

Cereal Rye Decomposition Dynamics on Topographically Varied Terrain Under a Corn/Soybean Rotation

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Introduction

Decomposed residue serves as additional source of nutrients for cash crops. Cover crops are capable to scavenge soil nitrogen during fall-winter period and provide it to the cash crops in Spring. Release of N from the cover crop litter depends on the rate of decomposition which could differ at different topographical elements.

Study objective

The objective of this study is to explore the effect of topography on decomposition of a rye cover crop in a corn-soybean rotation for two soils of Michigan.

Methods

- Locations: the LTER Kellogg Biological Station (KBS) and Mason, MI.
- Soil: Kalamazoo series sandy loam (KBS) and Marlette sandy loam/Colwood-Brookston & Capac loams (Mason)
- Plots: 10 x 10 m established at Summit (SU), Slope (SL), and Depression (DE)
- Crop rotation: corn/soybean with cereal rye cover crop for five years.
- Monitoring: Soil water content and temperature
- Decomposition: litterbags with cereal rye buried at 5-cm depth at all three topographical elements.
- Sampling days: 4, 8, 16, 32, and 64.
- Measurements: Decomposed mass, C and N content.

Decay Rate Constant k

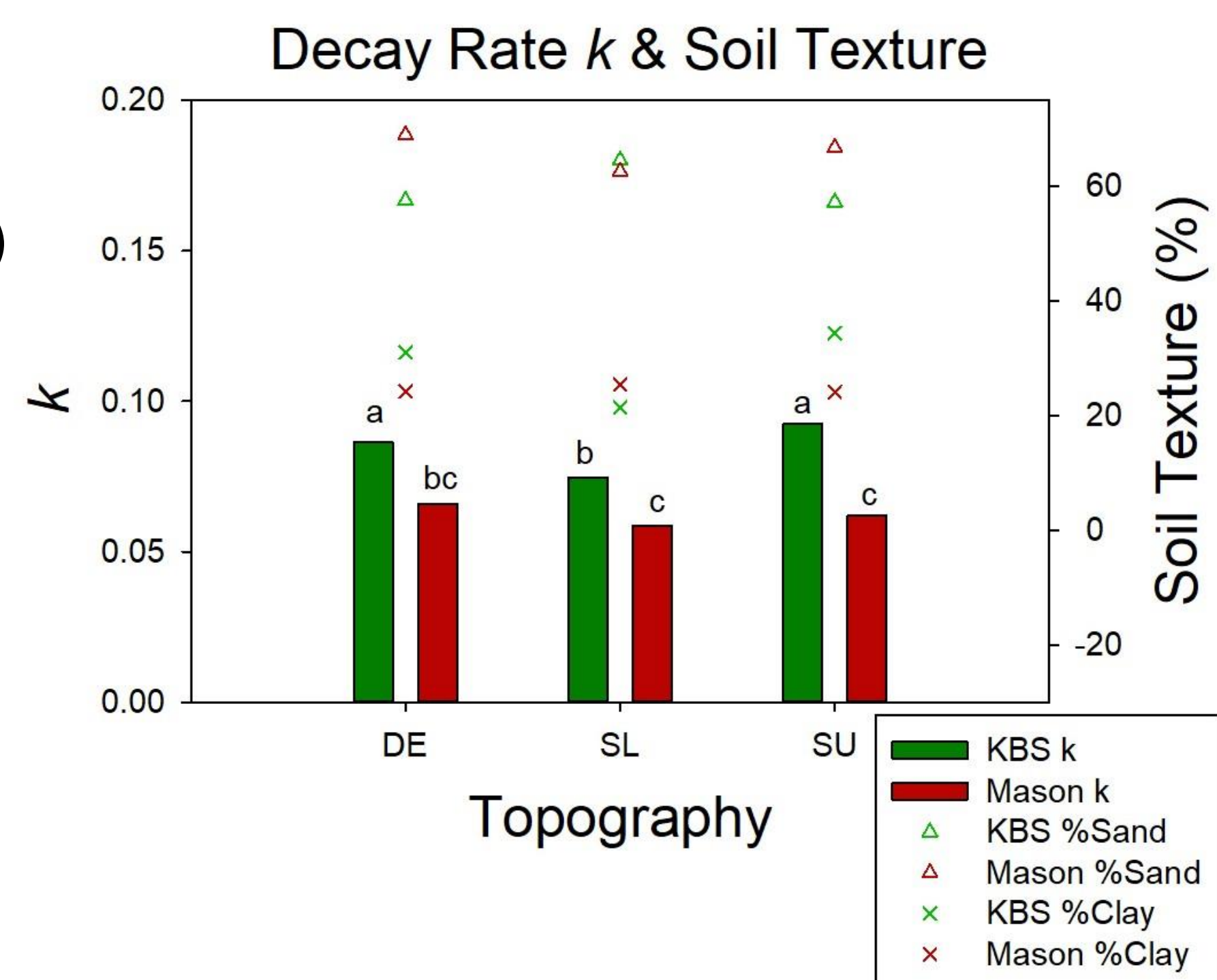
Decomposition of litter mass:

$$M(t) = M(t_0) (1 - e^{-kt})$$

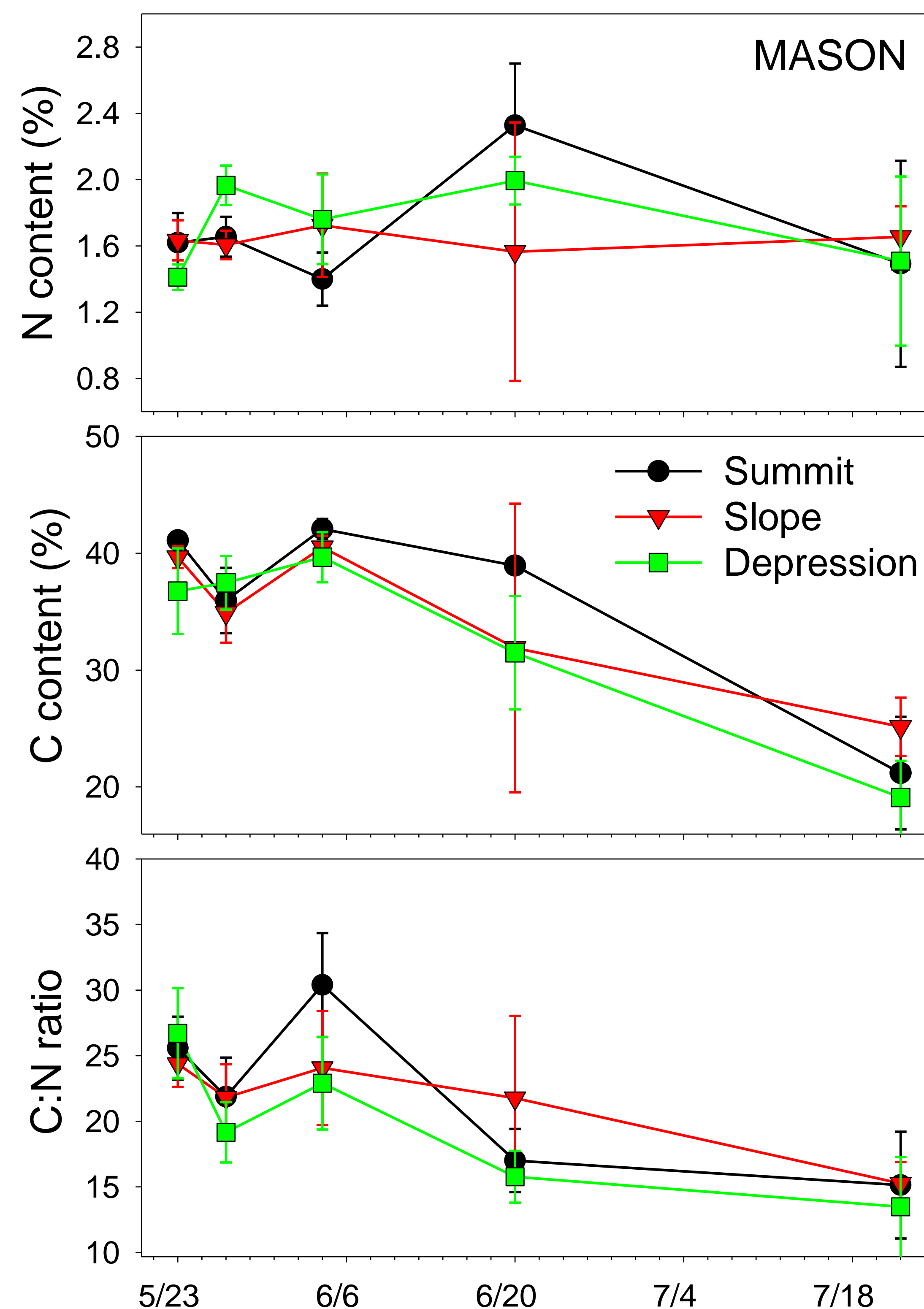
k is decay rate constant (day^{-1})

Results:

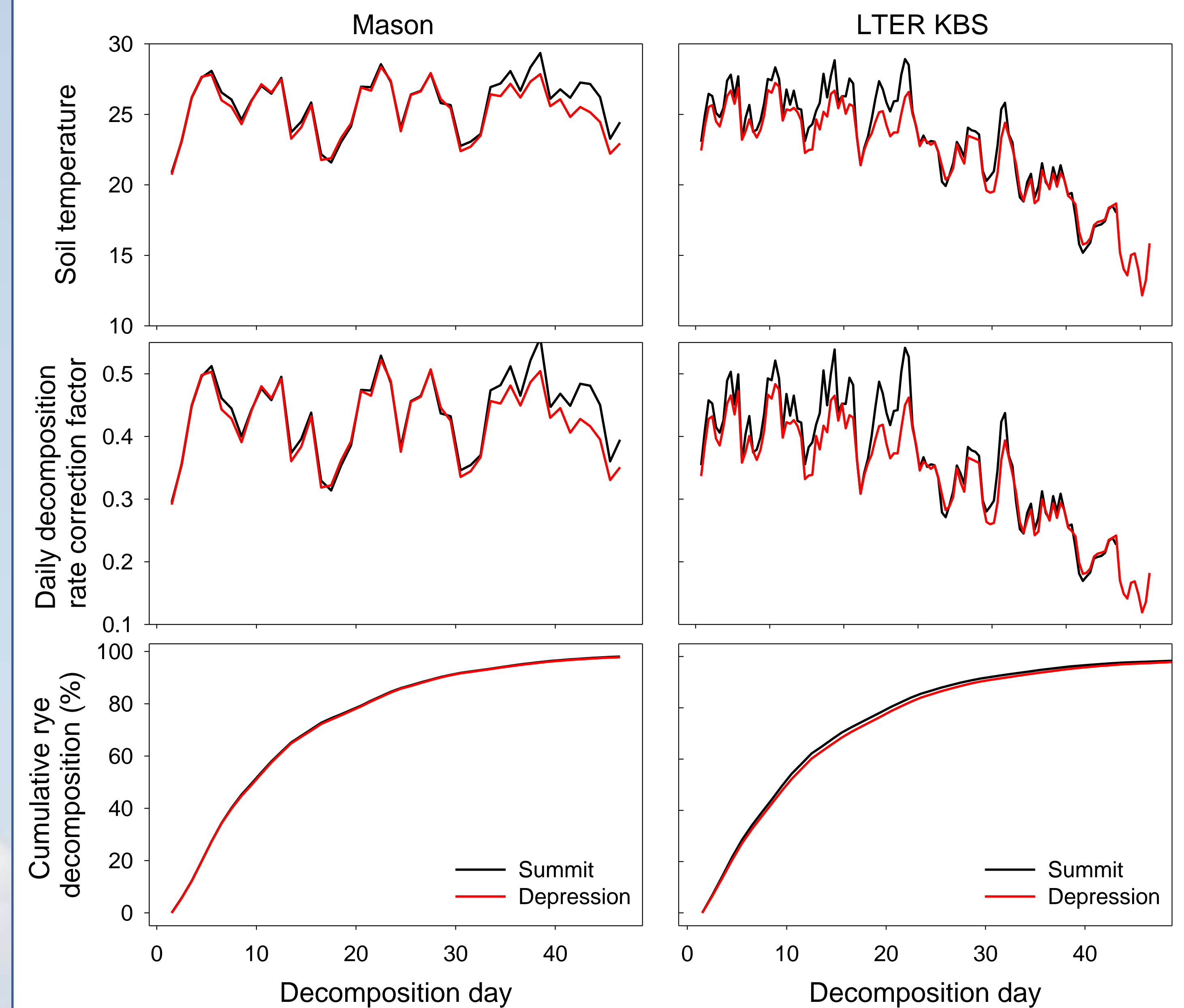
- k was significantly higher at LTER KBS than at Mason.
- Mason site: no significant differences in k -values between SU, SL and DE.
- LTER KBS site: significantly smaller k -values on SL



Cereal Rye Litter C:N and N% Dynamics



The effect of temperature on decomposition of rye litter calculated for two experimental sites



The decomposition rates were corrected for temperature as:

$$k(T) = k \exp[3.36 (T - 40) / (T + 31.79)] \text{ Kirschbaum (1995)}$$

Differences in the temperature dynamics measured at SU and DE translated into different daily rates of decomposition, however did not cause substantial changes in the cumulative values of decomposed rye residue.

Discussion and Conclusions

- The two studied sites had different texture in the top soil layer.
- The absence of differences in rye decomposition rate at different topographical elements of Mason, and presence at LTER KBS can be, at least partly, attributed to differences in soil texture at the KBS LTER site, and absence of these differences at Mason. Higher clay content at SU and DE increased soil water retention at these topographical elements of LTER KBS and likely created more favorable conditions for decomposition.
- C:N ratio in the rye residue changed during decomposition in all topographical elements at both sites and occurred mostly due to decreasing C content after 16 days of decomposition. The changes in C:N ratio can be attributed to temporal differences in cellulose and lignin decomposition and activity of different decomposers at different stages of decomposition.
- Soil temperature dynamics were rather different at two studied sites, and the differences were also observed between SU and DE at LTER KBS. These differences translated to differences in the daily values of the decomposition rates. However, they had only a minor effect on rye decomposition dynamics.