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Biogeosciences Discussions

Interactive comment on "Carbon input control over soil organic matter dynamics in a temperate grassland exposed to elevated CO_2 and warming" *by* Y. Carrillo et al.

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Response to Editor Comments:

Comment 1: Short duration of exposure to treatments

This concern was shared by Referee no. 2 and we also address it in the reply to her/his comment. We agree that responses of SOM pools are sensitive to the duration of exposure to treatments. However, early responses (first 1-2 years) to experimental manipulations have been observed to be representative of longer term responses (see reply to Referee no. 2's Comment 4). Also early responses can be critical to explain the longer term behavior of SOM and can be useful for modeling efforts because they

help constrain model assumptions on longer-term dynamics.

An advantage of our field experiment is that it was modeled in advance (Parton et al., 2007). The predictions produced by that modeling exercise span ten years after the beginning of treatments and demonstrate a high dependency on yearly variations. Thus we were interested in documenting the early response of our system. Additional ongoing measurements are following the longer-term responses of SOM pool dynamics in the PHACE experiment.

We also agree that changes in bulk soil C pools are usually detected only after long exposures. In the present study, we assessed labile and resistant pools separately and this allowed us to detect early interactive effects of warming and elevated CO2 in labile pool sizes and decomposition rates, despite no detectable effect on the total soil C pool. Our first collection time took place three months after the warming treatment started. Because we were interested in evaluating the role of plant inputs on the SOM responses to CO2 and warming, the beginning of the warming treatment was planned to coincide with the beginning of that year's growing season. Thus all new plant inputs for the year were exposed to warming and we were able to observe interesting effects of both warming and CO2 on the labile C pool.

Considering that the exposure to treatments had recently began and to account for pre-experimental soil C conditions and potential impacts on treatment effects, we standardized the obtained mineralizable C, pool sizes and decomposition rates. We did this by dividing them by the concentration of C (g C/g soil) present in soil in each plot and at each depth.

Comment 2: Possible confounded effects between incubation temperatures and warming treatments

We concur that different incubation temperatures will have an impact on the respiration rates and the parameters estimated based on them. However, our main interest was in assessing treatment effects of CO2 and warming on SOM pools, rather than

the change in the magnitude of the pools sizes or decomposition rates over time. We chose an incubation approach because it allowed us to examine whether the experimental treatments are modifying the characteristics of individual C pools that affect their susceptibility to degradation, while removing the environmental constraints and confounding effects at play in a field situation (Davidson and Janssens, 2006). An incubation approach, on the other hand, has the disadvantage of necessitating artificial conditions, including a set temperature. We chose different incubation temperatures for the mid-growing season samples and the early growing season samples (25°C and 15°C respectively) with the purpose of matching field conditions so as to not generate a shock response to an abrupt change in temperature that could mask any treatment effects (our main interest). We considered that incubating early season soils at 25°C, so that all soils were incubated at the same temperature, could be more confounding than doing it at a temperature closer to field conditions.

In order to evaluate whether the different incubation temperatures altered treatment effects, we conducted incubations of a subset of soils from July 2008 at both 25°C and 15°C including all replicates of all treatments at the 5-15 depth. We found that, as expected, the increase in incubation temperature increased the size of the labile pool size and the rates of decomposition. Importantly, we found that the lack of treatment effects observed at 25°C was still observed at 15°C. Thus we have no reason to suspect that the absence of treatment effects found for the April 2008 soils (the only ones incubated at 15°C) would have been modified if incubated at 25°C. Our revised manuscript now includes this information.

Comment 3: Comparison among the three different incubations

As stated above, we agree that the different temperatures and durations of the incubations will affect the magnitudes of the respiration rates and the estimation of pool sizes and decay rates. Consequently, we did not perform statistical comparisons among incubations or draw conclusions regarding the differences in the magnitudes of pool sizes or decomposition rates among collection times. Our goal was restricted to as-

sessing treatment effects of CO2 and warming on soils collected at different times to evaluate impacts of the duration of exposure to treatments and to examine the impact of the environmental conditions previous to soil collection. We present the figures together, to illustrate changes in the treatment effects with time, not of the magnitudes of the estimated parameters. We report statistical effects for each incubation separately.

Comment 4: Priming effects cannot be inferred using this approach

Enhanced decomposition of soil organic matter due to greater availability of labile C, called the priming effect, has been documented multiple times under incubation conditions following the addition of C substrates in the absence of plants (e.g. Fontaine et al., 2007; Blagodatskaya and Kuzyakov, 2008). Our methods did not directly assess priming resulting from live root C inputs, which is considered a specific type of priming and has been termed the “rhizosphere priming effect” (Kuzyakov, 2002). In our study, we found a positive relationship between the degradability of the resistant SOM pool under incubation conditions and dissolved organic C as well as field-assessed plant biomass. These relationships suggest that the greater concentration of labile C substrates present in soil at the time of collection, and thus, due to the experimental treatments, enhanced the susceptibility to decomposition of the resistant SOM under incubation conditions.

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