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Carbon balance of Russian agricultural land

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Russia managed 218.7 mln ha agricultural land (2009) in accordance with national statistics (FSSS, 2011: http://www.gks.ru/dbscripts/Cbsd/DBInet.cgi#1). Among that, 91.75 mln ha is arable land; 92.05 mln ha – hayfield and pasture; 34.9 mln ha – abandoned arable and fallow. Abandoned arable area is not indicated directly in the statistics, but can be calculated as a difference between "arable" and "cultivated" area.

We estimated carbon balance of agricultural land by accounting carbon fluxes. Carbon sink includes: net primary productivity (NPP), applying fertilizes and liming. Carbon losses include soil respiration (SR), harvest and lateral flux. The initial data (cultivated area and harvest distribution by regions and crop) was derived from national agriculture statistics (FSSS, 2011). NPP was estimated via harvest and set of regression models. Average NPP for agricultural land was estimated at 435 g C m^{-2} (530 g C m^{-2} for crops). Soil respiration was calculated by a model (Mukhortova et. al., 1011: http://www.iiasa.ac.at/Research/FOR/forest_cdrom/Articles/Mukhortova_2011_IBFRA_SR.pdf) developed for Russia which is based on all available empirical data and accounted for climatic parameters, soil type and management practice. Average SR of agricultural land is 344 g C m^{-2} (372 g C m^{-2} for the cropland). We applied the IPCC method (National inventory, 2010; IPCC, 2006) for fertilizer and lateral fluxes assessment.

The total carbon balance of agricultural land is almost in equilibrium (-0.04 t C ha^{-1}) in spite of arable land is a carbon source (-0.84 t C ha^{-1}). The highest sink (1.21 t C ha^{-1}) is provided by abandoned land. Carbon fluxes vary substantially depending on seasonal weather conditions. For example grains' NPP in 2010 (dry and hot summer in major agricultural regions of European Russia) was estimated at 32% less compare to 2009 and the total carbon balance of this land category decreased by order of magnitude.

We used Russian land cover (Schepaschenko et al., 2011: http://www.tandfonline.com/doi/abs/10.1080/1747423X.2010.511681) with 1 km resolution to produce a map of spatial distribution of agriculture related carbon fluxes. More details can be found here: www.iiasa.ac.at/Research/FOR/hlc/