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Fieldwork - model combinations : a next step in geomorphology?

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Outline

Landscape evolution hypotheses resulting from holistic geomorphological studies can be put to the test and improved with Landscape Evolution Models (LEMs).

Such fieldwork-model combinations have unfortunately rarely been attempted, and no studies combine fieldwork and modelling over 50ka timescales. One of the most important reasons is that process descriptions and input data for LEMs are lacking.

In this study, we add new process descriptions to LEM LAPSUS and attempt a fieldwork-model combination for a case study in KwaZulu Natal, South Africa. We draw conclusions about the feasability of such studies and explore the novel possibilities that they offer.

Methods

New descriptions of landscape forming processes were added to LEM LAPSUS and input data were prepared using results from fieldwork

Next to existing processes water erosion and creep, we added descriptions of physical and frost weathering and solifluction. These five processes were observed during fieldwork in the case study area. Descriptions included vegetation interactions. This resulted in the first landscape evolution model where five processes interact ed, of which frost weathering and solifluction had not been modelled before.

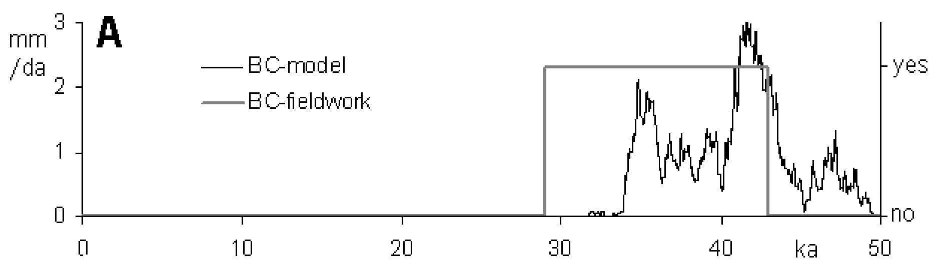
A paleoDEM and other input data were prepared using fieldwork results. Potential vegetation cover was calculated using 50 ka climatic records.

Case study

Earlier geomorphological fieldwork in the 7 km2 case study area led to conclusions about climate-landscape interactions that are applicable to wide areas in the Drakensberg Foothills.

In addition to a stratigraphical chronology and information about processes, fieldwork concluded that climatic influence on the landscape could be divided into three periods: cold and wet winters leading to strong slope processes from 50-33 ka, cold and drought inhibiting fluvial processes from 33-16 ka and warmer and wetter leading to fluvial erosion 16-0 ka

Results



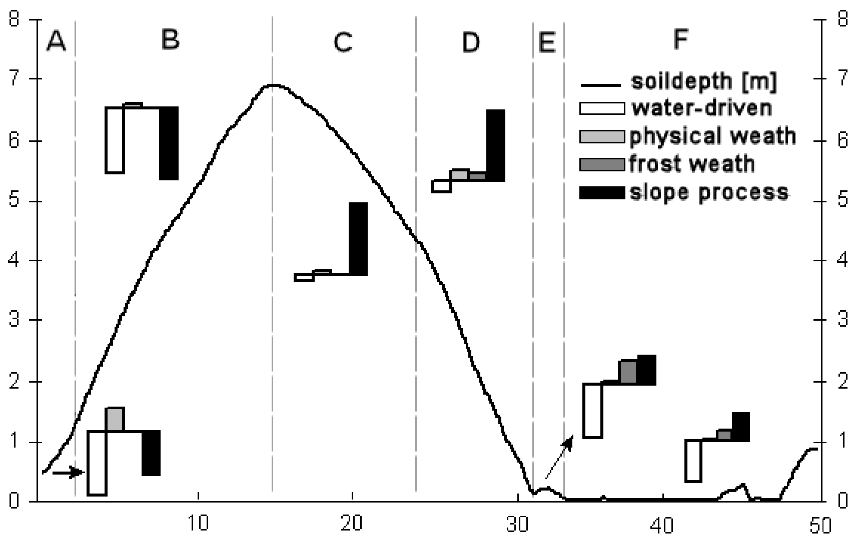
The non-guided interaction of five landscape forming processes over 50 ka resulted in outputs that were qualitatively comparable to fieldwork results.

Temporal development of soildepth for the six zones, and process activity in selected zones and for the whole area compared favorably to fieldwork results. As an example, the figure left show discrete fieldwork and continuous modelling results for solifluction in zone BC. For solifluction, OSL-dates taken during fieldwork indicate date of burial, whereas model results indicate date of deposition.

Recommendations and possibilities

The fieldwork-model combination presented in this work can be better validated when fieldwork sampling strategies are adapted.

Instead of only sampling at special and atypical sites that are important for the formation of hypotheses, more regular sampling can provide data for quantitative model validation. Next to that, more attention for quantitative methods of comparison is required because they give information that is difficult to obtain otherwise.



Fieldwork-model combinations have the potential to detail and improve conclusions and to fill in gaps in stratigraphical records.

Fieldwork can only observe preserved depositional phases and suggest the dominant process for those. As visible in Fig left, where model results for one site are displayed, modelling can show the assemblage of processes for both preserved and eroded phases. That is a big step ahead

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