

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

Date 1-4-01	Flight Number 1846	Experimental Observations	
Project name IMPROVE DURATION 2:31			
Engines on time 1907 UTC	Engines off time 2138 UTC	<p>TAKE OFF IN POOR MULTIPLE LAYER, NON-ACFTG SITUATION, FERRIED TO COAST AT ~40K FT, INTERPRETED NNW-SSE ORIENTED BANDS OF MARGED ACFTG LAYER BEGINNING IN PUGET SOUND-ABERDEEN RGN AND TWO (?) MARK THEREAFTER BEFORE ARRIVING AT PRE-DESIGNATED LOCATION. MARKS BTWN BANDS MARKED BY VAULTS OF HIGH AND LOW CLDS, NO OR LTL PCPN, SOME ^{BLW} SKY. BANDS MARKED BY SOME LWC AND DIFFUSE CONDITIONS, SOMETIMES LYSR COULD BE MADE OUT AOV & BELO AIRCRAFT. POOR VSBY DUE PCPN.</p> <p>SFC VSBY ~250' ASV RDR DUE FOG & PCPN. HI (RELATIVELY) DROP CONCS. AT & IN ST FRA CLDS NRST SFC. DTPNS DROP CONCS. XTMLY LOW (^{LOW}10⁵), SOME DROPS SEEM TO HV BEEN PRESENT MOST OF THE WAY FROM SFC - 15K. TOP FOUND 215KFT. CONSISTED OF LIQUID DRS. W VIRGA/PCPN. TEMP ~ -10°C</p> <p>FLY TEMP DUE INSUF DATA COLLECTION. TWO REPAIR KEY PROBES NOT WORKING OR NOT INSTALLED (CPI)</p>	
Departure airport PSE	Arrival airport		
Flight Scientist signature <i>C. Rangan / Nick Bond</i>		<p>Clouds sampled</p> <p>As <input checked="" type="checkbox"/></p> <p>Ns <input checked="" type="checkbox"/></p> <p>Sc <input checked="" type="checkbox"/></p> <p>St <input checked="" type="checkbox"/></p> <p>Cu</p> <p>Cb</p>	
Pilot signature <i>F. C. ...</i>			
Surface met. & visual obs. at takeoff R35 @ 10+ BINOC HIGH CLOUD VSBY, LOW ST FRA W RWU			
Research crew BOND WILSON GRAY SPURGEON RANGAN	Equipment failure J-W CPI - NOT INST. 2-DG LWC DATA ~1% OR LESS HUMS - QUASISTABLE POOR IMAGES		

Flight 1846
January 4, 2001
Voice Transcriptions*
IMPROVE

DS: Test 1, 2, 3. Okay. Recording works good.

GG: The Tans is up.

11:20 AM

GG: I believe we're rolling.

11:22 AM

AR: Testing 1, 2, 3. It sounds like somebody might have an open mike.

GG: Shut off.

DS: He pushed in his mike the rest of the way.

GG: Roger that.

AR: Cloud base at takeoff of about 4,500 ft. Estimated depth of <1,000 ft and higher altocumulus lenticularis north downstream of the Olympics, generic altocumulus with fallstreaks...(Don speaking over Art)...and multiple layers.

LS: Art, are you up?

AR: Yes, that's affirmative, Larry. You know you will be getting a flight track and stuff from Nick today.

LS: Right. Do you want to be pressurized or non-pressurized?

AR: I think we're going to need to be pressurized today.

LS: Okay.

11:26 AM

AR: As I was saying, ahead (that is southwest through west through northwest) we have multiple emerging layers of it looks like liquid water clouds shedding ice

* AR = Art Rangno, DS = Don Spurgeon, GG = Grant Gray, LS = Larry Sutherland (pilot), NB = Nick Bond, TW = Tom Wilson

and above that some cirrus. Before we get to the multiple layer system probably that first rainband that has made landfall that Nick Bond mentioned, we have a clearing in the cirrus. So the clouds are actually overhead of the plane and beginning to thin now as we approach kind of a thin spot this overall cloud cover. Then a couple of minutes, 3 or 4 min, I'll go into the bubble.

NB: Larry.

LS: Go ahead.

NB: Nick here. Talking with Mark Stoelinga in the group there is a small difference in kind of the starting point for our pattern to what you filed for and essentially it's the same longitude but he would like us to start at $46^{\circ}54'$ latitude.

LS: Say again that longitude.

NB: He didn't actually specify it. He said the same one that you were kind of filing for. Let's see it's $124^{\circ}20'$.

LS: $124^{\circ}20'$ and say again the latitude.

NB: That's $46^{\circ}54'$.

LS: $46^{\circ}54'$, okay.

11:28 AM

DS: Tom.

TW: Which spot, any spot?

DS: Anything except 5. Thank you.

11:31 AM

AR: We've entered the multiple layered cloud situation and we're picking up some liquid water here. I haven't seen any 2-D imagery change. It's hard to image that there was no precip in that. I was looking at the black stick. Visibility along the wing is good. Occasional puffs of liquid water going by. Sun's disc occasionally visible through thin spots in the cloud.

11:34 AM

AR: Larry is your radar working these days?

LS: Sure is. I don't have it on right now, but I'll get it on.

11:36 AM

AR: According to t-statr we're flying at the melting level at 1°. Flying level tans-alt 7,900 roughly. FSSP concentrations 30s. It looks reasonable considering the good visibility in cloud.

11:37 AM

AR: Continuing sun sometimes brightly visible and some bluish tinge visible to the sky, higher separate layer just above the aircraft within 2,000 ft. I suspect there's cirrus, although I can't really make it out. I'm guessing there's quite a separation between these liquid water topped clouds that are within 2,000 ft of the aircraft and the cirrus.

11:39 AM

AR: The sun almost full out now. The progress report for the HVPS's imaging and what appears to be not imaging precipitation particles. It seems to be possibly dirty. It's imaging like mad without showing any particles. I'm looking down at my laptop here. The 2-DC seems to be dead as well. 1-D cloud probe has particles.

11:40 AM

LS: Art.

AR: Roger, Larry.

LS: We're cleared into Whisky 237 and that coordinate you gave us isn't in 237.

AR: Okay. I'll pass you onto Nick who got that from Mark Stoelinga down on the ground.

LS: We can't fly in that airspace I don't think.

AR: Do you copy that, Nick?

NB: Yes, I do. Do we have to be then north of there?

LS: Yes. We've got to be 15 to 20 miles north of that.

NB: Okay. Well start on kind of the southern edge of the operating area then and at that same longitude 124°20' I guess it was.

LS: Okay.

NB: Also we'll wander around it and basically north-south tracks before. We'll probably want to be doing east-west tracks. I'd like to talk to the radar people before we actually start in there, but chances are we'll be going east-west.

LS: Okay.

11:42 AM

AR: A nice hole in this cloud off the left wing. I can look out about 30 to 40 miles out there and see the sun glinting on some clouds as we fly in some light precipitation here, broke out of that liquid layer. Nick, do you suspect that the solid cloud we just passed through was that first rainband or do you think it's still ahead?

NB: Good question. I think that's a little faster than Mark kind of implied, but it's possible I suppose.

AR: There are certainly more ahead. That's for sure. It's probably just a little thin spot here.

11:43 AM

NB: Art, Nick here. Can you go to the side channel?

AR: Roger. I'm on the side channel now.

NB: I just wanted to ask you how I got that map display on the system here.

AR: There should be an icon that looks like a map on there. Here comes Grant.

11:44 AM

AR: In that gap I did see off to the south about 30 miles a little row of altocumulus castellanus and floccus, so I'm feeling pretty good about this flight right now.

NB: Right. That definitely indicates warm sector rather than any sort of warm frontal zone type, right?

AR: Well, you guys are the experts on that. I'm just a cloud expert.

11:45 AM

AR: We're having some trouble imaging particles here. I don't see any viable particles either on the HVPS system, which is designed for the larger particles, or the 2-D cloud probe imaging. I don't see anything there either.

NB: What can you do? I mean is that something that you can fix in flight?

AR: I think they're working on it, but it may be that you or the powers may want to decide how long to fly if there are no precipitation particle spectra available.

NB: Well, my impression would be a pretty short time.

AR: Well, that's what kind of what I was thinking too unless our guys here, the engineers, think they can bring it up.

GG: It was working on the ground.

AR: That's right. The 2-DC had some images coming up through that first cloud, a few little drizzle drops. The HVPS started out okay. Well, it looks its come back now. So it looks like we're getting some particles on the HVPS. So we got one back.

11:47 AM

NB: Say Art and everyone else, I'm going to try to raise up John at Westport now. So I have to switch the headset.

AR: I thought I smell a little smoke back here. Does anyone else notice it?

GG: It might be coming out of the radar. That has a tendency to give you a little bit of a dust burning smell.

AR: Yes. That's what I would say it smelled like.

11:48 AM

AR: I'm not seeing any viable particles on the HVPS again. I'm still not seeing anything on the 2-D cloud probe. Tom, do you have any thoughts on that? Are you trying to get the 2-DC to work? Do you think it's recording data, but not displaying?

TW: I'm looking at the 2-DC right now. I don't think it's recording, but I can update the HVPS for you. Hold on a second.

11:52 AM

AR: We're getting particles on the HVPS. It needed to be updated. There's so much data coming in it gets behind.

TW: Hopefully for next flight I'm going to put an auto-end feature.

LS: We're about 7 miles from our point. We've got to maintain 10,000 ft when we get there, then we can go on down, and I'll spiral down as close to the surface as we can get.

GG: Larry, Nick is on the other radio taking to S-Pol right now.

LS: Okay. You can relay that to him if you will.

GG: Roger that.

AR: I also copy that, Larry. Thank you.

11:53 AM

AR: Nick, it looks like the temperature has climbed about 1.5° maybe 2° on this heading at 9800 fms-alt since we left Puget Sound. Sky darkening here as we get into probably what appears to be a rainband.

NB: Larry, Nick here.

LS: Go ahead, Nick.

NB: I talked to the radar people and we have an endpoint for this stack that we're going to do at 46°54' and 125° even.

LS: You're going to have to give me that again.

NB: The endpoint is 46°N 54' and 125°W 0'.

LS: Okay. So we'll start off. We're going to spiral down and we'll come over that first point you gave me. We're going to be starting off at 47°07' and 124°20' and then we'll go to the 46°54'/125°.

NB: Yes. That sounds good.

LS: We've got to stay in at Whisky 137 Alpha.

NB: Right. So our kind of southern limit is basically right near 47, right?

LS: That's affirm.

NB: That shouldn't be a problem. These bands are oriented north/south and kind of the north end of them would be okay.

LS: Okay.

11:56 AM

AR: It doesn't seem to be very well put together here. As I look around it's dark dead ahead at this point. The sky brightens back behind us, some hint of blue back there, and we are descending and passed through some altocumulus cloud in the area. I didn't notice whether we actually hit one or not. I didn't see anything go by. Looking down it looks like there's a solid layer of some kind below us, a liquid layer that would be because the temperature now is +5°. The freezing level was about 9,800 ft. There's a liquid layer above us. I'm not sure how far that goes. It's embedded in the precip, so it's a very diffuse looking liquid layer, but you can't make out lobules of droplet cloud out there. I have water running off the bubble here in the front now. I see the FSSP was starting to show something. Still in the melting level. Looking at the HVPS.

11:59 AM

NB: Hey Art, Nick here.

AR: Roger, Nick.

NB: So are you kind of just watching how the 2-D probes are working and that sort of thing?

AR: Roger that and then making comments, most of them on tape, so I don't disrupt everybody with the continuous stream on what I'm seeing out the window, the layering and what have you.

NB: Okay. That's good. One think that I kind of like to get is that if you could show me how to make some of the traces that I want, picking which ones. I'm sorry for my ignorance.

GG: I can give him a hand there, Art.

AR: Roger. I think that probably Grant or Tom would probably be the faster of the two because I haven't done much of that myself.

GG: Tom is definitely fast.

NB: What do you want to do?

GG: Why don't we go over the "chat."

12:00 NOON

AR: It looks like we're reaching cloud base here at about 1,000 to 1,100 ft. I can see the surface now by the way.

12:01 PM

AR: Along with a noticeable increase in turbulence. We may be running into a wind shear zone between the offshore flowing air and maybe air that's inclined a little more onshore or at least a shear zone. I noticed at cloud base we saw some non-maritime-like FSSP concentrations, something around 200 there and more to go, which would indicate a continental source of the air in here. It was 230, 237 just then.

12:02 PM

AR: About 400 to 440 ft looking down at the white caps, not tremendously numerous. Estimating winds 20 knots. It looks like swell lines out there though indicating some monster far offshore. Visibility is poor probably less than at flight level here. Below cloud base less than (garbled).

12:03 PM

AR: Still imaging on the HVPS, although the particles are rather squashed looking in the north/south or the up/down direction. Makes me think maybe true airspeed is a problem when we're seeing that effect of true airspeed being too low. That is the airspeed used by the probe is too low possibly because they're going by much faster than it thinks they are going by and so they're smaller in the transflight direction. Light turbulence here continuing. A bump just then.

12:04 PM

LS: Who's up back there?

AR: I am.

LS: It's kind of crappy down here, Art, so I'd like to go down to about 200 ft. We're about 15 miles from the endpoint now. We drifted out as we were circling down.

AR: Roger. I understand. Did you copy that, Nick?

NB: Yes, I got it.

LS: Can I make the request back there, Art, that everybody stay in their seat?

AR: Roger. I understand. Everybody stay in their seat.

NB: Nick here.

GG: Can you receive me on "science" now?

AR: Roger. I was just going to say that the 2-D cloud probe came up of its own accord, so we're now getting some images from that for the first time.

12:06 PM

DS: Art, we're strapped in.

AR: Nick, are you on line?

NB: Yes, go ahead Art.

AR: Did you copy that message about being 15 miles away from the endpoint because of drift when we spiraled down?

NB: Yes. So in a way we didn't necessarily have to go south, but I guess it doesn't hurt. We're that much closer to the radar, so that's probably a good idea. Say Art, I noticed that the winds aren't being updated, so I think our heading seems to be changing. Perhaps something with the track is.

AR: Yes. I can say that I've been looking at the cloud microstructure stuff and have not looked at winds yet.

GG: Winds are changing on my strip chart here.

NB: Yes. I should check which winds I actually have on my text data.

GG: One thing, the definitions file that you have on there if a roll angle goes over 5°, you'll get zero. It just shuts them off because you get inaccurate winds. Now I'm modifying that so we'll look at everything this particular flight, but you won't see it yet.

AR: Continuing tans-alt 440 right at the stratus fractus cloud base.

12:08 PM

AR: It'll be interesting, Nick, when we go back up to see whether this cloud that we have here connects up to anything that high. I noticed on the way down we had a base somewhere around 1,100 ft msl and then as we continued to go down there it was just kind of stratus fractus scud cloud. I think that's probably still the case. We have this kind of underlying stratus fractus and then a layer above that and I saw at least two more layers in addition to those two on the way down. It's pretty complicated all this precip falling through.

LS: Art, we're just a little bit west of that first point. I'm going to go to that westerly point for you.

AR: Roger. I talked to Nick on that.

NB: Sounds good. Thanks Larry.

LS: Okay. Nick, we're going to run direct to 46°54 and 125°.

AR: Tom, should the 2-D here be updating? We've been flying in precip, but I haven't seen any new images here in awhile. Is there an end button somewhere I can hit to update it?

LS: We're starting for the point now. We're going run down to the cloud base for you, Nick.

NB: Sounds good. Thanks.

TW: Yes. The probe just seems to shut off on a whim, but then it will start getting particles again. I'm looking into it.

AR: Thanks Tom.

GG: Nick, if you stop your strip charts and restart them, you should have winds and you do have t-stat, which is reverse flow.

12:11 PM

LS: Art, there's 300 ft and I'm not going to go any lower being in clouds.

AR: Roger. I understand.

LS: So you want to maintain this all the way out to the next point?

NB: That's correct.

GG: One other thing on the wind direction and speed, the speed units are okay, but the wind direction is degrees from true north rather than magnetic.

12:12 PM

AR: Grant, is your definitions filed back here on this laptop?

GG: It may not be on the laptop. I believe we transferred it over to that one. Let me come take a look after we're done here.

AR: That's okay. I'm mainly concerned with the cloud probes anyway, so that's okay. I just wondered.

LS: Nick, confirm that when we get out to 125°W we want to spiral up to the freezing level, is that the plan?

NB: That is correct. It should be something like around 10,000 ft or so.

GG: Something's haywire here. I might have modified it on the wrong computer. Let me check back over here.

NB: Okay. It's not a big deal, but it would just be moderately useful.

LS: Does anybody back there read the pilot?

NB: Yes. I copy.

12:13 PM

AR: Continuing flight a few hundred ft above the sea surface. The sea surface indicates winds of...

GG: Nick, sorry, I was on the wrong computer. I'll fix that.

AR: 20 to 30 knots judging by the number of white caps, which seem to be flying in what appears to be as much fog as cloud because it seems to go a little lower to the surface. There doesn't seem to be a cutoff now, something you would expect with a true cloud base. It may not be surprising considering it's a warm air invective situation over the colder water. I suppose fog and rain all the way down to the surface is nothing unusual. Along with that is pretty continuous FSSP readings in the low 10s as well as the teens that is, and then an occasional puff of real cloud somewhere producing 100 to 150/cc. That is beyond the fog there are these...

NB: Art, I've got an impression that precip has picked up a bit.

AR: Nick, I can't really tell back here because of the HVPS is not giving me what I would call good images of circular drops like I expected and the 2-DC is pretty lousy up there. It's been kind of a bad actor. I would probably get more from going up to the forward window where the pilots are and then looking at that.

NB: Right. I'm just basing mine on visibility and how much water is on my window.

DS: The one thing to note, Art, that this is what 35 microns where it said this is 25 microns, so there is quite a difference in size range.

AR: Yes, I understand that, Don, but they're not looking very spherical to me. It looks like they're being smashed on the lens system or something. They are just not looking like raindrops.

12:16 PM

LS: Does anybody in the back hear the pilot?

NB: Yes, loud and clear, Larry.

LS: We're about 5 1/2 miles to the westerly point. Confirm you want to spiral up to the freezing level, is that it Art?

NB: Yes that's correct. This is Nick here.

LS: Okay.

12:18 PM

AR: Tom.

LS: On your climb, what rate of climb do you want on that?

NB: There I'm going to defer to Art. What do you guys typically do? Is it 1,000 ft a minute or something?

LS: I can give you whatever you need.

AR: John Locatelli was talking about that and a lot of it depends on how much flight time you want to spend out here and so forth. We were kind of thinking about 500 ft/min, but it could be faster if you think the boys on the coast or you think we need to get up to the freezing level to do something else after that right away.

NB: If it's 500 ft/min to catch the better data, I think we want to go ahead and take the time.

AR: Roger that. Larry, I guess we want to go at 500 ft/min when we start that spiral.

LS: Okay.

AR: Thanks. Nick, because the software is still a little immature, we don't have concentrations from the 2-D probe.

LS: Art, is there any reason why we always have to operate right on the edge of these zones?

AR: You know it wasn't my design here. It was designed by Mark Stoelinga and some other folks and I don't know what all went into that. I was completely out of that picture.

LS: Somebody has to talk to him because with the airplane we just can't navigate that close going 400 ft up the ladder. We have to get further out into the area so we don't have to continually worry about getting violated on this.

NB: Right. We can certainly be a bit north of the edge of it. We do want to be kind of on the south end because we're in better radar coverage there, but certainly don't make yourself uncomfortable by trying to tip-toe.

LS: Okay. I'm going to have to talk to someone. It's apparent to me there there's too many dog gone levels of _____ here, but nobody knows what the other one is doing. I'm getting stuff handed down that I don't like and I can't operate with and I've got to talk to somebody about it.

AR: I think there's a meeting as a matter of fact, Larry, tomorrow. That would probably be a good time now that we've had this kind of shake out flight.

LS: Well, the same thing happened the last flight out here. You know they were right out over on the east border of it and the Center kept calling us and this is just something we've got to tend to.

AR: I see, they're calling you just because you're close not because you're actually in. They're sort of warning you that you're getting close, is that it?

LS: It's just that when we're right on the line there's only a mile or two difference and we're down this low we don't have the capabilities of spending all that time navigating.

AR: I see because you can't afford to drift even a half mile or mile and violate that area.

LS: Not only that, but we just can't leave the instruments of this airplane down there and have one guy spend all the time navigating. If you got us back up into the area a little bit, so we don't have to watch the chart continuously, it would make it a lot easier on us.

AR: Roger. I think I'm getting the picture now. Nick, I wonder if there isn't a cell or some part of this line a little further away that looks just as good it might make things easier. I wonder if that's a possibility.

NB: Right. I don't think there's anything magic about the line. I know we don't want to be a lot further north, but a bit further north I can't image why that would be a problem.

LS: I can't understand why we talk about this Whisky 237 continually and then we're on the phone with Whidbey and then we get out here and our coordinates are not even in it. They set the coordinates about 15 miles outside the area.

AR: I didn't realize that because they didn't really go through me. That's another good question to bring up tomorrow. Some of the people that are doing this, I know Mark has told me he's doing a real crash course in aircraft operations over this last few months.

LS: Well, he should have told me because I'm relying on him and things aren't working.

12:23 PM

AR: The 1-D cloud probe is certainly dead.

12:25 PM

LS: Art.

AR: Copy.

LS: That westerly point has us out of Whisky 237.

AR: Nick, do you have any comment on that?

NB: Could you repeat that, sorry?

LS: I say that westerly point has us out of Whisky 237. We're about 3 miles out the south side of it.

NB: Okay. Well, let's just move it 5 miles north or so just to make sure you're comfortable inside the zone.

LS: Okay.

12:27 PM

AR: Tom, I'm sorry. I missed your comment earlier. Are we recording more 2-D data than what I see click on the screen here to update?

DS: Standby Art. You'll have to ask him that again. He wasn't plugged in when you asked.

TW: Art.

AR: I couldn't remember how you answered that question earlier. I see the 2-D data here that strips up data every so often. Is that recording more than that or are we just recording the strips I see updating.

TW: You're seeing all the strips.

12:28 PM

AR: There's an awful lot of rain out there that we're not imaging that's for sure. I'd estimate that we're getting less than probably 1% of the particles we should be imaging with this probe just looking at the pilot's wind screen up there.

TW: I agree completely.

AR: I don't really like the way the HVPS looks either. It just doesn't look right. These particles don't look like drops to me. I'm not sure most of them aren't noise.

DS: Art.

12:30 PM

AR: Roger. Go ahead Don.

DS: Does the orientation of the probe make any difference?

AR: I don't think so. It should be seeing exactly the type of images, except a little clearer, because the pixels are so much bigger as we see on the 2-DC. They should look fairly spherical, but the bigger particles that might be spherical are either artifacts or they splashed on the arm somewhere before they went across the imaging lenses.

DS: Okay.

LS: Nick, what we're going to do is move all the tracks up north 5 miles. So instead of $46^{\circ}54'$ it's going to be at 47° .

GG: Larry, Nick was off the headset for a second. He's back on.

NB: Yes, I'm back Larry. Sorry.

LS: We're moving the track 6 miles north.

NB: That's fine. Thanks.

LS: I'll give you a call at the freezing level and also when departing the westbound coordinates for eastbound.

NB: Okay. I appreciate it. I'm also watching that also. I still think it's somewhere around 10,000 ft.

AR: Roger. 9,800 ft we're like at.

LS: I think freezing level is going to be at about 8,000 ft.

NB: I suspect it's going to be a little higher, but you've been out here more than I have.

LS: Actually, I've got about a +5° now, so about another 2,500 ft should put us at freezing.

AR: I did take a look at that and it was right at about 9,800 because I remember thinking how close the MM5 was on predicting that. That was tans-alt 9,800 it was like +0.1°, so I'm guessing there was some kind of overrunning inversion or stable layer between here and that level. That would be my guess.

12:33 PM

AR: Did I mention before that the temperature was about 2.5° warmer than the temperature at the same level when we started out of Puget Sound at about 9,800 ft or so. When we first got to 9,800 ft it was about -2.5° or so.

NB: Say Art, Nick here.

AR: Roger.

NB: I'm going to kind of trust you to kind of essentially make the decision about whether we're collecting good data or not.

AR: I don't think you're going to be able to much out of this personally for all the flying. I would tend to call it short from what I see here.

NB: Yes. There's no reason to be out here if we're not doing good things. I just wasn't sure about some of the other instruments whether they were of value. That's what I think you know more about than I do.

AR: I think we're getting pretty good liquid water measurements. The FSSP is looking pretty good and that probably is our key. So we are getting good liquid water measurements and we are getting good state parameter measurements. It looks to me like the reverse flow temperature and dew point and so forth are okay. How that fits into the IMPROVE project why in importance compared to the

precipitation spectra, which actually I thought it had a little less importance, but you may be able to shed some light on that.

NB: You were saying the precip spectra is less important. I think it's the most important. Right?

AR: Yes that's what I was saying. It's probably the most important and the liquid water measurements a little less important, the cloud droplet spectra.

NB: Right. That's what I was thinking too. If we're not getting, especially if we get up high here and we can't see the crystal habits, that's the main thing.

AR: Roger. Let me talk to Tom about the 2-DC and see. We're not going to get any crystal habits in great detail without the CPI and the next hope is the 2-DC, but it doesn't seem to be working quite right either. Let me talk to Tom for a second. I'll get back to you on that because I think what I would do is cut it short so there can be time to address these problems before something really good comes in.

12:36 PM

AR: Nick, I just talked to Tom and it's not something the 2-DC now is something that we're going to be able to fix because it's unclear whether it's a hardware or software problem. So with the CPI off as well, I just don't see the worth of the cost of flying at I don't know \$2,500 an hour with the state of the instruments as we have them for the precip particles.

NB: Yes. I know what you mean. Do you think it's worth trying to make a call to John and see what he thinks there too?

AR: Well, we could sure give him a call, but that's my 2 cents worth. I'll just leave it at that.

NB: Yes. Presumably John, do you think he's prepared to make that kind of decision or?

AR: Well, he should be. Although really, I think to be honest, it would be us that would be making that decision. We come back early, we let him know that we've got some instrument problems and that's the end of that. That's normally the way it's worked in the past, but you can give him a call and let him know that we've got some instrument problems and we're considering terminating the flight and going back and see if we can make some progress in fixing them.

NB: Right. I guess I'm inclined to do that. We're out here and we might as well go ahead and we're very near the freezing level. We're right at it, in fact, right now. We're going to be heading their way anyway, so we might as well go ahead and do this run at the freezing level.

AR: Yes that's right. If he's got some real interesting feature he wants us to fly in, it would certainly get liquid water measurements in it. Obviously there is a stack of that here today in the pancake formation.

12:40 PM

LS: How does that look to you for the freezing level, guys?

AR: Pretty darn close, Larry. We're indicating about -1.5° here now, so it was a little lower than what I called on the way out. No, that's 10,200 ft, so I probably was about right. It was about 9,800 ft I think before, but we went through zero since. Probably not too far from what it was earlier. I'm reading the tans-alt by the way, the GPS altitude.

LS: What's that?

AR: I was mumbling back here, Larry. Yes. It looks good. It's about -1.5° on our t-stat.

LS: Okay.

12:42 PM

LS: We're about 3 miles north of our westerly point as we approach it. I'm going to turn into our easterly heading and track back to your easterly point, which is going to be at about $47^{\circ}05'$ and $124^{\circ}20'$.

AR: Roger, Larry. Nick's on the phone talking to the radar right now and he'll get back to you in just a second. We're actually considering terminating the flight early because we're having some key instrument problems.

LS: Okay. Just let us know.

AR: We'll get back to you on that in just a couple of minutes here.

LS: Okay. You can consider us now at 145° west point and heading eastbound now for the $124^{\circ}20'$

AR: Roger. Heading westbound from 125° . Westbound or eastbound, eastbound at 125° .

12:43 PM

AR: I was looking at the probe data, talking to Nick and so forth. Didn't get a good handle on...

NB: This is Nick. I just spoke with John at the S-Pol and he reports that he's kind of losing interest in some of the features that we're seeing out here and he's going to check with Control in Seattle, but chances are we're going to cut this one off.

LS: Any time.

AR: Thanks for the info, Nick.

NB: I'll be checking with him in 5 min or so. Hey, Art, one other thing.

AR: Roger.

NB: He was wondering if it would help us any to go on up a little higher to get kind of higher into the snow whether that would help in the troubleshooting.

AR: I don't think so. We're at the level we should be seeing aggregates for example and the 2-DC is completely dead right now.

NB: On my window here I'm seeing mostly liquid water it seems.

AR: Yes, there is a liquid droplet cloud out there and what you're seeing is the collection of cloud droplets. The HVPS does have some snow particles in it.

12:45 PM

AR: Do they have any idea of what the tops are in this area?

NB: I didn't ask. From kind of the precip or the reflectivities they were getting, it doesn't sound like they would be that high.

AR: Roger. Sometimes getting to the top is interesting because you at least get a cloud microstructure profile even if you don't have the big stuff.

NB: The last time I talked to him, he thought it was something like 20,000-22,000 ft.

AR: I see.

NB: That's when we kind of headed over Westport on the way out.

AR: Roger. That's probably a little too high. It would take too much time considering the lack of data we're getting and the time needed to fix stuff.

12:46 PM

AR: We seem to be bumping into some altocumulus clouds embedded in this system now. I noticed some turrets, not visually, but in the microstructure measurements and liquid water peaks.

12:48 PM

AR: No clear definition of layers here.

NB: This is Nick. I just talked to the S-Pol and they recommend we climb up to get a little higher in the ice and just head in and see if we can fix the instruments.

LS: Okay. So what altitude do you want to go to.

NB: Here I'd like to defer to Art. I would guess maybe something around the -12° level, which might be something like 15,000 ft. What do you think, Art?

AR: That was exactly the number I had in mind, 15,000 ft.

12:50 PM

AR: Did you copy that, Nick? I think that sounds great, 15,000 ft.

NB: Yes. That's great and just kind of don't bother with the spiral just kind of ramp up.

LS: Okay. Do you want a 500 ft/min again?

NB: Yes. What do you think, Art, or do you want a little faster than that?

AR: I'd take it up as fast as we can since we're not getting really good data.

NB: Yes. So you heard him. Whatever, 1,000 ft/min perhaps or something.

LS: Sure, 1,000 ft/min is what you want?

NB: Does that work for you, Art?

AR: Roger. As much as you can get, Larry, up to 1,500 ft/min. What I was thinking about before when we were going to climb, I was getting the impression maybe it didn't go as high as 20,000-22,000 ft. Sometimes at these temperatures you get to the top and it turns out to be like altocumulus or up from this viewpoint up close like stratocumulus. It's kind of interesting. I guess this was a phenomena discovered years ago. They called it the upside-down storm because it's snowing out the bottom and the top is all liquid.

12:51 PM

AR: There are a couple bursts of nice columnar crystals there, which fit the temperature right now of about -6.5° . Unfortunately, it was just a burst. It's not that the probe is working correctly, but just for a moment. That was on the 2-DC if I didn't mention it.

12:55 PM

AR: FSSP thinks it's seeing some liquid water and I don't see anything going by the wing, excuse me, liquid water droplet concentrations up to about 40. I take that back. There maybe just a hint of something going by.

12:57 PM

AR: By golly, it looks like we are breaking out on top here right at about 15,000 ft and off the left wing you can see these kind of altocumulus-like clouds. Nick, did you want to be heading back or heading westbound at this point?

NB: Yes. I want to be heading back. I apologize if that wasn't made clear.

AR: I thought that's what you had said, but I just now just this second noticed we're heading westbound.

NB: Larry, do you copy that?

LS: Go ahead.

NB: Because of the instrument problems, we'd like to kind of head back. We're not doing much good out here now.

LS: Okay. You'd better put your oxygen on back here. That cabin crept up on us.

12:59 PM

NB: You know, if it would help to go a little lower, it's not that we need to be at 15,000 ft necessarily.

LS: I'm going back down to 13,000 ft.

AR: Are we pressurized, Larry, or did we...

LS: Jerry didn't get us pressurized, Art. I'm sorry.

AR: I started to have some pretty interesting thoughts.

NB: Just keep them to yourself.

TW: On the trip home, I'm going to try some experiments with the 2-D data since we're assuming that it's no good.

NB: That's a good idea.

TW: This will also affect the HVPS data.

AR: Roger. Let it blow.

1:00 PM

TW: It would be great if we could go through precipitation on the way back.

AR: We're in precipitation now. I'll let you know if we're not in precipitation. It could be a fairly long run though.

1:01 PM

DS: We need to stop and restart the 2-D display programs?

TW: Not at all.

1:02 PM

TW: We have a substantial leak over here in water, I think. It's not running now, but when we're in water it does. It usually runs from this bolt. I don't know why.

1:03 PM

TW: Art?

AR: Roger, Tom.

TW: Could you give notice when we get precipitation?

AR: Right. We're still flying in precipitation. We just had a burst on the 2-DC. We had some nice aggregates of columnar crystals there.

TW: Yes, a burst seems to be the way it goes for some reason.

AR: Before that we had just noise indicated for many, many minutes.

DS: Yes. We've been watching it. It's a real puzzle because when we got the thing on the ground and put stuff through we got stuff going like a bat out of hell through both of them.

TW: Right now I'm just trying to get the 2-D to work and I've turned off the HVPS. I was thinking maybe the HVPS was hogging things, but it doesn't seem to be that way. I just have the 2-DC on.

AR: That's a good test.

1:05 PM

NB: Larry, Nick here. I assume the cabin pressure is okay now.

LS: Say again, Nick, you were cut out.

NB: Sorry. I assume the cabin pressure is okay for now.

LS: It is coming down.

1:06 PM

DS: What kind of stuff is that, Grant? It looks good. When we get back, I'm going to go get one.

GG: Ham and turkey sub.

AR: Got a brief look at the sun there through what appeared to be ice cloud at that point about 30 s ago.

1:07 PM

AR: Is the radar working today? It looks like we're getting good ground signal, but I don't know. It doesn't look like it's doing much.

GG: It's off right now. I had to shut it down for a second. It's back on the warm-up cycle.

(TAPE SIDE 1 ENDED)

GG: Affirmative.

TW: Are we in precipitation, Art?

AR: That's affirmative. In fact, just before you spoke we had another burst of 2-D imagery in the 210634.

1:08 PM

AR: Sun's visible again, not the disc quite, but visible and it's through it looks like both ice cloud and droplet cloud, multilayers above the aircraft.

1:10 PM

DS: Do we have cloud below us, Art?

AR: Roger, there is cloud below us.

DS: Okay. How far would you say it's below?

AR: You're not going to see that. When you said cloud, I was thinking cloud droplets. You won't see that with that radar, but there is precip below us.

DS: Right. I saw some signal just below us.

AR: It was kind of a scruffy layers of clouds, but that radar would go right through that. We're still flying in precip.

DS: I'm getting some return just below us.

AR: Well, it's not going to be that stuff whatever it is. I can tell you that. Not with that little collector out there.

NB: Say, Art, I'm definitely getting some kind of melted aggregates on my little port hole here.

AR: Well, t-stat is -2.2° . They're probably melting on contact maybe due to that ram heating possibly. Yes, this would be an area of aggregation. We should be seeing precip, I would think, all the way to the ground with the radar. If it's working the way it has in the past, when we used to fly it about 10 years ago.

DS: It's not working quite that good.

AR: It's a tough project.

1:12 PM

DS: What's our altitude actually?

NB: It looks to be about 9,000 ft or so.

DS: Thanks.

1:13 PM

AR: What's our location, Nick, from your map?

NB: Yes. We're just about 47°20', I'd say, 123° even.

AR: Are we near Shelton?

NB: Yes, we're almost right on top of them.

AR: I was just noticing again here that the temperature had. Well, I'm going to have to take that back now. There was some kind of glitch going on. Sorry. Scratch that. Wait a minute. I've got this picture together. It's colder here by quite a bit. We're obviously are down around the freezing level now at 8,100 ft and, of course, offshore the freezing level was around 9,800 ft.

NB: Yes. Still the skiers aren't going to be too happy with this kind of freezing level.

AR: No, that's right, but this is water that will probably get down and over those hydroelectric dams right away.

NB: I note this bumpiness at the freezing level. It's something I've seen a lot of times where you have a little extra shear here just a little stability and you almost always get some chop at the freezing level.

AR: That's something, Nick, you know I've flown all these years and this is a great observations because I consider myself a pretty good observer and I have never noticed that before. But you've pointed out a couple of things that I've not observed. It's great.

1:15 PM

AR: Larry, what's our ETA to Paine Field?

LS: Standby Art. It's going to be about 12 min.

1:16 PM

NB: Say, Art, Nick here.

1:22 PM

DS: It looks like we're out of the precip, Tom.

GG: The FSSP and the PVM have been very close. The J-W is still a bit noisy.

DS: Did the J-W get zeroed before this flight?

GG: Negative on that. That was my oversight.

DS: That's a little hardware, also in rain at that time. We need to find a clear area up here to zero the J-W.

GG: Roger that.

1:23 PM

GG: The pyrometers and the UV radiometers have been quite quiet all flight.

DS: Occasionally one is lucky or smiled upon is maybe a better word.

GG: Why aren't we getting the noise spikes. That bothers me. Well, actually we are getting the noise spikes.

1:24 PM

NB: Art, are you there?

DS: Go again.

NB: I was just seeing if Art was on his headset.

DS: Negative. He's over in the back making some notes.

NB: No problem.

1:25 PM

GG: For a straight and level flight the winds have looked pretty good today.

NB: Yes, but now they don't. I'm still a little concerned that the drift angle might have some sort of bias in it or something.

GG: It did have a bias and we hopefully took it out. Maybe it was not accurately taken out.

NB: Right. I haven't yet seen a negative drift angle.

GG: Oh, the drift angle you're looking at there on the screen comes from the Shadin. We aren't even using that in the wind calculation because it is flaky.

1:26 PM

GG: I shut off the liquid water probes at half past the hour.

1:31 PM

END OF TAPE

Summary of Flight 1846

No summary given on tape.