Jinny Nathans: This is Jinny Nathans. I'm the archivist at the AMS. We're here at the Hurricanes and Tropical Meteorology Conference on April 18, 2018. Sitting opposite me is Jack Beven from the National Hurricane Center. He is here to do a quickie interview and talk about – actually, I'm not sure what. He's going to pick the topic.

Jack Beven: (laughter) OK. Well, I'll try to go down the list, but I'll probably elaborate quite a bit. I tend to get long winded. I'm Jack Beven. My current position is Senior Hurricane Specialist at the National Hurricane Center in Miami. Been in the Hurricane Specialist role at NHC since 1999. Before that, I worked as a marine aviation forecaster for five years in the tropical analysis forecast branch. I got my undergraduate degree, a bachelor's in physics, at Louisiana State University back in 1984. Then my master's in meteorology at Florida State in 1988 and my PhD at Florida State in 1994. So I've been in meteorology for a long time and natural sciences even longer.

The question here – what made me decide to be a meteorologist – well, I've always been interested in natural sciences, particularly earth and atmospheric. It might have been a storm back when I was younger that got me interested in weather, but I was also interested in earthquakes, volcanoes, rockets way back when, astronomy and the like. So, it was probably in college that I – as an undergraduate, I realized that I was going to be a meteorologist as a career. But one of the reasons I got a physics degree was that it was a good foundation for all the other things I might have been interested in doing. But my interest in natural sciences goes back a long way. Had there been volcanoes in Louisiana where I grew up, I'd probably be a volcanologist right now, but we have hurricanes instead. So, that's how I got into the field.

Once I figured I wanted to do meteorology as a career, that's when I went off the graduate school at Florida State to get all the good theory and background. Then started interning at the National Hurricane Center while I was getting my PhD. So, my job progression was like that.

I've had a bunch of teachers along the way that have helped out very well. I have to mention one in high school. My Catholic high school, Baton Rouge, Louisiana, taught earth and space sciences and physics by Brother Gordian Udinksy. He was the sometimes feared, but much beloved science teacher at that school. I learned a lot from him on many different things, not just meteorology, but he covered all sorts of aspects of earth and space sciences and physics and the like, and one of the greatest teachers I ever had.

In graduate school, I was studying under Dr. T. N. Krishnamurti, who just passed away earlier this year. He was a tremendous influence on my life, a man who was always full of ideas and always having projects he wanted to work on. Even right up to the moment he died, he had things he was working on. He was the one – now, Krish liked to have his students in hand, particularly in the middle of the night – you probably heard that story from other people who have come in here. But he also let me go intern at the Hurricane Center where he didn't see me for months at a time. That helped me get my foot in the door at NHC. On his own, he was a tremendous teacher, knew a tremendous amount of stuff.

Florida State had several excellent professors. Another one who was a big influence, Dr. Noel LaSeur, who was a walking encyclopedia of information. I always enjoyed talking with him

about various things and weather. Some people think I'm that way, but I'm a pale imitation of what Noel LaSeur was. Many others – Henry Fuelberg was my master's degree major professor and taught me a lot of good stuff as well, particularly on satellite remote sensing, and Dr. Eric Smith as well. Another one who taught me. So, those four professors at Florida State helped make me a lot of what I am today and helped get my enthusiasm for weather really going strong, and to teach me the theory that turned the weather enthusiast into the weather professional. That's probably the most important part of it.

So, Krish also sent me off to my biggest field program. I was a part of the Tropical Cyclone Motion '90 experiment back in 1990. That involved spending a month in the Philippines launching weather balloons to study typhoons and the motion of typhoons and then a month on Guam at the experiment headquarters processing data. That's where I met a lot of the people who at that time were the graduate student grunt workers and now are the people running the new round of projects.

So, when all the tropical cyclone projects of the mid-2000's and early 2010's came around, the people who had been doing all the data collection and the balloon launching and all that at TCM-90 were the PIs for the next round of projects that we had. So, that's the cycle. The people who are the graduate students at those projects will be running the next round of projects whenever they come around in the tropical meteorology field. That was a two-month experience that I've never forgotten. A whole bunch of us got to know each other quite well during that time.

I've done a lot of different projects over the years, both in education and research and in operations – in my master's work I did work on satellite data, analyzing data from some of earliest geostationary sounders. For my PhD work, I worked on motion of hurricanes, based on the current theories at the time. I was doing them in the early 1990s and fit some of those theories into the bigger picture of how synoptic scale things drove hurricanes, drove hurricane motion.

At NHC, I wear many hats. One of them is I am one of their big focal points for geostationary satellite data, which means with GOES-16, the GOES-R project and all that. I've been a major part of that for the last decade. Also, the reanalysis project of old hurricanes. Now, my colleague Chris Landsea is the spearhead of that, but I am the chairman of the best track committee at the National Hurricane Center that will actually examine this data that Chris submits and make sure the proposed changes of HURDAT are scientifically rigorous enough and justifiable enough to actually put in the official record.

So, we have a committee of people that look over this. I'm currently the boss of that. I've been a part of that project since about the year 2000 and took over the committee chairman about eight or nine years after that. I can't remember exactly when, but I've been running the show for a while on that. So, even though I am an operational forecaster, I do keep one foot in the research camp as much as possible, trying to keep up with the latest research, so I can come to meetings like this one and ask a lot of interesting questions, amongst other stuff. I do have a reputation for coming to meetings like this and being a professional pest.

JN: I'm sure you're not, I have to interject.

JB: (laughter) Well, we have – at the tropical meeting at the banquets in the years past we have had a parity, for better or for worse, of the awards banquet at the national meeting, but ours are gag awards. I've won the award for asking the most questions. (laughter) My reputation is deserved.

JN: What do you think your chances are tonight?

JB: I don't know. We will find out. That is up to the people who are actually running the meeting, but I don't think I've been quite as questioning as in years past, but I have not been idle either. So, I should note as part of the work I'm doing on GOES-16, we actually had a workshop at this meeting last night that covered various aspects of the satellite. So, that's part of our ongoing efforts to get GOES people used to it because there's so much new stuff on the satellite that it's very complicated, even for people like me. It's a big learning curve of how to make the best use of it in our operations.

There's a note here about what surprised me or didn't surprise me about my first job. My first job was actually the internship at the National Hurricane Center. I've worked there ever since. It's hard to say what surprised me, except perhaps how relatively small the operation is there in terms of the manpower, because at the time I went down there I was such in awe of being able to go and help out at the Hurricane Center – because I wasn't just sitting around idly twiddling my thumbs or working on the side on research, I was actually helping out the operations – just how relatively few people that there are compared to the demands of what the job is.

To some extent, even today, that's still the case. People who come into the office for tours are amazed by just how relatively small we are for the amount of work that we are doing. We get a tremendous amount of things done between our forecast operations, our outreach and our research, and all the things we need to do to do our job better. I can't say I felt super surprised because I was just so pleased to be working at the Hurricane Center when I got there in 1988 and started my internship. That was probably the thing that stood out the most, how relatively few people compared to your expectations there actually were working in the job.

Let's see here. There's a question here – have I acted as a mentor? I've not been a great one-on-one mentor to a lot of people, but I have taught a lot of people over the years in some way, shape or form. Probably the biggest one is at our office every year we have an annual workshop for meteorologists from other parts of the world – generally, the Caribbean countries, but sometimes we open it up to Asia and Europe and Australia, and the really far flung parts of the world. They come in for two weeks and we teach them about tropical meteorology and hurricane forecasting and all the aspects of that. This is all done under the World Meteorological Organization's part. It's officially the region for hurricane training course. Everybody at the offices pitches in on that. It's very high intensity. We cram a lot of things into two weeks. My big part of that is that I spend two days of that course teaching the Dvorak technique of estimating the intensity of tropical cyclones from satellite imagery to all these meteorologists.

So, in that regard, teaching is a significant part of the job. We also have courses of emergency managers that come in. We teach them a more basic version of the meteorology of hurricanes,

so they can understand that. I've been a part of that on many occasions. We get to come to meetings like this one where we get maybe not as much mentoring, but we teach ourselves what we see and operations and say to the research community, can you help us with what we're seeing here? We get taught the latest and greatest ourselves. Then we also have the outreach with the general public that we do.

It's not exactly a one on one mentorship the way that a professor would have of a student but interacting with people and teaching them about the science and about the profession has been a tremendously important part of that over the years. Actually, I was doing a lot of that even before I became a fulltime hurricane specialist. It's part of the job you can't underestimate the importance of. We get paid really to protect lives and property, but we can't protect lives and property unless A, we know the science and can teach other people the science, and B, get people to respond when the forecasts come out. The best forecasts in the world doesn't do you any good if all it does is sit on your desk after you've made it. You've got to get people to react to it.

JN: Can you talk a little bit more in depth about the reanalysis project?

JB: Yes. The National Hurricane Center keeps a couple of databases of tropical cyclones, one for the Atlantic and one for the Eastern Pacific. The Eastern Pacific record, I believe, goes back to 1949. The Atlantic goes back to 1851 now. What they are is a set of latitudes and longitudes, positions, the wind speeds, the intensities and when we know them, the sizes of the storms, every six hours and then all the landfall points that we can put in there from storms that we know made landfall and when we can accurately judge landfall location and intensity.

Now, this database was put together piecemeal over many years. The original was started by Charlie Neumann and John Hope back in the 1960s when they were working with the Spaceflight Meteorology Group and they needed a climatological dataset to help NASA determine what the hurricane risks were in areas of recovery ships for the space program. There was a lot of things that were not known about some of the older storms at that time. Therefore, there was a lot of things that were put into that database that were placeholder material that they put in certain values if they suspected the storm was of such and such intensity but didn't know.

What happened in later years is the forecast operations got a little bit more sophisticated, we actually started making more detailed best tracks as we call them – the positions, the intensities and the sizes of these storms, after the storm was over. There was always some part of this going on, but it became very formalized after the HURDAT database went into place. Since I've been working at the National Hurricane Center putting the best track together of the storm has actually been a very important part. Interest in a hurricane does not end when the hurricane is over. It can go on for months afterwards and debating just how strong it was – particularly how strong it was. These days, the positions are less of an issue. These debates can get quite interesting when we try to decide between sometimes conflicting data.

Even with today's modern data, we have issues sometimes with the intensities. If you go back to the past, back into the early 1900s or into the 1800s, data becomes more sparse. We know a lot of those records were incorrect that were originally put into HURDAT. We know they were

incomplete. We know there were things that were missed. Therefore, there was a need to fix this. One of the things I thought about when I was an intern was that I would see what I could do to help this and I started spending time in the NAC library looking up some of the older accounts of weather. Finally figured out quite quickly it was going to be too much for one person by himself, like me.

Well, my colleague Chris Landsea, who when he first started this was at the Hurricane Research Division across town from us, got a grant to put together a hurricane reanalysis project for the Atlantic Hurricane database. He was aided by a small army of people that were going and doing the grunt work, finding a lot of the old information. We had people who went through old insurance logs and old ship logs. We had people who are still doing that even now. They are now going into foreign countries looking at their ship logs and weather information to try to find out more information on these storms.

Chris would take this information and put it in – use it to analyze what we thought the position and intensity of the storm was using the modern ways of interpreting the data. So, with that, we went back to the 1850s and started working our way forward. We discovered new storms in the process. We changed the intensities and positions of a lot of the storms. We'd even take a few out that probably didn't belong. For example, the 1933 hurricane season, which is the second most active of record in terms of numbers. It was most active until eclipsed by 2005. We had 21 storms. The reanalysis showed we had to add a few, but we also had to take a few out. So, the net gain was zero. We still wound up with 21 storms, but we did change some of the tracks around.

As we worked our way up through the years, we tackled storms like the 1900 Galveston Hurricane, which I think we did a much better job of, if nothing else, understanding where it made landfall and what its intensity was, some of the aspects of that that perhaps had not been properly understood to now. We also, out of sequence, reanalyzed Hurricane Andrew of 1992, which was a very contentious storm – how strong it was. The work of the reanalysis project and the best track committee we finally established that the storm was category five hurricane at landfall in South Florida instead of category four. I believe we published a paper in BAMS about that. If you go to that, you can read all the information that went into that. We do publish quite regularly about aspects of the reanalysis project.

As we moved into the more modern era, we started getting more data, more ship reports. When we moved up into the 1950s, we started getting Aircraft reconnaissance and then now the project is getting into the satellite era. So, we're getting all the satellite data to work with. What we're finding is it may be getting easier to analyze the storms because we have more data, but that more data is bogging us down because there's so much more we have to look at to see if everything has been done up to a good rigorous standard. Each of the data types has their own issues. There are times it is clear that some of the older forecasters had access to some data that has been lost somewhere in the archives today. It's probably at NCEI or some other place or the National Archives. It sometimes worries me as best track committee chairman about making some of these decisions knowing that the guys who made these decisions for me had some information that I did not have.

The reanalysis project eventually – it's going to take a while because the people who do it are also operational forecasters. Chris spends time, but the operational forecast desk and several members of the committee are operational forecasters as well, who have the skill in putting the best tracks together. Eventually, we'll get up to around the year 2000, which is where we think we will not need a lot of work after that time.

There's a little detective story I'd like to tell about this. There was a hurricane in 1944 called the Great Atlantic Hurricane. The nearest analog to that in the more modern era might be Hurricane Gloria in 1985, although the 1944 hurricane was more intense than Gloria was apparently. A book by Ivan Ray Tannehill, where he said the central pressure of this hurricane must have been below 27 inches. Now, Tannehill must have had some source for saying that because he was not the kind of guy who would just drag this number out of thin air, but he never documented where it came from.

So, when it came time to reanalyze the 1944 Hurricane, it left us banging our heads a little bit trying to figure out – we didn't have any – we couldn't find any evidence of this in any of the data sources that we were using to verify why Tannehill had quoted such a low pressure, which would have been consistent with a strong category five hurricane. The only evidence we had was for a weaker system, still category four, but weaker than what people thought it was earlier. Well, we did some digging. It turns out there were a couple of early reconnaissance flights into that storm, but one of them was after it passed Cape Hatteras and it was much weaker, and one of them when it was further south had not made it to the center. It had to turn back. So, neither of those produced that pressure value.

We didn't get that from Cape Hatteras when the storm passed over or from the Long Island when the storm passed over Long Island. It was not that strong at that point. There the matter sat for a while. We went ahead, we put out our reanalysis of the storm, recognizing that it was probably incomplete and we actually leave a long paper trail of everything we discuss about it. So, it's online if people want to go and read it. But a few years later, as we were moving into the era that was covered by the National Hurricane Research project starting in the late 1950s and early '60s, we were starting to look through the reports that that project put out, to see if there would be anything useful to help, data there that would help us work on these storms of that era. There was one publication that was talking about the winds of the 1944 hurricane. It said very low pressure is verified by this ship, the USS Alacrity.

The USS Alacrity I immediately – after I picked my jaw up off the floor, I googled the USS Alacrity and it was a World War II vintage destroyer escort that had been on convoy duty off the east coast at the time of the hurricane. Now, this hurricane was rather infamous. It actually sank several Navy ships that were in a convoy that sailed into it with the loss of several hundred lives. The USS Alacrity, as it turned out, had actually sailed into the hurricane and survived it.

So, with that as a specific thing I could actually ask the National Archives to dredge up – the National Archives are so vast, you can't just say, go get me everything you got on hurricanes. You have to have a specific target in mind. In this case, it was ship's log. I contacted them and they gave me the ship's log for the USS Alacrity for the period in September 1944. Sure enough, it had sailed right through the eye of the Great Atlantic Hurricane and

reported a very low pressure, below 27 inches, but not too far from 27 inches – 919 millibars. That was some calibration of that particular estimate that Tannehill had had. It was quite possible that the storm was stronger before the ship encountered it.

So, we went back and re-did the peak intensity of the 1944 hurricane based on that data. The only mystery remaining is why did that particular report get lost in the midst of time. Because the people who wrote the NHRP report obviously had some access to it. World War II at the time – probably it was classified. It was not released to the public. It was not released to the Weather Bureau or to the scientists, but obviously, somebody afterwards knew about it and why it didn't get better widespread distribution in the community is the big remaining mystery on this, as well as how many other similar encounters do we not know about but could still be very useful to us. So, that's a side story of the reanalysis project.

JN: This has been absolutely fascinating. I'm so glad I asked you that question. But now I feel I need to let you go, so you can go ask more questions.

JB: Okay. One other detective hunt story, and this is a storm we did out of sequence. This regards Hurricane Camille, 1969. We actually published a paper on this in BAMS as well, which is why I wanted to bring it up before I left. Camille is well-known as a category five hurricane when it hit the coast. We were asked to reanalyze it because it was the only category five hurricane that had hit the United States that had not gone through the reanalysis project. The others, the 1928 San Felipe hurricane, the 1935 Labor Day hurricane, in 1992 Andrew, had all been redone through the reanalysis project. So, we were asked to do Camille out of sequence as well.

Aside from the fact that the data collection was not a regular as it is in modern era, there was a lot of good data to work with on Camille. But there were a couple of interesting quirks to it. One of them was when the storm made landfall there was a family living in a house on the Mississippi coast where the eye came in who had a barometer reading. One of the barometer measurements that had been widely quoted in the literature, 909 millibars – because the family had been interviewed, had supplied this data, and it made it to the National Hurricane Center. What is not so well known is that apparently this family took other readings and got even lower pressures.

We found this when one of the people – Margie Kieper, who's working on Camille, went to New Orleans and checked out the archives of one of the private meteorologists at a university, university library again – so, hence the importance of libraries. She found even lower pressures that had not made it to the NHC's report on this storm. We used that to revise the landfall pressure of Camille. Then, about 10 hours before landfall, in real time, it'd been reported that Camille had a pressure of 901 millibars. After the fact, that had been corrected, but the reason it had been corrected and the actual corrected value had gotten buried. It did not show up in the post storm report on Camille, did not show up in the Monthly Weather Review article. Eventually, we found it in Weatherwise, but after we had jumped through all these other hoops trying to figure out what happened.

We had a lot of the data from the dropsonde that made the measurement from the airplane that it had gone through the storm. We went through and did a lot of work, and this is documented in the BAMS article as well. It turned out that that dropsonde, it was actually – instead of 901 millibars, it was something like 918, 919 millibars. That was an interesting piece of the puzzle because when we looked at Camille, it had reached a peak intensity over the Central Gulf of Mexico. What this suggested was that it fell a little bit and then the pressure fell again as it was moving onto the Northern Gulf Coast, and that's where we got the much lower pressures reported by the family that was living up there, the Breath Family.

We therefore were able to better revise the intensity of Camille, not only over the Gulf of Mexico, but at landfall as well, on the basis of all this information. We gathered some of it at the University of Loyola of New Orleans library, some of it from our own archives. We put all this data through the ringer to try to better figure out what Camille had done. It turned out it was much more dynamic than we thought it had been. This is a case in particular where library research was a huge key to it because Margie Kieper went over to the Loyola library and basically copied the entire archive on Camille that they had there. That was invaluable to us in going to get this project done.

JN: Well, thank you again. That was a great story. One way or another, I'm going to figure out how to get in everything you've said about the importance of libraries.

JB: Thank you. I've spent a lot of time in libraries over the years, both in school and at the NHC library as well, for what I do – wonderful resource, wonderful batch of information. A lot of older data has gone into these libraries and gone into places like NCEI that we need to try to uncover and use for our operation. It's not only here. For projects like the reanalysis and need for reanalysis of tropical cyclones elsewhere, these old libraries, national archives and such, that's going to be vital to what we're doing.

JN: Absolutely. I live actually in New Bedford and the whaling museum has been digitizing using citizen scientists to digitize the whaling ship logs, which have huge amounts of information there.

JB: OK. Well, we'll probably come looking for that one of these days. (laughter)

JN: My card is right there.

JB: The thing is on projects like this, it never – the window for reanalyzing stuff never closes. If we get some new information in on a storm, it doesn't matter when, we will go back and take another look at it.

JN: Fascinating. Absolutely fascinating. I thank you very, very much for stopping in.

JB: You're welcome. Thank you very much for having me.