



## **A dual, uncoupled model of channel network initiation, development and maintenance in a tropical rain-forest environment in Borneo: simultaneous roles of tunnelling and erosion by overland flow**

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To explain drainage networks involves an understanding of the interplay of slope, channel-head and stream channel erosional processes within an inherited long-term geomorphological context. Pipeflow and Hortonian overland flow play a larger role in rain-forest hydrogeomorphological systems than previously thought. This paper presents process and morphological evidence that both piping and overland flow erosion, acting to some extent independently, are influencing the dynamics of individual finger-tip channels of the drainage network in rain-forest catchments at Danum Valley, eastern Sabah. Hortonian overland flow is shown to be more widespread and frequent on slopes than hitherto thought and the magnitude and dynamics of slope wash and channel erosion within and around channel heads over the period 1990-2006 are analysed. Piping is also widespread in the same catchments and morphological evidence (in terms of discontinuous piping and downstream remnant piping along stream channels) is presented of pipe networks being precursors of channel development. Monitoring since 2003 of (1) suspended sediment transport at pipe and stream channel sites and (2) cross-sectional changes of intact and collapsing pipe cross-sections, together with sediment fingerprinting evidence, demonstrate that tunnelling is both highly active and accounting for over 29% of catchment sediment budgets. Although some channels in the study area are linked to pipes, others are not and in contrast appear to be maintained by channel-head processes fed by overland flow. A dual, uncoupled

model of channel network development and maintenance incorporating both pipe and overland flow erosional mechanisms is proposed as operating currently in the area. In longer term geomorphological contexts, however, landsliding and down cutting by the nearby large Segama river may also have played a role in network initiation and development.