Geophysical Research Abstracts
Vol. 20, EGU2018-17184, 2018
EGU General Assembly 2018

Variation in carbon dynamics mediated by landslide activity in a Central American mountainscape

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Tropical mountains play an important role in biogeochemical cycles worldwide due to complex interaction between geomorphic and ecosystem processes. Of particular interest is the dynamic of carbon associated with landslide activity which involves the removal of carbon in biomass and soils from slopes, burial of this carbon within watersheds, and fixation of new carbon by ecosystems developing on landslide scars. The magnitude of these carbon fluxes, as well as the size of carbon pools, are likely to vary along the complex environmental gradients that characterize mountainous terrain. Here we focus on carbon stored in above and below ground biomass, including soils, and two population of landsides triggered by tropical storms in the Sierra de Las Minas of Guatemala to quantify the role of landslide activity on carbon cycling in the contrasting environments of this mountain range. We sampled vegetation and soil at forest and landslide sites both on the dry-mesic (Motagua) and humid (Polochic) aspects of the Sierra de Las Minas to characterize stand-level carbon pools. This data was subsequently used to model carbon pools as a function of bioclimatic variables in watersheds underlain by a relatively uniform geology, namely granite and granitic gneiss. Using automatic feature extraction algorithms, we mapped landslide scars and scours from high-resolution imagery collected in 2000 (landslides triggered by hurricane Mitch in 1998) and 2006 (landslides triggered by unknown storm between 2000-2006). This data is being used in a GIS environment to characterize pools and fluxes of organic carbon mobilized by landslide activity. Our field data provides strong evidence about differences in the size of carbon pools between both aspects of the Sierra de Las Minas (carbon in soil, roots, shoots of forest ranged between 32-240 MgC/ha, 1-18 MgC/ha, and 13-521 MgC/ha versus 42-152 Mg/C, 1-13 MgC/ha, and 67-500 MgC/ha in the Motagua and Polochic sides, respectively). Similarly, our mapping effort showed that the area affected by landslides as well as recovery rates by vegetation differs between them (areal extent of landslides was 849 ha and 459 ha in the Motagua and the Polochic, respectively). We postulate that these differences will translate into variable carbon dynamics between dry-mesic and humid aspects of the Sierra de Las Minas mountain range with consequences at multiple scales.