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Solid Earth
Discussions

Interactive comment on "Throw variations and strain partitioning associated with fault-bend folding along normal faults" *by* Efstratios Delogkos et al.

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This paper investigates how changes in the dip of the fault affect the throw recorded across the fault, based on seismic reflection and outcrop data. The authors present a simple geometric relationship to account for the discrepancy, which has clear applications to a range of geological problems.

Initially I was confused reading the manuscript because the authors refer to 'along-fault bends', and yet all figures and later discussion refers to concave or convex bends down dip of the fault (contrast this with Faure Walker et al., 2009; Iezzi et al., 2018 who discuss fault bends as changes in strike along the fault scarp at the surface). My

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Discussion paper

interpretation is that the authors are actually discussing "down dip fault bends", and if this is correct then it should be clarified in the title and abstract of the paper.

The assumption of "constant along fault displacement" is clearly stated, but I wonder what the implications of this assumption being incorrect would mean for the conclusions of the paper? For example, Wesnousky, 2008 presents a compilation of historical earthquake ruptures, including normal faulting earthquakes, that show that along a fault the coseismic displacement (and thereby probably the long term displacement) is highly variable. However, there may be confusion on my part given my point in the paragraph above – I think the authors are referring to "constant down-dip fault displacement" rather than along strike displacement?

Line 37 – "normal faults are often approximately planar" can you provide a reference for this? There are many active normal faults in Italy, Greece and Basin and Range that are not planar (although obviously it depends on the length scale of observation) Line 43 – others have investigated strain partitioning and variations in throw along-strike of non-planar normal faults e.g. Faure Walker et al., 2009; Iezzi et al., 2018 – and discussed the implications particularly for seismic hazard Line 239 – 243 – this is very similar to the conclusion in Iezzi et al., 2018, wherein they looked at the spread of data in the Wells and Coppersmith 1994 data set. Could the observations/models presented in this paper also explain the scatter in fault scaling relationships? Or is this less applicable given the different scale of observation?

Figure 3 – I mostly like this figure, but I am curious about the dots plotted on the graph that refer to the examples presented in the later figures. I'm assuming the dots are plotted according to the dips of the lower and upper fault segment – and then a percentage can be read off the graph. How do these predicted percentages compare to the actual measured percentages from the seismics/outcrops? This information/analysis seems to be missing from the paper. I think this would be a valuable addition to demonstrate that your simple (but effective!) geometric model works.

Overall this paper is good and presents a simple but compelling theory that would have implications for a wide range of geological research. Some terminology needs to be clarified (as explained above) but otherwise I recommend this paper for publication.

If any of my points raised are unclear, I am happy for the authors to contact me via email zoe.mildon@plymouth.ac.uk.

Some references that could be considered Faure Walker, J. P., G. P. Roberts, P. A. Cowie, I. D. Papanikolaou, P. R. Sammonds, A. M. Michetti, and R. J. Phillips (2009), Horizontal strain-rates and throw-rates across breached relay zones, central Italy: Implications for the preservation of throw deficits at points of normal fault linkage, J. Struct. Geol., 31(10), 1145–1160, doi:10.1016/j.jsg.2009.06.011. Iezzi, F. et al. (2018), Coseismic throw variation across along-strike bends on active normal faultsâĂŕ: implications for displacement versus length scaling of earthquake ruptures ., J. Geophys. Res., doi:10.1029/2018JB016732. Wesnousky, S. G. (2008), Displacement and geometrical characteristics of earthquake surface ruptures: Issues and implications for seismic-hazard analysis and the process of earthquake rupture, Bull. Seismol. Soc. Am., 98(4), 1609–1632, doi:10.1785/0120070111.

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