Coulomb stress study for the May 2012 North Italy earthquakes

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We model stress transfer for the May 2012 North Italy earthquakes assuming that failure of the crust occurs by shear, so that the mechanics of the process can be approximated by the Okada (1992) expressions for the displacement and strain fields due to a finite rectangular source in an elastic, homogeneous and isotropic half-space. We computed the Coulomb stress change in an elastic half space (Okada, 1992) by assuming a shear modulus of 3x10^10 Pa, Poisson's ratio 0.25 and an effective coefficients of friction, μ΄=0.4. We computed Coulomb stress change caused by the 20 May 2012 event on optimally oriented planes to regional compression (200 bar; Figure 1). For shortening azimuth we adopted the orientation of the P-axis of the USGS focal plane solution of the 20/5/2012 event (N21Ɛ). As a variation, Coulomb stress can be calculated on planes of fixed orientation if it is known that there is a fabric of existing thrust faults in the Po Plain area which are likely to provide planes of failure. In this case we assume that E-W striking, south-dipping thrust faults of the 29 May 2012 type-of-rupture will be of interest as candidates for failure (Figure 2). In both cases we found that triggering is promoted as the ΔCFF values were positive in the hypocentral area of the 29/5/2012 earthquake (between 0.6-0.8 bar).

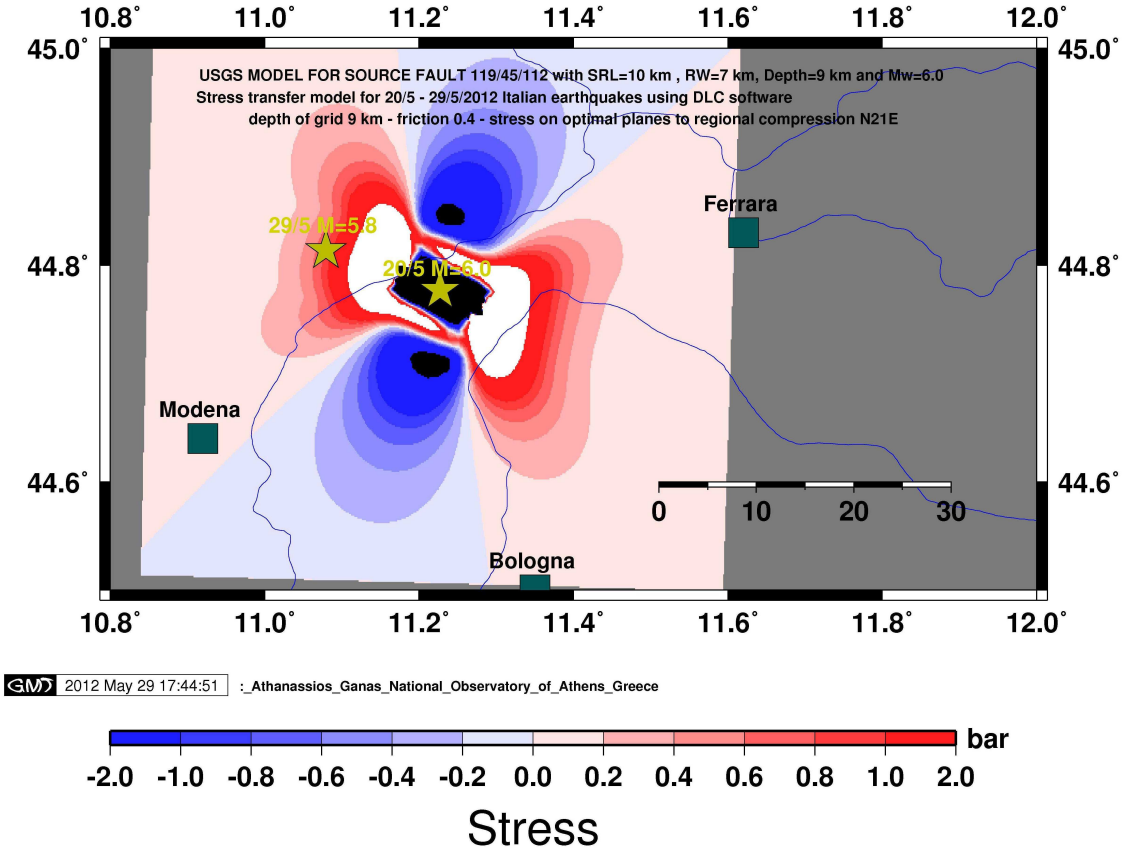

Figure 1: The map shows the distribution of Coulomb stress at the depth of 9 km (depth of 29-5-2012 hypocentre, USGS solution) for optimal planes to regional

compression (N21°E). The calculations consider an inclined rectangular dislocation that ruptured on 20 May 2012 according to a slip model published by USGS. Areas in red indicate loading of the crust, while areas in blue indicate relaxation (areas of stress shadows). Yellow stars show epicentres of 20 May and 29 May main shocks. The static stress transfer in the area of the 29 May earthquake amounts to 0.6-0.8 bar, i.e. suggesting that this earthquake was triggered by the 20 May 2012 event. Other modelling parameters are shown on the map.

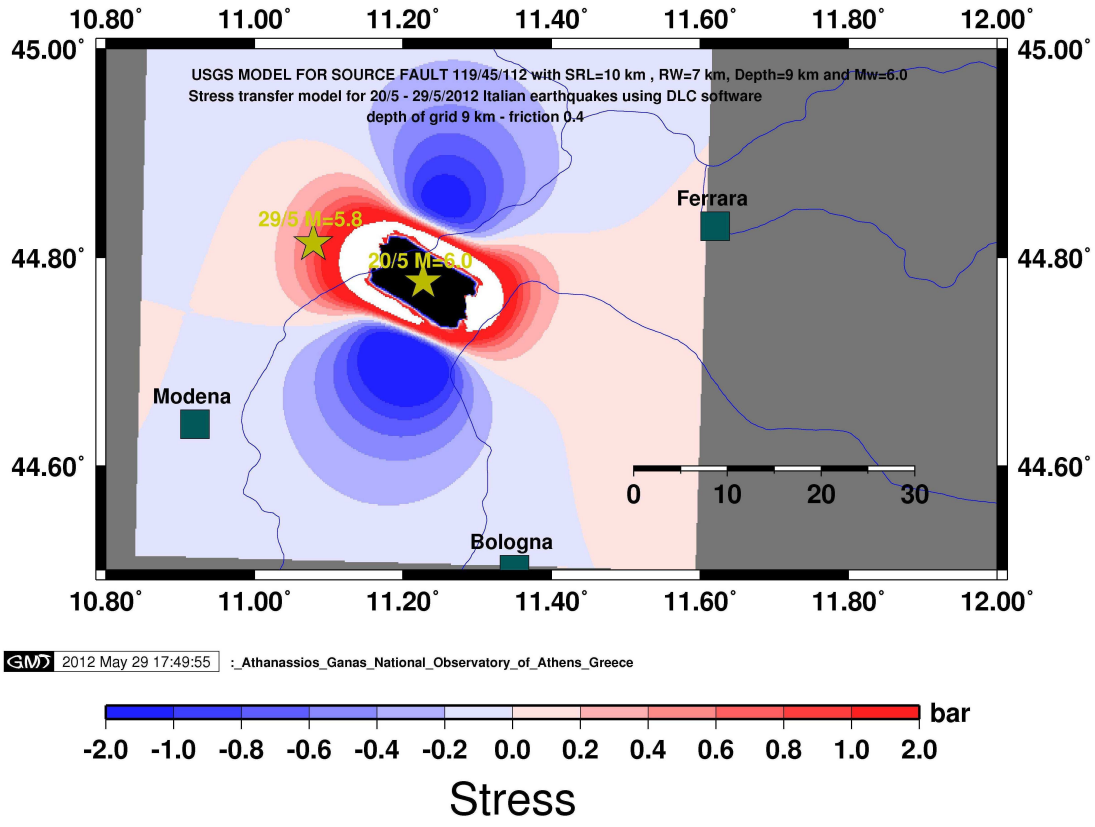

Figure 2: The map shows the distribution of Coulomb stress at the depth of 9 km (depth of 29-5-2012 hypocentre, USGS solution) for target planes similar in attitude to the 29 May 2012 focal plane solution by USGS. The calculations consider an inclined rectangular dislocation that ruptured on 20 May 2012 according to a slip model published by USGS. Areas in red indicate loading of the crust, while areas in blue indicate relaxation (areas of stress shadows). Yellow stars show epicentres of 20 May and 29 May main shocks. The static stress transfer in the area of the 29 May earthquake amounts to 0.6-0.8 bar, i.e. suggesting that this earthquake was triggered by the 20 May 2012 event. Other modelling parameters are shown on the map.