Molly Graham: [00:03] This begins an oral history interview with Max Mayfield for the NOAA Heritage Oral History Project. The interview is taking place on Friday, May 19, 2023. The interviewer is Molly Graham. It's a remote interview with Mr. Mayfield in Miami, Florida, and I'm in Scarborough, Maine. I wanted to learn a little bit more about that year-long program in the Air Force when you were learning meteorology. What did that look like? What were the tools and techniques you were being taught?

Max Mayfield: [00:35] It was actually a one-year stint at the University of Oklahoma grad school. They probably had around a dozen Air Force students that were sent back to learn the basics of meteorology. Really, I'd only taken one course in Introduction to Meteorology when I was in my undergraduate program at Oklahoma. By that time, I knew I was going to go back and get into the Air Force program there. Really, it was great. But it was just typical grad school. We didn't have to wear a uniform. We didn't have to march. We didn't have to do anything like we did in ROTC [Reserve Officers' Training Corps] and in the undergrad years. Oklahoma had some really great professors, and it's a great meteorology school today and always has been, specializing in severe thunderstorms and tornadoes. Again, anybody growing up in Oklahoma can't help but be interested in the weather. So, it was a good time. You got to draw maps, and you analyze these surface and upper-air maps, and you analyze cold fronts in blue and warm fronts in red. It was kind of fun. It just is all math – well, a lot of math involved. I thoroughly liked that. One of my old roommates, I hooked up with him again, and it was a wonderful time, and I learned all about meteorology while I was there. Then, the Air Force sent me to Fort Rucker, Alabama. I got in the Air Force to stay out of the Army, but they sent me to an Army post anyway. On my dream sheet, I had Tyndall Air Force Base listed as my number one choice, and they didn't give me Tyndall Air Force Base, but they got me about sixty miles north of there, and I thank them for that. I'd work a night shift and sometimes get off at eight o'clock in the morning. I'd drive down to Panama City Beach. Anyway, I really fell in love with Florida when I did that, and the Gulf Coast. I remember the year they opened up Disney World. I think, sometime in that first year, I went with some friends from Fort Rucker. I thought that was just amazing.

MG: [03:48] Were your instructors at the University of Oklahoma former World War II veterans who had served in similar programs in the Army or Air Force?

MM: [03:58] Some of them were. I remember the professor in charge of the Air Force students – Colonel Hall was his name – was certainly from that era. I really don't know about the others, but I suspect some of them were. They had some young professors too. It was a well-rounded program – the dynamics, thermodynamics, and synoptic meteorology, too. A lot of hands-on operational forecasting. But still, I didn't know – I hadn't really made an official forecast. I'll never forget the transition when I did get sent to Fort Rucker, Alabama, after the OU grad school. I remember the – well, I guess the first thing they taught me – I had this old master sergeant, a

wonderful gentleman that taught me. They put me on a week of midnights, like midnight to 8:00 AM shifts, with him. He said, "Lieutenant Mayfield, we're going to do two things. I'm going to teach you how to make coffee, and I'm going to teach you how to forecast the weather." [laughter] He was probably used to training these young kids that came out of grad school and had the theory but didn't know how to do operational forecasting. The forecast office there at Fort Rucker was for both fixed-wing and helicopter. Well, Fort Rucker had several large heliports and one fixed wing airport. So, they primarily trained a lot of helicopter pilots that were sent to Vietnam. But the weather station was right next to the little coffee shop there in teh building we shared at the airfield we were out in. They had a lot of people that would come in, and we had a huge pot that they made coffee in. He told me to clean the pot out, and he was going to teach me how to make coffee the right way. So, I cleaned it really good with soap and water. I guess I didn't get all the soap out very well. Anyway, after he taught me how to do that correctly, said, "Okay, Lieutenant Mayfield, we're going outside. I'm going to teach you how to forecast fog and stratus. You go out, and you touch this rail along the sidewalk. If it's wet on top, you're probably going to have stratus clouds. If it's more wet on the bottom of the bar, you're going to have fog, lifting up to stratus sometimes." Both status and fog can affect visibility. Anyway, he taught me some practical things. I really appreciated that. I learned a lot more from him than some of the other forecasters they had there. Certainly, the operational forecasting I didn't learn in school.

MG: [07:10] Can you say, more specifically, what you were doing in support of the Vietnam War? What was your role during that time?

MM: [07:18] Well, as a forecaster, these pilots, both trainees and experienced pilots, would come in, mostly helicopter pilots, but they would come in for briefings. We did thousands of these – where you had a form you filled out. It was all by paper. Now, I guess they can do it all online. But you filled out these weather briefing forms. They even trained pilots from other countries. They would radio in or sometimes call in before they took off. Sometimes it was a little hard to understand their English, and that was always a challenge. I remember one time there was a gentleman that – we actually had a tornado warning for the area. This one pilot, in particular, a rather obnoxious gentleman, came in in one of my first shifts. He had to get back to his family and said he absolutely had to take off. I said, "You can't do that. We've got a tornado warning. It's just not safe." Anyway, he pitched a fit. This old master sergeant that had been training me stepped in. He said, "I'll fill out that form." He wrote on there, "Tornado warnings. Severe thunderstorm warning. Not safe to fly. Do not take off." Anyway, he signed it. He taught me how to handle a lot of things like that. One time, I remember I broke the telephone. They had a phone hanging on the wall in the weather office. It was the base commander's wife who called, and she wanted a personal forecast. We had pilots lined up waiting for a formal weather briefing that I needed to take care of, but it was the base commander's wife, right? I told her there's an eighty-percent chance of rain, there's a line of thunderstorms coming through, not a good day to

be outside. Anyway, she was fussing at me for that forecast because she wanted to hang her laundry out. Anyway, I ended that as quickly as I could, that phone call, and I guess I slammed the phone on the receiver hanging on the wall and broke the hook on the wall; the phone fell off the wall. [laughter] Rather embarrassing. Actually, that first night, too, I might add that this old master sergeant that trained me, after he taught me how to make coffee – we had teletype machines in those days. They were just constantly feeding stuff out. We had observations and forecasts for countless different places, and you had to tear them off and file them in appropropriate placesf. They had dozens of clipboards to file these things on. Airports all have abbreviations. I knew a few in Florida, but I didn't know them for the whole country. He said, "Lieutenant Mayfield, those are the teletype machines, and you tear these off, and you file them on the appropriate clipboards. If you need me, I'll be in the coffee shop playing the pinball machine." And I was so mad I couldn't see straight there for a while. But he really helped me because I had to learn to correctly file those teletype observations and forecasts. I eventually thanked him for that. But, at the time, I didn't really think he was helping me.

MG: [11:37] I read that there were a few tornadoes that struck or impacted Fort Rucker in that year of 1972. One was in January.

MM: [11:48] Well, yes. I don't remember the date, but they had some damage. We were okay there. They had several different airfields, and the one that we were at was okay. I remember one event. Well, actually, this is not the severe weather event, but I was on the 4:00 AM shift, and I went out to – by that time, I was out of officers' quarters, and I was living in a mobile home. I went out. You never wanted to be late fora shift, and I thought I had it timed perfectly. I was going to leave at 3:30 [to] be there easily about 4:00 AM, and I had a flat, so I had to jack the car up and change the tire. Anyway, I hope I had a flashlight. I don't remember. Anyway, that was interesting. I loved that one year that I spent in Fort Rucker. It was just a great place. Great place if you like to fish. I made some friends there in the Air Force that I stayed friends with for many, many years. Actually, we had a little Bible study group there with some folks that I still keep in touch with to some extent. It was a good year.

MG: [13:28] You came to the hurricane center in September of that year. You talked a little bit last time about working under Robert Simpson. I read a little bit about him in the last week. He's really had a fascinating life. You mentioned this last time we talked, but I don't think I grasped its severity. He survived this storm when he was younger and had lost a family member in it. Was this something he talked about?

MM: [13:54] That was a hurricane that hit Corpus Christi. He grew up there. I think he was a about six years old. I don't remember exactly, but a young kid, really, when the hurricane hit. They had been to church, and they came back and were having a nice Sunday lunch after church. The water started coming in the house, and he still remembered – he had a box of doughnuts that

went floating out in the storm surge. He was carried on his dad's shoulders. His dad put him up on his shoulders in waist-deep or whatever-deep water there. They, fortunately, had some high ground. I think they went to the courthouse, if I remember correctly, and stayed there and were okay, although they lost most of the house. That certainly would make an impression on anyone, and I think he was fascinated with hurricanes, obviously, after that. As he rose up in the National Weather Service or Weather Bureau back in those days, he eventually became the Deputy Director of the National Weather Service. He actually took a demotion to come to the Hurricane Center to become the director down there. He had a deputy director, Neil Frank. They just made a super team. Since they did some – well, you could get by with more things in those days than you can now, even flying hurricanes. He had some tales that he wanted to go fly these hurricanes. I don't know how he sweet-talked them into doing it, but he didn't have to go through all the – nowadays, you have to schedule all this twenty-four hours in advance, at least. He was a really good research scientist, as well as an operational forecaster. He was married to Joanne Simpson. I suspect other people have told this story, as well, but she was the first female to get a doctorate in meteorology. When I came to the Hurricane Center those first few years, I took some courses at the University of Miami [UM], including a weather modification course from Joanne Simpson. She was amazing. She would just come, not running in but walking briskly and open up the books and just start lecturing. It was a very interesting course. She was in charge of the FACE program, F-A-C-E, Florida Area Cumulus Experiment, where they would go out and seed these towering cumulus clouds, in hopes of increasing the rainfall. They didn't really prove great success there. But it was a huge program at the time. Of course, Robert Simpson also was promoting the seeding of hurricanes. That's a whole other story there. Bob Sheets, who eventually became NHC director too, was at one time in charge of the hurricane seeding program for the Hurricane Resource Division part of NOAA. But there were some really interesting things going on. One story, if I may, on Robert Simpons's wife, Joanne Simpson – my father-in-law was a forecaster at the National Hurricane Center as well. In those days, they had to get permission from the director of the Hurricane Center – the Weather Service local office was underneath the Hurricane Center at that time. Now they have different lines of management. Back then, it was all one big happy family. If they had put up any type of warning, like a marine warning for the winds being so strong, they'd have to call the NHC director, even in the middle of the night, to get permission to do that. It's really just a way to let them know they're going to do this. Of course, you could never put up a hurricane warning or anything like that without letting the director know. That's still in place, I think, today. But one time, my father-in-law – he was a public forecaster – was putting out the public forecast for the state. He wanted to put up a wind advisory or some type of wind warning, gale warning, whatever it was, for part of the Florida coast. He called home, and Joanne answered the phone – Robert Simpson's wife Joanne answered it. My father-in-law said, "Well, can I speak to Dr. Simpson, please?" And she said, without skipping a beat, "This *IS* Dr. Simpson." [laughter] She was very proud of getting that Ph.D. as she should have been. Anyway, it was good. They had some really smart people when I first came in there that you couldn't help but love.

MG: [19:33] I think I read that Joanne Simpson worked for ESSA [Environmental Science Services Administration] and then later worked for NASA [National Aeronautics and Space Administration].

MM: [19:40] Right. After she left – well, ESSA then became NOAA. I forget the name of the lab; they changed the names of the labs, but she was there in the same building with us with the Hurricane Center. These NOAA labs were on one floor above the Hurricane Center. It was really a good relationship because the daily map discussions – you had all these researchers that would come in and chime in. I think that was really a mistake when they separated the two groups. Now the NOAA Hurricane Research Division and some of the NOAA labs are over in Virginia Key, and the Hurricane Center is separate, located on the Florida International University campus. I mean, there were some reasons why – they needed more space, and I understand that, but it's too bad they're not all together.

MG: [20:49] Last time, you mentioned Bob White, the then-NOAA Administrator, would come down. I got the impression that maybe Bob White and Robert Simpson butted heads a little bit. I read in an oral history with Robert Simpson that he got in some hot water with Bob White over a comment made to Vice President Agnew.

MM: [21:10] Well, my recollection is that – I'm a little fuzzy on that, so I probably ought to pass on that one. There is a good story there. Dr. Robert Simpson liked the attention, and he was used to being in a very high level there in Washington. He was very commanding. He was such an excellent speaker. He did so much. Simpson traveled to the Mississippi Coast within twenty-four hours of Hurricane Camille's landfall in 1969. He was boarding a return plane in New Orleans when Bob White's office called him and told him to accompany Vice President Agnew on a damage survey. Agnew asked why the NHC had trouble getting aircraft reconnaissance data to verify the strength of the hurricane. Simpson answered honestly that aircraft, new instrument systems, and beter facilities were needed. Simpson explained his frustration, stating that every effort over the last three budget cycles had been denied by the administration. You can only imagine how that ruffled feathers at pretty high levels. In the end, Simpson and the nation's hurricane program got what was needed. They also told me that when he was the director, every single person at the National Hurricane Center, at one time or another, got a pay raise and a promotion there. He was a mover and shaker. Neil Frank tells the story that when Neil became the deputy director under Simpson, the first thing Simpson did was [say], "I'm going to take you out." I think it was the Rotary Club. "I want you to become a member of the Rotary Club because you need to reach out to these influential people and help educate them about hurricanes." Then, Neil Frank took that to a whole other level as far as letting people know the dangers of hurricanes, especially the storm surge. This might be a place I could tell a Neil Frank story, too. Now, this would have been in the early to mid-'70s. He would take the

hurricane forecasters in a van. They would get four or five of them in a van that he would rent and take them up and down the U.S. Gulf and Atlantic coastline, showing them the dangers of storm surge or how vulnerable the coastlines were to storm surge. They'd usually meet with some local officials, be it a mayor or an emergency manager. Back in those days, most of the emergency managers wore multiple hats, maybe a fire chief or head of Veterans Affairs, and they're not dedicated certified emergency managers like we have today. But most of the hurricane specialists would tell these stories. They hated those trips because they were stuck in the van. Neil would get up at sunrise, they'd eat early, and they'd hit the coast and would walk some of the coastal areas. They wouldn't stop until it got dark. They were absolutely worn out. But it made an impression on them, and they understood the concern there. It also helped establish ties with the emergency management community or what eventually became a very strong emergency management community.

MG: [24:35] Oh, good. And when was this?

MM: [24:38] It might have been the late '70s or early '80s. I remember when we moved off the University of Miami campus – I think that was around 1980, '81, or so – they were talking about it. It would be near 1980, in that period there, and they did it for a few years. I don't remember how many years. That was kind of a precursor to these "Hurricane Awareness" tours when they started taking the Hurricane Hunter plane. They did the entire coast from Texas to Maine. Today, they still do it. They'll do the Gulf Coast. They'll do five or six stops one week on the Gulf Coast, and the next year, they'll do five or six stops on the East Coast. The idea is if they bring the hurricane hunter plane there – for the United States, the hurricane awareness tours are usually done with a NOAA P-3 Hurricane Hunter plane. They would get the plane there. The locals would bring out the school kids. You get the school kids to come out. You get the media to come out. It really gets some attention there. In fact, when I started doing these with Bob Sheets, they would do two stops a day, and you'd make a presentation for each one. It was a little like a fire drill. Between the stops, both Neil Frank and Bob Sheets were really, really good at taking pictures. They would take all these coastal "before" pictures to show the coastline before the hurricane hit, and then if there is a hurricane, they'd do a survey in the NOAA P-3 and go back along the same spots at low levels, which most people on the Hurricane Hunter planes would tell you they fear that more than flying hurricanes because after the event, you've got a lot of media helicopters also flying. It's kind of dangerous to fly at really low levels to take these pictures. I don't think I ever went on one of those with Bob Sheets when I didn't get a little air sick. He would have me loading the camera with film. He'd have two cameras, and he'd take these pictures. He was just continually snapping the pictures so you didn't miss anything because you're flying fast. He'd keep saying, "Give me the camera, give me the camera. Hurry up." He was really good. Neil and Bob were both really good at that. I was there standing up, bouncing around in the plane, trying to load the film. We were so cheap; we always loaded our own film in our own canisters. Anyway, it was cheaper that way to do it than buy film already to

put in these old cameras. But those before and after pictures were pretty motivating when people saw what places looked like. Today, I think they still show pictures of the Richelieu apartment complex in Pass Christian, Mississippi. They'd show "before" pictures before Hurricane Camille and then "after" pictures when there was nothing left there but the foundation. That gets your attention when you see something like that.

MG: [28:49] And I also wanted to ask more about your father-in-law, Vaughn Carmichael. Did you work alongside him in the Hurricane Center as well?

MM: [28:56] Yes, in the early days. This was starting in the '70s on the UM campus. By the '80s, we had moved into one floor of an office building not far from teh UM campus. There was one big office, and the hurricane forecasters – they had some little partitions, I guess, in some parts of the room. But the hurricane forecasters were on one side, and the local – well, now they call them the local forecasters on the other side. But back in the '70s and early '80s, the local forecasters did the forecasting for almost all of Florida except for the panhandle. They had to – one Weather Forecast Office did the Florida Keys and all the way up through the peninsula, including the Jacksonville to Tallahassee areas. They had a pretty big area of responsibility. So, he would do the local forecast or the state forecast, and that included the marine forecast and the public forecast as well. So, I knew him, and he was always so kind to me, and we ended up going fishing together a lot and playing tennis. That's how I met my wife.

MG: [30:12] And I didn't know about his background. He provided weather support during World War II and the Korean War. Did he fly reconnaissance flights during hurricanes as well?

MM: [30:22] My father-in-law Vaughn Carmichael did fly reconnaissance for the Army Air Corps in World War II, including hurricane reconnaissance. So yeah, he taught me a lot about hurricanes as well.

MG: [30:41] I wonder if your wife Linda knows a lot about hurricanes, too, because she's had so many experts in her life.

MM: [30:48] Right, and he worked shifts his entire life – a week of days, a week of evenings, a week of midnights. My wife likes to tell people that, technically, she's been in meteorology longer than I have given her experience with her dad. She was familiar with shift work, so when we got married, she was used to that. We have three children, but when they were little, she did everything, taking care of them and me and letting me sleep in the daytime when I'd work the night shift. That was a good thing that she was already familiar with that routine. And yes, she did know a lot about hurricanes thanks to her going through Hurricane Donna, Cleo, and Betsy, listening to her dad, and hearing me give countless hurricane presentations.

MG: [31:38] Well, talk me through just how your career unfolded up until the point when your position changed in 1988. Then, I was curious to hear about when you finished your master's degree. Can you take me up to that point?

MM: [31:54] Sure. When I came to the hurricane center in '72, I had been in the Air Force for two years. One of those years at school at OU getting some basics in meteorology and the second-year forecasting at Fort Rucker, Alabama. I was most knowledgeable about tornadoes and severe thunderstorms. Hurricanes were new to me. I had learned a little bit, but I had a lot of catching up to do. But it was so thrilling. In fact, I will never forget the first year I went to an American Meteorological Society Conference on Miami Beach. This may not have been the first year, but it was soon after I got there. I heard Neil Frank give a hurricane preparedness talk. He showed those before and after pictures from the Richelieu apartment complex after Camille, along with some others. That was it for me. I was hooked. I couldn't help but be interested in hurricanes. I had a little bit of interest before that. I think I shared that growing up in Oklahoma, my dad would take me fishing sometimes. One time, we took a vacation down to – well, actually, a couple of times, we took a vacation down to Padre Island on the Texas coast. There's this fishing pier. I think it's the Bob Hall Pier near Corpus Christi, and it got wiped out in a hurricane. I should remember the name of that. I think it was Hurricane Carla in 1961. Anyway, it kind of messed up one of our fishing places. So, I was somewhat interested in hurricanes; I just didn't know very much about them. But you couldn't help but learn about hurricanes when I got to the hurricane center. I started out as an intern, but even as an intern, they let me do high-seas forecasting and some of the offshore water forecasting. They'd divide these up into different areas. Again, this is the '70s, and we would do these maps – draw these maps by hand. Then we would convert some of the data onto IBM punch cards – like the steering currents – the different levels, the different layers. The maps were actually developed by one of the professors I had at Oklahoma, Dr. Amos Eddy. "Famous Amos," they called him. So, I was a little bit familiar with the analyses. So, we got to digitize those. But it's really archaic and very awkward, very time-consuming. Now, the computer can do all of this much more efficiently. Anyway, I started out as an intern, and then they rotated me around. I did get to do some of the public forecasting in the local forecast office. Then, in 1974, I believe it was, they opened up these satellite field service stations. I believe they had five initially. They opened up one in Miami that was technically not in the National Weather Service; it was in the National Environmental Satellite Service at the time. But it was something new. They had these geostationary satellites, and the SMS, Synchronous Meteorological Satellite, was going up. Anyway, I'll never forget a gentleman came, and I didn't really know him, but he sat down next to me while I was analyzing a map one day and said, "We're opening up these new positions and want you to work with us." I loved the job at the Hurricane Center, and there was a career ladder there, but this is something new and exciting. The satellite imagery was really interesting. So I took this job in the Satellite Service, which was still located there in the National Hurricane Center. I remember we had these technicians. You had electronic technicians that would take

care of some of the equipment. Then you had photographic technicians that would – they would take the – they had these big drums that they put the film on, and they would then take that into a dark room and process that and have an image, and then they'd give it to the meteorologist who put an overlay grid on top of it. Then, they'd take a picture of that. Anyway, it was a really convoluted process. In fact, I still remember one of the – well, they told me the story about this. I was not there; they'd already done this before I got to the Hurricane Center, but the first satellite image they got, a facsimile quality image, was amazing. You can see clouds and things. But the gentleman that told me this said it took them all day to figure out where they were looking. They had this, again, clear acetate grid with the outline of the coastline. They had to shift it around and try to figure out what they were looking at before they put the grid on it to even know where these things were. And then, as they saw hurricanes on there, it was a whole new world. Then, by the – I guess it was – mid to late '70s, they started creating movie loops out of the satellite images. That was a real process. You had these photographic technicians that would put them all together. Now, you can get satellite and radar animation on your cell phone, for goodness' sake. But it was hard. I remember one time we made these loops. We started out with just visible imagery. The initial geostationary satellites had a visible camera, similar to taking a picture witha black and white camera. So, you saw black and white images, and you put them together. The low clouds and the high clouds were both white. The hurricanes in the Northern Hemisphere go counterclockwise in the low levels. And then these new SMS satellites came on. They had visible pictures in the daytime and infrared pictures at night time – actually, infrared pictures twenty-four hours a day. We started making loops. You want to have loops for the early morning TV shows. These technicians would create these infrared satellite loops. The infrared, the high clouds, in those days, appeared white, and the low clouds appeared darker or gray. So, when you made a loop of a hurricane, you saw the high-level outflow primarily, and that goes clockwise in the opposite direction of the low-levels. We also made these available to the local TV stations. They would send a driver and come pick it up. I'll never forget one meteorologist at one of the local stations. After seeing one of hte first infrared loops with a hurricane, he called and was ranting and raving, and he said, "You idiots shot this movie backward. The clouds are not going counterclockwise; they're going clockwise." Well, it was an infrared loop, and he was looking at the outflow. Now, it's amazing how far the technology has come.

MG: [40:50] These advances in technology that you're describing were they born out of efforts from the director or increases in funding?

MM: [41:03] I think the research community gets tremendous credit here. They were doing things that were not available to operational forecasters. That's usually the way it works. You develop something in the research environment. And then, if it's successful, then you transition it to operations if the funding permits it. It's all of the above. You have to have the operational people asking for it. There was a lot of money going in. The satellite program was a new

program with a lot of money going into it. It was pretty well-funded from where I sat anyway in the beginning. I did the satellite job for a while. My recollection is that the satellite service stations eventually were absorbed by the Weather Service or ended up going back into the National Weather Service, which really didn't change what I did very much. One of the key things for me is that – one of the things that we did in that satellite unit was to apply the Dvorak technique. A brilliant gentleman by the name of Vernon Dvorak came up with this technique where you can look at the satellite imagery, assuming the geography is right. If you've gridded the imagery right, you can estimate the latitude, longitude, of the tropical cyclone's center. And then, based on things like the diameter of the eye, how much the eye is embedded within the central dense overcast, or the size of the central overcast and the amount of banding features, you can come up with a very decent estimate of how strong the hurricane is, or any tropical cyclone. You wouldn't expect that to be nearly as precise as aircraft reconnaissance data, but you can't afford to fly an airplane 24 hours a day for the life of the storm over all the ocean. Nobody can afford that. In fact, I think the United States is the only country that routinely sends airplanes into hurricanes. But we really only do that when they're a threat to land. So, the satellite is still, by far, the primary observing system. Vernon Dvorak would come down to Miami to train us, and we had workshops in Washington that we'd be sent to learn how to apply this technique. That, to me, was really a giant step. That led eventually to – I was pretty good at it thanks to Vernon Dvorak and other people who helped teach me. Eventually, when they had a hurricane specialist position open up, I applied for that. I'm sure the main reason they hired me was because I had experience with the Dvorak technique.

MG: [44:38] And you had just finished your master's degree at this point.

MM: [44:41] Well, that's another story. I was trying to stay out of school, [laughter] to be frank. I loved operational forecasting, but Neil Frank and Bob Sheets both strongly encouraged me to go back and get at least a master's degree. In fact, it got to where – if I was on a day shift and if I ended up leaving the office at the same time they did – if I rode down the elevator with them, they would gently encourage me to go back. Sometimes more than just gently, they'd tell me I'd need to go back. I got to where I'd take the steps to get out [and] go down eight flights of stairs or whatever it was to avoid them telling me to go back to grad school. Anyway, it was a smart move. I finally did. I think I went back in '81, and I had a year's worth of grad school, and actually, NOAA paid for that. Well, they paid for nine months of it anyway. Then, I spent a summer term there on my own. I came back to the job, and then it was tough to get the thesis completed while I was working full-time. We also started having kids in '81, '84, and '88. That was a busy time. My major professor, Dr. Noel LaSeur of Florida State was my main mentor when I went back to FSU for the master's. He semi-retired when I left school there, and he was amazing. I loved him as a professor. I learned a lot about hurricanes from him. So, when he semi-retired, he understandably slowed down. I kept sending proposals for a thesis, and he would take a month or longer to respond. Anyway, I was really frustrated. At one point, I had

sent him three different options of what I could do. One of them involved a satellite technique – statistics on the satellite technique. Another one on the usefulness of satellite derived wind vectors in numerical models. By the way, Noel LaSeur – I don't know if you've heard stories about him, but he was a little bit of a curmudgeon but a very lovable curmudgeon. I don't think I ever saw him without a cup of coffee in one hand and a cigarette in the other hand. They had map discussions – this happened before I got there. But I'd heard about it. I knew a couple of people who were in the class when this happened. When they had map discussions, they had these facsimile quality maps hanging on the wall. Students that didn't even take classes with him would go to these map discussions. He was so good. So, one day, he's there with his cup of coffee in one hand, a cigarette in the other hand, and he's lecturing and giving the map discussion. These maps were very flammable. One of the maps caught fire thanks to his cigarette. He finally notices the students' eyes are getting big, and he turns around, sees the flames, and just takes his coffee cup and douses the flames, and kept talking. Anyway, I couldn't believe that, but I verified that story. But when he semi-retired, it took forever. So, when I finally went up there, I drove back from Miami to Tallahassee. I said, "Dr. LaSeur, we really got to get this thing – you got to give me some guidance on what you want me to do." He took another puff of his cigarette and drink of his coffee and said, "Oh, hell, Mayfield. Just write the damn thing." So, I just picked the topic and came back and finally got it done. But that wasn't until – I think it was 1987. I only had, I think, seven years to do that. I had to get it done. Anyway, it got done. That helped me get a job as a hurricane specialist, too.

MG: [49:46] What did you end up writing about?

MM: [49:50] It was cloud vectors. Actually, it's so archaic now, using a barotropic model, a simplified numerical model, and the value-added with these satellite loops. You could track the cloud vectors at different levels. I'd been doing that in the satellite unit. You could run the simple model with and without the satellite vectors and with the limited number of cases, it did show great promise for improving. I remember there were a lot of – some people didn't think the satellite data were good enough to put into the numerical model. You could make them worse. Anyway, that certainly has changed, and now they are using this type of data – well, they've been using it for years now.

MG: [50:45] So 1988, you became a hurricane specialist. Tell me a little bit about how your work changed and your role there.

MM: [50:52] Well, it was certainly more pressure. It was a lot more visible. [laughter] I guess the biggest thing is the Weather Service forecasters – well, at least from the Hurricane Center – puts their name on every advisory that goes out. So, you don't want to do anything stupid. Your forecast, if they're bad, they're out there for the whole world to see. When you do put out the forecast, if you put watches and warnings up, there's a tremendous amount of actions that

happen, from evacuations and opening up shelters and things like that, you don't do that flippantly. If you don't do it right, people can lose their lives. The forecast meant a lot more. The local forecasts are extremely important. But it's different if you put out a forecast – I remember Neil Frank saying this – you put out a forecast for a twenty or thirty-percent chance of rain, is that going to ruin your picnic or not? It's different with severe weather like a hurricane. For local offices, the tornadoes, and severe thunderstorm warnings, it's the same for them, too.

MG: [52:42] In the first year that you were in this position, Hurricane Gilbert happened. Can you tell me about that? You were awarded a silver medal for your work around it.

MM: [52:51] You've done your homework. [laughter] I remember we had a hurricane in the Gulf of Mexico. I believe it was Hurricane Florence that made landfall near Louisiana. I remember giving a media interview with one of the local stations. I said that while this was already – it was making landfall, and I said there was another disturbance out here east of the Caribbean, and we need to turn our attention on that now. Of course, South Florida and that – well, at least the rest of the Gulf of Mexico really and the Caribbean needed to look at this. That's what became Hurricane Gilbert. It clobbered Jamaica as a category three and then became not only a powerful category five, but it was a large category five and did tremendous damage, especially on the Yucatan Peninsula. There were a lot of people that were killed, too, when it made landfall in Mexico. NHC Director Bob Sheets and teh hurricane forecasters were awarded a silver medal for our work. However, there are a lot of people involved in our Nationa's Hurricane Program. It's always a team effort. It's never about any one person. Three of the biggest players are the forecasters, the local officials, especially the local emergency managers, and the media. There are many, many other people involved, but those people have to work really closely together. I credit Neil Frank, Bob Sheets, and Jerry Jarrell for really taking that to a whole new level. Because the forecaster's job is to put out the best forecast or best forecast they possibly can; that's what the hurricane forecaster's trying to do. But you don't want a forecaster calling for the evacuations. They don't know every community's plan. The Hurricane Center puts out forecasts for tropical cyclones over the entire Atlantic Ocean – the entire Atlantic, the entire Caribbean Sea, the entire Gulf of Mexico, and the Eastern North Pacific. So, you've got all these different countries involved, and we coordinate the forecast through – the United Nations has something called the World Meteorological Program [WMO]. They have different tropical cyclone forecasting centers around the globe. The way it works in our region, Region IV, there's a hurricane committee. The director of the Hurricane Center is automatically the chairman of that committee, and they've got a plan. Anyway, the Hurricane Center puts out that five-day forecast. It used to be a three-day forecast. Then, we changed it, when I was director, to a five-day. But just like in the United States, you don't want the forecaster to put out the actions to be taken – opening shelters, reversing highway lanes, and things like that. That's the job of the local or countryofficials. Most places rely on a local emergency manager. In the United States, FEMA [Federal Emergency Management Agency]

does wonderful things, but FEMA doesn't call for evacuations; they don't open up shelters. It's the locals that do that in most states. There used to be one state where the governor called for the evacuation, but he did that based on input from the locals. So communication between the Hurricane Center, the local forecast offices, and those local officials is extremely important. We'll get to that here in a minute with the establishment of the Hurricane Liaison Team, for example. But you also have the media. The media's job, the way I see it, is to help get that official forecast out and the uncertainty in that forecast, as well as those emergency messages from the local officials. I don't care how good the TV anchors are or how good the local TV meteorologist is, you really don't want the media making the decisions on when people evacuate and when to put up their shutters. That's a job for your local official. The local emergency managers are charged with having hurricane plans, and they have timelines, and it doesn't always work perfectly, but you don't want the hurricane forecasters making those decisions, and you certainly don't want the media making those decisions. So, those three groups have to work together very, very closely. I give tremendous credit to Neil Frank, Bob Sheets, and Jerry Jerrell for really moving that coordination along.

MG: [58:41] Before we talk about the Hurricane Liaison Team, I was wondering if you could talk to me about Hurricane Andrew unless there's anything we're missing up to this point.

MM: [58:50] Andrew is one of those hurricanes you'll never forget. Well, let me backup a little bit here because I became a hurricane forecaster in 1988, and Gilbert is a hurricane I'll always remember. But in 1989, we had Hurricane Hugo. Hugo was a large category four hurricane that skirted the northeastern Caribbean and clipped the eastern side of Puerto Rico, and then came up and hit South Carolina primarily. And I'll never forget going up with Bob Sheets the day after Hugo made landfall and seeing the devastation that was just unbelievable. Again, the NOAA P-3 would fly at low levels, and there were stories there. There's one captain of a boat that was near McClellanville on the South Carolina coast. He was kind of a John Wayne character, not about to be scared by any hurricane. During hte hurricane, he started in his boat offshore, and he had the bow of the boat heading into the wind. The bottom line is he swears that he was lifted up in his boat over a two-story house. We couldn't really verify that because the house got demolished, too. But we've got a picture of the boat and what was left of the house that used to be two stories. He actually survived to tell that tale. The storm surge was tremendous in Hurricane Hugo, and the wind damage as well. Anyway, that was an experience that I got to see down close afterward. Bob Sheets, we dropped him off after we flew – we went from the Georgia coast all the way up along the South Carolina coast. Then we flew back to Charleston. The plane stopped briefly,f and Bob Sheets walked down the stairs of the plane to get off here, and then we took right back off again. Bob met someone in the airport that had a damaged home. I don't know if they were coming back or what, but they ended up inviting Bob to stay with him; he couldn't find a hotel room because there was so much damage in Charleston. He took this lady up on the offer. She had one of these old mansions, a two-story mansion down

near the battery, is my recollection, in Charleston. So, he stayed there, and she had leaks and her roof. So, Bob gets up on the roof with material to patch those leaks in her roof before he went out and talked to some of the local officials and showed the flag from the Hurricane Center there. Both of those guys, Neil and Bob, were that kind of person. So, then, Andrew – we skip forward to Andrew in 1992. We still had an unwritten rule – because the resolution of the satellite imagery was much, much better in the daylight hours with the visible pictures, than the nighttime infrared picture, so we had an unwritten rule not to start advisories off the infrared. I was on the evening shift from 4:00 PM to midnight. Actually, I remember it's the 17th of August 1992. This disturbance in the eastern Atlantic looked so good that I couldn't ignore it. I'm sure I had to call Bob Sheets and tell him I was going to do this. I wrote that first advisory on what eventually became Andrew and came home after midnight. I woke my wife up when I came home. I told her, "I started this advisory. I hope this thing doesn't fall apart. I'll look like a fool if it does." Well, a week later, I was praying it would fall apart. Andrew was interesting because it not only was a Category 5, and we upgraded that to a Category 5 ten years after the fact when I was the director. I'll get to that later if you'll remind me. At one point – it became a tropical storm in the central tropical Atlantic. Then, one day, the Hurricane Hunter plane – it was a NOAA plane – went out there, and they couldn't find a circulation at low-levels. My recollection is that one of the NHC forecasters had written an advisory saying that this is the last advisory on Andrew unless regeneration occurs. If you don't have a circulation, technically, it doesn't meet the definition of a tropical cyclone, so you can't write advisories. Bob Sheets very wisely said – and all the hurricane forecaster had to do was hit "enter" and transmit that advisory saying, "This last advisory." Bob Sheets very wisely said, "Well, let's hang on a little bit." He told the plane to go up 850 millibars, about 5,000 feet, so they went up a little bit higher. They found some really strong winds up there. They did hang on to it. They were going to hang on to it one more time to see what will happen, and then it eventually restrengthened. The upper-level flow was so strong at one time that the wind shear was just blowing the tops off. The thunderstorms couldn't organize there for a while. But that changed eventually, and then it turned back westward. Initially, the forecast had it going toward the Southeast U.S. coast much further north, then South Florida, as it gradually kept turning more westward. The models we had back then were – well, they are now much better than they used to be. There's been a vast improvement in the accuracy of the computer models since then. Anyway, it became what we thought at the time was a Category 4 hurricane East of the Bahamas. That certainly got everybody's attention. I remember the Miami-Dade County emergency manager actually came into the office when we were talking about itpossibly becoming a Category 4. I remember her telling Jerry Jarrell, who was the deputy director – I believe that was on Sunday. She said, "Do you know what this does to my plan?" She had to try to evacuate more people. Then, it weakened somewhat over the Bahamas. I stayed at the hurricane center there a couple of days, including Sunday night. The following Monday morning, about 4:30 or so on the 24th of August 1992, we were all working some pretty long hours. We had a plan that was not a very good plan at the time. The backup plan if we thought we were going to get hit was to send a team of people to Washington. If the Hurricane

Center had been knocked out, they could put the advisories out from there. So, we sent to Jerry Jerrell, the Deputy Director, Miles Lawrence and Jack Beven, two of the hurricane forecasters, John Pavone, the chief of NHC's Aerial Reconnaissance group, and forecaster Hugh Cobb from our analysis and forecast branch. I think there were those – what is that? – five people they sent to Washington. Well, that sounds great, but that left us with fewer people at the Hurricane Center. So, we were all working at least twelve-hour shifts, and many of us just stayed there for a couple of nights. I remember at about two o'clock or so in the morning, I went back and tried to take a nap in a back office, in the research section of the Hurricane Center, and I heard a window break. We had shutters on the windows, and I said, "Gee, that's not supposed to happen." So, I gave up on taking a nap. I went back out in the operations area. Then, at about 4:30 a.m., give or take, we heard a big boom. We had a lot of media in the NHC covering this, and Bob Sheets did just an unbelievable job with the media for I don't know how long. So, we heard this big bang, and we knew what it was. We'd lost the radar imagery, and the radome on top of the roof had blown off. Luckily, we did have a backup plan for that; we could get radar from Palm Beach. It took a while to make that happen, but the staff was just amazing. They did what they had to do. We had these two giant satellite antennas behind the Hurricane Center, one for GOES-East [Geostationary Operational Environmental Satellite] and one for GOES-West satellites. We do forecasting for the eastern Pacific, too. Both of those were just shredded, absolutely shredded. One of the media people – I think it was around seven o'clock in the morning – when the winds died down some, he opened up the shutters and started yelling. These cars in the parking lot were tossed around like matchsticks. Then he yells something I can't repeat. But basically, "Oh, there's my car." His car was perched up on this wall. We had a wall between the Hurricane Center and the Holiday Inn next door, about a three-foot high wall or so, and the car was balanced on top of that: two wheels on one side of the wall and two wheels on the other. In fact, I remember Hugh Cobb, one of the forecasters that went to Washington as part of our backup team, was watching CNN. He said, "Oh gee, there's my car." His car had a NOAA sticker on it. That car that was balanced on top of the wall had two of the wheels perched on top of Hugh's car. Anyway, we knew things were bad. We lost power, but we had generators, and the back-up generators worked fine, but the air conditioners on the roof of the building were damaged, and they didn't work. With all the computers and the media lights and all, it was pretty hot in there. Thankfully, Miami-Dade County emergency managers got us some portable air conditioners after a day or two, and that helped tremendously. We never stopped operations at the Hurricane Center, but we were limping along pretty good. The water system didn't work. The media folks would walk across the street to the University of Miami. They had a duck pond over there, and they'd bring in water to flush the toilets. Most of us had enough peanut butter and crackers, etc., to sustain life there for a little while. But we had to stay focused. Remember, as it's hitting Miami or about to hit Miami, we're getting really concerned for New Orleans and the North Gulf Coast. So, we had to put up – in fact, that morning, that Monday morning, we had to put up a hurricane watch and eventually a hurricane warning for Louisiana and Mississippi. Luckily, then it weakened some as it crossed over us and eventually

eased on into Mississippi. It didn't impact there like South Florida. Well, it had impacts on Louisiana and Mississippi, but not like Katrina did in 2005. Remember, Andrew was a small hurricane. It was a Category 5, a very powerful hurricane. The maximum winds were really strong. But it was small. That small size meant that didn't really impact a large area. The storm surge was not as large in horizontal extent or vertical extent because of that small size. There was a place called Cutler Ridge. There was Old Cutler Road that goes north-south along the coastline. It's really kind of a ridgeline. If you drive along that road, you can see it's higher than the land on either side, and that's why they call it Cutler Ridge, a very minor ridge but had some elevation. I remember there was – well, the storm surge – only in a few places did it cross over Old Cutler Road. But there was this giant ship – it was some type of research ship, if I remember – that had planned to dock at the Port of Miami, but they had some regulation back then that if you are not in before the hurricane watch or warning goes out, you couldn't do that. They've changed that now, I think. The ship was in Biscayne Bay, had engine trouble, and got caught in the eye wall, and it was pushed ashore. It was actually well inland, not too far east of where I live here. But it was just high and dry. The crew was okay, but it took them months and months to move that ship back into the water. There are stories galore. I had a friend at church who had – down in the Redland, they had tremendous damage. They lost their roof and windows. They had a lot of repairs to make, but they also had this horse that somehow ended up in their swimming pool. They don't even know where the horse came from, some farm nearby, I guess. It took them all day to coax that horse – they finally got it to go up the steps and get out. They had a lot of people trying to help save that horse. Anyway, they got it out. Other stories – we had a secretary at NHC that had been a former police officer, and she could handle a gun. But she also loved animals. She had tremendous damage and her windows blown in, the doors blown in in her house down in the Redland area, down in Southern Miami Dade. There was a place down there called Monkey Jungle, and they had a lot of damage. Some of monkeys got out, and at the time, there were reports on the radio that these monkeys had AIDS. These monkeys were doing the same thing we were: looking for food and water. So, they came into her house, and she couldn't shoot these monkeys, but she gave her a gun to a neighbor that, I think, maybe shot one, but at least that scared the others out for a while. But anyway, all kinds of stories like that. I couldn't contact my family at home – my wife and three kids, which were young kids at that time. Jerry Jarrell's wife, mother-in-law, and his son, a special needs son, stayed in our home with my family. We lost power, lost telephone service. I had somebody calling every thirty minutes, and they couldn't get ahold of anybody. Finally, two things happened. One, we had an administrative officer at the Hurricane Center; Vivian Jorge was her name. She was out, didn't live too far away, and had an old clunky car phone in those days. She came by my neighborhood, and she called in. I said, "How's my family?" She said, "They're outside. They look like they're fine." I said, "How's my house?" And she said, "Well, it's not too bad." And I said, "How are my trees?" She said, "What trees?" So, I knew I had a problem there. We had some palm trees in the front yard that were knocked down. When I came home, I came home just about sunset that Monday. The first thing was I'm glad to see the family was

okay. I didn't have any shingles – I didn't even have any tar paper – on the east side of my home's roof. The winds totally stripped that, and water had gotten inside. I had a tongue and groove roof, and water got in there. Also, a lot of water got into my soffit vents. The windblown water would get into the soffit vents. I've got stainless steel soffit vent covers now; I can cover those up to keep the water out. Anyway, I knew I had a lot of damage. I told the kids, "Go get the ladder. I need to get up there and see how bad it is." They just smiled and one of them said, "Dad, you don't need a ladder. Follow us." So, they took me around back. I had a neighbor that had a huge Bischofia tree that had fallen onto our back patio, and we just walked up the trunk of that tree up on top of the roof. I've got a picture – I think it's actually from the next day – with my brother-in-law who came down, Jerry Jarrell, who had come back, and my son, who was about ten years old at the time. We're all up on the roof, and all the adults are just standing there with our hands on our hips, shaking our heads. My son, God bless him, had a little hammer, and I had all these nails that had popped up through the roof sheathing, and he's up there trying to hammer these back in. He liked to say, technically, he was our home's incident commander in Hurricane Andrew. He's an emergency manager now. So, a lot of stories like that. I knew I had water up in the attic. I had a couple of construction people look at it. They said, "Yeah, you got water up there, but it'll probably dry out and don't worry about it." Well, a few weeks later, the walls and the ceiling started to turn black in some areas. We ended up – actually, our insurance adjuster told us to move out. I said, "I'm not moving out of my home." He said, "You really need to move out." And I'm thankful that we did. The insurance company was good enough to let us get a mobile home that we put on the side of our yard, and we stayed in that mobile home – let's see. Andrew was in August of '92. We moved back in July of 1993. So, it had an impact. A lot of people – probably half the people at the Hurricane Center and the local forecast office were impacted by the hurricane. One gentleman, one of the satellite meteorologists, I remember, came in and said, "Max, I'm homeless." He lived in a place called Country Walk, not too far south of where I live in Kendall, and his house was just gutted. It was also interesting that future Florida governor Jeb Bush had bought a house closer to the coast. He was advised to go inland to get away from the storm surge. They took him to somebody's house in Country Walk. Unfortunately, those homes had some design flaws and were heavily damaged. So, he saw the devastation up close and personal, probably one of the few governors that have actually experienced a Category 5 hurricane. That really helped after that. In 1992, he was not governor yet. Anyway, he really promoted the hurricane program after Andrew and did a lot of good. I keep saying Andrew is a Category 5. I need to clarify that a little bit. In real-time, we called it a strong Category 4 when it was east of the Bahamas. That was enough to get everybody's attention. Bear in mind that South Florida had not experienced a major hurricane, Category 3 or higher, for twenty-seven years. Hurricane Betsy in 1965 was the last major hurricane. So, Andrew was a Category 4 major hurricane just east of the Bahamas. I don't want to say this flippantly, but the truth is that it was almost a good thing for us because that really got people's attention here in South Florida. Then, it weakened a little bit, and then it strengthened again right before landfall. We called it operationally a Category 4 hurricane, which was bad enough.

But after the fact, ten years later, in 2002 – I was the director by then – after doing years of research, we upgraded Andrew to a Category 5, both east of the Bahamas and also at landfall in South Florida. My wife says, "Why'd it take you ten years to do that?" A lot of people said, "Why did it take you ten years?" Well, we didn't have any new data on Andrew, but we had a new instrument on the planes, on the NOAA planes anyway, at that time, called the Stepped Frequency Microwave Radiometer [SFMR]. It not only gives you flight-level winds, like we always got from the airplane, but it gives you decent measurements of the surface wind. We started getting that data in 1997. James Franklin from the Hurricane Center and Mike Black from the Hurricane Resource Division did a lot of research on this, and the only reasonable thing to do is to take a large sample of winds at a flight level in major hurricanes, which is usually going to be from 10,000 feet. How does that compare to the surface based on this stepped frequency data? On average, surface winds are about ninety percent of the ten-thousand-foot flight-level winds. So, based on that information and five years of data in – I forget – a couple of hundred cases, I think, we thought that was plenty significant. We had several people, including Herb Saffir, who developed the Saffir-Simpson Hurricane Scale on this committee that reexamined the aircraft winds in Andrew, along with some of the research meteorologists and a couple of guys from the Hurricane Center. Anyway, the recommendation was to up it to Category 5, which we did. I remember at the press conference we had – afterward, Herb Saffir didn't speak publicly, but he came up to me and said, "History has finally been corrected." [laughter] So, if it's good enough for Herb, it was good enough for me.

MG: [1:26:01] Were there other hurricanes that needed updating or upgrading in their categories?

MM: [1:26:06] That is still an ongoing process. Dr. Chris Landsea has done a really great job on that to look at some of the old data and make some adjustments. Some of them are being downgraded. A few are being upgraded. But you're never going to know, and even today, I think a hurricane forecaster would say if they're within ten percent of being right for the maximum sustained wind, that's about as good as they're going to get. Because even with airplane data, the airplane just can't be everywhere at one time. So you're getting flight-level information and surface information today. Anyway, it's much better, but you're never going to know for certain exactly how strong it is. We're also doing a lot better job on the size, on estimating the – it's not just that maximum intensity. It's really important how large the hurricane is. The larger it is, the more storm surge you can get. In the case of Katrina, that made a huge difference. Anyway, things are improving, but they're never going to be perfect.

MG: [1:27:25] Do you want to take a break here for today? I don't want to tax your voice too much.

MM: [1:27:31] Let's just take a few minutes here. I'll take a bathroom break if you don't mind.

MG: [1:27:36] That sounds good.

MM: [1:27:37] Okay, thanks.

[Recording paused.]

MG: [1:27:41] Before we talk about some other major hurricanes in your career, I just was curious what lessons learned were there from Andrew, things that you would maybe carry on to the events that we're going to talk about next?

MM: [1:27:53] Well, there are always lessons learned and lessons not learned. One of the most important things is that everybody who lives in hurricane-vulnerable areas needs to have a hurricane plan to protect themselves, their families, and their homes. And everybody's plan is going to be different. Some people may have a second house, they may have a boat down in the Keys or somewhere, and you need to estimate how long it's going to take you to implement that plan. People think they can do some of these things at the last minute, and you can't. You need to know your vulnerability to all the hazards – the storm surge, the wind, the rain, the tornados, and develop your own plan accordingly. There are some great websites out there: FEMA, various states – Florida has got a really good one. Just walk yourself through your own family plan and business plan. To me, that's the biggest thing of all. I like the way Craig Fugate, [former FEMA Administrator] says it; he says it more eloquently than I do, but basically, you should prepare for that worst-case scenario and then scale back as need be. It's a lot easier to scale back than it is to try to figure out what you're going to do you haven't thought of. "Oh my gosh, you've got a Cat. 5. It's coming right towards me." There's so much stress involved. People go to the grocery stores, and the shelves may be empty. We've learned that you just can't wait until the last minute to make those preparations.

MG: [1:30:05] We'll come back to some of the things that happened in the intervening years, but let's talk about the next big storm, Hurricane Katrina, and that 2005 hurricane season.

MM: [1:30:16] I became the director of the Hurricane Center in 2000, April of 2000. Fortunately, it wasn't too bad there for the first few years. But 2004 and 2005 were unbelievably busy. In 2004, Florida had four hurricanes just that one year; we had Hurricane Charley (Cat 4), Frances (Cat 2), Jeanne (Cat 3), and Ivan (Cat 3) in that same year, and that was pretty taxing. Then, of course, we had the 2005 season that was even worse with a lot of major hurricanes. But most people remember that year for Hurricane Katrina, which was not only a Category 5 at one point, but it was a very large hurricane and had devastating impacts and a lot of lives lost.

MG: [1:31:35] If you want to talk about Katrina, can we talk about the weeks leading up to it? What clues were there that this was going to be a big storm?

MM: [1:31:47] There were not that many clues in the very beginning. Katrina did not even become a depression until it was near the southeastern Bahamas. We had a tropical wave and another little disturbance that kind of merged. It was a mediocre or less wave coming across the Atlantic, nothing to get anybody's attention, really. Then it became a depression. One day, I forget the dates now, but in the Southeast Bahamas, and the next day, it became a storm over the Central and Northwestern Bahamas. We actually had it forecast to be a Category 1 hurricane when it came into the Southeast Florida coast. It did that just as it was making landfall, but when it came across South Florida, it was only a low-end Category 1 hurricane. We had rain, wind, but it wasn't devastating. Then, as it got into the Gulf of Mexico, the bottom dropped out. The upper-level environment was extremely favorable for development, and the water temperatures were unbelievably warm and deep, warm water, not just on the surface. It became a major hurricane. The size also increased. One of the worst thing that can happen is a powerful hurricane that also becomes a large hurricane. So, there was a tremendous amount of coordination that was taking place. We'll talk about this some more, but we had established a Hurricane Liaison Team. Interesting history on how that got started. What that meant is that we could give briefings from the National Hurricane Center, not just to FEMA – it's a joint project between FEMA and the National Weather Service. We were able to brief a couple of times a day, not just FEMA. Around the FEMA table, they've got all these different emergency support functions represented from the military to communications people to all kinds of people like that. But we also had the State Emergency Operations Centers online. For example, in Katrina, we had Texas, Louisiana, Mississippi, Alabama, Florida, and even Georgia online. I'll say this – the states do this a little bit differently, but in Florida, the governor, [who] at that time was Jeb Bush, was extremely active. He sat in on these calls. We mentioned that he had gone through Hurricane Andrew, a Category 5 hurricane, so he really understood the concerns there. He was a huge supporter, and he would be sitting there at the table with the Florida Director of Emergency Management (who at that time was Craig Fugate) and several other people from – actually, by 2005, they could let everybody in the whole Florida Emergency Operation Center participate or listen in on these video teleconferences. Again, we had Texas all the way across the Gulf Coast states there. So the federal and the state officials knew. Well, they knew we were greatly concerned. We were really emphasizing not to focus on that skinny black line, or the absolute center. A hurricane is not a point. it's a large-scale circulation. And Katrina was a very large-scale circulation. And there's uncertainty in the forecast, but this was so large that it was going to impact a huge area no matter where it made ultimate landfall. So, we did everything we could to let people know how bad this is going to be. We were putting out a complete forecast package every six hours but also had intermediate advisories in between, and it was a constant flow of information. Tremendous team effort. Again, both the Air Force and NOAA Hurricane Hunters supplied aircraft reconnaissance information. A lot of people had a lot of tough decisions to make there. At one point – I'll say it like this – the leader for FEMA at NHC – of the Hurricane Liaison Team was a young man at that time by the name of Matthew Greene.

Matthew had grown up in Louisiana, in New Orleans, and very familiar with that area. His mother still lived in New Orleans. He was getting information that most people were not heeding the warnings and heeding the evacuation orders. In fact, he couldn't convince his own mother to leave. We ended up – I called the state governors. We were already briefing the emergency managers, at least through the Hurricane Liaison Team, but I just felt like we needed to do something more. So we did call, and I talked to the Governor of Louisiana, the Governor of Mississippi. I didn't get the governor of Alabama, but I got the head of emergency management. The information was relayed to the Alabama Governor mainly because of the storm surge impacts on the Alabama Coast, which was well east of the expected center's landfall. I called Governor Kathleen Blanco in Louisiana. She was also concerned about people not heeding the evacuation orders. She actually encouraged me to call the mayor of New Orleans, Ray Nagin. So, I called him. Left a message. He was at dinner. He finally called me back. This is Saturday evening. I don't remember exactly what I said to these folks, but I know one thing I said was, "This is a life-threatening situation. You have some tough decisions ahead of you. You have the possibility of extreme loss of life. I wanted to be able to go to bed that night, knowing that I'd done everything that I could do." There's a friend that was an AP [Associated Press] reporter at the time. Every time I see him, we tell some of these stories. He says, "When I hung up the phone from Mayor Nagin, I said, 'He doesn't get it.'" That was Saturday evening. They were still not calling for a mandatory evacuation. All the studies say that you can recommend evacuations, but it just doesn't get people's attention. It doesn't carry the same weight. It doesn't get the same response as a mandatory evacuation, and they had not done that. They said the reason they didn't do that is because they didn't know for sure that they had legal authority to close schools and businesses. Well, goodness gracious, if somebody hadn't figured that out by now in New Orleans, they really did need some help there. So, I believe it was around eleven o'clock on Sunday morning; they had a press conference and actually called for the evacuation, and somebody asked Nagin why, and he said, "That fellow in Miami" – he didn't remember my name – "scared the bejeebers out of me." So, anyway, they finally did it. Louisiana had a plan; they just couldn't implement the plan. In New Orleans, for example, there's a lot of books written about this, but they had a plan to move all the school buses out. Well, they didn't even know where the keys were. A lot of the bus drivers, understandably, left. Anyway, they didn't have the response that they could have had and should have had. I know what really hurt me was at one point, the mayor said he thought they had over ten thousand people dead. I told my wife that night, "I can't live with that." Thankfully, it wasn't that bad. But any loss of life is not acceptable. When I talked to Haley Barbour, the governor in Mississippi, I told him that this is as powerful as Hurricane Camille in 1969 on the Mississippi Coast, but this, but this is much, much larger, and you're going to have an even higher storm surge. He said, "Well, tell people that. You tell people that, and I'll get people to move." So, we did, and I'm sure they did, too. They had a much better response in Mississippi, although their loss of life was unacceptable as well. I think there were four – I had four or five congressional hearings after Katrina. The forecast was much better than average – the track forecast and the

storm surge. They didn't fault the Hurricane Center for the forecast. At one of the Senate hearings, I remember – I believe it was Senator Bill Nelson from Florida who asked me when I first became concerned for New Orleans. And I said, "1947." There was a hurricane in 1947 that had been a powerful – I think it was a Cat. 4 at one time in the Gulf; it weakened to a Cat. 2 when it made landfall, but it overtopped the levees, and they had extreme flooding from storm surge. So, I can't tell you how many hurricane conferences I've been to – national hurricane conferences and state hurricane conferences in Louisiana – where people talk about how New Orleans is a bowl, and if the levees – if the water gets over the levees, we'll have a real problem. There's no way that people didn't know they had the possibility of tremendous storm surge flooding. Well, there are a lot of books written about that that are interesting to read and some of the lessons learned there.

MG: [1:44:22] I read that in April of that year, at the National Hurricane Conference in New Orleans, you said this is a scary place, and there could be major impacts here.

MM: [1:44:34] My recollection – Dr. Walter Maestri, one of the emergency managers from, I believe, Jefferson Parish, gave a general session talk and gave specifics on what happens if they really had a storm surge topping the levees. It's a very, very complex system there in Southeastern Louisiana with all the levees. Some of them are federally maintained and built by the Corps of Engineers, maintained as a result of legislation by the federal government. But then there are these parish levees, too, and some of them are dirt levees. Anyway, it's complicated. But in that 1947 Hurricane, water actually came in from Lake Pontchartrain, came down through the levees, and flooded New Orleans. The same thing happened here. This time in Katrina, they had some overtopping, but they also had levees that were breached, meaning that they actually broke. Some of the levees gave way. So, some people have said that if they'd been built better, none of this would have happened, and that's true to some extent. But if Katrina had not weakened and actually, after the fact, we downgraded it to a Category 3 Hurricane by the time it made landfall. We had stepped frequency data from the aircraft at landfall, and after the fact, it was downgraded to Category 3. If it had not weakened, it would have been overtopped anyway. Anyway, New Orleans is probably the most vulnerable area I can think of from storm surge flooding anywhere in the United States.

MG: [1:46:44] Yeah, I kept reading about instances where you talked about what could happen. What has to happen for your message to be taken more seriously?

MM: [1:46:57] Well, you certainly hope the response will be better next time. But again, the advice from the Hurricane Center – the Hurricane Center is going to put out the forecast, the best we can possibly put out. We don't know the intricacies of the coastline like those local officials do, especially the local emergency managers and the local forecast offices. By the way, before every single forecast is issued, the Hurricane Center has a hotline conference call with the

potentially impacted local National Weather Service (NWS) forecast offices, like in Slidell, Louisiana, near New Orleans. In Katrina, all those Gulf Coast NWS stations were on that conference call. We'll share the forecast, the track, the intensity, the storm surge, the rainfall – the rainfall information now comes from the Weather Prediction Center in Washington. They specialize in rainfall. But it's a coordinated forecast. If anybody has any questions about the forecast, they can ask us on that hotline call before the forecast actually goes out within an hour of the release time. The forecast is coordinated, but the forecaster is not going to open shelters. The forecaster is not going to reverse lanes on the highways. The forecasters are not going to tell people exactly when to put up their shutters or when to evacuate. Those are local decisions. It's so important to realize how important that is, and it's wonderful to have the President give attention, or a governor gives attention. But it's usually the local officials that know their local area that will tell people what to do. I remember one of the forecasters of the hurricane center, a dear friend, Lixion Avila, said, "I can't even pronounce these names in Louisiana, some of the names." Again, it's a team effort between the forecasters, the emergency managers, local officials, and the media to get that information out.

MG: [1:49:18] Greg Romano, who works for the National Weather Service and is one of the principal investigators on this project, shared a story with me about how the two of you were driving around Biloxi, Mississippi, a few months before the storm as part of a hurricane conference. He said you were pointing out how some houses were elevated and others weren't, and for those that weren't, you were concerned.

MM: [1:49:45] Yeah. Greg's a great guy. I don't remember if that's the National Hurricane Conference or a Louisiana conference separate from that. Unfortunately for my wife, when we go on vacation, I'm looking at the trees near power lines and the elevations. I drive her crazy always, saying, "They're going to regret doing this or doing that." [laughter] But the locals know the issues much better. You can't expect the Hurricane Center to know every little nook and cranny of the coastline up and down the whole United States coastline and the Caribbean. So, again, this goes back to that team effort and everybody having a part to play.

MG: [1:50:45] If you are still up for continuing, can you walk me through what that storm was like for you personally? How did you manage during those couple of days?

MM: [1:50:58] When I was the director, I had a sofa bed in my office. I made very good use of that in 2004 and 2005. I always liked to spend the night there if we were going to have a landfall. I always like to be there at the time of landfall and at least through landfall. I spent several nights in 2004 and 2005 sleeping in the office there. We would usually do continuous media coverage. They didn't really have to have the director of the Hurricane Center, but most people like to have the director or the deputy director, so my great deputy director Dr. Ed Rappaport and I would split up the day into twelve-hour periods. I'd do twelve hours' worth of

media, and he would do the other twelve hours. That worked out pretty well. I mean, you really wanted the forecasters – at the time, we had six – to focus on making the forecast. Again, we're doing the Atlantic, Caribbean, Gulf, and Eastern Pacific. So, that can get busy. We've had three or four hurricanes at a time on occasion. Even with Andrew, I remember we had a hurricane making landfall on the Pacific coast of Mexico the same day that we had Andrew making landfall. So, it can get busy, and the forecasters need to focus on doing what they do best, making the forecast. But Ed and I both spent years making forecasts ourselves. The media desk is a matter of a few feet away from the forecast desk, and it worked well. We could activate a media pool – we always do this when there was a hurricane watch or warning for the United States. Sometimes, even before that, if there's a big enough concern and the media can come in, and there's a pool coordinator. They actually are provided by one of the local TV stations. But they divide the day up into four- or five-minute time slots, and anybody can call in and request an interview with – in the case of when I was there – the deputy director or me. We would block out a period of time there, like an hour or so, when the forecast is being made, and that hotline coordination call is being made. But it worked really efficiently. You could hit the whole East Coast in a certain amount of time. TV stations had bumping rights. If you were in the hurricane warning area, you could certainly get in a lot easier than somebody from England. I mean, we'd have calls from foreign countries, too. We didn't mind that, but we really wanted to focus on people in the impacted areas. So, we had the national and international networks participating, including the Weather Channel. But then we also had the local stations calling. So the local station could get in and get their four minutes of time. Sometimes, I would sit there for hours doing the interviews, and somebody would bring me a cup of coffee, or really, I'd be drinking water most of the time. I remember wearing – sometimes, I'd have maybe four different microphones on for the national media, the local, and whoever else. Then we started doing it in Spanish as well, where we'd bring in one of the Spanish-speaking forecasters. That was important to get that out to the Spanish-speaking population.

MG: [1:55:09] At what point during Katrina did you have the conference call with the White House?

MM: [1:55:14] Well, that's interesting. We don't control who gets on the video teleconference calls given through the Hurricane Liason Team. FEMA would usually reach out to them and invite them. By 2004, we had that down well. Even before that, I remember Bill Clinton was on one of the calls, and then, in fact, I'll share, especially in Katrina and Rita in 2005, President George W. Bush was on some of those calls, too. I'll never forget – I know he took a lot of criticism for his actions, but he was really involved. I remember in Katrina before Katrina made landfall, when we heard that they were using the Superdome, the stadium there in New Orleans, for the shelter, he asked about how safe that was and is the roof sturdy enough. I'm going to have to ask you to come back to that. I've got somebody knocking on my door.

MG: [1:56:34] Sure, sure. I'll pause. [Recording paused.] We're back on.

MM: [1:56:40] Well, in Hurricane Katrina, I remember President Bush was on several of the conference calls through the Hurricane Liaison Team. FEMA would typically reach out and invite them. By that time, we also had the Homeland Security secretary on as well. In Katrina, I remember when we found out they were using the stadium there as a shelter, President Bush asked specifically, "Is that structure safe to use as a shelter? Is the roof safe?" He was concerned about the storm surge flooding. He was pretty savvy. I don't know about you, but I don't expect the President of the United States to drive a Greyhound bus in and rescue people. There were certainly some mistakes that were made and some blame to go around all around there, but you can't blame him for not being concerned and trying to get things done. FEMA is coordinating with the states, and the states coordinating with locals, but there were some breakdowns in those plans. Things just didn't happen as quickly as they should have.

MG: [1:58:22] I also read that this was the second time that you had called politicians to warn them about the severity of a storm. I think the first time was in 2002 with Hurricane Lily,

MM: [1:58:33] Lily. One of the emergency managers on the Hurricane Liaison Team, Clay Stamp, was there when we reached out to the governor of Louisiana in 2002. He is the one that reminded me of that during Katrina, and so I didn't hesitate to make the calls. I thought that was a great idea. So, I'm really glad that I did get to talk to the governors and Mayor Nagin, but you really don't want to rely on the NHC director making calls like that; it should not have taken that. They should have already been briefed by their state and local emergency managers. Anyway, you just can't expect the Hurricane Center to call every single little community up and down the coastline.

MG: [1:59:34] What were your concerns regarding Hurricane Lily?

MM: [1:59:40] The storm surge definitely. Fortunately, it went in a place where it wasn't as bad as it could have been. You're never going to have a perfect forecast track. Even with the aircraft, satellites, and all the computer models galore, the atmosphere is so complex that you're never going to get a perfect forecast. Part of the challenge is to convey that forecast and the uncertainty in the forecast to get people to respond.

MG: [2:00:21] I want to ask you a little bit about the aftermath of Katrina and the congressional hearings. Do you want to take a break for today? Or are you okay to keep going?

MM: [2:00:28] I'm okay to keep going.

MG: [2:00:31] Can you talk about how things unfolded after the storm and the devastation you witnessed and then having to talk to Congress about it?

MM: [2:00:47] Well, the devastation was just tremendous. I always like to get out, do an aerial survey after major hurricanes, at least in the United States. It's not just a matter of showing the flag, but I truly learned something from talking to people that were directly impacted. I liked to talk with emergency managers and even some of the residents that were actually impacted without being too intrusive there. I remember walking along the Mississippi Coast. I thought I was pretty familiar with the coastline there, and I remembered I had seen all those before and after pictures of Hurricane Camille. I remember Neil Frank showed these pictures of the Trinity Episcopal Church in Pass Christian, Mississippi, and there was a pastor there and his family. I forget how many kids he had. The church was devastated in Camille, and several family members died. There was actually a shelter just a couple blocks away that they could have gone to. I remember that the church was just demolished in Camille, but it was eventually rebuilt. So I saw some people walking along the coast after Katrina that had obviously had tremendous damage to their homes. I stopped the car and said, "Can you help me out here?" I talked to them a little bit first about what happened to them, and then I said, "Well, can you tell me where the Trinity Episcopal Church is? Is it still standing?" "Oh, yeah, it's still standing. It's just a block or two away." So, we drove down there, and well yeah, it was standing, but it didn't have any walls. No walls, period. It was a miracle how any of the structure was still standing. The storm surge just gutted it. They also had these huge – well, the casinos. They had ships, and they had these casinos that were actually on barges, almost like a ship, in the water. Originally, they didn't allow them to be on solid land, so they built them on the water, and the plan was they can move them to protected areas back when they first did this. Not a very brilliant idea. They move so slowly that you had to do it too early, way too far in advance. In fact, sometimes, they would take all the money off the casinos and leave the casinos in the water to handle some storm surge. Unfortunately, these structures were pushed well inland in Katrina. I remember a huge ship pushed well inland that was just unbelievable. Regrettably, a lot of people died. A lot also lost their homes. You don't just build back in a few months. It takes a long, long time.

MG: [2:04:34] Can you talk about what the congressional hearings were like for you? I was reading through some of the testimony, and it seemed like you had to explain that you made a really good forecast. The storm did what you said it was going to do.

MM: [2:04:50] Well, the Hurricane Center not just verifies the official forecast, the track and intensity, but they also verify the forecast from all the different computer models. We get a couple of dozen different computer models. But the Hurricane Center, because they've done these verifications every year, from the beginning of time, when you go back, you can see which models are the best. We learned a long time ago that you can take, let's say, the top five models – there are different ways to combine these, but you take the top five models, and they may

change number one, number two, every now and then, but the top five are usually about the same top five. So, if you just take a simple algebraic average of those, you add up the latitudes of all five models, divide by five, add up the longitudes of all five models, divide by five, and you get a consensus. It's kind of a poor man's consensus model that is usually hard to beat. It used to be – I mean, 70s, 80s, and even into the 90s, the forecaster can beat the models. But as the models have improved, and if you do come up with a consensus model, that's kind of the goalpost now. That's what you try to beat. The official forecast usually doesn't change too much from the better consensus models. There are different ways to combine them. You can weight the European model and/or the United States global models more than you weight some of the others. But the consensus models are usually relatively close together. So, if you don't deviate too much from that, you usually do very well. The forecasters can still beat it at times. But if you look at averages, they're pretty close. You don't want the official forecast to flip-flop back and forth. We call that a windshield wiper effect. If you do that, you lose all credibility. If you go with these consensus models, maybe they all shift – for example, you may shift closer to that, but not always, in case they flip back again – but you need to be consistent and still try to get the best forecast possible. So that's improved dramatically for the track. It's also improved some for intensity, but not as much as you'd like to see. On average, the Hurricane Center does very well on intensity, but they still have a hard time catching these rapidly developing and rapidly weakening systems. They're still working on that.

MG: [2:08:01] And what was the reason to call these congressional hearings?

MM: [2:08:07] Well, they always have these congressional reports, the House report, a Senate report, a Presidential report after disasters. So really, providing information for some of those reports, I think, is one thing. And if something glaringly went bad with the forecast, we would have been accountable for that. Fortunately, the forecast on Katrina was – I don't know how it could have been any better, really, thank goodness. But it's not all about the forecast. I learned that a long, long time ago. Bob Sheets and Neil Frank taught me it's not all about the forecast. If you don't communicate that forecast effectively to the decision-makers and the media, it's all for nothing, even if you have a perfect forecast. It doesn't mean a thing if people don't respond.

MG: [2:09:09] Were there ways that you changed or your approach to your work changed after Katrina?

MM: [2:09:19] I'm trying to think. I'm sure we had a disaster survey report with some recommendations, but I don't remember anything major. For me, the major change was in the funding. Regrettably, sometimes it takes a disaster to really get significant funding increases, and I know that you can't – well, the director of the Hurricane Center is not supposed to do budget issues, especially with the media or with Congress. That's a no-no. You go through the process. The process usually involved my boss telling me, "Hey, you got the same budget we

had last year or a small increase. Make it work." In one way, it made it kind of easy, but some important things didn't get done. After the 2004 and 2005 seasons, I believe we had three Presidential visits. President Bush came down. The last visit, he brought Governor Bush and several congressional people with him. In fact, I remember the President asking, "How's the staff holding up?" 2005 was unbelievably busy, too. It went beyond the end of the official season, and we used the Greek alphabet for the names because we ran out of letters in the alphabet. So I said, "Most of the people at the Hurricane Center, they'd rather do what they do than eat cake and ice cream. I mean, they love what they do. They're just really passionate about what they do. And they know that they can save lives." But I could not go out and talk about budget needs to politicians or the media. I remembered Bob Simpson's experience with Spiro Agnew after Camille. One thing we had been trying to get was this Stepped Frequency Microwave Radiometer that NOAA had developed with a lot of partners. They'd been working on that – actually, I've got a t-shirt that says, "Twenty-five Years in the Making: Stepped Frequency Microwave Radiometer" – to get surface winds, instead of just the flight-level winds, because you don't really know how that flight-level wind gets transported down all the way to the surface. You don't know exactly – it's not always the same. So, that's extremely helpful. We'd had it finally on the NOAA planes, but most of the operational reconnaissance flights into hurricanes are done by the United States Air Force. The Air Force has been doing this for decades, and they've done a tremendous job. NOAA flies primarily research missions. But they certainly augment the operational flights, too, when the Air Force is overtaxed with multiple storms or not enough flight crews available or whatever. But, again, they do ninety-some-odd percent of the operational flights, I would say. We could not get funding for stepped frequencies to go on to the Air Force planes. So, when President Bush asked how the staff are doing, I said, "They're fine, but their eyes are usually not this bloodshot." They were tired. I remember in 2005, one thing I hated to do is call somebody in on their days off. That year, we had hurricanes going through New Year's Eve and into the next year. I remember Brian Jarvinen – I think he had already worked six or so midnight shifts in a row, and I had to call him back for more because we had one storm out of the official season and we needed forecasters to cover shifts. Most of the hurricane forecasters wait until December to take time off after the hurricane season ends at the end of November. It's supposed to end in November. Mother Nature doesn't always follow that guideline. Anyway, I call him up and ask him if he could do a couple more midnight shifts. I knew he was tired, but he said, "Sure." I had to do that several times, and no one ever said, "No, I can't do it." They just said, "Okay." A couple of the congressional people that came down that last visit said, "Is there anything we can do for you?" I didn't want to get spanked for saying anything about the budget, so I said, "Well, we do have a one-pager here that Ed Rappaport, our deputy director, had typed up on things that we'd been trying to get done and that included Stepped Frequency Radiometer and also included buoys. I think there were fifteen additional buoys. These are deep-water buoys that are expensive to implement, deploy, and maintain. But in data void areas, when we don't have anything else; they're really helpful, especially tracking the weaker disturbances, even getting some east of the Lesser Antilles and in

the Caribbean. Those were two big-ticket items that were on that one-page list. I said, "I can't talk about the budget, but here's a list of things that some people might look at." Anyway, some Congressional folks picked those up Within days, I had a call from a high level person in the Department of Commerce. The Hurricane Center, Weather Service, and NOAA all fall under the Department of Commerce. Anyway, this gentleman was going to fly down to Miami and talk to me. He brought up some of these things. I said, "Yeah, these are things that can really help improve the hurricane program." Anyway, I was a little bit proud of that and glad we got – I think we got ten million for the stepped frequency. The program got ten million dollars for that. I don't remember how many millions of dollars in buoys. Anyway, there were some other things. Oh, one big thing – the staffing with the more active seasons – we ended up getting four additional assistant forecaster positions, which has made a world of difference. They're still benefiting from that. That was a very good thing.

MG: [2:17:01] I've also been thinking about how the folks I've interviewed from the Weather Service always have a weather story that inspired them to pursue meteorology. I'm wondering if Katrina will be the weather story for some future meteorologists or part of the Weather Service.

MM: [2:17:22] Oh, there are a lot of people that have stories. I'm sure that Katrina and other hurricane stories will inspire others to get into meteorology. One I like to tell is of a young man that – well, I was at the Hurricane Center. This was probably sometime around the late '80s or so. But it was a weekend, and I was there by myself, working the forecast shift. A lady came in unannounced from Louisiana, and she had her son, who was in high school, maybe even middle school. I don't remember. Anyway, she asked for a tour of the Hurricane Center. I wasn't too busy, so I said, "Sure, come on in." We walked around for thirty minutes, or so, I guess. Then, at the end of the tour, this young kid says, "I'm going to go to school in meteorology one day and come work here." I don't remember exactly what else he said. Maybe he even said he wanted to said have my job. Anyway, his name was Eric Blake. When I was director, I got to hire him. He got a master's degree from Colorado State Bill Gray, an outstanding professor in tropical cyclones and a pioneer of seasonal hurricane outlooks. Anyway, he is now one of the best hurricane forecasters NHC has. I always remember that story. I'm glad he ended up working at the hurricane center. Most of the people had some weather story to tell. I stumbled into it. I mean, I was interested in meteorology growing up in Oklahoma, but I stumbled into the job. I never had the goal of becoming director of the National Hurricane Center. I don't want to say I stumbled into it, but I think Bob Sheets, Neil Frank, and Jerry Jerrell helped me prepare for that. Actually, I also need to thank Dr. Bob Burpee, who's passed away now, but he was the director for a short time before he got ill. He had been the director of the Hurricane Resource Division of NOAA, a brilliant researcher. He got the job as director of the Hurricane Center after Bob Sheets left. He didn't have the operational experience, but he was so smart. He did a lot of things right. But I'll never forget – one day, soon after he got there, he called me into his office, and he said, "Max, this emergency management stuff. I want you to take care of it." I ended up

having the honor of teaching these emergency management workshops and attending state hurricane conferneces. We had partnered with FEMA, and Bob Sheets helped start this. We had these week-long workshops. Eventually, it started out in Florida, and then FEMA got involved and did a great job of coordinating – bringing in people from the state and local levels, and maybe one or two FEMA people, too. But that had tremendous payoff. So, I got to help teach these and organize these. Bob Sheets and Dr. Hal Gerrish actually started doing this with the first one we ever held in Florida, and the NHC staff still teach the workshops today. This is a fantastic way to bring in emergency managers. The goal is to let them understand not just how the forecast was made but the uncertainty in the forecast. And you can't leave that workshop without understanding storm surge. We used to make attendees analyze storm surge maps by hand to see how high the storm surge would be in their communities. Now, they probably do it on a computer, but there's tremendous payoff, and we developed that relationship between the emergency managers and the hurricane forecasters.

MG: [2:22:03] Well, was there anything else you wanted to say about Katrina, its impact, and what stands out about it to you?

MM: [2:22:17] I think that's pretty good on that. That might be a good place to stop. I do want to next time maybe talk about the beginnings of the Hurricane Liaison Team, the hurricane awareness tours and the WMO Hurricane Committee, these workshops, and a little bit about travel. But that stuff's going to go quickly. Maybe if you take a couple of weeks, you've got enough to chew on. You've done your homework, by the way. You read a lot about some of these storms. My memory is not what it used to be. [laughter]

MG: [2:23:22] Well, you're doing great. I'm on the edge of my seat. I have so many more questions to ask. This has just been such a treat and an honor to talk to you so far. I'll pause the recording, and we can figure out where we go next. [Recording paused.] We're back to record one more story before signing off.

MM: [2:23:41] One more story for the record. It's not all just about the forecast and having a plan and implementing that plan. One huge topic is mitigation and how to build better. We know how to do that. Can you afford to do it? There are some things you can't afford, and most people can afford, especially if you build a house like that – I'll never forget one year I went to this conference in Japan, and the hotel information said it was a high-rise hotel and if there's an earthquake here, don't worry, because it's built to withstand a major earthquake. We don't do that in the United States. You can't go to a hotel and find out if it's built to withstand a major hurricane or not. We could do that. But we don't. I've asked about that with insurance conferences, and nobody wants to be liable in case something does happen. And a lot of the social science – we've learned more about how to get the social scientists involved in. There are a lot of people who have made tremendous contributions here. But in the beginning, they – in

fact, I used to get my hand slapped. I'll never forget one time I had a call from the director of the National Weather Service, and I was told to stop talking about these other social issues. I mean, like building stronger homes, and somebody had found out I had talked to the governor of Florida and suggested that he consider putting hurricane days in the school calendar. We have snow days up north, right? They close schools if there's a heavy snow, and the world keeps spinning. Well, why not include a few hurricane days on a school calendar? It just makes it easier if you can do that. So, I shared that with Governor Jeb Bush, and he thought it was a great idea. They have that now. Anyway, I was told to stop talking to politicians about that, stick to meteorology. "You're a forecaster. You need to stick to meteorology. Do you understand that?" Anyway, it was easy enough to get around that. I didn't say things myself; I would just reference statements from others, like the Federal Alliance for Safe Homes, FLASH. The director there and CEO is Leslie Chapman-Henderson, who's done a fantastic job of promoting better building. We've still got a long way to go there. Now, I think it's pretty accepted that social scientists are really making a contribution. I'm glad that attitude has changed. The forecasters need to know what the social scientists think, and they're even helping to design some of the graphical products, like the storm surge graphics that have been successful. I think that's going to continue. That's a good relationship with the social scientist.

MG: [2:27:11] Well, as an oral historian for the agency, I appreciate those efforts, which help me make a case for my work, too.

MM: [2:27:22] Absolutely. Yeah, absolutely.

MG: [2:27:25] All right. I'll stop the recording.

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

Reviewed by Molly Graham 6/21/2023
Reviewed by Max Mayfield 7/16/2023
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