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Basin effects and aggravation factors for 2D trapezoidal basins: Preliminary analyses and results

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Over the last four decades many numerical and instrumental studies have focused their interest on the investigation of the effects of subsurface geometry (valleys, basins and lateral discontinuities in general) on seismic ground motion. However, due to the complexity of the problem, it has not yet been feasible to incorporate such effects into earthquake hazard assessment, risk mitigation policies and building codes. In the present work, which has been conducted in the framework of NERA FP7 EC project, extensive parametric numerical analyses of soil basins are performed with different incoming wavefields to explore the sensitivity of 2D seismic response of both symmetrical and asymmetrical trapezoidal basins to different parameters, such as the geometry of the basin (defined by its width, depth and inclination angles of lateral boundaries) and the soil mechanical properties (defined by the shear- and compressional-wave velocities, soil density and quality factor). Synthetic ground motion at the free surface of the 2D models is computed for receivers located at different locations both within and outside the basin. Basin effects are quantified through a period-dependent aggravation factor, which is defined as the ratio between 2D and 1D acceleration response spectra at the basin surface, and thus expresses the severity of the amplification of ground motion due to the 2D nature of the basin response above the corresponding prediction of the 1D analysis of the isolated soil columns. The variation of aggravation factor along the width of the basins, as well as the dependence of aggravation factor on the examined parameters are investigated, in order to identify general trends. The parameters which mostly affect aggravation factors are pointed out. The results of the analyses could further be used to propose simple and practical recommendations to the engineering community for the introduction of basin effects in the seismic design of structures.