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3D seismic-velocity structure of Campo de Dalías basin (SE Spain) from diffuse-field modelling of the ambient noise wavefield and estimation of its seismic response

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We use passive seismic methods to obtain a model of the seismic-velocity structure of Campo de Dalías, a large (∼300 km2) coastal plain in the southeastern mountain front of the Betic Cordillera (SE Spain).
To this aim, H/V spectral ratios of ambient noise were computed from broadband records at 310 sites, approximately on the vertexes of a 1000 x 1000 m square grid. Two approaches based on power spectral densities and the Hilbert-Huang transform have been compared. Most of the H/V ratios show clear peaks in a wide frequency range (down to $\sim$ 0.25 Hz) associated with up to $\sim$ 1000 meters of soft sedimentary rocks (mainly Miocene marls) overlying the stiffer basement. Broader peaks appear in the foothills of Sierra de Gádor mountains.

The spectral ratios were inverted in the range 0.15 – 15 Hz to obtain horizontal layered models of the local structure from which a 3D model was interpolated. Forward computations of H/V(f) relied on the Diffuse Field Approximation (DFA), which considers the surface- and body-wave components of the wavefield. Additional constraints were provided by 10 surface-wave dispersion curves derived from array measurements of ambient noise, 95 km of Vp profiles from multichannel seismic reflection, and by lithological data at deep boreholes. These constraints reduce the trade-off between Vp and Vs and between thicknesses and velocities. The inversion procedure combined Monte Carlo sampling with subsequent model refinements using the downhill-simplex algorithm.

The stability of the H/V has been assessed using 30 months of continuous records at three Güralp-3ESPDC broad band stations inside the basin. Even though remarkable stability exists in the band used for inversion, common seasonal variations appear for frequencies below $\sim$ 0.15 Hz.

The resulting model describes well the main structural features in this area such as the El Ejido Synform and the Guardias Viejas Antiform, with ENE–WSW-trend, and provides reliable ranges for the seismic wave velocities of the main geological units. Considering these alignments, a 2.5 D version of the model has been used to estimate, with moderate computational requirements, the response of the basin to the incidence of plane P, S and Rayleigh waves. The wavefield was computed at 3098 virtual stations using the Indirect Boundary Elements method (IBEM) for several incidence angles and azimuths. It presents complex amplification patterns depending on frequency, position and illumination. These results increase knowledge on wave propagation and site effects in the basin, which is located in a seismically active region.

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