Problematic assessment of the fault plane of the April 11, 2010, Mw 6.3, deep earthquake in southern Spain

Zahradnik, J.[1], Sokos, E.[2], Tselentis, G-A.[2]

[1]Charles University in Prague, [2]University of Patras

jiri.zahradnik@mff.cuni.cz and esokos@upatras.gr

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Based on the previous experience with the so-called H-C method (Zahradnik et al., 2008) applied in 2008 to five M6 earthquakes in Greece (e.g. http://www.emsc-csem.org/Doc/20080608_GREECE/H_C_08_06_2008.pdf) and to the 2009 L'Aquila earthquake (http://www.emsc-csem.org/current/evt/aquila.pdf) we report on our attempt to quickly assess the fault plane for the recent deep Mw6.3 event in Spain (20100411 at 22:08:15.9 UTC; GCMT event C201004112208A). The earthquake is interesting because of its relation with the positive P-velocity anomaly detected by tomography (Spakman, 1986), marking the subducted slab whose bottom part, below ~150km, is almost aseismic, with only a few deep events like the studied one (Buforn et al., 1991).We concentrate on the presumably most relevant hypocenter (H) determination, that by the local network IAG (Instituto Andaluz de Geofisica): Lat 36.950 N, Lon –3.647 E, depth 610 km. This H position is compared with three centroid-moment tensor solutions, i.e. the solutions including determination of the 3D position of centroid (C): Harvard, USGS and INGV; see Figures 1 to 3.

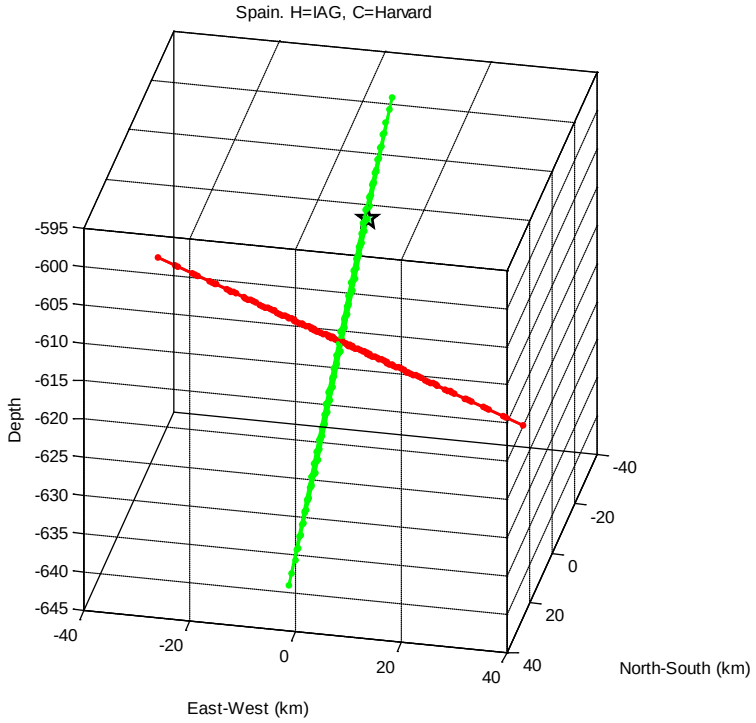

Figure 1. The H-C plot using the **IAG hypocenter** (asterisk) and **the CMT solution of Harvard**. The centroid C (Lat 37.12 N, Lon –3.66 E, depth 620 km) is in the middle of the two planes (green and red) whose strike and dip correspond to the CMT solution. Proximity of H to the green plane (strike 186, dip 74, rake -109) suggests that just that sub-vertical plane was the fault plane. The axes labeled North-South and East-West are positive to North and East, respectively. The distance between H and the green / red plane is 1.5 / 16.1 km, respectively.

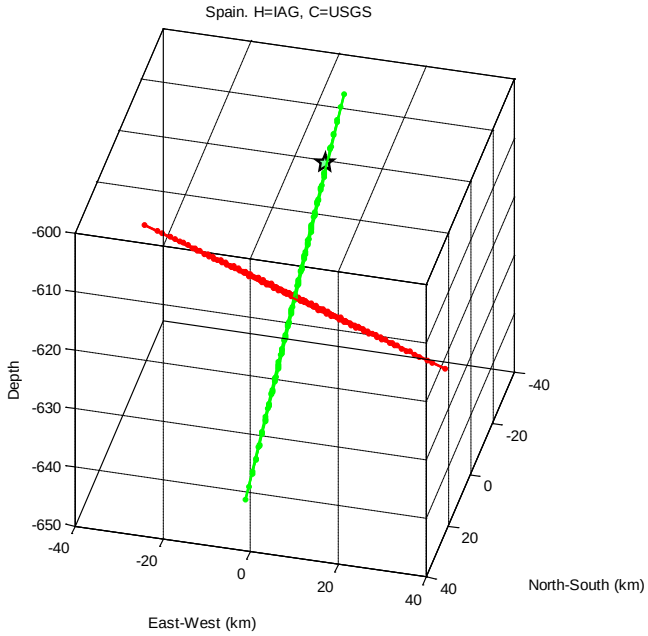

Figure 2. Same as in Figure 1, but combining the **IAG hypocenter** with the **CMT solution of USGS**. The distance between H and the green / red plane is 0.6 / 21.9 km, respectively.

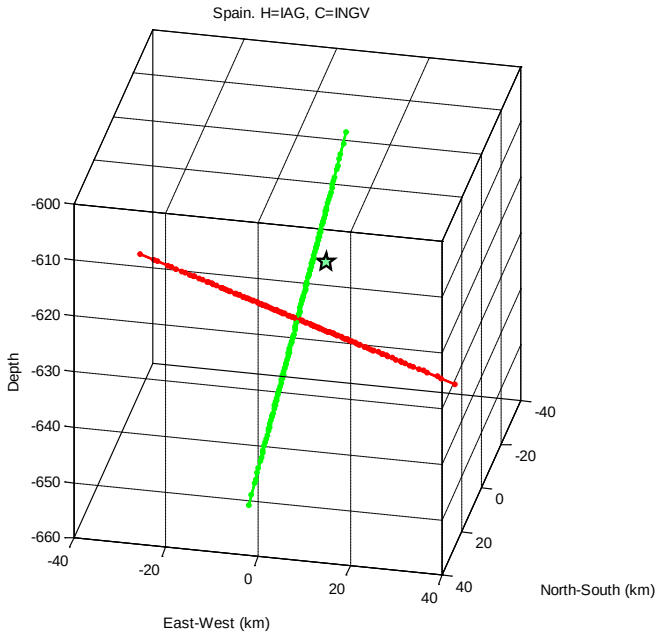

Figure 3. Same as in Figure 1, but combining the **IAG hypocenter** with the **CMT solution of INGV**. The distance between H and the green / red plane is 6.6 / 11.5 km, respectively.

It is also useful to compare the distances of hypocenter H from the centroid C for the three solutions: Harvard, USGS, INGV that yield 21.4, 24.9, 39.9 km, respectively. The latter distance (INGV) seems too large for an Mw6.3 event. It may relate with asymmetry of the INGV station network with respect to the studied event. The H-C consistency based on the IAG location and the CMT solutions of Harvard and USGS is much better, both preferring the sub-vertical fault plane. Nevertheless, independent check by means of the CMT solution based on the stations of the IAG network (including a 3D calculation of the C position) would be useful.

Note however, that the preference of the sub-vertical plane in this report is critically dependent on the accuracy of the H depth. (That is why we focused only on the local seismic network.) If, for example, we consider the Harvard CMT and the present IAG epicenter, but artificially move the hypocenter from the present depth of 610 km to 630 km, the sub-horizontal plane would be a more likely candidate for the fault plane. With hypocenter depths larger than 630 km, the H-C consistency would disappear. Final answer may be obtained with the focal depth constrained by the pP – P differential travel time from teleseismic stations.

If our interpretation is valid, the relative position of the hypocenter and centroid would suggest that the rupture propagated predominantly down and to the north.

Reference:

Buforn, E., Udias, A., Mezcua, J., Madariaga, R. (1991). A deep earthquake under South Spain. Bull. Seism. Soc. Am. 81, 1403-1407.

Spakman, W. (1986). Subduction beneath Eurasia in connection with the Mesozoic Tethys. Geologic en Mijnbouw 65, 145-153.

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