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Exploiting virtual sediment deposits to explore conceptual foundations

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Geomorphic concepts and hypotheses are usually formulated based on empiric data from the field or the laboratory (deduction). After translation into models they can be applied to case study scenarios (induction). However, the other way around – expressing hypotheses explicitly by models and test these by empiric data – is a rarely touched trail. There are several models tailored to investigate the boundary conditions and processes that generate, mobilise, route and eventually deposit sediment in a landscape. Thereby, the last part, sediment deposition, is usually omitted. Essentially, there is no model that explicitly focuses on mapping out the characteristics of sedimentary deposits – the material that is used by many disciplines to reconstruct landscape evolution.

This contribution introduces the R-package sandbox, a model framework that allows creating and analysing virtual sediment sections for exploratory, explanatory, forecasting and inverse research questions. The R-package sandbox is a probabilistic and rule-based model framework for a wide range of possible applications. The model framework is used here to discuss a set of conceptual questions revolving around geochemical and geochronological methods, such as: How does sample size and sample volume affect age uncertainty? What determines the robustness of sediment fingerprinting results? How does the prepared grain size of the material of interest affect the analysis outcomes?

Most of the concepts used in geosciences are underpinned by a set of assumptions, whose robustness and boundary conditions need to be assessed quantitatively. The R-package sandbox is a universal and flexible tool to engage with this challenge.