



UNIVERSITY OF  
EASTERN FINLAND

# Carbon and nitrogen release in decomposition – temperature sensitivity patterns

Ari Laurén, Marjo Palviainen, Mari Lappalainen

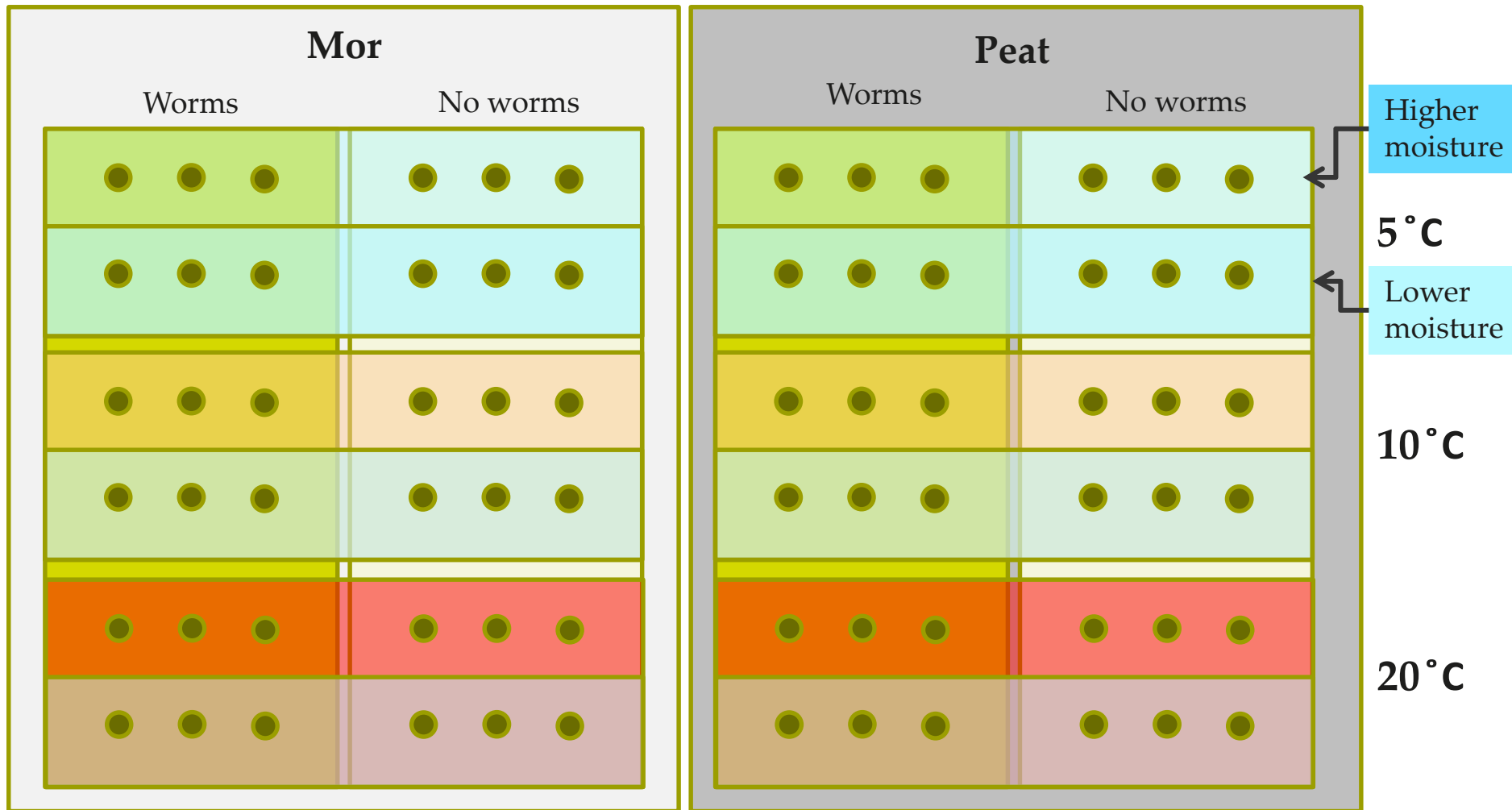
September 18, 2018

UEF // University of Eastern Finland

*Painting:  
Tove Jansson*



# Multi-factorial laboratory experiment: 180 days



# Measurements → Change rate

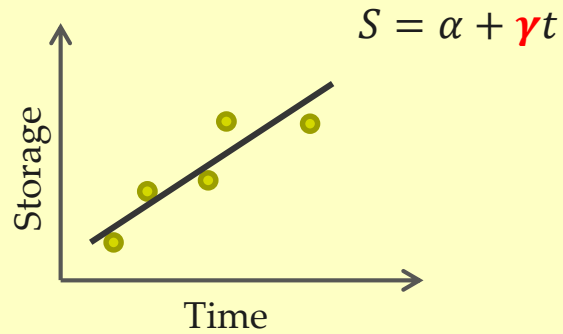
Repeated measurements



Soil solution  
CO<sub>2</sub>

CO<sub>2</sub>, NH<sub>4</sub>

HMW-DON, LMW-DOC  
HMW-DOC, LMW-DOC



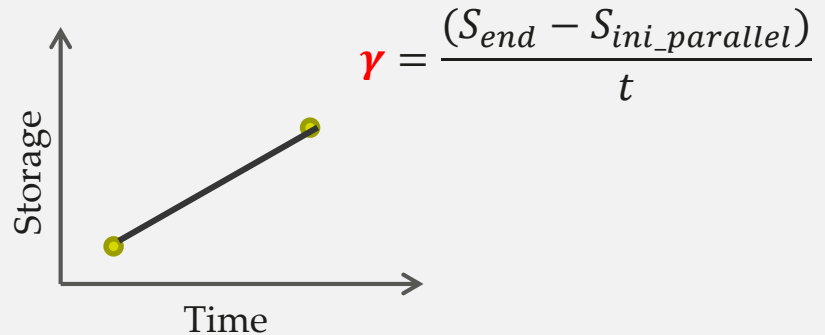
Destructive measurements



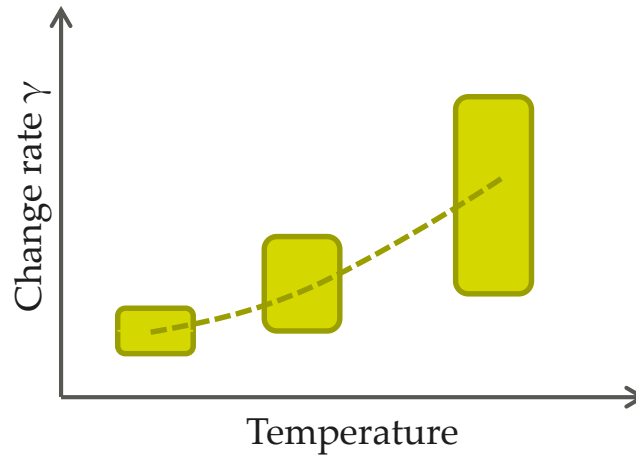
Extractable N, C  
Microbial N, C

NH<sub>4</sub>ex

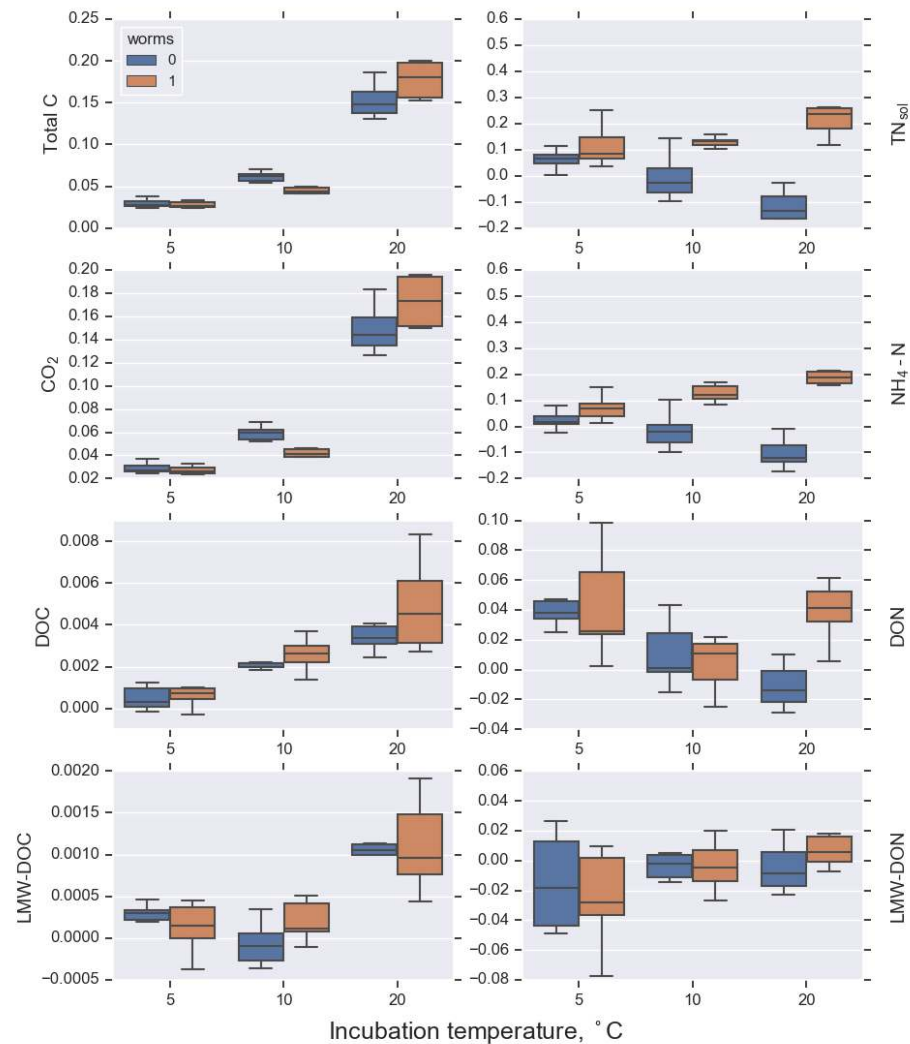
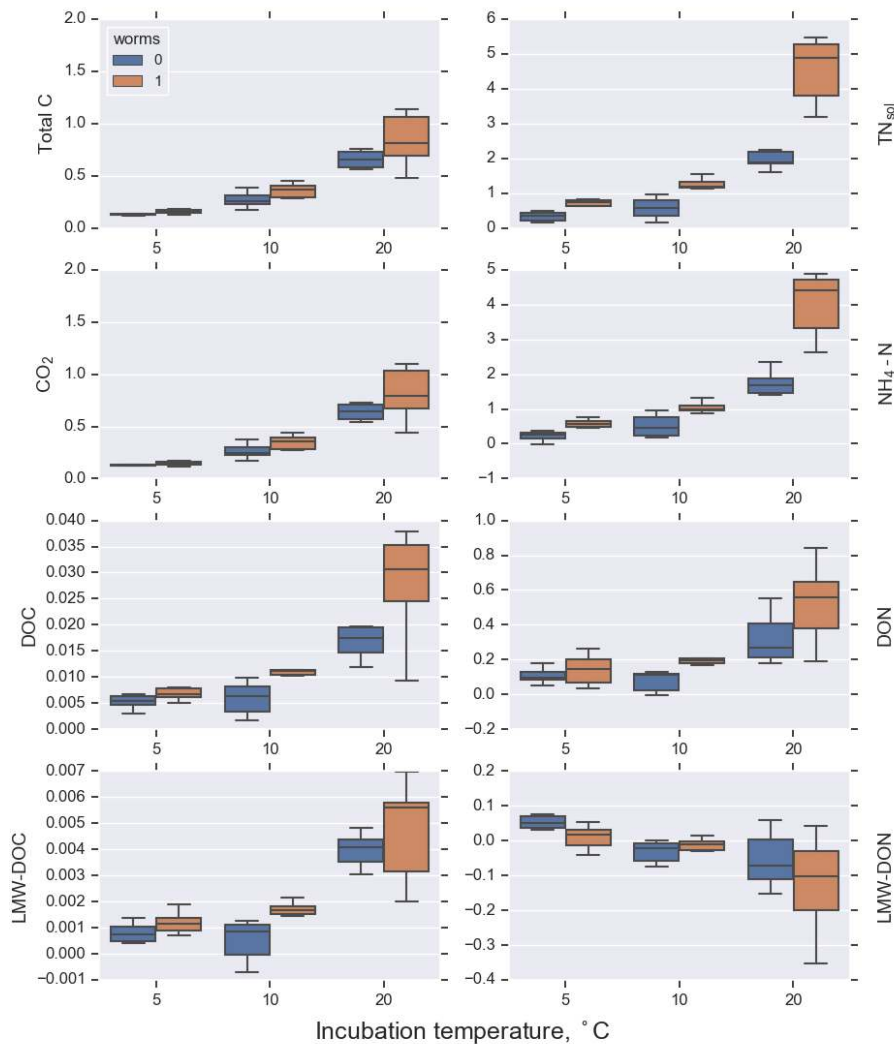
Microbial N, Microbial C  
ONex, OCex

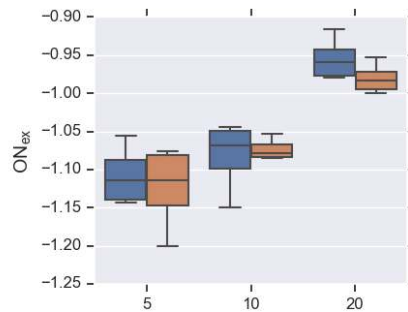
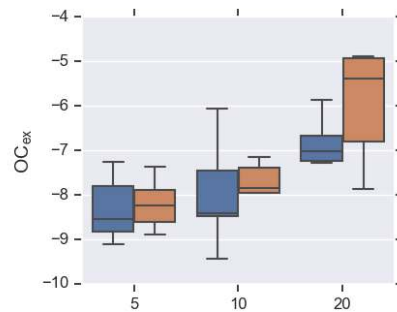
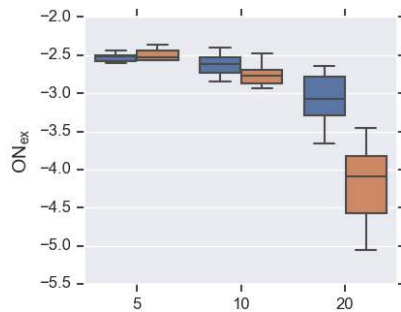
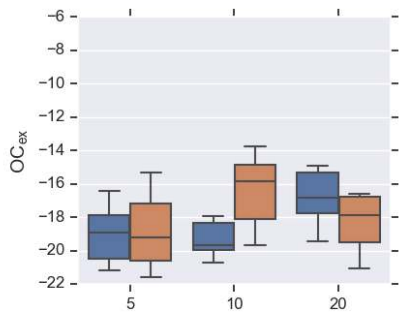
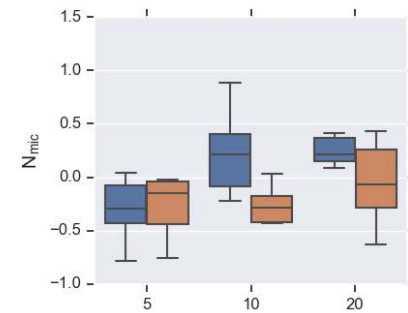
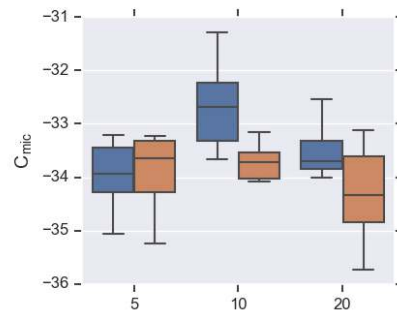
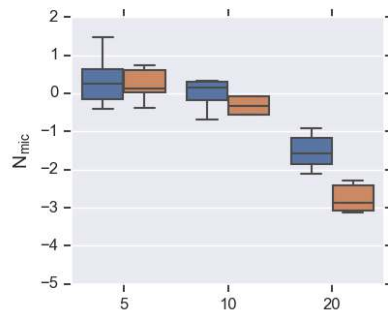
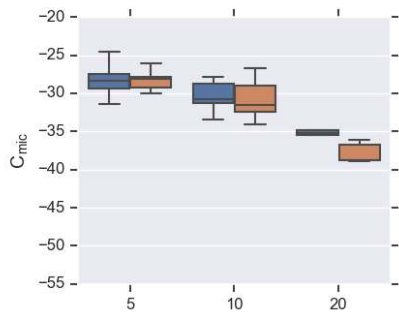
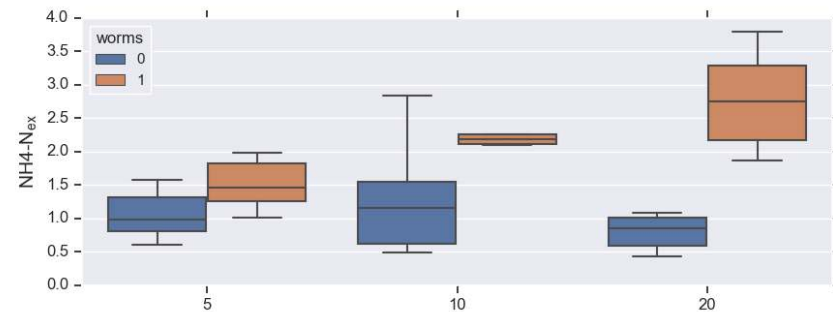
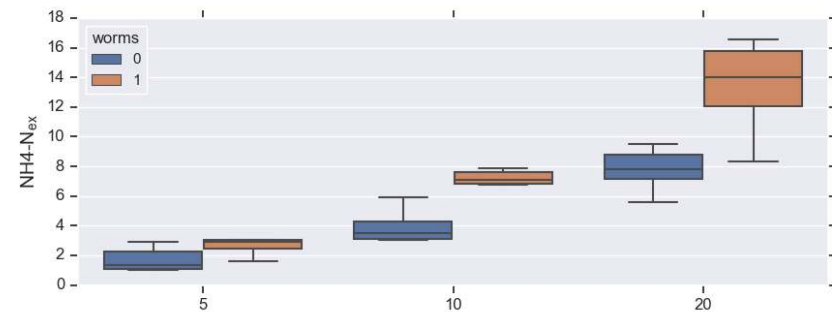


# Change rate $\rightarrow$ Temperature sensitivity $Q_{10}$



$$k_T = k_{ref} Q_{10}^{\left(\frac{T-T_{ref}}{10}\right)}$$

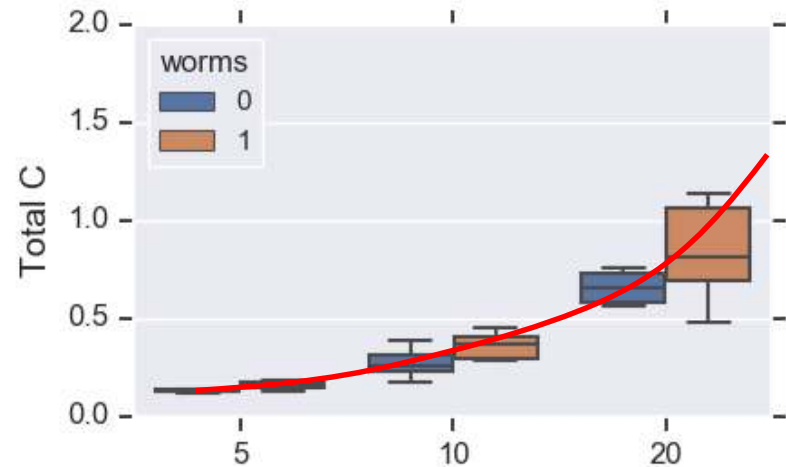
**Mor**Storage change rate  $\mu\text{g g}^{-1}\text{day}^{-1}$ **Repeated measurements**Storage change rate  $\mu\text{g g}^{-1}\text{day}^{-1}$ **Peat**

**Mor**Storage change rate  $\mu \text{ g g}^{-1} \text{ day}^{-1}$ **Destructive measurements**Storage change rate  $\mu \text{ g g}^{-1} \text{ day}^{-1}$ **Peat**Incubation temperature,  $^{\circ}\text{C}$ Incubation temperature,  $^{\circ}\text{C}$

# Patterns of temperature sensitivity, 1

Storage change rate or flux increases with temperature

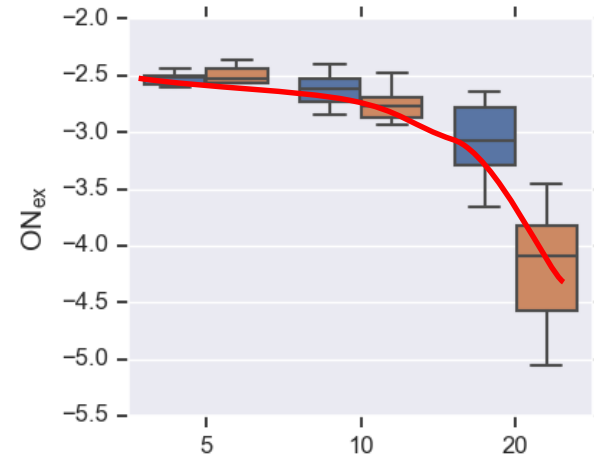
- Repeated:
  - All CO<sub>2</sub>, DOC
  - Mor NH<sub>4</sub>, DON
  - Peat NH<sub>4</sub> (worms)
- Destructive
  - Mor: NH<sub>4</sub>ex
  - Peat: NH<sub>4</sub>ex (worms), OCex
- Typical response pattern
- Q<sub>10</sub>-value: 1.7...3.3



# Patterns of temperature sensitivity, 2

## Negative response: decreasing pattern

- Repeated:
  - Not existing in data
- Destructive
  - Peat: NH<sub>4</sub> ex (no worms)
  - Mor: microbial C, ON<sub>ex</sub>
- No conceptual issue: Sign depends on point of view
- Q<sub>10</sub>-value 1.1...1.4

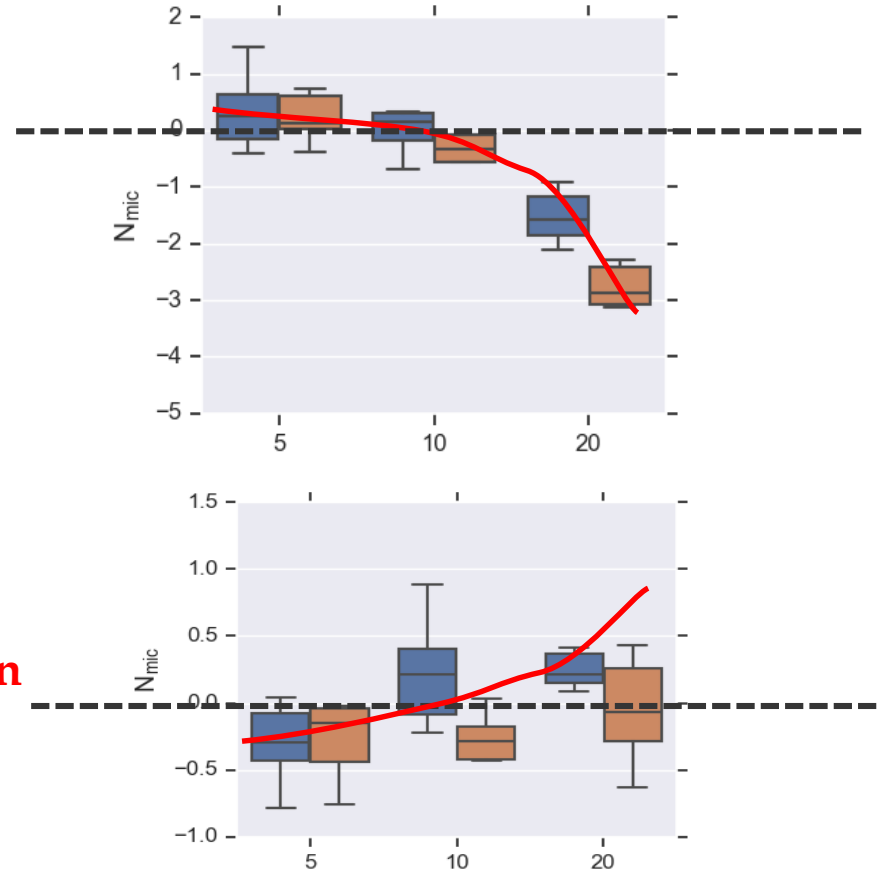




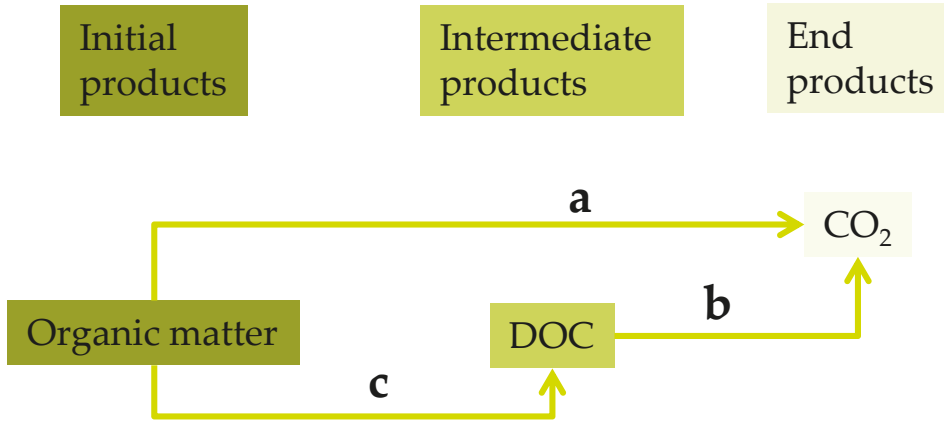
# Patterns of temperature sensitivity, 3

## Changing sign

- Repeated:
  - Peat:  $\text{NH}_4\text{N}$ ,  $\text{TN}_{\text{sol}}$  (no worms), DON
- Destructive
  - Peat:  $\text{NH}_4$  ex
  - Mor: microbial N
- Conceptual problem:
  - **$Q_{10}$  -function cannot change sign**
- $Q_{10}$ -value not applicable



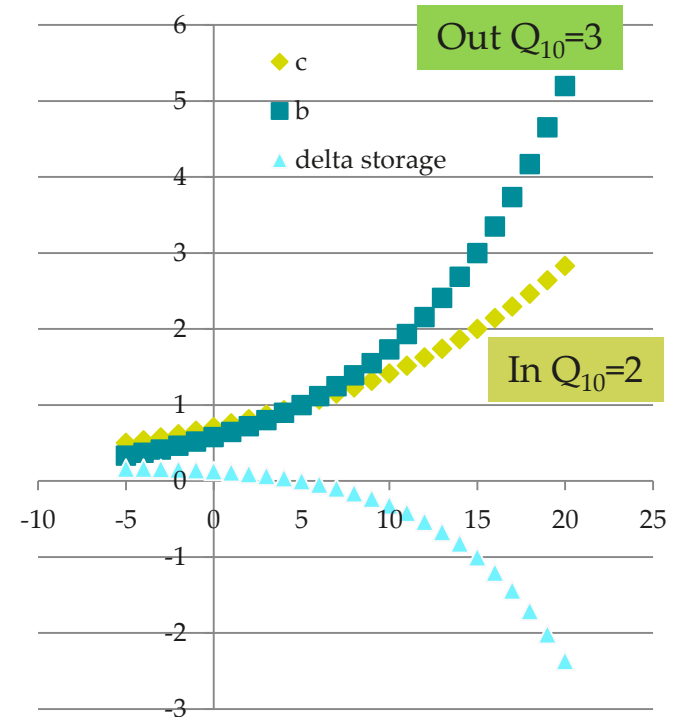
# Conceptualization



- **a**, **b**, **c** are fluxes
- $a + b =$  chamber CO<sub>2</sub> flux
- **c** difficult to measure directly but  
 $\Delta\text{DOC} = c - b$
- if **b**, **c** have different  $Q_{10}$   
→ allows temperature response pattern 3

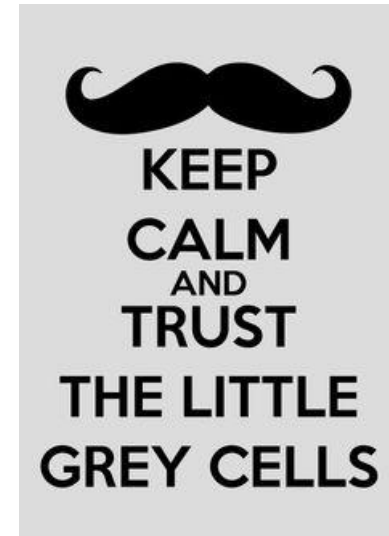
# Example

- This set up allows computation but we have to fix  $b$  using literature value (rate and  $Q_{10}$  of DOM)
- Influx  $b$   $Q_{10} = 2$  and outflux  $c$   $Q_{10} = 3$
- Resulting  $\Delta\text{DOC}$  changes sign



# Conclusions

- Intermediate products: Storage change rates are not same as fluxes
- Soil food webs may control temperature responses
- C and N have different responses



*Thank you!*



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