Molly Graham: This begins an interview with Tom Karl for the NOAA 50th Oral History Project. Today's date is May 20, 2022. It's a remote interview with Tom in Mills River. The interviewer is Molly Graham, and I'm in Scarborough, Maine. Where I wanted to start today was just to revisit and get a little more details about the NCDC [National Climatic Data Center] modernization program. Correct me if I termed that incorrectly,

Tom Karl: There was a Climate Data Modernization Program that began really under Ken Hadeen, who was the director of NCDC until, I believe, 1997. Then subsequently, I became director. Under Ken, there was a big push to migrate the data we have from paper records to electronic. One of the advantages that occurred for us and him was the fact that Congress, at that time, were doing add-ons to the budget. They would do a congressional add-on for specific funds; they put some strings attached to it, like the money had to be spent in a particular place and certain time. But that enabled us to digitize a lot of historical data that was inaccessible, and that carried on for a number of years. Ken was the director during those times, and it was probably one of those programs where every year NOAA [National Oceanic and Atmospheric Administration] would present a budget to OMB [Office of Management and Budget], and they'd either approve it or not, and Congress would bless it or not. But normally, if you propose something like digitizing old data, it rarely got the priority. In fact, it never got the priority above some of the other things that NOAA was trying to do, like ships that were decaying and needed repair and countless other things that NOAA is responsible for. So, we were fortunate that Congress had this write-in, and we had this budget that was specifically for digitizing data. As part of that, once you keyed in the data, there was a quality control component that went with it. Once additional data became available to everybody electronically – well, then obviously, there's a push to [see] how does this relate to our existing data? How do we quality control the whole data set in a consistent way? It really fit in nicely with the whole notion of reference datasets and reference datasets were something that I was particularly interested in and really tried to advance when I was a senior scientist and working for Greg Withee on his program. So that just was a match made in heaven. There were a number of reference datasets that were produced; not only weather/climate reference data sets, but ocean datasets, geophysical data sets, and everything you can imagine you'd want to understand how the earth and the climate is varying and changing, how the weather interrupts interoperate with climate, how solar weather affects the earth. So, it really was a challenge. I would say the big challenge was how do you tie all these things together? Also, part of that effort – we had at that time a number of radars that were implemented, Doppler radars, across the country. The one thing about the Doppler radar is they produced tremendous volumes of data. It wasn't long before we had a petabyte data problem on our hands. How are you going to make sure that that data is preserved, and you can actually access it? There's Doppler radar data at various levels. And level three data was more display-focused and wasn't as large. But if you ever wanted to reprocess the data, you wanted to save the original raw data, and that was huge. So as part of that data modernization program, how are we going to preserve not just the non-digital data, but the existing data that might be on tapes but we just couldn't get to it very easily. At that time, in addition, we were launching more and more high-rate data collection from satellites, geostationary/polar satellites. So that was another big data issue that we had to address. So, at the same time as the climate data modernization program, which was focused more on digitizing data, we recognized we need to do something to ensure not only that data but the other large datasets that are coming in that we're going to be able to preserve and provide access to. So, we recognized the problem. I

remember NESDIS [National Environmental Satellite, Data, and Information Service] had a contest to – what are we going to call this problem? Because it's a digital problem, and it's just amounting to be almost insurmountable if we don't address it. So, we had a contest. I came up with the name. (laughter) It was a fun contest; I think I won an umbrella. I think a NOAA umbrella was auctioned up for collection. Anyway, it was called the Comprehensive Large Array-[data] Stewardship System, or CLASS. It was all about trying to provide not only the archive for this data, but the access to it. So that was really important. It was recognized by the broader set of NOAA constituents as they all had an interest in it because they wanted to get access to that data as well. So, it made it through the budget process, and we actually had a formal program called CLASS that originated at NCDC. Eventually, it got to be big enough that NESDIS thought this is really a data architecture problem. Let's put some of our best computer scientists on it. We had computer scientists at NCDC, but we were more focused on the data itself. So, NESDIS, I think in the 2010s, decided that it might be best for them to actually manage and operate that program. So, they operated in our building in Asheville, but they sent some people down from headquarters and other offices at NESDIS to be co-located in Ashville to run the class program. So, it was a, I think, a success from the standpoint of it did provide access to these big petabyte datasets. Complimentary going on at this time, there were other interests. That was not only getting access to the data, but how do we get access to the model data. NOAA is producing the National Weather Service models that run weather forecasts every day, and there's numerous models. That data was recognized as valuable. You don't want to throw it away because you want to see how the model is doing under certain circumstances? Can we improve it? Is it better than what we had? There was a lot of interest in getting access to that data as well. So, Glen Rutledge, who worked at the NCDC, came up with the idea of, "Let's try to provide an operational and historical access system to that data." We called it NOMADS. I think it was the NOAA Operational Model Archive and [Distribution] System. So that was really a major success for us because it preserved the data that was again accumulating, getting to be large volumes, models got more and more complex. People wanted more and more variables. So that again started in the early part of the 21st century, continued to run through the time I retired, and I think was a pretty successful program. I know Louis [Uccelini] over at the National Weather Service, Louis Uccelini, who was then head of NCEP [National Centers for Environmental Prediction], became director, and was a strong advocate for that because it was important for him to make sure his models weren't thrown by the wayside, people could get access to them.

MG: Were you able to automate that data dump from various sources?

TK: Exactly. There was a lot of coordination between the various offices, the producers, and making sure that data could be shipped to us, and then making sure we have the adequate facilities to store it and develop the software to access it. So it was coordination across the line offices. Same thing with the NEXRAD [Next Generation Weather Radar] radar data, coordinating that with all the Weather Service offices. At one time, they started sending us tapes – mailing tapes. You can imagine what difficulty that became. But eventually, we had enough in the way of transport electronically that we could just ingest the data electronically. You didn't want to fall behind because once you fall behind, it's really hard to keep up. People don't realize that unless you've got some huge data pipes, once you get behind, they get clogged and you get in trouble.

MG: Did you feel like this digitization process was pretty well complete or underway when you took over as director in ’98?

TK: Yes, it was mature at that time and continued on. It ended early in the 21st century. Congress changed. But at that time, we had really digitized a great proportion of the data that needed to be. It didn't mean we did it all. There were still efforts at digitizing more, just not under that particular program. That was really, I think, the spearhead for the whole effort, the Data Modernization Program, because it was a consolidated activity.

MG: Were you able to evaluate or measure the impact of making this data more accessible to the public? What was the picture that was emerging as a result?

TK: We had a number of metrics that we developed, and some of the metrics included the amount of data that was requested and delivered online and also offline. So, our metrics were to trace that. It wasn't good enough just to say we saved all this data. How much are we delivering? So that increased by a large percentage, factors of two or three, over a period of years in terms of the volume of data we distributed. Once people found out that the data was there and could be used, from word of mouth it was spread. It’s amazing the number of users who want the data. Scientists were the big volume people; they wanted large volumes of data. But a number of users were really not scientists; they were engineers, companies trying to understand their marketing, cities trying to do urban planning. So, it was those that made up the greater number of requests, but it was the scientific organizations that had the biggest volume of requests. They had the facilities to handle it usually.

MG: Was the big picture of the climate record coming together for you and other scientists? Was this the evidence from which can trace the trends?

TK: The nice thing is, once the data is accessible, now there's all kinds of things that we can do about it. What we saw in terms of NCDC being a national scorekeeper for weather and climate – once this data became available, now you could use it to develop reference datasets. You can use it to start monitoring the weather and climate, not only locally, regionally, across the US, but globally. That that really was all dependent upon not just having access to the data today and a few decades earlier but trying to put it in historical perspective. So, there was a lot of effort. We're seeing this decade is dry. How does it compare to what we saw in the ’50s, the ’30s? The droughts of today, how do they compare? So having that data available enabled us to do those comparisons and provide the time series information that would go on to become an integral part of State of the Climate Reports, understanding causes of extreme events, IPCC [Intergovernmental Panel on Climate Change] reports, assessments of the climate and climate variability and change across the US. So those were key instruments. The popularity of that is evident. If you look at things like the US Global Change Research Program [USGCRP], the other agencies came in and used a lot of our data and tracked the information for their purposes. For example, USDA [United States Department of Agriculture] was very interested in growing degree days for their crop planting zones. So, they come in and use our data and try to work with us to produce those maps. The EPA [Environmental Protection Agency] [was] very interested in

the climate and its effects because they were responsible for looking at greenhouse gasses and the climate response. So, a lot of agencies then used what we had to help their missions as well.

MG: How did the quality control piece of this work? How did you validate the source of the data and things like that?

TK: Well, the source of the data was extremely important from the standpoint of what we called metadata, information about the data. It took certain personalities to really get interested in metadata because it's almost like a detective hunt, trying to understand exactly what happened to observing networks with instrument changes, instrument calibration, [and] if it was an in situ monitoring station, how the local site changed over time. So, you'd have a number of individuals who would focus a lot of their time trying to put together information about the data so others could use that if they wanted to see the effects of changes. Sometimes you didn't know whether or not a change – was it real or was it artificial? The metadata was often crucial to help understand that. So, there were whole efforts – I know that one of the reference datasets that we developed called CARS, Comprehensive Aerological Reference Dataset, and it used the information about radiosondes. Radiosonde manufacturers – [there's] probably dozen or more across the world. They've changed over time. How was that data processed? So, it was trying to garner not only the metadata for the US operated stations, but the international stations as well because it was a global dataset. That's one thing that's always important to recognize, is the weather and climate isn't just local, it isn't just regional, it isn't just national, it's global. So really, to get a complete picture, you want to get information not just from this nation, but our neighbors and our colleagues across the world.

MG: You had mentioned that some of those international relationships with scientists in China and the Soviet Union were developed in the 1990s.

TK: Yes. Well, the World Meteorological Organization [WMO] had been around for a long time, founded in 1951, I believe. It was a place where people got together to agree on exchanges of weather data and how we're going to do this and standards and protocols. It has grown to be a much more extensive organization without which you wouldn't get a weather forecast. You only get it for maybe a day or two because all this stuff is international. Well, today with satellites, it's a little bit easier, but still, we rely on international data exchange for many of the important variables. But the WMO was a great coordination activity. So, when we recognized that there were some new things we wanted to do with WMO, like reference datasets, one of the important activities [was] we'd go to Geneva where WMO was headquartered, sign up for various meetings. There was a push to develop a Global Climate Observing System [GCOS], a Global Ocean Observing System [GOOS], a Global Terrestrial Observing System [GTOS]. Those activities required a lot of coordination, a lot of meetings. One of the things that was really an important catalyst was the recognition to look at the weather and climate, not only in the atmosphere, but in the oceans. You had to have long datasets. You had to have reference quality datasets. To do that, I spent a lot of time developing relationships, as well as others at the center, with colleagues across the world because those were the people then who were advising the members of WMO [on] what to prioritize, so we can get agreements on data exchange, developing reference datasets. Things like COADs, Comprehensive Ocean Atmosphere Dataset, was started under Dr. Fletcher, who was at OAR [Oceanic and Atmospheric Research]; it was his

idea. NCDC played a huge role trying to advance that dataset with all the ocean obs. [observations] that we had, the marine ocean obs. taken from ships and buoys. So, data then became so important. It was one of the first ones that was internationally recognized as critical – developing data exchange with other nations, ships flying under flags of almost every country, making sure we understood how those observations were taken, how we could get access to them. Some of them were not digitized and promoting other countries to digitize them because they could then have a critical missing piece added to some of these datasets that were up and running. It was a complementary activity, COADs, to this whole reference dataset notion, and it was an important part of WMO, which then, with GCOS, recognizing it's not only the reference datasets; we got to keep these datasets viable and alive. So, we have to make sure the observing systems continue to operate and operate in a way we understand, operate in a way that is consistent with best practices, and operate in a way that doesn't introduce non-climatic biases. If they do, we would have to then go in and try and reduce the biases and make adjustments and corrections.

MG: The other thing I wanted to discuss before we sort of dive back into your career was the relationship with NCAR [National Center for Atmospheric Research] in Boulder. What was your office's relationship with NCAR? I wanted to ask about your connection with Warren Washington because your name came up in his oral history interview.

TK: NCAR was a good example – we just talked about COADs. Nice relationship with NCAR [and] with COADs. We had a number of people at NCAR who would be focused on unique quality control aspects of the COADs dataset. They spent years doing this and became important experts in terms of specific quality control algorithms. We would be coordinating back and forth on what programs to run and how we should adjust them. So, we had our marine group, but they had theirs as well. We subdivided the work. A lot of work that we had done [was] focusing on the metadata, focusing on kind of the big picture data exchanges, where they'd be focused on more of the very specific quality control algorithms and making sure that we had the latest update from what quality control they'd think was working best. So that was one example. Really, there were a number of examples where NCAR – because NCAR had a lot of our data. I'm not saying all of it, but a lot of it because they were focusing on pure atmospheric research. There was an individual over there, Roy Jenne; he was a data guru. He would just scour everywhere you can imagine and come up with these finds and datasets that people didn't know existed. He had a great memory. This was at a time when memory was key. It may not have all been recorded. He worked with us very closely, trying to identify which countries had which datasets, which ones they had at NCAR, and which ones had the same version numbers we did because keeping track of datasets with version control is extremely important because you could think, "We both have the same dataset," then you start to compare it, and you get different numbers for supposedly the same place at the same time. We realized, "Oh, someone made a correction. How did they do that? What algorithms did they use?" So, working with Roy was extremely important. Others there, like Kevin Trenberth [is a] good example, served on a number of NOAA panels, gave advice to NOAA, but also sat on panels where he engaged with the data side of the house and had numerous recommendations to improve our data with respect to the reference datasets that we were developing. So, it was a great relationship. Warren Washington was at NCAR as a modeler. I first met Warren in China, I think, on our way to China because we both had a grant with the Department of Energy. So, the Department of

Energy at that time was organizing numerous meetings with China. We both went over for our very first meeting and tried to present what we thought was important science from the standpoint of – obviously for Warren, it was modeling, but if you don't have data, you can't compare your models to anything. So, the data and the models went hand in hand. Warren and I had a good relationship, a good understanding of the reference datasets that we were trying to develop and how they could be useful for understanding his models, where they're performing well, and where perhaps they need some more help. I can remember being in China, and we're both trying to present. At that time in China, the facilities were not nearly what they were in the US, and it was almost a comedy trying to get a presentation off. Just to get a copy of a paper, a Xerox copy, took days because they had so many approvals they had to go through. I'm sure it's quite different today. But that was the start of a long relationship that I had with Warren in terms of – he was a good advisor to me in terms of trying to see bigger pictures that he was involved with. Warren was a key component of many National Research Commitees I eventually became chair of the interagency US Global Change Research Program. Warren was involved as a reviewer of that program from the outside. So, we had a lot of interactions.

MG: Good. I was curious what other opportunities or initiatives you were involved in, in the '90s when you served as senior scientist.

TK: I'm trying to think if there were any – I guess one of the areas that was an ongoing activity was working with the regional climate centers. These were centers that Congress had in the budget for many, many years. They were put there to take the national information that NCDC had, and scale it down to specific regions that were broader than states. Many states have something called a state climatologist. So, the state has an official position and they provide information to various state agencies and the public for the climatology within the state. There's a recognition [that] there's a lot of issues that transcend state boundaries. So, these regional climate centers were formed. In the '90s, NCDC worked pretty closely and continued on through today with the regional climate centers to try and ensure that there was a smooth transition of the global national data that we focused on to what they could do. They often specialized in unique datasets for their region. You can imagine in New England, there's a lot of interest in maple trees, sugar maple, developing datasets that are particularly important to help understand maple syrup production. In the Midwest, corn and soybeans and wheat [are] extremely important. So, focusing on agriculture-related activities. In the West, mountains and forestry management. So that was an important activity, and Congress was always interested in the regional climate centers and working with them was probably a challenge to try and keep Congress happy and keep the scientists happy because there was always this information transfer that's extremely important from the federal side to the congressional side, explaining what our role is in relation to the regional centers. So that was an activity in the '90s that grew and continued on into the 21st century.

MG: I have in my notes that in '92 and '93 you were the project manager of NOAA's Climate Continuity and Quality. I didn't know what program that was, what they did, and how it related to the rest of your work at NCDC?

TK: Well, I think that was what Greg Withee initially started, Climate Continuity and Quality. And that then, I think, migrated to – which Mike Hall developed – the global program that

NOAA was involved with from the standpoint of coordinating between all the agencies with the Global Change Act in '91. So, I think that was the fledgling component of what became a data management program that included Climate Quality and Continuity. So that was kind of the first leg, and we were trying to get our feet steadied, I would say, at that time.

MG: I just have a list of all these panels and advisory groups that you were involved in. I don't know if it makes sense to ask you about all of them. We'll be here all day. But are there any that stand out to you, or any initiatives from this kind of involvement that stands out to you? I'm thinking of the National Academy of Sciences, Science Advisory Panel for the Climate and Global Change Data and Information Management Main Program Element?

TK: We talked about the panel from Mike Hall's program, I think, right? So that we previously spoke about. The other programs that I think were important include some of the international ones, like GCOS, which I've already mentioned, but that really got us started in the '90s. That was really pretty big as a recognition not just nationally, but globally, how important this was. Once that happens, then from the standpoint of being a manager/administrator, it makes your life a lot easier when you try to preserve a program or ask for additional resources because there's a recognition [that] it's not just you; it's the whole nation and the world that needs this kind of activity. So that's a significant advancement.

MG: Then in the late '90s was when you started to get more involved with different groups within the White House and connecting with the Clinton and Gore administration. I think we've talked quite a bit about that. I don't know if there was anything else you wanted to say though.

TK: No, I think I probably gave all I can on that one. All I can say is, as a side story, it's funny how prior to really being engaged much with the White House activities, it seems almost surreal. But then once you get engaged, it's like any other job; it doesn't seem so much – the aura gets lost pretty quickly because you're focused on the day-to-day activities and all the problems, and the fact that you're in the White House working on it doesn't really make any difference. In fact, I can remember when I was going over there quite often, it seemed like it was always under construction, and it seemed like there could have been a lot better facilities to work in.

MG: The other thing I wanted to ask you about was that briefing you did with Joe Friday and just your interactions with the Weather Service in general. You two are briefing reporters on the 1997 global temperature data. Could you reflect on that briefing? What was significant about that briefing?

TK: I'm trying to remember. Was Joe Friday head of the Weather Service at that time?

MG: He must have been.

TK: Yes, because Joe had two positions. He was deputy and then he was director. I think [Richard] Hallgren was the director, and then he stepped in after Hallgren. At that time, climate and global change was still – there was a lot of uncertainty about it. There was a lot of interest, but a lot of uncertainty. Joe, being on the weather side, had a lot of credibility from the standpoint of, "I'm giving you the weather forecasts every day." So, he was really important to

have at some of these early briefings to – I don't want to say hold the hands of the climatologists, but I would say to provide the recognition that what we're talking about from the standpoint of climate is just weather over a longer period of time, trying to look at how it's changing, which we know from the past has changed, and the world is quite different over the ages of thousands of years and ten thousands and millions of years. I think that was really important. The Weather Service had a lot of credibility. People knew who they were every day. But climate briefings and changes in climate were relatively new in comparison. So, Joe provided that steady hand in some of these briefings.

MG: Was this the first time it was being really explicitly communicated to the public that earth is warming and human activity plays a role?

TK: Well, the IPCC put out their report in '92. The next report came in '96, '97. They said words like it's more likely than not that humans are having an influence on global climate – so those words were out there, and this was just reaffirming the fact that if you have to place your bets, you're going to start betting that we're doing something to the climate; it's not just happening all by itself. That position only strengthened over time, where if you look at the latest IPCC reports, it's virtually certain that humans are changing climate. For scientists, virtually certain, 99.9%, you don't get much higher than that. I know in quantum physics, they like to do five sigma events. But here, if you're out three sigma, that's pretty certain for us.

MG: You've talked about El Nino and its significance. But something you said last time was that "there was this recognition after El Nino that there was something going on here that was pretty darn interesting and something we needed to explore more fully." What did you mean by that? What did exploring it more fully look like?

TK: When the '98 El Nino occurred, Gene Rasmussen, who was with the Climate Prediction Center in '83, really put NOAA on the map with our understanding of El Nino at that time and NOAA became a major player. That was an important first, where we recognized what was going on with El Nino and its impact, not just in the oceans, where we see the warm temperatures, but its impact across the world, these teleconnections, as we call them. So, when the '98 event occurred, this was a once-in-a-century kind of El Nino. Everybody stood up and took notice. We had weather in the Pacific affecting virtually the whole world. In fact, at that time, we were monitoring global temperatures and reporting on them every year, and the whole globe clearly warmed up because of the El Nino event. The atmosphere, when you looked at profiles of temperature in the atmosphere, major changes, precipitation regimes, heavy precipitation events. So, all of a sudden, people really recognized, "Boy, this one event can make a major change." But at the same time, because it raised the global temperature so much, there was a lot of interest from people studying El Nino events, people looking at global change over longer periods of time. Are El Ninos becoming more frequent? More intense? Are they related to climate change? How will they affect climate change? What it did was forced the weather/climate people who are operating and focusing their interests on different timescales – maybe decadal, interannual, seasonal, sub-seasonal – to really look more broadly than they might have otherwise. It was a big event from that perspective that I think had a lot of ripple effects, and positive from the standpoint of getting people to talk across their domains.

MG: In 1998, you became the director of NCDC. Can you just talk about that transition a bit?

TK: Yes, that transition wasn't really too hard for me. It had a lot of positive attributes, where I thought I could help steer NCDC in terms of where our priorities were going to be. One of the things, personally for me, that was kind of difficult, was it meant a lot more trips to DC, in addition to the international and national trips I was taking. So, it was a lot of miles, and we didn't have a direct flight. So, from a personal standpoint – I always had to transfer from Asheville to Charlotte to DC. Headquarters would obviously want – NESDIS headquarters, which was the satellite information service, would want to have their directors up there as much as they could. Well, it was pretty easy if you worked up there because you just went to a different office. It was more of a problem for me because I always had to spend about six hours on airplanes getting up there and six hours getting back and couldn't do it one day because we didn't have a direct flight. So it was always multiple days. The advantage is that I tried to make use of that trip and met with other colleagues in NOAA and other agencies. But a lot of time on the airplane going up to DC.

MG: What were your priorities or goals as director? What did you hope to accomplish, work on, or look at?

TK: Well, one of the things that was extremely important if we were going to be successful was to ensure that we were providing the data and information for business and commerce to succeed. So, one of the goals I had was to try and understand what the various sectors of our economy needed from the weather and climate data perspective. There's numerous sectors out there from energy to commerce, transportation, engineering, ag [agriculture], forestry, fishing, marine interest, recreation, and manufacturing. The list goes on and on. We had at NCDC a user group that interacted with the public, and many public requests were from the private sector businesses trying to make and earn a living through their understanding of weather and climate. So, to try and develop those relationships in a way that we could better understand how to make our data most accessible [and] easily understood was a priority. So over time, we actually had a group in the NCDC that focused entirely on trying to work with the private sector and understand what their needs were. We held a number of workshops [with] the insurance industry, the energy industry, those interested in water resources. We would hold some meetings locally in Asheville, but they would come from across the nation and express what their concerns and needs were. We'd try to listen, explain what data we had, and then try to engineer our datasets to make it most effective for their use. That was extremely important. The nice thing about that is we could put dollar amounts on how valuable this is to the nation because they would tell us what they're using the data for. That was an important activity that we engaged in, and it was related to identifying these natural disasters that occurred, these weather events. We put together these billion-dollar disaster datasets, which are still going on today. In fact, it really is an international world effort to understand how these major weather events affect our economy, in addition to, obviously, loss of life and the harmful effects it has on human activities.

MG: Besides all the trips to DC, what was the nature of your work and scope of work different in this role?

TK: I think for me personally, the difference was spending more time with NESDIS concerns. Prior to that, as senior scientist, I could be more focused on purely scientific issues. It doesn't mean exclusively, but in this role, I could still engage in science, but now there's administrative activities. 9/11 happened. You can imagine all the activities with that. We became important off-site for some of NOAA's activities. I recall, after 9/11, they wanted to have someone who could be acting head of NOAA should something happen. So, I got selected to be that. There was a fair amount of additional work in terms of making sure we had the right kinds of activities, the right infrastructure to manage something should a major disaster like that occur again.

MG: This just popped into my head. Were you or anybody at NCDC worried about data loss or losing codes due to Y2K? Was that a concern for anybody, or is that a very silly question?

TK: Well, there were some COBOL programs, and COBOL was particularly sensitive to the Y2K issues. But there weren't that many that we were using, and it really was a non-issue. Certainly, we were concerned, but it was a non-issue after it occurred, thankfully.

MG: You brought up 9/11. I just was curious what that day was like for you. What do you remember? Did you happen to be in DC at the time?

TK: Actually, when 9/11 occurred, we were on a video teleconference with NESDIS headquarters. We had our Tuesday morning meetings at 930. All this took place right about that time, and usually those meetings would go from about 9:30 in the morning until 10:30, eleven o'clock. After the first few minutes, recognition of what was going on, the meeting abruptly ended. It was a period of – I don't know how many minutes it was. It seemed like forever trying to understand what was really happening. It was pins and needles. It was a shock, and [we were] trying to have an understanding of what was happening. But there was always good coordination with DC in terms of what we would do. Eventually, everybody was sent home that day once we realized what was going on, and then we regrouped after that.

MG: What were those following weeks and months like for you personally and professionally?

TK: I actually was up at the site in New York at the end of September and saw the damage that was done. Actually, at that time, I was with my wife and my brother-in-law because they're from New York. So, I went up there and saw what was going on. I know that my brother-in-law was running for his life in the chaos that was occurring with the big dust cloud. It [made] a good impression on me. Going back to NOAA, at that time, I think NOAA was beginning to come to grips with the fact that this may not be a one-off event and that we need to have some plans in action as to what we would do should this occur again. That's what led to all kinds of measures and security systems and people coming into our building. It used to be that you just walked into the building. Where we were located, there was the IRS [Internal Revenue Service] and a number of other offices, and people from outside would come in, obviously, to talk to the IRS. We had Federal Marshalls, the FBI (Federal Bureau Investigation], the DEA [Drug Enforcement Administration] was there too, the Air Force and Navy climatology and weather squadron and detachments. So, it was a building that was pretty open to numerous federal agencies. When 9/11 happened, you couldn't get in unless you were searched and you had to go through a metal detector machine. It just changed everything. A friendly southern city with

open hospitality to now you're going to come into a federal building and you're going to be under suspicion before you come in. Unfortunately, that's continued on through the time until I left. But that's the way life was. Traveling became a real nightmare. I can remember for the first month or two, going back up to DC was great, the airports were empty. I mean, I never had easier flights. It just was no problem. But then all the rules and regulations got put in place. That made life much more difficult in terms of getting on airplanes.

MG: What else about your role or your time as director stands out to you before we start talking about the next chapter?

TK: I think, as director, one of the things that you quickly realize is that you have people who are looking to you to provide some sage advice on their careers. So, I would have a "lunch with the director," and anyone could sign up. Once a week, I'd go to lunch with someone who wanted to go to lunch with me. The first couple of years after I was director, a lot of people took me up on that. I tried to understand their relationship to where the center was going and what they could do and what would be good for their career. That was useful, hopefully, for them. It was useful for me to understand what their concerns were from their perspective. Sometimes they had interesting ideas that played out over time to be relatively important. That was different and unique. One of the other areas that you really come to appreciate is we had a number of people who were hired that I can't imagine how far they came, given the fact that they weren't given the same gifts that I was given. We actually hired a meteorologist who was blind. It's like, "How could you do that?" She just was an amazing person. We had some people who were deaf from birth, and to see how they overcome these adversities and became very productive and publishing scientists, you're in awe of how they did that. So, it really was an inspiration, I think, not only for me, but I'm sure other people, when they saw what they were able to overcome in their careers.

MG: Did it make you think about users or stakeholders that also might have different abilities and access to this data and making sure that it was all ADA [Americans with Disabilities Act] accessible?

TK: Yes, that was an important aspect as the online systems became available, ensuring that they were accessible for people who had special requirements. Sometimes we'd have to print out those web pages and revamp the web page to ensure that they weren't too onerous for people who did have these disadvantages. You can appreciate that there's a lot of colorblind people – red and blues – and they can't tell the difference. So, you have to think through some of these things that you might not otherwise think through.

MG: Was this the era that you were really developing and populating your web presence so that all this digitized material was accessible worldwide?

TK: Yeah, exactly. This was the 2000s. The internet became – after the dot-com bust, it really became real to everybody. It was where everybody wanted to be because it was a recognition this was going to be a growing trend. The more data you could put out there, the more you can make it discoverable, but doing it in a way that makes sense for people. Again, for scientists, there was one way they would get in that might be very convenient for them, but then for others,

you're not going to have the same requirements because they're just not going to have that kind of capability. So, you have to recognize – we would get requests from attorneys' offices for litigation and making the data available to them is quite different than making the data available to a university scientist. It's just night and day. That was always a consideration and just a recognition that there's this wide diversity in capabilities of people who sometimes don't even know what they want. We'd have a user group to explain what's available, talk to them a little bit to help them understand what's available, what might be useful to them.

MG: Were there reference data archivists in place that would help field these requests from the public?

TK: Well, we had a number of people, probably about seven or eight people that just would answer public phone calls and help them sort through the information that we had that might be useful to them. It was interesting. We had a telephone system down there that – I say "down there" because I was up on the fifth floor; they were down on the second and third floors. It was really an important activity for them to – sometimes the lines would get really busy – important activity for them to have the technology to be able to have them leave a message, call them back, not be a typical stereotypical government agency where you can never get through. So, there was a lot of effort put into ensuring if we had contact made, we'd return the call, or they could leave email, [which] was starting to become popular then. Over time, it became a fact that email was the way people communicated as opposed to the phone. That doesn't mean they didn't use the phone. But that transition took over a decade, where the email became a prominent communication piece. Again, scientists early on, email was their mode of operation. Over time, the public came to use that as well.

MG: Is now a good time to have you walk me through, if you're comfortable, the "Climategate" controversy, what happened and what it looked like from your end?

TK: Yes. It was an interesting set of circumstances that, as climate became warmer and warmer and the statements about why that was occurring or becoming stronger and the attribution science was really becoming a more prolific and well recognized in the scientific community, there was a group of individuals who were pretty predominant in publication, sending emails internationally, talking about datasets from a scientist-to-scientist standpoint. When you're doing that, there's a tendency to be pretty casual, especially if you've been talking to an individual for a number of years. So, while the climate change information was building, the fact that humans were responsible, these emails were obviously growing. There was an intrusion. We don't, I don't think to this day, know who did it, who got access to the emails that were being sent between scientists. They got a hold of it prior to major IPCC meetings and IPCC assessments. Once they got ahold of all these emails, they looked at the number of emails, in particular the ones that could be interpreted differently from the standpoint of how the scientist might have originally wanted them to be interpreted. So once those emails got in the public, a whole controversy emerged with, "Boy, are scientists really being honest with the public? Because look at the way we can interpret these emails." That went on for, gosh, a couple of years [with] Congressional hearings and international hearings. I think, in the end, it was resolved that there really wasn't anything extraordinary about these emails. Of course, you can interpret them to be as negative as you wanted. But in the end, I think what they serve to

illustrate is when you're on email, the context is extremely important. You have to be very clear because if you use an email, it's not going to be something that someone else won't inevitably see, and they will see it through their eyes, so you have to understand you're not just writing to one individual, particularly if you're a well-known scientist; you're probably writing to a lot of people. So be careful how you word your emails. I think there's a lesson there.

MG: This must have been such a distraction.

TK: Yes, it was a distraction, and it was unfortunate. I think, on the other hand, there was a good lesson that science will prevail. You can try and interpret these emails any way you want, but in the end, continued publication of scientific papers, the data, and – I think we mentioned earlier – we're now virtually certain [that] humans are affecting the climate. So, again, let the process take its course. Science is one area where it's really difficult to propose an idea that other scientists won't try to show is incorrect. If you can't show it's incorrect, then you validate more and more frequently the original hypotheses, but scientists earn their living by producing a better understanding, and how you produce a better understanding is you show either the previous understanding was incorrect, or you build on what was correct. Again, I think the scientific process is extremely important.

MG: Can you point to anything like this that had happened up to this point, where the science community had to deal with something like this?

TK: Well, I think scientists are always skeptical of the first announcement of a new finding. When Albert Einstein produced his [statement that] nothing goes faster than the speed of light, it took a decade or two to validate that. People are still doing experiments continuing to show it works. But big claims require big science and many experiments to validate. So, you got a big claim that humans are changing the climate; you would expect it's going to take a lot of effort to show that this is indeed occurring. So, I don't think it's that unusual.

MG: I was just thinking about how Galileo was jailed for his views on the sun.

TK: Exactly. [laughter] Yes. You're often the first one in the firing squad if you're the first one out with a pronouncement or a major announcement that doesn't agree with what the prevailing wisdom is.

MG: Was NOAA the target of this hack, or NCDC specifically, or was it a whole group of climate scientists?

TK: No, NCDC wasn't targeted, and NOAA wasn't targeted. It was just a collection of emails that they had obtained. So, if you can imagine, you've got an email. It could be one person. Imagine the number of people you're interacting with. So, their emails then are in your email. So, you can see it expands like a tree. So many scientists then are engaged because that's usually who they're talking to is other scientists, who are then exposed with their emails. It was the number of scientists. Mike Mann was one of the scientists who was pretty prominent. Phil Jones, pretty prominent in the number of emails that they exposed. Again, I think, at the end, all

that's resolved. In the end, it just showed that science prevails, and there really wasn't anything there that was incorrect.

MG: Yes, but it took a long time for science to prevail. I read something like there were eight committees who investigated this. It took two years to issue the report saying no wrongdoing had been done. So, what was that time period like for you? Was it stressful? What was your role during that time as well?

TK: I wasn't directly involved. I was watching it. But it really put cold water on the collegial atmosphere that scientists had, at least initially, until I think people realized that, as I said earlier, any email you write isn't going to be just for the person. If you're putting something that's electronic – as we know today from a number of hacks, there is nothing that's electronic that's not going to be exposed. So, if you're going to be doing an email, try to be as particular as possible about your language. If you look at something that could be interpreted multiple ways, just recognize that's probably being interpreted different ways by different people. I think that was an important lesson.

MG: Mary Glackin talked a little bit about this. She was saying how it got really nasty. I didn't know if you wanted to share a story about when this got tricky or ugly.

TK: Yes. I guess it got nasty between individuals from the standpoint of accusations going back and forth. For me personally and NCDC, because we were kind of on the periphery of this, I wouldn't describe it as nasty. I'd just described it as we're watching what's occurring, what's going on. That was pretty much it.

MG: Was there anything else you wanted to say about that incident?

TK: No, I think we covered it.

MG: Something I wanted to also revisit was the NOAA Climate Service. It was launched in 2010. You had talked about this previously, but can you just tell me that story again?

TK: Sure. About the time that we had a transition in NOAA between administrators, prior to that – I don't know, maybe a year or two – there was a recognition that with climate becoming really an important part of the nation's understanding of how they're going to deal with changes, there was a recognition that, NOAA had a Weather Service, but it really didn't have a Climate Service. The Weather Service had a mission, and it really wasn't climate. Yet, climate was becoming important. Mary Glackin was the interim director for NOAA. She said, "We really ought to be teeing this up for the next administrator as something that he or she may want to consider." So, she did that. The next administrator, Jane Lubchenco, was appointed. Jane was a fishery scientist but was far more than a fishery scientist. She was an individual who was interested in all aspects of the environment, including weather, climate, fish, and geophysics. She was a great pick for NOAA. When she came in, she recognized that really, NOAA is in a unique position to put together a Climate Service. So, she tasked Mary and others to help devise what would be a Climate Service for NOAA. So, there was a call to Congress: "We think NOAA can put together a Climate Service that would serve the nation." So, Jane asked Mary,

and I worked with Mary. Jane asked me to help lead the effort for a National Climate Service. What would that consist of within NOAA? What organizations? Because we would build this out of what was already there, not start something brand new. So, we put together what offices could be part of this Climate Service, how they would interact and operate. We had meetings to discuss this. So, they asked me to sit at the AA table, which was associate administrator, to try and put together budget proposals for subsequent years for what the Climate Service might look like to work with. At that time, the Climate Program Office – Chet Koblinsky was director. So we worked closely together to build what could be a program. We got a lot of traction within NOAA, but obviously, the deciding factor wasn't just the executive office, it had to be Congress. Congress got our proposal. By that time, it was not a Democratic House, but a House that was led by the Republicans. There were enough Republicans at that time that thought it wasn't a good idea. So, once it was proposed, it was quickly disposed of. After that, we said, "Okay, let's just go back to NOAA without a Climate Service and see how we can work most effectively and efficiently as possible." I personally think that was a huge mistake because I think had that occurred, NOAA would be in a much better position, simply because it was linking together organizations that would naturally work together – Geophysical Fluid Dynamics Laboratory, the NCDC, and Geophysical Data Center and Ocean Data Center, working together with part of the National Ocean Service, the Coastal Services Center because of sea-level issues, working with the Climate Prediction Center, which was in the Weather Service, getting them to try to integrate climate on seasonal scales to longer term scales, and number of other components in OAR. I think it was a good idea. It could have, I think, advanced our role in terms of helping the nation adapt and cope with the changes that we're already seeing and those that are yet to come.

MG: Did you envision nesting it under OAR, or would it have been a separate service, like the National Weather Service?

TK: This would have been a separate line office with OAR still doing its research, but components of OAR that had some applied aspect to it would be in the Climate Service. So that never came to pass, obviously. But I think by having OAR still being entirely focused on research, the Climate Service would be more of a bridge. Much like the Weather Service is the bridge to the public, the Climate Service would be a bridge to/from the public to better understand climate. Now, if you're on the outside and you want to go to NOAA for climate, there's a lot of places you'll have to go to try and figure out how this all connects.

MG: Could this be something that's revisited under a different Congress that's more friendly to climate policies?

TK: I'm sure it could be. You'd have to have the right individuals because once you use your powder keg, you only have one or two chances. So, this has to be a high priority. Dr. Jane Lubchenco had it as a high priority. It's unfortunate that had it been proposed a year earlier, it might have made it. But timing is everything in DC.

MG: I think this is a great idea. I was thinking about how last month the CDC [Center for Disease Control] launched their Center for Forecasting and Outbreak Analytics, and how it's like the Weather Service of infectious disease. I thought something similar for climate disasters and climate change would be really important as well.

TK: Yes, yes. It may come about. Who knows? Politics is so unpredictable. It's more unpredictable than the weather, that's for sure, and the climate.

MG: You were involved in the Obama administration, there was a committee you chaired? The Global Change Research Program subcommittee.

TK: Yes, I was chair of the Interagency Global Change Research Program for, I guess, three years. It must have been 2012 – maybe four years – 2012 to the end of the Obama administration. That was a wonderful experience – more travel up to DC. But why that was really great [was] we had an opportunity not just to look within NOAA, but to look across all the agencies and figure out how we could best coordinate the funds that we had to do global change research. So, we would then look at the coordination activities that were needed to advance our understanding, go to the Office of Management and Budget in the White House, and make our petition for what we thought the priorities in the program ought to be. Then OMB would obviously have the final say in what the President's budget would be that would go to Congress. It was really eye opening. There were a lot of great things I thought that USGCRP did. The national assessment obviously came from USGCRP. But just the fact that you could now look at USDA, NASA [National Aeronautics and Space Administration], DOE [Department of Energy], Health and Human Services, look at all those activities – DOD [Department of Defense], the other agencies, EPA – and say, "Let's just not go individually to Congress with our proposals. But let's consider how our data, our information, our modeling, our understanding, fits more broadly and how we can coordinate best with what we do with what you do, for example." That was a great opportunity for us. We had advisory panels over at the National Research Council and people like Warren Washington serving on some of these committees, giving advice to the government as to how we could make that program most effective. It really was a great honor to do that and a really great learning experience of what the other agencies were doing. I like to think that we made a difference. Some of the agencies change their priorities based on what they saw other agencies doing and really worked together to produce some of these monitoring activities, the assessments, as I mentioned, but things like trying to bring up new scientists, trying to coordinate programs to help scientists grow and understand climate and global change, doing that in a coordinated manner. It was really the vision by Congress to produce and recommend USGCRP in '91. It was really visionary, and I'm glad they did that.

MG: Does it continue today? What has the work looked like since?

TK: Much the same today. The assessments are a really important part, but you can go on their website, and they coordinate monitoring across the agency, so you can get on their website and look at the latest information. They will direct you to the right place and the agencies as opposed to – "I'm interested in changes. Do I go to NASA? Do I go to NOAA? Do I go to where?" You can go to the USGCRP, and they'll direct you to the proper locations. So, it's something that can make what looks like an octopus with more than eight arms and legs and try to make that a pleasant experience for users.

MG: In 2015, NCDC turned into NCEI [National Centers for Environmental Information], born out of a merger between three data centers. Can you just say what happened organizationally and structurally? And then tell me about your new position there.

TK: Well, when we were going through the Climate Service, the three data centers were going to be combined. It was clear that each data center had a different discipline but the same kinds of missions. To keep them separate seemed like it would be inefficient. Sure enough, when we looked at it more closely, we said, "What we really ought to do is just take advantage, put together a proposal package that combines the three centers." I think I came up with the name National Centers for Environmental Information because each center had specific parts of environmental information. So, we put that package together. Congress seemed to like it. Anything you can do to be more efficient and effective. NESDIS liked it. NOAA thought it was a good idea. I was the first director of the National Centers for Environmental Information. I think it was in place in 2014. I was only director for a year and a half, two years before I retired, and then a subsequent director was hired. I just heard she has since retired as well. So, I'm sure they're going to be looking for a new director.

MG: Talk to me about that time period, the end of your career with NOAA, and what defined that year and a half.

TK: That was a lot of time spent trying to pull together similar cultures, but being in different locations, trying to produce one family so to speak. We all have the same interests. How do we ensure that we can leverage off what each other is doing more effectively? It was a lot of traveling back and forth to different site locations. We had people in Boulder, Colorado; Bay, St. Louis; Washington, DC; and Asheville. There's a little bit of different culture simply because you're in a different discipline, but you're in different locations as well. [I was] spending a lot of time on video calls, trying to get people to see what their interest is as being similar or different than other data centers and where they're different, recognize those differences, and try to make sure we don't lose that. Because you don't want to make a supercenter, so to speak, that loses the important aspects of each individual center. There were a lot of discussions and going back and forth. I think when I left – you need to have a sense of camaraderie and a sense of having each other's back. That is, if I develop a procedure that works well for me, I'm thinking, "Hey, this also could work in another location in another kind of dataset." So there's a lot of learning going back and forth. I think one of the things, one of the strong suits at Asheville, for example, was the sectors, understanding the sectors. The other data centers really picked up on that as well. At the other data centers – in Boulder, there was a strong tradition of being able to provide some really great access to some of their datasets and taking that knowledge of the way they were accessing the software systems and using the software systems and bringing that over to Asheville. That kind of coordination, I think, was extremely important.

MG: Were those the other data centers that merged into NECI? Were NGDC [National Geophysical Data Center] and NODC [National Oceanographic Data Center] located in other parts of the country?

TK: Yes, Washington, DC was NODC. NODC was not only in Washington, but Bay, St. Louis, and Boulder housed the National Geophysical Data Center.

MG: So did any of those employees have to move to Asheville or relocate?

TK: No, we decided initially that we weren't going to ask anybody to move. It's always costly to move. The only people who moved were anybody who applied for a job at a different location, and they were selected. Then they would have moved. But nobody was asked to move just [inaudible]. With the advances in communication, it really made it a lot easier to hold – it's not the same as being right next to each other but having great video conferences really helped a lot. We'd have meetings in Asheville, bringing together not only the managers but bringing in the scientists and the technicians and having them talk about what they do and how they can do it better in a coordinated fashion.

MG: The other thing I wanted to ask you was the opportunity you had to put the data stewardship of your career thus far to the test as it related to the global warming hiatus debate that I read about in preparing for this interview.

TK: That was kind of the culmination – one of the last papers I wrote while I was an employee of NOAA. That was a recognition that we had been using data that had some systematic biases in it, and we never corrected it. That was only because we didn't really know how to correct the data. We had buoys out in the ocean that were collected using one set of instrumentation. Then we had ships that used a different set of instruments to collect ocean temperatures. Previous to that, we didn't try to correct for the differences between the two observing systems. There was a recognition that the buoys were measuring temperatures significantly different than the ships, and there were more frequent buoys going on. So, it was going to reduce the proportion of data coming from ships and introduce a bias into the records. That then was the basis for writing a paper to say when we put this correction on our data, the rate of warming is greater than what we saw prior to putting this correction on. At the same time, there was debate about [how] global warming isn't occurring as fast as what we saw earlier in the period, in the '90s and '80s and prior to that. In fact, in the IPCC report, they had looked at a period from 1951 to 2000 and compared that to 1998 to 2012. So, we said, when we put our new data into that same analysis system, the IPCC pronouncements no longer hold that the warming is hard to see. The warming was clearly evident. The warming rate between 1951 and 2000 was about the same as 1998 and 2012 and 2014, which was an even warmer year. That paper garnered a tremendous amount of interest. We sent it over to *Science*. Before we did that, I should say, [we] sent a copy over to one of my NCAR colleagues, scientist Jerry Meehl – "Take a look at it. See what you think." Because Jerry had written a lot about the hiatus. Sent it over to Phil Duffy, who, at that time, was working at the White House as a science advisor. Said to him, "Take a look at it. Make sure this makes sense." So, they sent me some comments back. We made some revisions. I had about seven or eight co-authors at NCDC because this wasn't simply my work. We had a scientific team doing this. So, we then put in some other changes, sent it to the internal review at NCDC, which then took a look at it, and they sent comments back to us. Then we sent it to *Science* magazine. They had five scientists review. I've published a number of papers in *Science* and *Nature,* and usually you get two, maybe three reviewers, but five was an extraordinary number. Apparently, they thought this was going to be an important paper. We worked through those reviews. By this time, I gave a heads up to my NESDIS administrators – "This might attract some attention simply because we've got a fair number of people in the

science area that have taken a strong interest in this." We gave a heads up to the White House and said, "We're going to be, at NCDC, moving to these corrections, and it's going to change the rate of warming." Gave them a heads up. Got the paper published. A tremendous amount of attention on that paper, and it was, I think, fairly positive. Then subsequently, Congress took an interest. Some of them in Congress were very interested. But some of them were not looking at the results all that positively because it was saying, "Hey, the warming rate is really going up." There were some accusations put forward by some members of Congress that we were fudging the data, we were only doing this because there was going to be a Paris meeting, and we're doing this for some kind of political purpose. Those accusations were out there. They then asked for, as time passed – this was after I retired. They asked for an investigation. "Is this legitimate?" There were some questions that they asked of a special committee that they put together. When I say "they," this is the Department of Commerce, because it'd gotten to the Department of Commerce to take a look at why this paper was published. Was there collusion to change the records? Was it being done because of a Paris meeting or political purposes? How was the White House involved with this? They had this whole big investigation, came out with it, [and] landed with a big thud. That's how one of my colleagues described it. There was really nothing that was encountered that merited this huge investment in the study. I was told – I don't know for sure – that this was a million-dollar study to try and figure out what happened. The end result was it was pretty good science that went forward.

MG: I wanted to ask if you had planned to stay in that position of Director of NCEI for just a year and a half?

TK: If my health held up, I probably would still be there. I had some health issues. I just said, "I don't think I can continue to do the kinds of things that I was doing – traveling and managing NCEI and the international stuff." So, I made the decision to retire in the summer of 2015. I think that was a good decision for me. Subsequent to that, I did some consulting, which was a lot less onerous. Over time, I continued to consult less and less and less until today. I'm doing very, very little – very little consulting, I should say.

MG: You had talked about your work with Louis Uccellini when he was head of the Weather Service and in other roles. You had gone to school with him at the University of Wisconsin. I just wanted to make sure I asked you a little bit more about that time period before we wrap up.

TK: Louis was a friend, who was one that we met – not in the same class. We met in the facsimile room, where a model output would be produced on facsimile machines. I would say that Louis and I spent probably more time in that facsimile room than anyone that I can recall, and that's how we ended up being good friends because we'd always – I won't say argue. We would debate what we saw in terms of the coming weather. He just loves snowstorms, and I love snowstorms. So that was a common bonding experience, trying to understand when we'd had the best chance for major snowstorms. Back at that time, models weren't nearly as good as they are today. So you had a lot of diagnostics going on, in addition to help from some of the models. We would spend a lot of time in that facsimile room. There would be other people there. Charlie McDonald was sometimes a part-time student who would be in that room – very knowledgeable individual about weather, [and] climate as well. We had some great conversations and, as I said, friendly arguments about the weather and how it might unfold.

MG: What about some of the professor's you had when you were at Wisconsin?

TK: Some of the professors that I had that made a major mark on me – obviously, my major professor [Werner] Schwerdtfeger. He was my major advisor. But then there was another advisor, Professor [Eberhard] Wahl, who understood statistics in a way that most meteorologists don't. So, when I was doing my work for my thesis, he was very helpful in giving me a sense of how you could look at weather and climate data, not simply from dynamics and physical understanding, but from a statistical understanding as well. I had a background in statistics [as an] undergraduate. I think that was really a useful interaction. Other professors – Professor [Heinz] Lettau in micrometeorology, Professor [Stefan] Hastenrath, who was a tropical meteorologist – were just really down-to-earth individuals who could explain complex ideas in simple to understand terms, especially for someone who was trying to learn advanced concepts. Those were important influences on me, as well.

MG: The other thing I wanted to ask you about your family life. I know you remarried. Was that in the late '90s or early 2000s?

TK: 2002. I have to remember, or my wife will probably kill me. 2001, 2002, sometime about that time, I remarried and have been married since. My wife, at that time, was a social worker. She subsequently went into her own career as a psychologist, put up her own practice, and she's since retired as well.

MG: You said she's from Long Island. I am, too. So I was just a little curious about her background.

TK: Oh, yes. She always told me about her parents, who moved around a bit but were on Long Island. She spent some time being able to look and see the Empire State Building from her condo. She had spent some time at Madison Square Garden, going to concerts, things that I would hear about as a kid but never did. That's what she did growing up. She said, "I'm surprised. At that time, my mother let me, as a teenager, go to Madison Square Garden with my girlfriends. I can't imagine today letting your teenage daughter go to Madison Square Garden on her own." So, times definitely have changed in fifty years, that's for sure.

MG: And are your children grown and in college? Where have they ended up?

TK: Yes. My kids are – one lives here nearby in [the] Asheville area. The other one is in Mount Pleasant, South Carolina, which is just outside of Charleston. My daughter's got two great kids, fourteen and thirteen. I feel like if I was as good a parent as them, I would be thrilled because those two kids have been great students and personable. There are few kids that I know, when they were two, three years old, you go out to a restaurant, and they could sit patiently, and you could actually finish your food. It's pretty amazing. My son does not have any children. Those are the only two grandkids we have. My daughter received her M.S. in Nursing and my son earned a 2-year degree in auto-mechanics and has numerous GM certifications.

MG: What have the last few years been like for you with COVID and the world being a little wackier than usual?

TK: Yes. COVID has really – I think it has a psychological effect on you, as well, because there was such avoidance of people. Even when you do have a family get-together or friends together, you're always on edge as to who's got what. My brother just went to Disney World, and he got COVID along with his son and came back. My son's had it twice. It really interfered with the kinds of activities we [do]. Fortunately, my daughter and her kids have all managed to avoid it, so that's great.

MG: What things have you adapted in the last few years? What's changed? You mentioned social interactions. You probably can't travel as much. This is probably not how you imagined spending your retirement.

TK: Yes, traveling has been – not that I had that much desire to travel after I retired. I had really no desire. In fact, we're just talking – I had a colleague come to visit me this past week, and [we were] talking about the number of trips that I've taken on an airplane in the last five years is probably 100th of the number of times I flew when I was with NOAA. I'm thankful for that, actually, in some ways, because I can't imagine today, with COVID, doing the kind of traveling that was needed earlier. I have talked to some of my friends and [they're] traveling not as much as they did earlier, video conferences much more frequently, and many of them still aren't going into the office. It's really a change in environment for lots of people.

MG: Something you said in an earlier conversation was that your generation had left the issue of climate change at the doorstep. I forget how you termed it. But it was not a problem that we've solved. I was just curious if you could reflect on what you think the planet's in store for?

TK: I think the unfortunate thing is we studied the problem. We identified the problem. But maybe we didn't convey as effectively as we could why it's so important to address it and really put in place measures that would be lasting. Given the fact that we're still trying to deal with the same problem we were trying to deal with, really, fifty years ago, now we've already committed to fifty more years of greenhouse gasses in the atmosphere. What are we going to do? I think part of the problem that humans face is that it really requires us to do things so much differently than we've been used to doing and make investments in ways that we haven't invested in the past. To be quite honest, there's a lot of trust required between nations so that one nation may take some measures and another doesn't; you're all still going to be in the soup, so to speak. It's a challenge for the world, not only technology-wise, but how do you get along, and how do you develop trust? So that's part of the reason we weren't able to solve [this problem] in our generation, but it's going to be a huge challenge for this one. I think, unabated and even assuming that elements of technology are more rapidly implemented, we're on the route to some major disruptions. The disruptions will be most evident in the people who can ill-afford them. The unfortunate thing is it could lead to social disruption. With social disruption, we know that leads to inequalities, and inequalities then lead to revolutions and wars. So, it's not just the physical environment, but it's what we do to each other. So, it's definitely a major issue. It's one of the major issues of our time.

MG: I think that the international cooperation piece is really huge. I just was reading about how Bhutan is carbon negative, and there are these carbon neutral and negative nations that are impacted by nearby countries that are carbon positive. Those emissions are going into the atmosphere above places like Bhutan, which is doing its part.

TK: It's a case where if you're living in a neighborhood, and you have X-amount of water. Imagine you're living somewhere in California, and you're using it all up to water your plants. There's not going to be enough for your neighbors to drink. It's the same thing with the carbon issue. If you're emitting all the carbon, that's going to affect not only you but your neighbor. The advantages that energy provides are spectacular. We recognize you can't go without energy, and energy provides the means for us to overcome this problem. So, it's investing and understanding how we get energy that is effective for both production as well as the devastating negative effects it would have on the whole global system? I know that there are a lot of debates in terms of different types of energy. Now, there's some hope again that fusion might come into play, small fusion reactors, in addition to solar and wind, ocean, thermal, and geothermal. It's this mix. I think people are recognizing there are opportunities there. Can we put enough economic incentives in place so that people put in the investments? And hopefully, that'll be the case in the next few years.

MG: Well, I think you and I are doing our part. It looks like it's getting dark in both of our rooms. We haven't turned the lights on. Tom, I just have one more question, which is just to have you reflect on your career at NOAA and what stands out to you.

TK: I would say NOAA gave me the opportunity that I always dreamt of, as a little kid, in terms of forecasting weather. Early in my career, doing research, really teaching me a lot about how to do research [and] managing how to work with other people. I think the key component of all this is not only the work you do but it's the people you meet along the way. I met some really wonderful people, who I was always amazed at not only how smart they were, but often how kind they were. It was nothing but a positive experience from my perspective. The only negative I could say is too many airplane flights.

MG: Yes. That's been abundantly clear to me. Well, we can always get together again if there's more to add to the record, but you've had such an impressive career. It's been such a treat for me to get to know you in this way. I appreciate all the time you've spent with me over these few sessions.

TK: Well, I enjoyed it. You're a great interviewer, Molly. I think NOAA's in good hands if you continue to do these. It's really nice.

MG: Well, I hope so. I really enjoy this work.

TK: Great. Great.

MG: I'll pause real quick and just explain the next steps to you.

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

Reviewed by Molly Graham 7/9/2022

Reviewed by Tom Karl 7/13/2022
Reviewed by Molly Graham 7/29/2022