

Drier Summers: Effects on Deep Soil Carbon

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Abstract

- Climate change predictions for the SE include warmer and drier summers in coming decades.
- The soil carbon pool could lose 0.7% of its content for every degree of global warming or 5.8% of the global net primary production on land.
- Objective: This research investigates the effect of throughfall exclusion (~30% reduction) and the potential impacts of increased drying-rewetting cycles at depth (>1m) on soil CO₂ efflux.
- Result: Cumulative CO₂ efflux as a proportion of soil C content was greater in soil below 100 cm than in soil above 100cm (Figure 1).
- Result: Cumulative CO₂ efflux as a proportion of water-extractable C was greatest in 0-10 cm soil and showed decreasing trend over depth, suggesting interesting soil C decomposition mechanism (Figure 2).

Methods

- Loblolly pine (*Pinus taeda*) were planted in 2005 at a spacing of 2.1 x 3.5m.
- 2x2 factorial design with 4 replicate blocks.
- Four treatments: Control (C); Fertilizer (F); Throughfall exclusion (R); FxR.
- Soil samples at eight depths: 0-10, 10-20, 20-50 cm and 50-300cm in 50 cm increments.
- Physical and chemical attributes, including % C and N, water-extractable C, pH and soil textures as covariates for CO₂ efflux (Table 1).
- Soil samples from all depths were incubated in sealed 1-L vessels at field moisture capacity and 35°C and subject to repeated wetting (field capacity) and drying (air-dry) cycles to estimate CO₂ release.
- Gas samples for CO₂ were measured until concentrations reached equilibrium.

Table 1 Soil physical and chemical (mean ± 1SD) attributes for Kanhapludults at the study site (N=16 except were * indicating N=4)

Depth (cm)	Texture Class	pH	C (%)	N (%)	Water Extractable C (mg/kg)
0-10	loam	5.5 ± 0.5	1.92 ± 0.6 7	0.098 ± 0.025	503.5 ± 25.4*
10-20	clay loam	5.4 ± 0.2	0.87 ± 0.2 6	0.057 ± 0.012	274.8 ± 25.5*
20-50	clay	5.4 ± 0.1	0.44 ± 0.1 3	0.044 ± 0.008	157.0 ± 14.2*
50-100	clay	5.2 ± 0.4	0.25 ± 0.0 2	0.030 ± 0.002	94.8 ± 9.1*
100-150	clay	5.8 ± 0.0*	0.07 ± 0.0 3	0.004 ± 0.004	85.8 ± 8.2*
150-200	clay loam	5.6 ± 0.1*	0.06 ± 0.0 3	0.003 ± 0.003	82.6 ± 7.1*
200-250	clay loam	5.4 ± 0.3*	0.05 ± 0.0 2	0.001 ± 0.001	71.3 ± 2.7*
250-300	loam	5.3 ± 0.2*	0.05 ± 0.0 1	0.009 ± 0.002	68.8 ± 5.5*

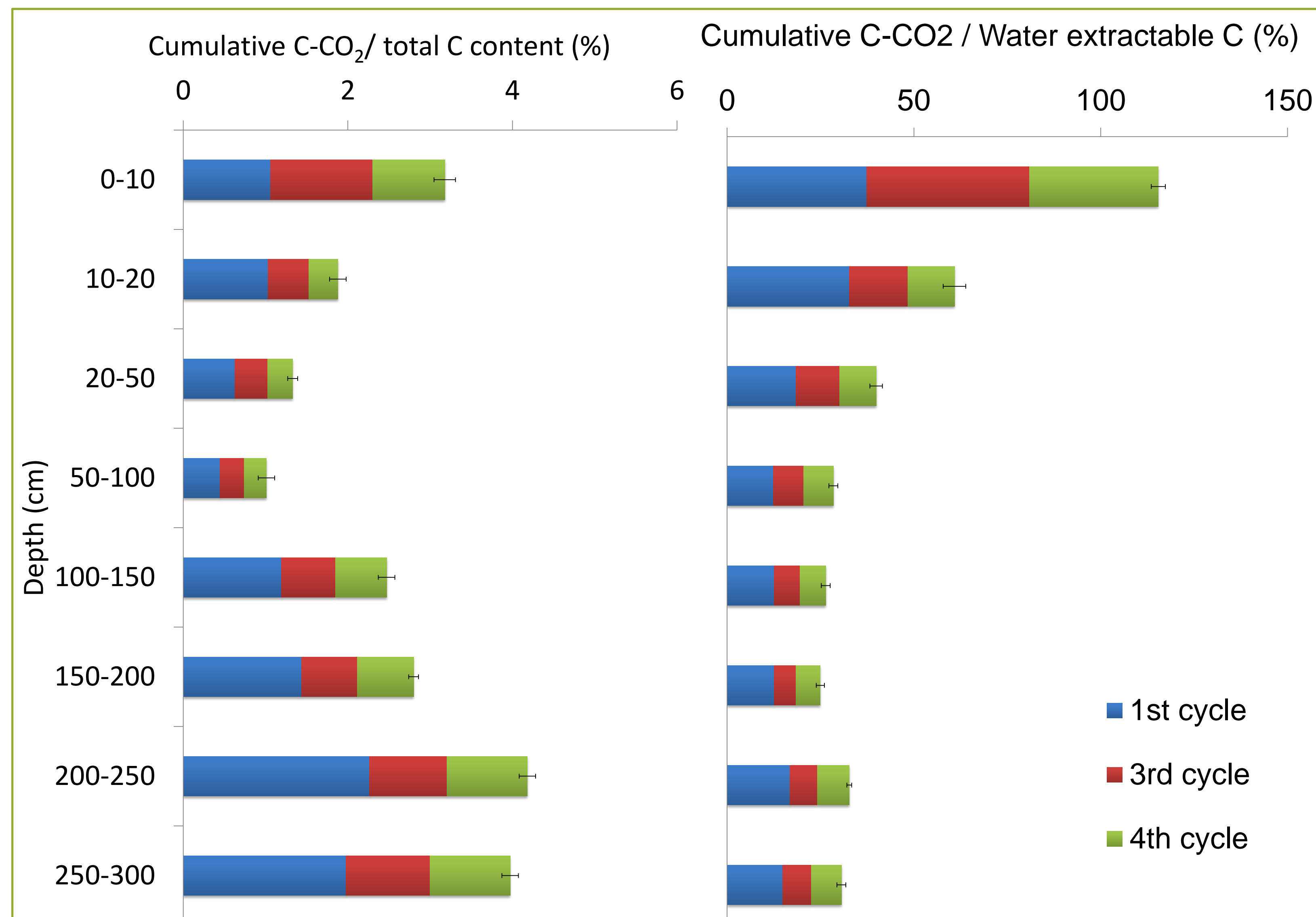


Fig 2. Cumulative C-CO₂ efflux as a proportion of soil C content (left) and soil water-extractable C (right) over drying-wetting cycles. Error bars represent ± SE.

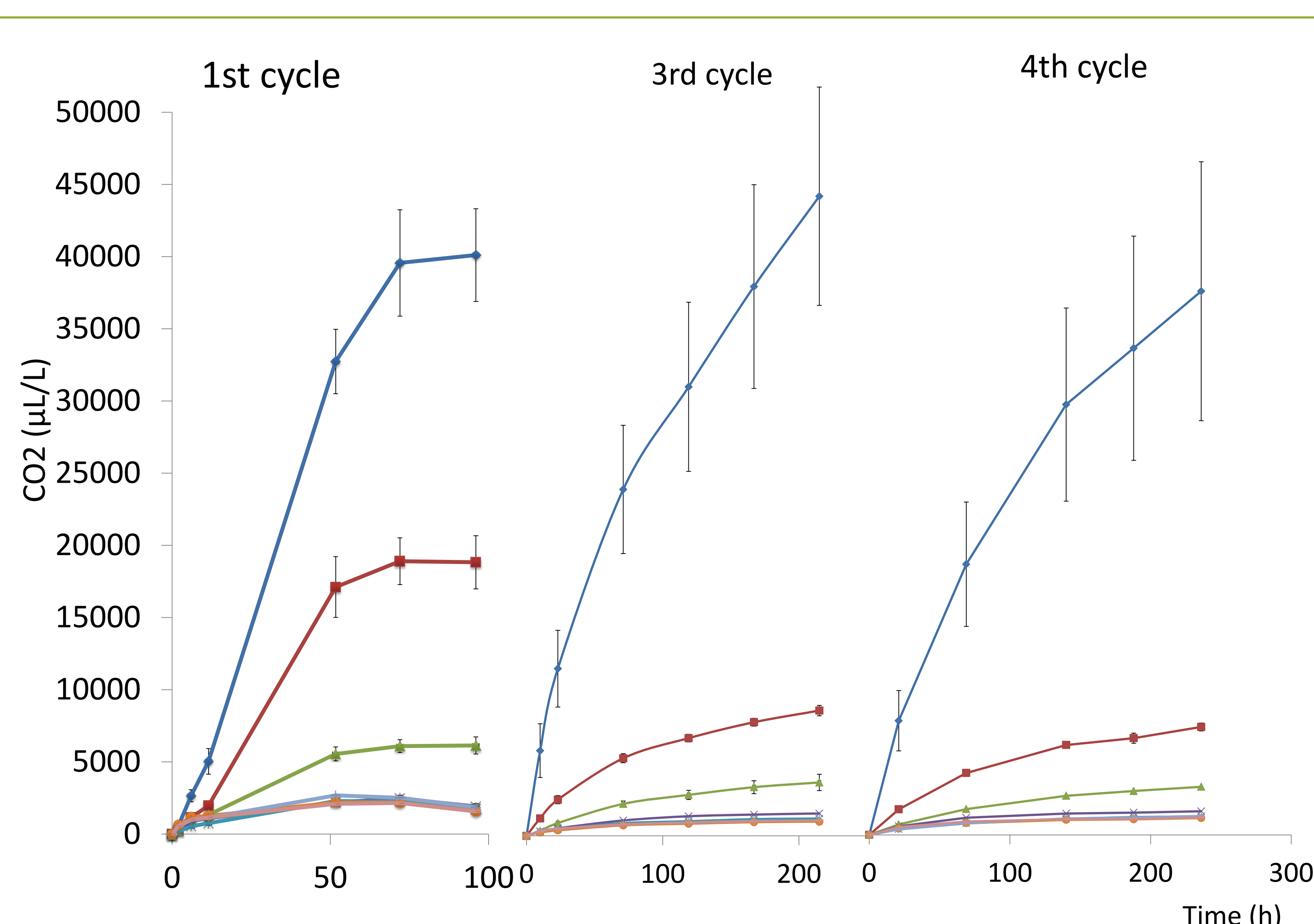


Fig 1. CO₂ concentration in sealed 1-L incubation vessels during repeated drying-wetting cycles. Soils and vessels were aerated between each cycle prior to rewetting.

Results & Conclusions

- Absolute rates of soil respiration with drying-wetting were greater in 0-10 cm soil (Fig. 1).
- At all depths there were measureable responses in CO₂ efflux with drying-wetting (Fig. 1).
- Except for the 0-10 cm soil, the cumulative soil respiration in all depths decreased over repeated drying-wetting cycles (Fig. 1).
- Cumulative CO₂ efflux as a proportion of soil C content was greater below 100 cm than soil above 100cm, indicating deep soils were more sensitive to drying-wetting cycles than top soils (Fig. 2 left).
- Cumulative CO₂ efflux as a proportion of water-extractable C ranges from over 100% (0-10 cm soil) to ~30%, suggesting only a portion of the water-extractable C was mineralized during incubations (Fig. 2 right).
- Further soil carbon fractionation is required.