

Reply Anonymous Referee #1

Thank you for passing on the review of our manuscript on the Elazig-Sivrice earthquake and comments. We have taken great care to address all of the concerns. The detailed one-by-one response to the comments is included below (the review itself is in black, and our responses are in green).

The study presents a detailed analysis and interpretation of the 2020 January 24 Mw6.7 The Elazig-Sivrice earthquake. The study presents a full geodetic and seismo-logical analysis of the source rupture and the peripheral seismicity including foreshocks and aftershocks.

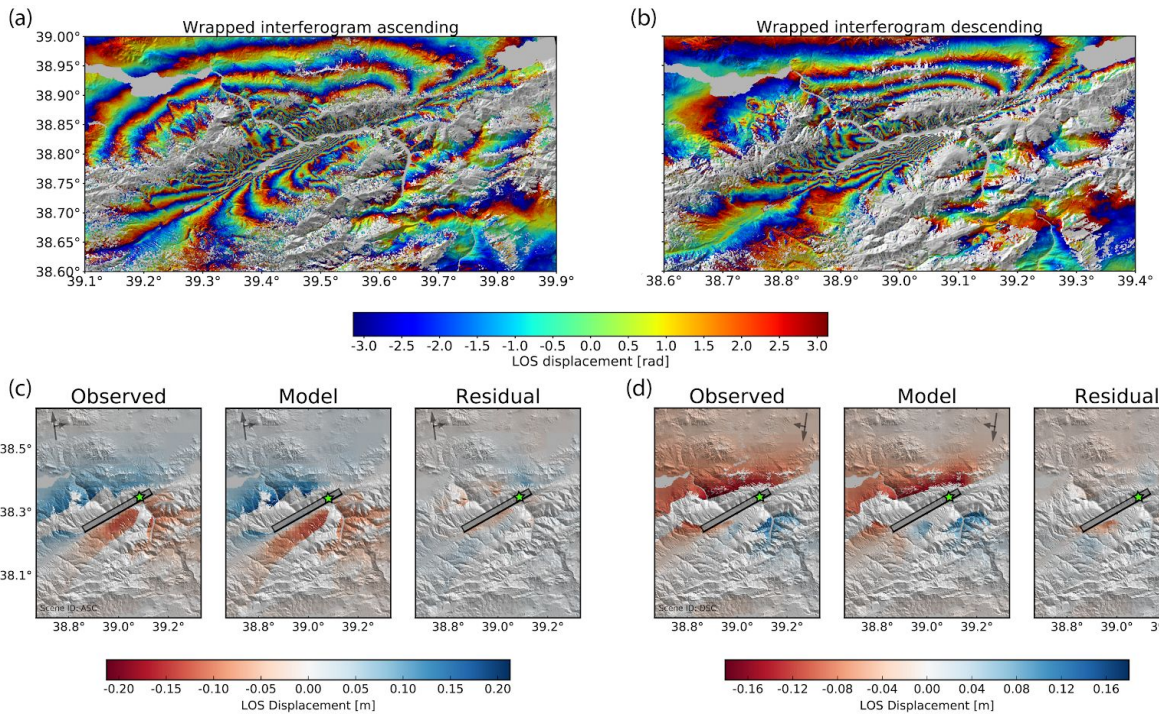
Coulomb stress and seismicity pattern – Interestingly, the south part of the fault has no aftershocks. This seismic quiescence is puzzling even more due to the prediction of the Coulomb stress analysis and the symmetry in the InSar data from both sides of the fault supporting that surface deformation took place at the south. Do you have explanation for that behavior?

The observation that the location of almost all aftershocks is north of the fault trace, is in good agreement with the focal mechanism solution and finite-fault modeling that point to an NNW dip of the fault plane. In a surface projection, an NNW fault dip offsets the rupture area at depth to the NNW. We show the centroid depth distributions of the aftershocks in Fig. 3, C1, C2, and C3.

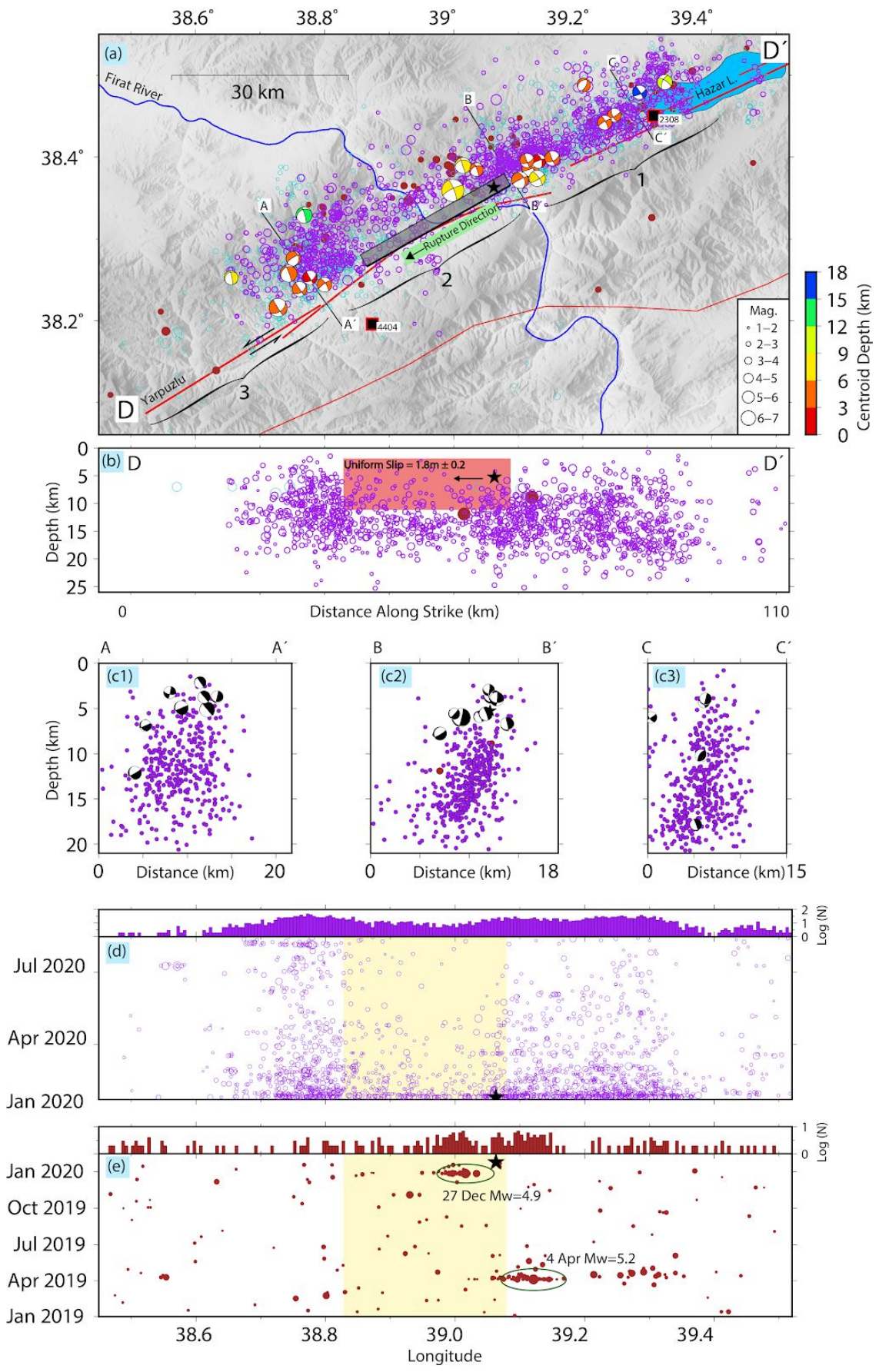
The surface displacement measured by InSAR shows surface deformation on both sides of the fault, but at depth, the deformation will also be largest close to the rupture plane and again would show an offset to the NNW in a surface projection.

We have also updated the former figure 3 (Figure 5 in the new version) and figure 2 (Figure 3 in the new version) to show this result more clearly.

We also have added new sentences about the limitation of Coulomb stress modelling.



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Specific comments:

1- L. 24: Please use quantitative rather than “small” for the described foreshock cluster:

Thank you for this suggestion. We rephrased the abstract and manuscript, being quantitative. There are indeed two foreshock clusters, with maximum magnitudes of 4 April Mw 5.2 and 27 December Mw 4.9.

We have added new sentences in line 4 of the abstract and we removed “small” in line 24.

“Two foreshocks with Mw ≥ 4.9 and clusters of seismicity (MI Ö 3) located in the proximity of the main rupture’s hypocenter”

2- L. 29: Please explain how the statement for shallow locking depth corresponds with the seismicity range presented in Fig. 1 (0 – 30 km).

We believe that the instrumental and historical catalogs (Fig. 1) have a poor depth accuracy to discuss the shallow locking hypothesis by Cavalié and Jónsson (2014). Our statement is only based on the analysis of the Elazi-Sivrice earthquake and supports this hypothesis. We have added the following sentences in the discussion section:

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3- L. 118: Please explain the usage of strong motion sensors to capture the low-frequency signal:

The low-frequency signals are used for the moment tensor inversion using regional and teleseismic broadband data. The resolved source geometry is then used to constrain the finite fault modeling. Here, we use higher frequencies (0.08-0.20 Hz) from strong motion sensors in the near field, to capture details of the rupture process. InSAR is important for finite-fault inversion to fix the lower-frequency image of the source and provides spatial resolution and constrains the fault position. Seismic data, especially near-field strong motion data is essential to resolve the temporal change in detail and provide better resolution (Anderson, 2003; Ide, 2007).

We have added the following sentences with references in the mainshock and method sections to clarify this issue and also the criteria that we selected the modeled stations:

In the mainshock section:

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4- L.131: Did the earthquake rupture to the surface? This is not clear.

Thanks for pointing out the lack of clarity. The mainshock did not reach the surface with significant rupture. We see some disrupted fringes in the interferograms but these motions are very small compared to the average fault slip. Also, the modeled uppermost edge of the rupture at ~2.5 km depth, explains the lack of surface rupture. Now we have added new clear sentences as following in the mainshock section and with new references suggested by reviewer #2.

Furthermore, we have added the new sentence which mentioned the recently published study and their results about the absence of clear surface rupture (Pousse-Beltran et al. (2020)).

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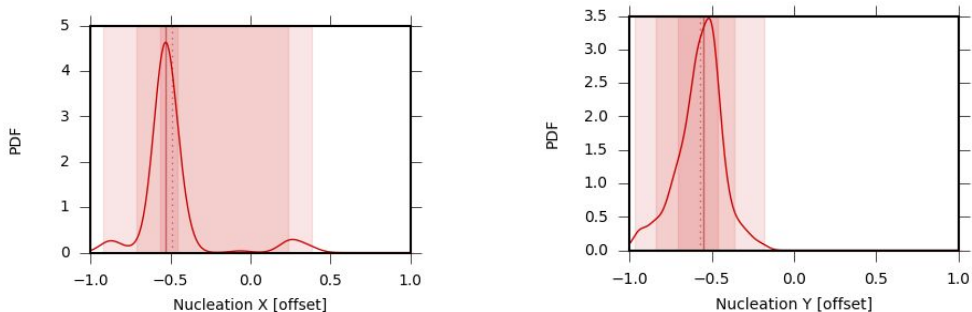
5- L. 206: It is not clear to me how did you conclude that the mainshock nucleated from the topper part of the fault plane from Fig. 3b. Please elaborate.

Thanks for pointing out the lack of clarity. In our finite fault modeling, we consider the fault as a rectangular plane. We optimized for the nucleation point, with variable locations on the faults along-strike and in depth. The finite fault inversion results show both that the rupture nucleated (1) at shallow depth and (2) ENE of the main ruptured area.

We apologize for the missing information on the resolution of the nucleation point and included a plot in Figure S13 to show the distribution of the hypocentral parameters. we provide the detailed output reports for all inversion runs in a separate online report at:

<https://data.pyrocko.org/scratch/grond-reports/2020-elazig-sivrice/#/>

We also clarify in former figure 3 (Fig.5 in the new version). They clearly show a shallow hypocenter of about 5 km, which is in the upper part of the fault plane with the confidence of 1 km (The uppermost edge of the fault plane is modeled at ~2.5 km depth and the width of the fault plane is ~9 km).



Missing information in the former figure S 13.

