Suspended sediment transport dynamics in tropical volcanic landforms

Josie Geris[1] and Christian Birkel[2]

[1]School of Geosciences, U of Aberdeen, UK; [2]Department of Geography, U of Costa Rica, Costa Rica.

Aim and Objectives: The main aim of this project was to gain a better understanding of the dominant erosion and sediment transport dynamics in humid tropical landforms to ultimately inform conservation and resources management with evidence-based knowledge. The specific objectives were to (i) initiate a catchment monitoring study for a novel high quality, high resolution dataset, and (ii) using outcomes from (i), to develop a conceptual model that explicitly accounts for the dominant processes and transport mechanisms in order to test hypotheses about source and pathways of eroded materials.

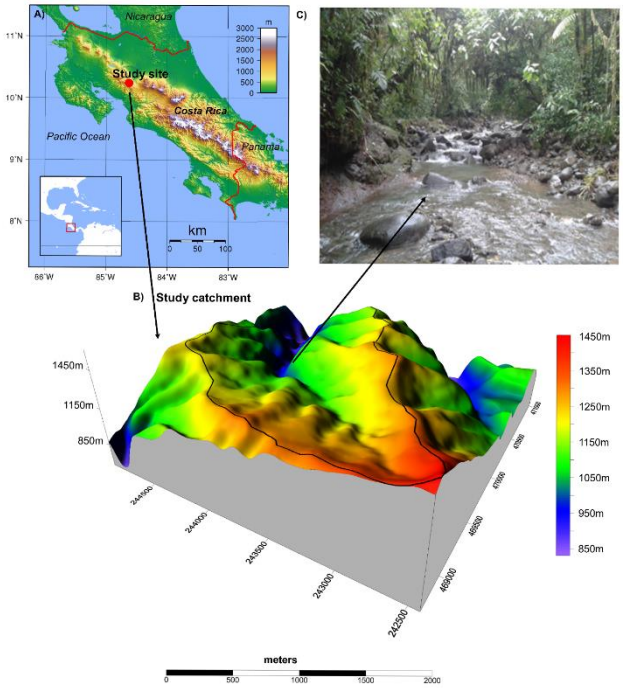

Figure 1. Study catchment of the San Lorencito, showing its A) regional context, B) topography and C) the monitored stream

Outcomes: For the San Lorencito headwater (3.2 km^2) in Costa Rica (Fig 1), we established a high temporal resolution (5min) water flow and sediment (turbidity) dataset (Fig 2) and repeatedly surveyed the river network for fluvial geomorphological and material properties. We found that the rainfall-runoff-sediment relationships and their characteristic hysteresis patterns are directly linked to variations in the climatic input (storm intensity and duration) and the size, form and mineralogy of the transported material. Periodic landslides contribute large volumes of material (> 100m^3 per year) to the drainage network, while high intensity rain activates superficial flow pathways and mobilization of sediments (laminar erosion). However, erosion processes are spatially heterogeneous and mostly consist of finer material (silt) originating from soils that developed on highly weathered bedrock. Extreme events (return period > 50 years) erode the streambed and banks cutting deeper into the bedrock and re-distribute large amounts of material by removing old alluvial deposits and depositing these elsewhere (Fig 2_event2). Recovery after such extreme events involves fine material transport even during low intensity rainfall (Fig 2_event3) and takes only about two to three months before returning to pre-event behaviour (Fig 2_event4). In summary, the study site represents a geomorphologically low-resistance, but highly resilient catchment that quickly recovers after the impact of extreme rainfall-runoff events. Further research will focus on the potential to establish more complete sediment budgets and time-scales of land-forming processes of these highly dynamic environments in the humid tropics. Based on this BSG grant, we were able to secure other funding (*€298K* DAAD, Germany; *USD$92K* MiCITT, Costa Rica) and increase the monitoring network.

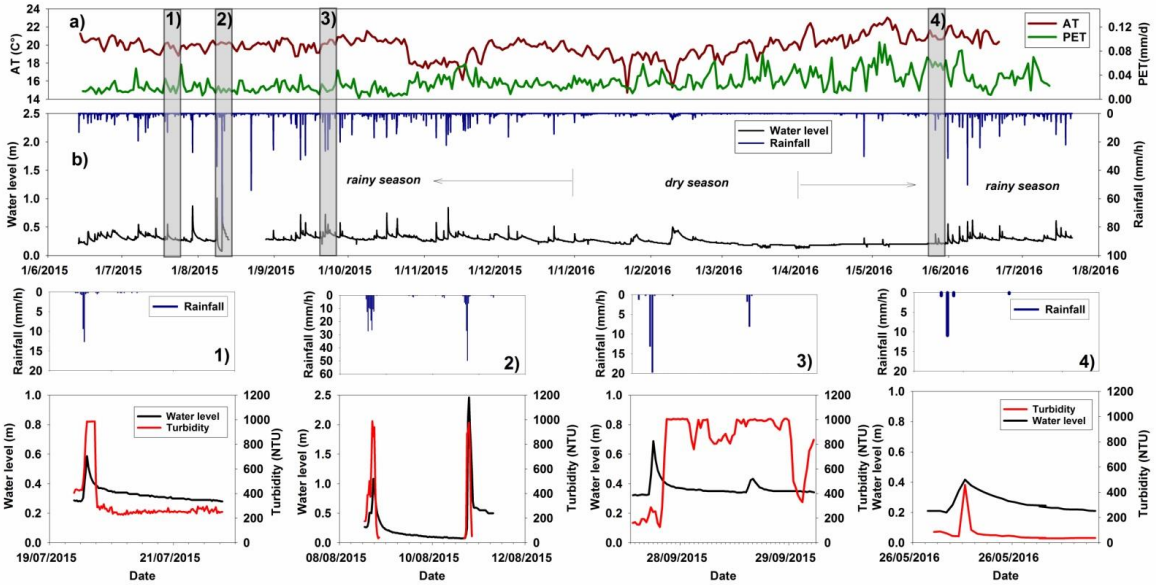

Figure 2 a) hourly average air temperature (AT) and potential evapotranspiration (PET) estimates combined with b) the hourly rainfall-water level relationship are shown for four selected water level-turbidity events over the first year of monitoring.