Geophysical Research Abstracts
Vol. 20, EGU2018-15153, 2018
EGU General Assembly 2018

Effects of elevation on soil organic matter composition in Mt. Kilimanjaro ecosystems

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Tropical mountain ecosystems cover a broad variety of climatic and vegetation zones and are a global hotspot of biodiversity. However, these ecosystems are severely threatened by climate and land-use change, which also strongly affect soil properties. Mt. Kilimanjaro with its associated large elevation gradients provides a unique opportunity to study and more fully interpret ecosystem responses to climatic changes.
Our objectives are (1) to identify key soil organic matter compounds that are affected by the different climatic conditions along a ∼3000 m elevation gradient and (2) to assess how changes in SOM composition are related to ecosystem specific characteristics. Furthermore, we aim to quantify the specific C fractions and relate these to C turnover processes in various ecosystems. Topsoil samples were thermally decomposed using evolving gas analysis mass spectrometry (EGA-MS) and analytical double-shot pyrolysis gas chromatography mass spectrometry (Py/GC-MS).
Percentage of alkanes/-enes/-ols varied between 4% and 30%, with a maximum at mid elevation (2120 m). Alkyl aromatic compounds were slightly above 20% on all plots and were unaffected by elevation. Fatty acids and fatty acid esters contributed with less than 3% to SOM composition on all plots. Both decreased to a minimum at Podocarpus forest (2900 m), followed by an increase at higher elevation. Cloud-forest types possess a similar organic matter composition with large percentages of stabile n-alkyl lipids and isoprenoid derivatives. Polysaccharide and lignin contents have their minima at mid elevation (2500 m), reflecting high input amounts at low elevation and slow decomposition at high elevations.
Soil organic matter quality and composition at Mt. Kilimanjaro is controlled by two major factors: First, the rate and composition of organic matter inputs that are controlled by vegetation type and climatic characteristics, and second, the microbial decomposition rate controlled mainly by soil environmental parameters (e.g. temperature and soil moisture) and thus having its maximum at mid elevation. The combination of these factors leads to high amounts of volatile compounds and at the same time increased stabile carbon pools at mid elevation ecosystems.