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A competition model for wormhole growth

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Flow preferential pathways generated by dissolution are commonly known as wormholes. Wormhole generation and evolution are topics of interest not only for karst aquifer studies but also for fields as CO_2 storage and oil industry among others.
The objective of this work is to show that given an initial perturbation, the development of the dissolution pattern can be considered deterministic. This means that the evolution of the effective hydraulic conductivity can be predicted. To this end we use a wormhole growth model in which wormholes compete for the available water.
In the competition model the wormholes grow proportionally to the flow rate through them. The wormhole flow rate is a function of the wormholes lengths and distances between them. We derive empirical expressions for the flow rates from steady state flow synthetic models with different geometries.
Finally, we perform series of simulations using this competition model, applying random initial perturbations and different number of wormholes for each set of simulations and we study the evolution of the dissolution pattern. We find that the resulting wormhole patterns are in good agreement with others generated with much more complex models.