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Interactive comment on “Global distribution of soil organic carbon, based on the Harmonized World Soil Database – Part 2: Certainty of changes related to land-use and climate” by M. Köchy et al.

Anonymous Referee #2

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General: This is an important paper because it makes a serious attempt at estimating the certainty associated with projected changes in soil organic carbon due to changes in climate and land-use on a global scale. The paper is very well written. The authors' state this work represents an advancement beyond another recently published certainty estimate (Hararuk et al., 2014) because it includes wetlands, permafrost zones, land-use, and land-use change. For this reason, I think the paper would be improved if the authors provided more clarity and emphasis on how wetlands and permafrost zones were handled in the analyses. In particular I found it difficult to discern how wetlands (including peatlands) were parameterized and how peatlands in permafrost

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zones were handled. As part of my review process I referred to the companion paper “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, wetland, and the world”. I was unable to open the files in Supplements 1 and 2. Overall my assessment is that this is an excellent paper.

Scientific questions/issues: There is no mention, in the introduction or discussion, of the potential impact of natural disturbances (e.g., wildfire, insect outbreaks, windthrow, etc.) on soil C dynamics. This is at least worth mentioning particularly because one of the main conclusions in the first paragraph of the Discussion is “The greatest changes in mean SOC stocks after 75 years globally were due to absolute changes in NPP and thus C inputs to soil”. Landscape scale natural disturbances can affect NPP, the timing and amount of inputs to soil, and in the case of wildfire, the loss of soil C particularly in organic horizons on mineral soils, and organic soils (e.g., peatlands). Page 367 lines 11-17; Is there a mechanism in your model or algorithms that allows for carbon the inaccessible pool to transfer to one of the accessible pools as a result of climate change, land-use, or land-use change? Please explain. Page 369 lines 16-18; indicates all inputs (equal to NPP) go into the fast and slow pool; then on page 367 lines 5-7 all inputs go only into the fast pool. Please clarify. If inputs go to both the fast and slow pools please explain the rationale for how the inputs are split between the fast and slow pools. Page 369 lines 24-25; It would help if you could explain the difference between your definition of zonal and azonal. Here you appear to describe wetlands as only being “azonal”. There are areas in the world where wetlands (e.g., peatlands) are zonal, as I would define them (widespread, dominant soil type). Please clarify. Page 371 lines 1 and 2; Please expand your explanation of how oxygen availability is determined, what data is used from the HWSD and how? Page 371 lines 22-24; I looked at Grace et al. 2006 which appears to apply only to mineral soils. Did you use the same expression based on CEC for organic soils that can have CEC values that are much higher than occur in mineral soils? Please clarify if this expression was only applied to mineral soil which would be appropriate. Page 375 lines 6-9; Please explain how C is

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protected by high CEC. How would this apply to organic soils? Page 377 line 27; Would you explain which tundra regions in the world are expected to be able to support boreal forest plantations? Where would soil profiles be thick enough to support plantations? Page 378 lines 2 and 3; This is an example where it was difficult for me to interpret or understand the statement because wetlands were not treated explicitly enough in the paper. This statement may be true for mineral soil permafrost areas that might convert to wetlands, but we also have permafrost peatlands that are already wetlands. What is expected to happen when they thaw? Page 378 line 4; Again a more explicit treatment of peatlands would help with interpreting this statement. Do you mean that regions that are boreal now, and remain boreal in the future will have more timber plantations and arable land? Or areas that are now Arctic or tundra, become boreal and they will have more timber plantations and arable land? For example, as one moves north in the boreal of Canada peatlands become more dominant on the landscape. It is unlikely that even if climate changes that these peatlands are an appropriate soil type for plantations or arable land. Please clarify your thinking. Page 379 lines 17-20; But doesn't Todd-Brown et al. 2014 question the validity of these models in the first paragraph of their conclusions?

Technical corrections: Page 372 lines 2-3; This statement is just a little bit unclear. Does your statement mean "Above- and belowground fine (leaf and fine roots respectively) and above- and below ground coarse (coarse woody debris and coarse roots respectively) contribute. . . ." Please clarify.

Page 374 line 21; Is NNP a typo? Should it be NPP? If this is the case NNP also appears in Supplement 3, page 5 and should be corrected.

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