Geophysical Research Abstracts
Vol. 16, EGU2014-3826-1, 2014
EGU General Assembly 2014

Advanced Simulation of Coupled Earthquake and Tsunami Events (ASCETE) - Latest Simulation Techniques for Tsunami Process Studies

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The ASCETE project develops a simulation framework for coupled physics-based rupture generation with tsunami propagation and inundation. Recently, several new results could be achieved.

Adaptive mesh tsunami propagation and inundation by discontinuous Galerkin Runge-Kutta methods allows for accurate and conservative inundation schemes. The adaptive mesh refinement allows for efficiency optimization, since computations are only performed in areas of interest and wave activity. A tree-based refinement strategy is utilized to highly optimize the code for high-performance computing architectures.

Rupture simulation is performed by an unstructured tetrahedral discontinuous Galerking ADER discretization, which allows for accurate representation of complex geometries. Advanced meshing methods allow for near-realistic geometrical set-ups. Currently physically consistent state of stress and frictional strength properties inspired from seismo-thermo-mechanical models are implemented, opening the path to cutting edge process studies of earthquakes in megathrust and off-megathrust faulting systems. Code optimizations with automatic code generation tools for vector performance show gains in execution time of a factor of five and more.

First results of coupled simulations with complex time-dependent rupture mechanics and correspondingly triggered tsunami events demonstrate the potential for novel process studies and uncertainty assessment of realistic events.