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Zonal and Seasonal Methane Emissions from Rice Production in the Vietnamese Mekong Delta

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Introduction

55% of Vietnamese rice are produced in the Mekong River Delta (MRD) (Fig.1). Rice fields are known to emit large quantities of methane (CH_4), but emissions strongly vary between seasons and locations within the MRD.

Rice in MRD is produced in three seasons, early year, mid-year and late year season, and in three zones, saline, alluvial, and flood-prone zone.

To date, IPCC guidelines provide general emission factors (EFs) at sub-continental scale without taking into account such seasonal and zonal effects.

This study investigates the effects of season and zone on EFs in the MRD.

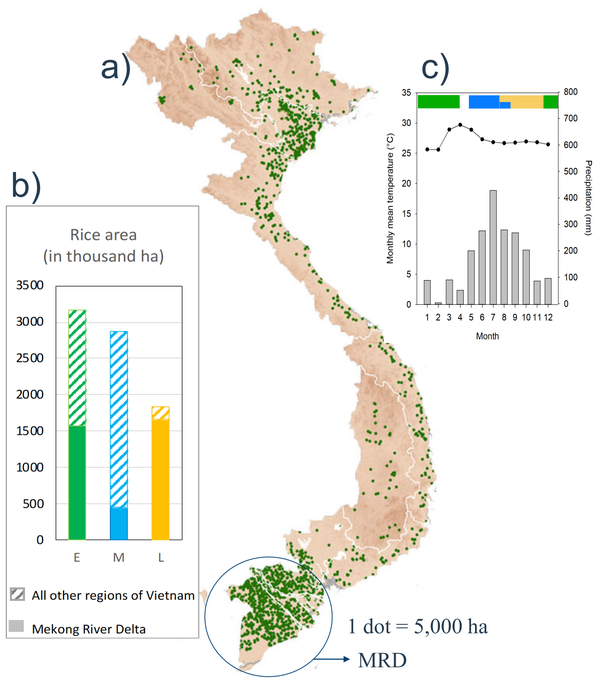


Figure 1. a) Distribution of rice in Vietnam. b) Total rice area (solid fills = rice in MRD, pattern fills = other regions. E-green = early season, M-blue = middle season, L-gold = late season). c) Timing of cropping seasons in the MRD.

Conclusions

- Cropping season is more strongly related to CH_4 emissions than the edapho-hydrological zone
- Using season-based EFs is preferable to zone-based Efs
- EFs of CH_4 are in range of magnitude 0.79–3.41 kg ha^{-1} d^{-1} .
- These data clearly show that EFs for CH_4 emissions in Vietnamese rice production are well above the default IPCC value given for Southeast Asian rice production.

Results and Discussion

Table 1. Daily emission factors specified per season; average (± SD), max and min emission rates, and average length of cultivation period (from seeding to harvest); No. = numbers of seasons measured. Values are aggregated across all edapho-hydrological zones.

Season	No.	Cult. per; (d)	Daily CH_4 emission factor (kg ha^{-1} d^{-1})			
			Avg ± std	p *	Max	Min
E-year season	12	101	1.718 ± 0.807	0.033	3.410	0.789
Mid-year season	8	99	2.797 ± 1.168		4.220	1.235
Late-year season	4	99	3.583 ± 4.838	nd	9.140	0.310

* The statistical significance value (p) at the confidence of 95% determined by one-way ANOVA. ($p \leq 0.05$: average emission factor of the two seasons are statistically significant different).

- The seasonal emission rates of the two seasons (E and M) are significantly different (p=0.033) while late-year season was not included in the analysis due to its limited number of measurements (Table1).
- Between the edapho-hydrological zones, seasonal emission rates are not significantly different
- Seasonal emission factors are higher than IPCC defaults for South-East Asia (Fig. 2)

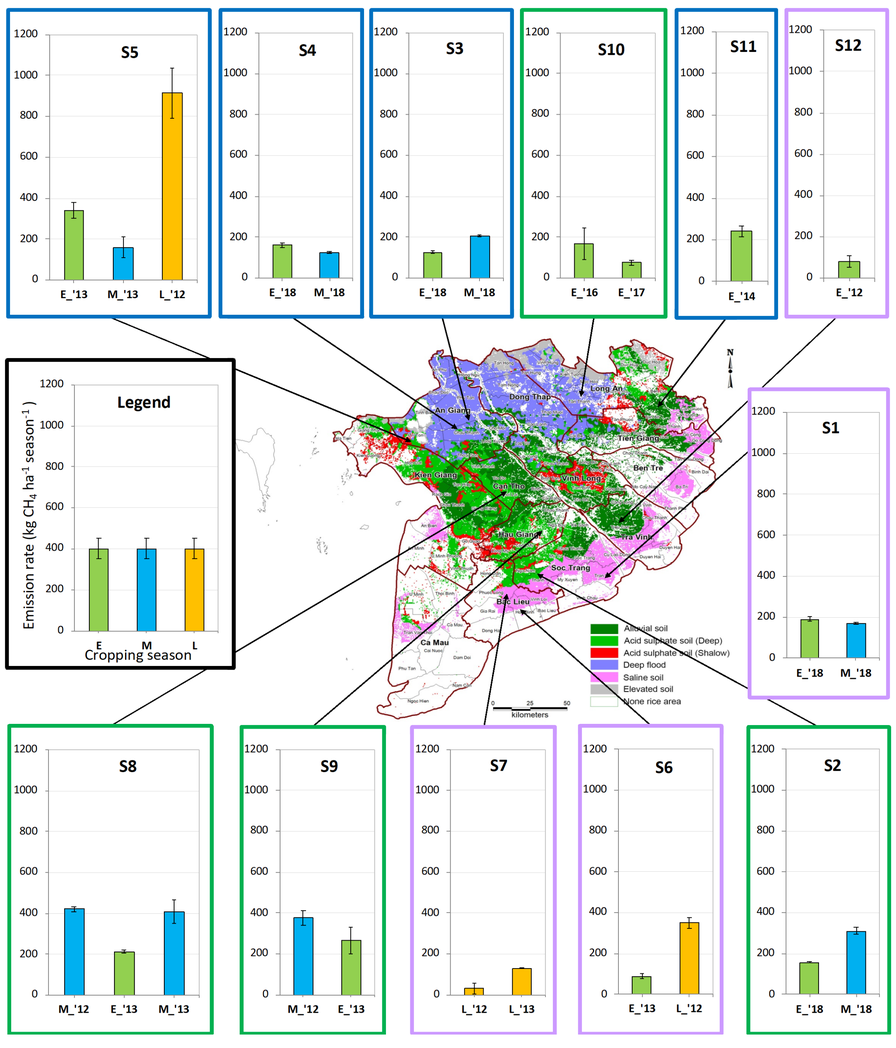
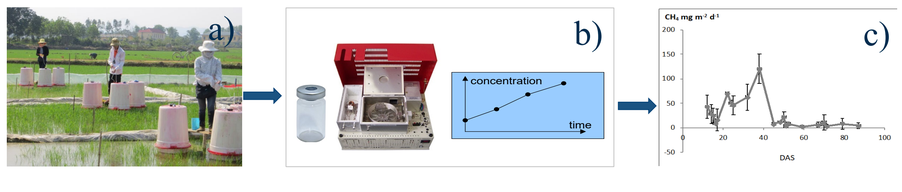


Figure 2. Seasonal emission rates from rice fields in the MRD. Frame color indicates alluvial (green), deep flood (blue) and saline (magenta) zones; Seasonal Efs (early year (E), mid-year (M) and late-year (L)) are color coded as in Fig. 1. Error bars = standard error; n = 3.

Notes on Materials and Methods



GHG measurement approach – Closed chambers a) Field sampling, b) Lab analysis, c) Daily emission

A data base derived from field measurements conducted at 12 sites with 24 cropping seasons using the closed chamber approach for field sampling in combination with laboratory analysis of CH_4 concentrations and standardized crop management. The field design consistently encompassed three replicates with IPCC baseline management while sampling was done in weekly intervals. The gas fluxes were calculated using the equation given by Minamikawa (2015). Comparison of average CH_4 emission rates among seasons and edapho-hydrological zones was performed using one-way analysis of variance (ANOVA) in SPSS v.20.