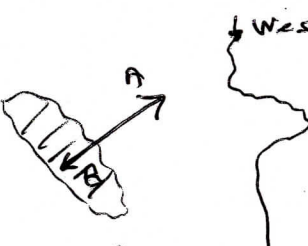


Aircraft Flight Log for the University of Washington, Cloud and Aerosol Research Group

Date 01/07/01	Flight Number 1847	Experimental Observations Flight out to ~ 140 nm SW of Westport (S-Pol radar location) through occluded frontal surface (good temp jump and windshift at 7 and 5 kft) flew shifting vertical stack profile. Passes at 12, 15, 18, 21, 15, 10, 7, 5, 3, 2 4 and 2 kft. A and B end points updated thru. flt to keep in rainband observed by S-Pol radar. (See "Timeline" form for this flight). Precip. light most of time. Clouds mainly glaciated (little LWC). Broken Sc below freezing level, some of which are part of frontal upglide. Low drop conc. and significant LWC ($\approx 0.5 \text{ g m}^{-3}$) in these clouds. Broad, maritime-type droplet spectrum scattered. By contrast, the Sc below this level were in an E-SE flow and were continental type (drop concentrations $\approx 500 \text{ cm}^{-3}$!). They could have enhanced precip. via "feeder-seeder" process. Encountered occasional clouds with significant LWC on NE slopes of Olympics on return flight to Paine Field.	
Project name IMPROVE: PHASE ①			
Engines on time 2300Z	Engines off time 0500Z		
Departure airport Paine	Arrival airport Paine		
Flight Scientist signature P. V. Hobbs			
Pilot signature			
Surface met. & visual obs. at takeoff No precip. at T/O from Paine field		AC AS Cb Cu Ns Sc St	Westport  frontal precip band
Research crew Hobbs Rango Gray Spurgeon Wilson Pilot: Sutherland Rhode	Equipment failure CPI } Not aboard 2-DC } FSSP-300 } 35 GHz radar not recorded Intermittent noise on several instruments, including PVM, DIT, JW		

Pilot: Sutherland
Rhode

DIT, JW

Flight 1847
January 7, 2001
Voice Transcriptions*
IMPROVE

GG: The intercom is up and we're recording.

AR: I just wanted to report that it was hot here in the back.

JR: It will take a little while for that to cycle, Art. It will cool down here in a minute.

PH: Have we been recording for the last 5 min or so?

GG: I just started it.

PH: This is flight 1847 on 7 January. The second flight for IMPROVE. On board are Hobbs, Rangno, Gray, Spurgeon, Wilson, Sutherland and Rhodes. Heading out to the coast to Westport where the NCAR radar is located. From there we will head southwest out for 150 miles or so to see if we can intercept the frontal rainband that's coming in.

AR: Cloud cover is overcast ice cloud, thickening and thinning. A northwest-southeast banded structures. The sun is about to disappear between one of the thicker northwest-southeast altostratus bands.

GG: Peter, go to "chat" for a second would you.

AR: Over the Olympics we have a few moderately developed altocumulus lenticularis clouds in the lee of the Olympics and none of the ice crystals coming from the altostratus appear to be reaching the tops of the Olympics at this time. There is virga, however, at the top of Mt. Rainer off to the southeast. The visibility is excellent in all directions. Well over probably 50 to 100 nautical miles visibility at this flight level, which is about a minute ago was about 5,000 ft. Now we're up to 7,300 ft just to update it. No low clouds in the area due to these strong easterly flow.

PH: Of the four liquid water meters, three of them are zero in clear air, but the DMT still has lots of noise on it. DMT occasionally coming up to 0.5 g m³.

3:20 PM

* AR = Art Rangno, DS = Don Spurgeon, GG = Grant Gray, JR = Jerry Rhode (pilot), LS = Larry Sutherland (pilot), PH = Peter Hobbs, TW = Tom Wilson

AR: I wanted to mention something about the satellite imagery showing a strong midlevel band just offshore of Hoquiam/Westport as we took off or about an hour before we took off. We expect to see that near land-falling point as we get out there. It looked like from the top, this visible from the Navy satellite image home, that specks of rain down to the ground out of that, but probably with the easterly winds bringing light rain and sprinkles and very little underlying low clouds. It looked like the main frontal band was still well off the coast.

3:22 PM

AR: Looking at a plume just behind the right wing out by the sound and near Shelton. I don't see the airport, however. The plume is coming from the north and spreading out toward the southeast a little bit. The plume heights probably no more than 100 ft above ground level.

3:23 PM

AR: I did remove the tape from the PVM opening prior to flight. I'd like to make a note of that. Now for the first time the sun's disc is disappeared into the altostratus overhead overhead of the plane now. It's showing some weak fallstreaks. The flight level about 8,000 ft. Temperature is just reaching the freezing level.

3:24 PM

AR: As we get deeper toward the coast, that is farther toward the coast, I'm looking off the left toward Tacoma and I see a lot of stratified low-level haze in the port of Tacoma. It's kind of filling up that whole valley there that heads off toward Mt. Rainier. Looking out to the south of there and southwest of there, there is a tremendous amount of trapped probably home fires and small slash burn smoke trapped right next to the ground. It must be a couple dozen sources of smoke.

PH: The "up-pyranometer," which is the one on the underside of the fuselage, is very noisy. The "down-pyranometer" is not too bad.

AR: The top of Mt. St. Helen's clearly visible. Had a little sudden shaft on it, whereas Mt. Rainer is obscured in light snow.

PH: The "up-UV" is also very noisy. "Down-UV" is okay.

AR: Continuing light snow from the altostratus clouds topping Mt. Rainier.

3:26 PM

PH: I'm getting occasional spikes every 2 min or so on the PVM.

3:27 PM

LS: Art, is that temperature coming down for you?

AR: That's a negative. It's still just as hot as it was before. You can't really put your hand on the ducting it's that hot.

LS: When I run the cabin pressure that's going to decrease the pressurization in there and so it probably shouldn't get as hot. See how that goes.

PH: The Cambridge dew point and the Ophir are tracking each other fairly well, but the dew point is a few degrees below the Ophir.

3:28 PM

PH: Flying in clear air at about 8,000 ft.

LS: Art, do you want to cross that first point out there as low as we can, is that affirm?

AR: That's what I understand.

PH: Larry, can you hear me?

LS: I got you, Peter, go ahead.

PH: We want to head out from Westport to the southwest on that radial I gave you and we might as well head out in cloud. We'll see what the cloud base height is when we get out there. This altitude is fine to get to Westport.

LS: Okay.

3:29 PM

PH: What's this?

TW: The particles should be flying by. Right now you're getting some ambient noise.

PH: Particles from where?

TW: From the HVPS. It might be getting a little behind too.

PH: We're got no particles at the moment.

TW: Sometimes things will land on the lens or something and then it will false read for awhile.

PH: We're in clear air at the moment. Can I get the forward video up?

TW: We're not running the Windows side right now. We could probably get it here though at a later date if we wanted.

GG: That one is not on the network right now is it?

TW: I don't know. It probably wouldn't be hard to get it on the network.

GG: Just needs a network card. We might even have another card back at the lab.

TW: You could do like a full screen video if you want on that one.

GG: How do you get the 2-D and the HVPS up?

TW: If you want you can run it on that one. It's still a little paranoid, but yes you could.

GG: That's fine.

TW: What you do is you know how you make those icons along the task bar? Maybe we should switch over the "chat."

PH: That is what Art and I are going to want to look at here, the 2-D and the.

TW: The CPI, right.

PH: Well the CPI is not on board. Today the 2-DC.

TW: The 2-D doesn't look very good so far. I've seen a little bit go by. I think it's still a wiring problem maybe.

AR: Well, what you see so far is sometimes what we start out with and then when we start to get into some snow it will usually, if it's working correctly, start to pick to pick up. We'll be running into some snow here and in 2 or 3 min.

TW: Okay.

AR: At this level because the ceiling is lowering.

TW: Sounds good.

3:32 PM

AR: There's this real spectacular plume just east of Mt. St. Helens, that is in the valley east of Mt. St. Helens (the I-5 corridor), and it might be around Kalama and that

area. It's streaming just exactly toward the west and in coming over this rise of mountains here off the left wing, back behind the left wing. Correction on that, I see the Kalama power plants.

LS: We're probably going to get some bumps out of this little bit of virga ahead of us, Art.

AR: Roger Larry. I was thinking about that compared to what saw in Namibia there because the air wasn't quite so dry in the heat. That's my thought on it.

LS: We'll find out.

3:33 PM

AR: We should see some snowflakes here in the next 30 s. Come on probes!

3:34 PM

LS: Art, has it cooled off at all back there on that duct?

AR: It's still very hot, although it doesn't seem to be quite as hot in the back as it was.

LS: Okay.

AR: That was a pretty good. We're in the snow now.

3:34 PM

TW: How big are these snow particles, pretty big?

AR: Yes, there's a big puff coming here in the next 10 s. It will begin in about 10 s. We're in it now. I see nothing on the 2-D probe and actually I see nothing on the HVPS.

LS: By the way, Art, I forgot to tell you that 237 Alpha and Delta are going to be open for us this afternoon.

AR: Roger, 237 Alpha and Delta are open.

LS: Did you get that Peter?

AR: I think he's in conference there with Grant.

3:36 PM

TW: Art?

AR: Roger, Tom.

TW: The HVPS has a buffer and it won't dump it to me until it's full. So you might get these particles at a later time, which you might have just saw some go by.

AR: I'm looking at it now. It looks like there is some data in there now. That's right.

TW: The 2-D doesn't. It's just putting vertical lines it looks like.

AR: Roger that. I haven't seen anything in that. The particles are looking pretty good on the HVPS. I've noticed that they look like snowflakes and so forth rather than those slivers we had before.

3:37 PM

TW: The good thing is that it's triggering at the right time. So I think it's just a matter of getting the right data because is putting out probably about the right amount. It's putting out about 10 strips per second there it looks like every click. So now it kind of just looks like maybe the imaging wiring might be just a little off or something possibly.

PH: Getting a lot of noise on the PVM now.

AR: Roger that. It looks awful compared to the last flight, which was very, very quiet on the PVM.

PH: The PVM is shooting up to 2 g m^3 on occasion. The DMT is also going up to a few tenths quite frequently. We're just coming up to the coastline here. I just made contact with the S-Pol radar. The plans are unchanged. That is, we'll head out southwest from the radar and we're going to have to head out way beyond the radar range to get into any rainband. Art, what sort of altitude do you think might be best to head out from point of view of data?

AR: I don't think there's going to be any warm clouds out there for quite awhile, so I'm thinking maybe this very level. It's near the freezing level/melting level and so forth. I don't know how important that is in this project, but it's looking pretty good as far as particles.

PH: We're at 8,000 ft, static temperature 1.6° . We'll stay here for awhile.

AR: Actually this maybe that midlevel band that was about to make landfall when we were in the office looking at that visible satellite image. I think actually if we go out 100 to 150 miles I think probably by that time we will see some lower clouds out there. I'm guessing this first band is maybe a midlevel phenomenon that may

bring sprinkles to the ground or a very, very light precip. I suppose the radar folks can fill us in on that.

PH: Are you getting anything on the HVPS.

AR: It looked real good here for awhile and now it's got a noise streak in it. That gets to be kind of a problem, but there are images there. They're coming through fast and furious.

PH: I'm looking at it. I can see the horizontal green line. Is that the noise streak?

AR: That's affirmative.

PH: I can't see much else. Are there flashes of little points or something on it?

AR: Yes. These little dots are the precip and we're in a weak area of precip right now. I wouldn't expect too much and they're probably on the small side. They will be increasing here again in a minute.

PH: Larry. Hello Larry or Jerry.

LS: Go ahead, Peter.

PH: I just made contact with the radar that we're just flying over now and the plan is unchanged. We'll head out southwest on that radial I gave you and we're going to have to head out for about 150 miles before we get into the rainband. This altitude is fine for awhile.

LS: I've got to block altitude for now from the Center from 3,000 to 12,000 ft. We can work on that and get something more later if you want.

PH: Fine.

AR: Particles on the HVPS are looking a little better now.

PH: I seen them now. They're just little flashes going by.

AR: It's maybe that we're in heavier precip.

LS: Peter, you want to be back in research speed at the first point?

PH: This is okay at the moment. I'll let you know when we need to drop to research speed.

LS: Okay.

TW: Art, it's going to be hard to tell spacing because if I made it real time going by you wouldn't even see them go by. So I have to shrink the spacing a little bit just so. If I drop the spacing, then the particles are going to be here and you're not going to be seeing anything and they'll get way behind. So what I do is you can set a value on how much you want the open spaces to be truncated. Like if you say 400 pixels, then anything over 400 pixels, like a gap, will be shrunk down to 400 or an overflow that means when the probe is blocked. It's hot back here.

PH: Larry, let's drop down to research speed now, down to about 160 knots.

JR: Okay Peter. Slowing to 160.

TW: But if it gets more crowded you'll be able to see it, but the maximum width or the maximum space between particles will be 400 pixels.

3:42 PM

AR: How would it do if you treated it like the 2-D where you had a strip that you could look at for a second and the rate of strips was proportional to the concentration.

TW: The strips are a little different format. I mean it's just one continuous movie here. I could try maybe drawing it as a strip. It's in a totally completely different format. The strips here are exactly 1,024 slices. Here they could be 4,000,000 slices.

PH: Lots more noise just came on the HVPS in the form of lines. It's gone off again now.

AR: Roger. That's the sort of thing we did see on the last flight as well. Those things coming and going with time.

PH: This reading of cloud particles I've got 2 to 47 microns. What instrument is that?

AR: The FSSP-100.

PH: Now for about 2 min there, the PVM was fairly quiet and then in just a half a minute or so ago it got some noise on it.

AR: Well, this is the phenomenon where it's real noisy when there's no liquid water and then when the liquid water kicks into some minimal value actually the noise quits and it looks pretty good during those times.

PH: Now I'm seeing pretty good correspondence between the liquid water meters over the last minute or so. Just by eye they seem to be tracking each other reasonably except for that DMT, for which the noise is destroying its reading I think. A whole lot of noise just came on the PVM again.

3:45 PM

AR: Well, the radar is working back here, Peter. That's another good thing here. We are seeing precip from the aircraft down to the ground.

3:46 PM

AR: Tom, do you copy?

TW: Yes I do.

AR: Do you have to set the true airspeed for the HVPS or does it read from our data files somewhere?

TW: It reads from the current readings right now. There's one caveat there is if you change how you compute TANS like post flight, that will not be affected in the 2-D because it's used instantaneously on the probe.

AR: Roger. Because I now that on the first processing software it does have an ____ for true airspeed at least the last time I looked at it.

TW: The probe and the board we need to feed it to the TANS so it will shape the particles correctly.

AR: Larry, it's still blazing hot back here. I don't know I guess there's nothing we can do about it.

JR: We've got it as low as we can right now, Art. You're going to have to wait for it to cycle again.

PH: You can come up here, Art. There's no reason to stay back there.

GG: Peter, I wanted to let you know that they added one little feature to that radio switch and there will be a little bit of audio cross talk from the radio into your headset, so you might be able to hear them in the background if you're trying to talk.

PH: Yes, I noticed that.

3:49 PM

PH: Go on "chat." Just tell everyone that we are going to be heading out quite a distance offshore, 150 to 200 miles, so you might want to put on your life jackets.

3:52 PM

PH: For the moment we've got clearance for between about 7,000 to 12,000 ft or something like that. We could go up to this stuff.

AR: I was just saying that looking ahead the ceiling lowers again, so at this level we're just going to go right into it again.

PH: Okay.

AR: I would guess it just continues to lower all the way out to the main frontal band. I don't think this is just an isolated band like that last thing was.

PH: What do you think the winds look like?

AR: 215, that looks pretty darn good. From the models we're predicting just about 200 to 210.

PH: We've got 180 magnetic there.

AR: That's looks outstanding. That would be $21 + 187$, so that's 208.

PH: The wind speed in knots is 23 meters per second.

AR: 45 knots. That looks excellent. At 8,000 ft and the way the models had this depicted, that looks right dead on.

3:54 PM

PH: We are supposed to be at research speed, but they're pretty high they're still at 180. Research speed is supposed to be down at 160. I'll ask him what speed he's got up there. Hi Jerry.

AR: It looks like the HVPS is dead.

PH: That's okay. It stops recording when we're not getting any images. Larry or Jerry.

3:56 PM

PH: Getting swamped with noise on the PVM now.

AR: It looks like precip in about 30 s to a minute.

PH: Jerry?

JR: Peter, what do you need?

PH: What speed do you have?

JR: We're flying at 160.

PH: Because I'm reading back here 189, is that wrong?

JR: It jumped up when that heat comes on for wing.

PH: But you're reading 160 are you?

JR: It's 160 right now Peter.

PH: Thank you. So the pilots are reading 160 knots and we're reading 181.

GG: Is that indicated or true?

PH: That's true.

JR: Ours is indicated.

AR: That explains it.

PH: Okay. Ours is true and the pilot's is indicated. Can we get indicated on here?

GG: We can do it, yes.

PH: That would be better, so I'm reading the same as the pilots. In fact, you can replace that true airspeed in meters per second there by the indicated in knots.

3:58 PM

PH: Replace this one here, true airspeed in meters per second, which is 8 down, by this new one.

4:00 PM

PH: Have you got the units in?

4:01 PM

PH: You've got it in meters per second instead of knots. We're back in precip here. It's still too fast. In knots it was 180 and he said he was 160. You may have to close it down and bring it up again to refresh it.

4:02 PM

PH: It's only in meters per second. All right, we'll take that. Back in clear air.

AR: There's more precip ahead and there's another vault here of lack of precip.

GG: Art, have you checked the actual winds lately for a comparison with what we're calculating?

AR: I looked at the Shadin winds compared to what the models were predicting for this level this afternoon and they looked dead on.

GG: Have you looked at the winds that we're computing from the tans.

AR: I think that's where they were coming from. Wind direction and wind speed here?

GG: Okay.

AR: Degrees from magnetic north.

GG: That's not the Shadin computed winds anymore, that's the tans.

AR: Dead on.

GG: Excellent.

4:04 PM

PH: Jerry?

JR: Peter.

PH: Can we climb 2,000 ft?

JR: Do you want to climb 2,000 ft?

PH: Yes, please.

JR: We can do that.

PH: I want to get up into snow a little bit more, although it's cooling off here.

AR: The ceiling does continue to lower ahead, so there's more out there for sure.

PH: John wanted us to get into a bit more snow.

4:06 PM

PH: Art, what we're going to have to do when we get into an area that we think is pretty good, we're going to have to decide the length of our leg. We'll do runs like this across the rainband.

AR: Today I don't think we're going to get to a back side. It's just too far out, but I guess we can go as far as we can possibly go and then turn around and come back.

PH: Right. Whatever we're in we'll go backward and forward maybe 20 or 30 mile legs and they were recommending changing altitude by 3,000 ft steps.

AR: Okay. It could be on the radar. I was thinking of a satellite picture when I said that. They may see some substructures, you know, banded substructures that aren't visible on the satellite imagery.

PH: We're going to be on our own that far out because we'll be beyond the range of the radar.

AR: I see. Are we out to the edge of the radar yet?

PH: No, nowhere near I don't think.

4:08 PM

AR: We still have a way to go then it looks like. That's good.

JR: We're level at 10,000, Peter.

PH: Thank you.

4:09 PM

AR: Have we climbed yet?

PH: Yes, we climbed to 10,000 ft. We're at 10,000 ft now and it's actually gotten a little bit warmer.

AR: That's interesting. We must be in the frontal boundary, which I guess would go with the sort of overrunning cloud here. That's exactly what I asked. I was looking at the temperature. The HVPS, that's exactly what we had to the best of my memory on that last flight. Periods where it was doing great and then we'd get this stuff.

PH: A lot is noise.

AR: Certainly it wasn't because we were out of the snow because it has been pretty continuous now.

PH: It's okay at the moment. The HVPS is no noise at the moment. It's showing some small images. It looks as if the J-W and the FSSP are the only ones that are giving us any reliable liquid water at the moment.

4:11 PM

PH: In cloud here. It looks as if we're going to go off the edge of our position plot soon. Is Tom there?

4:12 PM

TW: Hello.

PH: It looks as if we're heading so far out to the southwest we're going to go off the edge of our position plot.

TW: It might be a different color, the water, but it should still be tracking.

PH: Okay.

TW: When I get time, I'm going to try to get that semi-circle on there. It's a lot of work though. A lot of busy time just cutting up the map.

4:13 PM

LS: Peter.

PH: Yes.

LS: How high do you anticipate flying on this leg?

PH: I think we'd like to go to our max altitude if we can.

LS: I'll get a block on that.

AR: Flying in light snow and from the bubble I was able to detect an altocumulus layer below the aircraft. It appears to be the one that's been holding right around 8,000 to 9,000 ft just above the aircraft as we flew out here.

4:16 PM

AR: The ground is no longer visible. Peter is talking on the phone to the radar at 011105 and so if there's any interference we'll see it then. We're also continuing

to get altocumulus flakes in here. Not a continuous layer at least up until now, but we are getting concentrations up to about 100 from liquid droplet clouds embedded in the altostratus/nimbostratus cloud. The radar is working. It would appear to indicate precip to the ground, although just before this I, in fact, can see the ocean and I can see some droplet cloud going by. So I kind of doubt the precip goes to the ground. I'm going to check it right now.

PH: Larry or Jerry?

4:17 PM

DS: How's the video looking Grant?

GG: Video?

PH: Hello Larry or Jerry?

JR: Go Peter.

PH: Just to give you a heads up, once we reach the maximum point outwards on this radial here, we'll be doing tracks backward and forward on this southwest to northeast line. The tracks will be about 30 miles long each and after each track we'll climb 3,000 ft, do another horizontal track, climb another 3,000 ft, another horizontal track and so on up to our max altitude.

JR: We're going up to the furthestmost point and then climb 3,000 ft and about 30 mile legs, is that affirmative?

PH: Yes, that's right.

JR: Okay.

PH: Basically it's our stacked pattern, but instead of 2,000 ft intervals shown in that pattern we will be doing 3,000 ft. If you have the Ops Plans that I gave you, I can give you the page number so you can see the type of pattern we will be doing. It's on page 37. You got it there.

JR: Page 37, okay.

PH: It shows that stacked pattern. It shows the legs being about 43 nautical miles long. I think we can make them 30 miles today. It shows the interval between each leg as being 2,000 ft. We'll make it 3,000 ft today and we'll be starting at our present altitude and then stepping upwards to max altitude.

JR: Okay.

PH: But we'll do that when I give you the word.

JR: Very good.

4:20 PM

AR: The clouds are definitely starting to look more robust here in the last 5 min. Many more layer droplet clouds embedded in this fall of snow. To me it always indicates we're getting into a good lifting zone.

PH: I want to try to see where we are on our map here now. We're at about 125°40' and below 46°.

4:21 PM

PH: We're about there. When you think it starts to look pretty good, I think we'll start to do our tracks and do our steps upward.

AR: About 2 min ago I noticed that the clouds were definitely droplet layers were becoming more numerous. They were below or at the level of the aircraft and also above us. That was an enhancement that was pretty significant because usually you don't see those droplet clouds popping out unless there's some pretty good lifting going on. So I'm guessing that we're starting into the main rainband, which extends well out beyond that radar range.

PH: Jerry?

4:22 PM

PH: Jerry?

JR: Peter.

PH: When we get out to 100 nautical miles from Westport, that's where we'll start our legs. So let me know when we reach about 100 miles out.

JR: Okay.

4:24 PM

AR: I can still just make out the ocean surface down there looking straight down. So we're not in anything particularly heavy.

PH: So we're approaching 100 miles out from the radar and we're in some cloud and precip here. So we're going to very soon start our stacked legs starting at 12,000 ft and working upward in 3,000-ft intervals.

4:26 PM

PH: We're starting our climb to 12,000 ft.

AR: I needed to see the ocean surface and white caps and what not looking...

JR: Peter, are we getting ready to climb or do you just want to get up to altitude as fast as we can?

PH: Let's go up about 1,000 ft/min.

JR: 1,000 ft/min. Okay.

AR: From ocean surface you can see this is a pretty plainly evident here that high flight level and the radar is indicating that we're just flying in virga still.

4:27 PM

AR: Peter, does the radar see any precip off this way out to their limit?

PH: We're right at their limit now. Let me check with them.

4:28 PM

LS: Peter, do you just want to spiral up in this position and go up to 13,000 ft?

AR: He's talking to the radar, Larry. I believe he wants to continue the heading southwest bound or whatever we've been heading.

LS: No, that's not what he told us, Art. He said at 100 miles out he wanted to start his racetrack.

AR: Sorry. I missed that.

PH: Larry.

LS: Go ahead Peter.

PH: Yes. That's correct. So as we just discussed we're now climbing up to 12,000 ft. I think we're just about 12,000 ft now. So let's make this our starting point and go 40 miles southwest from here at 12,000 ft. That will be our first leg.

LS: Okay. I thought we were going to go northeast out of that point.

PH: Yes. Maybe I said that, but let's go southwest because that will head us into a bit more precip.

LS: Okay. So we're going to go out to about 140 out and then do a racetrack back to the northeast, is that right?

PH: Yes. If you just head from this point out to the southwest for 40 miles, that will be our first leg at 12,000. At that point, you can climb 3,000 ft and then we'll head back to the northeast at 15.

LS: Okay. We got you.

4:30 PM

AR: I kind of lost sight of the sea surface here, so we have a greater depth of cloud below us now. Still no precip to the ground.

PH: Charles said they were seeing some precip out here. He thought this was a reasonable location to do our stack here.

AR: Roger. At this second we don't have precip at the ground, but I would agree on this heading another 40 miles is probably the right thing to do to get into that precip if it does reach the ground.

4:31 PM

PH: Static temperature -4° here.

4:32 PM

PH: We just made our turn and we're now heading back toward the southwest. This will be our first leg at 12,000 ft. Terrible noise on the PVM.

4:33 PM

PH: HVPS looks okay no noise at the moment.

AR: Starting to add some patchy, I guess, but heavier droplet cloud below the aircraft now. So we're picking up a little more action.

PH: The J-W reading about 0.1, but the FSSP is only reading 0.01.

4:35 PM

PH: Larry?

LS: Go ahead Peter.

PH: So I see we're heading back south now and so this will be our 40-mile leg at 12,000 ft.

LS: Okay. We were going to go out 30 more miles here, Peter, and then start our turn back.

PH: Okay. It looks to me as if your heading is more south than southwest, is that correct?

LS: We got drifted on that turn and we just corrected back to our own course and we're turning on course now.

PH: Good. All right. If you're going to turn on course now, then let's start the leg there and make it that 40 miles from when you're on course.

LS: Okay. We'll remark 40 miles from here. We've got it.

AR: Sea surface visible. Two rows of altocumulus it looks like below the aircraft. They're thin at this point.

4:37 PM

PH: Art, is the 2-DC working at all?

AR: On the last flight we had a few images pop up every few minutes or so and we haven't even seen that on this flight. However, we are getting as a rule a strip pretty regularly, however, at the moment even that function has stopped for some reason. Whoops, there's a few. It should be firing pretty continuously in this snowfall and I know sometimes it stops and then sometimes it's firing, which we did not see much firing on the last flight. That is the triggering on something going by. So there is some improvement.

PH: You know what I'm thinking is the best thing we could do is send Don or Grant back to Boulder. Take the CPI and the 2-D and the 1-D back with them and spend a few days back there with the people back there and try to work things out and then bring them back here.

AR: You know, I think that's a fabulous idea.

PH: Let me talk to Don and see what he thinks. Can you put him on?

AR: Roger.

4:38 PM

AR: He's coming.

DS: Go.

PH: Don, I'm thinking that perhaps the best thing to do here to try to get our key instruments up is for you, or it could be Grant whichever is the better, to go back to Boulder with the instruments that are not functioning. Spend a few days there both with SPEC and DMT and see if you can't work out the problems with them there and then bring the instruments back with you on the flight.

DS: Okay. That would be fine for the HVPS. There's nothing wrong with the 1-D as far as we can tell and the 2-D looks fine too.

PH: That's not what Art tells me. He says the 2-D is not working.

DS: I know what he's telling you and that's fine and that's true it's not coming across, but the instrument works when it's in the other can. We have wiring problems in the cans that are causing the problems. We've tracked those down. We just have not been able to fix them yet.

PH: So you don't think anything would be gained by going to Boulder? The HVPS seems to be working.

DS: Of course, last flight it didn't work. I put it back in the can and I know it's working and it's working fine. The 1-D probe out there if I put it back in it will make images. I can show you what kind of images it makes. I have a file on one of these boxes. When it's sitting on the ground it does fine. It's when it's in that can.

PH: So you say it's problems with the wiring on the plane itself, both with the 2-DC and the 1-D, but you've just got to keep working on them. The folks back in Boulder can't help you on that.

DS: No really, unless we took the plane with us. The problem is actually in the cans themselves. We've gone through the wiring that's coming from the wings into the aircraft and that rings out fine. We did find one wire that was broken on a connector here and we fixed that. But the problems themselves are actually in the cans.

GG: And one pair that was switched as well.

DS: Yes.

PH: What about CPI? Do you think it's worthwhile one of you going back with the CPI on Monday?

DS: I think that might be a good idea.

PH: Okay. Let's talk about that on the ground.

DS: If I was going to make a suggestion, I would suggest that Grant go because he understands electronics far faster than I do.

PH: What do you think, Grant?

GG: That would fine. Yes. I could do that. Let's talk about it on the ground.

PH: Fine. Larry?

LS: Go ahead, Peter.

PH: We're on a nice heading now. When we reach the endpoint to the southwest, we'll want to do a spiral upward to our new altitude of 15,000 ft before we head back to the northeast.

LS: Okay. We'll do that.

AR: It's looking better below the plane now too. We've lost any indication of the sea surface. It's definitely more droplet cloud layering below us than we had say 3 or 4 min ago. So it's looking a little better.

4:42 PM

AR: Don, could you go to "chat?"

LS: Peter?

PH: Go ahead.

LS: We can operate up in Whiskey 237 if we need to now.

PH: I think this is fine where we are at the moment. Larry, do you remember the lat/long of our northeast position for this 12,000 ft leg?

LS: Yes. I've got it marked on my chart. Standby 1.

AR: That GHz radar is still not indicating precip to the ground even through the clouds below us...

LS: Peter, we're 100 miles out. We're going to do a climbing turn here to 15 and then start back.

PH: Okay. We're 100 miles out here, are we?

LS: Well, we're 100 miles out from that first point that you gave me when we started our plan.

PH: Okay.

LS: We started this leg at 45°45' North/125°50' West.

PH: Is that decimals like 45.41 and 125.5?

LS: That's degrees and minutes.

PH: Okay. Got it, 45°45' and 125°50'.

LS: Make it 125°40'.

PH: Okay. Thank you.

4:46 PM

AR: Even in here, Peter, the sky was slightly bluish as a thin spot in the air, overlying cloud comes across.

4:47 PM

LS: Peter, we're not quite at 15, but do you want us to proceed northeast bound or do want to go ahead and get the altitude before we start back?

PH: No. Let's get our altitude first before we start back on the same line that we came out on.

LS: Okay. Do you want to be on the line or just a couple miles off it?

PH: I'd like to be on the line, so as you climb if you can get back on the line back where we ended at the southwest position.

LS: Okay.

END TAPE 1, SIDE 1

AR: Sea surface not visible. The cloud has thickened overhead of the aircraft since I last mentioned the blue spot. That was probably a minute or two before the turnaround point. Continuing very light snow. HVPS shows little in the way of large, much in the way of aggregates I would say. Clearing some altocumulus

layers below us that have made the sea surface impossible to see. Still no precipitation much below the aircraft according to the radar.

4:50 PM

PH: HVPS looks okay. I don't see any noise on it. We're just coming up to completing our climb to 15,000 ft.

LS: Peter, we're at 15,000 ft now and we're northeast bound.

PH: Okay Larry. Thank you. We're at 15,000 ft now and starting our leg from the southwest back to me northeast.

AR: Turning to the northeast and that means the thin spot is actually quite a way out here, so we really don't appear to be in the main bank at least solidly in it of this frontal band.

PH: I'm hoping it will come through us during the course of our maneuvers here.

4:51 PM

AR: Indicating precip only just below the aircraft, nowhere near the ground out here, Peter. I was hoping for more since we are at our southwest point.

PH: We'll see what John is seeing on the radar. He said he saw something out here, but I don't know. As I say, I'm hoping it will drift through us as we do our climb and descent here. We're going to be here for quite a while, so something may come through us.

4:52 PM

PH: I just spoke to S-Pol radar and they say that our northeast point is right on the edge of the incoming precip and our southwest point is therefore deeper into the incoming precip. They're not surprised we're not seeing precip on the ground here because it's an overrunning warm front of situation, but things should get deeper and better from the point of view of precip as time goes on. So we'll keep on this track.

AR: Roger. It makes me wonder about the aircraft radar then. If he's seeing precip to the ground, then I we should see it you'd think. Are we going to go to lower levels and check out the bottom of this, Peter, or is it mainly aloft study.

PH: I thought since we were already at 12,000 ft, we'd climb up first of all and then we'll do our descent at the end.

4:55 PM

PH: Could someone put the lights on in the cabin?

4:56 PM

DS: Grant, go to "chat" please.

PH: Grant is trying to put the cabin lights on at the moment. Larry?

JR: Go ahead Peter.

PH: I think we're overshooting toward the northeast on our leg.

JR: Actually, we're right on the track now. We're just turning back right on the track.

PH: Yes, we're right on the track, but I think we overshot the northeast point that we started the leg on. We should be doing a spiral up now to 18,000 ft at this position before we head back to the southwest.

JR: That was a 30-mile leg there, Peter, so do you want to do 30-mile legs?

PH: Well, the initial point, the northeast point that Larry gave me was $45^{\circ}45'125^{\circ}40'$. That was the start point from the northeast, that northeast start point.

JR: We started at 48 miles on the GPS and we're showing 75 now, so we're coming up on 30 miles.

PH: Okay. Let's climb here to 18,000 ft. Spiral up at this point to 18,000 ft and then we'll return to our southwest location at 18,000 ft.

JR: Very good. Climbing up to 18,000 ft.

5:00 PM

PH: Got some noise on the HVPS, a horizontal line.

5:02 PM

PH: I don't think the FSSP is working well. The J-W is reading 0.13 g/m^3 and the FSSP is down near 0.01 g/m^3 . We're in a period here where the PVM is noise free.

GG: Spoke to soon there, Peter.

PH: There's one that popped up.

5:03 PM

PH: Now there's a whole burst of noise on the PVM. Jerry?

JR: Peter, go ahead.

PH: Are we pressurized?

JR: Yes sir.

PH: Thank you.

JR: We're showing 8,000 ft cabin, Peter.

PH: Okay.

5:04 PM

LS: Peter, we're at 18,000 ft now and we're swinging back to a southwest course.

PH: Okay. We'll do a 40-mile track back down to the southwest.

LS: Okay.

5:06 PM

PH: Larry, what do you think our ceiling will be?

LS: Probably about 20,000 ft with all this engine heat on, Peter.

PH: Okay.

LS: We were down to about 500 ft a minute rate of climb there from 15,000 ft to 18,000 ft.

5:07 PM

PH: The temperature is -13°C .

5:08 PM

PH: Larry tells me the ceiling today is going to be 20,000 ft, which is rather disappointing.

AR: What's the reason for that?

PH: He said something about engine heating.

AR: I hadn't heard that before. Is that because it's cold outside? I guess I'm not quite sure what that is. Maybe I should ask him.

PH: I don't know. It's a long way off from 32,000 ft we got in the Arctic. We're never going to be as light as this again.

AR: Yes.

PH: What's this flashing I'm seeing on the HVPS? It's sort of flashing strip numbers.

TW: That's due to the strips going by so fast. That's why it flashes. It's drawing it, but then it's scooting onto the left.

PH: Is it working okay?

TW: It looks like it.

PH: I haven't seen that flashing before.

TW: It's been there all the time.

PH: Tom, when you've got nothing else to do, and I'm sure you have at the present time, but it would be nice to extend that map out to I'd say about 200 miles in the southwest direction here, 200 miles from Westport.

TW: Okay.

5:10 PM

PH: Grant, go on "chat."

5:11 PM

JR: Peter, Jerry here.

5:16 PM

JR: Peter, Jerry.

PH: Go ahead Jerry.

JR: How high do you want to go on the next leg back? We're at 18,000 ft. So if we go up 3,000 ft, that will put us at 21,000 ft. I'd like to request that altitude.

PH: Yes. Let's try 21,000 ft if we can get there.

JR: Okay.

GG: Just to finish that statement, we're going to measure the attenuation out to both antennas through the wave deck.

5:17 PM

PH: Grant, after about what time do you think you'll be ready to leave tomorrow?

GG: If I can get the dog over there, I could leave by 9 or 10 o'clock.

PH: Okay. I'll relay that to John and maybe Jean can start seeing what flights are available.

5:18 PM

AR: Thin spots visible at overcast. It appears to be some droplet cloud up there actually, kind of amazing because we're at almost 18,000 ft now.

DS: Tom, are you there?

TW: Yes I am.

DS: Also notice that the strip chart is doing the same thing on this machine if that's of any help.

TW: It just kind of flakes out?

DS: Yes.

TW: I was wondering if maybe in the BIOS there might be some floating point settings or something like that possibly.

DS: Let's go over to "chat" real quick.

5:19 PM

PH: Grant? Jerry?

LS: Go ahead Peter.

PH: It looks as if we're approaching our southwest point, right?

LS: Affirm. We've got another few miles to go.

PH: Good. Then you'll be climbing to 21,000 ft if you can get that.

LS: Okay. If we can get it up there, we'll do it.

PH: Okay. If it starts to drag out to long and use too much fuel, then just cut it short.

LS: Okay. We'll take whatever altitude we feel is sort of a ceiling there.

5:20 PM

LS: Art, I think we might be on top. What do you say, between layers?

AR: Between layers.

PH: We're not on top I don't think, Larry.

LS: It's not on top, but I do think we're between layers here.

AR: Roger on that.

GG: Are we out of precip momentarily?

PH: There's a little bit of liquid water here on the J-W. We've got 0.1 grams per cubic meter. I don't see any precip.

GG: It seems to be a little bit high to me, but I'm not that meteorologically inclined.

AR: It's an offset that we had pretty much the whole flight about 0.11-0.12 g/m³. You can see there's no FSSP concentration.

PH: I've been assuming the J-W is correct and the FSSP was too low, but you're saying that the FSSP is correct and the J-W is too high. We've got four liquid water readings without knowing whether we've got a reliable one.

AR: The J-W (skip), but it does seem to have responded to liquid water regions. So once the offset is subtracted, that 0.11, it probably would be okay.

GG: I rezeroed the J-W shortly after we departed, but it might have drifted. Do you want me to rezero it now?

AR: Yes. That's what we should do.

GG: Roger that.

PH: Just got lots of noise on the PVM. The DMT has got its usual noise.

GG: I'm beginning to think we have a bad cable on that PVM.

5:25 PM

GG: Are we still clear of precip, Art?

AR: There are ice crystals (skip).

5:26 PM

PH: You zeroed the J-W now?

GG: That's correct.

PH: It's so unsatisfactory though to zero it and then have it drift. You never know where you are.

5:27 PM

PH: What's happened to Art? I think he's gone offline. He's coming in broken anyway. I think he's gone out completely now.

LS: Okay everybody, our cabin oxygen at altitude here is 10,000 ft, so there's oxygen available if you want it.

PH: Okay. Are we still climbing or is this it?

LS: We're at 21,000 ft right now, Peter.

PH: We're heading back toward the northeast.

LS: We're a little bit to the left of course, but we'll be back on here shortly.

5:29 PM

PH: Temperature here is -17°C .

LS: Peter, we're heading back more prescribed now.

PH: Thank you.

5:30 PM

PH: The J-W is now reading 0.03 and the FSSP is reading 0.005 g/m^3 .

5:31 PM

PH: Is Art on the line? What's happened to Art? I think his headset has gone dead.

5:32 PM

PH: I just spoke to the S-Pol radar, they said there's a nice rainband here that we're flying in, but there's not too much evidence in flight. They may shift us toward the northeast a bit later on. At the moment, we're about half way back from our southwesterly point heading back toward the northeast at 21,000 ft.

5:36 PM

PH: Getting noise on the HVPS here.

AR: Testing 1, 2, 3.

PH: I can hear you, Art.

AR: Don has generously loaned me his headset.

PH: Okay.

AR: I was just going to say we're flying so close to the top we're probably not going to get to much in the way of precip data. In fact, the stuff out there is probably even a little too small for the HVPS to really document as well as it could because they're probably little single crystals.

PH: Well we can't go higher. So on the next leg back to the southwest, we'll be dropping down. Any recommendations on an altitude?

AR: Yes. I was just saying that we're probably so close to the top that we're getting tiny crystals that probably only the CPI and the 2-DC would do a good job on and probably we would have to get lower, probably around 10,000 ft.

PH: You think we should go way back to 10,000 ft? Because they say they see a good rainband here on the radar. So you think it's way below us, do you?

AR: After I thought about this, I don't think they're seeing precip to the ground because of our distance away from them. You know, it would be looking at something in the midlevels; although this is an educated guess, but that would be my thought on it. Maybe precip gets down to 5,000 to 10,000 ft and either evaporates or is very light.

PH: Well we started at 12,000 ft, so you think we should go back and descend to 10,000 ft.

AR: I think I'd probably do halfway between here and 10,000 ft just to speed things up, so we don't miss anything on the way down just in case there's something interesting around 15,000 ft.

PH: We seem to be getting noise on the HVPS now.

5:39 PM

PH: I certainly haven't seen much of interest on this flight.

AR: No. I haven't seen anything in the way of structure looking at the HVPS or the FSSP or anything. It's been pretty much ice cloud above 15,000-12,000 ft and then some slivers of altocumulus around 8,000 and 10,000 or 12,000 ft. There were at least two layers at one point at around 8,000 and 12,000 ft.

5:40 PM

PH: Larry or Jerry?

JR: Go ahead Peter.

PH: When we reach our northeasterly point, we want to descend to that point at 1,000 ft/min. Let's descend down to 15,000 ft.

JR: Okay. 1,000 ft/min down to 15,000 ft.

PH: At our northeasterly point, yes.

JR: Okay.

AR: We can see the moon off ahead of the right wing now about 2 o'clock high.

5:42 PM

PH: So we didn't miss very much by not climbing higher than this.

JR: I got us about 3 miles to go, Peter, to start on down to 15,000 ft.

PH: Thanks Jerry.

5:43 PM

PH: We're at our northeasterly point and we're descending down to 15,000 ft, just going through 18,000 ft.

5:47 PM

AR: Just thinking on this pass, Peter, coming up, we'll be looking at the contribution of the dendritic temperature zone to this level. On that last one we were flying around -22° or so. We were in the region above the dendritic formation and so we could see what was falling down in there and now we're sort of looking at what's coming out the bottom. So maybe that will have some use.

PH: Yes. It would probably be quite interesting if we had the CPI imagery.

AR: Yes. That's really where that would come in because then you could see how much ice enhancement might have occurred in even this kind of dead cloud without any droplets or anything. It's probably supersaturated with respect to ice. But if there is fragmentation, it would have been without drops being involved why this would have been a good case for that.

LS: Peter, we're at 15,000 ft now southwest bound.

PH: Okay Larry.

5:50 PM

PH: What about this noise on the HVPS, Art?

AR: We can recover particles, but it is according to Alexi problematic.

PH: Have we seen that noise before? Did we get it in KWAJEX?

AR: I think we did, but I'm not 100% certain on that. I'm probably 60% sure. We have seen it in this project before in our test flights. We did have it on our last flight for example at times. Then suddenly it's like right now and it looks real good. Because we're going down does raise the possibility of some condensation on a lens some place.

PH: Well we had it going up as well, didn't we?

AR: Yes. It didn't look quite as bad as coming down, but that's a good point.

PH: Are you reading us, Grant?

AR: Sorry Peter, could you repeat that?

PH: I was wondering if Grant was listening. He's not. I'm going to go over and see if I can get him.

TW: I was listening to that and my guess is that HVPS every once in a while does a diagnostic check and it does like a "bean" profile and that's why it all of a sudden kind of fixes itself or the lens gets dried off. But when we're in the hangar and we get things like that, it usually means I sprayed the lens with water.

5:52 PM

TW: So Art, what kind of precipitation is this, pretty light?

AR: Exactly. This would be Colorado snow. That's what I'd call it, dry, unrimmed accumulating maybe 1/2 inch every 2 hr.

5:53 PM

PH: Temperature -6° here at 15,000 ft.

5:54 PM

AR: Don was just flipping the radar up and down and the signal looks real good. We have a lot of return above us probably for a 1 to maybe 2 kilometers or more and it thins out like a typical cirrus or altostratus cloud with height, but below us, Peter, not much. It's well above the ground. There's no echo anywhere near the ground here. The Ophir is about 3° higher than the ambient temperature at this point. So there's a problem there that maybe just cleaning it would do it. The chilled mirror is close within a few tenths of the ambient t-stat.

5:58 PM

PH: Larry or Jerry?

JR: Go ahead Peter.

PH: Our next level will be 10,000 ft, but I want to give you some new endpoints.

JR: Okay. You want 10,000 ft, but you've got some new coordinates.

PH: Yes. After we finish this leg, we'll finish this leg at 15,000 ft to our southwest point. At that southwest point, we'll descend to 10,000 ft, but before we go back to the northeast I want to give you new endpoints.

JR: Okay.

PH: I'll give you those new endpoints during the descent to 10,000 ft.

JR: Okay.

5:59 PM

PH: Art, are you seeing much at this level?

AR: I see about the same as we saw before at 21,000 ft except the particles are a little larger. There's no liquid water just all ice. A very inert cloud system.

6:01 PM

PH: We're still at 15,000 ft heading toward our southwesterly point. I was just given new endpoints from the S-Pol radar for the return to the northeast and I'll be relaying those to the pilot shortly.

JR: We've got 2 miles to go, Peter, and we're going to start descending to 10,000 ft.

PH: Let me give you the new endpoints as we descend to 10,000 ft you can start to head toward the new southwest endpoint.

JR: Go ahead, Peter, when you've got them.

PH: The new southwest endpoint will be $45^{\circ}40'/126^{\circ}0'$.

JR: Okay. Got it.

PH: The new northeast point will be $46^{\circ}20'/125^{\circ}$ west.

LS: Okay.

PH: Do you want to repeat those back to me?

LS: Okay. $45^{\circ}40'/126^{\circ}$ and $46^{\circ}20'$ and 125° .

PH: Correct. We'll now descend to 10,000 ft and as you're descending you can head toward the new southwest point.

6:03 PM

PH: Noise seems to have disappeared from the HVPS, so maybe it was condensation that we picked up on that 1,000 ft/min descent from 20 odd thousand to 15,000 ft. We're now getting noise on the J-W. Big spikes on the J-W every now and again.

AR: We're at our northeast endpoint?

PH: No. We're southwest. We're descending now to 10,000 ft.

AR: Right. I was just going say as we reached that endpoint then I wanted to make sure I had the right one. The moon is gone and suddenly the HVPS just over the last minute to 30 s has really started to pick up precip particles.

PH: Yes and the noise has cleared up. We're getting some noise on the J-W now every now and again.

AR: Right.

PH: We've got some slightly new endpoints, but essentially as far as we're concerned they don't really differ too much. But as we descend to 10,000 ft, we'll be picking up our new southwest endpoint before we return back to the northeast.

6:06 PM

AR: I just have a feeling that this big pickup in particles here, or back there actually when we were up at 15,000 ft, was the leading edge sense we were at the southwest point of that main rainband that I guess will come through Seattle tomorrow morning some time.

PH: Well they were telling me earlier from the S-Pol radar that our northeast point was at the leading edge and that was about an hour ago. So our southwest point should be into the rainband.

AR: Yes. Absolutely. Yes that makes sense, but again I'm suspecting they may have been looking at precip aloft. But I guess that as we get down, we'll sure find out.

PH: Well this is a warm frontal situation, so we're going to get most of it aloft.

6:10 PM

AR: And if we had all our small crystal imaging instruments on board, this would be another interesting area because we were right in the Hallett-Mossop riming splintering peak of about -4.5° to -5° or so here at it looks like we're a little below 10,000 ft now. I still didn't see any droplet cloud in that descent, so it's still pretty glaciated all the way up from here anyway.

PH: Are we at 10,000 ft now, Larry?

JR: Just leveling out now, Peter.

LS: Affirmative, Peter. We're at 10,000 ft and we're about 16 miles north of our point. When we go over it, we'll reverse and start back up northeast bound.

PH: Thank you.

6:11 PM

AR: Starting to get some droplet cloud in here now down at 10,000 ft on our way out toward the southwest again. Just momentary peaks up to about 50 or so.

6:16 PM

LS: Peter, we're starting our reversal here and we'll be back north bound on the track there in about 2 1/2 min.

PH: Okay Larry.

6:18 PM

LS: Peter, we're northeast bound and on our way to the second point.

GG: He's off the mike right now, Larry, but I'll tell him when he gets back.

LS: Okay.

6:21 PM

PH: Hi Larry.

LS: Go ahead Peter.

PH: Were you trying to talk to me?

LS: Yes. We're on our northeast bound leg there and it's 44 miles from point 2.

PH: Thank you.

6:24 PM

LS: Peter.

PH: Go ahead.

LS: I just talked on the radio there and got the weather for Paine Field. It's good, but they said they're starting to get some rain along the coast now.

PH: Good.

6:31 PM

LS: Peter, we're about 15 miles from our point there. What do you want to do when we get there?

PH: Then go back to the southwest at 7,000 ft.

LS: Okay.

AR: It's going to be a good test level, Peter, because this radar is not indicating precip at that level.

PH: Yes. John was seeing precip down to the bottom of his radar display on his RHI, but he didn't know what the bottom of that was out here.

AR: I'm pretty sure it's a few thousand feet at least at this distance. From the flight scientist's manual, I think there is one of those nomograms for radar height and distance versus distance.

PH: I think John has one. In fact there's one in the ops plan for IMPROVE.

AR: You're exactly right. That's where I saw it. Maybe I'll just go look it up.

6:33 PM

AR: It looks like at 100 nautical miles at 1/2 a degree elevation the minimum height would be 3,500 ft.

PH: 3,500?

AR: Yes at 100 nautical miles. I don't know how many nautical miles we are from them now.

PH: Well it's about that. We'll see how low we can fly here.

LS: Peter, starting our reversal and descending to 7,000 ft.

PH: Thank you.

6:36 PM

PH: Larry told me earlier on that the FAA would not allow us to fly below 5,500 ft in this corridor because we're off their radar. So we'll see if that's the case today.

AR: Yes. That's right. We're coming back into some droplet clouds in here at pretty much the same level as we saw very early in the flight. We were first climbing from about 8,000 or 9,000 ft on up. We had some droplet cloud layers here, very thin ones, and pretty much the same thing here.

PH: What are you looking at?

AR: I'm looking at the FSSP droplet concentration and also the FSSP liquid water content.

AR: We went through some cloud just a minute ago. If you have one of your liquid water traces, you can see there is a blip. But we're descending, so we went through the layer or at least a patch of a layer.

PH: Yes.

6:37 PM

AR: Going back through that inversion again because the temperature is falling as we descend pretty much like we saw before.

6:38 PM

AR: Inversion and wind shear probably explains the turbulence we're starting to pick up here.

6:39 PM

LS: If anybody is interested, the winds in this descent are from 140° at 55 knots.

PH: Larry, was that wind from true or magnetic?

LS: That would have been magnetic, Peter, and add 20 to that so make it 162°.

6:41 PM

AR: Your wind calculations are very close to that 168° at 35 knots just a second ago before they dropped out.

6:42 PM

PH: He gave 55 knots.

GG: Roger.

PH: Okay. We've got about 70.

AR: I'm reading back here. Maybe my file isn't updated, but it says 33 knots.

PH: Well it's fluctuating. It's 35 now, 33. It's close enough.

GG: Well, we're also not exactly in straight and level flight either.

LS: We're at 7,000 ft now, Peter, and heading southwest bound.

PH: Thank you.

6:43 PM

AR: It's starting to precip at this level. Now I suspect maybe the radar is missing precip because it didn't look like it extended much below the plane and it certainly does. The particles are larger and they're not evaporating but getting bigger.

GG: I suspect we have a problem with that lower antenna. The upper one seems to be doing all right.

AR: Yes. It looks really good.

6:44 PM

PH: You'd better make it clear when you talk about the radar, Art. Let's say the science radar or 35 GHz otherwise we'll get confused with the pilot's radar.

6:46 PM

AR: It looks like we've gone back through the frontal surface flying level. The warm frontal over running temperature took a climb of about 2°C in the last minute. It took 90 s at the most.

6:51 PM

AR: We had a wind shift from the southeast more to the south, so there was the correctional shear with that temperature change. So it looked pretty real.

PH: That's a nice temperature change there.

6:52 PM

PH: Larry?

LS: Go ahead Peter.

PH: What's our lowest altitude out here we can go to?

LS: We can get down to 2,000 ft, but I think that periodically I see the lower clouds. I think we can probably sneak down to 500 ft visual.

PH: Fair enough. On the return leg then, let's drop down to 5,000 ft.

LS: 5,000 ft. Okay.

6:55 PM

PH: The DMT seems to have gotten noisier as the flight has gone on.

AR: Starting to see the most significant liquid water we've seen in this flight up to about 3/10th to 4/10th.

PH: Right. The DMT is showing that as well. It's strange you know the DMT when it's recording some liquid water doesn't seem to suffer from noise.

AR: I think it's related to the same thing that Grant was talking about earlier this little slight rise in the voltage output from the probe triggers some noise. Once it gets beyond that level, it doesn't have any noise, something like that. I'm sure Grant could do a better job of explaining that.

GG: That's pretty close, Art. There's a narrow band around zero where it tends to produce noise spikes for some reason.

PH: Can you talk to the DMT people about that?

GG: It's not the DMT, it's the A to D converter board. Yes, I've been talking to them. They've sent us code snippets except they sent us the wrong code snippet, but I got back to them and hopefully we'll have some new code in tomorrow. They don't understand the problem either.

6:57 PM

PH: Grant, did you get the information you wanted on the BAT?

GG: I haven't pursued it because we just haven't had time to do anything on it. I've been in contact with Tim but not recently. He's perfectly willing to help me put it together. I just need the time to put it together.

PH: Okay.

6:59 PM

PH: Now we've gone back to low liquid water and the DMT has its usual noise problem.

AR: We just went through another temperature rise of half a degree to three quarters of a degree and further shifting of the wind toward the southwest. It probably happened again about 90 s ago that there was a significant rise.

PH: Jerry?

JR: Peter, go ahead.

PH: What's your roll angle?

JR: Right now it's zero.

PH: Thank you. We've got 1.4°.

7:00 PM

PH: Art, where will the CPI display be?

AR: Right there next to you on your left where that laptop is.

PH: Okay.

7:01 PM

PH: Art, you know that problem we had with the DMT in KWAJEX. We thought it went crazy and had big spikes when we got into precip. Have you noticed anything like that since here?

AR: No I haven't. That was at KWAJEX actually that we had those big spikes.

PH: KWAJEX, yes. What they did was to change the sensor head. We're using the new sensing heads now.

AR: I guess we fixed that.

PH: That's something to keep an eye on now. If we don't get that now, then they've made an improvement in the sensing head. They sent us four or a half a dozen new sensing heads right after KWAJEX, which is what we're now using.

AR: Wow! That sounds pretty good. Pretty generous it sounds too. To bad SPEC can't sent us 4 or 6 CPIs.

7:03 PM

GG: I'm going to change our audiotape right now.

END TAPE 1, SIDE 2

7:04 PM

PH: Larry?

LS: Go ahead Peter.

PH: How much more time on station?

LS: About another 20 min.

PH: Thank you.

7:05 PM

AR: More liquid water here and more cumuliform I would say type of cloud. The temperature is beginning to fall off again. So apparently we've gone through some kind of little warm tongue. It's part of that warm frontal structure. Now we're getting into some maybe slight colder convection as this trough moves toward the coast.

7:06 PM

LS: Peter, I'm going to be reversing here in about another 3 min starting our reversal and dropping down to 5,000 ft heading back northeast bound.

GG: He's talking to S-Pol right now, Larry. Give him a yell in about 3 min.

7:07 PM

AR: The moon is visible at this end of our run.

JR: We've got about 2 miles to go to the point, Peter.

PH: Okay. That's 2 miles to our southwest point.

JR: That's affirmative.

7:08 PM

JR: Here's our point.

PH: Thanks Jerry. So we'll descend to 5,000 ft here and then head back to the northeast.

JR: Okay. 5,000 ft and back to the northeast.

7:09 PM

PH: Let's descend at 1,000 ft/min.

JR: Okay.

7:10 PM

PH: We're starting our descent here to our southwest point at 1,000 ft/min. We'll see if we pick up any noise on the HVPS. It might indicate condensation.

7:11 PM

AR: The moon is continuing to be visible here as we circle down to 5,000 ft. I can see a lower layer. It looks like a lower overcast stratocumulus layer above the plane here. We may get into that. Let's see, it looks like we're at 5,000 ft now, so it's topping out below us. The moon's disc is clearly visible.

LS: Peter, we're at 5,000 ft.

PH: Okay. Let's head back to the northeast.

LS: We're on our way.

7:13 PM

PH: Art?

AR: Roger. I'm back online. I'm changing my clothes. It's flaming hot back here still.

PH: Really, they just haven't solved that problem have they?

AR: No. I know they were sometimes able to fix it, but today it's just one of those things. It's not going to happen.

PH: Why don't you come up here?

AR: I have this laptop that has all the parameters set up the way I like them.

PH: Anyway what I was going to say is we lost the J-W today, didn't we? It's not working.

GG: Yes. Something went berserk in it. The PVM seems to be working fairly well though.

PH: The other three seem to be working when we're in some liquid water, but the old J-W is gone.

7:18 PM

AR: I'm guessing the J-W might not be as bad as it looks outside the spikes.

PH: I can see it's way low even when there are no spikes.

AR: Right. I think that might be an offset because sometimes that happens when we have big altitude changes such as we've had on this flight. So I wouldn't throw it out completely.

PH: I think Don is trying to adjust it now. The J-W shouldn't have to be adjusted like that.

AR: Well from time to time you might. We've had times where Jack really never had to do anything to it and then there were other times in the late 80s and early 90s when it seemed like we were always fussing with it.

GG: Got it on the strip chart.

AR: Yes. I have a strip chart, but it's not the offset corrected one.

GG: I was trying to get that through to Don.

7:19 PM

PH: The good news is that all the other three look very good.

AR: Yes. The FSSP spectra looks real good too, very maritime looking, drops way out beyond 30 microns in diameter at the large end of the tail.

7:20 PM

AR: This maybe the frontal surface again. The winds are backing back toward the southeast a little bit and now the temperature has dropped about 3/4ths of a degree. Of course a little further down the road we will probably have that significant turbulence again or at least noticeable turbulence again.

7:21 PM

AR: It looks like what's happened is that stratocumulus layer that we were over flying at the southwest endpoint the tops have been rising as we've progressed to the

northeast and we've entered the cloud from the top going along this straight line at constant flight level.

7:22 PM

PH: Larry or Jerry?

LS: Go ahead Peter.

PH: I have some new coordinates for you.

LS: Hang on. Go ahead.

PH: Our new northeast point is $46^{\circ}30'/124^{\circ}45'$.

LS: $46^{\circ}30'/124^{\circ}45'$.

PH: Yes. The southwest point $45^{\circ}50'/125^{\circ}45'$.

LS: $45^{\circ}50'/125^{\circ}45'$.

PH: Right. So we'll head at this altitude to our new northeast point.

LS: Okay. So we'll proceed onto the northeast point and then head southwest.

PH: Yes. When we come back southwest, we'll drop down to 3,000 ft.

LS: Roger.

7:25 PM

GG: Just a note here. Don readjusted the zero offset on the J-W and it seems to have brought it back into some measure of functionality. The control is old and wire around and probably corroded from Kwajalein. We're going to replace it with a more modern unit.

PH: Good.

LS: Peter, did you want to proceed to the previous northeast point and then go to the new one?

PH: Yes. Let's go to the previous northeast point and then head to the new one, then drop in altitude and then head back to the new southwest point.

LS: Okay.

7:27 PM

PH: Now that the zero setting on the J-W has been adjusted, we're getting pretty nice agreement between all four liquid water probes except the J-W may still be a little low but not bad.

7:31 PM

PH: Larry, it's getting pretty warm back here.

LS: I've got the heat all the way down, Peter. Peter, we just checked the last point and we're going over to the northeast point that you gave us and it's 12 miles ahead.

PH: Okay Larry. Good. So they're shifting us so as the rainband moves up to the northeast, we're keeping with it.

LS: That's what it looks like.

7:32 PM

PH: Just catching up to that same turbulent region we went through before.

7:33 PM

AR: HVPS has died.

PH: Is that because there is nothing out there though?

AR: That's a very good question. Let me check and see what I can see.

PH: It's come back on.

AR: That's it.

PH: It's gone through a clear slot again here.

AR: It could be. I can make out the disc of the moon and that could very well have been it, Peter, because it's working. So I think that's probably what it was.

PH: We're heading out to our new northeast point, which is a bit closer to the coast each time, so we may have got out from the main precip here.

AR: That's right because I can see pretty clearly the coastline and all the whites and everything.

7:34 PM

AR: I don't know if the heat situation would get better if we weren't pressurized since we're down low we really don't need it.

7:35 PM

AR: Larry, would depressurizing help the heat situation back here, which is still pretty bad?

LS: I guess I can't do any more for you, Art, other than I could depressurize.

AR: I have no idea whether that would help or not. I just threw it out.

PH: So Larry, I assume we have time to go out at 3,000 ft to our southwest point and then the last leg will be back to the northeast at 1,000 ft and then we can head home.

LS: I think probably we are, Peter, we need to be back over Hoquiam headed home in 55 min, so that gives us quite a bit of time.

PH: Okay. We're just about at our northeast point now. When we get there, descend to 3,000 ft, head back at 3,000 ft to our new southwest point that I gave you.

LS: Okay. We're in the descent now.

7:37 PM

AR: We seem to have centered this band pretty well in that the wound was visible both at the southwest point and the northeast point.

LS: Peter, I estimate that we've got time to go back to that point and come back and then we've got to head for Hoquiam.

PH: That's fine.

LS: So how about down there at 3,000 ft and back at 1,000 ft?

PH: Correct.

LS: Okay.

7:38 PM

TW: Hey Art.

AR: Roger.

TW: How's the precip looking out there?

AR: There's none right now.

TW: Good.

AR: And looking out you can see all the lights along the coast. So there is little if anything out there right now.

TW: That's good because the HVPS has been very quiet for like the last 5 min.

AR: Right. The last time I saw that I was so used to seeing the snow go by that I was sure it was malfunctioning, but in fact it was part of a hole. That's what we've got now except it's a bit one.

TW: Thanks.

7:40 PM

PH: Larry?

7:41 PM

AR: There seems to be some bank of clouds out here. I can't really make out whether they're below or above the aircraft or at the aircraft level. We're going to try to head into them. This is offshore back toward the coast. I can see lights for probably 20 miles up the coast. There's a high overcast it looks like. It's probably altostratus up there. I don't see the moon right now though, so it must be pretty thick.

PH: Larry?

7:42 PM

LS: Peter, we're at the northeast point. We're proceeding now down southwesterly and we're at 3,000 ft.

PH: Good. There is no flight tomorrow. There will likely be an early morning flight on Tuesday.

LS: Okay.

7:43 PM

AR: Nice big solid bank of clouds that we're just flying under the edge now. It extends from the southeast through northwest and is pretty solid. It looks like stratus or stratocumulus. It looks like we're going to be near cloud base.

PH: But is it lowering as we go to the southwest?

AR: Well I'm sure there's precip out there I can't really see what it's doing, but it's rather spectacular because it's such a knife-edge wall of solid stratocumulus.

PH: Do you think we should change our altitude? We're on our 3,000-ft leg now just starting to head back to the southwest.

AR: It looks like it's slightly above us. But to be honest, I really can't tell. That would be my best guess that we would probably have to climb maybe 500 to 1,000 ft or something like that. But on the other hand, we may run into it further out here. It's just a little too hard to see for sure.

PH: We came out at 5,000 ft and we're going back at 3,000 ft. I was going to have a final leg back to the northeast at 1,000 ft.

AR: You may be under all that. But, you know, maybe at 3,000 ft I think I would anticipate that we're going to come into some clouds and precipitation out here. I know the precip is going to be there. It's just a question of whether those clouds are out there. My best guess would be that they will be.

PH: Let's hold it for awhile. But if you think we should change it, that should be no problem.

AR: Okay.

LS: Peter?

PH: Yes Larry.

LS: We're not going to be able to make it all the way down to that endpoint and back to Paine with sufficient fuel. We're going to have to cut it short some place.

PH: Okay. Well, just make it as far you can.

LS: Okay.

7:45 PM

PH: Larry?

7:47 PM

PH: Larry or Jerry?

JR: Peter, are you up?

PH: Yes. We're not getting much here. Let's climb 1,000 ft. Let's go to 4,000 ft.

JR: Okay.

LS: Up to 4,000 ft. Peter, we can proceed down this way another 18 miles before we have to turn back.

PH: Okay.

7:48 PM

PH: Larry?

LS: Go ahead.

PH: Would we gain any distance going toward the southwest as we are now if after you reach your southwesterly point we just gave it over to you to head back any way you like?

LS: Say that again, Peter. You were cut out.

PH: If after we reach our southwesterly point if I then just handed it over to you to go home any way you like from that southwesterly point, would that gain us any distance toward the southwest more than the 20 miles you just said?

LS: It probably will. Let me check on it.

7:49 PM

TW: Grant?

GG: Go ahead.

TW: Do you want to go to "chat?"

7:50 PM

LS: Peter, that's not really going to do us very much good because we'll be getting probably about 30 knots of headwind on that leg. Hang on there. I'm looking at the wrong point down there, just a minute.

7:51 PM

PH: Getting back into the turbulence here.

GG: A little disturbing the TANS has been off for about 5 min now.

PH: What was that, Grant?

GG: The TANS shut down. We're getting lat and long, but we're not getting altitude.

7:52 PM

GG: Actually, I'm not so sure about the lat and long right now either.

PH: Altitude looks okay.

GG: Yes. Altitude is changing. Lat and long are changing.

7:53 PM

PH: What are you seeing, Art, anything?

AR: No. I really can't see a thing. There is some scud cloud below us now. We didn't have that before. You can see it off the right wing there. To be honest looking ahead, it just continues to look like we're going to run into something, but it's probably more of an optical illusion since we haven't yet. On the other hand, the frontal zone should be within the next 5 min. That would be the best chance for clouds and precip and all that.

PH: If we get into something, then I suppose we might as well keep with our plan and come down for the return trip down at 1,000 ft as long as we're getting something. Once we come out of it again, there's no point in staying at 1,000 ft. We'll back into nothing.

AR: Right. With the exception of these stratocumulus clouds, for example, off the right wing, but they're a little patchy. They're not solid. So we would be going in and out of something say at 2,000 ft.

PH: At 2,000 ft.

7:54 PM

PH: We're into some rain here.

AR: Right. There is some stuff out there. It's certainly nothing like we saw near the southwest endpoint. We're probably about 5 min upwind of that.

PH: It's streaming off of my window now.

AR: I'm not showing too much on the HVPS though. I hope it's working.

TW: It's actually working. There's a whole bunch of precipitation on it right now, so it's dumping out a whole bunch of records.

AR: I certainly don't see much on there. I see some noise, but I don't see any particles that look like precipitation. From what Peter said, they must be out there.

LS: Peter, we can only continue on this track about another 5 min and then we have to turn for Hoquiam because I've got to check over Hoquiam in 25 min.

PH: Okay Larry. Just give us what you can and then we're heading back into the front now, which is just what we want to do. So that's good. So just keep going as long as you can then we'll break away and we'll come back. Instead of coming back at 1,000 ft, let's come back at 2,000 ft?

LS: Okay. You got cut out there. So you want to go down as far as we can and then come back at 2,000 ft?

PH: Correct. Yes.

LS: Okay.

AR: We're starting to get more precip now. It's bigger particles that just went by. Larry, can you flash your headlights for just a second?

LS: The landing lights are retracting. They'll shine down for you.

AR: Why don't you try that and let's just see what happens. See if we can see anything out there.

PH: It's heavy rain now, Art.

AR: I really can't see anything. Thanks Larry.

PH: I can hear it on the windscreen. It's quite heavy rain now.

AR: Good to get that report. I can pick out something of what the HVPS is doing in that regard.

PH: If you look at one of the bubble windows.

LS: Peter, we're going down to 2,000 ft now and going back straight to Hoquiam.

PH: Okay Larry.

AR: We have some broken clouds down there, stratocumulus.

7:58 PM

AR: The moon's disc is visible. Larry, we'd like to be in these clouds down here below the plane. So if that's not exactly at 2,000 ft, you can adjust your flight level for that in about the middle of them.

LS: Say that again Art.

AR: We want to be in these clouds. That's why we're coming down to 2,000 ft. But if 2,000 ft isn't quite right, although it's looking okay now, we'll adjust the flight level so we'll be in these clouds.

LS: Okay.

AR: So droplet concentrations, Peter, they are really continental. So that's definitely stuff embedded in that southeast or east offshore flow.

PH: Right. 500.

7:59 PM

GG: The TANS just came back.

PH: That's good.

LS: Art, how does it look here at 2,500 ft?

AR: Yes. This is good.

PH: The rain has stopped streaming off my window here now.

AR: Yes. I'm afraid we only nipped that, Peter. There was more out there. We just didn't get to the main bank of this thing and also we're going to be in and out of clouds because it's patchy on this heading.

PH: Yes. Just another 20 miles to the southwest would have done it.

AR: Yes. I think that's right.

LS: Art, do you see that sea sting down there?

PH: I can't see a thing.

AR: I can't see anything actually. I'll maybe look when it's a little darker.

PH: I can't see a thing. What did you want to point out, Larry?

8:01 PM

AR: Yes. I did see it, Larry. What would you say, 30 to 40 knots? If you look straight down, Peter, you can see it.

PH: I suppose we're doing a turn now, so the wind speeds are all over the place. See what they settle down to when we complete our turn.

AR: Just from the sea surface I'd say it's 30 to 40 knots down there.

GG: It was showing 33 meters per second for quite a while before we started that last turn.

AR: I've got a wind burr here that says 180 to 31 knots. Are you getting knots or meters at 30?

PH: That's not knots. That's meters, Art.

GG: Yes. It's meters.

AR: I don't know who put this together, but it says knots on the right-hand side of the text readout. That's not something I adjust.

GG: You an old definitions file. We'll have to update you.

PH: You'd better get that changed. It could cause confusion. We had that confusion earlier on. I was pointing it out to you, Art.

AR: Nobody pointed it out to me.

PH: Remember when I was saying meters per second and you were saying it looks okay.

AR: Mine is reading knots for some reason. It's not reading meters per second. It says its knots.

GG: That's from the old definitions file. I changed it on these other computers about 3 days ago.

AR: So Peter is looking at something different than I'm looking at.

GG: Yes. I'm looking at something different too.

PH: So according to this, we've got about a 60-knot wind out here. Do you think that could be correct?

AR: Not really. I think that's too high. I think 30 knots would have been gorgeous because that's about what the model is predicting, but it's not impossible. It's not one of those that's so far out that you can cast it aside. So I'll look at it closer tomorrow. I'll look at the Quillayute data and so forth.

PH: The direction looks okay, 178°.

AR: Absolutely. That looks pretty darn good. All this time I was so happy with the winds and I probably shouldn't have been quite so happy.

PH: They could be. Maybe my read out here and Grant's is wrong. Maybe that is knots instead of meters per second.

GG: All the calculations are done in meters per second. Let me check the disc file.

8:04 PM

PH: Just record for the tape here that we were going back from our northeast point to the southwest at 3,000 ft. Then we adjusted it up to 4,000 ft to get into more precip, but we had to cut that leg to the southwest short. We only got about halfway out along that leg if that because of fuel shortage. So we have now made the turn and we're heading back again to the northeast at 2,000 ft. So we didn't really get into the heavy precip, which was ahead of us if we had continued our leg out to the southwest which was a pity but there you are. So we're now heading back to the northeast and then we'll be heading home.

TO SUMMARY

GG: Just want to point out that the TANS and the Shadin are both indicating about 30 meters per second from about the same direction.

AR: Okay. That's good to know. I would have thought they were too high, but I'm really glad to hear that. The winds have looked so good in the last flight and really until I found out I was looking at meters per second I thought they were perfect.

PH: Let me check with John Watts and see what winds they've got at Westport.

8:11 PM

AR: Larry, was I talking to you just then? I think my mike was in the wrong position. Sorry about that.

GG: He probably just turned you off, Art.

AR: I can't blame him for that one.

8:12 PM

PH: We only have Westport on the surface, 13 knots.

GG: Can they do a VAD and get us a profile?

PH: Yes. They may be able to. That's just the wind on the surface. Probably just got an anemometer there.

AR: There's no cloud ahead here, Peter, and I don't know if we've past our endpoint or not, but it might be a little smoother and faster trip if we climb to 8,000 or 10,000 ft.

PH: Larry, you can climb now and do what you want to get back home most efficiently. Larry or Jerry, did you read that?

8:14 PM

AR: I think I did my summary and I was talking to the pilots, so they shut everybody off in the back.

PH: Is Don on the headset? Don, give Grant whatever help he needs tomorrow morning to get off. There are two things as far as you are concerned, the 1-D and the 2-D. Okay. If it's easier, do that first. Did you hear that there's no flight tomorrow, but possibly a flight early on Tuesday morning. I guess Grant won't be back then, but we'll go without him.

8:16 PM

TO SUMMARY

LS: Peter, we're going to have to start our climb here in about another 2 min.

PH: Larry, I'll just leave it to you now to get us back most efficiently.

LS: Okay.

TO SUMMARY

PH: Okay. When do we expect that radar component we're waiting for?

GG: It should be in Friday. We may have a handle on the PVM noise problem. It seems that there's a ground missing between the PVM chassis and the A to D converter. We'll put another cable in there that provides a ground and it's working better, so we'll pursue that.

8:17 PM

GG: Tom, are you still on?

TW: Yes. Both of us are.

GG: I just wondered which computer is the one that Art is looking at. I'll send that definitions file over to it.

TW: No. 12.

GG: That's #12.

8:19 PM

TO SUMMARY

8:21 PM

PH: I'm getting into some liquid water here as we go into the lee of the Olympics.

8:35 PM

PH: This transit flight back to Paine Field is almost identical to the one that we want to do across the crest of the Olympics except that in this case the front is still well off the coast. Grant?

GG: Go ahead.

PH: I'm sorry to say I don't think you solved the PVM problem.

GG: I'm sorry to say I'm afraid you're right. It does seem to be related to that cable though because in fiddling with it it should come and go, but on top of the other problem which is the problem around zero.

8:41 PM

PH: The J-W has gone quiet again.

GG: Really, I'll have to take a look.

8:42 PM

PH: Our wind speed has finally come down to more reasonable values. It's still too high I think.

8:44 PM

PH: If that meters per second were knots, it would be about right.

8:45 PM

TW: Grant to "chat."

8:47 PM

PH: Should I switch this radio off, Grant?

8:48 PM END OF TAPE

Summary of UW Flight 1847

PH: I'm going to give a short summary here. This was a pretty good case according to the radar people, synoptic situation and so on. It was a warm front. One of the situations we're interested in. We crossed the warm front several times. We got into some precip. In the early part of the flight, we climbed up to about 21,000 ft. In the later part of the flight, we went down to our lowest level, which is our present level of 2,000 ft. So all that worked out fairly well. Unfortunately, we didn't have the 2-D precip probe on or working anyway or the 2-DC. It was on board but not working. The 1-DC was not on board. We didn't have the CPI. On the good side, however, the HVPS should have provided some data, and the FSSP and the liquid water meters. So that's my summary of this flight. Anyone else want to summarize? Art?

AR: I'll just say that the radar worked real well as far as we could tell except in the downward direction there is some question whether we were looking at all the precip that was below us, but in the upward direction it looked fabulous. So I think we should be pretty pleased about that.

PH: But the radar wasn't recorded.

AR: It wasn't recorded, but at least there are some verbal notes here and there. Back to the black glove technique as far as aircraft measurements. Other than that, the system we flew through you could see on the satellite imagery. They were

northwest to southeast-banded structures coming around a large cyclone whose main center was in the Gulf of Alaska. A secondary center developing off southern Oregon and that actually caused some problems for us because as it redeveloped down to the south this particular band approaching the Washington coast was weakening. We past through a couple of bands on the way out that had really mutated to nothing more than altostratus with virga. Then our main frontal system that we sampled I thought we did a pretty job of centering that pretty well. Either the whole thing or one of the main bands with that warm front because at each end of the turnaround points the moon came out or at least was visible. The moon was not visible through the middle of our track, which is a pretty good indication that we under flew the thickest clouds anyway. The lack of liquid water generally, with the exception of that at the frontal surface around 7,000 ft, was kind of indicative of weak synoptic lifting in this whole thing. As a result we didn't see big aggregates, big ice crystals, rimming, or big clumpy ice crystals associated with rimming and that sort of thing. So it was kind of an inert system, which would produce very, very light precipitation when it makes landfall. That's for sure. Let's see. Can I think of anything else? We sampled at a couple of interesting temperature levels, -21° , -22° . We looked for plates and short columns and that kind of thing. Then our next pass after that highest pass was at the bottom of the dendritic temperature zone looking for change of crystal types and contributions of fragmentation and crystal growth in the dendritic and stellar regions, but of course they're difficult to make out with the HVPS. Then we flew again around 10,000 ft, which happened to be near the peak of the rimming/splintering process. There wasn't any liquid water there and, of course, we didn't see any evidence of splinters being produced. But the time that we had out here, we had a pretty good sampling strategy, I think, by targeting those temperatures because those are temperatures of interest in the cloud microstructure for these models. Then, of course, wrapping it up with the lower legs where we might have had a seeder-feeder type cloud. In fact, we did have one kind of a frontal over running stratocumulus that had liquid water up to half a gram, which is pretty significant. But that was the only place we really saw liquid water was in that stratocumulus layer that we transected at 7,000 ft. I think we touched a little bit maybe at 5,000 ft. Off four flow generally today and that was represented by the lower clouds around 2,000 ft having humungous droplet concentrations for a maritime environment. The highest I saw was over 500/cc, whereas in the meantime our droplet concentrations in the over running maritime cloud were in the 10s per cc. So with our FSSP looking real good and getting some measurements there, we're looking at kind of a continental maritime interaction in the seeder-feeder area of the storm. I guess that's about it. I'm getting too windy.

BACK TO MAIN TEXT

8:16 PM

PH: Do the engineers have anything they want to add to the tape recording? Tom?

TW: Nope.

PH: Do you want to say anything about the HVPS?

TW: It looks like it was working. A lot of times it gets precipitation on the lens and then it cross-triggers and overloads for a period of time. That usually happened when the plane was climbing or descending. So nothing you can kind of do about that. Like right now it's doing it.

PH: It's doing its job.

BACK TO TEXT

8:19 PM

TO SUMMARY

PH: Grant, do you want to put anything on the tape for summary?

GG: I basically just did. The noise problem with the PVM turned out partly at least to be a ground that has come loose or something. We got around that. Otherwise most everything was working okay except that we don't have the 1-D and the 2-D, but we'll have to work on that. It appears with the radar that we're getting some decent signals looking upward. Looking downward it appears we do get some signal through because we can see the ground, however, the precipitation, which we should see when we're in the middle of a cloud, doesn't show up. So I suspect that we have something attenuating the signal. It might be the antenna. It could be something beyond the wave-guides switch. It has to be beyond the switch because we're getting good response out of the upward looking antenna. We'll have recording capability within a week on the radar also. I can't think of anything else pertinent right now.

PH: Have you fixed the PVM now because there's still noise coming in?

GG: Well there's occasional noise, but it's much reduced over what it was. Earlier it was just painting the whole screen on the strip charts. Let me go take a look over here.

8:20 PM

GG: Well, I guess we've had quite a few noise spikes on it. Maybe we're not out of the woods yet.

PH: Yes and on the J-W as well.

GG: The J-W has been really acting up this trip.

8:21 PM