Dear Editor,

Thank you for passing on the review of our manuscript about the 18 April 2021 Mw 5.9 Genaveh earthquake. We have taken great care to address all of the concerns.

The detailed one-by-one response to the comments from the reviewers is included below (the reviewer itself is in bold black, and our responses are in green).

#Reviewer 1

I have read and reviewed the manuscript "The 18 April 2021 Mw 5.9 Genaveh earthquake in the South Dezful Embayment of Zagros (Iran); Co-seismic slip of the mainshock and analysis of the aftershock sequence from InSAR and seismic data", and I believe that it is suitable for publication pending major revisions.

This paper provides a thorough analysis of the Genaveh mainshock and aftershock, including seismic (relocations and waveform inversion) and geodetic (InSAR) analysis, as well as fills a data gap between Northeastern and Southeastern Zagros. I appreciate the careful way the work is acquired and recommend several points listed below to strengthen this work further.

We are very grateful for the positive feedback. The detailed one-by-one response to the comments is included below.

Major comments:

1- The introduction section needs more background information about the active faulting and seismicity in this region and more information about the previous studies (e.g., Golshadi et al., 2022) on this earthquake sequence.

We are grateful for this good comment. In the revised manuscript these criteria have been discussed extensively. We have added the following paragraphs in the introduction section:

"The Zagros changes morphology along and across strike, likely reflecting differences in the sedimentary cover — in particular its overall thickness and the spatial extents of weak, detachment-forming evaporitic layers. However, it's not well understood whether these morphological changes are reflected in (or perhaps even governed by) differences in the style of earthquake faulting. The advent of InSAR and recent improvements in seismic station coverage have allowed focused studies of major earthquake sequences that can shed light on these questions.”

“Recent studies show the variety of deformation styles and seismicity in different parts of the ZFTB (e.g. Nissen et al., 2019; Jamalreyhani et al., 2021b; 2022). The outer part of the ZFTB, named Zagros Foreland Folded Belt (ZFFB), is subdivided into four tectono-stratigraphy domains (Figure 1): from SE to NW, the Fars Arc, the Dezful Embayment, the Lurestan Arc, and the Kirkuk Embayment. Recent studies of earthquakes in the SE Zagros (Qeshm (Nissen et al., 2010), Fin (Roustaei et al., 2010), Khaki-Shonbe (Elliott et l., 2015), Khalili (Jamalreyhani et al., 2021)) and in the NW Zagros (Ezgeleh and Sarpolzahab (Nissen et al., 2019; Jamalreyhani et al., 2019), Mandali (Nissen et al. 2019), Murmuri (Copley et al., 2015)) have illuminated the structural style in those regions, but so far there has been an absence of large events in the central Zagros. The Mw 5.9 Genaveh earthquake on 2021 April 18, therefore, fills an important gap and provides an opportunity to study the characteristics of observed seismicity in the Dezful Embayment.”

“Nissen et al. (2011) suggested a vertical separation of the seismicity in the Zagros, implying that all moderate-sized events, especially those in the ZSFB, happen in the competent segment of the sedimentary layer and all the aftershocks in the basement, mostly triggered by stress perturbations. The recent relocation of 70-year instrumentally recorded seismicity in the entire Zagros shows that the earthquakes are mostly concentrated at focal depths of 5-25 km (Karasözen et al., 2019).”

“There are no historical and instrumental records of any earthquake unambiguously linked to faults within Bushehr province (Ambraseys & Melville, 1982; Berberian, 1995). The Genaveh seismic cluster partially filled the data gap in the Karasözen et al. (2019) study, in which there was no report of relocated events in the area. Nevertheless, the IRSC catalog indicates 3 events larger than Mw 5 colocated with the Gulkhari anticline and considered the background seismicity.”

“The coseismic slip distribution of the Genaveh earthquake mainshock has been investigated by Golshadi et al. (2022) based on Interferometric Synthetic Aperture Radar (InSAR) modeling and they only discuss the mainshock causative fault plane.”

2- The findings in this study need to be explained more thoroughly, both within the text and with figures. It is tough to link the results with the interpretations in the Discussion Section.

We have rephrased our statement in the discussion section.

Furthermore, figures 3 and 5 have been modified in the revised manuscript. We also now have presented several additional supplementary figures in the revised version.

3- I strongly encourage authors to include their results in the manuscript. Currently, relocations and waveform inversion results are missing.

Thanks for highlighting the need for more clarity. We have added new tables (Tables S1, S3, S4), including the relocation and waveforms inversion results in the supplementary file.

For example see below for the MT results (Table S4 in the revised supplementary file):

No	Date and time (UTC)	Latitude°	Longitude°	M_w	Depth (km)	Strike1°	Dip1°	Rake1°	Strike2°	Dip2°	Rake2°
1	2014-05-21 09:46:29	29.604	50.863	5.3	8.0 ± 1.0	119 ± 13	61 ± 3	94 ± 16	291 ± 14	29 ± 5	83 ± 20
2	2014-05-21 10:51:27	29.631	50.859	5.1	6.0 ± 1.0	123 ± 24	67 ± 2	89 ± 46	307 ± 2	23 ± 2	93 ± 2
3	2014-06-20 22:54:18	29.872	50.897	5.0	11.0 ± 2.0	97 ± 56	52 ± 7	37 ± 25	342 ± 14	62 ± 12	135 ± 42
4	2018-03-19 04:30:46	29.696	50.767	5.0	9.0 ± 1.0	130 ± 20	60 ± 5	89 ± 4	310 ± 5	30± 3	90± 4
5	2021-04-18 06:41:50	29.751	50.685	5.9	6.0 ± 2.0	131 ± 5	62 ± 4	92 ± 5	306 ± 5	28 ± 3	86 ± 8
6	2021-04-18 08:50:37	29.857	50.653	4.2	4.0 ± 1.0	129 ± 5	64 ± 3	86 ± 8	318 ± 6	26 ± 3	98 ± 7
7	2021-04-18 21:50:19	29.799	50.610	4.1	5.0 ± 1.0	122 ± 7	75 ± 6	88 ± 8	309 ± 8	15 ± 6	96 ± 12
8	2021-04-18 22:17:45	29.737	50.657	4.6	6.0 ± 1.0	135 ± 4	60 ± 2	94 ± 6	307 ± 4	30 ± 1	83 ± 4
9	2021-04-18 22:43:50	29.727	50.594	4.2	6.0 ± 1.0	320 ± 9	68 ± 6	93 ± 13	133 ± 9	22 ± 6	83 ± 12
10	2021-04-19 21:32:47	29.788	50.6543	4.0	6.0 ± 1.0	257 ± 10	69 ± 11	-68 ± 14	28 ± 11	30 ± 10	-135 ± 15
11	2021-04-20 17:55:27	29.680	50.620	4.2	4.0 ± 1.0	306 ± 6	47 ± 10	88 ± 9	129 ± 8	43±11	92 ± 8
12	2021-05-07 12:44:50	29.740	50.597	4.1	12.0 ± 2.0	94 ± 5	55 ± 2	68 ± 8	309 ± 4	40 ± 2	117 ± 4
13	2021-05-12 16:26:14	29.740	50.689	4.3	6.0 ± 1.0	134 ± 6	62 ± 4	92 ± 7	309 ± 6	28 ± 4	86 ± 8
14	2021-05-21 11:52:15	29.756	50.560	5.0	4.0 ± 1.0	310 ± 3	45 ± 2	88 ± 2	134 ± 3	45 ± 2	92 ± 3
15	2021-05-28 20:35:48	29.808	50.603	4.9	4.0 ± 1.0	307 ± 9	56 ± 11	80 ± 21	144 ± 20	35 ± 11	104 ± 21
16	2021-05-29 00:55:02	29.805	50.643	4.0	8.0 ± 1.0	293 ± 13	70 ± 3	68 ± 16	163 ± 14	29 ± 5	135 ± 20
17	2021-05-29 02:12:53	29.731	50.641	4.7	6.0 ± 1.0	287 ± 24	65 ± 2	56 ± 46	165 ± 2	41 ± 2	140 ± 2
18	2021-05-29 02:17:17	29.756	50.583	4.1	7.0 ± 2.0	298 ± 56	53 ± 7	78 ± 25	137 ± 14	38 ± 12	105 ± 42
19	2021-05-29 23:02:50	29.713	50.578	4.0	8.0 ± 1.0	292 ± 20	48 ± 5	95 ± 4	105 ± 5	42 ± 3	84 ± 4
20	2021-07-13 11:11:49	29.862	50.893	4.9	3.0 ± 1.0	131 ± 5	55 ± 4	96 ± 5	300 ± 5	35 ± 3	81 ± 8

21	2021-07-18 14:34:17	29.737	50.189	5.6	9.0 ± 1.0	119 ± 5	57 ± 3	85 ± 8	308 ± 6	33 ± 3	98 ± 7
22	2021-07-29 23:47:24	29.678	50.567	4.4	4.0 ± 1.0	132 ± 7	55 ± 6	106 ± 8	285 ± 8	38 ± 6	68 ± 12
23	2021-08-13 09:31:27	29.886	50.882	4.4	4.0 ± 1.0	302 ± 4	42 ± 2	83 ± 6	131 ± 4	48 ± 1	96 ± 4
24	2021-10-01 02:33:19	29.829	50.569	4.3	8.0 ± 2.0	120 ± 9	72 ± 6	103 ± 13	262 ± 9	22 ± 6	55 ± 12
25	2021-12-14 09:12:53	29.735	51.121	4.1	12.0 ± 2.0	230 ± 10	84 ± 11	-15 ± 14	322 ± 11	75 ± 10	-173 ± 15

Line by line:

Lines 129-137: The authors discuss the faulting briefly. However, this is very broad. More background information about the study region regarding active faulting and previous seismicity is needed. What are the active faults in this region? What's the related historical seismicity? Is the mapped faulting align well with the seismicity?

Please see major comment #1.

Lines 129-137: Berberian's (1995) faults are missing in the manuscript. His paper is listed in the references, but I didn't see a citation. Please include the related faulting (like the Dezful Embayment fault) in the introduction and related figures.

Thanks for highlighting the missing. The Mountain Front Flexure (MFF) is after Berberian (1995). We have added the citation in figure 1 and in the text.

Lines 139-147: Authors should introduce any other work done on this earthquake, like Golshadi et al., 2022 (which is discussed later in the paper).

Done.

Line 174: I didn't see a table for the relocations. Can authors include their results as a table? Or provide a link to their results if these are available somewhere else.

We have added new tables, including the relocation and waveforms inversion results in the supplementary file.

Lines 184-187: What's the magnitude range? What are the exact dates? More information is needed, especially for the events after the mainshock. Including a table and adding more discussion here is essential for the discussion afterward.

The date, magnitude, and focal solutions of all studied events are now presented in the supplementary file, Tables S1, and S3.

Line 185: Please specify the minimum number of phase readings and the azimuthal gap used to select the events for the relocation.

The minimum number of readings for each event that are connected to other events and, thus, used to estimate relative locations are 24.
The minimum and maximum azimuthal gaps are 19.5° and 163.7 °, respectively.
We have added these sentences to the relocation section.

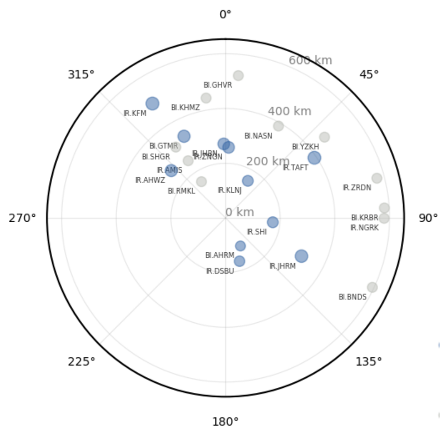
Line 187: What is the background seismicity? Please be more specific, for example, about the dates and magnitudes.
The date and magnitude of all studied events are now presented in the supplementary file, Tables S1, and S3. We have modified Figure 3 in the revised manuscript with the text string above or the beach ball.

Lines 189-195: Great explanation about the focal depth estimation. Please also include the depth uncertainty.
Done.

Lines 197-198: Please discuss all panels of Figure 2 in the text in detail. What do the authors mean by "the pattern and uncertainty of relative locations"? What's the background seismicity? Do the maps in Figure 2 show this? Figure 2c is a travel time plot. Is this a good fit? What's the interpretation here?

Thanks for highlighting the need for more clarity. We have added more explanations about Figure 2, in the text and also in the caption.

Line 219: Can authors include a figure (perhaps supplementary) showing the station distribution for the regional data used in MT? Waveform fits are shown in Figure S1, but the station distribution is necessary to assess the quality of these results.
Done. We have added a new figure in the supplementary file to show the seismic station distribution. Please see below:



Station distribution for the regional data used in MT

Line 211: Please include a table that summarizes the results of the MT solutions.
Done.

Line 233: Karasozen et al., 2019 provide custom crustal velocity models for smaller regions in Zagros, but not a regional one. Can authors specify what they mean by local and regional models? They may use a combination of a custom crustal model and ak135 together. This needs more explanation.

Thanks for this comment. "We use the modified 1-D layered "Karbaas" velocity model of Karasözen et al. (2019), which is the closest model to the region of study" in the waveform inversion. In the revised manuscript we have explained this and we have removed the word "local".

For the relocation, we use 2 layers crustal model (Moho depth 47 km), in a combination with the AK135 model (Table S2 in the revised supplementary file).
We have modified the text in the revised version.

Line 279: Are there any aftershocks recorded between the satellite passes?
Both interferograms recorded 8 events of M>4 after the mainshock.

We have added this sentence to the revised manuscript.

Lines 295-303: There is no discussion about the residual interferograms.
We have added the following paragraph to the InSAR modeling section.
"We observe more residuals in the descending track, those positive residuals reaching 9.4 mm can be due to post-seismic displacements inverted as being recorded in the ascending track. Indeed the ascending interferogram spans 4 days more of post-seismic period than the descending track."

Line 301: How does the geodetic and seismic moment compare?

We have added a comparison:
"The InSAR model moment is higher than the seismic moment (Mw 5.9), though it is possible that our InSAR models also include a small amount of postseismic afterslip."

Line 303: Lateral rupture propagation, but in which direction? What about up dip?
Thanks for highlighting the lack of clarity. We have rephrased the sentence:
"The hypocenter is located at the eastward limit and closer to the bottom of the slipping areas, likely indicating updip lateral rupture propagation toward NW."

Line 306 (Figure 4c): It seems like the aftershocks are below the main slip distribution of the mainshock. How do the authors interpret this?
We already discussed the aftershocks distribution and mechanisms in the discussion section.

"The result of aftershocks' focal mechanism and their distribution suggest that some of the aftershocks take place at the same fault plane as the Genaveh mainshock, but some are also distributed at ∼NW-trending, SW dipping fault, located at the northern crest of the Gulkhari anticline (Figure 3), likely the consequence of mainshock and bending stresses within the layers of the fold."

Line 314: Please include a thorough discussion on how the results of this study fit with each other. For example, how does the hypocenter depth from relocations fit with InSAR center depth and MT centroid? What about the aftershock cloud? What is the difference between seismic and geodetic moments?
The centroid depth and InSAR center depth are fit with each other.
We have added a discussion, following your comment (see above).

Lines 329-330: What are the differences between this study and Golshadi et al., 2022? What are the slip depth and maximum slip estimated in that study? Please introduce these in the introduction, and discuss the differences more thoroughly.
We add more comparisons now and a table to compare our results with Golshadi et al., (2022):

"The coseismic slip distribution of the Genaveh earthquake has been investigated by Golshadi et al. (2022) based on satellite data. They suggested the 5.0*9.5 km2 for the fault plane and the fault top-edge depth at 4 km. Our obtained source geometry based on InSAR data conforms to their finding although we use a different downsampling methodology. There are differences between the results of Golshadi et al. (2022) and our study concerning slip depth, and the amount of maximum slip. Golshadi et al. (2022) obtained a maximum slip around 4.5 m depth, whereas we obtained a maximum slip at depths of 5-6 km. The localization of the Golshadi et al., (2022) fault is not clearly specified enough to compare. In addition, it seems that they obtained higher residuals above 10 mm.“

Lines 345-350: Which aftershocks are at the same plane as the mainshock? What are the dates, for example? Please be specific.

Some of the early aftershocks are in the same plane as the mainshock. In the revised version we have added a table to show the obtained source parameters for the studied events, together with their uncertainties (68% confidence intervals).

Lines 354-355: This information is given too late in the text. Did the authors relocate these events? Where are these events located in Figures 1 and 2?

Yes, we relocated the background seismicity and the Genaveh earthquake sequence. Now we present tables including the relocation and focal mechanism solutions of the studied events.
Figure 1 is a large-scale figure. We have modified Figure 3 in the revised manuscript whit the text string above or the beach ball.

Figures:
Figure 1: What are the black lines represent?

The black lines represent the major active faults of Iran, after Hessami et al. (2003).
We have modified the caption accordingly.

Hessami, K., Jamali, F. & Tabassi, H., 2003. Major Active Faults of Iran, Map, International Institute of Earthquake Engineering and Seismology (IIEES), Tehran, Iran, scale 1:2,500,000

Figure 2 is too crowded; the seismicity pattern cannot be seen. In addition, it is impossible to understand which earthquake the map shows. Where is the mainshock? What are these different seismicity patterns? These figures need more explanation:

What’s the red circle on top of the seismicity in 2b?

The red stars need dates (Fig 2b). Currently, we don’t have a way to understand which earthquakes these refer to.

What are the numbers of these earthquakes (Fig. 2b)?

Can the authors explain the black lines in Figure 2b?

What are the cyan dots and lines in 2c? What's the vertical dash line refer to?

We have modified the caption of Figure 2 in more detail and also we have added more explanation of this figure in the revised manuscript.

Figure 3b needs cleaning up. Please delete the dots. The focal mechanism colors in Figure 3a, and 3b needs to match.

The dots represent the focal depth of earthquakes in cross-section. The color in panel "a" shows the centroid depths and in panel "b" which is a cross-section of depth, does not need to be colored according to the depth.

We have modified Figure 3 in the revised manuscript whit the text string above or the beach ball and following the other second reviewer's comments.

Figure 4 (InSAR): Where is the fault plane?

We have added the fault plane in the revised Figure 4.

Minor comments:

Line 84: I don't think these are the proper citations. In fact, the division of these domains does not need a citation.

Done.

Line 241: Please change the "weaker magnitude" to the "smaller magnitude."

Done.

Line 306: This should be Figure 5.

Done.

Bergman et al., 2022 is published now. Please update the citation:

Eric A. Bergman, Harley M. Benz, William L. Yeck, Ezgi Karasözen, E. Robert Engdahl, Abdolreza Ghods, Gavin P. Hayes, Paul S. Earle; A Global Catalog of Calibrated Earthquake Locations. Seismological Research Letters 2022; doi: https://doi.org/10.1785/0220220217

Done.

Reviewer 2

This study focuses on the recent Genaveh earthquake sequence in the southern Dezful Embayment, in the central part of the Zagros, one of the world's most seismically active fold-and-thrust belts. The Zagros changes morphology along and across strike, likely reflecting differences in the sedimentary cover — in particular its overall thickness and the spatial extents of weak, detachment-forming evaporitic layers. However, it's not well understood whether these morphological changes are reflected in (or perhaps even governed by) differences in the style of earthquake faulting. The advent of InSAR and recent improvements in seismic station coverage have allowed focused studies of major earthquake sequences that can shed light on these questions. Recent studies of earthquakes in the SE Zagros (Qeshm, Fin, Khaki-Shonbe, Khalili) and in the NW Zagros (Sarpolzahab, Mandali, Murmuri, Moosiyan) have illuminated the structural style in those regions, but so far there has been an absence of large events in the central Zagros. The Genaveh earthquake sequence therefore fills an important gap.

The authors use waveform modelling, hypocentral relocations, InSAR, and a local seismic reflection profile to characterize the Genaveh sequence. Some details of the methodology were lacking but the results appear self-consistent and in agreement with other available models for this event. The InSAR and waveform inversions both support reverse slip on a gentle, NE-dipping fault beneath the Gulkhari anticline, with slip restricted to the depth range ~4-7 km within the middle to lower sedimentary cover. The authors speculate that these top and bottom depths correspond to detachments in weak evaporitic layers that act to limit up- and down-dip rupture propagation (and thus, restrict the magnitude). However, the top and bottom depths are not checked off directly against a local stratigraphic column nor against the available seismic reflection profile, and the usual trade-off between slip and fault width should also be considered here (e.g. through depth sensitivity tests). The authors speculate that the mainshock may have been induced by nearby oil and gas production on the basis of its shallow (~5 km) centroid depth, but this is actually quite typical of similar sized earthquakes elsewhere in the Zagros and so I did not find this link to be convincing.

I have a number of suggestions to improve the paper. Some line by line comments are provided separately as an annotated PDF.

We are very grateful for your review and constructive comments. We have edited and revised the manuscript following your comments. Please see below for a one-by-one reply.

The motivations could have been clearer (see first paragraph above) and parts of the introduction were rather cursory. In particular, discussions of relations between buried reverse faults and surface folding and of the balance of basement and cover seismicity (all squeezed into lines 73-78) were much too brief. Studies over the past decade incorporating a wide variety of complementary methods (InSAR, waveform modelling, calibrated relocations) have converged upon a mix of basement and cover seismicity throughout the Zagros, with the preponderance of larger (M 6+) events within the cover. The cited geological cross-sections that depict faulting in either the cover (McQuarrie, 2004) or the basement (Mouthereau et al. 2007) — but not in both — are certainly much over-

simplified. It's possible that some of the very largest events may have ruptured steep reverse faults that cross the basement-cover interface to control rare, asymmetric anticlines (see Nissen et al. 2011), though other shallow earthquakes show little correlation with surface folds (Nissen et al., 2007, Barnhart & Lohman, 2013).

We are grateful for this comment. We have rephrased the introduction by adding your suggested paragraph as well.

Please see below:

"The Zagros Fold-and-Thrust Belt (ZFTB) is a seismically active region of Iran, formed during the collision of the Afro-Arabian continent and the Iranian microcontinent (e.g. McQuarrie, 2004; Mouthereau et al., 2012). The region presents one of the youngest continental collision zones on Earth and hosts frequent episodes of moderate to large shallow seismicity (e.g. Talebian and Jackson, 2004; Nissen et al., 2019; Jamalreyhani et al. 2022) (Figure 1). The Zagros changes morphology along and across strike, likely reflecting differences in the sedimentary cover — in particular its overall thickness and the spatial extents of weak, detachment-forming evaporitic layers. However, it's not well understood whether these morphological changes are reflected in (or perhaps even governed by) differences in the style of earthquake faulting. The advent of InSAR and recent improvements in seismic station coverage have allowed focused studies of major earthquake sequences that can shed light on these questions.

A long-standing question in the ZFTB is the extent to which the Precambrian basement and the thick Phanerozoic sedimentary layer participate in the observed seismicity (McQuarrie, 2004; Mouthereau et al. 2007; Talebian and Jackson, 2004; Jamalreyhani et al., 2022). Nissen et al. (2011) suggested a vertical separation of the seismicity in the Zagros, implying that all moderate-sized events, especially those in the ZSFB, happen in the competent segment of the sedimentary layer and all the aftershocks in the basement, mostly triggered by stress perturbations.

Recent studies show the variety of deformation styles and seismicity in different parts of the ZFTB (e.g. Nissen et al., 2019; Jamalreyhani et al., 2021b;2022). The outer part of the ZFTB, named Zagros Foreland Folded Belt (ZFFB), is subdivided into four tectono-stratigraphy domains (Figure 1): from SE to NW, the Fars Arc, the Dezful Embayment, the Lurestan Arc, and the Kirkuk Embayment. Recent studies of earthquakes in the SE Zagros (Qeshm (Nissen et al., 2010), Fin (Roustaei et al., 2010), Khaki-Shonbe (Elliott et l., 2015), Khalili (Jamalreyhani et al., 2021)) and in the NW Zagros (Ezgeleh and Sarpolzahab (Nissen et al., 2019; Jamalreyhani et al., 2022), Mandali (Nissen et al. 2019), Murmuri (Copley et al., 2015)) have illuminated the structural style in those regions, but so far there has been an absence of large events in the central Zagros. The Mw 5.9 Genaveh earthquake on 2021 April 18, therefore, fills an important gap and provides an opportunity to study the characteristics of observed seismicity in the Dezful Embayment."

There is also no discussion of the large, blind reverse faults that are inferred to cross the Dezful embayment (Berberian, 1995) accounting for discrete steps in the exposed stratigraphic level (these should be plotted on Figure 1). Discussion of the stratigraphy itself (lines 112-137) was more detailed but could be made more accessible to the reader by inclusion of a stratigraphic column tailored to the southern Dezful Embayment, and perhaps annotated also onto the seismic reflection line.

We already have plotted the Mountain Front Flexure (MFF) in figure 1. In the revised manuscript we have added a sentence about this fault.

Furthermore, following Shamszadeh et al. (2022a) we now have added the stratigraphic column of the South Dezful Embayment in the revised supplementary file. Furthermore, we have modified figure 3, in the revised manuscript. Please see below:

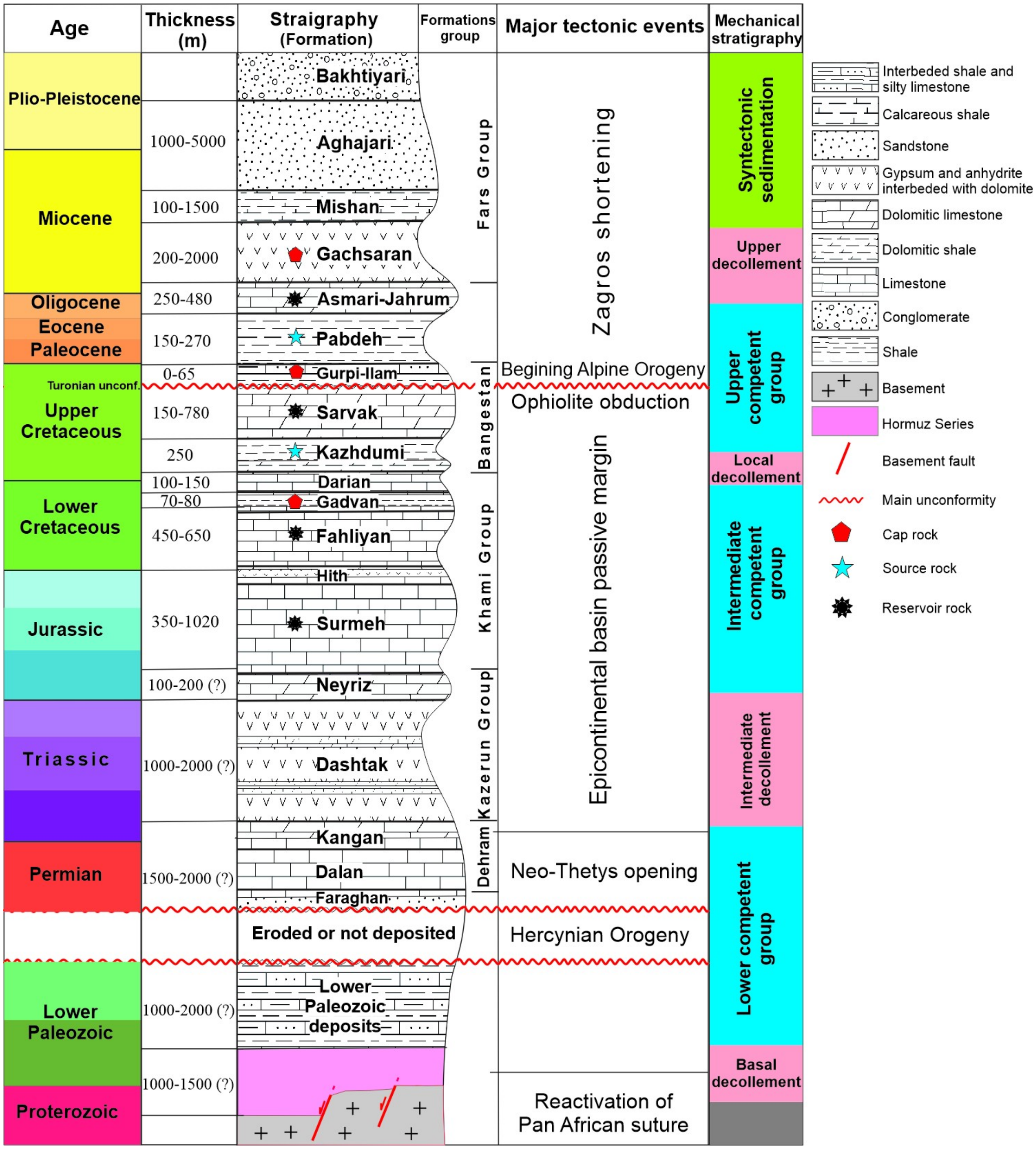
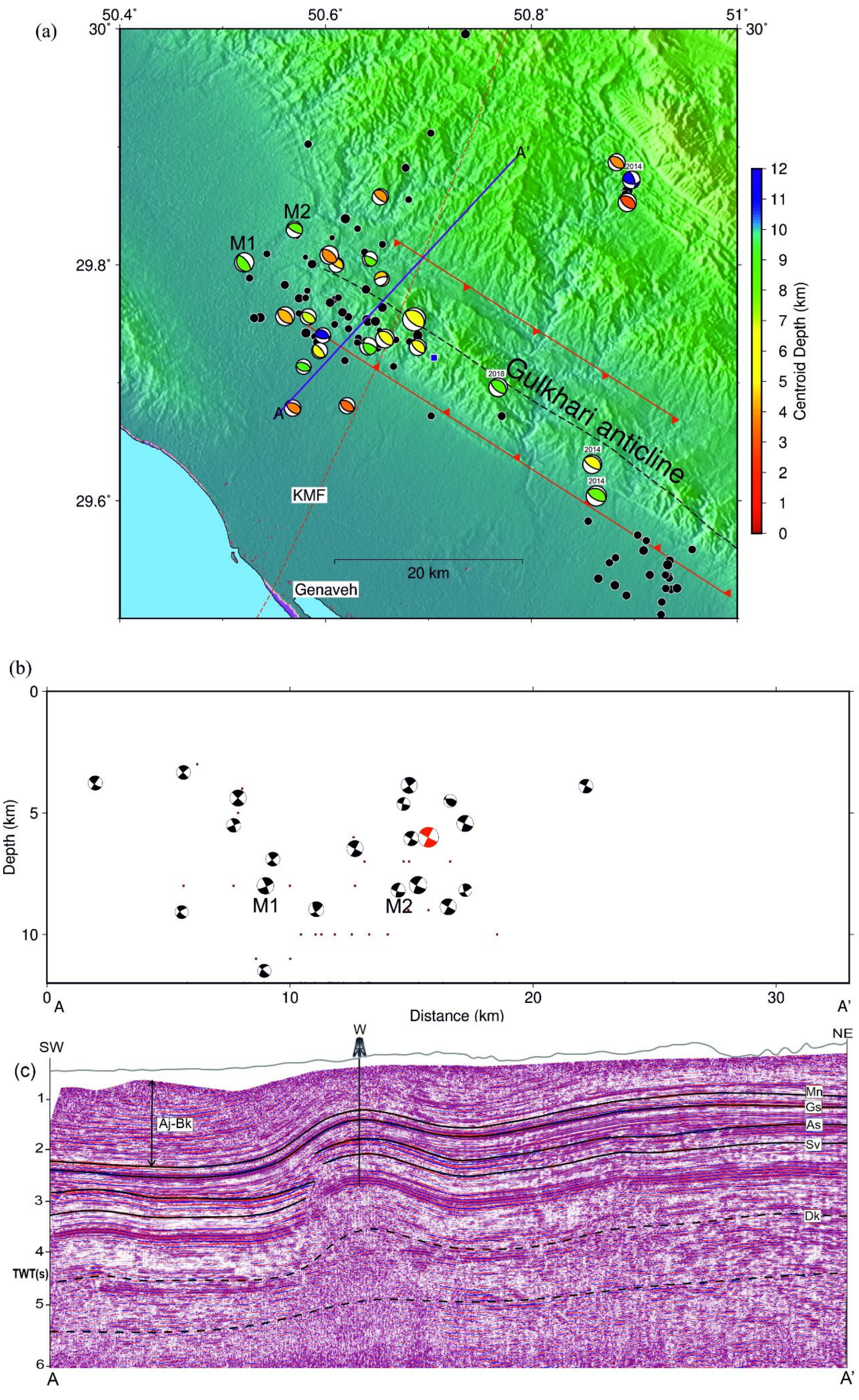


Figure S1 in the revised manuscript. Stratigraphic column of the South Dezful Embayment based on surface and subsurface data (after Shamszadeh et al., 2022a).



Revised figure 3, a) Relocated epicenters (Black circles) of Mn ≥ 3.0 events and focal mechanisms of Mn ≥ 4.0 events colored by centroid depth. The blue square shows the closest oil well to the seismic cluster. The Kharg-Mish Fault (KMF) and NW-SE trending blind thrust faults dipping NE and SW are shown by red lines. b) Cross section across the Gulkhari anticlines (A–A' profile) with our calculated focal mechanisms at their centroid depths. The red mechanism presents the Genaveh mainshock. c) Interpreted seismic reflection profile (AA' in panel a) across the Gulkhari anticline (Shamszadeh et al. 2022a). The y-axis is two-way travel time (TWT). Aj-Bk: Aghajari-Bakhtiyari formations, Mn: Mishan Formation, Gs: Gachsaran Formation, As: Asmari Formation, Sv: Sarvak Formation, and Dk: Dashtak Formation (for more information see figure S1).

There are also important missing details in the main "results" section. The velocity model used in the hypocentral relocations and waveform modelling is never explicitly stated — citing Karasözen et al. (2019) is insufficient since they incorporated a variety of models — and should be included as a supplementary table.

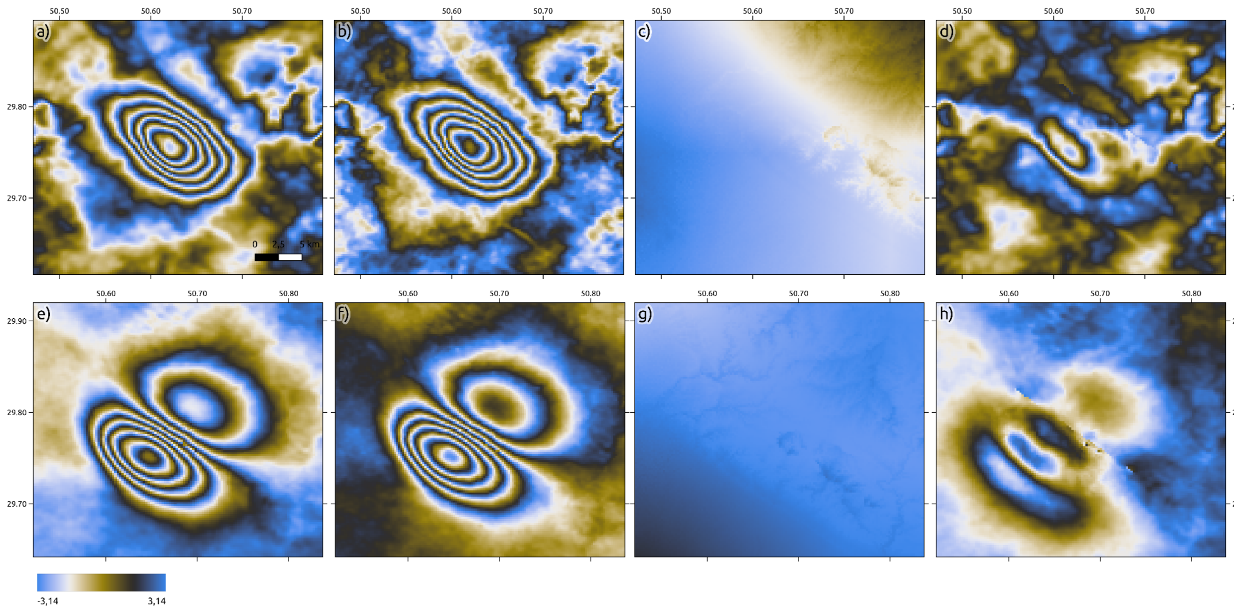
Thanks for highlighting the lack of clarity.
We use the modified 1-D layered "Karbaas" velocity model of Karasözen et al. (2019), which is the closest model to the region of study" in the waveform inversion (Generating Green functions). In the revised manuscript we have explained this.
For the relocation, we use 2 layers crustal model (Moho depth 47 km), in a combination with the AK135 model.
We include this model in the supplementary file (Table S2) and we have modified the text in the revised version.

For the InSAR, what are the line-of-sight incidence angles for the two tracks?

We have added a table with those details in the revised manuscript, please see Table 1 in the revised manuscript.

Did you consider tropospheric artefacts or try to mitigate them using weather models (and could this be important for assessing fold growth)?

No, we didn't consider atmospheric artifacts since we are studying coseismic signals that are significantly above atmospheric noise. To verify this statement we perform an ERA5 correction of the interferogram (see below, a and e: original interferograms versus b and f: ERA5 corrected interferogram). We display the result below to show that the atmospheric delay rewrapped (c and g below) are significantly below the residuals.



ERA5 correction of the interferogram. The first row corresponds to the ascending track and the second row corresponds to the descending track, all interferograms are unwrapped but are shown re-wrapped.

There is no description of how the InSAR slip distribution was solved for, including how smoothing was implemented and whether or not the uniform slip model plans was first extended along strike and up and down dip.

We add more detail about the extension and the smoothing:

“For the slip distribution inversion, we extended the model fault planes along strike and up and down dip obtained in the first step and we subdivided the model fault extended in 1 km square patches (Figure 5). We also applied a Laplacian smoothing operator and assessed misfits using the L-curve criterion in order to determine the appropriate degree of smoothing (Funning et al 2005, Wright et al., 2003).”

The authors’ preference of dip direction would be made more compelling if NE- and SW-dipping models were presented side by side, including the model uniform slip plane or distributed slip contours in map view.

We have added a supplementary figure to show side by side the two fault models and distributed slip contours in map view. See also below:

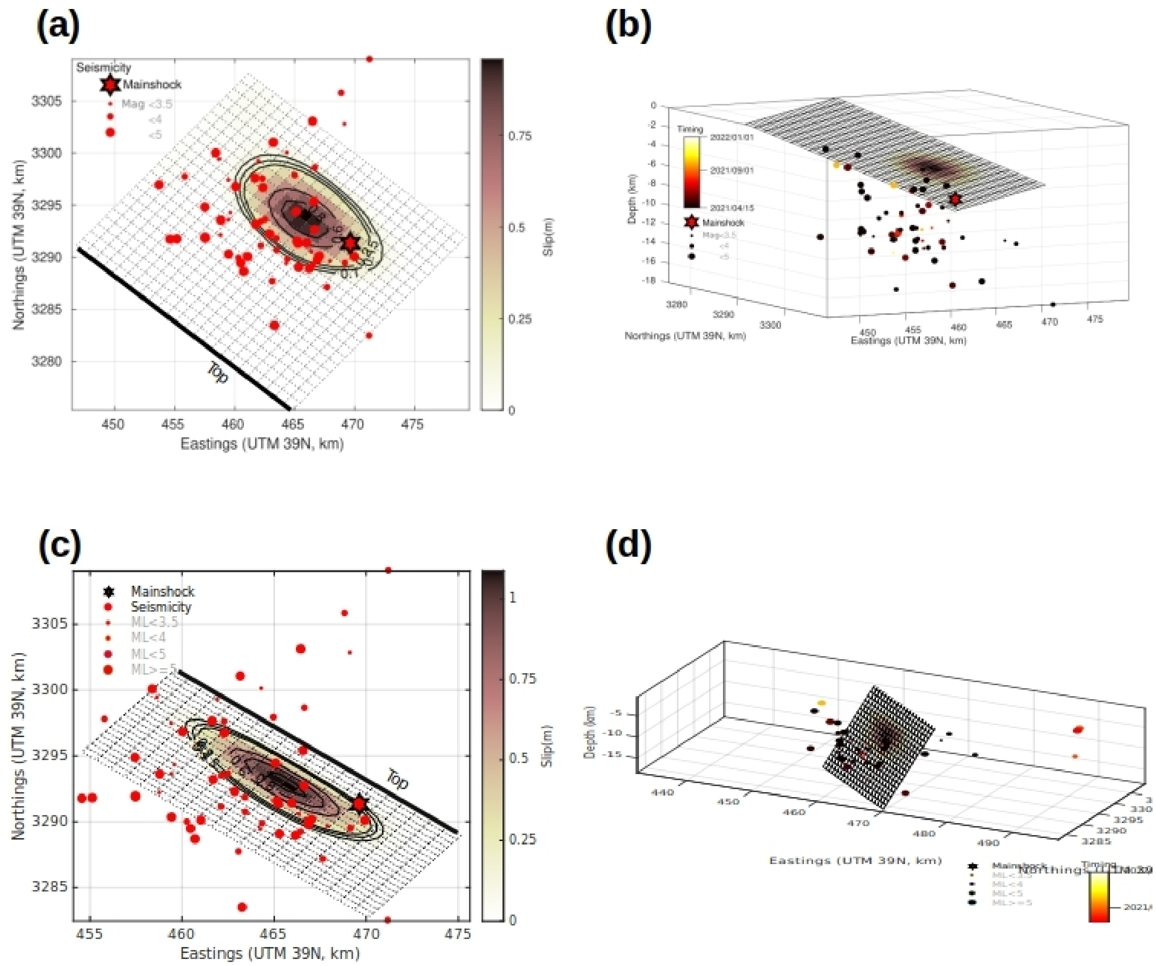


Figure S7 in the revised supplementary file. Comparison side by side of the two fault models; (a-b) the NE-dipping fault model, (c-d) the SW-dipping fault model. (a) and (c) are the distributed slip contours in the map view, the red star is the relocated epicenter, and the dots show the relocated aftershocks. (b) and (d) are the coseismic slip distribution in 3D, dots show the relocated aftershocks colored according to time.

(Related, the SW-dipping model is clearly impacted by the usual trade-off between slip and width and should be repeated with slip fixed to an appropriate value for a Mw 5.9 earthquake, such as 0.5 meters).

For the uniform inversion, we also test a model fixing the slip at 0.5, please see the table below:

Parameters	NE-dipping fault		SW-dipping fault	
Strike (°)	313	311	128	128
Dip (°)	19	20	59	66
Rake (°)	100	96	94	90
Slip (m)	0.5 (fixed)	0.76	0.5 (fixed)	4.7
Eastings (km)	457.1	456.6	467.4	467.4
Northings (km)	3284.6	3283.2	3295.1	3295.2
Length (km)	10.7	9.8	10.8	9.3
Top depth (km)	3.3	4.3	3.1	5.6
Bottom depth (km)	5.5	6.1	9.9	6.4
Moment (Nm)	1.1×10^{18} (Mw 5.98)	0.8×10^{18} (Mw 5.92)	1.0×10^{18} (Mw 5.95)	0.9×10^{18} (Mw 5.92)
RMS (m)	6.89×10^{-3}	5.79×10^{-3}	8.85×10^{-3}	6.32×10^{-3}

If we compare with the inversions where all parameters are free, here the RMS and Mw are higher. In addition, when the slip is fixed, for the SW-dipping model, the dip is 7° higher (66°) and the fault plane is wider (top at 3.1 km and bottom at 9.9 km). For the NW-dipping fault model, solutions are similar.

To observe the influence of those parameters on the slip distribution model inversion of the SW-dipping model, we made a new inversion using a fault with a strike of 128°, dip of 59° and a rake of 94° (see below the figure). We obtain a RMS of 0.00387 (vs 0.00384 for 69° dipping fault) and a slipping area constrained to 10.3 km and 3.4 km depth (vs 10.8 km and 3.6 km depth for 69° dipping fault). So here, the dip has a small influence on the depth distribution of the slip.

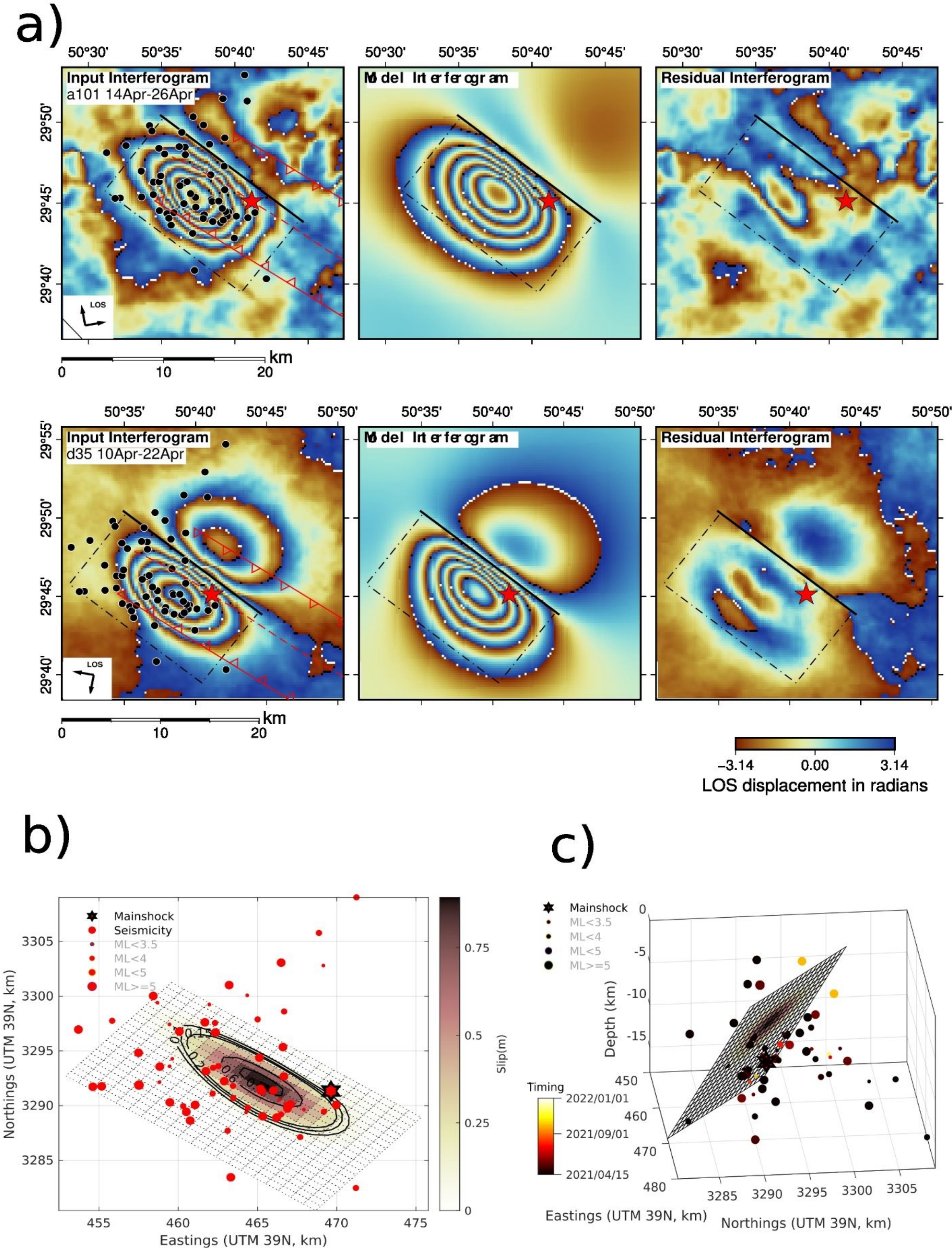


Figure S10 in the revised manuscript.

So in the revised manuscript, we have added those results in Text S1, Table S5, and Figure S10.

In addition, we also plot the results of the Monte Carlo restart to show the trade-off between parameters. For the NE-dipping fault, top and bottom depths are the most inter-dependent parameters, whereas others are not strongly showing trade-offs between each other. Although top and bottom depths do not affect the geometry of the fault (dip, strike, position), therefore we are confident in the slip-distributed fault model where we extended the fault plane.

For the SW-dipping fault, slip and top depth as well as slip and bottom depth show interdependence. Although as for the NW dipping fault, strike dip and rake seems unaffected by a trade-off. Therefore we are confident in the slip-distributed fault model where distribution and slip are not inputs.

in the revised manuscript, we have added those results in Text S1, figures S8, and S9 (please see below).

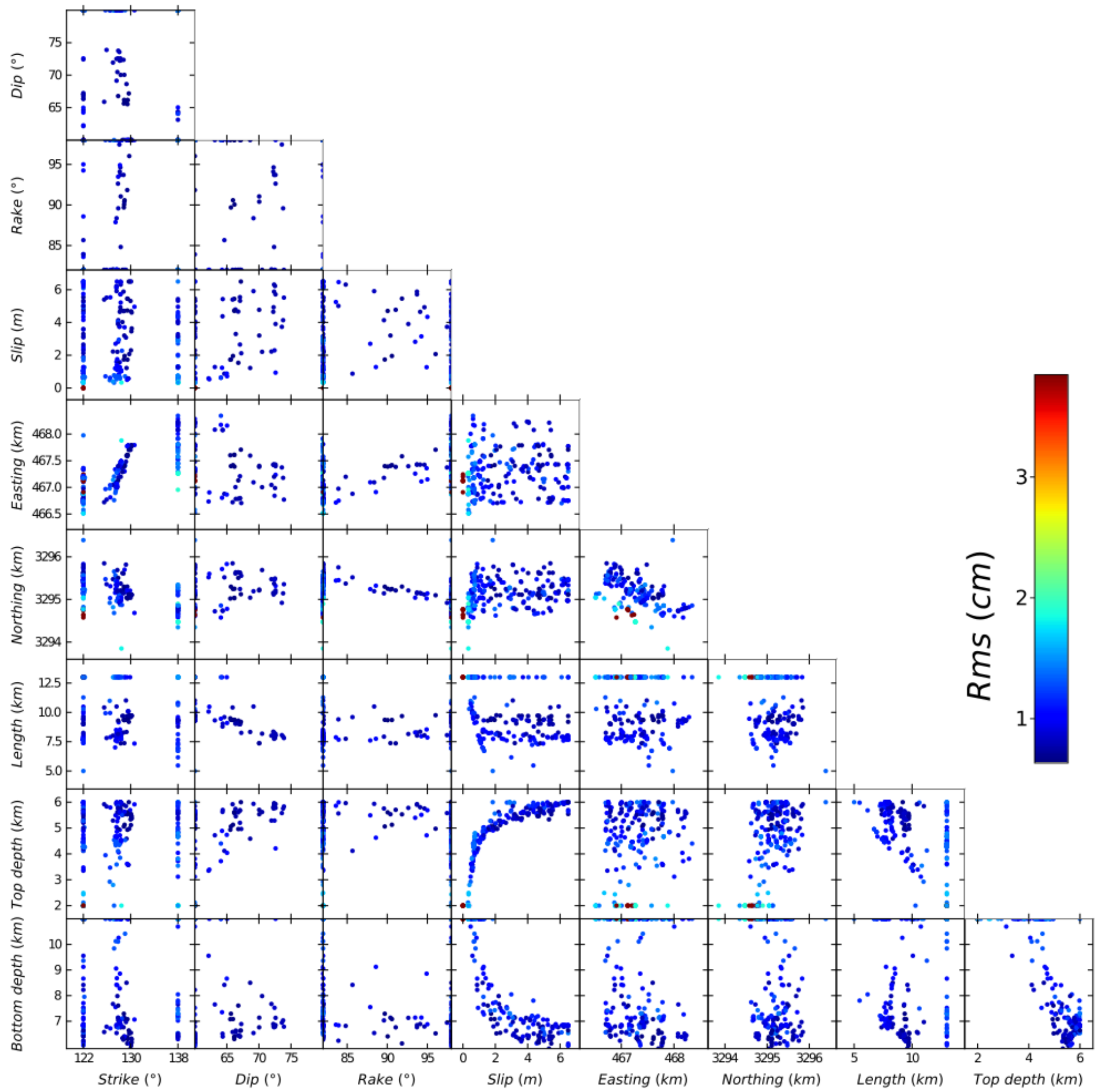


Figure S8 in the revised manuscript, Trade-off between fault parameters for the NW-dipping fault model. Each dot represents the result of the 300 Monte Carlo restart of the uniform inversion. Each dot is colored by the root mean square residual between InSAR data and the model.

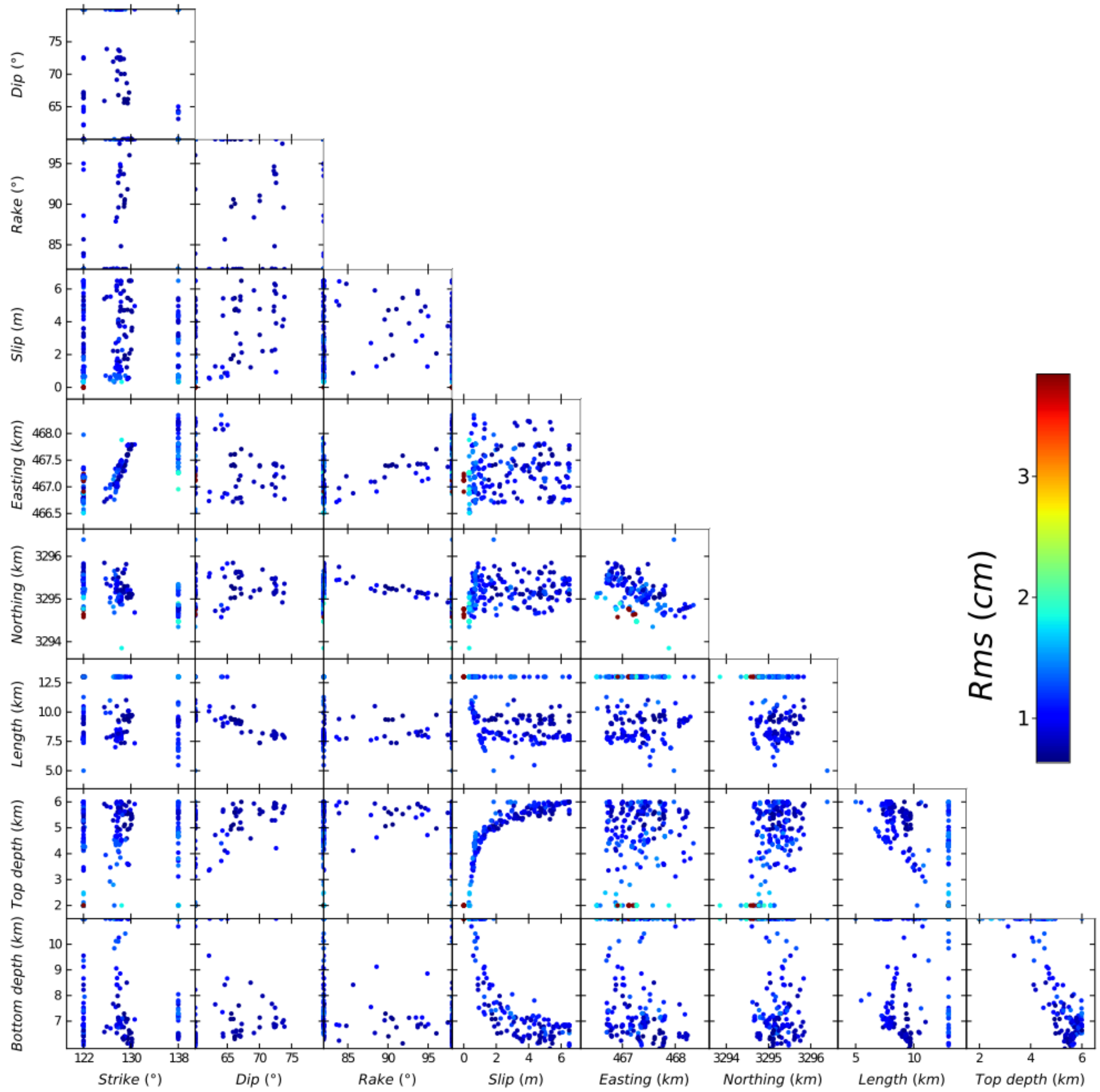


Figure S9 in the revised manuscript, Trade-off between fault parameters for the SE-dipping fault model.

All of the InSAR model plots show a pattern of residual displacements elongated along strike, and I wondered whether the authors could discuss whether they think this might reflect a change in dip angle (i.e. a listric or anti-listric fault).

It is difficult to find a list geometry that could reduce the residual since there would be a multitude of possible solutions. It is thus unlikely to obtain a meaningful solution (the uncertainties would be too great). One option would be to test an already known geometry, however, the seismic line interpretation cannot be converted into meters in a constrained way (see detail below). For these reasons, we prefer to explore a simple geometry in the manuscript.

A full table of results comparing InSAR models (this paper and also Golshadi et al. 2020) and seismological models (this paper, GCMT and USGS solutions) would also help gauge how well-resolved the various fault plane parameters are.

Done, please see below:

Table 2 in the revised manuscript:

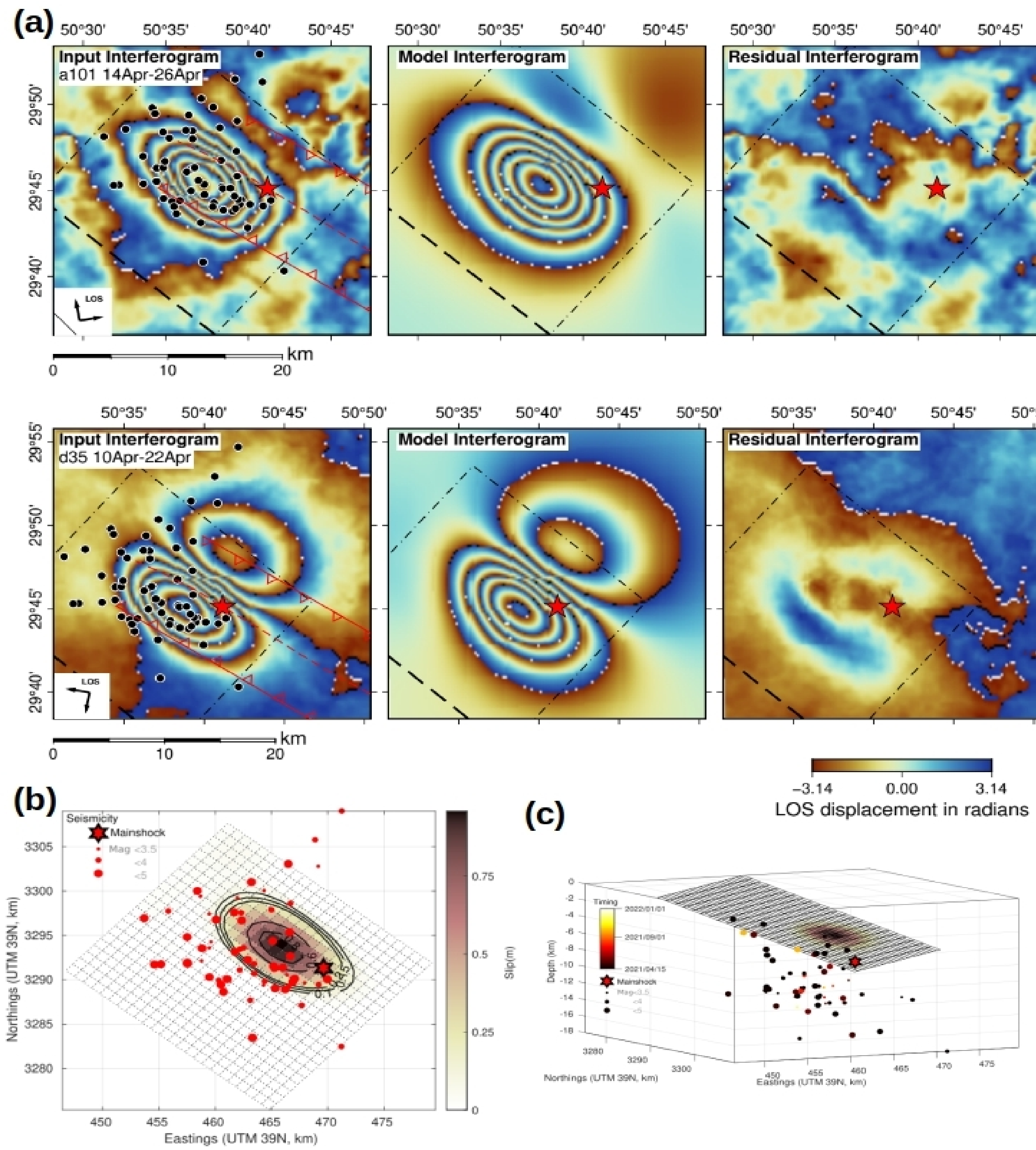
Method	Source	Magnitude (Mw)	Strike (°)	Dip (°)	Rake (°)	Depth (km)	Max Slip (m)
InSAR	Golshadi et al., (2022)	5.9	313	20	100	4	1
InSAR	This study	6	311	20	96	4-7	1

Tablse S3 in the revised supplementary file:

Source	Date and time (UTC)	Latitude°	Longitude°	M_w	Depth (km)	Strike1°	Dip1°	Rake1°	Strike2°	Dip2°	Rake2°
GFZ	2021-04-18 06:41:49	29.75	50.67	6.0	14	137	74	97	291	17	64
GCMT	2021-04-18 06:41:50	29.631	50.659	5.9	10	126	64	88	310	26	94
USGS	2021-04-18 06:41:49	29.753	50.678	5.8	12	139	62	95	308	28	80
This study	**2021-04-18 06:41:50**	**29.751**	**50.685**	**5.9**	**6.0 ± 2.0**	**131 ± 5**	**62 ± 4**	**92 ± 5**	**306 ± 5**	**28 ± 3**	**86 ± 8**

Equally, the maps of seismicity (Figure 3a) and InSAR (Figure 4a) would be improved by also plotting the known faults and fold axes.

We have plotted the fold axes and faults in the revised manuscript (in both Figures 3 and 4).



Revised figure 5.

In the Discussion section, I think that the paper would benefit greatly from better use of the seismic reflection profile shown in Figure 3c. Indeed, this is a rare chance to study a major earthquake that is almost exactly co-located with a seismic reflection line! In particular, assuming reasonable seismic velocities to convert from TWTT to depth, and accounting for vertical exaggeration of dip angles, where would the two (NE- and SW-dipping) model fault planes plot on the section? Do they actually line up with the interpreted faults? The NE-dipping fault interpreted on the seismic line seems to be quite steep, though perhaps

this reflects a vertical exaggeration. Can the seismic line provide better constraints on whether the upper edge of the Genaveh mainshock slip patch corresponds to a weak detachment? This is hinted at in the text (line 367) but is less clear in the seismic reflection profile.

We are grateful for this comment. We have re-interpreted the seismic section by adding the formation's names (please see figure below). We believe the vertical exaggeration of the dip in the interpretations and due to the absence of an accurately detailed velocity model, conversion of TWTT to depth is not possible. In our new interpretation (following Shamszadeh et al. 2022a), we have removed the steep NE dipping fault plane. However, the presence of an NE dipping fault is clear in the seismic section and it's grown in between Gachsaran and Dashtak layers. This explains top and bottom depths correspond to detachments in weak evaporitic layers that act to limit up- and down-dip rupture propagation and restrict the magnitude.

We have edited the discussion section in the revised manuscript.

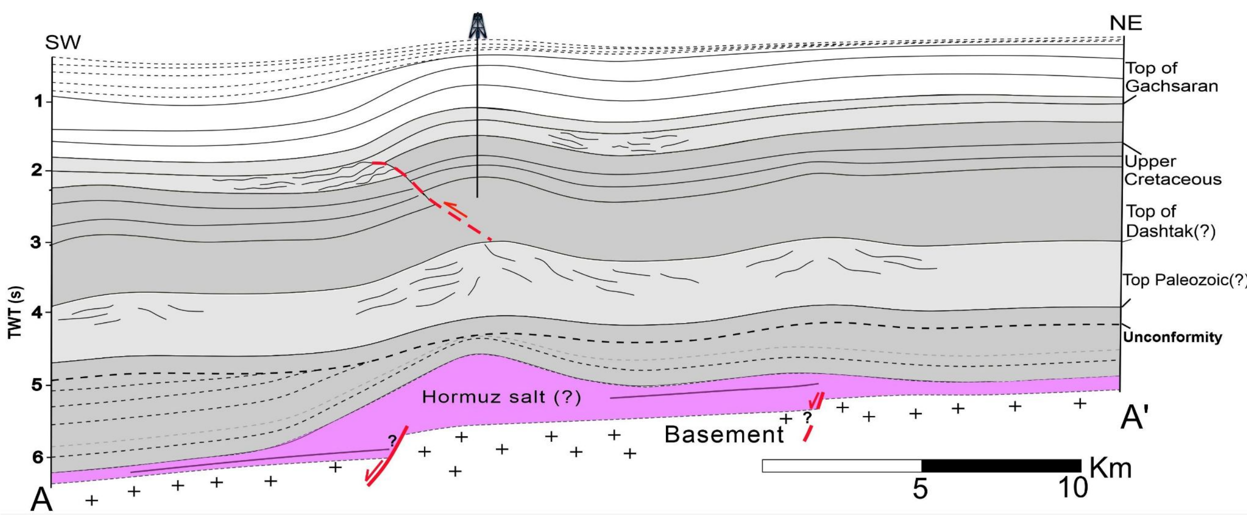


Figure S11 in the revised version. The interpreted 2D seismic profile of the Golkhari anticline (After Shamszadeh et al., (2022a)). The interpreted approximately NE-dipping reverse fault has an associated fold.

Finally, I do not find the link to oil and gas extraction to be at all convincing. The shallow depth extents of the Genaveh mainshock are actually very typical of M 6 earthquakes in the Zagros (for example the Qeshm, Fin, Khaki-Shonbe, Mandali, and Murmuri earthquakes). The authors should consider other discriminants of induced seismicity in assessing whether or not this may have been induced.

Thanks for highlighting the lack of clarity. Actually, we do not link the Genaveh earthquake to oil extraction. We already wrote in the last paragraph of the concussion:

"Although the Genaveh earthquake co-located with the major Gulkhari oil reservoir, but the detailed relationship between the oil extraction in the field and this earthquake needs sophisticated data to investigate, though, our results support the essence of a tectonic earthquake."

We have rephrased the discussion, which caused this unclarity.
Please see below:

"The depth of the Genaveh seismic sequence is in the typical earthquake depth range in the Zagros and **does not support an induced earthquake related to the oil field** (oil extraction starting in 1987 with 15,000 barrels per day), which is deeper than the oil reservoir's depth (~4 km). Although, the full moment tensor of the mainshock, suggests a notable non-DC component (Figure 4) and may reflect the source complexity (Dahm et al., 2015). The sequence also depicts typical mainshock-aftershock patterns and focal mechanisms representing reverse/thrust faulting, compatible with regional tectonic stresses and corresponding to the previously known fault(s). Furthermore, the Genaveh earthquake is spatially localized in the northern part of the Gulkhari anticline which is outward of the location of extraction/injection wells (Figure 3). Therefore, detailed sophisticated production data in the Gulkhari oil field is required to track the relationship between oil extraction and seismic activity in the past and future."

Line-by-line comments in PDF file:

Title somewhat long - could be shortened?
We have changed the title, following the suggestion for shortening it:
"**Co-seismic slip of the 18 April 2021 Mw 5.9 Genaveh earthquake in the South Dezful Embayment of Zagros (Iran) and its aftershock sequence**"

Edit in lines 42-44.
Done.

line 55. Debated → Unclesr
Done

Line 73:
It is a long-standing question of Zagros to … → A long-standing question in the ZFTB is the extent to …
Done.

Figure 1.
The colour scale bar only refers to the right-hand panel. This could be made clearer by moving it inside the bounds of the panel.

Also, Berberian's (1995) "master blind thrusts" should be plotted.
Done.

Line 146: "Karasözen et al. (2019) study" this study needs to be introduced briefly.
We have edited the introduction and introduced the Karasözen et al. (2019) study in line 80 (second paragraph of the introduction) of the introduction in revised manuscript;

"The recent relocation of 70-year instrumentally recorded seismicity in the entire Zagros shows that the earthquakes are mostly concentrated at focal depths of 5-25 km (Karasözen et al., 2019)."

Line 152: Nissen et al. (2011) study: There needs to be some context here. Perhaps you could have briefly introduced this paper earlier?
We have edited the introduction and extended the study by Nissen et al. (2011), in the second paragraph of the introduction;

"Nissen et al. (2011) suggested a vertical separation of the seismicity in the Zagros, implying that all moderate-sized events, especially those in the ZSFB, happen in the competent segment of the sedimentary layer and all the aftershocks in the basement, mostly triggered by stress perturbations."

Line 196: I believe Karasozen used a variety of velocity models along strike. Which specific one did you select and why?
Thanks for this comment.
We use the modified 1-D layered "Karbaas" velocity model of Karasözen et al. (2019), which is the closest model to the region of study in the waveform inversion. In the revised manuscript we have explained this.
For the relocation, we use 2 layers crustal model (Moho depth 47 km), in a combination with the AK135 model.
We have modified the text in the revised version.

Line 241: could you also compare with USGS and other available solutions?
We have presented a new table (**Table S3**) in the revised supplementary file to show the all available solutions of other agencies.

Figure 3: I would like to see the fold axes plotted (both the anticline and surrounding synclines). The faults could be clearer, too (e.g. teeth marks to indicate dip direction).
Done.

Line 277: Remove the word "static".
Done.

Line 281: this is a little lazy. Can you not describe it briefly?
Done. Please see below:

"The wrapped interferograms were processed with an online service and then were unwrapped using the branch cut algorithm, unwrapping errors were then manually fixed. The fringes patterns obtained from InSAR consist of 4-5 fringes (Figure 5) that could be produced with a single fault plane either by a gently NE-dipping thrust fault or by an SW-dipping one. To invert the ground displacements observed we followed routine elastic dislocation modeling procedures (Okada, 1985; Funning et al., 2005, Pousse-Beltran et al., 2020) in a half-space with elastic Lamé parameters λ = μ = 2.5 × 1010 Pa, to represent the sedimentary cover in which the fault is embedded (e.g. Nissen et al., 2010, Elliot et al., 2015; Jamalreyhani et al., 2021b). We derive the coseismic slip model in two steps; first, a uniform slip inversion with multiple Monte Carlo restarts (Wright et al., 1999), to search for the best fault geometry (position, strike, rake, dip, see Text S1, Figures S4, and S5), and secondly, we use this geometry to perform a slip distribution inversion. For the slip distribution inversion, we extended the model fault planes along the strike and up and down dip obtained in the first step, and we subdivided the extended fault plane into 1 km square patches (Figure 5). We also applied a Laplacian smoothing operator and assessed misfits using the L-curve criterion in order to determine the appropriate degree of smoothing (Funning et al 2005, Wright et al., 2003). Ascending and descending data were weighted equally in the inversion. "

Line 291: this needs to be described in more detail. For example, did you first extend the uniform slip plane along strike and up and down dip? How was slip smoothed?
Done.
Please see the reply to the previous comment.

Line 301: I expect that the peak slip mostly reflects your choice of smoothing factor, and so I don't think that this value is particularly robust. This should be discussed.
Done.

Line 316-325 in the discussion section: This whole paragraph belongs in the introduction, and much of it is repetitive.
Thanks for this comment. We have modified this paragraph and removed the repetitive sentences in the revised manuscript.

Line 332: locally, or altogether? On what basis?

We have modified the sentence and removed the word challenging and only presented our interpretation.

Line 391: But the centroid depth of 6 km is quite typical of the Zagros. This is certainly not enough on its own to say that this was an induced earthquake.

Thanks for highlighting our mistake.

Yes, the centroid depth does not support the induced earthquake. We have edited the discussion accordingly.

Best regards
Mohammadreza Jamalreyhani
On behalf of the authors

Dear Editor,

Thank you for passing on the second round of review.
The detailed one-by-one response to the minor comments from the reviewers is included below (the reviewer itself is in bold black, and our responses are in green).

Editor

Dear Mohammadreza Jamalreyhani, Léa Pousse-Beltran, MirAli Hassanzadeh, Samineh Sadat Arabi, Eric A. Bergman, Aref Shamszadeh, Shiva Arvin, Niusha Fariborzi, Ali Songori:

I hope this email finds you well. Based on the two reviews received, I am pleased to inform you that your manuscript "The 18 April 2021 Mw 5.9 Genaveh earthquake in the South Dezful Embayment of Zagros (Iran); Co-seismic slip of the mainshock and analysis of the aftershock sequence from InSAR and seismic data" may be suitable for publication after some revisions. I look forward to receiving your revised manuscript and rebuttal. If you deem it appropriate, please check that the revised version of your manuscript recognises the work of the reviewers in the Acknowledgements section.

I wish you all the best with working on the revisions. Please don't hesitate to contact me with any questions or comments about your submission, or if you have any feedback about your experience with Seismica.

Kind regards,

Yen Joe Tan

We are very grateful for the positive feedback. The detailed one-by-one response to the comments is included below.

Reviewer A:

The authors have done a good job responding to the original reviews and revising the manuscript accordingly. I have only a few remaining suggestions, all rather minor. Line numbers refer to the track changes PDF.

We are very grateful for the positive feedback and very thankful for your very constructive comments and suggestions.

Line 55. “the coseismic uplift of the Genaveh earthquake in the anticline” - you need to swap the words “earthquake” and “anticline”.

Thanks for highlighting this. We have removed the “*in the anticline*”. See:
“The causative fault is compatible and parallel to the trend of the Gulkhari anticline and the coseismic uplift of the Genaveh earthquake implies that the growth of this particular fold is linked to the fault (s)”.

The non-technical summary is a little thin and does not really describe any of the results, just what the authors did. I think you could write a much better one, without too much effort.

Thanks for highlighting the lack of clarity. We have rephrased the non-technical summary.

Line 86-88. Replace “all the moderately-sized earthquakes” and “all the aftershocks” with “most of the moderately-sized earthquakes” and “most of the aftershocks”. Moderate is a bit vague, so give the Mw range if possible.

Done.

Line 193. “Furthermore, The” -> “Furthermore, the”.

Done.

Line 245. “Slope with distance to the residuals”. Can you explain better what this means? It’s not clear to a non-specialist.

This is well explained in Bergman et al. (2022).

Bergman, E.A., Benz, H.M., Yeck, W.L., Karasözen, E., Engdahl, E.R., Ghods, A., Hayes, G.P., Earle, P.S., 2022. A Global Catalog of Calibrated Earthquake Locations. Seismological Research Letters. https://doi.org/10.1785/0220220217

Line 247. The 90% confidence ellipse *of the hypocentroid*.

Done.

Line 291. In assigning the 306 degree nodal plane as the fault plane, you are really assuming the dip direction rather than the fault trend (since the two nodal planes are parallel). The trend is more like NW-SE than ENE-WSW (I assume this is a typo). Rather, I suggest you give both nodal planes. At this point in the paper, we have little idea which of them represents the fault plane.

Thanks for highlighting the lack of clarity and typo. Done.

Figure 3. In panel (a), what are M1 and M2? I presume that the four earthquake mechanisms labelled with years (2014, 2018) are background events and every other mechanism is an aftershock of the 2021 earthquake, but please confirm so.

The M1 and M2 are two examples in the aftershocks showing that both NE and SW dipping faults, located at both crests of the Gulkhari anticline and parallel to the trend of it, control the growth of this particular fold. In the discussion section, we referred to these mechanisms.
We have edited the caption.

Are panels (b) and (c) designed such that they have roughly equivalent vertical scales? It is worth stating whether this is the case in the caption.

Yes, we have edited the caption.

Line 335. "Perform" -> “estimate”.

Done.

Line 340. Give the range of Mw, rather than the vague Mw > 4.

Done.

Line 343. Which online service?

The online service is GDM-SAR, which is not yet open to the international community (it will be in the future). For now, it is for the InSAR French community. This service uses NSBAS (Doin et al., 2011) processing chain.

We add the following in the revised manuscript;

"The wrapped interferograms were processed with GDM-SAR online service and then were unwrapped using the branch cut algorithm, unwrapping errors were then manually fixed."

Line 346. Is the SW-dipping plane also gently dipping, or steeper?

Steeper. Done.

Line 367. The lower angle NE-dipping plane. Worth specifying, since one of the criteria is the broad distribution of aftershocks.

Thanks for highlighting the missing.

Line 368. Mode -> model.

Done.

Line 382. Give maximum slip to 2 or perhaps 3 significant figures. Same elsewhere in the manuscript (e.g. abstract).

Done.

Figure 5. Ideally, the ascending and descending panels should have thee same latitude and longitude bands to allow a like for like comparison.

To cover the whole InSAR seen area we should use different latitude and longitude bands in both ascending and descending panels.

Table 2. Add the seismological models (your own, GCMT, USGS, etc.) Please write your Mw to 2 significant figures: “6” is too vague. Could you give the range of depths for the Golshadi model, not just the top depth?

We already showed the detail of the focal mechanisms solution of the 18 April 2021 Mw 5.9 Genaveh earthquake obtained in this study and other available solutions in Table S3. We now have added our obtained seismological solution to Table 2.
We also noticed a very recently published paper by Jafari et al. (2023) and we have added their result about the source model of this earthquake to Table 2, and in the discussion section.

Jafari, M., Aflaki, M., Mousavi, Z., Walpersdorf, A., Motaghi, K., 2023. Coseismic and postseismic characteristics of the 2021 Ganaveh earthquake along the Zagros foredeep fault based on InSAR data. Geophysical Journal International ggad127. https://doi.org/10.1093/gji/ggad127

Line 425. 4.5 m -> 4.5 km.

Done.

Line 449. “Distributed at” -> “distributed along the”.

Done.

Line 465. The wording here is not quite clear, and the adjective “large” is vague: try to be precise.

Done.

Line 479. Larger than what? (6.7, I think).

Done.

Line 480. “Moderate” is also vague. What magnitude do you mean?

Done.

Line 490. “Would require” -> “would be required”.

Done.

Line 517. “Gently (20 degree) NE-dipping fault plane”.

Done.

Line 519. “At the sedimentary cover” -> “within the sedimentary cover”?

Done.

Line 522. “Is colocated”. Remove the word “but”… with the “although”, it’s not needed.

Done.

Recommendation: Revisions Required

Reviewer B:

Thank you for submitting the revised version of your manuscript. I am pleased to see that you have carefully considered all of the recommended points from the previous review and have made significant improvements to the manuscript. I appreciate the authors' effort in addressing the concerns raised in the previous review. I have only a few minor comments for further improvement that I have listed below:

We are very grateful for the positive feedback and very thankful for your constructive comments.

- Figure 3 could be the most important figure in this manuscript. Showing (1) the relationship between the Gulkhari anticline and the causative fault that ruptured in this earthquake sequence and (2) how the weak evaporitic layers top and bottom of the fault plane are limiting the rupture. However, in this current version, it is impossible to convey these main takeaway points from this figure. The comparison between the seismic profile and the cross-section is not clear. The authors prepared a great supplementary Figure S11 to discuss that. I strongly recommend carrying that to the main paper and discussing these findings over FIgure 3 in Discussion.

Thanks for highlighting this point. We have moved Figure S11 to the main paper, following your suggestion.

- The main text should include a discussion about the different depth sensitivity analyses from moment tensor solutions (Fig. S3) and Insar (Figures S8 and S9). This region has a long history of depth discussions about similar earthquakes. It is great to have these figures, but how robust is the depth estimation? How do these analyses support your main conclusions?

For InSAR, and in particular, for the NE dipping fault, the Monte Carlo uniform inversion purpose is to find a fault plane geometry (dip, rake, strike) and a fault position. Those parameters are not dependent on the top depth, or bottom depth (see Figure S8). But we can see in this figure the low RMS for top depth and bottom depth is localized, this gives an insight into the depth sensitivity using InSAR.
For the moment tensor inversion, we determined the centroid depth of 6±2 km. Almost in the same range of InSAR depth.

We have added the following sentences in the revised manuscript:

"Our results show minimum RMS with a top depth around 4-5 km and a bottom depth around 5.5-6.5 km (Figure S8). This supports the slip localization around 5-6 km depth in our slip distributed inversion and at the same depth range determined by moment tensor inversion (Figure S3)".

- I still don't understand the red ellipse in Figure 2b, which sits on top of the western seismicity.

The red ellipse represents a reference circle of a 5 km radius. We have added this sentence to the caption of Figure 2b.

- Please simplify the non-technical summary and try to avoid technical words like "spatiotemporal." This summary can also need a result. What point(s) do the authors want to convene to a non-technical reader?

Thanks for highlighting the lack of clarity. We have rephrased the non-technical summary.

I look forward to seeing the final version of your work.

Kind regards.

Recommendation: Revisions Required