A dynamically adaptive wavelet-based method for geophysical flows on the sphere

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This talk presents a dynamically adaptive wavelet method for the shallow water equations on the staggered hexagonal C-grid on the sphere. The adaptive grid hierarchy is a dyadic subdivision of the icosahedron, which may be optimized to ensure good geometric properties. Distinct biorthogonal second generation wavelet transforms are developed for the pressure and the velocity, together with compatible restriction operators to ensures discrete mass conservation and no numerical generation of vorticity. Coastlines are introduced by a new volume penalization method of the shallow water equations which ensure inertia-gravity waves are reflected physically, and that no-slip boundary conditions are imposed for the horizontal velocity. The code is fully parallelized using mpi, and we demonstrate good weak parallel scaling to at least 1000 processors. The efficiency and accuracy of the method are verified by applying it to a tsunami-type inertia-gravity wave with full topography, to wind-driven gyre flow and to homogeneous rotating turbulence. Even in the unfavourable case of homogeneous turbulence significant savings in the number of degrees of freedom are achieved by the adaptivity. This talk is a sequel to the one we gave at PDEs on the sphere in Cambridge.