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Interview with Thomas Knutson

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What would you consider the most two significant achievements in your career?

I think the two most significant achievements have been the cumulative works done in two areas: the modeling of hurricanes and climate and the climate change detection problem, combining models and observations. This work has been very much a collaborative effort involving a number of colleagues, especially at GFDL, and I am very grateful to have been able to work with these colleagues to achieve much more than I could have done on my own.

In modeling of hurricanes and climate we have shown that it is possible to dynamically downscale the year to year changes in Atlantic hurricane activity surprising well using large scale climate forcings together with a dynamical model. We've worked to leverage the GFDL hurricane model—an operational model used for short-term (1-5 day) weather prediction – to simulate how storms may become more intense in a greenhouse warmed climate. My work in climate change detection has focused on several areas. Gabe Vecchi and I worked to assess the reliability of past Atlantic hurricane counts based on the evolving density of observing ship traffic since the late 1800s,

and we find an effect large enough to change a highly significant increasing trend into a non-significant trend. Suki Manabe and I documented the presence of substantial multi-decadal modulations of El Nino amplitude in the GFDL climate models. If such modulation also occurs in the real world, then there is a great need for caution in interpreting changes of El Nino amplitude as trends as opposed to background internal variability. We've assessed the consistency between historical climate simulations and past observed trends in regional surface temperature using methods that are fairly accessible to non-specialists. This latter work supports IPCC's general conclusion that there is already a detectable human influence on regional surface temperatures due to increasing atmospheric concentrations of greenhouse gases.

When you look back in time, what were the most significant, exciting or surprising developments in atmospheric science?

First of all, it was exciting to be a part of the science research effort as the global warming issue emerged over time. Not only has it been fascinating to watch the observational evidence mount over time, it was striking to witness the progress being made in climate modeling and analysis, which led to increasingly strong evidence that humans were responsible for much of the observed global climate warming. Moreover, it has been interesting to watch as this problem expanded into other disciplines in the social and natural sciences, and to see the growing interaction of climate science with the policy/political/private sector realms. I think these trends will only continue over the coming decades due to the long time scales and continued growth of the problem as well as its international dimensions. Among the more surprising developments have been the many innovative and clever methods that the community has developed to tease information out of models and out of available data of all kinds to learn more about the climate system. For example, it's amazing to see how scientists can use even

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tiny bits of geologic "proxy" evidence to piece together a history of past climates; how satellite data, ocean measurements, ground-based measurement, balloon based measurements, etc. are used together to build a coherent picture of the climate system; how statistical and numerical methods are used to analyze data, initialize models, confront models with data, improve model performance, uncover problems with observed records, probe mechanisms behind observed phenomena and much more.

Is there a politicization of atmospheric science?

Yes, I would say so, with a familiar specific example being the greenhouse warming problem. As climate science began to have stronger and more immediate policy implications, and as a more earnest policy debate began about whether to attempt to control greenhouse gas emissions through governmental actions, the science community in turn began to experience increased interaction with the public, policy arena, and vested interest groups (e.g., private industry). Not surprisingly, these interactions have become more vigorous, politically charged, and at times confrontational—perhaps more confrontational than many climate scientists were expecting. Humans are still in the relatively early stages of experiencing the greenhouse gas-induced changes, and of reducing or quantifying the uncertainties about what future climate changes may occur. We're still in the very early stages in terms of adaptation responses and mitigation. Therefore, I expect these interactions between scientists and society will grow and evolve over the coming decades in even more interesting ways. That is, climate science will continue to interact strongly with the political sphere for a long time to come due to the very nature of the problems that we face and their linkage to society in terms of both impacts and mitigation efforts. The days where climate scientists could work in relative isolation from the political implications of their work have now come and gone, especially for those scientists who either take on problems of great interest to policymakers or who take a special interest in communication between climate scientists and the society at large.

What constitutes "good" science?

Knutson at Shenandoah in 1978.

Good science truly advances understanding, perhaps not by providing proof, but by providing evidence and objective assessment of the evidence that allows for more informed understanding of a particular issue or physical phenomenon. Good science can be done in pursuit of problems that either may or may not have strong implications for society (i.e., knowledge for knowledge sake vs more practical problem areas). I prefer working on those areas which I see as having strong societal implications, such as future climate change and understanding and predicting the anthropogenic and natural influences on climate. For these areas, the importance of the communication of science to the broader science, policymaking, and public arenas should be recognized. In addition to conducting and reporting on science activity leading to improved understanding, it is the responsibility of scientists working in these more societally focused areas to communicate in such a way that the main points and uncertainties are understood, but without stretching statements (in either direction) beyond what is scientifically justified.

What is the subjective element in scientific practice? Does culture matter? What is the role of instinct?

I do see there being a subjective element with instinct playing a role. For instance, consider that a typical scientist will live ~80 yr and spend ~40 yr working during a typical scientific career. This means that your time is a limited resource. Deciding how to spend this limited resource requires choices to be made: What problem should one undertake? What is the best approach to the problem? Are there some approaches that, while intellectually more satisfying, are likely to be either too difficult or time-consuming to realistically pursue, given one's access to resources. How should one divide one's time between research and other related activities such as teaching/mentoring/communicating/service to the community, etc.? When choosing science problems to work on, there may be naturally a tension between exploring 'off-beat' hypotheses in pursuit of a big breakthrough vs maintaining focus and discipline that can lead to incremental increases in knowledge. In these and other areas, I think instinct and subjective judgment are very useful for guiding one's choices.

How did you come into the field of atmospheric sciences?

I was intrigued by the possibility of studying global climate change and greenhouse warming for quite a few years before I actually took the plunge into atmospheric sciences. For me studying atmospheric sciences was in fact mainly a vehicle I would use to study the global warming problem. I first became aware of the greenhouse warming issue as a teenager growing up in the mountains of Virginia, as I recall, reading a newspaper article in The Washington Post on one of Suki Manabe's early CO2 sensitivity studies. The thought of working on something as important as global climate change--something that could affect the entire planet--was really exciting. Growing up the son of a geologist, I already had a keen interest in the natural world and some conception of what a dramatic role climate change could play in shaping the world through ice ages and the like.

Although I wasn't prepared to take the plunge into climate science right at that moment, this remained in the back of my mind as I began my undergraduate studies in computer science at

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Announcement

STUDENTS: At the Atmospheric Sciences and Global Environmental Change banquet, Tuesday night, December 6, we will show slides featuring student presentations at the Fall Meeting. For all the students attending, please download this PowerPoint slide, http://www.agu.org/sections/atmos/YourNameAGUbanquet2011.ppt , fill in your information, change the file name to add your name, and email it to Alan Robock at robock@envsci.rutgers.edu by the end of the day on Friday, December 2, and we will show your slide during the banquet. Even if you will have already given your talk or poster by Tuesday night, please send a slide so we can tell people about your work. We look forward to seeing you all then.

the University of Virginia. There I had an opportunity to elect a minor course of study, and after looking through the course catalog, I settled on Environmental Sciences. One particularly influential course I took was Bruce Hayden's Holocene Climates course, which was fun and just fascinating to me. Bruce covered greenhouse warming briefly in the course as well as all sorts of interesting paleoclimate topics. I told Bruce I wanted to pursue the topic of climate change in graduate school and he gave me a list of programs to consider. Among those, I eventually chose the University of Wisconsin and John Kutzbach's group, where climate change was studied within an atmospheric sciences department. That's actually how I actually ended up in the field of atmospheric sciences. Although I started out doing my graduate research and an initial stint at GFDL working on the Madden-Julian Oscillations-- and even had a brief period away from science research, where I pursued graduate studies in management-- eventually I settled back on the greenhouse warming problem as my main career focus. As it turned out, I was fortunate enough to secure a position in Suki Manabe's group in 1990 and enjoyed several years of work with Suki before he retired from GFDL.

What would your advice be for young scientists coming now and the coming years into the field of atmospheric sciences?

Let me answer this question rephrased as "into the field of global climate change". I think that climate scientists have a special role to play in society now and going forward. The role is to use the power of the scientific method to inform decision-making and promote good stewardship of the planet. If climate science, over the long term, is to maintain credibility as a scientific endeavor and be a trusted source to inform decisions, this means above all that we must present highest quality science in as fair and clear a manner as possible, neither shying away from presenting findings that may make some in our audience (i.e., the world) uncomfortable, nor "stretching the truth" to attain some objective. Perhaps the advice of Bertrand Russell, from a 1959 BBC interview, suits the question best:

"When you are studying any matter, or considering any philosophy, ask yourself only: what are the facts and what is the truth that the facts bear out. Never let yourself be diverted, either by what you wish to believe or by what you think would have beneficent social effects if it were believed. But look only and solely at what are the facts."

Source:
http://www.youtube.com/watch?v=g3jnEqXhDNI&feature=player_embedded#!

The opinions expressed in this interview do not necessarily represents those of the reviewer or the AGU.

Extreme rainfall frequency in the Atlanta metropolitan area: An analysis of September 2009

Laura Belanger

National Weather Service, Peachtree City, Georgia

Extreme rainfall across north Georgia during

Atlanta Floods (September 2009): Downtown Flooding of I85/75 Connector (top, photo from Glenn Dyke, top). Six Flags Over Georgia (bottom, photo from MSNBC).

September 18-23, 2009 resulted in historic, catastrophic flooding. The most intense rainfall occurred in a 24-period from September 20-21, with amounts exceeding 10 inches in a large area of the western Atlanta metropolitan. Ten people perished in Georgia as a direct result of the flooding, and damage amounted to more than $300 million. To capture the statistical significance of this extreme rainfall event, a regional frequency analysis was performed using observed rainfall data from more than 30 state-wide locations to develop theoretical extreme value distributions via L-moments. This analysis supports the initial post-event conclusion that the 24-hour rainfall amounts during September 20-21, 2009 were in excess of a 10,000-year rainfall event.

Event Background

The September 20-21, 2009 extreme rainfall event fell within a prolonged rainy period for the Southeastern United States. Moisture from both the Atlantic Ocean and Gulf of Mexico contributed to a saturated atmosphere as a stalled upper-level low pressure system over the lower Mississippi River Valley began to lift out on September 20, 2009. A series of mid and upper-level disturbances moved over the area, providing a focus for shower and thunderstorm development (NOAA 2010). Precipitable Water (PW) values exceeded 2 inches at the peak of the event – more than two standard deviations above normal.[1] The combination of anomalous moisture and a strong low-level jet provided the ingredients for torrential downpours and training of storm cells over a particular area. In a 24-hour period, the western Atlanta Metropolitan area saw widespread 10-20 inches of rain, with isolated larger amounts. The maximum 24-hour rainfall total of 21.03 inches was reported at the Douglas County Water and Sewer Authority just west of Atlanta in Douglasville, Georgia (NOAA 2010).

Initial Frequency Analysis

The floods resulting from the extreme precipitation amounts were unprecedented in some cases, with historic and catastrophic impacts. Eleven people perished as a direct result of the event – ten of those in Georgia. In total, more than $300 million in property damage was reported (NOAA 2010). Following the event, a demand for the statistical significance of the event arose from Emergency Management Agencies, media, and citizens. A quick analysis was performed using a gamma distribution fit to the top 30, 24-hour rainfall events for the Hartsfield Jackson Atlanta International Airport observation site (KATL).[2]

The gamma distribution method achieved an unreasonably low return frequency for the 21.03 inch maximum observation, so the process was reproduced using 10 and 12 inches as a guideline. As a result, the Public Information Statement published by National Weather Service, Peachtree City stated that the chances of this event occurring "are less than one hundredth of one percent, or a 10,000-year event."

The National Service Assessment conducted by the National Weather Service highlighted the necessity for a more robust analysis of the September 2009 event in order to convey more statistically sound information. Rather than analyzing a single point using a limited data set, a regional frequency analysis was preferred in which data from several sites are used to estimate the frequency distribution at each site (Hosking 1990).

Regional Frequency Analysis

Previous studies indicate that for a regional frequency analysis, it is common and appropriate to comprise an Annual Maximum Series (AMS) and a Partial Duration Series (PDS) from the selection observed data for each site in the defined region. The AMS consists of the largest 24-hour rainfall total of each year for the length of the observed record. The PDS uses the highest N events where N is

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