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Functional interpretation of representative soil spatial-temporal variability at the Central region of European territory of Russia

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The essential spatial and temporal variability is mutual feature for most natural and man-changed soils at the Central region of European territory of Russia. The original spatial heterogeneity of forest and forest-steppe soils has been further complicated by a specific land-use history and different-direction soil successions due to environmental changes and human impacts. For demand-driven land-use planning and decision making the quantitative analysis, modeling and functional-ecological interpretation of representative soil cover patterns spatial variability is an important and challenging task that receives increasing attention from scientific society, private companies, governmental and environmental bodies.

On basis of long-term different-scale soil mapping, key plot investigation, land quality and land-use evaluation, soil forming and degradation processes modeling, functional-ecological typology of the zonal set of elementary soil cover patterns (ESCP) has been done in representative natural and man transformed ecosystems of the forest, forest-steppe and steppe zones at the Central region of European territory of Russia (ETR). The validation and ranging of the limiting factors of functional quality and ecological state have been made for dominating and most dynamical components of ESCP regional-typological forms – with application of local GIS, traditional regression kriging and correlation tree models.

Development, zonal-regional differentiation and verification of the basic set of criteria and algorithms for logically formalized distinguishing of the most "stable" & "hot" areas in soil cover patterns make it possible for quantitative assessment of dominating in them elementary landscape, soil-forming and degradation processes.

The received data essentially expand known ranges of the soil forming processes (SFP) rate «in situ». In case of mature forests mutual for them the windthrow impacts and lateral processes make SFPs more active and complex both in soils of windthrow mounds and holes: CO_2 emission increases by 30-60 %; proteolytic activities – by 50-200 %, average humification rate exceeds 100-1000 g/m2year, and the rate of aggressive fulvic acid formation – 40-300 g/m2year. The average lessivage rate may reach 2-3 kg*cm/m2year and the rate of oxalate extractable $Fe2O_3$, $Al2O_3$migration is 0.6-1.3 kg*cm/ m2year. Eluvial horizons can go deep on 6-18 cm per 50-150 yeas – depending on depth of initial impacts and on morphogenetic profile of background soil.

The carried out analysis of Chernozem regional-typological degradation processes has shown qualitative expansion of their set. The outcomes of statistical modeling show essential amplification of dehumification processes due to current violation of traditional balances of organic matter in agrolandscapes. A drop of humus content below threshold values (4.5-6.5 % for different Chernozems) considerably reduces farming effectiveness. Mean annual rate of humus decreasing and increasing varies from 0.1 up to 1.3 g/kg per year, acidification and alkalization – from 0.01 up to 0.13 dp per year, salinity – from 5 up to 18 mg/kg per year.

Succession analysis of modern evolution of natural and man-changed soils essentially increases accuracy of quantitative assessments of dominant SFPs' rate and potential, their influence on landscape and soil cover quality and diversity. Their results allow developing the regional and landscape adapted versions of automated systems of land agroecological evaluation (RASLEV) and demand-driven land-use DSS (LODSSAL).