

## ***Interactive comment on “Global distribution of soil organic carbon, based on the Harmonized World Soil Database – Part 1: Masses and frequency distribution of SOC stocks for the tropics, permafrost regions, wetlands, and the world” by M. Köchy et al.***

**Anonymous Referee #1**

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Soils stores a large fraction of terrestrial organic carbon. The soil organic carbon plays an important role in the biosphere. A reliable data set is the prerequisite to accurately represent the pools and fluxes of carbon. There are several estimation works based on global soil mapping (observation derived) and earth system models (simulation), and given the terrestrial organic carbon in a large range from 500 to 3000 Pg or higher. This manuscript gave us another number and geographic distribution. It is also valuable to

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improve our understanding on carbon cycle as a reference or benchmark data set. This manuscript gave us another estimation of soil carbon based on HWSD with adjusting the bulk density of Histosols, the definition of wetland, and incorporating more detailed estimates for permafrost from the Northern Circumpolar Soil Carbon Data Base. Though there is no anything original, it still is an important approach and valuable, and could be accepted after revision.

General comments: Soil depth matters in the SOC stock estimate, especially for deep soils. Though this paper corrected SOC of depth >1m in the peatlands, most of the true soil depth are not known in soil profile observations. Though we may lack data or method (extrapolation?) to reduce the uncertainty caused by the assumed soil depth, we need to keep this in mind. This uncertainty is not only for the <1m soil but also especially for the deeper soils. As a result, the uncertainty should be emphasized in some parts of the paper, such as page 338, line 8-17 and the conclusion section.

Consider describe the correction of frozen soils in the method section, since the combination of the three dataset is more reliable.

Consider change the order of section 3.3 and 3.4, i.e. correcting first and then overlaying with the wetland data.

With the above two modifications, corresponding tables and figures need to be redrawn or added.

Consider delete “based on the Harmonized World Soil Database” in the title.

The part 2 of the paper only uses the HWSD to calibrate a SOC model, which is not very close to the part 1. It is better to treat these two parts as independent papers.

Specific comments: Page 328, line 15: 1325Pg, to be consistent with the number in the conclusion.

Page 330, line 6-8: WISE(v.2) was once publicly available. But it is now replaced by the

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WISE (V.3.1), which is available online and includes all profiles of previous versions.

Page 331, line17-20: The description is not precise. Shangguan et al. (2014) used three soil profile database directly, i.e. China, WISE(V.3.1) and NCSS of US, and they also used estimates (produced by others) based on local soil profiles and soil maps from ESDB (Europe), SOTWISE(various regions), GSM(US), SLC (Canada) and ASRIS (Australia).

Page 331, line 17, line 23: change “Shangguan et al.”to“Shangguan et al.”

Page 332, line7: It should be “equal to or smaller than”.

Page 332, line9-29: Almost all the soil profiles in WISE do not have a real soil depth (or depth to the bedrock or R horizon), but have the observation depth. These soils are very likely much deeper than the recording depth in WISE. Only 189 profiles in WISE have an R horizon (some have a SOC great than 0, which seem to be errors). As a result, the overestimation for Cryosols, Podisols, and Umbrisols might not happen, especially for Cryosols and Podisols. Another point is that the soil depths in both HWSD and ISRIC-WISE are an underestimation of the true soil depth in almost all cases. It should not be named as “soil depth” in the paper. You may use the term “effective” soil depth in ISRIC-WISE (v3.0), or use the term “reference soil depth” in the HWSD.

Page 333, line7 and et al. : kg cm<sup>-3</sup>

Page 333, line9: Why these regressions and the R<sup>2</sup> are different from the authors previous report, i.e. Hiederer and Kochy (2011)? They are both based on WISE3.1. The difference of BD is 0.139 for the topsoil using the regressions when OC = 12%.

Page 333, line 9: ln(Corg \*100)

Page 335, line 13-17: It lacks a soil profile database with WRB classification information to develop a WRB based soil property maps. Taxonomy reference between WRB and FAO will increase the uncertainty.

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Page 335, line 23-24: the stock was estimated based on the polygon based soil map except Australia, not after rasterization.

Page 336, line 23: 13.4 Mm<sup>2</sup>

Page 338, line 6-7: in the other regional stocks and the stocks of soils deeper than 1 m.

Table 1: The authors used some definition which is not consistent with most literatures and may bring some confusion to the readers. I suggest using the general meanings of a terminology in the literature, instead of creating some new terms. Like the following: Content: organic carbon mass/soil dry mass; ??: organic carbon mass/soil volume (I do not see any use of this term in the paper); SOC density of a layer: organic carbon mass/soil volume×depth×(1–fractional volume of rocks, coarse roots, and ice); SOC density of all layers: areal density of fine soil integrated over all layers to a specified depth: SOC stock: stock integrated over a specified area.

Table 3: Tables should be self-explainable. Please explain what is the hist/soil and it is not explained in the text.

Table 3: What do you want to show with so many figures in table 3, while you only mentioned the total numbers in the text? This table needs further interpretation or you may delete it.

Table 5: It is better to show the percentage of the overlapping. Maybe use the overlap area/(GLWD +GLCC), and 50% indicate completely identical.

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