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A multilayer equation set for modelling large-scale ocean internal wave interactions

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The propagation and interaction of strongly nonlinear dispersive waves on the surface of a single fluid layer have been studied, both numerically and theoretically, using the Green-Naghdi set of equations. It is known that these equations possess a variational principal and may be derived using an anzatz of columnar motion, by following an averaged Lagrangian approach. We present here a new large-scale wave model, called Multilayer Columnar Motion (MLCM), which extends this theory to the general case of a fluid consisting of an arbitrary number of layers. This gives obvious connections to the Camassa-Holm and Choi-Camassa equations, through the inherited Hamiltonian structures. Since the MLCM equations remain effectively two-dimensional it is possible to solve them numerically at high resolution over large domains. Numerical results are shown from a novel finite element code implementing the MLCM equations and designed to study wave generation and interaction in the the area of the South China Sea.