# Shape evolution of soluble blocks under rainfall

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Rain is the masterful sculptor of a wide variety of exokarst features. It is the leading source of pure water running over karst fields, driving their dissolution and forming their skylines. The interaction of individual raindrop impacts with the topography has been linked for example to the emergence of ornamental-like rillenkarren [1]. The flow of rainwater films arguably plays a decisive role in the shaping of the larger scale as well.

In this contribution, we present a model for the two-dimensional and axisymmetric shape evolution of soluble blocks exposed to rainfall, $\eta(r,t)$ with the horizontal coordinate $r$, time $t$, and the vertical position of the solid interface $\eta$. The problem is complementary to the erosion problems under bulk flows, relevant for meteorites for instance [2], and under natural convection flows [3]. We describe the quasi-stationary thin-film flow in the draining regime [4] and approximate the solute transport therein using a dominant balance between diffusion and dilution. This leads to a non-linear initial-value problem for the evolution of the topography, which we solve analytically.

The temporal evolution "reads" the spatial distribution of the initial condition. We identify two *long-time* behaviours, depending on the *far-field* behaviour of the initial condition : namely, blunting for $\eta(r \to \infty, t = 0) \sim -r^p$ with $p < 4/3$ and sharpening for $p > 4/3$. Note that the former is somewhat uncommon to dissolution processes [3,5]. At the transition $p = 4/3$, the topography tends to a steady solution, which descends at a constant velocity and without being deformed.

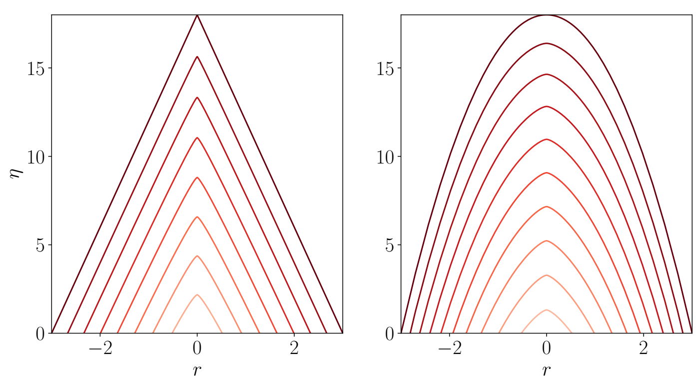


**Figure 1.** Shape evolution of a cone, $p = 1$ : the topography flattens (left) ; and a paraboloid, $p = 2$ : the topography steepens (right). Equally-spaced time steps, time increases from dark to light.

## Références

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