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Location of the L'Aquila main shock and the larger aftershocks in the following minutes

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Accurate location of a main shock and its very early aftershocks is important in order to understand the process of seismic energy release during and immediately after larger size earthquakes. Here we examine 1) the location of the hypocenter of the l'Aquila, M6.3 April 6, 2009, main shock, 2) the first burst of larger seismic energy that can be inferred from the available data during the main shock rupture, and 3) the location of more than ten earthquakes (M$\sim$3.5-4.5) that occurred in the first 4 minutes after the main shock and which are not listed in the INGV official catalogue.

For the main shock focus we perform a thorough analysis of uncertainties using both linearized-standard and grid search methodologies for earthquake location. To assess the robustness of the location, different velocity models and independently picked phase data sets are tested. All the resulting solutions fall within a radius of less than 1 km horizontally, whereas depth depends on the velocity model used. Secondly, the initial energy release at the hypocenter is comparable to that of a M$\sim$4 foreshock which occurred a few days earlier. The first burst of larger seismic energy is picked on some of the available data – its source occurs about 0.8-1.0 s after the mainshock OT, and locates updip ($\sim$2 km) and shifted the E-NE ($\sim$1.5 km) from the initial nucleation point of the mainshock. This location is consistent with a $\sim$50o SW dipping plane for the main rupture. Thirdly, the available strong motion records have been used to locate the >10 aftershocks in the first 4 minutes since the main shock OT. Because few data are available, prior information is used to condition the aftershocks to occur on or in the proximity on the main shock main rupture plane.