Geophysical Research Abstracts
Vol. 15, EGU2013-4145, 2013
EGU General Assembly 2013

Modeling long-term suspended-sediment export from an undisturbed forest catchment

Alexander Zimmermann (1), Till Francke (1), Helmut Elsenbeer (1,2)

(1) University of Potsdam, Institute of Earth and Environmental Science, Potsdam, Germany (alexander.zimmermann.ii@uni-potsdam.de, +49 331 977 2047), (2) Smithsonian Tropical Research Institute, Apartado 0843-03092, Balboa, Ancón, Panama

Most estimates of suspended sediment yields from humid, undisturbed, and geologically stable forest environments fall within a range of 5 – 30 t km-2 a-1. These low natural erosion rates in small headwater catchments ($\leq$ 1 km2) support the common impression that a well-developed forest cover prevents surface erosion. Interestingly, those estimates originate exclusively from areas with prevailing vertical hydrological flow paths. Forest environments dominated by (near-) surface flow paths (overland flow, pipe flow, and return flow) and a fast response to rainfall, however, are not an exceptional phenomenon, yet only very few sediment yields have been estimated for these areas. Not surprisingly, even fewer long-term ($\geq$ 10 years) records exist. In this contribution we present our latest research which aims at quantifying long-term suspended-sediment export from an undisturbed rainforest catchment prone to frequent overland flow. A key aspect of our approach is the application of machine-learning techniques (Random Forest, Quantile Regression Forest) which allows not only the handling of non-Gaussian data, non-linear relations between predictors and response, and correlations between predictors, but also the assessment of prediction uncertainty. For the current study we provided the machine-learning algorithms exclusively with information from a high-resolution rainfall time series to reconstruct discharge and suspended sediment dynamics for a 21-year period. The significance of our results is threefold. First, our estimates clearly show that forest cover does not necessarily prevent erosion if wet antecedent conditions and large rainfalls coincide. During these situations, overland flow is widespread and sediment fluxes increase in a non-linear fashion due to the mobilization of new sediment sources. Second, our estimates indicate that annual suspended sediment yields of the undisturbed forest catchment show large fluctuations. Depending on the frequency of large events, annual suspended-sediment yield varies between 74 – 416 t km-2 a-1. Third, the estimated sediment yields exceed former benchmark values by an order of magnitude and provide evidence that the erosion footprint of undisturbed, forested catchments can be undistinguishable from that of sustainably managed, but hydrologically less responsive areas. Because of the susceptibility to soil loss we argue that any land use should be avoided in natural erosion hotspots.