The global ocean stratification in repeated hydrography and high-res ocean GCMs

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Project Description

One of the defining features of the ocean is the ubiquitous presence of stratification, i.e., stability to vertical displacements, from about 100m down to the abyss. The global ocean stratification has been shown to have increased significantly over the past few decades (Li et al., 2020), and is predicted to continue to do so in the 21st century in response to anthropogenic emission of greenhouse gases (e.g., Capotondi et al., 2012). This increase is problematic because it tends to limit the transfer of nutrients to the upper mixed layer and thus limits the primary production in the global ocean, which can then cascade down do the whole food chain (Yool et al., 2015).

From the point of view of the physics, stratification is understood to result from the creation of certain type of water masses by air-sea interactions at the sea surface, and the subsequent transport and mixing of those water masses at depth. However, the understanding of these processes is not complete and their representation in climate models lacking. For example, no climate models include a dependence of mixing coefficients on winds and tidal forcings which are believed to drive the mixing (Wunsch and Ferrari, 2004).

To help improve our understanding and simulation of the global oceanic stratification we propose in this project to take advantage of repeated hydrographic measurements across the world ocean (Katsumata et al., 2022). By using these, we can identify mechanisms shaping the stratification (e.g., internal wave field, Rossby waves, mesoscale eddy stirring) in different location and depths in the ocean. This identification of mechanisms can then be compared with that obtained in the current generation of high resolution (grid size on the order of 10km or less) ocean general circulation models (OGCMs), taking advantage of simulations available to us from UK and EU modelling groups.

References

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