2015 Asia Sub-Group Meeting of GRA-PRRG
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Standardization of Measurement Techniques

National Institute for Agro-Environmental Sciences (NIAES)

Tsukuba, Japan

Progress until 2014

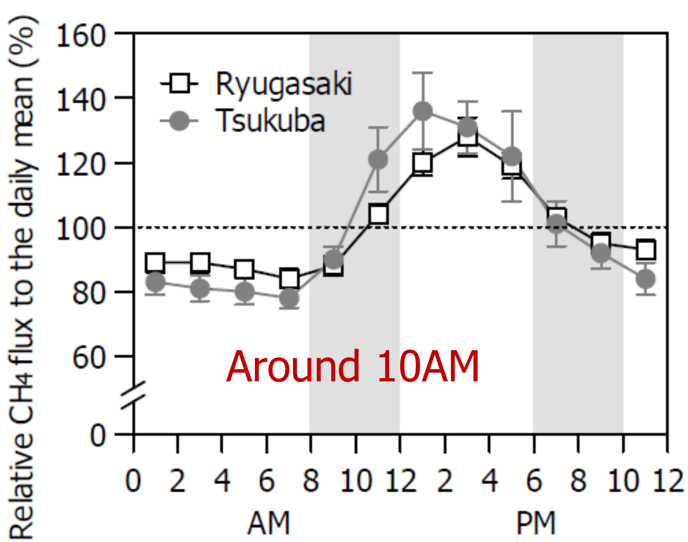
2010
GRA-PRRG activities started

2012
A method paper published

2013
MIRSA-2 project started

2013
Contents of guidelines confirmed

2014
RECOs of guidelines made *tentatively*

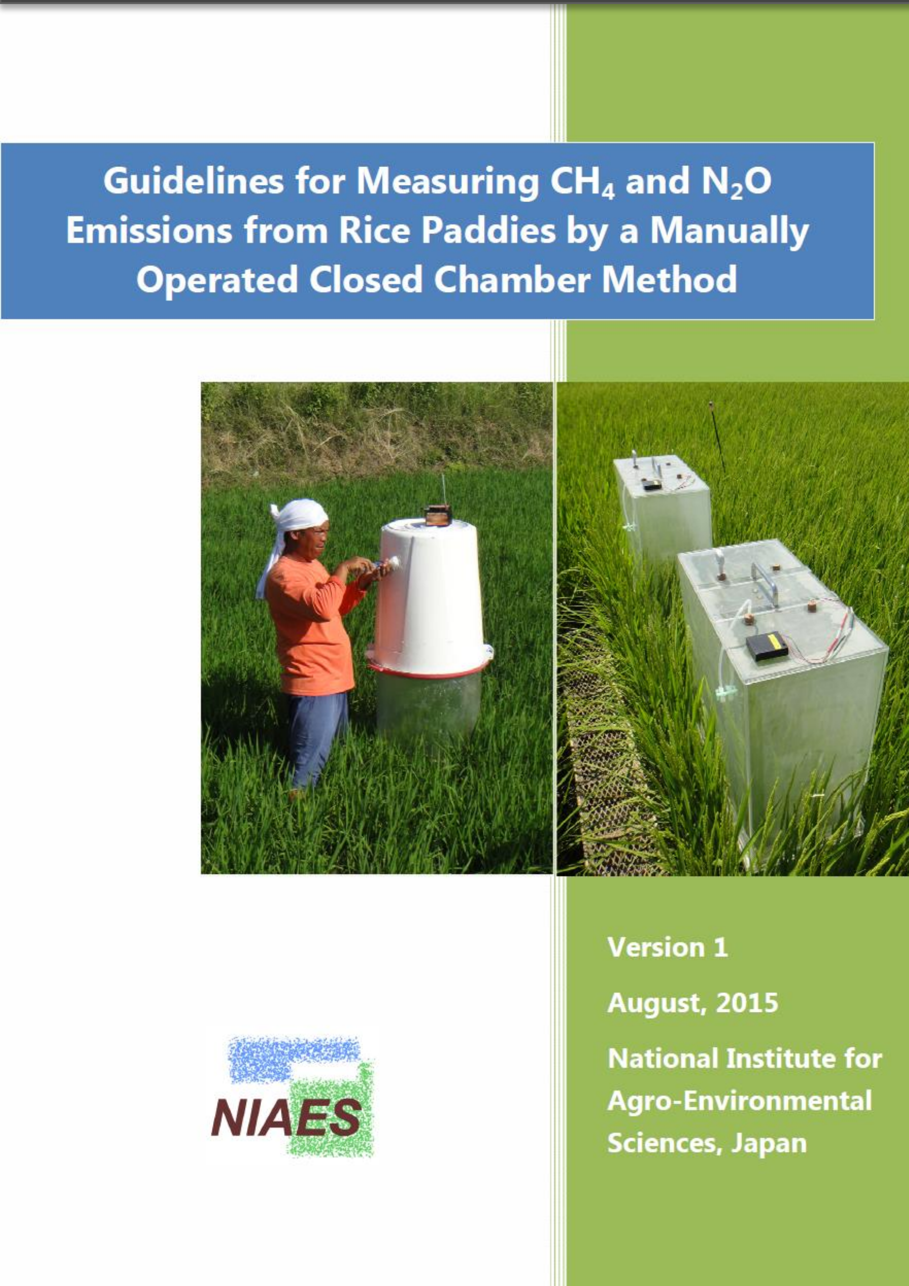


Appropriate time of day and frequency (Minamikawa et al., 2012)

Greenhouse Gas **M**itigation in **I**rrigated **R**ice Paddies in **S**outheast **A**sia (Part **2**): Field Demonstration and Consolidation of Procedures

International research project funded by Japanese government until 2017 among six Asian research institutes (➔ financial support for GRA-PRRG activities)

Measurement Guidelines just published



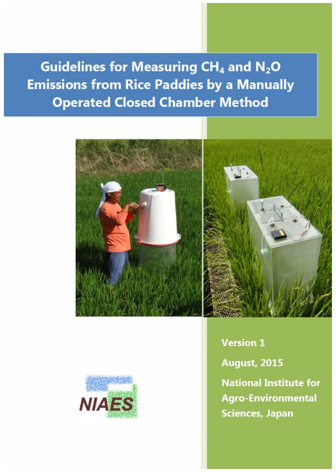
Preface
Table of contents
Recommendations
- Experimental design
- Chamber design
- Gas sampling
- Gas analysis
- Data processing
- Auxiliary measurements

Evolving issues
1. Experimental design
2. Chamber design
3. Gas sampling
4. Gas analysis
5. Data processing
6. Auxiliary measurements

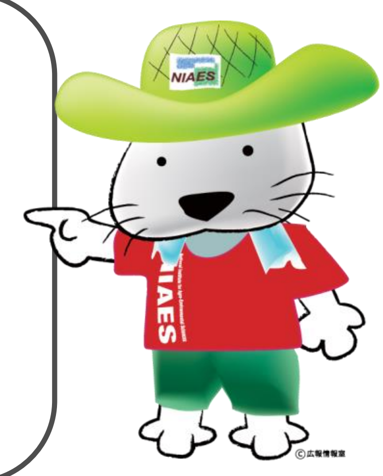
References
Appendices

Officially published online on 11 Aug.
Available from NIAES's webpage:
http://www.niaes.affrc.go.jp/techdoc/mirsa_guidelines.pdf

Measurement Guidelines: Contents



- Totally 76 pages,
- Minimum requirements are summarized as “Recommendations” at the beginning,
- Practical and technical methods for each step of measurements are described with photos/illustrations and scientific bases,
- Some unsolved problems are discussed as “evolving issues”.



Recommendations

Gas sampling

Category	Minimum requirements and *recommendations*
Period	✓ Determine the measuring period according to the research objectives. ✓ The measurement period should encompass the entire rice growing period for the estimation of seasonal emissions of CH_4 and N_2O. · *In accordance with IPCC recommendations, to calculate the N_2O emission factor, measurements should be obtained throughout a year.*
Time of day	✓ Mid-morning during flooded rice-growing periods (measure once daily to obtain the daily mean CH_4 flux). ✓ Measure all treatments at the same timing. · *Daytime during temporary drainage events during the rice growing period.* · *Late morning during dry fallow periods.* · *Measure the N_2O flux concurrently with the CH_4 flux.*
Frequency	✓ At least weekly during flooded rice-growing periods. ✓ More frequently during agricultural management events (e.g., irrigation, drainage, and N fertilization) and some natural events (e.g., heavy rainfall). · *Weekly or biweekly during dry fallow periods.*

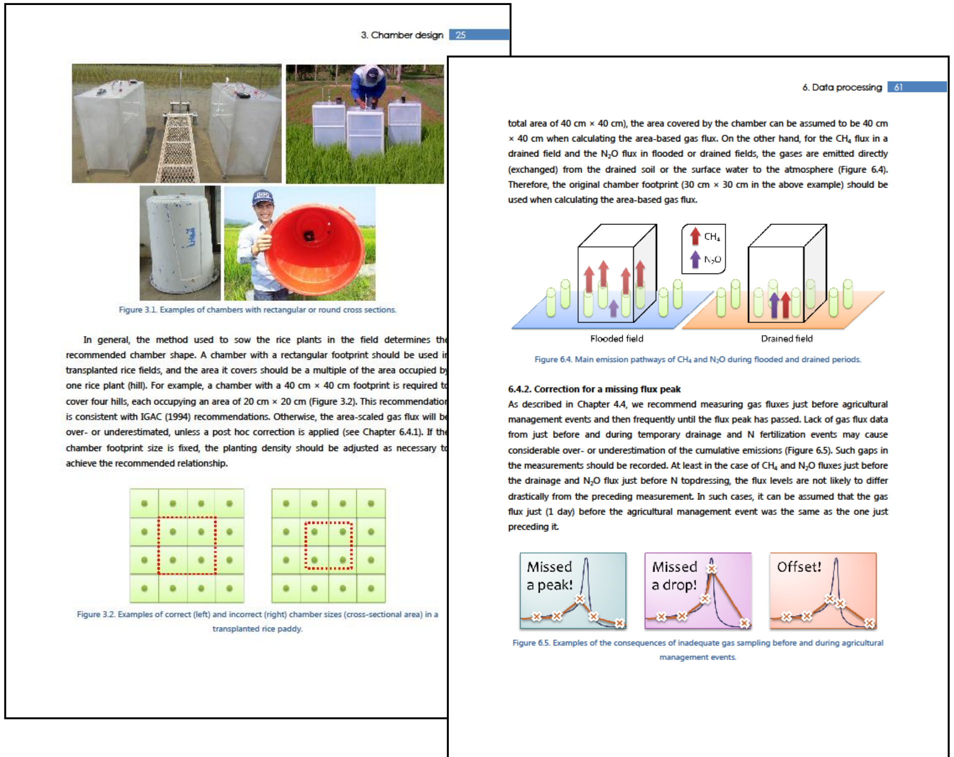

3. Chamber design 25

Figure 3.1. Examples of chambers with rectangular or round cross sections.

In general, the method used to sow the rice plants in the field determines th[e] recommended chamber shape. A chamber with a rectangular footprint should be used i[n] transplanted rice fields, and the area it covers should be a multiple of the area occupied b[y] one rice plant (hill). For example, a chamber with a 40 cm × 40 cm footprint is required t[o] cover four hills, each occupying an area of 20 cm × 20 cm (Figure 3.2). This recommendatio[n] is consistent with IGAC (1994) recommendations. Otherwise, the area-scaled gas flux will b[e] over- or underestimated, unless a post hoc correction is applied (see Chapter 6.4.1). If th[e] chamber footprint size is fixed, the planting density should be adjusted as necessary t[o] achieve the recommended relationship.

Figure 3.2. Examples of correct (left) and incorrect (right) chamber sizes (cross-sectional area) in a transplanted rice paddy.

6. Data processing 61

total area of 40 cm × 40 cm), the area covered by the chamber can be assumed to be 40 cm × 40 cm when calculating the area-based gas flux. On the other hand, for the CH_4 flux in a drained field and the N_2O flux in flooded or drained fields, the gases are emitted directly (exchanged) from the drained soil or the surface water to the atmosphere (Figure 6.4). Therefore, the original chamber footprint (30 cm × 30 cm in the above example) should be used when calculating the area-based gas flux.

Figure 6.4. Main emission pathways of CH_4 and N_2O during flooded and drained periods.

6.4.2. Correction for a missing flux peak

As described in Chapter 4.4, we recommend measuring gas fluxes just before agricultural management events and then frequently until the flux peak has passed. Lack of gas flux data from just before and during temporary drainage and N fertilization events may cause considerable over- or underestimation of the cumulative emissions (Figure 6.5). Such gaps in the measurements should be recorded. At least in the case of CH_4 and N_2O fluxes just before the drainage and N_2O flux just before N topdressing, the flux levels are not likely to differ drastically from the preceding measurement. In such cases, it can be assumed that the gas flux just (1 day) before the agricultural management event was the same as the one just preceding it.

Figure 6.5. Examples of the consequences of inadequate gas sampling before and during agricultural management events.

Evolving issues: toward near-future improvement (1/2)

Issue	Current status and prospects
Equipment availability	✓ For various reasons, it is not always possible to procure the required equipment, so measurement procedures **need to be flexible and, thus, may not be uniform**.
Standard gases	✓ It is sometimes difficult to obtain certified standard gases. ✓ If necessary, standards of the required concentrations can be produced by **diluting high-concentration standard gas** with an inert gas (He or N_2) with proper checking of the accuracy of the dilution. ✓ **Compressed air can be used as a working standard gas** after determination of the target gas concentrations.
Chamber transparency	✓ Chamber transparency (or opacity) remains an open question. ✓ Both transparent and opaque materials have **advantages and disadvantages**, but which type of material is used often depends on what is available.

Evolving issues: toward near-future improvement (2/2)

Issue	Current status and prospects
Chamber area and number of chambers within a plot	✓ The area covered by each chamber (i.e., its footprint) and the number of chambers that should be deployed within a plot **depend on the required measurement accuracy**. ✓ The larger the chamber area and the greater the number of chambers deployed, the more reliable the gas flux data will be. ✓ However, practically, the chamber area and the number of chambers **may be limited by the number of people** available to carry out the measurements. ✓ There is no consensus as to **what percentage of the plot area should be covered** to obtain a representative gas flux value.
Interpolation to fill gaps in the gas flux data	✓ Insufficient gas flux data collected during drainage or after N fertilization **may lead to considerable over- or underestimation** of total emissions. ✓ Any such gaps in the measurements should be recorded. ✓ The gaps may be filled by interpolation by making some reasonable assumptions.

Research gap filling (1/2)

4.8. Evolving issues

4.8.1. Uncertainty of diurnal CH_4 and N_2O flux patterns

There are few reports about the diurnal CH_4 flux pattern in a tropical climate. Therefore, it is not possible to recommend in this chapter a particular time of day for obtaining the daily mean flux in the tropics. Wassmann et al. (2000) reported that significant ebullition occurred at the beginning of rice cultivation in the Philippines, caused both by the application of straw immediately preceding cultivation and by hot weather. This ebullition is not the case for the temperate region. On the basis of a literature survey, Sander and Wassmann (2014) reported that in most studies sampling is carried out in late morning, regardless of the climatic zone. Further investigation is required to elucidate diurnal flux patterns in the tropics and the underlying mechanisms.

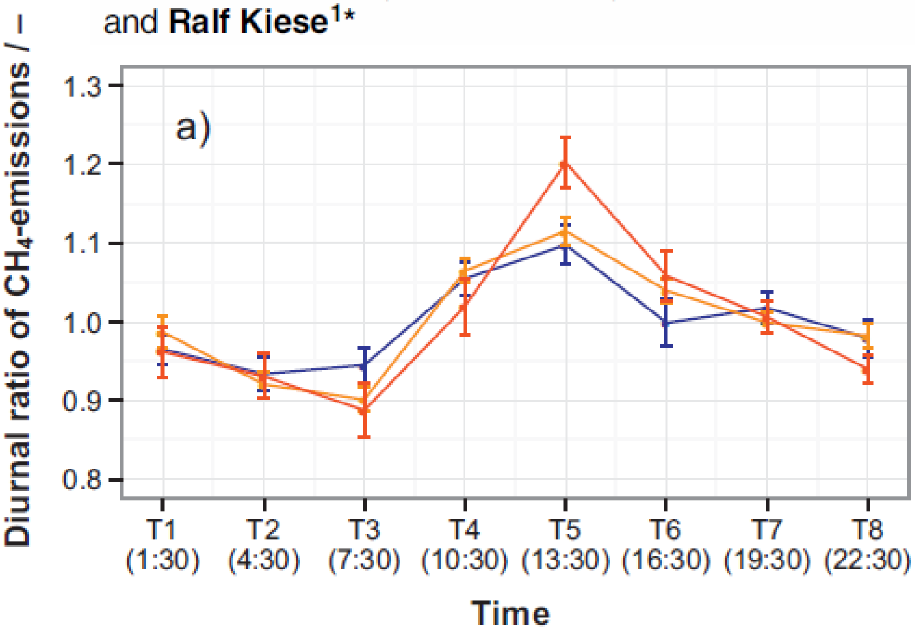
Another unresolved issue is the diurnal N_2O flux pattern during the flooded rice-growing period. As mentioned in Chapter 4.3.3, contradictory results have been obtained. The N_2O flux is generally low when the level of N application is low, and thus N_2O flux data from high-N-application fields will be helpful to elucidate the mechanisms underlying the temporal pattern of N_2O flux under flooded conditions.

Research gap filling (2/2)

J. Plant Nutr. Soil Sci. 2015, *000*, 1–13 **DOI:** 10.1002/jpln.201500092

Diurnal patterns of methane emissions from paddy rice fields in the Philippines

Sebastian Weller[1], **David Kraus**[1], **Klaus Butterbach-Bahl**[1,2], **Reiner Wassmann**[3], **Agnes Tirol-Padre**[3], and **Ralf Kiese**[1*]



- Dataset from the whole rice season
- Blue: 2012DS
- Orange: 2012WS
- Red: 2013DS
- No diurnal variation in N_2O flux

	Weller et al. (2015)	Minamikawa et al. (2012)
Site	Philippines	Japan
Time of daily mean flux	7:00-9:00 & 17:00-19:00	8:00–11:59 & 18:00–21:59
Typical observable stage	Early stage with low leaf area	After heading stage

Future Works

Subject 2: Development of the guidelines for implementing MRV

1. Collection of scientific information on MRV (from Minamikawa)
2. Analysis of social and natural limitation factors of AWD (from Yamaguchi)
3. Developing online database for data exchange and site information (from Sudo)