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Interactive comment on "Substrate quality alters microbial mineralization of added substrate and soil organic carbon" *by* S. Jagadamma et al.

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Referee 2 General comments:

COMMENT 13: The paper of Jagadamma and co-authors is focusing on the effects of addition of four 14C-labeled, chemically different organic substrates on the decomposition of native SOC and microbial decomposer community (bacteria and fungi) of four contrasting soils from tropical, moderate, sub-arctic and arctic ecosystems. Authors applied relevant isotope-based methods and molecular analysis to partition soil CO2 respiration and to quantify microbial gene copy numbers. Additionally, cumulative CO2 production was mathematically approximated to reveal best-fitted model for range of substrates and soils. Despite the up-to-date approach, quality of writing and the topic of the direct scope of Biogeochemistry there are, however, several issues which

prevent this paper to be accepted in its current state. Below authors will find general comments while specific recommendations for the paper improvement and technical corrections are directly in the draft file attached.

RESPONSE 13: Thank you for your detailed comments. They are very helpful for improving the quality of the manuscript. Please find below our responses to your general comments. We replied to each of your specific comments in the annotated version of the manuscript and is attached (File name: Annotated manuscript with responses).

COMMENT 14: First of all, the weakest point of the study, to my point of view, is a rather simplistic interpretation of obtained information: although long-term experiment with amendment of uniformly labeled substrates was conducted to estimate mineralization of added and native OM (e.g. priming effect, PE), very few discussion is devoted to the phenomena of PE as such. What kind of PE was observed? Which mechanisms were involved? How PE differed between such contrasting soils? What is the ecological relevance? These questions left almost unanswered.

RESPONSE 14: Thank you. Section 4.2 will be revised by including the discussion on whether substrate addition in this study caused positive priming effect. In addition to revising the existing text, the following paragraph will be added in section 4.2.

'Past studies which used sugars, organic acids and amino acids to understand the priming processes in soil and reported either positive, negative, or no priming effects (Kuzyakov et al., 2007; Hamer Marschner, 2005; Kuzyakov Bol, 2006; Blagodatskaya et al., 2007; De Nobili et al., 2001). Hamer Marschner (2005) added four diverse compounds (fructose, alanine, oxalic acid and catechol) on three different soils, and found that both fructose and alanine caused positive priming in all soils, and catechol and oxalic acid caused positive as well as negative priming depending on soil types. The priming effect is generally believed to result from an increased microbial activity when easily available substrates are added to soils. However, some studies found little or no priming of SOC when simple compounds such as glucose or fructose were added

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as oppose to more polymerized compounds such as plant litter or cellulose (Dalenberg Jager, 1989; Wu et al., 1993), which is consistent with our results. Brant et al. (2006) found positive priming from a forest soil in Oregon following the addition of glucose, glutamate, oxalate and phenol, but the extent of priming was greater with oxalate and phenol addition as compared to glucose and glutamate addition. Thus the causes and mechanisms of priming are more complex and closely linked to substrate type, soil characteristics, and microbial function (Blagodatskaya Kuzyakov, 2008)'.

COMMENT 15: Secondly, the reasoning of the hypothesis 1 ("cumulative respiration of substrate C and native C would be higher when soils are amended with easily metabolized substrates compared to relatively more complex substrates") is not clear, since it was not resulted from introduction.

RESPONSE 15: We admit that the reasoning for this hypothesis provided in the second paragraph of introduction was not obvious. The following statement will be added in this section.

'In general, accelerated SOC decomposition was noticed when simple, dissolved substrates such as glucose was added to soil because of the easy availability of C and energy sources to microbes (Blagodatskaya Kuzyakov, 2008)'

Hypothesis 1 will also be modified as below.

'cumulative respiration of substrate C and native C would be higher when soils are amended with easily metabolized substrates compared to relatively more complex substrates because of the faster availability of C and energy sources from simple substrates to microbes'

COMMENT 16: Thirdly, modeling part, especially biophysical meaning of each model applied, should be much better explained and justified (see specific comments).

RESPONSE 16: We used a 2-pool exponential decay model for modeling the 14C-cinnamic acid and 14C-stearic acid respiration data and also for native soil C respira-

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tion data. However we used a 3-pool exponential decay model for modeling the 14C-glucose and 14C-starch respiration data. Two forms of exponential model were used because of the following reasons. Following Farrar et al. (2012), we set two criteria for selecting the best fits: (i) dependencies less than 0.98, and (ii) a statistically greater r2 over a lower-order fit. In the case of 14C glucose and 14C starch respiration data, both 2-pool and 3-pool models met criteria (i), however, the r2 was statistically higher for 3-pool model over 2-pool model. So we selected 3-pool model to fit the data. In the case of 14C cinnamic acid, 14C stearic acid and native C respiration data, 3-pool model did not meet criteria (i). So in this case we selected the 2-pool model. Please also see the response of COMMENT 8 from Referee 1 for additional information. The responses to the specific comments on the annotated version of the manuscript are attached (file name: Annotated manuscript with responses)

COMMENT 17: Lastly, there is a lack of statistical information on some figures and tables either in main text of the manuscript or in Supplementary.

RESPONSE 17: We included the missing statistical information (alphabets to indicate statistical significance based on Least Significant Difference values) in Fig. 4, Fig. 5, Table S2, Fig. S2, Fig. S3).

COMMENT 18: Please also note the supplement to this comment: http://www.biogeosciences-discuss.net/11/C1324/2014/bgd-11-C1324-2014- supplement.pdf RESPONSE 18: The responses to the reviewer comments on the supplement was included in the supplement itself and this file is attached (file name: Annotated manuscript with responses)F

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/11/C2334/2014/bgd-11-C2334-2014-supplement.pdf

Interactive comment on Biogeosciences Discuss., 11, 4451, 2014.