

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

AN INTERVIEW WITH LOUIS W. UCCELLINI
FOR THE
NWS HERITAGE PROGRAM
ORAL HISTORY COLLECTION

INTERVIEW CONDUCTED BY
GREG ROMANO

COLUMBIA, MARYLAND
19 AUGUST 2021

TRANSCRIPT EDITED BY
GREG ROMANO

Greg Romano: This is an oral history interview with Dr. Louis W. Uccellini. The interview is taking place on Thursday, August 19, 2021. The interviewer is Greg Romano. It's a remote interview with Louis in Columbia, Maryland, and Greg is in Buckeye, Arizona.

Louis, before we talk about your return to NCEP, we'd like to pick up on a topic that occurred during your time leading NWS's Meteorological Operations Division, Hurricane Andrew. It was a Category 5 hurricane when it made landfall in August 1992 ... a Florida landfall on August 24th. It was, at the time, the costliest hurricane to make landfall anywhere in the U.S. until Hurricane Katrina in 2005, and the storm devastated homestead and other parts of south Florida before moving into the Gulf of Mexico and impacting New Orleans. There are several areas we'd like to unpack here, including the models used in the forecasting and the issues related to them, the NHC backup plan, the delayed federal recovery efforts, and you had also mentioned previously to me that you've said Andrew was a benchmark storm. So within that framework, let's go back to the beginning in terms of the models that were used and the issues that you ran into. So tell us about those.

Louis Uccellini: First, I'd like to note, for Andrew in August of 1992, that I was the division chief of the Meteorological Operations Division. That division was officially part of NMC. The Hurricane Center, the National Hurricane Center, was led by Bob Sheets who reported directly to the director of the National Weather Service, who at the time was Joe Friday. So you have one component within the National Meteorological Center, and the other organizational component actually as a separate entity reporting directly to the director of the National Weather Service. So it's fair to say that the Hurricane Center basically called the shots with respect to its organization, its budget plan. It's ... whatever it was going to do for the year... it was directly up to the 18th floor of the Weather Service headquarters to Joe's office, and Bob would use that perch very effectively within the Weather Service; within the bureaucratic structure of the Weather Service.

I'm saying that because we weren't equal partners in that light, and the way normal operations would occur is that we had, within the Meteorological Operations Division, to make sure that our precipitation forecast, for example, was consistent with the track forecast that would come from the Hurricane Center. There was no collaboration beforehand. We would wait for the hurricane conference call, and somebody at the Hurricane Center would then get on that call and read out the points and read out the intensity, the points for the track. That was it, and there might be some discussion that would be more interpretative. But you weren't going to change that forecast. That was just written down as what everybody was working off of.

So two things were happening in '92 preceding Andrew, and as it turns out, it was the first category five hurricane to hit the United States since Camille in 1969. At the time that Andrew started posing a threat, there was concern it would get up to a cat three. So people were thinking in those ranges as the storm was approaching Florida from the east. Two aspects from an operational perspective that were relatively new for 1992 was one, the global model, which was named the Medium Range Forecast Model, the MRF [...] and the aviation run, which was a subset of that, was run twice a day. The MRF was run once a day for an extended period of

time. Basically, the same models, just different designations. Well, this would be the first year that there would be a bogus low put into that model's initial state to represent the position of a known hurricane out there. So if there was a hurricane on the map, you could put a low pressure system into the initial state and adjust the mass fields above it and adjust the wind field around it and then let the model run with that. There had been some tests, obviously, that had been done with this in the previous years.

Steve Lord, who was the deputy of the Development Division, the Modeling Group, as it was called then, had come to NMC from the Hurricane Research Division. He had done his work, his PhD work, out at UCLA in the tropical meteorology [program]. He was a trusted person with the Hurricane Center, and so he had been working with them over the course of many years. On this item, he got to the point where he would get them to look at the Global Model runs now, and then an interesting thing [happened] here ... Bob Sheets decreed that they couldn't use those model forecasts as part of their official forecast because he just didn't trust the models to be able to predict the hurricane track. So even though we had done this at NMC, the Development Division had gotten us into the models ... [The NHC] could look at it, but they couldn't really use it. They really looked at 1992 as [...] an assessment year. Let's see how this works, and then we'll move forward with it.

At the same time, Joe Friday working with Bob Sheets and Ron McPherson, who was the head of NMC at the time -- Ron was the person, one of the two people, remember, that hired me into the job, into the MOD job -- decided, I believe in the previous year, that there needed to be a backup plan for the Hurricane Center. The backup for the Hurricane Center should be MOD, so it was one young John Sokich who was the head of that planning activity. We came up with a plan, and I say the collective "we" being MOD and the Hurricane Center. If the Hurricane Center was viewed as being under threat of being totally shut down, we needed to get the hurricane experts, a group of hurricane experts, up to MOD and they would operate out of MOD, including doing interviews with the media. A very big part of the operations of the Hurricane Center was the direct interviews with the national and local media outlets where local media outlets could plug in. We are talking 1992. Most of this was done through the national networks. So '92 was going to be this assessment of the model year. We've got this backup plan, and John was very careful in getting buy-in to whatever level he could out of the Hurricane Center. We certainly all bought into it. We needed workstations that people could work off of, product generation, not only within MOD's public weather segment, but we were also spinning up the marine unit there, which would be equivalent to their marine unit down at the Hurricane Center, the TAFB, Tropical Analysis and Forecast Branch. We had a section of the Meteorological Operations Division just spinning up that would be important because in the open waters as you go from south of 30 degrees north to north of 30 degrees north, there's a handoff [in forecasting responsibility] from the Hurricane Center to MOD as this was being developed.

So we come into 1992. It's a pretty slow tropical year. You go through the first half of August, no storms. So remember now, Andrew is the first storm of the year, and it's heading right towards Miami in terms of this new model showing that "L" that represents the hurricane with the isobar around it or two is heading right for Miami. So Bob was enforcing his rule of not using the track

from the model itself to influence the forecast, the official forecast track. He was pretty adamant about that, but it was very clear that people were looking at that, not only within MOD but also down at the Hurricane Center. Of course, from an intensity perspective, there were known things, like sea surface temperature, structure of the ridge, and that kind of thing, the data coming, of course, from the hurricane hunters, and the satellites. The geostationary satellites had become a main focus for sustaining situational awareness of these storms out there in the middle of the ocean. So it was clear that this storm had not only potential to intensify, but it had all the signs of intensification as it was approaching Florida.

So the day, the morning of the day that it made landfall -- it made landfall at night -- that morning it was decided through telephone calls, because I don't think Bob really wanted to exercise the backup plan, But there were obviously people down there that saw this storm and saw it heading towards the Hurricane Center, which was in a building close to the coast susceptible to impact from a full-blown, category three, four, or five hurricane. They said, obviously, said we need to consider this. I can tell you that there were a lot of discussions going on on the phone. Bob Sheets was hesitant about doing that. Bob had the ear of Joe Friday. Joe Friday was very careful not to order the director of the Hurricane Center to do something, but there was strong encouragement to consider this backup plan. So the morning of the landfall, the decision was made that Jerry Jarrell, who was the deputy director of the Hurricane Center, and a few of the specialists and one person from the TAFB, which turns out to have been, it was Dan Petersen who became a stalwart up in the Weather Prediction Center later. They all came up. There was about, I'd say, there were at least four people who came up, so when we heard they were coming, we got everything prepared. We had all this checklist stuff we had to do, where they would work out of, where they would do their interviews from, and the like. I made the decision at that point late that morning that I was spending my whole time there in that building. I wasn't leaving because I wanted to make sure that everything worked for those four people. Because I knew, of course, it could be that they will become the touchstone for the whole country making decisions.

So here we are in August. It made landfall, as you said, on August 24th. Here we are on that morning, preparing for backup [with] a brand-new plan that hadn't really been [tested]. It had been sort of tested, and we went through some of the motions on that. They arrived and we got them set up in the midafternoon to late afternoon of that day. Well, this storm was heading towards the east coast of Florida. At first, it looked like it was headed towards Miami, but the track itself seemed to be shifting more to the south and that clearly, Miami would be involved. But it was becoming more clear that points to the south were going to get hit harder. Well, guess what's south of Miami? It's the Hurricane Center. So the four individuals were really, I think, relieved that they had come, from a professional point of view because there was this increasing concern. We were watching this thing intensify. The eye was becoming better defined. We could actually see this hurricane with the new NEXRAD radar that was in Melbourne, Florida. We could see the hurricane, the bands and the eye structure. It was phenomenal, so this was our first view of NEXRAD on that floor. So it was approaching in the evening, and what happened there was that the Hurricane Center itself went through hell. The radar dome on top of it blew over. They were increasingly concerned for the safety of the people in there, and they were

losing functionality. In fact, the net of all this, they were down to, very quickly, down to one line between the World Weather Building that MOD was in and their building for all of their data that they were getting including the satellite feeds because, remember, within the World Weather Building, we also had the NESDIS distribution group up there on the sixth floor that distributed this information down to the Hurricane Center. So it got to be an exciting night with interviews being done from, very quickly, from the World Weather Building, Jerry Jarrell being one of those interviewees. You know, it was very busy doing that, and the hurricane experts were there as well. That worked out really well, actually. It was very exciting for me, three years in from the research community, to see this. To see the professionalism of the forecasters from the Hurricane Center was really, it was almost like a treat. They were very open. They invited me to do one of the interviews. I said, "No. No, thank you. I'm only here to support you." And you know, I had never ... I don't think I had done a national interview up to that point. Or if I did, it was in a domain space that I was very familiar with like a winter weather event or something.

So that was, up to that point, really well done. By early in the morning -- and I'm talking like three, four o'clock in the morning -- the people that were up there, the Hurricane Center personnel, became very concerned because now they were hearing what this storm was doing south of Miami, and many of them lived in these areas. They were very concerned for their house. They were very concerned for their family and friends. They were also concerned about the people who were still in the Hurricane Center down in Miami because it was pretty clear that there was a lot of angst down there, whether [...] windows were being blown out. It was really bad news, so that dynamic was unfolding. And you can imagine the distraction that was on the people who were up there, who had to do their job, to do the best they could working with the Hurricane Center folks that were still on shift down at the Hurricane Center, and were now picking up the interviews. But they were very worried for their families, and so that dynamic was happening.

The other aspect to this was that it (Andrew) was a lot more intense than they anticipated, even before it made landfall. It was pretty clear from the radar and from the satellite imagery, this thing was going beyond a cat three, and at that time, the only person who could make a change in the intensity designation was Bob Sheets. Bob Sheets had taken a break, I think, you know, and then came back in a couple hours later before landfall. But there was this period where there was, it was known that this thing was greater than a three coming in, and you know, there was this assumption made and initial observations suggested it was a [category] four coming in. But they couldn't upgrade that, so we had that issue to deal with. Jerry Jarrell was ready to make that call when Bob Sheets came back in, and he needed a break. I mean, the guy was there the whole morning, the whole thing, and then came in for the overnight period because they knew that's when the [storm would make landfall]. But it shows you the hierarchical structure that they had in the forecast process. So we viewed that as well, and I made a point of emphasizing to our folks afterwards that part of the postmortem, to make sure that we don't do this in MOD. I'm there as the division chief, but if there are forecast changes that have to be made, that's your job. You keep us informed, but that was the kind of thing that was sort of a lesson learned as a newbie in the weather service. We had to make sure that there was more flexibility in the forecast offices we had jurisdiction over.

The next day was really interesting. First of all, I had a buzz being up all night, sort of almost like the first midnight shift. I took a short nap, I think, for like an hour on a couch in one of the places, but it was pretty jazzed up. So I had kind of a buzz, and I was watching, again, making sure that the interviews -- there were a lot of morning interviews, obviously, what was going on. But the other thing, there were two aspects of this. The family dynamic was becoming more pertinent, especially to the people that were there at MOD because the damage -- with the sunrise now, the damage reports started coming in. And I'm telling you, there was silence when we were seeing some of the stories and what was going on south of Miami.

But two things happened from the forecast perspective. That storm cut right across Southern Florida and was back in the Gulf of Mexico, and there was very little degradation in the intensity. The structure was intact when it came out the other side. It passed right over the Everglades, probably with very little frictional dissipation, came out the other side, and now the model is saying it's going to hit just west of New Orleans. Bob Sheets looks at the model. The forecasters were told they could use the model. [...] It was very consistent from run to run which is [...] that it was going to hit New Orleans. It was going to go to the west of New Orleans. You know, it's going to go to Texas, and then it comes back to New Orleans. Bob would have said, "Like I said, don't use the models." It was very consistent in bringing that storm right up towards New Orleans and slightly to the west. Again, there was no, nothing to be said about intensification. It never did re-intensify to the level it was when it hit Florida, but it was still a fairly strong storm. So I always said that Andrew was an important marker, one of these inflection points in the forecast process for the hurricanes because this is where I believe models were now, the forecasters were allowed not only to look at the models but to start using them. Now, of course, there's a long way to go from there to the Hurricane Forecast Improvement Program and the high-resolution models we're seeing today, but Andrew was important in that regard.

GR: Louis, when we talked earlier about this, we talked about that there was a significantly delayed federal recovery effort in Florida, and when we compare that to the recovery efforts we see today, it's really striking. I'd like to hear what happened and why. But the other thing that strikes me, and perhaps you can comment on it, is to me looking back on the media coverage of this event, I remember the media coverage as well. And as you described, Jerry and others were doing interviews. I'm wondering whether in your perspective you saw that the coverage of the devastation in Homestead and South Florida took away from the potential threat to the New Orleans and other Gulf Coast areas.

LU: Okay. So let me address the first part of this first. So you know, the Hurricane Center even in the '90s was doing a form of IDSS (Impact-based Decision Support Services), probably more so than any other component of the National Weather Service. Bob Sheets did not believe the job was over with the issuance of a forecast and warning. The reason I say that is because the first time I met him, when I came on in 1989, and I might have met him like early 1990, I didn't even get a chance to say anything after I shook his hand and said, "I'm Louis Uccellini." He says, yeah, he said something like, "Yeah." He said hello, but then he said "I hear you're coming in from NASA. Well, let me tell you, if you think the job is over with the forecast and warning and

that there's not, and there's nothing else that you need to do, you know, go back to NASA." He basically said that, and I knew that the Hurricane Center spent a lot of time on the media conveying the best information they had in terms of the situation and the forecast and the potential impacts.

What I didn't know until I joined the Weather Service was the level of effort they had already been putting into working with emergency management. Now, emergency management at that time had a focus on natural disasters and was basically the local and state emergency management community. FEMA's mission was still [at the time] recovering from a nuclear war or a nuclear bomb kind of thing. So you had this situation as you don't really have a national umbrella that's organized in a way to deal with a predicted event. So there was work that was being done between the Hurricane Center and let's say the state of Florida, and there were tours that were already done up and down the East Coast during the off-season. In fact, the other expression I heard from Bob was, "We're as busy in the off-season as we are in the on-season." Because they're working to train emergency managers at the county to state levels.

It wasn't as obvious to any of us up in the World Weather Building [in Camp Springs, Maryland] as Andrew was approaching, whether or not, exactly, what the Hurricane Center was doing in terms of keeping the emergency management informed in the state of Florida. But I can imagine that there was work being done for the counties around Miami and the city of Miami itself. There were efforts to get people into safe ... there was some evacuation that was done, to get people into safe areas. But there wasn't any organized structure from a national perspective. So when people woke up the next morning and saw the magnitude of the damage in Homestead ... part of the other story itself was that Miami is looking okay ... There's this whole area where people live between Miami and Homestead that was absolutely devastated, including Homestead. So there was, I think, a slow motion response. I know there was a slow motion response, and there was practically no response from the federal government. And I remember this very clearly watching the news two days later, where remember, this is August. This is the end of August. President Bush spent his vacation time, his August time up in Kennebunkport, Maine -- the complex at Kennebunkport. And there was literally somebody on TV telling the President two days later from one of these state agencies down in Florida, you've got to get out of Kennebunkport. You've got a disaster down here. You've got people with no fresh water, no food, and no way to get it. That was what was on TV two days after, and it was only then that -- now, we as citizens could see. We didn't get any information up at MOD about what was going on down there with respect to connecting to the emergency managers -- that you could see the federal government starting to mobilize two days after. And, it took another two or three days before they got an organized effort down into southern Florida.

So this is something that is very sharp in my mind because I used that as a baseline of where we really were in the early '90s with respect to a response to a storm like this. And remember, we were coming off a period, a long period -- this is like 23 years after Camille, Camille was in 1969 -- of having a storm of this magnitude make landfall and do this kind of damage in the United States.

So this was a real gamechanger, I believe, for the emergency management community. And when Clinton won in 1992 -- Clinton won that election -- he hired, you'll have to remember who the senior administrator was, we'll have to get that name up there, because one of the first things they did was change the mission statement of FEMA to include natural disasters. And they were all hurricanes and tornadoes at that point very quickly. They really went all in on preparing for these natural disasters, and that provided a national framework then for the Weather Service to start plugging into on top of the Hurricane Center, of course. And they did focus on hurricanes first, but there was also severe weather that they were very much interested in. But that storm actually, I contend that storm and, of course, the presidential election afterwards, changed the mission statement of FEMA to include natural disasters.

GR: Was that James Lee Witt?

LU: Yes. And what was amazing going into this, I had a chance to visit FEMA later still during the Clinton administration, and when you walked into FEMA, it was pictures of James Lee Witt and others, you know, walking through all these disasters. They were all weather related. Every single picture along these walls were weather related, and that gives you an idea, I believe, of how important Andrew was to changing what FEMA was and is making FEMA what it is today because they spend a lot of their time, if not most of their time, dealing with natural disasters like hurricanes and floods and fires and stuff like that so.

GR: One other thing you've mentioned previously is that Andrew changed how the insurance industry operates, especially in Florida. Can we talk a little about that?

LU: Yeah. And I learned that from friends that I had, twin brothers, Anthony and Larry Battaglia who were friends of mine right from the time I was in grammar school. One lived in Miami, southwest of Miami, decided to stay in his house while his family evacuated, and he said it was the most harrowing experience he ever went through. And the other lived down in the Keys near Marathon, and visiting, interacting with them, and then literally visiting them in 1998, spending a week there with the family ... that was the whole story of how you can't get insurance anymore because of Andrew. Or that the insurance is so high that only rich people can build along the coast. You saw this transformation in many parts of Florida along the coast and in the Keys where people used to live in block houses and stuff like that. They couldn't even afford insurance on that, so Larry -- he was the one who lived down in Marathon with his wife -- they wound up living on their boat. That was their way. So that's kind of interesting the way that transpired, and I had other friends that wound up in the Keys for periods of time that I knew from Wisconsin, in Madison, Wisconsin, who wound up not owning anything when they went to Florida. They only rented because the insurance cost was so high.

Then, Scott Rader, who was the Chief of Staff for [NOAA Administrator Vice Admiral Conrad] Lautenbacher in the early part of this century, in the early 2000s, went ... When I was the NCEP director and was down in Miami, going to a conference or a new conference in the Hurricane Center, I always made a point of visiting my friend Anthony Battaglia. It turns out he had a boat, a sailboat in one of these marinas that was right across the dock from Scott Rader's uncle, and

he was one of the insurance people who actually survived Andrew. And the guy had the biggest boat in the whole marina, so you know, so I got all the insurance stories from him, too, and how the ones who survived, how they survived. But he really told the story about how that storm crushed the industry down in south Florida.

GR: On another occasion, I'll tell you my story with my friends who survived Katrina and their insurance story, which is actually, from their standpoint, a positive. So let's shift -- excuse me -- let's shift gears. You've got me talking about boats, and I want to say ships. I don't think living on a boat would be a bad idea, though I don't want to be on a boat in a hurricane. So that would be difficult.

LU: Yeah, even tied up. In fact, that's the worst place to be. It's like, get the boats out of there ...

GR: Yeah. I remember a conversation with somebody who had a boat in Annapolis right before Isabel hit and the preparations that she had made on that.

Okay. So now we're going to talk about your coming to NCEP. The NMC became the National Centers for Environmental Prediction, or NCEP, in 1995 I believe, based on the strategic planning effort that you led in the 1992 timeframe prior to coming to NWS's Office of Meteorology. Jack Kelly selected you to be the head of NCEP and I know administrator James Baker signed the paperwork in early 1999. And at that time, NCEP's tagline was "Where America's Weather and Climate Services Begin." Why don't you start by telling us about what was different at NCEP when you returned?

LU: So a couple of things were different. I did lead the strategic planning team to bring to fruition the outline that Ron McPherson provided us because it involved the reorganization and restructuring of NMC with the inclusion of the Hurricane Center and what at the time was the Severe Storm Center out in Kansas City, which also included aviation. So there would be six centers, six service centers that we were to write towards. If a hurricane would go through this ... we had [the National Hurricane Center]. We had climate prediction. We had the Hydrometeorological Prediction Center. We had the Marine Prediction Center. We had the Aviation Weather Center, and I'm missing one. So the thing is, we had this -- right -- oh, we have a separate Severe Storm Center, aviation, climate, hydro ... spread all around the center of this organization, which would be the modeling group, which was what we have now, the Environmental Modeling Center. And then Central Operations for NCEP. So the thing is, when I came back into the organization, those centers had about three or four years to gel together. And remember, both severe weather, which now is a separate center down in Norman [Oklahoma] -- and aviation, which was created, these were new. But the head of that center (SPC) was no longer reporting to Joe Friday. They'd be reporting to the head of NCEP, so that changed. Same thing with the Hurricane Center. Same thing with climate. Same thing with hydromet prediction, and same thing with marine.

So there was an opportunity, and this was by design, to start getting the service centers working collaboratively together, even within the forecast process, rather than being six separate nations

working on their own. And that could help drive the whole IT infrastructure, which was also way behind, still way behind. Remember, when I came into MOD, there wasn't UNIX. We were just spinning up GEMPAK as I left to go to headquarters. This was starting to happen, where the GEMPAK/NAWIPS system was available to be used in the centers, but the centers took their own time as to whether they were going to actually adopt or not. So they were all on different IT frameworks and workstations and still working separately. But they were all under the same management structure now. So that was new.

With respect to EMC, it was interesting that there were advances being made in the short-term weather and even in the extended-range weather [models], but the climate modeling that was being done was actually being done ... there was some climate modeling being done in the EMC. But there were also climate models being done in the Climate Prediction Center with people asking for their own file servers and computing structures to run those models. That was ongoing when I came in, so there was a lot more of a push in this building that really wasn't there to support a data center to actually bring this IT structure in. So when I came in back in 1999, that was a state that was different than when I left.

I'll just say that the last thing was that there was an interest in, there's always been an interest in getting out of that [the World Weather] building. There was a false start several years ago. While I was in OM, there was a false start to get out of that building into, onto Goddard Space Flight Center actually, and that had fallen apart. So there was really this sense amongst the workforce in the World Weather Building that they were stuck in an old building, and they could really never get out of that hole. I mean, that, what I mean by the hole is it just weighed on them. It really depressed a sense that we could be better than this. So when I came in, I was the one who came up with this where America's climate, weather, and water services begin. The big word here was begin, not end, and that we would be the first choice of the weather community. And that was a saying that I came up with to try to entice the outside people and the growing enterprise to work with us more effectively instead of competing with us. So in other words, at that time AccuWeather was competing with the Hurricane Center. They were putting people on the coastline saying the Hurricane Center is saying one thing. We're saying it's going to go someplace else. They were still doing that, by the way, well into 2005, 2006 during that season, but then they stopped doing that. But the point is I said, America's first choice.

I was also directing that towards the WFOs because it was very clear that we weren't connected well either from our service centers or even our modeling output. We needed to do something about that because what are we using all these local university models for their own local forecasts. The TV stations and the private sector folks were resonating with what we were doing but not necessarily the folks even within the Weather Service. And in fact, I said during my office visits as the director of the Weather Service, I had more interaction as the ... when I was the NCEP director, I had more interactions with foreign countries than I had with the WFO infrastructure of the National Weather Service because we were viewed as competitors, doing their jobs out in the local offices rather than acting as a resource. It's a cultural thing. It was more of a cultural thing than I even realized until Fine's book, Alan Fine's book (*Authors of the Storm: Meteorologists and the Culture of Prediction* by Gary Alan Fine) came out on the culture

of the Weather Service in 2004.

So that's what I basically walked into. Those were the kinds of ... the kind of things we put out there as a basis of our new strategic plan. Now, what are we going to make NCEP now that we've created it? And Ron gets all the credit for creating that structure, and I can imagine the tough road he had to haul to get Bob Sheets and Fred Ostby to report to him when they were used to reporting to the director of the National Weather Service. That's not an easy thing. It just doesn't work as easy. But you also have the Climate Analysis Center becoming the Climate Prediction Center and a lot of things going on outside of NCEP. IRI was being spun up, and Ron viewed that as just competition to CPC. And so NOAA was putting more money into climate work outside of NOAA than they were into the Climate Prediction Center. You know, so there were all of these things kind of swirling around when I came in in '99.

GR: When did the shift to and how did the shift to capturing the attention of the WFOs and becoming more collaborative with them, when did that start happening? I mean, you know, if they viewed you as competition, when did they really start recognizing, "Wow. Okay, these folks are a resource to us." When did that begin, and how did that transpire?

LU: I think that started really happening after I became the director of the Weather Service 13, 14 years later. The first task was to get the centers to work with each other in a collaborative way, and that took a number of years, several years, through strategic planning. That whole idea of being first choice meant that we had to find a better way of working together. You started seeing things happening along those lines when Max Mayfield became the director of the Hurricane Center. So Bob Sheets leaves. Jerry Jarrell takes over for three years, I believe, and then he leaves. And then Max comes on board, and Max was a lot more collaborative. You know, Jerry was starting it, and then Max saw the value of it. So you started seeing things like the severe weather part of hurricanes at landfall being collaborated with SPC. [It] included the rainfall ... the heavy rainfall that the Hydromet Prediction Center, as it was called then, started being adopted more readily, although there were some down in the Hurricane Center who felt that they should do the QPF, as if it was an easy thing to do. They've got enough trouble dealing with the intensity and the track. You've got experts who do QPF the whole year round, so I put a stake in the ground on that. So the thing is, was to get the service centers working together and use that as a basis to start getting more people working with this unit working collaboratively together because there was more to gain from that.

Other things that happened were that we couldn't afford to do three climate models. We could barely afford to do one, but we had to do something. For sub-season to the seasonal, we were responsible for it, so then we spun up the climate forecasters. We shut down the climate modeling going on in CPC and combined it all into one group in EMC. We decided to build off of the, what we call now the GFS, the Global Forecast System, not the MRF and AVN because that was just confusing people. There were people who didn't use the AVN because they thought it was just for aviation. They didn't realize it was a weather model just like the MRF. They'd wait 24 hours for the MRF, so we started doing that.

The other thing we did, the other thing I walked into was this ... We were working the procurement for the next computing system, and that was on its way. I didn't start that procurement, but it was on its way. It would be the first computer upgrade since we got the Crays, and there was another system, cyber system, that we had and were stuck with for eight years because it was a bought system. So what was being done was to lease computer systems, lease the facility was the idea and then move that ... start building up our computers. And the reason this new arrangement would work would be that you could get an upgrade built into these things every three years. If you had an owned system -- and it cost a lot of money to dispose of an owned system -- you usually got stuck with that system for a long time because people didn't want to make the tough decisions to pay those extra bucks and then go buy another one.

So all of this was in play when I took over in 1999. We were in the process of going through that transition. It was contentious because of two things. One, we wanted to get into a data center and get out of FB4, which were these big office buildings in Suitland, Maryland, which were old post World War II buildings, not designed as data centers. We had people who were very concerned that the infrastructure there couldn't support these bigger systems and that there was asbestos that we would have to deal with. Jack Kelly, who was the director of the Weather Service, was told not to goldplate any of these things with the model, with the computers and everything, and so when he heard about the asbestos and that it wouldn't support. This was just before I took over, by the way. So I wasn't there for this part of it, but he was not trusting what he was getting from NCEP. Let's just put it that way. When the IG report came back and said there was no evidence of asbestos and it can be done within the infrastructure and you can save X amount of money, everybody, of course, sided with the IG.

Don't forget, the Weather Service was just coming off the financial problems that Joe Friday encountered with the end of the modernization and not getting the budget. He claimed he had a \$43 million budget shortfall, and nobody believed him. Jack Kelly did a report, came up with a, like, \$42 million shortfall, but Joe was already gone. Jack takes over, but there was a credibility issue still with the Weather Service. Jack had to rebuild the credibility in the eyes of NOAA, the Department, OMB, and the Hill. So there was this inclination to believe the IG. Well, it turns out - - okay, I come in there. IBM had been selected as ... for a parallel processing computing system, not vector processing. All the old computers were vector processors. The cyber and the Crays before that were all vector processing machines, so there was uncertainty about whether this was the right way to go amongst the larger community within NOAA, within the world actually. We, it turned out, were the first operational unit to have a parallel processing machine, which would give us more efficiency in these big bursts of the use of global models on our modeling cycle. All of this was in play. All this was swirling around, but we had to put that computer in FB4.

Well, guess what happened in September? I came in in late January of 1999. Guess what happened in September of 1999? We had Floyd coming up, approaching Florida, coming up the East Coast. Another Hurricane ... this hurricane thing always seems to follow you around when you're in the Weather Service. And there's a fire in the Cray that we owned that runs all our

models, is not backed up and is located in FB4. The fire department comes rushing in. And one of the new fire chiefs ... we had gone through this drill with them. Don't grab a fire extinguisher from outside this room. Only use the fire extinguishers inside the room. So they grabbed one on the outside. It's all full of dust. It's that thing that smothers the fire with dust. They sprayed that all over the Cray. It's done. It's done. We laugh about it now. All right. So that happened -- okay -- and right about, just before that, just before that, maybe two or three weeks before that, in installing the new IBM system in FB4, it broke through the floor. The infrastructure that Waymen Baker and the others were trying to tell Jack would not hold the new system, broke through. And when it broke through the floor and our guys went in there with the IBM folks, the first thing the IBM folks said, "What's that under the floor? What's that white stuff?" It was asbestos. So who had to report that to Jack Kelly? That was me, and then when the fire happened, that was me. We were in the process of beginning the move of the IBM from there because Jack agreed after we came up with, very quickly, came up with a plan that was a data center out in Bowie, Maryland, that was opened up because the census work was spinning down for the 2000 Census, that we could use that data center.

So we had to move everything that we had already installed from FB4 over to this new building, from a known asbestos site so that people had to be dressed up in their suits and all that stuff to do all this work. We were in the middle of that move when the fire happened while Floyd was spinning up off the coast, and we had a backup plan that backed up about half of the products in a degraded mode. We instituted that backup plan, but the private sector was not happy with that plan. We moved. We got into that new data center in record time, spun up the new system, was able to shut down our connectivity. It took months. The chap at IBM that was leading that whole effort was one Kevin Cooley, who after that came into the Weather Service to work with us at NCEP, wound up as the NOAA CIO for a while, went over back to the Pentagon during the war, and then came back and is working in the Weather Service today. We pulled off this, what we called the miracle. Jack Kelly started calling us the miracle workers because we got that spun back up.

The other thing that happened from that, by the way, was the cry of "you need backup computing." How in the hell are you running this for the national needs without backup? Well, I can tell you that our predecessors at NMC, Jim Howcroft was one of the main people -- he was the deputy director of NMC when I came in, for example -- he was always working to get a backup computer for our models [but we] never could get it over the budget line. We had a backup system, got a backup computer, and that's what we have today now. We have primary backup. We have leased facilities, leased computers. The infrastructure we build into those is to get the data in, get the output out. What that allows us to do again is to build up every three years, but I always said that the ten years where we held constant in our computing capacity, prior to this is the ten years we fell behind the European Center. And even as we've gained, you know, under this new [focus], that gap has always persisted. We've always been behind the eight ball with respect to the computing capacity, but at least we could start upgrading and work towards the future.

So all of this was happening. So when you ask what's different, [it's] everything. It was either

just before we got there, just before I got there, I say we because Dennis Staley came over with me from headquarters and was my de facto deputy and my budget manager. Dave Caldwell was there. He became my de facto chief operating officer. In fact, I think that's the title we gave him within the headquarters, and the three of us basically were leading the headquarters of NMC, NCEP, and now working that forward.

GR: Given all of these expansions in the ability to do computer modeling, adding the parallel processing computers by IBM, leasing these computers, adding backups, etc., I also understand that this also allowed adoption of and promotion of more ensemble models. Do you want to talk a little bit about that?

LU: Yes. So as we built up the computing capacity with the primary/backup computer -- and not only improving the physics and the dynamics of the models but actually going down to higher and higher resolution -- we made some fundamental decisions that changed the whole model, the whole way the model suite was run. Change number one is we went from a 12-hour model cycle to a six-hour model cycle. So instead of just running the models at 12Z and 0Z, we would run this, we would rerun the model suite at 18Z and 6Z. Why? Because a lot of the pressure was coming from the media, but it also made sense in this regard. When you're running a model at 12Z, you start the model run, and the way the whole postprocessing was done, you went through all the postprocessing. And then you started faxing out the products. We were also getting onto the internet at that point. Remember, ICE ... the Internet Changes Everything.

So we were starting to get our model up, and you could actually start projecting the model output into the web and showing it even if the model was running. So you could get the model's output out more quickly. But what was happening is that sure, you get the models out by 11 o'clock, 12 o'clock; 11 o'clock in the morning, 12 o'clock noon. You could influence the early morning, the early afternoon forecast if there was any change, and then you'd have the evening forecast dependent on that 12Z run, still. So even 12 hours later, you're still using the same model. When you spun up the 0Z model, which was 7 o'clock in the evening here in the winter, 8 o'clock in the summer, there's no way you're getting that model output out for the 11 o'clock news. From a news cycle perspective on the East Coast, and even into the Midwest, everything people are getting during that day to the time they're going to bed is coming from the 12Z run. So what we saw with the internet being able to distribute the model data more quickly is that if we went to six-hour cycles, we would be getting the 12Z data out, in two hours it would start coming out. It was in effect, 9 o'clock to noon updates. The new cycle was starting to be more continuous. CNN, MSN now, local news now was ... they're more regularly [updated]. So it's updating the 12 noon [run]. You'd do the 18Z run. You're updating the evening run based on the new models. The news cycle starts advertising to stay tuned for the latest model results. This was a teaser to get people to stay with the news there for the evening, and then, very importantly, as people are going to bed, they're getting a forecast from the 0Z run, not from [...] the 12Z run. We did that.

That had important implications for us. From building better data assimilation systems because data assimilation takes a long time to assimilate the data. If we were on six-hour cycles, you

basically have your data assimilation cycle about two and a half hours. But from a user perspective, this was a big deal.

The second thing we did during my tenure there, and this was a very conscious decision. And this was based on the research community. So the idea of an ensemble model where you perturb the single model runs that we were relying on -- we were calling the deterministic run -- you can perturb the initial state. You can perturb it with the known observation errors of the observation systems you're using, and you can do that twenty different ways, which is what we decided to do. And then, so you have now a set of runs, twenty runs plus the one deterministic run, that you've perturbed, and then you let them run. So now you get an envelope of solutions, and from that envelope of solutions, you could get 21 different 540-thickness lines. That was a measure of -- at the time -- was an indication of where the rain-snow line is, and you get a whole collection of them. If they were all collecting in one area, you say, "Okay. Well, that's likely where the rain-snow line is going to be." You could get twenty different tracks of lows. This [inaudible] are the spaghetti charts that people talk about, but you could also extract from that, with statistical postprocessing, what the most likely solution is going to be. There was research involved in that as well. Well, there were these experiments going on about what is the value of running these different models or running one model twenty different ways. The first one was the SAMEX experiment that was run over the central US for short-range models. And there were models from NCAR, the WRF. There was ours, the NGM, and other new ones that were, the North American Model that we were calling it. Should we just select one model and then run an ensemble off of that? Or were the best ensembles coming from the collection of models running? So this became known as the multi-model ensemble run. And it turns out that when you went from one model to two models to three models, you got an incremental increase in skill, especially in extending skill levels out further in time. So using the SAMEX, we used that as a basis for establishing the short-range ensemble forecast (SREF) system, not just based on the one model we were running. We incorporated the WRF from NCAR and ran both. Now, we were viewed on the outside as being afraid to make a decision in doing this, but the reason we ran both was to get on the frontend of the curve with respect to the ensemble world that was coming from the research community. And the short-range ensemble was one way we could do that.

Now, what was really interesting was that we were criticized ... or questioned -- I wouldn't say criticized -- we were questioned by the European Center at the same time [by] Tony Hollingsworth, who I admire tremendously. The guy was a real gem. Another tragedy, in terms of him dying early. They didn't see where you would get enough spread in the ensembles in the very short range to make that worthwhile. Well, it turns out with the physics that you employ on a high-resolution model -- there was a lot of spread even from the, in the short range model. So there was uncertainty in that, but we made it work for the SREF. Then there's the NAM going into the SREF.

We also, of course, did it with the global model, and that research project was actually run by the WMO. It was called THORPEX, and we were a collection center for different models that was being run in real time to see if individual centers and their ensembles made a difference.

One of those centers that we worked with very closely was CMC, the Canadian Meteorological Center. during the experiment. The United States, under my insistence and with the assistance of Zoltan Toth, insisted that we collect that data and do all this in real time. We run the models in real time. We collect the data in real time, analyze it with the idea that if this thing worked, we would go into the ensemble world in partnership with Canada, and that's what we did. First, we spun up the GEFS, the G-E-F-S, the Global Ensemble Forecast System, for the US based on what we were seeing during THORPEX and then signed a partnership. D.L. Johnson was the head of the Weather Service at the time. We had this big ceremony out in Camp Springs to run a multi-model ensemble that we now call the North American Ensemble Forecast System. So that now gets us from the short range to the medium range -- that we have multi-model ensembles. And then when we were running the Climate Forecast System, we ran that as an ensemble system. We didn't do the seasonal forecast every day, but we ran four, through that cycle, six-hour cycle, we ran four runs of the CFS every day to build up a forty-member ensemble out through the ten days so that we could then do the seasonal forecast off. But it then grew to a multi-model ensemble using again the Canadian Climate Model as a partner and also now research models. So when you look at our seamless suite of products, during the time I was the NCEP director, we developed that seamless suite from short range all the way up to seasonal forecast system with a very strong basis for all of those scales being ensemble modeling and most of those scales being multi-model ensembles. Until just about when I was ready to leave, we were experimenting with multi-model in the seasonal forecast system. The Climate Forecast System for seasonal prediction. We were the first operational center in the world to have this range of multi-models, which was really, I think, a proud achievement for everybody that worked on that in the research community, in NOAA, and especially within NCEP. We made that happen, and I can tell you one of my major disappointments with the WMO is that they published a book on the seamless suite of modeling maybe four or five years ago. We're not even mentioned in it. None of this is mentioned in that book. It's written almost as this aspirational thing that's happening in Europe, but the fact is, we were the first operational group to do it. And we did it in partnership from day one with the research community and with the international community writ large as we worked through Canada, and to a certain extent, we influenced what was going on there in the European Center and Meteo France and UKMET. But we had it ... we made that work during the time I was the NCEP director.

GR: That's fantastic.

LU: I should mention one thing.

GR: Yeah.

LU: I mentioned Zoltan Toth's name.

GR: Oh, yeah.

LU: For the medium range. I should say that for the seasonal forecast system, it was really, I would say, Wayne Higgins. Jim Laver as the director of CPC and Wayne Higgins really

encouraged us to bring in this dynamical model. Ed Olenik was also a big part of that effort as well and to do it with an ensemble mode. On the SREF, without a doubt, it was Steve Tracton. Steve Tracton was a force of nature in bringing that forward with the surprise snowstorm of January 2000, which we might want to talk about sometime because that was a game changer. Steve started working the SREF while I was the OM director before 1999 and could not get any support at NCEP. Zoltan Toth was working almost solo out of EMC. He did have support with Eugenia, but then Eugenia left. She went to the University of Maryland, Eugenia Kalnay, and so Zoltan and Steve, especially Steve, had no support. So I got Steve support through OM, through OM money, and you had folks out in the university community that were working with Steve. There was Steve Mullen at the University of Arizona and one of his top students, Jun Du, who is still at EMC. So he came over just about the time I arrived in that late '90s timeframe, and Steve Tracton and Jun Du just made it happen.

They waited for their opportunity to show that if we had had this in real time, there was uncertainty in that forecast that said the storm was going to stay off the coast and that there were members that brought it farther inland and showed that Washington had a reasonable chance of getting snow. That case and Steve's tenacity brought it into the operational world. And another part of this story -- sorry for going on, but there's just so many stories here -- but it does show the dynamic that we were dealing with in 1999 when I came back into this mode, into this job as the NCEP director going into 2000. There were folks at EMC that didn't embrace ensemble modeling. Now, Steve Lord did. And you've got to hand it to him, but he didn't fight for it necessarily until I got there. And we fought for the resources together to make this work because I had already put resources into Steve Tracton's work. But you know, the first meeting I had with EMC when I came back, they had an agenda set up. And I told folks at the end of the agenda they didn't have Zoltan Toth or Tracton on the agenda. And I said, "I want them on the agenda." And of course, the rest of the agenda went over time, and there were people that announced, "Well, time's up. We've got to go." I said, "I'm not going. I haven't heard from Tracton or Toth yet." And then they got up and made their [presentation]. Everybody sat there because I was still there taking notes, by the way, and they came in and gave their talks. I got Zoltan really plugged into and supported for THORPEX, and Steve Tracton was just coming off the SAMEX. So he was ready, Jun Du, they were ready to rock and roll. So I obviously, from a management perspective, provided the basis for them to excel, and they certainly grabbed that ring and ran with it. So these individuals really deserve a lot of credit for building the systems, these systems out.

GR: Okay. I'm looking at our time, and I want to be cognizant of that. We've got about a half-hour left of time available and it's really an option for you. We can talk more about that surprise snowstorm of 2000 if you want. We cannot talk about your time at NCEP without talking about the genesis and ultimate construction of NCWCP, and I'm not sure if a half-hour is going to be enough to talk about that. So it's really up to you what direction you want to go in.

LU: Yeah. Let's talk about the computer. We'll save the NOAA Center for Weather and Climate Prediction for the next interview.

GR: All right.

LU: January of 2000 was now my first year there, and a lot of interesting things had happened. We got the new computer delivered and ready to be turned on for operational use. There was a celebration of sorts that involved not only NCEP and the Weather Service but also NOAA because the deputy, the undersecretary for operations, Scott Gudes, was fundamental in fighting for what we needed. He was very important, he was almost inspirational in his leadership because when he came onboard in NOAA as the deputy undersecretary, and he had been a staffer on the Hill, a senior staffer for [Sen. Fritz] Hollings and really knew NOAA inside and out. He knew he had to come in to support what we did. So he was instrumental, in fact, for us getting the computer that we talked about. And he was part of the process, the selection process, I assume, with Baker in terms of me being the NCEP director. And he was very supportive of that, too. He was always complimentary to me and others in the Weather Service, and you know, of course, he understood Jack Kelly, the pressure of working for Jack Kelly. And I think he admired the fact that I stuck it out. I impressed Jack. And Jack selected me as the NCEP director. It was something that we were all kind of working on in this first year. So as we're approaching the big celebration for the computer being delivered, and its use was in January of 2000, towards the end of January.

Right about that time we started seeing the possibility of this storm that was developing off the southeast coast of the United States. So we had this big news conference and everything and, you know, this big celebration of the rollout ... and Scott Gudes was there. I had a chance to make a few comments about what we would be able to do with this new computer. With the resolution of the models that we were going to be able to run on these computers in the next several years, we would be able to get snow watches and warnings down to the county level. I said that we would have ... we would be able to see the development of these types of extratropical storms like this, secondary to the really tough development aspects off the East Coast of the United States in ways we've never been able to model before.

When I drove home from, drove back to our building in Camp Springs from that conference, I got out ahead of a situation which was pretty devastating to the city. It was like a half-inch of snow fell in the evening rush hour. It was one of those things where people got stuck for two or three hours, and comments were made about that in the local press the following day. But the big thing that was happening was we were watching this storm, this potential storm situation that could develop off the coast. So several days later, the models were ... they're still the same existing models. We haven't implemented any new models that we would be implementing over the next several years, but the models actually were developing a system off the southeast coast but shearing, what we called shearing it out ... just stretching out. The upper level dynamics were stretching out, not phasing right to really move the storm up the coast but shearing it so it would move out. And all the model runs, all the model runs including what we were getting from Europe, were showing this storm would stay far enough off the coast. We knew there was a storm out there, but it would stay far enough off the coast that the western boundary, a very sharp western boundary that you could have actually mapped, you know, bifurcating counties. So we were getting, already getting this mesoscale aspect, but it would be

east and southeast of Washington, DC. I came in on the morning of the event. The event was being forecast for the night timeframe, and it was like January twenty-something, 24th, 23rd, something like that. I come in that morning, and I'm looking at the surface map. And Steve Tracton is standing there with me looking at the surface map, and there's a low sitting in Carolina, in the Georgia, southeast Georgia region that is looking like this thing isn't shearing. It's like the self, what we call the self-development process was occurring, and I was getting frustrated because there were no watches being issued for this storm. And remember, I'm the NCEP director. Watches were the decision of the local forecast offices -- even to the point where one local office could do a watch and local offices on either side could not, could decide not to. There was none of this collaborative forecast process we have today. So I was very frustrated by that, and so were some of ... some of our people were a little concerned. So as we approached, but they were afraid to call the offices. We had orders from ... there's this cultural thing like we weren't supposed to call forecast offices. If we had concerns, we had to call the region, and then the region would call the local office to sort it out.

So we used to have our briefings at 11 o'clock in the morning. And the 15Z, I have the 15Z surface map already in my hand, the raw map, and it's looking even more ominous. And by the way, it's now starting to look like the snow threat in North Carolina is looking ... it's like it's real. It's already happening. That wasn't supposed to happen, either. So they already have this thing pulling in from the west, and I'm looking at the upper air maps. And every wind at 850 and 700 millibars in Georgia and South Carolina was perpendicular to the height lines. It was unbalanced flow, and this trough was starting to look like the wavelength was shortening between the trough line and the ridge line. So I said, I got up at this briefing, I said, "If you had these maps and you didn't have a model, what would you do?" And somebody finally mumbled, "I'd put out a watch." I said, "We need a watch." And then they said, "Well, we don't do watches here. Remember, Lou? We don't do the watches. The local offices do." So I called, I called them up, and they said, "Well, we'll look to see what the next model run is." See, the model runs hadn't come out yet for the morning. They were just starting to come out. Well, the model runs sheared it off again, and I couldn't believe it. And then, I saw all these winds perpendicular to the height fields. Well, what happened was the models either threw those winds out because they were so far out of balance, or they just turned them to be in more geostrophic balance with the wind field. So it got sheared off.

It wasn't until we started seeing the 18Z run at four or five o'clock at night that it looked like it was going to come up the coast, so our folks then started actively calling. The new shift came in. The afternoon shift came in. Bruce Terry, I remember saying, "We've got to do something about this." This was now three or four o'clock in the afternoon. By the time we got to 0Z, it was pretty clear that this system was more likely coming up the coast, but not everybody was still all in. Our folks had to work with the local offices. By the time they all got together on the same storm page that this was going to come up the coast, it was about 9:30 at night, so if you happened to stay up for the 10 o'clock news on Channel Five in Washington, DC, or 11 o'clock news on all the other channels -- and a lot of government workers were not staying up that late because, rush hour traffic, people were waking up four or five in the morning -- you didn't hear that a warning went out, a blizzard warning of all things, went out. The forecast was updated at

10 o'clock or something like that that night. So you wake up to a surprise. And oh, by the way, the National Weather Service strategic plan had already just come out. What was that? Remember that, Greg? The "No Surprise Weather Service."

So the thing is, it was sort of like the perfect storm. New computer that we have just rolled out, all these accolades about how we're going to forecast improvements, et cetera, et cetera. The models shear this thing off. The forecast process was such that any updates had to be coordinated very carefully. Individual forecast offices had to buy into it. We didn't have a winter weather desk that people could actually come to and have these discussions, so it was the precipitation lead forecast in the Hydromet Prediction Center that started making calls. Obviously, something that I was raising -- and I'll say that because anybody who was in that weather watch will remember -- I got up and was walking around with the surface map. What would you do? At 10 o'clock that morning, it took 12 hours for the Weather Service to change the forecast, and I compounded the problem the next day.

So I wake up about six o'clock in the morning. It's snowing so hard you can hardly see out the window. Wind is blowing. There's a blizzard warning out. It's incredible. It's like a winter wonderland out there. It basically shut down the city. And so they want to know what's happening. You know, the media wants to know what happened. So there was a news conference, and they ... Jack Kelly happened to be in Geneva as part of his WMO duties, so he's in Geneva, Switzerland ... and the deputy of the Weather Service at the time, John Jones, nobody could find him.

So it was decided by NOAA Public Affairs that I would be the person that would run a news conference for about eighty news outlets around the country. They wanted me to come down to the Herbert Hoover Building. I think that's where the biggest capacity was for doing a news conference at the time. I said, "Well, you could try." I said, "I'll do this." Because they were telling me they could not find John Jones, and the Weather Service needed a spokesperson. I said, "I will be the spokesperson for this. But I don't think you're going to do this from the Herbert C. Hoover Building because right now I got about a quarter mile of visibility outside my window, and the streets are filling up with snow. And you've got to go up about a 30-degree incline to get out of this cul-de-sac to get onto a main road, which I think are all closed up here ... you'd have to get some kind of vehicle in to get me out of here, but I don't think that's going to happen." So they set up a telephone interview. Now, Greg, you know the kind of training or the kind of preparation you would have, what to say, and what not to say. [I had] None of that. None of that. So in the course of the news conference, they referred to the models. And I said, "Well, look. We just rolled that out." Remember, I said in time we would put the new models on this computer yet and the like. And they were also building on the surprise aspect, that we were surprised that there was even a storm out there. And I said, "No, we were not surprised. We knew there was a storm out there." It was just a matter ... I was trying to get them focused on that sharp boundary on the northwest part of the storm, that a shift of a hundred miles to the west was the only thing that was needed to get us into either a blizzard or no snow at all -- right -- not one snowflake. And all the models were leaning in that direction of keeping that storm that we knew about far enough east that we wouldn't get the snow. Well, they wouldn't let up.

Another reporter comes on and basically asks the same question that you were caught totally by surprise. I said, "Look, we were watching this thing like a hawk." Well, what winds up in a cartoon is the penguin, the cartoonist that has the penguin, you know, buried in snow up to its eyeballs. And it has the Weather Service office buried in snow, and it says in a big headline on there with our biggest, newest computers we can be quicker, faster to be wrong or something like that. Or we can be wrong quicker and faster, but more importantly, he has this penguin buried with this hawk sort of perched on this snow laden, crumpled-up radar system. And the hawk is saying to the penguin, "We're watching this thing like a hawk." And the penguin's responding back to him, "Well, let me know when the hawk gets here." By the way, it cost me \$500 out of my own pocket to buy that cartoon. It was in ... Oliphant. It was O-P-H, Oliphant. I had \$500 to get a signed copy of that cartoon, which I have hanging up in my office to this day, it's still hanging there to remind me.

So every time I go out, I'm reminded of that, so I make sure that I have public affairs working with me, going through the do's and don'ts. But that basically put that storm right there, right at the top of the list of my baptism as the NCEP director on what to do in terms of supporting the forecasters and the people developing the models and implementing the computers. I felt like I had to defend them in what they were doing, because of what they were working with, but [you] also have to be careful in that defense. But, not to be too flippant, number one, but also be careful in terms of making sure that the people understand the magnitude of what has to be done to elevate the whole forecast process and the models that are supporting that process and that we're in this for the long haul, which is one of the things I was actually trying to get across on this.

It was an incredible experience, and when I got back into the office two days later, we had a meeting. And I said, "We're implementing the SREF." Because Steve Tracton had been sending me the stuff, and I saw what he was getting at. It's written in his paper that he wrote in the Sanders volume, AMS tribute to Fred Sanders. It says why do snowstorms, surprise storms have to be a surprise. And we, I came in with Steven and said, "We're implementing the SREF." Yeah. That was the driver of it, and that started the whole process, you know, getting back to the original thing in terms of the seamless suite of products. We're implementing the SREF. We were doing the experiments with the GEFS and with the Canadian model, so we implemented the GEFS after that and then implemented the NAEFS to get us up to 16 days in advance. And then several years after that, we had the Climate Forecast System running as an ensemble system. So, I really did, you know, [put my] foot down. We're doing ensemble modeling here. Big decision. That was a big decision. And in the process of making that decision -- this will be the last comment I make here -- we had to decide, were we going to get into the ensemble world, or were we going to do 4D-Var for data assimilation because we couldn't do both. And we decided to do the ensembles because we felt that those, that kind of computing, that kind of model guidance in the long run would get ... would be more important to our forecasters, as we just saw, if we had had it in realtime and that this was something we could do now. So that's the story behind going with the ensembles and the implications of that. We never did get into 4D-Var with the computing capacity we had because basically the ensembles chewed it up.

GR: It also demonstrates, once again, that, an event that was a catalyst for change.

LU: Yes.

GR: Because you could make the argument that without the "surprise" in air quotes, that it drove that decision to keep moving forward on the ensemble modeling.

LU: It was certainly an accelerant for that and made us realize the importance of that, and it also, that whole system drove the creation of the winter weather desk. We can save that for the next interview, but without that and storms that occurred within the same year that caused consternation amongst the forecast offices, especially up and down the East Coast, we wouldn't have had a winter weather desk. That also brings in Scott Gudes as well because who took the silver bullets for us when the department was not too happy with our performance during that January 2000 storm? It was Scott Gudes. Scott Gudes wanted to know what happened. We told him what happened. He entertained the idea of bringing me along but then realized that this was not going to be a good meeting, and so he decided to provide the top cover for us, which he did, because he knew we were on the front end of a journey of ensemble modeling, of a collaborative forecast process, and that we would need to do something for winter weather like we had for severe weather and hurricanes. That's the other thing this storm drove. We would have to do something for winter weather like we do for hurricanes and severe storms. We couldn't afford a separate center, but we could afford a coordinating desk if the WFOs would play with us. And this was the first time that started happening, so we'll save that for the next one.

GR: That's great. I think the line "this was the front end of a journey" is as good a place to end here because we are still on that journey.

LU: Yup.

GR: So thank you, Louis, for your time today and I look forward to our next discussion.

LU: Okay. Thank you.

[SESSION ENDS]