Warming rate drives microbial limitation and enzyme expression during peat decomposition

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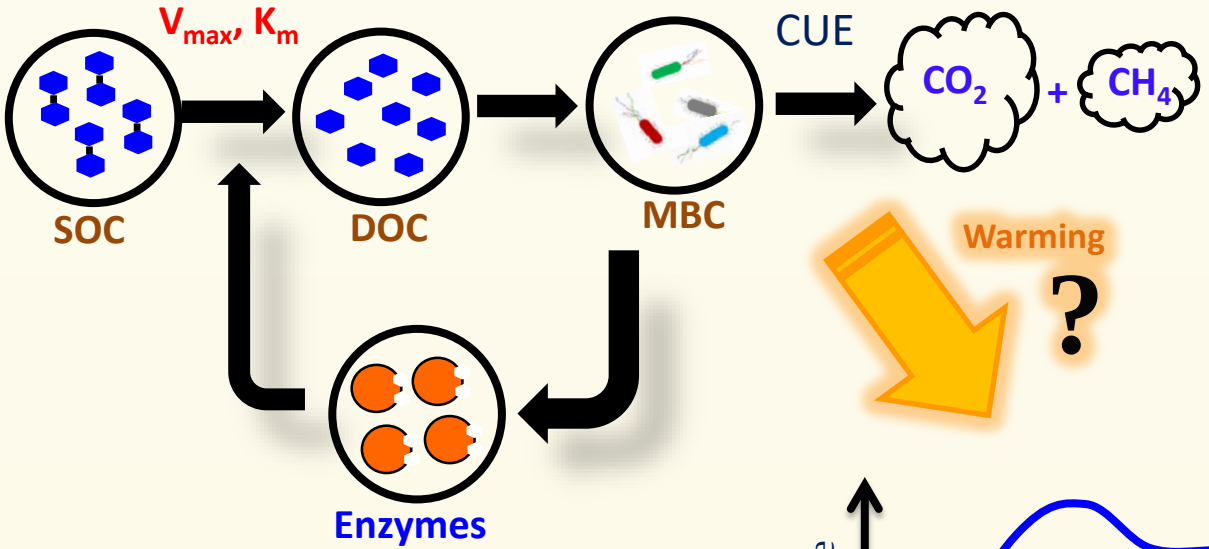
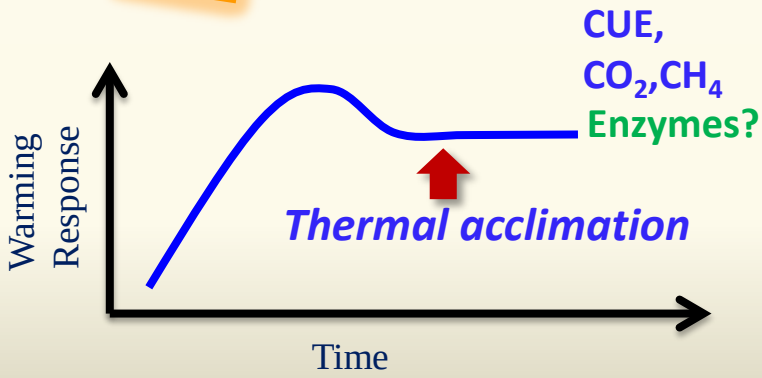
Decomposition Models

(Modified from Allison et al., 2010)





SOC-Soil organic C; DOC-Dissolved organic C;

MBC-Microbial biomass C; CUE-C use efficiency;

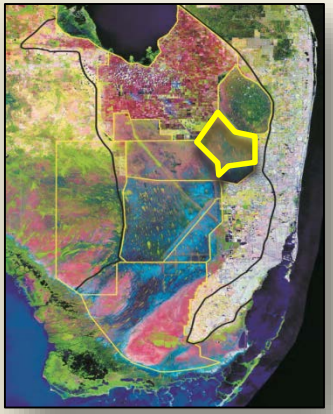
Vmax & Km-Enzyme kinetic parameters

Objective

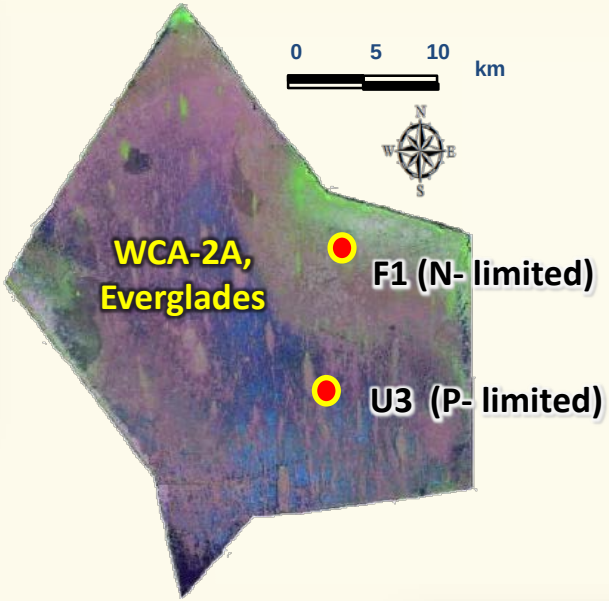
- Determine effect of warming rate on enzyme kinetic parameters for C, N, P related enzymes in contrasting soils

Hypotheses

- 1: Changes in Vmax/Km would be less in slow warming treatment than in rapid
- 2: Observed changes in Vmax/Km would be reflective of microbial nutrient stoichiometry

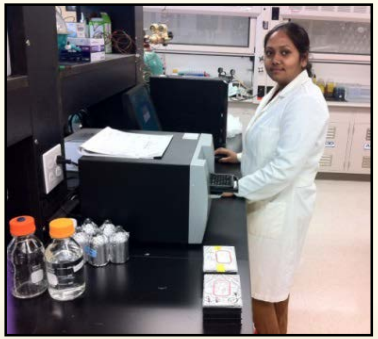


Florida, USA

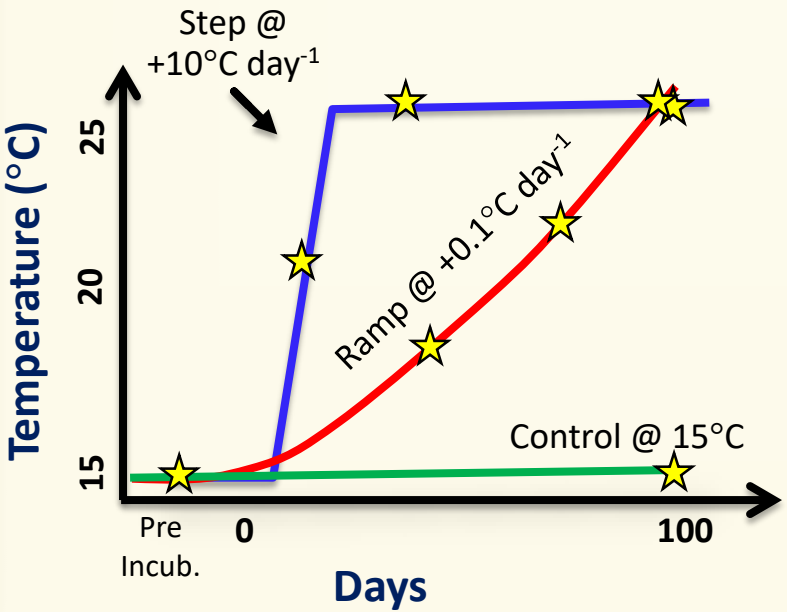


Methods

Inglett and Reddy, 2006
Sihi et al., 2016, 2017



Methods: Warming

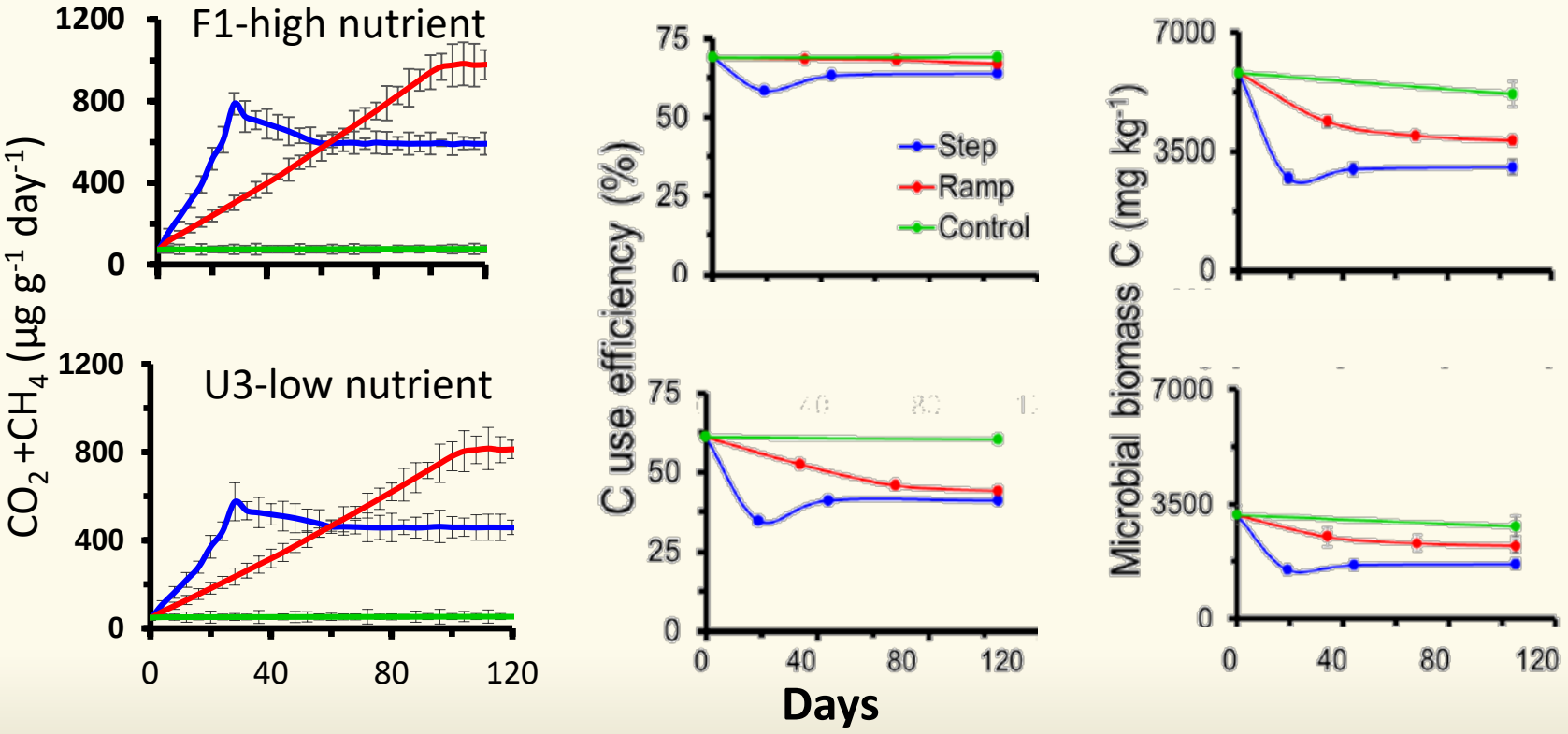


Parameters Monitored

- CO_2, CH_4 (Continuous)
- Enzyme V_{max} &K_m (Mult. Pts)
- Microbial Biomass C/N/P (Mult. Pts)

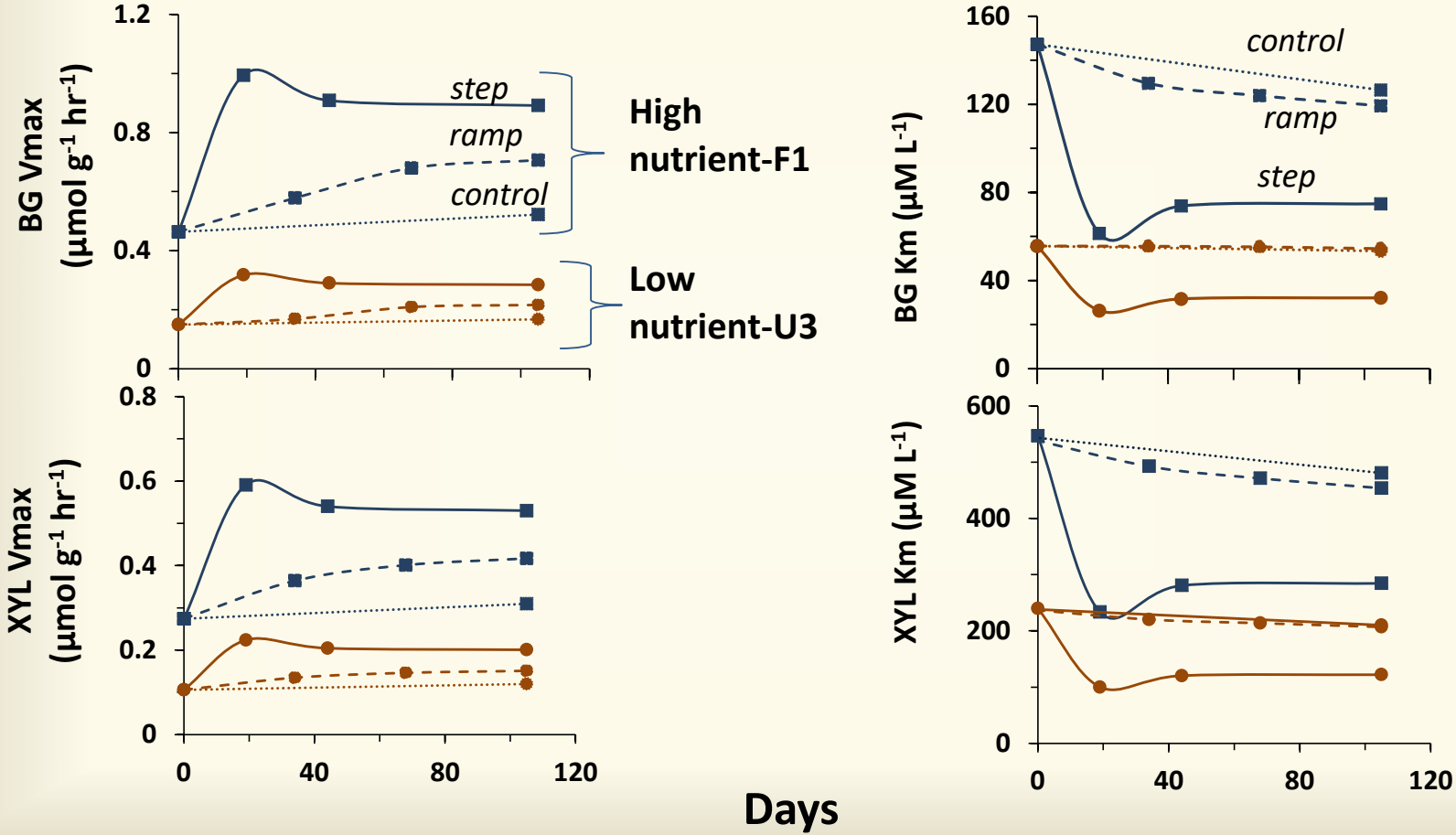
Enzymes analyzed		Abbreviations
Enzyme Group	**Enzyme Name**	
C acquisition enzyme	ß-D-glucosidase	BG
	ß-D-xylosidase	XYL
N acquisition enzyme	Leucine aminopeptidase	LAP
	N-Acetyl-ß-D glucosaminidase	NAG
P acquisition enzyme	Phosphomonoesterase	PHO
	Phosphodiesterase	BPHO

Warming Rate Effect

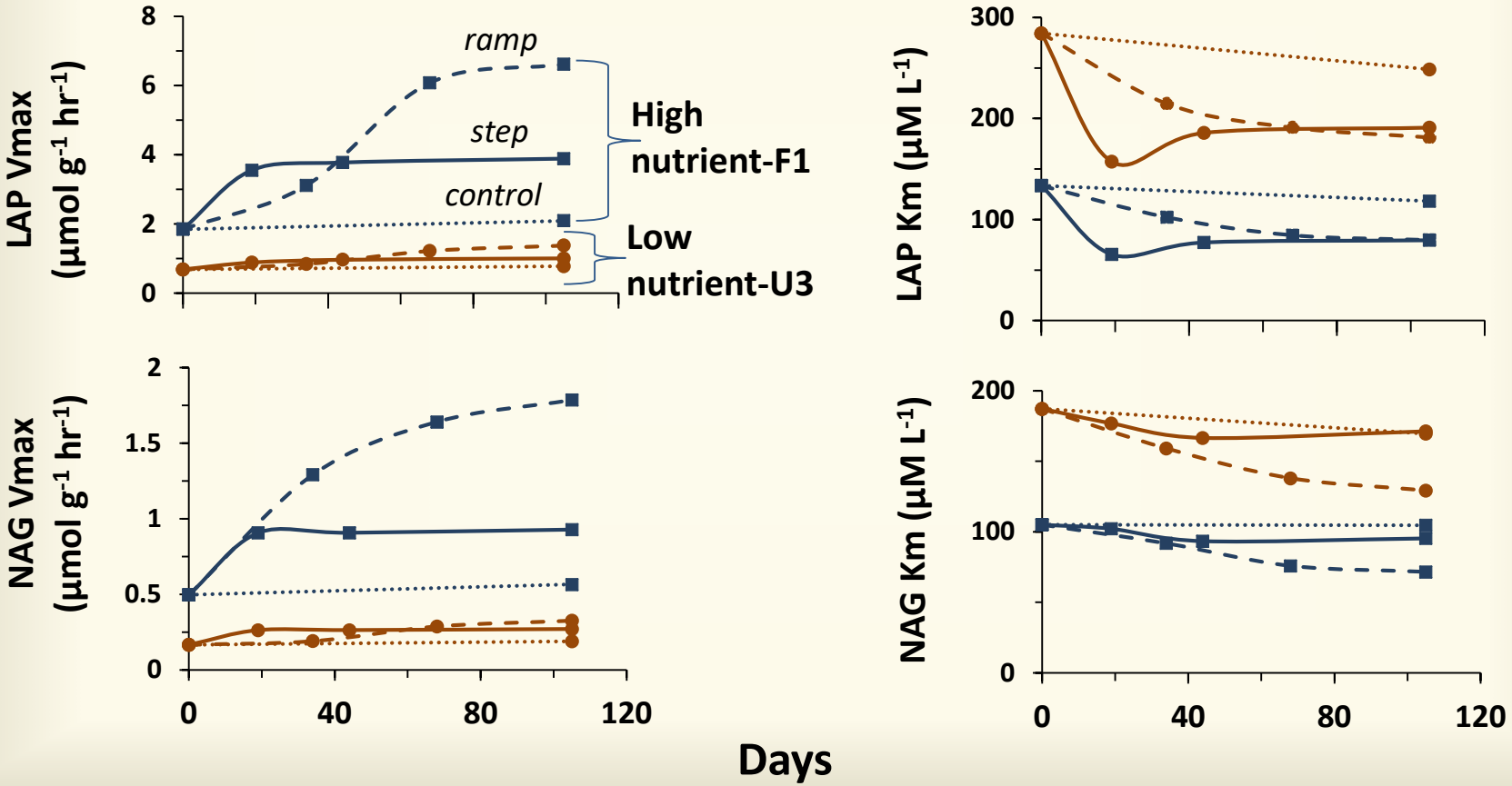


Sihi et al., 2017

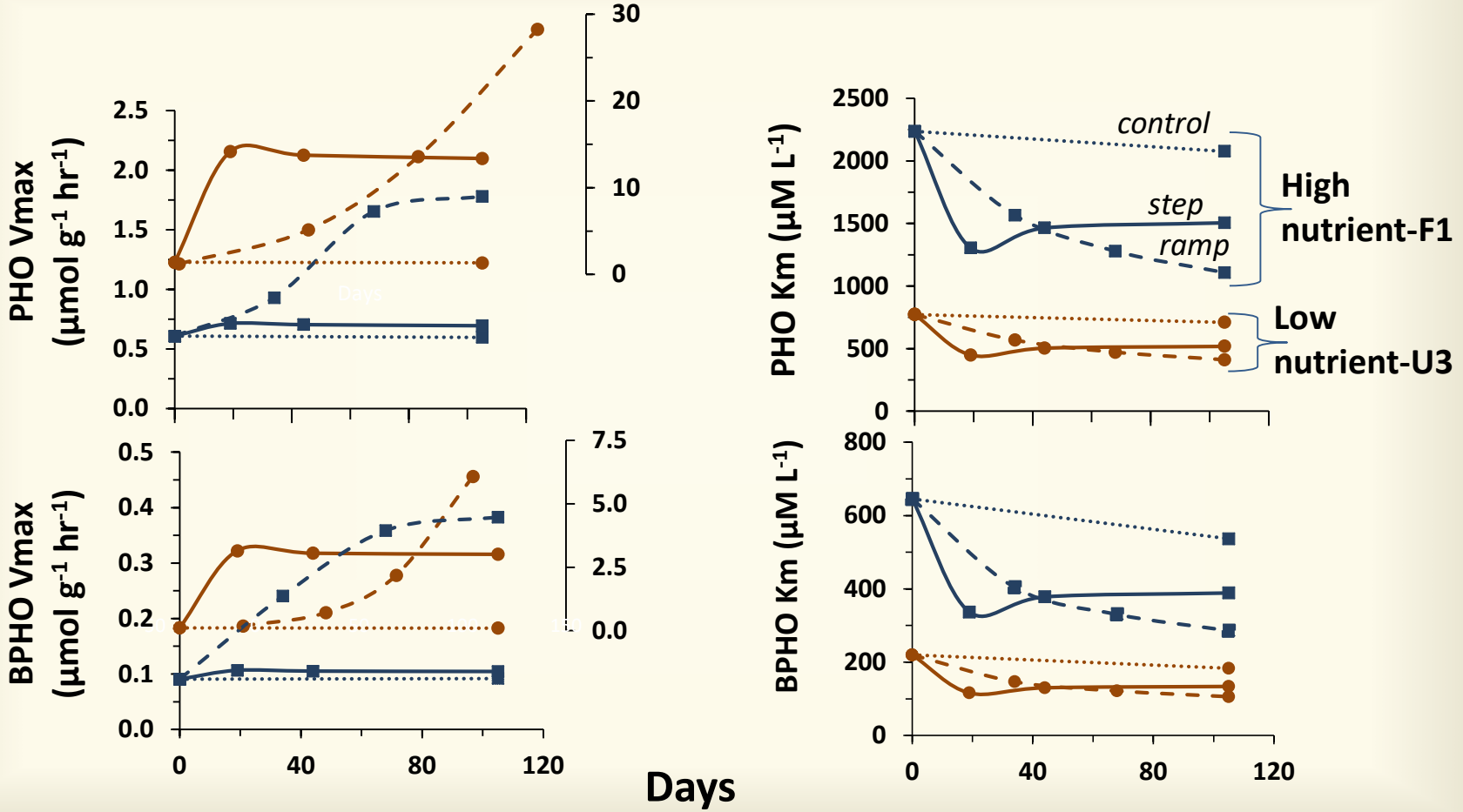
C Acquisition Enzymes



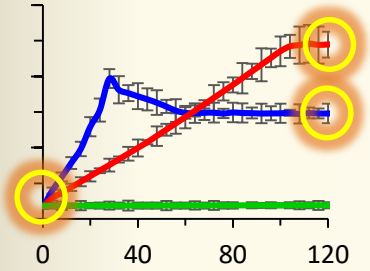
N Acquisition Enzymes



P Acquisition Enzymes

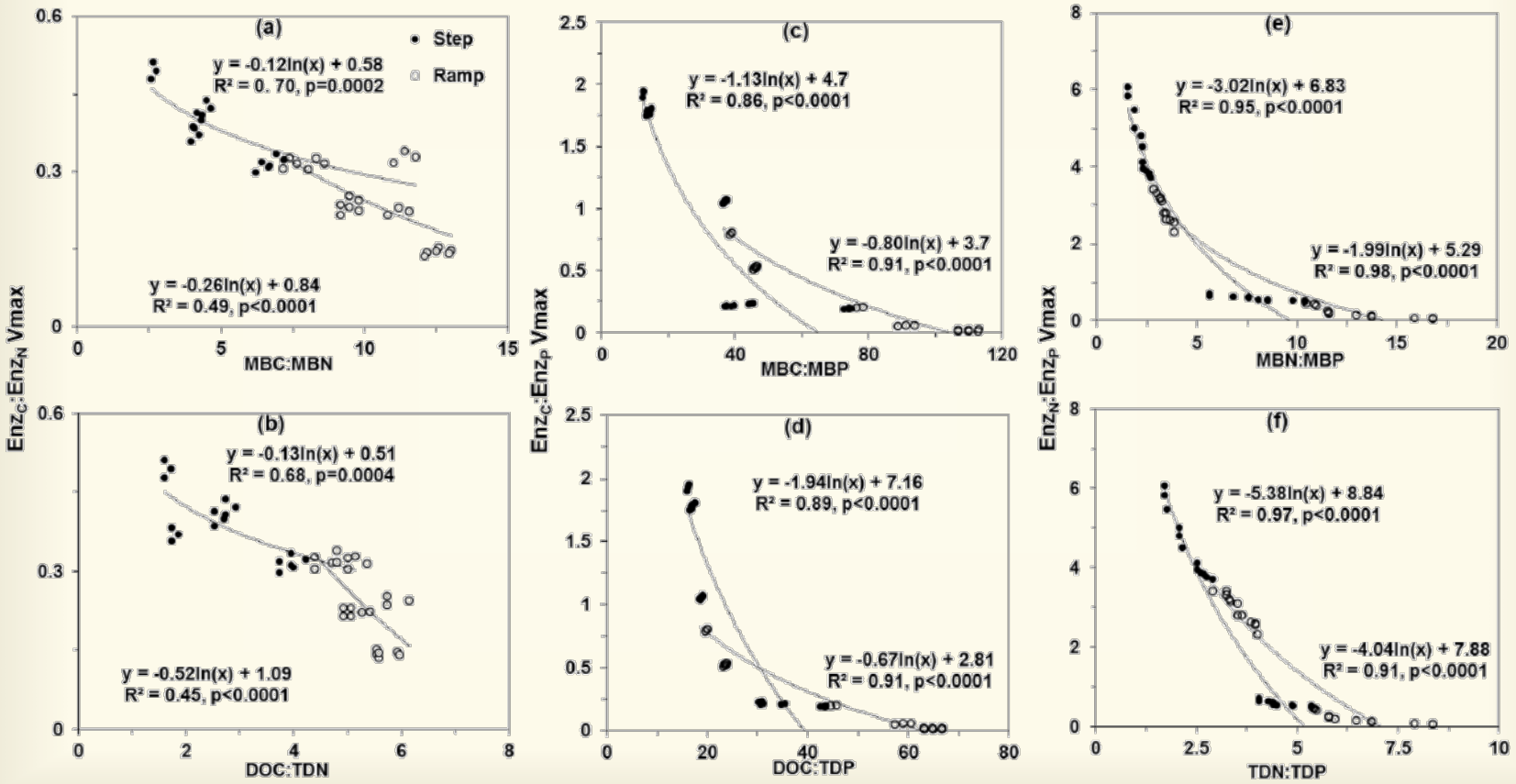


Microbial Biomass Stoichiometry



		Init./ Contr.	Step/ Fast	Ramp/ Slow
C:N	N-Limited Site	12.3	6.5 ⇩	11.5
	P-Limited Site	7.3	3.9 ⇩	8.8 ⇧
C:P	N-Limited Site	37	13 ⇩	46 ⇧
	P-Limited Site	73	27 ⇩	105 ⇧
N:P	N-Limited Site	3	2 ⇩	4 ⇧
	P-Limited Site	10	7 ⇩	12 ⇧

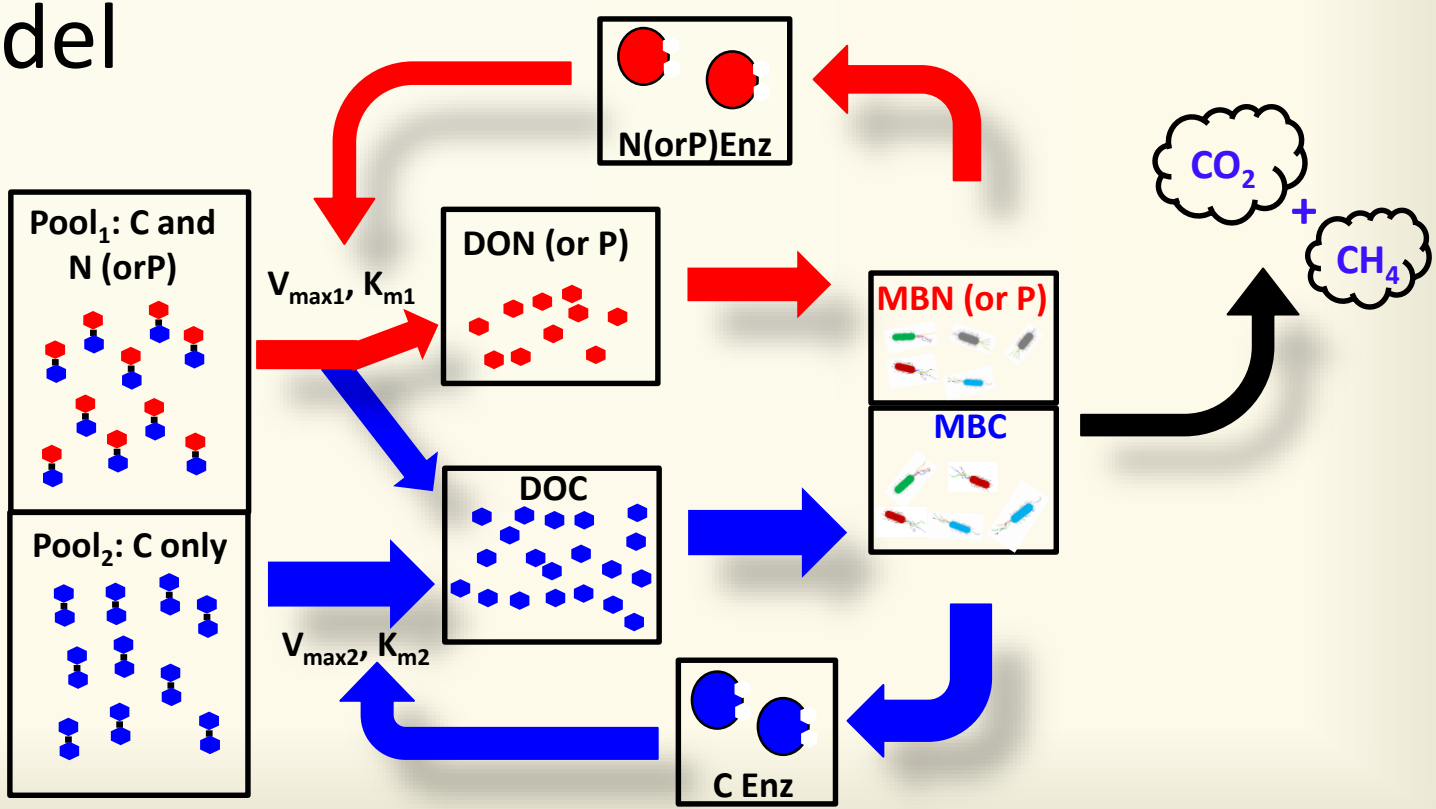
Enzyme Ratios vs. Biomass & Dissolved Pool



Summary

- Apparently different endpoints (alternate states) under contrasting warming rates
  - CO_2 & CH_4, microbial identity
  - Biomass stoichiometry, enzyme expression
- Microbial demand likely drives enzyme kinetics
  - Greater C demand vs. nutrients under fast warming rate
  - More N vs. P starvation under fast warming rate
- Findings identify need for improved representation of warming in decomposition models.
  - Parameterization experiments as well as inclusion of stoichiometry

Stoichiometric Model



(Modified from Moorhead et al., 2012)

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