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Recent Research Progress for Improving Japanese GHG Inventories of Agricultural Soils

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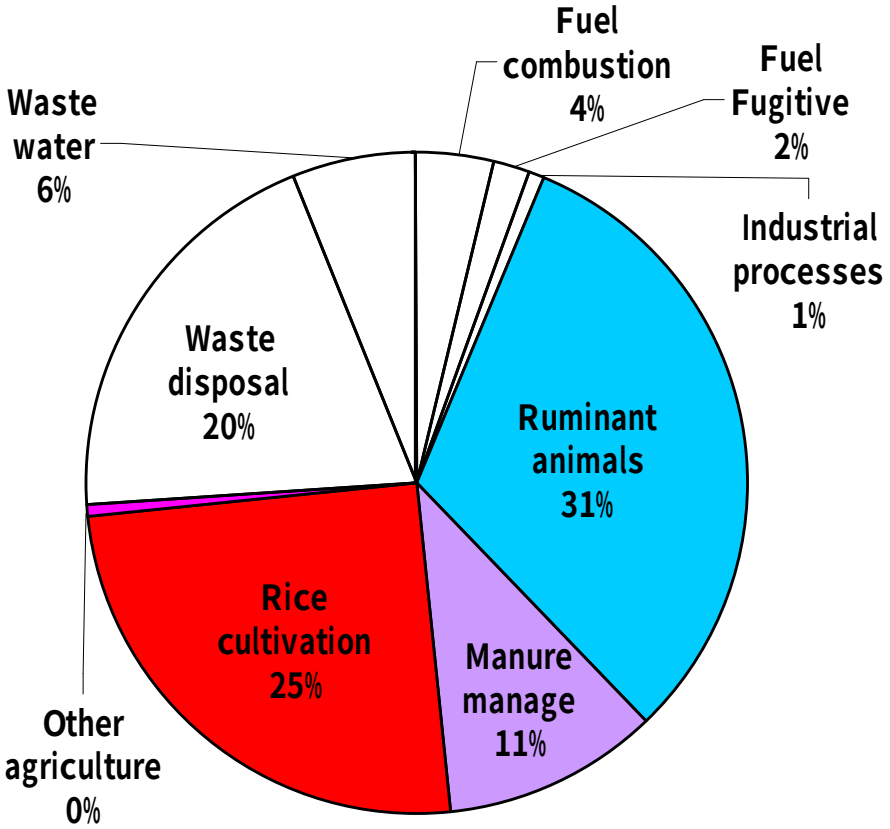
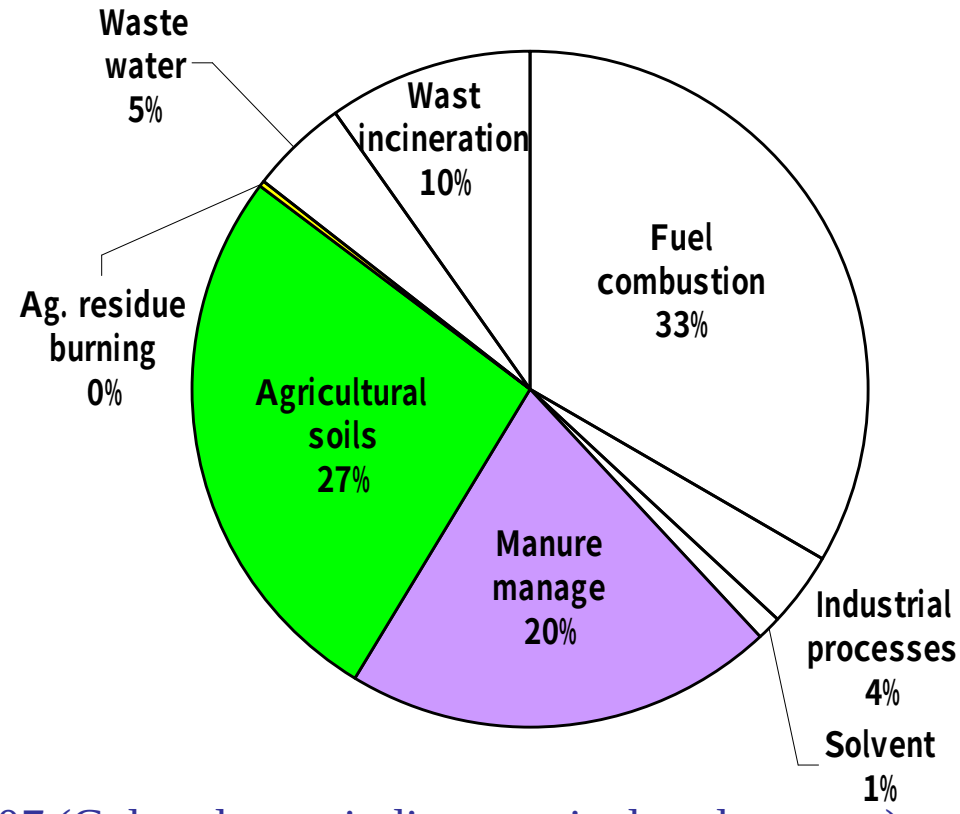
NIAES

National Inventory for Japan
Anthropogenic Sources for CH_4 and N_2O

CH_4：1.08 Mt (22.6 Mt CO_2 eq.)



N_2O：0.049 Mt N (23.8 Mt CO_2 eq.)



Inventory in 2007 (Colored parts indicate agricultural sources)

National Inventory for Japan

Summary of Agricultural Soils

Category			EF	AD	note
6.4	Rice cultivation		Tier 2	Tier 2	Specific EFs for soil type and org. amendment
6.5.1	Direct N_2O	Synthetic fertilizers	Tier 2	Tier 2	3 EFs for crop types
		Organic fertilizers	Tier 2	Tier 2	Same EFs as synthetic
		N-fixing crops	Tier 1	Tier 2	
		Crop residue	Tier 1	Tier 2	
		Plowing org. soil	Tier 2	Tier 2	2EFs for paddy & upland
6.5.3	Indirect N_2O		Tier 1	Tier 1/2	
6.7	Burning of ag. residues		Tier 1/2	Tier 1/2	

Recent Research Progress for Improving Japanese GHG Inventories of Agricultural Soils

CONTENTS

- Effects of improved water management on mitigating CH_4 emissions from rice cultivation
- Tier 3 methodology for estimating CH_4 emissions from rice cultivation by the DNDC-Rice model
- National program for collecting updated activity data preparation

NIAES

National Inventory for Japan

CH_4 Emissions from Rice Cultivation

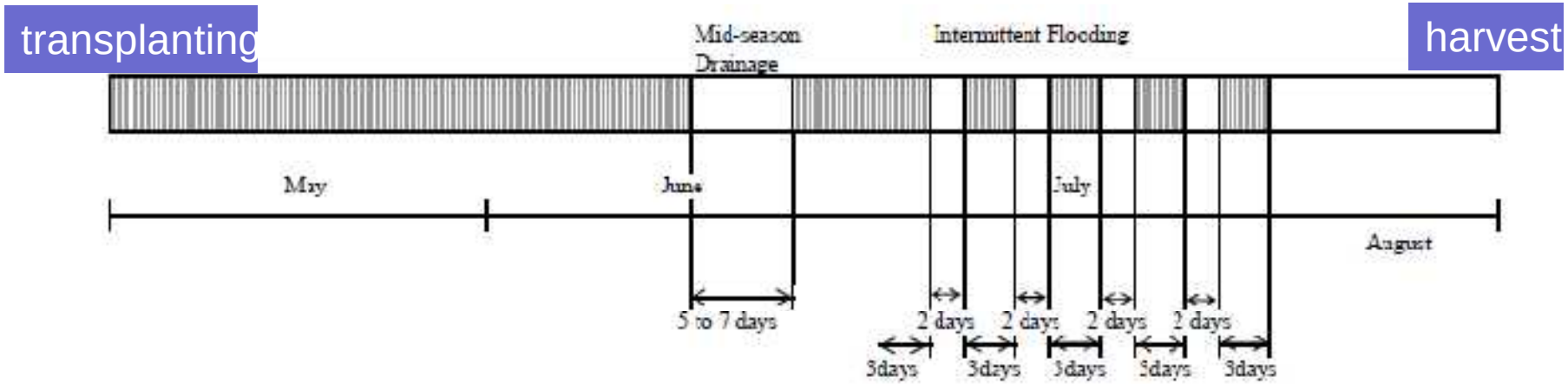
Emission Factors

Type of soil	No. of data	Straw amendment	Various compost amendment	No-amendment	Proportion of area
		[gCH_4/m^2/year]			%
Andosol	2	8.50	7.59	6.07	11.9
Yellow soil	4	21.4	14.6	11.7	9.4
Lowland soil	21	19.1	15.3	12.2	41.5
Gley soil	6	17.8	13.8	11.0	30.8
Peat soil	2	26.8	20.5	16.4	6.4

- Based on field monitoring campaign during 1992-1994 at 35 sites over Japan
- Measured by conventional water management with mid-season drainage followed by intermittent flooding

Conventional Water Management in Japanese Rice Cultivation

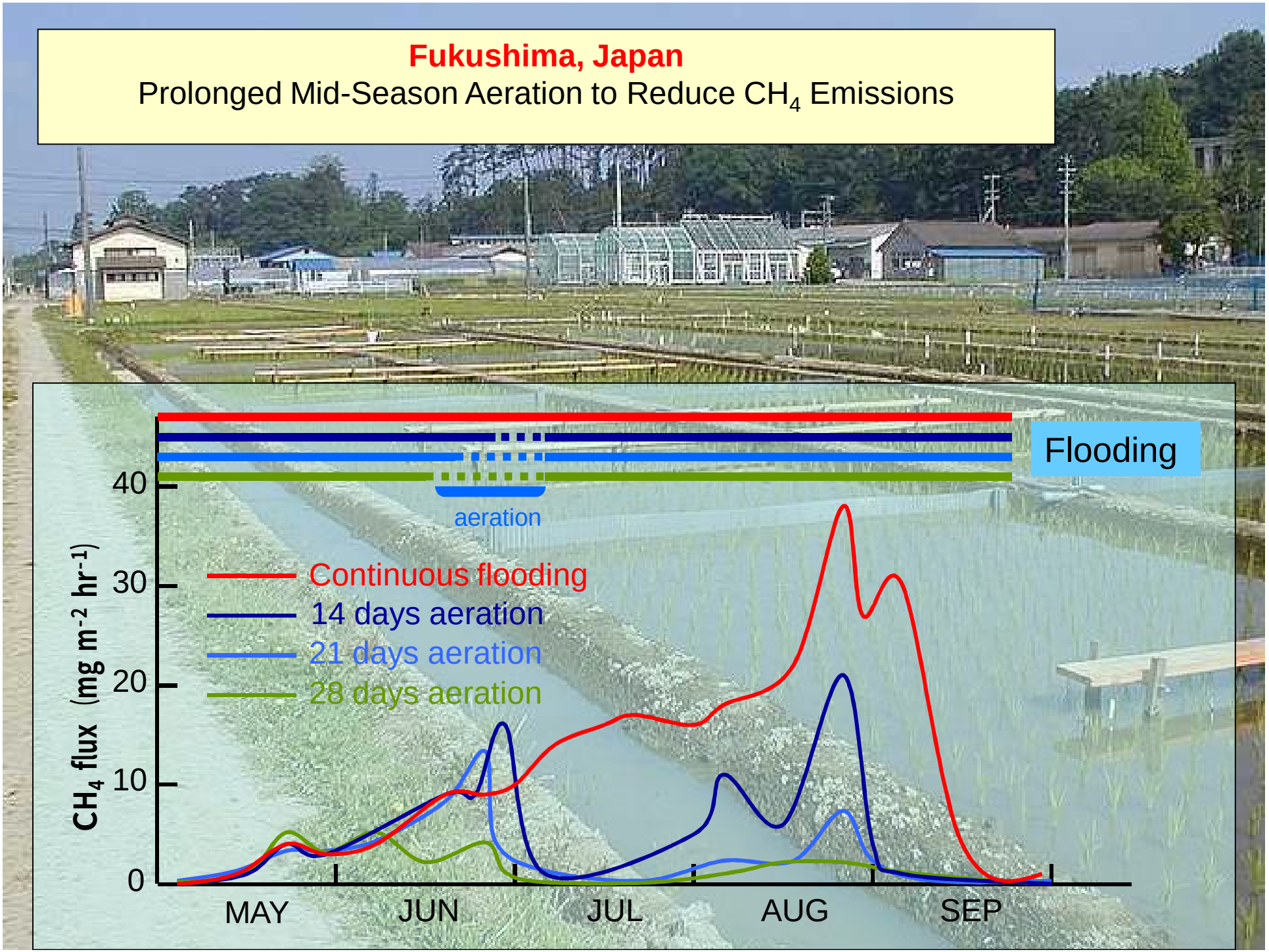
- Most of Japanese paddy fields are managed by intermittent-irrigation scheme



- in order to give a high yield of rice

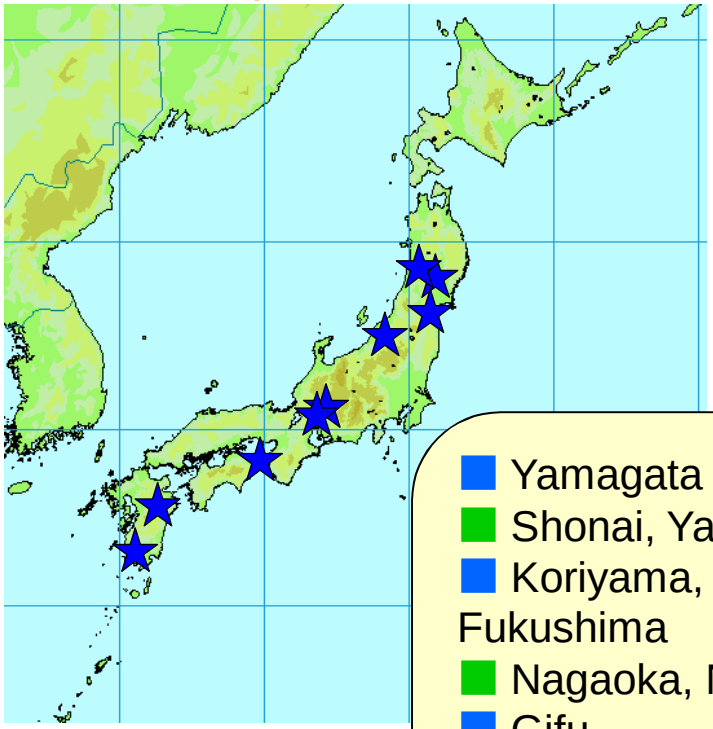
– by reducing numbers of ineffectual tillers

– by enhancing root activities


Fukushima, Japan
Prolonged Mid-Season Aeration to Reduce CH_4 Emissions
Flooding
aeration
Continuous flooding
14 days aeration
21 days aeration
28 days aeration
CH_4 flux (mg m^{-2} hr^{-1})
0
10
20
30
40
MAY
JUN
JUL
AUG
SEP

National Campaign to Test the Effects of Elongated Mid-season Aeration on Mitigating CH_4 Emissions from Paddy Fields

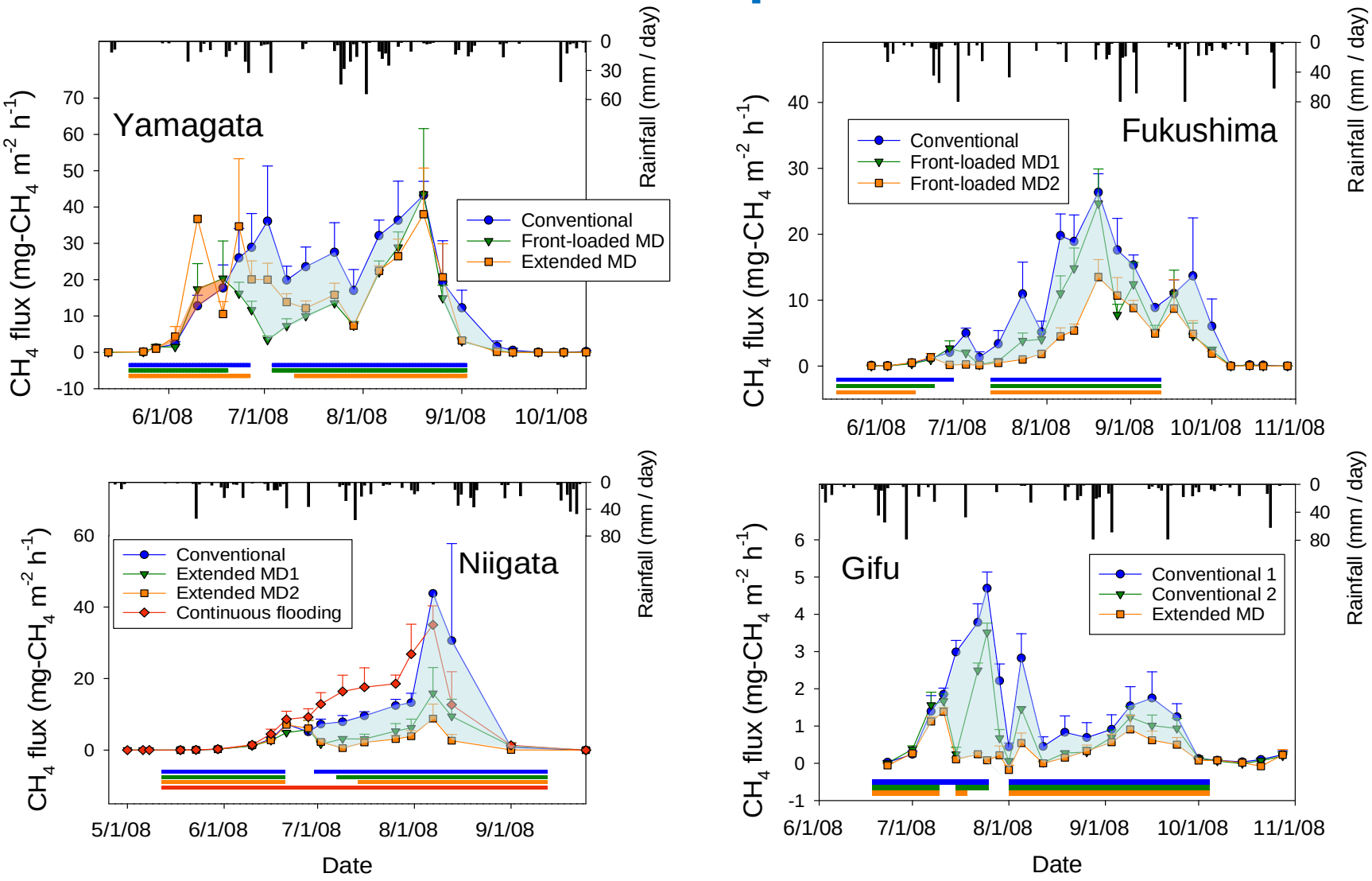
Experiment Sites



- Gray lowland soil
- Gley soil
- Gray upland soil
- Wet andosol

- Yamagata
- Shonai, Yamagata
- Koriyama, Fukushima
- Nagaoka, Niigata
- Gifu
- Nagakute, Aichi
- Tokushima
- Kumamoto
- Kagoshima

Results: CH_4 Emissions

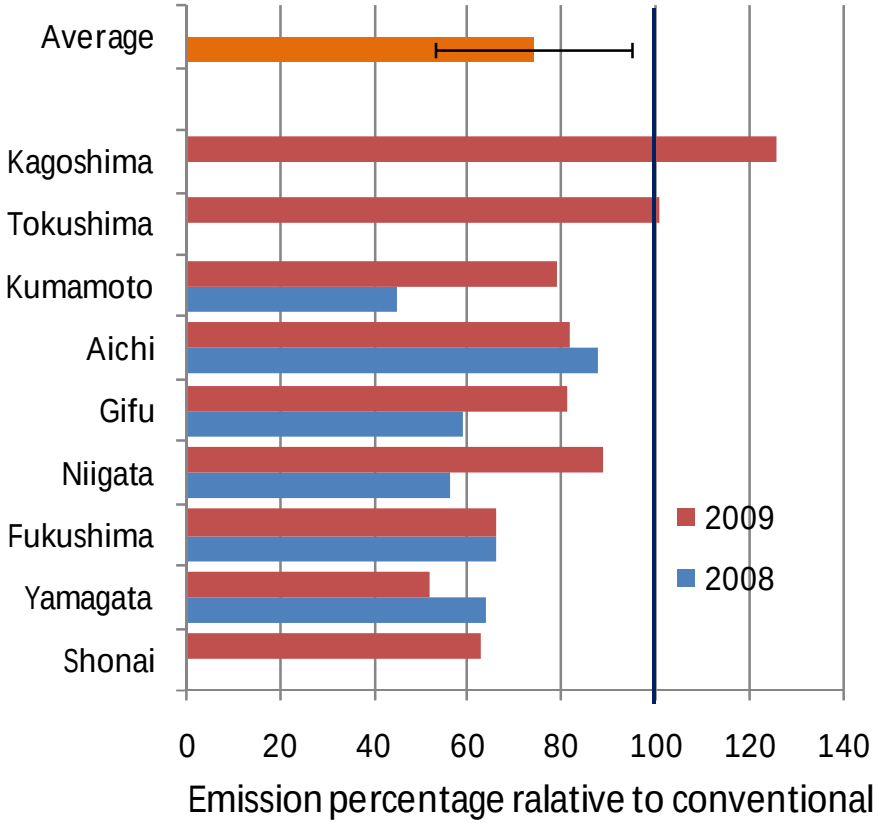


Reduction in CH_4 emission of most effective management compared to conventional

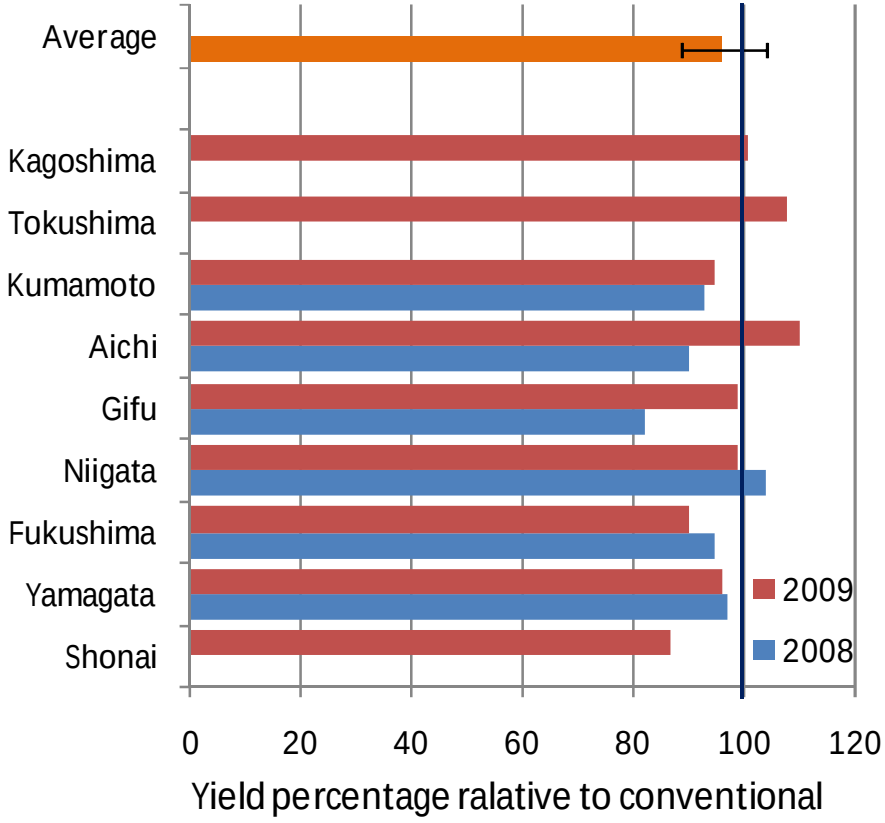
Increase

Summary of Results

CH_4 Emissions

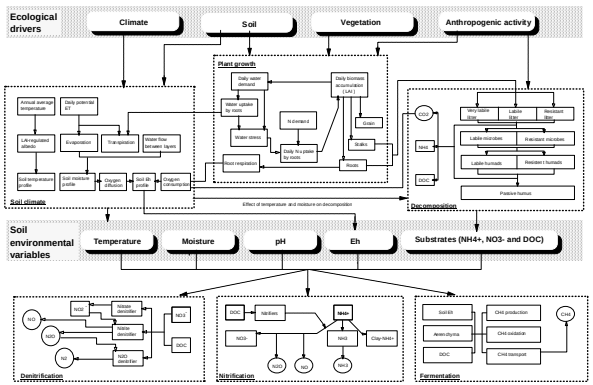


Grain yield



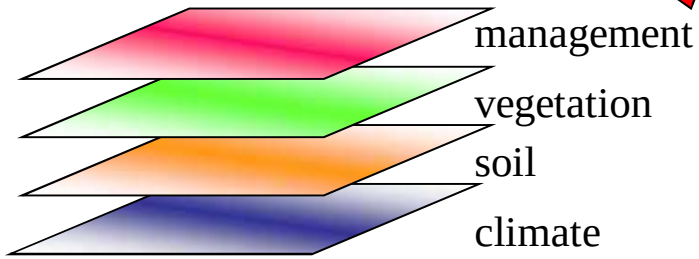
Estimation of GHG Emissions by a Process-Based Model

DNDC model



Simulation and validation

GIS data for parameters



Regional estimation

DNDC-Rice Model

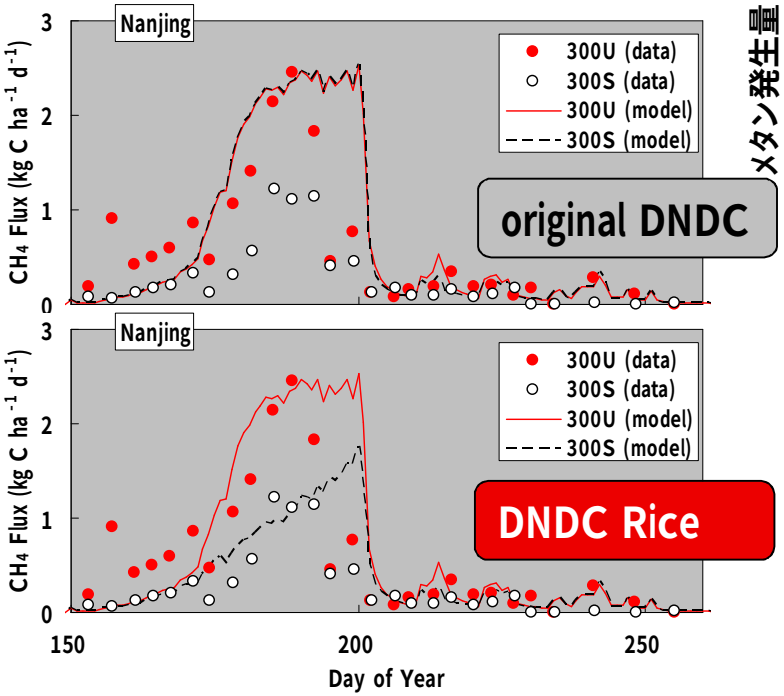
Original DNDC

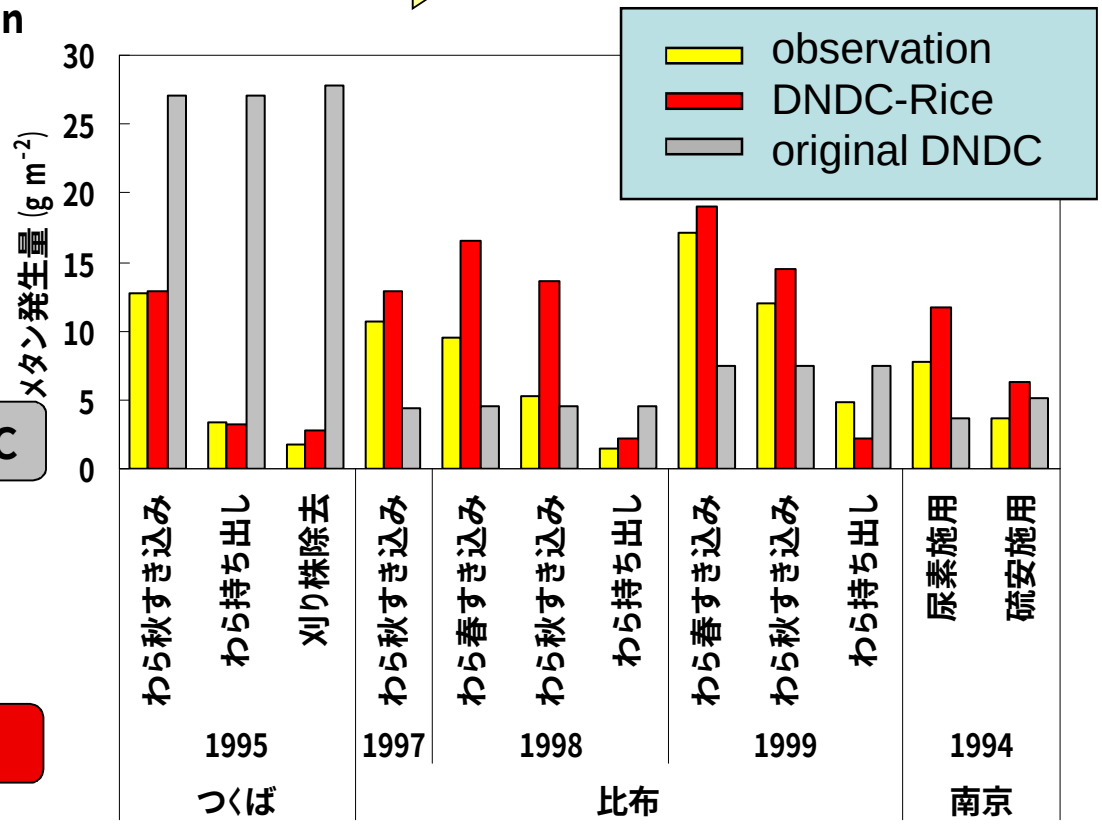
- introducing rice growth sub-model
- revising soil redox sub-model

Revised DNDC
DNDC Rice

Comparison of the model simulation with monitoring data:

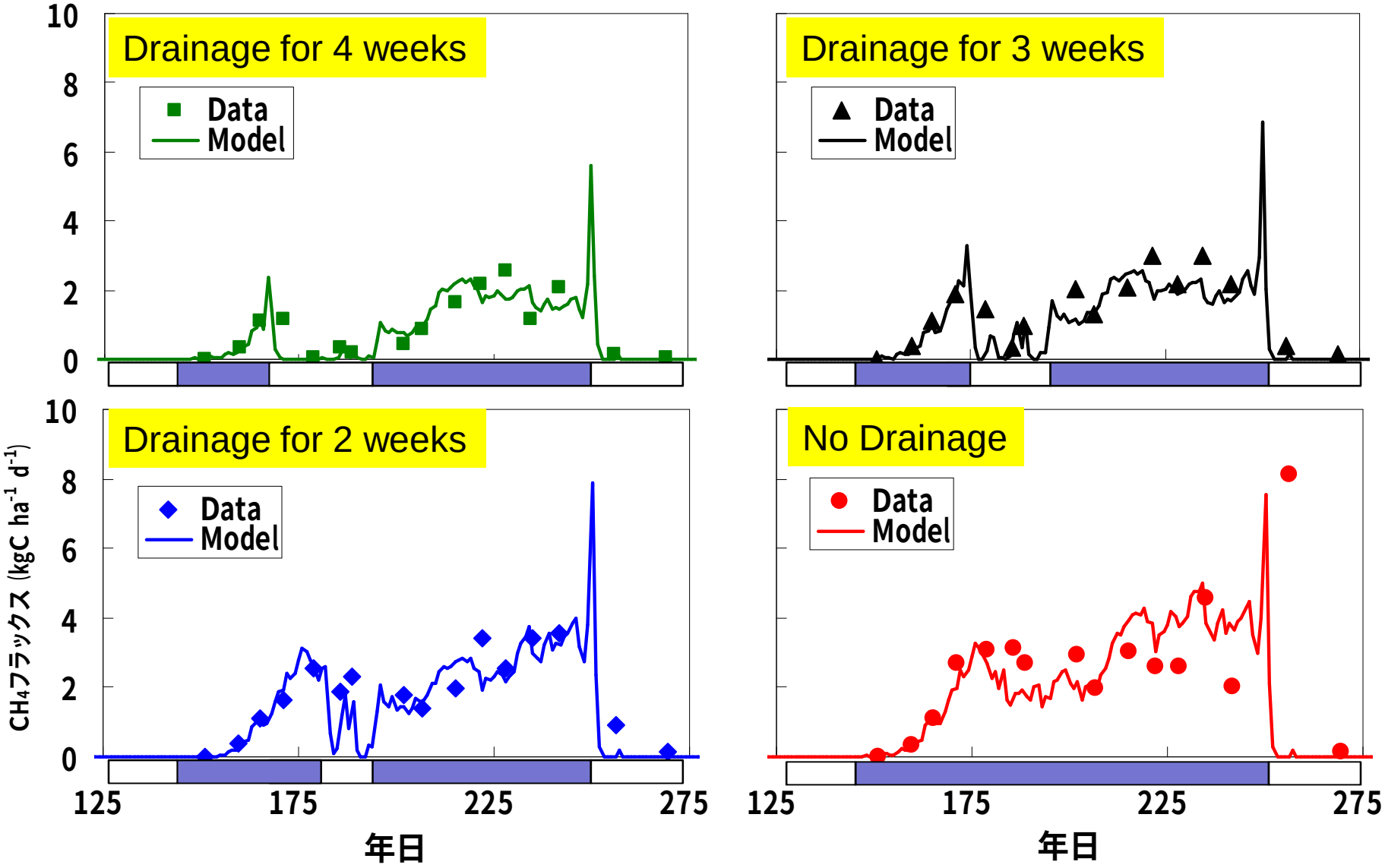
Urea application (300U) and $(NH_4)_2SO_4$ application (300S)





Fumoto *et al.*, *Global Change Biol.* (2008)

Validation of the DNDC-Rice model with observation data for different length of mid-season drainage at Koriyama, Fukushima in 2005



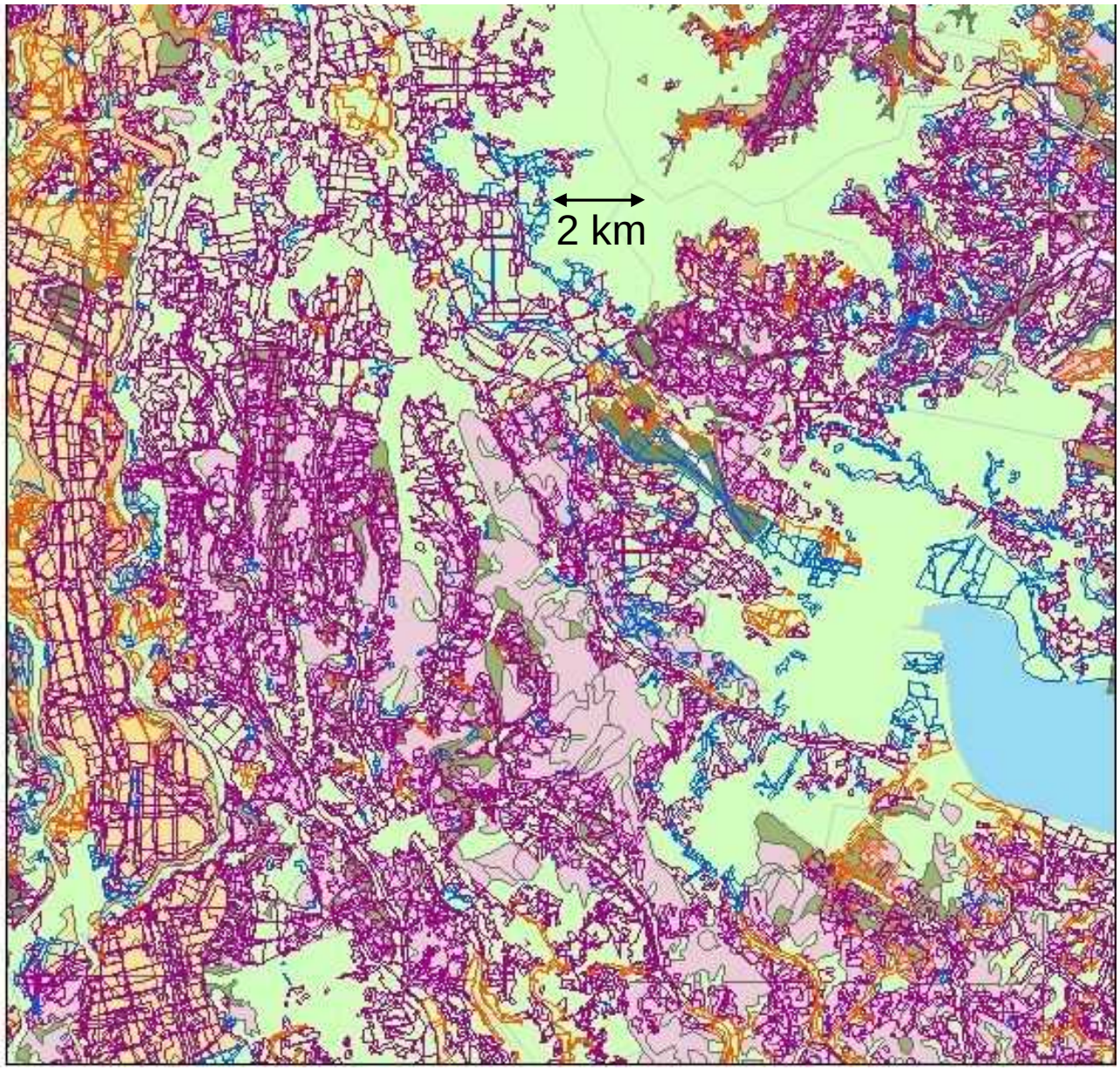
Combining the databases of soil and drainage on GIS.

Polygons of drainage categories

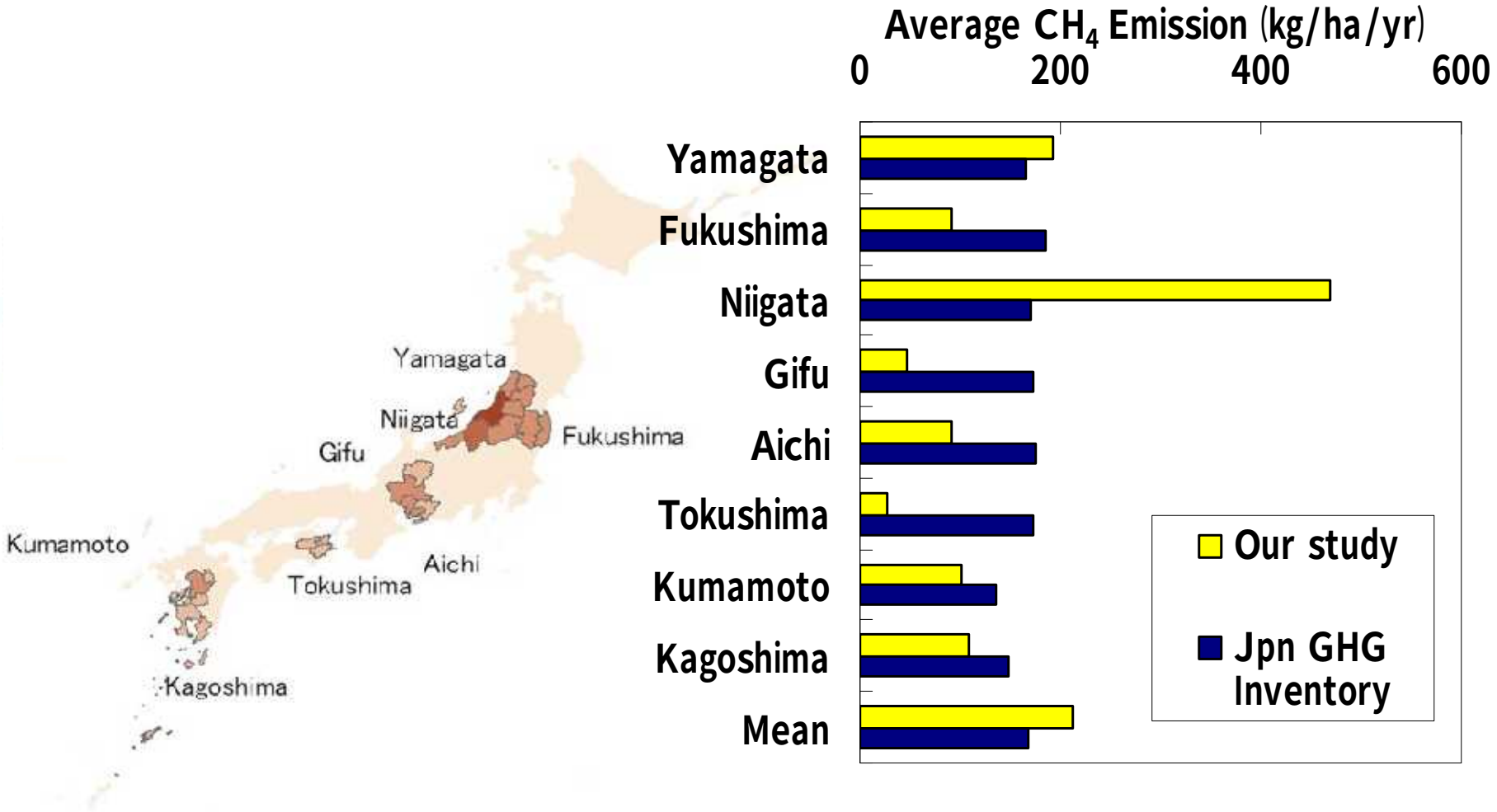
- 排水不良　70cm以浅
- 排水不良　70cm以深
- 日排除程度70cm以浅
- 日排除程度70cm以深
- 4時間排除70cm以浅
- 4時間排除70cm以深

Polygons of soil group

- グライ土
- 多湿黒ボク土
- 暗赤色土
- 泥炭土
- 灰色低地土
- 灰色台地土
- 褐色低地土
- 褐色森林土
- 赤色土
- 黄色土
- 黒ボクグライ
- 黒ボク土
- 黒泥土



Estimated CH_4 emissions differed from those of the national inventory by the Tier 3 approach.



Average CH_4 fluxes from rice fields of 8 prefectures estimated by DNDC-Rice model and by the National GHG Inventory of Japan (Hayano et al., the MC^2 Conference, Palmerston North, NZ, 18-20 November, 2009).

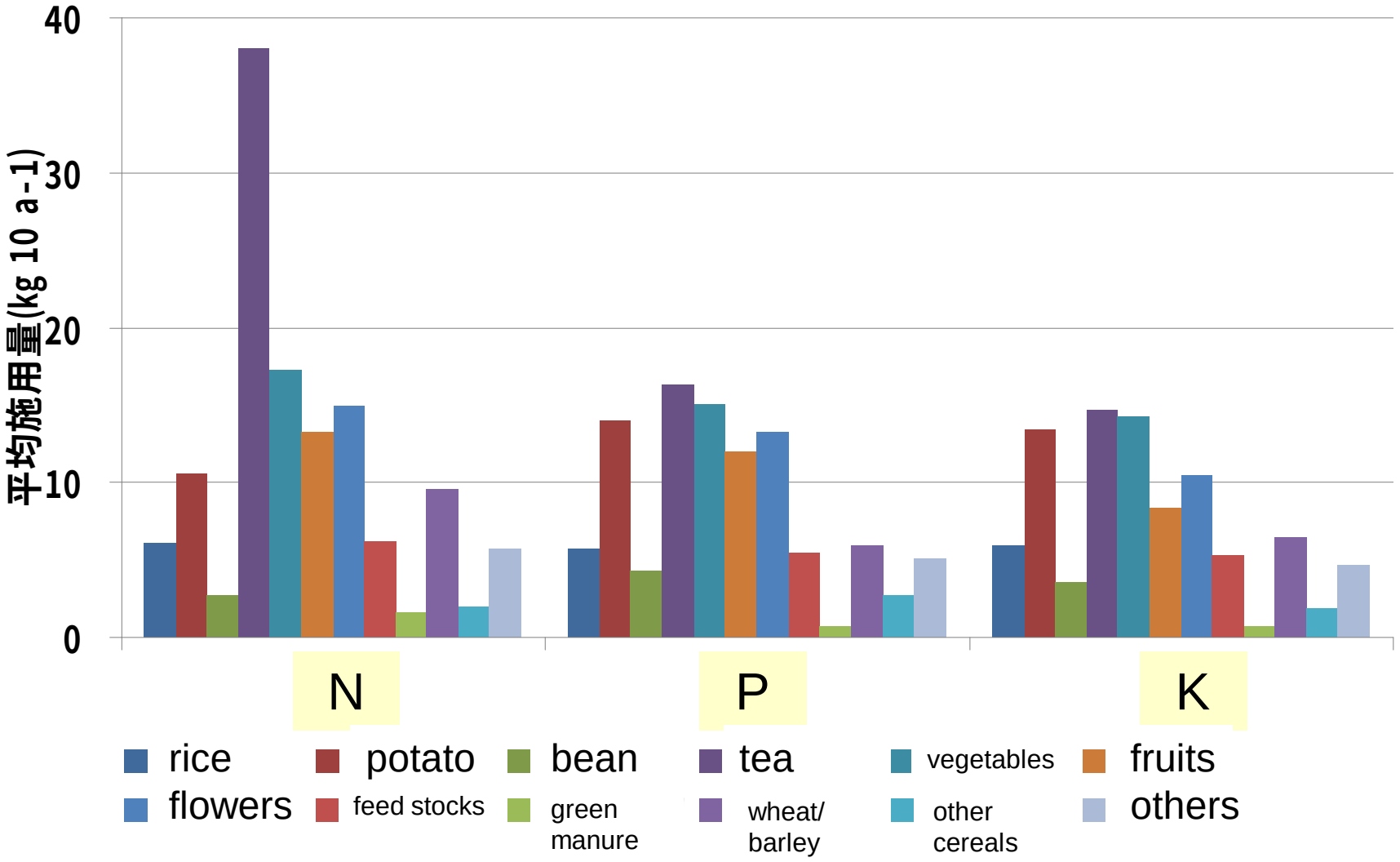
National Inventory for Japan
Activity data preparation

- National statistics
  - MAFF crop statistics
  - MAFF statistics of cultivated and planted area
  - MAFF vegetable production and shipment statistics
  - Yearbook of fertilizer statistics
  - etc.
- Research and interview
  - MAFF basic survey of ground strength: soil type distribution, organic matter management
  - Research on nutrient balance of crops in Japan: N content of non-harvest aboveground portion by crop
  - etc.
- Still some default factors and expert judgments

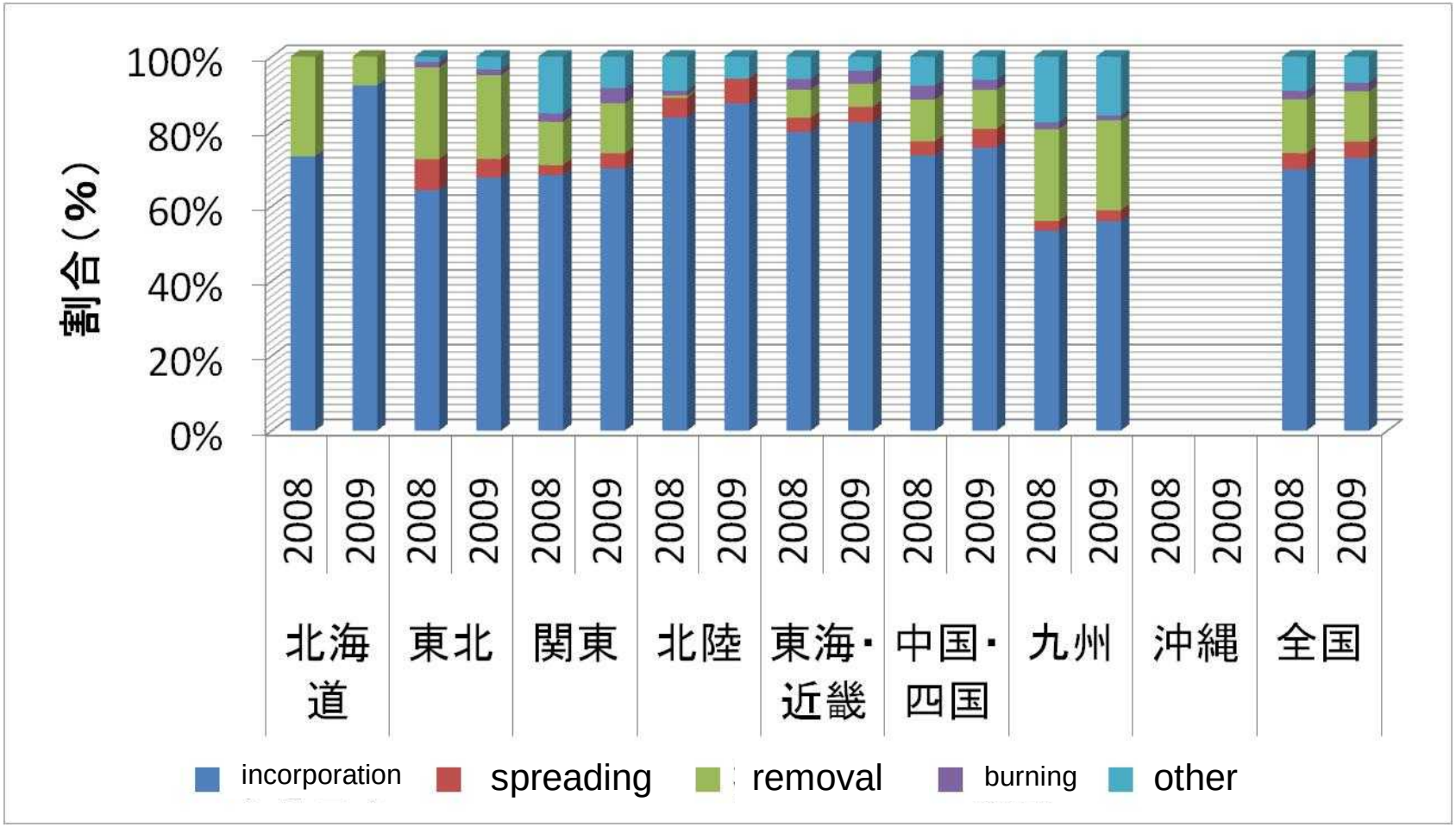
National Program for Collecting Updated Activity Data Preparation

- Program during FY2008-2012
- Interviewing about 3,200 farmers all over the country, and ca. 90% recovery
- Asking:
  - Land use & crop
  - Chemical & organic fertilizer use
  - Tillage, water, crop residue management
- Comparison with the past data for time series analysis

Average Fertilizer Application Rates

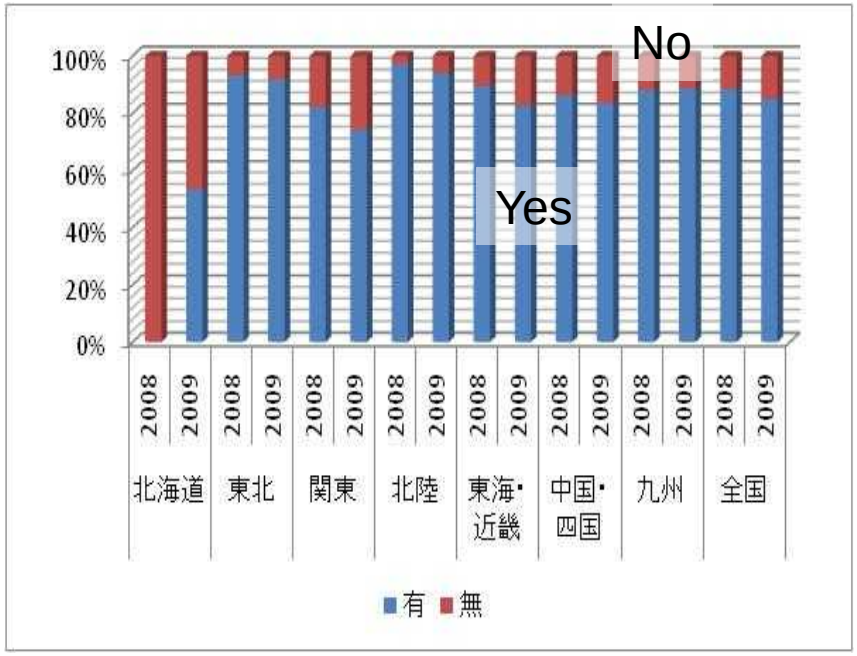


Rice straw management in paddy fields

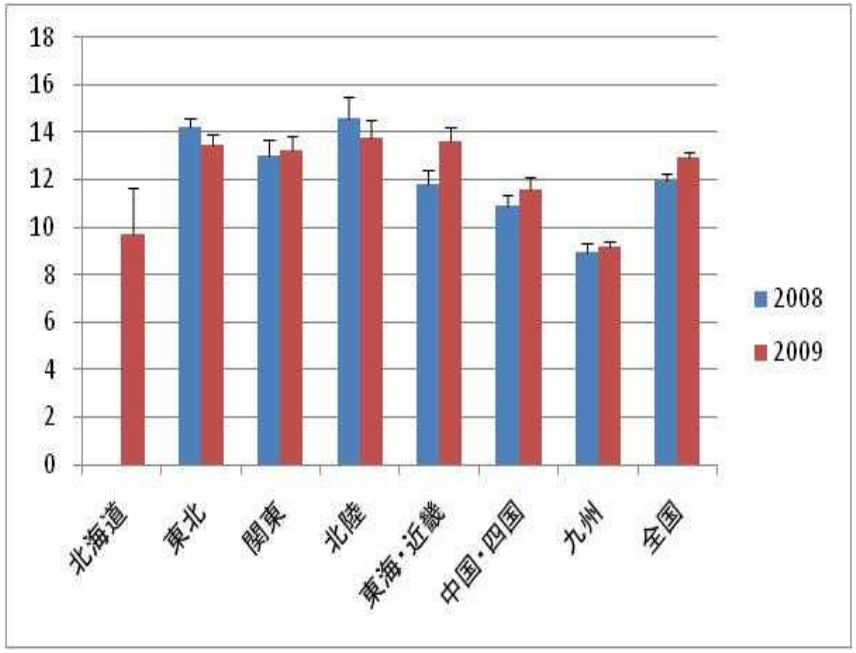


Mid-season drainage in paddy fields

Yes/No



Period



National Inventory for Japan

Summary for Soil Emissions

Present state:

- Tier 2 for CH_4 from rice
- Tier 2/Tier 1 for N_2O from soils
- Mostly Tier 1 for residue burning

Further improvement:

- Tier 3 for CH_4 from rice by the DNDC model
- introducing factors for mitigation, e.g. water management for rice cultivation
- CS-EF for N_2O from organic amendment and crop residues/legumes
- Improving AD by national program

Outline of
the Global Research Alliance
on Agricultural Greenhouse Gases

GLOBAL RESEARCH ALLIANCE
ON AGRICULTURAL GREENHOUSE GASES

http://www.globalresearchalliance.org/home.aspx

- was launched on Dec. 2009 in the COP15.
- is consist of member countries and partners.
- aims at contributing to mitigating agricultural GHG emissions, while enhancing food security.
- is currently in its establishment phase: Member countries will carry out a stock-take of relevant domestic research, technology development and extension efforts.
- set 3 research groups: paddy rice, crop, and livestock.
- also plans 2 cross-cutting groups: soil CN cycles, and inventory.
- Paddy rice group will hold the 1st group meeting during 1-3 September, 2010, in Tsukuba, Japan.