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Landscape Evolution in Active Tectonic Settings: Diagnosing Dynamic Coupling Between Climate and Tectonics

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Much research, and much debate, has been focused on the potential for climate and climate change to directly influence the rate and pattern of deformation in tectonically active mountain belts. Key contributions have been made in all areas of endeavour: analysis of field data, laboratory experimentation, numerical simulation, and theoretical argument. Whereas models (of theoretical, numerical, and analog varieties) uniformly predict that climate, through its influence on the efficiency of erosion processes, can and should strongly influence the rate and pattern of deformation and rock uplift, no field data as yet convincingly demonstrate such a dynamic coupling operating in nature, though much data is certainly suggestive. This partly reflects the great difficulty of developing field observations that can be unequivocally interpreted. However, defining more precisely what suite of observations are needed to test the hypothesis that climate and tectonics importantly influence one another through feedback loops may illuminate the way forward. What questions should we be asking? What constitutes a true dynamic coupling? What sort of relations can be expected? At what time and space scales should we examine processes? What are diagnostic criteria for evaluating whether climate and tectonics are coupled? What time scales of observation are required for confident diagnosis? Different perspectives on the answers to these questions may explain some of the controversy over interpretation of available field observations. Recent theoretical and numerical work on eroding orogenic wedges goes some distance to framing answers to these questions and, as such, may provide a useful guide to on-going and future research. Much recent research has focused on the Himalaya and the European Alps; I exploit these two field settings as case studies

to highlight the importance of answering the above questions to facilitate progress.