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Strategies for the set-up of a multi-process landscape evolution model

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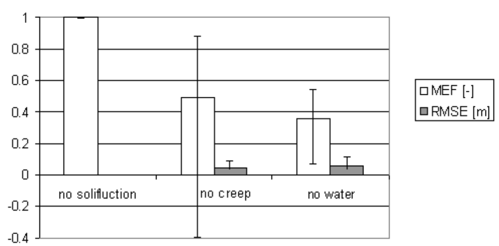
Focus on the interaction of processes means making new decisions

Landscape evolution models have become geomorphology's virtual laboratories, in which wide ranges of assumptions and conditions can be simulated over large spatial and temporal scales. The larger the spatial and temporal scale, the larger the probability that landscape evolution is a result of multiple, interacting processes. Building a landscape evolution model that combines these multiple geomorphic process requires special attention for the formulation of interaction between these processes. This poster focuses on that formulation and presents strategies and model tests that can be used to inform model setup decisions.

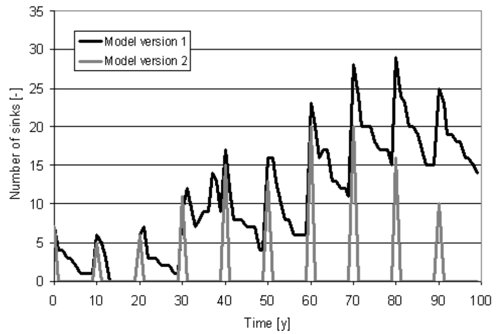
1: Define process relevance

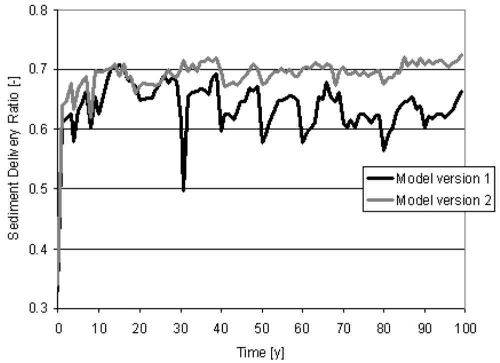
Processes that are irrelevant in individual case-studies, can be ignored in model formulation. An ex-post-test of process relevance should not only focus on the volumes involved in individual processes, but also on their effects on other processes. In this way, small-volume landslides that block rivers with major consequences would still be found to be 'relevant' . In the example below, we used two measures of output-similarity (Model Efficiency Factor, MEF and Root Mean Square Error, RMSE) to assess the effect of turning off individual processes, while taking uncertainty of the model into account. We would conclude that the role of solifluction in this landscape is so small that it could be ignored in the model.



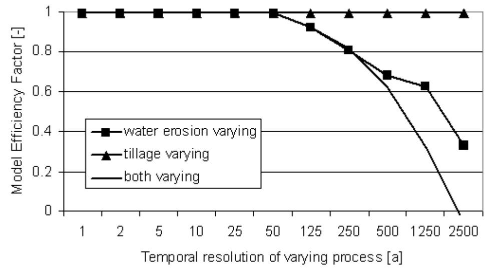
2: Define spatial interaction

For spatial (or topographic) interaction, we face the choice of whether to include sinks as valid landscape elements. We used two model versions, version 1 with sinks and version 2 without sinks. In a setting with landslides blocking valleys every ten years, we assessed the effect of this choice on the number of sinks in every timestep, and on sediment delivery ratio (SDR). We would conclude that the effect of blocking is significant and that full topographic interaction should be included.





3: Define temporal interaction



For temporal interaction, we must determine whether there are processes that can run at more than the minimal temporal resolution without compromising the model outcome. In our case study we assessed the effect of varying temporal resolution on the Model Efficiency Factor of the calibrated model. We used three model versions combining tillage and water erosion: one with both processes at the varying resolution, and two with only one process at varying resolution and the other process at minimal resolution. We would conclude that 1) optimal model performance is not compromised as long as minimal temporal resolution is 50 years, and 2) tillage erosion could even be run at temporal resolution of 2500 years (which equals the temporal extent), without compromising model performance.

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