Geophysical Research Abstracts
Vol. 19, EGU2017-2859-1, 2017
EGU General Assembly 2017

Biogeomorphic and pedogenic impact of trees in three soil regions

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Vegetation is an important factor of soil formation which together with topography, geology, climate and time modulates chemical and physical soil characteristics. Tree/soils/regolith interaction was recognized in recently uprooted trees and relict treethrow mounds and pits. In our present study we focus on effects of individual standing trees in pedogenesis and biogeomorphic processes. Constant pressure of tree root systems, changing hydric and temperature regime, together with rhizospheric microbes and root mycorrhizal associations may cause multiscale alterations to regolith and soils. We hypothesize different soil chemical properties under old tree stumps compared to unaffected control pedon resulted from affected pedogenetical pathways at the analyzed microsites.
The present project highlights changes in soil properties under tree stumps in three different soil regions: Haplic Cambisols (Turbacz Reserve, Gorce Mts., Poland, hereafter HC), Entic Podzols (Zofin Reserve, Novohradske Mts., the Czech Republic, hereafter EP), Albic Podzols (Upper Peninsula, Michigan, USA, hereafter AP). These three regions represent different degrees of soil weathering and leaching. Pedons under fir, beech and hemlock stumps, as well as unaffected control pedons were sampled and laboratory analyzed for several chemical properties; active and exchangeable soil reaction, oxidized carbon, total nitrogen, and various forms of Fe, Al, Mn and Si. At the same time we studied age of the sampled tree stumps, as well as age of their death using radiocarbon technique and dendrochronology.
While no effects of the soil-trees interactions can be visible on hillslope surface, we found important evidence of biomechanical activities of tree roots (e.g. root channels) and biochemical changes which add to the discussion about biogeomorphic and pedogenic significance of trees and tree roots as drivers of biomechanical weathering and soil processes in the decadal and centennial time scales.
Preliminary results from the first site at Turbacz (fir tree stump) indicate some significant differences with higher amount of Cox, clay and C-THS (carbon content in total humus substances), pHH_2O and Fe in the control soil profile as compared to stump soil profiles. Content of various chemical indicators were more homogenous between soil profiles at the second microsite (beech). There were significant differences between soil regions for the following chemical properties: N (nitrogen) (AP vs. EP), Cox (oxidized carbon) (AP vs. EP), C-HA (carbon content in humic acids) (AP vs. HC), C-FA (carbon content in fulvic acids) (AP vs. EP), Fed (crystalline forms of iron) (AP and EP vs. HC).