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*Turbulent self-diffusion in isopycnal coordinates*

A recent paper by Dukowicz and Smith (1997), henceforth referred to as [DS97], extends the classical theory of turbulent transport of a tracer particle (Morin and Yaglom, 1987) to encompass the problem of self-diffusion in stratified mesoscale oceanic turbulence, thereby shedding light onto the mathematical status and physical meaning of the recent parametrization of Gent and McWilliams (1990). This is interesting and important in view of the fact that the theory of geostrophic turbulence is still in its infancy.

The stated objective of [DS97] is to develop the stochastic theory of turbulent diffusion from the standard Fokker–Planck equation (Morin and Yaglom, 1987; Gardiner, 2004) in such a way that it also applies to compressible flow. The reason why this is deemed necessary is that when the classical, incompressible Boussinesq equations are expressed in isopycnal coordinates the velocity field ceases to be solenoidal. We will show that the argument presented in [DS97] is incorrect, although their main result can, fortunately, be salvaged.