Note to the editor: we thank you for soliciting two informative reviews on our manuscript. Reviews that were provided to us are shown below in black text, and our replies are indicated in blue italicized text. When quoting directly from the revised manuscript, we use red italicised text. Line numbers refer to the tracked changes version of the manuscript.

Best wishes,
Jack

Reviewer A:

In this paper, Williams et al. investigate the stress field across the Southern South Island of New Zealand, through analysis of earthquake focal mechanisms derived from local seismic networks. This work contributes new stress estimates from a previously undocumented region, and offers a hypothesis linking strain partitioning to magnitude scaling of micro vs. macro-seismicity/faults. The paper is of good quality, with appropriate high-quality figures and is well written. However, I feel some additional analysis, and more balanced discussion and interpretation of results in the context of existsing stress studies is warranted before publication.

Main comments:

1.) The non-quantitative grouping of focal mechanisms for stress inversions purely by geographic region is not usual and needs to be strongly justified further through comparison with other approaches, before results can be interpreted. The current approach using elongate regions inherently investigates only NE-SW changes in stress state, and doesn't account for any NW-SE variation within blocks. This is particularly relevant as the blocks run perpendicular to the plate boundary. Other New Zealand studies address this by adopting quantitative grouping using spatial clustering algorithms such as k-means or quadtree gridding, which is an approach also more usual globally. The choice of grouping can have a significant impact on stress results (e.g.,*Hardebeck and Hauksson*, **1999**; *Townend and Zoback*, **2001**; *Hardebeck and Michael*,**2004**), and is an important methodological step which needs better testing in this case. I direct the authors to Martinez-Garzon et al. (2016), which provides a good overview of the quality control steps needed for robust stress inversions (https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016JB013493).

In the revised manuscript, we now include an objective routine for grouping the focal mechanism based on the k-means algorithm (Lines 212-217, Fig S1 in the manuscript, Fig. 1 below):

....we objectively group the focal mechanisms using a k-means algorithm (Hartigan and Wong 1979, Martinez-Garzon et al 2016, Warren-Smith et al 2017b). This algorithm assigns earthquakes to clusters through an iterative approach that attempts to minimize an error function between the earthquake locations and a predefined number of cluster centroids. For this study, we tested cases with two or threee clusters given the 102 available focal mechanisms, and that the number of events in each cluster is >30 (Martinez-Garzon et al 2016). Based on the average silhouette coefficient of these cases, we group the focal mechanisms into two clusters (Fig. S1).

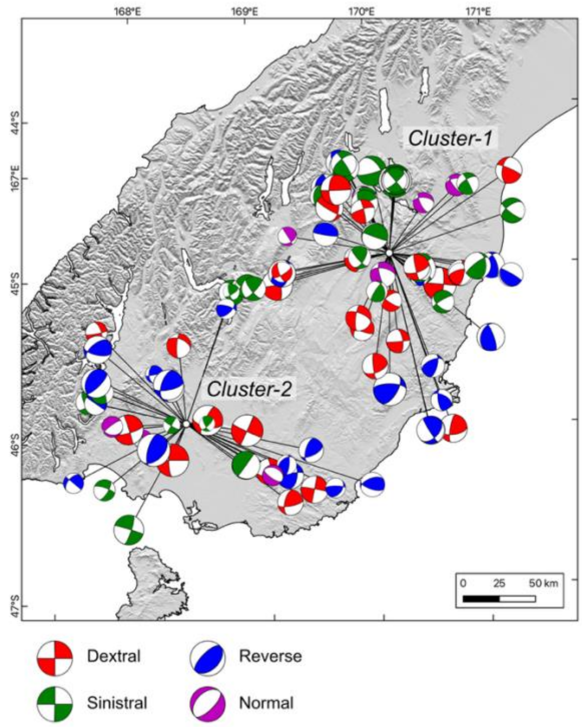

Figure 1 Grouping of southeastern South Island focal mechanisms into two spatial clusters using a k-means algorithm. This is equivalent to Figure S1 in the revised submission.

Ultimately, subdividing focal mechanisms in this way does not indicate any significant variations in the stress state between Cluster-1 and 2 (Figure 2 below).

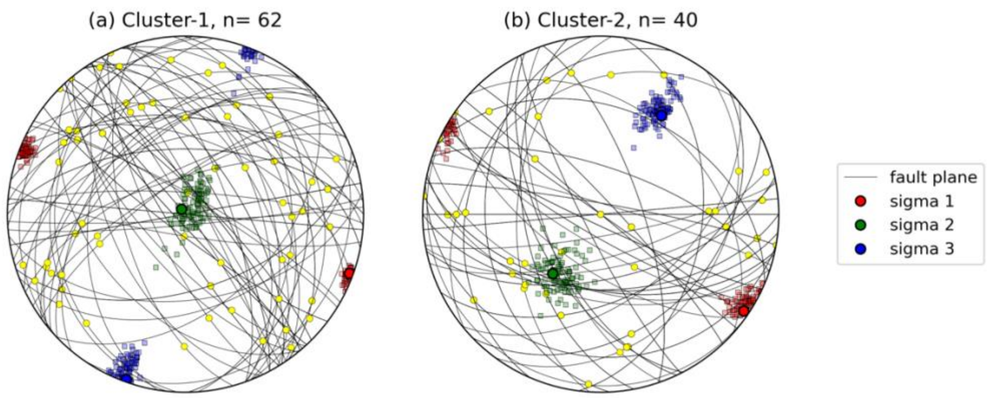

Figure 2: Lower hemisphere equal area stereonets indicating the orientation of the principal stress axes derived from focal mechanisms in Cluster 1 and 2 (see Figure 1 above). Figure follows convention of Figure 4 in the revised manuscript. This figure is incorporated as Fig. S4 in the revised submission.

We also maintain our qualitative grouping of focal mechanisms in the revised manuscript. However, we have slightly modified how we group these focal mechanisms and provide more justification for how these groups are defined at lines 202-211:

....focal mechanisms are grouped into three sub-regions based on NZ CFM fault orientations and the crustal rheology (Fig. 3): (1) Southland, where there is a mixture of NE- and NW-striking reverse faults, and the crust is composed of relatively strong and rigid mafic terranes that were

accreted onto the Gondwana margin during the Mesozoic (Turnbull and Allibone 2003, Eberhart-Phillips et al 2022, Williams et al 2025) (2) the Otago ` Range and Basin Province,' which is dominated by NNE-striking reverse faults hosted in relatively weak quartzofelspathic Haast Schist (Turnbull 2000, Norris 2004, Eberhart-Phillips 2018, 2022) and (3) the Waitaki region, which lies at the transition between Haast Schist and relatively strong Rakaia Terrane derived greywacke, and is dominated by NW-striking Waitaki and Waihemo reverse fault systems (Forsyth 2002, Upton et al 2009).

In this way, we demonstrate that these groupings are not necessarily 'geographical' but are linked to differences in these region's tectonics, and that in turn, could conceivably correspond to changes in their stress state. As noted by the reviewer, the geometry of these regions implies that any spatial variations in the stresses we observe would reflect changes in stress-state along, and not across, the plate boundary (see Figure 3). However, given that the stress state we obtain for the southeastern South Island is very similar to those derived for the Alpine Fault (i.e., adjacent to the plate boundary, Lines 323-325), we would not expect to see NW-SE changes in the stress states across the South Island anyway.

2.) More work is needed in the Discussion to compare the results with other regional stress studies across the South Island. I give more examples of this below.

We address this comment in our replies to this reviewer's comment at 'Section 5.1' and 'Figure 6.'

Line 17: Please define the numbers provided after 'strike-slip'

We have revised this sentence to clarify this (Lines 16-17)

Line 34: I'd remove 'only' from the end of this sentence. It's a bit in conflict with the 'generally indicate' a few words earlier and you do observe non strike-slip mechanisms.

Agree, and corrected (Line 34)

Line 80: The maximum compressive stress, S_1, trend, while sub-horizontal in many cases here, shouldn't be confused with the maximum horizontal compressive stress, S_{Hmax}. The authors tend to refer to the former when commenting on trends across South Island, yet previous studies (e.g. Warren-Smith et al.,2017a) actually constrain S_{Hmax} as trending ~115degrees.

Good point. We have revised this sentence so that it describes a "sub-horizontal ESE-trending maximum principal compressive stress" (Line 80).

Line 82: Reference to Warren-Smith et al. (2024) should be given for the sparse network coverage in Southland (https://www.tandfonline.com/doi/full/10.1080/00288306.2024.2421309)

Added, Line 83.

Lines 89-95: It's not clear here whether the authors are trying to argue that the NW-striking sinistral faults are incompatible with a region S_{Hmax} of 115? Because so long as that azimuth sits within the tensional quadrant of those faults (which I believe it does), it is still able to drive slip, and isn't inconsistent with the regional inversions. This may just need some more clarification.

In the revised submission, we have revised the first sentence of this paragraph to (Lines 90-91):

In addition, the presence of the active NW-striking Waitaki and Waihemo reverse fault systems in north Otago/south Canterbury implies that sigma_1 is locally rotated to a NE trend

This clarifies that while the presence of NW-striking sinistral faults in this region would be consistent with an ESE trending S_{Hmax}/sub-horizontal ESE trending sigma1, the NW striking faults we describe are predominantly reverse (e.g. Barrell 2016), and so suggest a NE trending S_{Hmax}/Sigma1.

Figure 1: I assume the MT solutions show here are from all time periods (i.e. the entire catalogue)? but this should be explicitly stated. I make a similar point later about Figure 3 – but how are the sinistral and dextral moment tensor solutions distinguished here? There's no preferred fault plane given in the MT catalogue. It looks to have been done solely on proximity to major faults, which is not reliable, as conjugate faulting can exist in the crust surrounding these faults; without verification of on-fault earthquakes (relocated aftershocks for example), this distinction is speculative (even if stressinverse is used) and shouldn't be included.

We thank the reviewer for highlighting that the RMT catalog alone does not indicate which of the nodal planes is the fault plane. Hence, our plotting of distinct dextral and sinistral RMTs in Figure 1 was incorrect, and in the revised version, we now group these as strike-slip RMTs. As discussed below in reply to this Reviewer's comments for Figure 3, it is possible to use the nodal plane selected by STRESSINVERSE to distinguish dextral and sinistral RMT solutions. However, there is a high uncertainty in the RMT stress inversions (Figure 4e), and so we do not apply this selection technique to the RMTs.

In addition, we now clarify in the Figure 1 caption and at Lines 210-211 that we sampled all currently available solutions for RMTs in the southeastern South Island, and which occurred between 2004-2023.

Line 128: peak to trough amplitudes?

Corrected to 'maximum amplitudes' for simplicity (Line 135)

Table 2: It seems all of the quality C mechanisms were used in the inversion, despite only 50% of them having an rms uncertainly <=30 degrees? The recommendation by Kilb and Hardebeck (2006, **https://doi.org/10.1785/0120040239**) is to only use mechanisms with rms <=35 degrees. I recommend a stricter quality control cut off should be used, or at least compared to the presented results to investigate the effect.

To examine this comment, we show in Figure 3 (below) the principal stress axes' orientations that are obtained from a stress inversion in which 14 focal mechanisms with a RMS uncertainty >30 $^{\circ}$ are removed.

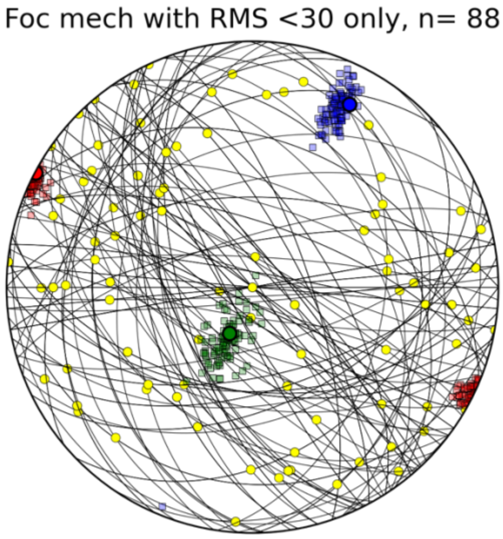

Figure 3: Lower hemisphere equal area stereonet indicating the orientation of the principal stress axes that are returned from the southeastern South Island focal mechanisms, with those (n=14) with a root mean square (RMS) error >30° removed. Convention of the figure follows Figure 4 in the revised manuscript, with red, green, and blue circles indicating the orientation of sigma_1, 2, and 3 respectively. Large and small circles are the stress axes' orientations from returned by the 'preferred' and 'accepted' focal mechanisms in HASH. Great circles and yellow circles indicate the focal mechanism's nodal plane and rake selected by STRESSINVERSE.

The stress shape ratio returned from this inversion is 0.78. This analysis therefore indicates that the stress tensor derived from only using focal mechanisms with RMS uncertainty <30° is essentially identical to those derived using the entire dataset (compare to Figure 4 and Table 3 in the main text). We also highlight that: (1) no focal mechanisms used in the stress inversion have a RMS uncertainty >35°, and so they all meet the quality criteria outlined by Kilb and Hardebeck (2006, Lines 195-199), and (2) our stress inversion procedure weights focal mechanisms by quality (Lines 194-195), and so the influence of C-quality focal mechanisms with >30° RMS on the stress tensor we obtain are low. Given the above points, we do not consider it necessary to revise the quality criteria used to select focal mechanisms in our stress inversions.

Lines 176-179: See main comment about clustering of these mechanisms geographically. This isn't the most robust way to assess spatial stress orientation changes.

This comment is addressed in our reply to Main Comment #1 by this reviewer.

Figure 3: I think the distinction between dextral and sinistral is ambitious given many of the red and green mechanisms look extremely similar within the same stress region, occur very close to each other, yet have been assigned different preferred planes by stressinverse.

It is our preference to maintain distinguishing between dextral and sinistral focal mechanisms in Figure 3 for the following reasons:

- *Implicit in the reviewer's suggestion is that we should group all strike-slip focal mechanisms together, and then during the stress inversions randomly sample a fault plane from the focal mechanisms two nodal planes. However, this increases the chance that the inversion selects the auxiliary plane, which can result in the incorrect stress* *tensor being retrieved (Michael 1987, see also revised text at Lines 174-176). Subsequent studies using real and synthetic datasets (Lund and Slunga 1999, Martinez-Garzon et al. 2016) demonstrate that stress inversions are improved when, as in STRESSINVERSE, the fault plane is selecting using additional constraints from the Mohr-Coulomb failure criterion (notably the assumption that the fault plane should be orientated ~30° to sigma_1).*

- *The dextral and sinistral focal mechanisms shown in Figure 3 are intuitively consistent with what be expected given the southeastern South Island's stress orientations: NW-SE striking sinistral fault planes and E-W striking dextral planes. This is indicated in new supplementary figure (Fig. S3) that shows individual stereonet plots for the orientations of dextral and sinistral faults selected by STRESSINVERSE. Notably, the angle between the mean orientation of dextral and sinistral planes is 54°. This is consistent with the focal mechanisms sampling a set of conjugate strike-slip faults with typical Byerlee friction values (Lines 236-238), and so provides additional confidence that STRESSINVERSE is selecting the correct fault plane in the strike-slip focal mechanisms.*
- *Ultimately, the principal stress axes that are retrieved by distinguishing between dextral and sinistral focal mechanisms are very similar to those in which fault planes are randomly sampled (Table 3, Lines 274-286). A higher stress shape ratio (r) is observed when these nodal planes are distinguished (0.74 vs 0.96, Table 3, Lines 247-255); however, a high r value is consistent with studies elsewhere in the South Island.*

Nevertheless, we have modified Figure 3 so that the strike slip mechanisms are now indicated as 'dextral favored' and 'sinistral favored.' In this way, we highlight that there is still some ambiguity in these focal mechanism's slip sense.

I can see several examples of beachballs which don't match their assigned slip sense (e.g. one very obviously vertical/horizontal green mechanism which is coloured as sinistral in the Southland block, and other dextral and sinistral mechanisms in the east of the Waitaki block which look very similar, but are coloured with opposite SS senses). Some (e.g. sinistral offshore event just south of Dunedin) have a good dextral alignment with the neighbouring fault, yet are assigned sinistral. This needs further investigation. My recommendation would be to not attempt to distinguish between dextral and sinistral here, and in Figure 1.

With regards to the specific focal mechanisms highlighted by the reviewer:

- *Sinistral event in Southland (event: 2014p961162): the two available nodal planes for this event are a NE-SW striking vertical plane with normal slip (strike/dip: 215/90, rake: -95, instability in the initial iteration (I): 0.179) or, as selected by STRESSINVERSE, a NW-SE striking sub-horizontal plane with sinistral slip (strike/dip: 125/5, rake 0, I: 0.629, Figure 4 below). Hence although the sub-horizontal sinistral plane appears erroneous - and is still unfavourably oriented with respect to the regional stress state- it is correctly selected by STRESSINVERSE as the plane most susceptible to failure. This focal mechanism is also poorly constrained (Figure 4).*
- *Similar dextral and sinistral events in eastern Waitaki are events 2014p775099 and 2015p010427 respectively: In both cases, the instability (I) of the two nodal planes are relatively similar (I = 0.663 vs 0.511 for 2014p775099; I = 0.663 vs. 0.547 for 2015p01042) and so we acknowledge that in these cases there is low confidence that the STRESSINVERSE procedure is selecting the correct nodal plane. However, placing strict limits on what is an 'acceptable' difference in I for selecting nodal planes is beyond the scope of this study. Note too, that although colored as strike-slip focal mechanisms, in*

detail, these are oblique-slip focal mechanisms (rake: 135° and 41°). However, for clarity, we do not distinguish between strike-, oblique-, and dip-slip in Figure 3.

- *Sinistral offshore event south of Dunedin (event 2014p407423): the two available nodal planes for this event are a NE-SW striking moderately dipping plane with dextral slip (strike/dip: 230/55, rake: -160, I: 0.579) or a NW-SE striking steeply dipping plane with sinistral slip (strike/dip: 332/74, rake: 37, I: 0.893). In this case, although the NE-SW striking plane is parallel to the nearby Takapu Fault: (1) this nodal plane is not favourable for dextral slip as it is moderately dipping, and (2) the Takapu Fault is reverse, and so it wouldn't necessarily be parallel to surrounding strike slip faults. Indeed, this situation may be analogous to the nearby ML 5.0 1974 Dunedin Earthquake, which is thought to have ruptured a steeply-dipping E-W dextral/SE-NW striking sinistral plane, even though this event was located close to NE-SW striking moderately dipping reverse Akatore Fault (Adams and Kean 1974).*

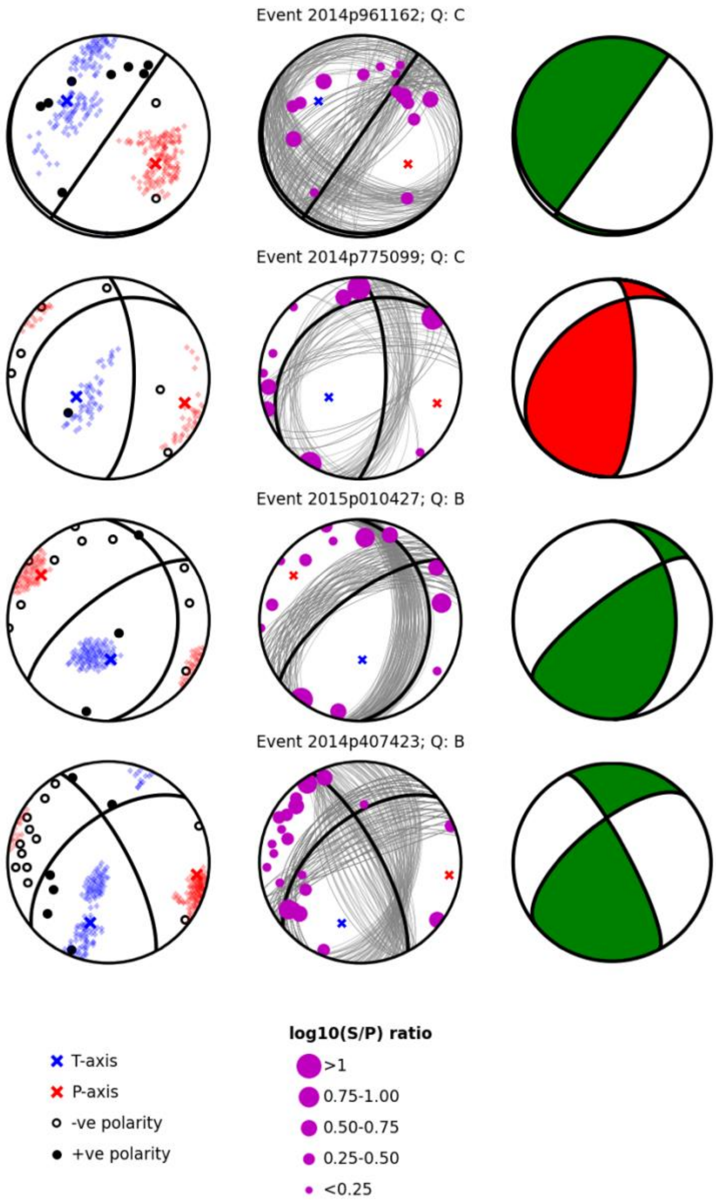

Figure 4: Focal mechanism plots for events where the nodal plane selection was questioned by Reviewer A. Figure plotted as Figure 2 in the main text, with the left column indicating the event's polarity picks and P- and T-axes, centre

column indicting the S/P amplitude ratios and range of accepted nodal planes, and right column indicating the event's preferred focal mechanism as a beachball plot.

Line 190: typo: events

Corrected (Line 230)

Table 3: Are the uncertainties for trend and plunge equal to each other? From the scatter it looks as though trend is often better constrained than plunge. S_{Hmax} should also be provided for each grouping to allow direct comparison with other South Island studies.

The principal stress axes uncertainties reported in Table 3 are the average angular distance between the preferred stress axes, and corresponding principal stress axes returned by randomly sampling 100 (N_noise_realizations) accepted mechanisms in STRESSINVERSE. Hence, these uncertainties do not explicitly distinguish between uncertainty in the principal stress plunge and trend. As suggested, we have added a column for S_{HMax} azimuth to Table 3

Line 208: sigma_3 doesn't have to be compressive. It's simply the minimum principal stress by convention, as it can be tensional.

We have removed this reference to sigma_3 being compressive (e.g., Line 250).

Section 5.1: More quantitative comparison with other South Island studies, especially the results of Warren-Smith et al. (2017a) should be provided here, especially given there is overlap in the NW of the study region with their clusters. How do the R values compare for example? How does this influence the mix of faulting styles observable here vs. elsewhere in the South Island? The mix of strike slip and reverse mechanisms – particularly with magnitude? Is this magnitude dependent stress pattern seen in those other studies too? Or is it just limited to the area of this study? Figure 3 notes the lack of coverage in Central Otago, yet other datasets infill this gap, and should be compared. Missing references to more recent Alpine Fault inversion studies of Michailos et al. (2020, (https://doi.org/10.1016/j.tecto.2019.228205) and Warren-Smith et al. (2022,**https://doi.org/10.1029/2022JB025219**) should also be given at the end of this section, given the older Alpine Fault study of Boese is already cited.

In the revised manuscript, we have restructured the manuscript to add a section that explicitly addresses this comment (Section 5.3: 'Comparisons to slip partitioning in the South Island and beyond'), and in which we have added more comparison to our hypothesis of scale dependent strain partitioning to seismicity to the west in the Southern Alps (Lines 411-418).

In addition, the 1994 MW 6.7 Arthur's Pass Earthquake is interpreted to have activated a NE-striking reverse fault within an overall strike-slip stress regime (Abercrombie 2000, Robinson and McGinty 2000). West of our study area, microseismicity is also dominated by strike-slip faulting (Warren-Smith et al 2017a,b). However, slip is interpreted to preferentially occur on ENE-striking dextral planes, thereby indicating a rotation from E-striking dextral planes in our study area (Fig. 6) to ENE-striking as the Australian-Pacific plate boundary is approached.

At Lines 323-325 we provide more detail on how our stress inversions compare to those conducted along the Alpine Fault, and which includes the updated references suggested by the reviewer:

To the first order, this includes on the plate-bounding Alpine Fault itself (azS_{HMax} azimuth between 107-121 º: Leitner et al 2001, Boese et al 2012, Michailos et al 2020, Warren-Smith et al 2022).

In addition, our stress inversions now include 11 focal mechanisms reported by Warren-Smith et al (2017a) using data from the Central Otago Seismic Array (COSA), and that coincide with the north and west of our study area (Figure 3 in manuscript, Lines 158-161). Unfortunately, however, these focal mechanisms do not overlap with the region in southern Otago where relatively few focal mechanisms were resolved from the OtagoNet and SOSA deployments (Figure 3).

We do not discuss the relatively high stress shape ratios (R~0.8) that we derive compared to those reported in Table 1 in Warren-Smith et al (2017b) (R~0.3-0.8):

- *The relatively low number (<25) of events used in the grouped stress inversions in Warren-Smith et al (2017b) can result in unreliable stress tensors being derived, particularly when R is close to 1 (Martinez-Garzon et al 2016). Indeed, this is an issue with our own regional stress inversions (Lines 302-307).*
- *Each nodal plane was assigned an equal probability of being the fault plane in the stress inversions performed by Warren-Smith et al (2017b), while our study's stress inversion selects fault planes based on constraints from the Mohr-Coulomb failure criterion. As discussed in our reply to the comment at Figure 3, using these different approaches to selecting fault planes can influence the R value in stress inversions (see also Michael 1987, Vavrycuk et al 2014, Martinez-Garzon et al 2016).*

Hence, it is not immediately clear if the differences between the R values between our studies derive are real, or if they reflect how the stress inversions were performed.

Line 256: r only estimates the rupture patch size, not the diameter of the overall fault. Large faults can have small asperities and produce small earthquakes.

The point of these rupture diameter estimates is to convey the differences in scale between the (typically strike-slip) earthquakes from which we derived focal mechanisms, and the reverse fault surface rupturing earthquakes that are suggested by the southeastern South Island's paleoseismic record (e.g., Barrell 2019, Williams et al 2025). We have revised this sentence to clarify this (Lines 340-342):

By contrast, the NZ CFM, in conjunction with this region's paleoseismic record (Barrell 2019, Williams et al 2025b), indicates that surface rupturing (M_W >~7.0, r~20 km) earthquakes in the southeastern South Island release strain on NE-, and subordinate NW-, striking reverse faults

Figure 6: This plot has some similarity to Figure 4 in Warren-Smith, Lamb & Stern 2017. The previous study considers orientations in terms of slip vectors, rather than fault orientations. In that sense, the slip vectors for the strike-slip and reverse faulting here are actually quite compatible. I'd like to see more discussion about this, and the hypothesis from the previous study that dextral planes are preferred because they align with the plate motion vector. Again, I think this comes down to relying too heavily on the results of the preferred plane from stressinverse, which, as the authors admit, is somewhat circular in its function.

As discussed in our reply to the comment at Section 5.1, we now compare the E-striking dextral planes we observe (Fig S3) to the ENE-striking dextral planes noted by Warren-Smith et al

(2017b, their Figure 5) at Lines 415-418. We acknowledge that the nodal plane selection procedure in STRESSINVERSE is not definitive (see our reply to this reviewer's comment for Figure 3); however, it is no more subjective than Warren-Smith et al (2017b) interpretation that the fault plane of strike-slip focal mechanisms in the Southern Alps is predominantly the dextral plane.

Recommendation: Revisions Required

Reviewer B:

The manuscript by Williams et al. examines the stress state and the inconsistency between the regional stress pattern (predominantly strike-slip) and the active faults (predominantly reverse) in the southeastern South Island. It is a well-written manuscript with a strong scientific foundation and robust analysis, which I believe are valid and sound. The structure is excellent, and the figures and tables are of high quality.

I only have a couple of very minor suggestions that do not affect the overall story but might strengthen the discussion if incorporated. My recommendation is therefore minor revision.

1.) The authors excluded events deeper than 40 km from their analysis, considering them as sub-crustal. Could the authors clarify why the threshold of 40 km was chosen? Does this correspond to the Moho depth in this region? It would also be useful to slightly expand the explanation (line 113) to justify why sub-crustal events should be excluded, especially if they occur within remnants of the Hikurangi Plateau.

We highlight in the revised manuscript that the 40 km threshold is chosen to exclude Hikurangi Plateau events that nucleate below the frictional-viscous transition zone (Lines 117-120):

Events with focal depths >40 km were excluded as these earthquakes are likely to be nucleating within subducted remnants of the Hikurangi Plateau (Reyners et al 2011, 2017, Eberhart-Phillips 2018. As such, the stresses that these deep earthquakes are responding are not necessarily mechanically coupled to this region's 15 km (in Canterbury and Otago) to 40 km (in Southland) thick seismogenic layer (Warren-Smith et al 2017a, Eberhart-Phillips 2022, Williams et al 2025a).

This threshold does not necessarily correspond to Moho depths in our study area as: (1) a 'single' Moho depth estimate cannot be assigned to our study area, as the crust thickens from 27-30 km thick in the east to 42 km in the west at the Southern Alps crustal root (Spasojevec and Clayton 2008), and (2) there are significant uncertainties in these Moho depth estimates as the mafic lower crust precludes a distinct velocity contrast between the lower crust and upper mantle (Eberhart-Phillips et al 2018). Only 3 focal mechanisms have depths >30 km, and so the results of our study are not sensitive to the whether a depth threshold of 30-40 km is chosen.

2.) Two hypotheses have been proposed and discussed for the observed inconsistency: (i) the presence of small-scale strike-slip faults (which have not been incorporated in the FCM?), and (ii) stress rotation. It would be helpful to elaborate a little more on the stress rotation aspect. Since stress is a tensor, the rotation of one parameter generally implies the rotation of others. In that context, why is SHmax not considerably rotated if stress rotation is indeed occurring?

To address this comment, we have added additional clarification on what components of the stress tensor are required to change for the large-scale NZ CFM faults to be active in the southeastern South Island (Lines 360-368):

In detail, two types of changes to the strike-slip stress state suggested by the focal mechanism are required to explain the activation of NZ CFM faults in the southeastern South Island. Firstly, sigma_2 and sigma_3 must locally rotate about a vertical plane orthogonal to sigma_1, so that they switch positions, and NE-striking faults can activate as reverse faults(Koons 1994, Enlow and Koons 1998); the possibility of this is favored by the prolate stress ellipsoids we infer for this region (i.e., R is close to 1 and the magnitude of sigma_2 ~ sigma_3, Table 3). By contrast, the activation of NW striking Waitaki Faults requires that sigma_1 and sigma_2 locally rotate about a horizontal axis (Upton et al 2009). In both cases, these rotations can be driven by small changes in the horizontal or vertical shear stress (Enlow and Koons 1998, Upton et al 2009) that could conceivably occur in relatively fractured and compliant damage zones of these faults (Twiss and Uruh 1998, Faulkner et al 2006, Gudmundsson et al 2010, Ziegler et al 2024).

Our hypothesis does not require S_{Hmax} rotations to explain slip on NE striking faults in the southeastern South Island. This is because activation of these faults requires rotation and switches between sigma_2 and sigma_3 only, with S_{Hmax}/sigma_1 unchanged (see for example Figure 6 in Upton et al 2009). A local rotation in S_{Hmax}/sigma_1 is required to explain the activation of NW striking faults in the Waitaki region, and it is true that we do not observe this from the focal mechanism stress inversions we perform (Table 3, Figure 6c). However, as explained at Lines 402-408, this might reflect that the S_{Hmax} rotations are occurring at the scale of individual fault zones, and so are not sampled by the focal mechanisms occurring in 'background' crust.

Best regards,

Mojtaba Rajabi

Recommendation: Revisions Required

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