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Spectral element modeling of 3D wave propagation in the alpine valley of Grenoble, France.

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Located in a Y-shaped valley filled mostly with late quaternary deposits, the city of Grenoble is subject to strong site effects which are characteristic of Alpine valleys (see the SISMOVALP web site at http://www-lgit.obs.ujf-grenoble.fr/sismovalp/). In order to (1) understand the variability of the site effects observed in weak motion data and (2) estimate strong ground motion for realistic scenarios, we propose a numerical approach based upon the spectral element method (SEM). Previously applied to the simulation of strong ground motion in the Los Angeles basin (Komatitsch et al., 2004), the SEM is particularly well suited to model wave propagation in Alpine valleys. First, it naturally accounts for topography at the free surface and at the interface between bedrock and sediments. Second, it provides an accurate computation of basin edge diffracted surface waves, which are predominant in small embedded valleys. We use a conforming 3D mesh of hexahedral elements that honors the stiff surface topography as well as the deepest part of the contact between the sediments and the bedrock. Assuming a simple sedimentation history throughout the basin, we use a 1D velocity model which extrapolates the velocities measured within a borehole that reached the substratum at 535 m depth in 1999. Results and comparison to data are shown in the time and frequency domain for small-size local events recorded in the past years. A reasonable fit is obtained for frequencies up to 1 Hz both in amplitude and duration, which constraints the value of intrinsic attenuation within the basin. Realistic scenarios are then considered, which consist of strike-slip events with magnitude greater than 5 on the eastern border of the basin. The results compare well at low frequencies (less than 1 Hz) to those obtained by the method of Empirical Green Functions. A special attention is further devoted to estimate the amplification expected on the basin edges.

References: Simulations of ground motion in the Los Angeles basin based upon the

spectral- element method, Dimitri Komatitsch, Qinya Liu, Jeroen Tromp, Peter Süss, Christiane Stidham and John H. Shaw, Bulletin of the Seismological Society of America, vol. 94, p 187-206 (2004).