Climate and Hydrologic Research

Interview with Chris Milly
July 18, 2007

BARRY REICHENBAUGH: This is Barry Reichenbaugh with the NOAA Research Communications Office. I'm with Chris Milly of USGS here at the Princeton, New Jersey, Geophysical Fluid Dynamics Laboratory. Chris, welcome.

I'm wondering if you could start us off here by explaining just what is a US Geological Survey employee doing here at GFDL?

CHRIS MILLY: Well, sure. GFDL is a NOAA lab and NOAA is responsible for looking at oceans and atmospheres. One of the things GFDL does is try to understand climate, and the climate system includes the oceans and the atmospheres but also the land. Land is where all the water is that we use and land is coupled to the oceans and the atmospheres.

So, although oceanographers and atmospheric scientists have a fair understanding of how the land interact with them, they felt it would be useful to have a little more expertise from the land side, from a hydrologist, someone who studies water on the land. And, that's why some 20 years ago, the USGS and NOAA GFDL got together and said that they thought there should be some researchers working together on this problem.

BARRY REICHENBAUGH: Could you maybe offer an example to clarify just what you mean by the human interaction piece of this?

CHRIS MILLY: Yeah, of course. Much of how we as humans experience a climate system is coming through the fact that water is part of the climate system. We, of course, our bodies are mostly water. We keep our bodies hydrated by drinking water. We keep our bodies clean by washing in water. We nourish ourselves by eating food that's been produced with one of the main inputs being water. We have developed societies. We have manufactured products whose manufacture relies on processing using water and relies on energy whose production in turn consumes large amounts of water.

In fact, we use water directly in hydroelectric plants to generate electricity. We transport our products through the rivers, over water. The fish and fowl that we enjoy in nature rely in turn on water.

So, these are the things that make the connection, really, between the climate system and human society.

BARRY REICHENBAUGH: Okay. Here is where I think I want to ask about water availability. Or, do you think we've covered that?

CHRIS MILLY: Yeah -- so -- I mean, we talk about how, you know, how -- I mean, when I talk about water, that's kind of a vague thing. I mean, what specifically? There's precipitation, there's stream flow, there's soil moisture, there's groundwater, there are glaciers, there are lakes. And so, it's a multidimensional kind of thing. How do we, you know, when we do science, we want measurements so that we can be quantitative and we can relate our models and our theories to the real world and we can test models and theories and so forth.

Well, the measurement that a lot of us hydrologists use is that of stream flow. How much water is flowing past a given point on a river or a stream as a function of time? This is a measurement that can be made very well, has been made for many decades over many river basins in the world. It's a quantity that integrates over large areas upstream of the point where one is measuring.

So, we can get an idea what's going on in the heartland of the US simply by monitoring the flow of the Mississippi at Vicksburg over time.

This is something that then allows us to sort of link in observations to the modeling activities such as those going on here at GFDL. GFDL models produce runoff from the land. We route it. We construct models of the water system as part of the GFDL climate modeling efforts. And, as part of that, we route the runoff from climate models down the rivers and we generate synthetic stream flows of the Mississippi at Vicksburg and we can compare those to the actual observed stream flows.

So, a lot of the work we do is in trying to look at how realistic the climate models are with respect to water. And, relate climate model projections to projections of water availability. And so, the stream flow, again, it plays a really important role there because it is a very direct measure of water availability. And, much of our water use comes out of flowing rivers.

BARRY REICHENBAUGH: Can you tell me a little bit about how you're using the GFDL climate model in the research you're involved with?

CHRIS MILLY: Of course. GFDL scientists who model the global climate system which -- and, part of the global climate system is the global water cycle. So, we can look at what's going on in the climate models here and relate that to what's going on that we know of from real-world observations and see how they agree, see where they disagree, where there's room to improve on the model, and where the model can give us some idea about what's going to happen in the future.

We conducted a study where we looked at the GFDL model's ability to say how stream flow ought to have changed during the course of the 20th century. We compared that to observations of stream flow trends around the world and showed a degree of correspondence that is actually much too high to be explained as a natural coincidence but rather indicates skill of the GFDL climate model.

And, we built on that to look forward in the future and say, well, the model seems to have some credibility based on its track record. What does it say about the future of stream flow runoff, water availability?

BARRY REICHENBAUGH: Can you get a little bit into the results of what you're finding, the projections?

CHRIS MILLY: Yeah. The projections for changes in water availability going into the current century, say by the middle of the 21st century, are, of course, like many other things with climate projections, highly uncertain. However, there are some areas of strong agreement among various models including the GFDL model on which areas of the world may be expected to be coming wetter or drier with respect to say amount of stream flow expected in a year.

There are some areas where the models project that less rainfall will be falling, more evaporation will be occurring and, as a result, the bottom line, the stream flow, the runoff, will be reduced.

These are areas like southwestern North America, the Colorado River Basin, for example. In Europe and

Africa, the Mediterranean region that would be northern Africa, the Middle East, and southern Europe -- all projected to have a sustained period of drying during the 21st century.

Southern Africa is another such region where the majority of models agree on a rather robust signal of drying. There are also regions that are expected to receive more water, generally these are regions where there's no shortage of water historically in the first place; regions like northern North America, that's Canada, Alaska, Siberia, all of northern Eurasia, and some tropical regions.

BARRY REICHENBAUGH: Okay. Let's shift over to a different but related topic. And, I'm wondering if you could just talk a little bit about how you became a scientist, what got you interested in science?

CHRIS MILLY: Yeah. How did I become a scientist? I got interested in things quantitative in my early years in school simply because it was interesting. Math and science courses were interesting. I was a child of, sort of, the 60s and 70s so there was, sort of, a natural interest in the environment.

And, when I went to college, I just sought those areas where I could kind of merge this sort of aptitude and interest in math with the kind of interest in natural sciences, Earth sciences, environmental sciences.

And, I ended up in civil engineering, which is where hydrology traditionally has been taught and studied. Hydrology, even though it's one of the Earth science, because it is such a practical one, has ended up being taught and studied by engineering rather than science faculty.

So, I went into civil engineering. I got a couple of degrees in civil engineering, studying water. And then, I went into research and I somehow, just the luck of nature, I stumbled into the US Geological Survey, which is a wonderful place to do research.

And then, the second big stroke of luck was getting into this sort of collaboration with GFDL. I'm really kind of going off from your question here. It's a good question.

BARRY REICHENBAUGH: You were just anticipating my follow up question.

CHRIS MILLY: Yeah.

BARRY REICHENBAUGH: I guess I'd like to end with just, you know, your thoughts on what you say to someone who is interested in pursuing a career in science.

CHRIS MILLY: I would say to one who is interested in pursuing science to go for it. It's an area where our country has a very surprisingly small number of students entering the field. And, if the student feels some interest in it, it's a real opportunity because it's under stocked field -- what is it? It's an understaffed field. It's a wonderful life doing research if you enjoy it. And, I think it's a very useful sort of profession that they can return a lot to people in its benefits.

BARRY REICHENBAUGH: Chris, thanks for joining us.

CHRIS MILLY: Okay, Barry. Thanks very much.