Advancements in Sea Surface Salinity Research Transcription

OK. So we talked about the title of this is skin to deep. So far it's mostly about deep; let's talk about skin for a moment. Now this is the kind of the climatological average of surface salinity in the world ocean. You can see that there is a definite pattern here. High latitudes, in the Pacific, in the Arctic, in the Antarctic are blue here; they tend to be low.

Mid-latitudes you can see in every one of the oceans there, these circular features of high salinity, especially in the Atlantic, north and south Atlantic, but you can see the same thing in the Pacific there around Hawaii. It's not as pronounced, but it's there, the yellow feature. You can see it in the South Pacific; you can see it in the Indian Ocean as well. This is the subtropical gyres; the salinity tends to be very high in these areas because the evaporation exceeds precipitation. It just sucks the water right out via evaporation and increases the salinity.

In the Atlantic for example if you look at the area there of high salinity that is midway between the U.S. and the coast of Africa. Well the wind in that area is off the continent of Africa; that's the Sahara Desert. That wind tends to be warm and it's very dry. When it comes in contact with the ocean, that's a perfect match for large evaporation. That's the reason we get that very high contour there. Some of those salinities are almost as high as 38 Salinity Units which is as high as you'll find almost anywhere in the world ocean. It's because of that hot dry wind coming off of Africa, coming in from the desert that causes so much evaporation out there in the middle of the Atlantic.

OK. Now all of our data historically about salinity in the ocean has been collected from ships, and more recently things like Argo floats. Temperature was originally collected from ships, but since about the mid-1970s we had satellites that could measure the temperature of the ocean surface and do a pretty good job of it. The advantage of the satellites is they get a repeat orbit every few days or a week, so that means you can get a complete global map of temperature every few days or a week, which things you could never get with ship-based or float-based measurements. The disadvantage is that the satellites can only see the real ocean surface, the upper centimeter or two.

What you're seeing now is a map of the salinity of the sea surface collected from Aquarius satellite which NASA launched in June, 2011. Now we have a way to measure salinity from space. The advantage again is we get a complete global map, a new map every 7 days. It is only the salinity right at the sea surface, the upper few centimeters. The accuracy is not as good as you might be able to get from an Argo float, but the signal at the sea surface is pretty large, and even if there's a little bit more noise in the measurement the signal is large enough that this is still a very useful thing.

You can see here from the Aquarius maps—this was done I believe late last year (one month from a map late last year)—you see the same kind of things we saw in the previous slide; you saw the climatology. You can see in the Atlantic that area of red, that's the subtropics of the area I mentioned with the winds off of Africa. You can see its mirror image in the South Atlantic. You can see in the South Pacific there is an area of red; it's a little bit smaller. You can see the North Pacific, it's green there, but it's still saltier than anything else around. You can also see west of Australia there is an area there where the salinity is a bit higher that is analogous to these other things. We now have Aquarius that can do a lot of these things from space. We can get global coverage which is great for looking at the large scale ocean and thinking about climate problems.

This is just a picture of what the Aquarius satellite looks like; it's got antennas and a lot of other things on there. You might say how do you get salinity from space? It's almost like magic. The way it works is the surface of the ocean is emitting thermal energy across the entire electromagnetic spectrum, but in the microwave range, or in the gigahertz range—sorry—the amount of energy that's emitted is magically proportional to salinity.

So this satellite is designed to measure the amount of the thermal energy emitted in that band very precisely, and then to convert that to a salinity number. Doing that we can get salinity accurate to about a tenth of one of these salinity units, which is not as good as Argo, but it is very good for looking at this surface ocean. As time goes on this technique is going to be refined and get even better.

The Aquarius satellite is a U.S. satellite. There's also a European satellite called SMOS, Soil Moisture and Ocean Salinity satellite. SMOS does something similar to Aquarius, but SMOS is also equipped to look at soil moisture. Most of the time, 70% of the time, the satellite is over the ocean, but 30% of the time it's over the land, and when it is over the land some of the same techniques can be used to measure how much moisture there is contained in the soil at the surface of the land. We're not really using that here, but there is plenty of people that are interested in that and are getting some interesting and new results out of it.