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The epicentral fingerprint of earthquakes

Patrizio Petricca[1], Christian Bignami[2], and Carlo Doglioni[1,2]
[1]Sapienza Università di Roma, Italy (patrizio.petricca@uniroma1.it)
[2]Istituto Nazionale di Geofisica e Vulcanologia (INGV), Italy

InSAR images allow to detect the coseismic deformation, delimiting the epicentral area where the larger displacement has been concentrated. The main observations are: 1) the most deformed area in the ideal case is elliptical (for dip-slip faults) or quadrilobated (for strike-slip faults) and coincides with the surface projection of the volume coseismically mobilized in the hanging wall of thrusts and normal faults, or the crustal walls adjacent to strike-slip faults; 2) the dimension of the deformed area detected by InSAR scales with magnitude of earthquake and for M≥6 is always larger than 100 km, increasing to more than 550 km^2 for M≈6.5; 3) the seismic epicenter rarely coincide with the area of larger vertical shaking (either downward or upward); 4) the higher macroseismic intensity corresponds to the area of larger vertical displacement, apart from local site amplification effects; 5) outside this area, the vertical displacement is drastically lower, determining the strong attenuation of seismic waves and the decrease of the peak ground acceleration in the surrounding far field area, apart from local site amplifications; 6) the segment of the activated fault constrains the area where the vertical oscillations have been larger, allowing the contemporaneous maximum freedom degree of the crustal volume affected by horizontal maximum shaking, i.e., the near field or epicentral area; 7) therefore, the epicentral area and volume are active, i.e., they coseismically move and are contemporaneously crossed by seismic waves (active volume), whereas the surrounding far field area is mainly fixed and passively crossed by seismic waves (passive volume). Therefore, here we show how the InSAR images of areas affected by earthquakes represent the fingerprint of the epicentral area where the largest shaking has taken place during an earthquake. Seismic hazard assessments should rely on those data.