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Trace gases emission from croplands in Monsoon Asia

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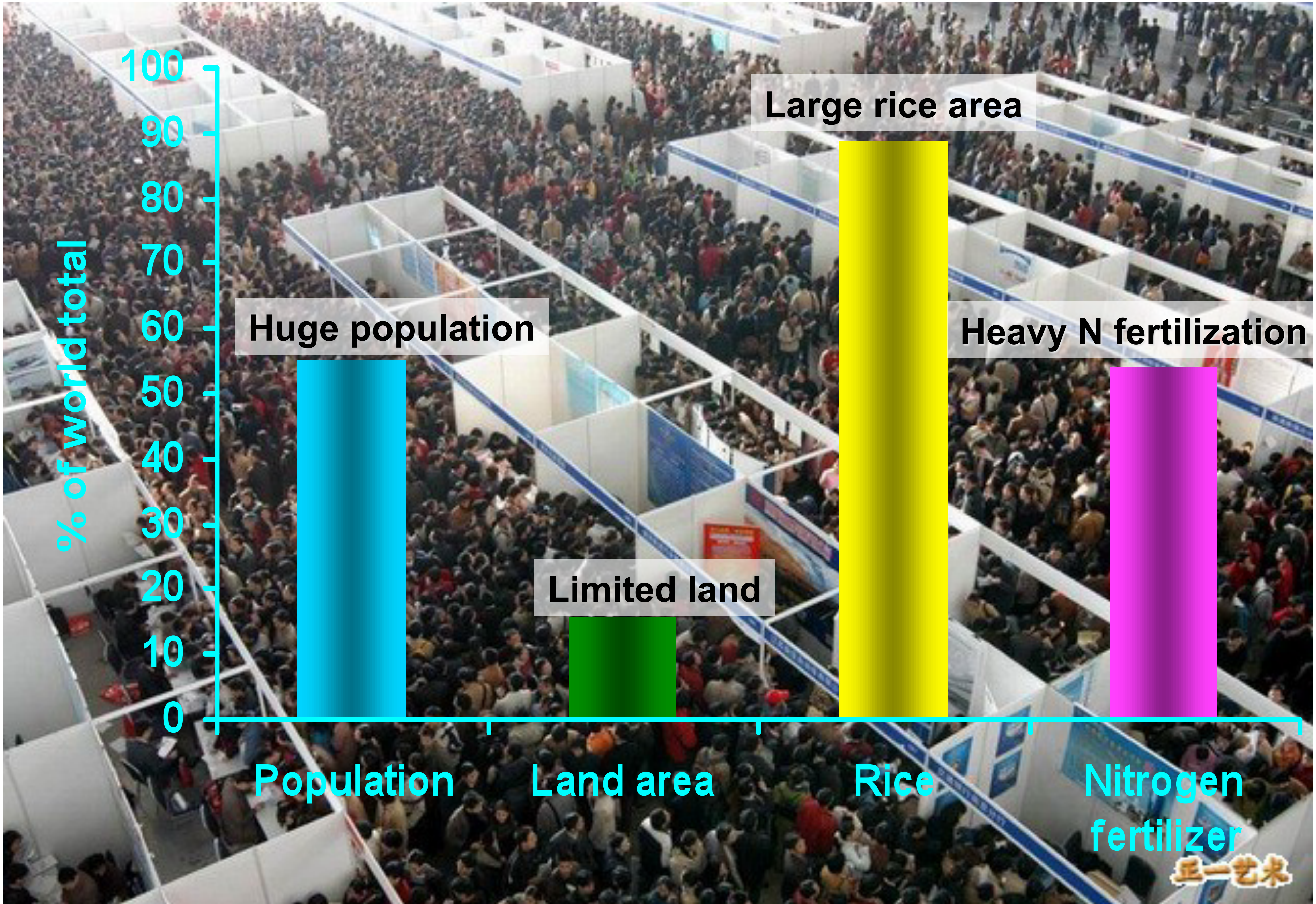
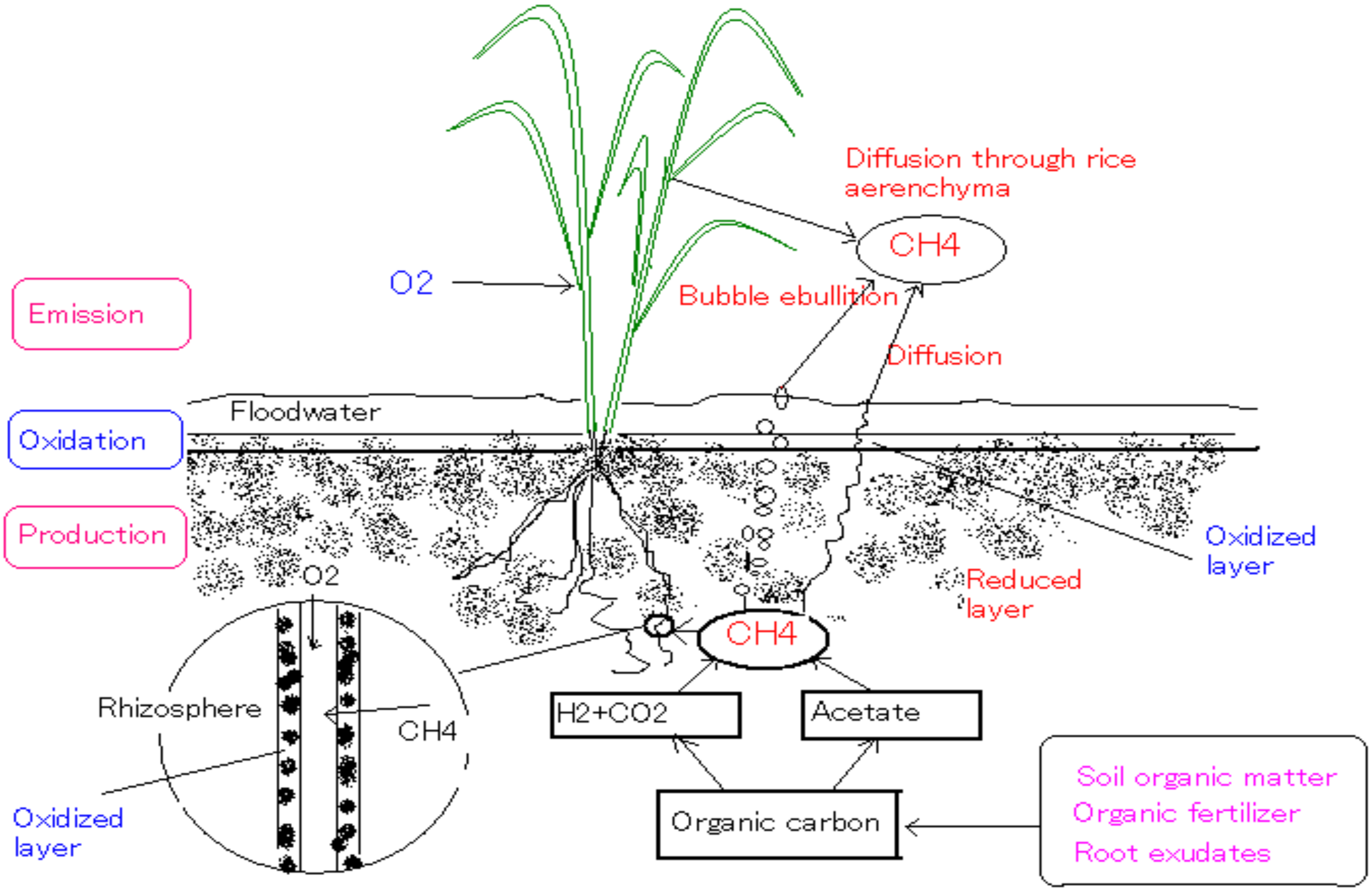
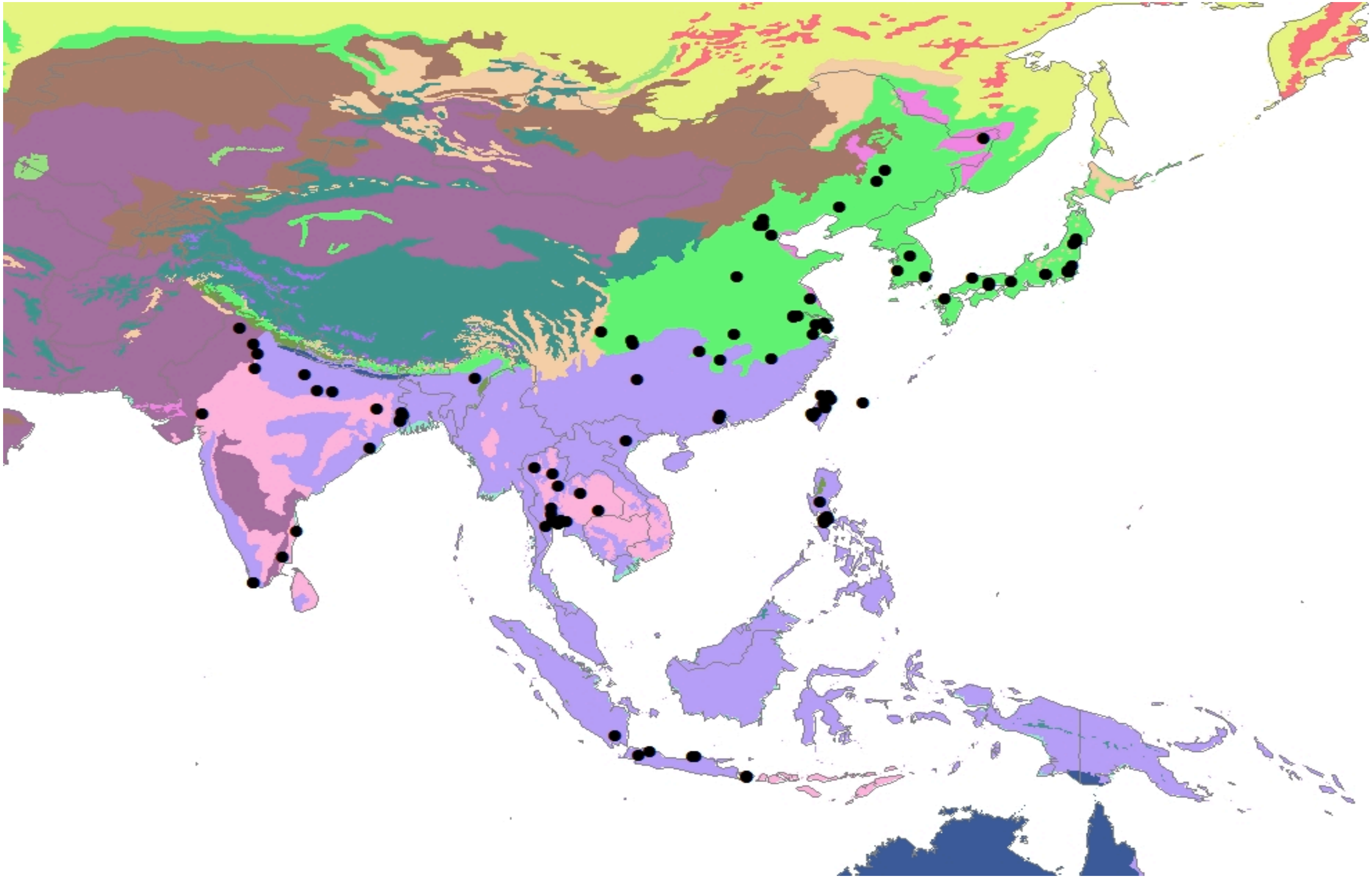
Characteristics of agriculture in monsoon Asia



Methane emitted from rice paddy



Data documentation



Statistical analysis

A linear mixed model

$$Ln(flux) = \text{Intercept} + a \times \ln(OC) + pH_m + PW_i +$$

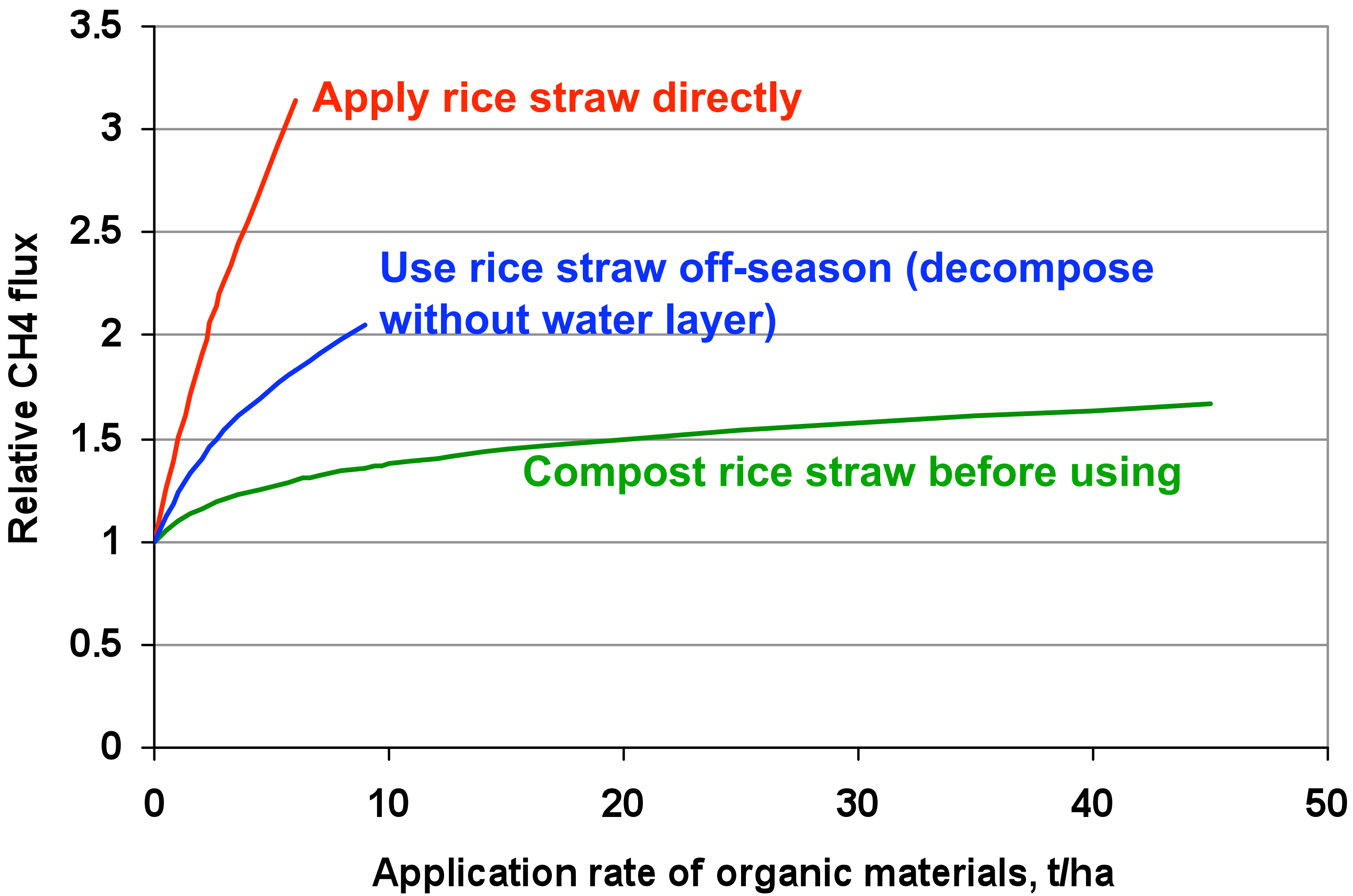
$$Water_j + Climate_k + OM_l \times (1+AOM)$$

flux:	CH_4 emission rate
OC:	Soil organic carbon content
pH:	Soil pH
PW:	Water status in the season before rice planting
Water:	Water status during rice growing season
Climate:	Agro-ecological Zone
OM:	Type of organic fertilizer
AOM:	Application rate of organic fertilizer

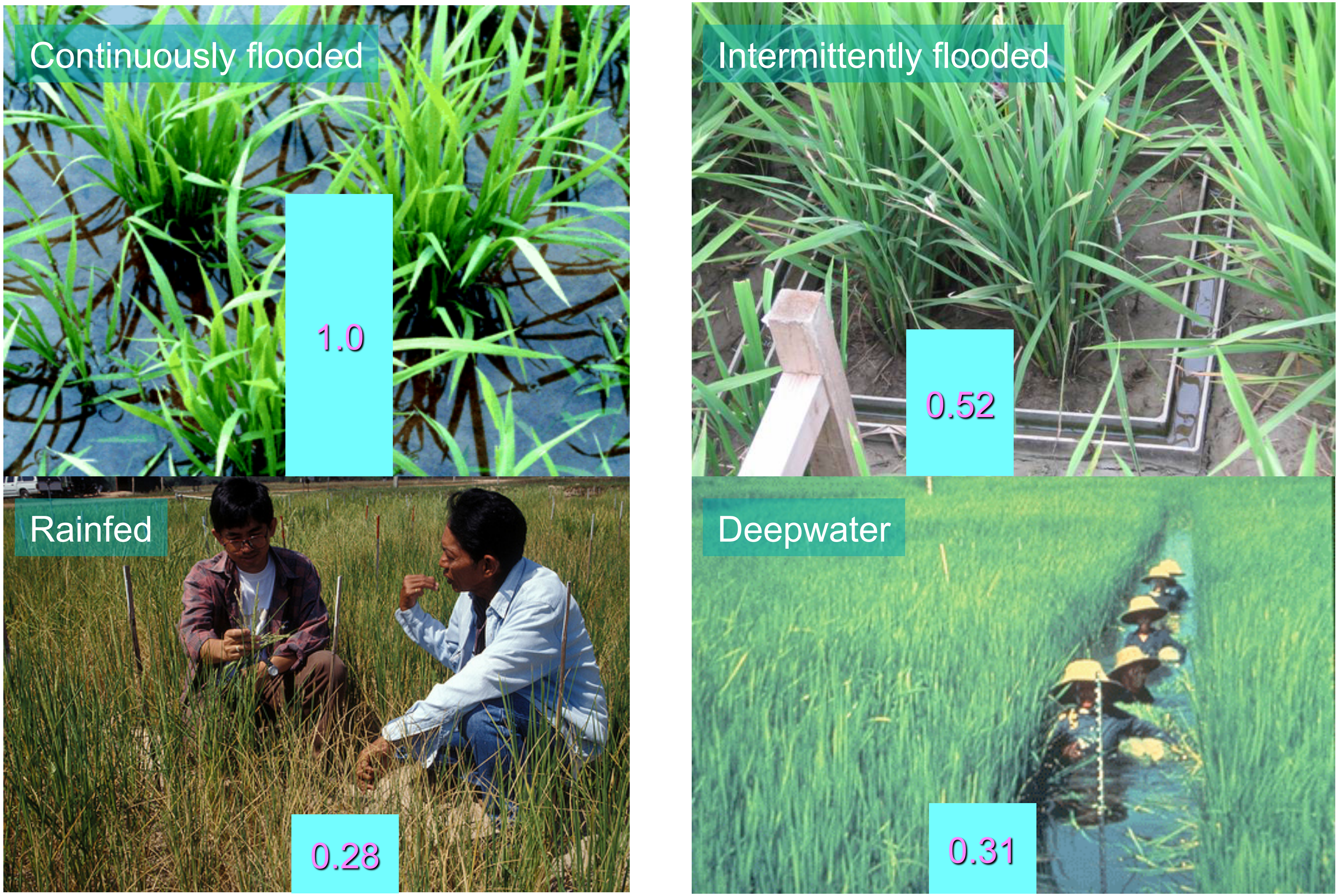
Statistical results

Effect	Numerator DF	Denominator DF	*F* value	Pr > *F*†
SOC	1	1784	47.95	<.0001
pH	7	1784	91.42	<.0001
Pre-season water	4	1784	89.55	<.0001
Water regime	5	1784	104.74	<.0001
Organic amendment	5	1784	116.48	<.0001
Climate	6	1784	32.46	<.0001

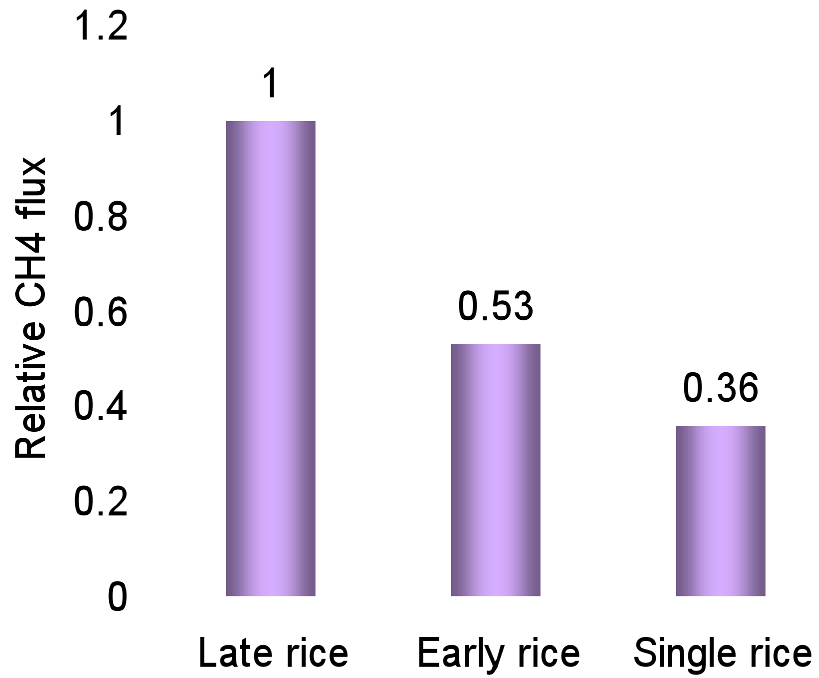
Effects of organic amendment

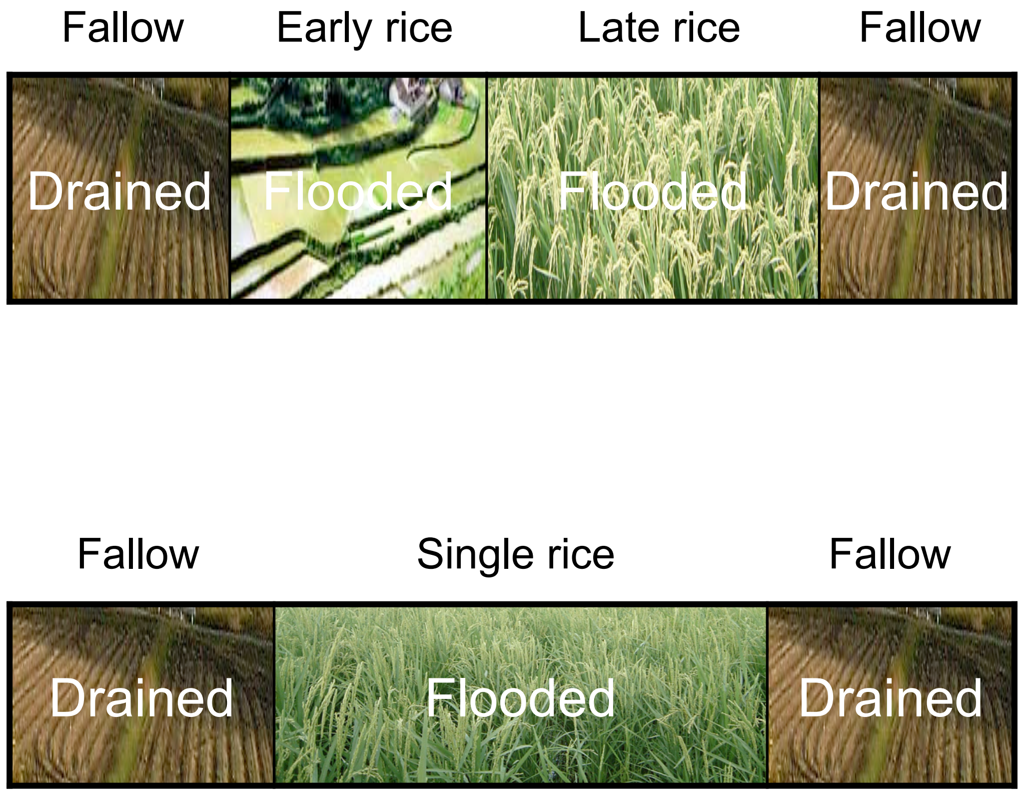


Effect of water status in rice season

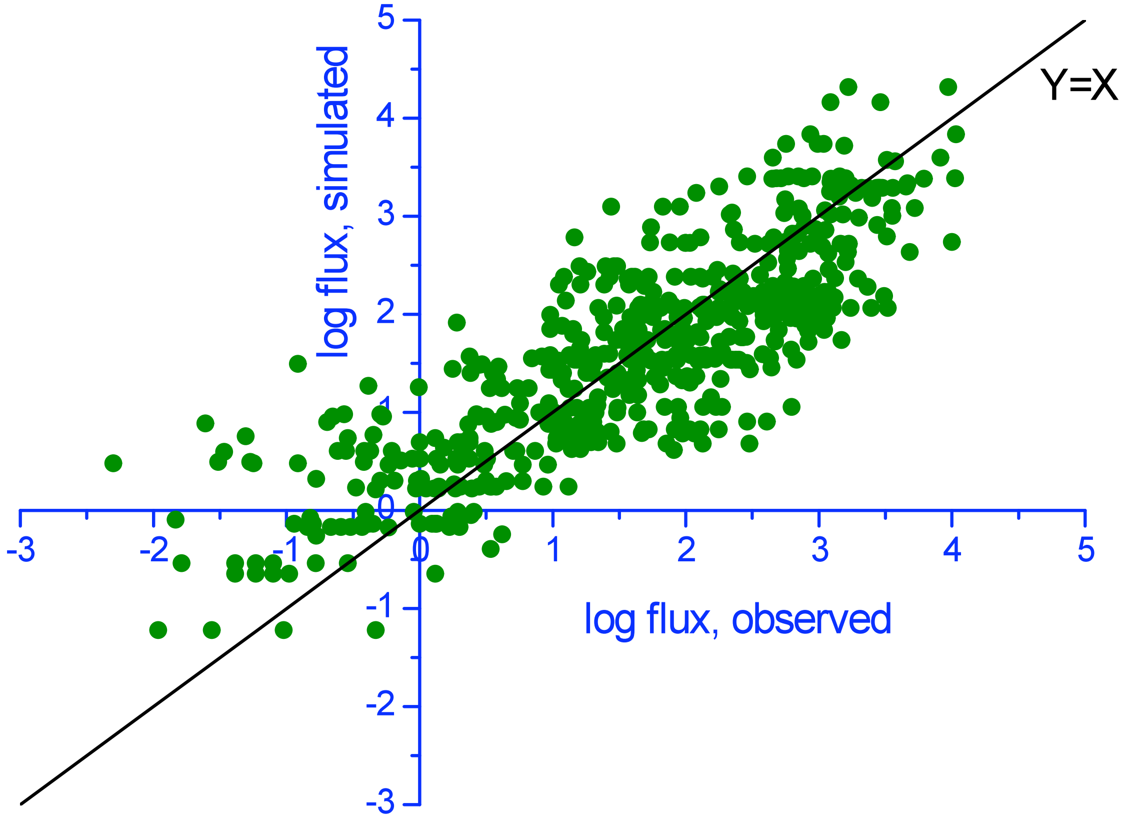


Effect of water status in pre-season

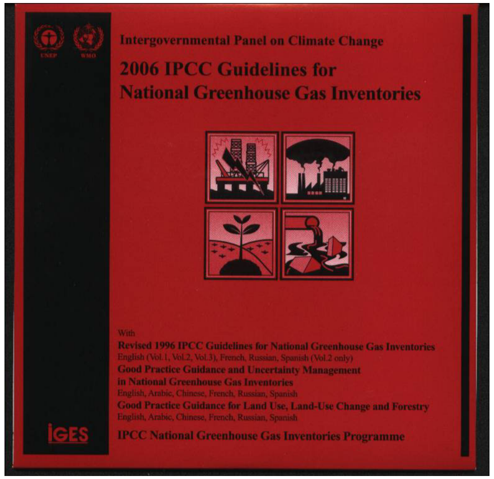




Model performance



Developing 2006 IPCC Guidelines



Equation 5.1

CH_4 Emissions from Rice Cultivation

Emissions from Rice Cultivation (Gg/yr) = $_{ijk}$ (EF_{ijk} t_{ijk} A_{ijk} 10^{-6})

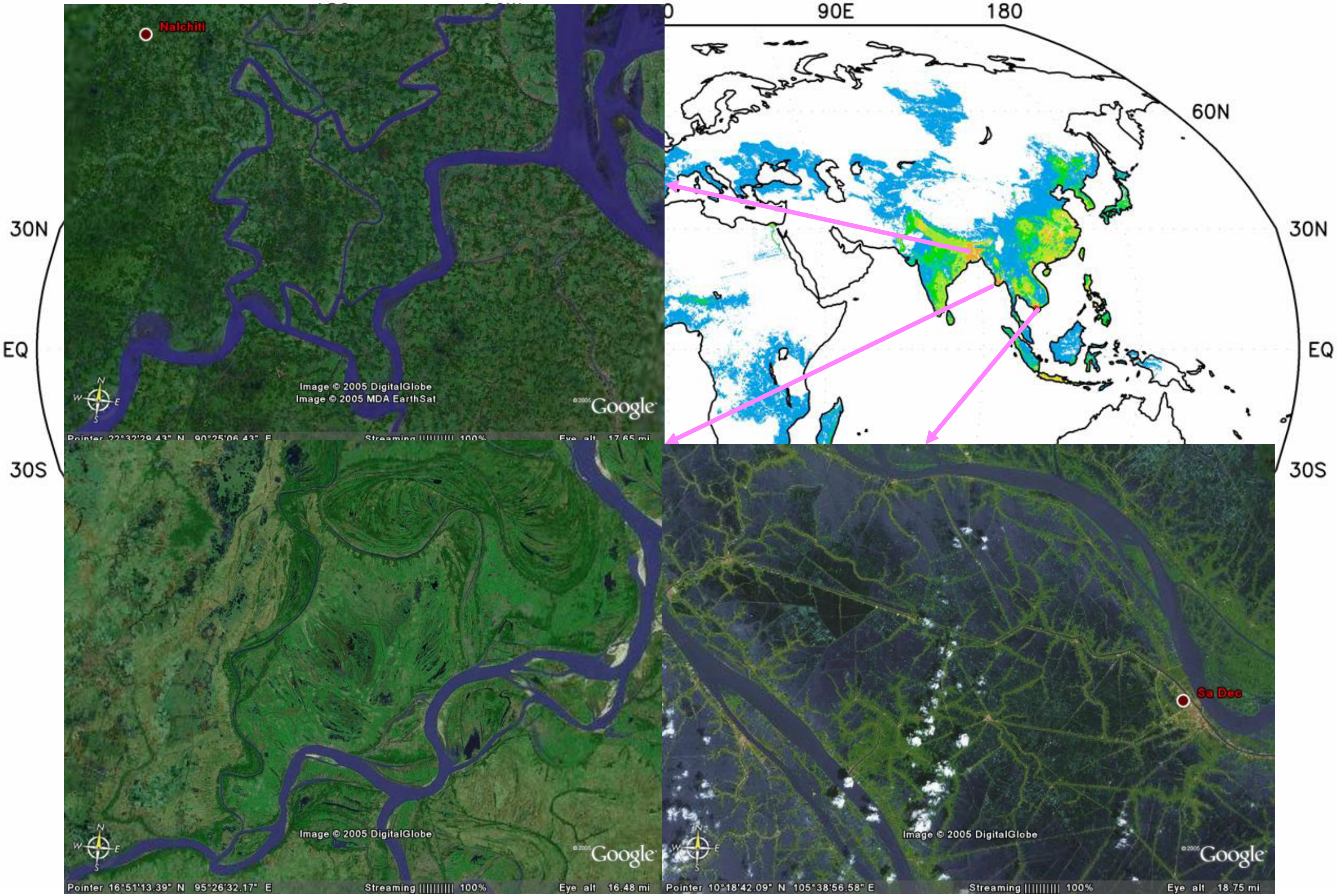
i, j, and k: different ecosystems, water regimes, organic amendments, etc.

Equation 5.2

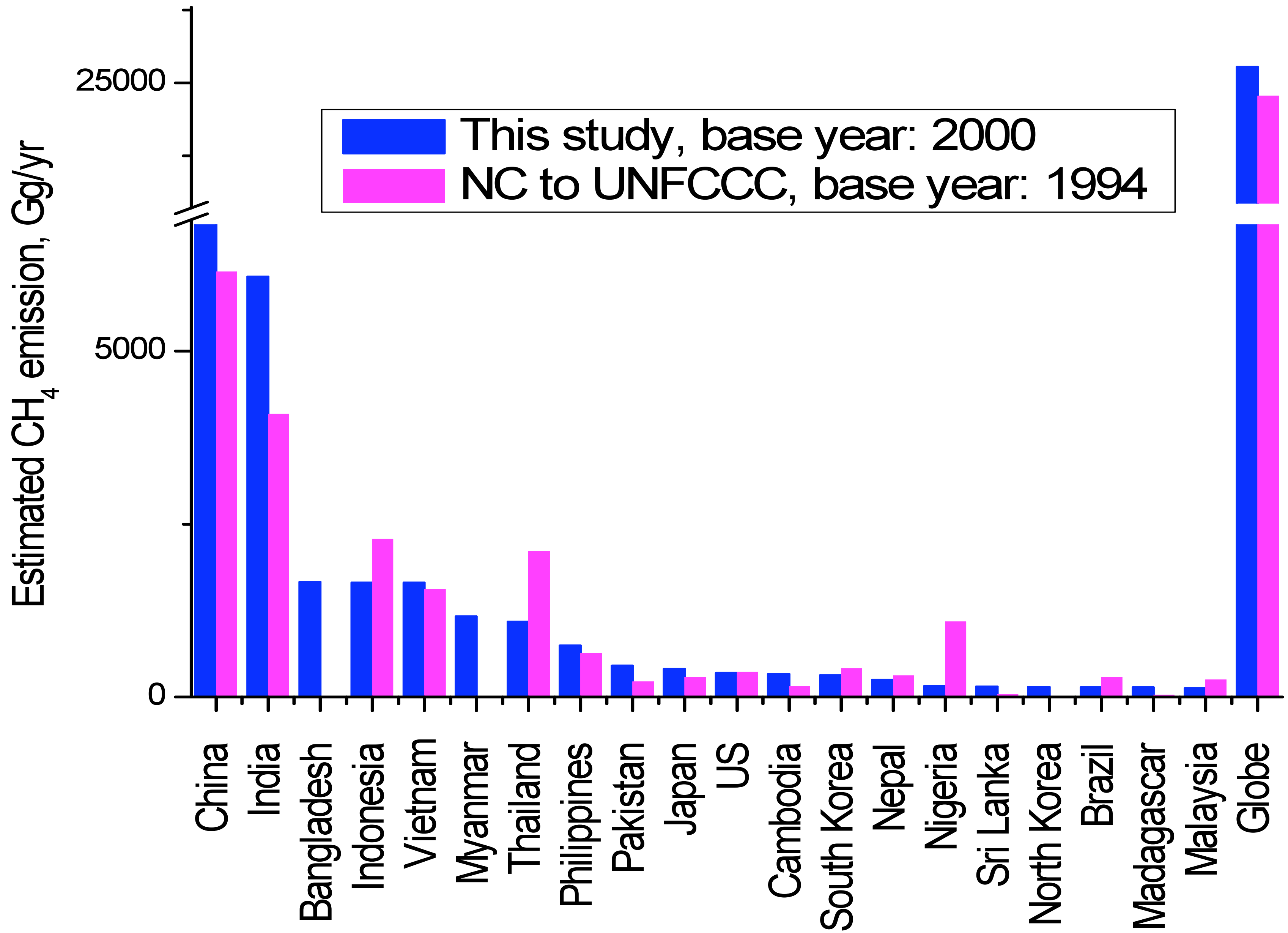
Adjusted Daily Integrated Emission Factor

EFi = EFc SFw SFp SFo SFs,r

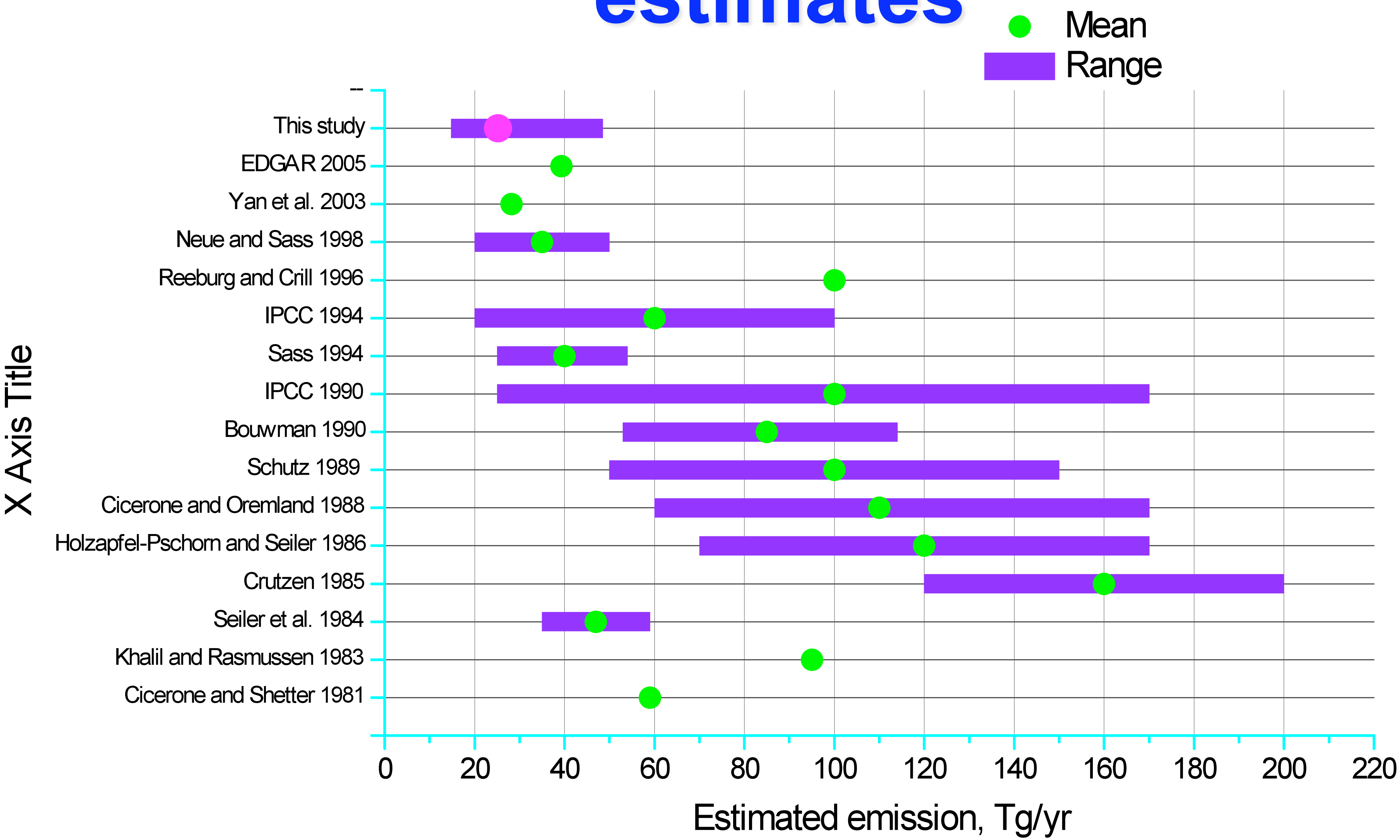
Applying the method to globe



Comparison to National Communications



Comparison to other global estimates



N_2O emission from croplands

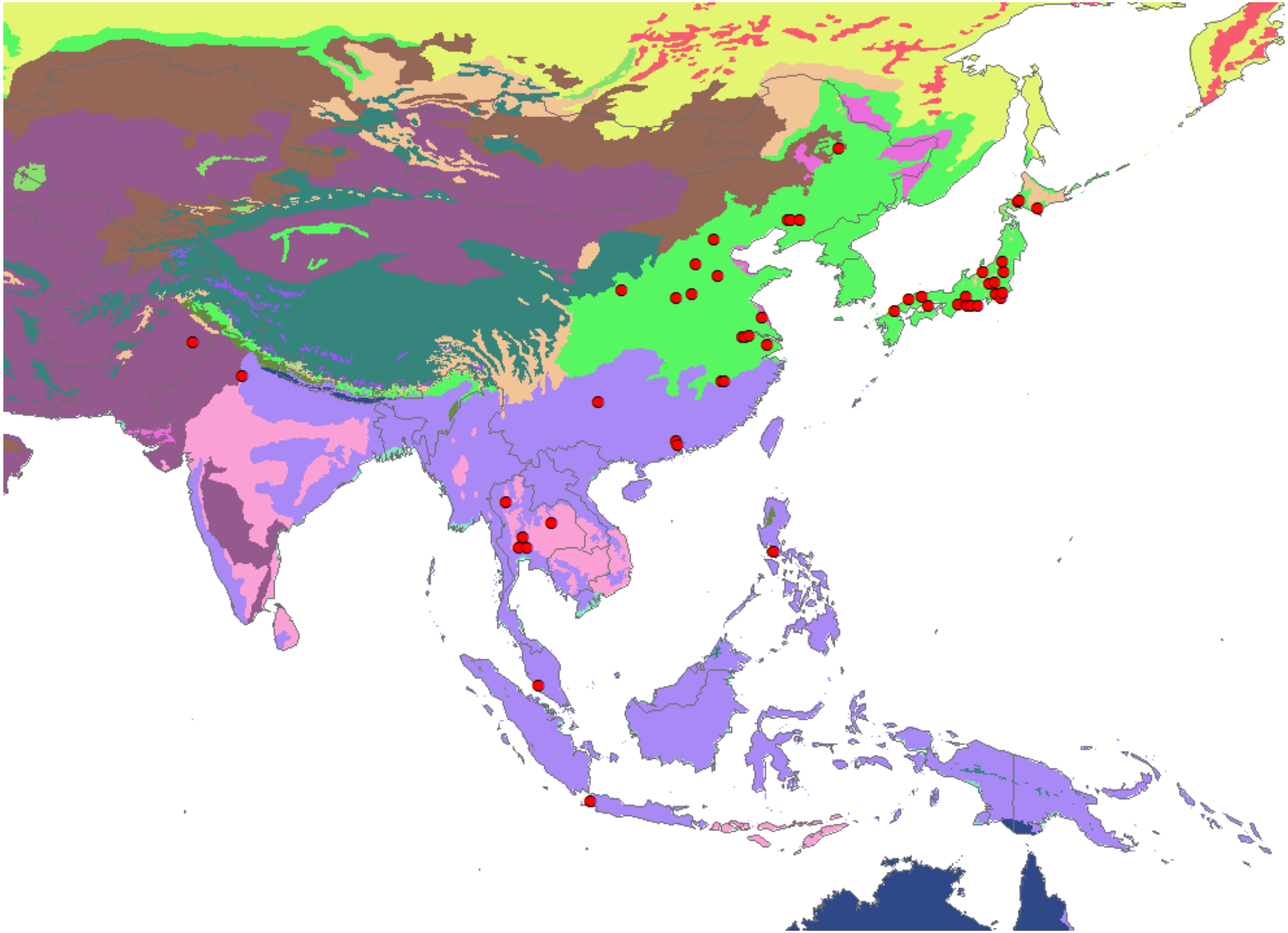
Nitrosomonas *Nitrobacter*

Nitrification: NH_4^+ ----------> NO_2^- ---------->NO_3^-

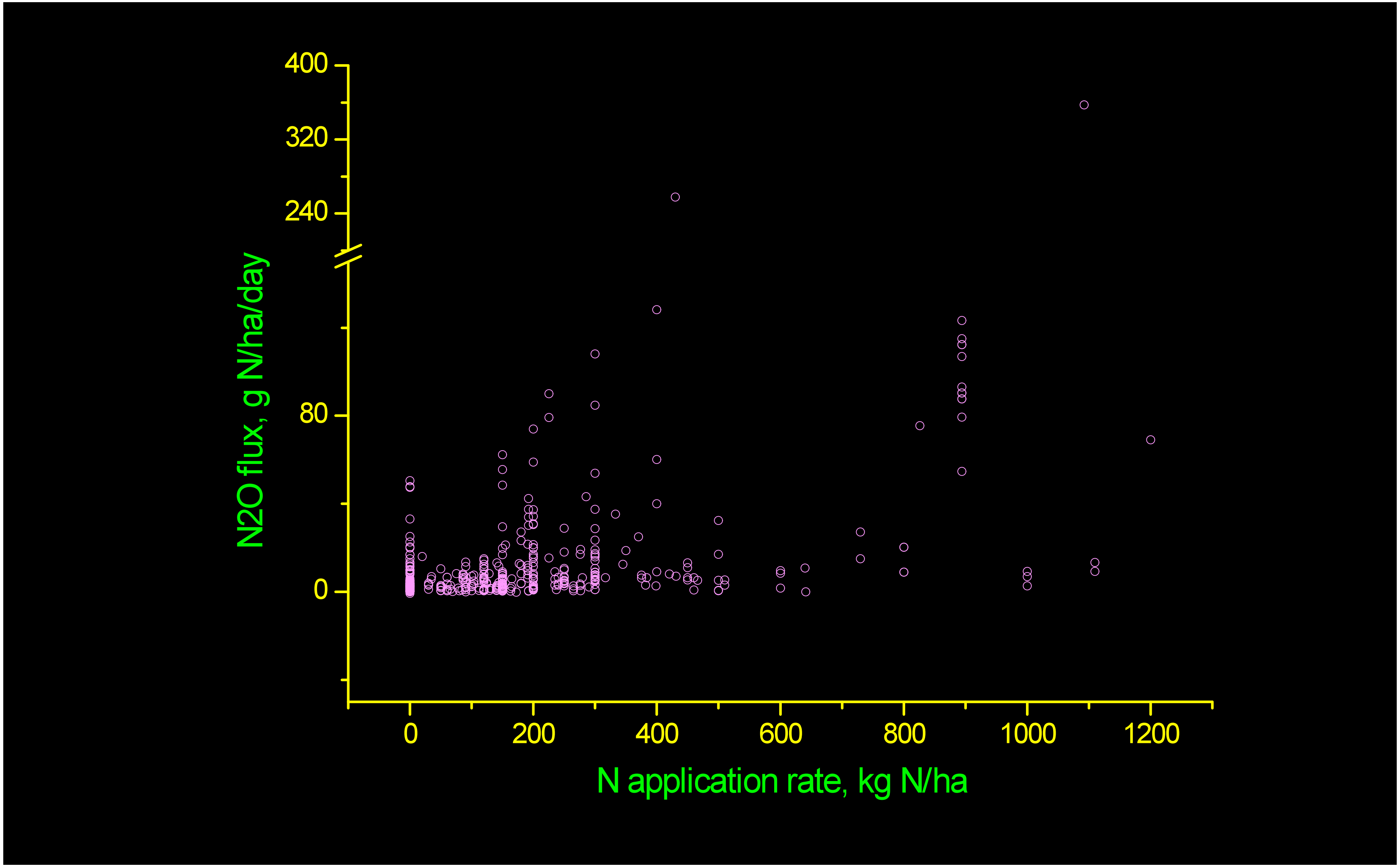
N_2O, NO N_2O, NO

Denitrification: NO_3^----->NO_2^----->NO----->N_2O---->N_2

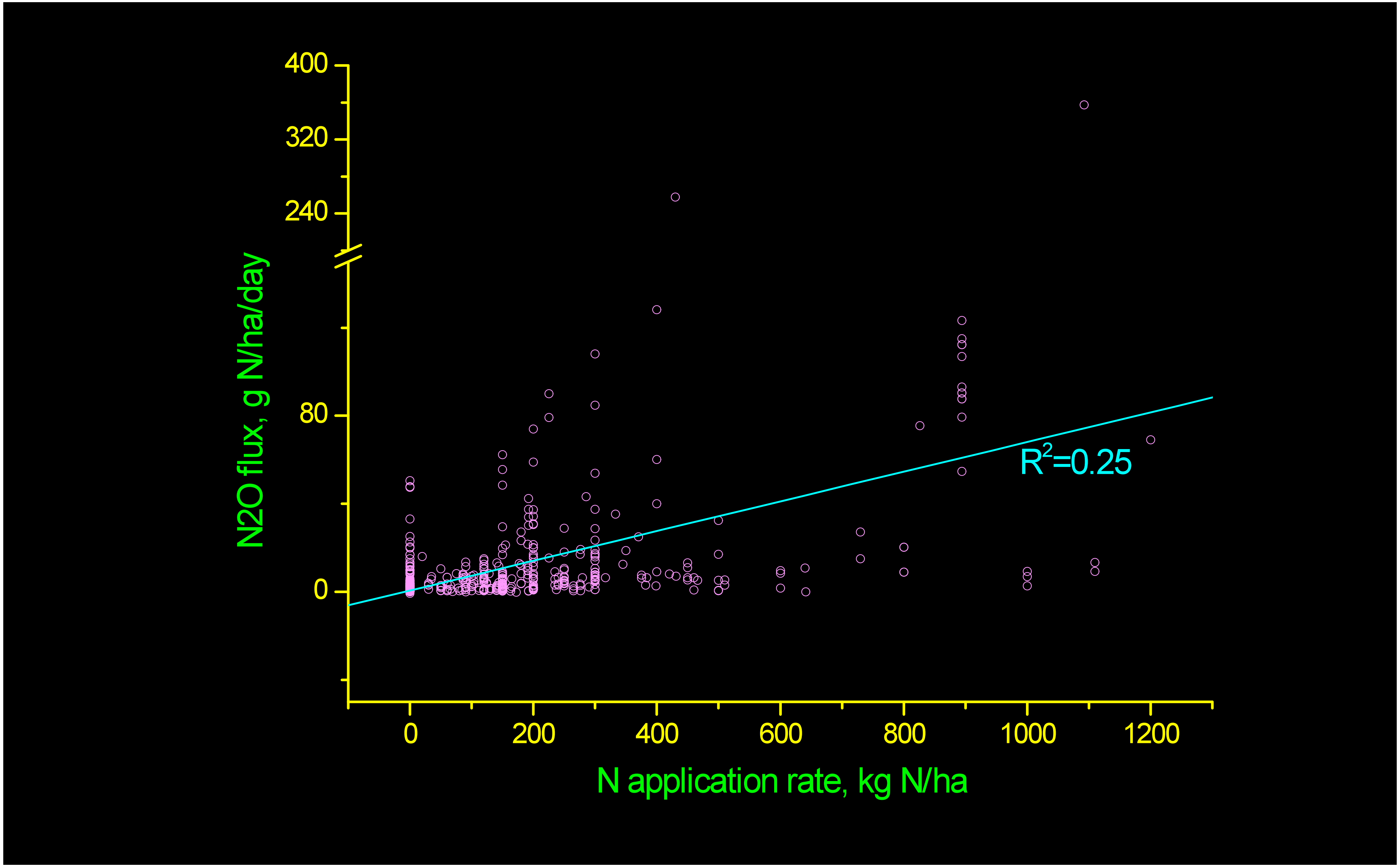
Field measurements of N_2O emission



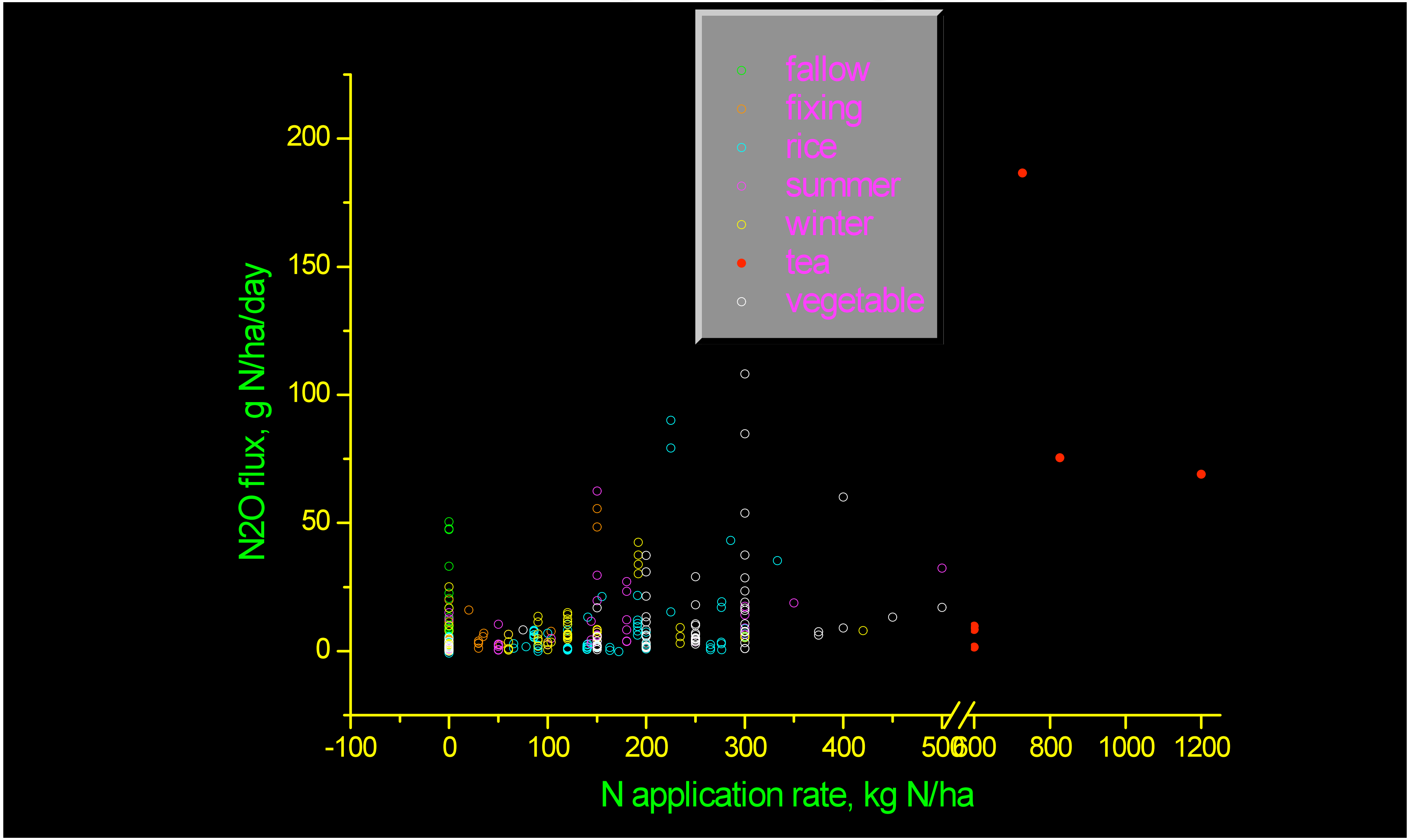
N_2O flux and total N application rate



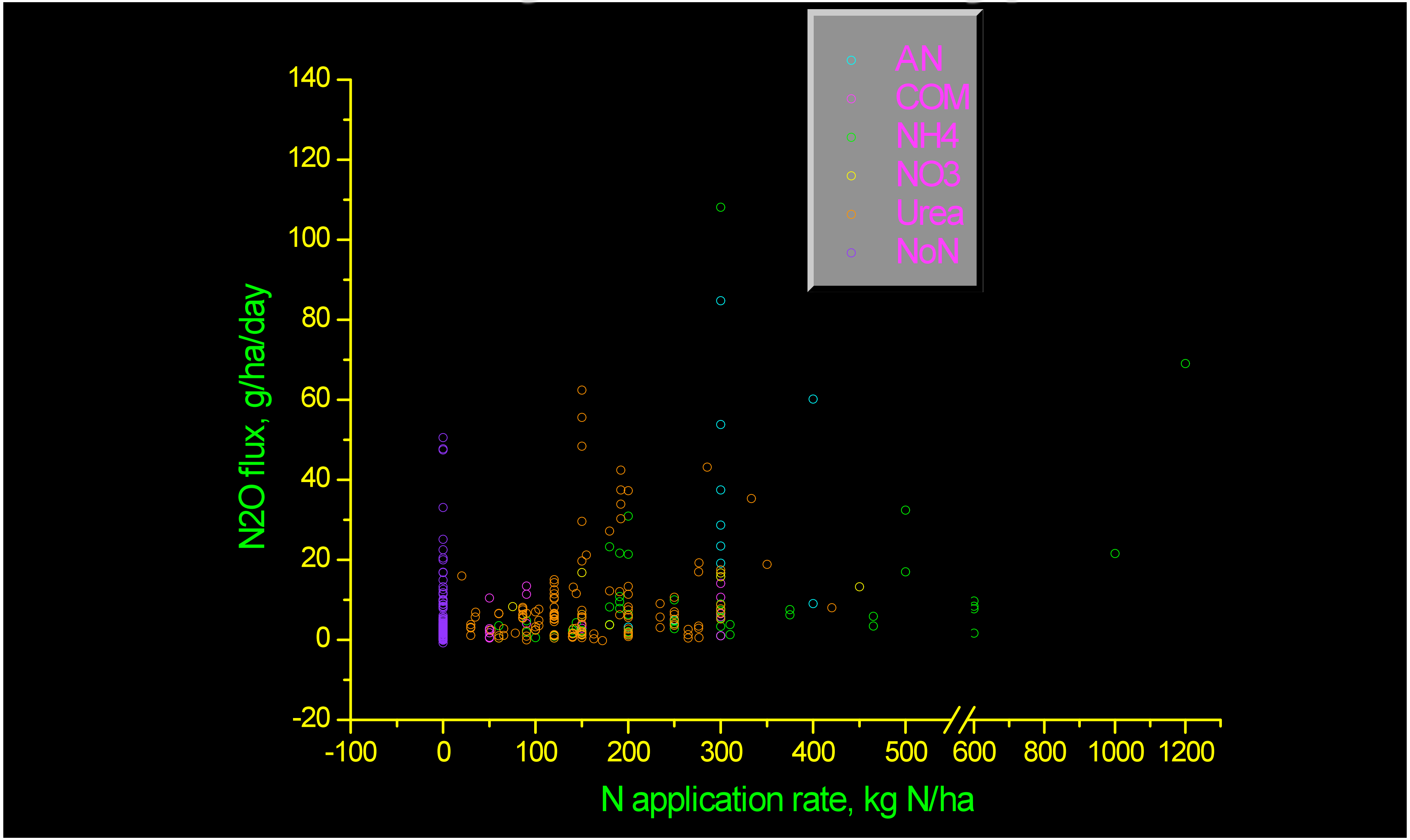
N_2O flux and total N application rate



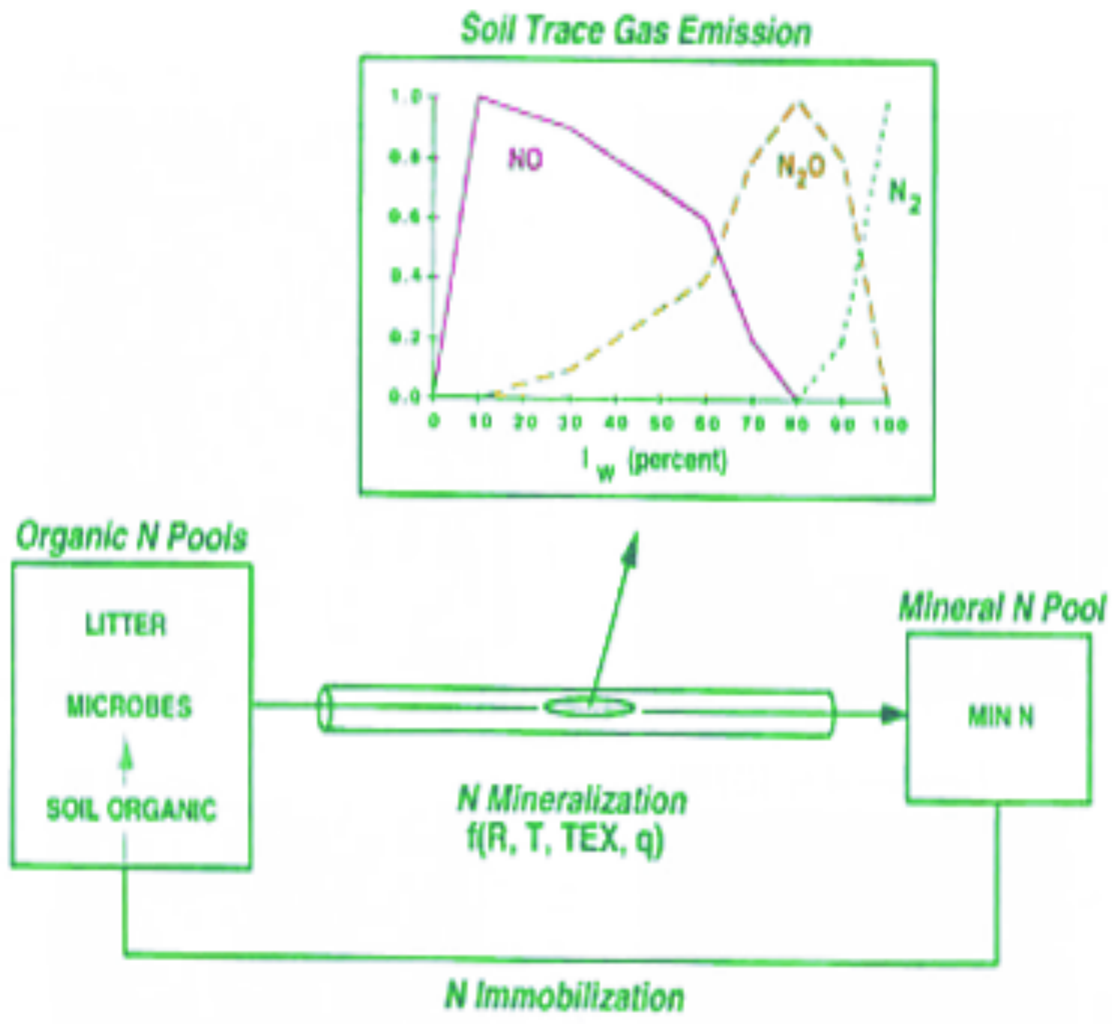
Chemical N application rate and N_2O flux by crop type



Chemical N application rate and N_2O flux by N fertilizer type

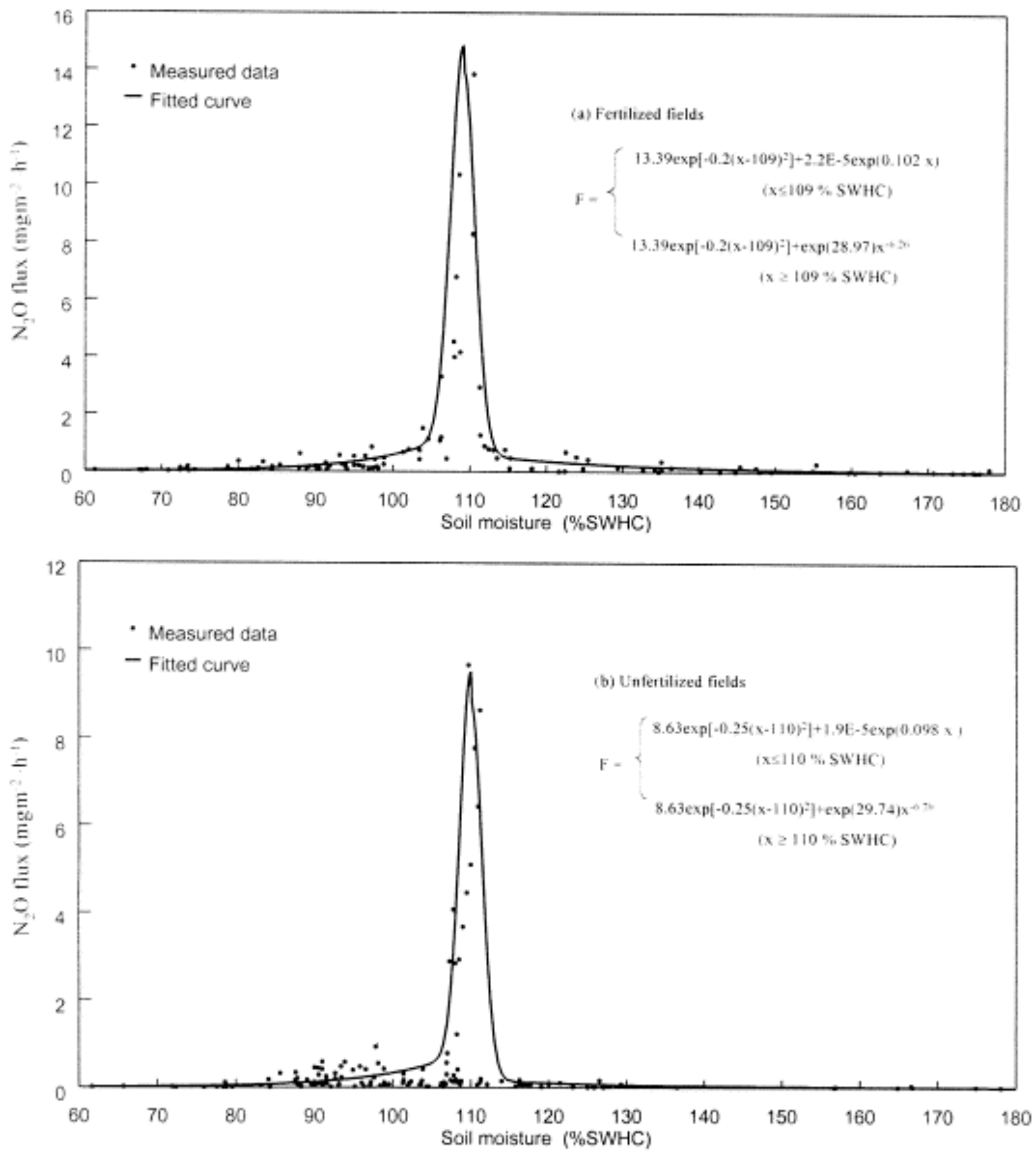


Sensitivity of N_2O emission to soil moisture



Potter et al., 1996

Sensitivity of N_2O emission to soil moisture



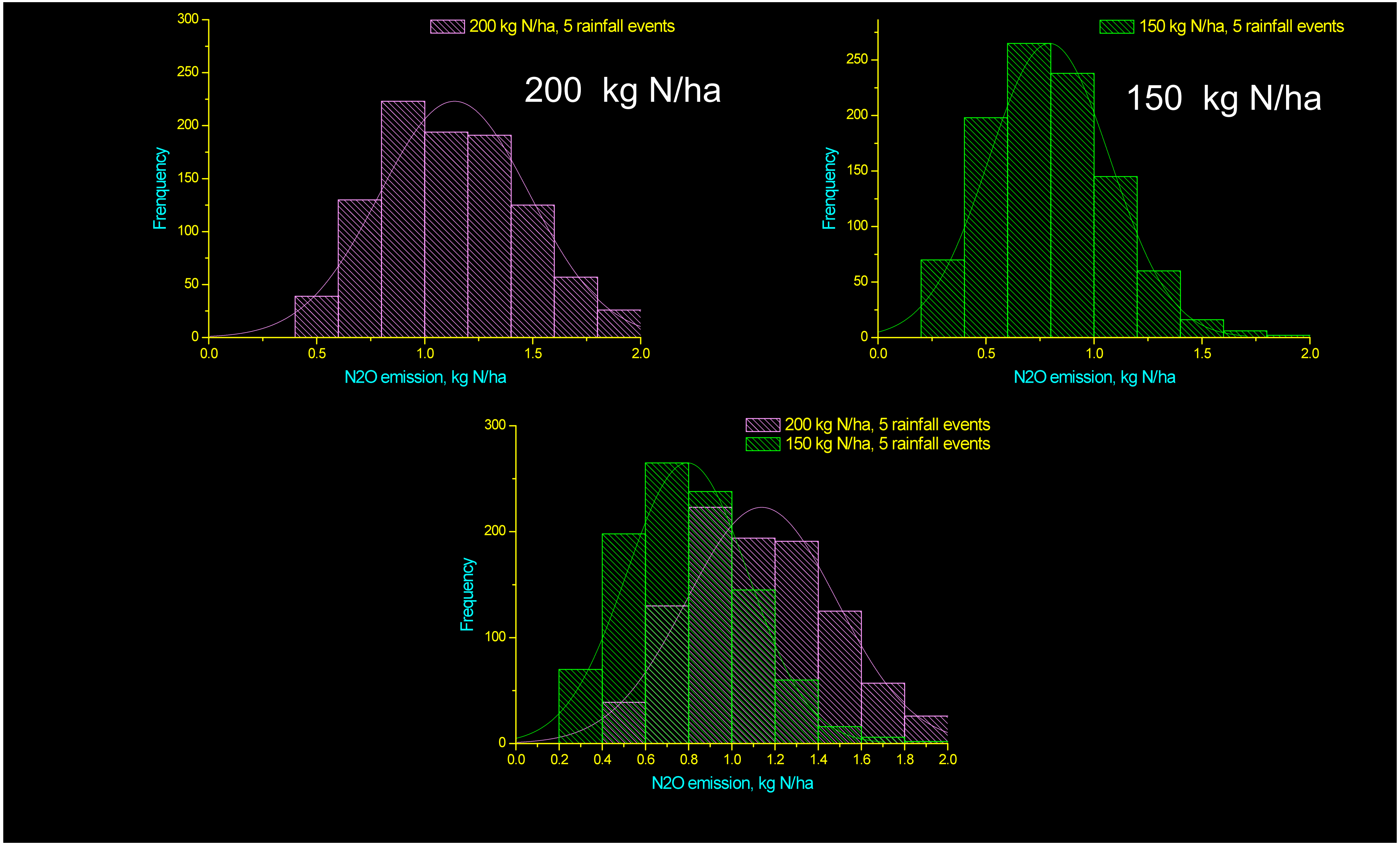
Zheng et al., 2000, Chemosphere-GCS, 2, 207-224

Monte Carlo simulation of N_2O emission

Assumptions:

- 5 rainfall events in a season
- randomly distributed in time
- Nitrification rate: 1/2
    - N_2O ratio: 100 times
- Denitrification rate: 20 times
    - N_2O ratio: 1/2

Variability caused by timing of rainfall event



IPCC 2006 Guidelines: N_2O from managed soils

$$N_2O\text{-}N_{Ninputs} = \left\{ \begin{array}{l} [(F_{SN}+F_{ON}+F_{CR}+F_{SOM})\bullet EF_1] + \\ [(F_{SN}+F_{ON}+F_{CR}+F_{SOM})\bullet EF_{1FR}] \end{array} \right\}$$

Where:

F_{SN}: amount of synthetic fertiliser N applied to soil

F_{ON}: amount of organic N additions applied to soil

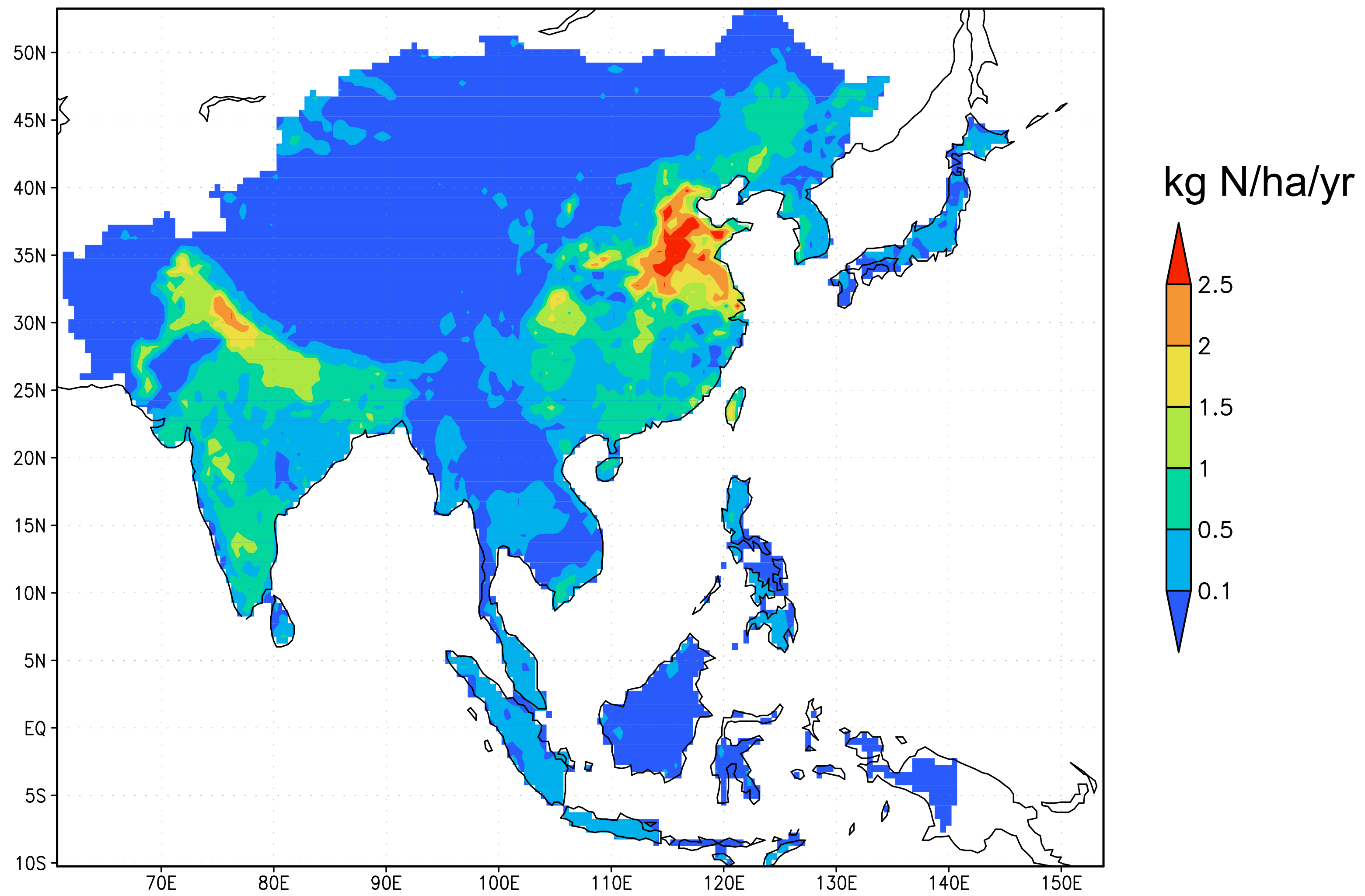
F_{CR}: amount of N in crop residue returned to soil

F_{SOM}: amount of N in mineral soils that is mineralised, in association with loss of soil carbon

EF_1: emission factor for upland, 1.0%

EF_{1FR}: emission factor for flooded rice, 0.3%

Emission of N_2O from croplands



Conclusions and comments

- CH_4 emission from rice fields in monsoon Asia accounts for 94% of global total, but the global total has been overestimated in the past.
- N_2O emission is sensitive to rainfall, thus more difficult of estimate
- Emission inventories with 0.5°resolution available to download at FRCGC website