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Crustal fracturing field as revealed by seismic anisotropy in three seismogenic areas of the Apenninic chain

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In the last three years, we developed, tested and improved an automatic analysis code to calculate the shear wave splitting parameters, fast polarization direction (φ) and delay time (∂t). The code is a set of MatLab scripts able to retrieve crustal anisotropy parameters from three-component seismic recording of local earthquakes using horizontal component cross-correlation method. The analysis procedure consists in choosing an appropriate frequency range, that better highlights the signal containing the shear waves, and a length of time window on the seismogram centred on the S arrival (the temporal window contains at least one cycle of S wave).

The code was compared to other two automatic analysis code (SPY and SHEBA) and tested on three Italian areas (Val d'Agri, Tiber Valley and L'Aquila surrounding) along the Apennine mountains. For each region we used the anisotropic parameters resulting from the automatic computation as a tool to determine the fracture field geometries connected with the active stress field.

The anisotropic fast directions are used to define the active stress field (EDA model), finding a general consistence between fast direction and main stress indicators (focal mechanism and borehole break-out). The magnitude of delay time is used to define the fracture field intensity finding higher value in the volume where micro-seismicity occurs.

Furthermore we studied temporal variations of anisotropic parameters in order to explain if fluids play an important role in the earthquake generation process. The close association of anisotropic parameters variations and seismicity rate changes supports the hypothesis that the background seismicity is influenced by the fluctuation of pore fluid pressure in the rocks.