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Soil cover patterns influence on the land environmental functions, agroecological quality, land-use and monitoring efficiency in the Central Russia

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First decades of XXI century actualized for soil researches the principal methodical problem of most modern geosciences: what spatial and temporal scale would be optimal for land quality evaluation and land-use practice optimizing? It is becoming obvious that this question cannot have one solution and have to be solved with especial attention on the features of concrete region and landscape, land-use history and practical issues, land current state and environmental functions, soil cover patterns and variability, governmental requirements and local society needs, best available technologies and their potential profitability.

Central Russia is one of the most dynamical economic regions with naturally high and man-made complicated landscape and soil cover variability, long-term land-use history and self-contradictory issues, high potential of profitable farming and increased risks of land degradation. Global climate and technological changes essentially complicate the originally high and sharply increased in XX century farming land heterogeneity in the Central Russia that actualizes system analysis of its zonal, intra-zonal and azonal soil cover patterns according to their influence on land environmental functions, agroecological quality, and land-use and monitoring efficiency variability.

Developed by the Laboratory of agroecological monitoring, ecosystem modeling & prediction (LAMP / RTSAU with support of RF Governmental projects #11.G34.31.0079 and #14.120.14.4266) regional systems of greenhouse gases environmental monitoring RusFluxNet (6 fixed & 1 mobile eddy covariance stations with zonal functional sets of key plots with chamber investigations in 5 Russian regions) and of agroecological monitoring (in representative key plots with different farming practice in 9 RF regions) allow to do this analysis in frame of enough representative regional multi-factorial matrix of soil cover patterns, bioclimatic conditions, landscape features, and land-use history and current practice versions. Well-elaborated monitoring collaboration with the principal natural reserves in south-taiga and forest-steppe zones provides process-based interaction with long-term data on zonal climatic, landscape and soil features necessary to test the process, functional and evaluation models in the specific conditions of each bioclimatic zone.

The dominated erosion and dehumification trends have been essentially activated for last 3-4 decades due to hu¬mus negative balance around 0.6-0.7 t ha-1year-1 and connected disaggregation with annual rate between 1 and 25 g/kg for aggregates 10-0.25 mm. “Standard” monitoring objects and regionally generalized data showed characteristic for Chernozems 2-2.5 % humus drop during this period and active processes of CO_2 emission and humus eluvial-illuvial profile redistribution too. Forest-steppe Chernozems are usually characterized by higher stability than steppe ones. The ratio between erosive and biological losses in humus stock can be ten¬tatively estimated as fifty-fifty with essential variability within slope landscape. Both these processes have essential impacts on different sets of soil environmental and agroecological functions (including atmospheric air, surface and ground water quality, biodiversity and profitability) that we need to understand and predict. A drop of humus content below threshold values (for different soils between 1.5 and 6%) considerably reduces not only soil environmental regulation functions but also effectiveness of used fertilizers, crop yield quality and possibility of sustainable agricultural land-use.

The carried out long-term researches of representative natural, rural and urban landscapes in Tver, Yaroslavl, Vladimir, Moscow, Kaluga, Kursk, Belgorod, Tambov, Voronezh and Saratov regions give us validation and ranging of the limiting factors of the elementary soil cover patterns current features and transformation processes, environmental functions and agroecological quality, monitoring results functional interpretation, spatial and temporal interpolation and extrapolation. These data allow essentially improve our understanding and quantitative assessments of the regional and within-field variability of land agroecological and environmental functions that is crucial for agroecosystem services evaluation, current and planned land-use environmental impacts, and DSS development for land-use agroecological optimizing taking into attention the regional and local landscapes

features and most realistic scenarios of climate change and agro-technology transfer. Developed and verified within the project regionally adapted DSS (ACORD-R – RF #2012612944) gives effective informational and methodological support for land-use agroecological optimization.