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Testing multiple ambient noise methodologies to map the basement of small-scale sedimentary basins

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The potential of different ambient noise methodologies to map the geometry of a small-scale sedimentary basin has been tested using data acquired in the Cerdanya Basin (eastern Pyrenees). We present results based on a 1-year long broad-band deployment covering a large part of the Eastern Pyrenees and a 2-month long high-density deployment covering the basin with interstation distances around 1.5 km. The explored techniques include autocorrelations, ambient noise Rayleigh wave tomography, horizontal-to-vertical spectral ratio, and band-pass filtered ambient noise amplitude mapping. The basement depth estimations retrieved from each of these approaches, based on independent datasets and different implicit assumptions, are consistent, showing that the deeper part of the basin is located in its central part, reaching depths of 600-700 m close to the Têt Fault trace bounding the Cerdanya Basin to the NE. The results show also that when high-density seismic data are available, HVSr and ambient noise amplitude analysis in a selected frequency band are useful tools to quickly map the basement of a sedimentary basin. On the other hand, surface wave tomography, more complex to obtain, provides detailed information on the 3D velocity structure. Besides this methodological aspect, our results help to improve the geological characterization of the Cerdanya Basin and will provide further constraints to refine the seismic risk maps of an area of relevant tourism and economic activity.