Modelling the effects of permeability, groundwater flow and water table depth on landscape evolution

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The role of groundwater flow in determining overland flow, drainage density and landscape evolution has long been debated. Landscape models often only address groundwater as a simplified storage term and do not explicitly include lateral groundwater flow, although recently some model codes have started to include lateral flow. However, the role of groundwater flow on landscape evolution has not been explored systematically to my knowledge. Here I present a new numerical and analytical model that combines groundwater flow, saturation overland flow, hillslope diffusion and stream erosion. A number of model experiments were run with different values of transmissivity and groundwater recharge. The model results demonstrate that transmissivity, groundwater flow and the depth of the watertable strongly govern overland flow, the incision of stream channels and erosion rates. The results imply that the permeability and transmissivity of the subsurface are important parameters for explaining and modelling landscape evolution.