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A generalised Q-vector formulation of vertical velocity (w) in the ocean: A study of w-sources

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A generalised form of the w-equation deduced from the primitive equation system is proposed in this paper in order to unravel the physical sources of vertical velocity and ageostrophic circulation in the ocean. Two thermal and three dynamical w-sources were indentified from the Q-Vector approach and diagnosed in a realistic simulation using data from the POMME experiment (21-15W/38-45N. September 2000 - October 2001). They allowed to precise the processes taking place around stirring eddies, in frontal regions and into filamentary Mixed Layer Depth (MLD) structures. An important point was the emergence of energetic small horizontal scales (20 km) near the surface in the w and MLD fields. Thanks to the Q-Vector approach, it was possible to show that an identified filamentary MLD structure of 40 km wide and 200 km long was maintained by the solely w-sources associated with the buoyancy and momentum turbulent fluxes during one week, in spite of the strong restratification acting during this period. The identification of the origins of the vertical motion in such MLD structures allows the understanding of their dynamic and life-time that are important parameters for biological processes. The conditions required to activate the vertical velocities associated with the thermal and dynamical turbulent fluxes will be presented in this paper.