

# PROJECT FICHE result report Bilat.R&D coop.China – Project BL/02/C28 - UG

**Project title :** In situ methane oxidation and methane emission scenarios from Chinese rice fields

**Geographic study area:** China

**Satellite imagery used** (type and co-ordinates images purchased by OSTC): no

**Other data:** literature data and State Soil Survey Service of China

## Context and objectives (max 14 lines)

Methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) are two important atmospheric greenhouse gases. The abundance of CH<sub>4</sub> and N<sub>2</sub>O in the atmosphere has been continuously increasing since industrialization, with current increasing rates of 7.0 and 0.8 ppb per year, respectively. Irrigated rice fields are considered major anthropogenic sources of atmospheric CH<sub>4</sub> during the flooded (reduced) period of the fields and of N<sub>2</sub>O during the remaining non-flooded period. China has about 30 million ha of rice fields. Recently, Li et al. (2004), using a process oriented modelling approach, predicted that CH<sub>4</sub> and N<sub>2</sub>O emissions from Chinese rice fields are in the order of 6.4 – 12.0 Tg C per year and 0.29 – 0.41 Tg N per year respectively. Methane emission from irrigated rice fields is controlled by production, oxidation and plant transport. A significant amount of CH<sub>4</sub> produced in the soil can be oxidized before escaping from the soil. Stable isotope techniques offer a potentially powerful tool to study and quantify the importance of the magnitude of *in situ* CH<sub>4</sub> oxidation in irrigated rice soils (Krüger et al., 2002).

The objectives were as follows:

- Study in situ methane oxidation in irrigated rice fields using stable isotope techniques;
- Provide technical to start-up stable isotope facilities at the Institute of Applied Ecology;
- To evaluate methane emissions from rice fields on a regional scale using different management scenarios.

## Methodology (max 11 lines)

The measurement and method development related to stable isotopes is not straightforward and requires state-of-the-art equipment and well trained technicians. There for the main emphasis during this bilateral cooperation will be on assisting the Chinese partners in the start up of their Isotope Ratio Mass spectrometer and in the set-up of state of the art field experiments. The following methods and techniques were used: Laboratory incubations to study the kinetics of CH<sub>4</sub> oxidation; CH<sub>4</sub> measurements by gas chromatography; Stable isotope analysis from laboratory data. Extensive experiences in the analysis of land use and management scenarios and evaluating their impact on greenhouse gas emissions. The Chinese partners will carry out a meta-analysis of the critical factors for greenhouse gas emissions in rice fields and relate these to management options. The distribution of the different management options within northern China and scenarios for future distribution will be investigated

## Results (max 16 lines)

The results can be split up in two activities that were carried out:

### 1. Assessment of CH<sub>4</sub> mitigation techniques from Chinese rice fields via linear mixed model

For different regions of China field methane emission data and background data were compiled via a meta-analysis. Methane emissions were calculated using a linear mixing model. The effect of several management options was tested via the model: organic matter type and water level management. It was observed that removal of organic matter and optimal water management reduced methane emissions in all regions simulated. From these "extremes" realistic management strategies per region have been developed. Most potential for methane emission reduction (48-64%) is situated in East, Southwest and South China via optimal organic matter type and application management and water level management.

### 2. Variation of isotope fractionation during CH<sub>4</sub> oxidation in paddy soils

Next to fact that Chinese researcher were trained in the use of stable isotopes for research the following scientific results were found. Methane oxidation potential of a Chinese rice soil (Shenyang) varied between 0.4 and 1.6 mg/kg/h and highest methane oxidations occurred when organic matter was added. These observation should be fed back into the observation made in (1). Isotope fractionation is a function of land management and the values ranged between 1.02 and 1.04, which agrees with literature data, but confirm that the use of one fractionation factor as was done by Krüger et al. (2002) is not correct.

## Products and services (if applicable)

It is anticipated the two peer reviewed publication could be published from these

Anticipated titles are:

1. Assessment of CH<sub>4</sub> mitigation techniques from Chinese rice fields via linear mixed model
2. Variation of isotope fractionation during CH<sub>4</sub> oxidation in paddy soils

## Execution

**Period:** 01/12/2004 – 21/12/2006

### Laboratory:

- Belgium : \* Lab.of Applied Physic.Chemistry (ISOFYS), Fac. of Bioscience Engineering , UGent  
[Pascal.boeckx@ugent.be](mailto:Pascal.boeckx@ugent.be); oswald.vancleemput@ugent.be
- \* Department of Geography, UCL (Prof. B.Van Wesemael)
- China : \*Institute of Soil Science, CAS, Nanjing – gxchen@iac.ac.cn
- \* Institute of Applied Ecology, CAS, Shenyang

### Discipline (select one or more appropriate disciplines)

Atmosphere  
Agriculture Environment

## Way forward R&D recommendations

The next step with respect to the isotopic techniques used in this project is application of this technique in field experiments to assess in situ methane oxidation rates. The time period and funding with this bilateral S&T project was insufficient to carry this out. If this could be done experiments could be carried out to understand, which management techniques actually reduce methane emissions

With respect to the observed management scenarios (organic matter type and timing) and water management) long-term field trials should be established to verify in the field the observed simulated mitigation effects. Once this verification is successful actual large scale implementation of the simulated and tested techniques can be carried out.

## Peer reviewed publication

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Anticipated titles are:

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2. Variation of isotope fractionation during CH<sub>4</sub> oxidation in paddy soils