you.

2:35 PM

PH: Getting big clumpy snowflakes here at a temperature of -0.1°C .

LS: Peter, confirm you wanted to climb to 3,500 ft on this leg?

PH: Confirm.

2:36 PM

PH: Getting good liquid water readings here of about 0.2. Picking up to about 0.4.
Temperature -1.2°C .

2:39 PM

AR: Sun continuing not visible since the middle of the first leg.

2:40 PM

AR: Droplet concentrations rarely over a $100/\text{cm}^3$ here. So even though the liquid water content is about $0.3-0.2 \text{ g}/\text{m}^3$ depending on which probe you look at.

PH: Larry?

AR: Those high droplet concentrations aren't getting up to this level.

LS: Go ahead Peter.

PH: Our new easterly point will be $47^{\circ}00'/124^{\circ}22'$ and we'll be heading back at 3,500 ft to that point.

LS: Okay.

PH: That's after we've reached our westerly point.

LS: What was your last comment?

PH: After we reach our westerly.

LS: Roger.

AR: Wing tip barely visible due to high droplet concentrations and liquid water contents about 0.8. Flight level 3,000 ft.

PH: The CPI is not doing anything at the moment. The 2-D is triggering up. Art, would you take a look at the CPI?

2:42 PM

PH: Getting FSSP back from here. Good liquid water.

2:43 PM

PH: Art has been playing with the CPI. It's triggering, but the background is not as good as it could be. Probably the ascents and descents we did on the early flight today and this flight is having its toll on the quality of the images.

2:46 PM

AR: It kind of looks like we've climbed on top of most of stratocumulus here after I got back after fiddling with the CPI. Not much above us, it looks like mostly ice cloud although there is a little droplet cloud here now.

2:47 PM

AR: I should correct that saying, at the west end we seem to have topped most of the stratocumulus. Certainly at the east end we'll hit more of those cumulus-type turrets on the way back. Now we're coming into more droplet cloud above the aircraft. We don't seem to be hitting it here.

2:48 PM

AR: I can barely make out the wind top there in this high liquid water and fairly high droplet concentration, not very maritime.

PH: Right, 100/cc. FSSP liquid water going up to nearly 0.8 grams per cubic meter.

AR: Back there in the peak the droplet concentrations were well over 200 too.

PH: A nice FSSP spectrum.

AR: Yes. Don's doing a good job there keeping that up.

PH: Our temperature here is -2.6°C and that's the level we'll be going back to the east on. It would be better if it were a little bit cooler so we were in the Hallett-Mossop zone, but we're just below it.

AR: That's right. You'll probably want to climb 1,500 ft or even 2,000 ft to really nail the fiddle of it.

PH: We'll be doing that on the return trip to the west.

AR: There's about a degree temperature gradient back toward the east. It cooled off going east, which is something we haven't seen.

PH: I know. I was trying to figure out why it should cool off going east.

AR: I'm just guessing it's some of that offshore draining cold air that's out there. If that's the case, then we would not see it at this higher level would be my guess.

2:53 PM

PH: Larry?

LS: Go ahead.

PH: Our new west point will be $47^{\circ}15'/125^{\circ}02'$.

LS: $47^{\circ}15'/125^{\circ}02'$.

PH: We'll be climbing steadily from 3,500 ft to 5,500 ft.

LS: Okay.

AR: Ice cloud above aircraft and stratocumulus below aircraft, 225230.

2:54 PM

AR: Can't see any turrets around the aircraft at this point. Continuing as before a sundog.

2:55 PM

AR: Picking up droplet cloud above the aircraft and at flight level.

2:56 PM

AR: Sun no longer visible. I've a definite visual on top. Droplet clouds above the aircraft estimating 3,000 ft by rate of movement.

PH: Art, the CPI has gone out again. It's triggering something now, but not as much as it should be. Nice clumps of needles here.

2:59 PM

PH: We're starting our turn at our easterly point.

3:00 PM

PH: Okay, Art's struggling with the CPI. It's got something up again, but we have to keep working on it. There must be some water inside it again. It's going to need to be dried out, which can only be done on the ground.

AR: I think the camera is busted or at least getting flaky.

3:02 PM

AR: I've got a nice view of the exhaust here now for some reason. Got a bright background in back and the left engine looks like it's putting out a little more exhaust than the right engine.

PH: We're heading west climbing slowly to 5,500 ft.

AR: Front visible at turnaround point. That would be the east turnaround point this time. I was away again from the bubble, so I missed clouds. Sky looking pretty bright here. The sun is quite bright. Not quite strong enough to remove shadows, but it's getting close. The flight level is about 3,600-ft gps. This is at 230150.

3:04 PM

PH: It seems some quite dramatic changes in the 2-D imagery in the last 5 or 10 min from clumps of needles to bigger flakes. As we climb we've just gone through the -3°C level, so we're going into the Hallett-Mossop zone here.

3:05 PM

AR: Sun brightly visible through mainly ice cloud. There may be some droplet clouds between the aircraft and the sun's disc, but it's pretty marginal. A little patch of blue sky overhead at 2 o'clock.

3:06 PM

PH: Larry?

3:07 PM

AR: A thin spot just passed back behind the plane and the clouds are thickening a bit overhead, still moving snow overhead.

PH: Larry?

AR: Sun's disc visible.

LS: Yes Peter.

PH: I have a new easterly point for you.

LS: Okay.

PH: $47^{\circ}00'/124^{\circ}22'$. We'll be returning to that at 5,500 ft.

LS: Roger.

AR: There were several levels of droplet clouds back there just a second ago. Now only ice cloud, it appears, between the aircraft and the sun. That was just maybe 10 s ago. There was a little patch that looked like at least two layers of droplet clouds above the aircraft. Below the aircraft we have solid stratocumulus. Essentially flying in an ice-crystal precipitation haze layer.

PH: Temperatures have fallen now to -4.5°C as we travel west climbing.

3:09 PM

PH: Getting some big snowflakes here on the 2-D.

3:10 PM

PH: Although we're in the middle of the Hallett-Mossop zone here, there's not enough liquid water at the moment on the FSSP to give us anything. Cloud particle count is 0 essentially, 2 to 47 microns.

AR: We're flying in an ice crystal haze. Stratus/stratocumulus clouds below the flight level estimating maybe a couple hundred feet below flight level.

3:11 PM

AR: Continuing to under fly a lot of bluish sky. Radar is indicating tops of about 5,000 ft above aircraft.

3:12 PM

AR: Still continuing to have solid liquid cloud below us. That's not counting that layer that I just mentioned was only a couple hundred feet behind.

PH: Turning at our westerly point and setting up to head east at 5,500 ft. We've got a temperature of about -6°C at 5,500 ft.

3:13 PM

AR: At the west end we do have some scattered it looks like droplet cloud above the aircraft of this ice crystal haze. The impression is one of dissipation of the band however.

3:14 PM

AR: Picking up a bit of a halo now. A partial halo behind some altocumulus clouds suggesting low-temperature crystals.

3:15 PM

AR: Picking up a subsun now off behind the right wing. As ice crystals fall this is probably ice crystal haze dropping down into this lower stratocumulus layer.

3:16 PM

PH: We're now heading back east at 5,500 ft at a temperature of -6°C that puts us nicely in the middle of the Hallett-Mossop zone.

3:17 PM

AR: About 50 ft of droplet clouds/droplet cloud tops.

3:18 PM

AR: Very porous-looking ragged tops, not well formed at all. Sun brightly visible. Capable of producing shadows.

PH: Art, I think the CPI may need looking at again. We're getting some triggering, but the images are not very good.

3:19 PM

AR: I think it's about the best we're going to do. I think the camera is getting flaky, as Grant was saying there. I think that is what's causing the black images there. It's just not firing or at least no image is being created if it is firing. As long as the windows are flashing and it's not stuck as it was before (the program halted in some way), then I think probably it's as good as we're going to get. At least we're getting something.

PH: Yes. It looks similar to what we had in the flight before last, well actually two flights ago now, that I was on and that was improved dramatically when Don cleaned it on the ground, so it maybe that.

AR: Remember we had that mottling background. Remember it looked like bowling balls or something around the particles, at least we still don't have that. I think the condensation is still okay, but I think the black images are telling me the camera, which I remember SPEC said had some problems warming up and so forth. I think that maybe it's on its last leg.

PH: That camera is the one SPEC sent back to the makers and they brought it back up to SPEC. We paid for that and it was shipped back to us.

AR: Well that would be my guess. You're absolutely right on that and it shouldn't be doing this, but that's my first guess.

GG: It was also doing fine before the lightning hit, which is a little worrisome.

AR: Yes, Grant made a major point right there. I had forgotten about already. Peter, that's probably the cause of this problem. I had already forgotten. How could I forget a lightning strike?

PH: Well maybe, but it seems to deteriorate very often as the flight goes on.

AR: You weren't on the last flight, but it worked beautifully after Don cleaned it. There was never a problem the whole as far as I know.

PH: The flight before last, yes.

3:22 PM

AR: I'm back in the bubble. Still mostly ice above us. Some trace droplet clouds possibly. I won't swear to it. Lots of bluish sky with very high cirrus. That is the highest cirrus that we saw before off the left wing there probably close to 25,000 ft estimated. That was the cirrus that was mainly above any of the ice cloud tops, the ice haze tops.

3:23 PM

PH: Larry?

LS: Go ahead.

PH: A new west point.

LS: Okay.

PH: 47°15'/125°02'.

LS: Say the longitude again.

PH: 47°15'/125°02'.

LS: Okay.

PH: Let's make it a 3,000 ft climb this time up to 8,500 ft steady climb on the way back to the west.

LS: Okay.

AR: Now getting altocumulus in front of the sun, estimated 3,000-4,000 ft above flight level. That seems to be more of a patch than a layer.

3:24 PM

AR: At the east end looking at sun through deep ice cloud. The sun is moderately visible. That's between brightly and dimly visible.

3:26 PM

PH: The CPI is not triggering at all now. Well it just triggered then, but not triggering very often. Seeing some nice cap columns here on the 2-D.

3:27 PM

PH: Quite a mixture of crystals on the 2-D from little notch bullets to fairly large plate-like snowflakes.

3:29 PM

PH: Completed our turn and we're heading back to the west climbing to 8,500 ft. So we're stepping up by 3,000 ft on this leg. We're still getting something on the CPI. Art is doing his best to get what we can, but we seem to have a camera intensity problem.

3:34 PM

PH: Just spoke to the radar. There's nothing to the west of the rainband we're working in. This is about it. There are convective cells coming up from the south and might intercept our rainband on occasion. Larry?

LS: Yes Peter.

PH: When we head back east, which will be at 8,500 ft, we want to head to 47°00'/124°22'.

LS: Okay.

3:38 PM

PH: As we climb steadily on our westward track, we're running out of HVPS images. There are still some there, but they're getting fewer. Art is still playing with the CPI trying to get it as best he can. The 2-D imagery is good.

3:39 PM

PH: We've just gone through 2,300 ft on the gps altitude and temperature just dropped to -10°C .

3:40 PM

PH: Big flakes mixed in with very tiny crystals on the 2-D.

3:41 PM

PH: We're at our westerly point and we're making our turn.

3:43 PM

PH: We're in a clear slot here broken out. Just a few rimed columns, some plates on the 2-D are occasionally coming up.

AR: Right. I was just going to say they're still in this ice-crystal haze here. A new cumulus below us mounding up toward our flight level, but we're going to be well above it.

PH: Art, we're at our westerly point and we're making our turn to head back east at 8,500 ft.

AR: I lost track fiddling with the CPI.

3:45 PM

PH: There's nothing to the west of this rainband, so once we finish climbing up through this that will be it.

AR: This will be stepping up through it, Peter?

PH: Yes. Just continuing to do what we're doing.

AR: We're picking up that 22° halo again, so probably a few ice crystals pretty high up again.

PH: We should have another 2 hr on station if we need it. Give us an hour to get back and land with a 5-hr flight.

AR: Roger. There's a nice shot out the window there, Peter, of that enhanced stratocumulus at the west end that we hit. I forget the level now. Yes, 5,000 ft.

PH: Convective cells that are sort of moving up from the south that are intercepting our rainband on occasion.

AR: Yes, there's one of them.

3:48 PM

AR: Sun bright enough to produce shadows along this leg, blue sky or at least bluish sky, 22° halo, subsun off the right wing. No sign of any convection near this level. There are some weak stratiform clouds in the area.

3:50 PM

AR: Ice crystal haze does thicken toward the east.

3:51 PM

AR: Grant, it looks like the CPI is dead again.

GG: I'll take a look.

AR: Thank you.

3:52 PM

AR: As we had in our earlier flight today we have structured cirrus above the homogeneous ice crystal haze here. That structured cirrus appears to be 20,000 ft or higher. That is it has a lot of detail in it, striations, and wisps.

3:53 PM

AR: Off to the right here we are seeing a few very weak wispy droplet clouds passing near the disc of the sun. So there is water saturation up here. Like they were slightly higher than flight level maybe 1,000 ft. One of those higher cirrus clouds is a nice little cirrus uncinus with a nice long vertical tail. Passing just above the disc of the sun.

3:54 PM

PH: Jerry?

JR: Go ahead Peter.

PH: I have a new west point for you.

JR: Go ahead.

PH: 47°15'/125°02'.

JR: 47°15'/125°02'. Got it.

PH: Right. We'll be climbing steadily up to let's make it 2,000-ft climbs or up to 10,500 ft.

JR: Okay.

AR: Droplet cloud passing underneath aircraft here indicating another zone of water saturation, estimating 2,000 ft below aircraft, very thin less than 100 ft thick, at 235330.

PH: Art?

AR: Roger.

PH: So we're going to be heading back and climbing to 10,500 ft, but we're not seeing much at this altitude at this end of the band anyway.

AR: We're just coming into the finger ice-crystal part of this. I don't know how much farther we have to go to our endpoint, but things should be picking up and the sun is beginning to dim now.

PH: We've got a little way to go, 10 miles or so maybe 15 miles to our endpoint. Anyway, we'll be climbing up to 10,500 ft on the westerly route.

AR: Yes. Things are much less homogenous at 8,000 ft than we saw on the earlier flight today. I definitely get the impression of dissipation with this whole thing.

3:56 PM

AR: Sun is almost gone. There it goes. Sun's position is not detectable now.

3:57 PM

PH: The CPI is not triggering now.

AR: Grant said about the only thing we're doing now, and it's nothing, is simply restarting it and that brings it back for awhile and we'll probably have to do that the rest of the flight.

GG: It looks as if some of the power supplies have died inside.

3:58 PM

AR: The sun is emerging from the thicker cloud there.

3:59 PM

AR: Do you have your camera today, Peter?

PH: Yes.

AR: A nice 22° halo with a subsun maybe in the same photo off the right wing.

4:02 PM

AR: Just seemed pretty characteristic of most of the cloud tops we've had this sort of icy hazy cloud top that kind of thins out as you go up.

PH: More liquid water than we had on the earlier flight today.

4:04 PM

PH: For the tape, we're not getting much now on the CPI. It's just not triggering much at all, so we're stuck with the 2-D and the HVPS.

AR: It's kind of a shame after it worked so well two flights ago.

PH: It's just started to trigger a bit and still getting some images.

AR: Fortunately with this ice haze being so uniform and structured, maybe it only takes 25 crystals to characterize it.

PH: We've completed our turn and we're heading back to the west.

AR: A jumbo jet passing overhead probably above 25,000 ft. Virtually no contrail so it's pretty dry. The highest cirrus has been, I would guess, certainly below 25,000 ft.

4:05 PM

AR: Grant, can you tell how the tape is doing?

GG: Sorry, say again.

AR: Can you tell how much tape is left?

GG: On the audio?

AR: Roger.

GG: We have not gone to half yet. We've probably gone three quarters of the way through the first side.

PH: We'll probably be okay unless Art really takes off.

AR: I'll try to cut it back.

GG: Actually it has been a bit quieter this time.

AR: I talk to the tape a lot so I don't bug people.

GG: Does the tape talk back?

AR: No.

GG: Good.

AR: The sun briefly disappeared behind this thickest ice cloud.

4:08 PM

PH: So we're heading west at 2,500 ft. Still picking up plenty of crystals on the 2-DC and the HVPS.

AR: We just exited the thickest ice cloud on any of these legs is down at that east end there.

PH: We've just broken out in the clear here now. Got an overhang that extends a little bit ahead of us to the west.

AR: Then there's another enhanced icy top out at the west end.

PH: Yes I can see that.

4:09 PM

AR: It looks like the origin for a lot of that ice back there is off the right wing now that sort of what I'd call cirrus spissatus, that heavy whitish cirrus out about 2-3 o'clock.

PH: Yes.

AR: That seems to have a trail that goes down back behind the tail.

PH: Right. Have you been checking the forward video to make sure it's recording okay?

AR: Yes I have.

4:10 PM

PH: Jerry?

JR: Go ahead Peter.

PH: Our new east point will be 47°00'/124°22'.

JR: 47°00'/124°22'.

PH: Correct.

4:11 PM

TW: Grant?

GG: Yes.

TW: Can you go to "chat?"

4:12 PM

AR: We're back in the region with the big 22° halo and subsun. We are passing through thicker ice crystal cloud, but the cloud is brightly visible and is producing shadows. Also have some altocumulus droplet cloud it looks like at this level, which is 1,000. These would have been the clouds I noticed on the leg below at 8,000 ft, I'm quite sure.

PH: Getting one or two identifiable hexagonal plates as well as the larger irregular snowflakes.

AR: Altocumulus passing before the disc of the sun. I notice some irisation there confirming the liquid phase.

4:14 PM

AR: We're making our turning point here. We're underneath the altocumulus, estimated actually it's going to be a good 1,000 to 2,000 ft above us. Very chaotic looking sky, fragmented layers that is not contiguous layers, patchyness, and this ice crystal haze that we continue to fly through.

PH: We've got this thin cirrus veil quite high above us, but at the moment is not putting any crystals down to this level.

AR: Peter, we are getting ice here. The 2-D is showing that.

PH: I haven't seen the 2-D trigger for a few minutes.

AR: There is goes there.

PH: Just went there. Yes.

AR: At least visually we seem to have continued in this thin haze.

PH: You can see it visually, can you?

AR: Yes. The concentrations were pretty darn low, but we're definitely in something. You can see the subsun below the aircraft and so forth.

PH: Very bright subsun, but that's in other stuff below us.

AR: I think it's fallen down to that level. Admittedly it's off ahead of the plane a little bit, but we're definitely in that stuff.

PH: It must be very low concentrations.

AR: Tom's calculating 2 or 3 per liter, but I think when you put in a rejection criteria it will probably be below 1.

PH: Yes. Mainly columns.

4:16 PM

AR: Continue to have the nice big 22° halo now behind the tail as we turn toward the east.

4:18 PM

AR: Continuing to have layer clouds below us. I can see the droplet cloud below the aircraft a droplet layer and there are a few higher altocumulus clouds the ones I mentioned earlier off the left wing. So there are two droplet clouds here that are easily visible.

4:19 PM

AR: Some streaky cirrus passing behind the tail now and by that I mean north, it looks like north to south fall streaks slanting downward toward the south. One goes across the sun just now and its tail drops way out down below the plane out ahead of the right wing.

4:20 PM

PH: The CPI is still triggering.

4:22 PM

AR: It's starting to look like bullet rosettes even though we're at -15° to -14°C rather than dendrites at least many of them. The sun is dimming. I'm guessing that thick area has moved this way. I'm pretty sure that's what has happened here since that was further down the line before, but we'll check. The sun looks like it's going to disappear again, almost disappear, as it did the last time we went through this area.

4:23 PM

PH: As we head west at 10,500 ft, we're getting into more crystals than at this altitude at our westerly point.

AR: I'm beginning to think some of the thicker stuff we hit at the east end because of our southeast winds has kind of tracked down our legs here and so we're running into the stuff we hit at the east end more toward the middle of our track because it's translating up this way to the northwest.

4:24 PM

PH: Jerry?

JR: Go ahead Peter.

PH: Our new westerly point.

JR: Okay.

PH: $47^{\circ}15'/125^{\circ}02'$.

JR: $47^{\circ}15'/125^{\circ}02'$.

PH: Yes. Let's climb steadily to 13,500 ft.

JR: You want to go to 13,500 ft, 3,000 ft?

PH: Yes 13,500 ft.

4:26 PM

AR: Here it looks to me like we're out of the ice crystal haze completely.

PH: Yes. Even though there is still some cirrus above us, we're not picking up anything here.

AR: Right. They have really long fall streak tails. You can see it off the right wing slanting from northwest to southeast and downward. I don't know how much farther we're going, but I don't think we're going to hit any crystals in this heading.

PH: If that's the case, we might as well turn here.

AR: Yes I think so.

PH: Did you hear that, Jerry? Let's do our turn here.

JR: Okay. You want to do the turn and we'll climb 3,000 ft on the way back.

PH: Yes.

4:28 PM

PH: The CPI has improved as we've got colder here.

AR: Well that's good news.

4:30 PM

AR: As we made that huge turn to the north, we did swipe a cirrus fall streak on the north part of that turn. Now back in the hole as we start heading northwest bound and into some rather dark looking cirrus. Now it's kind of darkening up because of the low sun angle. From the ground it would be altostratus this darkness. A piece of cirrus uncinus off the left wing. Nice little fall streaks there seem to be above or at least part of the highest level of the altostratus/cirrus. A couple of droplet clouds going by just little tiny fragments, but they do indicate water saturation up there. Estimated height at 2,000-3,000 ft above aircraft by their relatively slow movement.

4:33 PM

PH: We're heading back to the west. No particles at this level, this location.

AR: We're just moments from going back into that heavy cirrus back there, so it should start showing up here any second.

4:34 PM

PH: These are crystals from above aren't they, Art?

AR: That's correct Peter.

4:35 PM

AR: One thing that's different about this band this flight and the other one was pretty homogeneous up here and on this one there is lots of thick fall streaks that we have grazed or gone through. It's not very homogeneous in terms of just being a simple haze.

4:36 PM

PH: Jerry?

JR: Peter, go ahead.

PH: Our new east point.

JR: Go ahead.

PH: 47°00'/125°02'.

JR: 47°00'/125°02'.

PH: That's correct. We'll be going back there at 13,500 ft.

4:38 PM

AR: A tiny patch of cirrocumulus along with cirrus uncinus with short tails off the left wing, a 22° halo, amorphous sort of ice fog off the right wing (not much structure), and heavy cirrus ahead. Well, it's looking more like a thicker ice fog ahead.

4:39 PM

AR: This would be the thicker ice cloud just tended to persist at the west end. Perhaps it's a stream coming up from the southeast of us and continuing across this point. It certainly wouldn't be the same ice crystals. At our turnaround here mainly flying in ice fog. A little structure except in the higher clouds, which have a lot of structure, and seemed for the most part at the west end to be separated from the lower clouds and fewer in coverage. Flying in the upwind-downwind orientation as the winds have been pretty consistently out of the southeast or south-southeast. So it's almost upwind-downwind.

4:45 PM

AR: Looking back behind the tail now, it looks like we actually did go through a fall streak from higher cirrus. I don't know where that came from. Maybe I lost my bearing there for a moment when I said it was completely amorphous at the west end. I see a huge turn. That's what did it. We flew maybe 5 miles to make this turn off to the north.

4:46 PM

END TAPE 1, SIDE 1

4:46 PM

JR: Peter, Jerry.

AR: He's not on the headset. He's eating an apple, but he's coming forward now.

JR: Okay. Just wanted to see if he wants to climb.

4:47 PM

AR: It looks like we're going to miss the big fall streak off the left wing now from higher cirrus spissatus.

PH: Yes Jerry.

JR: Do you want to climb again when we get to the next point?

PH: We're heading east now and we should stay at this altitude, 13,500 ft.

JR: Okay.

PH: Then when we reach our easterly point and turn back to the west, we'll be climbing up to 16,500 ft.

JR: Another 3,000 ft, I'll work on a clearance then.

PH: Yes.

4:48 PM

AR: I'm pretty sure the tops have lowered substantially since we flew this band this morning with the exception of that higher structured cirrus you see off around 2 o'clock toward the sun's position, 2-3 o'clock. I think we're going to mainly continue on top of this by 18 to 20 K, whereas before 21 K we stayed much in it.

PH: Good. I hope to finish this flight on station here in about an hour. Jerry?

JR: Go ahead.

PH: You've overshot your path to the south.

JR: I went directly to 47°N/125.02.

PH: So that's quite a bit different from what we have been doing.

JR: Yes it is. It's almost north-south onto the heading.

PH: Let me check on that. It seems strange.

AR: Yes it does.

4:49 PM

AR: I was wondering why we didn't go back through that patch of cirrus that we went through about the midpoint of this flight leg.

4:50 PM

PH: Jerry?

JR: Go ahead.

PH: That was a mistake on their part. We should be back on our regular track. So we should be heading to 47°00'/124°22'.

AR: Peter, can I suggest we go back to where we veered?

JR: 47°00'/124°22'.

PH: Yes. What was that, Art?

AR: I was just saying because we missed the most interesting part of that band, I would like to suggest we go back to where we veered off and go back through that thicker cirrus that we completely missed.

PH: Okay Art. Jerry, let's go back to our previous westerly point, which was at 47°15'/125°02'. We'll go back there and then we'll head to this new easterly point I just gave you. In other words, do a 180° and go back to our.

JR: We're going to go to our westerly point and then we'll come back.

PH: Go to our westerly point and then we'll set up back on our usual track.

AR: We missed that altogether and we've been profiling that for some time now on these legs.

PH: That was a mistake by John and I should have noticed it. I did when I looked at the plot, but I was up from my seat for a few minutes.

TW: Grant.

AR: Good thing you noticed it because I was shocked when I looked down. Maybe I could have caught it earlier too.

4:52 PM

AR: Peter, just for your information, out there about 1 o'clock is that patch of cirrus that we've been profiling. So we want to be on the west edge of that of so.

4:53 PM

AR: What's happened, Peter, as we drifted away, that patch of cirrus has continued to move off toward the northwest. I think if we really want to get it, we want to veer a little bit to the west to repeat our pass at this level to get that same feature.

PH: Heading back to our previous westerly point at the moment.

AR: Right. That cirrus is translating to the northwest so it's moved a little beyond where we would have hit it. I'm just suggesting maybe if we go a little bit say 20° left and then circle back down that line we'd nail this particular feature like we had been doing before. But at this point, we'd be sort of in the middle tail end of it.

PH: Okay. Jerry?

JR: Go ahead Peter.

PH: Let's veer about 20° to the left of our present track. That will put us back a little west of our previous westerly point. That's where I want to be.

JR: Okay.

AR: Jerry, see that cirrus cloud up ahead now and it extends off to the left there at about 11 o'clock?

JR: The one over at 11 o'clock, way over there.

AR: We should have gone through that if we hadn't veered off. We've been profiling that stuff all along in these legs and so we need a good bit of that.

JR: Okay.

4:56 PM

AR: It looks like, Peter, at 16,000 ft.

JR: Is that the one you want on the nose, Art?

AR: That's correct. It's about 1 o'clock now the thicker of that, but it's kind of under that at about 12:30. Peter, it looks like at 16,000 ft we'll be kind of in and out of cloud, these ice crystals, these spaces, and then you'll run into a patch of this stuff off at 1 o'clock. We'll see a lot of clear air, I think, for the next climb of 3,000 ft.

PH: Okay. For the tape, we had a little bit of confusion there. We got the wrong coordinates from the radar that sent us south, but we're rectifying that now. We're heading back. We're nearly back to our earlier westerly point and once we get there, we'll get into this higher level tufts that we've been wanting to follow. From that point, we will go to our new easterly point at 13,500 ft.

AR: I suggest, Larry, you could turn at any time here and head back down that line again.

LS: Okay. We'll be coming right and we'll need our eastern coordinate, which one do you want, Peter?

PH: We'll be heading to the easterly point, which is 47°00'/124°22'.

LS: Fine. We'll put that in there and we'll take you right down there.

4:57 PM

AR: The feature we were under flying before was out there at about 4 o'clock now.

PH: Good Art. We'll be turning back and flying into that now.

4:58 PM

AR: Now it's pretty much off the right wing.

4:59 PM

PH: That little error there cost us about \$700 in flight time.

AR: I was thinking about that one up in FIRE-ACE where we were heading to the ship for the first time and we were kind of looking out the window at everything and then Jack in his inimitable way said "Hey, where are we going?"

JR: How does this look, Art, is this the cirrus you're looking for?

AR: That's affirmative, Jerry. Thank you.

JR: We aim to please.

PH: Jack thought we were going into Russian territory.

AR: Right. But instead of saying, "Hey, we're going into Russian territory;" Jack says "Hey, where are we going?" Then we look at the map and see there's something wrong.

5:00 PM

PH: We're now east bound at 13,500 ft. If we climb 3,000 ft on the westerly trek back, it will put us up at 16,500 ft. Do you think that's going to top it out or are we going to need to go up one more step?

AR: I think we'll be in and out, Peter. I think we'll have to go one more after this. The cirrus up there is moving pretty slowly from where all this is coming from, but we would be in and out of cloud for long periods, out of ice crystals, before you hit these sort of patchy things here still above the flight level.

PH: We might run out of time. I think we're going to have to leave the station here about 1 hr from now.

5:01 PM

AR: Continuing to fly in crystals dropping down from the higher cirrus layer. There seems to be a patch here that runs in the northwest-southeast direction. We hope that corresponds to the rainband. We're pretty close to our previous tracks.

5:04 PM

PH: Jerry?

JR: Go ahead Peter.

PH: Our new westerly point actually is the same as the old westerly point, but I'll give it to you again. It will be $47^{\circ}15'/125^{\circ}02'$. We'll climbed 3,000 ft to 16,500 ft.

JR: Okay. We're going to 47°15'/125°02' and we're going to climb up to 16,500 ft. We'll do that.

PH: That's correct.

AR: Peter, it looks like the lower tops have invected off to the north. So we might be flying in clear air on the previous leg before this one, but now I think we're going to see pretty uniform ice crystals along the whole leg ad we've under flown a band of cirrus this whole leg, which we did not under fly before.

PH: That's good.

5:07 PM

PH: Jerry?

JR: Go ahead Peter.

PH: Since we're sort of running out of time a bit (when I consider what I want to do) on this next turn back to the west, do the turn the most efficiently as you can. It doesn't matter if you leave off a little bit of the leg but just do the most efficient turn to get us back heading west.

JR: Okay.

5:08 PM

AR: How much farther is our turnaround point, Peter? It looks like we're in a big hole here.

PH: We should turn here. We can do our turn here, Jerry.

JR: Roger.

PH: The most efficient turn to put us back going west.

5:10 PM

AR: I can see quite a bit of structure in that cirrus even now overhead where it's transparent you can see fall streaks in it. Then looking back off around 7-8 o'clock very inhomogeneous looking cirrus with dense fall streaks leaning right to left or northwest to southeast or north to south, something like that. That was the band we were just under flying and it should be along that same path the next time we go down it too. Right now we're kind of turning over the saddle area making this large turn with completely clear air this time. This is the kind of stuff we're

over flying two legs ago I think it was when it looked like cloud tops would be below, much of it below 16,000 ft.

5:12 PM

PH: Jerry?

JR: Peter, go ahead.

PH: How much more time on station?

JR: Standby.

5:14 PM

JR: I'd say an hour and 30 min and then we'll have to head back to Paine Field.

PH: That's more than enough.

JR: Fair enough.

PH: I think I'll get us back before then.

JR: All right.

5:15 PM

PH: Jerry, just to let you know what I have in mind.

JR: Go ahead.

PH: We're heading west now and we're climbing to 16,500 ft. Then we'll do our usual route back at 16,500 ft to the east. Then we'll do a final leg to the west climbing to 19,500 ft, let's say 20,000 ft, and then we can head back to the east at 20,000 ft and then home.

JR: Okay. We'll finish up this and then one more pattern back west and east and then head on back.

PH: Yes. Once we finish this leg we'll be going east-west, east-home.

JR: Very good. We'll program that in.

5:16 PM

PH: Jerry?

JR: Go ahead Peter.

PH: Our new easterly point. When we start heading back $47^{\circ}00'/124^{\circ}22'$ and we'll be heading back there at 16,500 ft.

JR: Okay. That's 16,500 ft and we're going to do $47^{\circ}N/124^{\circ}22'$ west.

PH: That's correct. Yes.

AR: Here's an interesting situation, Peter. The cirrus line that is kind of oriented along path is translated off to the north. You can see it off the right wing now. We're kind of in this ice fog, thin ice fog-type ice crystal environment, but what we were sampling for quite a while was kind of like the stuff off about 2 o'clock there.

PH: Yes.

AR: I was just thinking how difficult it might be to put the crystal structure together because now we're higher and the crystals look like the ones we have here, but they're not the ones that came down from over there. They're not going through the same growth mechanism.

PH: Right.

AR: Or environment I guess. I mean you can't follow cirrus around. I mean it could be translating pretty fast.

PH: Right. That's why some comments on the tape will help things like that.

5:19 PM

AR: Heavier cirrus is maybe 2 or 3 miles off the right wing now. We're flying in ice crystals. We're getting some here, but it's not the same thing as we had before. We have newly formed cirrus with Kelvin Helmholtz waves in it suggesting some droplet clouds at least momentarily forming in this newly forming cirrus overhead now extending south, but it doesn't seem to have fall streaks coming out of it. At least if there are any, they don't seem to get to here. So this is really part of some old ice crystals that we appear to be flying in from the sort of ice haze top of this rainband.

5:21 PM

PH: Anything ahead at this altitude, Art?

AR: Yes there is. He's in his turn because he's at that western most point.

PH: He's just starting his turn.

AR: Until now with that line of cirrus gone, we're going to be in the situation I thought we would have earlier and that is over flying most everything.

PH: So if we return on this track climbing to 19,500 ft, you don't think we'll get anything?

AR: Well there maybe a crystal or two coming out of this patchy thin broken cirrus you see out there overhead.

PH: We're scheduled to go back at 16,500 ft now to the east.

AR: We'll virtually hit nothing at 16,500 ft. We're in a saddle. A saddle has moved into this geographic line that we've been flying. All the high stuff is gone with the exception of a little tuft down toward the east end.

PH: If we climb to 19,500 ft on this easterly leg, would help us?

AR: No. It's going to be too low for the cirrus we see off the right.

PH: So is there anything else useful we can do now?

AR: Well I'd be tempted to go back there and sample that line of cirrus off the left wing 2 or 3 miles and we're close to the top of that.

PH: Why don't you direct Jerry to that? Jerry?

JR: Go ahead Peter.

PH: Art is going to direct you for awhile to some cirrus that was I think just to the west of our westerly point. Because if we keep at this altitude and even if we climb to 19,500 ft, we're not going to hit anything. So I'm going to hand you over to Art.

JR: Fine.

AR: Jerry, that cirrus we were flying in before is off the left wing there. Can you give me a right 270° and go back to that west end of that stuff and just go down that? That looks like it's going to be fairly close to cloud top.

JR: Yes. We'll just turn to the right and come back around and go through that cirrus over there.

AR: Right. Because that was the stuff we were flying in at lower levels as well. It had big long wide fall streaks and so forth.

5:23 PM

PH: Do you have him climbing, Art?

AR: I don't know if he's climbing yet.

PH: But have you asked him to climb?

AR: No. I figured that was already plugged in.

PH: No.

JR: We're still at 16,500 ft, Art. We're level here.

AR: Wasn't that the next leg, 16,500 ft?

PH: That's all canceled out. I've handed the pilot over to you, Art.

AR: I don't think that's a bad level. We're going to be pretty close to cloud top. I'll take him up a little bit more. Jerry, can we continue climbing to say 18,000 ft?

JR: We can go up to 18,000 ft, Art, no problem.

AR: Thanks. Then the cirrus is out there about 2 o'clock. That's the stuff we were flying in earlier. I think once we get in it just turn down the same heading that we were taking before. We should be able to nail the tops of the stuff pretty well. I don't think we'll be exactly topping it out, but at least we'll get fairly close.

JR: We're swinging around and we'll get back into it and we'll climb up to 18,000 ft.

5:26 PM

AR: Can you start with the one that's about dead ahead?

JR: Right. The one that's dead ahead I'm going to it and then make a right turn and go back down the track toward the easterly point.

AR: Roger that. Thank you.

TW: Grant?

GG: Yes.

TW: Should we recycle power maybe? Before this leg it looks like the 2-D kind of went blank on us.

GG: Okay. It was running a second ago.

PH: There's nothing here at the moment.

TW: I'll see what happens. I hate to wait until we're actually in something and have it go bad, but we can wait.

PH: We'll be in something soon. We're heading for some cirrus. Hopefully we'll be in it soon.

AR: It will be a couple of minutes though, Peter.

GG: I have a hypothesis on the CPI. I think the heater blew out in there because all the internal electronics were way subzero.

PH: Can you fix the heater?

GG: Not here.

PH: I mean on the ground.

GG: Yes. I'm sure we can.

PH: You might want to do that even though we probably won't have any more IMPROVE flights, or we'll forget about it 2 months from now.

GG: I'm going to make a note on the engineer's sheet.

PH: Similarly the J-W should be fixed in the next few days.

5:28 PM

PH: Art, after we've finished sampling the cirrus here, we'll be heading back to Paine Field. We're maneuvering to try to get into this wispy cirrus. You can see it very nicely outside the right window now.

5:29 PM

PH: We're going to have to climb a bit is my guess to get into that.

5:30 PM

AR: Is the 2-D dead?

PH: Well I haven't seen any particles on it. Are we in something here?

AR: No. Absolutely.

PH: The 2-D is dead then.

AR: Rubbish.

GG: Let me cycle power. Standby 1.

PH: Tom thought it was, but since we're in clear air we couldn't tell.

AR: That's right. We were in clear air until about 30-40 s ago. Jerry, you can turn down that heading now.

GG: I'm going to cycle.

PH: I don't want to spend an hour sampling this cirrus, Art. We'll just get a good sample of it and that will be it.

AR: Okay. This is probably it.

PH: We've got the 2-D up now.

AR: Outstanding.

PH: Getting nice little particles here.

AR: It's good. It's going to be a little in and out down this line.

5:33 PM

GG: Are we in the clear, Art?

AR: Yes. Peter, do you want to meander on this thing a little bit or do you want to just fly a straight line?

PH: We can meander for 10 min or so and then we should start heading back.

AR: We kind of missed one there off the right wing, but it was too late to get back. We'll fly under one here in another minute or two. There are probably a few ice crystals before we get into a thicker one again.

5:34 PM

AR: This would be the stuff that we were under flying on a leg at 12,000-12,500 ft.

5:36 PM

AR: Coming into some more ice crystal.

5:37 PM

AR: Passing under a fall streak with transparent cirrus.

PH: We're getting a few uniform sized small crystals on the 2-D. This is probably what we're going to see here. I don't think we need to do too much more of this, Art.

AR: I would agree, Peter. In fact there's not much ahead just very low concentrations of the same stuff maybe a little puff maybe 2-3 more minutes ahead that would jack up the concentrations. That looks like that's the end of it.

PH: We'll do that and then we'll be heading home.

AR: I'll give you when we go under it, through it. Perhaps the cirrus is a little higher at the point where we began probably as high as 3,000 ft above the aircraft. Then they sloped down a bit in this direction.

5:38 PM

PH: Jerry?

JR: Peter, go ahead.

PH: After we finish sampling this cirrus, which will just be in a few more minutes we'll finish with this, I'll had it over to you to head back to Paine Field.

JR: Fine. Let me know when you're all done and we'll head back to Paine Field.

5:29 PM

PH: Art?

AR: Yes Peter.

PH: I was off the headset. Are we finished there now?

AR: Not quite, probably within the next 1 min.

PH: Okay.

AR: I'd say for crystal sizes this maybe the best top that we've characterized because I don't remember seeing any quite this tiny that we've sampled in cloud top. Either we didn't quite make it, you know, another few thousand feet above us, the crystals still fairly large.

PH: We're still in the tops of this cirrus are we? We're still sort of looking at the fall streaks.

AR: That's correct.

PH: How much higher above us are the cirrus themselves?

AR: I'm estimating the ones in this band about 3,000 ft above flight level by the rate of movement above the aircraft.

PH: Okay.

AR: They did tend to slope down in this direction. I think we'd be over flying some tops here if we are not already. It looks like coming out of the haze here is another patch of cirrus. I suppose we could stay at this level on this heading a little longer now. Getting quite a lot of 2-D action considering it looks almost clear outside.

PH: Okay. Let's call a halt to this now.

AR: Peter, we're just coming into this heavier band right now. But actually if we do head home, we'll probably go into the same stuff as we're sampling on this heading. That sounds great to me.

PH: Jerry, we can start to head back to Paine Field now.

JR: Okay. We're headed for the barn. We'll take it from here, Peter.

AR: Is this still the same day as when I got up?

GG: Mores the pity.

5:42 PM

TW: Grant to "chat."

5:43 PM

PH: Can we point the radar down? Is the radar pointing down?

AR: We aren't able to do that.

PH: It's still point upward?

GG: That's right.

PH: Then it's not doing it any good. You can switch it off.

GG: Okay.

AR: Peter, you might do us some good as we pass through this cirrus band here because we'll get a firmer top on it.

PH: Okay. We'll just do that. That will just be a few minutes and then we can turn it off.

5:44 PM

AR: Grant, we've cleared the cirrus so you can turn off the radar I guess.

GG: Roger that.

5:45 PM

PH: So we're now down to 15,000 ft actually still heading southeast, but we'll be heading back to Paine Field shortly. I think that maybe he's maybe going to Hoquiam and then heading to Paine from Hoquiam.

5:46 PM

PH: Jerry?

JR: Go ahead Peter.

PH: You're heading back to Hoquiam before returning to Paine?

JR: That's affirmative.

PH: Okay.

JR: Right now we're about 13 miles to the west of Hoquiam.

5:48 PM

TW: Grant?

GG: Go.

TW: How are the gel cells going to be when we shut down, okay?

GG: Sorry?

TW: How are the gel cells going to be when we shut down?

GG: They should be okay. We've been charging them for 3-4 hr, so they should have 20 min on them.

TW: That's plenty.

5:48 PM

TO SUMMARY

AR: What little tape is left.

PH: Now is your chance to be recorded.

5:57 PM

PH: Picking up some precip here, crystals anyway, at 9,000 ft.

5:58 PM

PH: So neither Justin or Stan want to go on record.

AR: Stan said his mike doesn't work and he won't be able to do the summary.

PH: This will probably be the last flight for IMPROVE-1 unless something spectacular moves in on Tuesday or Wednesday, which it's not forecast to do, but you never know. Officially we have used up our flight hours now, so it's likely to be the last flight. I feel the effect of the Olympics here. We're picking up thin cloud, 2-3 images.

6:00 PM

PH: I think we've crossed Olympus now. Now we're on the lee side of the Olympics. We're out of cloud here. We've dropped to 5,000 ft as well. Still occasionally picking up a few particles that must be falling from the layer above us.

6:06 PM

TO SUMMARY

- TW: It's hard to track down all of the 2-D problems because I don't know if it's software. I don't know if the hardware is malfunctioning. I think actually if we send it to them, and they give it back to us and say the hardware is working perfect now, then I can really narrow down the software problem.
- PH: Okay. By and large I think things have worked very well. Actually the next big task I think as far as you're concerned is we've got to take serious strides to officially archive the SAFARI data.
- TW: Right. I was also going to work on that TANS-vector thing and get the lat/longs to come out at a reasonable clip because right now they're like every 3 or 4 s. I don't think it will be too hard, but it will probably take like a week or so to program it all in to get the other port. I think they have to do some wiring too.
- PH: Will that just be for these IMPROVE flights or will that go back to SAFARI?
- TW: No. It's a connection we don't have to the TANS-vector. We're only using the TANS-vector on channel B, which means you've got a lot of attitude like pitch and roll and stuff. You don't get lat/long every 3 s or something. So what we need to do is hook the other channel, hook it into our system and then start recording that too, which gives lat/long at a much faster pace.
- PH: We haven't been recording it now. We don't have to worry about that just yet. We'll worry about that in preparation for the summer field program.
- TW: Right.
- PH: So I think before that first of all we have to get out this very small amount of data from SAFARI that the Goddard guys have asked for. I think I sent you an e-mail on that on Friday.
- TW: Right.
- PH: Mike King and Platnick, and I forget the guy that works for Platnick, they've asked for a particular segment, one of those flights off of Namibia. We'll get back to them and then we should look at the whole SAFARI data set and archive it after we've checked quality. Some of the quality has been checked already. I mean you've been making some progress there.
- TW: Right.
- PH: I shouldn't really be talking to you on "science," I should be talking to you on "chat" here.

6:15 PM

Summary of UW Flight 1860

5:48 PM

PH: I might as well give a quick summary here of this flight. After taking off from Hoquiam, we've been doing a profile through the same rainband that we worked earlier this morning. This rainband moving very slowly, almost stationary off the coast, about 40 miles wide. We profiled it from 2,000 ft up to 18,000 ft. The temperatures were -33°C . Got good measurements. Microphysical measurements the main structural change was compared with this morning when the rainband had liquid water in and it was probably precipitating harder than it is this afternoon. So this afternoon we've be looking more at the aging-dying rainband, but still producing some showers on the ground no doubt.

5:52 PM

PH: Is Art on the headset?

GG: Not at the moment.

PH: I'll get him. Just passing over Hoquiam now heading northeast back to Seattle. There's no precip over the Olympics according to the radar so we're not doing the official Olympic Mountain transect, but of course we will be flying roughly on that transect anyway on the way back to Paine Field.

5:53 PM

AR: Peter, did you call?

PH: Do you want to do a quick summary of this flight?

AR: I was just checking the audiotape to make sure there was enough. Actually I did check with Grant and there is enough if I speak just a few words here.

This second flight was sampling essentially the same rainband. That rainband had a number of the same features at least in the lowest 2,000 ft and that is a large liquid water content on the east end. I think that it got over 0.5. That would be almost a gram and that occurring in high droplet concentration clouds. They're indicating a continental aerosol rising up to 3,000-5,000 ft levels.

PH: Art, I think that was the convective cloud that was moving in from the south and intercepting our rainband on the east side.

AR: Right and we had that again on the second flight. That is one little red cloud. We went through it twice as we turned around. I don't remember whether it was at the