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Interactive comment on "No Silver Bullet for Digital Soil Mapping: Country-specific Soil Organic Carbon Estimates across Latin America" *by* Mario Guevara et al.

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Responses to referee 2

The authors appreciate the constructive and positive feedback from the referee. The authors will follow the referee suggestions in order to improve the quality and value of the paper. Below, we also clarify some concerns about our decision of using only publicly available data.

1) It would be interesting to see a map showing the geographical distribution of SOC on each country

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Discussion paper

We fully agree and will include a map of the observational data used for our model evaluation.

2) Explain the country-specific pedotransfer have developed to address missing bulk density values.

We appreciate this comment. We clarify that we did not developed any new pedotransfer function applied to missing bulk density values. To fill missing values, we used a simple pedotransfer function based on organic matter OM (Drew, 1973, BD = 1/(0,6268 + 0,0361 * OM). We decided to use the equation because it showed less extreme values than other available pedotransfer functions during preliminary training exercises (data not shown, see FAO, 2017 p7). Another reason is that there is not a single pedotransfer function applicable to all soil types across Latin America. The proposed equation is representative for soils with organic matter content between 0.17 to 13.5% (Drew, 1973). We assumed a value of 0 when coarse fragments were missing, which could lead to overestimations of SOC stocks. Because of these reasons we focus on model comparisons across 19 possible scenarios of data under a variety of environmental conditions, rather than reporting SOC stocks. Country-specific SOC stocks are required by the United Nations to be officially reported by the institutions of each country with the mandate to generate soil information with certain data-specifications (e.g., 1km or less). This effort is beyond the scope of this study as our intention is to provide a fully reproducible framework with no major computational requirements (i.e., conventional laptop) and in short periods of time (2-6 hours). This approach is meant to provide capacity building for digital soil mapping across Latin America.

3) Compare and contrast your results with other national/global SOC mapping studies. What added values your study provide?

We will enrich the discussion of our results in a revised version of the manuscript. We will mention SOC stocks but will focus on model performance and model performance metrics (as SOC stocks is not the main focus of the paper, but we will make modifications in the results [see next response]). With this study we aim to provide a benchmark for model performance evaluation across Latin America using a publicly available dataset and publicly available covariates at a contextual resolution of 5x5km, in a country-specific basis.

4) Include a Table with the total SOC stocks for each country you've mapped and compare the values with other published estimates

We will include more information (e.g., a new Table) about the estimated soil organic carbon stocks from the predicted maps. Another possibility could be to modify Figure 4 to and report SOC stocks. We will also include a brief discussion based on previously reported estimates but will emphasize the importance of model accuracy within the available datasets.

5) Top-down rather than a bottom-up approach regarding the data used

The authors agree that this effort represent a top-bottom approach regarding the data used. The authors recognize that country-specific SOC estimates should be ideally based on all the best available information on each country. However, our effort to highlight in a country basis that the no-free-lunch theorem should also apply for soil carbon mapping does not seems to be compromised by the used data. ISRIC's soil profile dataset is a compilation of national soil inventories from a large number of nations which has been successfully used to generate global hypothesis about soil carbon dynamics (Sanderman, Hengl and Fiske. 2017), and we would argue that is a suitable dataset for a multi-model approach, such as the one presented here.

Recently the United Nations requested Latin American countries to build technical and institutional capacities on digital soil mapping, thus, each institution responsible on each country has dedicated efforts to rescue legacy data and assembling a national covariate space with the ultimate goal to implement an efficient spatial inference system customized to their country-specific needs (e.g., country level soil carbon reports). Large amount of information is still on a "rescue phase" (e.g., from paper to digital) and/or being curated by a soil expert designated by each country.

From a bottom-up approach, each country has a unique digital soil mapping story to tell and we consider important to encourage the institutions of each country to lead scientific research around the use of publicly and non-publicly, yet available soil data sets across their countries. We believe that such effort would strength the formulation of public policy around soil resources management and country-specific soil conservation capabilities. However, we also argue that countries should learn from each other experiences and work together towards the development of reference frameworks for the country-to-region validation of global information sources and models. Such collaborative effort would be of high priority since large discrepancy has been reported on globally available soil carbon datasets at this contextual coarse resolution (Tifati, Guenet and Hatté. 2017). Thus, we believe that studying the effect of using top-bottom standardized datasets to train country-specific models represent a middle point that could contribute to explain the current discrepancies between country-specific and global soil organic carbon models.

The work of Padarian, Minasny and McBratney (2017) is an important reference framework, which will be cited in the following manuscript version. It shows a good proportion to available data across Chile. The use of Google earth for digital soil mapping is currently underutilized and may represent the best option to handle big datasets incredibly fast and with access to multi-source and multi-temporal environmental information sources relevant for soil mapping applications. We invite Padarian, Minasny and McBratney (2017) to consider the participation of Chilean institutions in future efforts to map soil properties and functions across this country. Current soil mapping efforts across large countries such as Chile with large gaps of information and sparse data would benefit from the interaction between the expertise of the authors at the University of Sydney and the institutions with the mandate to generate soil information across this nation (e.g., Ministry of Agriculture).

The authors appreciate your constructive feedback to this manuscript.

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