Effects of Soil Assessment Unit Scale on Quantifying CH_4 emissions from rice fields in the Tai-Lake region of China by DNDC Model

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ABSTRACT

Soil polygons are the preferred format for DNDC regional scale modeling because a large area of relatively homogeneous properties can be encompassed within a single boundary. Despite this, it is not yet fully understood how map scales of the soil polygons affect modeling.

Six soil polygonal datasets were generated from soil vector maps at scales of 1:50,000 ~ 1:14,000,000, to estimate CH4 emissions from paddy soils in the Tai-Lake region of China using the DNDC model. The 1:50,000 scale dataset (P005) was the most detailed and accurate soil database of the region. DNDC simulated CH_4 concentrations from input of the other 5 datasets were compared with that obtained by input of the P005 dataset using metrics with the following outcomes.

a.) Relative variations (VIV, %) of three indices, paddy soil area (APS, ha), annual mean CH4 emission (AME, Gg y^{-1}) and emission rate (RGE, kg ha^{-1} y^{-1}), calculated for 1: 200,000 (P02) data were all < 5%.

b.) VIVs associated with the three indices assessed for 1:500,000 (P05) and 1:1,000,000 (P1) data ranged from 0.8% to 15%.

c.) VIVs for the three indices determined for 1:4,000,000 (P4) and 1:14,000,000 (P14) data were all > 20%, the greatest equaling 138%.

Accuracy and computational efficiency assessments of regional scale DNDC modeling indicate that P02 scale input are preferred, those at scales of P4 and P14 are the source of unacceptable error, and even greater uncertainty exists when assessment units at scales of P05 and P1 are used.

The results provide guidelines for modeling soil carbon/nitrogen cycle and climate change impacts in China. Further, they help build a global understanding concerning appropriate scale input data for carbon/nitrogen cycle modeling.

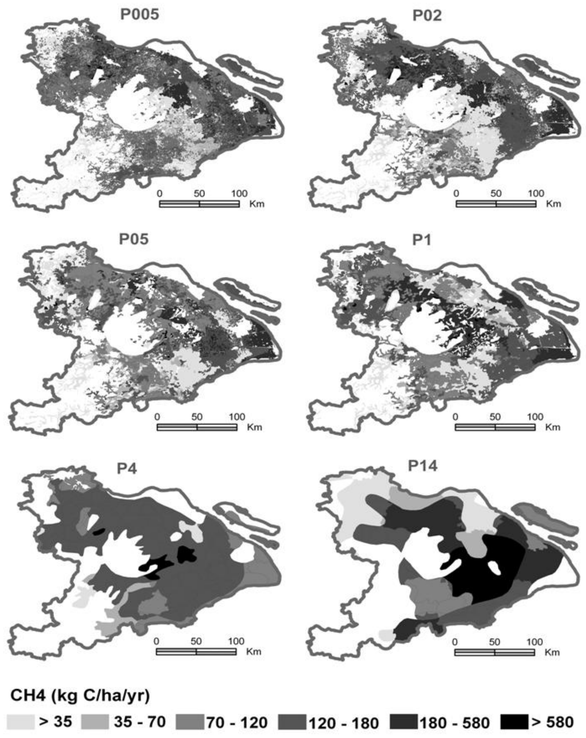

Fig. 1 Map of CH_4 emission rate quantified from all paddy soils by DNDC model with soil assessment unit datasets at different map scale in the Tai-Lake region of China

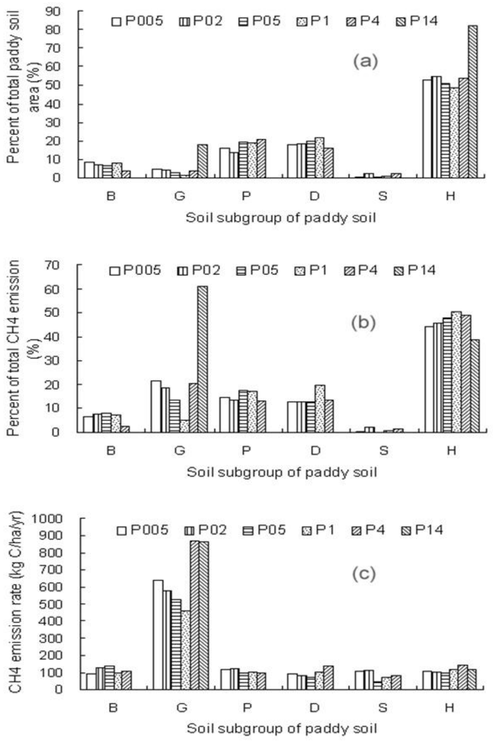

Fig. 2 Soil area (a), CH_4 emission (b) and CH_4 emission rate (c) quantified from six subgroups of paddy soil by DNDC model with soil assessment unit datasets at different map scale

Table 1 Soil type and assessment unit numbers of Paddy soil contained in the assessment unit datasets at different map scales in the Tai-Lake region of China

Item	Numbers of soil type and assessment unit in different datasets					
	P005	P02	P05	P1	P4	P14
Assessment units	52034	7263	4766	1163	248	74
Soil subgroups	6	6	6	6	6	2
Soil families	137	78	68	48		
Soil species	622	127				
Total area of paddy soil (Mha)	2.32	2.41	2.53	2.58	2.74	2.80
Assessment unit density (units per Kha)	22.43	3.01	1.88	0.45	0.09	0.03

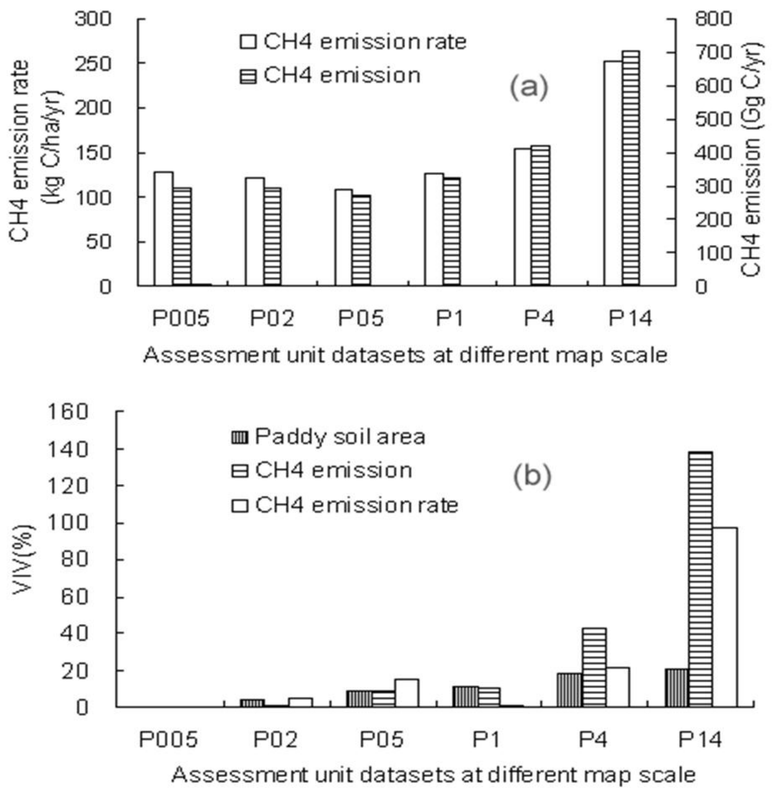

Fig. 3 CH_4 emission and its rate (a) as well as their variations (VIV) (b) quantified from all paddy soils by DNDC model with soil assessment unit datasets at different map scale in the Tai-Lake region of China