Geophysical Research Abstracts
Vol. 20, EGU2018-4935, 2018
EGU General Assembly 2018

Orographic precipitation and landscape evolution in Basse Terre Island, Guadeloupe archipelago (Lesser Antilles Arc)

Pierre Valla (1), Eric Lajeunesse (2), Romain Delunel (1), and Pascal Allemand (3)

(1) University of Bern, Institute of Geological Sciences, Bern, Switzerland (pierre.valla@geo.unibe.ch), (2) Institut de Physique du Globe, Université Sorbonne Paris, Paris, France, (3) Laboratoire de Géologie de Lyon - TPE, Université de Lyon, Lyon, France

The Earth's surface evolution involves interactions between endogenic and exogenic processes. Quantifying such interactions has remained difficult, in part due to the intrinsic differences in spatial/temporal scales at which these interactions operate, the non-linear geomorphic response to climatic/tectonic forcing, and the existing feedbacks of evolving topography on the triggering processes. One illustration of these questions is the potential coupling between topography and orographic precipitation. Although the impact of precipitation on landscape dynamics has been long recognized, assessing the feedback of evolving topography on orographic precipitation has remained challenging. Tropical volcanic islands are natural environments where to investigate such couplings between topographic relief and orographic precipitation. They form small-scale objects with relatively uniform lithology, and are subject to tropical climatic conditions with spatial gradients in precipitation. Finally, detailed information on the volcanic activity generally exists which sets an ideal framework for the quantification of landscape evolution under climatic forcing.

Here, we study Basse Terre Island (Guadeloupe Archipelago, Lesser Antilles Arc) as a natural laboratory where the volcanic activity has progressively migrated southward from $\sim$3 Ma until present. This unique setting offers a tight temporal framework for quantifying landscape evolution under tropical climate with a "space-for-time" substitution. The regional tropical climate is characterized by eastern trade-winds with strong orographic precipitation. Using existing knowledge on the volcanic activity and information about modern precipitation patterns, we conducted a detailed morphometric analysis of Basse Terre Island. Our results show that the topographic relief and the drainage divide evolve with the volcanic edifice age, illustrating the post-volcanism erosional destruction which is modulated by climate forcing. Moreover, our data evidence a co-evolution of orographic precipitation with evolving island topography. Detailed investigation of river catchment distribution and relief characteristics confirms spatial variations in topographic relief with both landscape maturity and precipitation forcing, with ongoing drainage reorganization and divide migration. This inverse approach of natural landforms allows to further discuss the long-term couplings between landscape dynamics and precipitation forcing in a broader context.