A new way of thinking about ocean currents

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Kevin Speer has a "new paradigm" for describing how the world's oceans circulate—and with it he may help reshape science's understanding of the processes by which wind, water, sunlight and other factors interact and influence the planet's climate.

A Florida State University professor of oceanography with a passion for teaching, Speer and a colleague recently published a significant paper in the respected journal *Nature Geoscience*.

Working with John Marshall, an oceanography professor at the Massachusetts Institute of Technology, Speer reviewed—or essentially synthesized—vast amounts of previous data on ocean circulation (including their own earlier papers). As a result, they have created what Speer calls a new paradigm in the study of ocean currents on a global scale.

Here's how it works: Basically, the oceans, together with the atmosphere, rebalance heat on the planet. The sun shines on the Earth and heats up the tropics more than the poles. Near the poles, the ocean is cold and the water sinks; near the equator, the surface of the ocean is inviting and warm—and floats on top of the colder deep water.

So the question is this: Where does the water that goes down come back up?

Speer, Marshall and other oceanographers now believe that it comes back up in the Southern Ocean surrounding Antarctica—not as much in

the warm oceans as had been previously thought.

"We're not saying that nothing comes up in the rest of the World Ocean, just that the main thrust is in the Southern Ocean," Speer said. "To a large extent it's driven by the wind."

Very strong winds, to be precise.

In the rough waters around Antarctica, sailors call those winds the "Roaring Forties" and the "Furious Fifties." They originate near the Equator, where hot air rises and then is pushed toward the North and South poles by cooler air that rushes in to take its place.

The resulting "eddy-driven upwelling" in the Southern Ocean, as Speer characterizes it, may in fact describe the most important process to date that helps scientists understand the role of the ocean and climate.

Speer, who holds a doctorate in physical oceanography from the prestigious Massachusetts Institute of Technology/Woods Hole Oceanographic Institution Joint Program, spent years living in France as an oceanographic researcher for a French governmental agency. (Yes, he's fluent in French.)

Today, from his office on the Florida State campus, Speer serves as interim director of the Geophysical Fluid Dynamics Institute, a warren of intriguing laboratories just a few steps outside his door. It is there that Speer helps students and postdoctoral researchers learn about how climate works.

The laboratory's equipment includes a large, vintage rotating table designed nearly a half-century ago by the lab's founder, Florida State meteorology Professor Richard Pfeffer. (The device may be old, but it's one of the biggest and best in the United States, Speer says). Here

students can recreate the ocean's churning and study natural phenomena such as the Antarctic circumpolar current.

Speer and his students have been studying ocean currents thanks to $2.5 million in funding from a larger $10 million National Science Foundation grant that FSU shares with eight other universities and institutions worldwide. Research has included releasing tracers and floats into the ocean to study the mixing and spreading of currents.

One of Speer's graduate students, Druv Balwada, recently took part in a joint U.S.-United Kingdom research program to study ocean currents aboard a ship in the Southern Ocean. To view the cruise blog of the nearly three-month voyage, visit dimesuk3.blogspot.com/.

"Our students learn and help in various ways," Speer said. "They certainly help generate some interesting and lively oceanographic research.

Speer and Marshall's Nature Geoscience paper is titled "Closure of the Meridional Overturning Circulation Through Southern Ocean Upwelling."

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