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Interactive comment on "Methods and uncertainty-estimations of 3D structural modelling in crystalline rocks: A case study" *by* Raphael Schneeberger et al.

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Methods and uncertainty-estimations of 3D structural modelling in crystalline rocks: A case study

Schneeberger et al.

General comments The paper is a well-written account of modelling uncertainities in fault continuation into the sub-surface. The authors have the advantage of access to sub-surface tunnels through which they can test their models and assertions. The authors do this using surface data from which they predict and test against the subsurface

tunnel exposure. Due to the nature of the fault systems, actual faults cannot be confidently correlated so the findings are based on probabilistic best-fit models. The result is a deterministic model informed by probability – which is an interesting halfway house between 'normal' deterministic 3D models and probabilistic offerings. The paper topic is suitable for publication in Solid Earth. It reviews well the existing literature in this area of geoscience and introduces the topic well before providing new insight and data to add to geoscience uncertainty literature.

My main thoughts concern the validation process. Given that the spacing of faults in the surface and sub-surface is such that individual faults could not be positively correlated, then the calculated distance misfit of less than 6% for any extrapolation method is partly a function of fault spacing at depth. In reality none of the extrapolations or the associated best-fit models may represent reality. I think this should be considered more explicitly and discussed.

Specific comments

1. Introduction Page 5 line 9 Do you use dip information or purely strike? This makes a big difference in terms of how you can construct a schematic 3d block diagram (Figure 2).

5. Discussion Page 17 lines 19-20 Can you explain/expand the sentence starting "Therefore, faults..." So the impact of the modelling and the best-fit model is clear. Where is the centre of the rotation? Is it in a single plane? Do you really mean rotation in this sense?

Page 17 lines 20-22 You introduce the effect of boundary conditions here, and make an assertion in line 20 that because the observations are different in the GTS then there must be boundary condition effects. But in lines 11-14 you discuss differences in the outcrop on the surface and in the GTS, due to vegetation cover, and the ability to identify faults. I think there are modelling reasons why you might have boundary affects... you should discuss these, rather than simply saying it doesn't fit out observations so

there must be effects.

Technical corrections

Abstract Page 2 line 4 Insert 'a' between 'as' and 'study area'

1. Introduction Page 3 lines 2-5 The reference to Bond et al. (2007) (as reference in the reference list) should be referenced in line 2. In line 3 the reference should be to Bond et al. (2007b). Knowledge Transfer in a digital world: Field data acquisition, uncertainty and data management. Geosphere 3 (6), 568-575.

2. Geological Setting Page 5 Figure 2 A North arrow would be useful.

Page 5 line 19 I would refer to figure 2 again here.

3. Methods Page 7 line 11 The word 'obtaining ' is in the wring place in the sentence. Change to " …remote sensing allowed a structural surface map to be obtained."

Page 7 line 39 Could you expand this sentence to provide a bit more context, again you could refer back to figure 2.

Page 8 Figure 4 Expand the figure caption to discuss the outline of the GTS and the elements annotated in the figure.

Page 9 Figure 5 Expand the figure caption to explain the different elements in the figure.

Page 9 Figure 6 The caption for c) could be clearer, suggest change to "…..10,000 times and all patterns are compared, the number of crossing faults within the generated pattern are minimized by addition a penalty factor yielding a…"

Page 9 line 13 The information in brackets is not clear suggest removal of 'in the' to improve clarity.

4. Results Page 12 line 14 Insert "(GTS) facility" at the end of the sentence "…mapped in the underground…".

Page 13 line 13 Delete "above-presented" it does not add anything and makes the point of the sentence harder to follow.

Page 13 line 14 Ditto remove "mapped in the underground"

5. Discussion Page 18 line 5 This sentence is not well constructed, suggest change to "We initially compared the three extrapolation….."

Page 18 line 13 Add "The" before "extrapolation 3D structural model…."

Page 18 line 14 It feels like the end of this sentence needs a bit more… "obtained dips vary substantially" from what? How?