Geophysical Research Abstracts
Vol. 19, EGU2017-11392, 2017
EGU General Assembly 2017

Mass and tracer transport within oceanic Lagrangian coherent vortices as diagnosed in a global mesoscale eddying climate model

Nathaniel Tarshish (1), Ryan Abernathey (2), Carolina Dufour (1), Ivy Frenger (3), and Stephen Griffies (4)

(1) Atmospheric and Oceanic Sciences Program, Princeton University, Princeton, New Jersey, USA, (2) Lamont-Doherty Earth Observatory, Columbia University, New York City, New York, USA , (3) GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany, (4) NOAA/Geophysical Fluid Dynamics Laboratory, Princeton, New Jersey, USA

Transient ocean mesoscale fluctuations play a central role in the global climate system, transporting climate relevant tracers such as heat and carbon. In satellite observations and numerical simulations, mesoscale vortices feature prominently as collectively rotating regions that remain visibly coherent. Prior studies on transport from ocean vortices typically rely on Eulerian identification methods, in which vortices are identified by selecting closed contours of Eulerian fields (e.g. sea surface height, or the Okubo-Weiss parameter) that satisfy geometric criteria and anomaly thresholds. In contrast, recent studies employ Lagrangian analysis of virtual particle trajectories initialized within the selected Eulerian contours, revealing significant discrepancies between the advection of the contour's material interior and the evolution of the Eulerian field contour.

This work investigates the global mass and tracer transport associated with materially coherent surface ocean vortices. Further, it addresses differences between Eulerian and Lagrangian analyses for the detection of vortices. To do so, we use GFDL's CM2.6 coupled climate model with $\sim$5-10km horizontal grid spacing. We identify coherent vortices in CM2.6 by implementing the Rotationally Coherent Lagrangian Vortex (RCLV) framework, which recently emerged from dynamical systems theory. This approach involves the numerical advection of millions of Lagrangian particles and guarantees material coherence by construction. We compute the statistics, spatial distribution, and lifetimes of coherent vortices in addition to calculating the associated mass and tracer transports. We offer compelling evidence that Eulerian vortex methods are poorly suited to answer questions of mass and tracer transport.