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Role of energetically constrained turbulent transport coefficients in ocean climatology

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In many fluid turbulence problems one is often interested in diagnosing or specifying the turbulent transport coefficients and/or turbulent diffusivities that arises from a turbulent closure, for example to inform the magnitude and distribution of said coefficients / diffusivities to use in models that require sub-grid turbulence parameterisations, or as a means to quantify bulk transport/diffusion of tracers. In the ocean modelling community there is increasing evidence that specification of the adiabatic transport coefficient that parameterises the effect of baroclinic mesoscale eddies result in leading order changes in the ocean climatology, with important consequences for the overall Earth climate system. This talk outlines some of the efforts the ocean community has made in the past decade or so to improve the diagnostic techniques for turbulent transport coefficients and diffusivities, and the recent theories on how we approach wave/eddy-mean flow interaction. A special focus will be on energetically constrained eddy parameterisations, where the parameterised eddy energetics play a central role in constraining the distribution and magnitude of the turbulent transport coefficients and/or diffusivity. The recent works suggest a shift in the paradigm in wave/eddy-mean flow interactions, where the diagnoses and representation of the underlying energetic pathways should be placed on equal footing with how the turbulent eddy fluxes are closed.

References

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A framework for parameterizing eddy potential vorticity fluxes
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A new gauge-invariant method for diagnosing eddy diffusivities
Ocean Modell., **104**, 252-268

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Global ocean circulation and its key dependence on eddy energy dissipation time-scale

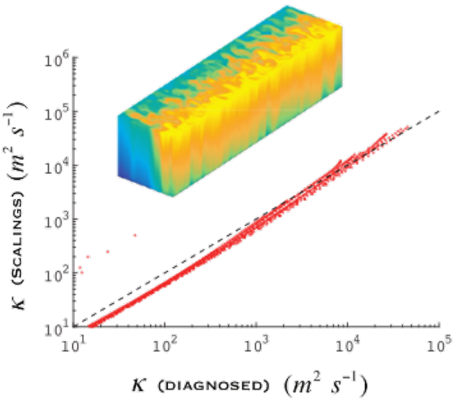

Figure 1: Result from Bachman *et al.* (2017), showing model setup and theoretical prediction of eddy induced transport coefficient derived in Marshall *et al.* (2012) against diagnosed eddy induced transport coefficient, using a method based on dispersion of multiple tracers developed in Bachman & Fox-Kemper (2013).