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WAVETRISK-OCEAN: an adaptive dynamical core for ocean modelling

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This talk introduces WAVETRISK-OCEAN, an incompressible version of the atmosphere model WAVETRISK with a free surface. This new model is built on the same wavelet-based dynamically adaptive core as WAVETRISK, which itself uses DYNAMICO's mimetic vector-invariant multilayer rotating shallow water formulation. Both codes use a Lagrangian vertical coordinate with conservative remapping. The ocean variant solves the incompressible multi-layer shallow water equations with inhomogeneous density layers. Time integration uses barotropic-baroclinic mode splitting via a semi-implicit free surface formulation, which is about 34-44 times faster than an unsplit explicit time-stepping. The barotropic and baroclinic estimates of the free surface are reconciled at each time step using layer dilation. No slip boundary conditions at coastlines are approximated using volume penalization. The vertical eddy viscosity and diffusivity coefficients are computed from a closure model based on turbulent kinetic energy. Results are presented for a standard set of ocean model test cases adapted to the sphere (seamount, upwelling and baroclinic turbulence). An innovative feature of WAVETRISK-OCEAN is that it could be coupled easily to the WAVETRISK atmosphere model, thus providing a first building block toward an integrated Earth-system model using a consistent modelling framework with dynamic mesh adaptivity and mimetic properties.