Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08371, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08371
EGU General Assembly 2008

Improved modeling of seismic waves using the discontinuous Galerkin scheme on different mesh types

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The discontinuous Galerkin finite-element method has been developed and introduced into the field of computational seismology for unstructured triangular and tetrahedral meshes. However, many problems do not require the discretization of the entire computational domain with such meshes. Therefore, we present different approaches to formulate the discontinuous Galerkin scheme on quadrilateral and hexahedral meshes and compare their performance with respect to previous formulations. In particular, quadrilateral or hexahedral meshes allow for the use of different sets of basis functions, both leading to the important property of a diagonal mass matrix. Furthermore, the incorporation of highly variable material properties can have an important influence on the accuracy of modeling results, especially if very coarse meshes in combination with high approximation orders are used. We show comparisons of the performance and CPU requirements of the different approaches and clearly state their advantages and disadvantages with respect to particular problems. Finally, we present realistic applications of scientific and industrial interest.