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Solid Earth
Discussions
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Interactive comment on "Seismicity related to the eastern sector of Anatolian escape tectonic: the example of the 24 January 2020 Mw 6.77 Elazığ-Sivrice earthquake" *by* Mohammadreza Jamalreyhani et al.

Anonymous Referee #3

Received and published: 17 July 2020

General Comments:

The coseismic data from some seismological networks and from SAR Sentinel-1 satellite are analyzed in order to estimate the fault parameters of the 24 January 2020 earthquake, understand the aftershock distribution, and the future distribution of events on the EAF. The paper is well structured and written. It represents an interesting application of mature software, with some interesting conclusions about the seismic gaps on the EAF fault. But, some conclusions and discussions are not examined with sufficient details, and some sentences are not completely debated. The time correlation among

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the seismic events can be not studied (only) with an elastic model (Coulomb 3.3), but using also other types of models, for example, visco-elastic, visco-plastic. Some connection between the probable forecast events and the mainshock should be discussed with more detail, especially for the journal where the authors have submitted. The reviewer suggests acceptance after major revision.

Scientific Comments:

In the Introduction, the authors describe briefly the geodynamic context about the Anatolian plate and the East Anatolian Fault. The slab pull model and mantle flow model are only two of the several models discussed in the literature. For, example, the lateral extrusion of crustal wedges as discussed in Mantovani et al. 2001 (Short and long term deformation patterns in the Aegean-Anatolian systems: insights from space geodetic data (GPS) and Numerical simulation of the observed strain field in the central-eastern Mediterranean region) explain the kinematic of the Anatolian plate using a different point of view. I think, for the sake of completeness it is right to describe briefly and mention the other models of the Mediterranean geodynamic pattern. The paper represents an interesting application of mature software to analyze and inversion of seismic and SAR/GNSS data. Also, the authors use the Coulomb 3.3 software in order to estimate the coseismic static stress changes. The authors have developed and elastic model in order to estimate the spatial evolution of the Coulomb stress and they have discussed the correlation between the stress pattern and aftershocks distribution. Also, they have suggested that the increased stress in some parts of the EAF can expedite large earthquake activity in this region. I think that this elastic approach is a good model to understand the aftershock distribution, but to study the time distribution of the seismic events in an area it is necessary to use other models, for example, a visco-elastic model where the visco-elastic proprieties of the lower crust can be modeled and reproduce the time evolution of the stress field in the study area. I suggest to the authors introduce in the discussion and/or conclusion paragraph a brief discussion about the problems and limitations of the elastic model when are used in the earthquake

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correlation time studies.

Technical corrections:

Line 44: ....it did not host major earthquakes during the last hundred years (Fig. 1): the most recent, large earthquake on the EAF dates to 1971 ...... A more strong earthquake along EAF was 2010.....

The 1971 event has occurred only about 50 years ago, and 2010 is only a few 'geological seconds' before now. It is not clear why the authors speak about the last hundred years. I agree with the authors that the large earthquake recurrence time on the EAF is greater than the NAF, but I suggest to the authors to modify the time span in these sentences in order to have an agreement.

Line 55: I think it is not completely correct to mention a paper only submitted.

Bletery, Q., Cavalie, O., Nocquet, J-M., and Ragon, T.: Distribution of interseismic coupling along the North and East Anatolian Faults inferred from InSAR and GPS data, Geophys. Res. Lett. Earth and Space Science Open Archive, https://www.essoar.org/doi/10.1002/essoar.10502450.1, submitted, 2020.

Line 69. Same consideration about a submitted paper. I think the mentioned results can be not reported.

Line 76: I suggest to the authors to use the same decimal digits about the Elazig-Sivrice earthquake (6.8) unless they have estimated the magnitude with associated uncertainty on the second decimal digit.

Line 116: Unfortunately, I am a physics, and if I write 6.77 ± 0.1 I do not pass the first exam of the Laboratory. I suggest to the authors to write 6.8 ± 0.1 and change in the text substituting 6.8 at 6.77. In Table 1, about this study are reported two 6.7 values, perhaps these values are 6.8.

Line 158: Most of the foreshocks including two Mw $\sim$5 are located very close to the mainshock nucleation point, suggesting that they could have played a role in the mainshock preparation. This is a 'strong' sentence with support of only two references, but it can have important fallout, why the authors believe these earthquakes could have a role in the mainshock preparation, these events have anticipated or delayed the mainshock?

Line 187: Why do you use these values for Young, shear, and Poisson modulus? Line 188: I suggest to the authors to discuss briefly why they have chosen the middle value of the apparent coefficient of friction.

Line 192: In the caption of Figure S6 change Figure 3 with Figure 4 (I think)

Line 218: These loaded stresses can expedite future large earthquakes on either one of these segments. . . .. I think that the Coulomb stress has been estimated on the fault plane of the previous earthquake or . . .. I suggest to the authors to explain in more detail these concepts.

Line 227: I suggest to the authors to indicate the Figure where the aftershocks cloud north of the EAF can be seen. I think it is the cloud at the NE near the lake.

Line 255: I suggest to the authors to report the three sectors discussed in Figure 3 in order to help the reader.

Line 264 and ...: I can in agreement with the authors about the increasing of the stress on some fault segments due to the study earthquake. The problem could be represented that the elastic model adopted to give the 'instantaneous' stress increasing, as briefly discussed for the authors to provide the energy for the aftershocks. The possibility of a stress transfer could be investigated with viscoelastic or similar models where it is possible to model the distribution of the stress/strain in the time. But another approach could require a lot of time, therefore I suggest to authors to discuss briefly the different approaches between elastic and viscoelastic (for example) models and the kind of results that they can obtain.

Line 264.... It is not clear in the text which scenario the authors believe it is more realistic (1, 2, or 4). Please clarify this point

Line 284: Local seismicity clusters, appearing months prior to the ElazÄśÄ§-Sivrice earthquake occurrence, probably track the slip instability onset. Probably I am in agreement with the authors, but they could briefly explain why these events have increased the stress on the Elazig-Sivrice fault. There is also a possibility that they have decreased the stress on the fault.

Line 525 Caption Figure 1: lost references about the kinematic pattern shown in the left up corner of the figure.

Line 675: lost reference about the active faults (Basili et al. 2013)?

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