Modelling internal tides using plane waves: a Plane Wave Discontinuous Galerkin method for the (linearized) rotating shallow water equations.

Ezra ROZIER, Odyssey, INRIA - Rennes **Noé LAHAYE**, Odyssey, INRIA - Rennes

Internal tides (IT) are internal waves generated by the interaction of the astronomical tide with the ocean irregular topography. Using the framework of vertical mode decomposition [3], the dynamics of ITs can be described by the (linerarized) rotating shallow water model. Owing to the nearly time-harmonic character of ITs, it appears that the solution of these equations can be locally decomposed into plane waves – which is confirmed by inversion-based estimates of satellite data [4]. Therefore, in this research, following the work on Plane Wave Discontinuous Galerkin (PWDG) methods done for acoustic problems [1] or electromagnetic wave equation [2], we study the PWDG method applied to the (linerarized) rotating shallow water equations. PWDG is a numerical method that is part of the more general Trefftz methods, where the local approximation is a superposition of local solutions, in this context, plane waves. We notice that this method is giving good results for low spatial sampling : we can compute solutions for less than one point per wavelength and it does not struggle solving source terms and open boundary conditions. This reduces the computational cost compared to the often used spectral methods and finite difference method.

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Contact : ezra.rozier@inria.fr