Analysis of the Vertical Structure of Lateral Eddy Stirring Using Argo Profiles

A. Fagerheim[1], D. Balwada[2], J. Busecke[2], R. Abernathey[2]

[1]Department of Earth & Environmental Engineering, Columbia University
[2]Lamont-Doherty Earth Observatory of Columbia University

Stirring and subsequent mixing facilitate material and heat transport throughout the world's oceans. Ocean eddies, produced by wind forcing and intrinsic turbulence, stir water masses with different properties. This stirring produces fluctuations or variance in temperature profiles both laterally and vertically. Here we analyze vertical temperature profiles from Argo floats to quantify the properties of temperature fluctuations that result from this stirring. Previous work to study eddy mixing using Argo floats has focused on examining lateral effects of lateral stirring, making our approach of studying vertical profiles a useful and new contribution. In this study, we quantify properties of the vertical temperature structure at different scales. We quantify this structure by passing all profiles in a specific region through a Gaussian filter with different filter scales, and calculating the variance of the temperature anomalies as a function of this filter scale. By plotting anomaly variance vs filter scale, we can compare how large-scale and small-scale anomalies differ across regions and how the vertical tracer variance is distributed as a function of vertical length scales. We find that large-scale anomalies have higher variance in regions with a more pronounced vertical temperature gradient or stronger thermocline gradient, which is set by the properties of large-scale ocean circulation. Small-scale anomalies (once standardized with respect to this large-scale gradient) have higher variance in regions with higher eddy kinetic energy or stronger stirring. While our current work has focused on the variance of temperature profiles in a few representative regions, this will be extended to other tracers and more regions to build a global picture in the future. We hope that these findings regarding small-scale anomalies in the vertical structure will help provide useful observational constraints on stirring and mixing properties in the global ocean.