

I have read with interest the submitted manuscript by Spang et al. which builds on Spang et al 2024. I found it well written, well organized, and the goal of the paper is also properly stated and addressed convincingly. I here wish to commend the authors for their didactic approach (e.g. the detailed section 3, and the Appendix) which helps the reader to make sense of the rather technical presented research without having to necessarily first read the previous article on the topic by the same authors.

**Reply:** We thank the reviewer for the encouraging words.

Furthermore, because of the review process of this journal I have the luxury to have access to the thorough review of Prof. Le Pourhiet and I agree with all her points. As such I will keep my review very short and also recommend minor revisions.

**Reply:** We posted our reply to Prof. Le Pourhiet, so we will not copy them here.

My only point of criticism is the fact that the 2d case presented in the paper is very simple (which of course allows for testing the various approaches) but I feel a more 'realistic' case could be added (for example a simple crustal model which does not rely on periodic boundary conditions?).

**Reply:** We agree that our 2D example is very simple. Our aim for this paper is to explain how rapid ductile localization can be dealt with numerically. As such, we don't think an application case fits the scope of the paper. Furthermore, the focus of our study is thermal runaway as a potential driver of deep earthquakes, therefore a crustal model would not be appropriate in our opinion. A more appropriate setup would include a subducting slab in the mantle transition zone where the model domain of our 2D example would be aligned with the slab. This would require a larger domain size and thus significantly limit the resolution of the shear zone. It would also require oblique boundary conditions to induce a deformation field that is comparable to the 1D simple shear case. We therefore think, a more complex model setup is out of the scope of this study. Regarding the periodic boundary conditions, similar results can be obtained with pure shear boundary conditions. In this case, the shear zone forms at an angle of 45°.

Finally, a minor problem: at line 64 the authors state that "Adif and Adis are multiplied by 2, and sigma\_b is divided by 2". Adif and Adis are defined a few lines above, but not sigma\_b at that stage of the paper.

**Reply:** We followed the suggestions of Reviewer 1 and reorganized sections 2 and 3. Line 64 now comes after the rheology section, so sigma\_b will be defined before it appears in the model setup description.