

## ***Interactive comment on “Permafrost soils and carbon cycling” by C. L. Ping et al.***

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**General comments** This paper gives a great review of the current literature and geomorphologic phenomena of permafrost soils. It is a much needed compilation of the growing number of papers concerning permafrost and carbon. I recommend publishing the paper after implementing following minor revisions.

**Specific comments** Page 710: Please add a conclusive sentence to the abstract sentence

We added the conclusive sentence as suggested “The low temperature and cryoturbation in permafrost soils enhanced the accumulation and sequestration of OC that is less humified due to low temperature thus more vulnerable to decomposition upon release from thawing permafrost.”

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Page 710, line 23: After Zhang et al 2008 (doi: 10.1080/10889370802175895) permafrost underlies 24% of the landmass of northern hemisphere, not Earth. The 22.79\_106 km<sup>2</sup> permafrost described by Zhang et al 2008 would be ~15% of the Earth landmass (assuming an land area of 148940000 km<sup>2</sup>).

We revised the sentence and added the reference of Zhang et al, 2008 as suggested “Permafrost underlies approximately 22.79x106 km<sup>2</sup>, nearly 24% of the landmass of northern hemisphere or ~15% of the Earth landmass (Zhang et al., 2008).

Page 710, line 25: ice-free land areas could be misunderstood as there is a lot of ice in the sediments (but not above: : :) Please change to e.g. unglaciated or non-ice-covered.

We changed the “ice-free” to “non-ice covered”.

Page 715, line 23-24: The water, which fill the thermal cracks, are refreezing immediately and not in the following winter. Add “Lachenbruch 1963” to this paragraph and “Lachenbruch, A. H.: Contraction theory of ice-wedge polygons: A qualitative discussion, in: Proceedings of the 1st International Conference on Permafrost, edited by: Woods, K. B., National Academy of Sciences - National Research Council, Washington, 63-71, 1963.” to the reference list

We revised the sentence as suggested and added the reference of Lachenbruch, 1963).

Page 717, line 17: Add the review chapter of Grosse et al. 2013 (Grosse G., Jones B., and Arp C. Thermokarst Lakes, Drainage, and Drained Basins. In: John F. Shroder (Editor-in-chief), Giardino, R., and Harbor, J. (Volume Editors). Treatise on Geomorphology, Vol 8, Glacial and Periglacial Geomorphology, San Diego: Academic Press; 2013. p. 325-353.

We added Grosse et al., 2013.

Page 724, lines 4-7: Ice-wedge polygons are not restricted on Arctic coastal plains.

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Such patterned ground also dominates river floodplains, valleys, lowland areas and thermokarst depressions of e.g. Interior Alaska and Central Yakutia.

We thank the review for pointing this out and revised the sentence as "Arctic coastal plains, which are widespread across the lowlands of the northern circumpolar regions, and also dominate river floodplains, valleys, lowland areas and thermokarst depressions in Arctic foothills and subarctic, e.g. Interior Alaska, northern Canada, and Central Yakutia, Russia (Péwé, 1975; French, 2007).

Page 725, line 3: Thaw lakes with ice-rich permafrost are not restricted on Arctic coastal plains. They also exist in Interior Alaska and Central Yakutia and beyond.

We added the sentence "In addition to Arctic coastal plains, thaw lakes are also common in permafrost areas of the subarctic, such as interior Alaska (Péwé, 1975; Jorgenson, 2013) and northern Canada (Sannel and Kuhry, 2011).

Page 725, line 16: "kg C m<sup>-2</sup>": it is hard to understand how a weight (kg C) fits in an area (m<sup>2</sup>). Of course, you are giving the missing depth dimension afterwards, but to be consistent with the units (kg C m<sup>-3</sup> later on), I would recommend to calculate this carbon density of the 0-3m interval to kg C m<sup>-3</sup> as well.

We changed as suggested.

Page 725, line 26: It is debated if Yedoma is "mainly" windblown dust. I would recommend to delete mainly and insert references showing the Yedoma genesis opinions (e.g. Kanevskiy et al. 2011 (doi:10.1016/j.yqres.2010.12.003), Schirrmeister et al. 2011 (doi:10.1016/j.quaint.2010.04.004), Strauss et al. 2012 (doi:10.1029/2011GB004104) and Schirrmeister L., Froese D., Tumskey V., Grosse G. and Wetterich S. (2013) Yedoma: Late Pleistocene Ice-Rich Syngenetic Permafrost of Beringia. In: Elias S.A. (ed.) The Encyclopedia of Quaternary Science, vol. 3, pp. 542-552. Amsterdam: Elsevier.)

We agree and revised the sentence as "Yedoma deposits are polygenic; accumulations

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of water-related as well as aeolian origin deposits, that formed during interglacial periods and became frozen once air temperatures dropped below zero (Kanevskiy et al., 2011; Schirrmeister et al., 2002, 2011; Strauss et al., 2012)."

Technical corrections page 710, line 8: please introduce the abbreviation C here.

Revised as suggested

Page 711, line 13: comma before "but rather", not afterwards.

Corrected as suggested.

Page 713, line 28: a word is missing in this sentence, like e.g. "structures". Moreover, to my mind, the term "massive" is often misunderstood as massive ice (a term which you use in the paper as well) and not as massive cryostructure. I would prefer that you use, according to French and Shur (2010) and Murton and French (1994), the term "structureless" instead.

Indeed, we missed the word "structure" at the end of the sentence. However, we cannot agree with the change of "massive" to "structureless". When describing cryostructure we followed French & Shur and Murton & French. But after permafrost thawed and the cryostructures become soil structures, we follow the USDA Soil Survey Manual (1994) in which "massive" structure refers to continuous, unconsolidated mass". Thus massive is a soil structure type whereas "structureless" is used to describe the grade of soil structure, i.e., how strongly the structure appears.

Page 714, line 22: Change freeze to refreeze

Changed as suggested.

Page 715, line 3: Please change "massive" to structureless

Please see our reply to comments related to Page 713.

Page 715, line 6: change to ice-lens formation

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Changed as suggested.

Page 718, line 7-9: "lower, higher, cooler" compared to what? Change to low, high, Cool

Changed as suggested.

Page 719, line 24: insert a comma after "as mentioned above"

Inserted as suggested.

Page 720, line 3: delete "most" and avoid "massive" as description for "structureless" cryostructures. E.g. like "The cryostructure of the upper permafrost deposits is often structureless"

We deleted the word "most" and also "massive". We agree with the reviewer that here is the right place to use the word "structureless".

Page 720, line 19-23: This is a very long and complex sentence, which would be easier to understand in 2-3 separate sentences

We shortened the sentence as "Cryogenic processes that result in redistribution or mixing of soil horizons, are generically termed cryoturbation."

Page 726, line 7: change "regions" to deposits

Changed as suggested.

Page 726, line 7: As 1 Pg = 1 Gt, please decide which unit you want to use (Pg on page 711, 726, 727, 733) or Gt (page 726). Both units are not related to the SI base unit for masses (kg). Terra kilogram (Tkg) would be the right unit, but is not introduced as a carbon inventory unit so far.

We changed to Pg for consistence.

Page 726, line 26: change Stoblovoi (2002) to Stolbovoi (2002) as in the reference list.

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We corrected the spelling.

Page 753, Figure caption: change arctic Canada to Arctic Canada

Changed as suggested.

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