SOIL Discuss.,
https://doi.org/10.5194/soil-2020-76-AC1, 2020


# *Interactive comment on* "Simulating soil organic C dynamics in managed grasslands under humid temperate climatic conditions" *by* Asma Jebari et al.

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Received and published: 31 December 2020

Answer to comment 1

We agree with reviewer 1 that, ideally, the best way to modify and construct a model would be by using new large and high-quality datasets (e.g. long-term experiments, best-tech and sample numbers). However, since specific data (e.g. isotopes and fractionation that account for changes in vegetation growth) on grasslands under humid conditions seem to be missing, or at least not available, to our knowledge, we explored, as a hypothesis, the potential value of constructing small changes in the Roth-C model based on: i) changes already tested in other similar models (e.g. soil moisture function



by ECOSSE), ii) the scientific literature to account for particularity of exogenous organic matter (EOM) such as ruminant excreta and for the different components of plant residues and distinguish its quality (iii) and available experiments under humid temperate conditions to add a poaching effect sub-model. In the manuscript, we highlight that the poaching modification is rather uncertain because of lack of long-term experiments in the scientific literature (line 350, line 387 and line 430). The paper includes a sensitivity analysis of the modified model to assess the robustness of the different modifications (See "sensitivity analysis" section). In general, the model is more sensitive to C input quantity than to quality and to soil moisture function, particularly at saturation conditions.

Answer to comment 2

As previously mentioned, we agree that the more quality data used for a validation exercise the better to prove the validity of a model within certain environmental and management boundaries. Unfortunately, only four field studies have been found with data availability. We tried to obtain data from at least three more sites (e.g., Dripsey intensive grassland site and Carlow grassland site in Ireland, Haller research farm in the USA...) but we could not get hold of these data. The validation of the model improvements were made with the field experiments in humid temperate conditions included in the FLUXNET program (http://www.fluxnet.ornl.gov/) (Baldocchi, 2008), which have been presented in many studies (e.g., Ammann et al. 2009; Klumpp et al. 2011; Skiba et al. 2013...) and their data are considered of high quality and have been used in many studies before (e.g., Soussana et al. 2007; Ben Touhami et al. 2013; Sándor et al. 2017...). We opted for grassland sites that are under temperate climatic conditions (with precipitation > 1000 mm) and management regimes that are common for intensive grassland-based livestock systems in this agroclimatic region of Europe: Laqueuille intensive grazing grassland (France), Oensingen intensive cutting grassland (Switzerland), Easter Bush intensive grazing grassland (United Kingdom) and Solohead dairy research farm (Ireland) because they presented similar climate and

management conditions (managed grasslands under humid temperate conditions). All these four experimental sites presented initial and end SOC stock values which were used in our model validation. For instance, Vuichard et al. (2007) improved PASIM model and tested it against measurements of 3 sites. Nemo et al. (2017) tested RothC initialisation referring to 4 sites. We understand that this validation exercise is useful but certainly, is not definite. This is recognised in the manuscript (validating against more sites would greatly improve the confidence of the model) (line 351, line 364, line 383, line 385, line 392, line 433).

Answer to comment 3

We agree that, ideally, the best way to get the IOM pool of RothC model would be from soil radiocarbon-SOC measurements. This is indeed something that the RothC developers indicate for example in Fallon et al. (2000). Since radiocarbon measurements are costly and rarely performed routinely, the same RothC developers indicated that IOM can be estimated, alternatively, from an empirically-derived relationship between IOM and total SOC (Falloon et al., 1998), which showed good fit (Falloon et al., 2000, 2006). The estimation of IOM with the equation proposed by Falloon et al (1998) has, in fact, been used in almost all the RothC modelling studies (e.g., Giongo et al., 2020; Francaviglia et al., 2012; Mondini et al., 2012. . .).

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