Review on "The effect of temperature-dependent material properties on simple thermal models of subduction zones" by van Zelst et al.

The authors implement temperature-dependent thermal parameters in numerical models to test their effects on the thermal structure of subduction zones. I appreciate their efforts on pushing forward the community to use more sophisticated/realistic processes to simulate plate tectonics, and it's good to see the model changes affected by the temperature-dependent thermal parameters. However, I feel the strategy of this MS is a bit strange. On one hand, the authors claim that we should use more realistic/complex temperature-dependent thermal parameters in subduction simulation. However, on the other hand, the authors test the effect of the temperature-dependent thermal parameters with an extremely simplified model (not only the model setup, but also the governing equations). I do not believe that important physics could only be revealed by simplified models. I am fine with the current results presented in the MS, but would like to suggest the authors to use more sophisticated models for their future numerical studies.

My questions and comments are listed below.

- Temperature could affect brittle-ductile deformation, which in turn affects seismicity. Unfortunately, the authors do not provide any discussion. Maybe add some brief discussion in section 4.1.

- Lines 11-12: strange conclusion: "……temperature-dependent thermal parameters…… has a secondary effect on ……compared to…… ". I fully agree with the previous reviewer who also questioned this conclusion. This kind of expression is indeed very confusing. In my opinion, the aim of this study is to clearly show readers the effect of the temperature-dependent thermal parameters on subduction evolution. I guess the authors do not need to emphasize the competition in terms of importance between the thermal parameters and other model parameters (e.g., plate rheology or age).

- Line 105: the temperature equation. What are the "external heat sources"? Shear heating, for instance? If so, I really do not understand why, since you are dealing with temperature evolution. It's really unnecessary to exclude the heat sources (especially when we are able to implement).

- Equation 2: Please explain explicitly with several lines why do you use zero gravitational acceleration, even for the vertical direction (and do not just refer to the van Keken paper without giving any necessary explanations). Besides, does "zero gravitational acceleration" mean there is no pressure? Is subduction purely driven by the velocity boundary condition?

- Line 141: Do not like this expression: "as we do not aim to …"'

- Line 147 Could different overriding plate structures (thickness and thermal structure) affect the slab thermal structure?
- Fig. 1b: Do the authors use constant temperature for the asthenospheric mantle underneath the overriding plate? In my opinion, this is over-simplified, since it is not compex to implement the adiabatic temperature gradient (and it is more realistic).
- Line 180: Plate model also has the shortcoming to describe the thermal structure for young plate ages.
- Line 210, Figures S8-S17: Too many 2D figures. Please show the difference in a concise manner, e.g., plot difference with temperature profiles?
- Figure 2 "The lighter colors indicate the crustal approximation for the thermal conductivity (i.e., multiplied by 0.5) and the density (i.e., multiplied by 0.79)." and Line 295. Why do you use the approximation rather than the realistic thermal parameters for the crustal domain?
- Line 245 "……first-order effect……" is confusing.
- Fig. 6: It's good to plot the difference between the two models. However, except the thermal parameters, the T-profile left boundary is different in these two models, i.e., the ref. model using the half-space cooling model while the preferred model using the plate model. This is weird. One should keep all other parameters (except the three thermal parameters) identical. Alternatively, one could compare the case2c_bc model with the case2c_all model.
- Lines 387-389, 392-393, Figs. 6a-b: The main reason of the colder slab and the overring plate in the preferred model (case2c_all) is larger thermal diffusivity (e.g., Fig. 3)? The lower part of the slab in the preferred model (case2c_all) is slightly warmer, why? One should explain and section 3.5 is the right place.
- Figs. 6c-d: It is quite difficult to understand the initial setup of the case2c_all_cp model. Since this is quite an important model, why not describe it in Table 1? Furthermore, this model behaves much different from the case2c_all model, and one should provide description in section 3.5.
- Supplement: Do readers really need to read through the 29 figures? Are these figures really essential for readers to fully understand the main text?