Are Freshwater wetlands a carbon sink or source?

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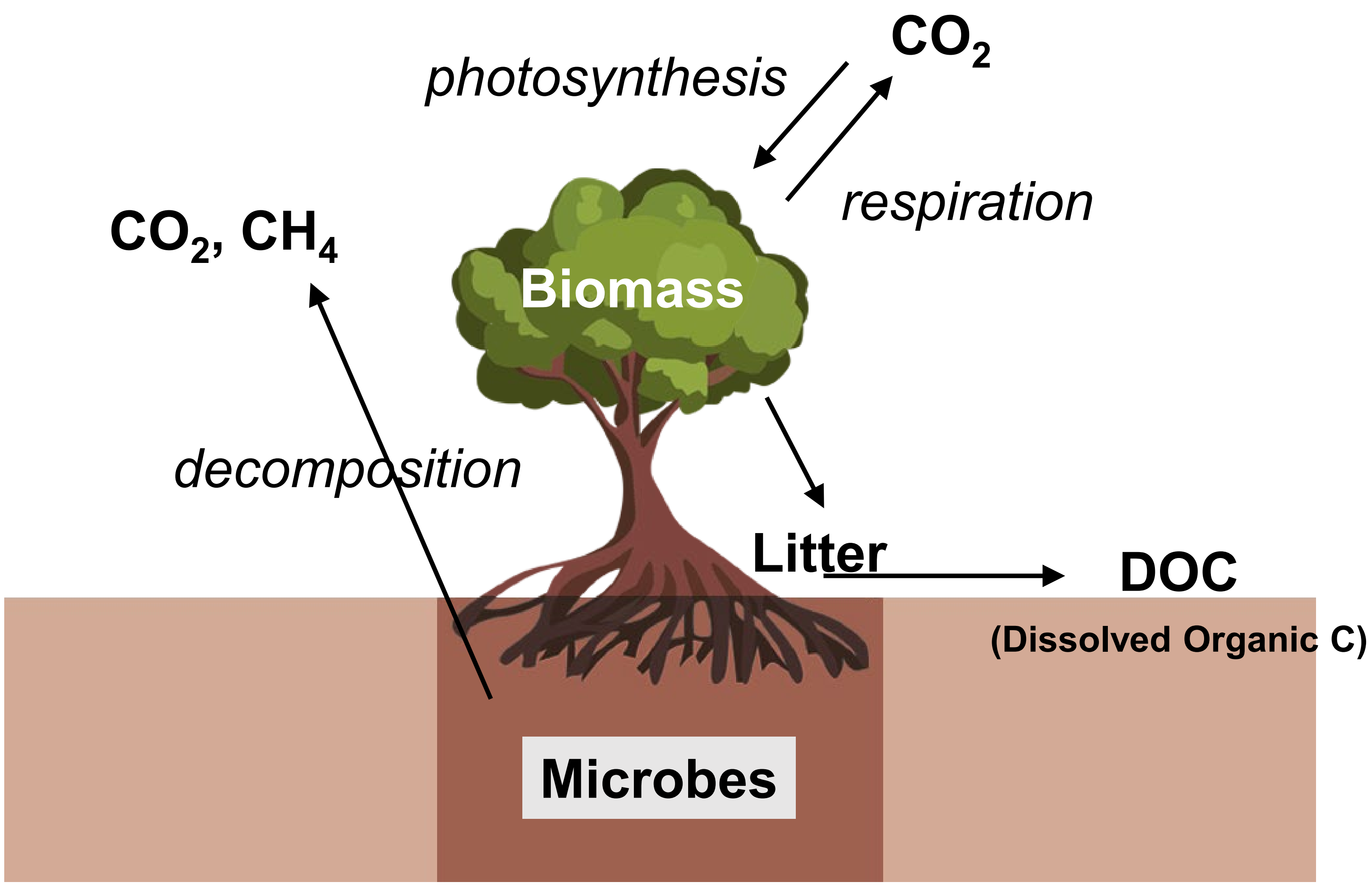
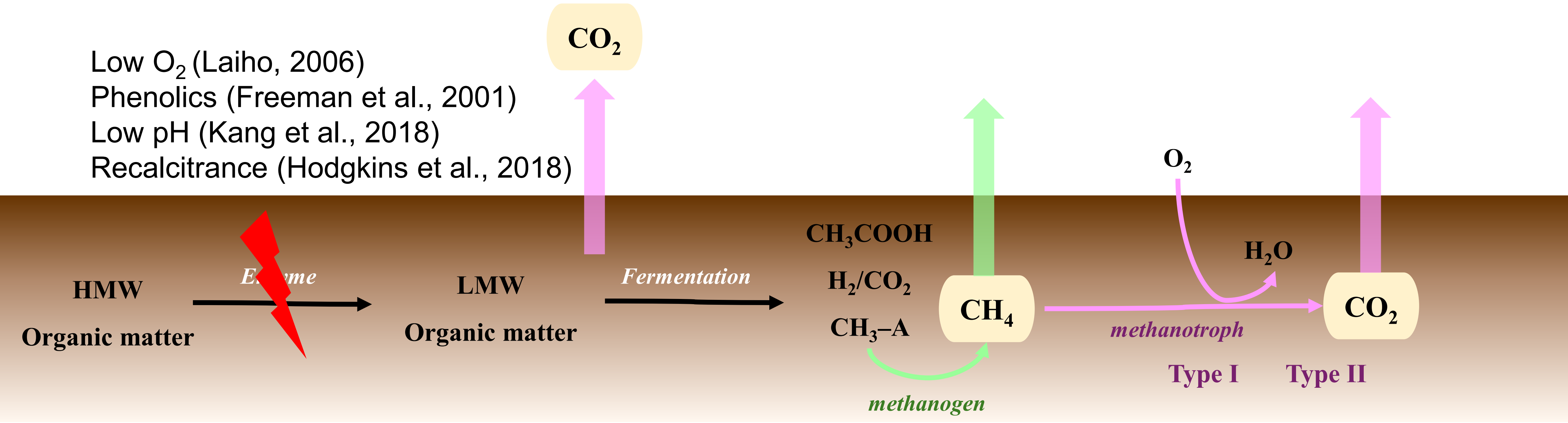
Carbon cycle in wetlands



C dynamics in wetland soils

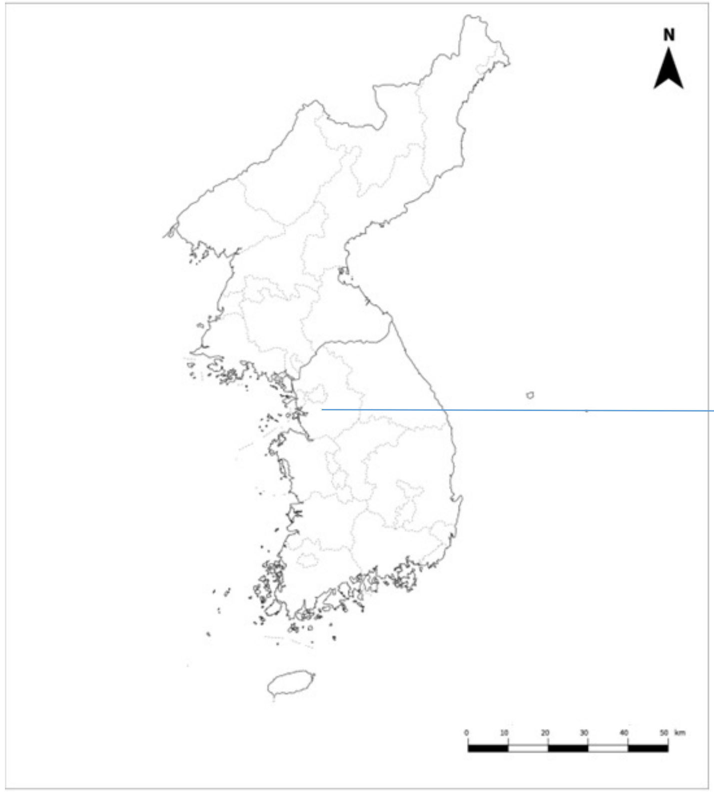
Low O_2 (Laiho, 2006)
Phenolics (Freeman et al., 2001)
Low pH (Kang et al., 2018)
Recalcitrance (Hodgkins et al., 2018)



Local scale

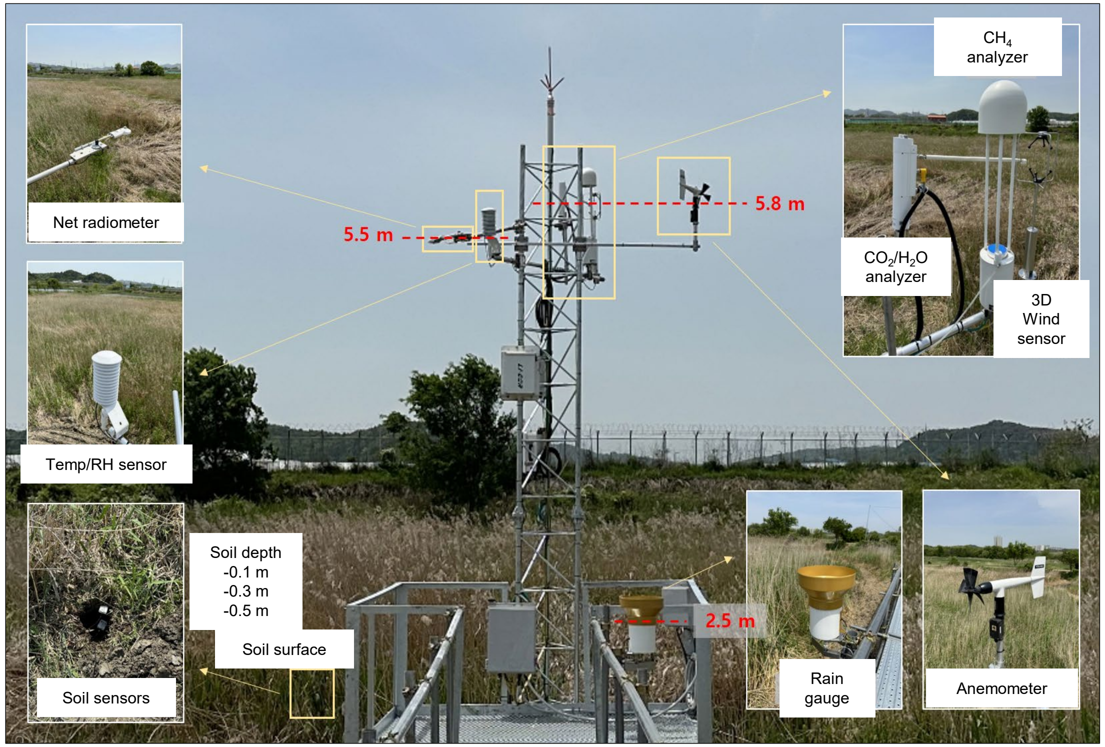
- NEE vs. CH_4 emissions (Eddy flux tower)
- Microbial modeling of SOM decomposition

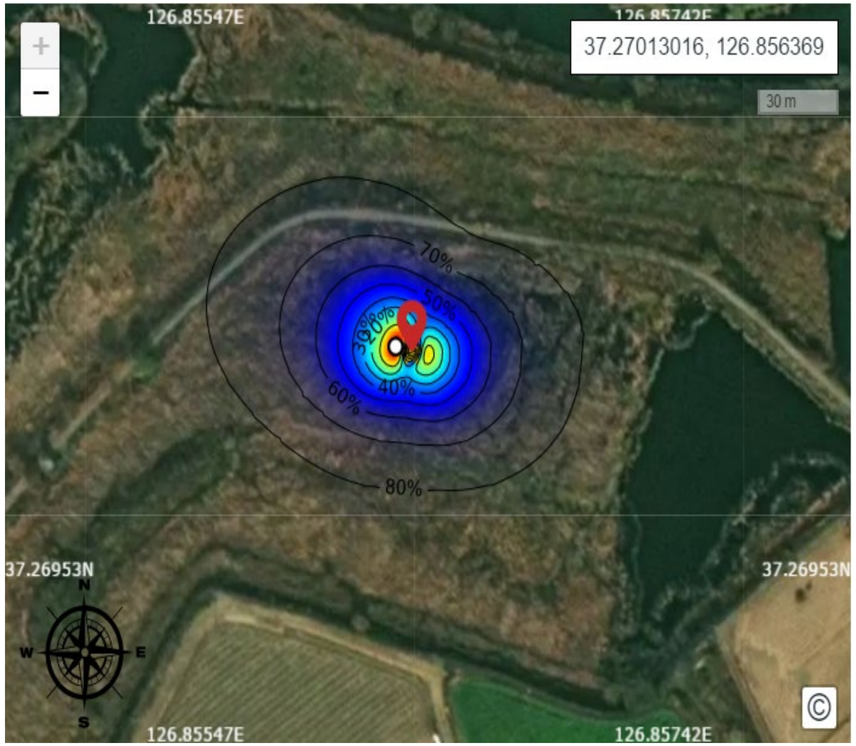
Study site



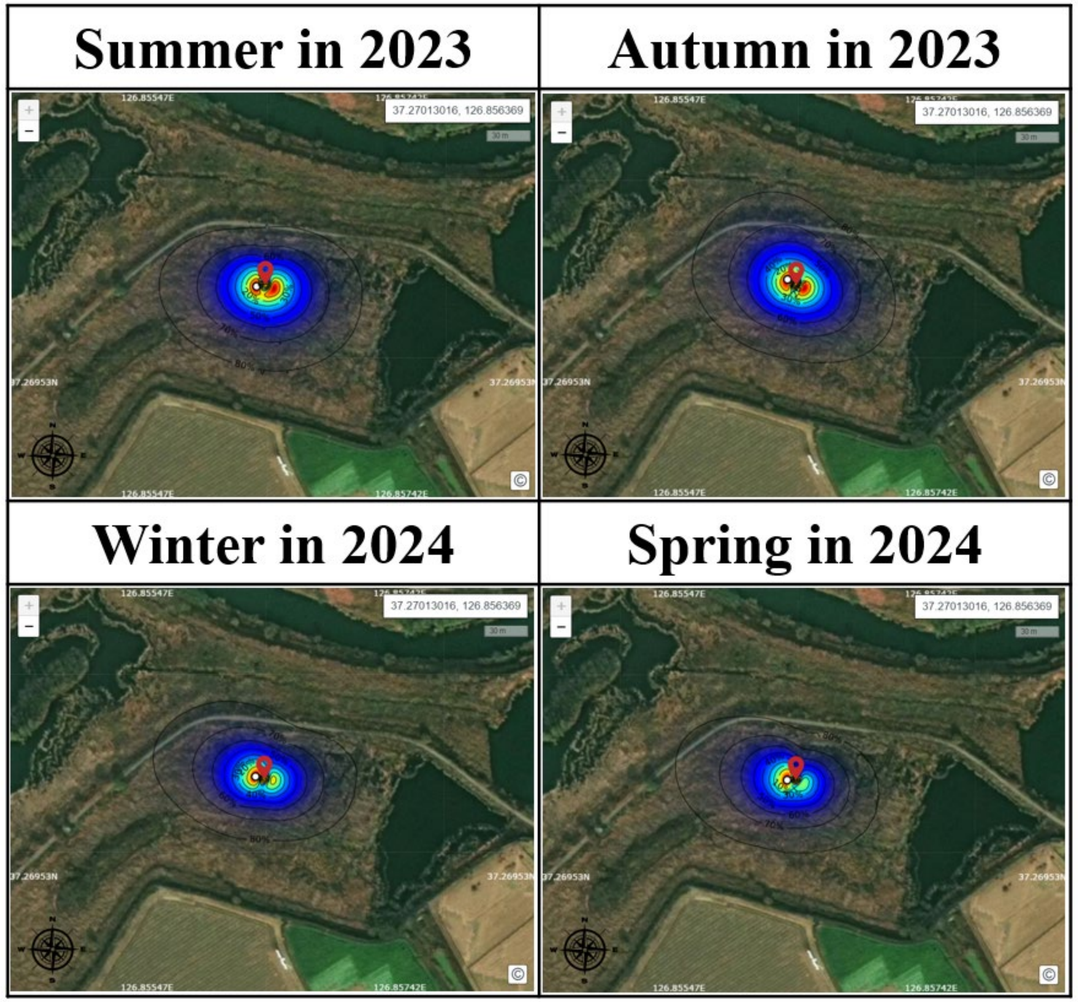
'Bibong' wetland
Freshwater marsh
Phragmite australis

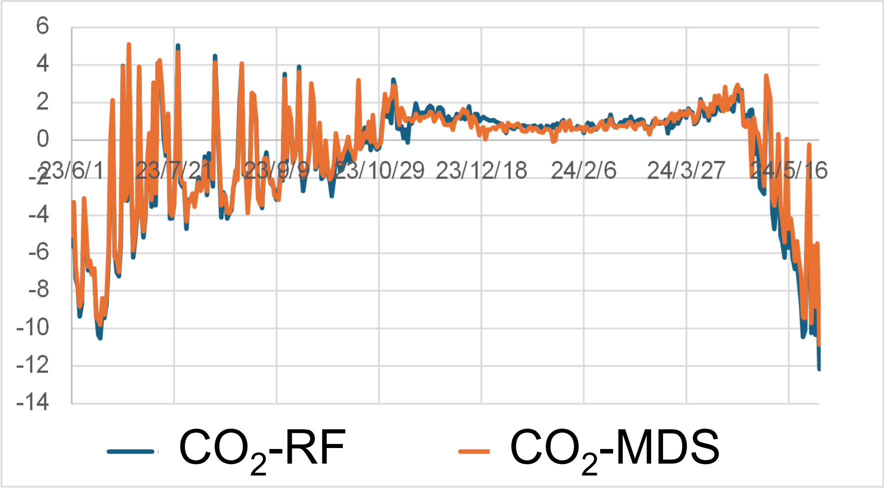
Eddy flux tower

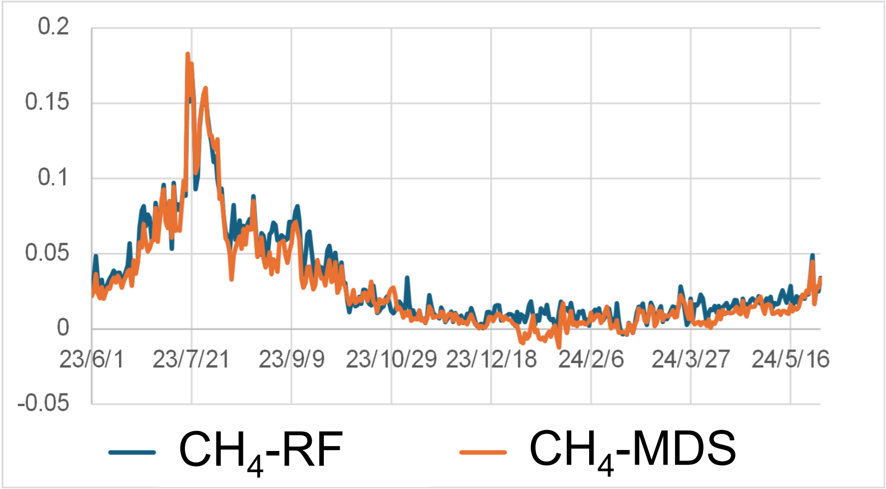


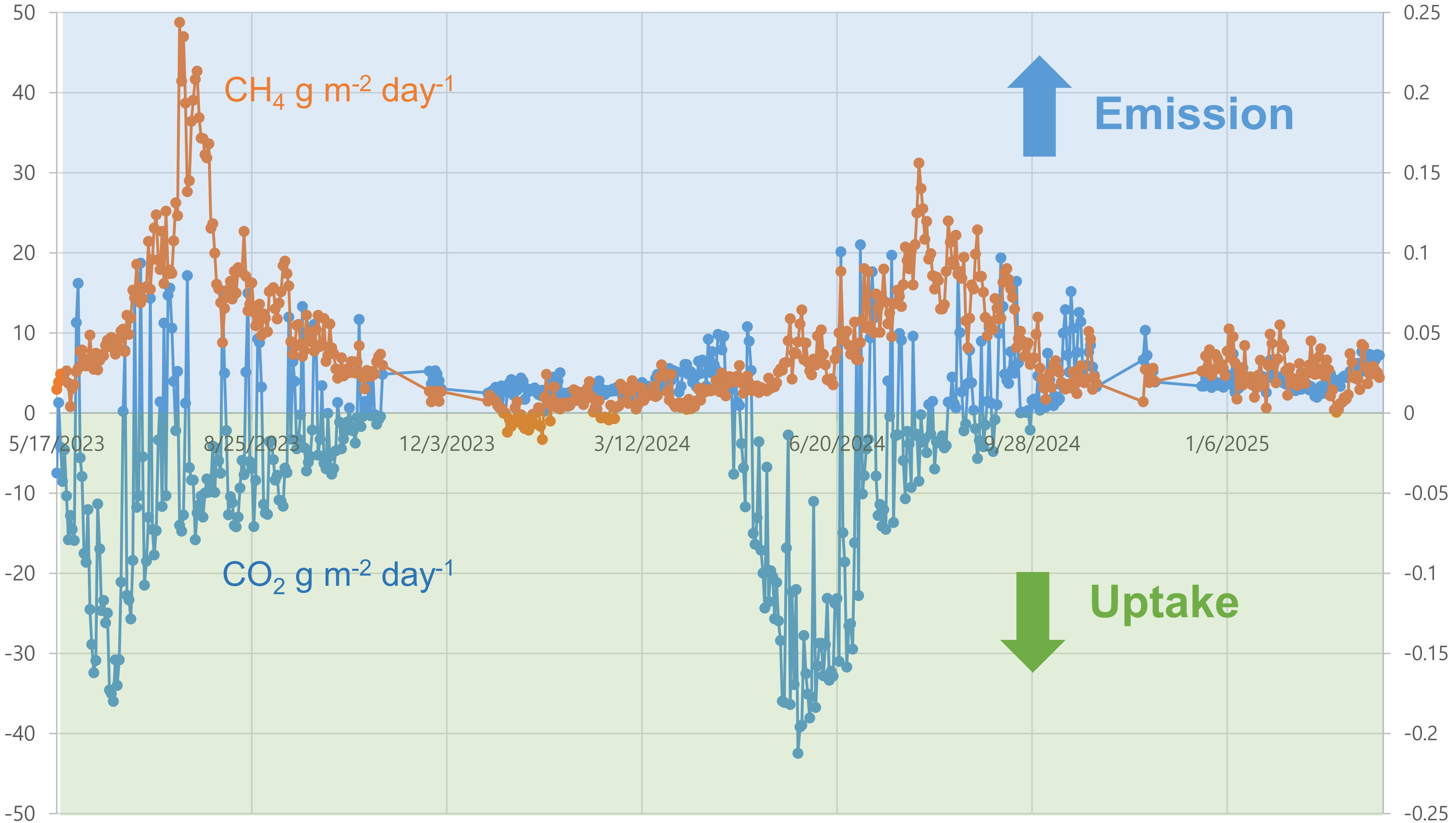


- Minor seasonal changes in footprint
- Gap filling was conducted by RF and MDS



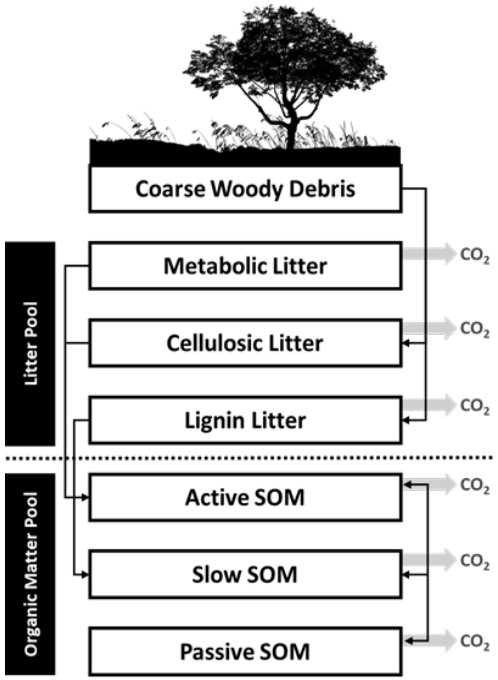




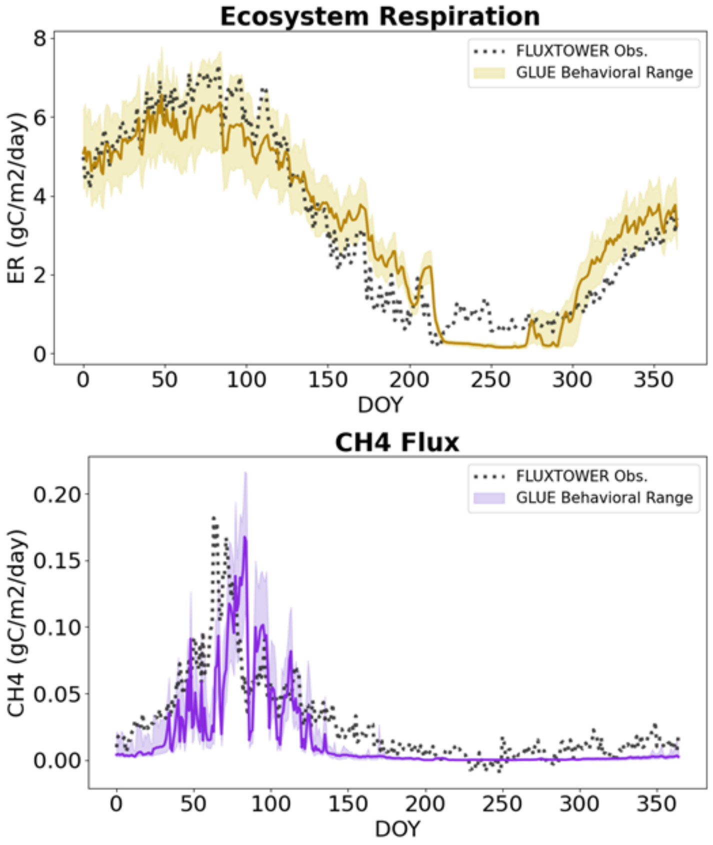


$2,104\ g\ CO_2\ m^{-2}\ yr^{-1}$ vs. $40\ g\ CH_4\ m^{-2}\ yr^{-1}$

CLM (Community Land Model) - FATES



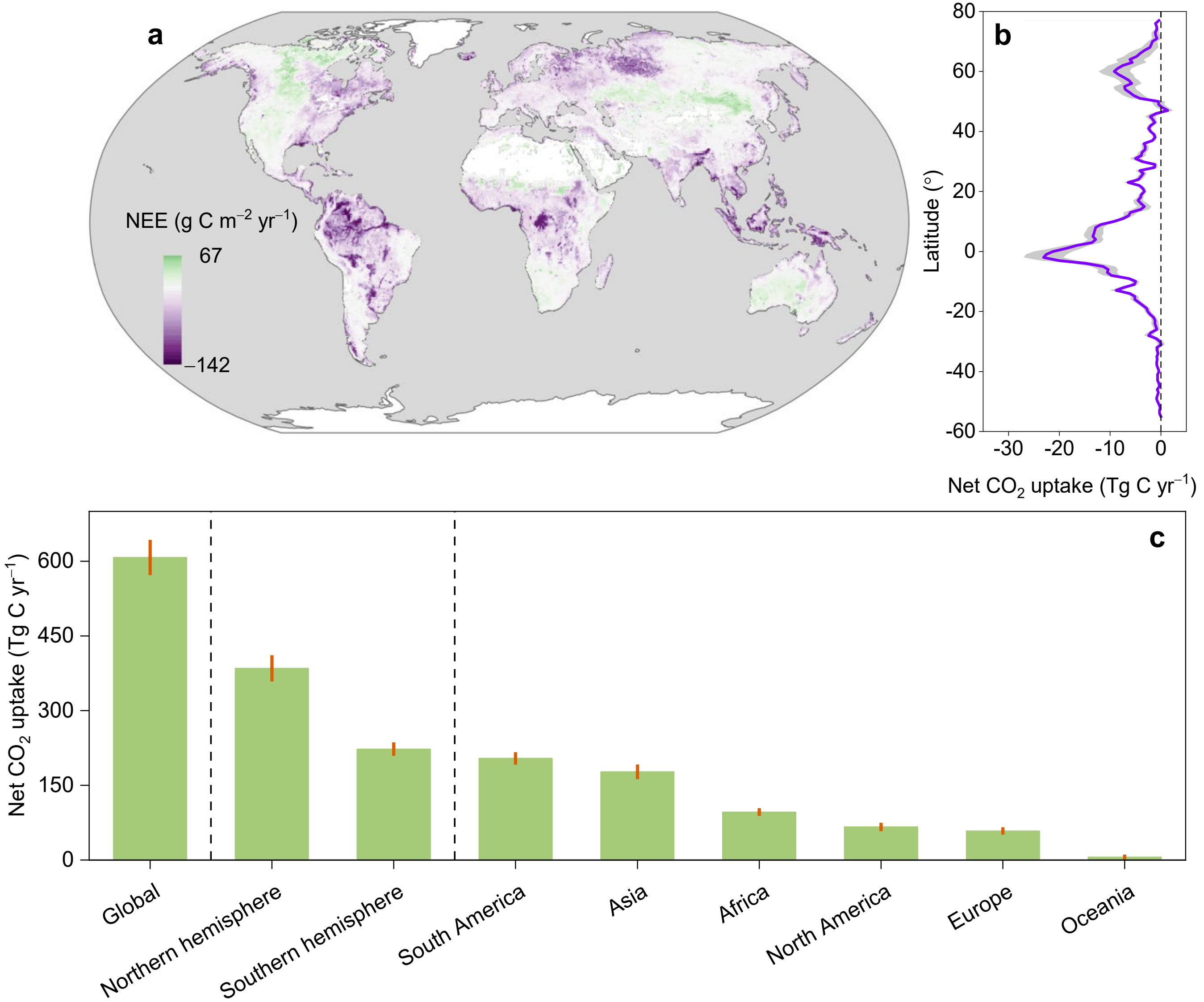
Conventional decomposition module



Global scale

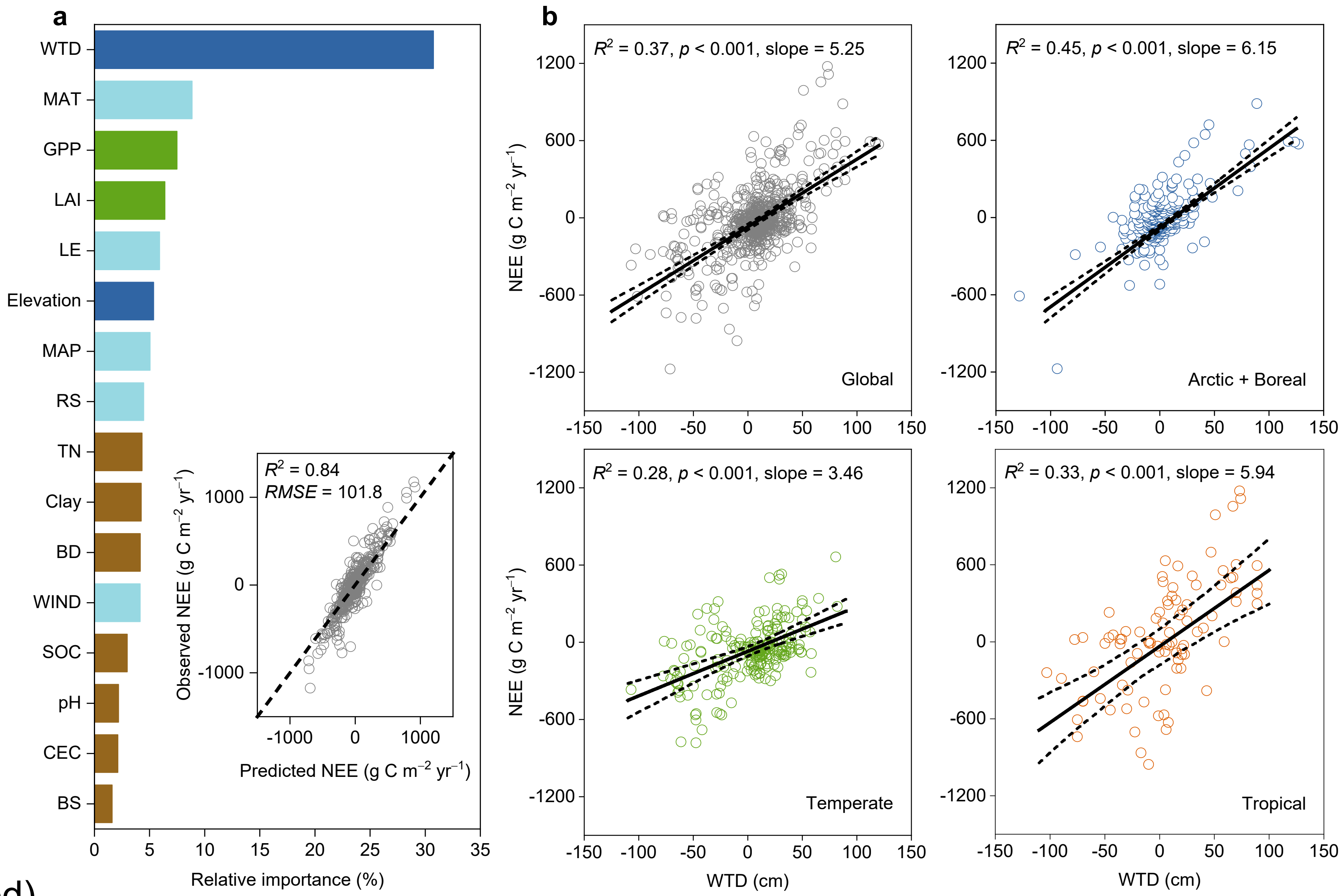
- NEE vs. CH_4 emissions (RF of 'FluxNet + literature')
- Key controlling variables

Global wetland CO_2 sequestration
(RF of FluxNet, 2000-2020, 0.5x0.5˚)



(Li et al., accepted)

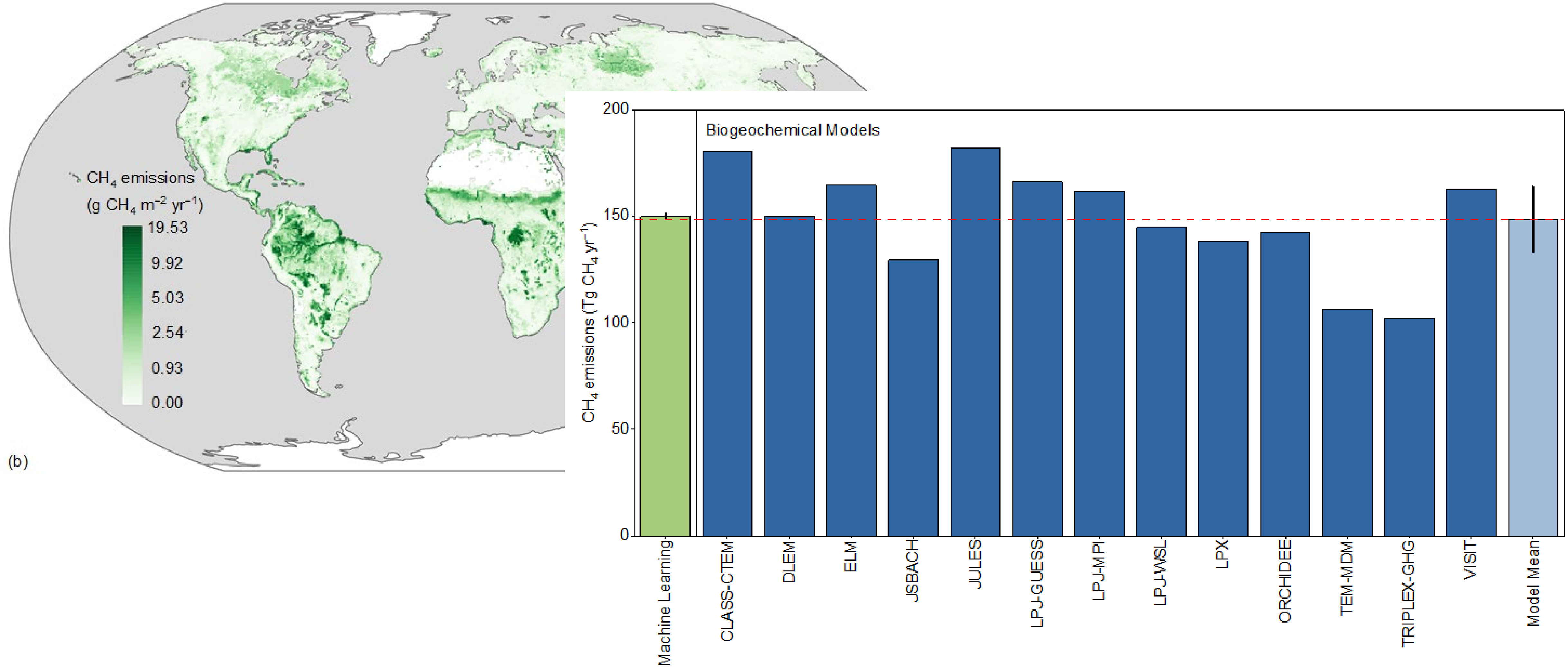
Water Table Depth as a key factor for NEE



(Li et al., accepted)

Global wetland CH_4 fluxes

(RF of CH_4FluxNet, 1950-2020, 0.5x0.5˚)



(Unpublished data)

600 Tg C (CO_2) vs. 112.5 Tg C (CH_4)

2200 Tg CO_2 eq. vs. 3375 Tg CO_2 eq.

Summary

- Local scale ('Bibong' wetland)
  - GWP of NEE > CH_4
- Global scale
  - GWP of NEE < CH_4
- Water level as a key factor

[Microbial CLM-FATES respiration & carbon transfer scheme]

For Each 20 Soil Layers →

- CWD
- L1: MET. LIT
- L2: CEL. LIT
- L3: LIG. LIT
- S1: DOC
- S2: MIC
- S3: ENZ
- S4: mSOC

STEP	Donor Pool	Receiver Pool	Respiration Fraction	Carbon Transfer Fraction
L1S1	MET. LIT.	DOC	0	fl1s1
L1S2	MET. LIT.	MIC	1 – (**l1_cue**)	(1-fls1) * **l1_cue**
L2S1	CEL. LIT.	DOC	0	fl2s1
L2S2	CEL. LIT.	MIC	1 – (**l2_cue**)	(1-fl2s1) * **l2_cue**
L3S4	LIG. LIT.	mSOC	1 – (**l3_cue**)	fl3s4
L3S2	LIG. LIT.	MIC	0	(1-fl3s4) * **l3_cue**
S1S2	DOC	MIC	1 – (**mic_cue**)	**mic_cue**
S3S1	ENZ	DOC	0	1.0
S4S1	mSOC	DOC	0	1.0
CWDL2	CWD	CEL. LIT.	rf_cwdl2	fcwdl2
CWDL3	CWD	LIG. LIT.	rf_cwdl3	1-fcwdl2

* Carbon Use Efficiency (CUE) = (Biomass production) / (Carbon uptake)

[Microbial CLM-FATES Decomposition Rate]

Carbon Pool	Decomposition Rate	Order
Litter Pools (L1, L2, L3)	Function of turnover rate of each pool	1st order kinetics
DOC	Function of microbial biomass carbon & DOC turnover rate	**2nd order Michaelis-Menten kinetics**
MIC	Function of turnover rate of microbial death & enzyme production	1st order kinetics
ENZ	Function of enzyme turnover rate	1st order kinetics
mSOC	Function of enzyme carbon & mSOC turnover rate	**2nd order Michaelis-Menten kinetics**