NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
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IN PARTNERSHIP WITH NOAA HERITAGE AND THE NATIONAL WEATHER SERVICE

AN INTERVIEW WITH DOUG WHITELEY
FOR THE
NOAA 50th ORAL HISTORY PROJECT

INTERVIEW CONDUCTED BY
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Molly Graham: This begins an oral history interview with Doug Whiteley for the NOAA 50th Oral History project. The interview is taking place on December 5, 2019, in Silver Spring, Maryland. And the interviewer is Molly Graham. Well, I like to start at the beginning. If you could just say when and where you born?

Doug Whiteley: I was born in Chestertown, Maryland, March 31, 1963, a small town on the Eastern Shore of Maryland. So I haven't moved too far from home.

MG: Well, tell me a little bit about how your family came to settle in that area.

DW: My grandparents were already there. I put in my paperwork that any immigration occurred back in the 1800s. I know it happened, but I don't really have a lot of details. My grandparents were all in the relative area. My parents both grew up within probably an hour of each other, met, and then I came along. [laughter]

MG: What do you know about your family history starting on your father's side?

DW: My father's side, my grandmother, I think she was like one of eleven. They were all farm/agriculture/watermen. My grandmother did odd jobs, worked at a hosiery factory on the shore there. My grandfather, the same thing, various jobs. As I remember him as a child, he was a painter, did house painting. My grandparents had separated when my father got out of high school, and my grandmother remarried another gentleman, and they moved off. He worked for a chemical company, so they did some traveling to Columbia and the Netherlands, where his job took him, and then eventually came back and settled back at the shore. What else is relevant there?

MG: Well, I was curious about him. What was your step-grandfather's name?

DW: That was Robert Allen Smith.

MG: Yes, I read his obituary, and he sounded like a really interesting person.

DW: Yes, he's an interesting character – "Tuckahoe Bob." He liked to write poetry. He published a small book of his works.

MG: He and your grandmother lived on a houseboat in the Netherlands.

DW: [laughter] They lived in a houseboat in the Netherlands. When they came back here, they bought another houseboat, and they lived on that for a little while. Then finally settled in a house down on the shore.

MG: I saw that the name of his houseboat in the Netherlands was *Rumtiki*. That sounds like a cocktail.

DW: I believe it was. I do not remember the story behind that one. I was still pretty young at the time. The one that they had once they came back was the *Afghan Queen*, like a blanket,

because my grandmother used to do a lot of knitting, and that was her thing. She would make afghans and give them out.

MG: As a kid, would you have sleepovers on the houseboat?

DW: No, not so much. I'd go down and visit with them. We'd take it out during the day, and go crabbing or fishing or whatever.

MG: How did your paternal grandfather's life unfold after they were divorced?

DW: I remember growing up, living in his house with my parents, and then, I think when I was about seven, we moved. My parents got their own house, and they thought, "Okay, now we got our house, and my grandfather will continue doing what he's doing." And the day of the move, my grandfather was out there, loading his furniture onto the truck first. They quickly realized that he was staying with the family unit. So he moved in with us, and that was a couple of years. He passed [away] of lung cancer, I think, around 1974. So it was a brief stint.

MG: Were you close with him, having grown up in the same house?

DW: Yes, because, like I said, he grew up in the household, so I was much closer to him than I was with my grandmother. I saw her at holidays and whenever she came into town, until they lived back in the area, but that wasn't until I was in high school. By that point, I was doing what any high schooler was – see grandma on the weekends or the holidays kind of thing.

MG: I read that she worked at a place called Kentmore. What was that?

DW: Kentmore, they had a small general store there. So when they came back, one of the first things they did was settled there. There was a store and then an apartment above it that they lived in. It was a general store [and] – I don't want to say deli, but a small restaurant, counter-type, the locals come in, get breakfast, lunch kind of thing.

MG: Did your father have siblings?

DW: No, an only child. So after they separated and he got out of high school, he went into the Air Force for a three-year stint.

MG: What do you know about his service? Was he stateside?

DW: He stayed local. His main place was – I should know this. It was out in Kokomo, Indiana. I think the base is still there, but it's under a new name now. He signed up under a program – apparently, the Air Force had a buddy program where if you had guys that you wanted to go in with and stay with, you could all sign up, and they promise – well, I think after basic training, they all went in different directions. But, it turned out good for him because he met quite a few good people – a friend that lived close [to] where I am in Frederick. It's pretty much a lifelong friend for him. They buddied up. So it turned out to be a good experience for him.

MG: Do you know what years those would've been?

DW: He graduated '57, so probably '57 to '60, '61.

MG: I'm curious about your mother's side of the family and her parents.

DW: So my grandmother and grandfather – I'm trying to think. I didn't really know my grandfather's side of the family all that well. He died when I was fairly young. Then my grandmother remarried, and I knew my step-grandfather, who was effectively my grandfather, the best. I spent a lot of time with them growing up. They had a farm. They were about an hour away from us. They did normal crops – corn, beans, and such. But, he also grew chickens for the poultry, the various poultry guys, whether it was Purdue or name any one of the other ones. He did them all through the years.

MG: Neat. And do you have other siblings?

DW: I'm an only [child].

MG: Okay. Well, tell me a little bit about some early childhood memories and what growing up was like for you.

DW: Like I said, the early years, living with my parents and my grandfather, small-town life. I can't even fathom the number of people that were in the town. Maybe a couple hundred at best where I grew up. It was right along the [Chesapeake] Bay, the upper part of the Bay. So we could go down to the beach during the day in the summer and hang out there, but just small-town life – a lot of relatives local, so visiting family and such. I said my grandfather lived with us. After he passed, that was probably when we started spending more time with my grandparents on the farm. We had more time to go down there on the weekends. So a lot of that growing up with them. My grandfather had German Shepherds that were his dog of choice. So, a lot of dogs. Not too many other animals because, like I said, he just had the chickens. So, growing up on the farm, helping out on the farm, just running around, doing whatever kids do on a farm.

MG: What was the name of the town you grew up in?

DW: Where I started out was a place called Betterton. It was right on the bay. Then we moved outside of Betterton, between Betterton and a little place called Still Pond, which is on the road in between. It was probably about a mile, mile and a half. After we moved out into the house outside of town, when I was old enough to ride a bike and be out on the road by myself, because there weren't any sidewalks, I'd ride back into town to see friends or go to the beach or do whatever until I was old enough to drive.

MG: What was the beach you would go to?

DW: It was called Betterton Beach. I don't know whether you're familiar with Maryland. The big thing now is you go down to the ocean to Ocean City. Everybody crosses the bay and then goes down the shore. But before that was even an option, the bay beaches were where everyone

would go to vacation and get away. They would have steamships that would either come from Philadelphia or Baltimore over to the various bay beaches, and Betterton was one of the main ones. They had a pier with arcades and dance halls and various forms of entertainment. That was back in the beginning of the century, maybe even late 1800s. As I was growing up, it was at the dying edge because everything was migrating to Ocean City. So I got to see the demise of that. The town had about a dozen hotels that would come in and host, and all the restaurants. It was a big source of employment for locals and such.

MG: So it's less of a tourist attraction.

DW: There's pretty much nothing left. I mean, there's the beach, but the piers, the boardwalks, most of the hotels had either burned down or had been burned down because they were no longer being used and were dilapidated. So it's shifted. Where some of the prime hotels were that had water views, it's now condos and weekend vacationers. The town's still pretty small. It's not very lively. It's out away from the main activity of the county. It's all pretty rural to start with. So it's a vacation destination.

MG: I'm curious about how your parents met each other.

DW: I believe it was through my mom's cousin because they were a county or two apart. Like I said, most of the grandparents and relatives were within probably twenty to fifty miles. I think my dad went to school with her cousin, and [had a] chance meeting, got introduced.

MG: What did your parents do for work?

DW: My father, after he got out of the Air Force, did a couple of small odd jobs, and then he got a job with what was at that time, the Chesapeake and Potomac Telephone Company. That's where he spent his entire career. I'm not sure if it was still C&P when he retired, but C&P eventually became Verizon after the Bell breakup, so it was all part of that. Then my mom did various secretarial, clerical type jobs as I grew up. I'm trying to think. Either junior or senior year of high school, she also got a job with Verizon. She was working in one of their service centers. Basically, you got a problem, and you call in; that's who you talk to. She did that for as long as she needed to, to retire. I'm trying to think. That was probably the late '90s, early 2000s. So she retired out of there. Then after that, she stayed gainfully unemployed as a homemaker. She took care of my grandmother, her mother, and also my godmother, who was an older spinster until both of them passed. My dad, after he retired, he thought he was going to do a lot of great home projects. After about six months, he did them all and then decided he needed something to do. So he went to work for the local college in their IT [information technology] department, which was Washington College. It's a small liberal arts school there.

MG: Neat. How did he get IT skills?

DW: Basically, with the phone company. He worked in – what did they call it? He was a central office tech [technician]. Basically, it was where all your calls go into. I remember as a kid, there were these big metal boxes; every phone number had one. And these mechanical things moved up and down to make the calls go through. Over the years, it all went from an

analog to digital, so it all downsized. So he got his background and in doing that, and he just carried that forward.

MG: Neat. On your survey, you wrote that you grew up in the Apollo era. What did that mean for you? What stands out?

DW: Well, as a kid in the '60s and early '70s, seeing the progression to the moon and beyond, that was what I grew up with. At the time, it was more publicized. It was more prevalent in daily life. I mean, rockets go up today, and nobody knows unless you're paying attention, which I do. But, it was on the news, special broadcasts. Things would stop. You'd see what's going on. They'd be telling you whether they're landing, or they've made it to orbit or whatever. It was just part of my growing up. I was one of those kids who hung onto that, and was like, "Wow, I'd like to do something like that when I grow up." We took a family trip to visit my uncle, who was in Jacksonville, Florida, at the time, and then we used him as a launching base and went down to Orlando and Kennedy Center at the time and got to see it firsthand. It was an exciting time. It's just something that stuck with me.

MG: Did you watch the moon landing on television?

DW: Yes.

MG: Do you remember it?

DW: Yes. It was pretty cool.

MG: You talked about a picture you took with your father and how you recreated forty years later. What was the initial moment?

DW: Like I said, we were down at Kennedy. We took the bus tour; they take you around, and we stopped at one of the Apollo pads. I don't know if it was Pad A or Pad B, but definitely one of the Apollo pads. It was just a picture of he and I, standing there in shorts in the middle of summer, and the pads behind us. I had it back in the photo archives. As I started working here, my mom, she kept good photo albums, and then, as time progressed, she started digitizing what she could. When an occasion would pop up, she'd pull pictures out. A few years ago – I think it was 2015 – I went down for a launch, and she happened to pull that picture out and sent it to me while I was down there. Then, more recently, I had the opportunity to go down [to] see the launch, and I had an opportunity to bring them with me. We went down, and it happened to be the same pad that they were using. SpaceX has repurposed it for their work. So then we got a forty years later picture of the two of us standing there.

MG: I'd like to see that picture.

DW: I've got it somewhere. I'll have to dig it out of my phone.

MG: Okay. Tell me a little about the schools you attended growing up.

DW: So, stayed local. The elementary school was just called Wharton Elementary. I think we only had a handful of elementary schools in the county. It was right next to our high school. I think the elementary school came first, and then the high school. But went there, and then went to Chestertown, which is probably about six miles away, to the middle school. Again, the county had a couple of those. Then back to the high school next to where the elementary school was. The county only had one high school for the whole entire county. At max, there were twelve-hundred kids going through there at one time. That's probably a high point. So a really small community.

MG: You said you really focused on math and science when you were in high school.

DW: Yes. At the time, it wasn't what I intended. It was just how it rolled out. But those are the ones that I seem to do better in and enjoy. I wasn't so much in the English and language arts type things.

MG: What were your plans when you graduated from high school?

DW: Basically, just go to college. I was looking for a college that had an aerospace degree. At the time, there were a few on the East Coast. There was probably about a half a dozen that I applied to. I ended up going to [the University of] Maryland in College Park, stayed relatively local.

MG: Tell me a little bit about the program there and the classes you were taking.

DW: It has expanded greatly since I went there. As a matter of fact, it was in the process of expanding when I went there. In the first semester, I got one semester in the engineering building, and then they shut it down and completely gutted it and rebuilt it. I got to see the first semester and maybe my last semester, too, of the engineering building itself. But, basic engineering, all the prerequisites in terms of math, physics, science. The one thing I can say is that, at that time, they were still using computers that use punch cards. [laughter] I still have a few old punch card programs that are tucked in a box somewhere.

MG: Can you say how those punch cards worked?

DW: Basically, it was about a third of the size of this sheet of paper, kind of cardboard-ish. You would type in what it is you're trying to do, and it would literally punch notches in the card for whatever the numbers and the algorithms that you were trying to get it to do. That translated into some machine language. You stacked them all up, and you put them in a card reader. It spit them all in there and read them out. Then, it would do the calculation for you and then spit it back. I can't remember whether we got a card or a printout at the time, but it was pretty nutty. Fortunately, we only had to do a basic type of programming. You might get a stack of cards – I think the biggest one I had was maybe an inch tall, but you would see comp. sci. [computer science] majors with the boxes that the cards came in, and they'd have three of those tucked under their arms going over to load the program. Yes, and you'd see some poor guy drop his box on the way over. Programming code is line by line, so each card was numbered. If you drop

them, it didn't re-sort them for you when you put it in there. You had to go through and then put them all back in order. Otherwise, your program wouldn't run,

MG: This is a silly question, but did it feel nutty at the time, or did it feel like this was advanced technology?

DW: [laughter] It didn't feel advanced because PCs were starting to come on the scene, but at that time, they were still pretty expensive. We toyed with getting one for school, but at the time, you could get a program calculator that was fairly powerful for the time. It'd take a little bit more time to punch stuff in, but you can do the same thing that the computer would do.

MG: What were you hoping to do with your aerospace engineering degree?

DW: So, like I said, I wanted to do something in the space field. Maryland did aeronautics and a little bit of astronautics. Aeronautics, dealing more with what happens within the air atmosphere and getting out of the atmosphere. Then astronautics, more of what's going on in space. At the time, I was more focused on the aeronautics, so in my track, I took things like propulsion, flight, rocket engines, jet engines, that kind of stuff with a desire to go to work for somebody like Pratt and Whitney, or one of the manufacturers that was dealing with planes and such. At the time, there was still a lot of government activity in terms of planes being built and new versioning fighters and stuff like that. It seemed like a cool thing to do. Little did I know, right down the street from the University of Maryland was Goddard Space Flight Center. I happened to be going through the halls, and I saw a thing posted on the wall – "Help wanted." I looked at it, and I'm like, "Oh, that's pretty close. I could go do that." So I called, and the guy's like, "Yeah, I think I put that up last semester, but we could still use somebody. Come on in." I went over and talked to him. That was my first intro into the satellite side of things. I ended up getting a job over there, working on the Landsat program, just as a data tech, somebody to work numbers, whatever they needed me to do at the time. That was my first intro in the whole scene.

MG: This was a NOAA [National Oceanic and Atmospheric Administration] program?

DW: Interestingly, at the time, I didn't know what NOAA was or what they did, but the Landsat program was under the Department of Commerce and NOAA. It does land imaging. I think it was just that they needed a place to stick it at the time. It's now under the U.S. Geological Survey; they run that program.

MG: Can you talk a little about the Landsat program? They were early satellites.

DW: I'm not real good on the history, but yes, Landsat 1 through 3, probably '70s into the early '80s, which I was not part of. I got over there about '87, so they were flying Landsat 4 and Landsat 5 at the time, and they were pretty much copies of each other. They were getting old for satellites at the time. They'd probably been flying for three or four or five years. They already had expendable components that were starting to get to end of life, and they were having to nurse them along. But, yes, I can remember, while I was there, Chernobyl happened, Mount St. Helens happened. Like I said, it was land imaging, but in terms of imaging you can do – I forgot what the term is, but taking a picture, your reds, greens, and blues, or you do the other spectral

imaging, and it comes out in false colors like pinks and greens and whatever. So they could see things – like with Chernobyl, you could see the heat of the fire and the heat of the water flowing in and out of the reactor and the cooling pool. Mount St. Helen's was probably one of the most interesting, both the difference between the cloud of gas and all the stuff that got spewed out of it. There were pinks and greens, and it made for quite a picture.

MG: What do you do with that information when you see these things on a picture?

DW: So, at the time, we were just the guys that made sure that the spacecraft was flying and that the imaging was coming back. We didn't really do much of the post-image capture processing, but you hand it off to geologists and other folks that have the expertise to dig in and find out what's really going on there.

MG: Chernobyl must have been really interesting to look at because it was discovered from particles that were first detected in Sweden. Then, folks at the Air Resources Laboratory did a retroactive tracking based on forecast models to discover the source of the radiation was around Chernobyl. So I'm curious about what you saw on your end. Could you point to the radioactive impact on the atmosphere?

DW: For that type of imaging, not really. It was more of just looking at the incident there and trying to figure out just how bad the situation was at that site because it was still pretty much Russia, and the conversation wasn't all that good back and forth. So it was like, what are they telling us, versus what can we see with the imaging that we have? It was interesting. Most of what went on stayed in the room. They actually allowed us to come and see it, which wasn't part of our normal day job. That was pretty cool.

MG: Did you go?

DW: Yes.

MG: You went to Chernobyl? I'm sorry.

DW: Oh, no. No, no. The guys that did some of the basic quality checks of the imaging were in the same building that we were. So they let us come in and see what they were seeing. It wasn't like when the satellite would fly over, and we'd actually get the picture on our screen to see what was going on. It was more – our part was just looking at satellite telemetry, which is just words and numbers on a screen to make sure that it's behaving okay.

MG: And this is when you're with the Landsat program?

DW: That was with the Landsat program, yes.

MG: I've been learning a lot about GOES [Geostationary Operational Environmental Satellites] and POES [Polar-orbiting Operational Environmental Satellite] satellites in these interviews. Can you talk about how the Landsat is different?

DW: Right. When I talked about the different – you think of the different spectrums of light and the different frequencies, they'll build the instruments that are tuned to pick up different frequencies based upon different things that they're looking for, whether it be on the ground, in the air, or whatever. That's my basic knowledge. The satellites that I've worked with – I've got guys that are a lot smarter than me that know all the specifics about if you're looking at this frequency, you're going to pick up this, you're going to pick up that. But that's generally how that works. You see infrared, and you can use them for heat [inaudible] or whatever. They do the same thing from above, looking for various types of things or microwave, or things on the higher end of the spectrum. It's all just extracting information out of the light spectrum to tell you different things that you want to know about either the atmosphere or what's going on, on the earth.

MG: How long were you with the Landsat program?

DW: I'm going to say from about '86 to '89. I did a couple of semesters as an intern, and then worked there for a year, a year and a half.

MG: After that, you worked for the University of Wisconsin?

DW: I worked for the university. How that worked out was a friend, who was working at Landsat, moved on. He got a job with them. Wisconsin had actually developed an instrument to go on the Hubble space telescope. They've got their Space Science and Engineering Center at Madison. They needed folks that were back at Goddard because that was where things were going to be flown, and also at the Space Telescope Science Institute, which is in Baltimore, where the actual Hubble instrument information was coming down, being processed. So they did the instrument stuff at Hopkins in Baltimore, and then they did the actual flight of the satellite from Goddard. So they were pretty close to each other, and they could talk, but they needed somebody back here to work that. He started with them. I went over to work with him. So we both worked that effort back here. Then we worked with the folks in Madison, who actually designed the instrument to implement that.

MG: Can you tell me about the folks in Wisconsin working on the Hubble instruments? Was Robert Bless one of them? [Editor's Note: Dr. Robert Bless was a professor in the Astronomy Department of the University of Wisconsin, Madison. Bless is also credited as the designer and principal investigator of the High-Speed Photometer, an instrument on the Hubble Space Telescope.]

DW: Bob Bless, yes. God, you're digging in. I probably should have gone and done my own homework. Bob Bless, Jeff Percival. I'm trying to remember who the (manager?) was. Evan? I can't remember Evan's [last] name. [Editor's Note: Mr. Whiteley is referring to Evan Richards, who was Project Manager for the Hubble Space Telescope High-Speed Photometer at the University of Wisconsin, Madison's Space Science and Engineering Center from 1977 to 1995.] Evan was a general manager. Jeff was a grad student, PhD. It's basically a lot of students really that were there were supporting that. Some were professors and staff there.

MG: Was Verner Suomi around then?

DW: I did not know the gentleman then, so I'm not sure. I did not realize he came out of there.

MG: Can you talk more about the Hubble Space Telescope and what's unique about it?

DW: Hubble was the first one to get outside the atmosphere and give us a window on the universe outside of the earth. Yes. It can speak for itself. I can't do it justice, but the fun thing about the instrument that we worked on, it was actually designed to fit in a shoebox. They had two types of instruments on the Hubble; it was the axial and the radial. The axials, they were about the size of phone booths, and they all stacked in next to each other. The light would shine down, and they'd all pick off what they needed to see there. Somehow, they got picked, and they had to upsize it, and it fit in there. Do you know the story of Hubble and the mirror issues?

MG: No.

DW: No? [laughter] When they contracted for the mirrors, Kodak and PerkinElmer were the two vendors. Both of them made mirrors to fit it, and then they chose one to go in there. I believe the PerkinElmer mirror went in, and there was an issue in the way that they did their measuring as they were polishing and grinding the mirror. It ended up that – I think they said it was a spherical aberration, but basically, it was like needing glasses; it couldn't focus. So after they launched it, they actually had ways to adjust the mirror in and out to get that focus. They ran it all the way out, all the way back a couple of times, and realized that it wasn't going to be able to focus. They started digging in and realized that there was a problem there. They came up with an idea to give it glasses, and they needed an instrument to come out to be able to put in the corrective fix. And ours was the one that came out that had the least amount of observation requests. So they tried to get as much done as they could. Then when they did the refurbish [inaudible], they pulled that instrument out and then put in the corrective optics. And it's been going ever since.

MG: When you say, "our instrument" –?

DW: The High-Speed Photometer. They pulled that instrument.

MG: That's what you were working on.

DW: Yes. That was the one that the University of Wisconsin built.

MG: It's hard to figure out how everyone's working together. Hubble was a NASA [National Aeronautics and Space Administration] program. Were you were employed by NOAA or the University of Wisconsin?

DW: Actually, I was employed by the university. Consider the university is like a contractor that was designing an instrument because I think it was (ESA [European Space Agency]?), JPL [Jet Propulsion Laboratory], and I believe Ball [Corporation] might have been in there. I'm trying to think of what else. You consider everybody was contracted to build their own instruments, and then NASA was the integrator and then the operator, along with the Space

Telescope Science Institute. That was more like an association of universities that came together to do the science for that type of stuff.

MG: What else stands out to you about those two years working on the Hubble and with the University of Wisconsin?

DW: The funny thing was, Wisconsin is big in weather, and I had no idea at the time, but I walked in the building, and they had the TVs with the weather loops on. I'm like, "Oh, that's interesting." So, early on, I kept crossing paths with NOAA and my future work, and just wasn't paying attention. [laughter]

MG: Did you live in Wisconsin for any of that time?

DW: No, no. So the guys from Wisconsin didn't want to have to relocate here to do the work. That's why they hired us. So we did most of the work here, and then we'd travel out there to do meetings with them, or they'd come back in for any particular testing that we needed to do.

MG: Did you go back to the Landsat program after this work?

DW: No, that's when I went to GOES. Was my timing mixed up?

MG: No, it's probably my notes that are mixed up.

DW: Most of my transitions between jobs have typically been knowing people and folks needing somebody and knowing what my capabilities were. So, at the time that my activities were winding down with Hubble, they were standing up the launch mission operations and support team, or they call it the MOST for the next series of GOES at that time. So I ended up transitioning over that. That was when I was working for Computer Sciences Corporation. That was that from about '91 to '98 there, with launch and operations of the early GOES.

MG: Was that with NOAA?

DW: [laughter] That was on a NASA contract in support of NOAA. Most of what we do – we do assisted acquisitions with NASA, in this case. We have the operations expertise and the requirements expertise. So we take that, we go to NASA, and we say, "Can you help us out here?" Then they'll help us with the acquisition. They'll bring more engineers into play and contract support. We work together on that front.

MG: Did you meet Tim Schmit when you were doing the work in Wisconsin or with GOES?

DW: I did not. You know what? I don't think I've met Tim to this day, but I've been on many a telecon with him.

MG: What did you know about GOES going into this position?

DW: Not a whole lot, really. At the time, satellite operations was what I did, and they needed people will do that. So I'm like, "Okay, let's go. What's it about?" At that time, we had a small team. We went in. We worked with the satellite manufacturer, who was Space Systems Loral, at the time. We built all the command databases, command procedures, operational procedures, everything that the operators down there would need to operate the satellite. Any of the contingency procedures – "Hey, if something goes wrong, check here, check there" kind of thing. Then we checked everything out. We launched it. We babysat it and helped them get comfortable with it, and then moved on to the next in the series. It was [GOES] I through M, so that's eight, nine, ten, eleven, twelve. Yes.

MG: Were you present for all of those launches?

DW: I was there for three of the launches. So I did eight, nine, ten. I can't remember what I wrote down. The first one I did the power and the comm. [communications] subsystem. Then, at some point, I moved over to the attitude, which is always the fun stuff when it comes to satellites.

MG: What do you mean?

DW: You're basically the guy making sure the thing's pointing in the right direction. If it's not pointing in the right direction, you need to figure out how to get it back to where it's going. So, power; it's either there or it's not, or you see it coming, see it going, because the attitude's moving around from the attitude side. You're looking at different sensors, different actuators. If one of them is not behaving, you need to figure out which one it is so you can take that out of the loop or do whatever you have to, to save the spacecraft, to keep it from harming itself.

MG: So you're testing the instruments before they go out.

DW: We would do the last part of the checking. Once the manufacturer put the spacecraft and the instrumentation all together, we had a couple of opportunities where we would actually go to their factory floor. Some of us would do things like sun sensors. They're looking for bright light, so we would take a very bright light with us, and we told the guys on the other end, "Hey, we're going to test this sensor." We'd shine the light past it, and then they'd say, "Yeah, we saw it. Oh, by the way, you came from this side to that side." We're like, "Right." In one particular case, we found out that the manufacturer had wired one of the sensors backward, and it was something they had to change in the database in terms of polarity, but it something that we caught early on. But we would do that, and the main objective was to test out the end to end flow from the spacecraft back to the control center using all of our products through the system to make sure that everything was good for launch. That was the extent of our testing. Then, once a launch came around, it would launch, we would go through the deployment and checkout procedures, and then there would be some on-orbit testing per se. It was mainly monitoring the systems to see how they behave. Some stuff we would actually make it do things that it wouldn't normally do just to make sure that it would respond.

MG: Like what?

DW: Actually, I take that back. We would run it through all the things that it would normally do – thrusters, make sure the actuators pointed. There's a lot going on there.

MG: Were you ever present for any launch failures?

DW: Any launch failures? We did not have any launch failures. We had a couple of things that happened during launch; I would call them features. [laughter] The first GOES that we launched – one of the harder things to get a handle on is what temperatures are going to be in certain phases. It's important, depending on what type of equipment you're dealing with, if you get it too hot or too cold. So when they launched the satellite, it goes into this intermediate orbit, and then you have to do maneuvers to get it out to where you need it to be. So the first maneuver was probably about a fifty to sixty-minute burn, where the thruster's on the entire time, and you're watching it go out. So there were certain parameters set on the nozzle to make sure that it didn't overheat. We got most of the way through it, but the temperature limit flagged. Nobody wanted to push any farther, so we stopped, which put us somewhere in between where we should have been and where we needed to be. As it turned out, the spacecraft was in the Van Allen radiation belt, which is a heavy radiation area within the atmosphere. The attitude control computer mounted on the side of the spacecraft – at the time, all the analysis said we could bolt it up, but we don't need to put a backplate on it. We'll just bolt it to the side of the spacecraft, which is like a honeycomb structure that everything goes on to. Turns out, in the Van Allen belt, things were a little more –

MG: Harsh?

DW: – harsher than predicted just because that's where we stopped. So the computer started showing some glitches of being in that area for too long. So we had one problem that turned out not to be a problem because they went back, they ran the temperature, and said, "Hey, we could have burned until it went to whatever temperature, and we would have been fine." But because we had to stop and got left in there, we had another problem to troubleshoot, which turned out was just because we stopped there. Once we got beyond it, it wasn't a problem. But for the later spacecraft, they determined that they just put an extra piece of metal on there to cover it up, which doesn't seem like a big deal, but for putting anything in space, any weight that you add, you're paying to put it out there.

MG: The satellite you're describing was part of the GOES series.

DW: It was. It was the GOES-8.

MG: I interviewed Thomas Wrublewski, who talked about a launch failure that was the result of a technician using one washer under a screw instead of two.

DW: I think that was the POES. So we have our geostationary spacecraft. If you see the six o'clock news, you get the big, pretty picture of earth. Those are all coming from GOES. The POES are our polar spacecraft. They take little swaths as it flies over. Occasionally, you'll see NASA put up pictures from some of those spacecraft, but most of what we do, that data goes into the numerical weather modeling. So it's more data than pictures.

MG: Were you seeing how the GOES were evolving or changing over time in terms of more spectral resolution, for example?

DW: I was able to see that over my career. The series of GOES that we launched was the first three-axis stabilized, which means it just sits there and points at the same spot. Prior to that, the GOES spacecraft were what they called spinners, so they were spin-stabilized. What would happen is the camera, they can either put it on top of the spacecraft and let the spacecraft spin under it and then they have to de-spin the camera to keep it pointed at the same spot. Or, in the early days, the camera was actually mounted in the body, and it would take a picture every time it came around. So it wasn't a constant viewing type of thing. So we went from that to the GOES that I worked on at that time. When they went to the next generation of spacecraft, they kept pretty much the same capability in terms of instruments. So it hasn't been until GOES-R, the newer ones that we've launched in the last couple of years, that we've gotten more capability in terms of the instruments and the spectral, and the ability to scan faster.

MG: What's the next GOES to be launched?

DW: It'll be another one in the R series. I'm not sure what the date is on that one, although I should, because we have some activities tied to it with some of our programs, but probably for the early '20s. Don't quote me on that. [laughter]

MG: You can always fix the transcript.

DW: But it's all in the same series. It's R, S, and then T and U.

MG: What was your title when you worked for the Computer Science Corporation?

DW: Yes, CSC. Subsystem engineer. I basically had a subsystem that I was responsible for, so I needed to know how it worked inside and out, and then, if there were any issues that came up, I was the subject matter expert that they would talk to if there was a problem. One of the things we'd have to do is – they would call it battery reconditioning. If you've got your Ni-Cd [nickel–cadmium] batteries, if you really want to make them last a long time, you do a deep discharge on them to extend their life. Otherwise, you notice stuff that you've had before where if you only used it so much, after a while, you only got that much use out of it because the batteries would get a memory in them. So we would do things where we would have to put loads on them. So I'd be the guy who would have to monitor that type of activity and make sure that the battery health was good – stuff like that.

MG: What was a typical workday or workweek like for you?

DW: Well, it depends on whether you're in the launch flow or whether you're in operations. [laughter] Launch flow was pretty nuts. I can remember before the first launch, probably from about January up through April, it was probably sixty, seventy-hour work weeks, pushing to make sure that everything got done. After launch, it was a little more relaxed until you got into the launch flow for the next one. Like I said, for the, for the first couple of spacecraft, we did some babysitting. So we'd actually stay with the controllers while they're operating it, and they

worked twelve-hour shifts. So we would rotate on the shifts that they were on for a couple of months just to be there to monitor and react when things happened. And then after that, it went back to more like a day job type situation. But then it was digging in, making sure the procedures were good for the next spacecraft. You'd think it would be like cut and paste, but there's some nuances between each of the spacecraft, so you'd have to make sure that all that got fixed and it was good to go.

MG: Where was your office at this time?

DW: I worked between – it was Lanham, which is right down the road from Goddard Space Flight Center, and down at the operations center in Suitland, which is not the one that's there now. There actually used to be an old federal office building adjacent to that, that it used to work out of. That was pretty interesting.

MG: I keep hearing great stories about these old buildings.

DW: FOB [Federal Office Building] 4 was a World War II-era building. I think the story was it was supposed to be a veterans' hospital after the war, and they repurposed it. So it was just a big multi hallway federal office building. I'm trying to think who we shared it with. We were part of the census complex, but I think we had the outer rings, and don't know who had the inside. You'd be amazed to see a satellite control center in this building.

MG: You've used the term "attitude control" a couple of times. Could you say what that is?

DW: That's how you keep your spacecraft pointing where you need it to be. There's a computer that takes all the inputs you have, sensors that take the data to feed to it, and then you have actuators, either wheels that spin orthogonally – think of a kid in a gyroscope, spinning on the floor. Well, you put a couple of those, and you can spin them up or spin them down, and that's going to make the spacecraft move whatever direction you need. If that doesn't work, then it goes over to thrusters, and it just starts pulsing to make it do what it needs to do.

MG: And it's called attitude.

DW: Attitude, yes.

MG: Is there anything else you want to talk about in terms of this position and the work with GOES? Was it I through K?

DW: I through M. I would probably say that was one of the best times that I had working on a NOAA program. We had a really good group of people dedicated to the mission, and it gave us some really fun challenges that we had to work through. One of the things, after they put it up there is, they realized that they needed to store – you can either launch on-demand, or you can launch and then store them and then bring them out of storage for when you need them. It's easier to have them there at-the-ready than to do a launch call up and try to get something up there. That'll take, if everything's ready to go, probably ninety days to make something happen. The Air Force has got deeper pockets than we do, so they're more capable of doing something

like that. NOAA, we typically do the launch and store it. The problem is, if you put it up there and you store it [and] you run it, you have, like I said, life-limiting components. So the wheels that I was talking about, they run on bearings. There's also gyroscopes that do the rate sensing; they run on bearings. So if they're up there just running the entire time, it's like having one in operation. So what you try to do is put it in a state where it's impacting those components the least so that you'll have them. One of the solutions we came up with was to basically turn everything off and then fire the thrusters, and then just put it in a spin around its primary access to keep it in a stable spot. It would spin like that for a while, and then, like a gyroscope, once it starts to slow down, it'll start to waddle a little bit. Then we'd bring it out and then fire back up and spin it again.

MG: What do you mean bring it out?

DW: Turn everything back on, stop the spin, reposition it to just some functional checkout. When everything looks good, shut it back down, and spin it back up.

MG: Then what? Does it continue to function?

DW: It just stays in a stable, inert mode until you're ready to use it.

MG: So you can turn them on and off.

DW If you have to. There's certain elements that stay on. The attitude computer stays on. Your communication stays on. The gyros – did we turn those off? I think we did turn the gyros off because I actually wrote a program – the magnetometer senses the magnetic field, and we use that data to determine – you could see a sinusoid of the space environment around it from the magnetometer. So we'd use that to calculate the rotation rate and how it was going, and then we use the sun sensors to determine whether it was pointing off too much to do that. I have to do my fact-checking. I'm pretty certain we turned the gyros off because that was one of the life-limiting components.

MG: What's the purpose of some of those things? I'm having a hard time getting my head around how all of this work and then what it's used for.

DW: Your spacecraft bus is your main platform for all your instruments. So take the instruments and what they do aside, you need to have something that can support them with power, some sort of temperature control to be able to pass the data back to earth, and basically point them where you need them to take the data. So that's your spacecraft bus. Then, at that time, the GOES spacecraft looked like a big Kleenex box. It was just a big square thing that they were mounted onto. But within that, you've got a propulsion system, which contains all your gas and your thrusters. Like I said, your attitude computers. So that thing takes in inputs from different sensors. Let's say you have a sun sensor, so it's looking for a bright thing out there. You have a coarse one that just says, "Hey, there's one out there." And then you have a more fine sun sensor that can actually tell you how many degrees off once you get it within its field of view. So you use those, and then they have earth sensors that you can actually see the earth and whether it's moving left, right, up, down; even has magnetometers that sense what's going on

with the space environment around it and whether that has any input to the body. They even have magnetorquers. So you can put a magnetic current through there to create a magnetic field that will make it stay pointed – very fine-tuning type of thing. I'm trying to think what else is involved there. The gyroscopes, they spin at a certain rate, and if they sense any movement, they try to react to compensate for that. So you can get position, and you can also get velocity, depending on how it's moving and where it's going. The wheels, they take that feedback, and the wheels actually point it back to where it needs to go inside of it. So it's a pretty complex system, but if you're around them long enough, it's simple. I think I've seen some of my son's Lego robotics things get a little more involved.

MG: He probably knows more about this than I do.

DW: No, he doesn't. [laughter]

MG: [laughter] In 1998, you changed positions. I was curious about what that transition was like and what you were doing.

DW: I'd been working the GOES program since '91. At that time, there were a couple of things going on. I can't remember who was president, but there was a presidential directive. There was the Defense Meteorological Satellite Program, DMSP, and then there was the POES program. There were two polar weather satellite programs that were doing the same thing, but for different end-users. There were some differences between the sensors and what they were doing, but pretty much identical. They said to merge those programs – merge them on the operational and merge them in the future. So the NPOESS [National Polar-orbiting Operational Environmental Satellite System] program was the next generation of the polar, which is going to be the [combination] of those two. Then, DMSP was being operated out of the Air Force Weather Agency in Omaha, Nebraska. NPOESS was out of our operation down here. So they were bringing DMSP into the NOAA operation center to try to reduce costs and merge that. So they were looking for engineers, and I made the transition from contractor to government at that time, working with DMSP. So I went from GOES to, effectively, POES, but DMSP. So, not much of a transition because at that time, I was pretty much full time, working out of the Suitland location. So it was just new people, different position.

MG: What happened with NPOESS? It dissolved at some point.

DW: In early 2010 – I should know more about this – basically, they decided to end the program and redirect it. The Department of Defense [DOD] and Department of Commerce [DOC] severed ways there. So they're back to working on their program. What was left of NPOESS then turned into the JPSS, Joint Polar Satellite System, which is still going on over at Goddard. They've launched J-1. I forget when J-2 is coming out.

MG: Can you say a little bit more about this work you were doing? Were you working with the Air Force during this time?

DW: So, employed by NOAA, but we were still operating the DMSP system for the Air Force. They were our main customer/end-user, but basically doing the operations out of Suitland there.

It was a different group of folks. We work with folks from the Air Force Weather Agency, Space and Missile commands out at Los Angeles. That was where the main program office was. At the time that I came in, we had four or five more satellites that they were going to launch. Of that, I think they only launched four. One of them decided not to launch it, and I think it's sitting out at SMC [Space and Missile Systems Center] now in one of the lobbies.

MG: How come?

DW: Cost. There's a whole lot of stuff that goes down on the Hill that I try to stay out of.

MG: Were some of these on Titan 11 rockets?

DW: Yes. I think all of ours were on the Titans. All the ones that I dealt with were on the Titans. I do know that one of them was the last of one of the Titans. I can't remember which.

MG: Can you say a little bit more about the Titan rockets and their background or history?

DW: Limited knowledge, but most of the DOD vehicles were, at some point, tied to ICBMs [intercontinental ballistic missile] and launching warheads and stuff like that. Then they repurpose them to do stuff like this. But, I think the Titan heritage goes all the way back to the Apollo era. I think one or two of them might even have done some manned space flight type thing. There's a lot of heritage there.

MG: How was the nature of this work different than what you were doing previously?

DW: Not much, really. Just a different system I was working with – went from geo to polar. So, in terms of geostationary spacecraft, you point at a spot, [and] it stays at the same spot over the earth. For us, we want weather over the U.S., so there's one over the East coast, one over the West Coast. All our antennas point out all the time, so data comes down all the time. With the polar satellites, you typically have to put the antennas at the northern latitudes to get the most out of them. You can put them anywhere, but if you want to see it every orbit, you got to get them up pretty high and pretty low. So typically, we get a burst of data for about ten to fifteen minutes every hour and a half. Then, there'd be post-processing to make sure that everything was going good and checking it out. So that's the difference in the operation of the bus itself.

MG: What was the connection with the military? How were they using this data?

DW: So what we do here at NOAA is all for civilian purposes. Theirs are all targeted military purposes. So if they are going to go do an operation in a certain place on the earth, and they need to move heavy artillery, stuff on the ground, is it wet? Are they going to get stuck? Stuff like that – if they have to send an aircraft. Are they going to be able to see what they're going after? Do they need to re-plan it? That type of thing.

MG: You worked in this office until 2006.

DW: I worked down at Suitland until 2006, yes. Came in there again as a subsystem engineer and worked my way up to the engineering team lead, which was over all the guys with the different subsystems. We had folks on the government side, and we had contractor support. So we all worked as a team to keep that going. Did two or three launches while I was there, as well.

MG: Does anything else stand out to you from that time?

DW: It was different. [For] the GOES, with the type of mission and the way that we flew it, presented its own challenges because these spacecraft, they bought them as a bulk buy. So a lot of these things have been built and sitting for quite a while. So we'd launch them. They'd present some challenges at times that newer spacecraft wouldn't. But, again, it was good; a good group of people that we worked with. I would say that people now that do computer programming probably don't really have a sense of what it means to have a computer with limited size and computing capacity. Because there were times when we'd have to update the flight software, and guys would have to do some really rigorous scrubbing of the code to find space and make sure that a certain program would execute within the certain allotted time, or else you get an overflow, and the computer would start doing odd things, which you really don't want. [laughter] So, yes. I don't know. In both cases, there was a sense of mission, but when you're supporting the military, there's a strong sense of mission there, even though you don't know what it's all being used for.

MG: Especially during those years. That was the beginning of the Iraq War.

DW: Yes.

MG: Were you still on NPOESS work in 2006?

DW: I made the transition – at that time, the tie between NOAA to the Air Force lied within that office. We still have support from uniformed personnel on the program. But, like any uniform personnel, they go through rotation. So you'd have somebody there for a while, you train them up, then he'd leave, and they'd keep going. So they were looking for someone to be the corporate knowledge to work with these guys. So I applied and got into that position. Quickly after I got there, they're like, "Hey, we need to fill a hole over here on NPOESS. Do you think you can do that?" I'm like, "I'll give it a try." So they put me over there, and that was my rotation for the next couple of years.

MG: Which office was that in?

DW: The NPOESS office was actually located right up the street from here, across from the Discovery [Communications] building.

MG: Okay. Tell me more about what you were doing.

DW: It was completely away from operations. I call it upstream from what I had been doing. This was more in program development, what you do to put things together before you hand it over to operations. So while I was familiar with it working, the last mile, when we were testing

out the satellites, I didn't have the experience going further back from that – pulling their requirements together, designing, and developing the systems. That was all new to me. [inaudible] – the ground system component was command, the control, and the networking. The NPOESS program, in order to get the data latency down – if you get the information faster, helps with better predictions. So they were trying to get it down to, I think, under thirty minutes. So, as I mentioned, the receptors up at the poles, you could go from ninety minutes, cut that in half to forty-five minutes. But in order to do that, you had to start distributing receptors around the globe. So part of what we had to do for that was go find partners in places around the globe to put them in and try to reduce that latency. So we were looking at places like Hawaii, a couple of places in South America, South Africa, Europe, Japan, Australia, New Zealand.

MG: Did you get to go to those places?

DW: I got to go to most of those, yes. There was a period there where we were checking out sites. In about eighteen months, I hit all the continents. So that was pretty cool.

MG: Was that before or after you had your son?

DW: I had him before I went to the IPO Integrated Programs Office]. It would have been afterward. But he was relatively young at the time.

MG: Well, what were the groups you're working with internationally? Other government agencies?

DW: It was a mix of both. Where we could, we would work with government agencies. So in South America, in Brazil, we were working with their group INPE [*Instituto Nacional de Pesquisas Espaciais*/National Institute for Space Research]. I can't remember what that stands for. Then we went over to Chile, and that was going to be more of a commercial arrangement. Japan, we were working with JAXA [Japan Aerospace Exploration Agency], but then we went to New Zealand, and we were working with a telecom provider down there. Then, when we went to Antarctica, the base down there is actually run by the National Science Foundation. So between NASA, who had an antenna down there, and NSF, who run it, that was just another interagency partnership within the U.S. to do that one.

MG: What does the partnership entail?

DW: So, it depended. In most cases, to be a partner, it just – I don't want to say it was a *quid pro quo*, but where possible, if they could either host a receptor or provide the receptor as part of the system. It just meant that they would get access to the data. But in most cases, pretty much everybody had access to the data anyway. So some cases, it was just being able to say, "Hey, we were part of the partnership and helping make the mission go."

MG: When NPOESS dissolved, where did you go from there?

DW: [laughter] That's when I went across the street and shorten my commute to the office where I'm at now.

MG: Can you say what the name of the office is?

DW: At that time, it was the Office of Systems Development [OSD]. When I had worked down in Suitland, they were our sister office within the building down there. They provided a lot of support to the ground systems and the stuff that we did down there. So it wasn't too much of a stretch to come to OSD after that because I knew who our customer was and some of the things we needed to do to support them. So more along the lines of program initiation and development, and then getting it ready for operations.

MG: What's the office called today?

DW: It is the Office of Projects, Planning, and Analysis.

MG: When did the name change?

DW: In 2015, NESDIS [National Environmental Satellite, Data, and Information Service] went through a reorganization. That's when we got the new name. We used to have the spacecraft, as well as the ground system activities under our office. They separated the ground system out, and they're their own office now. We focus more on the flight side of things, as well as partner activities. Say we want to host one of our instruments on a partner spacecraft or they have data coming off an instrument that we'd like to get, we partner with them, and then we work through the logistics to make that happen.

MG: What other things changed during the reorganization?

DW: They stood up another office for architecture and engineering, so a sister office to us downstairs. Probably something else that I'm missing, but, to me, those were the three big things.

MG: You've had a number of titles under this office.

DW: Yes.

MG: Can you just walk me through each one, and what your roles were at each stage?

DW: I came in from the IPO as a senior engineer, helped out with various things. I helped with a little bit of the cosmic ground system in the early days. I'm trying to think what else I went to. I had a spell where they needed an acting branch chief, so I did that for a while and then did branch chief. That's basically overseeing some of the projects and the personnel. From that, went to deputy director for a few years, overseeing all of what was going on with the various projects. Our office covers project formulation, early project studies, what type of instruments should we use or how should we improve these instruments to do what it is that we need to do, canvassing the industry to see what capabilities are, working with other agencies like NASA and JPL to perform some of the studies on the instruments and do whatever. We formulate a program saying, "All right, we're going to need a spacecraft. We're going to need these instruments. We're going to need this ground system that's going to be able to support this."

[We] package that all together – "Oh, by the way, it's going to take us this long to build it. It's going to cost this much over the years." Then we have to start walking it through the process for getting it approved through our organization here in NESDIS, through NOAA, and then on up to the greater good. So one of the ones we walked through was COSMIC [Constellation Observing System for Meteorology, Ionosphere, and Climate] and DSCOVR [Deep Space Climate Observatory], some of our recent missions that have launched and gone up for operations. We're now working on the next mission to back up DSCOVR, which is our space weather mission, space weather (follow-on?). So that's the general what we do in our office kind of thing. So it was overseeing that. Then, stepped into the role as more of a systems engineering – how do we pull this stuff together in a consistent manner type of thing. More recently, in a branch chief role, working again with the research to operations and formulation type activity.

MG: What was the COSMIC program?

DW: COSMIC is a very interesting program. The technology has been around since the '60s, but we've only really been employing it for the weather forecasting since the late 2000s. These guys came with the idea that if you measure a radio signal as it goes through the atmosphere, it's going to change what it does. It'll slow it down. It'll actually cause it to curve as it gets low enough down, and the atmosphere gets thick enough. What they do is you have a source and you have a receiver, and what the receiver measures, they then go through a whole lot of math and physics and extract information like pressure, temperature, water vapor, and, in weather parlance, they call it a sounding. They use that information in the models. So they had done that on some of the early NASA missions, going to the planets to see what the atmospheres are like. They wanted to try it here, but it was going to be pretty costly to do something like that until DOD put up the global positioning satellite constellation. So the thing that tells you where you are on your phone, it's got all these satellites flying around with these signals. All we did is put a constellation of satellites below it that's now receiving these signals, and we pulled this information out.

MG: Neat.

DW: So National Science Foundation did the first round, we refer to as COSMIC-1; that was launched in 2006. Then we recently launched COSMIC-2 in 2015.

MG: What was the Jason-3 satellite project that you worked on?

DW: Jason is an altimetry series basically doing sea surface height measurement. So I think the original was OSTM [Ocean Surface Topography Mission], which is NASA. Then Jason-2, which was the follow-on to that. OSTM/Jason, then Jason-2. Now, Jason-3. I believe it was ESA [European Space Agency] that supplied the spacecraft bus and some other instruments. We worked with JPL to provide the altimeter and another instrument on there.

MG: Is Jason an acronym?

DW: I'd have to look it up. I don't think so. [Editor's Note: The name Jason stands for "Joint Altimetry Satellite Oceanography Network."]

MG: Tell me a little bit about work today.

DW: Like I said, with the branch research to operations, so doing a lot of study work. We have an office called STAR [Center for Satellite Applications and Research], which is our operational science group. We fund them to do studies on what extra things can they extract out of the data or how can we use the data to improve the weather prediction type stuff. We've worked through them to get to other groups to do simulations, whether it's actually using actual data and either putting it in and taking it out or if we had a future data type, how would it impact what's going on. So they do those kinds of studies. I'm working on something now where we're doing some research with industry beyond JPSS. If we don't want to put everything on satellites as big as this room and we want to put it on something about the size of that trash can or a little bit larger, what would those instruments look like? How many will we need? Is it cost-effective? Can we get them up there faster, cheaper, that kind of thing? What else? That's been my main focus as of late.

MG: What do you think is on the horizon? What's next for the program?

DW: Two things that we're looking at and dealing with. One, like I said, the smaller satellites. We've typically been large behemoth satellites with these instruments, and they're twenty-year programs because the time it takes to develop the technology, and finally getting it out there, space is becoming more achievable. So there's a lot more out there in the way of vendors. It's not just your big Lockheed [Martin Corporation] and Northrop [Grumman]. A lot of smaller guys are coming into play, who are getting talent that can do these kinds of things smaller. So it's figuring out how to best utilize that, again, to do it faster, cheaper. If you get it right and you get a cadence going, you can make improvements to your instruments and your measurements without having to wait twenty years and then be able to insert it into the system. So proving that out, ensuring that it's going to be capable enough to support what we need to do because yeah, you can't have it today and then not have it tomorrow. You got to have something reliable. In the transition from POES to NPOESS, there was a little bit of a lull there because of the whole NPOESS to JPSS thing. There was a great concern over a potential gap because the POES satellites are old. You don't want to be in a gap situation, so you want to make sure that whatever system you designed can keep the cadence going. The satellites we design now are five to ten-year satellites. If your satellites only last three years, can you keep that build and launch cadence going so that you can get them up there fast enough so that as they die and go offline that you've still got a reliable source of data coming down? So there's that. Then, because space is becoming so accessible with instrumentation as well as the rockets and such, there are companies that are now providing commercial weather data, and they want to sell it to us. So we need to determine how we can best work that into our system. Again, you can't have it today and not have it tomorrow. So you have to choose what your core mission is. There's things that you may want to retain as inherently government so that you ensure that you've got that, and then you augment it with what the commercial sector can provide. Since we work for the Department of Commerce, there's a lot of tension there because commerce is their goal. But we also have the mission of the weather.

MG: It would seem like you'd want to coordinate those efforts if the private sector is sending up satellites and gathering their own data. What organizations or businesses are developing private weather data?

DW: There's a couple out there. There are two that are currently on the move, and there's one that's coming up behind them. There's Spire, GeoOptics, and PlanetIQ that are all radio occultation data. There are others that are providing commercial data, but more in terms of imagery. We don't use imagery as much as, like I said, the type of weather data that we're looking for. So there's others out there that are coming online, and we're talking about – I made the analogy to the Kleenex box, but so many satellites are literally not much bigger than a Kleenex box or a stack of Kleenex boxes. They're really small. I don't know whether you've seen – you'll see pictures of them. They're being launched from the space station and such. They're ten centimeters by ten centimeters, and then they just either stack them or build them out.

MG: Looking back on your career, what stands out to you as some of the most meaningful or interesting things you've worked on?

DW: I'd have to say all of it. I said the part early on, working with the GOES and that team, was pretty rewarding. The period while we were traveling, doing the site surveys for the safety net, was very interesting in terms of getting to meet people and negotiating what we were going to do in terms of the receptors, but mainly just the travel to get to see the different locations. Not everybody can say they've flown in a C-17 and landed on a sheet of ice. [laughter]

MG: Well, what was that like?

DW: Probably one of the best flights that I've ever had in an airplane because the guys don't slam it on the runway and hit the brakes. [laughter]

MG: What were you doing there?

DW: That was Antarctica. That was the lower latitude site. We were also up in the Arctic, above Norway. There's actually a group of islands up there, and the Norwegians put a satellite ground station up there. If you think of your latitude, McMurdo [Station] is at about seventy-eight degrees south, and those guys are about seventy-eight degrees north. So those two locations gave us pretty prime coverage. Then we started filling in around the globe for the rest of the things. But the Norwegians are a very good group to work with, very hospitable folks. I spent a lot of time, had a lot of good memories up there.

MG: Good. Well, I'm worried I moved through your career too quickly. Are there things that I forgot to ask about or that you want to get on the record? You're welcome to look at your notes if you'd like.

DW: I don't know. I feel bad. I had just a little bit of time to pull this together with everything that has been going on. We did the satellite launches. I can say the DSCOVER launch was interesting because all the GOES and DMSP launches, like I said, I was working the subsystems.

So we were at the control center at the ops center in Suitland. DSCOVER was my first opportunity to actually be at the launch site for that. So we were sitting in the rocket control center for that one. We really didn't have a role other than just as a customer and oversee everybody. It was pretty cool to see that side of things. We always heard it through the net as the countdown was going on, the different activities that were going on outside us. But in that particular case, we got to observe it from that end. Then, as it takes off, you run out of the control center and watch it take off from there. So that was pretty cool. More recently, with the COSMIC launch – a lot of stuff we do out of our office is small and cheap. So instead of buying a rocket, we'll get what we call a rideshare. So we'll either work with NASA or DOD. In this particular case, the Air Force provided us the launch for the COSMIC program. It was part of a larger – they call it a stack when they put them all together. It was part of a larger stack. We were like the primary, secondary payload on that one, but it was on the Falcon Heavy. I don't know whether you followed SpaceX; they have the single stick rockets. The Falcon Heavy is like three of those things strapped together. SpaceX has been launching, and then they will retrieve the rockets and land them. For that particular launch, they retrieve the two side boosters. The launch was at 2:30 in the morning. So you're out in the middle of the swamps there at Kennedy, and then all of a sudden, the whole place lights up like a football stadium. It takes off, and then you wait. About six or seven minutes later, you see these two lights pulsing in the sky, and these things actually came back and landed a couple of miles down from us at the viewing pad. So that was pretty cool. I think just the progression of what I've seen in my career – the funny thing is – I'll tie it to the commercial. When I worked the Landsat, it was a government program, but they were trying to make it commercial at the time. They tried it for a couple of years. It didn't work. I don't have all the details, but like I said, it ended up going to the U.S. Geological [Survey] and has stayed with them ever since. Here, progress from the late '80s to late 20-teens, and commercial's back in play, but it's not us trying to commercialize something. It's actually the commercials that are trying to sell to us. So seeing that progression and even the commercialization of the launch, from seeing the Apollo pad when it was NASA to now it's SpaceX's pad doing their launches.

MG: What do you make of that?

DW: I think it's pretty cool. Like I said, I grew up watching space and have followed it ever since. I saw it go from Apollo to space shuttle. The government did the reusable returnable, and now industry is doing their own thing.

MG: Well, tell me a little about your life outside of NOAA.

DW: [laughter] I don't feel like there is much at this point, but I live in Frederick, Maryland. It's about forty miles from here. The trip down [Interstate] 270 is a bear. So I take public transportation. We have a train that runs back and forth. So I commute from about ten minutes away from my house down on a train that drops me off right in front of the building. So that consumes most of my day. I have a son who just turned fourteen. He plays pretty much any sport that he wants. No real passions there, but he enjoys all that he does. He's also into scouting, so that pretty much takes up most of my time outside of here.

MG: Does he think what you do is pretty cool?

DS: Some days. [laughter] Some days I tell him stuff, and I don't get much of a reaction. So either I didn't explain it, or maybe he's just not that impressed. Back in the day, anything that went to space, it was big news. I'm lucky to see something to show up for just a fifteen-second blurb on the news anymore when we launch something.

MG: How would I find when there are launches?

DS: Well, there's some trade magazines that follow that, *Space* or *Spaceflight Now*. They're usually pretty good. I think if you go to NASA, they have some of their sites. Virginia, they've put the launchpad down at Wallops [Flight Facility], but that's a quasi-state commercial venture down there. You can check with them. You're further north. Although depending on which way they launch, I'm not sure how visible would be – but from where I am in Frederick, what is it? It's probably a couple, three hours to get to the beach where they launch. But once it goes up and gets over the horizon, I can actually see the launch. It's just the glow of the engines, but I can see it from where I live. So depending on how they go up and down the coast and where you are, it's a good chance you could see it if they go north. I think most of them go south, though.

MG: Are you presenting at the American Meteorological Society [AMS] annual meeting next month?

DW: Not to my knowledge. I think I've probably got my name on a poster or something, but some of the folks – we work together as a team in the office, putting together either presentations or posters.

MG: Are you planning to attend?

DW: I might end up there. I have never been to AMS.

MG: This would be the year to go because it's their 100th anniversary.

DW: Is that what it is?

MG: Yes.

DW: It's in Boston in January. [laughter] I've done Boston in January.

MG: Well, anything I forgot to ask you about or anything we're missing?

DW: I don't know.

MG: Well, I'm going to be in Silver Spring for a couple more days. You'll also have an opportunity to add to the record or edit the transcript. I want to thank you for all your time.

DW: I wasn't quite sure where this was going to go in terms of the discussion, but thanks for digging in.

MG: Sure. Well, thank you so much for your time.

DW: Sure.

----------END OF INTERVIEW----------

Reviewed by Molly Graham 1/17/2020