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Re-evaluation of slope processes in the CAESAR landscape evolution model

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Soil erosion and land degradation may be of pressing concern for the future, particularly due to changes in climate and increasing pressure on land as populations grow. Changes in climate and land use can alter hillslope erosion rates and flow regimes of rivers which subsequently has the potential to modify sediment dynamics within catchment which may cause reduce water yield, alter water quality of lake or cause flooding. In order to identify possible future changes to sediment dynamics, we can make use of sedimentary archives of environmental change such as lake sediments to inform our understanding of the present and in turn, the future.

The detrital allogenic component of lake sediments varies through time, with significant changes in sediment composition and rate of accumulation triggered by extreme events, climate and land use changes. These sediment records are routinely analysed by magnetic, geochemical, grain size and other methods to discern variations in allogenic sediment supply. However, separately the relative importance of different delivery or conditioning factors of allogenic sediment is very difficult to assess. Hydro-geomorphic modelling at a catchment scale can be used to address these issues.
This research explores the value of a reduced complexity hydro-geomorphic model (CAESAR model, Coulthard, 1999, Van de Wiel et al., 2007) to identify the controls over sediment delivery to a lake. Hourly rainfall data are a requisite of the model, therefore the impacts of short, high magnitude rainfall events on sediment dynamics can be identified rather than being masked within lower resolution daily values.

Preliminary simulations showed that the fluvial erosion and deposition, driven by precipitation and conditioned by land use failed to sustain sufficient sediment flux (Welsh et al., 2009). Representation of hillslope processes in CAESAR was simplistic and independent of land use and soil moisture. Here we present recent updates to the soil erosion, soil creep and slope failure components of CAESAR and demonstrate an application of the updated model in the Petit lac d'Annecy, SW France.

References

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