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Constraints on lateral changes of a static stress drop from geodetic strain rates and statistical seismicity

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The strain rate measured geodetically on the surface and the yearly number of earthquakes exceeding a given magnitude are two critical items entering the energetic budget of a seismic province. Based upon one of the most complete and recent seismic catalogues of Italian earthquakes and on the strain rate map implied by a multi-year velocity solution for permanent GPS stations we focus on 36 homogeneous Seismic Zones of known Gutenberg-Richter a- and b- parameters, effective depth and maximum magnitude. For each Seismic Zone we use the appropriate Gutenberg Richter relation, based upon Catalogue seismicity, to estimate a seismic strain rate, that is the strain rate associated to the mechanical work due to a coseismic displacement. We show that the seismic strain rate scales with a static stress drop. By imposing that the GPS derived strain rate is, for each Seismic Zone, not smaller than the corresponding seismic strain rate, an upper limit for the stress drop can be estimated. We show that the implied regional stress drop varies from a minimum of 0.03 MPa to a maximum of 3.4 MPa in the magnitude range [4.5 - 7.3]. The stress drop results to correlate neither with the a- and b-parameters, nor with the moment magnitude and depth, but attains the largest values in those seismic zones which are catalogued as very active. The values of the static stress drop can be compared with independent estimates of the dynamic stress drop implied by frequency domain analysis of source spectra.