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Interactive comment on “Stress rotation – The impact and interaction of rock stiffness and faults” *by* Karsten Reiter

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I have to thank Referee #2 for having read and reviewed the manuscript carefully and in detail. The reviewer correctly summarises, that the manuscript “. . . presents simple and unrealistic models of the Earth’s crust”. Realistic models with a complex geometry, variable material properties, laterally and with depth, and a complex rheology are appropriate to reproduce observed mechanical features in detail. This is suitable for generating best-fit-models. However, the more ‘adjusting screws’ are technically implemented, the easier it becomes to achieve an optimal fit to the observation. To me the question is: Are such best-fit-models suitable for identifying the most important parameters for stress rotation in the crust? Do such complex models give us a better understanding of the interaction of the properties used and discontinuities, which

create or prevents stress rotation? For me, the answer is simple: No.

It has never been the aim of this study to present a model of the earth’s crust that is as realistic as possible. It was mainly concerned with identifying the influence of density, elastic material properties (Young’s modulus and Poisson’s ratio) and discontinuities on the stress orientation, which deviates from the assumed stress orientation due to plate boundary forces. Therefore, simple generic models are used, to test each parameter separately at first. Interaction of these parameters tested afterward.

Referee #2 mentions the following regarding the models on which the mechanical properties of the Variscan units are tested: "This means, that the area selected for the model evaluation is incorrect". This area has inspired the model geometry. A reader of the manuscript would never understand the chosen geometry, neglecting that background of observation (stress orientation) and zoning in the Central German Highlands. The model, which uses the variation of material properties from the German Variscides, reproduces some observed stress orientation pattern, and some not. Therefore, I summarized carefully: ". . . the model results are not able to prove the significant influence of the material properties on the stress orientation for this region." This is true, because I could not exclude other factors that contribute significantly to the observed stress rotation. Furthermore, a model is never able to prove a hypothesis. The statement in my conclusion "Comparison of model results with observed stress orientation in the region, which inspired the models, provides limited consistency" is in contrast to the re-interpretation of Referees #2: "In conclusion, the author admits that the modeling results do not reflect the stress rotation in the reference part of the Alpean foreland."

Referee #2 suggest presenting more details of the model results, such as different stress rotation with depth, or more details of the models with variable Young’s modulus, separated by low friction faults. However, I am aware of the simplicity of the models used. Therefore, I have avoided to present too much details, which probably would pretend the use of realistic scenarios. Much more realistic models are needed to study such details. According to Samual Karlin’s remark: “The purpose of models is not to fit the data but to sharpen the question.", the used simple generic models sharpened the question for detailed studies in the future.

The major findings of that study, that (1) the Young's modulus is capable to cause significant stress rotation in the crust away from the material transition, (2) low friction discontinuities do not cause significant stress rotation away from that structure, and (3) low friction faults are capable to compensate stress rotation due to different Young's modulus are independent from the question, up to what depth in the crust, elastic material properties are sufficient. I think this interesting question is a fundamental one that cannot be adequately addressed in this study.

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