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## ***Interactive comment on “Patterns and persistence of hydrologic carbon and nutrient export from collapsing upland permafrost” by B. W. Abbott et al.***

### **Anonymous Referee #1**

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This study compares nitrogen and carbon export under various thermokarst degradation features across Alaska’s North Slope. An impressive number of features are covered (83 in total) which makes for an encouraging dataset in a largely empirical study. The manuscript is extremely well written and covers the topic at hand thoroughly. With that, there are general comments about the methodologies considered for analyzing and assessing the representativeness of these data. These fundamental concerns are presented in the following and must be address through revision of the manuscript/study. If these main comments are taken up in earnest by the authors (which will require some additional work) and addressed via appropriate analysis, this paper stands makes a good contribution to this special issue and the general arctic

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scientific literature.

The first general comment is on the potential for temporal and/or seasonal variability between the samplings. As the current study is presented, this is apparently not necessarily considered. The various features and their outflows are monitored at different times over different years. How have you controlled for seasonal and between year variability in biological activity or wetness across the sites? This impact could be rather large given the inherent connection between, for example, DOC and wetness and temperature. Further, there must be variability in the antecedent conditions (e.g., heavily vs. light snow years). As it is currently presented, the reader gets the impression that the differences in time between observations from the 83 features over the span of 2009 to 2012 and/or the span June to August within a given year are largely ignored. This most certainly cannot be the case, correct? How have you accounted for these impacts or (alternatively) how have you justified to ignore the variability? Clear discussion and clarity is required for these issues since they appear rather central to me.

The second general comment/concern are the seemingly arbitrary classifications. For example, the 0-3 system for development extents and the age groupings (P2069). How robust are the findings presented in the face of the uncertainty and subjectivity of these groupings? There needs to be a simple sensitivity analysis to justify that the grouping definitions did not have strong influence on the significance of the results. This would strengthen the study and provide rigor. A simple methodology could be to randomize the data considered in each group or explore the impact of group boundary definitions. The primary goal of any analysis should be to show that the statistical significance is not purely a function of the definition of data groupings (that is fundamental). The current study does not convince me that this is the case for these analyses.

The final concern/comment is the lack of consideration of the size of the various themokarst features. It is difficult, from the current presentation of the study, to assess the extent of size of the landscape features and further their size relative to the

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size of potential drainage areas or regions of water accumulation. This is the case for both the 83 features and the 61 adjacent sites. This makes it difficult to gauge the impact of the changes estimated in biogeochemical fluxes against the full body of literature since many other studies cover many different (relative) impacts of thermokarst features. This simply need to be handled better so the data presented can realize its full potential relative to previous work. This is particularly true given the structuring of the discussion. Are the estimates presented valid only for very small thermokarst features that cover a majority of their own drainage areas such that any relationships discovered here tend to dissipate rapidly as we move away (downstream) from the features? Full consideration is need here to help put the findings in context of their landscape extent.

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Interactive comment on Biogeosciences Discuss., 12, 2063, 2015.

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