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Structure of the crust beneath Northeast Italy and Slovenia from ambient noise tomography

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We present a model for the structure of the crust and the upper mantle beneath Northeast Italy and Slovenia. The region is located at the central part of a convergent boundary zone between the African and Eurasian plates and specifically at the junction between the South-Eastern Alps and the External Dinarides. The active tectonics accommodates part of the motion of the Adriatic microplate (Adria) into the European plate with thrust and dextral faulting at rates of ∼3-4 mm/yr. Despite the importance of the area for the understanding of the tectonic processes acting at the boundaries of the different domains as well as the high earthquake hazard, only little is known about the lithospheric structure.

During the last decades the institutions in Italy, Slovenia and Austria put significant efforts to build a dense digital seismological network. Therefore high quality waveform data are now available that allow the study of the lithospheric structure in the region. We use the ambient noise surface wave tomography to overcome the limitations caused by the non-homogeneous distribution of seismicity and to fully exploit the available seismological data.

By cross-correlating two years of continuous seismic noise records from 69 broadband stations, we have been able to measure Rayleigh wave group and phase velocities in the period range 5-37 s for about 4000 station-to-station paths. We first apply a dispersion analysis using the frequency-time analysis to obtain the dispersion curves of the fundamental mode of Rayleigh waves for periods ranging from 5 to 37 sec. We then invert path-averaged dispersion curves to obtain 2D maps, on a 0.5ºx0.5º nodal grid, of group and phase velocities for discrete periods using a method that is the generalization to two dimensions of the Backus and Gilbert method. We obtain tomographic maps that image the main structural features of the crust and uppermost mantle in Northeast Italy and Slovenia with an unprecedented detail. We then inverted the group and phase velocity curves to obtain a Vs velocity model of the study area. The implications for the regional geodynamics and for the local tectonics will be discussed.