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Solid Earth Discussions

Interactive comment on "The 11 May 2011 earthquake at Lorca (SE Spain) viewed in a structural-tectonic context" *by* R. L. M. Vissers and B. M. L. Meijninger

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For the purpose of this discussion, we first wish to thank anonymous referee #1 for the thoughtful comments, to which we should like to reply as follows.

We were somewhat surprised that referee #1 expresses such a firm objection against our suggestion that the Lorca earthquake may be understood in terms of Africa-Eurasia convergence. As written in our paper, we suggested this because the regional bulk strain ellipse based on structural data, seismological and modelling work has a shortening direction close to the Africa-Europe motion of DeMets et al (1994). As said, this led Meijninger and Vissers (2006) to conlude that the latest Miocene to recent defor-

mation on the fault network was controlled by that motion. We certainly did not intend to even suggest that the earthquake motion on the Alhama de Murcia fault should equal the Africa-Europe plate motion vector. First of all, the Betic and Alboran crust is strongly broken up during a Miocene history related to extensional processes in the Alboran domain. Such a fractured crust calls for heterogeneities that may cause considerable variations in local stress fields (Martinez-Diaz, 2002). More importantly even, the Alboran lithosphere became thermally anomalous due to transient changes in the upper mantle structure, and the region still has a high heat flow. The consequence in our view is that the current Africa-Eurasia motion is accomodated in a diffuse way by the entire Betic-Rif-Alboran domain, and that local motions may considerably deviate from the overall Africa-Eurasia motion vector. The WNW trend in the GPS data seems to substantiate this view, which is opposed to that of considering the system as a discrete boundary between essentially elastic plates. We therefore only wish to say that the earthquake motion on the Alhama de Murcia fault as inferred from seismology is consistent with the overall setting of current Africa-Eurasia plate motion, a conclusion which seems in line with previous structural as well as seismological studies (Martinez-Diaz, 2002; Buforn et al., 2004).

As to the seismological data on the Lorca earthquake, we have mentioned the USGS/SLU regional moment solution but indicate that we prefer the Global, IGN and GeoAzur CMT solutions as opposed to the regional moment solution because it uses the low frequency signal of the seismogram. We have indeed refrained from discussing the CMT solutions reported by the Italian INGV and GFZ that are similar to the USGS/SLU regional moment solution but clearly less consistent with the structural data. While this latter aspect and our intention to keep matters simple certainly played a role, there are two reasons that led us to discard the INGV and GFZ solutions. First, there is a remarkable consistency of the global GMT solution with that of the Spanish IGN, and this latter solution is based on data from 64 seismic stations distributed over the Iberian Penisula. Secondly, the Italian INGV solution is based on data from the Italian seismic network which is clearly in a geographically much worse position to study

an event in S Spain. The GFZ website indicates that their CMT solution for the Lorca earthquake, almost identical to the INGV solution, was done manually but, although unclear in this particular case, GFZ reports that lower magnitude events are commonly interpreted on the basis of up to 25 stations only. In addition to a poor consistency with our structural data, we therefore decided to discard the INGV and GFZ solutions. We thank referee #1 for recalling the study of Martinez Diaz (2002), which we omitted to quote probably because of the short time in which our paper was written. We are fully aware of that publication which in our Meijninger and Vissers (2006) paper we quoted as a previous study lending clear support to our structural work.

Additional reference: Martinez-Diaz, J,J.: Stress field variation related to fault interaction in a reverse oblique-slip fault: the Alhama de Murcia fault, Betic Cordillera, Spain, Tectonophysics 356, 291-305, 2002

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