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Modelling the tidal mixing fronts of the northwest European continental shelf

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Tidal mixing fronts are a key hydrodynamic feature of many shelf seas that delineate seasonally stratified from permanently well mixed or sporadically stratified waters. In the summer they separate low light, high nutrients regions from nutrient depleted stratified waters. Hence the associated cross-frontal transfer processes can result in their being regions of high biological production. Despite the importance of tidal mixing fronts, their position and the detailed timing of stratification produced by three-dimensional circulation models has yet to be subjected to a rigorous quantitative analysis for the Northwest European shelf. In this work we investigate the sensitivity of the frontal positions and the timing of stratification predicted by POLCOMS (Proudman Oceanographic Laboratory Coastal Ocean Modelling System) to the choice of turbulence model through a range of numerical experiments. The application considered is the MRCS model (˜7km resolution) described by Holt et al 2005 using two models to simulate vertical turbulence: the Mellor-Yamada model with an algebraic mixing length used in previous POLCOMS applications (MY) and the k-e; model described by Canuto et al (2001; CA, in the GOTM frame work). Hydrographic data from the North Sea Project and the ICES database are used to assess the models'performance. The results demonstrate that the MY model has a tendency to overestimate the extent of the stratified regions, particularly in the Western English Channel and St. George's Channel. This shortcoming is not apparent when the CA model is used. Further investigation demonstrates the significance of limiting the mixing length in stably stratified water and that this provides an important control over the mixing. Model experiments are also conducted with POLCOMS coupled to the ERSEM (European regional seas ecosystem model), and the effects on the primary production of the details of the turbulence model explored.