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Interactive comment on "Verification of an ADER-DG method for complex dynamic rupture problems" *by* C. Pelties et al.

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Answer letter to referee #2 Anonymous

Response prepared by C. Pelties, A.-A. Gabriel, and J.-P. Ampuero.

The authors thank the referee for providing a thorough review. We prepared the following changes and clarifications to improve the manuscript accordingly. In the following we address all suggestions and comments of the review in detail. Each of our response items starts with the corresponding quote from the review. A revised version of the manuscript can be found in the supplement.

"This is a useful paper that presents thorough benchmarking of an arbitrary high-order derivative Discontinuous Galerkin (ADER-DG) method on unstructured meshes for ad-

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vanced earthquake dynamic rupture problems. The authors validated the method in comparison to well-established numerical methods in a series of verification exercises and showed that the combination of meshing flexibility and high-order accuracy of the ADER-DG method makes it a competitive tool to study earthquake dynamics in complicated setups. I think that this paper is worth publishing in GMD. My minor points are the followings: P5983: Ohnaka and Mogi (1982) is not an appropriate reference because this paper did not discuss a constitutive law. Examples of better references to cite here are Ohnaka and Kuwahara (1990) or Ohnaka and Shen (1999). Ohnaka, M., and Y. Kuwahara, Characteristic features of local breakdown near a crack-tip in the transition zone from nucleation to unstable rupture during stick-slip shear failure, Tectonophysics 175, 197-220, 1990. Ohnaka, M., and L. Shen (1999), Scaling of the shear rupture process from nucleation to dynamic propagation: Implications of geometric irregularity of the rupturing surfaces, J. Geophys. Res., 104(B1), 817–844, doi:10.1029/1998JB900007."

The reference is changed to Ohnaka and Kuwahara (1990).

"P5988 lines 3-5. "The development of a supershear daughter pulse in TPV11, caused by stress concentration ahead of the sub-shear rupture front (Dunham, 2007), is equally well captured, as shown in Fig. 2." I cannot catch well the development of a supershear daughter pulse from Figure 2. More explanations will be necessary."

Changed to "The development of a supershear rupture front in TPV11 is equally well captured, as shown in Fig. 2. The rupture time contour plot in Fig. 2 (a) captures the boost in rupture velocity after supershear transition."

"P5995, line 25; P5996, line 16; p5992, line 21 "rate-and-state dependent constitutive relationships" should be amended to "rate- and state-dependent constitutive relationships""

Changed accordingly.

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“Equation (1): Definition of L should be added.”

Changed accordingly. The definition of L was moved forward from being defined only after Eq. 6. Furthermore, the naming convention of L was unified between tables 5 and 6 to ’characteristic slip scale’.

“Equation (4): W and w should be defined. If spatial distribution of a is shown in Figure 15a, this equation seems to be unnecessary.”

As suggested, equation (4) is removed and replaced by a reference to Fig. 15 (a).

“P 5997, line 20: Since a usual rate- and state-dependent friction law is introduced, slow velocity friction seems to be better.”

We assume the reviewer refers here to p. 5996, line 1, the heading of subsection 7.1 “Slow velocity weakening ”. We followed the suggestion and changed this heading to “Slow velocity friction”.

“P5986 line 11 “ we compare our results to the well-established software FaultMod” → “we compare our results to that from the well-established software FaultMod””

Changed accordingly.

“Equation (7) Is vˆ8/v_* correct ? In the paper by Dunham et al. (2011), this term is (v/v_*)ˆ8. Also mu_s seems to be mu_w.”

Changed to (v/v_*)ˆ8.

“P6004 lines 14. The unit of L should be added.”

Added.

“Table 1. tau_0 is used for nucleation shear stress along-dip and nucleation shear stress along-dip.”

Nucleation shear stress along-dip is now referred to as tau_nuc.

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“Table 6: this is not referred to in the main text.”

A reference is added.

“Figure 8: Unit of X and Y should be added.”

Units are added.

“Figure 9: In the main fault (a), it would be better to show the location where fault branch occurs. Please add an explanation on a blue zone (concentrated blue lines).”

The branch occurs at along-strike distance 0. We added a corresponding sentence. Furthermore, we added a discussion about the ’concentrated blue lines’: “The concentration of rupture fronts after along-strike distance > 0 km on the main fault for ADER-DG without gap (concentrated blue lines in Fig. 9(a))is simply the result of a smooth, spontaneous rupture arrest in the branch (as opposed to abrupt arrest by a barrier).”

“Figure 15 a: It would be better to divide this figure into two figures; initial stress and friction parameter a.”

Since the initial distribution of the parameter a only affects the domain boundaries, whereas the initial distribution of stress acts in the vicinity of the hypocenter, we believe both visualizations can be shown in one figure and would carry too little information shown separately.

“In Figure 17, the unit of L should be added. Caption “the nucleation zone. for different” -> “the nucleation zone for different””

Dot is removed and unit is added.

Interactive comment on Geosci. Model Dev. Discuss., 6, 5981, 2013.