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Solid Earth Discussions

Interactive comment on "The hydraulic efficiency of single fractures: Correcting the cubic law parameterization for self-affine surface roughness and fracture closure" *by* Maximilian O. Kottwitz et al.

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We sincerely thank the referee for reviewing the revised manuscript. Please find below a point-by-point response to the referee comments (comments of the reviewer in black and our response in red, text changes appear in italic font)

On behalf of all authors, yours sincerely,
Maximilian Oskar Kottwitz

* Line 299: this parametErization" – spurious E.

Thanks for pointing out, we removed an "e" at the indicated location

* Lines 300-301: I have the feeling that the message "fluctuations of the flow behavior have to be taken into account" is not exactly proper. If Lc is on the order of some scales in the DFN then the DFN's permeability can simply not be computed as the product of the permeability of the corresponding parallel plate DFN (where each fracture is replaced by the parallel plate of identical mean aperture) and a factor accounting for the mean permeability reduction due to roughness. Precisely due to changes in network SCALE flow connectivity (in you sentence on line 302 "scale" is missing between "network" and "flow").

We revised the sentence at lines 300-302 to:
If DFN's of scales close to the correlation length are considered, fluctuations in the average flow behaviour are expected. This can modify network scale flow connectivity and thus requires additional concepts to compute permeabilities (e.g., de Dreuzy et al., 2012)

* Line 224: my comment was not about the boundary conditions but more about the fact that the smallest dimension is along the fracture aperture and therefore it is along that direction that the highest shear occurs. So it is the discretization across the aperture that matters most when solving numerically.

Yes you're right. We made the sentence at line 224 clearer according to your sugges-

tion:
For numerical permeability estimations of single fractures, the resolution perpendicular to the aperture field is the most crucial part.

* Lines 251-253: it is also because at small Lc/L the in-plane tortuosity acts at a scale that is not much larger than the scale at which the vertical tortuosity acts. In-plane flow channeling has a much reduced impact on transmissivity, and thus vertical flow tortuosity has relatively more impact.

We incorporated your suggestion at line 253:
With decreasing l_c/L ratios, the impact of vertical flow tortuosity on its permeability increases relative to the impact of in-plane tortuosity, as both start to act at comparable scales and generally the fractures exhibit larger portions of flow inhibiting regions compared to flow enhancing ones (see Méheust and Schmittbuhl, 2000).

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