The American Meteorological Society in collaboration with
the University of Wisconsin-Madison Space Science and Engineering Center

An interview with

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NATHANS: This is Jinny Nathans, librarian and curator at the American Meteorological

Society. We are in Boston at the Joint Satellite Conference. It is October 1, [2019,] and [I'm here with] Jean Phillips who is at [the] University of Wisconsin-Madison at SSEC [Space Science and Engineering Center]. We are interviewing Tim Schmit. [. . .] Tim, what was your first awareness and interest in the weather?

SCHMIT: Well, my interest really goes back to the remote sensing part of the weather. My dad actually worked at a research institute in Honeywell and did crystal growth and actually helped in the pioneering work of mercury cadmium telluride, the crystals that are used in infrared detection. Fast forward, those are actually the ones on the GOES [Geostationary Operational Environmental Satellites] satellites today. So when I was growing up, I mean, I kind of thought that every kid at the dinner table would hear about, you know, band gap and electron carrier concentrations and liquid phase epitaxy and crystal growth. But, you know, at that time, since this was in the infrared, he would tell me stories about, you could take a picture of, let's say, a parking lot, and let's say it's all smokey. Well, in the visible, you would just see the smoke. Well, in the infrared, you could see, well, that spot is cool there. Hmm, there must have been a car there that recently left. Well, that engine of that car is hot. That must have recently got there. And all this from seeing, you know, in the infrared with some ideas of kind of maybe hints of what has happened or maybe then what will happen. So I was always interested in remote sensing.

So then in seventh grade, we did a study job fair, and we took an aptitude test. And I have to tell you, this was before you'd do them online. This is, you know, you fill out the bubbles, and you send them in. And one of the jobs that came back for my personality fit said, you know, meteorologist. So I looked at different schools in the area. I'm from Minnesota originally, but there was a school in Madison, Wisconsin. And so then I thought, "Hmm, maybe get a master's degree in meteorology from the University of Wisconsin." And fast forward—and I'll get rid of the cliffhangers—I got a master's degree in meteorology from the University of Wisconsin. It wasn't maybe as direct a path as I make it sound, but that's what happened.

NATHANS: Now if you are from Minnesota, there's a lot of weather in Minnesota. Did you— The usual story is where people are in a storm and they try and get out and go up on the roof to be in the storm. Did you feel that way about weather?

SCHMIT: Yeah, even as a kid I thought, well, maybe the roof wouldn't be the good spot for during a storm [they laugh]. You know, I do remember waiting in the backyard for the northern lights, you know, one time they had come through. And of course [there's] that whole connection with remote sensing, et cetera. And again, fast forward, you know, some of our satellites now measure and can look at, you know, the northern lights and the southern lights as well.

NATHANS: What was your first job after graduate school?

SCHMIT: Well, after graduate school— During graduate school, I had a project assistantship with CIMSS, Cooperative Institute for Meteorological Satellite Studies, there in Madison, Wisconsin. So I had— Well, earlier I had a research assistantship, and then during school I did that. So I graduated— So I worked with them until Friday, graduated on a Sunday, and on Monday, I started with [the] Space Science and Engineering Center. So I worked subsequently nine years getting ready for the next generation weather satellites. So at this time that was— As you know, we give letters to our geostationary satellites when they're on the ground and then numbers when they get to geostationary orbit. So this was GOES-I [Geostationary Operational Environmental Satellite-I], or we'd sometimes call it GOES-Next. I was hired in '87 because I was going to get ready for this launch that was going to maybe happen, you know, in the late '80s still, you know, maybe '88. Well, fast forward, there were some delays. The launch was not until 1994. But I was able to work with some of the federal government employees there that [were] also located in Madison, Wisconsin, the birthplace of satellite meteorology. Some of the federal groups had come in the late '70s to work with professor Suomi and others.

So again, we were able to simulate what the data was going to look like and practice our algorithms to turn that satellite data into environmental data before launch. And then once we got data in '94, we were able to get some of the first data and help during the post-launch test or on-orbit check out. So obviously, before a satellite goes to the weather service to be used operationally, it needs to be checked out: what are its characteristics, noise characteristics, striping, any other issues? So that was kind of my first experience of getting ready for a satellite beforehand, post-launch tests, and then supporting it while it was in operations.

NATHANS: Now, I'm looking over your shoulder at your notes, and I see you have mentors. I assume these are people who mentored you.

SCHMIT: Yes.

NATHANS: So please talk a little bit about that.

SCHMIT: Yeah, I've been very fortunate [with] mentors of both types. The mentors just to watch from afar and ones that more, you know, I worked with on a day-to-day basis. So [when] I was in grad school, my major professor was John ~~Martin~~ [Young] from the University of Wisconsin-Madison. But I worked with a researcher, Dave Martin—who had been in the field for decades—and then when I had switched to be a state employee—a CIMSS employee—then I worked closely with Dr. Christoper or Kit Hayden, who is literally the combination of hardest worker and smartest guy that I've ever worked with.

PHILLIPS: With a great sense of humor.

SCHMIT: With a great sense of humor! He had a strong bark, but underneath he had a— But it was pretty far underneath sometimes. Being able to work with him, Paul Menzel, also from Wisconsin, there at Wisconsin. He was a state employee, then a federal employee, then a state employee. But he was the one— So okay, fast forward, so you know, there was the GOES-8 series, and again, we helped check out GOES-8 and -9 and -10 and -11. And then there was a slightly modified spacecraft in GOES, you know, -13, -14, and -15. Well, at that same time, now, in the late '90s, I'm working with the Office of Systems Development. We started to work with—on the new next generation, or the next-next generation [laughs], which was then GOES-R, which had subsequently became GOES-16. So, same deal. It's now 1999, and we have to get ready for this launch because it's going to be in 2008. It turned out not to be in 2008. It was— but again, same deal, initially when we got involved, there were eight spectral bands that were envisioned for this imager, which is more than the previous generation that had five. But there was also this long list of requirements from the National Weather Service. Circling back to mentors, Paul Menzel kind of let me take the lead on that, although he was there to ask the questions to.

So we were able to say, “Well, there's no way you can do what you want to do with just 8 spectral bands. You need at least 12 spectral bands.” We got that up to the powers [that] be, and they said, “Okay, you can have 12 spectral bands.” “Ah, okay, this is getting to be fun. We don't really need 12 spectral bands. I don't know who said that. We need 18 spectral bands!” Well, they'd kind of caught on by then, and we ended up with 16 spectral bands. Two in the visible, four in the near-IR [near-InfraRed], [which you can] think of as near-visible, and ten in the infrared. And that's now really kind of been the international standard, if you will. Japan's advanced imager: 16 spectral bands. Korea's imager: 16 spectral bands. Europe's Next-Generation [imager]: 16 spectral bands. [There are] some differences, some substitutions, et cetera in the details, but again we were able to kind of, you know, set that. And I was able to do it because I was able to work with the rich history and knowledge of my colleagues at the Cooperative Institute. So I could go to somebody and say, "Well, if you could add one more band, what would you add?" "Well, I would add the 8.5 [mircometer]." "Well, why would you add the 8.5?" "Well, dust and SO_2 [sulfur dioxide]." "Okay, that's a good idea." And [you] could get that back through the system.

I should say [that] in 1996 there was an opening in the federal position, so then I switched over from being a state employee to a federal employee, but still staying at my duty station in Madison there.

[. . .]

PHILLIPS: So you kind of opened the door to now federal service. And can you talk a little bit about—we'll get back to the satellite piece, but how has—you've been a university scientist, now you're a federal scientist, and how has your location within the Cooperative Institute as a NOAA [National Oceanic and Atmospheric Administration] scientist, ASPB [Advanced Satellite Products Branch], how has that facilitated your research?

SCHMIT: So when I was a CIMSS employee, I was really more of a—I guess I'll call it support scientist. And then switching over to the federal government side, working with [the] Advanced Satellite Products Branch, it turned into—and this wasn't an overnight thing, [that] now you're a federal employee so now you're in a leadership position, but—and like I say, I had already been there for nine years. It was more of a gradual thing, where early on, I can certainly say it was more of a support scientist role, whatever I'd get asked to do. Then as I matured as a federal employee, it was more of leading our own programs, being chairs of various groups.

There's what's called the Algorithm Working Group, and I'm a chair of two of the subgroups there for imagery and soundings, so temperature and moisture profiles. So it kind of, you know, morphed over time. I won't say it was just because I got a different title or different email that it magically changed, but it did also open some doors for being in some different meetings that maybe only federal government people could be at.

I will say the pros and cons of both. You know, there was, I think, a lot more flexibility for being a state employee. On the other hand, as a federal government employee, the federal government—i.e., the taxpayers, i.e.., you all, thank you—paid my salary [laughs]. So I don't need to— any grants that we get [are] then to support other state employees, but it doesn't have to fill in my salary because that's covered or paid on hard money, which is a nice attribute.

PHILLIPS: And the location of the Advanced Satellite Products Branch, working with— side-by-side with the Cooperative Institute— Talk a little bit about the government-university partnership that we like to—

SCHMIT: Yep, I mean it really is key just to be able to be collocated. So [you can] literally walk down a floor and talk to some of the world's experts on, like I say, on one sub-spectral band that we are thinking of. And even if we say, "Okay, we want to put this band on." Well, then there's attributes within that. Well, how spectrally wide do you make it? What signal-to-noise do you need? What are the uses? And so the combination of being right there with CIMSS and the expertise on the science side, coupled with the Space Science and Engineering and the [SSEC] Data Center, and having this long, rich history of the archive— I could be on telecoms with people in D.C., and they would ask a question, some artifact would come up, and click, click, and [I'd] bring up the image and I'd email it to them, like, during the telecom. And again, that's, I think, in part because we have the close relationship between, like I say, the data providers and the space science on the science side and then of course just directly working with a number of CIMSS employees on our teams to be able to build that expertise to leverage.

PHILLIPS: Okay. Getting back to our rich satellite history, you've been fond of saying that, well, SSEC has been involved in satellite formation since the very beginning, and you've [been involved] since the 1980s. What have been some of the dramatic changes that you've seen beyond the number of—I mean you talked about spectral bands being available on GOES-R.

SCHMIT: Well, the big change in my career is when we had those early-on satellites that we were helping check out, so like I say, GOES-8 through GOES-15. We got the data, and we were interested in it. People, let's say, were interested in what we had to say with it—let's say, a few people in the Weather Service—but it was a small group that either knew that was happening or interacted. Fast forward to this next— the GOES-R, which becomes GOES-16, which has a hundred times better attributes.

So now it wasn't just a few researchers looking at this and [saying], "Oh, that's interesting" and "Oh, we'll tell the Weather Service at some point so they can go operational." It was in conjunction with the satellite being so much more capable but then also the whole social media. So being able to even before the satellite was operational—so well, originally, we'd get the data in [and] we can't share that before— for example we would have— get the data in to just make sure it's okay, help make these first slide images that would go out for the NASA [National Aeronautics and Space Administration]/NOAA press release. But then after that, then we could start sharing some of the data with the proper disclaimers on it, so being able to put that out on social media. And just, people are so excited about it and sharing their thoughts and seeing what they see. To me, that really went from a small group of, I'll call it, satellite enthusiasts in

NESDIS [National Environmental Satellite, Data, and Information Service], to really everyone. Meaning not just, you know, people in the United States but, you know— Obviously our satellites see the whole hemisphere, as we say we see from the western edge of Africa with between GOES-16 and GOES-17 to basically New Zealand. And so there are a lot of people in that area that are interested in these new capabilities and how it would affect them.

So to me, that is really the biggest change. And I guess part of that, this whole concept of just—it's either good or bad—that people just take it for granted. I sometimes joke that people think that the satellite data is just beamed down from space, which of course it is [laughs], but there's work that's been done ahead of time. Somebody had to decide what spectral bands and calibrate it, navigate it, and do that. And so I think the good news is we're to a point where everyone just kind of expects, "Something happened today in the environment, I wonder how GOES saw it?" It's not a question of, well, do we have any satellite that happened to have an overpass time that would just see it? Again, we have some imagery we get routinely, the full disc every ten minutes today, over the continental United States every five minutes and the regions of interest every one minute—so small mesoscale areas. So you might, you know— Here's the looking at something at five minute, or here's looking at the hurricane as it comes on shore in the mesovortices at one minute. And that was something. You know, ten years before launch I said, "Boy, we're going to be looking at one-minute data [for] mesoscale vortices as it, you know, goes across the Gulf of Mexico." Well, fast forward, here's GOES-16, [with] one-minute data, I've got mesoscale vortices. And I could just watch on Twitter, everybody excited and sharing loops or whatever, and I could kinda sit back and say, "Good, I'm glad that worked out," or whatever.

PHILLIPS: So since you're talking about GOES-16, you published a paper, I think, with Dan Lindsay on the return to true color?

SCHMIT: Yeah!

PHILLIPS: What is that? Tell us about that.

SCHMIT: Full circle! So ATS-1 [Applications Technology Satellite-1] in 1966 was launched with one visible band, ironically in the green part of the electromagnetic spectrum, which was great and cool because it was the first geostationary that you could look at these loops and see the clouds move, et cetera. So fast forward just a year later in [1967] when ATS-3 then took—with three visible bands, centered nominally in the red, the green, and the blue part of the spectrum. So there it was. Of course, that was a research satellite in 1966. Well, then for the follow-on, GOES, it was decided it was more important to get more infrared bands on because, of course, visible data is great and wonderful during the day, but the clouds can't be seen at night. And so for GOES-A, which became GOES-1 and the subsequent one, [we had] one visible band, one visible band, one visible band, until ABI [Advanced Baseline Imager], where we were able to get— And this was— It was [at] a GOES users' conference. I had given a talk on this ABI. Fred Mosher, then the Aviation Weather Center head, stood up and said, "Any reason why you didn't put a blue band on in 0.47 so we could look at aerosols better?" "Huh, never really thought of that."

And [we] worked it through, and that was actually one of the bands that got on. So now we had the blue band and a red band that we historically had had and could make these nice true color images. We did still have the green band, but we could— what we had was called the veggie band or a 0.86 band, which is very sensitive to vegetation. And you can't just replace it because then the vegetation looks way too green, but you could take 10 percent of that band and do a combination with the other bands and make these nice-looking images again. And I think that's really what has captured people's attention because it's not exactly what it would look like if your eyeball was out in space, but it's very similar. Clouds are white, the ocean is blue, you've got the gradation with the land, more vegetative green, you can see the— you know, if there's flow of sediment into the rivers, you see the brown sediment transport there.

And again, I think that's just really captured people's imagination. But it also shows the patience sometimes required going from having something experimental. And nobody's saying that's a bad idea, it's just other things were more important. And [with] these satellites, you only get a new generation every so often. So it's not like you're getting a new geostationary weather satellite in 18 months, even though maybe that's what happened in the '60s when they were experimental. You know, in fact, [with] the first ATS-1, my understanding [is that] the proposal went into NASA in 1964 and then [they were] looking at data by the end of 1966. So that is something to be very jealous about, of idea to— from data to space, which is truly remarkable how quickly that went.

PHILLIPS: We talked with Pam Sullivan yesterday, and one of the things she brought up was the importance of training users, National Weather Service Forecasters, to use the new data from the new geostationary satellites. You've been heavily involved with training, and talk about that a little.

SCHMIT: Along with colleagues at CIMSS and other places, there was this recognition that to have a great new capability is wonderful, but then not to exploit it is even worse. So we've been able to do a number of training exercises. So initially, some distance learning, putting together videos, et cetera, and then also in-person. For example, there was— So the National Weather Service at each forecast office has what is called the SOO, or Science Operations Officer. So each SOO cycled through Kansas City to get a weeklong course on GOES-R and what was new. We were part of that, supporting it for the imager. There were also other new instruments as well. For example, the geostationary lightning mapper, other people handled that.

So between the whole gamut of writing papers, a bit more formal, to online activities, to in-person, being at conferences or, like I say, training or going out to National Weather Service locations, or even colleagues that work [on the] CIMSS satellite blog, other people that are showing real-time or near real-time events to keep things kind of fresh or remind them.

And of course it's not just a one-way street. As we show some of the new capabilities, we get a better indication of how the forecasters and others are using the data. And of course, it's not just in the United States Weather Service. As I said, these satellites see Central America, South America, et cetera, and I've been able to provide materials for some of their training as well.

PHILLIPS: Do you want to— You talked a little bit about the ABI earlier, do you want to talk about the recent solution to the loop heat pipe?

SCHMIT: So as I said, sometimes it is rocket science. Not everything goes perfect[ly]. And we had an issue with the GOES-17 ABI. Once it got on orbit, it wasn't cooling the detectors as much as it should have, which is a little bit ironic because space is really cold, but at certain times of the year and certain times of the day, the sun comes around and heats basically the face of the ABI instrument. That increases the temperature of the detectors and makes the infrared—most infrared bands—affected, first maybe noisy or striped, and then at some point, if it's too hot, actually saturated or no data.

And so they've done a really good job of optimizing that to have those outages as small as possible by, for example, we yaw flip, or 180 degrees flip, the satellite twice a year because there's more shading in one direction than the other. So that can help keep the detectors a little bit cooler, operate the detectors a little bit differently. And then recently, there was what's called the predictive calibration mode put in. The vendor came up with this algorithm. But earlier, the calibration algorithm kind of made an assumption that everything was a nice stable temperature, which it is for example on GOES-16. But that wasn't the case. So this algorithm basically extrapolated in time to calibration events to get a better calibration. But they first did that off-line, and so then they gave us some data sets and said, "How did that look? Is it better? If so, how much? What bands?" And [it was] just this summer that went into operations. So it doesn't solve the problem of some outages for some times, but that's been minimized as much as it can. But it does give— It used to be that you would have good data, and then it would get towards the heating, and the calibration would go off and off and off and off, and then you wouldn't have any data. And now with this predictive cal [calibration], you get good data, then you have no data. So that's more the case that you want to be, and not try to give people that, you know, "That cloud's actually warming," and the cloud's not warming. It was a calibration issue.

I'll just also say one thing. We've had GOES-14 as our backup satellite for a number of years, and back— We knew we were going to get the special one-minute data with the ABI, and we knew that, well, we had done that in a few—GOES-8, GOES-9 had a couple days sometimes of one-minute data, but it didn't really get to the forecaster in their office to understand how we'd use this new thing. It might be the same spectral information, but now if it's coming at one minute, how does that affect your workflow as a forecaster or whatever? So some of us said, "Hey, we have this GOES-14 that they take out of storage once a year to just make sure it's still working." So we said, "Well, it's not the next-generation stuff, but could we operate in that special one-minute mode? And that way we could have practice first of all knowing where to look." And that was a lot of fun because there was a small group that decided—but I guess I was the final decider—to tell then the satellite operators that today we're going to look at Florida, or Colorado, or Wisconsin, et cetera.

Our tagline is we wanted to make sure nobody was too happy because, of course, the fire guys wanted to go look at fires every day, and the hurricane guys would say, "Well there might be a development, we've got to look there." And the convective guys, of course, wanted to look where there's convection. So that was the first part of just where to look. Then we got one-minute data, and then that flew through dataflow, for example, to the Storm Prediction Center. So then they could— and others, the Aviation Weather Center, et cetera— So people and researchers could start getting an idea of how best to use this one-minute data. So then fast forward when GOES-

16 came online and had these two one-minute sectors, people could be like, “Oh yeah, I got this because this is how we can use that.” So we did that in parts of 2012, ‘13, ‘14, ‘15, and maybe ‘16—by then we had ABI.

PHILLIPS: There were some major storms and hurricanes where you requested the GOES-14 data, right?

SCHMIT: Yep, yep.

PHILLIPS: Can you talk about any of those?

SCHMIT: So Hurricane Sandy was in the Caribbean and was forecast to make this crazy S-shaped thing [track]. Well, that was on the same— So usually in the summer in August is when they take GOES-14 out of storage. So we had run some, and it was slated to be put back on or not take the imager data again. And that was going to happen, let's say, the next day. Well, this is when a colleague, Scott Bachmeier, told me, "You know, there's this storm out there, and it's supposed to do this, and it could be an epic storm. We've got to have one-minute data!" And so I thought, well— I started to write the email to the powers [that] be to say, "Could we extend this for another week?" And I said, "Well, there might maybe possibly be a storm." [Inaudible] Well, what the heck. "There's going to be a big storm. We've got to get one-minute data. Can we keep this thing on for an extra week?" They said yes. We got seven days of one-minute data as this thing did the S-shape and went into New York. One of my great worries was that I was going to mess up the coordinates that I sent to the [satellite] operators. And so, for example, instead of saying 35 [degrees] north [latitude], they would somehow get 35 south, and we would have one-minute data for some trade cumulus somewhere [laughs]. That did not happen. But again, I think that was the— It really opened people's minds of what you could do with some of this one-minute data.

NATHANS: I'd like to move over to AMS [American Meteorological Society] and your experience as a member of AMS. You mentioned you're making your debut at this conference as a fellow, but when did you first join AMS?

SCHMIT: Yep, I first joined AMS, I think it would have been, [in] 1984 as a student member. I was a member for a number of years. I think I actually let it lapse for a number of years [laughs]. I can't remember when I became a member of good standing again. But it's just, you know— I really enjoyed, obviously, the people that you can meet at these conferences and international colleagues as well, of course. You know, meteorology in general is an international, shared enterprise, but I think satellites are an especially small world insofar as there are only so many satellite providers in this world. And so the AMS, you know, being able to leverage their conferences to meet with people.

Yeah, it was a great honor becoming a fellow. I was surprised and honored about that. Although I do have to say, when I started this that somehow only, like, old people became mentors [fellows], so that was a little bit hard [they laugh]. And then people would say, “Oh yeah, becoming a mentor, or a fellow, is the pinnacle of your career. And I thought—this is the way I think, “Oh, that means I'm only going one way, and that's down. My gosh.” [Laughter.] But that's all good. But yeah, it was quite an honor.

NATHANS: That's great. You mentioned the conferences being very helpful, what about the journals and publishing in the journals?

SCHMIT: Yeah! I'm a co-editor for satellites for *BAMS* [*Bulletin of the American Meteorological Society*]. So I'm all for— You know, in fact, that's another— Circling back to mentors, my colleague, Chris Velden, I think used to be one of the co-editors for *BAMS*, and I think it was maybe when they were going to the new management system or whatever, [he said,] "Hmm, this might be a good time for a change. I nominate Tim Schmit to be the new one." So I guess— Yeah, we had a paper in *BAMS*. I don't know how they figured it out—this was on introducing the ABI—and I think for eight months running—this is my claim to fame—it was the most read AMS article.

NATHANS: Ahh.

SCHMIT: So, as I tell people, you really can get a big reach. Like I say, I'm a little biased to *BAMS*, but again, it would be hard to get that type of reach, I think, anywhere else. I mean, but like I say, [to] be able to write that and then know that people are at least downloading it. Maybe that's how they figure most read. So yeah, I think it's critical, you know, the whole journal enterprise.

PHILLIPS: Are there any—

NATHANS: Well I was going to say, is there anything else that you'd like to say about AMS and your membership or anything else?

SCHMIT: Yeah, just [that] especially if you're a student and younger, I mean, become—I guess at any stage of your career—become a member, get involved. There's a spot for everybody to help out, like I say, between being a reviewer or editor or just, you know, helping out at conferences, session chairs. There are more committees than I'll ever understand, but that means there's a niche for everybody to get involved in whatever their passion is. So, you know, I would say that don't just look at it as, “I've paid my dues, and then I'm done.” It's like anything else. It's what you put into it is what you get out of it.

NATHANS: Thank you, I'm all set.

PHILLIPS: Thank you.

SCHMIT: Okay, well, thank you guys for your questions and putting this down.

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