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A source parameter study of the October 27th, 2004 Vrancea (Romania) earthquake from empirical Green's functions modeling

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The Vrancea region, located in the South–Eastern part of the Carpathian arc in Romania, is one of the most seismically active areas within Europe. The earthquakes, which occurr here in a narrowly confined focal volume at intermediate depth, pose a significant threat to Romania, its neighbouring countries and especially to the city of Bucharest.

The October 27th, 2004 earthquake ($M_W = 5.9$) is the most recent relatively large shock which occurred in the area since the deployment of the K2–accelerometer network in the framework of the CRC 461 'Strong Earthquakes: A challenge for geosciences and civil engineering' (operative since 1997). Thus, this is the first somewhat larger Vrancea earthquake with numerous high–quality digital strong–motion recordings. Therefore, a source study of this event is indeed very promising.

In order to estimate the source parameters, we applied Irikura's simulation technique (1999), which uses the recordings of small earthquakes ($M_W = 4.0 - 4.5$) as empirical Green's functions. The method of Irikura is based on the self–similarity concept and assumes constant stress drop for small and large earthquakes. We considered the K2–accelerometer recordings at 19 stations. By searching for the best fit between the observed traces and the modeled ones, we estimated the source area and particle dislocation rise time of the October 27th, 2004 earthquake. With this information, it is possible to compute estimates for the dynamic and static stress drop, average displacement and particle velocity on the fault.

The results indicte a moderate static (around 380 +/- 200 bar) and a very large dynamic

stress drop ranging around 1550 +/- 700 bar. This very large dynamic stress drop leads to a remarkable particle velocity of about 4.5 m/s and is responsible for a very effective high–frequency radiation. This fact is of high importance for strong ground motion estimation in the area, as i.e., the dynamic stress drop controls the acceleration high–frequency spectral level, following the ω^2–model of Brune (1970). However, the strong dependence of any stress drop estimate on the considered rupture model is a key issue whose implications must be discussed carefully.