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Environmental transition in badlands: an analogue model for the impact of climate change on geomorphic systems?

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On a continental scale, the effects of climate change, along climatic gradients, on surface processes and landforms are well understood. In this study, the geomorphic reaction of two badlands, the Zin Valley in Israel and the Dinosaur in Alberta, to changes of rainfall characteristics are analysed. In Alberta, weathering limits erosion rates and the reaction of slope erosion to climate change is therefore largely controlled by its effects on weathering. In the Zin Valley, hillslope erosional response is more complex because the pattern of runoff generating areas, runoff frequency and continuity as well as surface properties are strongly influenced by rainfall characteristics. The analysis of the Zin and Dinosaur badlands shows that relatively small changes in the amount of rainfall have the potential to produce a highly variable range of geomorphic responses. Our understanding of the impact of such climate change on surface processes and landscape development is limited in two ways. First, climate will be in a quasi-permanent state of change, which affects the nature, spatial and temporal patterns of surface processes. Second, over time, surface properties will be altered in response to changing processes, generating themselves a feedback on surface processes. A key element to assessing the impact of climate change on desertification is therefore the recognition of the dynamic interdependence between surface processes and properties. Continuing climate change, accompanied by further land use change on agricultural land, will create environments characterised by a permanent state of transition during the 21st century. The impact of future climate change on surface processes and desertification cannot be addressed, as is commonly done, by simply linking future climate to runoff ratios and erosion rates observed under current surface conditions. Such an approach

ignores the dynamic nature of surface-climate interaction. Geomorphologic research on desertification has to gain a better understanding of such transitional environments, in particular the identification of synergies and discontinuities that would alter present surface process regimes beyond the validity of current model projections.