Geophysical Research Abstracts
Vol. 21, EGU2019-9661, 2019
EGU General Assembly 2019

Agropedogenesis: Humankind as the 6th soil-forming factor and attractors of agrogenic soil degradation

Yakov Kuzyakov (1) and Kazem Zamanian (2)

(1) RUDN, Göttingen (kuzyakov@gwdg.de), (2) Department of Soil Science of Temperate Ecosystems, University of Göttingen, Germany

Although agricultural land covers 5100 million ha (ca. 50% of potentially suitable land area) and agriculture has immense effects on soil formation and degradation, no concepts or theories of agropedogenesis have been advanced. For the first time, we introduce a theory of anthropedogenesis – soil development under the main factor 'humankind' – the 6th factor of soil formation, and deepen it to encompass agropedogenesis as the most important direction of anthropedogenesis. The developed theory of agropedogenesis consists of (1) broadening the classical concept of Factors – Processes – Properties with the addition of Functions along with their feedbacks to the Processes, (2) a new concept of attractors of soil degradation, (3) selection and analysis of master soil properties, (4) analysis of phase diagrams of master soil properties to identify thresholds and stages of soil degradation, and finally (5) a definition of multi-dimensional attractor space of agropedogenesis. We show that the factor 'humankind' dominates over the effects of the five natural soil-forming factors and that agropedogenesis is therefore much faster than natural soil formation. The direction of agropedogenesis is mainly opposite to that of natural soil development and is thus mainly associated with soil degradation. In contrast to natural pedogenesis leading to divergence of soil properties, agropedogenesis leads to their convergence because of the efforts to optimize conditions for crop production. Agricultural practices lead soil development toward a quasi-steady state with a predefined range of measured properties – attractors (an attractor is a minimal or maximal value of a soil property, toward which the property will develop via long-term intensive agricultural use from any natural state). Based on phase diagrams and expert knowledge, we define a set of 'master properties' (bulk density and macroaggregates, soil organic matter content and pH, microbial biomass and basal respiration). These master properties are especially sensitive to land use and determine the other properties during agropedogenesis. Phase diagrams of master soil properties help identify thresholds and stages of soil degradation. Combining individual attractors to a multi-dimensional attractor space enables predicting the trajectory and the final state of agrogenic soil development and to develop measures to combat soil degradation.