Geophysical Research Abstracts
Vol. 13, EGU2011-3413, 2011
EGU General Assembly 2011

Modelling the migration of a mid-Pleistocene erosion wave in the Ardennes (western Europe) drainage network: approach and first implications

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Model parameterization through adjustment to field data is a crucial step in the modelling and the understanding of the drainage network response to tectonic or climatic perturbations. Using a data set of 18 knickpoints that materialize the migration of a 0.7-Ma-old erosion wave in the Ourthe catchment of northern Ardennes (western Europe) as a test case, we explore the impact of various data fitting on the calibration of the detachment-limited stream power model of river incision, from which a simple knickpoint celerity equation is derived. Our results show that statistical least squares adjustments (or misfit functions) based either on the stream-wise distances between observed and modelled knickpoint positions at time t = 0.7 Ma or on differences between observed (0.7 Ma) and modelled time at the actual knickpoint locations yield significantly different values for the m (more exactly, m/n) and K parameters of the model. As there is no physical reason to prefer one or the other approach, we suggest that an intermediate least rectangles adjustment might be the best compromise. In the Ourthe case, this leads to a m/n value lower than that obtained from the classical distance adjustment (0.79 against 0.86), leading to an increase in the non linear character of the dependence of knickpoint celerity on discharge. If we now recall that *m/n = c(1-b)* (Whipple & Tucker, 1999, *JGR* 104B: 17661-17674), where c and b are the exponents of the power law relations respectively linking discharge to drainage area and channel width to discharge, we can compare the calculated m/n value with that derived from field measurements of channel width, discharge and drainage area in the presently graded sections of the rivers. Such data taken from Petit et al. (2005, *BSGLg* 46: 37-50) allow us to derive m/n = 0.48 at equilibrium. As c may be considered constant, the higher m/n value obtained from the knickpoint retreat modelling must be ascribed to a lower b, i.e., to a channel narrowing associated with the transient phase of knickpoint migration.