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Application of a model for point-wise prediction of stream flow statistics using climatic and geomorphologic data to Taiwan

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Fluvial erosion controls the shape of many mountain belts. Much effort has been put in understanding how climate affects river discharge and consequently fluvial erosion. In particular, it is important to develop a better understanding of the link between rainfall variability and mean, and discharge variability and mean in order to build predictable models of long-term geomorphic evolution of mountain belts, but also to predict the magnitude and frequency of natural hazards. Most existing models rely, however, on the assumption that rainfall characteristics are uniform over a given catchment. This is clearly not the case for many mountainous catchments which are affected by orographic effect or for catchments much larger than the average storm size. The main focus of the work presented here is to overcome these limitations, and to improve current models of the relationship between rainfall and discharge characteristics. Ultimately, our work can be used to predict how these forcings affect erosional processes characterized by a threshold. We have used the same stochastic, analytical model as Deal [1] and developed by Botter et al [2]. An analytical expression, used in the model for the prediction of discharge probability density function, is defined by four physically based parameters that are the mean rainfall depth, the frequency of flow producing rainfall events, the coefficient and the exponent describing the discharge recession equation $\frac{dQ}{dt} = -aQ^b$, which are estimated using only climatic and geomorphologic data from Taiwan. We have also used the geomorphic recession flow model of Biswal and Marani [3] further improved by Doulatyari et al [4] that uses digital elevation maps to estimate the geometry of the drainage network and its evolution through time to compute discharge variability at various points along the drainage network. We show, using this model, that we can predict with reasonable accuracy discharge variability observed at various gauging stations in a catchment affected by a strong orographic gradient.

References

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