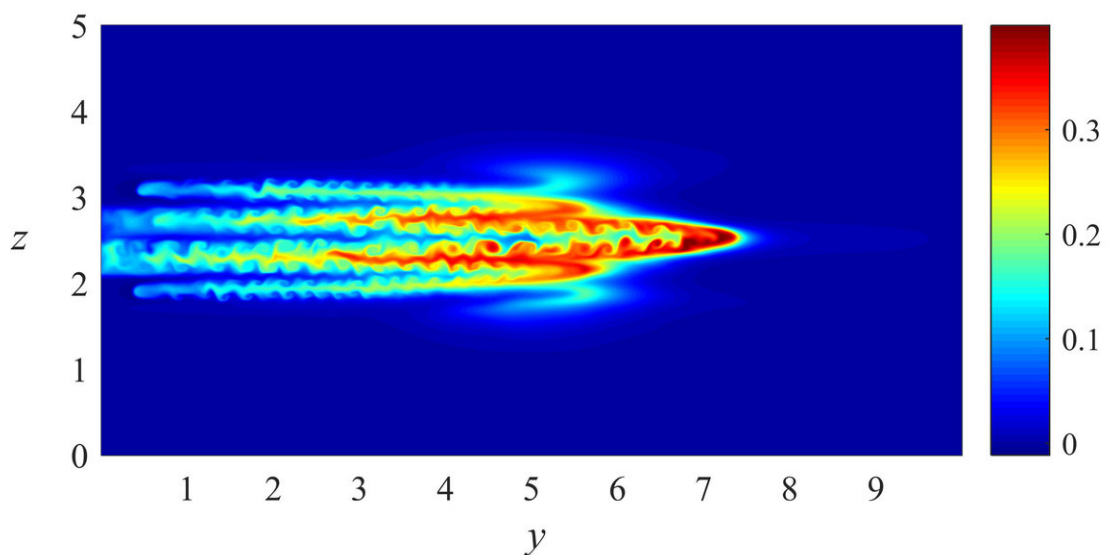


# Researchers challenge our assumptions on the effects of planetary rotation

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A 2D image of the velocity in an internal jet with the Rossby number of 100 that shows how planetary rotation leads to the destabilization and dispersion of an initially coherent flow pattern. Credit: Timour Radko and David Lorfeld

The earth's rotation causes the Coriolis effect, which deflects massive air and water flows toward the right in the Northern Hemisphere and toward the left in the Southern Hemisphere. This phenomenon greatly impacts global wind patterns and ocean currents, and is only significant for large-

scale and long-duration geophysical phenomena such as hurricanes. The magnitude of the Coriolis effect, relative to the magnitude of inertial forces, is expressed by the Rossby number. For over 100 years, scientists have believed that the higher this number, the less likely Coriolis effect influences oceanic or atmospheric events.

Recently, researchers at the Naval Postgraduate School in California found that even smaller ocean disturbances with high Rossby numbers, like vortices within submarine wakes, are influenced by the Coriolis [effect](#). Their discovery challenges assumptions at the very foundation of theoretical oceanography and geophysical fluid dynamics. The team reports their findings in *Physics of Fluids*.

"We have discovered some major—and largely overlooked—phenomena in fundamental fluid dynamics that pertain to the way the Earth's [rotation](#) influences various geophysical flows," Timour Radko, an oceanography professor and author on the paper, said.

Radko and Lt. Cmdr. David Lorfeld originally focused on developing novel submarine detection systems. They approached this issue by investigating pancake vortices, or flattened, elongated mini-eddies located in the wakes of submerged vehicles. Eddies are caused by swirling water and a reverse current from waterflow turbulence.

Last year, a team led by Radko published a paper in the same AIP journal on the rotational control of pancake vortices, the first paper that challenged the famous "Rossby rule." In this most recent paper, the researchers showed, through numerical simulations, that internal jets of the wake can be directly controlled by rotation. They also demonstrated that the evolution of a disorganized fine-scale eddy field is determined by [planetary rotation](#).

"Here is where our discovery could be critical," Radko said. "We find

that cyclones persist, but that anticyclones unravel relatively quickly. If the anticyclones in the wake are as strong as the cyclones, this means that the wake is fresh—the enemy passed through not too long ago. If the cyclones are much stronger than the anticyclones, then the sub is probably long gone."

The algorithm that the researchers developed is based on the dissimilar evolution of cyclones and anticyclones, which is a consequence of planetary rotation. "Therefore," Radko concluded, "such effects must be considered in the numerical and theoretical models of finescale oceanic processes in the range of 10-100 meters."

**More information:** Timour Radko et al, Effects of weak planetary rotation on the stability and dynamics of internal stratified jets, *Physics of Fluids* (2018). [DOI: 10.1063/1.5049598](https://doi.org/10.1063/1.5049598)

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