HALM: A Hybrid Asperity Likelihood Model for Italy

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The Asperity Likelihood Model (ALM), first developed and currently tested for California, hypothesizes that small-scale spatial variations in the b-value of the Gutenberg and Richter relationship play a central role in forecasting future seismicity (Wiemer and Schorlemmer, SRL, 2007). The physical basis of the model is the concept that the local b-value is inversely dependent on applied shear stress. Thus low b-values (b < 0.7) characterize the locked paches of faults –asperities- from which future mainshocks are more likely to be generated, whereas the high b-values (b > 1.1) found for example in creeping section of faults suggest a lower seismic hazard.

To test this model in a reproducible and prospective way suitable for the requirements of the CSEP initiative (www.cseptesting.org), the b-value variability is mapped on a grid. First, using the entire dataset above the overall magnitude of completeness, the regional b-value is estimated. This value is then compared to the one locally estimated at each grid-node for a number of radii, we use the local value if its likelihood score, corrected for the degrees of freedom using the Akaike Information Criterion, suggest to do so.

We are currently calibrating the ALM model for implementation in the Italian testing region, the first region within the CSEP EU testing Center (eu.cseptesting.org) for which fully prospective tests of earthquake likelihood models will commence in Europe. We are also developing a modified approach, 'hybrid' between a grid-based and a zoning one: the HALM (Hybrid Asperity Likelihood Model). According to HALM, the Italian territory is divided in three distinct regions depending on the main tectonic elements, combined with knowledge derived from GPS networks, seismic profile interpretation, borehole breakouts and the focal mechanisms of the event. The local b-value variability was thus mapped using three independent overall b-values. We evaluate the performance of the two models in retrospective tests using the standard CSEP likelihood test.