Salinity Processes in the Upper Ocean Regional Study
NASA Jet Propulsion Laboratory
Video Transcripts

Video: General Overview of Instruments
URL: https://vimeo.com/59301736 [08:24]

Description

Dr. David Fratantoni summarizes how data will be collected during the first SPURS cruise.

Transcript

Flipping over to the next slide here, Image 9 which shows a photograph of the research vessel *Knorr*. This is the platform from which we'll be conducting our experiments on this trip leaving about 24 hours from now.

Oceanographers have historically gone to sea on ships with the purpose of making measurements from the ship itself. During the SPURS experiment the ship is actually going to serve two purposes. We will make measurements directly from the ship and from instruments dangling from the ship on long wires to understand what's been happening beneath the surface. The *Knorr* will also be used to deploy a relatively smart sensor web made up of a variety of different types of platforms and autonomous vehicles, some of them simply drifting through the ocean, some of them fairly complex robots whose trajectory we can control. This sensor web will be used in real time to telemeter information about ocean conditions and meteorological conditions back to shore where that data will be integrated with numerical models to confirm and improve our understanding of ocean physics.

From the ship itself we'll be deploying several different types of instrument packages. One of the principal ones used on most oceanographic voyages is called the CTD rosette. CTD stands for conductivity, temperature and depth. Salinity is highly related to conductivity in the ocean. Fresh water does not conduct electricity well. As the salinity or the amount of salt in solution in fresh water increases the conductivity increases. So we use an electronic sensor called a CTD to infer the salinity of the ocean. With the CTD rosette we can actually capture discrete water samples which can be analyzed in a laboratory to confirm our electronic measurements. We have a neat device called an UnderwayCTD which will allow the collection of salinity profiles through the water column to be obtained while the ship is moving at relatively high speed. We'll also be using a device called a microstructure profiler which will collect information on a very small scale (centimeter scale in variations of temperature and salinity in the upper ocean).

Moving on to the next Slide #10. One of the initial goals the first few days that we are out on the *Knorr* will be to deploy an array of three oceanographic moorings. Each of these moorings has a surface buoy from which we can measure meteorological parameters to measure things like wind speed, solar radiation, humidity - indications that will tell us how the ocean is interacting with the atmosphere. In addition all of these moorings have subsurface instruments either in the form of discrete instruments connected to a long mooring wire such as the WHOI surface flux mooring on the left hand side of this slide. Or in the case of the NOAA Pacific Marine Environmental Laboratory's Prawler moorings, a single small weight-powered sort of passive profiling device which will carry a single sensor up and down a wire repeatedly. All three of these moorings will be in the water for a 1-year period collecting information in the central part of the SPURS study area.

On the next slide I show several free drifting instruments which will be deployed from *Knorr*. On the upper left is a satellite tracked surface drifter which will tell us things about the large scale ocean currents and the eddy field. Many of these surface drifters will also carry salinity sensors. It is sort of a novel use of these devices. On the right hand side on the top a profiling float which are used widely in the global ocean right now, particularly as part of the global ARGO program. It's sort of an oceanographic analog to the terrestrial Radiosonde network measuring the atmosphere and for measuring the ocean. There are about 3,000 of these globally. For SPURS a total of 26 of these will be deployed on this cruise equipped with two CTD sensors for really high resolution measurements near the ocean surface, as well as some novel acoustic sensors for measuring rainfall directly and surface wind by listening to the ocean. Finally on the lower part of this slide there will be two highly specialized Lagrangian drifters. These are smart sensors which drift freely with the ocean currents in all three dimensions. So they can control their buoyancy very carefully to allow them to move not just horizontally with the currents, but also up and down. Vertical motion in the ocean is one of the very hardest things we have to measure. So this is an interesting tool to apply in this setting.

I'm moving on to Image 12. We have four different types of robotic autonomous underwater vehicles to be used on this trip. Three of them are actually used underwater and are shown on this slide. Starting with the one on the upper right, the Iver 2 or Eco-Mapper vehicle. This is very similar to a small submarine. This is a torpedo shaped propeller driven vehicle. Energy is stored onboard in the form of batteries driving the vehicle forward at three or four knots. It can do so for three or four hours while making relatively high resolution measurements of temperature, salinity and other water properties. This will be used for studies on scales of a few kilometers down to a few tens of meters in the ocean. It's a relatively small scale measurement taking only a few hours.

In contrast the two gliders shown, the Slocum glider on the left and the Seaglider on the bottom right are very high endurance vehicles. They are buoyancy driven.

They have no external moving parts. They profile up and down through the ocean for days, weeks and months at a time. The Slocum gliders on this expedition will be carrying some microstructure sensors to measure some very fine scale variations in salinity and temperature. They will remain in the water for several weeks while *Knorr* is in the SPURS study region. Then they will be recovered as we leave the area. On the other hand, three of these Seagliders will be deployed during the beginning of our occupation of the SPURS region. They will remain in the water for six months. We'll revisit this area on a different vessel six months from now. Those Seagliders will be recovered. Three more will be returned to the ocean in their place. So we'll have a continuous 1-year record of temperature and salinity over about a 100 to 150 kilometer square in the middle of the Atlantic from these devices. The advantage of a high endurance autonomous platform like the Seaglider is that it allows us to really magnify what we can do from a research vessel. Humans are not really able to stay on site in the middle of the ocean for a year, but these robots can do that work for us.

Finally, one fourth class of autonomous vehicles (Autonomous Surface Vehicles) is called a wave glider. It's relatively new. We'll be deploying three of these, again in a 100 to 150 kilometer region surrounding a SPURS moor array. The wave glider is an environmentally powered vehicle in that surface waves provide all of the energy for forward propulsion. All the electronics and sensors and communications needs on board are powered by batteries that are recharged by solar cells. Theoretically these vehicles could last a very long time in the ocean. We expect them to stay out in the SPURS region operating all by themselves for about a year. We'll be able to control them from home, and update their course. Every now and then they give us a call on a satellite phone about every five minutes while measuring temperature and salinity near the ocean surface.

The information from all of these varied sensors and this network of measurements both from very small scales to very large scales are fed back to shore where it is integrated into a coherent picture of what the ocean is doing on scales of the entire Atlantic down to centimeter scales.