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Interactive comment on "Multiscale Roughness Influence on Conservative Solute Transport in Self-affine Fractures" *by* Zhi Dou et al.

Anonymous Referee #2

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Summary: The authors study the impact of fracture roughness on non-Fickian transport through self-affine fractures. The roughness is decomposed into two different scales and authors show that the small-scale secondary roughness has major impact on non-Fickian transport. Finally, authors fit ADE and MIM and discuss how the secondary roughness affects the fitted model parameters.

General Comments: The idea of decomposing the fracture roughness into two different scales and studying its impact on transport is very interesting. However, the definition for the secondary roughness is too vague/qualitative. The level of analysis, interpretation and writing is not yet appropriate for HESS.

Major comments: 1. Overall writing should be improved: there are quite a few typos (some of them can be found in the specific comments), and a few parts lack details.

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Discussion paper

2. The sensitivity of the results with respect to the cut-off level should be discussed. It is not clear why different levels of approximation walls are chosen for the top and bottom fracture walls. It seems like some of the major results are caused by the fact that level 5 instead of level 4 was chosen for the bottom fracture wall.

3. Interpretation is not insightful enough: It is intuitive that the secondary roughness will make flow more heterogeneous, which in turn makes transport more non-Fickian. The authors do not provide enough insights for two different roughness scales. For example, can you quantitatively link the MIM model parameters with the two different roughness scales? Or can we have some understanding on the quantitative criteria for defining secondary roughness?

4. RTD is not properly defined.

5. It seems like fitted BTCs doesn't honor mass conservation (Fig 8). Please double check.

6. Table 4: D_f/D_Taylor decreases as Peclet number increases. Can you explain why?

Specific Comments:

Line 25: "BTCs decreased" – increased??

Line 55-56: Not clear.

Line 69: "well-behaved BTCs" – vague

Line 121: MIM model is not inverse model.

Line 188: "level 4 and level 5" – What is "Zou's quantitative criterion"? The criteria for choosing the cut off should be discussed in detail.

Table 1: sigma is not defined.

Line 352-: More details on Table 2 should be provided.

Line 393: RTD not defined

Figure 8: Mass conservation?

Table 4: D_f/D_Taylor trend: can you explain?

Line 485: weak -> stronger?

Line 490: “curial” - typo

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