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Evolution of gravel-bed channels in response to flash floods in dry environments

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Longitudinal profiles of alluvial channels may be altered rapidly in response to base-level lowering or changes in streamflow regime.
Previous models simulating the response to such changes assumed steady and uniform streamflow discharge, or used a calibrated diffusion coefficient as a proxy for stream discharge. Such models do not account for intra and inter annual variance of flash flood volume and peak discharge which is typically high in channels of dry environments.
We developed a new model for evolution of longitudinal profiles of gravel-bed channels combining kinematic wave flood routing with sediment transport based on the Meyer-Peter-Muller equation. The model predicts changes in channel longitudinal profile in response to changing streamflow regimes and base-level lowering rates.
We have adopted a stochastic approach by formulating a "flash flood generator" which produces a synthetic data series of floods based on the probability distribution of peak discharge and hydrograph properties in a specific basin.
The model was applied to the lower reach of Nahal Darga gravel-bed channel which drains into the Dead Sea Lake and is located in a dry climate regime. During the last 40 years, the initial uniform-gradient profile of this reach has changed to a convex profile as a result of a drastic artificial lowering of the Dead Sea level at a rate of 1 m/y. Measured channel profiles at several points in time were used for the model evaluation. The effect of different scenarios of lake level drop and of flash flood regime on the channel profile has been examined.
The modeling results indicate a wide range of possible channel profiles due to the natural flow variance under a given flow regime. Extreme flow events play a major role on the channel profile evolution. Nevertheless, the effective discharge at the Darga channel, consists of floods with medium peak discharge and a recurrence interval of $\sim$10 years.