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# How to test experimentally if soil hydraulic conductivity can be predicted with the maximum power principle?

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Drainage of water in soils happens for a large extent through preferential flowpaths, but these subsurface flowpaths are extremely difficult to observe or parameterize in hydrological models. To potentially overcome this problem, thermodynamic optimality principles have been suggested to predict effective parametrization of these (sub-grid) structures, such as the maximum entropy production principle or the equivalent maximum power principle.

These principles have been successfully applied to predict heat transfer from the Equator to the Poles, or turbulent heat fluxes between the surface and the atmosphere. In these examples, the effective flux adapts itself to its boundary condition by adapting its effective conductance through the creation of e.g. convection cells. However, flow through porous media, such as soils, can only quickly adapt its effective flow conductance by creation of preferential flowpaths, but it is unknown if this is guided by the aim to create maximum power.

In this work we aimed to experimentally test if this is indeed the case. In the lab, we created a hydrological analogue to the atmospheric model dealing with heat transport between Equator and poles. The idea was to induce piping (a backward internal erosion process) as the mechanism to change the effective flow conductance.

Although, this is ongoing research, a couple of setups have demonstrated that the setups were not adequate to test the maximum power hypothesis. The reasons why this is will be discussed, while we are also looking forward to discuss ideas on how this hypothesis can be adequately tested.