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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 manuscript focuses on how changes in the dip of a normal fault in cross-section (fault bends) result in the formation of folds in the hangingwall and partitioning of true total throw between discontinuous throw (faulting) and continuous throw (local folding). The authors demonstrate this principle using theoretical sketches and a quantitative model, supporting their claims with field and seismic-based natural examples of fault bend folds and associated analyses. The authors clearly show: i) how the proportion of total throw that can be assigned to continuous deformation varies predictably with the degree of convexity or concavity of the fault bend; and ii) that if fault-bend folds are not accounted for in fault throw analysis, fault throw estimates may be subject to errors of up to 50%.

The scope, motivation and implications of this work are clearly expressed and are well-grounded in key normal faulting literature. The manuscript is very well written and the argument that is presented is logical. To my eye at least, I could see no significant flaws in concept or scientific approach and the concepts and conclusions in the manuscript are valuable. The figures effectively communicate the points made in the text. A spot check of the reference list suggest it is complete and consists of the key references I would expect. Without doubt, I recommend this manuscript for publication as I consider it useful for the structural geology community, both academic and industrial. The manuscript is in an excellent condition although there are a couple of minor points that I have noted below and on the marked-up PDF attached that the authors may consider addressing.

1) I suggest the authors add extra sketches (or modify existing sketches in earlier figures) to support section 4.2. as this discussion is relatively complex and difficult to digest

2) In section 4.2. I was finding myself getting a little confused by terminology (e.g. lines 209-210). The use of the term normal drag when referring to ‘monoclines between different stratigraphic sequences or between different fault segments’ needs clarifying. To me, what is described in lines 209-210 and shown in Ferrill et al 2017 (their figure 6) is more reminiscent of a ‘fault-propagation fold’ (e.g. Coleman et al., 2019), but this may be me being confused by the scale or the description. Either way, the terminology can probably be clarified or shown in the sketch as mentioned in Point 1 above.

3) Perhaps rotate Fig 5b by 90 degrees and put it to the right of 5a so that there is more of a visual link between the two parts

4) Possible references that could be considered for citation:

âĂć Spahić, D., Grasemann, B., & Exner, U. (2013). Identifying fault segments from 3D fault drag analysis (Vienna Basin, Austria). Journal of Structural Geology, 55, 182-195.
âĂć Long, J. J., & Imber, J. (2010). Geometrically coherent continuous deformation in the volume surrounding a seismically imaged normal fault-array. Journal of Structural Geology, 32(2), 222-234.

If any of my handwritten notes are unclear, I am happy for the authors to contact me at oliver.duffy@beg.utexas.edu.

Regards,

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Solid Earth Discussions

Throw variations and strain partitioning associated with fault-bend folding along normal faults

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Abstract. Normal faults have irregular geometries on a range of scales arising from different processes including refraction and segmentation. A fault with an average dip and constant displacement on a large-scale, will have irregular geometries on smaller scales, the presence of which will generate fault-related folds, with major implications for across-fault throw variations. A quantitative model has been presented which illustrates the range of deformation arising from movement on fault surface irregularities, with fault-bend folding generating geometries reminiscent of normal drag and reverse drag. The model highlights how along-fault displacements are partitioned between continuous (i.e. folding) and discontinuous (i.e. discrete displacement) strain along fault bends characterised by the full range of fault dip changes. Strain partitioning has a profound effect on measured throw values across faults, if account is not taken of the continuous strains accommodated by