Rebuttal letter

We would like to thank the three reviewers for their careful evaluation of the manuscript and for the constructive comments provided. In the following, we outline how we addressed their points. Except for the extended explanation of the changes in the World Stress Map quality ranking scheme and the new table that shows the new version, the changes in the revised version are minor.

Beyond the recommendations and suggestions of the reviewers we add small changes in the text to increase the precision of the statement. Furthermore, we suggest to change the title slighty to "*Patterns of contemporary horizontal stress orientations in the Earth's crust derived from the World Stress Map Database 2025*".

Reviewer #1

Specific comment: I just wonder why the authors used A-C quality data in northern Alps area and A-D quality data in Australia. I guess the choice was due to the amount of data relative to the size of the area. This could be misleading for readers.

REPLY: We agree that presenting A-D quality data in the Australia stress map is misleading. We replaced the figure with a stress map that shows only the A-C quality stress data records. The interpretations and discussions of the S_{Hmax} orientation pattern are not affected by these changes.

Technical corrections: Consider some reorganization of the References. Following the Journal guidelines "Heidbach group" is not listed correctly. Rajabi et al. 2025 should go at the end of the "Rajabi group". Ziegler et al. 2024 should be at the end of the "Ziegler group". Also Reiter et al. 2024 should be after Reiter at al. 2014

REPLY: We changed the order the reference list as indicated.

Reviewer #2

Abstract – a rotation from N-S to NNW-SSE in the Alpine foreland is probably more than 50 degrees. Do you mean WNW-ESE?

REPLY: This is a typo and the rotation is from N-S to NW-SE to be consistent with the cited paper of Heidbach et al. (2025) for the stress pattern of Switzerland. We changed this in the revised version.

Line 56 – no mention of flat jack methods in the list - why not?

REPLY: The listed eight stress indicator used in the WSM are the ones that can result in reliable values of one or several components of the in-situ stress tensor. The flat jack method as well as borehole slotter are applied close to a free surface (e.g. borehole, cavern) which means that they are affected by stress changes due to the free surface to some extent. The measurement itself can be of good quality, but it has a high probability to reflect a very local stress state that is not representative of the in-situ stress state (i.e. the undisturbed one) for a larger rock volume. This is the main reason why these methods are not represented in the WSM. We will add a sentence to clarify this.

Line 97 – exceptions (plural)

REPLY: This is corrected in the revised version of the paper.

Line 98 – also Tingay et al. for Nile delta stress rotations with depth

REPLY: We now cite two publications of Tingay et al. where they show two well documented examples of stress rotations due to geomechanical decoupling in the Nile delta and in Brunei.

Line 97 – exceptions (plural):

REPLY: This is corrected in the revised version of the paper.

Reviewer #3

Line 70+: I would like to see a bit more detail on the refinement and clearer rules for quality ranking. For someone using the WSM data this is of course very significant, and perhaps most significant is changes to the old scheme. The Rajabi et al. (2025) report does not detail changes to the ranking scheme but gives the updated scheme (in Section 3):

REPLY: We will include the new WSM quality ranking scheme as a table and provide a clear description of the changes made compared to the previous scheme. The reviewer is correct that these changes are not fully explained in the referenced technical report. Most of the updates (beyond the removal of the BS, PC, and FMA stress indicator) relate to a clear distinction between D- and E-quality data. This distinction was not well defined in the earlier version but is now consistently implemented usable in Python routine that is now doing the quality assignment automatically.

Line 112: text missing "... a few kilometres, where is most relevant..."

REPLY: We will modify this section.

Line 116+: Add somewhere, perhaps here, which data qualities that go into the SHmax grids. The reference https://doi.org/10.5880/WSM.2026.001 says A-C data, which is also indicated in line 141, but in the manuscript A-D data for Australia is used.

REPLY: Yes, the reviewer is correct. Using A-D data for Australia is misleading. We will revise this and clearly state in the text that only A-C data records, as shown in Fig. 1 for the estimation of the mean S_{Hmax} orientation. The results and interpretation will be unaffected by this change.

Line 128-129: Different font.

REPLY: We will revise this accordingly.

Line 139+: It would be interesting with a bit more information on the weighting scheme. Which of the three items is most important, is the distance weighting just 1/r (in km?) for all radii such that the weight is always 0.1 at 10 km, is the weight in point 3 equal to one over the distance at 10% of the search radius?

REPLY: Thank you for this comment. Yes, the reviewer is correct. The way we currently present and describe the weighting is misleading for two reasons. First, there are only two weighting parameters, but we wrote that there are three. The first is based on the assigned data quality and the second on the distance to the grid point. For the latter, we use inverse-distance weighting in estimating the mean SHmax orientation, with a cut-off applied when the distance r between a data record and the grid point is less than 10 % of the respective search radius. This means that all data records within 10% of the search radius receive the same weight, in order to avoid an overrepresentation of data records located very close to the grid point. We will revise, expand, and restructure the text that describe the weighting to make it clearer and precise.

Line 158: I would write "130N" as N130E

REPLY: We will revise this accordingly.

Line 176 and 180: Curiosity would have liked to see the answer to why the rotations occur.

REPLY: This is a good question, and the short answer is that we do not yet know. So far, we can largely rule out faults (which would have only a very local effect, if any) and topography (which is not that high in Australia and little correlation with the topography gradient). This leaves two potential candidates. Given that stiffness plays a key control on the horizontal stress magnitudes, lateral stiffness contrast could result in a rotation of the SHmax orientation. In addition, where the horizontal differential stress is low, local stress "sources" (such as stiffness and density contrasts associated with fault systems) may have a relatively large impact. At present, however, this remain uncertain and is the focus of our ongoing work using 3-D geomechanical-numerical models. We will add a brief discussion to the manuscript, but we are not able to provide a definitive explanation at this stage.

Line 242: Perhaps write Zoback, M.D. for extra clarity.

REPLY: We will modify this accordingly.

Fig 2-4: I appreciate that colouring is difficult, but the white bars are not easy to see in all terrains.

REPLY: We will try our best to increase the contrast by lowering the saturation of the topography.

Fig 4: The combination of grid size and search radius produces (I guess) the effect of multiple averaged data points at increasingly large distances away from the data itself. Which makes the averaged data look a little overly extrapolated, in my opinion.

REPLY: Yes this is correct. However, because we apply the inverse-distance weighting, data records at large distance have significantly smaller impact on the estimation of the mean. Our moving-window approach effectively filter the wavelength of the SHmax orientation pattern, as described in the text. An alternative would be to use square bins, which would avoid a data record contributing to the mean SHmax estimation multiple times. The bin size would define the wavelength under consideration, but much less grid points would return a value with the requested minimum number in particular if we would use small bins of 0.2° or 0.5°. This is why we prefer to stay with our approach.