Transcript of "Tom Kilpatrick, Oceanographer at the Bureau of Ocean Energy Management in Sterling, Virginia"

Clear Skies Ahead: Conversations about Careers in Meteorology and Beyond

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Kelly Savoie:

Welcome to the American Meteorological Society's podcast series, Clear Skies Ahead: Conversations about Careers in Meteorology and Beyond. I'm Kelly Savoie, and I'm here with Rex Horner, and we'll be your hosts. We're excited to give you the opportunity to step into the shoes of an expert, working in weather, water, and climate sciences.

Rex Horner:

We are happy to introduce today's guest, Tom Kilpatrick, who is an Oceanographer at the Bureau of Ocean Energy Management (the BOEM) within the U.S. Department of the Interior, located in Sterling, Virginia. Welcome, Tom. Thanks very much for joining us.

Tom Kilpatrick:

Thanks guys. Pleasure to be here. Very excited.

Kelly:

Tom, could you tell us a little bit about your educational background and what sparked your interest in oceanography?

Tom:

Yeah, yeah. So I started out as an undergraduate at MIT [Massachusetts Institute of Technology] in the Civil and Environmental Engineering Department. So even at that age, I had some interest in applying science to the environment. Because [at] that department, they study construction and materials, but also there's a whole environmental engineering wing. So I worked in a laboratory there at Parsons Lab as an undergrad. So I was interested already in environmental fluid dynamics, for example.

Tom:

I ended up switching majors into applied mathematics after a school trip to Hawaii, actually, where I was for the first time exposed to a huge surf, actually. And surfing was maybe the initial hook that drew me in and wanted me to learn more about the ocean. So, that inspired me to work at Woods Hole [Oceanographic Institution] for another summer internship and then eventually to apply to graduate school at the University of Hawaii in physical oceanography is where I got the qualifications that enabled my career path after that.

Rex:

Tom, how did you end up at MIT? I know that's a pretty high profile school. Most people know it. How did you find out about it and how'd you apply and ended up going there?

Tom:

Yeah, that's a great question. Well, MIT was my dream school, so I was fortunate enough to have a chance to go there, basically just working hard in high school. I had taken a couple classes at the University of Michigan as well when I was still in high school, which probably helped me prepare that application package. And also, I think I was a recruited athlete as well. So MIT sports are Division III, so it's not like what you see on ESPN, but they do have limited recruiting for the different sports teams where the coaches get a little bit of a say in admission. So I think that might've helped as well.

Rex:

What was your sport?

Tom:

So I played baseball and football. So, I think I was a recruited athlete for baseball, possibly for football. I don't remember exactly. And so, for young student athletes out there, it's good to reach out to coaches at the schools you might be interested in.

Rex:

And did you play for all four years of college?

Tom:

I did play football for four years. Baseball, just one year.

Rex:

What was it like balancing your sports career with your academic career as far as time management and those different responsibilities and commitments?

Tom:

That's a great question. It was really a challenge, especially during the season, because we'd have practice for two hours every day and then extra time in the training room, icing or rehabilitating injuries. So that was quite a challenge. So by my third or fourth year, I remember I would try to take a lighter course load in the fall and then load up more on courses in the spring. So, it's definitely an extra challenge. And for preparing your application for grad school, if you were thinking about going down that road, there's an opportunity cost as well.

Tom:

Sometimes I second guess myself that maybe I should have spent a bit more time, for example, some of that time, I was playing sports, which I loved. It was a great experience just for my life. I could have used that time for other things like working in the lab, like take an extra elective class in a topic that maybe you have some interest in, but otherwise you wouldn't have a chance to explore. So yeah, this was just the choices that you have to make in life.

Kelly:

Yeah, because that's a lot of time, two hours a day. Wow. That gets into that study time. Doesn't it? You must've been up very late at night doing studying.

Tom:

Yeah, a lot of late nights. Definitely a lot of late nights. Still when you're 19 years old, can pull it all night. I don't think I can do that anymore.

Rex:

I don't think I could either. What opportunities, Tom, did you pursue while you were in college that helped you to securing a job in your profession of choice or [in] propelling you into the next stage of your career after college?

Tom:

So I had a couple of internships. So I mentioned the research internship I had at Woods Hole Oceanographic Institution. They had this great long-running summer program. That's part of the National Science Foundation R.E.U. or Research Experience for Undergraduate program, [which] has been going for decades there. So I definitely recommend undergraduates who are interested in learning about oceanography and getting really a hands-on experience with some of the top people in the field to take a look at that. But also on the industry side, I had internships with a construction company in Boston one summer.

Tom:

And I worked in Japan as part of the MIT-Japan program. As I mentioned, I started out in engineering. I thought I wanted to go that route. So, I was exploring opportunities with internships in industry, which are also great, give you a hands-on experience, up-close view of what the day-to-day life is like in that field. I ended up deciding I wanted to go more, at least initially, the academic route and try to get a graduate degree in oceanography after that.

Rex:

So the opportunities, I guess were traditionally beneficial in a sense—they led directly to a job—but they were [also] very beneficial because they gave you context and lots of experience to help inform your choice of what you wanted to do next. Does that sound like a good characterization?

Tom:

Absolutely. So, I would strongly recommend for undergraduates to pursue those types of internship opportunities. You might have some sense of what you think you want to do from your classes or from friends that are older than you gone on to different career paths, but there's nothing like being there yourself and working on the actual assignments that the professionals in that field have to really let you—and then you really know if you like something when you're sitting there doing it on a day-to-day basis, working with professionals in that field.

Tom:

So those are fantastic, when you can do in different fields in industry, a lot of opportunities. It's almost like a prerequisite, I think, for some fields now to get job offers is at least people who have interned with a company, I've heard, could be at the front of the line, depending on the company. But also, you want to go to government and work in policy, or certainly if you want to go to graduate school, that's almost like a prerequisite, I think, for the top graduate programs to have some substantial research experience.

Rex:

Good to know.

Kelly:

So speaking of careers, what was your first job in the field, and how did you end up at the Bureau of Ocean Energy Management?

Tom:

So after I got my Ph.D. in physical oceanography at the University of Hawaii in 2013, I guess you could say my first job was as a post-doctoral scholar, what you call a post-doc position at the Scripps Institution of Oceanography at U.C. San Diego. So I worked there for five years as a post-doc. I wouldn't recommend people working that long as a post-doc, but Scripps is so nice there, in La Jolla. I stretched it out to the max. And then I stayed two more years as a—my title was Assistant Project Scientist. So that's a similar flavor where those are not really career positions.

Tom:

When you see someone with a title like post-doc or project scientist or research associate, research scientist, that usually means that it's a temporary contract position where you're working on a funded research grant. That usually has a timescale of maybe three or four years. So I was working on a couple of NASA projects there, which were great experience in Professor Shang-Ping Xie's group.

Kelly:

And do most people do that while they're pursuing a Ph.D., or do you do that afterwards?

Tom:

No. The way it works is usually for those is [that] a Ph.D. is required to be a post-doc or to be a research scientist or a product scientist at these research schools in the U.S. or at the national labs [which] have those kind of positions as well. So yeah, you would complete your Ph.D. and then the usual path, if you want to go the academic route—which I had aspirations for a while there—is to try to become a tenure track professor, to be a research scientist at some of the national labs, like the NOAA lab or the Department of Energy, where you're doing research as your full-time job.

Tom:

Usually, you need a couple of years of post-doctoral experience. So, that was the path that I was pursuing there for a while.

Rex:

Tom, what convinced you not to follow the tenure track career path?

Tom:

So I tried pretty hard. Basically, it's highly competitive. So, at a certain point it just became clear that I think I had to explore other opportunities besides just trying to be a tenure track professors. This I think happens, at least among my friend group, that this a pretty common issue that people face. You just run into this arithmetic, that there are just very few of those career scientists positions or tenure track faculty positions at research schools.

Tom:

So compared to the number of Ph.D.s that are graduating every year and even that are doing productive post-docs where you have a number of publications, it's still quite competitive. So, I made a pretty good try of it. Even was interviewing for faculty jobs as well, but then when the pandemic hit, I was looking into all the opportunity as well in the industry, and be happy to talk a little bit about that, my experience interviewing for different types of positions. But then I had this great opportunity arose basically working for this government agency, Bureau of Ocean Energy Management or BOEM, where I'm going to be working more as a project manager or a program manager type of role, I should say.

Tom:

Or I'll be on the other end of the table, overseeing their science projects that they fund. So it's pretty cool. I think it definitely aligns with my interests. I can use what I've learned and still be around science and try to put some of what I've learned to use for a purpose, which is our main responsibility. Our jurisdiction is the Outer Continental Shelf or the O.C.S. of the United States, and trying to utilize that for energy in a responsible way.

Rex:

How far does that Outer Continental Shelf extend past the coastline?

Tom:

That's a good question. I think it starts at nine kilometers from shore. So the initial coastal region from the beach out to nine kilometers or in some States it's out to four kilometers, that's usually state jurisdiction. And then typically beyond that would be federal jurisdiction.

Rex:

Got you.

Tom:

So most of the Gulf of Mexico, where there are thousands of oil and gas rigs currently, that's all considered the OCS that's under BOEM's jurisdiction, or now there's more of a push toward renewable energy, wind turbines. Specifically the Southeast coast, there are already a number. I think two wind turbines just went live recently in federal waters. There's a couple of in state waters off of Rhode Island as well, the Block Island project, but there's going to be—it's looking like more in the future, there's a bunch of leases that have been issued for future wind turbine development in the OCS.

Rex:

Great. So, I understand you started your new job at BOEM recently in August, and you'd been at Scripps for seven years, as you said, before that. So clearly, you said you had a lot of affinity and a lot of passion for Scripps and the community there. So can you give us a little bit of insight into what role Scripps played in the atmospheric science community and what made it a unique employer?

Tom:

So I really only have great things to say about Scripps. It's, I think, really a special place with a terrific research environment, collegial environment with just really talented faculty, lots of amazing lead talented researchers and post-docs and grad students as well. But just a very positive environment

where people try to support each other. I didn't really sense the toxic environment that you can develop at schools, unfortunately, sometimes. Their heart and soul is really more in oceanography than in atmospheric science, I think.

Tom:

Maybe some of the atmospheric science people might object to me saying that, but their legacy goes back to their origins, I think, as a naval research laboratory. It actually predates the main U.C. San Diego campus with which it's now affiliated. But they still have, I think, a solid group of atmospheric science professors, especially in cloud physics and aerosol, they've had some great people working on that stuff for decades now as well, but they've been expanding more into climate science recently.

Tom:

So yeah, as we move forward to the future, studying oceanography as one component of the integrated earth system, I think Scripps has already made great contributions where it's poised to continue being a leading research institution due to the location and just the great personnel they have there. And just the positive culture, I think, that they've been able to cultivate over time.

Rex:

What is La Jolla like as a place to live and to work in?

Tom:

It's really beautiful. For the listeners who haven't visited San Diego or seen it, Scripps is literally on the beach. I don't know if anywhere else, other oceanographic institutions even—maybe Woods Hole would be the closest where like the buildings are literally on the beach. Or even if you're just a little bit up the road, the grad students. They keep their surf boards and their wetsuits in their office and just walk down for a surf session before their class. It's an amazing thing to see. Once you get used to it, sometimes you still have to take a step back and appreciate what you got to experience there on a day-to-day basis.

Kelly:

So the transition for you, this is going to be quite a transition from the West Coast to the East Coast and also interviewing during a pandemic. Could you tell us a little bit about how that worked for you?

Tom:

Yeah. Definitely, it's just been crazy. So I started applying more for a career. So I mentioned this project scientist role I was in was more of a temporary contract type of role. So I was applying for different types of more career positions, both in government and in industry and for university faculty jobs as well, starting the previous cycle. So really it was before COVID hit, when I started applying. So I was pretty far down through the process at various places before everything started to shut down.

Tom:

When things were normal, one faculty job that I was interviewing for, that one got shut down halfway through the search, unfortunately. And I think some of the industry positions, they did end up filling some of those. I think the university hiring seems to have dropped off a cliff since then, just based on my anecdotal experience and people I've talked to, but industry hiring seems to be pretty strong for Ph.D.s. It hasn't been affected too much. So anyway, this opportunity for government came up. I don't know if it

was in spite of COVID or just perhaps the government budgets maybe are a little bit less sensitive to economic forces the way you might expect in other areas of the economy.

Tom:

But I guess for this one position for which I ended up getting hired, we just did the interview process over Zoom. And I never got a chance to meet people in person, but otherwise, I think it was fairly smooth and they didn't have to change too much. For government positions, you just apply online via this website, USAJOBS, and then they reach out to you if you're selected for interview. That's pretty straightforward.

Kelly:

So, are you going to have to relocate? Probably not for a little while, right? They're going to let you work remotely?

Tom:

Yeah, yeah. So I asked the director of BOEM about that just last week. We had an orientation program. And he said that he doesn't foresee people coming back to the office anytime soon, basically until there is a vaccine that's widely available. He didn't see any reason for it. They've been apparently pretty happy with people's productivity working from home. So, it's looking like spring at the earliest, but from what I've read about the vaccine available, they might not be until autumn or even winter of '21 before people are back in the office on a daily basis.

Kelly:

Wow. So could you walk us through a typical day on the job there since you started in August, some of the things that you've been doing?

Tom:

Yeah. One thing I learned is onboarding for a government position takes a lot of time. There's a lot of the initial paperwork and then tons of training of all different kinds; learning how to use different software systems. So, really it's been more than two months, and the majority of that time has been doing these different onboarding trainings and tasks. So I still haven't completed that actually. The time I've been able to carve out for other stuff, that's been getting up to speed on the different projects. So this is the Division of Environmental Science that I work in within BOEM.

Tom:

So we have a research budget of something like $30 million a year. We use to fund scientific studies on the Outer Continental Shelf or across the continental U.S., and also Alaska and Hawaii for stuff that's relevant to the energy industry and the permitting of future oil and gas or future wind turbines. We have to do studies and make sure that things are safe. So that's what I've been doing now is just trying to get up to speed, reading all the proposals, getting in touch with the other people who've been working on these projects, having a little bit of communication with the scientists and the research teams that are carrying out the work. Just trying to get up to speed, so that I can manage those.

Kelly:

And once COVID's over, would you be doing any traveling or field work?

Tom:

I think so. Yeah. So BOEM has the headquarters office in Sterling, Virginia, right outside D.C. And then there are other offices in New Orleans and in Camarillo, California, near Los Angeles and then also in Alaska. So I think for some of these—like I'm involved in this big project that was recently awarded funding for fiscal [year] 2021 that will be led by the New Orleans office. I think for that, I'm going to definitely be traveling to New Orleans, to meet with some of their staff who put in a lot of the legwork for that project and possibly to all their offices as well.

Tom:

So it's pretty cool. Possibly, there'll be some international travel, because there's an emphasis now to try to work on studies in partnership with other agencies or even with other countries. So yeah, that's definitely something I'm looking forward to, once things get back to normal, is being able to go out in the field a little bit.

Rex:

Tom, do you feel that some of your day-to-day responsibilities from your contract position at Scripps transferred to your new role as an oceanographer?

Tom:

I think so. I think so. Definitely. So at Scripps, my day-to-day time was consumed by actively doing research. So pulling data from satellite sensors, from institute buoys and ships and doing analysis on my computer in MATLAB or in Python. Also, running simulations with a numerical model. There's an ocean circulation model or atmospheric circulation model we used to run to compare with observations. And writing manuscripts and communicating with colleagues, going to conferences. All that builds up your knowledge base for how science works that's certainly, at least, on background going to be vital for my new position, because I'm going to be overseeing these scientific projects.

Tom:

Maybe doing a little bit of science on the side, I'm hoping a little bit hands-on. Be able to spend a little bit of my time on scientific research, I mean, but majority of my time is going to be overseeing these projects. So it's basically a prerequisite, although my current job function is a little bit different from what I was doing before.

Rex:

It certainly helps when you're managing to know the job that the folks you are managing are doing, so that you can treat them fairly and make sure that they're doing the job as they should, and as it is done, and as you know from experience. So on a different note, can you tell me from your time at Scripps, was there a particular project—and this could also apply for college and not just Scripps—was there a particular project you worked on that you felt was especially influential or eye opening to you, your interests, or the future of your career?

Tom:

I'm not sure I would go that far, but the main project I worked on was I thought a really cool project. We were funded by the NASA Physical Oceanography program to utilize their satellite wind observations and observations from their other satellite sensors, which measure sea surface temperature or sea level,

to study air-sea interaction processes. So specifically, the main thing I worked on was how, when you get down to the ocean basin-scale, which is maybe 200 or 300 kilometer scale, how do the sea surface temperature gradients impact the surface winds?

Tom:

Basically, there's this air sea coupling at that scale that's still very much an active area of research and how that affects the ocean circulation. And more generally, how does it affect climate? Also, a little bit on regional rainfall, how ocean circulation can affect rainfall at the regional scale was another thing I worked on. So those were really cool projects, I thought, just intrinsically and a chance to use satellite observations and computer simulations together to further our knowledge of the earth system. So just on a day-to-day basis, I did appreciate every day, just being able to work on something. At least to me, that was just such a cool thing to work on.

Kelly:

So, what do you like most about your job, whether it be Scripps or the Bureau of Ocean Energy Management? Are there certain things that you enjoy more than others?

Tom:

I would say at Scripps, so working as a post-doctoral researcher and a project scientist, the number one thing I liked was just the terrific intellectual environment. Just the level of people they have there is really amazing that you get to sit in lab meetings with the professors and the other young scientists, the post-docs and so forth that are there. It's just a great environment to be in. And the creative aspect of science where you're attacking these problems that there's no answer. It's not like when you're in school and you're going through a textbook and the teacher gives you some homework and the right answer is known and you just have to produce that answer.

Tom:

At the graduate level, things are really different where you're addressing these unanswered problems in science. So no one really knows what the right techniques are, whether it's the right observations even that you necessarily need and the new technologies that you need to observe this phenomenon better to improve our understanding. So that is really great where you did have a supervisor or I had a supervisor, but it wasn't like I was being told in detail what to do every day. There's really a lot of room to explore problems that you think are interesting, but also to choose the approach that you think is interesting, that's going to gain some traction.

Tom:

So that is really what I value most. And then the downside though, for those kind of temporary research positions is the pay is not that great compared to what I think someone at that same age would be able to earn in industry or in other types of more "normal" jobs. And the job security is also not great, because like I mentioned, the timescale of the research grants that you're working on as a post-doc or a researcher is usually just a couple of years. So you always have to worry about your funding. It's just paying your salary. So that leads to a lot of anxiety among the young scientists.

Kelly:

So for post-doc, do they provide you with housing or do you have to pay rent?

Tom:

I lived in university housing, so yeah. U.C. San Diego has pretty good housing for their staff, that many post-docs live in. But it was maybe 10 or 20% cheaper than the off-campus housing. So, some people lived off campus as well.

Rex:

Were there any other challenges you faced in your job at Scripps or your job currently, besides I guess, lack of job certainty in the long-term? Are there any other challenges that you felt you faced that you haven't mentioned yet?

Tom:

I guess I'll talk briefly about Scripps and then try to touch on my current situation. So working in research, the thing that can be a bit of a challenge is, it can be a bit isolating sometimes that you're working on your own project. Which is part of the appeal for many people as well, too, that they're staying on this problem that's important to you in solitude. But the downside of that is it can be quite isolating sometimes. And if things don't go well, it can be a little bit tough. It requires some mental toughness. I think, to get through the challenges sometimes.

Tom:

So there's a certain mental toughness, I should say, that's required, I think, to do well in science. It'd be another challenge, I would say, about having worked in a university. And then I forgot to mention about my current situation. Mostly, like I said, doing onboarding and training, so I haven't really been able to get too deep into the projects yet. But I'm really excited about BOEM's role in helping to provide energy for the country in coming decades in a responsible way by utilizing these considerable resources that we have over the Outer Continental Shelf.

Tom:

So far, it's been pretty smooth sailing, considering that, I guess as an aside, trying to onboard into new job during COVID has been very strange to not be able to meet my coworkers in person. That's probably been the toughest part, frankly, for my new position is just the lack of being able to go knock on my coworker's cubicle and ask for tips or questions or go for a cup of coffee. And that's something that I guess might be here for a while as well, so for those of you young people out there that are looking for jobs and are starting out in new positions.

Tom:

I don't know if people have really figured out how to overcome some of those hurdles yet. That's, I guess, been the toughest part.

Rex:

Does your job offer any social hour on zoom or some chat-based channel that's more casual, not for work-related matters or any other fun activities like that?

Tom:

Not to my knowledge. I think there are regular coffee breaks, at least on the schedule, but last time I checked into one of those, there was no one else there. So, I'm not sure how active those are. And we

do have group meetings maybe every other week. So I at least see some other faces sometimes. But just when you're starting out in a new group, sometimes to get that feel, not just for your work, but to get your feel for other people, it's nice to have some of that informal time with people. And to not have that has been definitely just a bit of a challenge to get a feel for the other people.

Rex:

Maybe it's going to have to be your mission, Tom, to bring the coffee break back to life.

Tom:

Or happy hour, yeah. It's the other thing great about Scripps I didn't mention. They have this awesome happy hour every Friday called TD. So, maybe we can get that going from my new position as well, Zoom happy hours.

Kelly:

The happy hour. And then after that, go surfing. Sounds like fun. So going back to your college days, for our listeners who might be interested in pursuing careers in oceanography, what types of courses' skills should they acquire while they're in school?

Tom:

So that's a great question. So what I'm about to say, this is specific to physical oceanography, because—and I say that because oceanography at the traditional oceanography programs, like the one I went to in Hawaii or even most schools still, I think Scripps or University of Washington, it's split or divided between physical oceanography and chemical oceanography and biological oceanography—and the nature of the work is very different, depending on which specialty you're in and the prerequisite coursework and so forth.

Tom:

So my specialization is physical oceanography, and I had a background in applied math, which is good for that. So yeah, I would recommend to young people, if you're interested in physical oceanography, by that I mean ocean circulation, different types of ocean waves. Not just surface waves, but also internal waves, the role of the ocean in global warming, the role that it plays in the climate in terms of how much heat is stored in the ocean, how it is coupled to the atmosphere, for example, that's all considered, I think, physical oceanography.

Tom:

So for that, I would recommend taking as much physics, applied math and statistics, and also computer programming classes as you can stomach as an undergraduate. And also, I think what's vital is to get some hands-on research experience, if you can at your school. Hopefully at your institution, there's maybe a physical oceanographer or a climate scientists that you can get some hands-on research experience with, or if not there, then you can reach out to people at other schools that look for these summer internship opportunities.

Tom:

I mentioned this REU program where there are some places like the Woods Hole Oceanographic Institution that bring in interns for the summer. And those hands-on research experiences are really

important to see what research is like, which I think is intrinsically important for everyone to, even if you don't necessarily want to be a researcher, at least give it a try to see what it's like to attack these problems, where the answer is not known. And you have to try to approach a problem creatively using new tools or things that haven't been tried before to try to learn something.

Tom:

But also, those experiences are important, because your advisor could then write you a letter of recommendation and letters of recommendation play a really big role in academia in terms of not just graduate admissions, but also as you proceed down the career path for further job opportunities. So that's, I think, a bit of a difference between industry maybe and academia. So those would be my tips.

Kelly:

So for field research and other projects, do they post them in the department? Do professors post these opportunities that students can just apply to?

Tom:

Sometimes, but you can just go knock on doors as well. Yeah, so definitely keep an eye on the job board. I remember at MIT, there was a undergraduate research office called the UROP office there. So they used to post funded projects, but you can also go knock on professors' doors. Or say you're taking a class that you think is interesting and you have a good vibe with the professor, for example, you can go knock on his or her door and ask if you could get involved. I think most professors would be thrilled to have a eager undergraduate that they could assign to a project.

Tom:

Because the way it works, a lot of the faculty have tons of ideas, but maybe they don't have the time to write a grant proposal and hire a graduate student or a post-doc to work on it. But an undergraduate who can get spun up on something, they'd be happy to—basically, I think there's no shortage of possible projects for undergraduates to work on for an eager undergrad who's willing to take some initiative. And you can even get funding for that too, even if the professor hasn't got money beforehand. There's work-study opportunities sometimes, I think.

Tom:

Or check if your school has a UROP office, they might have funding to pay for undergrads to work on those research projects.

Rex:

So Tom, it says on LinkedIn that while you were at Scripps, you utilized deep learning for remote sensing algorithm development. Now, to me, deep learning sounds like pretty in-depth science. And so, I'm just wondering, how did you become fluent in that language and that field? Because certainly, I can imagine if I was in high school and someone said, "I know deep learning," I would have said, "I have no idea how I would ever become fluent or gain entry into that field in that technology." Can you give us some insight?

Tom:

All right. Yes. I would say I'm nowhere near fluent in that, but I was utilizing it a little bit in my research mostly as a support role with a graduate student. There's this great grad student, Will Chapman—let me

give a shout out to him—at Scripps who's been, I think, quite innovative in applying deep learning to the study of rainfall forecast in California. But I was working with him a little bit on this remote sensing problem where we had discovered these errors in the satellite wind fields were around coastal mountains, like around Hawaii.

Tom:

Or even in Southern California, there's areas where the mountains along the coastline have a pretty strong influence on the coastal winds over the water. They create these leave water seas, which were not being detected in the satellite wind products. So our idea was to try to use deep learning to fill in those gaps where we could try to train the deep learning algorithm using output from computer simulations on what we thought the winds' behavior really was like. And then it could hopefully apply what it learned to fill in some of those gaps in the observational data set.

Tom:

And we actually ended up having some success that did seem to improve the observations, some manuscript in preparation detailing that work. But yeah, I guess again, for the young people out there, this wave is already arriving, this application of all these different machine learning techniques, which have been applied more in other fields and a lot in industry, for example, in advertising, in other fields of science. I think it's coming a little bit later to earth scientists, maybe a few years delayed relative to some other fields, but I see people are quite excited about it.

Tom:

Because we have a lot of these large data sets in our science from satellite observations, from computer simulations. There's tons of data or model output out there that can be used to try to train these deep learning algorithms. And one of the strong points I should say of deep learning is that as you have more and more data available, it's able to "learn" more and more. So it's, I think, certain types of like prediction problems or for statistical downscaling is what we were doing is trying to fill in these gaps, using statistics. That's called statistical downscaling.

Tom:

For the certain types of problems in earth science, I think there's a lot of excitement for some of these modern machine learning techniques. To try to learn for people out there, there are some good courses online. Like on Coursera, Andrew Ng from Stanford has great little series of courses you can do on your own. I also just bought a book by this guy, Engineer Chollet, C-H-O-L-L-E-T. He's an engineer at Google who wrote a guide to using the Keras module in Python. He's, I believe, the author of that module.

Tom:

So if you get his book is maybe $30, $40, and you can learn basically how to run those codes that he's written, and then you can apply that to maybe some problems that you're working on. So my sense, just working on it a little bit for a few months, it's something you have to develop a feel for still. So, requires a lot of tuning different parameters properly to try to get the algorithms to work as well as possible. So certainly an area of a lot of active research. A lot of excitement I think is going to grow. It's already grown a lot in the last couple of years. I see a lot of people are working on this.

Tom:

For example, at the AMS Annual Meeting this upcoming January, I think there's going to be a whole session on machine learning methods in earth science or atmospheric science. Yeah, I foresee a lot of growth as well in the next decade.

Kelly:

That's some good tips. Thank you for that. So now that you're established in your career, for you personally, what helped you the most in your professional journey? Did you have mentors or did you pursue this machine learning or what helped you the most?

Tom:

So, first I would want to acknowledge my mentors. That would be Professor Shang-Ping Xie at Scripps. And also, I work with a researcher there, Bruce Cornuelle, who's an amazing scientist and person as well. And then my graduate school advisor, Niklas Schneider at the University of Hawaii. So for those guys cademia, it's really almost like this apprenticeship model of the way you read about the ancient Greeks, I think learn that way. So it's cool to see that, in some ways, things haven't changed that much even, since ancient times.

Tom:

So you really work a lot one-on-one or maybe one-on-two or three with your advisor or a couple of other co-advisors. That's how things seem to operate at the graduate level. But also, I think just trying to keep an open mind towards new things, towards new trends and be curious and go to a lot of seminars and talk to other people, to your friends about what's going on. Because like I said, in science, people don't tell you what to do next, what the next important problem is. That's one of the cool things about being in science is that it's up to you to decide.

Tom:

That's up to the science community to figure out what the important questions are to address and how best to address them. So, just don't get so burrowed into your little narrow problem that you're working on, that you miss these larger trends. Which I just mentioned one, this rise of ... Apply these machine learning techniques and big data techniques to these huge datasets that we have in earth science is one obvious example that's coming down the road.

Kelly:

Are there any mistakes you wish you had avoided now looking back?

Tom:

How much time do we have for this? No. You can always second guess, but I guess a couple of things I didn't know when I was younger that I would maybe like to emphasize to younger people out there would be the importance of, like I mentioned, the recommendation letters. So when you're an undergraduate, if you can be a little bit strategic, if you think you want to go to graduate school in a certain field, you can either major or double major in that field. But at least take some classes in that department at your school, so that you can get recommendation letters from faculty in that field.

Tom:

Because I didn't realize how much weight is placed on those kinds of recommendation letters. It's different from like undergraduate admissions that way, because in graduate admissions, the way it works is the admissions committee, if they see a candidate for admission, who's got recommendation letter from someone they know, a personal colleague, that's going to carry a huge weight, more so than your transcripts alone might or your test scores. So that would be one tip. Also, let's see—I think as far as just your career track as well, I mentioned just how tough it is for people who are in these temporary contract research positions like post-docs or product scientists. You don't want to stay too long in those positions. If you have an ambition to try to make it to a tenure track professor job or a career scientist position at a government lab, that's fantastic career track. So definitely go for it if you want to, if you want to pursue that path, but you can stay too long. So I think looking back, I maybe stayed a bit longer than I should have in that role.

Tom:

Because I think there's a lot of opportunity out there in the economy doing things besides just being a university researcher. So, that's one thing I wanted to mention in this interview, and I think you guys are doing a great job of highlighting some of those other career options available to people with an earth science background in this podcast series. So I've seen a lot of people who got Ph.D.s in oceanography or in atmospheric science who are working in industry as a data scientist or as a software engineer. You can apply the general things that you learn in science to other career paths, which are also offered a lot to young people, I think.

Tom:

So don't have that tunnel vision where you miss the big picture, as well as keep in touch with some of your friends from undergrad who maybe studied other things and just try to keep some sense of what else is going on out there in the economy, because there's a lot of opportunities for people to do all kinds of stuff. I have friends that got a Ph.D. in oceanography and are working in finance as well. There's many [opportunities] working in government, helping to advise our government on having intelligent policy that's related to an environment.

Tom:

So just a lot of great things you can do that utilize your general knowledge or even your earth science knowledge where you're not just working as a researcher in a university or a lab. Those would be some of my tips.

Rex:

Tom, we're so grateful for everything you've told us about career tracks in general and oceanography as a specific career, not to mention everything else about mathematics and your other interests. However, before you go, we always ask our guests in general, and for you specifically, one last fun question at the end of our show. So I know you received your master's and your Ph.D. at the University of Hawaii in Honolulu. And when I think of Hawaii, I think of, it's natural wonders from volcanoes to massive waves, and of course the crystal blue water that, of course, you must be familiar with given your field.

Rex:

And I have learned you're a surfer as well. So is there a particular part of Hawaii that you miss the most now that you've left the state?

Tom:

Yeah, that's a great question. So I talk about that with my wife all the time, because we met in Hawaii, actually. She also was in graduate school there and we still have some friends out there. So think about all the time. We're hoping to even visit this year, but with COVID, that hasn't been possible. So yeah, there are many things I love around Oahu. I loved the windward side up there, like Kailua Beach. Also, down in Mokapu was great place just to go bodyboarding down there sometimes with friends.

Tom:

There is lots of great hiking up all the ridges based on each mountain range there, there's trails you can hike up, which are fantastic. Great food, the fresh fish and poke and just the warm people that you have there as well. So, many things. I miss Hawaii all the time.

Kelly:

I have never been, and it certainly makes me want to go. Hopefully someday after COVID, I will make it to Hawaii.

Tom:

I hope so. So, actually, one thing that we're working on is potential future renewable wind projects out in Hawaii. I already told my bosses, "I want to work on that project."

Rex:

Thanks so much for joining us, Tom, and sharing your work experiences with us.

Tom:

Thanks, Kelly. Thanks Rex.

Kelly:

Well, that's our show for today. Please join us next time, rain or shine.

Rex:

Clear Skies Ahead: Conversations about Careers in Meteorology and Beyond is a podcast by the American Meteorological Society. Our show is produced by Brandon Crose and edited by Peter Trepke. Our theme music is composed and performed by Steve Savoie, and the show is hosted by Rex Horner and Kelly Savoie. You can learn more about the show online at www.ametsoc.org/clearskies, and can contact us at skypodcast@ametsoc.org if you have any feedback or if you would like to become a future guest.