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News Notes

Climate

Shifting winds shift warming trends?

Oceans serve as one of Earth's biggest carbon sinks, swallowing megatons of carbon dioxide every day by cycling huge water masses like a gigantic water mill. As Earth warms, these circulation patterns change, which, scientists have said will likely lead to a sharp decline in the oceans' ability to remove the greenhouse gas from the atmosphere in the future and thus lead to further warming. But a new study shows that just the opposite may be true for the cold Southern Ocean surrounding Antarctica, researchers reported in the Dec. 15 *Journal of Climate*.

Because the water channel around Antarctica is not blocked by continents, the strong Southern Hemisphere westerly winds push huge water masses unhindered around the continent, creating the Antarctic Circumpolar Current, the strongest current in the world. "That's why we have vigorous mixing in the Southern Ocean which brings water from as deep as 2.5 kilometers up to the surface," explains Joellen Russell, of the University of Arizona and formerly with the NOAA Geophysical Fluid Dynamics Laboratory (GFDL).

Carbon dioxide and heat are pulled out of the air when this cold, dense water from the depth of the ocean rises to the surface. Most global warming simulations show that as Earth warms, the oceans tend to separate into different layers with a warmer surface layer sitting atop a large column of colder water. Layers of water with different temperatures have different densities and do not mix easily, making it harder for wind to break through this stratification. Scientists had thought that as a result, the vigorous mixing in the Southern Ocean would cease, or least become much more shallow within the next 50 to 100 years, Russell says.

To find out mixing rates, Russell and colleagues at GFDL simulated two different scenarios that differed only in the position and the intensity of the strong Southern Hemisphere westerly winds. These winds have continuously migrated southward over the past three decades. One of their models provided a realistic simulation of this shift while the other positioned the winds farther north. In the version of the model that put the winds farther south, the team observed a much higher turnover rate of deep-ocean water, resulting in a higher uptake of carbon dioxide and heat.

The new model simulations indicate that a poleward shift in the Southern Hemisphere westerly winds could cause the Southern Ocean's carbon dioxide and heat uptake to increase by up to 20 percent. "This is a very surprising result," Russell says. The simulations also suggested that as Earth warms, the winds tend to intensify, preventing stratification in the Southern Ocean, she says.

"An absolute flurry of studies is emerging now, all trying to understand exactly what's

happening in the Southern Ocean. Many of these have focused on the southward migration of the winds," says Sarah Gille of the Scripps Institution of Oceanography. "But this study is quite unique in that it looks at the implications of this shift for the carbon dioxide and heat uptake of the ocean."

The study's results highlight the importance of positioning the Southern Hemisphere westerly winds in the correct locations when modeling climate change scenarios of the ocean, Gille adds. "If we are not getting the winds in the right locations, we are not getting the Antarctic Circumpolar Current in the right location and then we get potentially the wrong answer."

More heat and carbon dioxide in the ocean means less heat and carbon dioxide in the atmosphere, which is likely to slow down global warming, Russell says. But the feedbacks are uncertain. The team's next step will be to simulate how the ongoing shift of the Southern Hemisphere westerly winds will affect the biogeochemistry of the ocean, "because we are very concerned about what this may mean for both marine ecosystems and sea levels," Russell says.

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