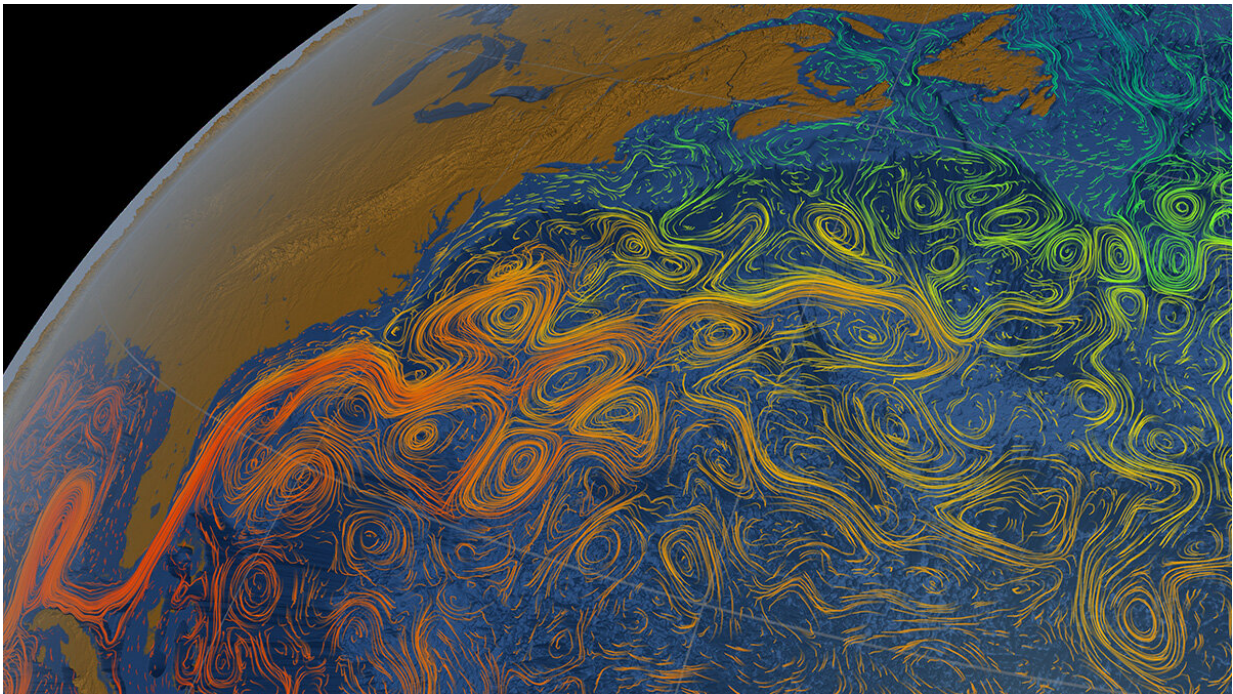


Hidden upwelling systems may be overlooked branches of ocean circulation

April 15 2022, by Alexandra K. Scammell



New research suggests there are overlooked upwelling systems along western boundary currents, including the Gulf Stream, pictured above. Credit: [NASA Goddard Space Flight Center Scientific Visualization Studio](#)

Upwelling and downwelling play an important role in transporting the heat, carbon, and nutrients that affect Earth's climate. Many studies have focused on these vertical motions in the ocean, including in eastern boundary currents, along the equator, and in the Southern Ocean.

Previous research has suggested that western boundary currents (WBCs) are associated with vertical water transport, but the strong presence and dynamics of vertical motions in the main WBC areas have not been described to date, in part because powerful horizontal water movement and eddies associated with WBCs make it hard to detect direct WBC-associated vertical motions.

In a new study published in the *Journal of Geophysical Research: Oceans*, Liao et al. distinguished patterns across various ocean data sets. They looked at vertical velocity using six ocean data sets spanning January 1992 to December 2009 under different ocean circulation models. Next, the team categorized five major subtropical WBC regions: the Kuroshio, Gulf Stream, Agulhas, East Australian, and Brazil currents.

Although not directly observed, strong subsurface [upwelling](#) was seen in all major WBC areas in all six of the data sets. The authors say that upwelling systems are necessary for the WBCs to be in geostrophic balance. In addition, they found that vertical motion in the WBC areas is relatively deep—deeper than upwelling near the equator, for example—and the WBC upwelling can reach the surface mixed layer. This finding suggests that in [subtropical regions](#), WBC upwelling plays a role in the vertical movement of heat and [carbon](#), which could be significant in heat and carbon regulation in the upper ocean and atmosphere over long timescales.

In addition, this upwelling and associated circulation in subtropical regions suggest that WBC upwelling is a path through which various biological, chemical, and physical processes travel. But the authors note that more research is needed to better understand the dynamics of WBC upwelling and the role it plays in the climate system.

More information: Fanglou Liao et al, Hidden Upwelling Systems Associated With Major Western Boundary Currents, *Journal of*

Geophysical Research: Oceans (2022). [DOI: 10.1029/2021JC017649](https://doi.org/10.1029/2021JC017649)

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