Approximating a continuously stratified hydrostatic system by the multi-layer shallow water system

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Abstract : We consider the 1D multi-layer shallow water system with an additional regularizing, diffusive term motivated by the work of the oceanographers Gent and McWilliams on isopycnal mixing and eddy diffusivity (in the 90's) and which could be interpreted as a turbulence term. The goal is to establish a bridge between this system and the 1D continuously stratified system with a similar regularizing, diffusive term under the hydrostatic approximation. This is done by exploiting the structure of the regularized multi-layer shallow water system and finding an appropriate way to interpret the relation between the two systems. Once the dictionary that enables us to do this interpretation has been set up, the multi-layer system can be seen as a discretization of the continuously stratified system. We will show the convergence of the discrete solution to the continuous one as the number of layers tends to infinity, and we will provide an explicit convergence rate.

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