Numerical Modelling of Pressure Gradient Effects on Oceanic Turbulent Mixing Layers

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Abstract

In this paper, we study the numerical modelling of horizontal pressure gradient effects on oceanic turbulent mixing layers. The main purpose of this study is to justify the interest of taking into account pressure gradients in the modelling of turbulent mixing layers.

We consider Richardson number-based one-dimensional eddy diffusion models (*cf.* [1]). We study existence and uniqueness of discrete equilibrium solutions, their non-linear asymptotic stability, and their convergence to the continuous equilibrium states.

In order to justify the validity of the one-dimensional model (*cf.* [2]), we propose a two-dimensional model, based on the Primitive Equations of the Ocean. We have that, in case of zero horizontal pressure gradient, the solution of the one-dimensional mixing-layer model coincides with the solution of the two-dimensional Primitive Equations of the Ocean. Finally, we perform numerical experiments, that lead us to conclude that including horizontal pressure gradients in the one-dimensional model is needed when the initial velocity is not divergence-free.

Mathematics Subject Classification: 76D05, 35Q30, 76F65, 76D03.

Keywords: Oceanic turbulent mixing layers, Gradient Richardson number, Eddy diffusion models, Primitive Equations of the Ocean.

References

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