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Interactive comment on "Modification of the RothC model to simulate soil C mineralization of exogenous organic matter" *by* Claudio Mondini et al.

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We would like to thank the Referee #2 for her/his valuable and relevant comments to the manuscript. Please find below our response to the main concern raised by the referee about the current version of the manuscript.

Comment of Reviewer #2:

My main issue with the current version of this manuscript is that the authors do not formally show an analysis that justify the modification of the current structure of RothC. The authors do mention some preliminary work (lines 335-336, 358-360) in this direction, but concrete results are not presented in the manuscript. I think it is very important

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that the authors show how a simple modification of the DPM/RPM ratio is not enough to predict C mineralization from incubations with added EOM. Further, I think it would be important that the authors provide an analysis of the added benefit of a more complex model structure through calculation of common indexes such as Akaike Information Criteria, which would be helpful in deciding if a more complex model structure with more parameters increases predicted power or whether the simpler more parsimonious model structure is preferred.

Authors' reply:

We agree with the referee concerning the importance to demonstrate the necessity of the proposed model modification. In fact, and as reported in the manuscript (LL 358-367), the initial idea of our study was to fit the respiratory curves of laboratory incubated soil by only modifying the partitioning factors of DPM, RPPM and HUM of added EOM and leaving unchanged the standard decomposition rates of RothC (i.e. 10, 0.3 and 0.02 y-1 for DPM, RPM and HUM, respectively), as carried out by Falloon (2001) and Peltre et al. (2012). However, results of the fitting procedure showed that RMSE was not satisfactory in most of cases, being higher than 20%. Therefore, we modified the model by introducing the possibility to vary the decomposition rate of decomposable and resistant pools of EOM and this model structure showed a more accurate predictions of respiratory curves (mean RMSE of 4.5%). Following referee's suggestion to demonstrate in an analytical way the benefit of a more complex model structure, we have performed the calculation of the AIC index (Symonds and Moussalli, 2011) from the results of the respiratory curves fitting of 2 different model structures:

1) Current RothC model: the model only allows for variation of partitioning factors for EOM pools (DPM, RPM and HUM), while decomposition rate constant are fixed (i.e. 10, 0.3 and 0.02 y-1 for DPM, RPM and HUM, respectively).

2) Modified RothC (proposed in the MS): the model allows for modification of partitioning factors and DPM and RPM decomposition rates of EOM.

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In total we calculated the AIC index for more than 80 respiratory curves and for the two model structures and results clearly showed that the increase in model complexity due to the introduction of new parameters was justified by the significant improvement in the model performance. According to the threshold values, based on AIC, indicated by Snipes and Taylor (2014) to determine the level of evidence for selecting between different models, the modified model was decisively better than the current one for all the respiratory curves selected for AIC determination.

The rationale beyond the proposed modification arises from the consideration that the current Roth C model structure is not adequate to describe the mineralization dynamics of EOMs characterized by a huge variability in terms of structure and degradability. We consider that the model performance would be increased by the possibility to set specific decomposition rates for decomposable and resistant EOM pools. In this perspective, models with a similar complex structure as in the proposed modified RothC (5 different pools of C input to the soil and specific decomposition rates for decomposable and resistant EOM) have been already proposed and successfully validated for amended soils (NC-SOIL: Noirot-Cosson et al., 2016 - CN-SIM: Petersen et al., 2005; Cavalli and Bechini, 2012).

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