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

An interview with

Stephen Volz
Assistant Administrator
Satellite and Information Service
National Oceanic and Atmospheric Administration

At the
2019 Joint Satellite Conference
28 September - 4 October 2019
Boston, MA

Conducted by

Jinny Nathans
American Meteorological Society

Jean M. Phillips
Space Science and Engineering Center
University of Wisconsin-Madison

October 1, 2019

Transcript by

Aaron Gregg, University of Wisconsin-Madison
Sophie Mankins, American Meteorological Society

NATHANS: This is Jinny Nathans, AMS librarian and curator, on October 1, 2019 at the Joint Satellite Conference in Boston with Jean Phillips from University of Wisconsin-Madison, SSEC [Space Science and Engineering Center], and we are here doing an interview of Stephen Volz, of NOAA [National Oceanic and Atmospheric Administration], and I'm going to start, just as I said I would, by asking you how you came to be an expert in remote sensing?

VOLZ: Well, I wanted to be an astronaut, and that's what got me interested in sort of physics and understanding how things work. And growing up during the '60s, I was born the same year as Sputnik, 1958, so I grew up in the early '60s, [with] all of the space craze and, you know, *Lost in Space* and *Astro Boy* and *Space Ghost* and all of the cartoons, so that was really what energized me. My father was an aerospace engineer, so he had little models of airplanes around the house. He had little models of rockets that he used in wind tunnel testing. So all that was very exciting to me, and that was sort of the birthing of being interested in space and in science. And I remember as my first time I had a chance to fill out "what do you want to do when you grow up," the fill-out-the-education things, I looked and I saw what was the highest level of education that was listed. They said PhD, so I picked that one because that was the highest they had on the table. And physics looked really cool because it was all about physicists and science and that's what I had always seen was fun. So I wanted to be a physicist. So I didn't know I wanted to be a remote sensing scientist. I didn't even know what that was.

But I studied physics in college, and then in graduate school, I went to University of Illinois. And I discovered at that point what was really neat was being able to visualize problems, and not necessarily poke at them to visualize them, but actually to imagine the phenomenon, and then how do I observe and understand that? So I got interested in solid state physics and then eventually low temperature physics, which is remote sensing in a different sense. I was studying superfluid heliums, atomic physics, quantum physics, at one degree Kelvin and below, which has to be multiply layered, insulated, and separated from the environment or it doesn't exist. So we learned how to create a test subject in, you know, an ice cell about a centimeter cubed with gaseous helium which I'd have to cool to liquid. So I'd have to test this object in a very remote way, through multiple steps of insulation, isolation, and visualizing the steps of how you extract information from an object by proxy, in a sense. By heat here— Putting heat to figure out how an atom is moving, and figure out how the atom is moving by looking at the change in frequency of a particular capacitor plate because the amount of liquid changes by an atomic layer [inaudible].

So in a sense, I really had to— it was the visualization that was always challenging and fascinating. How to think about how to visualize a problem and then how to mechanically develop the approach to prove that visualization was accurate and correct. Along the way, I got to work with a lot of different scientists, a lot of different physicists. I didn't take any engineering courses. I loved math because it was, again, kind of a visualization of challenges, of how to frame the pictures of the phenomena or the world that you're trying to imagine, and it just was all very interesting, and it was a good puzzle, and it was a way to sort of understand things and how things worked.

And as I was working, along the way I realized that it takes a lot of work and technique to be able to do all these things. I don't program very well, I can't solder very well, I'm not a great machinist, but I needed all of these things for the system to work. So I sort of accreted friends and colleagues along the way—this lab partner was a great programmer, this guy knew how to do, you know, circuit board building—and get those people, and I could work with them. And I added something I could visualize, and I could envision how it might work and how things would fit together. So I found that was a great way to work with partners in collaboration, and that sort of set the path. I never got to be an astronaut, obviously, or I'd be wearing a blue jumpsuit right now, but that set the path that got me to always working with people of different skills in different disciplines, usually who knew their job, always who knew their part of it, a lot better than I did. But I was always able to find a way to get them and me to work together so that we could come up with something that worked. As a team, we worked much more effectively. So in a sense, it started with remote sensing, and that's what I found I was good at. I was good at doing that and envisioning, and putting the physical parameters around it as well, understanding the physics well enough, and partnering with others, too, to actually explain what was happening in something I could never touch.

Turned around a few years later when I got my PhD, and I was looking for a job. I had a job in low-temperature superfluid helium physics, which is not a really marketable career, but it turns out at the time NASA [National Aeronautics and Space Administration] was looking for low-temperature superfluid helium physicists. Lo and behold, Goddard Space Flight Center was building cryostats [a device to maintain low temperatures for samples]—liquid helium is a good cooling system for infrared detectors in astrophysics. So I got a job at Goddard Space Flight Center, which was doing— Talk about remote sensing, I started with single atoms in a test capsule at half a degree kelvin, and I ended up working on cosmic background exploring, which is looking at the origins of the universe. And that's as a remote sensing job as you can ever get because you're looking back for the birth of the Big Bang, three hundred thousand years after the creation of the universe, 13 billion years ago, but using the same physical observations, you know, the same liquid helium to cool the detectors, studying the phonons and thermal physics and understanding how a photon that's 13 and a half billion years old is absorbed into a detector, and that turns into a science understanding of the universe. And that's the kind of thing which was always fascinating to me, is that the same principles that work in a little cell at two kelvin a foot away can work with a photon at 13 billion light years away and explain how you can understand that as a remote signal of a phenomenon that you're trying to interpret and understand.

So that's what got me into the study of physics, but got me into remote sensing. And then I spent a number of years working as a designer of cryostats and systems that enable astrophysics experiments. Cosmic background explorer was one. I worked on an X-ray astronomy mission. I worked on a superfluid helium test cell mission on the space shuttle, each time working with different organizations and different people, but—

PHILLIPS: But at NASA.

VOLZ: This was all at NASA, when I was at Goddard. And that sort of got me— When I think about why I went from one task to the next, it wasn't consciously, "Okay, I've done this one now. This is another piece of the universe I want to understand." It was, this was a really exciting job, I was working with great people, and relax[ing] afterwards, or we had at a point when it was sort of routine, and then like what next, what's different, what's new? And moved on to another job which took what I knew but also added something different, gave me more skills to flex and try.

PHILLIPS: Are there some people or program managers or whoever at NASA who you met along the way who were influential in some of the decisions you made, or mentors, or—

VOLZ: I never had a formal mentor. I think there were lots of informal examples, though. In working in teams and working all the way through graduate school, my physics advisor in grad school was a first example of that, I think. He was a kid, in a sense. He was just incredibly curious about things. A little bit absent-minded, like an absent-minded professor, but he was always enthusiastic about what he was doing and about, let's see if this works, let's understand how this is happening, and not like, here's the routine that you have to do to get your PhD. Let's find out if this is going to work, and let's play with it, and let's see. And that sort of encouraged or maybe, you know, reinforced the idea that it's fun. It's rewarding to investigate the unknown. And it rewarded that and said, "So it doesn't work. You try it, and you see what happens."

So I think when I got to NASA, working in the government side, it was similar. It was different skills of different people. My first program manager on cosmic background explorer, Dennis McCarthy—I don't think he was actually the program manager, but he was the person I looked up to as my manager—he was suave, and he was, you know, diplomatic, and he was smart, and he was calm. And he was managing an incredible ship which could have fallen apart at any moment. But I learned from him sort of [that] you let everybody talk, and you let people communicate, and yet you never show that anybody is stressing you out, and you manage your work through problems and you delegate. You have a team around you that is empowered and capable.

And there are other examples of people I worked with. When I was at Goddard as well, my first job was actually managing a crew of technicians who were operating the cryostat and figuring out how to transfer the liquid helium and all that. And this guy, he probably had a high school diploma, he didn't have a bachelor's degree or anything that I'm aware of, but he'd been in the business for thirty years. And he was arrogant and confident that I didn't know anything, and I was probably similarly confident that he didn't know anything, but we both developed a great respect for each other because of the skills that he had that were things that I didn't understand or I could have understood or I could have visualized and told myself I understood, but he developed it and knew it.

So we learned that there were— Again, you learn how to work with different people with different skills, and that's— I would say throughout my career it's been that sense, it's individuals who've shown me in real life examples of how you act in a positive way or how you act in a negative way. And that's how I sort of built up a model of good performance and good partnership and good collaboration. But I wouldn't say there was anybody who took me under his wing and said this is how— this is a good career choice. It was sort of picking examples of sort of symptomatic or emblematic of individual capabilities, individual skills. And I find that since the environments we work in are highly variable, having that mixed toolbox has been very helpful.

But as far as remote sensing, it was more task-driven. It was more, what are the challenges that are interesting? But the common theme being that if you want to understand a system, you have to be able to stand back from it and observe it. You can't actually just, you can't go in and poke at it to understand it. It's one of the physics principles, the Heisenberg Uncertainty Principle. Are you familiar with that? It basically says the more you— you can't know everything perfectly. If you try and know the position of a particle, for example, too exactly, you disturb its momentum, and that's an actual physical principle. The product of the two is a fixed number. So the better you know one number, the less you know the other. So you have to kind of understand that the observer perturbs the system. So how do you observe the system in a way which is the least disruptive? And that's the essence, in my mind, of remote sensing. It's not remote probing, it's remote sensing and trying to understand it. So trying to understand the phenomenon, what are the passive signals? What comes from it that you can interpret? And that is— There's active remote sensing, but that's the passive. What we see mostly is how to take, how to learn from just the stuff that's laying around. It's almost like detective work in a sense, trying to understand how the systems work. And that was what really has guided me through the multiple examples of what we're doing.

But I'm not an Earth scientist. I'm not an environmental scientist or meteorologist. It's physics and then astrophysics, which is where I've done most of my remote sensing before I came to NASA Earth Science about fifteen, now seventeen years ago.

PHILLIPS: But it brings another perspective to the science.

VOLZ: It does, and it shows—it highlights the differences and the similarities as well. One of the biggest differences when you work in space science—I'm talking about astrophysics mostly—every photon is sacred is kind of the term we use because the sources are very weak, and they're very low-energy, or you might be looking at one X-ray photon a day from a star that you're trying to observe, so you count every photon and you suppress the noise as much as you can, the background as much as you can. But when you get to Earth science, you're overwhelmed with signal. You look at the Earth and the radiation of the Earth is just massive. You're trying to discriminate one part in 10 to the fifth or one part in 10 to the sixth of a significant signal. So it's a whole different approach to filtering out signal to find the individual signal because there's a lot— it's a cacophony of noise coming from it. But they all have little pieces to it, and trying to separate them out, not to— sometimes to suppress one to obtain the other, but the other time is to— That's the first step, is I want to understand this phenomenon, so I suppress everything else. But as I've come to work in Earth science, what I find even more and more true is that all the phenomena are interconnected, so you can't just suppress them. You have to tease them out and understand them so that you see how they contribute.

I'll give you an example. When I was working on a polarimetry experiment trying to look at ocean color, and that's sort of if you look at the color emission from the ocean you can tell what's the phytoplankton or chlorophyll in it depending on the way it radiates. It's a reflection from the sun. But the atmosphere can do the same thing, so you have atmospheric effects. You have to understand what the atmosphere looks like before you can understand what the water looks like because you're looking through the atmosphere. So to the atmospheric scientists, they don't care about the water, they worry about the atmosphere. So your noise for the phytoplankton is their signal, and vice versa. If they're looking at thin atmosphere and they're seeing signal, that noisy sea surface is the big noise source they've got to blanket out. So understanding both, you know, one person's noise is another person's signal. In Earth science, they're all interconnected in some way, some strong connections and some weak. And the beauty of Earth science system science is trying to understand the individual phenomena, but then reconnect them so you understand the collective behavior of the system. Which what I think is the— What we're going to now in our field is going from individual science to earth system science, which brings all of these phenomena back together in a fashion that they're understood.

NATHANS: I was going to say that leads right into the way we're talking about meteorology, or what's under the meteorology umbrella now.

VOLZ: Right. For many years you studied clouds or winds or aerosols or one phenomenon or another, and now what you hear a lot of is the air-ocean interface. I can't understand the atmosphere unless I understand what's happening in the ocean. A bumper sticker one of my colleagues at NOAA has is "If you like today's weather, then thank an oceanographer" because with oceanographers, it was five days ago when the water and the air were mixing over the north Pacific that gives you a storm or dry air in the eastern US. And then so it's the connection of all of those which is the real beauty and richness of the phenomena we're observing.

NATHANS: In a way, it's sort of like medicine. You know, why does your toe hurt? Because something's going on up here in your shoulder.

VOLZ: Right. And the surgeon just wants to fix your toe.

NATHANS: Exactly!

VOLZ: But the doctor should want to understand how you're feeling and understand what are the connections and what can they do.

NATHANS: But the insurance company doesn't care. [They laugh.]

VOLZ: That's right, they have a different approach to that.

PHILLIPS: So talking about connections, continuing that thread, two questions, even though we're not supposed to ask two questions at once. What prompted your— Talk a little bit about— Because you've been on the NASA side and the NOAA side of things, and these are agencies that collaborate with each other for environmental satellites, talk a little bit about that relationship, having been on both sides of that in the research-operations process and pipeline, and then sort of what prompted you to— why did you move to NOAA?

VOLZ: So the— Okay, a couple of— You shouldn't ask two questions because those are long answers to each, so we'll save the second question for a little bit from now.

PHILLIPS: Okay, good.

VOLZ: [Inaudible.] So the NASA versus NOAA, or not versus, but the different perspectives.

NASA is a great place. It was a good place for me to start because number one, it was something in my alley. It was a very easy transition from doing research to doing cryogenic studies for astrophysics experiments. But it was also neat because NASA has the unique ability maybe in U.S. agencies to define its own mission. You can ask a question, and then explore it, and then implement it, and develop it, and try and answer it. Most agencies are told what to study and told what to do, and they have to figure out how to do it. At least NASA, it's not entirely driven— The space science or, you know, the science mission director who I worked for— You're told, "Understand the universe." That's a pretty broad agenda, and it allows for a lot of flexibility. And that was neat because as I described, I could go from "what are the phenomena that I'm trying to understand and how do I get there?" to how to develop the way you would answer it or study it. And there's literally a universe of opportunities there to investigate.

And NASA had a number of interesting and exciting opportunities at Goddard Space Flight Center with a rich pool of very capable people, some of whom were similar to me in terms of sort of the broad perspective and trying to understand, just curious and wanting to understand problems. And most of whom were much more focused on "I want to understand how a field program or [inaudible] works, and I want to be the best in the world to do that" or "I know how, you know, to build little filaments that are useful. I don't know how the hell they're useful, but I want to build them and they're neat" and somebody else figures out how to make them useful. So it was a great place for that mixture of creativity and sort of specificity that a systems guy, and I consider myself a systems person, can fit into that and start making connections that can lead to good solutions.

PHILLIPS: Because you can see a larger [picture].

VOLZ: Yes, I'm comfortable looking at the larger thing and then saying, "That might work over here. Why don't we try that?" And I didn't start that way, obviously. I started off being much more concrete because I had to, because I had to learn.

After a few years of that, as I moved up through my career at NASA Goddard, I found myself moving further and further away from hardware, which is what you— It's a choice you make. And I was not going to be the expert in any single thing, so I knew that in hindsight it was inevitable, but I found myself working at different levels of collective management or test engineers or project management or things like that. And it was still very interesting, but it was a different discipline. And what got me to move away from Goddard and from NASA for a while was that I got frustrated a little bit because I got a little bit separated from— How do I frame this? Part of the challenge of working with the government is that you work with government and you work with industry because you have contractors and the like, and my job was always secure, but my programs could come and go. And there were a couple of times when a program which was going well would be delayed, deferred, canceled. And for me that just meant, okay, I'll work on something else this week. But I realized it was much more impactful on the people who worked with me. Sometimes I'd laid off— I'd cancel contracts, and I know that the impact on some of my partners in the industry [is that they] would be laid off or be really scrambling to survive. And that was frustrating for me that I couldn't do anything about it, but it was also a challenge, I think. I thought we could do these things better, so I looked for a job outside of government for a while. So I moved to industry to do similar work at Ball Aerospace, which we kind of described as a halfway house for government employees [laughter]. It was government work but on the industry side, so I just flipped to the other side of the table.

And I found that was much more— it was interesting in a new way because it was much more mission-focused and success-oriented, but it was still building the same sort of thing. Long story short—you asked me about R-to-O [Research to Operations] and NOAA versus NASA, and I'll get to that in a little bit—but what I found was I missed the larger mission part of working for the government. The industry is more focused. There's nothing wrong with that, but from my particular point of view, I liked having the larger mission, that it was more question-driven or service-driven, which brought me back to the government after about five years. It was fun in the industry, but I liked coming back to the government. And I'm not implying that industry can't be mission-driven as well, but my particular feeling was I wanted to work for the government. And that got me back to Earth Science [NASA Earth Science Division], because it was just that was where I could get a job, working back at NASA.

But in the research versus operations side, what I did like and do very much like about NASA is their ability to investigate any problem as much as they want, but they were a little bit agnostic in the sense of the end. It was not servicing an end use other than increasing knowledge and understanding. NOAA has a different mission. NOAA is, who was the customer, who was being rewarded, who was being sort of supported? And in Earth Science, that's where I really saw that for the first time. I'm not an Earth scientist, but I saw it in Earth Science at NASA. These measurements have real meaning, and they have real impact on people and understanding in economies and in people's lives and disasters and many things. There are so many things we could understand, and that was really a new sort of source of energy and compelling nature for me when I came back to NASA at Earth Science.

And so I spent about twelve years at NASA Earth Science helping enable missions, develop missions, and really seeing the value of what we do in remote sensing and in observing the Earth and delivering to the customer, to the user, to the people, to the planet. But what I saw was also frustration in the research to operations side of the house. We would research something, we would show it's a really great measurement, we would show what it's possible to do, but we weren't authorized or funded or supported to make it a service. It's not what NASA does. And we were actually— Many times if it was a choice between better science or better end-user delivery, science almost always won because that was the mission of NASA. NOAA or somebody else would pick up the service delivery.

And over time, that got frustrating because I saw the possibility of what we could do with it, but I knew my mission. And I wasn't mad at NASA, I just knew that wasn't their mission. I worked with NOAA when I was at NASA, and then in this position when I got a chance to work at NOAA, I saw this as the opportunity to actually be on the service side, to actually put my energy and effort into helping turn these observations into service. NOAA's been doing that. They didn't need me to do that because they've been doing it for a long time, but I saw I could help and contribute. But that allowed me then as the NESDIS [National Environmental Satellite, Data, and Information Service] lead to start looking at the systems delivery, the system performance, how to make all those parts work together, as we were talking about a minute ago. But having worked at NASA, I know the hundred and one ideas that are cool and neat and could work, and working at NOAA, I know the eleven of those or the nine or ten of those that are actually operational. And the gap is really significant there. Now, not every "maybe" or "possible" should be operational, but we are not doing a good job about bringing that transition over.

So I think the biggest problem in the research-to-operations is that— It's not necessarily a problem, it's just there are so many things we can do with the information we have, and it's resource limited in terms of the capacity to do all those things. Or as I found working with the National Weather Service and our own people, the capacity to deal with all that information. I mean, everybody— People who are doing emergency management are not desperate for something to do. They have lots to do. So finding a way to make their life easier so they can do more is part of the challenge of research-to-operations. It's not about more observations, it's about better observations delivered in a better way. So the research-to-operations challenge, I know we talk about it's a funding gap, or it's a programmatic mismatch between two organizations. Fundamentally, I don't think it is. I think there's a capacity challenge on the back end about operational for what purpose.

I can provide more services, but if they're not used, it's not a value added. So we have to look at the whole system, back to expanding the system end-to-end. It has to be in the capacity of the user and the community to deal with it and to work with it. And I think that's where we found—I was talking with Louis Uccellini a lot—the social engineering side of our services under-appreciated historically. It's not just a better forecast, it's in a way that can be received and acted on. And the information more broadly is the same challenge, it's not just more information. The doctor can describe exactly what's wrong with your toe, but that's not what you need to know. You need to know: what do I need to do so it doesn't hurt again? And that's the challenge that we have.

PHILLIPS: How do I prevent—

VOLZ: How do I prevent it, and how do I recover from it, you know. And that's a little bit—that's beyond just the observations, but it's definitely part of the mission that we have, is to improve lives.

PHILLIPS: And you're right. Certainly it's a balancing act because the goal of basic science, pursuing science for the sake of science and knowledge, you don't want to quash that. But being selective about what goes forward and what its use and purpose will be in the long term.

VOLZ: Yes. It's not an either/or, by any stretch. If you say, “I'm not going to spend more on research because that's wasted, just what-ifs. It's a waste of money. I want to spend on operations and services.” The people who are focused on delivering services are not going to be the ones who think outside of the box and come up with a completely new way of doing something. I will never improve— You just will never get the improvement in the system by adding more money to that system. You'll get a little bit of incremental improvement, but you'll get the real breakthroughs by having somebody outside of the system say, “Why are you wasting your time doing it that way? Here's a different way.” And being open to that when it occurs. And that's not just in systems, it's in observations as well. Finding a different way to observe the same thing is usually the incredibly—the most beneficial way to change the system performance. You measure something new in the system or in a new way, and all of a sudden you see connections and interactions that were not obvious.

PHILLIPS: That you didn't see before.

VOLZ: Again, back to that, you're observing and you're observing in a particular spectrum and you're blind to the other spectra, but somebody comes in with, you know, night lights or something in a different way, and they say you've been missing this all the time. And then it's obvious in hindsight, but it's never obvious when you're in the middle of it. So the research-to-operations— The research side is absolutely essential because it shakes up the system. Something my wife always tells me: if you get sick, you go to a teaching hospital because the doctors there are used to being challenged all the time by younger doctors who have the newest science. NASA's kind of the teaching hospital part of NOAA. You need that kind of constantly shaking you up and saying why are you wasting your time on that, that's old, this is new. And it keeps you alert, and not just— It makes you open to change when it's beneficial, while still understanding you have to make sure the patient doesn't die in the process.

NATHANS: That's very interesting. That's a very different way of looking at things.

VOLZ: It's disruptive, too, and it bothers people. It makes people uncomfortable. One thing I noticed when I came from NASA to NOAA, that's a completely normal attitude for NASA. Okay, try something new, throw a new idea on the table and create a satellite around it. At NOAA, that is not what you do. You'd better not miss your forecast. You'd better make sure that satellite continues to work for another 10 years. And you say, "Why don't we operate it a different way?" "What? No, you can't do that."

And there's a lot of merit to the continuity and consistency of the NOAA mission, but it makes it really hard to change. So coming in with— And I think— And this is the change per— We're in the middle of that right now in that everything is changing in our systems: the way we handle data, the way we have observations, the way we build satellites, the way the customer is demanding information from NOAA and from the environmental observation systems. And the way that we've been doing business in the past has got to change, or we're going to be obsolete. Others will take over the business, for better or for worse. They'll get their data from the internet, and they don't know whether it's good or not, but what the heck, it's free. So we have to respond to that, and our system has to be adaptive and open to that. It's completely changing everything we do.

NATHANS: Yeah, I find the best things always happen when you take something apart and look at it spread out on the table, and then you think of something you've never thought before.

VOLZ: The important part of that sentence is you take it apart, you don't blow it up.

NATHANS: No.

VOLZ: So yes, you take it apart and you say, “Okay, do we want to rebuild it the same way?” Yes. And but you're critically examining the functions of the systems you have, or the pieces that you have. And environmental observation is the same way. You have to understand all the individual phenomena, and then you look at them in isolation and in collections and you say, "Okay, so how do they work together?" But you don't just stare at one, you have to look at them all together and understand how they're behaving.

So now we're looking at how does biochemistry— and we're talking about ecosystem modeling. It's just an incredibly rich field. And we've never had to have biology in our forecasts, but if you're doing water quality and harmful algal bloom forecasting, there's biology in there. There's biochemistry in there. It's not just physics of this atom moves over here and interacts with that, and you have a chemical reaction. You've got life creating in there, and it's based on runoff on the ground because somebody fertilized a week ago, or the pig farm was upstream and there's, you know, biomatter. So imagine the complexity of that system change. So our forecasting group has to think now beyond just the physics, but to the biophysics and the biochemistry. And it just makes it much richer, but it requires a whole different appreciation of the different organizations, the different disciplines that have to get engaged.

NATHANS: Now this is a way of working that you've come to understand is a useful way to work, but you've come to the understanding of it throughout your whole career. How do you train young people, new graduate students to work this way? Because it's different.

VOLZ: I think it's not as— I would say I look at it differently. I think the younger students coming out today are all involved in cross-disciplinary science.

NATHANS: Yes, you're right.

VOLZ: When I grew up, there was a physics department, there was a chemistry department, and you maybe met during the spring softball game, you know. And the math department's on the other side, and the engineering, god, they were a different species entirely. Now, though, you have biophysics and bioengineering and computer science and computer engineering and, you know, biomechanics. So I think the connection between these fields is much more blurred than it was. So I think the real challenge is training the older people who have spent a career understanding a phenomenon, and telling them that's not enough. The solution to our problem is not a better LiDAR [Light Detection And Ranging] or a better microwave sounder. The solution may be we don't need a better microwave sounder, we need a different kind of measurement in a different way. We need to introduce a surface measurement or an airborne measurement or something else different to change the way you get it rather than just refining one extra point to what you've spent your lifetime doing.

PHILLIPS: One piece that is sort of evidence of that is when you look at just academic publishing over the years. We very rarely now have papers that are single authors. They're all multiple authors. There's so much collaboration and multidisciplinary work. And I'm based at CIMSS, where everything is team based, and people are from different disciplines.

VOLZ: And what do you think is driving that? Is that natural, or is it forced, is it—?

PHILLIPS: I think that PIs look for, just as you have, most of them look for strengths to bring to a problem or area of research.

VOLZ: Yeah, I think we're at a point in maturity where the growth in understanding is at the interfaces between disciplines. We spent a lot of time— You know, a hundred years ago we didn't know how crystals were designed, so we had to understand the bulk crystal, how the different molecular bonds form, and now it's about crystal fractions, and, you know, where the cleavages are and then what comes in and how those interactions occur. So we understand the mean field approach, we understand what the average is now, or what the individual phenomena are. It's where they mix where all the dynamism is and where all the excitement is. And I think in Earth science and remote sensing, it's the same way. We understand just general winds, but it's how do they change, what's the turbulence, where's the interface when you have cold and wet and dry and hot mixing, or wet and dry mixing, or the ocean-atmospheric interface? And that's where the physics gets very nonlinear and very complicated. And we're able now to probe with enough accuracy that we can see those boundary layer occurrences. I mean, it was brought up yesterday, what's the biggest problem? It's the planetary boundary layer. It's where you have this layer between two different media interacting. We don't understand it.

That's where the greatest growth is going to be, in understanding the boundaries between different interfaces. And the ocean-atmospheric interface is one, you know. For example, I think the air, land and ocean— One of the richest fields of discovery right now, I think, is going to be in the coastal zones. How to— It's not discovery as much as understanding of the impacts, of how the ocean and the coast and the land and the atmosphere all mix together and what that means for humans in that area. So understanding sea level rise, but also the way that the algal blooms occur on the edges of the coast and why. And how is that influenced by land use, and how is it influenced by human populations?

All of these things bring in so many different disciplines and different measurements in a way that we haven't really managed that kind of investigation well in the past. It's been the city managers who have managed that, not the physicists or the scientists. But now we're at a point where we have the information to develop the models. And it's not going to be done by an atmospheric modeler or an ocean modeler, it's going to be done by a multidisciplinary team which brings these different kinds of disciplines together. That's where the growth is going to be, and that's why you see these teamwork projects and assessments. But it is disruptive, it's challenging because you have to bring somebody in who speaks a different language, and we've seen that quite often as we've talked at NESDIS about making changes in the way we do our business. The guys who do algorithms to process data are not the ones who manage the instrument development and not the ones who manage the operations of the satellites. And getting them to work together in the same room is tough because they all have to get a little bit outside their comfort zones as they work together.

PHILLIPS: And everybody talks a different language.

VOLZ: And they do. We all talk the same words, we talk about requirements. [But] you use the word "requirement" and you throw it into that room, you get fifty different explanations. And they're all valid in their little ecosystem, but they're confusing in the bigger one. So you have to go to a lot of common— We call it storming and forming, you know, where you kind of get that, you know, common understanding of what the phenomena you're trying to address is. And that's really the biggest, I think, inhibition to initial success, is getting through that sort of common language, common framework for discussion. And we're going through that right now in our Earth observing systems for NOAA as we're trying to define what does the next generation of remote sensing organization look like.

PHILLIPS: That's my next question, yeah.

VOLZ: So do we build more satellites, or do we build better ground systems? We're in an incredible period of availability of data from dozens and dozens of satellites on orbit, some good, some better, some not so good, but all producing data. And the answer to our problems in improved forecast is not a better satellite, necessarily. It's better use of the data we have. So that's a challenge for those of us who build satellites, who want to build more but know that the data that we're making right now are not necessarily being used efficiently by the modelers. So in NOAA, we're looking at how to improve the model building to take in data, the assimilation of new datasets, so the models can be updated more frequently and more rapidly. So we just had a talk in here on ADM-Aeolus [Atmospheric Dynamics Mission-Aeolus], which is a LiDAR, wind LiDAR measurement, which is a great new measurement because it can directly measure the motion of winds in the atmosphere as opposed to inferring it from clouds or from particles. And it's much more accurate. It's only really narrow slices of it, it's not global. So how do I fit that in? How do I add that to the system which is already optimized around a different measurement parameter? So that's where we're looking at our observing system. It's not just to get a better measurement, but to get a better collaboration of the measurements to produce a better outcome. And that requires the modelers to work with the observers from the start, not just give them data and have them work with it. And that's the challenge we're facing right now as we look to the next investment in the future for observations.

NATHANS: Very interesting, yeah. Can we turn a little bit to AMS [American Meteorological Society]?

VOLZ: Sure!

NATHANS: Because I notice from your bio, you very nicely put the dates that you became a member of the various societies.

VOLZ: You can tell my pedigree from that timeline, right?

NATHANS: Yes, it caught my eye. And you didn't join AMS until 2008. So this, what we've been talking about, is what has brought you to AMS.

VOLZ: So yeah, it's interesting. You'll see— Somebody else made the comment, "I became a member of AMS when it was how I got my reduced registration fee for the conference." [They laugh.] And you'll probably find in that I got my memberships when it came up [for] reduced registration fees for conferences I was going to: APS [American Physical Society], AAS, American Astronomical Society, GRSS [Geoscience and Remote Sensing Society], et cetera. So why AMS not until 2008? Well, I didn't need to be a member. I didn't recognize— I was a physicist, and I was an astrophysicist, and then I was in the Geoscience and Remote Sensing Society, that was GRSS, and that came around when I joined— after I came to Earth Science. And I was still building instruments and satellites, but individual ones. When I joined— When I became the associate director for the Flight Programs at NASA Earth Science, I was responsible for the whole portfolio of missions. And also in '05 and '06, I was responsible for the continuity of all the operating satellites of Earth Science. So I got to see, for the first time, really, from a professional point of view, I got to see the suite, the whole suite of missions that we were flying. And got to really see how they were complementary to each other and, you know, the big picture of what we were able to see.

So I joined the AMS and GRSS, the Geoscience and Remote Sensing Society, around the same time because I saw where that was the place where this larger observing system interacts, and that's where I saw the value in that. And it was conference-based. That's where people go to talk, and that's where you get these interactions between different disciplines in the bigger discipline, but that's where you get the interactions. And so the value in that was going to those and seeing that, and joining AMS was a way to see the ecosystem of the meteorologists and how they interact and how they work together and what challenges, what questions they're facing and addressing.

And every one of these positions when I moved on is bringing what I have to it, but at the same time absorbing and learning from what's there at the same time. So I brought— When I came to AMS in '07, '08, I brought the observing system from NASA—I didn't bring it obviously, but that was my portfolio, the expertise that I had—and I felt comfortable enough to talk from that position of strength. I knew the remote sensing, I knew the satellites, and getting into this in the AMS environment, I could see then from the research side some of the research in atmospheric science and weather science that AMS was doing. It was my first real introduction to NOAA as well, although I worked for it a little bit during the development of JPSS [Joint Polar Satellite System] and Suomi-NPP [Suomi National Polar-orbiting Partnership].

But it was the observing system side of the house that brought me to AMS, not the— I'm not one of those who looked up and thought, "Hurricanes, these are cool. I've got to understand those." They were cool, but it wasn't a passion for me to understand atmospheric or Earth science. It was more the beauty of the interacting phenomena that you could observe in remote sensing and how you could actually understand these things. The universe, the Big Bang is a lot simpler to understand than the Earth, surprisingly. I mean, the Big Bang is just energy and photons. The Earth is a lot messier. There's chemistry and physics and gravity and biology, and the understanding of the Earth is a lot more complicated than the understanding of the universe. And that was a challenge as well. When you talk about big data and big challenges, understanding how all these things work together is a lot tougher than postulating the creation of the universe.

NATHANS: Did the— The conference structure, you know, over the course of the year then suits you, the way AMS is organized to provide that?

VOLZ: Yeah, I think so. I think that the conference and the workshops, I think those are sort of the watering holes of our ecosystem.

NATHANS: I like that.

VOLZ: It's where the different species come together, and they don't fight. They drink, and they communicate. And it's a good place to get that kind of communication because everybody prepares for it because they all want to look good to their neighbors. You know, it's a chance to shine and a chance to exchange your latest ideas, but it's also— serendipity is key here as well. I came to AMS late in my career, so I never had the opportunity to come in and give sort of my own fundamental research applications that I was able to do in physics. But so I come in not— I found the one drawback I would think from where I am in my career is that I don't get to as many talks as I'd like to get to because I tend to be talking in the hallways more than I talk in the conference rooms. But still, it's a place where the people come, and you get a lot of energy, and you get a lot of interest. And that's where the new ideas are kicked around, and where you see— and when I talk to my colleagues in the observing system field, from international and interagency as well. But it is really a place where people come to meet and talk. Not so much— They come to present, but they come to meet and talk just as much.

NATHANS: Yes, yes.

VOLZ: And it's not just these big ones, but it's like the summer workshop and the spring forum they have in Washington D.C. is useful. I think all of these are— We're communications challenged. There's too much information available on the web and everything else, and too little face-to-face, where I think you can really discuss the underlying issues, not just the physics of it. So these are good opportunities to do that.

NATHANS: Well, and that actually goes all the way back to building teams.

VOLZ: And collaboration.

NATHANS: And collaborations. And you have to know the people.

VOLZ: Yeah, and where I am in my career right now, both when I was at NASA and now here at NOAA, I'm on a lot of different organizations, multilateral, multinational organizations that we have a lot of like CGMS, the Coordinating Group for Meteorological Satellites, CEOS, which is the Committee on Earth Observing Satellites, GEO, the Group on Earth Observations. I spend a lot of time in those meetings. At some point, too much time at the watering hole, and you just get— you're not thirsty anymore. So there are the places where you have the forced collaborations, but I think the conferences are better in terms of the serendipitous opportunities that you get. I appreciate that they're different from those forced collaborations, which are necessary but sometimes onerous. The conferences, I think, are a great place for the opportunistic meetings.

NATHANS: Do you have anything else?

PHILLIPS: Just is there anything that we didn't touch on that you would like to share or expand on?

VOLZ: I said when we started at the front of this I'm an odd candidate for AMS because it's not been my roots. I think, though, that what AMS and what meteorology and weather and observations brings [is] the incredible energy that there is in the community. The generation, not the next, but two generations behind me—I'm 60, so, you know, the 15-35-year-olds—is incredibly powerful. And I'm concerned that we're not tapping into it well enough, or we're not finding the right avenues to enable that kind of energy and intensity, and that— You asked, “Is it tough getting people to think multidisciplinary?” It's tough getting the people who don't think multidisciplinary to step out of the way a little bit or go open their minds. So finding ways in AMS or other organizations where you can put that generation in front in terms of challenging an approach to problems I think would be to everybody's benefit.

[Cross talk.]

PHILLIPS: So we had a meeting this morning with a young man who is a high school student, and he's at the conference, and we were left with just, you know, the wow factor of his presence here, people he sought to connect with and network with, and—

NATHANS: And his initiative on his own to do observing, to go to conferences, to take courses, because he's only a senior in high school.

PHILLIPS: To seek out ways to connect. And how do we replicate that?

VOLZ: That's key. And as much as these exemplars are really great, it's the next 90 percent, not just the one percent or the 0.1 percent, the 90 percent. That energy in that community is incredible, and that is what will get us through this next fifty years.

PHILLIPS: Yeah, he's very passionate.

VOLZ: So we have to figure out how to enable that, and how to channel—not channel it, channel it sounds like too controlling—but to ride it, to ride that wave of energy and intelligence in an effective way.

NATHANS: Yes, because he's also hugely smart.

VOLZ: They don't know it's not possible.

NATHANS: Right.

VOLZ: We do know it's not possible, and that's why we're blinded to seeing— We've been in it so long we need somebody that says well, of course—

PHILLIPS: That's why you can't see the one parameter that they can see.

VOLZ: No, and I can't. I don't understand how the internet of things is going to change the way we do this. I can give you a theory on it, but that's not— I'm still thinking of how it's going to change things. They think of how it is the thing. And that's a different way of looking at problems.

NATHANS: Well, and he was just like a giant sponge because anything that we told him that he hadn't heard of before, you could just see him drinking it in, and that was amazing.

PHILLIPS: The watering hole was still working for him [they laugh].

VOLZ: Okay, good.

NATHANS: Yes, he was right there [laughs]. So yeah, that absolutely bears you out and connects to— I love it when interviews connect.

VOLZ: That's the only thing that occurs to me as I struggle with getting our community to change: to accept that the change is inevitable, number one, and that it's not necessarily negative, number two. I know that if I were able to get outside of a couple of circles, it would not be a problem.

NATHANS: Yeah. Well, this was great, thank you.

PHILLIPS: Thank you so much.

[END OF INTERVIEW.]

[. . .]

[END OF TRACK.]