Scilight

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Deep-sea temperature measurements reveal ocean turbulence patterns

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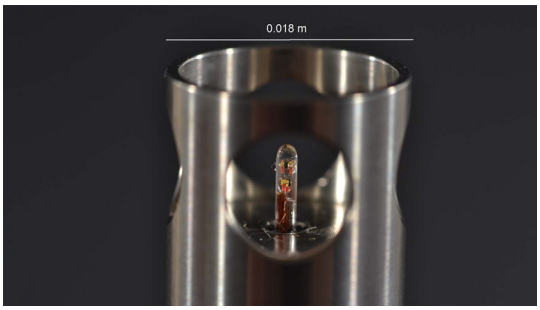
Ultra-precise measurements collected in the Mediterranean show the interplay of convection and shear-induced turbulence in the deep sea.



Off the southern coast of France, the waters are cold and dark. However, they are far from calm, making this environment an ideal place to study ocean convection and turbulence.

Hans van Haren collected temperature measurements in the deep waters of the Western Mediterranean. He reported episodes of shear-induced turbulence, likely caused by near-inertial internal waves originating from the surface that alternate with convection turbulence caused by geothermal heat from the sea floor.

Like the deep ocean, the Western Mediterranean Sea is weakly stratified, particularly in the winter when solar-driven stratification at the surface is reduced and convection takes over. This weak stratification makes it possible to study convection patterns seen in the deep ocean in a more accessible location.

The findings were enabled by custom-designed temperature sensors — glass-embedded temperature-sensitive resistors and electronics — moored to the seafloor 40 kilometers south of Toulon, France. These sensors collected ultra-precise data over 18 days of observations.

The time-series data showed three periods of turbulence: a stable stratification and two near-neutral conditions with dominant semi-inertial and inertial temperature variability. A clear change in the spectral slope was found between shear- and convection-induced turbulence.

“The distinction between different turbulence processes may help us to understand how matter and life are continually redistributed in the deep sea,” van Haren said.

The instruments used in the study are again moored deep in the Mediterranean and van Haren plans to use the resulting data to study the evolution of internal wave-turbulence types in three dimensions.

Source: “Convection and intermittency noise in water temperature near a deep Mediterranean seafloor,” by Hans van Haren, *Physics of Fluids* (2023). The article can be accessed at https://doi.org/10.1063/5.0139474.