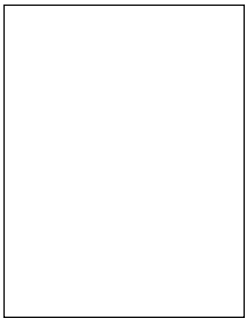

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PII: S1002-0160(17)60436-3
DOI: 10.1016/S1002-0160(17)60436-3
Reference: NA

To appear in:

Received date: NA
Revised date: NA
Accepted date: NA

Please cite this article as: QIN Falv, ZHAO Yongcun, SHI Xuezheng, XU Shengxiang, YU Dongsheng, Uncertainty and Sensitivity Analysis for Modeling Long-term Soil Organic Carbon Dynamics of Paddy Soils Under Different Climate-soil-management Combinations, *Pedosphere* (2017), 10.1016/S1002-0160(17)60436-3.

PEDOSPHERE
Pedosphere ISSN 1002-0160/CN 32-1315/P doi:10.1016/S1002-0160(17)60436-3

Uncertainty and Sensitivity Analysis for Modeling Long-term Soil Organic Carbon Dynamics of Paddy Soils Under Different Climate-soil-management Combinations

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ABSTRACT

Reporting modeling results with uncertainty information attached can benefit decision making, by decreasing the extent that variability exerts a disproportionate influence on the options considered and selected. In order to make decisions with more confidence, the uncertainty interval should be as narrow as possible. In this study, the soil organic carbon (SOC) dynamics of four paddy soil subgroups were modeled using the DeNitrification-DeComposition (DNDC) model for the period 1980 to 2008. The four paddy soil subgroups are located in four counties under different climate-soil-management contexts. Uncertainty intervals associated with the SOC dynamics for these four subgroups were estimated by a long-term global sensitivity and uncertainty analysis (i.e., the Sobol' method).Further, their sensitivities to each of seven influential factors were quantified with the total effect sensitivity index (ST_i). Results, modeled with high confidence, indicate that in the past 29 years the studied paddy soils in Xinxing, Yixing, and Zhongjiang Counties were carbon sinks, while paddy soils in Helong County were assessed to be carbon sources. The three carbon sinkssequestered12.2 (5.4, 19.6), 17.1 (8.9, 25.0), and 16.9 (-1.2, 33.6) tC ha^{-1}(values in the parentheses are the 5 and 95 percentiles, respectively. The same rule is applied in the following parts of this paper) in the past 29 years, respectively. Conversely, the carbon source had a loss of -5.4(-14.2, 0.06) tC ha^{-1} in the past 29 years. Seven factors, which changed with the climate-soil-management context, exhibited variable influence on modeled SOC. Measures that have potential to conserve or sequestrate more C into paddy soils, such as incorporating more crop residue into soils, reducing chemical fertilizer application rates, and using chemical fertilizer more efficiently, were also recommended for specific soils based on the sensitivity analysis results.

Key Words: carbon source, carbon pool, DeNitrification-DeComposition model, influential factors, Sobol' method