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Influence of orographic precipitation on the incision within a mountain-piedmont system

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The geomorphological evolution of a mountain-piedmont system depends both on tectonics and climate, as well as on couplings between the mountain and its piedmont. Although the interactions between climate and tectonics are a fundamental point for understanding the landscape evolution, the erosion of a mountain range and the sediment deposition at the mountain front, or piedmont, have been poorly studied as a coupled system. Here we focus on the conditions driving an incision within such a system.

Classically, it is thought that incision results from a change in climate or uplift rates. However, it is not clear which are the specific conditions that favor the occurrence of river incision in the piedmont. In particular, studies have shown that the presence of a piedmont can modify the incision patterns, and even drive autogenic incision, without any change in external forcings. This is a crucial issue in order to interpret natural incisions in terms of uplift or climatic modifications. Such a problem is further complicated by the modification of local precipitations and temperatures during uplift, because the progressive effect of climate change may superimpose to uplift.

In this work we explore the hypothesis that a mountain-piedmont coupled system may develop incision in its piedmont as a result of enhanced orographic precipitations during surface uplift. We use a landscape evolution model, Cidre, in order to explore the response of a mountain-piemont system in which the mountain is continuously uplifted but in which precipitation rates depend on elevations. Thus precipitation amounts change during the mountain uplift. We test different peaks and amplitudes of the orographic precipitation pattern, maintaining the other conditions constant. Preliminary results show that elevation-dependent precipitations drive temporary but pronounced incisions of the main rivers within the piedmont, contrary to experiments without orographic precipitations.