Reviewer 1:

The manuscript presents the results of investigation of dissolved organic carbon and several major ions (sulphate, magnesium, calcium) concentrations, electrical conductivity measurements relationships with catchment discharge and seasonality using general additive models (GAMs) in the permafrost regions in Alaska. The authors tried to link the selected stream chemistry parameters with discharge and seasonality. I am not sure if the GAMs are applicable in this context. For me personally, It was difficult to understand the presented results (e.g. figure 5 and 6) that used the derived statistical modelling such as sDOY and CV ratios, thus it was accordingly difficult to follow the discussion.

Thank you for your feedback. Figure 6 has been edited where the colors now represent permafrost extent and topographical gradients. In addition, the caption along with the methods section have been expanded and clarified to aid in interpretation of the figures. GAMs are an emergent technique used to explore CQ relations, and we are furthering this new area of inquiry which we believe is quite fruitful.

The authors discuss the links of water chemistry with permafrost extent, topographic gradients, active layer. Perhaps, they can add catchment characteristics to their statistical model. As of now, the discussion reads more as a bare speculation. Significance of the work in terms of environmental implications must be more strongly highlighted. I provided some detailed suggestions on how to improve the work.

Although we have a limited number of sites, we have added further statistical tests to determine the influence of catchment characteristics on the seasonality and the average of solute concentrations. The tests are discussed in detail in the newly added sections 2.6 and section 3.3. Specifically, we use correlations between mean catchment slope vs sDOY range for all solutes. Since permafrost extent can only be estimated as a categorical variable, we opted to use ANOVA and Tukey tests to assess significant differences in sDOY range. Similarly, we use ANOVA and Tukey tests to assess significant differences in median concentrations of solutes amongst permafrost extents, and we use Pearson's correlation to assess the influence of mean catchment slope on average solute concentrations. The discussion now also incorporates these findings.

We cannot include catchment characteristics more broadly as a part of the model, as the focus of this paper is to assess the drivers of seasonality not total exports or avg concentrations. Additionally, the geology and climate are distinct among the catchments and it would be difficult to account for considering the data available. We have instead conducted statistical tests to assess the influence of permafrost extent and topography on stream chemistry seasonality (model outputs) separately. Please see the first paragraph, or section 2.6 and 3.3 for additional details.

The introduction is very long, LL54-104 I would recommend to include in the discussion section or made more focused. The portion of text may better fit into methods (LL76-84).

We agree with this comment. There was some redundancy and irrelevant information in the introduction. Much of the introduction has largely been rewritten and clarified.

Section 2.1. Perhaps, it is better to combine the figures 1 and 2. Sections 2.1 and 2.2 are mostly land cover description, I would merge them.

Sections 2.1 and 2.2. have been combined. We explored alternation options yet feel that it is better to separate Figures 1 and 2, as the catchments are quite far apart, and two panels may make it difficult to read the maps.

Section 2.2. Table 1 seam more of land cover classification map, not catchment characteristics. I would move it to the supplement.

The table has been updated and improved. It now includes median specific discharge values, classifications for permafrost extent, and classification for topographical gradients. We believe it now plays a more integral role to the paper, especially for readers to cross reference site names with permafrost extent, and topographical gradients.

Section 2.3. for consistency LL203 replace sulphate with SO4 and elsewhere in the figures and text.

Thank you for noting this. We have made this change throughout the manuscript.

The main: You talk about discharge while presenting runoff data mm/day in the strict sense (see section 2.4). That's confusing. Discharge is flow data (m3/sec) though a catchment outlet, while runoff is calculated per catchment area? I think if you talk about specific discharge in mm/day (e.g. LL260 you state this explicitly) you need to describe this in methods (section 2.4). Given the high variability of contribution area to runoff in this region, use of specific discharge is maybe not appropriate.

We have replaced Runoff with specific discharge where appropriate, as runoff can at times be confused with overland flow. The decision to use specific discharge was primarily made to ease comparison among sites. The statistics i.e. sDOY range, log-log slopes, along with any interpretation of our results would be unaffected by the units of the measurement ($L^3 T^{-1}$ vs $L T^{-1}$).

LL259-260. Which figure or table do you refer to for median specific discharge numbers?

Table 1 now includes this information.

Fig. 7 and 8. I would recommend combining the figures, or better revising the figure to incorporate the topographical gradients and permafrost extent together, if possible.

Figure 7 and 8 (now figures 8 and 9), cannot be combined for this paper. Largely because topographical gradients and permafrost extent do not correlate across our study sites. For example, Km 71 has both high permafrost extent and strong topographical gradients.