

Flight 1893
November 29, 2001
Voice Transcriptions*
IMPROVE-2

PH: This is UW Flight 1893, 29 November, Thursday. On board Hobbs, Rangno, Wilson, Vidal Salazar (NCAR), Larry Sutherland, Ken McMillen and Calvin Ingram.

4:12 PM

PH: The purpose of today's flight is to go out over the Oregon Cascades to the Santiam Pass area, do our standard vertical profile for IMPROVE-II on a west-east cross-section. There is a trough or maybe a cold front moving in over the Cascades. It's moving pretty fast so we'll see if we get there before it's through. Cloud tops are about 15,000 ft. So with cloud tops at 15,000 ft we'll probably come down from 15,000 ft to as low as we can at 1,500-ft intervals instead of the usual 2,500 ft.

4:13 PM

AR: I've got up to the bubble here after...

PH: Ken?

4:16 PM

PH: Hello Ken.

AR: Clear air counting with the HVPS and 2-D probe at this point. I'm hoping it will go away. It's possibly due to water on the lenses. Noise in DMT as per usual. The computer was not able to be started up by the way for several minutes into the flight so we missed the boundary layer clouds most often because they were too shallow and we got above them before the probe is working. Now we're starting to get some 2-D imagery. In addition to the noise strips, we're starting to get some, that is some particles.

4:17 PM

PH: Ken or Larry.

* AR = Art Rangno, CI = Calvin Ingram, KM = Ken McMillen, LS = Larry Sutherland, PH = Peter Hobbs, RR = Roy Rasmussen, TW = Tom Wilson, VS = Vidal Salazar

AR: These snow crystals are falling from a thin, middle-level virga from it looks like altocumulus clouds, smooth bottoms due to virga. The virga is visible reaching actually to the tops of the Olympics off the right wing.

4:18 PM

AR: We're flying in very light snow. Actually now we've gone into the virga as it lowers toward the south and we're still getting a considerable amount of noise in the 2-DC. Tom, do you copy?

TW: Yes.

AR: The 2-DC doesn't look too good. We're getting particles occasionally, but they should be continuous. I wonder if it's worth cycling the power on that thing and seeing what happens.

TW: I'll try it.

PH: It started off like this yesterday and then it switched in, didn't it?

AR: That was my recollection.

PH: Also I'm getting no strip chart liquid water parameters.

AR: We haven't actually been in any liquid water yet. We went in some as we took off, but the computers weren't up.

PH: Art, we have been in a little bit.

AR: Right. We haven't been in any lately. Any liquid water you see now is probably due to the ice crystals out there, say in the FSSP generating minute amounts.

TW: My guess is that something has got on the probe.

PH: Hello Ken.

4:20 PM

AR: Ken, do you copy? I'm right here at the bubble.

PH: I don't think he's switched in.

AR: Yes. I'm suspecting that.

PH: Do you want to try the CPI, Art?

AR: We talked about it and we thought because it's archiving so much data (90 megabytes a minute), which would fill up that hard drive, we decided we would try it when we got a little closer to the research area because it had some good images in with the junk and the junk is causing all the accumulation, but you don't want to throw out the good images. So we're going to be accumulating a massive amount when we get in the project area as it is with those black images being full frame pictures with a million pixels.

PH: Okay.

AR: Did I tell you what Paul said?

KM: Go ahead.

PH: Ken, just to make sure we got contact here. Let's go in at 15,500 ft. They tell me the cloud tops an hour ago were at 15,000 ft over Santiam Pass.

KM: Okay. We'll make a request for 16,000 ft.

PH: Fair enough.

4:22 PM

PH: We don't need to be at research speed until we get down there.

KM: Go ahead Peter.

PH: You can go at cruise speed down there. We don't need to be at research speed until we get down there.

KM: I understand.

AR: At this location after being away from the bubble for a few minutes trying to get the computer windows setup, looking out at the sun through all ice. There is no liquid water here at this location. The blue sky is visible with some scattered...

PH: Art?

AR: Roger.

PH: The dew point doesn't look good at the moment. It's quite a few degrees above the t-stat.

AR: Which one, Peter?

PH: DP.

AR: Actually they both look like they're above the ambient temperature.

PH: I don't think that was the case yesterday.

AR: No. That's true, at least not in the times I was checking that. It's almost always due to some contamination on the windows of either one of these. Almost every time Don has cleaned those, they have returned to normal operation. So it's something we probably should do maybe before every flight.

PH: Before every flight everything that can be cleaned should be cleaned.

4:24 PM

AR: I'll try to continue that thought after that interruption. Looking off to the sun again...

PH: The 2-D probe is fine now. It seems to do that at the beginning and then it sort of dries out and switches in.

AR: I think that maybe exactly it, that there's some condensation on there because this is an old time thing. In fact we lost that KWAJEX first hour because I was trying to avoid all the memory used by the noise and then I forgot to turn it on record. So it was a dangerous little tweak to try to improve something and then ended up ruining something.

4:25 PM

PH: We are getting some J-W readings at the moment, but they are about twice as high as the FSSP.

AR: I don't think those are real, Peter. Looking out the window here it's mainly just a few ice crystals. There's no indication of droplet clouds around and notice the top hat feature of those things too. Nice halo out there off the left wing coming from the crystals at this level actually or just above this level. Sun just coming over the horizon.

PH: It looks as if we've still got J-W problems.

AR: Yes. I was looking and there's just nothing out there but these few little crystals that you see popping up on the 2-D. It looks like that will be thickening up ahead, but I don't see any droplet cloud as we go into this stuff, but no doubt we'll hit something sooner or later.

4:26 PM

AR: I'll try to finish this up. Conditions are changing now. I still see that halo out there at least sun dogs with a partial halo below it actually extending down toward clouds indicating the ice.

PH: Tom?

TW: Yes.

PH: When are you going to put in those other locations in Oregon on the map?

TW: I haven't had time to look up the lat/long.

AR: Looking off now there is a liquid layer that's beginning to obscure the sun. It has a very flat top and these ice crystals appear to be in the foreground of that. The sun is now disappearing behind that. We're heading into some thicker ice, ice cloud I would say, and I suspect there's going to be some liquid droplet cloud on top of that and maybe even embedded.

PH: Now we're getting noise again on the 2-D.

AR: Yes. That doesn't look too good that type of noise to me.

PH: And on the HVPS looks noisy.

AR: Yes. We're in a fair number of crystals right now, so there should be a lot of activity on that 2-D too. This is a little bit disconcerting.

PH: It was working okay a few minutes ago.

VS: CCN is up and running and is running at 0.3 supersaturation and is showing 32 counts.

4:28 PM

AR: The windspeed direction here agreed pretty much with what Cliff was anticipating at 295° at about 13 meters per second at this location and probably that's going to hold down through the ferry flight here to Santiam Pass.

PH: Vidal that was 32 what did you say for the CCN?

VS: That's correct. At the moment it's 33.9 numbers per cc at 0.3.

PH: I just want to make sure that the typist can understand what you're saying. So say things very clearly.

AR: Vidal, you should look at the transcripts of my conversations.

PH: Full of gaps.

AR: Exactly, I call it "stream of consciousness." Some nice liquid clouds off the left wing now and they would be altocumulus clouds with fallstreaks underneath, looking kind of like weak fallstreaks. The sun is just behind them having a bright line at the water top. Off the right wing more liquid clouds but little patchier holes.

4:31 PM

PH: The 2-D is back in operation. Still a flashing sort noise on the HVPS.

AR: Coming back to the bubble again after having a conversation with Tom Wilson. The 2-D problem he surmises is because of our excessive true airspeed trying to get down, of course, the research area as fast as possible and the circuitry apparently has an upper limit of about 125 meters per second, which we are exceeding at this point. Of course, that raises the question of how the P-3 would get 2-D images from this probe as well, but then again they have a more modern probe than we do, which our probe being one of the first manufactured. The solid undercast now coming into view with the precipitation. Actually I didn't really give it a hard look back there in the precipitation. But now that we're out of the precipitation and the altocumulus coverage becoming scattered in this locale, there is a vast overcast stratocumulus deck well below the aircraft probably topping out below 3,000 ft above ground level.

PH: We're in clear air, but the 2-DC is triggering noise signals in clear air. It seems to work when we're in cloud.

AR: Peter, Tom and I were just discussing that. Tom has noticed that in the circuitry for the 2-DC that it doesn't like to go faster than about 125 meters per second. There can be problems imaging. I think maybe he's come into something that we just haven't noticed before probably because we don't go 125 meters per second. That maybe the cause of this noise that we're going too fast for the probe to pick up the occasional ice crystals out there and the many more we had a few minutes back.

PH: We'll check that out on the way back.

AR: Certainly when we get down in the research area we're not going to be going 128 meters per second and certainly things should pop into view if that's the correct explanation, but I really think he's hit on something. There's no reason to think it has suddenly malfunctioned. It worked and then didn't work. We were kind of flirting with that 125 meter per second upper limit.

PH: Tom, this would be a good time to zero the liquid water measurements.

4:35 PM

AR: As we work south we have the decreasing middle cloud coverage, now isolated altocumulus at about flight level off the right wing. It looks like they've lowered just a bit from those clouds that were back behind the tail. No precipitation seems to be falling from them even though we're at about -26°C .

TW: I've zeroed the J-W and the PVM.

PH: Thank you.

4:36 PM

PH: That trough was moving pretty fast into the Oregon Cascades. We may just get into the tail end of it.

4:37 PM

PH: These heaped up clouds...

4:39 PM

PH: It's the cloud that we're just now going in, just came out of.

AR: Again low droplet concentrations, only about 10 to 20 per cc. It looks like the J-W had a little response to that. I see it has another little blip here in clear air. Darn it.

PH: You know it's responding when the FSSP responds, although showing somewhat higher values. But it doesn't look like a good response. It's got a top hat type of profile to it. That instrument went back and was looked at again by the guy that now services the J-Ws and returned to us.

AR: Right and it seemed to work for that one flight. It seemed to me like we had one test flight there where it had excellent agreement with the PVM and DMT.

PH: Yes. The test flight last week. But then yesterday's flight it was off most of the time, but when it came back on it didn't look too bad.

AR: I don't understand how things break after a flight and between that and the next flight. We see that quite a bit and I just don't understand how that happens.

4:41 PM

AR: Flying at 520 mbars. Looking down again I'm going to raise those estimates of the tops of the lower cloud. It looks like they're probably much higher than I was guessing or they have elevated in this direction. I'm not sure, but anyway it looks to me like they're closer to maybe 500 or 1,000 ft above ground level instead of that 3,000 ft I gave before, maybe even a little higher than that, but not too much. Looking off to the Cascades behind the left wing, that is to the northeast, the altocumulus deck thickens up and produces more precipitation and it looks like the low stratocumulus layer and the middle deck combine over that area. The tops of the altocumulus being quite flat. There's a little mound off about 7:30, but other than that they are very flat. That mound being maybe 1,000 to 2,000 ft above the rest of the layer suggesting some preferential lifting zone. Then ahead of the left wing, looking at the Cascades, the altocumulus layer thins out and disappears completely. Then you see over the Cascades variegated cloud tops.

PH: Just passing over the Columbia River.

AR: Protruding just a few thousand feet above the main layer or maybe less than 2,000 ft actually.

TW: The CNC-1 should be working now on the display.

PH: Good.

4:43 PM

PH: So they're both on the same scale per cc?

TW: Yes.

PH: I don't think we're got the right calibration on the CCN. I don't that's being converted properly to ccs.

VS: At the moment I'm reading on the CCN a 0.3 supersaturation, 44.6 number per cc, and on the CN I'm reading 89 particles per cc.

PH: On my strip chart display I've just got a steady constant value. It doesn't vary at all on the CCN in excess of 100 per cc. So its not getting a signal I think. The CNC-1 count maybe okay. It looks as if it's reading something real around about 100 per cc. Is that what that instrument (the CNC-1), Vidal, is showing on it's output there about 100 per cc?

VS: Right now it's showing 78.

PH: So that looks okay. I've got a reasonable readout of that.

4:45 PM

PH: Ken?

KM: Go.

PH: Can we head a bit more directly toward Sweet Home?

KM: Present clearance is out to that westerly point, we call it Lima, but we'll see what we can do to get us closer to Sweet Home.

PH: I don't think we're going to start at the coast today. I haven't made radio contact with Sweet Home yet, so I haven't got our starting point, but I would guess it's east of where we're heading.

AR: An update on the cloud situation below the aircraft. It's now looking more cumuliform with ragged, shredded stratocumulus tops of the type we saw yesterday over the Cascades. I'm looking down actually at the coastal range, clouds that would be over the coastal range according to our position plot. Mixed in with those ragged tops are brighter topped cumulus turrets that have a nice little cauliflower shape indicative of a bit more updraft and liquid water content. In places it looks like there is precipitation coming out off the left wing. It's a little more visible in an opening. Striations of precip falling out and probably ice. Definitely more of that off toward the right wing and another opening there seems to be fallstreaks or an ice crystal haze underneath these clouds, but judgment here will have to wait until we get a little closer to make sure that it's not some smoke. I noticed today we had a little haze layer sliver off the right wing today above the clouds with a kind of a slot underneath.

KM: Peter, could we have the coordinates for Sweet Home if you have it.

PH: Standby.

4:50 PM

PH: Ken.

KM: I think I've got something I can work with here, Peter.

PH: I've got them here, 44°23.18' and 122°51.28'.

KM: Got it.

PH: If you look at page 41 of the Ops Plans, it's given there under M. M is the S-Pol radar. That's Sweet Home.

4:51 PM

AR: Also I should mention that looking upstream we can see the first cirrus vanguards of the next system off about 1 o'clock to maybe as much as 3 o'clock. They're probably a good 100 nautical miles or more out.

4:52 PM

AR: These comments just as we make our turn at 085207 UTC; correction, local standard time. We're about 40 min into the flight. Looking out over the water as we turn from the coastline and head further inland now. I can see what are certainly ice fallstreaks from these shallow clouds out over the water. They are numerous I would say. Right now I'm judging that ice content by the extremely flat slope of an ice fall off and behind the right wing. It would not do that if it were liquid precipitation. Also the opacity as well which disappears some distance below of what appears to be virga. (?)

4:54 PM

AR: I have to remind myself to look for the inversion on the top of this stuff before we get into cloud top.

4:56 PM

AR: Here's something that's becoming evident now, that you can really see here, is the mounding tops sticking up above the general top of the stratocumulus are confined to offshore or very near offshore locations. Inland as we're flying toward the east...

PH: Ken.

AR: Southeast.

KM: Go.

PH: Our westerly starting point will actually be right at Sweet Home and then we'll be heading east from there to Santiam at 15,000 ft and lowering to get into cloud as necessary.

KM: We'll start at Sweet Home and head east at 15,000 ft.

PH: Correct. Actually there won't be any cloud at 15,000 ft at Sweet Home, but as we head east the cloud tops should increase in height and we can lower down to get into them.

KM: Okay.

4:57 PM

AR: As I started to say, as we head southeast, it's very evident to where the ocean ends and the land begins just by judging where the mounding cloud tops, mounding above the overall tops, are and where they end. The mounding tops being produced by the heating of the ocean of the cold air flowing over it and then moving inland; and then the dissipation of that phenomena caused by the cold land. It's a very simple explanation, but it seems pretty valid. So a lot of this ice that's coming out of the clouds and the stratocumulus below us here and there is actually out of those cumulus turrets that have fallen back just a bit. Now they're probably not more than 1,000 ft maybe 1,500 ft, I would guess, at the maximum above the stratocumulus tops looking back behind the wing and near the mountains. They are probably a little more than that above the even lower tops over the valley here that are showing some virga. Looking over the Cascades you see a similar phenomenon. This will be a little different because it's caused by forced lifting rather than heating from below. Along with that the mounding, the cumulization you might say, of that deck over the Cascades is more muted and the mounding tops, at least from this vantage point, look a little bit broader and don't stick up quite so much. Overall it's pretty close, but nevertheless there is a visual difference.

5:02 PM

PH: Ken.

KM: Go.

PH: Have you got the lat/long for Santiam Pass?

KM: Yes we have.

PH: Good. The clouds are diminishing rapidly on that track because the front has sort of moved through. So we'll see what we see when we get there, but it may be quite low down.

5:03 PM

TW: Were any of those on, Art?

5:05 PM

AR: There's a label on this one green light I can't read because it's so dark.

TW: I think that is the power one so I don't think that's it. I'll be right there.

AR: There's another one that's flashing next to it and I can't read what that is either. There's a little icon there that's barely visible.

5:06 PM

PH: Ken.

AR: We may see a little bump in the PCASP because as we dropped down there is a haze layer on top of this stuff. There's not much of a haze layer, but it is visually present.

5:07 PM

KM: Go ahead Peter.

PH: I see you're doing what I want, which is to lower to 15,000 ft. You can get a good view now of cloud top, so we're probably going to have to come down way below 15,000 ft. On the other hand, the tops will increase a bit as we head toward Sweet Home so don't come down too low.

AR: Roger. That's right, Peter, they go up an appreciable amount.

PH: Maybe you can work with Ken on getting a good altitude as we head from Sweet Home to Santiam.

KM: We're just about to Sweet Home now.

PH: Yes. We're just coming up to Sweet Home.

AR: We're going back up here.

5:08 PM

AR: I'm estimating the highest tops are going to be close to this level, Peter. When we get a little bit closer, of course, we'll know positively. I think I'd hang in at this level and then drop down if it turns out it's going to be a little bit too high, but it's going to be close.

TW: Art, should we be firing up the CPI?

AR: I turned it on. Yes. We should start the software. Might as well turn the computer on.

TW: Okay. I checked to make sure that disk was found and it is, so we have 8 Gig of space.

AR: Great. I guess we'll have to keep an eye on it and watch out for those black images and see how many we're getting.

5:09 PM

PH: We're starting to head east, aren't we Ken?

KM: That's affirmative.

5:10 PM

KM: Santiam Pass is 35 miles ahead of us, Peter.

PH: Thanks Ken. I think 15,000 ft will do it for the first pass.

5:12 PM

PH: For this Thursday flight on 29 November, I just took my first photograph on the digital camera looking approximately east showing the clouds beneath us and rising in height toward the Cascade crest. That photograph was taken at 1713 UTC time or about 9:13 local time, which will be the time on my camera, local.

5:14 PM

PH: Ken.

KM: Go.

PH: We want to go east beyond Santiam at this altitude. We want to go to 122°30'. That will be our easterly point just east of Santiam.

KM: Roger. 122°30'.

5:16 PM

PH: Then we'll do a 180° and we'll head back to Sweet Home descending steadily to 13,500 ft.

KM: We'll go to that point and do a reversal to Sweet Home and descending to 13,500 ft.

PH: Correct.

AR: Peter, while I was fiddling there with the CPI, the clouds I thought were heading for are those off about 1 to 2 o'clock. They appeared to be up at this level, but on this heading they are well below us. Sorry. I lost track of those.

PH: Why don't you work with Ken to descend so we get into some clouds on this easterly track?

AR: Before I do that, Peter...

KM: ...below our vectoring altitude, but we'll go as low as we can.

PH: Yes. On the first track we just want to get into cloud tops and then subsequently as we work down we'll get into the rest of the cloud, but there is no point being up here in clear air too long.

AR: Yes.

PH: Try to start your descent if you can, Ken.

AR: It looks like there is a bit of a saddle here, because they are certainly higher off the right wing there than they are in this heading. Also, Peter, the thought that occurred to me yesterday was is this clear air valid for the model or the fact that maybe the model thinks the clouds are up here?

PH: It's of some value, but we want to spend most of our time in cloud.

KM: Things don't look very good ahead for clouds, Peter.

PH: Can you descend?

KM: Yes. We're trying to get the clearance now.

5:18 PM

AR: We were heading for that clump of cloud off the right wing now until we made the turn at Sweet Home. Now we are going to go miss that, although there are taller clouds off the left wing and the right wing; that's too bad.

5:19 PM

KM: Peter, I think that you probably meant $121^{\circ}30'$, not $122^{\circ}30'$.

PH: Let me double check. He gave me 122° . Standby.

5:20 PM

PH: Yes, Ken, $121^{\circ}30'$.

KM: Say again, Peter.

PH: You're correct. It was 121°30'.

5:21 PM

PH: We're just passing over Santiam and we've descended to 11,000 ft and we're still not in cloud top here.

AR: Roger. In fact we're just about to finish overflying clouds as well here as we come into that clearing zone in eastern Oregon.

PH: Peter, it looks like the cloud tops right now are going to be about 10,000 ft here. Ahead of us it's clear.

PH: Okay Ken. So there is no point proceeding further east. Let's do a reciprocal and descend so that we put ourselves just below cloud top, whatever altitude that is.

KM: We'll do a reversal here and descend just into cloud top.

PH: Right, and then head back to Sweet Home.

5:22 PM

VS: CCN concentrations are pretty constant around 50 number per cc at 0.3% supersaturation and CN concentrations are around 100 particles per centimeter cubed.

5:23 PM

AR: We have a lot of ice down below us. It would be exhaust ice crystal part of this orographic cloud. Peter, off the right wing there you can see that illuminated ice trail coming out of the orographic cloud. That's kind of a nice photo because that extends all the way out from, you know, those orographic clouds back maybe 20 miles or more.

TW: He's on the radio.

5:24 PM

AR: Very impressive plumes of ice coming out of the Cascades at various portions. Like plumes of smoke almost leaving the droplet cloud behind and then the ice streaming out toward eastern Washington.

5:25 PM

AR: This going with the strong winds indicated to be 40 knots or so at flight level 10,000 ft out of the northwest and west-northwest or west-northwest, correction.

5:26 PM

AR: Maybe just a bit of turbulence ahead, so you want to make sure you're buckled in like say 1 min.

PH: Art.

AR: Roger, Peter.

PH: You know we're probably always going to see a bit of a saddle in the cloud on our legs, because that's where the pass is and we've got higher ground to our north and south.

AR: Roger. I'm hoping these tops will translate...

KM: This is as far as we can get here with the terrain, Peter, 9,800 ft.

PH: Right. I saw that from the map. But as we head west, can you lower down?

KM: Well we will go lower when we can, but we can't for awhile yet.

PH: Okay.

AR: Roger, Peter. There were some higher tops to the northwest of the pass and it will be interesting to see if they translate in there, whether they do in fact follow the terrain.

PH: For the tape on that first leg from west to east from Sweet Home to Santiam just beyond, we didn't get into cloud that we just below us. We're now heading back toward the west, just past Santiam, heading west and the cloud still mainly below us. We can't get down there at this point because minimum altitudes here are 10,800 ft. But as we head west, we'll try to descend and get into some cloud.

AR: Peter, is it correct that the tops were 15,000 ft earlier from the site?

PH: They may have been very much earlier, but the trough has gone through now and so it's just been lowering here.

AR: Roger, I understand. I jus wonder how quickly those tops came down.

PH: When I spoke to Mark Stoelinga from the hangar just before takeoff, he said they were down near 10,500 ft then.

AR: They were down at 10,500 ft then?

PH: Yes.

AR: There are tops up to that level in the area. It would just be interesting whether they can make it in here or not as discrete elements or, in fact, it's all orography. Off the right wing is the area of higher tops that I was mentioning before that are upwind. We're going to come into some of those now, which are a little lower too.

PH: Yes, 98 on the p-alt, just in cloud now. The 2-D is working. The HVPS is working.

AR: I'll check the CPI. This gives credibility to Tom's note that maybe we were just going too fast in the ferry leg down here for the 2-D to work.

PH: The FSSP is showing the highest liquid water with the PVM below it and some activity on the J-W, but I don't know how much that can be believed. Just skimming cloud tops here. Right in cloud tops here.

5:30 PM

PH: Just west of Santiam. Our tops on p-altitude 10,000 ft.

5:31 PM

PH: Liquid water is about 0.1 g m^{-3} .

AR: Nice cloud bow off the right wing. Ragged looking tops.

PH: Ken.

KM: Go.

PH: So on the return to the east leg, we just want to get down another 1,000 ft or so and just follow terrain to keep you above minimum altitudes.

KM: Of course, we're headed west bound now. In about another 2 min we can go down a little bit lower, if you like. We're still about 38 miles out of Summer Home or whatever it is.

PH: Sweet Home. Yes. Let's do that. Let's sort of follow the terrain as it were so we keep roughly at constant altitude above terrain.

VS: Peter, do you think this is a good time to start our CCN spectra?

PH: We're in and out of cloud, so I don't think it is. But before we finish today's flight, we'll do a profile or certainly get below cloud base on the west side. That will be a better time I think.

VS: All right.

PH: For the next hour or so, we're probably going to be in and out of cloud all the time, so I don't think your spectrum would be all that useful.

KM: We can go down as 8,000 ft now.

AR: That tops descend, Peter.

PH: That's good, Art. Go to 8,000 ft.

KM: Tell me what altitude you want us to level at.

PH: Let's level at 8,000 ft. Does that look good, Art?

5:33 PM

PH: Vidal, something else, if we have time, we might try doing is to get a CCN spectrum on the east side of the outflow from the cloud later on.

VS: That would be totally great.

PH: How long does it take for you to get a spectrum?

VS: Approximately 10 to 15 min.

PH: Okay.

AR: Ken, can we hit this cloud a little bit more on the right there as we head this way just slightly. Thanks. Right there, that's good and then resume. I was afraid we were going to miss it.

PH: Went into a little convective area there. The liquid water went up to nearly 1 g m^{-3} on the FSSP.

AR: Yes that was a nice newly risen turret. It wasn't very hard looking, but it was nicely rounded in shape, not much updraft.

PH: I think it was a record liquid water so far on the first two flights of IMPROVE-II. Yes the J-W is showing some action, but measurements are of no use. We do have PVM and FSSP. As I said several flights ago, if I have one or two liquid water parameters I'm happy.

AR: To a degree I agree.

PH: They do agree very well except the PVM is just somewhat below the FSSP but following it very closely.

AR: That's good. Great.

5:36 PM

KM: In about another 3 min we can go down to 7,000 ft.

PH: Art, are there any clouds ahead at this altitude?

KM: Clouds are about 500 ft below us ahead.

PH: Then on this leg go down so we're just in cloud top.

KM: Just below cloud top?

PH: Yes. Just below cloud top on this leg. On the reverse leg we can go down a little bit lower.

AR: I can't see ahead right now. I got iced up in those turrets.

KM: Okay. But on the reverse leg we can't go, at least where we are here now, any lower than we are now.

PH: I understand. We'll just do the best we can on each leg.

AR: Tom, one thing I've noticed that's difference with this computer compared with the other one is that the display of the data in real-time is much later than it used to be. For example, only in the last few seconds have those nice wet turrets shown up on my strip chart.

TW: I think I know what's wrong. Hold on a second.

AR: As you were commenting on those turrets, Peter, I had no indication we had even gone into any cloud yet.

5:38 PM

PH: Ken.

KM: Go.

PH: You're going to be skimming cloud tops as best you can, as you're doing now on this leg. Then on the return leg back to Santiam just give us the lowest altitude you can all the way back to Santiam.

KM: That's going to be what you have right now.

PH: It is? Okay. Even when we're over Sweet Home?

KM: We can go down to 7,000 ft right now, which is what we're doing. It looks like the clouds are slightly lower ahead of us.

PH: So you've been following terrain essentially on this westerly leg and we'd have to do the same on the easterly.

KM: That's right. We step up going east and step down going west.

PH: Okay. I'll still want to do that though. I want to do the reverse back to Santiam at minimum altitudes. Then we'll go a bit past Santiam and then we want to sample in clear air the air that's coming out of those clouds over the crest. That's on the easterly leg.

5:41 PM

PH: Art, are you there?

AR: Roger that. Tom and I are working on the computer.

PH: When we get back to Sweet Home on this leg, let's get into an area where we're sampling the inflow into these clouds in clear air, for a CCN spectrum measurement.

AR: Roger. Do you want to go below cloud base then?

PH: Yes. Out over Sweet Home somewhere.

AR: I think also there were some clearings. It's possible there will be something sort of out the side as well. I don't know how far west of Sweet Home you'd want to go. It would probably be better to go under cloud base I would guess.

PH: Under cloud base would be okay.

AR: Do you want to tell Ken that when we get to Sweet Home we're going to do a spiral down then or do you want me to talk to him?

PH: Did you hear that conversation, Ken?

KM: I caught most of it. You'd like to get under it when we can.

PH: Not yet, but over Sweet Home we'll get under the cloud in clear air and we'll grab some measurements in that air going into the clouds.

KM: Right. We're 6 min from Sweet Home.

PH: Art can guide you on that.

AR: I'm sorry, say that again. Tom spoke to me just as you said something.

PH: I just said, you can guide Ken on the inflow into the cloud over Sweet Home.

AR: Roger.

PH: Vidal, in about 5 or 10 min, you should be ready to do a CCN spectrum in the inflow here.

VS: That's good. I'll set up the CCN into the spectrum mode. Is that okay if I use 0.2, 0.3, 0.5, 0.7 and 1 supersaturation?

PH: Yes. That's fine. Art?

AR: Roger.

PH: It's going to take Vidal about 15 min to get that spectrum in that inflow air.

AR: Okay, 15 min.

PH: We don't want to be sampling our own plume when we're circling around there. Probably the best thing is to do a straight-line path maybe north to south roughly.

AR: Roger.

PH: When you're half way through maybe do a reversal, but keep out of our own plume.

AR: Right. We can do legs maybe perpendicular to the wind and then keep turning upwind.

PH: I'll leave it to you.

AR: I think that's what we've done in the past for some of that work.

PH: Talk to Ken about that.

TW: That PVM is blue. The FSSP is yellow. Those colors match what Peter's display is. He wanted you guys to be on the same page.

PH: That's right. I've got FSSP yellow and PVM blue and J-W red. It's nice if everyone has the same colors. Shed a bit of ice there.

5:45 PM

PH: Ken.

KM: Go.

PH: When we do that sampling of the inflow air around Sweet Home, you'll be working with Art on that, but we want to avoid sampling our own plume.

KM: Understand. We can go to 6,000 ft now if you like.

PH: Let's do that.

AR: Ken, to get the inflow, we're probably going to want to.... I don't know, if we can spin down in a clear spot, but you'll probably want to get under that lowest scud down there right below the right wing. Out there off the left wing there is a nice hole. Can you descend in this hole or would you have to change your clearances?

KM: We'd have to change the clearance and probably lose our IFR, but we're clear down to 5,000 ft now.

PH: We're not over Sweet Home yet.

KM: We're still 2 min from Sweet Home.

PH: We can keep at this altitude for awhile.

AR: Roger. I understand. I thought maybe we could get something. I would be surprised if the bases were that high.

PH: Also, Art, we want to get some good spectral, droplet spectrum measurements near cloud base here to compare with the CCN.

AR: Roger. I guess those convective turrets were almost certainly boundary fed. That's for sure. I was just getting a little worried that stratiform cloud might have a little different inflow type of air mass than say the convective stuff down below us right now, but probably over the Cascades they're all mixed together.

PH: Ken, we have icing building up on the top of the wing.

5:47 PM

PH: Flying in the clear air around Sweet Home will help to get rid of that.

VS: The CCN is ready to run in spectra mode. Just let me know when you want to start it.

PH: Will do.

5:48 PM

PH: How high above cloud base are we, Art?

AR: We're at 5,000 ft and it looks to me like the scud goes down to 1,000 to 2,000 ft above ground level.

PH: The FSSP spectrum looks very nice.

AR: Roger.

PH: Although we're still getting some high counts in channel 1.

AR: Roger, but they're not nearly as high as they were, where they far exceeded the...

KM: Over Sweet Home at this time and we can go down to 5,000 ft now. We'll continue westerly.

PH: Let's do it.

5:49 PM

AR: Just for planning ahead, Peter, if we're still in cloud at 5,000 ft, do you want Ken to find a hole and then go down? Because it's going to pose a problem then if we don't break out.

PH: Yes we should. After awhile here, a few miles, we'll see if we can get down below cloud base to get those CCN measurements.

AR: Right.

KM: What I suggest, Peter, is that we continue west bound and we'll be stepping down as terrain permits. Then if we end up getting below it, we can do a reversal below the clouds.

PH: Okay Ken.

AR: That's not a bad thought. Also, as we flew over this way, there were some pretty large clearings here and there in this overcast stratocumulus over the Willamette Valley.

5:50 PM

AR: In fact, here comes one now.

PH: Also, Ken, can we depressurize the cabin?

KM: Yes we can.

PH: That will help the CCN measurements. We've broken out of cloud base here, so this would be a good region to do it, Art.

AR: I tell you the stuff feeding into and lifting over the Cascades is the stuff off the right wing and behind the right wing. It's actually much lower and you can see that going into this shelf cloud we're flying under right now. It's kind of an inflow coming into the shelf cloud right above the right wing.

KM: Everybody watch your ears.

PH: You put us where you think it's best to get those measurements, Art.

AR: Roger.

PH: We're getting rid of our icing here as well.

AR: Which is always good.

PH: Particularly before going back east.

AR: Ken, can we descend to say 1,000 to 1,500 ft above ground level in this area without causing air traffic problems?

KM: I'm depressurizing now and we're talking with Center to see what it will take to cancel and pick it up again.

AR: Looking back at the Cascades, Peter, that's kind of the air I see going up the slopes of the Cascades is a fairly low boundary layer air. Then that goes up...

End of tape 1, side 1

AR: ...just above the right wing now.

KM: We're now on a VFR flight plan for the time being and so we can do a reversal out here. Let us know when we're down to the altitude that you want. We're not sure just what the terrain elevation is here.

PH: Art, I think the air in this region is going to be pretty representative of the whole air mass here that's affecting these clouds. So let's just do it here somewhere.

KM: We're about 1,500 ft now. Do you want to do a circle here?

PH: Not a circle because we want to avoid our own effluent.

KM: We'll start a left turn and we'll try to avoid our own wake.

PH: Okay Art?

AR: Looks good to me. Ken, if you have to circle upwind, that's good or do little short straight legs. The wind looks like in the boundary layer from the southwest looking at a smoke plume down there from a factory of some kind.

KM: We'll do kind of a track and move generally to the south.

AR: Sounds great. I guess we need 15 min. Is that correct, Peter?

PH: About that, I'll let you know. You tell us when we should start the CCN measurements, Art.

AR: I think any time in here. I'd probably go a little bit lower, but I think we're splitting hairs.

PH: Can we go a bit lower, Ken?

KM: Sure. Let us know when you want us to level off.

AR: How about 500 ft, Ken, can you lose 500 ft? Peter, that will put us just at or below the base of that scud cloud off there and back behind the right wing.

PH: You tell Vidal when he should start his spectral measurements. We had a nice profile of increasing CN measurement here from CNC-1 as we decreased our altitude. I don't have a readout of the CCN.

AR: I'd say right in here it looks good. This elevation right here.

PH: Vidal, you can start your spectral measurements.

AR: This is a great elevation if we can just kind of work our way around upwind this would be superb.

KM: Is this low enough for you?

AR: Yes.

PH: Ken, just avoid your own effluent for the next 15 min. Anywhere in this area is good.

AR: There's a plume off the right wing, Peter, from that factory complex over there.

PH: Let's avoid that.

AR: Yes.

VS: The CCN spectra just started and I'm going to do five different levels of supersaturation at 0.2, 0.3, 0.5, 0.7 and 1%.

AR: The way I see this, Peter, this air from the southwest is rising up those slopes off the right wing and behind the right wing toward Santiam Pass, but as they get higher it curls off back toward the southeast toward the pass.

5:56 PM

PH: At 09:57 local time I took a photograph. My digital camera is showing the area in which we're doing our CCN spectral measurements showing the cloud base and general cloudscape and the fields below. This area is very flooded here, lots of water on the ground.

5:58 PM

PH: Get any rock board up last night, Tom?

TW: We got almost all of it up. We've only got about three sheets left to do.

PH: How late did you work?

TW: I worked until about 11:00 and then I went to the UW instead this morning rather than...

PH: My keys.

TW: I already gave them to you. I gave them to you on plane on the ground.

PH: I got them, yes. Good. So it's nearly finished.

TW: Then we've got to mud it and that's going to take a long time.

PH: That's a terrible job.

TW: We don't have a radiator up there either, so it's going to be really cold. So I'm going to have to go rent some heaters.

PH: I've got a couple of big electric heaters that might help.

TW: I might take you up on it if we don't find any.

PH: They don't blast air out. They're radiators. They have oil inside, and they put out a lot of heat. They will heat up a room very quickly.

TW: I might take you up on that. Thank you.

6:02 PM

VS: I've just completed one cycle, so I just want to get another one for comparison.

PH: Okay.

6:03 PM

PH: Ken.

KM: Go.

PH: So just to repeat, after we finish this, we'll give you the word and then we can head back toward Santiam at the lowest altitude you can.

KM: Okay. When you're finished here we'll go back toward Santiam at the lowest possible altitude. Okay.

PH: Right. Actually then we'll go east of Santiam and get into the outflow from the cloud.

KM: Okay.

6:04 PM

PH: What's that factory off the right wing, any idea?

KM: Say again.

PH: Any idea what that factory is off the right wing there? Is it a paper mill?

KM: We're trying to stay away from that paper mill. We're doing all our maneuvering upwind of it.

PH: Because paper mills put out lots of particles, particularly CCN.

KM: We've always been upwind of it.

6:04 PM

PH: Seeing a few plume-like spikes on the CN measurements here now and again. We had one 2 min ago and one 5 min ago. I don't think it's our own plume because that would produce sharper peaks than those.

AR: I know, that doesn't seem possible.

6:06 PM

PH: The dew point looks okay now, Art. It's below the air temperature.

AR: Right.

6:07 PM

PH: They've had a lot of rain here, haven't they?

AR: Say again.

6:08 PM

AR: I should mention that we're experiencing slight turbulence is all. We seem to be below the... Peter, it's hard to imagine, but it looks like there's a slash burn or a forest fire out about 12 o'clock.

PH: Is it affecting us?

AR: Not at all. It's going right up into the orographic cloud there, but it's just kind of amazing anything could burn after the amount of rain that's fallen here in the last few days or week.

PH: It's absolutely sodden down there, still got some snow on the ground as well.

AR: Do you see that fire? It probably wasn't the right angle for you.

PH: No. I didn't.

AR: Ken, do you see that little light plane down there near the ground, about a couple hundred feet off the ground, and behind the tail now?

KM: We've got him.

VS: I have completed the CCN spectra.

PH: Good. Ken, we can start to head back east.

KM: We'll go and pick up our east-west line and start moving east.

PH: I don't think there's any need to pressurize the plane again.

6:10 PM

KM: I understand you want minimum vectoring altitudes as we move east, right?

AR: He must be talking to the radar folks, but that's correct, Ken. Peter, do you copy?

TW: He's on the radio.

6:11 PM

AR: Peter, do you copy?

TW: He's still on the radio.

AR: I tried to get a photograph of a fire, a forest fire actually, in the forest on the foothills there east of our location where we did the CCN sample. Another amazing phenomenon considering all the rain that's fallen in this area in the last 2 weeks or so, and especially yesterday. Now we're climbing at the MVA altitudes back toward Santiam Pass and as we have we went through a cloud base back there. That was not the lowest cloud base, I should point out, but a shelf type cloud base a little bit above the LCL. Right now we've popped out on top of that shelf as we continue to climb. Cloud depth doesn't look like it's more than 1,000 ft here right below the aircraft, but up ahead it thickens. Actually what we're doing is adding another layer from the side it's not rooted in the same layer as below the plane right now it appears. Then above that (the clouds) another shelf appears, perhaps two more shelves appears. This is looking pretty interesting here. A very thin one that's almost connected to the very highest shelf of stratocumulus-like clouds. Elevation is about 4,000 ft, about 4,680 ft right now.

PH: We're just coming up to Sweet Home again and we're at 5,000 ft in cloud.

AR: Roger. Ken is proceeding east bound on the lowest possible elevation he can fly.

PH: Right.

AR: I was just going to point out earlier, of course, it's gone now, but off the right wing was that forest fire. Actually, it's a fire in the forest in the foothills where we did those CCN measurements. I thought maybe you'd get a picture of this incredible phenomenon, considering the many inches of rain that has fallen in that area.

6:16 PM

AR: Looking back again we've just gone through that area I was just describing and come into another saddle area. I would call it multiple levels of stratocumulus clouds back there all looking...

PH: Art, after we do this leg to the east and do our outflow CCN measurements, we're going to go just a little distance away from Santiam to the east over the Battelle microwave radiometer site where they've got some scattered cumulus. We'll want to profile up through those cumulus to get liquid waters for comparison with their radiometer measurements. After we do that, we'll be heading back to Paine Field.

AR: Roger. I understand. It sounds interesting.

PH: Those cumulus are very scattered and it maybe that when we get there they'll be gone. I don't know but we'll see.

AR: Roger that. They were pretty scattered. I don't know, how far out from the crest is that? I don't have my Ops manual in front of me.

PH: It's very close, just a few miles.

6:17 PM

AR: As I was saying, before that first cloud grouping was multiple layers of sort of inert, weakly developed stratocumulus clouds, very smooth on the sides almost like lenticulars, not much rumpling. As we come in here...

PH: It's about 20 miles east of the Santiam crest.

AR: Roger. Thanks. After we had been through that clearing with the shelf above us, we're coming into some convection.

6:18 PM

PH: We'll probably pick up quite a bit of icing on this run so keep an eye open, Art.

AR: Roger.

6:19 PM

PH: We've got some supercooled drizzle here as well probably.

AR: Yes. It looks like there are some traces of it, nothing like yesterday, but it's there.

PH: HVPS and 2-DC working fine. We may get a bit of turbulence as we go through cumulus on this trek so buckle up.

AR: Also it looks like the CPI is stuck.

PH: I haven't been looking at the CPI. It doesn't look good.

6:20 PM

PH: Pretty steady liquid water contents of half a gram per cubic meter here.

6:21 PM

PH: Ken.

KM: Go.

PH: We have to keep an eye on the icing on this run.

KM: We're doing it.

PH: Liquid water is up to 0.7 g/m^3 now.

6:22 PM

PH: Getting some frozen drops on the 2-D. Liquid water has fallen off now, 0.1 g/m^3 .

6:23 PM

PH: Getting occasionally 1 gram per cubic meter on liquid water on the FSSP.

AR: Ken, is this lower than the elevation we flew at through here last time or the same?

KM: It's about the same.

AR: That's what I was thinking, so it's quite a bit different than we saw before.

PH: Just hitting a few more cumulus.

AR: Right, that have moved in over this sort of pass area. So I guess they are translating through here. Well, orography isn't killing them all off, which is nice.

PH: We're getting up to near cloud top now though.

AR: Right. But I think the top...

KM: 10,000 in 4 min.

PH: Half way between Sweet Home and Santiam.

6:25 PM

AR: That wasn't nearly what we saw the last time, Peter, we came through here. We're kind of in and out of tops. This is great. A lot of data, nice flat topped orographic cloud (relatively speaking flat top).

6:26 PM

TW: I think the CPI has a fatal error.

KM: We're going up to 10,000 ft.

AR: I've been fiddling with it. I haven't been able to get it to wake up. I see you've got something else there. What does that window say?

TW: It says, "Failed to stop acquisition."

AR: I'll come up there.

PH: Just broken out of cloud top at 8,000 ft.

6:27 PM

PH: Quite a bit of cumulus here. Just a few miles west of Santiam now, still in cloud.

AR: We should break out any second. I missed the cloud top on that little window of sun we had while I was looking at the CPI, darn it.

PH: I noted it. I forget what it was, but I put it down.

AR: Cloud top?

PH: Yes.

AR: What was it?

PH: I forget, but I recorded it.

AR: You'd have to look backwards to see it.

PH: It's coming up to the crest.

AR: Now we're getting into that leeway stuff. I think that's more way we're starting to bounce around back there. We may see a little bit more of that. I don't know. That aggregate point didn't look like cloud tops more than 1,000 ft above the flight level, say in that last 1 to 2 min.

PH: Just over the crest now and cloud tops near 9,500 ft. Is there much ice on the wing, Art?

AR: No, I don't see much and I don't have much on the Pilewskie probe fixture here as we had yesterday.

PH: I've got a lot on my window.

AR: It's a lot, but it's just not as much as yesterday.

PH: Art and Ken, we need to get into that outflow air now over on the east side of the crest here. So I'll leave it to Art to tell you where to go, Ken.

KM: Say again, Peter.

PH: Art's going to tell you where to go to get into the outflow air on the east side here.

KM: Okay. We'll probably need to circle up it up here and get rid of some of this ice.

PH: Right. Let's do that.

AR: I think too, Ken, that we're going to have to go down into the boundary layer again maybe 2,000 to 3,000 ft, not as low as last time. In fact, I think that will probably help clear that ice off. Do you have any surface temperatures down there? I'm thinking they would be above freezing, but this might be close.

KM: No, I don't. We'll head this direction for a way until we can see what's down below us. We don't want to give away any altitude here now.

AR: Roger that. Peter, I think this is going to be pretty easy to do because almost anywhere is going to have this outflow air.

PH: I think that since we've got our altitude here the best thing is to now go to, I'll give you a lat/long to go to Ken.

KM: Go ahead.

PH: Actually we want to go to the Sisters Airport and the Sisters Airport is shown on page 41 of the Ops manual. It's point K. The lat/long is 44°18.27'/121°32.35'. Let's go there at this altitude.

6:32 PM

PH: Did you get that, Ken?

KM: Yes. I'm trying to locate it on my map here.

PH: The Sisters Airport maybe a very tiny airport. It's on page 41. It's going to be to our south from here, Ken.

6:33 PM

AR: Kind of a nice view of the Cascades back there where we passed through. Certainly there are no particularly protruding tops in a line that we just flew. So they couldn't have been more than 1,500 ft, I'd say, above our flight level at the maximum.

PH: These are the little cumulus that the Battelle people are interested in us sampling.

AR: Sorry, Peter, I had my volume turned down.

PH: That's okay.

6:34 PM

PH: Ken?

KM: Go.

PH: Did you find the site?

KM: Yes. We've got it on our GPS. We're turning to it now.

PH: Yes, it's just to the south of us maybe 20 miles or so.

KM: No, 10 miles.

PH: Just a guess.

AR: Ken, we'd want to be under these cloud bases, these scattered to broken small cumulus clouds. Peter, did you want to go down below these clouds first or spiral up to it or?

PH: Let's not lose our altitude. Let's stay up here. When we get over that site, we can sample the clouds from the top downwards.

AR: Okay. I'm not sure what the clearance problem might be. Sometimes when the clouds are low, you can't really go in them right away. We might have to do a touch-and-go or something, talk to Ken.

6:35 PM

PH: Ken.

KM: Go.

PH: What we want to do when we get to that site is sample a few of these cumulus clouds by spiraling down through them from on top to below cloud base.

KM: Okay. We'll see what we can do.

6:36 PM

PH: I'm going off the headset for a few minutes.

6:38 PM

PH: How are we doing, Ken?

KM: Okay, Peter. We're going to get rid of some of this ice. Probably what going to do is we'll spiral down over the airport in a clear area, and then circle and spiral up over it, through it. Then we know what we have.

PH: Good. We want to sample clouds as close to the airport as we can. There's an instrument down at the airport that's looking up at these clouds.

6:40 PM

PH: For the tape: We've got scattered cumulus here. I'll take a photograph in a minute, small cumulus (non-precipitating), we'll get a liquid water profile through them for comparison with the Battelle microwave radiometer at the airport here.

6:41 PM

PH: At 10:41 local time I took a photograph of the scattered cumulus in the vicinity of the Sisters Airport. These are the cumulus we'll be sampling shortly.

6:42 PM

PH: Art?

AR: Roger.

PH: We want to pick up a characteristic, you know, something that's pretty typical of the cumulus here for spiraling up through.

AR: I'd say that thing right below the right wing here is pretty typical, although there's a little bit of fluffing and plumping itself there about 2 o'clock.

PH: You heard Ken say that he's going to descend in clear air first and then he's going to spiral upwards through the cloud. So pick up a cloud when he's ready to do that.

AR: Okay. I haven't seen the airport yet. Have you seen it yet, Peter?

PH: No, I haven't seen the airport, but it's pretty small. Have you seen the airport, Ken?

KM: Yes. It should be back behind us slightly.

PH: When you get down below cloud base, Art will choose a cloud for you to spiral up through. We want to go through a typical cloud in this region, not anything that's overly big or small, but average.

AR: Roger. I understand.

6:44 PM

PH: If it's right over the airport, that would be great.

AR: Yes, that's what I was thinking if we could find something that happened to be passing right overhead that would be superb.

KM: We could wait for the wind to blow some stuff over the airport.

PH: Yes, then we know for sure that what we're sampling is what they are looking at at that same time from the ground.

KM: There's the airport out there at about 2:30 low.

PH: I've still got ice on my window. There's still some icing on the wings as well.

KM: We're waiting for it to sublimate here.

PH: Got an outside temperature of -11°C .

AR: Yes, we're not going to get above freezing unless we went out there about 30 miles to the northeast in the lower terrain.

PH: Is that an airport you could land at, Ken?

KM: We could probably get in, but we wouldn't get out.

PH: It's nice to know it's there.

6:45 PM

PH: Vidal, after we've done this exercise, then we'll go back and do those CCN spectra in the outflow.

6:46 PM

PH: Art, can you see icing on the wings still?

AR: I don't see any ice on the wing per se, on the top of or on the leading edge, I only see ice on the ray dome out there. That's comparable to the kind of ice we have on the Pilewskie structure here and on the top of the tail. There's nothing on the tail other than right in the warning light.

PH: I can see some white on the red top of the wing.

AR: Maybe you're right. Maybe that is ice there. You must be right, Peter.

6:47 PM

AR: Ken, just for a reference, how much drag do you notice with this kind of icing that we have right now compared to what you were talking about yesterday when you were talking about having to increase horsepower?

KM: It would probably be pretty close to the same, although we're getting a lot more ice noise today.

PH: By ice noise, do you mean shedding ice?

KM: No, the antennas make a noise up there.

AR: I see.

PH: We were shedding much more ice yesterday.

6:49 PM

PH: Art, have you figured out the good outflow regions to fly in?

AR: Peter, I would say almost anything below these cloud bases is going to be the outflow from that Cascade mass of clouds back there.

PH: If that's the case then, Ken, when we do go down low below cloud base, we'll do our circling to get another set of CCN measurements keeping out of our own plume before we profile up through the cumulus.

KM: How long do you want to circle down there at the bottom?

PH: About the same time as we did west of Sweet Home, about 15-20 min. Then we'll circle up through the cumulus. Then we'll be ready to go back to the stable. There are lots of cloud heights here, Art. It's going to be difficult to choose an average sort of height.

KM: Say again.

PH: Sorry, Ken, I was talking to Art.

AR: Do you mean for the clouds there?

PH: Yes. I think we have to try to get one over the airport if it doesn't mean waiting around too long, because there is a great spectrum of cloud heights here.

6:51 PM

AR: At least right here by the airport, they seem to be pretty topped out in these humps you see there at 1 o'clock, that seems to be the highest. Then, of course, there are those shred clouds down below. Maybe we should avoid the shred clouds.

PH: Yes. I think we've got a hit list at 4 or 5 o'clock now.

AR: I'm embarrassed to say I have still not seen the airport. I don't see ice on the plane anymore. I don't see the airport.

PH: Still ice on the wing.

AR: Right, I have seen that. I was just kidding, but I still actually have not seen the airport. I know Ken is circling right over it and I keep looking.

PH: It's very small.

AR: Has the runway been cleared?

PH: I don't know. I haven't seen it either. We're both in the same boat.

AR: Ken, I have to ask your help again. I still have not seen this airport and I'm embarrassed to say. I keep looking and looking. Is the ice cleared off the runway?

KM: It's at 1 o'clock low at this time. It's just a strip that kind of runs almost across our path.

AR: Thanks. I'll look back there.

KM: It's coming under the nose now.

AR: Thanks.

6:52 PM

PH: Ken, how much longer do you think you're going to need to stay up here?

KM: Starting down now.

PH: Good. The cloud we'll be coming up, Ken. It is not the deepest clouds you see around here. It's going to be something more typical. How deep do you think it is, Art?

AR: Maybe 2,000 ft thick.

PH: Yes. If we can get it over the airport, that will be perfect.

AR: These actually do have a little ice plume coming out of it. I see there's one just out there about 2 o'clock now. See that little virga trail?

PH: Yes.

AR: I think that's stuff that came out of the Cascades. I don't think that developed sort of in situ here.

6:53 PM

PH: Do you still have ice on your dome, Art?

AR: That's affirmative. I'm unable too see very well. Well actually I can see through the lower part because it's clear icing. It's just like another window.

PH: That on top of your natural deficiencies.

AR: Yes, today especially. We've got some ice falling off. Actually I can see quite a bit of ice crystal haze out here coming streaming out of these clouds.

KM: It's off our nose now.

PH: Since we're below cloud base, Art, let's do our CCN spectrum measurements. Is Vidal there?

VS: I'm right here.

PH: We'll be setting up for CCN measurements very soon now.

AR: Do you want to avoid these little snow showers such as you see off at 1 o'clock?

PH: Yes, let's keep out of those and keep out of our own plume and any other obvious plumes.

AR: Roger.

VS: I'm ready to start.

KM: Where do you think the wind is from, Art?

PH: I've got 278°, true.

KM: 278°.

AR: That sounds about right. I was looking at the cloud shadows down there and they're trucking out about that direction, 280° to 290° maybe.

KM: Let us know when you want to level off.

PH: Got some wind here as well.

AR: I was going to say, down here we'll certainly get that turbulence off the mountains.

PH: A 20-knot wind?

AR: Ken, can we level off at this level and can you turn downwind toward the west about 90°? We need to get out of the little snow showers that we're having in here

and they're going to be coming out of the Cascades almost continuously if we're this close. We need to find a spot there. Actually back behind the left wing, can you see there's a spot of clear air?

KM: Back behind the left wing a spot of clear air.

AR: As you come around you can see we've got that real high visibility and a little snow flurry off just ahead of the left wing out in the distance.

KM: Tell us when to level our wings.

AR: Roger.

6:56 PM

AR: How about right in here, Ken? You can see all that great visibility you have almost dead ahead. We'll be out of the snow showers. If we can just kind of orbit and drift and stay out of the little snow showers like we have off the left wing that would be superb, and off the right wing for that matter.

PH: Let's start the CCN spectrum measurements now.

VS: All right.

PH: You'll need about 15 to 20 min here, Ken. Keep out of your own effluent.

AR: If we can head in this direction a little bit more and get away from the snow over there off the right wing now. It seems to be closer than that on the left wing.

KM: Just one at a time back there. Say again, Art.

AR: I was just saying left a bit.

KM: Tell us when you want us to turn and which way to turn.

AR: Give me about another 30 s on this heading and then you can start your orbiting, drifting upwind away from the exhaust.

KM: Okay. We'll probably go pretty much...

AR: I'd kind of avoid the snow shower back behind the left wing that's going to come over this spot.

KM: Okay. We're going to start our turn to the left and work our way west.

PH: I don't think the snow showers will be devastating, Art, if we do go through one or two.

AR: Roger. Thanks. That looks good, Ken. With this kind of wind we don't have to work our way very fast upwind. Everything will blow away pretty fast.

6:59 PM

VS: So I'm taking CCN measurements at 0.2, 0.3, 0.5, 0.7 and 1% supersaturation.

AR: I guess, Vidal, you're on your way now?

PH: Yes he is. Tom, I'm not getting the CNC-1 measurements now, which I was getting very nicely before.

TW: On your strip chart?

PH: Right.

TW: My guess is that it probably went over 1,000/cc.

PH: I doubt it.

TW: Right now I read 1.14×10^4 .

PH: Really! I'm surprised it's higher than it was on the west side. It should be very clean over here.

VS: I was just going to say that the CCN concentrations are a lot lower in this area.

PH: I think there's something wrong with CNC-1. Have you checked the liquid?

AR: There was an attempt to fill it before the flight, I saw Tom.

PH: It was working fine. I had a lovely trace when we were doing this type of thing 45 min ago on the west side. Now I don't even see it anywhere on my trace.

TW: It's definitely up above off your graph upwards.

7:01 PM

PH: So that's a bit of a mystery why the CNC-1 counts are so high here. They'll have to be compared with some of the other aerosol measurements in post analysis.

AR: Yes, I don't see any plumes around. PCASP is only a tad higher than maybe it was on the other side. Just as I say that it drops back down. I don't see much difference here east and west.

7:02 PM

AR: Rubbish! That's probably PCASP measurements that I was looking at above the boundary layer so that maybe moot.

7:03 PM

AR: Gee, I think I've finally seen the airport.

PH: Where?

AR: About 2 o'clock out about 3 miles or so.

PH: Is it covered in snow?

AR: Yes.

PH: That's why we couldn't see it.

AR: How do they expect anybody to land? Looking toward the Cascades there is precipitation.

VS: The CCN cycle is finished and it's a lot different. So I'm just going to give you some values for 0.2 supersaturation we have about 5 counts per cc. For 0.3 we have around 30. For 0.5% we have 200. For 0.7% we have around 500 and for 1% supersaturation we have around 1,000/cc.

PH: Well, it sounds very reasonable and interesting. If you have 1,000 on the CCN, the CNC could well be above 1,000/cc. What are you reading on that, Tom, the CNC-1?

TW: I'm reading 1.9×10^4 /cc.

PH: Well maybe it's right. Vidal, are you doing another run?

VS: Let's go ahead and do another run.

7:06 PM

PH: I don't know where all those particles are coming from though, something like 20,000 per cc.

TW: Do you think they're coming from us?

PH: No. We're avoiding our own effluent.

AR: That's certainly impossible.

PH: Impossible, yes. Is it pretty steady at that value?

VS: Sometimes the CN counts go up to 2,000/cc.

PH: At 1%?

VS: No, this is the CN count.

PH: The CN up to 2,000/cc? Well what Tom is saying is 20,000/cm³.

7:07 PM

PH: That's CNC-1.

VS: Yep.

AR: It looks like the ice on the wings is gone and off the tip of the tail.

7:08 PM

PH: Art, is there a cloud over the airport?

AR: It looks like it. It's that thing right over 2 o'clock high. We're very, very close to the airport now.

PH: That's where we'll circle up over that airport.

AR: It actually looks really good right now. There would probably be a little liquid water in that compared to some of the little scruffy things that were going by.

PH: We'll climb up at about 500 ft/min. It should be okay. It's getting a bit cold back here, isn't it?

AR: Yes. I can't hold onto the metal.

PH: Ken, can you give us a bit of heat back here?

KM: I'll have to pressurize again, but I'll try to keep the cabin altitude the same as where we are here.

PH: Well don't pressurize just yet. I'll tell you when you can pressurize.

7:09 PM

AR: Ken, we just passed over the airport, right, about 30 s ago?

KM: Right.

7:10 PM

PH: I can still see a little ice on the wings, Art.

AR: Right out there by the ray dome?

PH: Yes.

AR: I see that knob out there on the ray dome. That's pretty prominent. I don't see the other stuff that you saw before that I didn't see.

PH: I think it's ice. It comes and goes with the lighting, but I think it must be because it does that. It gets spectral reflection in certain directions.

AR: You were quite right about the ice on the wing. I didn't see it at all. I see that big knob on the ray dome though. That's the thing that catches your eye.

7:11 PM

PH: If you want to be alone, this is the place to live.

AR: Yes, alone and cold.

PH: Producing some nice little showers some of these clouds.

AR: Right. Remember on top it didn't look like they had much coming out of them, but, by golly, it's quite a bit. Also that good cloud is south of the airport now.

PH: Do we have video today and did we have it yesterday?

TW: I never had any time to look at it.

PH: We still don't know? Okay. The video is a question mark.

AR: Roger.

VS: The CCN cycles are completed.

PH: Okay.

KM: Go.

PH: Let's head for the airport and we'll do a spiral up at 500 ft/min over the airport through the cloud there, if there is cloud there, I think there is. You can pressurize now and give us some heat back here.

KM: Okay.

7:12 PM

AR: This is very Colorado looking sky to me. That is the little clouds with all the ice coming out of them. Good visibility.

7:13 PM

AR: Ken, could you call out when we pass over the airport. I can't see it.

KM: Okay. We're over it now.

AR: Ken, can we spiral up in this cloud at 10 o'clock high.

KM: Okay. Do you want those straight ahead and spiral?

AR: Over the airport.

KM: Tell us when you want us to start to spiral.

AR: Now.

PH: Spiral, Ken. Yes.

KM: Starting it now.

AR: This looks pretty good, Peter. It looks like we had a pretty good, pretty typical cloud up there. I'll keep an eye on it and see where it goes.

PH: Keep with it then.

AR: We might want to mark the time when we went over.

PH: I did, 1914 UTC. So we're starting our spiral up over the Sisters Airport where the Battelle microwave radiometer is. We're still in clear air at the moment, but we'll be spiraling up about 500 ft/min through cloud over that airport.

AR: Ken, actually probably wind isn't going to change much. I was assuming we would spiral and drift with the wind. That would kind of keep us with the cloud that passed over at that moment.

KM: We'll just maintain a constant banked turn and we'll drift.

PH: Then we're going to stay with that cloud that went over the airport at pretty close to 1914 UTC. If I can get a photograph of that cloud sometime, Art, let me know.

AR: Roger. We'll be coming around again here in 2 min probably.

7:16 PM

AR: It looks like cloud base here, droplet cloud. It looks like it's going to be about -6°C .

PH: Getting sort of lumped graupel falling out of it, frozen drops or supercooled drops.

7:18 PM

PH: Had a little liquid water back there, but it was only about 0.15 g/m^3 or so.

AR: Just had a little cloud bow back there for just a second.

7:19 PM

PH: Still with that cloud, Art?

AR: We're going in and out of it because our circle of radius is a little bigger than the cloud itself. We're oriented in kind of a line that was more or less east to west. So now we're coming into what would be like that cloud in that same part of it, although it's probably a little bit impacted by lifecycle right here. I have a pretty good idea of what it looked like when it was over that site, so we'll make sure we get something. If it's fading because it's getting further out over the plain, we'll get something like it.

PH: Peak liquid water so far over this cloud about 0.15 g/m^3 on the FSSP.

7:20 PM

PH: The CPI still not working on today's flight at all, Art?

AR: I wasn't able to get it back. But as I say, if you have somebody sitting there trying over and over again, you might be able to get it back.

PH: Did it work at all?

AR: Yes it did. In fact it worked better than the previous flight as it started out. It surprised me, but then it quit. Again it seems like it's an instrument maybe not quite ready for primetime because you really have to sit and baby-sit it.

PH: We did hit our highest liquid water then. It just peaked momentarily at about 0.28 g/m³ or so.

PH: It's going on now at about 0.15 g/m³.

AR: Just about to rake out on top here.

PH: Some quite bit spherical-type ice particles coming from it and a few supercooled drops. So we got good 2-DC images on this cloud but no CPI.

AR: As soon as we get up here and I'm not looking around, I'm going to go up and try to start that thing because I think it's important to see what they are. They could be little points at this temperature.

PH: Have we cleared cloud top?

AR: I'm looking around. Yes, it looks like it. Yes.

KM: Gentlemen, what's your pleasure?

PH: We can head home, Ken.

KM: Roger. Home.

PH: Cloud tops were at about 9,000 ft.

AR: I just wanted to make sure we went to through the type of top that was over the radar. Looking around the cloud was plumped up a bit. It's probably not going to make a lot of difference. It's not worth looking around too much.

PH: No, we have spent enough time here.

TO SUMMARY

7:35 PM

PH: No flight tomorrow, official. Larry?

7:38 PM

PH: Ken.

7:40 PM

PH: I see CNC-1 has gone soaring up again for no apparent reason.

8:12 PM

AR: There's nothing visual evident.

PH: 5 min ago it went up and now it has gone way up.

AR: The trace of a haze layer back behind the tail, but it would have been in whatever that thin, thin thing is for many, many minutes.

PH: Did CNC-2 track CNC-1 pretty well?

AR: I wasn't watching those two, Peter.

PH: I was asking Tom. He's just putting his headset on. Did CNC-1 track CNC-2 pretty well? Could we put up a time history on those?

TW: What was the question?

PH: Was CNC-1 and CNC-2 tracking each other fairly well?

TW: CNC-2 is not working.

PH: Because CNC-1 has gone very high in the last 5 min. It's gone shooting up and there's no reason why it should do that. Why is CNC-2 not working?

TW: I don't know, but you just told us to get one working. So I think we just got one working.

PH: There's no reason why it shouldn't work. It was working previously. It just needs to get some butanol and it should be up and running. Then we'll be able to see if that CNC-1 has some problems with it.

8:14 PM

PH: I wonder if there could be a leak so that it's getting cabin air.

8:16 PM

TW: Peter.

PH: Yes.

TW: Don would probably need to look at it. We'll need to prioritize what we want Don to look at.

PH: Yes. I always do that with Don anyway. It's low on the priority compared with the CPI and the 1-D cloud probe. What else was there, J-W? Although as long as the FSSP and the PVM are working, which they are at the moment, I'm not quite so concerned with the J-W.

TW: Okay.

PH: But the only aerosol measurement I actually need to compare with the CCN is a good CN measurement. If it's just a matter of switching CNC-2 on and putting the butanol in, we could do that on the next flight without doing any work on it.

TW: Right. Was Vidal running his CCN on the transit back?

PH: I assume he is. I think he runs it continuously.

TW: I wonder if he noticed any shoot up in the last like 10 min.

PH: He's not there at the moment. I guess we did descend. Have you got a pressure altitude trace? We were at 16,000 ft and now we're at 13,000 ft.

TW: I don't have one up, but I could probably look at it later.

PH: Normally that change in altitude wouldn't make that much difference.

AR: Ice falls. Ice falls from stratocumulus...

PH: Unless you're very near the surface.

AR: ...of virga and on the sharp north edge of a vast bank of stratocumulus clouds on the south side of the Olympics that extend southeastward.

PH: The other thing to check on when you've got time is that we're getting a proper conversion to cc measurements from the CCN counter.

TW: Yes. Actually over Three Sisters what he was saying was lining up pretty much what I was displaying, but it seemed like yesterday it was never lining up. So I don't know what the deal is. He said all the voltages looked correct and that's what I'm using. So what I can do is I can send the equations to Roelof or have Vidal look at them because I really don't know what it's doing.

PH: Do you have the same output as I have on your strip chart? I mean I've never got anything that looks right on that.

TW: I mean it's tricky because it's had a constant rate for a long time and it changes and it stays at constant rate for a long time because it's only every once in a while that you get a value. So actually a strip chart representation is not the actual best way to view it.

PH: Okay. What's your count on CNC-1 now?

TW: About $5 \times 10^3/\text{cm}^3$.

PH: 5,000, yes.

AR: This is supposed to be a convergence zone-type day and so the clearing in the lee of the Olympics extending toward the southeast probably goes with that. There are some modestly enhanced cumuliform clouds banked up against the eastside of the Olympics extending toward the east. Then this large clearing, which I mentioned, and then on...

PH: We're going to be close to 15 hr flown after today's flight.

TW: We only flew 7 hr yesterday, right?

PH: Did we, I forget?

TW: I think we got a 5 1/2 and a 1 1/2 and then another maybe 5 at most today.

PH: Right. It just seemed longer yesterday.

AR: On the north side of the vast bank of stratocumulus clouds is an ice rift in the clouds, suspiciously like an APIP where there are just glaciated tops visible, but most of it liquid tops, ice underneath, little short ice falls (I guess) that seem to terminate probably where the freezing level is possibly.

8:22 PM

AR: This is probably some turbulence in the lee of the Olympics I'm guessing. Also today is a convergence zone-type day and there are some elevated tops ahead in this stratocumulus. We should get some good cloud microphysics of that.

PH: Okay. Let's keep the measurements on until the last moment.

8:23 PM

AR: It looks like we'll be entering cloud top in about 10 s.

8:25 PM

AR: 20-25. Tom, I guess the video, if we do have it, it wouldn't have any time hacks on it, will it?

TW: Absolutely not.

AR: I don't see the 2-D working.

TW: No, it looks like it's pretty sleepy. I could probably recycle the power. Do you want me to shut the CPI off?

PH: Yes, why don't you do that? Let's get the 2-D up if we can.

AR: The 2-D, there goes the HPVS.

PH: I'm not getting any liquid water here. Just the first liquid water came in.

AR: Right. It's in and out.

8:26 PM

PH: Art, you should tell Don to clean all the instruments prior to each flight, you know, all the ones that can be done reasonably quickly.

AR: Right. Will do.

PH: Radiometers are not important, don't need those.

AR: Right. I know which ones you're thinking about.

PH: Nice FSSP and PVM measurements in cloud.

8:27 PM

PH: Is the 2-D up again?

AR: I didn't see any decent imagery, but it has changed lately. It looks like we've got a couple of streakers and that's probably a good sign it's not the noise images we saw earlier.

PH: Have you recycled the 2-D?

TW: Yes, I have.

8:29 PM

AR: I'm guessing, Peter, that view off 1 o'clock that's probably slightly enhanced area of the convergence zone. Those tops that kind of go off in a line there to the east-southeast.

PH: I see now. We're not seeing 2-D.

AR: We'll be in and out of cloud here for awhile.

8:30 PM

AR: Whatever it was we're passing under that cloud line or in the cloud line right now. I see the 2-D is coming to life, good, excellent.

PH: Also supercooled drops.

TW: I wonder if like the laser turns off due to inactivity or something like that.

AR: I don't know. Our data aren't updating, Tom.

PH: Our text data is not working.

AR: Something has gone dead. I don't think it's -2°C , Peter, but I'm not sure.

PH: All the text data has gone red.

AR: Right. It hasn't updated for some time. Because those are probably drops that are above freezing temperatures because the ice is melting up here.

PH: Still getting liquid water measurements and 2-D measurements. Are all your text data red, Art?

AR: That's right.

TW: You just might want to stop them and restart them. It didn't happen to mine.

8:32 PM

PH: That does it. We got some big liquid water there, the highest of the day.

AR: Wasn't that something? It probably was the zone because that's probably _____ clouds like that.

PH: Well over 1 gram per cubic meter in the convergence zone there.

AR: I'll check that out just to make sure it is.

PH: Yes, that might make a nice little study there, the microphysics of the convergence zone.

AR: My text data never did come back, but I'm going to shut the computer down now.

PH: Did you recycle it?

AR: Yes, I did.

PH: Mine came back all black.

AR: Well I have some blanks.

8:33 PM

PH: More high liquid water back there.

END OF TAPE

Summary of UW Flight 1893

7:22 PM

PH: A summary of this flight. This was in a weak post cold frontal-type situation that had, I think, already passed over the Cascade crest by the time we got there. So we started out at Sweet Home and headed east to Santiam Pass starting out at 15,000 ft. But even though we decreased our altitude to 10,500 ft on that easterly leg, we didn't get into any cloud. We then returned to the west back to Sweet Home descending in altitude from about 10,000 ft down to near 2,000 ft when we were just west of Sweet Home, which put us in cloud as we descended. In fact, we picked up quite a bit of icing during that descent. Then we did CCN spectrum measurements below cloud base just west of Sweet Home at 2,000 ft and got, I think, two sets of measurements there, which Vidal will describe. Then we headed back east through Sweet Home to Santiam Pass following minimum altitudes over the rising terrain, which again gave us a good set of cloud physics measurements. On the east side of the Cascade crest, we headed to Sisters Airport where PNNL has its microwave radiometer for measuring total liquid and vapor water paths. At that site we first of all did another set of CCN spectral measurements below cloud base, in what should have been the outflow from the cloud system over the Cascade crest. After we finished that, we spiraled up through a cumulus cloud that had just passed over the Sisters Airport at about 1914 UTC. From 1914 to 1922 UTC we spiraled up through that cloud and out to cloud top at about 9,000 ft for comparison with the PNNL microwave radiometer.

It was not a very strong weather system today, but we got some pretty good measurements in what there was. The PMS 1-DC probe is still not working. The J-W looks as if it is certainly out; it's giving some measurements, but they're not correct. The CPI started off fairly good but then packed up. Art couldn't get it back up again. The P-3 didn't fly today because they're fixing a deicing problem, so we've been by ourselves up here.

That's it. Art, summary.

AR: Roger. Today was a classic postfrontal day but with well capped cloud tops. An inversion was capping them at about 10,500 to 12,500 ft. Mounding cloud tops extending occasionally to that highest temperature, which was I'd have to say about -13° to -15°C . Cloud bases on the west side running about 0°C to 2°C . On the east side, cloud bases in the lee clouds forming and coming off the Cascades at about -6°C . Droplet concentrations very maritime, surprisingly maritime for being an inland site I thought, again in the tens per cc, and along with that lots of formation of drizzle drops with a collision-coalescence process being active again. Also tremendous amounts of ice also in pockets. It resembles yesterday even though we have less wind pounding against the mountains and more in the neighborhood of 20 to 30 knots at cloud level from the west-northwest and lower cloud base temperatures today than we had yesterday, but nevertheless the tens per cc of droplet concentrations producing the broad spectrum required for collision-coalescence to operate in these clouds at supercooled temperatures. The other thing that we had on the way down here was a great example of seeing the influence of the warm water on clouds over the coast and just inland, which were producing large mounds above the general stratocumulus cloud tops (very cumuliform looking), and then just as soon as they crossed the coastline the poop went out of those things. The air went out of them and essentially they became stratocumulus clouds, probably within 30 miles of the coastline. That's pretty much what we see along the Washington coast. Then over the Cascades the lifting, overcoming the cold surface by producing similar mounds of clouds above the general stratocumulus level, but on a scale that was different than the type seen over the water. The mounds looked broader and probably didn't stick up above the general level of the clouds that much. So I found that quite interesting looking at the clouds going from the ocean to the valley where there was no convection whatsoever, and then the forced convection producing mounds as the air uplifted over the Cascades.

In the Willamette Valley the air channeled out of the southwest and then with a northwest flow above the boundary layer, let's say at 850 mb and higher when turning to the northwest, much as we see in the Seattle area. The southwest wind with northwest wind aloft and that producing upsloped flow from the southwest and when we were sampling the radar CCN sample that was advected into the mountains going northeast, but then as it rose up it got caught in that gradient

flow from the northwest and then tracked back toward the southeast as it traversed the Cascades. So I guess that's it, way too much.

PH: Fine, that's good. Vidal.

VS: It was a very exciting day for CCN measurements for me. The first cycle that we did over the town of Sweet Home was relatively clean air, with CN counts of around 250 cm^{-3} . So we did two cycles of CCN and the data was like 60 counts per cc at 0.2%, around 80 per 0.3%, around 90 for 0.5%, around 100/cc for 0.7%, and around 120/cc for 1% supersaturation. So this was relatively clean air compared to the last one we did over the town of Santiam.

(End of tape 1, side 2)

VS: The second set of CCN measurements, which we did over the Sisters Airport on the east side of the Cascades, was up to 2,000 particles per cc. At 0.2% we got 2 counts per cc, 0.3% around 30, 0.5% around 250, 0.7% around 500/cc, and for 1% supersaturation around 1,000/cc. So it was a really exciting day for CCN measurements.

PH: Good. Tom, anything?

TW: Yes. Pretty much the same instruments were out that we were having problems with yesterday, except for the CNC-1 (TSI 3022). The serial cable on the back was connected to the wrong instrument. I fixed that and it's connected to the correct instrument now. That's about it.

PH: Okay.

PH: I'll take a look at that CCN-1 and see what it does on the way back home.

7:33 PM

PH: Well the CCN-1 reading has declined as we climb here. It's come down into the hundreds. Vidal, were your CCN measurements at one particular supersaturation higher on the west side or the east side?

VS: Let me check my notes. Hold on a second.

7:34 PM

VS: My CCN measurements on the west side at 0.3% supersaturation were around 40 to 50 numbers per cc, and on the east side they were more around 60s to 70s numbers per cc.

PH: That's what we would expect. Probably some activation and growth of the CCN in clouds, and then we see the enhanced CCN expelled in the outflow on the east side.