Geophysical Research Abstracts, Vol. 9, 03497, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03497

High-order h-adaptive discontinuous Galerkin methods for ocean modeling

P.-E. Bernard (1), N. Chevaugeon (2), E. Deleersnijder (1,3), V. Legat (1), J.-F. Remacle (1,2)

(1) Université catholique de Louvain, Center for Systems Engineering and Applied Mechanics, Belgium, (2) Université catholique de Louvain, Department of Civil Engineering, Belgium, (3) Université catholique de Louvain, G. Lemaitre Institute of Astronomy and Geophysics, Belgium (bernard@mema.ucl.ac.be)

The present work deals with transient adaptive high-order quadrature free discontinuous Galerkin schemes for solving the non-linear shallow water equations. It can be shown by rigorous error analysis that the DG discretization error can be related to the amplitude of the inter-element jumps. For a DG scheme using polynomials up to order p, the discretization error can be shown to be of the order of hˆ(p+1) with h the characteristic element size. Jump amplitude are also of the same order. Therefore, we use the information contained in jumps to build error metrics and size field. This approach is shown to be valid for any order p and is a step forward from classical mesh metric estimates based on Hessian functions of the field and originally designed for first order continuous finite elements. This error field is then used to build a new mesh metric. The mesh is locally adapted and the solution is locally projected at the same time from one mesh to another. The method is first applied to simple model problems such as the classical Stommel gyre, and then to larger scale problem, such as a realistic portion of the Atlantic. We show that the computation time to modify the mesh and project the solution on the new mesh is small compared to the time to solve the equations, and that the overall gain in computation time is large for the same accuracy.