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A method to extract transient erosional signals from hillslopes in fluvial valleys

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Records of temporal variations in erosional activity within a landscape have been demonstrated to be retained in the morphology of affected hillslopes (e.g., Colman and Watson, 1983). Recently, advances in the evaluation of river channels have shown that transient erosional signals can preserve detailed information on the formation of topography and morphology of mountain ranges (e.g., Perron and Royden, 2012). Here, we present a new method bringing together both the record of erosional activity stored in the hillslopes and the transient erosional signals stored along the river channel.
We identify erosional landforms on hillslopes that may be correlated to relatively stable periods of minimal erosion at the valley axis, during which the landforms would have reached their strength-limited slope angles (Selby, 1982). Employing third-order topographic derivatives (Minár et al., 2013), we identify low-angle slope sections/plateaus corresponding to terraces and/or extrapolated ridges that project onto either former or present-day valley floor levels. Identifying these features and their relationship to past variations in erosional activity allows us to treat them in a similar manner as fluvial knickpoints. This can provide a means of testing for regionally consistent changes in coupled fluvial and hillslope activity that may then be tied to major structural, tectonic, or climatic changes.
Integrating information stored in the hillslopes adjacent to a channel extends the surface of analysis from the channel to its catchment, providing a source of data partially disassociated from active channels, and thereby increasing the potential for the identification of transient signals within the landscape. We present a case study in which the obtained regional distribution of erosional stages is in good agreement with results obtained from a river profile analysis and corroborate the value of added information in a plan view dimension.

References

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