UNIVERSITY of WASHINGTON
Applied Physics Laboratory

North Atlantic Bloom Experiment

Ocean eddies drive early onset of springtime phytoplankton blooms

Narrator: This video feature is based on the paper published in the 6 July 2012 issue of ***Science/AAAS***, "Eddy-driven stratification initiates North Atlantic spring phytoplankton blooms," by Amala Mahadevan, Eric, D'Asaro, Craig Lee, and Mary Jane Perry.

Every spring the North Atlantic blooms. A wave of microscopic plant growth greens the ocean surface from Bermuda north to the edge of the Arctic ice.

Eric D'Asaro: The plants grow. It's a big bloom of algae and phytoplankton. It's a major event in the Earth's biogeochemistry. It pulls in a lot of carbon from the atmosphere and feeds the fisheries of the North Atlantic to a large degree.

Narrator: Through photosynthesis phytoplankton produce abouth half of the Earth's oxygen. Recent findings detailed in *Science* tell of new insights to how the North Atlantic bloom begins. In particular, how the phytoplankton in the ocean get the sunlight they need to grow. The key is mixing: deep in the winter and shallow in the spring.

D'Asaro: When the phytoplankton are closer to the surface there's more light and they grow. That had been the traditional way of thinking about it. What we discovered was that there are more complicated things going on.

Narrator: Namely, complex shifts of ocean layers driven by eddies.

D'Asaro: This had been discovered theoretically in computer models over the past decade. You can have a complicated slipping of the heavy water under the light water, where blobs of heavy water slide down and blobs of light water move over. Eddies are mixing the heavy water under and mixing the light water up and that makes a stratification.

Narrator: In recent years the North Atlantic bloom has come under the most intense scientific scrutiny yet thanks to the deployment of new robotic platforms.

Craig Lee: It has really revolutionized the way we do oceanography. These are the floats, gliders, and drifters that are capable of staying out for very long periods of time and making measurements of physical, biological, and chemical quantities. Pretty much everything you can measure with light, electricity, or sound can be measured by these robots.

Narrator: Over a span of months extensive measurements by these robot explorers helped confirm the eddy phenomenon.

D'Asaro: If you think about a deep mixed layer in the North Atlantic Ocean, it is colder to the north and warmer to the south. Even though the water may be well-mixed in the vertical, it's not so well-mixed in the horizontal. There is heavy water here and light water here. You can think of it as a set of lines and what can happen is the heavy water can slip under the light water. So you start out with uniform water, then it slips, and then there is light water over heavy water, which is a stratification. That limits the depth of mixing.

It's a combined physical and biological effect. Different physics means different biology. And that's the essential message of the paper. There's a new physical mechanism, in which eddies take horizontal density gradients and convert them to vertical density gradients that causes a stratification, that in turn causes more sunlight to reach the phytoplankton, therefore they grow earlier. And that is what is initiating the North Atlantic bloom.

This is APL — The Applied Physics Laboratory at the University of Washington in Seattle.