

The DNDC model: Development and Applications in Chinese Agro-ecosystems

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Abstract: The DNDC model was originally developed to simulate N₂O emissions from cropped soils in the US. It has since been used and expanded by many research groups covering a range of countries and production systems. In this presentation, we reviewed how the DNDC model has been developed, validated and used by Dr. Qiu's group, including modification, site and regional scale simulations, sensitivity analysis, database establishment and scenario assessment, in Chinese agro-ecosystems with published more than 20 inter. journal papers and graduated 10 graduate students. The group's works involved DNDC model has a great respect to develop a Chinese version of DNDC (such as CHN-DNDC). (1) DNDC model has been modified to adapt it to local production systems and many of these modifications have been incorporated into the original version of DNDC model. These included re-parameterizing the crop parameters (e.g. C/N, biomass) for local conditions, modifying the model equations to the water drainage and N adsorption to better simulate measured nitrate leaching, and adjusting the farm management facilities (e.g., feeding lot, compost, lagoon, anaerobic digester, manure land application) in the Manure-DNDC, a new version of DNDC, to better match these local conditions. (2) A sequence of validation tests from different cropping systems (e.g., Winter wheat/summer maize, Winter wheat/ Green onion, Greenhouse vegetables, Spring wheat, etc.) on DNDC predictions of soil emissions of N₂O, CH₄ and CO₂, plant growth, soil organic carbon (SOC), soil climate etc., were examined. Most of the test results indicated that the model was capable of simulating the magnitudes and dynamics of C and N pools with limited modifications. However, the discrepancies between simulations and observations of GHG emissions, N leaching, and crop growth still existed across different environment conditions. (3) By using the methods of field sampling, household investigation and remote sensing, the databases (including parameters of climate, soil, crop type, management practices, etc.) supporting modeling calculations at regional or national scale were established. Especially, the group firstly developed the distribution of 47 different single- and multi-crop rotations

in mainland China through combining county-scale agricultural census statistics with remote sensing data. (4) The validated DNDC model was then applied for the site scale, catchment scale and regional scale simulations, these include evaluating comprehensive effects of climate change and management measures changes on crop yield, SOC sequestration and greenhouse gas emissions, modeling SOC dynamics, GHGs emissions, N leaching at typical cropping sites, quantifying impacts of different SOC contents on crop yields in different croplands of China, and estimating the regional and national inventories of SOC, GHGs, N-Balance, N-Leaching, etc. The researchers expect these efforts will enhance the applicability of DNDC for predicting GHG emissions, N leaching and crop yields in different agro-ecosystems that are attracting more attentions across China.

Keywords: Reviews; modification and validation; carbon and nitrogen cycles; DNDC model; Chinese agro-ecosystem.