C-131A FLIGHTS FOR SCAR-C
September 21 – October 4, 1994
Flight Summaries, Position Plots, and Voice Transcriptions
Assembled by
Peter V. Hobbs
PREFACE

The Smoke, Clouds and Radiation (SCAR-C) field study took place in the Pacific Northwest from September 21 through October 7, 1994. The centerpieces of this study were in situ airborne measurements from the University of Washington's Convair C-131A research aircraft of the particles and gases in the smoke from a number of prescribed fires and wild fires and remote sensing measurements of the fires from a NASA-Ames, high-flying, ER-2 aircraft. In some cases, measurements from the two aircraft occurred simultaneously on the same fire.

Contained herein is a brief summary of each of the eleven research flights of the C-131A in SCAR-C, maps showing the C-131A tracks for each flight, and transcriptions of the tape recordings of intercommunications between crew members on the flights. Taken together, this information provides a broad overview of the goals of each flight.

Information on the measurements obtained aboard the C-131A may be obtained from Professor Peter V. Hobbs, Department of Atmospheric Sciences, AK-40, University of Washington, Seattle, WA 98195.

The University of Washington's participation in SCAR-C was made possible by grants from NASA, NSF, EPA and NOAA.

Peter V. Hobbs

17 October 1994
SUMMARY

Flight #1653
September 21, 1994
Engines On: 1016 PDT  Engines Off: 1448 PDT
Departure Airport: Paine Field, WA
Arrival Airport: Hoquium, WA

This flight provided good measurements on a prescribed burn of 48 acres (5,000 tons) of old growth cedar slash on the Quinault Indian Reservation, Washington (47°19'/124°16'). Helolit fire. Produced good fire and plume that fanned out nicely over ocean and near top of marine boundary layer (~3,700').

Obtained chemical samples at several distances downwind and along length of plume. Did CAR-type banked flight in, below, and above plume. Also, level flights above and below plume for Valero radiometers. Obtained clean air (background) samples over ocean.

ER-2 flew over Quinault (and the nearby ITT and Simpson burns) from ~1200 to 1500 PDT, obtaining extensive remote sensing measurements. Roger Ottmar (USFS) made observations from ground of Quinault, ITT and Simpson fires.

(Sampled plume from ITT burn (47°8'/123°38') on way in to land at Hoquium – just one traverse across width of plume)

Summary: Excellent data set in Quinault (WA) fire with ER-2 overhead.

P. V. Hobbs
University of Washington
September 26, 1994
GPS track of flight 1653, 09/21/94 10:29:00 - 14:44:00
AIRCRAFT POSITION PLOT

GPS track of flight 1653, 09/21/94 11:05:00 - 14:44:00
Flight 1653  
September 21, 1994

PVH*: 21st of September, 1994. The first of the SCAR-C biomass flights. We're heading out to the Washington Coast to look at possibly 3 prescribed burns. On board are Hobbs, flight scientist, Hegg, Herring, Russell, Spurgeon, Weiss, Levin, chief pilot Larry Sutherland, co-pilot Sorensen. The weather is clear and sunny. It is expected to reach 80 degrees today. Unfortunately, the first fire that we are supposed to look at, the Quinault, we were told that it was going to be ignited today and therefore scheduled a 10:30 take-off which we are now about to do. We heard just before take-off that they lit at 10:00. We'll go out and take a look at it and get measurements if we can. If not, we'll move to the other two fires.

10:29 AM
PVH: Can you hear me, John?
JH: Yes.

10:30 AM
DS: Ready in the back.

10:32 AM
PVH: Take-off at 10:33 AM.

10:35 AM
PVH: Rod, can you hear me? Can you hear me, Larry and Rod?
LS: I've got you now, go ahead.
PVH: OK. Just checking if we've got our communication here.
LS: OK.

10:37 AM
RS: Jack, this is Rod.

10:39 AM
RS: Anybody in the back, this is Rod.

* PVH: Peter V. Hobbs; DH: Dean Hegg; JH: John Herring; JR: Jack Russell; DS: Don Spurgeon; RW: Ray Weiss; IS: Irina Sokolik; LS: Larry Sutherland; RS: Rod Sorenson.
10:50 AM

PVH: We're heading due west now toward the Quinault fire. We haven't managed to make contact with the forest service on the ground yet. We seem to have a problem with the continuous flow into the continuous gas measuring instruments. It may be blocked but that shouldn't interfere with our getting the bag samples and the emission factor measurements. We may have no continuous gas measurements.

11:02 PM

LS: We have the fire in sight up here. Did you copy, Peter?

11:03 AM

RS: Hello back there? Anybody up?

11:04 AM

RS: Is anybody up back there?

11:05 AM

JR: Yo, Rod.

RS: We're in the area. A few minutes ago I sure thought I saw some good smoke. Not so sure now. What level do we want to start at, if and when we see that?

JR: Beats me. Did you cover up the inlet when you washed the airplane?

RS: What inlet?

JR: The one on top of the plane.

RS: We covered things and two of us looked over it real carefully to make sure we got everything off. Do you think we missed something?

JR: There's a possibility. I don't know. There's one by the chemistry rack.

RS: At this point, if it's important we'd have to go to Hoquium and land.

PVH: No, we'll go ahead for the time being. I've just heard from the forest service that they're going to light the Quinault fire, the first fire, in about 15 minutes time. I guess that's about the time we'll be arriving, isn't it?

LS: I've got the helicopter down here, Peter, I think.

PVH: Good. There should be quite a lot of activity down there. Now they'll start to ignite in about 15 minutes but it will take them a while to get it going so once we've definitely located them, let's position ourselves well upwind of them and then we'll do a vertical profile from about 1,000 feet up to 6 or 7,000.

LS: OK, 1,000 to 6 or 7. I see some smoke down here to the south. It looks like the wind might be north maybe 3 or 4 knots. It's not very much.
PVH: I'm going to come up there to spot the fire myself.

LS: OK.

11:08 AM

PVH: We're at the sight. They've just begun to ignite the fire. We're going to do a vertical profile upwind, say from about 1,000 feet up to about 6,000. Then we'll move into the smoke as it develops.

JH: Peter, to take a full background sample would take me about 45 minutes so, you want to save that for later?

PVH: Yes, let's save that for later. I want to get an idea of the vertical stability here. Go ahead.

LS: I'm going to do a right turn and come down the upwind side at the fire at 1,000 feet.

PVH: OK. What altitude are we at now? I see, 1,200. Fine. Then we'll do a slow spiral upwards.

LS: OK.

11:11 PM

JR: Peter, we're over a populated area here.

LS: Peter, how close in do you want us to the fire?

PVH: We don't need to go close in to the fire at all. We can get out of their way upwind.

LS: OK, I'm going to pass 2 or 300 meters to the east of it here at 1,000 feet.

PVH: OK.

JR: Do we want the Lidar on or not?

PVH: We will want the Lidar on when we move into the fire but we don't need it on until the smoke picks up.

JR: All right. Don, turn that thing off.

11:19 AM

PVH: In about 5 minutes time we're going to penetrate the plume just to take a first look at it. Then we'll come round and we'll penetrate again and at that point we'll take our bag samples. Is everyone ready to have a first penetration?

JH: I'm ready, Peter.

DS: Ready back here.

LS: Peter?
PVH: Yes?

LS: We're going to drop her down now to about 1,500 or 1,200 or so.

PVH: OK. Are you reading me back there in the back?

JR: Yes.

PVH: OK. Let's go ahead, Larry, and you can give us a countdown as we approach the plume so we can look and see what's going on as we go into it.

LS: OK. It's going to be about 3 minute.

PVH: We may get a little bump as we go through the smoke.

11:27 AM

JR: Do you want the Lidar turned on now?

PVH: No, not yet. We'll do a pass across the top of the plume and turn it on then.

LS: Peter, we're about 1 minute before and we're going to go through the upper 20% of the plume.

11:28 AM

LS: Peter, do you read from the cockpit?

PVH: Yes I do.

LS: Looks like that plume is up there at 1,900 or 2,000 feet for the top but we'll go through it at about 1,700, how's that?

PVH: OK. Give us at 10 to 0 countdown.

LS: OK, you're at 10 seconds now. 5 seconds. About 3 or 4 seconds now.

11:29 AM

LS: Peter, would you like another one of those?

PVH: No, let's now do a pass across that portion of the plume so we're clear of the smoke and we'll look down on it with our lidar. So let's have the lidar on now, Jack.

JR: Roger.

PVH: Don't do that pass until Jack has told us that the Lidar is on.

DS: The lidar is on.

PVH: OK, you can do it then. Give us a countdown again as we go across the plume.
LS: OK. It's going to be about 3 minutes from now.

11:30 AM

LS: Peter, you're at about 20 seconds now. We've gone past just about 100 or 150 feet over the top.

11:31 AM

LS: About 15 seconds, I'd say.

11:32 AM

PVH: That is 15 seconds from going across the top of the plume.

LS: About 10 seconds. You're directly over the top now.

PVH: Did we see anything on the lidar? Good.

11:33 AM

PVH: John, are you ready for a penetration of the plume back the way we went before to get some samples?

JH: Yes sir.

PVH: OK Larry, we want to go through the same portion of the plume as we did before. Same altitude, try to pick the same portion. Give us the best countdown you can as we approach the plume. A few seconds before we hit the center of the plume say "sample" and that's when John will take his sample.

LS: Make that at the same altitude?

PVH: Same altitude, same location as before.

LS: OK.

PVH: Actually, what you're trying to do is find the densest portion of the plume so if that differs a little bit from the one before, that's OK.

11:34 AM

PVH: So John, you've got your readouts. When you see that CN or the neph start to pick up, that's probably when you should bring your bag in but you'll get some help from Larry as well.

JH: Roger.

LS: About 30 seconds from the top.

11:35 AM

JH: Larry, we want to be in the smoke on this one, you know that, right? We're not going over the top.
PVH: Pick out the densest portion of the smoke.

LS: 10 seconds.

PVH: CN is starting to pick up a little bit.

LS: 5 seconds. Sample.

PVH: Did you get it John? If not, we'll dump it.

JH: Dean suggested, actually, told me not to sample there, that we would sample down the plume axis instead.

PVH: I was going to do that next if you though this was no good. So you didn't sample that?

JH: No, I didn't take a sample at all.

PVH: OK, then let's try another maneuver. The plume is so small in cross-section, Larry, that we're not getting much. Let's go down the long axis of the plume starting over the fire and going downwind through the thickest part of the smoke along its axis. Do you understand?

LS: You want to drop down and fly right down the trail.

PVH: You pick the altitude in order to pick out the densest region of the smoke and try to keep in the smoke as you go down it's axis downwind.

LS: OK.

11:37 AM

PVH: Larry, we're probably going to have to be at a lower altitude than we were last time, otherwise you'll miss the long axis of the smoke. You're just going through that little cumulus blob, but we really want to get a long smoke sample. So you need to drop down a bit so we go through the long axis of the smoke.

11:38 AM

JH: By the way Peter, we fixed the inlet on the gas instruments.

PVH: Great. What, did you just blow hard again, John?

JH: No, I stuck a tube up through it.

PVH: I'd like photograph of that one on your door.

JH: I tried blowing on it. It wasn't enough pressure.

LS: 5 seconds to penetration.

11:39 AM

LS: 2 seconds. We're in it. Sample.
PVH: Keep in it as long as you can.
JH: Got it.
PVH: You got your sample, John?
JH: Roger.
PVH: So you're going to need 5 minutes now, right?
JH: Yes sir.
PVH: OK, you've got it.
LS: Do you want to go back the other way through it?
PVH: No, we have to stand off now while we get our measurements on that sample.
LS: OK.
PVH: Stay out over the ocean here. I want to do a maneuver that has nothing to do with the smoke. Let's get a portion of the ocean that's clear of the smoke.

11:40 AM
PVH: Irina?
IS: Yes
PVH: I'm going to do 2b (banked turn for CAR) on our chart here. The surface. We'll do it over the ocean.

11:41 AM
PVH: Change of plan, Larry. We want to do another sample just as we did before so come around back and go through it the same as you did last time.
LS: I think we need to be at 900 feet going out there.
PVH: A bit lower than we were before? Is that going to keep you clear of the heli?
LS: Say again?
PVH: Will that keep you clear of the helicopter?
LS: No problem.
PVH: Are you in touch with them yet?
LS: Negative.

11:42 AM
LS: Peter, we'll be penetrating in about 2 and 1/2 minutes here.
PVH: OK.

11:44 AM

LS: Penetrate in 1 minute.

11:45 AM

LS: 30 seconds.

JH: Peter, we're going to be another minute here before we're ready to go again.

PVH: OK. Just go through it nevertheless. This wasn't for you, John, this was for the aerosol.

LS: We're about 15 seconds, 10 seconds. Penetrating.

11:46 AM

PVH: No need for you to rush, John. How much time do you want? How much time does he need?

11:47 AM

PVH: Tell John to put the headphones on.

RS: We finally made contact with the helicopter and he's departing for the next site now.

PVH: John, how much time do you need?

JH: One minute.

PVH: OK, no need to rush. Larry, let's go back along the length of the plume but above the smoke so we get a lidar cross-section looking down the long axis of the plume.

LS: OK, I'll make that from over the water back over the shore this time.

PVH: That's correct.

JH: The only problem with this is that it's completely ridiculous for me to try to do all this stuff.

PVH: So you do our things first and then you take care of other things as best you can.

JH: OK.

11:48 AM

LS: Peter, do you want me to just clear the top of the vertical?

PVH: No, you can be about 500 feet above the smoke.

LS: OK.
PVH: Don, do we have the lidar on?

DS: Yes.

PVH: OK, so we'll get a section along the axis now. John, I can give you more time to do what you want because we've got other things we can be doing.

JH: We're going to need a few more minutes.

PVH: You've got 5 or 10 minutes while we do this next maneuver.

JH: I'm ready to go again now but I'm just saying that in general we're going to need a couple more minutes.

PVH: There's no rush.

11:49 AM

LS: We're about 1 minute from entering over the top of it so we'll be over the horizontal here in about another 30 seconds.

PVH: Try to go along a line that is directly above the main long axis of the plume.

LS: We're 30 seconds to being overhead to vertical.

11:50 AM

LS: 20 seconds.

PVH: John, did you get everything done?

LS: Directly overhead to fire sight.

JH: Most of the stuff. It looks like the duplicate cans are going to be the first thing to go because that's a real pain in the butt.

PVH: OK. Shortly we'll go back and do the same thing that we did before. We'll go through the smoke again, as you did before, Larry, keeping along the long axis so we get a second sample that's pretty much the same as the other one we got, going in the same direction as we did before.

LS: OK.

PVH: Mainly west.

LS: Do you want to be back down in that stratus layer then?

PVH: Yes, you guide it through what you see to be the densest portion of the smoke, keeping in that horizontal area that's a bit lower than the capping smoke.

11:52 AM

PVH: Does everything seem to be working on your station?
11:53 AM
PVH: Is the power in the photometers working OK? Don, can you read me?

DS: Go.

PVH: Is the CCN working OK?

DS: Seems to be.

PVH: And the power in the photometers?

DS: No problem with those.

PVH: After we've done this next penetration we're going to do some of this CAR work so we'll set up to do that after this next penetration.

DS: OK.

11:54 AM

LS: We're about 1 minute and 45 seconds to penetration.

PVH: Nice view on the screen now.

LS: 40 seconds to go.

11:55 AM

LS: 30 seconds. 20 seconds. 10 seconds. OK, you can tell by now.

11:56 AM

PVH: You OK, John?

JH: Yes.

PVH: You've got quite a bit of time now because I want to do some CAR work. I'll come up and talk to you, Larry.

11:57 AM

PVH: Irina, do you read me?

DS: Go ahead.

PVH: We're going to do the CAR circles in the smoke. We'll be banking to the left and here try to keep in the smoke while he does 4 circles in the smoke. When we get set up for that she should follow the instructions. Lock on that 1.64 μm. Have you got the instructions there?

DS: Yes.
PVH: Lock on that 1.64 and then Rod will tell us when we're about to point to the sun and then she has to change the range setting. But you'll probably know as well when we're coming up to pointing to the sun.

DS: Very likely, it should show up on the CAR.

PVH: So Larry will tell us when he's starting to do his circles and at that point we switch to the 1.64 microns.

DS: OK.

LS: We're going to be into smoke in about 20 seconds.

12:00 PM

DS: We're standing by at the CAR station.

RS: We're still setting up on you. We're pointing at the sun now. At least the sun is off to our right, which I think is what you mean by pointing to the sun.

PVH: You know where the CAR is located. Pointing out to the right to the nose of the plane. So whenever that's coming up to pointing into the sun, let us know so we can switch down the gain.

RS: OK. We're pointing at the sun steadily right now while we're setting up.

12:01 PM

RS: We're starting our bank. This might take us a circuit to nail down.

PVH: That's OK. We'll try 4 circuits so we'll get it right.

RS: OK.

12:02 PM

PVH: You can do a trial circuit if you'd like but once you decide on the circuit that keeps you on the smoke, let us know and we'll do 4 like that.

LS: OK. It's going to be a lot tighter than 20 degrees and I'm not even sure I can stay in it at that. It's not that wide.

PVH: OK, just do the best you can.

LS: OK.

PVH: Does the fire look as if it's diminishing, or is it a pretty steady state or what?

LS: It looks about the same.

12:03 PM

LS: 40 seconds before we're in it. Then it's going to be straight for about 35 or 40 seconds and then I'll commence my turning.
RS: Coming up on the CAR.

LS: Coming into it in about 10 seconds.

12:04 PM

PVH: OK, are you on track back there?

DS: Yes we are.

PVH: We'll do 3 circuits then.

LS: We're starting a turn.

RS: We're doing a 35 to 40 degree bank up here. The plume is sloping down out to sea which makes it difficult to have a good level elevation for the whole thing.

PVH: OK.

12:05 PM

RS: There's about 6 seconds for the CAR.

PVH: Switch to that lowest range then.

12:06 PM

PVH: Let us know when you finish your first and second circuits. John, do you read me?

RS: About 8 seconds to the CAR.

12:07 PM

PVH: Is that the end of our first circuit?

LS: End of the second, Peter.

PVH: Are you doing OK, Don?

DS: Yes.

12:08 PM

JH: I'm ready to sample again whenever you're ready, Peter.

PVH: I just want to complete this maneuver for the CAR and then we'll do another sample for you along the axis. Are you watching that sun angle, Don?

12:09 PM

LS: Peter, we're starting our third circuit.
PVH: I think we're just starting our third and that will be the last one.

LS: OK.

PVH: After that, Larry, I want to go upwind of the plume again and come down through the axis of the plume, right in the smoke, the same way we've done twice before.

LS: All right.

PVH: It's coming up to the sun again.

12:10 PM

PVH: Is that the end of our third circuit?

LS: We just passed it.

PVH: OK, let's head upwind.

12:11 PM

PVH: Larry, we'll come back heading west right through the thickest part of the smoke, down its long axis. Give us a time call again.

LS: OK. You're 3 and 1/2 minutes now.

PVH: Are you ready, John?

JH: Yes.

12:12 PM

PVH: Don, do you have a camera with you? Mine has packed up.

DS: I did not bring one, no. There ought to be one in the back.

PVH: I'll try to get that. The batteries just went on mine.

LS: Peter, there's 2 minutes.

PVH: It's a pretty nice looking plume, although it's not very big.

12:13 PM

LS: We're 1 minute.

12:14 PM

LS: 30 seconds. 15 seconds.

12:15 PM

LS: 10 seconds. 5 seconds. Sample.
JH: Done sampling.

PVH: Just keep in the plume down it's axis.

JH: Peter, could you turn on the switch in front of you called "Zev's filters"? That's it, yes.

12:16 PM

PVH: When we've come out of the end of this plume I want to do that same sort of banking turn we just did in the same location but below the smoke, clear of the smoke so we're looking at the ocean.

LS: OK.

PVH: Don, we're setting up for another CAR mission but below the smoke.

DS: OK.

12:17 PM

LS: Peter, are you going to be looking for right hand turns this time?

PVH: We'll be banking as we did before. Banking to the left.

LS: OK.

PVH: Same as we banked before.

JH: Peter, this is a 10 minute sample here so it will take me about 13 to get ready again.

PVH: That's fine. We're going to do a CAR mission above and below the plume so we'll need that time ourselves.

DS: Peter, I'm ready for the next CAR.

PVH: OK, Larry's just setting up for it.

LS: It's going to be about 3 minutes and we'll be back in. We'll be under the plume.

PVH: Yes, we want to be in the clear air under the plume and by banking to the left we'll be looking up with the CAR into the smoke. Again, we'll need to watch as we come around to the sun to switch the gain down, Don.

DS: That's not a problem. I just watch the monitor and as it starts saturating I switch down and keep just ahead or behind it, depending on which way it's going.

12:18 PM

LS: We're 2 and 1/2 minutes from it now.

12:19 PM

LS: We'll start our turns in about 1 minute and 20 seconds.
DS: Can you guys hear me up there, Larry?

RS: What do you need?

DS: I just wanted to make sure I had the switch turned on. It's kind of hidden behind a seat.

12:21 PM

LS: We'll start our circle in about 15 seconds.

12:22 PM

PVH: So far we've got 2 bag samples for chemistry going down the length of the plume. We've done 3 circuits in the plume for the CAR and we're about to do 3 circuits now below the plume.

LS: Starting the second one.

PVH: We're now in the second circuit below the plume for the CAR. The next thing we'll do is go down the length of the plume again to get a third bag sample for chemistry. Whoops, you got in the smoke here, Larry. Try to keep below it.

12:25 PM

PVH: Perhaps we should drop down a bit more. Do you read me, Larry? Larry, we're in the smoke, we need to be in the clear air. We need to drop down a bit more.

LS: OK.

PVH: Let's try that again. Do 3 circles but well below the smoke.

12:26 PM

LS: We'll give you 400 feet.

PVH: How much more research time before we have to leave here and head for Aberdeen?

RS: About 2 hours.

PVH: Good.

12:27 PM

LS: Peter, that completed a third. Do you want to go above it now?

PVH: Have we made our 3 turns now?

LS: I'll give you one more, how's that?

PVH: OK. Then we're going to need to go upwind again and come back to get a third sample in the plume along it's axis.
LS: Roger.

12:30 PM

PVH: Larry, don't make that penetration until I give you the word. They're still getting set up back here.

LS: OK, I was going to go up to about 1600, 1700 feet. I'll get out to the east and then we'll cross over.

PVH: I just spoke to the forest service man on the ground. He said this fire is still picking up in intensity and it will be going for a few hours yet. I see another one off on our right. Would that be in the location of the second burn, the ITT burn?

LS: Yes, the one up there at about 2 o'clock would be the ITT burn.

PVH: OK. I think we'll stick with this one.

LS: Peter, that vertical plume is to the east of the horizontal. We're going to have to go right over the top of that or do you want to go around it and just get over the flat spot?

PVH: Let me come up there and see.

12:32 PM

PVH: We're setting up now for the third penetration along the axis of the plume. I think everything is ready back here so go ahead, Larry. Give us a call as we go into it.

LS: You're 1 minute from it now.

12:34 PM

LS: Make that 2 minutes. You've got 30 seconds now.

12:35 PM

LS: 15 seconds. This one is going to be rougher.

12:36 PM

LS: 5 seconds. Here we go.

PVH: Just keep in it as we go downwind, Larry. About how far are we from the coast now?

LS: We're probably about a mile and a half.

PVH: We're still in some smoke.

12:38 PM

LS: What's next, Peter, so I can start getting oriented here?
PVH: I want to go across the plume, in the smoke, about half of it's length out from the coast. We sort of got out of it about 2 miles downwind so let's go through the width of the plume about 1 mile downwind from the fires.

LS: OK.

PVH: The plume is probably wide enough there that we can get good samples just by going across it's width.

LS: OK. I'm going to take a left turn and get south of it and then I'll give you a 90 back through it about halfway, which is going to be about 5 miles out from the fire.

PVH: How many?

LS: About 5.

PVH: Is the plume 10 miles long then?

LS: Pretty near.

PVH: OK, then 5 will do it.

12:40 PM

LS: We kind of came out of the south side of it, Peter, and it extended out. We're just at the end of it now as we're starting back in.

PVH: We just did the third chemistry bag sample down the length of the plume. Unfortunately, the smoke was sufficiently thick that it was going off scale on most of our aerosol and neph measurements so we're now setting up to do across the plume about 5 miles downwind to get some aerosol measurements.

JH: We'll be ready to take another bag whenever you're ready.

LS: Peter, I'm going to start the turn in 10 seconds and then you'll be in it in another 10 seconds.

12:41 PM

LS: We're starting our left turn now and we're going to be in the plume in 10 seconds.

12:42 PM

LS: 5 seconds to the plume. We should be entering it now.

RS: Peter?

PVH: Larry, let's do that again at the same distance downwind on a reciprocal.

12:43 PM

PVH: Larry, let's do that again on a reciprocal. Same distance downwind.
JH: Peter, we're ready for another bag sample, too.

LS: OK, I'm going to give you a 80/260 and go back through the same track we came through northbound.

PVH: OK, so you can get your bag on this one, John. We're going across the width of the plume, 5 miles downwind.

JH: Roger.

RS: Peter, the torch helicopter is completely finished with ITT. They're going to survey or something for a little bit and then be starting on the Simpson.

PVH: Thanks, Rod.

12:44 PM

PVH: Give us some warning and a countdown as you go into the plume, Larry.

LS: Roger, you've got a minute and a half now.

12:46 PM

LS: About 40 seconds.

12:47 PM

LS: 20 seconds.

PVH: We're making our second penetration of the width of the plume. 5 miles downwind, this time for a chemistry sample.

LS: 10 seconds. OK, sample.

PVH: Our neph still seems to be saturating. We're going to move further downwind.

12:48 PM

JH: Should I sample that one, Peter, or are we going to find one farther downwind?

PVH: I think you should look at this one since we've got good measurements at this distance downwind and then we'll go further downwind as well.

JH: OK.

PVH: How long will you be, John?

JH: About 8 minutes.

PVH: Larry, let's now go back into the plume at this distance downwind. Sorry, go above the plume at this distance downwind. Then we'll go down the axis.

LS: Sorry. Go ahead, Peter.
PVH: Let's go down the axis of the plume heading west from 5 miles outwind but above the plume, about 500 feet, so we look down with our lidar down the axis of the plume as we fly out west.

LS: OK, I'll get 5 miles to the east, go right down the top of the plume about 4 or 500 feet above it.

PVH: The point where we just sampled, that distance downwind and then head out west from there above the plume.

LS: So we want to be 5 miles east before we start our run?

PVH: No, 5 miles west.

LS: We're going to be eastbound or westbound on this one?

PVH: Westbound but we start 5 miles west of the fire. Start at the point where we just sampled and then head out west from there.

LS: Got it.

PVH: Don, are we OK with the lidar?

12:50 PM

LS: Peter, we're going to come right over the vertical plume and we'll give you a mark when we're at the sample point.

12:51 PM

PVH: But you're heading east now. I want to head west down the length of the plume.

LS: Right. I want to get above it and then I'll start a westerly turn.

PVH: OK.

JR: Peter, if you're planning to do a lidar scan of the thing it's best to be several hundred feet above it.

PVH: I asked for 500 feet, is that enough?

JR: How high is the...you mean 500 feet above the plume?

PVH: Yes, 500 above.

JR: That's probably enough.

PVH: Did you read that, Larry?

LS: 500 above, got it.

PVH: We have a bit of a dead space on the lidar so we have to have that sort of distance.
12:52 PM
PVH: Unfortunately, my own camera...

LS: Peter, I'm starting a west turn. We're going to come over the plume about 500 feet. The horizontal is almost at the top of the vertical now.

PVH: OK. Head out about 10 miles down it's length.

LS: Roger.

PVH: My own camera's battery is packed up so I've got no photographs but I've started to use the on-board hand held camera and I've taken a couple of shots of the plume. It's a pretty nice looking plume.

12:53 PM
LS: Peter?

JR: He's not in his seat right now.

LS: When we get back into that 7 mile point, what do we do?

JR: I'll round him up.

12:56 PM
DS: Irina?

12:58 PM
PVH: Larry, let me know when we're out at 20 or toward the end of the plume, it doesn't have to be exactly 20.

12:59 PM
JH: Go ahead, Peter.

PVH: We're taking this lidar traverse along the axis of the plume out to about the western extent of the plume, which is 20 some odd miles out. Then we're going to come back in the plume, heading back east, until we're about 15 miles out. Then at 15 miles out, we'll do a full traverse across the width of the plume and 15 miles out for your bag. Then we'll do the same thing at 7 miles out. OK?

JH: OK.

LS: Peter, I've got some more information for you here.

PVH: Go ahead.

1:00 PM
PVH: Let's head back in the plume now, down the axis of the plume, heading east down to 15 miles out from the fire.
1:01 PM

PVH: Sorry Larry, I was on the wrong switch here. Let's head back in the plume, heading east until we hit 15 miles out from the fire.

LS: OK. We're about 35 seconds from going into plume.

PVH: Did you have a message for me?

RS: We actually came to the end of the plume at 15 miles. How far would you like us to go back in the plume?

PVH: In that case let's go down the axis of the plume heading east until we're about 8 miles out and then we'll do a traverse across the width of the plume at 8 miles out.

RS: OK.

LS: We're 40 seconds from going into the plume.

PVH: This is not for your sample, John. We're just going down the axis now.

JH: Right.

1:02 PM

LS: We should be going into the plume now.

1:03 PM

PVH: Larry, we've come too far east. The smoke is still too thick for us here. Do a 180 and go back in the smoke down the axis of the plume until I can see that it's the right thickness for us to do our cut across the wind.

LS: OK. I'll just do a 180 and get back into plume westbound.

1:07 PM

PVH: We may be out at more like 10 or 12 miles out until we hit the right spot.

LS: I'll take you back in the plume at 7 and then outbound, westbound in the plume. Then I'll get you set up to do that cross-section at 8. How's that?

PVH: Sounds good.

LS: At 12 miles here.

1:08 PM

LS: Peter, we're going to be back into the plume on a southerly heading at about 30 seconds. Then I'll turn westbound into plume.

PVH: OK.
JH: Let me know when you're ready for that bag, Peter.

PVH: I'm trying to find the right distance downwind where we're not saturating on the neph. I'm heading out a bit further west.

LS: OK.

1:09 PM

LS: We're in the plume and turning westbound.

PVH: About what distance downwind are we now?

LS: We're 7.7 miles.

PVH: OK, so at 7.7 miles we're still saturating on the nephelometer here. So we'll go a bit further downwind.

JR: That's the 20, Peter. It's the neph 100 that you don't want to have saturated.

PVH: Well, Dean was worried about the neph 20 as well. OK.

JR: It's CN that's saturated that would be a concern to me.

PVH: The CN is saturated as well.

1:11 PM

PVH: Larry, do a 180. Go back toward the fire at that point, about 7.7 miles out or so. Then we'll do another 180 and head out west from that point.

LS: OK.

PVH: What we're going to do, John, is to give you a bag sample heading west about 7 or 8 miles out, down the axis of the plume. You can get your bag sample going down there rather than do a cross-section.

JH: So as soon as we turn downwind in the plume I should take the bag?

PVH: As soon as we start heading west again in the plume, yes.

1:12 PM

LS: Peter, we're about 14 miles out, northbound and turning into the plume to go east in the plume to 7.7 miles.

PVH: OK, about 8 miles is good enough. Come back in the plume and then head west in the plume. Let us know when you start heading west in the plume.

LS: OK. I'm in the plume eastbound now.
1:14 PM
LS: Peter, we're at 8 miles and starting our course reversal. I'll give you a mark when we're back in it.

1:15 PM
PVH: How are we doing, Larry?
LS: We're just north of the plume, coming up on a heading of south and I'll be ready to turn back down the plume westbound in about 30 seconds.
PVH: OK.

1:17 PM
PVH: When you head west, go right down the center of the smoke.
LS: Will do.

1:18 PM
LS: We're turning westbound into the plume.
PVH: Are you ready, John?
JH: I was just sampling there, but I'm emptying now. I'll be ready in about 3 seconds.
PVH: I wouldn't do it straight away. Wait until we're heading west and we see the neph come down a little bit. Then you can get it out from there on.
LS: Peter, we're westbound in the plume now and we're 9 miles out.

END OF TAPE SIDE 1

1:43 PM
PVH: We're now in the middle of our turns above the smoke. Right hand bank with the CAR looking down into the smoke. This should be a good set of CAR measurements. The smoke is a bit patchy. We can occasionally see the ocean beneath it.
RS: We've been through 2 circles now.

1:44 PM
PVH: It's sort of like looking down on a broken strato CU.

1:45 PM
LS: We just completed three.
PVH: Let's drop down into the plume, head west along the axis of the plume until we're about 10 miles out or until I let you know.
LS: OK. When you do want me to enter into the plume, Peter?

PVH: As soon as you can.

LS: I'll get up there to the north, do a 180 and come back and get in it and then turn westbound.

1:46 PM

LS: Peter, we're going to be in the plume westbound in about 45 seconds.

JH: Peter, do you want to give me a call to take the bag sample?

PVH: Yes. What I'm going to do is, as we go down the plume, see when we've got a reasonable neph signal and then we'll do a 90 and come out of the plume. Then we'll do a full cross-section at that point.

1:49 PM

LS: In plume in 20 seconds.

PVH: Give us some distance markers as we go down the plume every mile or so.

1:51 PM

PVH: Larry, give us some distance markers as we move out.

LS: You're at 10 miles now. 15 out.

PVH: It's still very thick here. Quite a bit thicker than the last time we came out, isn't it?

1:53 PM

LS: You're 20 miles out, Peter.

PVH: I think we'll go back to about 18 or 19 miles out and then do a traverse across the thickest part of the plume that you see at that point. That is, across the width.

1:55 PM

PVH: Let's go back 1 mile from where you came to the end of the plume. Then pick a good altitude and a good path to get some smoke as we go through the width of it.

LS: Say that again.

PVH: When you've gone back 1 mile, then pick the best altitude and the best flight track to take us across the width of the plume through the smoke.

LS: OK. I'm starting my turn to go through now. We're just a mile inside of where we were.

PVH: Can you see some smoke there?
LS: We've got some good heavy smoke about 30 degrees left.

PVH: We don't want it too heavy. We're trying to tread a track between not too heavy and not too light.

LS: I've got a spot up here I'll put you on.

1:57 PM

PVH: Give us a countdown as we go into it, Larry.

LS: You're just coming into it now. We're going to go across it at 45 here.

PVH: You've got your sample, haven't you, John?

JH: Still taking it. Got it.

PVH: Good. That looks good. You now need 5 minutes? OK. What I want to do now, well, we're going to do that track 2 more times but there's going to be an interval of time between those while we do our sampling back here. While we're waiting for the second traverse let's go on top of the plume at that same distance downwind and do a level track above the smoke.

LS: Do you want it on the same track as we're on now?

PVH: Yes, the same one we just went through in the smoke.

LS: OK, I'll put you on top of the same track.

PVH: Irina?

IS: Yes?

PVH: This is for you. We're going to do one on top and then one below.

IS: Sounds good.

PVH: We want to be well clear of the smoke on these two tracks above and below, Larry. This first one is above so take us well clear of the smoke.

LS: Will do.

1:59 PM

PVH: Larry, we want to be as conservative as we can now on fuel usage because we still have quite a bit to do with the remaining time.

LS: OK.

PVH: So once you've done one pass above the plume we should be ready to do another pass through the plume, the same one as we did last time, the same distance downwind.
2:01 PM

PVH: Let me know when you're ready, John.

LS: We're over the plume now.

JH: It will be about 3 minutes.

PVH: OK. We may only be able to give you two samples but we'll try to get a third. I want to try to get the ambient in before we land.

JH: Why don't we just do two samples then.

PVH: OK.

2:02 PM

PVH: Do you have a good fix on the altitude of the top of the plume, Larry?

LS: Just about 3,000 feet. Make that about 3,200.

PVH: Let's keep that in mind. We'll need to know that in about 15 minutes DME.

RS: Peter, our altimeters read 4,450 right now. I believe that's about 200 different than the altimeter on your panel.

PVH: OK. The thing is, I'm going to want a clean air sample pretty soon and I want to get that clean air sample over the ocean and just about the height of the top of the plume but rather, below the top as opposed to above the top so we're sampling the air that is mixing with the plume.

RS: OK. I just wanted you to understand any discrepancy between what we might be flying and what it looks like on your gauge.

LS: That was 42, not 32, I'm sorry.

PVH: 42, OK.

LS: I'm starting my reversal now and I'll start dropping down to go through that plume.

PVH: OK, so same track as before. Head for medium looking smoke. It was almost perfect before, and give John a warning when you're coming up to heading in the smoke.

2:04 PM

PVH: He doesn't look ready back here so just hold off for a moment.

LS: Keep me advised.

2:05 PM

LS: We're going to be back in plume in about 45 seconds but I can give you a racetrack pattern if you need it.
PVH: Are you ready, John?

JH: Yes sir.

PVH: OK, we're ready so just give John warning when you're going in.

LS: 40 seconds.

2:06 PM

LS: Looks like maybe 25 to 30 seconds. We're out a little further than I thought.

2:07 PM

LS: 20 seconds. We've come up with some layers right in this spot, it looks like.

PVH: We may have to drop down a little. I don't see any response on our instruments here.

LS: It's getting thicker here.

2:08 PM

PVH: We're in it now. Got it, John?

JH: Yes.

PVH: How much time do you need on this one?

JH: 5 minutes to sample and about 2 to change over.

PVH: OK. Larry, drop down now. We'll do a reciprocal below the smoke. Make sure it's below the smoke, a straight path back towards the south.

LS: OK.

2:09 PM

PVH: Irina this is another one for you.

IS: OK, thanks.

PVH: You owe me a lot of favors today. Another cross-plume sample about 10 miles downwind for chemistry. That was the second one on this particular set. We're now going to cross the plume under the plume as we head south to get some measurements for the NASA radiometers.

2:11 PM

PVH: How much more flying time on station here, Rod?

RS: Half an hour here. At 2:40 we need to head to Hoquium.
PVH: I think with a bit of luck that will just about do it.

LS: We're just going under the smoke. We're in the clear. We're on the same track.

PVH: We should position ourselves advantageously for another traverse of the plume like the one we had a moment ago so we need to do a reciprocal so we'll head through the plume again, the same way we did before, toward the north.

2:12 PM

JH: Peter, I think it would be a good idea if we did a background with some of that remaining time. The next bag sample, if we do the third in the normal sequence, would be a 10 minute bag, and it would take me about 4 minutes to switch over so that would pretty much eat up the rest of our time.

PVH: OK, we'll skip the next bag. What I want to do now, Larry, is head north, clear away from the plume, still over the ocean about this distance downwind, downwind is fine, but I don't want to be in the smoke. I want to get a clean air sample over the ocean at an altitude—you said the top of the plume was about 4,200, so let's say about 3,700 or so. Circle there and we'll get some ambient air samples.

LS: OK, so I'm going to get up on the north side at 3,700 feet.

PVH: Correct. In no smoke. Clear the smoke completely.

LS: Roger.

2:15 PM

PVH: We only got 2 chemistry samples at that distance 10 miles downwind. We're running out of flight time so we're now heading up north clear of the plume and we'll get some ambient air samples for chemistry at an altitude just below that of the top of the plume.

2:18 PM

LS: Peter, it looks like the tops are right here at about 3,600. We're about a half a mile north of the plume.

PVH: Do you think we're at the level of the top of the plume now?

LS: We're just a little bit above it by about 200 feet.

PVH: I want to come down below it so, you thought it was at 3,700, did you?

LS: Affirm.

PVH: Let's come down to 3,200.

LS: OK, and I'm going to stay up here to the north of it, is that what you had in mind?

PVH: That's right. Nice clean air.
2:19 PM

PVH: We can just circle in here. Try to avoid going through your own track. In fact, I prefer you not to circle, just do straight lines. We don't want to sample our own emissions.

2:20 PM

PVH: The two chemistry samples here in the ambient had to be rushed a bit because one of the instruments was fading on us. I think we got two clean air chemistry samples OK, north of the plume and out of the smoke, as we move around here at about 3,200 feet.

RS: Peter, with that climb, I believe we're going to be down to about 10 minutes from now.

PVH: OK.

2:21 PM

PVH: John, do you have your two samples?

JH: I'm working on the first one now.

PVH: We've got 10 minutes on station here.

JH: That will give me two.

PVH: Larry, we're going to be taking another clean air sample soon, so keep in this area and keep out of your own emissions.

LS: Roger.

2:22 PM

PVH: Have you sampled, John?

JH: I'm just about to.

2:25 PM

JH: OK, I've got my last sample.

PVH: OK, we can head toward Hoquium now and we might as well go through the smoke as we head south. Larry, we're heading south to Hoquium now. We'll go through the smoke on the way back. We got our two clear air samples. We're now heading back. We'll go through the plume as we head to Hoquium for refueling. To summarize, this was a good flight. We had a good fire which produced a very nice fan-like shaped plume that went out over the ocean. We got, hopefully, good chemical samples at various distances downwind and we did a couple of traverses along the axis of the plume. We did a lidar cross-section of the plume along its length and across it's width at a couple of points. We did a full sequence of CAR measurements in, below and above the plume. We did some straight line paths below and above the plume for the NASA radiometers. So it should be a pretty
good data set on a very well specified fire on the surface, assuming the foresters
know what they were burning.

2:28 PM
PVH: Don, is the lidar still on?
DS: I believe so. Would you like it off?
PVH: No, leave it on. We'll go above the plume on the way to Hoquium.
DS: OK, I'll go make sure it's still running.
PVH: Larry, can you, instead of going through the plume, go 500 feet above the plume
on the way back so we can get some lidar measurements?
LS: OK.
PVH: So we won't be going through the plume on the way back. I think it would be
more interesting to get a lidar cross section since we haven't done one for some
time.

2:29 PM
PVH: Rod, what is the ETA for Hoquium?
RS: We'll be landing in Hoquium at 2:45, 2:46.
PVH: Ray, can you hear me? Why don't you use the recording system here now to
record your impressions of the flight from your point of view. What measurements
you got, what you think was good, what you think was bad.

2:30 PM
RW: This is Ray Weiss. My view of flight 1653 from the point of view of the optical
measurements was pretty good. The aerosol appeared white. Single scattering
albedo typically .95 to .98. The particle asymmetry analyzer indicated that the
particles were essentially round, no asymmetry to them. This is to be expected
since these types of particles don't form chain aggregates very well. The
aethelometer didn't work because the pump wasn't providing an adequate flow
through it. Hopefully we can get another pump on it for the next flight. All in all it
was a pretty good flight.

2:31 PM
DS: Are you through, Ray?
LS: Peter, we're just coming over the plume now.

2:32 PM
DS: On this flight I was pretty happy with the CCN. It actually worked, for once. Only
problem was towards the end of the flight when the temperature got so high that I
could no longer remove the heat as fast as it was being put into the cabin itself. All in all the measurements were quite successful.

PVH: We're going over the top of the plume now.

LS: Peter, we're pretty much over that plume and I'm going to duck down to get under this. There's another one up ahead from the other fire.

PVH: Let's go through that one ahead of us.

2:33 PM

PVH: Larry, let's go through that one ahead of us.

LS: Roger.

RS: Are you done with the vacuum pump?

JR: Yes, I'm done.

2:34 PM

PVH: Larry, are we coming up to this other plume now?

LS: You're coming up to it in about 20 seconds.

PVH: OK, this is a plume from which fire?

LS: One of those that are further east.

PVH: Is it the closer one or the farther one?

LS: I'll be able to tell you when I get on the other side of it.

PVH: OK. This is not the plume we've been looking at all day. This is, for the record, a plume from one of the other two fires that were lit today.

LS: Peter, I'm having to descend to stay in this thing. That's about the end of it.

2:36 PM

DS: What is the ETA until we start descending for our landing?

2:38 PM

JR: Do you want to know when to turn the lidar off?

DS: Both the lidar and Irina's equipment.

JR: I think the CAR door should start being closed and so forth now. I can't get a hold of Peter, he's up front.

DS: I'll go ahead and start. There's not a whole lot now anyway.
PVH: We're not sure which plume we sampled as we headed into Hoquium but we'll try to establish which of those other two fires we went through.

JH: Here's some flight chemist's perspective on this flight. We took 8 bag samples of smoke and 3 background samples using a whole array of different filters. It worked out fairly well, although some of the filters didn't behave as expected. We were collecting Teflon filters for us, quartz filters for us, Nuclepore filters for two other investigators, and 2 different types of quartz filters for other investigators. Changing filters back and forth is kind of a mess and there were a few mistakes made today. Some of the samples got contaminated with a little bit of cabin air. Overall, the sampling went quite well and we got a few bugs worked out of the system. The first smoke samples we did were very heavily loaded with the CO2 concentrations in the bag. Generally above 600 parts per million. Then we did a few lower concentration samples, a couple of those, and the background samples were a little bit short but we're out of fuel so we're heading into Hoquium to refuel now.

RS: Is everybody ready for landing with your seat belts on?

PVH: 1 minute to landing.

END OF TAPE
Summary: Very limited data collected on ITT and Simpson fires in dying, smoldering stages.

P. V. Hobbs
University of Washington
September 26, 1994
GPS track of flight 1654, 09/21/94 16:26:00 - 17:39:00
VOICE TRANSCRIPTIONS

Flight 1654
September 21, 1994

PVH*: Clear sky, except for the smoke we can see to the north from the prescribed fires.

4:27 PM

RS: We're departing.

4:30 PM

PVH: Unfortunately, in the last couple of hours, the winds changed direction at the surface, so the plume from the Quinault fire is now going off to the south and then mixes from the plumes from the other 2 fires and then sweeps out to sea. That's far too complicated to make it worthwhile looking at. We're heading out now to take a look at the ITT fire and then the third fire out there to see if it's worthwhile to sample them. Because of the heat in the cabin, we've got quite a few instruments down. The 3 wavelength nephelometer overheated, Dean's instruments don't seem to be working, the humidifier is not going too well, if at all. So, the best we can do is get some basic aerosol measurements and a couple of chemical samples, should the ITT plume look interesting.

4:43 PM

PVH: We're heading out to the third fire that was lit, which is called the Simpson fire. The second fire that was lit (ITT) is off to our right here. You can see that it is dying out. The Simpson fire is also dying out. It may not be worth looking at. But we're going to go up to the source and then I'll decide if we want to take any measurements or not. If we do, it will just be a couple of chem bag samples and a bit of aerosol since quite a few of our instruments are out of commission at the moment.

4:50 PM

RS: Are you up Peter?

4:55 PM

DS: Are you on, Peter?

PVH: Go ahead.

RS: You wanted to fly right over the burned ground itself to check that temperature, is that correct?

PVH: What appears to be the hottest spot on the ground. I want to see if we can pick it up with our remote sensing temperature sensor.

* PVH: Peter V. Hobbs; DH: Dean Hegg; JH: John Herring; JR: Jack Russell; DS: Don Spurgeon; RW: Ray Weiss; IS: Irina Sokolik; LS: Larry Sutherland; RS: Rod Sorenson.
RS: Understand.

PVH: We decided not to do much on the ITT burns and Simpson burns because by the
time we arrived, which was about 4:45, they were just smoldering and rather small,
not worth looking at. We're going to do a traverse just above the Simpson burn
that's still smolder and see if we can pick it up on the IR temperature sensor. Let
me know, Rod, when we start to go over the fire.

RS: Will do. It will be about a minute from here. I'm assuming this darker part on the
left is the hotter part.

PVH: I can't see very well back here.

4:56 PM

RS: We should be coming up on it within 10 seconds. It's under us so I don't see it.
We're over it.

PVH: We picked it up. The temperature jumped up from about 25 to 35. It's gone down
again now.

4:57 PM

PVH: Have we passed through it now?

RS: Yes.

PVH: Let's go about a mile or so downwind and go through the thickest part of the smoke
and we'll just get one set of aerosol measurements.

RS: That will be about a minute and a half.

4:58 PM

RS: The smoke is thicker off to the left but I think we're about a mile downwind now.
I've lost site of the fire. I see now. I'm not quite perpendicular to it but we're
crossing through right now.

4:59 PM

PVH: We got a few readings there. I don't think there's anything else we can do here.
Let's head home and patch up our instruments.

RS: OK. I'll probably go through our the plume once more on the way home, whether
you need it or not. Go ahead and use it if you need it.

PVH: OK, just a bonus.

RS: We should be either in the plume or very close to it now.

5:01 PM

PVH: Heading for home.
PVH: The last two shots that I took, which were numbers 15 and 16 on the onboard CAR hand-held camera were of the Simpson burn, showing it's very small, smoldering phase. We just had two penetrations a short distance downwind through the smoke. We didn't take any chemical samples, we just did some aerosol measurements. Unfortunately, the 3-wavelength nephelometer is out, so we couldn't get any absorption cell measurements. Dean has some problems so we're now heading back to Paine Field to see what instruments we can fix up before tomorrow's flight to Oregon.

RS: Peter, we've got 18 or 20 minutes until we get to Paine. Have you tried that flight phone?

PVH: I just tried it but no response at all from the operator. I'll try again as we get closer to Seattle.

RS: You did get that tone on channel 1 though, correct?

PVH: Yes, I was getting that high pitch which cut out when I pressed the speak button.

RS: I would try holding the speak for a half of a minute and also rapidly pulsing the speak button for another 20 seconds or so. That's the major difficulty I had, was getting that computer to ring the operator.

PVH: Oh, you hear it ring, do you?

RS: Yes, after you do whatever you do with the press to talk, it will trigger the computer to ring the operator.

PVH: I'll try again.

RS: Don Spurgeon, do you have a minute to come up and write a number down from our radio rack?

PVH: To summarize, this flight was the second flight today. It wasn't of much research interest. We just looked very briefly at the ITT and Simpson burns. They're both very small, just smoldering. We went over the Simpson burn to see if we could pick it up on the IR thermometer, which we did. We did a couple of quick traverses about a mile downwind across the width of the Simpson plume just for aerosol measurements but several key instruments are down and so we gave up at that point and headed back to Paine Field. That's the end of the recording on this flight.
SUMMARY

Flight 1655
September 22, 1994
Engines On: 1010 PDT  Engines Off: 1519 PDT
Departure Airport: Paine Field, WA
Arrival Airport: Tillamook, OR

The prescribed "Creamery" fire, located 2 miles north of Tillamook, Oregon, was lit by a helicopter just after we arrived on site at ~1130 PDT. During the course of the next 3 1/2 hours or so we obtained measurements 1) in the vertical column of the smoke soon after ignition, 2) in several sections across the width of the plume, and 3) near the top of the old plume and in the new young plume (produced by further helolits.) during the period of ignition. Our measurements included at various times: chemistry, aerosol, and lidar (across width and along length of plume), banked turns above and below plume (for CAR), straight passes above and below plume (for NASA radiometers). All instruments appeared to work (including the new humidigraph and DMPS), although toward end of flight (as the cabin heated to upper 90's) temperature control could not be maintained on CCN.

The main problem with this case is that there was not much wind and quite a lot of shear in the vertical. Consequently, a well-developed plume did not develop downwind (as it did on Flt. 1653). Most of our measurements were therefore fairly close (< 10 miles) to the fire. We did sample old smoke (about 3 hrs old) at higher altitudes (as did the ER-2 at about the same time, ~1445 PDT).

(PVH has several photos of this fire)

Summary: Good flight for comparing new (flaming) and old (~3 hr) smoke from Creamery fire, Oregon. ER-2 overhead during last part of flight.
VOICE TRANSCRIPTIONS

Flight 1655
September 22, 1994

PVH*: 10:10 in the morning on the 22nd of September for a SCAR-C flight. We're heading down to Tillamook, Oregon where a prescribed fire, located 2 miles north of Tillamook airport. It is expected to be lit at about noon. On board we have Hobbs, flight scientist, Herring, flight chemist, Rangno, Russell, Spurgeon, Weiss and our guest Martins from Brazil and Sokolik. Our pilots are Sutherland and Sorenson. Take off from Seattle. Weather is clear and sunny. Cloudless sky.

11:01 AM

PVH: During the first 45 minutes or so of this flight we haven't switched all the instruments on because we want to keep the cabin temperature low. As we approach the location of the prescribed fire, we will switch up the instruments. Larry?

LS: Go ahead.

PVH: Let us know when we're within 10 minutes of the fire.

LS: Roger.

11:02 AM

PVH: About how long until the fires now?

LS: Just about 20 minutes.

11:05 AM

LS: Peter?

11:15 AM

LS: Peter? Anybody in the back?

JR: I'm here.

LS: We're 10 minutes out now. You might want to ask Peter to come up here and take a look at it.

JR: OK, he's trying to talk on the radio right now. Hold on.

DS: 11:20, taking background sample with CCN. When we get into the smoke after the fires start, I shall put on the dilution filters and proceed from there.

PVH: The fire hasn't been lit yet but we think we're over the location of the fire. We could get our background sample but we've got to be careful of this other fire that you can see up on the foothills, which is an older fire that was lit a couple of days ago. It's still going. We don't want to get contaminated by that so we'll try to find an area upwind that clears us of that smoke and we'll get the chemistry samples. OK, John?

JH: OK.

PVH: Larry, see if you can find an area upwind of the fire that we're going to be looking at but clear of that smoke from the old fire. We want to get a background air sample.

LS: OK, I'll have to come down. How high over the site do you want it?

PVH: It doesn't have to be over the site. In fact, it should be upwind of the site in case they start to light. We don't want to get contaminated by the smoke.

LS: When would you like to start sampling?

PVH: Whenever you're in a good location and you're not contaminated by any smoke, let me know and we'll start.

LS: Go ahead and start now and I'll start a turn back around towards the site.

PVH: OK, John.

LS: We are upwind now.

PVH: You can start sampling, John.

JH: OK, I'll start sampling in about 10 seconds.

JH: Rod, could you turn on the aircraft vacuum for me?

RS: OK.

LS: Peter, we just passed over the site and we're downwind of it now so I'm going to put you back upwind.

PVH: Did you see their cross?

LS: No, I never have seen their cross. They've got a helicopter down there with a device on it. He looks like the same guy that was lighting off there yesterday.
11:28 AM

LS: Peter, that helicopter is heading up to that same site we were looking at so I think that was it. It looks like they're lighting it now.

PVH: I just made contact with the forest service. They spot us here and they're just starting lighting. Let's keep away from that smoke over there.

LS: OK.

11:29 AM

PVH: Where is the location of the fire from us now?

LS: It's at our 7 o'clock position about 4 miles. I can see the smoke now.

PVH: We've just taken a background sample just upwind of the Creamery fire, just before it was lit. It was lit at about 11:30.

11:30 AM

PVH: They've just lit the fire. It's off on our left side. They just started to light it. John, you didn't hear that. They've just lit the fire off to our left side.

11:31 AM

PVH: John, let me know when you finish your background sample.

JH: Peter, I think for this background sample let's just take 2 bags. I'll need about another 4 minutes before I'm ready for the next one.

PVH: I can give you more time if you want to because we want that fire to settle down a bit before we start sampling.

JH: OK, we'll take a third bag then.

PVH: Larry, keep upwind of the fire and keep out of the smoke for the next 5 minutes.

11:33 AM

PVH: John?

JH: I'm a little busy right now, Peter. What is it?

PVH: OK.

11:36 AM

PVH: The fire is immediately off our left side right now. They're just getting in to start it up.

11:37 AM

PVH: It should be at full force in about 10 minutes or so and will probably last pretty vigorously for about an hour and a half to 2 hours. OK, Larry, let's then go
through the vertical column, not too dense. Let's take a look at it a little way up and see what sort of signal we get.

LS: Peter, it's going to be about 2 minutes.
PVH: And we'll probably get a bump, right?
LS: Not too bad. It's going to be a little bit.
PVH: So, this is for initial aerosol sample. Let's see what we get.
LS: 1 minute.

11:40 AM
LS: 30 seconds to go. 15 seconds.
DS: 11:41. Dilution filters are now on the CCN.
LS: 10 seconds. Sample.

11:41 AM
PVH: CN went up to about 39,000 on CNC-1. It looks as if the neph remained just about on scale. Let's repeat that at about the same place.
LS: Roger.
PVH: Are you ready for a sample, John?
JH: You mean another background sample or a smoke sample?
PVH: A smoke sample.
JH: Remember we were going to do 3 bags on the background sample. I'm on the second bag. Do you want me to stop doing the background sample now?
PVH: No, go ahead. That's all right. We'll do some aerosol sampling.
JH: OK. If you could put me in position for another background sample in about 2 minutes, that would be great.
PVH: It will be a bit longer than that. We're going to do another hit on the vertical column of the plume for aerosol.
JH: That's fine.

11:42 AM
LS: Peter, it looks like in about 2 and a half minutes we'll be back in it. It's really starting to burn now.
PVH: That one straight ahead is the old fire, right?
LS: Affirm. The other was just off our left wing tip. We're coming around for it now.

11:43 AM

PVH: The purpose of these aerosol measurements is for the flaming phase in the vertical column. Ray, the purpose of these measurements is for flaming phase of the fire in the vertical column. We're getting some aerosol samples. It probably differs quite a bit from the smoldering smoke.

11:44 AM

LS: 1 minute. You've got about 40 seconds. Peter, this one is going to be rougher.

PVH: We don't want to go into any more dense smoke than we did before so a little bit lighter smoke than before.

LS: Lighter?

PVH: Just a little bit. No more, anyway.

LS: OK. I'm going to just nip the edge here. I don't want to get into the plume here. It's really boiling up.

PVH: I see what you mean.

11:45 AM

LS: Sample in about 10 seconds. Now. Peter, this thing is really starting to build in the vertical now. Would you rather stay here or go up higher?

PVH: I'm going to come up to the cockpit and take a look at it. Is it shearing off the end?

LS: Give me about another minute here and you'll get a good look at it off to the left side.

PVH: I'm coming up.

JH: Peter, as we're coming around here I'll take that third bag for the background.

11:46 AM

PVH: This thing is really bubbling up now so we'll have to go up about 800 feet so we don't get too much knocking around here. We're going to take another sample in the vertical column. It's burning so rapidly, I don't expect this fire to last too long. Let me know when you're ready, John.

JH: I'm sampling off the third bag now and I'll be ready in about 6 minutes, well, 7 minutes, to take the first smoke sample.

PVH: We'll make a penetration for another aerosol prior to that. So let's go ahead, Larry and go through it.

LS: OK, 2 minutes.
PVH: It may be pretty bumpy.

11:48 AM

DS: 11:48. Last background filter on chemistry rack. CCN does have the dilution filters in and they shall remain in throughout the rest of the experiment.

11:49 AM

LS: 40 seconds. I'm going to get some more altitude here, Peter, because the whole thing is growing quite rapidly.

PVH: I don't want to go into much more smoke than we did before.

LS: OK, I'll give you the south side then.

PVH: It's straight ahead of us now.

LS: 30 seconds. Penetrate in 10 seconds.

11:50 AM

LS: Sample.

PVH: The CNC hit 39 again there. The neph 20 went off scale. The neph 100 is OK.

11:51 AM

PVH: Larry, the next time we do that I'd like to get a little bit less dense smoke. We were still going off scale on our measurements here. If possible, for a longer period of time in the smoke.

LS: OK. I'll see what I can do for you. I don't know if I can put you in the smoke any longer because it's such a vertical column but I'll try to stay a little less dense.

PVH: Maybe you can slow down a little bit.

LS: OK.

PVH: Don't penetrate until I tell you.

11:52 AM

LS: Peter, we're going to climb another 3 or 400 feet because there's a little horizontal layer just above us working out. I'll come around the north side and come back down. If you come up here I'll show you.

PVH: We're going to make our third penetration of the column. We're going to go up a little bit higher but we're going to pick off a little horizontal bit that's coming off from the vertical column so as to stay in the smoke a little bit longer and maybe bring the aerosol measurements down a little bit.
11:53 AM

PVH: Do your measurements look OK, Ray? OK. We're going to make another penetration of the column and try to stay in it a little bit longer this time. Are you ready, John?

JH: Ready.

PVH: This will be a measurement, John, in the vertical column. You won't be in it too long so you'll have to grab your sample when things start to happen pretty quickly. Let's go, Larry.

LS: OK, give me 2 minutes here.

11:54 AM

PVH: So this will be another measurement in the flaming portion of the fire.

11:55 AM

PVH: The fire is off our left side now. I guess this is the fourth penetration, isn't it Larry?

LS: This is the third and 20 seconds.

11:56 AM

JR: It's the fourth. You can see that on the screen.

LS: 20 seconds.

PVH: We're coming up, John.

JH: I'm ready.

LS: Sample.

PVH: I think you missed the peak on that first one, John.

JH: What do you mean I missed the peak?

PVH: The CN went up quite a bit after you took it.

JH: Do you want to dump that one?

PVH: No, if you think you got a good sample, we'll take it. Just a bit quick on the trigger. The CN has been peaking at about 39,000.

JH: I can dump it if you want to. The CO2 in the bag isn't that high. It's only about 40 parts per million above the background, so...

PVH: OK. Larry, let's do that again. Let's dump that one. We'll try another one. Same location.
11:57 AM

PVH: Do you have a CN reading, John?

JH: Yes, I do. That's what I was going off of. When it shot up above 5,000, that's when I started sampling.

PVH: 5,000 is pretty low. It's been going up to over 40,000.

JH: I thought you were try to sample a more diffuse area of the plume.

PVH: True. I've been going off scale a bit here on the CN. Let's take it when the CN goes up to about 30,000.

JH: OK.

11:59 AM

LS: Peter, I'm going to start a 180 degree turn now so it's going to be about a minute and 30 seconds before we're into it.

12:00 PM

PVH: Are you doing OK, John?

LS: About 45 seconds now.

PVH: It's just coming into view.

12:01 PM

LS: 20 seconds. 10 seconds. Sample.

PVH: Good, you got it nicely there.

12:02 PM

PVH: Has John got his headset on?

JH: That's a thick one.

PVH: How long do you need now?

JH: 5 minutes.

PVH: Don?

DS: Go ahead.

PVH: Have you got any CCN measurements in these last 4 passes?

DS: It's been running so there should be some.
PVH: OK. The fire is engaged nicely now. We've got a good orange-looking vertical column going up. It's punching it's way through the inversion. A bit of horizontal spreading at the inversion and we'll be taking another sample through the same region of the vertical column as we did just a while back to get our second chemistry bag.

12:05 PM

LS: Peter, I'll go ahead and start a turn back and give you a 2 and a half minute warning if that's OK.

12:06 PM

JR: He's off the headset.

LS: Advise him that in 2 minutes we'll be in it. 1 minute until entering the horizontal.

12:07 PM

JH: Peter, I'm ready for another sample.

12:08 PM

PVH: We're going to make our second penetration of the column. You can go straight ahead, Larry. We're all ready.

LS: Say that again?

PVH: Go through the vertical column about the same location as we did last time. We're all ready to go.

LS: OK. You want to take the heavy stuff this time?

PVH: No, no more heavy than it was before. That was just about right before.

LS: OK.

12:09 PM

LS: We'll be back in in 2 minutes. 20 seconds until penetration.

12:11 PM

LS: 10 seconds until penetration. Sample.

JH: OK.

PVH: Larry, we've got 7 minutes or so, let's say 10 minutes, before we want to return and do that same thing again. In the meantime, let's go a mile downwind and we'll go through the width of the plume at that point.

LS: OK.
12:12 PM
PVH: We went way off scale on the CN on that one.

12:13 PM
PVH: It went up to about 390,000.

LS: Peter, did I understand you right? You want to traverse across the horizontal on this next one?

PVH: That's correct. Let's go about a mile downwind and then I'll take a look at it before we penetrate to see what it looks like. I'll come up there.

JH: Peter, we'll be ready for the next sample in about 2 to 3 minutes.

12:17 PM
LS: We're 1 minute until penetration to traverse the plume.

PVH: We're going to go now through the horizontal portion of the plume. What distance downwind, Larry?

LS: 2 miles.

PVH: Roughly 2 miles downwind to see what it looks like. This will be our first penetration across the width of the plume. There's not much wind out there so we're not getting much horizontal transport of the plume. There's a lot of shear so it's transporting off in different directions in different heights. We're taking the main horizontal portion that is spreading out toward the west.

LS: 30 seconds.

12:18 PM
LS: 10 seconds. Sample now. We're on the south side.

12:19 PM
PVH: That was good. We kept on scale on the neph, I think. We may have gone off scale on the CN. The next penetration which you can set up to do, Larry, will be our third penetration similar to the other two we did of the vertical column.

LS: OK.

PVH: Are you ready, John?

JH: Ready.

PVH: Any time you'd like, Larry. Try to pick that same region. Maybe a little bit less smoke than we had the time before last.

LS: OK. It's going to be 4 or 5 minutes before we're in it because I have to maneuver around to the northeast side.
12:20 PM
LS: We're about 2 and a half minutes to the smoke. About 30 seconds now.

12:24 PM
LS: 10 seconds.

JH: Peter, this is the longer bag for the hot and cold DMPS so we'll be about 12 minutes or so at least.

PVH: OK. Larry, I want to go back to where we were the penetration before last about 2 miles downwind and do a traverse across the width of the plume, but not in the smoke, above the smoke. That same distance downwind.

LS: Roger.

12:25 PM
PVH: Irina?

IS: Yes.

PVH: This will be a horizontal one for you above the plume and then we'll do one after that below the plume.

IS: Sounds good, OK.

12:28 PM
LS: OK, we're just about entering the overhead to plume now.

PVH: This is for the NASA radiometer measurements so we'll be in the clear air above the plume.

12:30 PM
LS: We're passing the south side of the plume now.

12:31 PM
PVH: When we've completed that one, we'll come down and we'll do one beneath the plume. We'll try to get below the bottom of the plume and cross its width at the same location.

LS: OK, I'll give you the same pattern below the plume.

PVH: Correct. That can be on a reciprocal.

LS: You want to go through on a reciprocal heading?

PVH: Yes, except below the plume.
12:32 PM
PVH: It looks as if we stayed clear of the smoke pretty well on that one. That's good.

LS: Peter, there are 2 layers in that plume. I assume you want to be below the bottom layer.

12:34 PM
PVH: Roger Ottmar just told me that the helicopter has gone off for 20 minutes or so but will be back shortly and we will continue to ignite.

12:35 PM
PVH: John, on the next pass for you we'll go through this width about 2 miles downwind that we've been looking at one the aerosol measurements.

LS: Peter, it's going to be 3 minutes until we go under the plume. I'll have to get down from 7 to about 2,000 feet. There's 2 layers in the plume. There's an upper one and a little hole and a little one down low.

PVH: We want to get below the lower one. What's the height of the base of the lower one?

LS: I'll let you know in just a minute.

JH: Art, are you done with the hot sample?

AR: Right, Jack didn't like the looks of it. It was very flat. He's checking it right now for a leak.

JH: Roger, go ahead with the next sample, Art, and we'll try to get another good hot and cold on the next batch.

12:36 PM
PVH: John, what I think we'll do is 3 samples of that 2 miles downwind distance.

JH: Very fine.

PVH: We don't have very much plume to work with because we're not getting much shear.

12:37 PM
LS: 1 minute to under the plume.

PVH: What is the altitude at the base of the smoke?

LS: Looks like about 14 or 1500 feet. It's really indiscriminate.

12:38 PM
LS: I'll certainly bank off to the left.
12:39 PM
LS: We're under the plume.

PVH: Got a little peak in the CN and neph there, but nothing much.

12:40 PM
PVH: How much longer for you, John?

JH: I'm ready.

LS: That's about all I can give you, Peter. We have to get out of here.

PVH: OK, fine. Can you take me through the plume again at that 2 miles downwind?

LS: Affirm. Do you want the lower one or the upper one?

PVH: The thicker one.

LS: OK.

PVH: Which is the one we penetrated before, right?

LS: Right.

PVH: The wide looking one.

LS: Right.

PVH: Same track as we did previously, right across its width, in the smoke.

LS: OK.

PVH: This next sample will be for chemistry. It will be the first bag sample on the horizontal plume about 2 miles downwind.

12:41 PM
PVH: Not too thick smoke, don't pick the heaviest smoke, Larry. We sort of went off scale a bit the last time we did this.

LS: OK. I'll give you a little bit more down wind on this one.

PVH: Good.

12:43 PM
LS: Peter, I ought to have you in there in about 4 minutes.

PVH: Are you ready, John?

JH: Yes, I'm ready.
12:44 PM

LS: We'll be penetrating it again in about 1 minute.

12:45 PM

PVH: Don, is the lidar working?

DS: Yes.

LS: 30 seconds.

12:46 PM

LS: 10 seconds.

12:47 PM

LS: Peter, if that's too thick for you I can take you back down a little further west.

PVH: Yes, let's do that. Dump that one, John. I think we went off scale. Let's get in a little thinner stuff.

12:48 PM

PVH: John?

JH: I already started sampling off that one, Peter.

PVH: OK, we'll take it. Cancel that last instruction, Larry. Let's now do a reciprocal across the track we just did but above the smoke.

LS: OK.

JH: Jack, let's take some cans on this one.

PVH: This will be for lidar measurements.

JR: We've got to make sure we're at least 500 feet up.

PVH: Thanks, Jack. Larry, you must be at least 500 feet above the smoke for this one.

JH: These are 25 and 26, right Jack?

12:49 PM

PVH: Has Don got his headphone on?

DS: Yes I do. I had to adjust the switch so I could talk to you. Lidar is up and ready and going.

PVH: Good, so we'll go across the top of the width of the plume. How much more flying time do we have, Larry?
LS: 2 and a half hours.

PVH: Great. John, my concern with some of these is that the aerosol is going off scale. I don't know how much that will affect our analysis.

JH: Are you talking about the nephelometer in particular?

PVH: No, the neph seems to be remaining on, it's the CN.

JH: I don't think that's too bad of a problem. I'd be more concerned if the PCASP was going off scale.

PVH: That seems OK.

JH: I think we're all right then.

12:51 PM

LS: We'll be over it in about a minute and a half.

12:52 PM

PVH: Distance downwind, Larry?

12:53 PM

LS: I think we're going to be about 6, Peter.

PVH: 6 miles, OK.

LS: I can give you a better one when we've got it on the gauge.

PVH: Is that where we were for the in-plume sample a moment ago?

LS: Yes, the under sample.

PVH: No, the one we just took inside the smoke. Was that 6 miles downwind?

LS: Affirmative. Hang on a second. Let me see what the GPS is going to say here.

12:53 PM

LS: We're just starting to come over the plume now.

PVH: And this is a reciprocal of our previous line but above the plume, is that correct?

LS: Affirm.

JH: Peter, I'm ready for another sample.

DS: Looks pretty good on the lidar. We're picking up some structure below the smoke plume.

PVH: There are actually 2 layers of smoke plume.
DS: It's starting to show on the IR. I see what looks like at least 3 layers.

PVH: Larry, was that a yes on this being a reciprocal of the previous path that was in the smoke?

LS: Affirmative.

PVH: And the same distance downwind?

LS: Yes.

PVH: We're ready to drop down and go through the smoke again, same path as before. So a reciprocal on this, but through the width of the plume.

LS: OK.

12:55 PM

PVH: About how far downwind is the plume extending to the west now? Is it over the ocean yet?

12:56 PM

LS: Peter, it's going from the fire site to about a half mile offshore.

PVH: And what is that total distance?

LS: 6 miles.

PVH: I can see that smoke over the cloud, isn't it?

LS: That's affirm.

PVH: Do you think any of that smoke is going into that lower cloud layer?

LS: We've been talking about it up here. I guess unless we drop down to the cloud layer and take a look at it, we're not going to know, but we can do that.

PVH: We'll do that a bit later on. Let's take care of this penetration first.

LS: OK.

12:57 PM

PVH: We'll be coming up for our second chemistry sample across the width of the plume.

LS: You're 1 minute and 15 seconds from entering the plume.

12:58 PM

LS: In the plume in 30 seconds.
LS: I do think you're getting some mixing of the fog and the smoke now.

PVH: OK, the smoke into the cloud?

LS: Affirmative. I know where to look for it when we go.

PVH: Great, that will be great.

PVH: Are you going to want a third sample, John, or are you using too many up?

JH: If the DMPS is working and we can get hot and cold on it then we'll take a third. If not, no.

PVH: OK. When will we know that?

JH: Jack, do you think the DMPS is working? We'll get back to you on that, Peter.

PVH: Larry, let's now go above the top of the smoke and from this distance downwind, head up towards the fire, keeping above the smoke so we can get a lidar pointing down on it.

JH: We'll do cans on this one too, Jack.

LS: I'll come back on a reciprocal until we're over the plume and then turn right, up toward the fire.

PVH: Right. We don't want to go through the vertical column. Just up the horizontal extent of the plume.

LS: How about I just tell you to turn out to the west and get above it and then just come right down to plume?

PVH: That's fine.

AR: John Herring, do you copy?

JH: Yes.

AR: I had an error there. I started with a hot sample on that last one. Can you go hot and then cold, or is that messed up?

JH: We're probably not going to have time to do both on this one. That's fine. Just do a hot on this one and let me know if it looks like it's working, OK, because that will determine what kind of sample we take next.

AR: If I understand you, I'm processing a hot one. Ignore trying to process a cold one and do a hot one on the next pass?
JH: What we do on the next sample has yet to be determined. It's going to be determined by whether or not the DMPS is working. You won't have time to take a cold sample.

JR: You're going to have to take a look at it, John, and see if it's working.

JH: OK.

1:04 PM

PVH: Larry, let us know when we're heading back toward the fire.

1:05 PM

PVH: The purpose of this track is to get lidar measurements down the length of the smoke, starting out from the west over the ocean. There's some cloud out there as well so we'll probably pick the cloud up, at least up to the coastline. Then we'll continue going east along the axis of the smoke, up towards the fire itself. The cloud finishes at about the coastline.

JH: Peter, as far as I can tell, the DMPS is working, so why don't we go ahead and take a 10 minute sample on the smoke next, on a third pass.

PVH: OK, are you ready for that now?

JH: No, it will take me a little while. It'll be about 2 to 3 minutes.

PVH: OK, no hurry. We're going to go down the axis of the plume and get a lidar profile.

1:06 PM

LS: We're going to be over the plume in about 30 seconds. We're just going to be clearing it if you want some more altitude, we can make a 360 here.

PVH: We must be 500 feet above the smoke for the lidar measurements.

LS: I'll do a 360 to get above it.

PVH: Larry, don't forget roughly the location of our last pass through the plume, when we went across the width because we're going to want to do that again after we finish this lidar traverse.

LS: I've got it marked on the ground.

1:09 PM

LS: In about 1 minute we'll be traversing the plume laterally. Another 15 seconds we will be over the smoke.

1:10 PM

LS: We're over the fire right now.
1:12 PM

PVH: Don, are you with me?

DS: Go ahead.

PVH: Are we getting good lidar?

DS: Yes. We started picking up a lidar image of a very faint smoke plume about...

LS: Sorry Peter, I think we flew across it. The plume extends out to the northeast and it's behind us.

PVH: So we've gone across it instead of along it's length?

LS: Yes. How about I do an 80/260 and come back down the other way.

PVH: Fine, do that and then we'll do our banking turn.

LS: OK.

PVH: We were hoping to go, this is just for the record, we were hoping to go along the length of the plume but instead we crossed it, so we're going to try going along the length heading west this time. What I plan to do then is while we're up at this altitude, we'll do a banking turn. 3 circles for our CAR measurements. Then we'll drop down and get John's third sample inside the plume.

1:14 PM

DS: I'm starting to pick up some plume or some cloud or something below us already now.

LS: We're back inbound over the fire. We're northeast of the fire and I'll try to give you a mark when we're directly over it.

1:16 PM

PVH: I just spoke to Roger Ottmar and he says in the last half an hour or so the fire has died off somewhat because it hasn't been ignited continuously. The smoke has dropped down some places to the terrain. The helicopter for lighting it will be back again and will light the last third in half an hour or so.

1:17 PM

PVH: Larry?

LS: We're going to be over the fire site in 1 minute.

1:18 PM

PVH: Larry, the fire is very variable in strength at the moment because it hasn't been lit for a while so you're probably noticing it is dropping down in altitude.
LS: We're over it in another 40 seconds.

PVH: Over the fire itself?

LS: Yes.

PVH: Then you're going to go down west?

LS: Yes, then I'll go out west and do your circles for you and the right turn.

PVH: If it looks too patchy, I'll come up there and take a look at it and decide if we want to do that. It's a very unsteady state. The copter will be back in 15 minutes and will light the last third of the fire.

LS: OK.

1:19 PM

PVH: What we do have to do after this is get our third chemistry sample penetrating the plume the way we've done twice before.

LS: Is that a lateral or transect the plume crosswise?

PVH: Transit across the width of the plume and in the plume.

LS: We just passed about a third of a mile downwind of the center of the fire.

PVH: We don't need to go any further west than the coastline.

LS: OK. We're going to drop down and give you a transit back through the plume at our standard point.

PVH: That's after you've hit the coastline. Keep this altitude until that time.

LS: OK.

JH: Peter, we keep hearing my name coming over your squawk box over there. Is there another message from Rasmussen?

PVH: You're picking up this radio from the forest service?

JH: We can hear it over here a little bit.

LS: We're not talking to anybody.

PVH: I'll check to see if they've got any more messages. That message came from Dean and was just concerned with the method of sampling.

1:20 PM

PVH: John, do you think you're last two samples have been compromised?

JH: You mean by us waiting until the fires died down a little bit?
PVH: No, you said you filled the same cans twice.

JH: That was actually one of our first samples was compromised because of that. Not the last two. The last two were fine.

PVH: OK. The first one was through the vertical column. We did that just once, did we?

JH: We did that twice. We got two sets of RAS cans on that and one of the sets was contaminated.

PVH: Contaminated with what?

JH: Clean background air. The cans had already been filled with background air and then we pumped a little smoke into them on top of that.

PVH: Oh, I see. So you've got no background sample.

JH: We took two sets of background samples as well because I was trying to do that thing for Rasmussen.

PVH: I don't know anything about "this thing" for Rasmussen—news to me! So you got your background samples and we got something in the vertical column. That's probably good enough. We'll get our third sample at 6 miles down wind.

JH: I think we're OK.

LS: Peter, we're at the coastline now.

PVH: OK. Turn around and drop down and head back to the point we've gone in the plume twice before.

LS: OK.

JH: The only thing we lost there was one of our two column samples in the RAS cans and then we lost Rasmussen's duplicate sample through the stainless steel inlet. But I'm not too worried about that.

PVH: We can do that again some other time.

1:22 PM

PVH: Are you still seeing that smoke-cloud interaction, Larry?

LS: We're pointing the wrong direction now but when we're heading northbound we'll take a look at it for you.

PVH: If we are, that's the next thing I'm going to do after we've done this traverse across the width of the plume.

LS: OK.

1:23 PM

PVH: Does anyone know of anything not working on the plane at the moment?
1:24 PM

DS: As far as I know everything is working.

PVH: We might have a good chance to look at this smoke interacting with the marine stratus, which we’re going to take a look at after we’ve done this next pass. What we want to do there is to obtain a good aerosol sample of the smoke going into the cloud and then we’ll sample the cloud at various distances downwind and see the effect of the smoke on cloud structure.

JH: Peter, are we going to wait to take the third chemistry bag on the smoke?

PVH: We’re going to do the third right now.

JH: OK.

LS: Peter, you’d better come up and take a look. The conditions have changed somewhat.

PVH: OK.

1:25 PM

DS: Is there any residual sample in the bag, John?

JH: No, it’s empty right now.

DS: That’s good. I was wondering why the CCN had a very odd count on it.

1:26 PM

PVH: The situation here is a bit confused because the fire has diminished in intensity quite a bit since we took our number 2 chemistry sample. We’ve got a lower layer of smoke, which is being produced by the current fire, and then we’ve got this upper layer at about 7500’ or so of smoke that was probably produced when the fire was going more vigorously. It’s the upper layer that we sampled for chem samples number 1 and 2 on the width of the plume. I think we’ll go for those same remnants of smoke up there again.

1:28 PM

LS: I’d say we’re about 1 minute from penetrating the smoke.

PVH: Did you read me on that, John?

JH: Yes, that sounds good.

PVH: It’s pretty old smoke now but I see no point in going down and sampling something completely different from what we sampled before.

JH: I think it’s interesting to look at the old smoke. That’s fine.

PVH: Apparently, that’s lofted as well, that smoke, in the last 15 minutes. It’s gone up 1,000 feet or so. We’re approaching the penetration.
1:29 PM
PVH: Give us a countdown, Larry.

LS: We'll be in the smoke in about 10 seconds.

1:30 PM
LS: You're in it now.
JH: OK.

PVH: So you'll need 12 minutes. We probably won't do any more chem samples for a while.
JH: Roger.

PVH: Before we lose our altitude here, let's get a bit nearer to the top of this upper layer of smoke and circle around a bit in the upper widths of the smoke so we can get a sample of what the ER-2 will be looking at in half an hour or 45 minutes.

LS: I'll climb up to about 9,000 then.

PVH: Are you monitoring the ER-2 frequency?

1:32 PM
PVH: Ray, I want to do some aerosol samples in the top layer of this smoke, because in half an hour the ER-2 will be sampling this smoke and they want some aerosol characterization. So we'll do some absorption measurements and so on. Larry is going to circle around in the top of the smoke. Let us know when you're doing that, Larry.

LS: I'm just circling right now to get some altitude. Do you want me above the smoke or just in the tops?

PVH: In the smoke, near the top.

1:34 PM
LS: Do you want that same track back through there, Peter?

PVH: No, we don't have to worry about that track anymore. Just circle around in the top of the smoke.

LS: OK.

PVH: The one problem with this plume today is that it's pretty unsteady because of the periodic ignition of the fuel.

1:35 PM
PVH: Let's lower down gradually into the smoke and I'll let you know when we seem to be at the right altitude and then we can circle around at that altitude.
LS: OK.

1:36 PM

LS: In about 30 seconds we're going to be into the...

END OF SIDE 1

PVH: We might have to drop down a little bit to keep in the smoke.

LS: Roger.

1:38 PM

LS: I had to put us on an IFR clearance, Peter. We just got a lower altitude so I'll put you down in it.

1:39 PM

PVH: That sort of density is about right if you can keep in that.

LS: OK.

PVH: We're sampling in the top of the smoke. Nothing too deep in order to keep the CN on scale. We're in the upper layer of smoke. Pretty old smoke now. This is for the purpose of the ER-2, which will be sampling in this same area in about 1/2 hour from now.

1:40 PM

JH: Jack, is there any way to let the computer know if I switch range on the ozone monitor?

PVH: Have you got enough measurements, Ray? OK, we can come out of this now. We can drop down and let's go take a look at that smoke intercepting the cloud.

LS: Let me get clear here and cancel the IFR and we'll get you down there.

PVH: They're really going to get fed up with us, aren't they?

LS: Probably.

JH: The ozone concentrations in this aged smoke are exceptionally high. Well over the EPA's recommended guidelines.

PVH: I noticed that.

1:42 PM

PVH: If we had time, which we don't, it would be interesting to follow the history of this old smoke, particularly seeing how it's lofting. So we want to drop down and find that smoke going into the cloud. How much more flight time, Rod?
1:43 PM

RS: An hour and a half.

PVH: That's perfect.

RS: Peter, the ER-2 will be here in 1 hour.

PVH: They got delayed then. So not until 2:45.

RS: That's affirmative, so probably at around 3:15 we'll have to stop for fuel.

PVH: That's OK. We may coincide with them on our second flight.

RS: OK.

1:45 PM

PVH: I'm going to come up and take a look at this smoke going into the cloud. Larry, give us some warning when you're going to go into the cloud that is affected by the smoke.

LS: OK, about 2 or 3 minutes.

1:48 PM

PVH: What we're going to do here is, first of all, look at some marine stratus that appears to be affected by the smoke, visually. Then we'll look at neighboring stratus that's not in the smoke and compare the two.

LS: Peter, come up here and take a look. That will be worth a thousand words.

PVH: OK.

DS: Water in cloud.

1:54 PM

PVH: We've got another hour before we have to land, either in Astoria or Tillamook. The fire is in a very non-steady state. They haven't ignited it again, but they will do so sometime in the future. What I've decided to do is spend the next half an hour or 45 minutes getting some more chem samples of the old smoke aloft so we're climbing up to that old smoke layer. It's drifting off aloft and we'll do a bit more chemistry on that. Then we'll decide the best place to land. Then we'll reassess on the ground what we want to do.

JH: Peter, I need about 5 minutes on a calibration here.

PVH: It's going to take that amount of time to climb up to the old smoke so that's OK.

2:02 PM

PVH: Unfortunately, when we went down lower, we couldn't find any smoke interacting with clouds so we didn't do any measurements. We then went down
south a bit, down the coastline, to see if an old smoke plume was interacting with the cloud, but it wasn't. So we've abandoned that and we're now climbing up to look at the old smoke from the Creamery fire, the old smoke that we've already done 3 chemical samples on.

2:03 PM

LS: Peter, looks like we're going to start sampling here in about 20 seconds.

PVH: Oh, hold off a bit, we're not quite ready. Well, we can do an aerosol sample. Just take us right through it. Are we a bit further downwind?

LS: Affirmative, about another 4 miles.

PVH: We'll do our first pass for aerosol sampling. This is not for chemistry.

2:06 PM

PVH: This may work out well since the ER-2 is probably over us about now, at 2:15. So, we'll coincide with them.

2:07 PM

JH: Peter, I'm ready to do sampling.

PVH: We just did an aerosol sample. How much further downwind was that than before, Lany?

LS: About 3 miles and Peter, we've got the same problem here, we've got 2 layers. I'm going to take you up and get the upper layer.

PVH: Let's do that.

2:08 PM

PVH: So this upper layer is broken into two layers? So, as I was saying, the ER-2 will be over us at 2:15 and we'll be sampling the upper plume at that time. They are due to reignite the last third of the fire in about 15 minutes, roughly at 3:25. We're not going to be able to do much sampling after that reignition because we have to refuel.

2:09 PM

PVH: What is all this stuff below us, Larry?

LS: Ocean fog.

PVH: So we're out over the ocean again, are we?

LS: That's affirm. I've got to maneuver out here in the clear to get the altitude to get back up over this thing.
2:10 PM
PVH: So what we were referring to as the upper deck of the smoke at about 9,000 is now split into 2 layers?

LS: It had the lower layer down at about 3,800 and looks like the upper layer here is about 6,000. We'll come back south-southeast bound at 6,000 a little further downwind.

PVH: That's lower than it was before, isn't it?

LS: I think it has subsided somewhat but it's definitely the same cloud.

2:11 PM
PVH: John, how many samples do you want to take of this older cloud?

JH: 2 would be fine at 5 minutes apiece.

PVH: That will be further downwind than we were before.

JH: Great. Just let me know when to sample.

LS: Peter, about another 3 minutes I'll take you back on a track that's just a little further downwind.

2:12 PM
LS: You're 30 seconds to the smoke.

2:13 PM
PVH: How high...(superimposed by LS)

LS: 20 seconds.

2:14 PM
LS: Sample. That wasn't very thick there, Peter.

PVH: That's OK, we've got a signal.

JH: I only got a couple of seconds on it, Peter. I think we should dump that one.

PVH: OK, let's dump that one and go into a thicker part of the smoke. Do a reciprocal and give us a bit more smoke.

2:15 PM
PVH: It was actually a nice sample on the aerosol, John.

JH: Unfortunately, I just got it for a couple of seconds. I didn't even fill the bag halfway.
PVH: It was very short. Those only went up to 100 or so.

2:16 PM
PVH: This smoke is probably about 3 hours old now, isn't it Larry?
LS: At least that. Just about 3. You've got 1 minute and we'll be back in the plume.
DS: We're just past the coast. Water's that way, land's that way.

2:17 PM
DS: We're along the coast now.
PVH: Can you see it on the lidar?
LS: Another 30 seconds.
DS: I'm looking out the window.
PVH: That's good remote sensing.
DS: Also portable.

2:18 PM
LS: 10 seconds. Sample now.
JH: That was OK Peter, although I missed the core of it here.
PVH: If you're happy, we'll take that one.

2:19 PM
PVH: We'll give you at least 5 minutes.
JH: I'll just need 5.
PVH: Are we near the top of this, Larry?
JH: Jack, we'll do one can on this one.
LS: It's a couple thousand feet above us.
PVH: Are we near the bottom?
LS: Let me get a look at it over here on the north side. I'd say we were in the bottom third.
PVH: Let's drop down so the base is just above us and let's do three turns to the left. Circles beneath the smoke for our CAR measurements.
2:20 PM

DS: I'm standing by by the CAR.

PVH: What I planned for the rest of the flight, Larry, is we'll do these three circles, we'll go back into the smoke where we were just a moment ago and get our second chem sample. Then we'll try to do three circles above the smoke, banking turns, and then we'll either go into Astoria or Tillamook.

LS: Roger.

2:21 PM

LS: I'll be below and under it in about 1 minute. Then I'll start my turns.

PVH: You want to choose the area for the turn where, as we bank around our radiometer on the nose will be pointing at the smoke during the circle. So it will be a bank to the left.

LS: I'm going to start the turns in here.

2:22 PM

PVH: We still seem to be in some smoke here, are we? That's better. You can count off the turns for us, Larry?

LS: Will do.

2:23 PM

LS: That's one turn.

2:24 PM

LS: Do you want this turn in the same geographical position? I can put you in some denser smoke, Peter, if you'd like.

PVH: Under denser smoke is better.

LS: OK.

2:25 PM

PVH: When we climb up and do our turns above the smoke we'll want to be in about the same position as this.

JH: Peter, we're ready for another sample.

PVH: OK. We're doing something else at the moment so we'll get to that in about 5 minutes. Ray, we're doing some banking turns and then we'll climb back up and do one more penetration of the smoke for chem and aerosol samples. Then we'll go on top and do some more banking turns and then we'll go and land.
PVH: We're in our second turn beneath the old smoke. We're doing banking turns for CAR measurements. The ER-2 should be overhead.

PVH: Are we on our third turn now?
LS: Starting the third.

PVH: What is about the radius of these turns?
LS: 2 miles.

LS: Sorry, radius is 1 miles, diameter would be 2. OK, that completes the third turn. I'll go ahead and get above for penetration now.

PVH: Right, back where we were before.

PVH: Rod, any more word on refueling at Tillamook?
RS: The thing is supposed to go on right at 4:00 so if we did a little bit more here and then landed, we might have an hour delay.

PVH: Is there any way to eat at the airport at Tillamook.
RS: Standby, I'll ask them.

PVH: Larry, about how long would it take us to fly from here to Redding, California?
LS: Standby, we'll put it on the GPS.
JH: Redding is about 30 miles north of Red Bluff.
LS: We'll have it here for you in about 40 seconds.

LS: Peter, it's going to be just under 2 hours to Redding.

LS: Start sampling here in about 2 to 3 minutes. You can start your sampling in 1 minute or so.
2:34 PM
JH: What is the temperature over there, Jack?
JR: Hot.
JH: Over here too.

2:35 PM
LS: You can start sampling in 30 seconds now.
RS: Peter, they've got something 2 miles away and I think our rental car is sitting there waiting for us. If not, he said they can arrange transportation no problem.
PVH: Thank you.
LS: 10 seconds.

2:36 PM
LS: Sample now.
PVH: It's going, John.
JH: It's about the same thing we got last time so that's fine.
PVH: OK, so we'll climb on top and do our banking turns to the right.
LS: Roger.
PVH: I think we'll land at Tillamook. That will give us an hour or so to rest up and get something to eat and get refueled. We'll either stay at Tillamook or do another flight here or go to California. We'll decide when we're on the ground.

2:37 PM
LS: About 500 above, is that all right with you, Peter?
JH: Jack, let's blow that last can on this one.

2:38 PM
PVH: They're going to be reigniting the fire again in a few minutes. So when we drop back down on our way in to land, if we see a fresh plume developing, we'll do a pass through it on the way to land.
LS: OK.
PVH: That would just be an aerosol sample, not chemistry because we can't do a full chemistry sample on it anyway.
2:42 PM
PVH: Are we almost in position to do our banking turns?
LS: Here in another 3 minutes.
PVH: So we're going to do 2 turns here. Bank to the right and then we will skim the tops of this cloud layer and we should be at just about the time the ER-2 is overhead so we'll get some aerosol measurements on that. Then we'll go in to land. On the way in to land if we can go through any fresh plume that might be popping up due to the new ignition, we'll do that.
LS: Gotcha. I'll start my turn in another 30 seconds.

2:45 PM
PVH: We're now on top of the old smoke. We're doing 2 bank turns to the right for CAR measurements. We've made contact with the ER-2 and they should be overhead just a minute or so from now. So the earlier information about the ER-2 being over at 2:15. It's overhead here at 2:45. We're sampling the top of the cloud...
LS: Peter, we're going to start the turn.
PVH: We're sampling the top of the old cloud, which is what the ER-2 is going to see because it's quite extensive now and it's the upper layer. We'll be sampling that for aerosol measurements shortly after we finish these 2 banking turns.

2:46 PM
RS: Peter, the ER-2 will be here in 5 minutes from now, or from 40 seconds ago, and he sees a fresh plume. He was wondering if it's the active fire and I think it is from the information you gave us. Do you want him to fly right over that? Any other instructions for him?
PVH: That must be the fire they're just igniting. If he can see this big spread out plume that we're looking at now, at least for the next 10 or 15 minutes, it would be better for him to look at that while we do our measurements in that, and then he can concentrate on the new plume, which we won't be able to do very much in.
RS: Understand. I'll pass it along.

2:47 PM
PVH: After we've done these two banking turns...I've lost what we're doing here now. Are we doing our banking turns now, Larry?
LS: We just had one and we're starting our second.
PVH: After we've finished that second turn, Ray, we're going to skim the tops of this old cloud for aerosol measurements. The ER-2 is finally on-site. It was half an hour late so we'll get some aerosol measurements in the top of this cloud and then we're going to go in to land. On the way in to land, if we're lucky, we'll go through the new plume that is now being produced by the ignition that is currently going on just
as we come in to land. So we want to do some aerosol measurements in that as well.

2:49 PM

PVH: Rod, how long does the ER-2 expect to remain on station here?

RS: I'll find out. He will be about 15 minutes. He's doing one east to west pass, some kind of reciprocal and then one west to east pass and then he'll go home.

PVH: We'll try to stay with him as long as we can. You passed on the message for him to sample this old smoke and you say he is seeing some new plume popping up. Is that above this smoke, have we seen anything of the new plume?

LS: Yes, we saw the new plume. We're looking down across this layer but it's not up this high and we've just now completed our second turn. I'm going to swing off to the north and come back around the top southbound.

PVH: OK. When we've done that we should try to go through the new plume that he is looking at about the same time.

LS: We should be able to do that.

RS: His track that he cuts through will include both the new plume and this smoke filled valleys.

PVH: Perfect timing.

2:51 PM

PVH: Are you busy, John?

JH: I'm calibrating the CO₂ instruments.

PVH: Get back to me when you've done that.

JH: OK.

LS: Peter, we're about 1 and a half minutes from sampling the top, southbound.

2:52 PM

PVH: So Ray, let's try and get some absorption measurements here.

LS: 45 seconds and we'll be back in the top.

2:53 PM

PVH: Try to pick out a sort of representative bit of the smoke that might be representative of what the ER-2 is seeing.

LS: We're just in and out of the tops now.
PVH: That looks pretty good. Try to keep in it. Larry, I'm going to leave the rest of the timing to you. I want you to carry on doing this for a while but give yourself enough time to sample that new plume on the way back into landing.

LS: My plan is, I'm going to fly through this until I see the plume. It's on the south side of it. Then I'm going to throw some flaps out. We'll descend and try to go through the plume straight in to land. It's all right in a direct line.

PVH: Sounds good.

2:55 PM

LS: That's about it. We're coming out of the south side of it.

PVH: John, are you finished?

JH: Nope, a couple more minutes.

PVH: We're just going to do one traverse of the new plume as we go in to land. I don't know if you want to try and get something on that. We'll get aerosol anyway.

JH: I'd like to continue calibrating the instruments for a minute here.

PVH: OK. They just reignited so we've got a new plume and the ER-2 is over us at the moment.

LS: Peter, maybe you should come up here and take a look.

PVH: Will do.

2:56 PM

DS: As of about 14:59:20 the CCN is no longer maintaining any kind of supersat so I'm shutting it down.

PVH: We're going to do one more traverse of this new plume that's popping up. I can see it off to the starboard now, coming up to the old smoke.

2:59 PM

LS: We're 3 minutes to hitting the top of the vertical plume there.

PVH: The old smoke is now filling all the valley in this area. We took a couple of photographs, 2 or 3, showing the new plume from the latest ignition of the Creamery fire. It is popping up through the old smoke, looking a bit more orange and brown. Also in one of those earlier 2 or 3 photos I got the old fire from yesterday or the day before that seems to have regenerated itself more south of where we've been working. It hasn't interfered with our measurements. We're coming up to intercept the new plume that's 500 feet or so above the old smoke.
3:01 PM
PVH: I see the new plume off to starboard now.
LS: 1 minute to the new plume.
PVH: If you can get any measurements here, John, it might be interesting. The new plume we're about to penetrate looks pretty nice.
LS: 40 seconds.
JH: I'm going to have Art do hot and cold DMPS on this.
PVH: Good. This should be a very nice flaming smoke from the flaming combustion.
DS: Peter, I shut down the CCN. The supersats were all flat.
PVH: I understand, Don. It's OK. We'll get a bit of a bump as we go through this fresh plume.
LS: It's not going to be very long in it. 10 or 5 seconds.

3:02 PM
LS: Sample now. I can go back through that if you need it.
PVH: Would anyone like to do it again?
JH: That was pretty short but it's enough for a DMPS.
PVH: Let's do it again anyway to get another aerosol measurement.
JH: OK, I'll fill the bag up a little bit more.
PVH: That's a pretty sharp plume. It's actually a nice plume because it didn't send us off scale.

3:03 PM
PVH: Are you going to get any emissions on this one, John?
JH: I wasn't going to take any filters on it. I could do mass though.
PVH: Emission factors are very interesting for flaming combustion. Most of the data is for smoldering.
JH: If I get a full bag I could.
PVH: Give it a try.
JH: OK.
LS: 2 minutes to the plume.
LS: You've got about 20 seconds. 10 seconds.

3:05 PM

LS: 5 seconds. Sample.

PVH: Didn't even have to pay for that one.

JH: Peter, do we have 10 minutes or so before we land?

PVH: Can you give us 10 minutes in clear air, Larry?

JH: Doesn't have to be in clear air, it just has to be before we land so I can pull the filters off this bag.

PVH: We'll give you that and I'll come up front now, Larry.

3:06 PM

DS: We'll be landing as soon as John finishes pulling his filters.

RS: Anybody up back there?

3:07 PM

DS: Peter, how long do you want to keep the CAR and lidar going?

3:09 PM

RS: Can somebody go ahead and secure everything for the landing? We'll be touching down in 4 or 5 minutes.

DS: OK, I'll look a little more.

3:10 PM

RS: John, are you up?

DS: He's too busy right now.

RS: Can I turn the aircraft engine-driven vacuum pump off?

DS: Standby.

3:11 PM

PVH: We got a couple of aerosol samples and the second one also a chem sample through the new vertical plume coming up from the new ignition. We're now coming in to land after a 5 hour, 12 minute-odd flight. The plume wasn't all that well-behaved today, not as well behaved as the plume in Washington that we looked at yesterday. It didn't spread out very much horizontally but I think we did everything we could. We got some good measurements in the vertical column. We got some
measurements downwind. We did some CAR-type banks, straight flights above and below for the NASA radiometer. Quite a bit of aerosol and chemistry. So, by and large, a pretty good flight. That's the end of the tape.

3:12 PM

DS: I believe he's still using the engine driven pump to pull his final filter. He should be done within a minute or so.

JH: What's that?

DS: Are you still using the engine driven pump?

JH: The generic pump? Yes, I am, but as long as I can have it on, whatever that is.

DS: Just tell them when you're done with it.

JH: Rod, you can shut the aircraft vacuum down now.

RS: Thank you.

3:13 PM

JH: Peter?

RS: We're landing.

3:14 PM

JH: You can shut off that Zev filter switch.

PVH: What did you get on that last one, John? Everything or did you miss some things?

JH: I wasn't able to take a can, so I won't do any emission factors on that one, but I got CO₂ off of it, as well as total mass for Teflon filter, quartz filter, organic carbon, and also pixie analysis from a nuclepore filter.

END OF TAPE
SUMMARY

Flight 1656
September 23, 1994
Engines On: 1418 PDT   Engines Off: 1536 PDT
Departure Airport: Tillamook, OR
Arrival Airport: Paine Field, WA

Spent night of Thursday 22 Sept. in Tillamook, with expectation of 0800 take off the next day for California. However, unable to take off next morning due to fog and lack of navigational beacon at Tillamook. Finally, took off at ~1430 PDT. No point going to California because ER-2 not flying, and it would have been too late in the day by the time we arrived to get much by way of measurements. Therefore, returned to Seattle. The only relevant data obtained on this flight were very brief measurements of marine clouds – perhaps affected and unaffected by smoke from the Creamery fire – as we gained altitude flying out of Tillamook.

Summary: See preceding paragraph.

P. V. Hobbs
University of Washington
September 26, 1994
AIRCRAFT POSITION PLOT

GPS track of flight 1656, 09/23/94 14:30:00 - 15:31:00
Flight 1656
September 23, 1994
Voice Transcriptions

PVH*: Transit flight from Tillamook, Oregon to Paine Field, Washington. We spent the night at Tillamook, expected to take off at 8:00 the next morning, but were socked in by low visibility and fog. Finally we got off at about 2:30 in the afternoon and are now heading back to Seattle. On board are Hobbs, Herring, Rangno, Russell, Spurgeon, Weiss, Levin, Sokolik, Sorenson and Sutherland.

3:12 PM
RS: We'll be landing shortly. If you guys can begin getting your stuff together, that would be great. Probably about 5 minutes.

DS: Looks like we're all together back here already.

RS: Good.

3:27 PM
RS: We'll be landing in about a minute. I need everybody in with their seat belts.

* PVH: Peter V. Hobbs; DH: Dean Hegg; JH: John Herring; JR: Jack Russell; DS: Don Spurgeon; RW: Ray Weiss; IS: Irina Sokolik; LS: Larry Sutherland; RS: Rod Sorenson.
The main purpose of this flight was to ferry to Lewiston, Idaho, on our way to the Idaho wildfires. However, on the way, we passed through the smoke plume from the Tyee, Washington wildfire (located just west of Chelan). From a distance, this plume looked substantial and fairly well defined, even at ~40 miles downwind. We obtained aerosol, gas, etc. measurements in 1 or 2 passes across the width of the plume at ~40 miles downwind. No chemistry bag samples.

(Met up with Darrold Ward in Lewiston, as planned, and coordinated arrangements for dual flying of Idaho fires that afternoon).

Summary: Some data (minimal) on smoke well downwind from the Tyee fire.

P. V. Hobbs
University of Washington
September 29, 1994
GPS track of flight 1657, 09/27/94 09:52:00 - 11:40:00
Flight 1657  
September 27, 1994

9:51 AM

RS*: Is everybody ready back there?

DS: Ready in the back.

AR: Ready way in the back.

9:52 AM

PVH: This is flight 1657. Take off from Paine field at 09:40. Same crew as we had on flight 1656. We're heading to Lewiston, Idaho to meet up with Darrold Ward and plan a flight of forest fires in Idaho, probably the Chicken fire. So, this is a transit flight to Lewiston.

9:56 AM

AR: Heading westward toward the Puget Sound and the Olympics. An unusual sight in that there is virtually no snow, just several tiny, tiny, patches on the very tops of the Olympics, an extremely unusual sight here in Seattle.

9:57 AM

AR: We have clear skies, layers of haze near the surface of patchy ground fog east of the foothills, toward the foothills of the Cascades.

PVH: Looking to the north about 30 miles away we can see a lot of smoke coming from the Tyee fire heading off to the south. Present plans call for us to head toward Lewiston.

10:15 AM

PVH: It looks as if we'll go through the fairly extensive plume coming off the Tyee fire at Lake Chelan before we reach Lewiston, so as we go through it, we'll get some measurements.

10:23 AM

PVH: We're heading for a good chunk of the Tyee smoke. We've diverted a little bit from our direct path to Lewiston in order to sample this smoke. It's quite a distance downwind from Chelan.

10:34 AM

PVH: How far to the smoke, Ken?

KM: I'd say we're just about to enter it now. We're in it now.

PVH: We'll go right through it and then we'll do a 180 and then set up to come back through it and get some measurements on the second pass.

KM: Understand you want to go all the way through and we'll do a 180 coming back. Put the microphone up against your lip, Peter, you're hard to hear.

PVH: Is that better?

KM: Lots better.

PVH: We'll go through it and then do a 180, wait for John to get set up and then go through it again for our proper measurements.

KM: OK. Looks like we hit a little branch of it but there's more ahead of us another couple of miles.

PVH: We want to get the full plume.

10:36 AM

DS: Dilution filters are on the CCN. The time is 10:37.

10:37 AM

JH: OK, Peter.

PVH: We just went through a little of it but the main plume is up ahead so you've got plenty of time.

10:38 AM

KM: This thing has split into, it looks like, many tongues. We'll be coming out of it very shortly. If you'd like, we'll make our reversal to the north a ways, or I guess to the west now, and go back through it when you're ready and we'll maybe catch some stuff that's a little thicker.

PVH: We're not in very much here. The last patch we went through about 5 minutes ago was better. Maybe you can pick out an even better piece of the plume.

KM: OK. Are you ready to go back through it again?

PVH: Yes, but that piece we just went through is not enough. Let's see if we can get a bigger one. We are ready to go back.

KM: OK, we'll turn left here and go up a ways and see if we can find some thicker stuff before doing a reversal.

10:39 AM

PVH: Are you reading us, Don?

DS: Affirmative.
10:43 AM
PVH: Are we approaching it again?

10:44 AM
KM: The thickness of the smoke out there is probably dependent on the light. We're going to cut over to the right a little bit. Maybe we can get something a little thicker for you.

PVH: I see what you're doing. John, we'll go through it once to see what it looks like and then we'll go back into it if it looks good for your measurements on the second go through.

KM: Say again, Peter?

PVH: I was talking to John. We'll go through it and if it looks good we'll turn around and go back through it.

KM: OK, we should be hitting it in another 2 or 3 minutes. We're letting down to try and get into this.

10:45 AM
PVH: Is this the Columbia below us or just a lake?

KM: It's the Columbia. And that's Wenachee to our right.

PVH: How far off is the source of the fire?

KM: Let me work it out. We're about 10 miles south of Wenachee at this time and I think the fire is about 30 miles north of Wenachee in the Chelan area, so that's going to put it at about 40 miles downwind.

10:46 AM
KM: This is probably about as good as it's going to get.

PVH: What do you think, John? We got a little response, is that good enough for you?

JH: We would have to sample a long time to get anything out of that, I think.

PVH: Well, then we won't do it. That means that if we come back up here we're going to have to get closer to the fire. You picked out the best smoke, did you?

KM: Yes, we'd have to get a lot closer to the source to do much better than this.

PVH: OK. Let's go back through it. We won't do any chem samples but we'll just head into Lewiston.

KM: OK. We'll give you a right 180 degrees and off towards Lewiston.

DS: How does the bag look, John?
JH: Not so good.

DS: Do we still have a CO₂ leak somewhere?

JH: Still chasing it around.

10:47 AM

DS: Just before we land, John, why don't you fill the bag up loosely. It will be easier to find a hole if there's another one in it.

JH: Gotcha.

PVH: So John, you'd like something twice as big as that on the CN, or on the ozone?

JH: I only saw the CN go up to about 2,000 on that one. Before we were sampling when it got above 30,000 so, that was pretty thin.

PVH: It was going off scale the other day but...

JH: We could certainly sample smoke like that but it would take about twice as many bags to get as much mass as we would need on the filters.

PVH: OK. If we come back here we'll go 10 or 15 miles closer to the fire.

JR: We were getting about 9,000 on that, John.

JH: I didn't see that.

10:48 AM

JR: There's 8,000 right now.

10:50 AM

PVH: So we just got 3 aerosol samples of portions of the plume at about 40 miles downwind of the Tyee fire. We didn't do any chem samples at this time because the plume wasn't that thick. It would have required quite a few bag samples. But if we come back here later on today we'll get a bit closer to the fire and get into some thicker plume. It does look like a pretty good plume to work.

11:14 AM

PVH: What's our ETA, Ken?

RS: We should be touching down in about 25 minutes. That would put it at 11:40.

PVH: Thank you.

AR: Peter, do you copy?

11:25 AM

AR: Peter, this is Art, do you copy?
11:26 AM

DS:  Art, are you done with the DMPS?

11:35 AM

KM:  Are you finished with the vacuum pump back there?

JH:  We're finished.

KM:  OK, we've got it off.

PVH:  We're just coming in to land at Lewiston at about 11:39.

AR:  Did somebody say something there?

PVH:  I was just recording something on the science tape.

11:39 AM

RS:  Everybody ready for landing?

DS:  We're ready for landing back here.

PVH:  No obvious signs of any smoke plumes around Lewiston. Visibility is pretty good here at Lewiston.

RS:  You are ready for landing back there?

DS:  We are ready for landing.

RS:  Very good. We will be touching down in about a minute and a half.
SUMMARY

Flight #1658
September 27, 1994
Engines On: 1429 PDT   Engines Off: 1821 PDT
Departure Airport: Lewiston, ID
Arrival Airport: Lewiston, ID

Corral wildfire, Idaho (near McCall). Coordinated flight with Forest Service Cessna 340 (Darrold Ward) and NASA ER-2.

Extensive smoke in area from numerous wildfires, collecting in valleys, etc. Difficult to isolate plumes from individual fires.

Made 3 penetrations of vertical column from Corral fire for chemistry and aerosol measurements. Also, 3 penetrations of smoke for chemistry and aerosol measurements ~ 8 miles downwind. Banked turns above and in (separated in time and slightly in space) pall of smoke in valley (not a distinct plume) for CAR measurements.

Flew at ~15,000 ft near top of smoke at ~8 miles downwind and crossed the width of the plume several times for lidar cross-section measurements at same time as Forest Service Cessna obtained neph (and gas) measurements at various altitudes below.

Made a final pass through the width of smoke downward for filter and aerosol measurements.

ER-2 overhead during major portion of flight.

(PVH has photos of this fire.)

Summary: Good measurements in Corral fire (Idaho) but in complicated smoke situation. Some coordinated measurements with Forest Service Cessna.

ER-2 overhead.

P. V. Hobbs
University of Washington
September 29, 1994
AIRCRAFT POSITION PLOT

GPS track of flight 1658, 09/27/94 14:41:00 - 18:14:00
Flight 1658
September 27, 1994

JR*: This is the beginning of flight 1658.

2:40 PM

JR: We're ready to go, Peter.

PVH: We just had a meeting with Darrold Ward at the Lewiston airport and we've arranged a coordinated flight.

2:41 PM

PVH: We've arranged a coordinated flight over the Corral fire in Idaho, located at 45 degrees, 8.5 minutes and 116 degrees 01 minutes. Then perhaps after that the Chicken fire, also in Idaho. Both of these fires are slightly northeast of McCall, Idaho.

2:48 PM

AR: Don, the liquid level light on the DMPS is out. I didn't see the connect point to hook up the reservoir. It may need something.

2:57 PM

KM: We're through 10,000 and the oxygen is on.

2:59 PM

JH: Hey, Rod, would you turn the aircraft vacuum on?

3:00 PM

PVH: We're about 15 minutes from the 2 fires now. They can be seen on the video and look like pretty good plumes.

3:01 PM

PVH: We're going to go around to the south of the plume and then come back through it in about 5 minutes.

3:07 PM

PVH: Although we can see the vertical column coming up through the overall mist and smoke below us, it may be difficult to pick out a good horizontal plume that's not mixed in with all the smoke and haze that's down below us. We can see it ahead of us now.

3:09 PM
PVH: John, don't take a sample on the first pass. We'll just go through it and then we'll turn around and take a sample on the way back if it looks good.

JH: I'm still doing my background sample so I won't be taking any smoke yet.

PVH: Don't go into the smoke yet, Ken. Avoid the smoke because we're still doing a background sample.

3:10 PM
KM: Stay out of the smoke now?
PVH: That is correct.

KM: OK, we'll swing around to the south here. This looks like the whole world is burning down there. It's hard to identify where one fire stops and another one begins.

PVH: I know. That's not a good situation for us.

3:11 PM
DS: This is a background sample at 15:11. The CCN has it's dilutors removed at the moment. When we start sampling smoke I will make a note accordingly and a diluter will be in.

JH: Jack, are those cans on yet?

PVH: Tell us when you're ready, John.

JH: Everything takes 50% longer up here at 10,000 feet, so we're going to be a bit longer.

3:13 PM
PVH: Irina, we're passing over an extensive area of smoke below us. It's not any particular plume, it's just a big pall of smoke, but it should provide you with some good measurements.

IS: OK, I should see this in my signal downlooking radiometer. Definitely something.

3:15 PM
JH: I'm taking the last background sample so it will be about 7 minutes before we're ready to sample smoke.

PVH: 7 minutes?

JH: Yes.
3:17 PM

PVH: Ken, let's set ourselves up so we can go through the column in about 5 minutes.

KM: Understand you want to penetrate in about 5 minutes. The Cessna 340 is entering now and he'll let us know when he's clear. We'll just stay out to the east here.

PVH: Is he sampling the column?

KM: He's hitting the column a little bit higher than us and is going from south to north, almost following the direction of it.

PVH: When he clears out we might want to try to get to the same area so we can compare our measurements.

KM: They're out the other side. They went from south to north. You want to make the same penetration?

PVH: Yes, if that takes us through some good smoke.

KM: It should. They made the penetration at 13 so we'll do it at 12.5 then.

PVH: OK. We'll just hold on for John. I'll give you the word. Are you ready, John?

JH: Be ready in about 30 seconds.

PVH: If we see we're getting into some good smoke, take your sample. We're going to go along a track that the Cessna has just been through so it will be a good comparison measurement.

DS: Switching CCN over to dilution filters. The time is 15:21.

3:21 PM

KM: If you're ready, we'll be hitting in another 4 minutes.

PVH: I think we'll be ready.

3:22 PM

PVH: Are you ready, John?

JH: Ready.

PVH: We're ready, Ken. Any time.

KM: We'll need 3 or 4 minutes. You don't have anything loose hanging around on the floor there, do you? We might get a few bumps.

PVH: OK.

KM: Take a look around, Don, I'd appreciate it. I'll let you know before we go in.

DS: OK.
3:23 PM
DS:   Everything is secured back here, Ken.
P VH:  If you'd give us a countdown from about 10, Ken.
3:24 PM
KM:   We're about 90 seconds out.
P VH:  If it looks good, John, take your sample.
KM:   What's that?
P VH:  John? If it looks good, take your sample.
JH:   Roger.
KM:   About a minute. I'm guessing 30 seconds.
3:25 PM
KM:   15 seconds. 5 or 6 seconds. 3 or 4 more seconds. And we're entering.
3:26 PM
KM:   Clearing on the other side.
JH:   I didn't hit the core of that one, Peter, but I got some of the thick stuff. Do you want me to go with that?
P VH:  I think so. We went off scale on the CN and the neph. Would you want to penetrate on that one again, John?
JH:   Let's go ahead and sample on that one.
JR:   Do you want 2 cans?
JH:   Yes.
3:27 PM
PVH:  OK, Ken. While we're waiting for the next penetration pick out some fairly good smoke below us and let's do a banking turn to the right so our radiometer on the nose points down into the smoke below. We'll do 3 turns like that.
KM:   OK.
P VH:  Try to keep us pointed at the smoke beneath us.
KM:   Is the smoke beneath us right now thick enough for you?
P VH:  Well, if you can find any thicker nearby it would be better.
KM: We've got some stuff here to the south in this valley. We'll do a right turn over there. It looks as if a fair bit of it is settled in there.

PVH: OK, so you'll be banking to the right about, well, just so our radiometer points down into it.

KM: I understand. Peter, the ER-2 will be here in 10 minutes.

PVH: OK, so you'll be banking to the right about, well, just so our radiometer points down into it.

KM: I understand. Peter, the ER-2 will be here in 10 minutes.

3:29 PM

JR: Cookie.

PVH: John, will you need another sample of that column?

JH: Yep.

PVH: OK. In about 5 minutes?

KM: In about 5 minutes we'll be over this valley and ready to start our turn.

DS: I'm standing by the CAR and ready, Peter.

PVH: We're going to be doing banking turns on top of fairly heavy smoke in a valley here. This smoke is not from any particular plume that can be identified. It's smoke that has accumulated here. This will be for the CAR measurements. We won't be able to go below the smoke because of the high terrain.

3:31 PM

JH: Jack, let's cut those cans off.

3:32 PM

KM: We'll be starting our turn out here in a couple of minutes.

PVH: After we do these three turns, Ken, we'll go back through the vertical column. We can penetrate it in the opposite direction to what we just did. But try to take about the same line through it.

KM: OK, we'll give you three turns here and then we'll head back to the column and we'll go at it at that time in the opposite direction, which will be north to south.

JH: That will be perfect, Peter.

3:33 PM

KM: Starting our turn now.
JH: We've got a couple of minutes before the next sample so I'll wait until you've got the cans on until I sample again.

PVH: John, it's going to be probably 10 minutes before we get back to the column.

JH: Roger.

PVH: As we do our banking turns there is smoke below us, although we can't see the ground below us very clearly. The smoke is fairly uniform here.

3:34 PM

PVH: We are on top of it. Ken, just call out the turns as we complete them.

KM: OK, there's one.

3:36 PM

KM: That's two turns.

3:38 PM

PVH: Don, do we have the lidar up?

DS: Affirmative.

3:39 PM

PVH: OK, John, we'll be setting up to go through that same region again but in the opposite direction.

JH: Roger.

PVH: We went off scale on the CN and the neph so perhaps we should go through a little less dense smoke.

KM: We're at 3 turns now. We'll do another half turn and then head up for the next penetration.

3:41 PM

PVH: Will that be OK with you, John? A little less dense?

JH: That's fine.

PVH: Ken, we'll go roughly through the same track as before but maybe a little less smoke this time.

KM: You want a little less smoke on the penetration?

PVH: That is correct. We went off scale here a bit. We still want a good amount of smoke but not quite as much as before.
KM: OK. I'll try and catch the downwind edge of the plume then this time. Do you want it in the same direction, from south to north?

PVH: That's fine. No, I mean, we can do it the way we're going now, north to south. So it would be the reverse from what it was before.

KM: OK, we'll do it north to south then.

JR: We caught our own plume there a couple of times.

3:42 PM

PVH: What's the Cessna doing now?

KM: They're elevating behind us right now. They just finished a penetration about 7 or 8 minutes ago, I guess.

PVH: Also of the column? OK. We finished out three turns and we're heading back to the column, north to south.

3:43 PM

PVH: John, will you need another one after this one in the column?

JH: Yes, the third one will be the 10 minute sample.

AR: Just as a note, it looks like we've gone back through our exhaust a couple of times there on the CN strip chart.

PVH: That's why we were doing the turns. We want to avoid that. Those turns were for the radiometer measurements.

3:44 PM

PVH: Is this our column off on the right now, Ken?

KM: Yes it is.

PVH: Photograph number 7 on Hobbs CAR camera was of the vertical column that we are about to penetrate from the Corral fire.

3:45 PM

PVH: Ken, do you think we're going to be able to pick out the horizontal smoke coming from this fire, or is it going to be mixing with all this old stuff?

KM: I think it's going to be mixed. It looked like there were ten thousand fires down there. Every place you looked there was something smoldering.

PVH: Photograph number 8 on the Hobbs CAR camera is another view of the vertical column and the pall of smoke beneath it from the Corral fire taken at 3:47.
3:47 PM

KM: This run will be from northwest to southeast to try and hit a lighter place. We're about a minute and a half or two minutes out. About 40 seconds.

3:48 PM

KM: 20 seconds. 10. 5, 4, 3, 2, 1, we're entering. And we're clearing to the southeast.

3:49 PM

PVH: Ken, if we went back to that region where we did our three turns, could we get down into the smoke there?

KM: It's really hard to tell. It's below the valley rim and the light is at such an angle that you can't tell whether it would be any better or not.

PVH: I'm wondering if, from an altitude point of view, could we get down into the smoke and do 3 turns in the smoke in that same location?

KM: I think we could get down lower. We were able to see the ridges around it.

PVH: John's going to take about 10 minutes here to analyze his samples. So let's go back to that same region where we did our three turns before.

KM: OK.

JH: Peter, this is actually the short sample. We haven't gotten to the third bag yet. That was only our second smoke sample.

PVH: OK. So you'll be ready to go in 5 minutes?

JH: Maybe 6.

PVH: OK. Hold that then, Ken. We'll do that after the next penetration of the column.

KM: OK.

PVH: We'll just stay out here. Well, we might as well go through the column again to get some aerosol measurements. So let's go back through it. Then we'll do another penetration of it for John.

KM: OK, you want about the same density this time as in the last run?

PVH: Yes, that looked OK.

3:51 PM

PVH: We're heading for the column again.

3:53 PM

KM: A minute and a half or so.
3:54 PM
KM: About 20 seconds. 10. 5. Entering. And we're exiting.
PVH: ...on the NOx there, and the CN went up to about 360,000-odd.
3:55 PM
PVH: The next thing, we'll be going back through that column when John has finished his sampling, which will probably be in a few minutes. We'll go back through the column in about 4 or 5 minutes, Ken.
KM: Say again, Peter?
PVH: We'll go back through that same column in about 4 or 5 minutes when John is ready.
KM: OK. So we're putting off the 360's for a while.
PVH: Until after this next penetration.
KM: OK.
3:56 PM
DS: When you start feeling a little sleepy or yawny, a little oxygen at this altitude will wake you back up.
3:57 PM
JH: Peter, we're ready for the next.
3:58 PM
JH: We won't use those cans on this sample. We'll wait until the next one.
DS: Is this the sample you want a humidigraph sample with as well?
JH: That's right, Don.
3:59 PM
PVH: How much longer, John?
JH: Ready.
PVH: OK, we're ready for our third penetration, Ken.
KM: OK, about 2 minutes out.
PVH: There are lots of fires popping up all over the place here. The whole valley is full of smoke.
4:00 PM
KM: About a minute. 30 seconds. 15 seconds.

4:01 PM
KM: 5. 3, 2, 1, enter.
JH: Peter, if we could dip back in that one again.
PVH: You want to do another one?
KM: We're exiting.
JH: I didn't quite get the bag full on the smoke there.
PVH: OK, let's do a reciprocal, Ken, and go back through it again on the column.
KM: How soon will you be ready?
PVH: Straight away.
KM: We're about 2 and a half minutes out.

4:04 PM
KM: 30 seconds.

4:05 PM
KM: 15. 3, 2, 1, entering. And exiting.
PVH: OK, John?
JH: Yes.
PVH: You need 10 minutes now, right?
JH: That's right. It will be about 12 before we're ready to sample again.
PVH: OK, let's head back to our place we did our circles and let's see, where are we now, south of the plume?
KM: Northwest.
PVH: West?
KM: Northwest.

4:06 PM
PVH: OK, we'll just head back to where we did our samples.
KM: Let us know when you're ready and we'll descend at that time.
PVH: You can go straight back to where we did our circles and descend.

KM: Right. Let us know when you're close to being ready. It won't take us longer to get down into it.

PVH: We're ready now. What we want to do down there, Ken, are 3 circles in the smoke, banking to the left.

KM: So you want to be looking up, is that correct?

PVH: That is correct. So we're in the smoke and the radiometer is looking up through it to the sky.

KM: OK. Let's get over here. We won't start down quite yet. We want to take a look at this valley and see what the visibility is.

4:08 PM

PVH: We just completed our third penetration of the column from the Corral fire for our chem measurements in the column. We're now going back to the area that we did our 3 bank turns in. Previously we did them backing to the right and above the pall of smoke, not really the plume. Now we're going to do 3 banking turns to the left in the pall of smoke. We'll see if we can get down there safely. This is the general smoke in the valley, rather than any particular plume.

4:09 PM

DS: I'm at the CAR and standing by.

4:10 PM

PVH: Do we have permission to go lower, Ken?

4:14 PM

PVH: Are we doing our turns now, Ken?

KM: Not yet. We're still waiting for a clearance.

4:15 PM

KM: We've got our clearance. We're going to be orbiting while we descend and we're going down to about 7. It should put us in the smoke. I don't know how thick it's going to be, but it's smoke.

PVH: OK.

4:16 PM

PVH: Don?

DS: Go ahead.
PVH: We're doing our CAR measurements again so you'll need to watch the sun.

DS: OK.

PVH: We'll be banking to the left so we'll be looking up at the sun this time.

4:18 PM

PVH: We're now doing our 3 banking turns to the left in some, well, it's actually supposed to be smoke, but it's not very thick smoke. It's also not in the same area that we did our banking turns above the smoke. We're a few miles south of there but we're not in very much smoke here because the CN count is only about 1,000 or so.

4:19 PM

KM: We're going to go down to 7 but it looks like we're in the smoke already at 8.5. Let us know when the smoke is good enough and we'll level there.

PVH: OK, we're picking up a little smoke, not very much but it's probably as much as we can get.

KM: Yeah.

PVH: So when you've got into as thick as you can get into then let's do our three circles.

KM: If you're talking to me, Peter, I can't hear you. You'll have to put the mike up a little closer.

4:20 PM

PVH: Ken, can you hear me now?

KM: Loud and clear.

PVH: You've done a couple of circles already in this smoke, haven't you?

KM: Yes, I've been doing circles while we've been descending down to what I estimated to be about 7,000 where the smoke was. It looks like we may have gone through the smoke now.

PVH: Put us in as thick of smoke as you can and then do a couple of circles in that.

KM: OK.

PVH: The CN count has fallen off here so we need to climb a little bit.

KM: We're going to go up a ways and see if it gets thicker.

4:21 PM

KM: We're going to move just a little bit north here. It looks like it's better over there.

PVH: That will put us closer to our previous 3 circles above the smoke as well.
KM: Say again?

PVH: That will put us closer to the circles we did above the smoke. We’re a little south of there, aren’t we?

KM: Yes, we’re generally south of the plume that we were working before. We’re just going to move up probably 5 miles. Right now we’re probably about 15 miles southwest of the plume.

PVH: You remember the location where we did our circles above the smoke?

KM: This is generally the same area.

PVH: I think it’s a little south of there.

4:22 PM

DS: It’s pretty good.

PVH: How are you doing, John?

JH: Ready to take another sample.

PVH: But you’ve got your three samples of the column now, haven’t you?

JH: Right. I’ve got the three column samples so I’m ready to go downwind.

PVH: OK. I don’t know if we can get a decent plume that is distinct from the general pall of smoke, that’s the problem. But we’ll go up and take a look. We’ll complete these 3 circles first and then we’ll do that.

4:23 PM

PVH: OK, we’re doing another 3 circles here in some better smoke. The CN is going up to 2,000. These are bank turns to the left for the CAR. We’re pretty close to the area where we did the bank turns to the right above the smoke.

4:24 PM

KM: We’re completing our second turn.

4:28 PM

PVH: What is the Cessna doing now?

KM: Standby.

RS: He’s working in or north of that second plume over about 25 miles from us right now.

PVH: Ask him if he prefers to do the combined measurements across the width of the plume on the plume that we’re working, the Corral, or does he prefer another plume?
4:29 PM

KM: This is 2 turns, now.

PVH: The CN is up to 7,000-odd. Ken, what I want to do next after this is to go back to our plume and see if we can go across the width of the plume at about 5 miles downwind, assuming there is a horizontal plume there that is sort of distinguishable from the overall smoke.

KM: OK, it's about 9 miles downwind?

PVH: 5.

KM: 5.

PVH: When you get set up and are approaching it, I'll come up there and we'll see if we can see a distinct plume.

4:30 PM

DS: If you can't see one, Peter, we could try the lidar and see if it can pick out a thicker area.

PVH: It's not so much a thicker area, Don, it's that I want to get a plume that's not mixed with old smoke.

DS: Oh.

4:31 PM

PVH: Is the ER-2 still working this area?

KM: We haven't heard from him in a while. Standby, we'll check.

RS: Peter? Wait, standby.

4:32 PM

PVH: Are we heading back to the column now, Ken?

4:33 PM

RS: Peter.

PVH: Yes.

RS: The ER-2 is still up there. The guys in the Cessna would like to go ahead and do that work on the Corral fire. They'd like to know when you want to plan that and they'd like for us to be at 14,000.

PVH: Tell them that we're not quite ready for it yet. I want to do this maneuver 5 miles downwind and penetrate the plume and get our chem samples there. Then when
we've done that, which will take us 20 minutes or so, we'll go on top, above that area at the same distance downwind, assuming we've got a good plume there.

RS: OK. At that time, start this coordinated thing we were talking about?

PVH: That's correct.

RS: OK, I'll talk to them. Thank you.

4:34 PM

KM: When we've done this orbit, Peter, we'll go back up to 12,000.

PVH: OK.

AR: John Herring, the heater popped out twice during that hot sample, so I'm not sure how reliable that is going to be.

PVH: Ken, when you've located yourself about 5 miles downwind of the column, let's go across the plume, above it first, with the lidar and see if we see something good down below that we can then get our chemical samples in.

KM: OK, we'll continue to climb up until we're above the plume.

PVH: What height is that?

KM: It will probably be about 15,000, I'm guessing, but we'll see.

PVH: In that case, don't do that climb at this point. Let's just go through the plume.

KM: OK. We'll look at it at 12,000 or 12.5 that we were flying before.

4:35 PM

JH: Hey, Don?

4:42 PM

JH: Is Don on the headphone back there?

PVH: We're setting up to go across the width of the plume about 5 miles downwind, John. If that looks good, we'll do 3 samples through that plume.

KM: We're coming up close to being 5 miles downwind. About another 2 or 2 and a half miles to cut across it here.

PVH: If it looks good we'll do your 3 samples and then we'll climb up and then we'll fly over that same region of the plume, but above it and we'll let the Cessna go down into the smoke.

4:45 PM

KM: We're starting our turn in now. We'll probably be in it in about 3 minutes.
4:46 PM
DS: How does it look?
PVH: Are you still getting CCN measurements, Don?
DS: The bag looks like it's pretty empty at the moment.
JH: It is empty because I am emptying it.
PVH: But is the CCN working OK?
DS: I think it is. I'll let you know the next time we get a sample. The supersats are fine.
PVH: It should be within a few minutes and we should be in.
DS: At this high an altitude, the cabin stays cool enough that I don't have any trouble keeping it operating.
KM: We'll be in it in another minute or so.

4:47 PM
KM: 30 seconds.
DS: Is it working?
KM: 15. We're starting in.
JH: That looked like a good one.

4:48 PM
PVH: We're still in it, deep in it. We're still deep in the plume. Pretty wide.

4:49 PM
PVH: There's the sun.
KM: We're coming out here now. How long until you're ready to go back through?
PVH: I'll be a few minutes.
KM: OK, let us know about 3 or 4 minutes ahead of time and we'll start our reversal.

4:50 PM
PVH: That is quite a wide plume.

4:51 PM
PVH: A few more minutes, John?
JH: Yes, we have to wait until Jack sets up the next set of cans. We're still sampling off this. It will be about 4 minutes.

PVH: OK. You see how wide that plume was, and how dense it was? You took your sample as we started to go into it, which probably wasn't bad because we were still on scale on the measurements. But we got deeper and deeper into it after your sample.

JH: I cut the leading edge of it.

PVH: Does he know that we are not flying above and doing lidar measurements at this point? That that's going to come a bit later?

KM: He knows that we are at 12,500.

DS: Do you want the lidar laser shut off for now, Peter?

PVH: You can if it's a good thing to do because we won't need it until we go across the top of the plume.

DS: As far as data, there's no danger of running out of room on the tape, but if there's a personnel danger, we probably should shut it down for a while.

PVH: OK, let's shut it down, but let's not forget to pull it up again.

DS: OK.

PVH: I think we can turn and position ourselves now, Ken.

KM: OK, we're in the turn.

DS: I see the light.
4:55 PM
PVH: Are you ready, John?

4:56 PM
JH: No, we're waiting for the next set of cans.
P VH: Don't go through it until I tell you, Ken.
KM: We're about 4 minutes out of the plume, Peter, so let us know if it's OK to penetrate.
P VH: Not yet. We're still waiting for John.

4:57 PM
PVH: About 1 more minute, Ken.
 KM: One more minute and we'll be completing part of this right turn and then we'll be turning to the left.

4:58 PM
DS: Re-wet CCN felt at 16:58 with the big pump. The CCN is still working quite well this flight.
P VH: Are you ready, John?
JH: Jack is back wrestling with the cans.
KM: We're about 30 seconds out, I would guess. There's kind of a ragged edge here.

5:00 PM
RS: Peter?
P VH: Yes?
RS: You've got about 1 hour on station.
P VH: We're going in again, John.
JH: I'll take the sample while Jack is putting the cans on.
KM: Starting to enter.
JH: It doesn't look much like what we passed through before.

5:01 PM
PVH: It looks thick out there but the CN is not picking up very much.
JH: I wonder if we're below it a little bit?
5:02 PM.
P VH: Here we go. It's gone down again.

5:03 PM

PVH: You didn't get a sample, did you John?

JH: No, I didn't. I suspect we might have been below it. It got pretty dark there.

PVH: It's going up again now.

JH: Got a good sample of that.

PVH: How long do you need, this time?

JH: Better give us about 8 minutes. It will take a little longer to do the can, so I think that will do us.

PVH: OK, Ken, I think we can get out of this and then we're going to make a third penetration of the plume but we can gain a bit of altitude since we want to get up higher anyway. The next penetration will still be in smoke but we can climb a little bit.

KM: OK. We're coming out now and we'll go up, what, 500 feet?

PVH: As long as it puts us into some smoke that's fine. What do you think the altitude of the top of the smoke is?

END OF SIDE ONE

PVH: The next fire is the Chicken fire. (Was it? Or did we continue with Corral fire?)

5:10 PM

PVH: How are you doing, John?

JH: We'll be ready in a minute.

5:11 PM

JH: Go ahead and head on in whenever you're ready.

PVH: OK, Ken, let's do it.

5:12 PM

KM: I'd say we're a minute and a half to two minutes from entering.

5:13 PM

KM: Probably in the next 10 seconds or so.
5:14 PM

JH: Hey, Don, could you run a humidigraph on this sample?

DS: Sure.

5:16 PM

KM: We're coming out.

5:17 PM

PVH: We should start climbing now, Ken.

KM: Up we go.

PVH: You can tell the Cessna that they can do their traverses beneath us backwards and forwards and we'll be going above them with our lidar. Tell them not to look upwards. Ken, we want to try to make sure that we're pretty much over them as we go backwards and forwards. I don't mean over the aircraft, but over the same area that they are crossing. Don, we'd better switch on the lidar.

5:18 PM

PVH: Does it look as if 15 will put us above most of the smoke, Ken?

KM: It does. Apparently it's a little bit lower than it was. We'll go to 15.5 and see what we have.

PVH: OK. How much more flight time, Rod?

KM: About 40 minutes. 35.

PVH: This will probably be about all we'll do. We'll criss-cross backwards and forwards as much as we can while they're below us and that will probably eat up the rest of our time.

KM: OK. We'll be starting our reversal in about 1 more minute. We'll go up to 15.5 and if it's doesn't put us above it, it will be darn close.

PVH: As long as they're...what's their maximum altitude?

KM: They were planning, I think 14.

PVH: That's fine. We have 500 feet of dead space on the lidar so as long as they are more than 500 below us, we'll be OK.

5:20 PM

KM: What was the last thing you said, Peter? We were talking to the aircraft.

PVH: If they're at 14 and we're at 15.5 that's fine.
KM: OK. We're going to start a right turn. They've got us in turn and they'll position themselves slightly behind us at 14,000.

PVH: Tell them not to look up at our lidar. You've got all the time you need now, John.

DS: I'm having a little bit of trouble getting the lidar laser to go, Peter.

PVH: OK, keep trying.

5:21 PM

PVH: Don, do you think it might be altitude?

5:22 PM

PVH: Any luck, Don?

5:23 PM

DS: Lidar is going.

PVH: Good job. We just switched the lidar on. We're at 15.5 and we're going to be criss-crossing the width of the plume with the Forest Service Cessna flying at various levels below us to get nephelometer readings to compare to the lidar. About how far are we downwind from the fire, Ken?

KM: About 9 miles. It'll be another 4 or 5 minutes until we get there.

PVH: So we'll be crossing the plume about 9 miles downwind of the fire?

KM: We'll start a little before then, I think.

JR: The computer quit.

PVH: Well, just carry on. Pull it up as soon as you can, Jack.

5:24 PM

JR: Peter, we should turn off that sun monitor. It's starting to crap out.

PVH: Just switch off the power?

JR: Yes.

KM: We're starting to pass up part of the plume now. The highest part is still ahead of us.

PVH: Just proceed. We've got to bring our computer back up but we'll just carry on this track and then after you've gone across the width we'll turn around and come back again.

KM: Let us know when we're clear to turn around and go back.
5:26 PM
JR: We're up and going again.

PVH: Well done, Jack. After you've passed out of the edge of the plume, you can turn around and come back again, Ken.

KM: OK, as soon as we get out of the end we can turn around and come back, Roger.

PVH: We'll keep doing that for a while.

DS: I'm getting a wonderful lidar image of the plume.

PVH: I'm going to come up and take a look at it.

KM: We're clearing on the other side and I'll start my 180/260 for the reversal.

5:29 PM
PVH: Ken, keep in touch with the Cessna and tell them to let you know when they've done various altitudes and just pass that information on to me.

KM: They're just breaking out now and they're at 11.5 and they're going to climb up another 1,000, I guess.

PVH: We'll try to let them do as many altitudes as they can while we criss-cross.

5:30 PM
PVH: Art?

5:31 PM
PVH: Art, have we got some good humidigraph samples in the smoke?

DS: Yes, we have.

PVH: Good. It should be an excellent data set.

JH: We got two, I think. That's something that it wouldn't hurt to grab another bag for another hot and cold DMPS and humidigraph.

PVH: OK, we'll try and do that before we leave here. As long as we get good neph measurements with it. That's what we need.

RS: Peter, fuel wise, it looks like we'll cross, do a reciprocal, come back and then we'll need to head on home.

PVH: OK. I'd like to cross and then on the reciprocal back, I'd like to go through the smoke to get one more smoke sample, so you need to coordinate that with the Cessna. It doesn't have to be deep down in the smoke, but provided we get a good bite of smoke.
KM: We've both completed our turns to go back. He's at 12,500. We were talking to the other aircraft and missed most of what you said you wanted to do when we complete this leg.

PVH: We'll complete this leg at this altitude and then on the reciprocal, which Rod tells me will be the last pass, I want to come down into the top of the smoke so we get a good bite of smoke, so you need to coordinate that with the Cessna. It doesn't have to be deep down in the smoke, but provided we get a good bite of smoke.

KM: OK, we'll take a bite out of it.

5:33 PM

PVH: John?

5:34 PM

DS: He's doing something with the filters at the moment, Peter.

PVH: Is Art on the line?

DS: Negative. He's back taking a picture.

PVH: OK, Don, when we do a reverse path on this one, which will be our last pass, we'll go through some smoke and I want to try and get some good simultaneous CCN humidigraph and neph measurements.

5:35 PM

PVH: John, when we do a reciprocal on this one, we'll drop down into the smoke. That will be our last pass through the smoke. So we'll try and get some good simultaneous CCN humidigraph and neph measurements. Maybe we can get a sulfate filter if we do it getting some sulfate measurements as well. Are you set up to do that?

JH: Not now, but I very easily could be. So I'll set up a Teflon filter to do sulfate.

PVH: So we have simultaneous measurements of the particulates and the nephelometer readings and the humidigraph and the CCN.

JH: Roger.

PVH: Try to grab your sample before the CN measurements go off scale.

KM: Peter are you ready for the reversal? We're out the other side.

PVH: Not quite. Just hold off for a minute or so while we put one more filter in here. But you can maneuver into position.

KM: OK.

PVH: What altitude is the Cessna at now?

KM: 12.5.
PVH: And you're going to drop down to what?
KM: About 14.
PVH: OK. Good.
JH: Peter, how long until we hit the smoke?
PVH: Are you ready?
JH: Yep.
PVH: We can go into the smoke, Ken. How long will it be?
KM: Another 6 minutes.
PVH: John, when you sample this time, try to get it before the CN goes off scale.
JH: Roger.
5:38 PM
PVH: Are you all set up for this last pass, Ray? We want to try and get everything simultaneously here.
5:39 PM
PVH: My sun monitor is out because of arcing at this altitude so I haven't got very much data. Give us a good countdown on this next one, Ken.
KM: OK, it's about 4 minutes off.
5:41 PM
KM: A minute.
5:42 PM
PVH: Is that going to give us a good bite of smoke?
KM: About 30 seconds.
5:43 PM
KM: We're starting to enter it.
PVH: Looked good.
JH: That was a good one. Jack, let's take those cans on this.
DS: Humidigraph is going.
KM: We're coming out the other side and heading for home.
PVH: Tell the Cessna we're leaving and we'll see them at the airport.

KM: They're leaving too so it's almost a race back.

PVH: Tell the ER-2 we're leaving as well.

5:44 PM

PVH: A brief summary of this flight, which concentrated on the Corral fire in Idaho and the surrounding smoke. We started off with three good samples of the vertical column for chemistry and aerosol measurements. We did CAR, banked turns, not in the plume from the fire, but in the overall pall of the smoke in the nearby valley. First above the smoke and then we did banked turns in the smoke. Then we sampled the plume about 5 miles downwind with 3 penetrations for chemistry and aerosol samples. Then we climbed up to near the top of the smoke and did several croses across the top of the smoke, across the width of the smoke about 8 miles downwind with the Forest Service Cessna of Darrold Ward flying beneath us in the smoke at various altitudes for neph measurements and gas measurements. Finally, we made 1 penetration through the plume at about that same distance downwind, 8 miles, near the top of the plume for a final set of measurements of filters, humidigraph, CCN and neph readings and DMPS. By and large a very good flight. The computer went out just once. Jack brought it up again pretty quickly. Everything else seemed to work, as far as I know. The only problem here was the numerous fires on the ground, a very confused situation as far as smoke was concerned. So there's no knowing what sort of aged smoke we were sampling, except perhaps from the vertical column.

5:47 PM

PVH: Don, why don't you switch to the science channel and record briefly your impressions of the flight.

DS: The CCN seemed to work quite well. Didn't have any particular problems with it and we finally figured out how to run the humidigraph with the programming that is available. It seems to be working fine, from what I can see here. Lidar worked good. We had a brief time when we had a hard time getting the laser up but when it came up everything there worked fine. The CAR, as far as I can tell never stopped running and never stopped working.

5:48 PM

PVH: Art, would you record briefly your impressions of the flight as far as the measurements were concerned, and anything else you think is important?

AR: Roger.

5:49 PM

AR: Our flight today, as far as the DMPS goes, was quite good, with the exception of the fact that the heater for the hot samples occasionally failed. Jack has looked into it and noticed a fault in the system. He will be working on that, but more often than not the hot sample...
JH: Jack, just leave those on there while I empty the bag. We'll get them off when we land.

DS: Are you going to take the bag now, John?

AR: The cold curves were excellent in all cases. It looked very "Gausian" considering the format. It visually appeared Gausian, not in reality, considering the long format. We had widespread smoke, regional smoke, also situated in layers in some of the hotter plumes. Probably minor stable layers are causing less well-heated plumes to spread out in thin slivers downwind. It is very much like the Kuwait fires situation. The highest plume going over 20,000 feet and heading eastbound. We never did actually sample that particular one. That was located some 20 miles or so to the east. In the area here there are many small smokes. It is again a fire of many smokes much like Kuwait in that there are many isolated hot spots of various sizes down in this wild fire. As a result, the smoke plumes are ascending to many different heights, causing a very complex smoke pattern where the mini-smokes are fixed together in some cases and in other cases they've remained separate entities as slivers above slivers. The winds appear to be light and southwesterly at the low levels, perhaps less than 10 knots.

PVH: Art, good. Did you record how your instruments worked?

AR: That's right. I put it on the record position so you wouldn't have heard my comments.

PVH: I only hear that when I'm pressing the button, right?

AR: Right. When you're in the "record" position, you're not going to be speaking to anybody but the tape and that's what I was doing.

PVH: OK, good. Ray? Do you read me? Would you record your impressions of the flight.

5:53 PM

RS: Don? I've got a half a sandwich in that ice chest. Could you tell Ken to bring it up for me?

DS: Sure.

RW: This is Ray Weiss. I was running the optical extinction cell and the aethelometer. The flight was pretty good. The smoke was good. The problem with flying at high altitudes with the extinction cell is that it was hard to get adequate flow through the instrument such that the time response could be max flow with the nephelometer. But it think it will be pretty easy to post-process the data. The aethelometer worked OK. It's probably going off scale and (too faint). What else? That's about it.

5:55 PM

DS: Are we done with the CAR and the lidar? Peter, are you up?
This is the flight chemist recording. This was a very good flight. We got a good series of chemical samples on the column of smoke, a good series on the stratiform smoke and actually 2 pretty good chemical measurements on the stratiform smoke. The one continuing problem we had was the mysterious CO$_2$ leak and it's kind of a problem for several of the instruments because once the bag starts getting empty we seem to be sucking cabin air into the sampling system. In the future, I think what we might do on these flights is to not start taking canister measurements or CO$_2$ measurements before we start emptying the bag with the pumps for the filters. It would take a few more minutes but it would also guarantee that we would get good CO$_2$ measurements out of the bags.

John, the humidigraph is done. Do you want to take any more samples with it?

I'm done with it.

OK. Then I'll shut it down and save some air.

Is there any reason why we're up at 12.5

We're slowly coming down. It's just a terrain. We're going to descend further once we're past the next ridge here.

Peter, are you up?

It is 1801, the last bag is empty. I'm shutting down the CCN.

We're just coming in to land so end of a pretty good flight. Everything worked pretty well.

On board today were Hobbs, flight scientist, flight chemist John Herring helped by Vanderlay, Jack Russell, flight engineer, Don Spurgeon operating CCN counter and lidar, Irina Sokolik who is operating the NASA Pilewskie radiometers and Art Rangno operating the DMPS and the humidigraph.

The pilot was Ken McMillen. The co-pilot was Rod.

Yes, you can turn the aircraft vacuum off, Rod.

We are all strapped down out behind the baghouse.
RS: Can I turn the vacuum pump off?

JH: Roger, you may turn it off.

6:09 PM

AR: Looking at the stacks in the vicinity of Lewiston, we have no wind here at all. They seem to be going straight up.

6:13 PM

KM: Is everybody ready in the back?

AR: Ready in the back.
SUMMARY

Flight #1659
September 28, 1994
Engines On: 1001 PDT  Engines Off: 1254 PDT
Departure Airport: Lewiston, ID
Arrival Airport: Wenatchee, WA

The purpose of this flight was to obtain measurements in the plume from the Tyee wildfire located just west of Chelan. Went to source of fire, which consisted of ~ 50 small fires and a few larger fires in a relatively small region. Largely smoldering combustion. Made passes across width of plume at ~ 15 and ~ 10 miles downwind for chemistry and aerosol measurements. Smoke samples may have been marginal for emission factor measurements and extinction cell measurements. Also made pass across top of plume for Valero radiometer (cloudy overhead). Could not fly below plume.

Summary: Few measurements of smoldering combustion from Tyee fire (WA).

P. V. Hobbs
University of Washington
September 29, 1994
GPS track of flight 1659, 09/28/94 10:14:00 - 12:49:00
GPS track of flight 1659, 09/28/94 11:11:00 - 12:49:00
Flight 1659
September 28, 1994

PVH*: Flight 1659 leaving from Lewiston. We're going to go out and look at the Tyee fire in the Lake Chelan area, Washington. On board we have chief pilot Ken McMillen, Rod Sorenson, co-pilot, flight scientist Peter Hobbs, chemist John Herring, flight engineer Jack Russell, CCN lidar operator Don Spurgeon, Art Rangno, humidigraph and DMPS operator, and our guests Irina Sokolik who is doing the Valero radiometers, and Ray Weiss who is doing the aerosol station.

10:15 PM

PVH: The date of this flight is Wednesday the 28th of September.

10:38 AM

PVH: We're getting more mid-level cloud here than was expected and some signs of CU to the north.

10:54 AM

DS: The time is 11:08, Wednesday, 9/28. I am taking background samples of air. I shall put in the dilution filters once we get to the smoke.

11:08 AM

JH: Rod, could you switch on the aircraft vacuum?

RS: OK, I'll get it on in about a half a minute.

11:12 AM

PVH: We are over the Columbia now, due east of the Tyee fire but the smoke looks pretty old here and we can't see a clear source so we're going to now fly west to see if we can find the source of the smoke. Initially we'll have to keep above 10,000 feet.

11:13 AM

PVH: The Tyee area, where the fire is supposed to originate, is actually located some miles west of Chelan.

11:14 AM

DS: I didn't get a very good vacuum sample for the CCN. The bag is empty this time. The CCN is just barely coming up. We have reached the Tyee area and are about to start sampling smoke so I'm going to have to put back in the dilution filters.

PVH: We have fairly thick, mid-level clouds over us. The fire looks as if it's just smoldering because there is no vertical column. We do have a plume going off to

the south that we may be able to work. We're just heading up to the fire to see if
we can get a better idea of what the fire is doing. The smoke plume is way below
the cloud above us so there are no interactions between smoke and cloud.

11:17 AM

PVH: We're over the source of the fire now. We can see about twenty-odd small burns
and then one or two bigger burns but it's not very hot and it looks to me as if it's
smoldering more than flaming. I don't see any flames, really.

11:22 AM

PVH: Photograph number 10 on my CAR camera. It's just upwind of the smoke
showing some of the smaller fires and the somewhat bigger one. We're now going
to fly from the source of the fire downwind to see if we can trace this plume. We'll
go about 20 miles downwind and then we'll see if we can cross it. My previous
estimate of the number of small fires here was probably an underestimate. There
are probably more like 30 or 40 quite small fires burning in odd patches. Then a
couple of bigger ones that are putting off some slightly brown-orange smoke. The
smaller ones are putting off more greyish smoke.

11:23 AM

DS: Taking background measures on CCN. I should note that the supersats look a little
funny. I may have a wire that's doing something funny or a _________ is doing
something funny. The cold plate is .8°C, warm plate 1 is 17.5°C, warm plate 2 is
18.3°C, warm plate 3 is 18.9°C, warm plate 4 is 19.9°C. It should be used to
computate supersat but there is a question as to whether they are correct or not.

11:26 AM

PVH: We've been up to the source of the fire and we're taking at that. There are probably
40 or 50 little fires up there and a couple of somewhat bigger ones. Now we're
about 11 miles or so downwind and we're going to do a pass through the width of
the plume here. We'll do 2 chem samples so that will be 2 passes at this distance
downwind.

11:28 AM

PVH: Irina?

KM: We're clear to go through. It will be about 11 miles downwind.

DS: Standby 1.

11:29 AM

IS: I'm here.

PVH: This is not much good for you, is it, because of the overcast?

IS: Yes, but I can try to see what will go with the filterization anyway.
PVH: Later on we'll do a pass above the smoke. I don't think we can get below it because of the terrain.

IS: OK. It's OK.

PVH: At least this is a better plume than the one we had yesterday at the Coral fire. At least it's coming from, although multiple sources, they're all coming from the same general area so it's producing a more well-defined plume. Surrounding it the air is fairly smoke free. It's a sort of smoldering fire.

DS: Going down.

PVH: Are you ready, John?

JH: I'm ready.

PVH: OK, we should be entering pretty soon if you could give us a countdown, Ken.

KM: Will do.

DS: 11:30, putting dilution filters on CCN.

RS: It looks like a half a minute.

11:31 AM

RS: Peter, with the terrain higher ahead, the altitude doesn't look good this direction. We're going to turn around and go south to north to give it to you.

DS: Temperatures on CCN: Cold plate 15°C, warm plate 17.8°C, warm plate 2, 18.5°C, warm plate 3 19.2°C, warm plate 4 20.4°C.

11:32 AM

RS: About a half a minute. We may be in the fringes right now but about a half a minute for the main penetration.

11:33 AM

RS: We're about 13 miles downwind. Doesn't look like a clearly defined site so we may be in it now.

PVH: No, we haven't got anything yet.

RS: We're coming out the other side so we've been through the thickest part of it.

11:34 AM

PVH: It's very thin, not thick enough for us.

RS: We can't do much closer to the source. We're hugging the terrain as it is.

PVH: So you think you went through the thickest part of it here, even if you went down lower?
RS: We might could go a little bit lower going south to north again, and we could see what it's like, it's hard to tell whether it would be thicker down there or not.

PVH: Let's try that. We've got a small blip here so I'd like to compare it with a little lower down.

RS: OK. I'll swing out further downwind and back to the other side and then retrace this track a little bit lower.

PVH: Actually, we're in as much smoke here as we were there.

RS: Peter, we're just barely hearing you up here. Can you put your microphone closer to your lips when you're talking to us?

PVH: OK.

RS: Thank you.

11:35 AM

PVH: If we got permission to go further in, could we fly the plume there from the terrain point of view?

RS: Say that again, the first part.

PVH: If we got permission to go closer in, could we fly the plume from the terrain point of view.

RS: Ken doesn't think we'll do any better any closer to the source. We could go look and see and give you what we could on any given pass, but we wouldn't give you much up closer to the plume.

PVH: That's surprising because the plume looks fairly substantial.

11:36 AM

PVH: I think we may have been a bit too high last time. That's higher than we had before.

JH: That was pretty good.

PVH: It still looks as if it's mainly below us. Is that as low as you can go?

KM: I think this is the thickest part here. On the last pass we were 100 feet higher than we were before so I think going lower isn't going to improve the density of the cloud.

PVH: OK. That last pass was OK. We got a good signal there. Let's repeat that and we'll get our chem sample on this one.

KM: OK. We'll move up a little closer to the source and we'll try it at the same altitude as we made this last pass in.
PVH: You could probably keep it the same distance from the source because that signal was OK last time.

KM: OK, we'll do a 180 here.

DS: There seems to be a wire that may have shaken loose in the temperature sensors that are feeding into the computer. I'm fiddling with it. As soon as we land I will try and get this repaired. Until then maybe I can make it work by what I'm doing. At this time at 11:38, temperature in the plates are 15.4°C for the cold plate, warm plate 1 is 18.1°C, warm plate 2 is 18.8°C, warm plate 3 is 19.4°C and warm plate 4 is 20.8°C. These are all in centigrade.

PVH: John, are you ready for the next one?

JH: I'm ready.

RS: We're just going to be easing into this so you should see on your instruments about as quickly when you get in.

11:39 AM

RS: That's pretty much it. The thicker part we see further west is just hugging the terrain so that becomes inaccessible for us.

PVH: We didn't hit anything that time. That was quite different from the one before.

11:40 AM

RS: I believe we're very close to where this plume elbows and that might be causing us some problem as well, I don't know.

PVH: We didn't see hardly a blip on that one.

RS: Within about 15 seconds we should get something here.

PVH: John, you got your sample, was it OK?

JH: I was a little quick on the trigger there. I was trying to get anything and then missed the core. If we can do a quick 180 I'd like to get that one again.

PVH: We got 2 max on that one. Let's do that one again, Rod. We got a double max on the CN there, John.

RS: We'll reverse course and do that one again.

11:42 AM

PVH: This time since we're doing a reciprocal, you should hit that big max first.

JH: Roger.

11:43 AM

JH: Peter?
PVH: Yes?

JH: Please switch the NOx pump switch on.

PVH: It's on.

RS: We're heading back across, we should get to the plume in a minute.

11:44 AM

RS: It should be within about 15 seconds.

11:45 AM

RS: I'd say we're in it.

11:45 AM

JH: We got that one.

PVH: OK, we've got 10 minutes now to give John to analyze that sample. Let's go back on that same track but above the smoke and give Irina some measurements.

IS: May I ask to level for a couple of minutes before over the smoke?

PVH: Right. So when we do our traverse above the smoke we want to have a nice level flight track.

IS: thanks.

11:47 AM

PVH: We just did our first chem sample in a rather weak plume. I made a mark on the position plotter when the chem sample was taken.

DS: 11:50, the humidigraph is running and the CCN is going. The channels still look good, the supersats still look funky so I'll give you temperatures for this sample. Temperatures are cold plate 15.9°C, warm plate 1 is 18.7°C, warm plate 2 is 19.3°C, warm plate 3 is 19.9°C. Warm plate 4 is 21.4°C.

11:51 AM

RS: We'll be overflying the plume at 9,500 feet in about a minute and a half.

PVH: OK, keep a nice steady altitude. How far downwind are we?

RS: We'll be 14 to 15 miles. It's about where we've been doing our tracks.

PVH: OK.

11:52 AM

PVH: Irina, will you want another pass after this one?
IS: Yes, it looks great.

PVH: So you'll want a second pass?

IS: I definitely can see changes in outflow and flux. It's very interesting.

PVH: Rod when we've gone beyond the edge of the plume we'll turn around and do the same again above the smoke.

RS: OK.

11:54 AM

DS: At the moment the temperatures look pretty lucid. Let's hope my diddling did something.

11:55 AM

RS: We're heading back about half a minute from the plume and still at the same altitude.

11:57 AM

RS: We're clear of the plume. What would you like to do now, Peter?

12:00 PM

PVH: What we want to do now, Rod, is to come back and we want to do a pass through the plume at the same altitude as before, same location as before for another chem sample.

RS: Are you ready for that now.

PVH: I think we will be in about 3 or 4 minutes.

RS: OK.

PVH: Are you ready, John?

JH: Just about.

PVH: Hold off for a bit, Rod.

RS: How long?

JH: About 2 minutes.

12:02 PM

PVH: Do all our measurements look OK?

JH: So far so good.
PVH: How are you doing, Don?

DS: Things look pretty good. I think I have a loose wire in the CCN. The supersats look a little funky. I'm in the process of trying to track it down at the moment but the measurements look good. I've been recording the temperatures of the plates so they can get the supersats post-process.

PVH: Good.

JH: Peter, we're ready to sample again.

PVH: OK, Rod.

RS: OK.

12:03 PM

PVH: Did the humidigraph look OK, Don?

DS: What I could see looked fine.

12:04 PM

RS: Peter, will you come up here?

DS: It looks like I may have my temperature problem solved. I'll keep an eye on it. the supersats are 20, 78, 102, 150. Temperature of the cold plate is 16.8°C, warm plate 1 is 19.3°C, warm plate 2 is 19.9°C, warm plate 3 is 20.8°C, warm plate 4 is 22.2°C. This is all in C.

12:05 PM

PVH: The plume appears to have split into two but we're going to keep at this altitude and go through the lower part and see what it's like. If that's no good then we'll climb a bit and come back on a reciprocal and go through the upper part and see if we pick up something there. The CN is picking up. Are you watching, John? We're picking up here. It's a good time.

JH: OK.

PVH: I think we've got a good one then.

12:06 PM

PVH: That was bigger than the last one we did, Rod.

RS: Well, now that we're in the middle of it, it looks like we're at exactly the right altitude.

PVH: Now if we should move closer into the plume are we still going to be able to keep in the smoke?

RS: We'll go another 3 or 3 and a half miles and I think we'll be in the smoke and see what it's like there.
PVH: John's going to need 10 minutes to do his analysis so let's set ourselves up closer in.

RS: OK.

12:07 PM

PVH: John, are you analyzing your sample?

JH: Yes I am.

PVH: OK, we'll give you another 8 minutes.

JH: This will be longer because after this sample I'll have to change everything, including the can. This will be more like 12 minutes, depending on when Don started the humidigraph.

DS: I started it right after you got the bag going. At the moment it has 8 minutes and 56 seconds.

12:10 PM

DS: CCN 12:10, counts look reasonably good. Temperature cold plate is 17.2°C, warm plate 1 is 19.6°C, warm plate 2 is 20.3°C, warm plate 3 is 21.1°C, warm plate 4 is 22.3°C.

12:11 PM

DS: A little more diddling with the temperature probes and I'm getting a pretty steady reading at the moment. I'll keep an eye on it and I will continue reading the temperatures off.

RS: Will you be ready in a couple of minutes?

PVH: Yes. Hold on, Rod. Yes, Jack?

JR: Rod was calling you.

PVH: Oh. No, we're not quite ready yet, Rod.

JH: The humidigraph sample will be done in about 4 more minutes. Then I have to change all the filters.

PVH: I think we need another 8 minutes or so, Rod.

RS: OK.

DS: Peter, it looks like I may have the temperature problem on the CCN fixed.

PVH: Good.
12:16 PM

PVH: We have thickening overcast here above us. It's not interfering with our measurements. The smoke is way below it but we're getting some virga as well coming from the middle-level cloud now. We made the right decision not to have the ER-2 flying today.

12:19 PM

PVH: Rod, do you think you're going to put us back into a little thicker smoke if we go up closer?

RS: Possibly a little bit but mostly it will be a look and see and you guys will tell us if it's thicker.

PVH: And about what distance downwind will this one be?

RS: 11 miles.

PVH: And the first one was?

RS: 14 and a half to 15 miles.

PVH: Tell us when you're ready, John.

JH: Ready to go.

PVH: OK, Rod, let's go.

RS: OK, we've got 2 minutes, 2 and a half maybe.

PVH: John, let's just look at it without taking a sample on this first pass. Then we'll see if it's worthwhile doing 2 more samples at this distance downwind. It's only a few more miles closer to the plume to the fire than before, so it may not be worthwhile doing.

JH: Roger.

12:24 PM

RS: About one minute.

12:26 PM

PVH: The plume looks pretty substantial.

RS: About one minute from here. Something in here, I would say. Either here or within 10 seconds.

12:27 PM

PVH: It's picking up now.
RS: I just eased down a little bit lower into it. That could be why it just at this point started.

12:28 PM

PVH: It looks as if that lower altitude was what we needed so when we come out of it we'll do a reciprocal and go back in at that altitude.

RS: OK.

PVH: John, do you see anything to be gained by doing chem measurements at this distance downwind?

JH: Using research hours?

PVH: What was that?

JH: Never mind. No.

PVH: OK.

12:29 PM

PVH: Rod, then we might as well head back to Wenatchee.

RS: OK, going land at Wenatchee.

12:30 PM

AR: Peter, do you copy?

PVH: Yes.

AR: There is a small turret now rising out of the origin area of this fire. It looks like it was a hot spot that was beginning to go up.

12:31 PM

PVH: OK, so it's a little disappointing, that flight. But we did obtain 2 comprehensive chemical and aerosol measurements about 13 miles downwind of the smoke from the Tyee fire. We did a pass across the top of the fire, 2 passes actually, at about the same distance downwind for their radiometer measurements that looked interesting. That was about all.

12:32 PM

PVH: We're getting into more smoke as we lose altitude here.

12:33 PM

KM: Are you done with the hydraulic, the vacuum, anyway?

JH: We're done.
12:43 PM

KM: Is everyone ready in the back?

DS: Ready in the back.
SUMMARY

Flight 1660
September 28, 1994
Engines On: 1421 PDT  Engines Off: 1558 PDT
Departure Airport: Wenatchee, WA
Arrival Airport: Paine Field, WA

(As per arrangements with Darold Ward and Yoram Kaufman earlier that day, we contacted Yoram from Wenatchee Airport to see if Darold recommended that we return to the Corral fire (Idaho). However, Yoram had not heard from Darold by the time we phoned (~1330 PDT). Therefore, we decided to look again at the Tyee wildfire (WA) to see if it had increased in vigor. Later, we learned from Darold that Corral fire was very vigorous that day.)

Made two passes through the plume of smoke from the Tyee fire (at ~15 and 10 1/2 miles downwind) but the smoke was fairly thin. Therefore, decided to return to Seattle.

Summary: Few measurements downwind of Tyee (WA) fire.

P. V. Hobbs
University of Washington
September 29, 1994
GPS track of flight 1660, 09/28/94 14:30:00 - 15:51:00
VOICE TRANSCRIPTIONS

Flight 1660
September 28, 1994

2:29 PM

PVH*: Flight 1660 leaving Wenatchee on the afternoon of the 28th of September. Basically a flight back to Seattle, but we'll take a look at the plume from the Tyee fire on the way back. If it's much as it was this morning we will not take any further measurements. If, on the other hand, it looks more interesting and has picked up, we will get some measurements before going on to Seattle. The flight crew is the same as this morning, flight 1659.

2:35 PM

DS: Your mike is not going to be alive. We only have the one feed.

2:41 PM

DS: CCN is operating and the dilution filters are in. The time is 1443.

2:43 PM

DS: That way is the desert. That way is the trees.

PVH: We're going through some smoke here. It's quite high actually.

2:48 PM

DS: Something.

2:49 PM

DS: Was that long enough?

2:50 PM

PVH: Let's head home, Ken.

DS: He said let's head home.

PVH: I don't see any point in taking any more measurements so we'll head back to Seattle.

2:51 PM

PVH: Let's head home Ken, sorry, Rod. Things don't seem to have changed much out here from earlier on. There's less overcast now but I don't think we'll get anything more significant than we got this morning so we're heading back to Seattle.

2:52 PM

PVH: Rod, about what distance did we pass through the plume on this flight?

RS: On the second pass that you told us to go home in the middle of, we were at about 10 and a half miles. The first pass was more like 15 miles.

PVH: Thank you.

2:57 PM

PVH: I'm going to get some members of the crew to make some statements about this morning's flight, that is flight 1659. Not to be confused with the current flight, flight 1660.

3:00 PM

PVH: Would you summarize your impressions of this morning's flight. Make it clear that it's a summary of flight 1659 and not the current flight.

3:01 PM

RW: This is a summary for the optical measurements on flight 1659. The fire wasn't very extensive or very big. We did get some decent measurements. All the equipment seemed to work pretty well, so we should be able to get something out of it. That's about it.

PVH: Don, would you make a few statements about this morning's flight, 1659, for the record.

DS: Will do. The CCN counting seemed to work. We had some problems with the reporting of the supersaturation. I diddled with it and got it working. At the moment it seems to be working, which is going to make the problem a little more difficult to find. Beyond that, the CCN seemed to work pretty well. The humidigraph, as far as I could tell, was working the way it was supposed to, once we timed it down to a 10 minute downscale run. Lidar we had a little bit of problem with double flashing and towards the end the power output looked kind of weak. As far as I could tell the CAR unit seemed to work fine.

PVH: On the CCN measurements, when you were having some trouble, you took down the temperatures by hand, didn't you?

DS: I put them on the tape.

PVH: Good. Tell Art to put the headphones on.

AR: For some reason, I could barely hear Peter just then. What did he say?

DS: He wanted you to put on the headphones and make a short report of your data on the last flight.

AR: Roger. We did DMPS measurements. They all looked pretty good, except in the hot mode it appeared there were too many counts in the smaller channels. Other than that, the data looked quite good.
PVH: Art, can you hear me now?

AR: For some reason, Peter, your voice is much weaker than the other voices on the headset.

KM: It looks like Mount Rainier is smoking again.

PVH: Is that better?

AR: That’s much better.

PVH: I'm putting my mouth right up against the mike now.

AR: I have no trouble now, it’s excellent.

PVH: OK. Say a bit about your impressions about the fire this morning, the fire itself and the smoke.

AR: What I saw, Peter, was just a very weak fire, much like what we have out the window, which I just took a photo of. It doesn’t look like it’s changed much. Very weak plumes, not much vertical motion. If anything, we have a little bit more overshooting of the hotter plume right now than we did this morning. A very flat top over the fire indicating a semi-smoldering condition and no particular hot plumes. A gradual dispersion and spreading of the plume downwind toward the southeast. Our wind measurements agreed with that so our winds looked pretty decent on this particular flight. We’re also starting to get a few cumulus underneath the altocumulus here so there’s a chance there might be some smoke links into the clouds tomorrow.

PVH: Thanks, Art. Where’s John? I can’t see him. Has he parachuted out?

AR: He’s way in the back looking out the window.

PVH: Ask him to come and put his headset on.

3:06 PM

PVH: John, I’d like you to summarize what you did this morning on flight 1659.

JH: ...chemistry measurements of them. The filters might be a little lightly loaded for calculating emission factors though, so I’m not sure if we got anything too valuable today.

PVH: That was for flight 1659 this morning.

3:07 PM

PVH: We’re going to go over and look at Mount Rainier to see if it’s smoking. It looks as if it might be. We’ll go over and see if we can get some measurements.

3:08 PM

DS: It’s coming right out of the summit.
PVH: We're diverting from our track to Seattle to take a look at Mount Rainier that seems to be steaming.

3:09 PM

DS: We have several active volcanoes in the area.

PVH: Photograph number 10 on Hobbs camera is of the emissions from Mount Rainier as we approach.

3:12 PM

PVH: Ken, I wonder if air traffic can give you any information about reports on these emissions.

KM: What was that, Peter?

PVH: I wonder if air traffic can give you any information about reports on these emissions from Mount Rainier.

KM: Still didn't catch it.

PVH: Can air traffic control give you any information on the emissions from Rainier.

KM: They don't seem to know anything about it.

PVH: OK.

AR: Peter, I was just looking down toward Mount Adams and there seems to be a similar type of cloud that way. Much larger, but there is some kind of convection near it that resembles the small one by Mount Rainier.

PVH: They all decided to pop off at the same time?

AR: I'm thinking maybe there's a little bit of instability here and it's the heated south slopes producing a little microcumulus cloud.

KM: We're going to go up a ways.

AR: Sure looks like something, doesn't it?

3:14 PM

KM: Oxygen is on.

3:17 PM

DS: O₂ is on if you need it. Probably at about 15,000 feet.

KM: We're going to shift the blowers. You'll hear a little bump here.

PVH: We're still heading for Mount Rainier. It now looks as if what we're seeing is a cloud that is just behind the mountain to the south of it that is based just below the level of the mountain. We'll see as we get around to the south of Mount Rainier.
3:19 PM

DS: 1520, the dilution filters are off the CCN for whatever we may encounter at, in or around Mount Rainier.

3:20 PM

DS: We're just flying to see if it is actually smoke or a cloud on the far side of the mountain.

PVH: Art, along with that report of smoke from Mount Rainier, I'll be able to provide a photograph.

3:24 PM

PVH: Jack, I see my Sun is playing up again at this altitude.

JR: I'll turn it off again.

PVH: Just switch off the power?

JR: Yes.

3:25 PM

KM: Well, can't be right all the time. We're going to do a right turn and head for home.

3:27 PM

PVH: OK, let's head back to Paine Field. What appeared from the north to be some emissions from Mount Rainier, fortunately turned out to be a little cloud, a little cap cloud. With the lack of wind, it was almost over the mountain itself and looked very much like emissions. But, as we got around the south side of it, we saw that it wasn't, it was just a little cap cloud hugging the top. We are now heading back for Paine field.

3:28 PM

DS: We're going back to Paine Field. It's a cloud but not smoke.

3:29 PM

AR: This is the situation, Peter. We've got ice crystals but I'll be darned if I can find the cloud. We seem to be flying in an extremely thin haze of ice crystals.

PVH: I noticed that, Art. Nice little plates on occasions.

JR: We're out of it now, though. It was only for about a minute and a half.

3:30 PM

PVH: It must be coming from this cloud overhead and being blown off south. Jack, how often does the PMS 2-D imagery update?
JR: Once every 3 seconds.

PVH: So what's on there now gets erased after 3 seconds, or if nothing else is recorded, does it just stay there.

JR: That's right. It stays there until something else comes along to replace it.

3:31 PM

PVH: Jack, do you know where my instruction sheets on the Sun went? I had them here yesterday and they're not here now.

JR: I think maybe Ray has them.

PVH: Ray has his own, which I gave him. It's different from mine. Mine has the calibration for the FSSP, et. cetera at the back.

JR: Let me look.

3:40 PM

PVH: So apart from that one pass and then half a pass through the Tyee burn smoke, we didn't do any research on this flight.

3:43 PM

DS: What's our ETA to landing?

KM: We'll be on the ground in 5 minutes.

3:46 PM

PVH: The NOx is getting a negative readout for some reason. It's doing that continuously.

KM: Is everybody ready in the back?

DS: Ready in the back.

PVH: ...coming up to 24 as we come up to Paine Field at 2,000 feet.

2:50 PM

PVH: John, do you know why we're getting a negative reading on the Knox?

JH: Yes, the instrument just barely warmed up so I never had it turned on.

PVH: I think I noticed it on some of the earlier flights as well, though. You mean it's been on all through this flight and hasn't warmed up yet?

JH: I'll tell you later.
SUMMARY

Flight 1661
October 3, 1994
Engines On: 1110 PDT   Engines Off: 1549 PDT
Departure Airport: Paine Field, WA
Arrival Airport: Hoquium, WA

Raymond, Washington. 46° 50'/123° 47'. Prescribed fire. 54 acres/1100 tons fuel (Western Hemlock debris-?).

The fire initially produced a good vertical smoke plume in which we got 2 chemical samples that should be representative of flaming combustion. Obtained chemistry measurements at two distances downwind (≈1 1/2 and 6 miles). Also, lidar measurements across the width and along the length of the plume. CAR measurements above and below plume. Obtained measurements in older smoke ≈20 and 30 miles over ocean, then measurements along length of plume from ≈30 miles out to the fire.

(PVH has photos of this fire.)

Summary: Good data set (probably best chemical measurements so far).

P. V. Hobbs
University of Washington
October 4, 1994
GPS track of flight 1661, 10/03/94 11:22:00 - 15:45:00
GPS track of flight 1661, 10/03/94 11:52:00 - 15:45:00
Flight 1661
October 3, 1994

11:23 AM

PVH*: This is flight 1661 on the 3rd of October, SCAR-C flights. We got notice this morning at about 9:00 that there was going to be a prescribed burn at Raymond in western Washington. Latitude 46°, 50 minutes, longitude 123°, 47 minutes. 54 acres, 1,100 tons of fuel. So we're heading out there. Flight crew Hobbs, Rangno, Herring, Russell, Sokolik, Martins, pilot Sutherland, co-pilot Sorenson, Spurgeon and Weiss.

11:28 AM

PVH: Roger Ottmar from Forest Service is heading out to Raymond by road in the hope that he can get there about the same time as we do. We're expecting the burn to be ignited between midday and 1:00 pm.

11:37 AM

DS: There's the Olympic mountains.

11:47 AM

PVH: John, is the NOx going to work today?

JH: It's not warmed up yet.

PVH: How long will it take?

JH: Well, I don't know. Probably another 10 or 15 minutes, I suppose. I just wait for the little light to go off and then I can turn the pump on.

PVH: OK. Is everything working in the back, Don?

DS: CAR is up, CCN is up and the humidigraph is running.

PVH: OK, good.

11:48 AM

PVH: Larry.

11:50 AM

RS: Peter.

PVH: Yes. Do you see any smoke yet?

RS: No, 11:50 now. We'll be over the burn site at about 11:55, no contact with the helicopter at this time.

PVH: OK, I'm in contact with the forest service people on the ground. They haven't found the site yet either. They think they're about 15 minutes from it. The last they had from the forest service people lighting the burn was that it will go off pretty close to noon. Is this Willipar (?) Bay we're just coming up to?

RS: No, this is Gray's Harbor. Hoquium on the western side of the town and Aberdeen on the eastern side of the town.

PVH: Got it. Thank you.

RS: The fire is much closer to here than to Willipar Bay, the Raymond area.

PVH: Is that right? It's closer to Hoquium than Raymond?

RS: That's right. Do you see the airport out there at about 1:30 out your window?

PVH: Yes.

RS: The fire is 16 miles southeast of that airport.

11:52 AM

RS: That is the Hoquium airport.

11:53 AM

RS: We've got some smoke ahead. It's only 11:53. It's in the general vicinity of the burn. We'll let you know if it's exact in a minute.

PVH: If it is, we'll go straight to it. You should try to make contact with the helicopter and if there's a vertical column coming from it we'll take a look at that first.

RS: This is just a little wisp here, so if it is it, it's just now starting. I'll try again on the helicopter. Peter, do you know what we should see on the ground? Will there be a bunch of trucks or what?

11:54 AM

JR: He's talking on the radio.

PVH: Yes, there should be several trucks around. Roger Ottmar from the forest service on the ground is pretty close to the site. He hasn't quite managed to get up to it yet.

RS: OK.

11:55 AM

DS: 11:55:31, a few background samples of CCN. When we get into the fire I will put on the dilution filters.
PVH: Rod, Roger Ottmar said there's another unit very close to the one we're heading for that has a lot of logging equipment on the ground. You may spot that. If you spot that, the fire we're looking for may be pretty close to that.

DS: When the fire gets going I'll put in the dilution filters and I will note the time at that time.

11:56 AM

JR: Peter, the Ophir hygrometer seems to not be working.

RS: It should be off to our left, out the left hand side of the airplane.

PVH: Do you see any smoke?

RS: No, it hasn't been lit.

PVH: You can see the site?

RS: The GPS is pointing at it and there's a truck down there so we're suspecting that's it.

PVH: OK. No contact with the helicopter yet?

RS: Not yet.

PVH: I'm going to come up front.

11:57 AM

PVH: Larry or Rod?

12:04 PM

PVH: Larry, the unit we're looking for should be just to the west of where the logging equipment is and there should be a red and a white and perhaps a yellow vehicle there.

LS: They said they'd be lighting in 5 minutes.

PVH: Oh, you made contact with the heli?

LS: Yes, I don't know who it was but it must have been the helicopter. We haven't seen him yet.

PVH: OK, good.

LS: How far west would it be?

PVH: I don't know. He said just to the west.

12:05 PM

PVH: Larry, it's just a half a mile or a quarter of a mile to the west of the logging unit.
PVH: Rod, are we west of highway 101?

RS: We should be. I'll double check. It takes some turns right in this area so I'll look it over.

PVH: I'm surprised that Roger Ottmar on the ground cannot see us. He says he can hear us.

12:08 PM

DS: 12:08, still taking background samples with CCN. When the fire starts I will put in dilution filters and make a note.

12:09 PM

RS: Peter, do you see out your window, it looks like it might be going under the wing now, the helicopter and the 3 rigs. He's getting ready to light on the right side.

PVH: I've got him.

12:10 PM

PVH: The helicopter is just off our right wing now. They're just starting to light. There's some smoke coming up now. So we should get ready to do some measurements shortly, if we get a nice column there.

12:11 PM

DS: Putting dilution filter into the system now. The time is 12:11:58.

12:14 PM

PVH: Larry, would you bring the plane around so I can see it out of my window?

LS: Are you on the right side?

PVH: That's correct.

LS: OK, I'll switch around.

12:15 PM

JH: We're starting to get a good column on this. It's really picking up now.

PVH: Let's go through it then, make our first pass through the column.

LS: We'll make a first pass, probably ought to hit him about 270 or so.

PVH: I still can't see it. Oh, there it is, behind us. OK. Photograph number 12 on Hobbs camera shows the Raymond fire just starting up at the flaming stage.
12:16 PM
PVH: Give us a countdown as we go in.

LS: We're 15 seconds now. 10 seconds now.

12:17 PM
LS: 5 seconds. Here we go, penetration.
JH: That wasn't too bad. The column is pretty small but I got a good sample of it.
PVH: Let's analyze it. We'll give you 5 minutes.
JH: Peter, the way we're sampling today, everything is going to be 10 minutes, so we'll have at least 10 minutes and maybe 12 depending on if we're changing samples between chemistry passes.
PVH: OK. So about 12:30.
LS: You want to go back through at about 12:30?
PVH: Yes, that's when we'll want to do the next chemistry sample but let's go a little bit higher up and go over it and get a lidar cross section through the column.
LS: OK, 500 feet higher?
PVH: Let's try that and see where that puts us with respect to the column.

12:18 PM
LS: Peter, I can take you back to it here in about another 2 minutes.
PVH: Will that put us above the top of the column?
LS: Negative.
PVH: How far above us is it?
LS: Right now about 7 or 800 feet.
PVH: Let's go up another 500 feet before we go through it.
LS: You want me to take you through the top of the plume then?
PVH: Yes. Is the lidar working, Don?

12:19 PM
PVH: Is the plume starting to develop any horizontal extent?
LS: Yes it is, it's up at about 3,500 feet now.
PVH: I'm going to have to come up there because I'm not getting a good view of it from here.

LS: OK, I'm just starting a right turn around so you've got about a minute and a half before I'm going to be able to see it.

12:20 PM

PVH: Is the lidar working, Don?

12:21 PM

PVH: Is the lidar working, Don?

DS: It's working.

PVH: We're going to do a pass across the top of the vertical column. Then we'll go above the top of the horizontal plume that's developing.

DS: OK.

12:22 PM

LS: Peter, we'll be passing over the top in 2 and a half minutes.

PVH: When we've done that we'll keep about the same altitude and we'll go along the length of the horizontal plume but above it.

LS: OK. If you want to come up here you can get a good look at it now.

12:23 PM

LS: We'll be passing over the top in 3 minutes.

PVH: Let's turn around and go back and go across the vertical column, this time from due south to due north, perpendicular to what we just did.

LS: You want to traverse the plume from south to north.

PVH: Still above it.

12:27 PM

LS: Give me about 3 minutes to cross him.

PVH: We just went up the long axis of the plume, flying above it at 6,600 which took us also about 500 feet above the vertical column. We were flying due east so the plume was going off due west. We're now going to do a cross-section across the vertical column north to south direction, again above it for lidar measurements.

12:28 PM

PVH: Just drop your right wing a bit, Larry, and I can get a photograph.
LS: Peter, we're just parallel to it now and it's on the right side out there about three miles. I'm going to take you across on a southeast-northwest heading. One minute until crossing the plume.

PVH: Photograph 13 on Hobbs camera showing the fire just before our section across north-south, actually south-north across the vertical column for the lidar measurements.

LS: 30 seconds to crossing.

12:29 PM

LS: 15 seconds to crossing. We started over the plume now, but we're still not over the concentrated part.

PVH: We're over the horizontal portion. I wanted to be over the vertical column.

LS: We are over the vertical. If you want to be right over the fire I can do that, but the vertical drifted off southwest.

PVH: I think we just went over the horizontal portion here. The vertical column is way off to our right.

LS: OK, I'll swing around and get that for you.

12:30 PM

LS: Make it about 90 seconds and we'll be through the...well, you'd better come up here and take a look when I get broadside to it, Peter. The plume is not vertical, is the problem.

PVH: I can see it very clearly here. It's that yellow-orange portion we want to go over. It is sliding off a bit but that's what I call the vertical column, before it actually shears off horizontally and looks more white.

LS: I gotcha. 1 minute.

PVH: We're in good flaming stage now, it's a good orange-looking plume.

12:31 PM

JH: OK Peter, let's go.

PVH: Try to put us right over that orange portion.

LS: 15 seconds.

12:32 PM

LS: 5 seconds. You should be crossing it now.

PVH: Once we've cleared it, I want to drop down a bit, go through the smoke of that vertical column but we'd better not get down too low in it because it think that
would be too bumpy for us. If we can take a bit off near the top for our second chemical measurements.

LS: You want to go through it at 90 degrees then or down to plume?

PVH: Through it at 90 degrees. I don't want to go down the plume yet.

LS: Give me about 2 and a half or 3 minutes and I'll have you through there.

PVH: Are you ready, John?

JH: Ready Peter. For this sample I'd like to get as thick of smoke as we can fly through safely.

PVH: Safely is the operative word. It's looking pretty vigorous at the moment. Really in the flaming stage so I think we'd better take it easy. We'll try to get enough smoke going through near the top. If that doesn't look good we'll drop down 500 feet and try again, John.

JH: OK.

12:33 PM

JH: Don?

PVH: Is that 101 below us, Rod?

RS: I think it is.

12:34 PM

PVH: It doesn't look too bad from here now. Larry, see that main mass of smoke coming up and shearing off? It's just to the west of the fire itself. Let's take a bit out of the top of that. Photograph number 14 on Hobbs camera is just prior to...

LS: Peter, I'm too fast to penetrate it here. I'm going to do a 360 turn so we'll be penetrating in 2 and a half minutes.

PVH: OK. I see lots of flaming combustion on the ground now. That shot number 14 on Hobbs' camera was of the fire about 3 minutes prior to the second penetration for the chemistry measurements.

12:35 PM

LS: 2 minutes until penetration.

12:36 PM

PVH: Pick up something that looks like pretty fresh smoke coming up from the fire.

LS: 1 minute until penetration. 30 seconds.
12:37 PM
LS: 20 seconds to penetration. 10 seconds.

PVH: We're just coming into the top of the smoke, taking a little bite out of the top.

LS: OK, Sample now.

12:38 PM
JH: Ixnay on that.

PVH: We didn't get it?

JH: There wasn't much to get. There was only about a second in the smoke.

PVH: We're going to have to come down a little bit deeper through that same portion Larry. We didn't get enough smoke that time. So through this same region but lower down, get a bit more smoke.

LS: OK.

12:39 PM
PVH: Just dip your right wing, Larry and I'll get a...oh, you're coming round. Don't worry.

LS: Give me about another 90 seconds and I'll have you back through. About another 2 minutes, Peter, and I'm going to get you a good, heavy sample.

12:40 PM
JR: How did it go from 90 seconds to 2 minutes?

DS: Time warp.

12:41 PM
LS: 1 minute. 30 seconds.

DS: You may want to hold or, or you know, put on a seatbelt. This is a little deeper into the smoke.

LS: 20 seconds. 10 seconds.

12:42 PM
LS: 5 seconds. Sample now.

JH: That was pretty good, I guess.

PVH: Let's take that. That's good flaming stage smoke. Just turn it around so I can get a view of the plume out of my right window here, Larry.
12:43 PM

PVH: Good, let's do a penetration through the horizontal portion of the smoke at about this distance downwind. Almost perpendicular to our flight track now let's go through the middle of the smoke there, just for some aerosol measurements.

LS: OK. About 2 minutes and I'll have you through the horizontal about halfway down the plume.

PVH: Very good. Would you say the fire is past its most vigorous stage now, Larry?

LS: No, I don't think so.

PVH: Do you think the plume is going to go out over the ocean?

LS: It's doubtful. We're about 80 seconds from penetrating here.

12:44 PM

LS: About 40 seconds from penetration.

12:45 PM

LS: There's 20 seconds from penetration. 10 seconds. Sample.

12:46 PM

PVH: About what distance downwind was that, Larry?

LS: Rodney says about 5 to 7 miles. Make it about 3 miles there Peter. I'll tell you what, I'll take you to the same place and I can get a look at it.

PVH: Take us not through the same place but above that same place, above the plume at that same distance downwind. We'll get a lidar cross-section there.

12:47 PM

PVH: This should also be a good one for you, Irina.

IS: OK.

12:46 PM

LS: Peter, I'll have you back through in 2 and a half minutes. Correction, over the top in 2 and a half to 3 minutes.

PVH: So you don't think the plume will reach the ocean?

LS: It might. It's about 3 miles from the shoreline now but it's subsiding and it looks like it's going down closer to the deck there but give it a little time and we'll know for sure for you.

PVH: OK.

RS: Also, the forecast calls for a windshift within about 2 hours that would be out of the northwest, so at some point it will start going the other way.
PVH: We have 2 portions of this horizontal plume, one above the other.

12:48 PM

PVH: We went through that lower one so let's go just 500 feet above that lower one.

LS: Gotcha.

12:49 PM

LS: 500 feet above is just going to probably put us through the upper one there.

PVH: We'll take that.

LS: You've got 20 seconds and we'll be over it. 10 seconds. 5 seconds.

12:50 PM

LS: You're about 2 and a half to 3 miles downwind of the site, Peter.

PVH: OK, that was about the same on the penetration through the smoke, wasn't it?

LS: Affirm. Here we are over the plume now.

PVH: I can see the ground through the plume. It's not that thick at this distance downwind, it's sort of patchy. Looking down on it, it's sort of whitish, bluish looking. Let's do another penetration through the plume a little closer in, through the horizontal plume a little closer in. About 1 mile or so.

12:51 PM

PVH: Larry, let's do a penetration through the plume about 1 mile from the fire.

LS: Roger.

PVH: Through the horizontal plume

12:52 PM

LS: We're going to need about 3 and a half minutes to get set up on this one, Peter.

12:53 PM

JH: Peter, what kind of chemistry sample would you like to take next? Should we take another sample of the flaming phase or is that kind of dying down now?

PVH: It is dying down. Do you think you got a pretty good set on the flaming phase? If so, we'll take one of the horizontal plume.

JH: I think I do.

PVH: We're just turning around to come up to do a penetration so you can get one on this one. We'll be one mile downwind.
JH: We're still taking the humidigraph sample, so it will be a couple of minutes before we're ready.

LS: You're about 2 minutes from penetration.

DS: 1 minute, 23 seconds until the humidigraph is done.

PVH: I think we'll be OK then for this sample.

JH: Well, I have to change filters too, so that's a little too tight. Well, maybe not.

PVH: No, it's OK. Larry, hold off on that penetration for a minute or so. Give them a bit more time back here.

LS: I'll get a 360 in here. That'll take us 2 minutes.

12:55 PM

PVH: Larry, we haven't been above the plume at this distance downwind, have we?

LS: No, we have not.

PVH: So if we get a good chem sample on this penetration through the smoke, we'll go above the plume at the same distance downwind.

LS: I'll penetrate at this altitude, then we'll come back across above it.

PVH: Right.

12:56 PM

PVH: John, I think you'll find much more smoke on this penetration than you had in the column.

JH: Great.

PVH: Photograph number 15 on the Hobbs' camera showing the plume a couple of minutes prior to the first chem penetration.

LS: We'll have penetration in one minute.

PVH: ...just prior to the third chemical sample, which is the first sample in the horizontal plume, one mile downwind.

12:57 PM

LS: 35 to 40 seconds.

PVH: I think we'll hit some good smoke here.

LS: It's fairly thick right ahead of us. 30 seconds.
12:58 PM
LS: 15 seconds. Sample now.
PVH: Too early, John.
JH: Actually, that was just perfect.
PVH: The second one? OK, good enough.
JH: Good enough.
PVH: So we'll go across the top of the plume now. Same distance downwind.
LS: Give me about 3 minutes and I'll take you on top of the plume.
PVH: 500 feet above. After that, Irina, we'll come down and go below the plume for your measurements.
IS: OK, sounds good.
1:00 PM
LS: About another minute and we'll be crossing.
1:01 PM
LS: 30 seconds. 15 seconds to over the plume.
1:02 PM
LS: 5 more seconds. There you are, over the center of the horizontal. Peter, did you say you wanted to drop down under it this time?
1:03 PM
PVH: That was a pass over the top of the plume about a mile or so downwind above where we took our third chemical sample. Let's turn around, Larry, and go now below the plume at that same distance downwind.
LS: OK, give me about 3 and a half minutes and I'll have you below it. I'll mark you down.
1:04 PM
LS: There's 90 seconds until under the plume.
PVH: OK, Irina, this is for you, going under the plume at the same distance downwind that we went previously through the plume and above the plume.
IS: OK.
1:05 PM
PVH: Is the helicopter still in there, Larry?

LS: I don't see him from here but I'm not sure.

PVH: Better see if you can contact him since we're dropping down.

1:06 PM
LS: We'll be under the plume in about 90 seconds from now, Peter.

PVH: Roger Ottmar on the ground just told me that they're still lighting portions of the fuel but it's pretty much all burning now.

LS: 1 minute until under the plume.

1:07 PM
LS: There's 30 seconds.

PVH: Number 16 on Hobbs' camera showing the fire pretty much fully engaged, just prior to our penetration, not our penetration but our pass under the plume 1 mile downwind.

LS: There's 20 second to under the plume. We're under the plume now.

PVH: Number 17 on Hobbs' camera looking upwind at the column of smoke and the fanning out of the smoke as we pass under the plume at 1 mile downwind.

1:08 PM
PVH: I'd say it's still flaming combustion based on the appearance of the smoke. Very orange, reddish looking. How are you doing, John?

JH: We've got a couple of minutes left on the humidigraph.

PVH: OK, then we'll give you another penetration through that same distance downwind, a mile, mile and a half or so through the plume.

JH: OK.

LS: You want a penetration this time, same distance downwind.

PVH: Yes, but we need to back off for 3 or 4 minutes.

JH: Don, how is the humidigraph doing?

DS: 3 minutes, 18 seconds.

PVH: Are they cleaning the humidigraph out this time to make sure they burn everything off?

JH: I don't know anything about it.
PVH: Apparently, last time the reason we were getting those high readings at small sizes was because Dean hadn't told Art to burn off the old residue that deposits on the vessel prior to a new measurement.

1:10 PM

JH: Don, do you know if Art is going to burn off the humidigraph?

DS: I have no idea how it's done.

PVH: I think Art knows about that. I'll just check that he's doing that.

JR: I think he's talking about the DMPS.

DS: OK.

LS: Why don't you tell me when you want to go through, Peter.

DS: He's not on the headphones.

LS: OK, I'll just hang out around here.

1:12 PM

LS: Peter, when do you want to go through?

JH: John?

LS: Peter, from the cockpit, we can give you penetration here in about 90 seconds if you'd like.

PVH: I'm not sure if we're ready yet. Is Art ready on those humidigraphs?

DS: The DMPS is ready and the humidigraph will be done in about 1 second. It just finished.

PVH: We should be OK then.

JH: OK.

PVH: Rod, sorry, Don, ask Art if he's heating those off between samples.

DS: Will do.

LS: Penetration in one minute.

1:13 PM

PVH: This will be our second penetration for chem samples at a mile or so downwind.

DS: Yes, Peter, he is heating stuff off between samples.

LS: 30 seconds. 20 seconds. 10 seconds.
1:14 PM
LS: You can sample now.
PVH: I think they're missing the really heavy stuff there.
JH: I thought that was perfect.
PVH: Are you taking it on the second sound I hear or on the first one?
JH: It starts on the first one and ends on the second.
PVH: OK, you got it then.
JH: That one was just as heavily loaded as the previous sample. It's OK.
PVH: OK, we'll give you another 12 minutes there. In the meantime, Larry, let's come around and I want to go through the vertical column again and pick up some smoke there but without bumping us around too much in order that Ray can get some measurements this time. He missed his measurements there last time.
LS: OK, I'll take you through the vertical column at about this altitude. It doesn't look too bad. I'll take you right where it starts drifting off to the west there. I'll have you back through there in 95 to 100 seconds.
PVH: Very good.
1:15 PM
LS: Penetration in about 70 seconds.
1:16 PM
PVH: This may be a bit bumpier.
LS: 50 seconds.
1:17 PM
LS: 30 seconds. 20 seconds. 10 seconds.
PVH: Just downshear of the vertical column.
LS: Sample.
1:18 PM
PVH: That should have been a pretty good sample through the vertical column for Ray and for aerosol measurements. All right. Now, let's come around and go above the plume and do another lidar section that will take us through the vertical column and down the length of the plume.
LS: We want to go above it and down the length of the plume.
PVH: Correct.

LS: Give me about 2 and a half minutes and I'll have you right over it.

1:19 PM

IS: Peter, may I ask to fly along the long axis below and out over the plume?

PVH: We're going above along the long axis initially to get our lidar and then we'll come back below it.

IS: OK.

PVH: Photograph 18 on Hobbs' camera shows the nice...

LS: Give me a minute and a half to 2 minutes and I'll have you over the fire site above the plume.

PVH: ...nice vertical column with the horizontal portion coming off just prior to our second lidar survey above the plume and for lidar measurements above the plume and along its length.

1:20 PM

PVH: A pretty nice looking plume now, coming straight up and then going up horizontally.

DS: How high are above the plume are we going to be, Peter?

PVH: About 500 meters. Is that enough?

DS: You may want a bit more.

PVH: A bit more?

DS: Affirmative.

PVH: How much more?

DS: Try about 800.

PVH: Better make it 800, Larry.

LS: OK, I'm going to have to do a 360 to get into position. This thing is higher than I thought it was.

PVH: I see the helicopter below us on the right hand side.

LS: It's going to be 2 minutes and I'll have you over the plume.

PVH: What did you say the height of the plume was just about?

LS: Just about right at about 6, maybe 6,200.
1:21 PM

PVH: Don, we're going to go along the length of the plume.

LS: Peter, how high above do you want to be?

PVH: Better make it 8 or 900 feet.

LS: OK.

PVH: Will that be OK, Don?

DS: Yes.

PVH: Go right along the length of the plume this time and see if we can get a nice lidar cross section. Does the lidar seem to be working OK?

DS: Seems to be working. I haven't been watching it the whole time because I'm also working the humidigraph and the CCN.

PVH: You might watch it as we go along the length. In fact, I think I'll come back there and watch it as well.

1:22 PM

PVH: Go right along the length as long as you see some smoke below us, Larry, which will probably take us out near the coast. Then we'll come back under the plume along it's length so we'll be going upwind at that point.

LS: Give me one minute and we'll be over the plume.

1:23 PM

LS: 30 seconds to over the fire site. We should be over the burn site now, outbound. We're probably about 5 to 600 feet above it now. It's climbing as it goes west.

1:24 PM

JR: Please maintain an altitude over the plume.

1:25 PM

PVH: We're taking this run over the ocean. There's still smoke below us so hopefully we'll get some good lidar measurements through this, and then we'll come back down under and do a reciprocal under the smoke, back down it's axis with our lidar measurements and the Valero radiometer measurements.

1:29 PM

PVH: I can just see the ocean now beneath the smoke. I'm seeing some little ships or whitecaps. I think we still have some smoke below us, don't we, Larry?

1:30 PM
RS: We don't see any.

PVH: You think we've cleared it now? Maybe we've just about cleared it now. So let's drop down and come through a 180, come back under the smoke, down it's length. I'm trying to take us right down under the axis of the smoke.

1:31 PM

PVH: Number 19 on Hobbs' camera looking back to the smoke plume after our traverse out over the ocean above the smoke.

1:32 PM

PVH: Larry, did we come out right over the axis of the smoke?

LS: That's affirm.

PVH: We'll go back along the same track, but under.

LS: OK. I might have to give you a 360 degree turn right here to get down below it, Peter. That will put us under it in about 3 minutes.

1:33 PM

JH: Peter, how long do you think until the next chemistry sample?

PVH: Probably 10 or 15 minutes.

LS: Peter, you're going to pick up a little bit of smoke offshore here because it's really down lower but then I think once we cross the shoreline you'll be under the plume and the plume will be up higher.

1:35 PM

PVH: Larry, get as low as you can under the plume.

1:36 PM

PVH: Where do you think the base of the plume is?

LS: I would say it's probably about 3,500.

PVH: That's out here over the ocean? If you put us about 2,000?

LS: It's lower over the ocean but I think the plume itself is pretty non-descript right now.

PVH: The compromise is between putting us at least 800 feet above the ocean's surface and yet below as much of the smoke as we can get.

LS: I'm still about a mile offshore and it looks like the fire has died out quite a bit up ahead of us.
1:37 PM
LS: I'll do a 360 to get us set up so we can really get a good look at what we're doing.

PVH: I didn't expect that fire to last all that long. It was only 45 acres and it was going pretty good.

1:38 PM
PVH: It was perfect timing for our arrival on the site.
LS: We're inbound to the fire site now, Peter. We're about 1,000 feet over the beach coming up here and we should be below the smoke.

PVH: OK.

1:39 PM
PVH: Go in until we are about 3 miles from the fire, then do a 90 out of the plume. Then we'll come back into the plume at about 5 miles downwind.
LS: OK.

1:40 PM
RS: Peter, after we get to 3 miles, we'll do a 90 out and then come back in at 5 miles. Then what? Do you want us to cross through or under or something or do you want us to go along?

PVH: At about 5 or 6 miles downwind we'll take a look and see what the plume looks like there. We want to do 2 more chemistry samples through the width of the smoke itself.

RS: We'll come in in the smoke and we'll be crossing perpendicular to the plume at 5 miles. We'll go on up to 3 miles now.

1:41 PM
LS: Peter, there's 2 or 3 miles there, so we're going to turn out to the south here.

1:43 PM
PVH: This burn was western Hemlock logging slash. I'm going to come up and take a look at the plume before we decide what distance downwind to go through it.

JR: I'm going to turn the tape over now.

END OF TAPE SIDE ONE

LS: We're going to be penetrating in one minute.

1:46 PM
PVH: Ready John?
PVH: OK, ready to do a penetration of the plume about 6 miles downwind. First chemistry sample at this distance downwind.

1:47 PM

PVH: Is that our 5th sample overall, John? For chemistry?

JH: That's right. I would like to get 2 more of the smoke after this if possible. Otherwise, I want to take a background sample as well. That will take 20 minutes.

PVH: Will you need 2 samples at this distance downwind?

JH: I'd like to get 3 altogether.

PVH: At this distance downwind.

JH: That's right. The smoke is going to be a little more dilute so I'd like to get 3 if possible.

PVH: OK, we'll do 3 here and then we'll do a background sample and then we'll decide what to do.

1:48 PM

LS: You can sample now.

JH: Peter, I screwed up on that one. I didn't have the bag all the way empty. So if we could quickly come around and make another pass that would be good.

PVH: OK. Did you hear that Larry? We missed that one. We have to do a reciprocal and go through the same area.

JR: Yo, Larry or Rod.

1:49 PM

PVH: Larry, we missed that one. Would you do a reciprocal and go back through the smoke again?

LS: Will do.

PVH: That was pretty good smoke there, John.

JH: Yes, that was a pretty good spot.
PVH: Number 20 on Hobbs' camera shows the plume a few minutes prior to the penetration 6 miles downwind for chem samples.

1:50 PM
LS: 90 seconds to penetration.

1:51 PM
PVH: Go through that orange thick looking portion. It doesn't matter what the exact distance downwind is.
LS: 45 seconds. 35 seconds. 25 seconds.

1:52 PM
LS: 10 seconds. Sample.
JH: That was pretty good.
PVH: Larry, while he's sampling that, let's go back across that same region of the plume but 800 feet above it.

1:53 PM
PVH: We seem to be getting some nice images on the 2-D PMS in the smoke.

1:55 PM
PVH: It's a nice, bright, clear, sunny day. No clouds above. Should be good for radiation measurements.
LS: OK, about 75 seconds to overhead.
PVH: Is the plume wide enough here Larry that you could do a circle above it with smoke below you?
LS: About 1 minute.
PVH: Larry, is the plume wide enough at this point downwind that we could do a circle above it and still have smoke below us?
LS: I'll be able to tell you when we get over it.
PVH: That really looks as if it's dying out now, doesn't it?
LS: Yes, it does. I think out further towards the coast it broadens out so I can stay over it.

1:57 PM
PVH: OK.
LS: Peter, another 3 or 4 miles downwind I can stay above that smoke.
PVH: All right. Let's do that after. I want to come back to this distance downwind again shortly to get 2 more chemical samples. But we're not ready for that yet so we could do our banking turns a bit further downwind where the smoke plume is wider.

LS: How far above it do you want to be?

PVH: This altitude is fine.

LS: It's a little bit higher downwind so I'm going to sneak up another 4 or 500 feet.

PVH: So we'll do 3 banking turns, banked to the right.

1:58 PM

PVH: I'm a bit concerned that by the time we do our 2nd or 3rd chemical samples at this 6 mile distance downwind that the smoke will be quite a bit thinner. The fire seems to be past its best now.

LS: We'll start our circling in 30 seconds, Peter.

1:59 PM

PVH: We're just about to start 3 banking turns to the right above the smoke for CAR measurements. We'll be over land here. The smoke is sort of patchy.

LS: Give me another 30 seconds and I'll start your turns.

PVH: What's the approximate distance downwind of the fire?

LS: 10 miles.

2:00 PM

LS: Turn starting now.

PVH: We have beneath us, land and we're also coming out over the beach and over the surf beneath us for part of this turn. Smoke is sort of patchy but no problem seeing the land beneath us.

2:01 PM

PVH: Just coming up to the beach and the surf beneath us and out over the ocean.

2:02 PM

PVH: Hobbs photograph number 21 taken looking down the length of the plume, looking back to the fire as we fly above the smoke over the beach. We are now over the land again in this turn.
2:03 PM
PVH: Just coming up over the surf again below us, looking through the smoke. How much more flight time, Rod?

RS: An hour and a half.

PVH: Thank you.

2:04 PM
PVH: Larry, after we've finished these three turns, I want to drop down below the smoke and do 3 banking turns to the left in the same area.

LS: OK.

2:05 PM
LS: There's a completion of your 3 turns. We're going down below it. In 2 and a half minutes we should be back in to our turning point.

2:06 PM
PVH: Let's make it 2 turns here. We're running out of smoke. Then we'll go back towards the fire. We want to get at least 1 more chemistry sample in some thickish smoke back there. It doesn't have to be exactly 6 miles downwind where we were before. The most important thing is that it's in thick smoke.

LS: OK, but you want to be in the smoke downwind about 6 miles.

PVH: Yes, after we've made these 2 banking turns here, which you can do pretty quickly.

LS: OK. Give me another 75 seconds and I'll start your turns.

PVH: I don't think we've got much more than half an hour or so for this smoke plume.

2:07 PM
LS: Peter, we're going to have to do a 360 to get below this. It's really kind of low over the beach.

2:08 PM
PVH: Are we going to be landing in Hoquium?

LS: I don't think so. If we stay on station 45 minutes we can still depart with sufficient reserves.

PVH: To go straight back to Paine Field.

LS: Affirm.
2:10 PM

LS: We'll start our circle in 30 seconds.

2:11 PM

PVH: I was talking on the other radio with the Forest Service man. Have we finished our banking turns now?

LS: No, we're just going to start them now. I want to get you what I think is going to be a bit clearer air. We're going to start in 10 seconds.

2:12 PM

PVH: Don?

LS: Here we go, Peter. We're starting the turns and I think we're going to be in the bottom of the smoke.

PVH: Do you read me Don?

IS: Yes he can.

PVH: Don, we're going to be doing these banking turns now so you need to watch the CAR.

IS: He's watching.

PVH: Good.

LS: Peter, the smoke is right down on the ground over here so I don't know if you're going to get a clear sample or not.

PVH: OK. Just do the best you can.

AR: It did afford the ability to wave at a few people on the ground though.

PVH: On the beach?

LS: All the way back to the fire, it looks like.

2:13 PM

AR: I consider my waving the public relations aspect of the flight.

PVH: Actually, Art, they were shaking their fists at you.

LS: I guess it's got to be 1,000 feet, doesn't it?

2:14 PM

PVH: So we're doing our banking turns to the left now below the smoke. Same sort of area, partially over the water and then over the land. Only 2 banking turns because we're running out of smoke here. We've got to get back and do our chemical
samples. Not completely below the smoke, which may be reaching close to the ground, but below most of it.

2:15 PM
LS: Peter, there's 2 turns. What is your next sequence?

PVH: We want to head back to the fire. I want to get 6 miles or so downwind and I want to go through the plume, through the width of the horizontal plume and get a nice chunk of smoke for another chemical sample. Distance downwind is not as important as getting a good chunk of smoke but if we can get close to where we were last time, about 6 miles, that would be good.

2:16 PM
PVH: It's looking pretty thin now.
LS: Peter, it's going to be pretty thin in here.
PVH: Then go a little closer up.
LS: OK.

2:17 PM
LS: I'll take you through at about 4 miles downwind and it'll be about another minute.

PVH: Are you ready, John?
JH: Ready.

2:18 PM
LS: 40 seconds. 20 seconds.

2:19 PM
LS: 10 seconds. OK, sample.
JH: That was extremely weak. I was a little quick on the trigger but I don't think I could have gotten too much more on that.

PVH: Do you want to dump it and go closer in?
JH: I think that would be a good idea.
PVH: Hear that, Larry?
LS: I'll take you up a couple of miles. About another 2 and a half to 3 minutes we'll be in an area that's a little bit thicker.
2:20 PM

JH: That last sample, the CO₂ in the bag was only about 3 parts per million higher than the background, compared to 100 on our good smoke samples.

PVH: This fire is very short-lived. It's dying rapidly.

LS: I don't know that this next sample is going to be any better. It looks like it's almost burnt out here.

PVH: What we could do instead, if this is not a good one, John, is go way downwind and see if we can get some sample in some very old smoke over the ocean.

JH: That might be useful for getting the DMPS sample and the humidigraph and maybe a mass filter.

LS: In 40 seconds we'll be back through it.

2:21 PM

LS: This will be 3 miles downwind.

2:22 PM

LS: 20 seconds and it's not going to be much. You can start sampling. Sample now, I guess.

JR: The previous one was huge compared to this one.

JH: I missed the second peak here.

PVH: Let's go down low over the fire itself. I think we'll get something there. Dump that one, John. There's still a bit of a plume coming out right over the fire.

2:23 PM

PVH: John, as we head out over the ocean you could be doing your background samples.

JH: It'll take me about 20 minutes of sampling to get those.

PVH: Either on the way out or the way back you could do that so we get 2 things done. The trouble is when we get way out over the ocean, I don't know what I'm going to be looking at here to pick up anything. I guess just the CN may show something.

2:24 PM

RS: Peter, it looks like 15 to 20 minutes. Probably 20 minutes and we'll head to Paine, or you can stay longer and land at Ocean Shores. Figure that into your decision making. Excuse me, stay longer and land at Hoquium.

PVH: I'm doing that already. Photograph 22 on Hobbs' camera shows the fire in its dying stages as we try to get our last...
LS: 3 minutes I'll have you through the fire as low as I can take you.

PVH: OK, good.

2:25 PM

JR: How about if we go to Olympia instead?

PVH: There's probably more smoke downwind now over the ocean somewhere than there is here.

2:26 PM

LS: 60 seconds. 30 seconds.

2:27 PM

PVH: That last shot on Hobbs' camera was showing the fire in its dying stages as we come up to it for the last chem sample right over the fire.

LS: 10 seconds. 5 seconds. Sample. Peter, I might be able to get you down another 100 feet on that.

PVH: I think that was probably OK, wasn't it, John?

JH: That wasn't too bad, actually.

PVH: We'll take that one. Let's head out now, Larry, over the ocean. You can keep in clear air. No, let's head down along the axis of the plume over the ocean.

LS: If you want another one, let me know.

PVH: Sorry, Larry, I was on the wrong switch there. Let's head down the axis of the plume out over the ocean.

LS: OK, I'll come right over the fire and right down the axis.

PVH: No, you don't need to come over the fire again. We got a good sample there. Let's just head out down the axis out of the ocean.

LS: OK. I'll turn back over it and put us just downwind of the fire.

PVH: What I'm looking for now is to get out over the ocean and get into some old smoke out there and we'll do one last sample in some old smoke if we can find it out there.

LS: OK.

2:29 PM

LS: Peter, we're about 5 miles from the coastline. We're directly in the plume. What do you want when we get there?

PVH: I want to go out over the ocean and see if we can still see some smoke and do one last sample in the smoke down there.
2:31 PM
PVH: Are we in the plume as far as you can tell now?
LS: Yes, we're basically under it. It's up and down here. We're going to be in it here in about another half a mile.
PVH: It may get thicker as we go further out.

2:31 PM
PVH: Try to keep us in it as we go out and then I'll pick a point where we'll do a cross section.

2:32 PM
PVH: You're probably going to have to climb to get up into it, aren't you?
LS: OK, we'll go on up another 500.
PVH: We may hit some thicker smoke out there that came off the fire earlier.

2:34 PM
LS: We're coming up into the thickest that I see out here right now, Peter. Any time here in the next 10 seconds you're going to see the best you'll see.
PVH: It's pretty thick out here. Better than we had closer in.

2:36 PM
JR: I think the majority of it is still above us.
PVH: Yes, go up through it, Larry, and see if we get higher.
LS: We're going up another 5 for you. I got a nice little spot out here another 30 seconds out here. I'll swing a left into it. OK, Peter. Here in the next minute I'll have you in what looks like the best out here over the water.
PVH: That looks pretty good.

2:37 PM
LS: You can start sampling any time here now.
PVH: Larry, we want to come back into that thicker smoke you put us into that looked pretty good in about 4 minutes.
LS: OK.
PVH: About how far are we downwind?
2:38 PM
RS: We're about 20 miles.
LS: Peter, I'm going to have you back in that same smoke in about 3 minutes.
PVH: OK. Check with me before we go in it. Can you be ready in 3 minutes, John?
JH: Yes sir.
PVH: OK, put us back into it in a few minutes, Larry.
LS: Right.

2:39 PM
PVH: This smoke out here is probably the oldest initial smoke that came from the fire.
AR: I think the leading edge is still quite a ways out there. I don't know how important that is.

2:40 PM
LS: One and a half minutes and we'll be back to where we started.
PVH: According to the winds, Art, we've only got a 5 knot wind. The fires have only been going for about 3 hours so it couldn't be much farther out.
AR: I'm going on a visual thing here, Peter. Our winds are probably a little bit on the light side for that main stream going out there.
LS: I'm going to take you up another 300 feet.
JR: That's in meters per second, Peter, so that's about 10 knots.
LS: One minute and we should be back in the thicker part.
JH: It's good for me, Peter.

2:41 PM
LS: Peter, you can start sampling here in about 20 or 30 seconds and it should last for about a minute.
JH: Peter?
PVH: Yes?
JH: How high did the CN go last time you went through this?
PVH: 180,000 I think. Something like that.
JH: OK, I'll try to hold off until it gets pretty high then.
LS: I think we're probably in the thick of it now.

2:42 PM

JH: I caught the first peak. That was still a pretty diffuse sample. Good for doing DMPS and a mass filter though.

PVH: Do what you can with it.

JH: Roger.

PVH: If we land in Hoquium, how much more flying time do we have, Rod?

RS: We'll have an hour. If we don't, we head back right now.

2:43 PM

JR: How long do we have if we land in Olympia?

PVH: Larry, let's go down the plume further out. I think we'll still see some smoke 30 miles or so out. We'll try a sample there and then we'll start heading back.

LS: We'll do as you say. We'll probably have to stop at Hoquium.

2:44 PM

JR: I still haven't gotten a response about Olympia.

2:45 PM

PVH: What do you want to know about Olympia, Jack?

JR: How long can we stay out here if we just land at Olympia?

RS: These guys are putting on a longer hose, or they put one on for us, they haven't got it back off yet, after I told them we're not going to land there. So we've got good fueling and we'll be taking off light and I'd just as soon use Hoquium.

JR: OK, as long as we can get the plane up to the pump.

RS: About 3 hours ago they got a longer hose on there just to accommodate us so we're in good shape.

PVH: The oldest smoke of all should be out about 30 miles from the fire. Let's see if we find anything out there.

LS: OK.

2:46 PM

LS: Peter, it looks like offshore the smoke starts going up to the north here, unless there's another fire up there.

PVH: How far are we off from the fire now?
LS: We're about 28 miles from the fire.

PVH: OK, let's see if we can get back into some smoke here.

LS: OK.

2:50 PM

LS: I've got a little layer over here to the right. I'm going to drop down a little bit.

2:51 PM

LS: We've got a little bit of old smoke right ahead of us here. give me about 30 seconds and I'll have you in it.

2:52 PM

PVH: I guess we went through it then.

LS: I've got some more a couple of miles ahead.

JH: Peter, there's 3 minutes left on the humidigraph sample.

PVH: We went through some old smoke there and the CN went up to about 12,000 or something like that. Will that be enough for you to do anything on?

JH: That'd be enough to do a mass and a DMPS sample and a humidigraph.

2:53 PM

PVH: How much more flight time do we have, Rod, if we're landing in Hoquium?

RS: 45 minutes to an hour. Probably closer to an hour.

PVH: OK. After we've got this sample out here, and we still need a couple of minutes before we get that, all we've got to do on the way back is go back over the land as you head into Hoquium, put us at about the same altitude as the smoke plume was, but out of the smoke so we can get a background sample as we come into Hoquium.

RS: OK.

LS: You're going to be able to start sampling here in the next 15 seconds, Peter.

PVH: All right, let's just go through it and then we'll come back through it if it looks good. Looks better than the other. It's going up to 33,000 here, 40,000.

2:54 PM

PVH: This is pretty thick here.
2:55 PM

JH: Peter, if you can keep track of where this thick spot is so I can sample it on the way back that would be really good.

PVH: Do you hear that Larry? This is pretty good so we're going to want to come back through this in a couple of minutes.

LS: OK.

PVH: We're still in it here. CN going up over 200,000.

2:56 PM

JH: I'm ready to sample again, Peter.

PVH: You could start now because we've still got high CN counts.

JH: I'll have to empty the bag so I can start in about 10 seconds.

PVH: Good counts here. Just try to stay in this stuff, Larry.

LS: I'm just coming out the east side of it, Peter. I'm going to have to do an 80/260 and put you back in it in about 3 minutes.

PVH: Don't go through your own plume.

LS: OK.

2:57 PM

PVH: They're falling off now, John.

JH: I dumped that bag there.

PVH: You dumped it?

JH: Yes, I just started taking it when we left the plume.

PVH: All right. Let's go right back into the smoke down that track, Larry, back into the smoke.

2:58 AM

PVH: Nearly all the samples we've got in the previous flights have been of fairly new smoke, so this is the only smoke we will have gotten into.

LS: About another minute and you'll be able to start sampling, I think.

2:59 AM

PVH: John, it looks pretty good.

JH: We're not up to 30,000 yet.
PVH: Art estimates winds speeds at the surface between 15 and 20 knots here.

3:00 PM

LS: In about 1 minute you should be in the thickest part.

JH: That was a pretty good sample.

PVH: Not bad. It's still going up but that was OK.

LS: You should be just coming into the thicker part now, Peter.

PVH: If that's enough to work with, John, I'd go into that.

JH: I think it's good.

PVH: OK, Larry. Let's head straight back to the fire, stay in the smoke if you can but you don't have to weave around too much.

LS: OK.

3:01 PM

PVH: So we got a pretty good sample of old smoke there out over the ocean, depending on what the wind speed is, it should be maybe 2 or 3 hours old.

3:02 PM

PVH: We're now going to head back towards the fire, staying in the smoke if we can but since we're running out of flight time we're not going to be weaving around too much. We'll get some measurements of aerosol as we go back.

LS: Another minute and I'm going to hit as much of the plume as I can and then I'll turn directly to the fire.

PVH: Very good.

3:03 PM

PVH: Now we're going to head back down to the fire to get some aerosol measurements on the way back. Then we'll do our background samples from the chemistry and head back in plume.

3:04 PM


3:05 PM

PVH: So Larry, we'll head right up to the head of the fire, then find some clean air free of the smoke at about the same altitude as the smoke plume was when we sampled it earlier and we need to stay in that sort of clean air for about 10 minutes to get background sample. Then you can head in for Hoquiam.
LS: OK but you want to go present position direct to the fire now in the smoke plume?
PVH: Correct.

3:07 PM

IS: Peter, may I ask to level plane when we will measure background position.
PVH: He's trying to stay in the smoke plume, though, which changes altitude.
IS: I mean after that, when I will take samples in background conditions.
PVH: Yes.
IS: Thanks.
LS: I'm going to have you in some light smoke all the way to the fire from this position, Peter.
PVH: That's fine.

3:08 PM

JR: I'm pretty impressed with the aethelometer, Ray. It seems to work just great.

3:13 PM

LS: Peter, we're about a mile and a half from the fire site now. We're still getting a little bit.
PVH: John?
JH: I'll be ready to take my background in about 5 seconds.
PVH: OK. He's climbing up to about 2,500, which will be a more typical altitude and then he'll stay there for about 12 minutes.
JH: Very good.
PVH: Once we reach that altitude, Larry, let's stay at steady altitude.

3:15 PM

LS: I'll level right here at 2,000.
PVH: Keep it steady there. You can go, John. Avoid your plume during this next 12 minutes, Larry.

3:16 PM

PVH: Larry, avoid the aircraft plume during the next 12 minutes.
LS: Roger.
PVH: We did a nice pass right up through the length of the smoke plume from out over the ocean, 30 miles or so out. Smoke of course was quite thin at this stage, but at least we came right up through it. Out through the other side of the fire, which is now just smoldering and now we're doing our background sample for John at a constant altitude. Ray, why don't you record what you've done on this flight now.

3:17 PM

PVH: To summarize this flight, it was pretty good. We had a fairly nice plume, fairly vigorous to start with, although it was relatively short-lived. We did some good sampling of the vertical column, although John tells me there may be something wrong with his chemical measurements, don't know what it was, in the vertical column. Then we did sampling of the horizontal plume for chem measurements at 1 and a half miles downwind and 6 miles downwind. We did some cross-sections above and below the plume for the Valero radiometers. We did some banking turns above and below the plume for the CAR just out over the coastline. We went out to sample old smoke at 20 or 30 miles out over the ocean then we came down the length of the plume, pretty thin by now, emerged out the other side and did some background samples. So it should be a pretty good data set. As far as I know all the instruments were working OK.

3:19 PM

RW: This is Ray Weiss, running the optical extinction cell and the aethelometer and the A³. Everything worked pretty well, other than the serial cable which was ripped out on the OAC at the beginning of the flight, and lost a few of the first column passes but we may have been up a little bit later. Other than that it was pretty good. That's about it.

3:21 PM

PVH: Just hold it in this region until I let you know, Larry.

DS: Time 15:20, remove dilution filters from CCN for background sampling.

3:22 PM

DS: On this flight the CCN was used with dilution. The count looked quite good. Didn't seem to have as much trouble with the supersats this time. I'm still going to take a look at that. Lidar was up and functioning. It has the old mirror back in it. CAR unit has been running the entire time. The humidigraph has taken samples with every chem bag.

AR: We have a situation of easterly to east-northeast flow, 15 to 25 knots at our flight levels and at smoke levels taking the smoke off a nicely defined plume. Being a lofted plume at the beginning and then with heating we had some mixing which took some puffs down to the surface along the beach which we subsequently sampled at low levels. As far as DMPS measurements go, they were occasionally very good and occasionally unusual looking. The heating of the tube for a couple of minutes before the hot sample did improve the general appearance of the DMPS curves. However, there were still some indications of an artifact, artifacts occurring in some of the smaller size channels when going into the hot mode or
from the hot to the cold mode right away if the cold mode was affected by some artifacts in the small sizing channels. I guess that about wraps it up.

3:24 PM

DS: Peter, do you want to keep the lidar and CAR running or do you want those shut down?

PVH: They can be shut down now.

DS: Thank you.

3:25 PM

JH: Peter, I've got that other...

3:30 PM

PVH: Irina?

3:31 PM

AR: She's not on the headset, Peter.

PVH: Tell her if she likes she can record her impressions of the flight, what she did.

JH: Peter, I'm sampling off that last background now.

PVH: Can we start heading back?

JH: I've taken all the samples I need. It will take 10 minutes to process that one.

PVH: So as long as we don't land within 10 minutes, that's OK?

JH: That's right. I'd prefer 15 but 10 would be OK.

PVH: OK, Larry, let's start heading back. As long as we don't land in less than 15 minutes, we'll be OK.

LS: OK. We'll plan on landing in about 40 seconds.

PVH: OK.

RS: John? Are you going to be using the aircraft vacuum pump for this last little bit you're doing?

JH: I'm going to be using it up until the very last minute, so I'd appreciate it if...I'm going to need it for the next 10 minutes.

RS: No problem.

3:33 PM

PVH: Irina?
3:34 PM

PVH: Tell us when you're ready, John.

JH: Don, is the humidigraph done yet?

DS: It just finished.

JH: OK. You can switch off the aircraft vacuum now, Rod and we're done.

RS: OK.

PVH: You're all done, John?

JH: Done.

PVH: OK, we can land, Larry. John, just record quickly what you did on the flight.

JH: This is John Herring flight chemist. On this flight we took 7 smoke samples and 2 background samples. We did a much better job of getting good values for all the gas-phase species because this time we were not getting any leaks from the bag or from any plumbing that I could tell, so that was good.

3:41 PM

JH: Don, did anyone secure the cans in the back because I sure didn't.

DS: Negative. How much time do we have?

JH: Hey Rod, can we secure some cans in the back before we land?

3:42 PM

JH: Rod?

RS: What?

JH: Do we have time to secure some cans in the back before we land?

RS: Sure. How much time do you need?

JH: 2 minutes.

RS: That's fine.

DS: The cargo is now secured if everybody is sitting down.

JR: Did you turn the ozone off, John, or did it just run out? The ethylene?

JH: The ethylene has probably run out. We were getting pretty low at the beginning of that flight.

JR: It's down to zero now.
3:43 PM

PVH:  John, we may have another flight tomorrow so you'd better check all of your supplies.

JH:  Roger.
SUMMARY

Flight 1661a  
October 3, 1994  
Engines On: 1626 PDT  Engines Off: 1716 PDT  
Departure Airport: Hoquium, WA  
Arrival Airport: Paine Field, WA

Transit flight; no data collected.
Flight 1662
October 4, 1994
Engines On: 0930 PDT  Engines Off: 1111 PDT
Departure Airport: Paine Field, WA
Arrival Airport: Tillamook, OR

Ferry to Tillamook. Background aerosol measurements taken at burn site. Planned prescribed burn was canceled due to strong easterly winds. Waited for weather to change, but subsequently all prescribed burns were canceled for that day.

Summary: Ferry flight.

Arthur Rangno
University of Washington
October 5, 1994
GPS track of flight 1662, 10/04/94 09:50:00 - 11:05:00
AR*: The foreword camcorder is loose, it's bobbing up and down there.

JR: I can't get to it at this point.

KM: Is everybody ready in the back?

DS: Ready in the back.

9:49 AM

AR: We just exited Paine Field. We're over the sound. No white caps. Plumes out to the northeast show no wind until about 200 feet off the ground and then a strong shear to the southwest.

9:52 AM

AR: We're about 20 minutes from Tillamook at this time. Off to the right are the Satsop nuclear power plant stacks.

10:17 AM

AR: Thin cirrus is off to the west through north. It's a thin band as well up to 35,000. Very high cirrus...plagued by haze, unfortunately. This region is quite urban and possibly smoke (too faint)...well mixed plume still has a westward drift to southwesterly and drift down to the ground. Looking at some smoke plumes down there. Today in the Tillamook fire we'll do something different from sampling the plume and that is to treat it like a cumulus cloud and I'll be pointing Ken to these quasi-spherical blobs that we've referred to as tufts of cumulus clouds. The purpose of this is to evaluate the way that dry air gets into a dry plume, compared to dry air in a moist plume and evaporation happens. So this will be a no evaporation case. We'll look at the turbulent structure and it would appear to be, similar substructures in the smoke plume when compared to a cumulus cloud plume.

10:31 AM

JH: So we're getting pretty close.

AR: We're still testing. Testing 1,2,3. Can you hear me.

JR: Roger, Art. I hear you loud and clear.

DS: Likewise.

10:32 AM

RS: That works. The other one I like a little better but that works.

AR: Thanks. I'm going with Jack here. The jack won't go in, the one marked "headset". What is our ETA to Tillamook?

KM: I would say about 10 minutes.

JR: What did I hear about Hillsborough?

10:33 AM

AR: Say again?

JR: Wasn't there talk of Hillsborough earlier?

AR: I think the fire spot may have been called Hilldale or something like that. Is that correct John?

JH: Don't know.

DS: Is this a background sample, John?

JH: Supposedly it's an instrument test, but if you want to do some sampling, that's fine.

DS: OK. I'll take a background with the CCN.

10:34 AM

DS: How's the CCN look on the printer, Jack?

10:35 AM

JR: The computer stopped.

10:36 AM

JH: Art, should I start taking my background now?

AR: At 6,500 feet he's going to over fly the site first to locate it exactly and see whether it's on top of a ridge or down in the valley and then we'll descend to about 4,500 for the background. I'm estimating looking at the haze and so forth but that's about the level we'll see the plume stratify out at. Does that sound good?

JH: That's good, just let me know.

10:41 AM

AR: Ken, we're just west of the site. Let's descend to 5,000 MSL, flight level 5,000 and we'll begin making our background measurements. Do you copy that, John?

JH: Roger.
AR: Descending from 6,500 to 5,000. It's a pretty high site and according to the Forest Service man, they are waiting to get confirmation on whether there will be a burn today and he will advise us when he gets it.

10:44 AM

DS: Well, it's a wonderful day for a flight if nothing else.

JR: We can stick around here in Tillamook until tomorrow and find out.

DS: I wish you hadn't said that, Jack.

10:45 AM

JH: Don, I'm going to start taking background samples here, so go ahead and start up the humidigraph after I fill up the bag.

DS: Will do.

10:48 AM

AR: John, we're at 5,000 now and circling at this level, although it seems a little close to the site, you can see the site is pretty high. We may see some overshooting above 5,000 I think but I think it will be ultimately settling in at 5,000.

JH: I think this is good. Rod, could you turn the aircraft vacuum on please?

RS: OK.

AR: Ken, they request that we do something like a figure 8 over the area, the reason being that we've run into our wake.

10:53 AM

AR: Ken and everyone. We've just gotten word that they're going to delay the burn until 3:00 pm. Therefore, we'll be landing at Tillamook and standing by for the final word.

DS: John, as soon as the humidigraph is done I'm going to go ahead and shut it down so we don't waste any more air.

10:57 AM

AR: I'll check in the back. John, are you ready to land?

DS: Standby one, he's not at his headphone.

10:58 AM

AR: John, are you ready to land?

JH: Yes, Art, I'm ready to land.

AR: This was a lot easier than I thought.
DS: What's our ETA to landing, about 5 minutes?
AR: We should land within 10 minutes.
DS: I'm going to go ahead and go back and shut down a few things.

10:59 AM

RS: Are you done with the vacuum, John?
JH: Go ahead and shut it off, Rod.

11:04 AM

DS: We're all tied down in the back here behind the baghouse.
RS: Very good, thank you.
KM: It might be a little bumpy down here so strap in well.

11:05 AM

RS: Is everybody ready in the back?
DS: Ready in the back.
While approaching Seattle, a thin column of smoke was spotted in the Olympic Mountains, Washington. We detoured to investigate this fire (the Mt. Anderson wildfire at 47°44'/123°20'). There were two main columns of white smoke from this fire, both substantially tilted, although the winds were less than 20 knots. Due to the variable winds at the level where the smoke topped out, smoke was widely dispersed and showed no particular pattern but was instead quite widespread to the north of the fire. The top of the highest smoke column was about 2,000 feet above the mountain and was confined to a stratiform (widespread) layer downwind not more than ~500 feet.

Two "Lagrangian-style" passes (separated by ~10 mins) were made near the top of a particular smoke puff, with bag samples (for chemical measurements) taken on the second pass. Obtained aerosol, trace gas, humidigraph, DMPS and CCN measurements on both passes.

Summary: Data will add to composite picture of NW fires.
GPS track of flight 1663, 10/04/94 15:41:00 - 17:07:00
VOICE TRANSCRIPTION

Flight 1663
October 4, 1994

3:40 PM

RS*: Are you listening, Art?

AR: Roger.

RS: We are 6 miles from the burn site. Is there anything in particular you want to look at?

AR: No, we'll just continue our heading to Paine Field. Is that better?

RS: Especially when you speak up.

AR: Do you spot any tidal wave damage on the coast over there?

3:48 PM

RS: Did you want to look at all at the Olympic fires or anything?

AR: Let's continue our heading to Paine Field and on the way if we see a plume out there we'll go look at it but if it's too hard to see, I don't think we should mess with it. I'm going to step back now and talk to Bob.

JR: Do we still have his radio?

RS: We'll get it back to him in Seattle sometime.

AR: John's going to like to take a bag sample on this stuff. That higher plume maybe 10 degrees left. You still can't hear me?

4:20 PM

RS: Art, you're looking for the bump there in the middle or just through the horizontal plume someplace?

AR: The bump there in the middle, unless we hear different from John because that will take you through that stratiform stuff in the back too.

JH: How long until we get to that plume, Art?

AR: 5 minutes.

4:21 PM

JH: I'm going to take a background sample here. How does that sound?

AR: Roger, a background sample.

DS: John, are you ready for a humidigraph sample?

JH: Yes, start it up, Don.

4:23 PM

AR: Here's further information on our plan. John would like to go through the smoke once and then make a reciprocal back through it. We'll take the bag sample on the way back through it the second time and then head back to Paine Field.

DS: Art, do you want the lidar and anything else running back here?

AR: We won't be above the plume. I think we're just going to get a smoke sample here so the lidar isn't really going to show you too much because it won't give you enough dead space to get a profile.

DS: What about the CAR?

AR: I honestly don't know. I don't want to make a decision that...hang on just a minute, standby. John says no, Don.

4:24 PM

AR: Rod, are we going to go through the middle of the stratiform there? That would be nice. The top of the bubble, the stem of the plume, and then into the stratiform behind it. That will give a wider plume.

RS: When we clear this ridge right here, we're going to dip down a few hundred feet and that should be right in the middle of it.

4:26 PM

AR: I want to go through the stratiform part, that brown line dean ahead and the stem coming up to that level. The winds were supposed to drop off quite a bit. At least this morning the winds were only about 15 knots at 5,000 feet. Rod, how about 2 degrees right. It's just a bit thicker off to the right side of that because of the lean of the rising columns.

4:28 PM

AR: You can see there's not too much wind here compared to Oregon. We can go right through the middle of that bulge just about dead ahead.

4:29 PM

AR: We're about 30 seconds to plume. There'll be a little bump.

4:30 PM

AR: Give me 2 more degrees right. 5 seconds. Let's continue this heading for 3 more minutes and then do a reciprocal.
4:31 PM
JH: Art, we pegged the CN on that. This smoke is actually fairly thick near the source.
AR: I tried to get the thickest blob I could find.
JH: You did a great job.
AR: We’re going to do a reciprocal in about 2 minutes. How does that stand? Is that time enough for you?
JH: Let me check with Don. Don, how’s the humidigraph doing? How much time left?
DS: 3 minutes and 6 seconds.
JH: That’s our constraint, Art.
AR: Then our present set up will be just about right for that blob. There’s a difference in turbulence over these mountains.

4:32 PM
DS: Dilution filter is on the CCN. Time is 16:32:33.
AR: There are 2 other small fires somewhere. Darned if I can see where they’re at though. We’re turning now for the reciprocal course.

4:34 PM
DS: Humidigraph is finished.

4:36 PM
JH: Art, when we get close if you could give me a signal as to when to open up the bag sampler, that would be great.

4:37 PM
AR: Rod, we’re going to need to be about 2 degrees or so right.

4:38 PM
AR: John, you’ll see the counts pick up before we really get back near that spot we hit before so you may wonder why I’m not saying anything even though you see the counts go up there for a while.
JH: I’ll go on your call, Art.
AR: Is that the same flight level, Rod?

4:39 PM
AR: Another degree or two to the right.
4:40 PM

AR: We're going to be coming into some smoke here in just a few seconds. Then they'll continue and then there should be a peak toward the back side, John. I'll probably hold up here just a bit before I say go.

4:41 PM

AR: We're coming up on the puff, John. OK, go. That might have been even the same puff even later in it's life cycle, John.

JH: That was pretty good.

AR: You need about 10 minutes now?

JH: Yes, but we can do that on the way home.

AR: Still want to go back to Paine?

JH: I don't want to do anything else on this.

AR: Roger, did you catch that Rod? He says Paine Field.

4:42 PM

JH: Rod, could you turn the aircraft vacuum on, please? You guys can shut off the aircraft vacuum now. I'm done with that.

4:53 PM

DS: So, John, do you have any idea what this humidigraph is supposed to look like exactly when it's taking a sample.

JH: Nope.

DS: It just finished is why I was asking because it's drawing a graph which will vanish in a moment.

4:55 PM

KM: Finished with the vacuum?

JR: Yes, turn it off.

KM: Understand no, let me know when you're done.

JR: I said go ahead and turn it off.

KM: OK.

JR: I think there was that much oil on when we took off this morning, wasn't there?

DS: Pretty close to it.
5:01 PM

AR: What's up, Ken?

KM: They want us to land in the other direction, so we're just cutting out to the right to enter downwind and land to the left.

5:04 PM

RS: Is everybody ready in the back?

DS: Ready in the back.

JH: Ready in the back.

JR: We're all falling asleep in the back.