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Soil cover patterns and SOC dynamics impacts on the soil processes, land management and ecosystem services in Central Region of Russia

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In the Central Region of Russia (CRR) the soil cover patterns usually play the very important role in the soil forming and degradation processes (SFP & SDP) potential and current rates, soil organic carbon (SOC) dynamics and pools, greenhouse gases (GHG) emissions and soluble SOC fluxes that we need take into attention for better assessment of the natural and especially man-changed ecosystems' services and for best land-use practices development.

Central Region of Russia is the biggest one in RF according to its population and role in the economy. CRR is characterized by high spatial variability of soil cover due to as original landscape heterogeneity as complicated history of land-use practices during last 700 years. Our long-term researches include the wide zonal-provincial set of representative ecosystems and soil cover patterns with different types and history of land-use (forest, meadow-steppe and agricultural ones) from middle-taiga to steppe zones with different level of continentality.

The carried out more than 30-years region- and local-scale researches of representative natural and rural landscapes in Tver', Yaroslavl', Kaluga, Moscow, Vladimir, Saransk (Mordovia), Kursk, Orel, Tambov, Voronezh and Saratov oblasts give us the interregional multi-factorial matrix of elementary soil cover patterns (ESCP) with different soil forming and degradation processes rates and soil organic carbon dynamics due to regionally specific soil-geomorphologic features, environmental and dominated microclimate conditions, land-use current practices and history.

The validation and ranging of the limiting factors of SFP and SDP develop¬ment, soil carbon dynamics and sequestration potential, ecosystem (agroecosystem) principal services, land functional qualities and agroecological state have been done for dominating and most dynamical components of ESCP regional-typological forms – with application of SOC structure analysis, regional and local GIS, soil spatial patterns detail mapping, traditional regression kriging, correlation tree models and DSS adapted to concrete region and agrolandscape conditions.

The outcomes of statistical process modeling show the essential amplification of erosion, dehumification, CO_2, CH4 and N2O emission, soluble SOC fluxes, acidification or alkalization, disaggregation and overcompaction processes due to violation of environmentally sound land-use systems and traditional balances of organic matter, nutrients, Ca and Na in agrolandscapes.

Due to long-term intensive and out-of-balance land-use practices the most zonal soils and soil cover pattern essentially lost not only their unique natural features (humus horizons depth till 1 m and more in case of Chernozems, 2-6 % of SOC and favorable agrophysical features), but ecosystem services and ecological functions including terrestrial ecosystem carbon balance and the GHG fluxes control.

Key-site monitoring results and regional generalized data showed 1-1.5% SOC lost during last 50 years period and active processes of CO_2 emission and humus profile eluvial-illuvial redistribution too. A drop of Corg content below threshold "humus limiting content" values (for different soils they vary from 1 to 3-4% of SOC) considerably reduces effectiveness of used fertilizers and possibility of sustai¬nable agronomy here. Forest-steppe Chernozems are usually characterized by higher stability than steppe ones. The ratio between erosive and biological losses in humus supplies can be ten-tatively estimated as fifty-fifty with strong spatial variability due to slope and land-use parameters. These processes have essentially different sets of environmental consequences and ecosystem services that we need to understand in frame of environmental and agroecological problems development prediction.