Popular science abstract

Water-extractable organic matter (WEOM) is the most dynamic and bioavailable fraction of organic matter. It is responsible for the mobilization and translocation of many elements in the soil environment and therefore is involved in a range of soil processes. WEOM is highly vulnerable to decomposition due to ongoing climate change and at the same time, it makes WEOM a useful tool for tracking changes in the soil environment caused by global warming. WEOM claims attention especially in subarctic and arctic regions, where harsh conditions unfavor organic matter decomposition but favor accumulation of it in volcanic soils (Andosols). Imposing permafrost decline as a result of annual average temperature increase causes microbial activity escalation, organic matter decomposition, increase of its bioavailability and as a consequence enhancement of CO_2, CH_4, N_2O emission into the atmosphere while these gases are the main ones responsible for global warming.

Organic carbon accumulation is one of the most characteristic Andosols properties which generate many morphological and physicochemical features. In the case of Icelandic soil, these features have been undergoing particular transformations because of intensified land denudation on account of glacier melting and mass wasting as well as continuous erosion and aeolian deposition combined with periodic tephra deposition (pyroclastic rock from volcanic eruptions). Nowadays traditional sheep grazing and domination of intensive pastureland have been diminishing (due to sociocultural changes) in favor of extensive pasturelands as well as fertilized and unfertilized mowing meadows. The mentioned natural and anthropogenic processes with the global changes in the background significantly modify the volcanic soils of Iceland and organic matter stability. Therefore the aim of the project is (1) to track the impact of the different types of land-use on the most dynamic fraction of organic matter (WEOM), (2) investigate greenhouse gases flux as a direct response for natural (climatic) and human-induced changes and (3) verify the possibility of shifting function of Andosols from important carbon sink to large carbon source so they may become greenhouse gases hot spot.

To achieve the purposes, the research area was chosen nearby Vatnajökull (the largest glacial mass in Europe) reflecting the variety of land use and natural habitats where the research sites will be set and samples for WEOM and greenhouse gases analyses will be taken. The measurements of GHG emissions will be conducted for three years, twice a year, in May/June and September/October. To provide proper information on maximum and minimum fluxes of GHG and track their seasonal dynamics measurements will be made two times during the sampling day. Analyzes of carbon and nitrogen forms (total organic carbon, total nitrogen, water-extractable organic carbon, and water-extractable total nitrogen) will be conducted as well as of typical parameters characterizing Andosols (pH, texture, phosphate retention, iron and, aluminum forms, etc.). In the gas samples CO_2, CH_4 and, N_2O content will be assayed using the gas chromatography technique. Moreover, to support the research of WEOM and GHG, microbial C and N biomass will be analyzed.

It is predicted that the results obtained from water-extractable organic matter and greenhouse gases emission analyses will allow to understand ongoing environmental changes and predict their directions. They will contribute to getting attention to the effects of global warming in subpolar and polar regions and enable a better understanding of Andosols' role as sink or source of carbon and nitrogen (depending on land use conditions and actual climate), particularly in the context of land-use changes and sustainable agricultural development in volcanic regions.