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Soil carbon dynamic after freezing/thawing and drying/wetting in a temperate forest soil: Dual labeling of 13C and 14C

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Temperate forests in Chile have experienced increasing temperatures and extreme climatic events, such as severe drought and short winters in unique Araucaria araucana forest in Nahuelbuta National Park. Therefore, it is relevant to understand the impact of drying and rewetting (D/R) or freezing and thawing (F/T) on SOM turnover in these ecosystems. Particularly important is the destabilization of soil organic matter (SOM) by microbial activity, which is highly heterogeneous and influenced by soil properties and water cycles. Drying and rewetting or F/T cycles accelerate particulate organic matter (POM) decomposition by aggregate disruption, thereby, decreasing carbon (C) availability for soil microorganism. We hypothesized that frequent D/R and F/T cycles release labile organic C locked away in the aggregates for microbial consumption. We assumed that a repeated number of D/R and F/T cycles enhance the preferential C utilization of fresh organic substrate. In the present study an incubation experiment was conducted for 27 days to assess the effect of F/T (-18 ºC to room temperature) and D/R (-500 kPa to 33 kPa, field capacity) cycles on labelled ^{14}C glucose and ^{13}C lignocellulose decomposition, soil aggregates size and POM fractions distributions. CO_2 efluxes and priming effect (PE), i.e. the turnover acceleration or retardation of native C mineralization, C use efficiency (CUE) and C allocation in soil aggregate classes as POM-light, POM-occluded and heavy fractions were also determined. Labelled glucose was mainly allocated in macro (> 250 mm) and microaggregates (< 250 mm) as part of the POM-light fraction. In contrast, labelled lignocellulose was allocated in microaggregate in the POM-occluded and heavy fraction. CUE was similar amongst all treatments. The PE was negative in soil with and without cycles and it was much more pronounced (-125 mg C

kg^{-1} soil) for F/T cycles than D/R (-50 mg C kg^{-1} soil) at the end of incubation. The C:N ratio of soil following mining theory is further discussed. We conclude that D/R cycles clearly retarded the native C mineralization by preferential use of labelled ^{13}C-lignocellulose, while F/T cycles led to preferential use of ^{14}C-glucose.