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Spatial-temporal variability in GHG fluxes and their functional interpretation in RusFluxNet

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High spatial and temporal variability is mutual feature for most modern boreal landscapes in the European Territory of Russia. This variability is result of their relatively young natural and land-use age with very complicated development stories. RusFluxNet includes a functionally-zonal set of representative natural, agricultural and urban ecosystems from the Central Forest Reserve in the north till the Central Chernozemic Reserve in the south (more than 1000 km distance). Especial attention has been traditionally given to their soil cover and land-use detailed variability, morphogenetic and functional dynamics.

Central Forest Biosphere Reserve (360 km to North-West from Moscow) is the principal southern-taiga one in the European territory of Russia with long history of mature spruce ecosystem structure and dynamics investigation. Our studies (in frame of RF Governmental projects #11.G34.31.0079 and #14.120.14.4266) have been concentrated on the soil carbon stocks and GHG fluxes spatial variability and dynamics due to dominated there windthrow and fallow-forest successions.

In Moscow RTSAU campus gives a good possibility to develop the ecosystem and soil monitoring of GHG fluxes in the comparable sites of urban forest, field crops and lawn ecosystems taking especial attention on their meso- and micro-relief, soil cover patterns and subsoil, vegetation and land-use technologies, temperature and moisture spatial and temporal variability.

In the Central Chernozemic Biosphere Reserve and adjacent areas we do the comparative analysis of GHG fluxes and balances in the virgin and mowed meadow-steppe, forest, pasture, cropland and three types of urban ecosystems with similar subsoil and relief conditions.

The carried out researches have shown not only sharp (in 2-5 times) changes in GHG ecosystem and soil fluxes and balances due to seasonal and daily microclimate variation, vegetation and crop development but their essential (in 2-4 times) spatial variability due to different meso- or micro-relief forms, natural or man-made succession studies, topsoil texture or organic matter state, subsoil or perched groundwater features.

Zonal, seasonal and functional subdividing the monitoring data allows essentially increase the regression links between GHG fluxes and air or soil temperature and moisture (to 0.75-0.87) that is very important for their modeling and prediction. In taiga and mix-forest zones usually there is stronger effect on GHG fluxes by air temperature than soil one due to comparatively thin (from 3 till 10 cm) layer of principal soil organic and/or humus-accumulative horizons with maximum biological activity that usually determines the total rate of GHG soil fluxes.

Unfavorable seasonal conditions (dry season or low temperature) determine essential (in 1.5-2 times) decreasing not only in soil GHG fluxes but in level of their spatial variability, intraseasonal and daily dynamics too. These trends are most obvious in case of more open and sensitive to the external factors ecosystems, for example in case of industrial area lawns or at the first stages of the windthrow or fallow-forest successions.

Understanding the principal regional and land-use-determined regularities of spatial and temporal changes in ecosystem and soil GHG fluxes help better modeling them in the process of spatial intra- and extrapolations, seasonal and interseasonal predictions, taking into attention basic and current principal ecological factors limiting GHG fluxes and balances.

Their introduction in the ecological or agroecological models and land-use decision support systems allows improve the quality of environmental/agroecological monitoring and control not only for GHG emission but also for soil organic matter conservation, manure and nitrogen fertilizer application that is often crucially important for sustainable rural development and profitable farming.