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A continuous/discontinuous unstructured finite element method for a new equation for modelling large-scale nonlinear internal wave interactions

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There is currently great interest in nonlinear internal waves which are generated by tidal flow through the Luzon Strait between Taiwan and the Phillipines, as part of the NLIWI project. These long waves are coherent enough to be visible from space, and exhibit fascinating and beautiful nonlinear reconnecting interactions with islands and each other. We introduce a new large-scale model, called Multilayer Columnar Motion (or MLCM), for studying the propagation and interaction of these waves. As the MLCM equations are 2D, it is feasible to solve them over the whole South China Sea region in order to provide support to local nonhydrostatic models being used to investigate wave generation at one end and interaction with the ocean shelf at the other. One of the key features of this equation is the elliptic problem which must be solved to obtain the velocity from the momentum. To this end, we have developed a new finite element method for these equations which uses continuous quadratic elements for layer depth and velocity, with discontinuous linear elements for momentum. We will describe the method and show numerical results which illustrate why this special treatment of momentum is necessary for accurately modelling the nonlinear wave propagation.