Accounting for rupture directivity in ShakeMap

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The rapid and accurate information about the ground shaking following an earthquake is necessary for emergency response planning. A prompt strategy is contouring the real data recorded at the stations. However only few regions, i.e. Japan and Taiwan, have an instrumental coverage as good as needed to produce shaking maps relying almost entirely on real data. ShakeMap has been conceived in order to "fill" the data gap and producing stable contouring using the ground motion predictive equations (GMPEs) and site effect. Thus for regions where the data coverage is sparse, the interpolation plays a crucial role and the choice of the GMPE can affect strongly the goodness of the ground shaking estimation. However the GMPEs derive from an empirical regression describing the averaged behavior of the ground shaking and tend to mask, when present, specific trends due to multidimensional effects like the asymmetry of the rupture process (directivity effect). Thus, ShakeMaps for large events may not reproduce faithfully the ground motion in the near source if determined without the introduction of rupture related parameters.
One way to improve the ShakeMap prediction is to modify the ground motion modeling in order to better explain the ground motion variability. To this purpose, the empirical model can be refined with information about the rupture process (Spagnuolo PhD2010), in this case using the directivity term defined by Spudich and Chiou (Earthquake Spectra 2008).
The aim of this work is to quantify the effectiveness of refined GMPEs in improving the performance of ShakeMap. We quantify the agreement of this new GMPE with the real recorded data, and make inference about the reliability of this new ShakeMap. The test is focused on the study of the ShakeMap degradation when the number of the observations is reduced, and on the quantification of the improvements due to the directivity term. In order to conduct properly the test, we investigate two well-recorded events from Japan: the 2008 Iwate-Miyagi (M7) and the 2000 Tottori (M6.6) events.
This work is part of the DPC-INGV S3 project (2007-09), as described in the companion abstract Ameri et al. (ESC2010).

Ameri G., Cirella A., Cultrera G., Faenza L., Herrero A, Pacor F., Piatanesi A., Saraò A., and Spagnuolo E.(ESC2010):*Testing the improvement of ShakeMaps using finite-fault models and synthetic seismograms.*

Spagnuolo E. (2010): *Fault direcitvity and seismic hazard*, Ph.D.thesis.

Spudich, P. and Chiou, B. S.(2008): *Directivity in NGA Earthquake Ground Motions: AnalysisUsing Isochrone Theory*', Earthquake Spectra 24(1),279-298.