Biogeosciences Discuss., 11, C387–C390, 2014
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Interactive comment on "A spatial investigation of the environmental controls over cryoconite aggregation on Longyearbreen glacier, Svalbard" *by* H. J. Langford et al.

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Received and published: 17 March 2014

General Comments:

Overall this paper addresses relevant scientific questions and advances our understanding of cryoconite aggregation. The manuscript is suited to publication in Biogeosciences. Procedures used here are appropriate and descriptions herein will likely be useful for future studies. Methods have been mostly clearly and thoroughly explained, although some further elucidation of the filament length measurements would be useful, as explained in the specific comments. Traceability of results and repeatability of the procedures have been considered and appropriately managed in this manuscript.

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The literature cited is relevant and new contributions made by this work are clear. The scientific and presentation quality are therefore excellent, however the relevance of this work might not be obvious to a non-specialist reader. I suggest some reference to, and discussion of, albedo, microbial community and contaminant storage literature to emphasise the importance of this work as explained below.

Specific Comments:

1. To generalists the significance of cryoconite aggregation might not be obvious, and it is not well explained in the manuscript. Some early illustration of the importance of this research would be useful. For example, reference to literature on prolonged residence of dark minerals on ice surfaces (Hodson et al, 2008), NEP (Cook et al, 2010; Telling et al, 2010) and establishment of micro-environments and microbial community structures (Zarsky et al, 2013) as well as storage of potentially harmful radionuclides (Tieber et al, 2009) in the introduction. Some contextualisation of the findings of this study in the discussion would also help to highlight the relevance to wider glaciological, microbiological and climatological research.

2. The degree to which the filament length measurement process was automated is not clear in the text – if automated, how did ImageJ manage folding, tangling, curvature and orientation of filaments? How were individual filaments isolated for measurement? If manually assisted, how was this managed and how easy was it to distinguish individual filaments?

3. Cryoconite holes and cryoconite debris show stark contrasts in their morphology and biology even between adjacent glaciers (Edwards, 2013), so a caveat about the representativeness of cryoconite sampled only on Longyearbreen is required.

4. How reasonable is the assumption that the chlorophyll a concentration vs absorbance curve derived from spinach is applicable to cryoconite? If it is a standard procedure some supportive literature could be cited.

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5. The comparison of phycobiliprotein extraction techniques seems like a useful addition to the literature that should receive mention in the discussion. This paper indicates the paucity of studies employing phycobiliprotein as a biomarker, and some further explanation might help to address this.

6. The term 'photic zone' requires definition early on in the manuscript, perhaps in reference to the spatial variability of IR receipt in section 3.1. It is not immediately clear that you are referring to areas of the glacier surface that contrast in their cumulative solar radiation receipt.

Technical Comments:

1. pg 3425 line 20: Add reference Yallop et al, 2012

2. pg 3439 line 10: consider changing "As such, and given the patchy nature of phototrophic bloom activity, this activity is likely to preferentially raise carbohydrate concentrations in "hotspots" related to earlier bloom activity." to "As such, and given its patchy nature, phototrophic bloom activity likely preferentially raises carbohydrate concentrations in "hotspots" associated with earlier blooms."

for clarity.

References: Cook, J.; Hodson, A.; Telling, J.; Anesio, A.; Irvine-Fynn, T.; Bellas, C. 2010. The mass-area relationship within cryoconite holes and its implications for primary production. Annals of Glaciology, 51 (56): 106-110.

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