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An assessment of vertical mixing schemes in comparison with observations in the European shelf.

Maria Luneva (1), Holly Pelling (1), Matthew Palmer (1), Jeff Polton (1), Jason Holt (1), Sarah Wakelin (1), Matthew Toberman (2), and Mark Inall (2)

(1) National Oceanography Centre, Liverpool, Liverpool, United Kingdom (mane1@noc.ac.uk), (2) The Scottish Association for Marine Science

Simulating the North West European shelf seas using the NEMO Atlantic Marginal Model configuration with 7km resolution (AMM7), we examine 5 different subgridscale turbulent closure schemes. Based on the k-epsilon version of the Generic Length Scale model these schemes are a Galperin (1988) type closure, two schemes from the Canuto group (2001ab), and two schemes by Kantha and Clayson (1994, 2004). The simulations are compared with SCANFISH temperature sections and realistically reproduce the depth of mixed layer and the pycnocline. The simulations are also compared against direct turbulence observations, across the domain, during 1998-2013. In general all models show high correlations between observations and simulated pycnocline depth and bottom temperature. However 'less diffusive' Kantha Clayson and Galperin models exhibit smaller biases in bottom temperature, while 'more diffusive' Canuto models better predict pycnocline depth. All models underestimate dissipation rate of turbulent kinetic energy in the subsurface layer by an order of magnitude, with a positive correlations about 0.3. In the pycnocline, correlations between predicted and observed dissipation rate of TKE are negligible. We hypothesis the deficit of turbulence in the models are due to unrepresented internal waves and near inertial waves that arise from non-traditional Coriolis force. Non-traditional Coriolis force is also responsible for redistribution of energy between vertical and horizontal components of turbulent pulsations. We derive new closure for structural functions with effects of non-traditional Coriolis force and estimate these effects in the mixed layer and pycnocline.