

## S1 Table

**Table 1. Parameters for rough surface domain**

| Notations    | Parameters                                   | Units | Values             |
|--------------|--|-------|--------------------|
| $r_{\min}$   | minimum size of roughness element            | m     | $10^{-7}$          |
| $r_{\max}$   | maximum size of roughness element            | m     | $10^{-3,a}$        |
| $D$          | fractal dimension for pore size distribution | -     | Vary <sup>b</sup>  |
| $\bar{\Phi}$ | mean surface porosity                        | -     | Vary <sup>b</sup>  |
| $l_p$        | size of a patch                              | m     | $5 \times 10^{-4}$ |

Parameters used to generate roughness domain.

<sup>a</sup> We have used  $10^{-3}$ m for all simulations as the largest roughness domain except for the comparison with data of [1] to consider their sample size,  $50 \times 10^{-3}$ m.

<sup>b</sup> Values of  $D$  and  $\bar{\Phi}$  vary for different simulations and the values are chosen under considerations of experimental data to be compared (such as for Tuff rock (Fig. 3 in the main text),  $D = 1.4$  and  $\bar{\Phi} = 0.1$  are used as a single patch and for sandy soil (Fig. 9 in the main text)  $D = 1.35$  and  $\bar{\Phi} = 0.4$  are used). Used values are given in the caption of each figure.

## References

- [1] Tokunaga TK, Wan J. Water film flow along fracture surfaces of porous rock. *Water Resources Research*. 1997;33(6):1287–1295.