Earthquake focal mechanisms

We take into account earthquakes with M≥4, usually moment magnitude (Mw), and crustal depth within the first 40 km, although most of the hypocentres with depth ≤20 km. We assign C-quality to all focal mechanism data.

For the oldest 23 seismic events, occurred between 1908 and 1975, we consider results from polarity solutions of earthquakes computed by different authors in the past.

For the seismic events from1976 to 2017, we take into account CMT-like solutions of earthquakes selected from the European-Mediterranen RCMT Catalog (Pondrelli and Salimbeni 2015, and reference therein) and the Italian CMT dataset (Pondrelli et al. 2006). Taking into account the systematic error of CMT-like solutions (±14° according to Helffrich 1997) and the range of stress orientations that would be consistent with each focal mechanism and that the orientation of the P-, B- and Taxes could slightly deviate from the principal stress orientations (McKenzie 1969), the World Stress Map project (Heidbach et al. 2010, 2016) assigns C-quality to focal mechanism data (stress orientations within ±25°) (see also Montone et al. 2012 for a detailed explanation).

Since 2018, we have used the Time Domain Moment Tensor catalogue (Scognamiglio et al. 2006; ISIDe). The focal mechanism solutions (Scognamiglio et al. 2009) are obtained from the high-quality data of the Italian broadband and the Mediterranean seismographic networks using the long period full waveform inversion code originally proposed by Dreger and Helmberger (1993).

Although focal plane solution principal axes could not be indicative of stress axes, the possible differences between Shmin derived from P, T and B axes and Shmin from slip vectors lie within the error of the attributed quality as shown in Montone et al. (2004) for the Italian dataset. Moreover, regional compilations show that the average orientation for compression (P), null (B), and extension (T) axes determined from a number of earthquakes gives a good indication of the stress orientation throughout a region (e.g. Zoback and Zoback 1980). Thus, the orientation of the kinematic P, B, and T axes is assumed to coincide with the one of the dynamic sigma1, sigma2 and sigma3 axes.

To identify the Shmin azimuth and the tectonic regime, we use the plunge of the P, T and B axes applying the criteria of Zoback (1992), modified for Shmin instead of SHmax (see table 5 in Montone et al. 1999). We discard all the focal solutions with P, T and B axes that do not define a clear tectonic regime. We show on the map all the possible categories: in addition to TF (pure thrust faulting), NF (pure normal faulting) and SS (pure strike-slip faulting), we also include NS (normal with strike-slip component) and TS (thrust with strike-slip component).

WSM guidelines, see cap 3.

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Table - Stress regime assignment for earthquake focal mechanism data (modified from Zoback 1992; see also World Stress Map project guidelines, Table 3.5-1).

P/S1-axis	B/S2-axis	T/S3-axis	Stress regime	S_{Hmax} orientation	S_{hmin} orientation
pl≥52°		pl≤35°	NF	azimuth of B-axis	azimuth of T-axis
40°≤pl<52°		pl≤20°	NS	azimuth of T-axis+90°	azimuth of T-axis
pl<40°	pl≥45°	pl≤20°	SS	azimuth of T-axis+90°	azimuth of T-axis
pl≤20°	pl≥45°	pl<40°	SS	azimuth of P-axis	azimuth of P-axis +90°
pl≤20°		40°≤pl<52°	TS	azimuth of P-axis	azimuth of P-axis +90°
pl≤35°		pl≥52°	TF	azimuth of P-axis	azimuth of B-axis

P, B and T axes; pl: plunge of P, B and T-axes; S1, S2 and S3 correspond to sigma1, sigma2 and sigma3 axes; NF: normal faulting; SS: strike-slip faulting; TF: thrust faulting; NS: normal/strike faulting; TS: thrust/strike faulting.