Recent advances in monitoring and modeling of global wetland CH_4 emission

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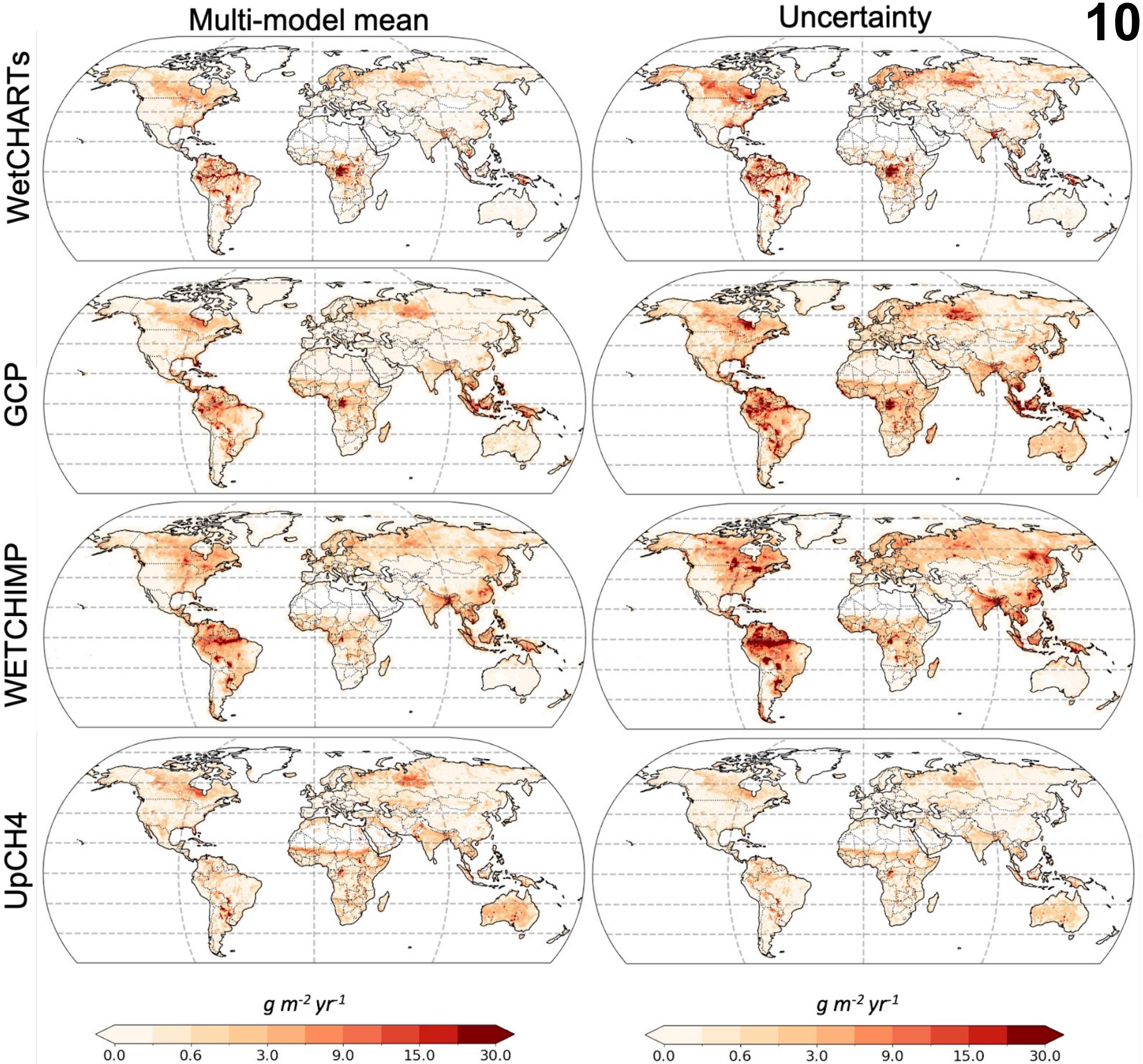
10 years of efforts

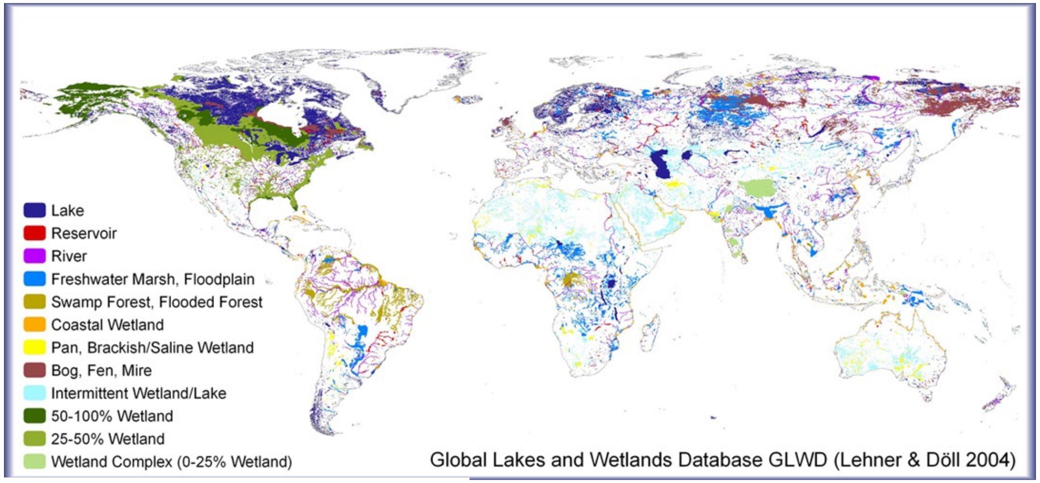


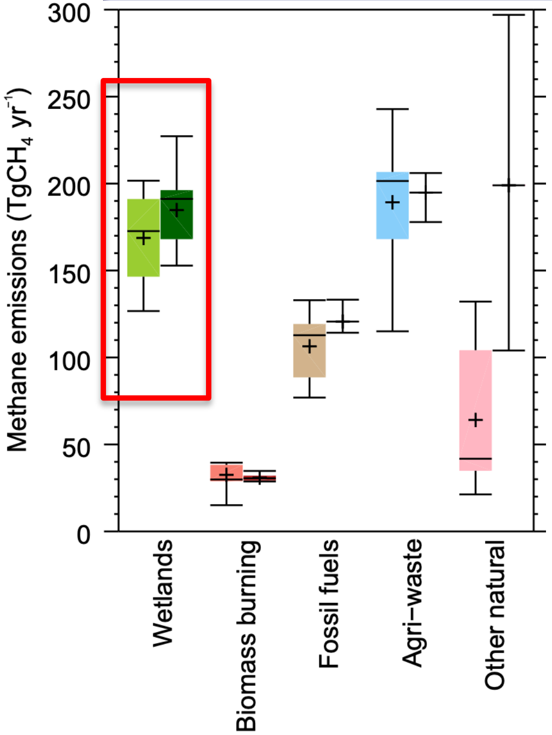
Bloom 2017
125-208 Tg/yr

Saunois 2020
102-182 Tg/yr

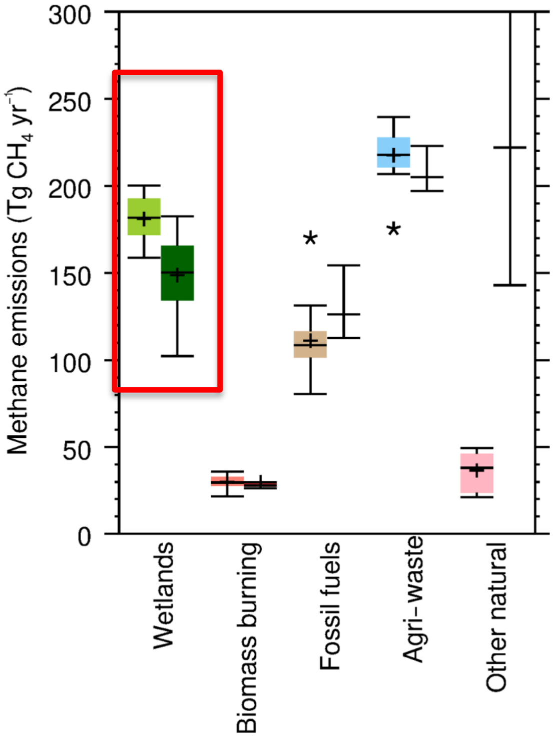
Melton 2013
151-229 Tg/yr

McNicol 2023
103-189 Tg/yr

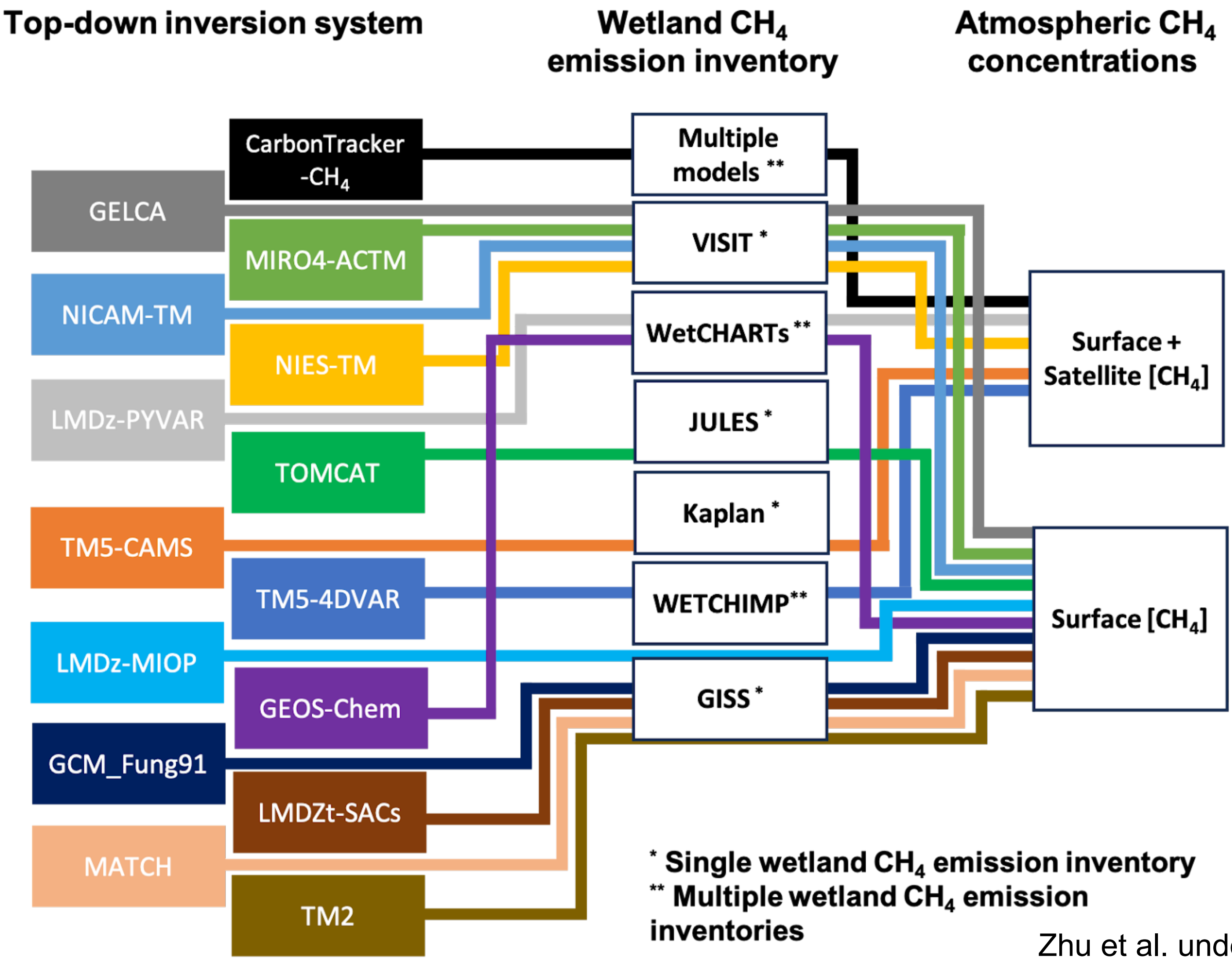




GCP-CH4 (Saunois et al., 2016)

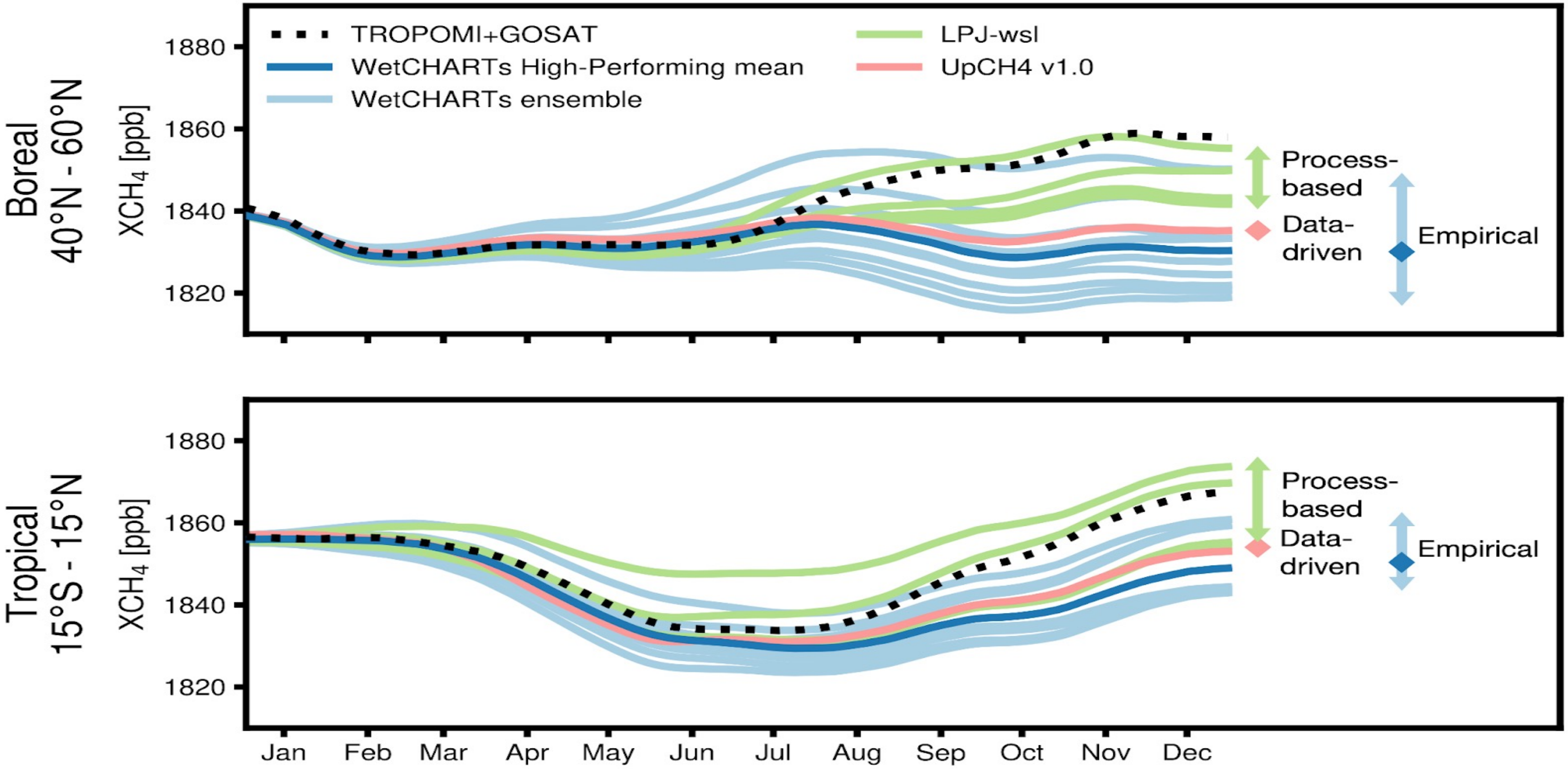


GCP-CH4 (Saunois et al., 2019)



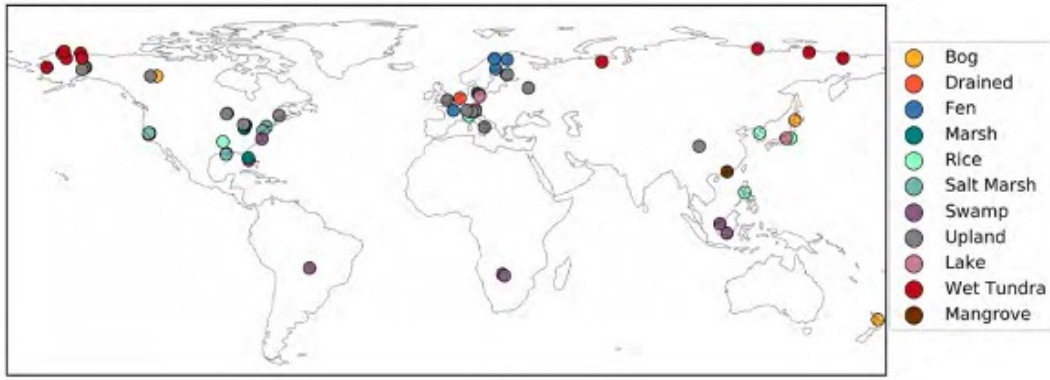
Zhu et al. under review

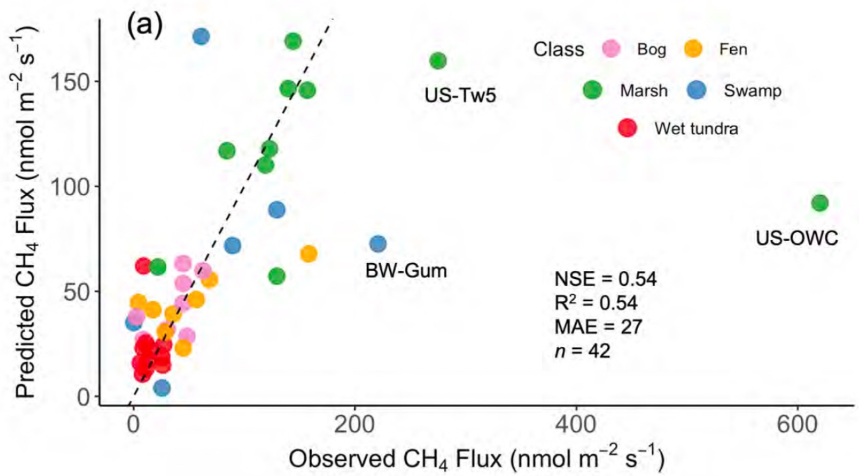
Uncertainty propagation to XCH4

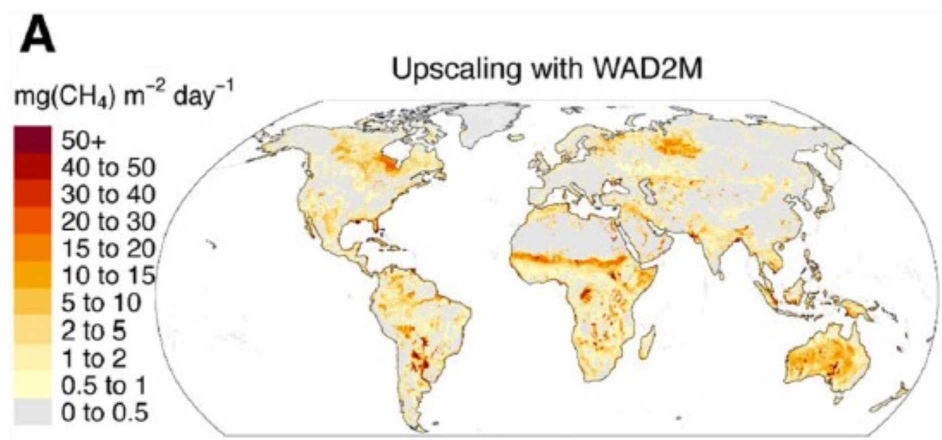


Zhu et al. under review

FLUXNET-CH4 Version 1.0: 81 sites, 254 site-years







McNicol et al., 2023 AGU Advances

1. Process-driven: Calibrate ELM-CH4

$$\frac{\partial(RC)}{\partial t} = \frac{\partial F_D}{\partial z} + P(z,t) - E(z,t) - A(z,t) - O(z,t)$$

a) CH-Cha (PFT-13: Cool c3 grass)

	Q_{10}	β	f_{CH_4}	z_τ	τ_{cwd}	τ_{l1}	τ_{l2-l3}	τ_{s1}	τ_{s2}	τ_{s3}	$C_{e,max}$	f_{D_0}	p	R	r_L	F_a	K_{CH_4}	K_{O_2}	$R_{o,max}$
EM	0.67	0.03	0.14	0.02	0	0.01	0	0.00	0.00	0	0	0	0	0	0	0	0.00	0.00	0.02
PROD	0.77	0.01	0.15	0.02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIFF	0.53	0.01	0.19	0.01	0	0.00	0	0.00	0	0	0.02	0.11	0	0	0	0	0	0.02	0.02
EBUL	0.63	0	0.26	0.03	0	0.00	0	0.00	0	0	0.01	0.01	0	0	0	0	0	0	0
AERE	0.17	0	0.23	0.01	0	0	0	0	0	0	0	0	0.00	0.01	0	0	0.15	0.01	0.33

Parameters

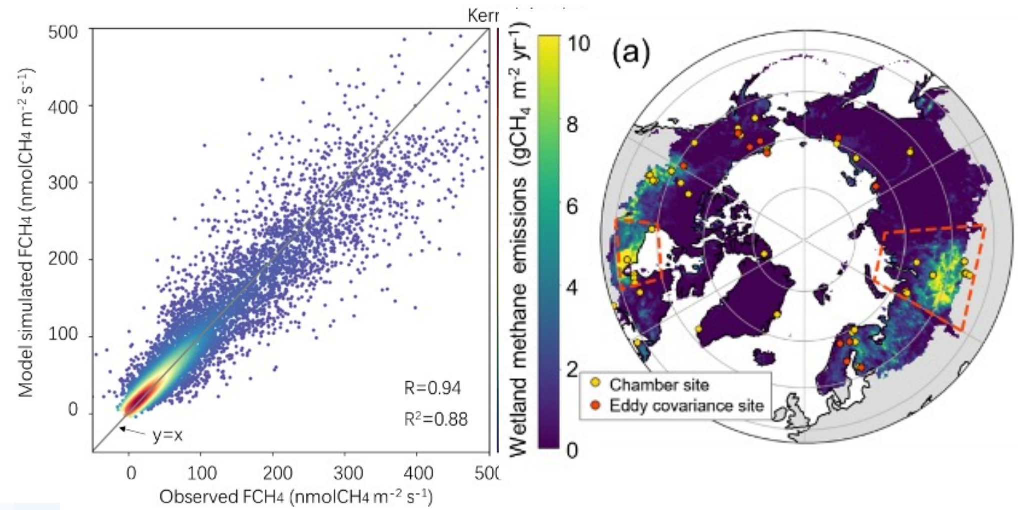
b) SE-Deg (PFT-12: Arctic c3 grass)

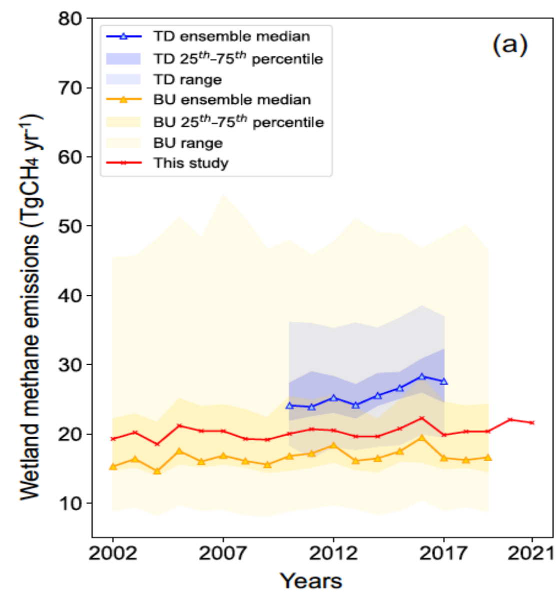
	Q_{10}	β	f_{CH_4}	z_τ	τ_{cwd}	τ_{l1}	τ_{l2-l3}	τ_{s1}	τ_{s2}	τ_{s3}	$C_{e,max}$	f_{D_0}	p	R	r_L	F_a	K_{CH_4}	K_{O_2}	$R_{o,max}$
EM	0.74	0.01	0.15	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROD	0.77	0.01	0.15	0.01	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0
DIFF	0.50	0	0.21	0.03	0	0.00	0.00	0.01	0.00	0	0.02	0.13	0	0	0	0	0	0.01	0.02
EBUL	0.62	0	0.24	0.04	0	0.00	0	0.00	0.00	0	0.01	0.01	0.00	0	0	0	0	0	0
AERE	0.26	0	0.25	0.06	0	0	0.00	0.00	0.01	0	0.00	0	0	0	0	0	0.12	0.01	0.20

Parameters

Chinta S., X. Gao, Q. Zhu 2024, JAMES

2. Data-driven: develop physics-guided ML





Yuan K., et al. Q. Zhu, 2024 Nature Climate Change

Summary

- Ground measurements of CH_4 flux (like FLUXNET-CH_4) is critical to reduce uncertainty wetland CH_4 emission
- Great opportunities to test different BGC formulation, calibrate physical parameters for process-based models.
- Growing opportunities to run more advanced and complex ML architectures.