Ocean Thinking: From Skin to Deep_ Q & A Transcription

Website for this webinar: From Skin to Deep

Video:

Note: Bold text in the transcript indicates questions from the audience. Non-bold text is a response from Steve or the moderators.

01:19:28

Question: The paths of these floats are so complicated. How do you make sure that any of those floats go to where you want them to go?

Steve: Well, they don't go where you want them to go. They go where they want to go. We're not really concerned as to where they go as to what the profiles are. The other thing is that while these floats are measuring the upper ocean, they're actually spending most of their time at a 1000 m. The flow at a 1000 m. is much weaker than it is at the sea surface. They tend to stick around longer than you might think at a 1000 m. They won't stay in one place. In the time of their life—6 or 7 years—they won't generally cross an ocean basin. They'll stay relatively close, to within a few hundred km., oftentimes to where they were deployed. That's not a problem.

Now if you want to study something like the Gulf Stream or the Antarctic Circumpolar Current, you can get into trouble there, because you can have a float cross the whole ocean over its lifetime. But most of the places like the SPURS region that we might want to study, dispersion is not as big a problem as you might think. If you really want to have something measure exactly where you want it to, you might want to use a glider instead of the float.

Carla: Gliders would be able to move against some kind of ocean current.

Steve: As long as it's not too strong. But they are much more expensive and much more labor intensive than floats. That's the reason we try to stay with floats whenever we can.

Question: You may have mentioned this in your talk, but where were the new types of floats developed? Who developed those?

Steve: The floats and sensors are built by Sea-Bird Electronics which is a well-known oceanographic instrumentation company in the Seattle area. We developed those kind of jointly with Sea-Bird. We came up with the idea that said here is the capability that we need. Can you do this? Sea-Bird is not very far away from us at the University of Washington. They're just a few miles away. We talk to them often. They took our idea of what we needed and started building prototypes. We went back and forth with these prototypes until we kind of converged on something that was useful, and that's what we are using now.

Question: How were those 3 km. salinity measurements collected? Do the floats go that deep?

Steve: No. Those are all based on ships. If you go back 50 years probably there were very few useful measurements at 3 km. In the 1980s and 1990s there was something called the World Ocean Circulation

Experiment (WOCE) that sent ships out and covered the world on long lines—a one-time survey. A lot of this data comes from WOCE. Most of that data probably is from the 1980s and 1990s. The quality is very good. It's just that you could never get enough ships out there to do the kind of thing we are able to do in Argo right now.

Question: How would an accelerated water cycle affect all of us?

Steve: For one thing—I forget the exact numbers here—there's something like a doubling. Every time you increase the humidity in the atmosphere (the water content of the atmosphere) you increase the vapor pressure. Let's put vapor pressure a different way. If you put enough water into the atmosphere [?via] an accelerated water cycle . . . water is a greenhouse gas, that's how it will affect all of us. It affects us the same way as putting more CO2 into the atmosphere. Water is a greenhouse gas. In places where the water content of the atmosphere is going up, you can expect similar things to appear as you might expect from increased CO2. Most of what we know about increased CO2 comes from climate models. People argue about how good those are sometimes.

Maybe you could argue the same thing about water vapor. The point is that we know that water vapor is a greenhouse gas. If you increase the water vapor, it's going to potentially have a climate effect. The whole idea of the thermodynamics of the atmosphere depends on the water cycle. We tend to think about warming, but water vapor, humidity, and CO2, and temperature all affect the thermodynamics of the atmosphere. So whenever you change any of these things, you're potentially saying the climate is going to change. Most of the emphasis people think about is warming, but the hydrological cycle is just as important. It's changing in a very big way right now. You can expect that may have an important climate impact.

Question: What is the chance that some kind of decreased amount of salinity in the North Atlantic will push the Gulf Stream south?

Steve: That's a good question. If any of you have seen the 2004 movie *The Day after Tomorrow* you know something about that. That's science fiction of course, but it depicts something just like that. It's been thought that if you lowered the salinity in the North Atlantic you would shut off the deep convection at high latitudes, and it may change the position of the Gulf Stream in the same idea. The whole deep circulation of the world ocean is somehow connected to the North Atlantic. We know that. If you start messing around with the surface salinity you could change convection and lots of things.

My own thoughts about that are if you look back at the paleo record, amazingly enough, you can look back and see the position of the Gulf Stream during the last ice age. You can do that because biologically there are certain species of zooplankton associated with the Gulf Stream. You can look at the sediment records to see where those existed in the last ice age, and they didn't really change their position that much. The chances of the Gulf Stream changing its position a great deal in any kind of climate scenario that people are talking about I don't think is very good.

If you'd like to know why, I guess we can linger on that for a moment. What determines the position of the Gulf Stream? Really 3 things: the large scale winds, the rotation of the earth, and friction along the

side of the ocean, like along the Atlantic Coast and along the coast of Europe. None of those things are likely to change a great deal if we change the salinity of the ocean. If you look at these things in the last ice age, they didn't change that much. All kinds of things may happen in a climate change scenario, but the Gulf Stream is still going to be there, and it may not change its position all that much in spite of what science fiction movies might tell you.

Question: Is there an official way for classes to adopt an Argo float?

Steve: This is something that has been done in a number of countries. I don't know how much of it has been done in the U.S. There have been other countries that have done this. My suggestion there would be to look at the Argo web site that is at Scripps Institute of Oceanography at sio-argo.ucsd.edu. You can send a question to the webmaster at that web site, and they can answer your question, because they have been the ones who have developed the adopt a float program in other places.

Question: Did you go on any of those SPURS cruises?

Steve: I did not. My graduate student Jesse Anderson went on the first two. The third one is out recovering instruments right now. I've spent several years of my life at sea, and I don't do too much of that anymore. It's always a great thing for students to do that. Jesse is very capable and did a great job out there. It's a great way to get some really basic oceanography. You can learn all you want in classes, but until you actually go to sea and do it, that's the real learning place. So I'm always happy to have students go if there is room for them.

Question: What happens to the floats that were deployed as part of SPURS now? Are there any more plans to deploy any of the advanced ones after this?

Steve: The SPURS floats have been out now for about a year. As I mentioned they can last 7 years. So they're going to keep on going for 6 more years. They may or may not be around the SPURS area 6 years from now, but they are going to keep on providing data as part of the Argo array for another 6 years. They'll probably stay somewhere around the eastern Atlantic or the subtropical Atlantic. There's always room for more observations there. Those have a long life ahead of them mostly.

Do we plan to do more of this? Well, we still have a few floats in our inventory that were not deployed in SPURS. I think we have 6 or 7 more. We're likely to put them some place, most likely the eastern tropical Pacific. There are already plans for something called SPURS II, which would be another SPURS like experiment, but in a different place. SPURS I was chosen because the evaporation is very high there. SPURS II is likely to be chosen at a place where the precipitation is very high. The eastern tropical Pacific is an area that is favorable to that. So we may save those floats and use them in SPURS II. The answer is that as long as Aquarius goes up and there's interest in salinity, this kind of work is likely going to continue.