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Interactive comment on "Towards a nappe theory: Thermo-mechanical simulations of nappe detachment, transport and stacking in the Helvetic Nappe System, Switzerland" *by* Dániel Kiss et al.

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"Towards a nappe theory: Thermo-mechanical simulations of nappe detachment, transport and stacking in the Helvetic Nappe System, Switzerland" by Kiss and colleagues is an interesting paper that investigate the thermo-mechanical processes of nappe formation. Overall, the paper is quite short, but well-written, pretty balanced, and the illustrations are to the point. It provides a modern and clear perspective on the topic. As soon as the authors consider the comments below, I will be happy to recommend this work for publication in EGU Solid Earth. I think with some improvements this review paper will be ready to have a big impact and long shelf-life.

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Discussion paper

GENERAL COMMENTS:

- I found the title “Towards a nappe theory” and the first part of the introduction a bit far from the aim of this study. This study is definitely a step towards a better theory of tectonic nappes; however, it is focused on a specific case (Helvetic Nappe System) and the model setup is also made for it. Based on my comment, I suggest to remove “Towards a nappe theory” from the title and rephrase the first part of the introduction (see my next comment).

- The introduction is very detailed. The authors provide a very broad overview. I would recommend to make it shorter. Also, the authors go back and forth between the general knowledge on the topic and what is addressed in the study. I suggest to separate this parts and improve the transition between the two; for examples, I would add some lines to highlight how numerical simulations can help to overcome the uncertainties from e.g., geological interpretation and/or typical limitation of analogue models.

SPECIFIC COMMENTS:

Page 1:

#5: “of a thrust nappe and stacking of this thrust nappe” - remove "of this thrust nappe"?

#10: “and the resulting brittle-plastic shear band formation” - shear band (bands?) cutting through the cover layer?

#10: “weak sediments” - décollement?

Page 2: #5 “, for example, a basic definition” - ; for example. . .

Page 5:

#15 “We assume slow, incompressible deformation” - please be more specific with the term “slow”. Maybe long-term tectonic deformation?

#25 “With ongoing deformation, this marker chain needs to be locally remeshed which

is achieved by adding marker points in the deficient chain segments." - The term remesh is odd, as it refers to the "Lagrangian" markers. Please specify whether this criterion assumes a minimum number of markers per cell. If so, please clarify how these markers are added and how the physical properties are interpolated from the nodes.

Page 6:

#20 "ambient pressure and temperature"?

#25 "The top boundary is a free surface, using the algorithm of Duretz et al. (2016)". I recommend to spend a few more lines to specify how this algorithm works and that this is not "the usual" pseudo free-surface used in many geodynamic models.

#25 I suppose the velocity discontinuity at the bottom right corner introduces a stress singularity - how do you treat this issue in the boundary conditions?

Page 7:

#20 "deviatoric stresses reach ca 250 MPa". This values seems pretty high. In section 4.4 the authors discuss the effects of softening mechanisms - e.g., lower effective friction to mimic the presence of pore fluid-pressure. I was wondering what is level of deviatoric stresses when the model is under hydrostatic conditions.

Figure 1: could you please add a small inset to locate the region of the cross-section?

I hope my comments contribute the authors to improve the manuscript.

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