

Development of DNDC Modelling Method for Evaluation of Carbon Dioxide Emission from Arable Soils in European Russia

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Abstract : Carbon dioxide (CO₂) is the main component of carbon biogeochemical cycle and one of the most important greenhouse gases (GHG). Agriculture, particularly arable soils, are one the largest sources of GHG emission for the atmosphere including CO₂. Models may be used for estimation of GHG emission from agriculture if they can be adapted for different countries conditions. The only model used in officially at national level in United Kingdom and China for this purpose is DNDC (DeNitrification-DeComposition). In our research, the model DNDC is offered for estimation of GHG emission from arable soils in Russia. The aim of our research was to create the method of DNDC using for evaluation of CO₂ emission in Russia based on official statistical information. The target territory was European part of Russia where many field experiments are located. At the first step of research the database on climate, soil and cropping characteristics for the target region from governmental, statistical, and literature sources were created. All-Russia Research Institute of Hydrometeorological Information – World Data Centre provides open daily data about average meteorological and climatic conditions. It must be calculated spatial average values of maximum and minimum air temperature and precipitation over the region. Spatial average values of soil characteristics (soil texture, bulk density, pH, soil organic carbon content) can be determined on the base of Union state register of soil recourses of Russia. Cropping technologies are published by agricultural research institutes and departments. We offer to define cropping system parameters (annual information about crop yields, amount and types of fertilizers and manure) on the base of the Federal State Statistics Service data. Content of carbon in plant biomass may be calculated via formulas developed and published by Ministry of Natural Resources and Environment of the Russian Federation. At the second step CO₂ emission from soil in this region were calculated by DNDC. Modelling data were compared with empirical and literature data and good results were obtained, modelled values were equivalent to the measured ones. It was revealed that the DNDC model may be used to evaluate and forecast the CO₂ emission from arable soils in Russia based on the official statistical information. Also, it can be used for creation of the program for decreasing GHG emission from arable soils to the atmosphere. Financial Support: fundamental scientific researching theme 0148-2014-0005 No 01201352499 'Solution of fundamental problems of analysis and forecast of Earth climatic system condition' for 2014-2020; fundamental research program of Presidium of RAS No 51 'Climate change: causes, risks, consequences, problems of adaptation and regulation' for 2018-2020.

Keywords : arable soils, carbon dioxide emission, DNDC model, European Russia

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