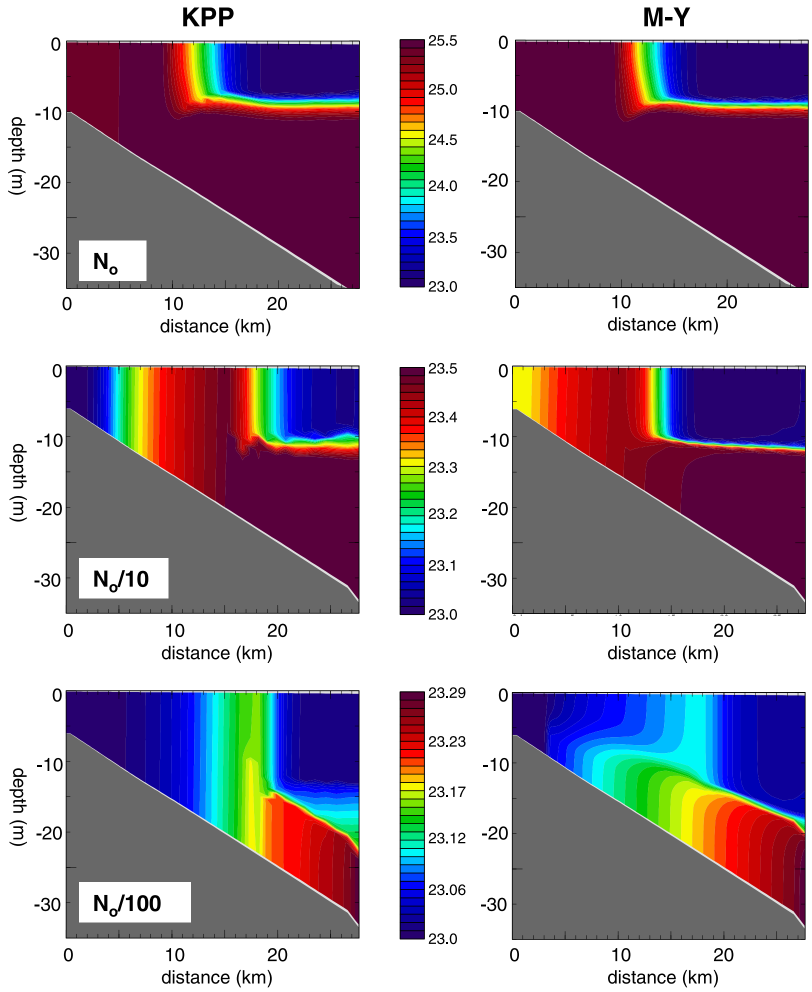

Figure 17. Potential density anomaly sections for three upwelling simulations with different initial stratification, 5 days after the initiation of the wind stress.

tions for the two different mixing parameterizations. In the top two panels the model was initialized with a strongly stratified (N_o) 5 m thick pycnocline between 7.5 and 12.5 m depth, which separates well-mixed surface and bottom layers. The middle two panels are for a case that differs only in that the stratification in the pycnocline is one-tenth as intense ($N_o/10$). The bottom frames are for a low stratification case ($N_o/100$) in which the initial stratification is uniform everywhere below 7.5 m depth. All of these were forced with a steady 0.3 dyne wind stress spun-up as described previously. At high stratification the solutions with the two mixing schemes are quite similar. At lower stratification however they differ markedly. In the $N_o/10$ case KPP leaves a 5 km region of low-density water trapped near the coast which does not develop with M-Y. The upwelling front with KPP is also approximately 4–5 km farther offshore. In the $N_o/100$ case KPP produces a vertically well mixed water column out to 15 km from shore by day 5 while the M-Y scheme allows a shoreward bottom flow that produces stratification to within 5 km of the coast.

[73] Coastal upwelling circulation in general results from the wall constraint on a system with offshore transport in a surface boundary layer balanced by onshore flow below. Examination of the evolution of the density, across-shore velocity, vertical velocity and vertical mixing coefficient fields over the first four days of the simulations in the $N_o/10$ case help to illuminate the relationship between vertical mixing and advection in these systems. Figures 18 and 19 show these fields for simulations with the two parameterizations. These simulations are initialized with a pycnocline that intersects the bottom bathymetry several kilometers offshore. Thus the water column within approximately 2 km of the coast is initially well mixed. In this region, if vertical mixing is sufficiently intense, Ekman transport will be shut down and the Ekman divergence will develop offshore. This response is illustrated with the KPP simulations. A strongly mixed water column develops in the 3–4 km region closest to the coast, shutting down the cross-shore circulation. Intense vertical velocities develop as a result where this Ekman divergence occurs. The pycnocline upwells to the surface at this position and moves offshore. A region of well mixed "surface layer" water is trapped at the coast. A single surface-to-bottom boundary layer extends offshore with the migration of the upwelling front. Intense vertical advection persists at the position offshore where this well-mixed circulation ceases and the two-layer onshore/offshore flow begins.