A quantitative approach to the loading of seismogenic sources in Italy

Caporali A. 1), Braitenberg C. 2), Montone P. 3), Rossi G. 4), Valensise G.L. 3), Vigano’ A. 5), Zurutuza, J. 1)

1) University of Padova, 2) University of Trieste, 3) INGV Rome; 4) INOFS Trieste; 5) Provincia Autonoma di Trento, Servizio Geologico
SIF 1986, first GPS receiver and first results on Mediterranean/Global geokinematics with LAGEOS

Cenci, Fermi, Sciarretta, Devoti and Caporali AGU Geodynamic Series n.23, 1993
Strain rate as horizontal gradient of the velocity field interpolated at the location of 87 ISSs.
How does a regional stress field load Individual/Composite seismogenic sources

- Strain rate tensor from GPS geodesy (2D)
- Convert to elastic stress rate (plane stress)
- Normal and shear stress (rates) can be computed by projecting the total stress rate onto the normal and slip directions of the ISS

\[ \Delta CFF = \tau - \mu \sigma_n = f(\sigma, \mu, \text{Strike, Dip, Rake}) \]
• Rate of CFF computed at 87 selected ISSs

• Qualitative correlation with historical seismicity (CPTI2015)

• Strike slip faults have highest rate of CFF (Tocco da Casauria; San Giuliano di Puglia; Ripabottoni..)
Statistics of the loading rate on 87 ISSs

- Loading rate is modest for most ISSs
- Major exception is Tocco da Casauria and (for optimal friction) San Giuliano di Puglia and Ripabottoni in the 5-6 kPa/yr range
- For a fault to accumulate a stress comparable to a typical stress drop e.g. 3 Mpa it takes 600 years or more
Some details

Strain rate eigenvalues mirror in most cases the geological stress regime.
Some exceptions suggest stress on inherited faults
Statistics on the actual orientation of faults relative to their ‘optimal’ orientation (based on the criterion of maximum rate of CFF)
Conclusions

• We expect that the seismic potential of a province can be better characterized if measurements of increasing or decreasing state of stress on the fault plane complement statistical seismicity data.

• It is premature to claim that a source of high CFF rate has a high seismic potential: the regional load can be accommodated aseismically or as a permanent deformation.

• Seismic gaps, i.e. areas of high CFF rate but low historical seismicity (e.g. Mirandola, San Giuliano di Puglia...) need to be investigated in a systematic manner.

• Some interesting hint on the relation between GR’s \(a,b\) (and their temporal rate?) and the energetics of a seismic province may result.