How Do RAFOS Floats Work?

By Amy Bower, Physical Oceanographer

Woods Hole Oceanographic Institution

One of the most important ways to measure ocean currents is to put something in the ocean that drifts along with the currents and see where it goes. Anyone can do this, using a "message in a bottle" dropped from a boat or released at a beach. The bottle with the message inside drifts around and around until it washes up on a beach. If someone finds the bottle on the beach, the message inside instructs the finder to contact the person who dropped the bottle in the ocean and let them know where it was found. This provides information on where the bottle started and where it ended up, but not how it got there.

Oceanographers use more sophisticated equipment to track the entire path of ocean currents. One of these is called a surface drifter. It does just what its name implies: it drifts at the surface of the ocean, but in this case, the drifting buoy communicates with satellites overhead to measure its position every few hours, just like a GPS can be used to track where you are if you have a smart phone. Thousands of these drifting buoys have been released all over the world to measure surface currents.

But how do oceanographers measure currents below the sea surface? Satellites cannot be used to track drifting buoys underwater. So instead they use sound to track the buoys. Sound travels very quickly and efficiently over long distances underwater—whales use this to communicate with each other.

How is sound used to track underwater drifting buoys? First, oceanographers put several several sound beacons in the region where they want to measure currents. They can be hundreds to thousands of miles apart. Each sound beacon is anchored to the sea floor so it won't move. Then oceanographers release many small buoys—called RAFOS floats--that are constructed to sink down to a specific depth in the ocean where there are interesting currents to measure. These buoys start drifting with those currents, and while they are drifting, they listen for signals from the sound beacons and record the time they hear each beacon. They keep recording that data for two years and store it in a tiny computer inside. After two years is up, the buoys drop a weight and pop up to the sea surface to transmit all the data they have collected. Using the speed of sound in water, and the time it takes for the sound to travel from each beacon to each float, oceanographers can calculate the distance between each float and the beacons, and triangulate the exact location of the float every day. All these calculations, and the reconstruction of the buoy trajectories, is done after the buoys have popped to the sea surface and transmitted their data. So while the buoys are underwater, oceanographers don't know where they are, but after two years, they can draw very precise trajectories of each buoy. By analyzing the trajectories of many such buoys, they can make maps of currents far below the sea surface.