Geophysical Research Abstracts
Vol. 20, EGU2018-11538, 2018
EGU General Assembly 2018

Modeling the timescale of landscape response to the instantaneous excavation of a large meteorite impact crater in wet tropical mountains

Ruken Alac (1), Gilles Brocard (1), Tristan Salles (1), Dietmar Müller (1), and Pierre Rochette (2)

(1) EarthByte Group, School of Geosciences, University of Sydney, Australia, (2) OSU Institut Pytheas, CEREGE, Université Aix-Marseille, France

Meteorite impact craters rarely leave a topographic signature at the surface of the Earth due to the permanent resurfacing of continents by erosion and burial. As a result, initial impact morphologies only survive for more than a few millions of years over tectonically stable and relatively dry areas. The recent discovery of a large (>10 km diameter) and young (< 1 Myrs) impact crater in the mountainous volcanic highlands of Nicaragua (Rochette et al., in review), formerly known as the Pantasma valley, offers the opportunity to study the rapid degradation of these ephemeral features. It also offers an opportunity to study landscape reaction to an instantaneous topographic change.

The 800 ka-old impact excavated a 14.5 km-wide depression which obliterated a landscape composed of overlapping dissected Oligocene to Pliocene arc volcanoes, dominantly composed of volcanoclastic rocks. Streams flowing towards the crater were either deflected by the crater rim, if their degree of topographic confinement was low, or forced above the crater rim into the crater, if they were more strongly constrained by their valley sides. Rivers forced to flow into the crater have incised steep gorges into the crater rim, and deposited thick aprons of fluvial sediments inside the crater.

We use the numerical model Badlands (BAsin anD LANdscape DynamicS) to simulate the dissection of the crater. Erosion is simulated through a combination of diffusive slope processes and advective stream erosion. Stream erosion is here simulated using the Stream Power Law. We use a Monte Carlo technique to explore a parameter space defined by four variables, namely the dependency of river incision on drainage area, river gradient, rainfall, and bedrock erodibility. We retrieve the values of these parameters that best reproduce the observed morphology. We also assess the sensitivity of these results to the rate of lowering of the crater outlet. End member values of bedrock erodibility are constrained by the volume of fluvial sediments currently trapped on the crater floor. Best-fit values of erosion and erodibility are compatible with the proposed age of the crater, highlighting the evanescent nature of crater morphologies in tectonically active, steep, and wet terrain.