Geophysical Research Abstracts, Vol. 9, 11629, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-11629


# Rupture, Waves, and Imaging: The Role of High-Performance Computing

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Despite more than two decades of intensive developments in numerical algorithms for wave propagation and rupture problems and the rapid increase in computational power, the solution of realistic 3D problems remains a challenge even in the upcoming Petaflop age. Today, only a fraction of the information contained in observed seismograms is used in the standard data fitting and imaging procedures. Several issues related to the forward problem are still being investigated: How to efficiently cope with complex model geometries and strongly heterogeneous media? What rheologies are needed in the various areas such as exploration seismics, rupture propagation, or earthquake strong ground motion? How can we efficiently investigate soil-structure interaction? What is the best strategy to make use of supercomputing infrastructure or GRID technology? In the past few years the FP6 funded EU project SPICE (www.spice-rtn.org) focused particularly on issues of forward problems in computational seismology. We will report substantial progress on issues like (1) strong motion prediction for finite-fault scenarios; (2) dynamic rupture propagation in 3-D; (3) the seismic signature of mantle models and others. The quality and resolution of our subsurface and earthquake source images will only improve if we understand how to incorporate our advanced computational modelling tools into automated imaging methodologies with appropriate uncertainty estimates. We will discuss the road ahead into this full-waveform inversion era.