Anonymous Referee #2

<u>**Specific comments:**</u>

First, and most importantly, fluxes of DOC, DIC and elements are discussed throughout. However, the units reported are for yields (mass per area per time, e.g. tons C km-2 yr-1) rather than fluxes (mass per time, e.g tons C yr-1). Much of the discussion and figures 9 -12 depend upon these calculations. Please either revise the text to discuss yields, or calculate fluxes. As it stands, evaluating many of the conclusions are difficult without knowing precisely which the authors intended. In the case of multiple size rivers, the export flux calculations may be misleading without normalization to the surface area. The total yield (export to the ocean) would make sense for largest rivers of WSL (Ob, Nadym, Taz and Pur) which integrate the flux from the watershed. These fluxes are given in section 4.2 (L 508-512) of the revised manuscript. However, in this work, the main interest in flux assessment was the comparison between large and small rivers, which should be normalized to km². Note that in geochemistry, the weathering fluxes are presented in t/km²/y (Gaillardet et al., 2003; Dessert et al., 2003; Pokrovsky et al., 2010, 2012). Presenting them in 'ton per year' unit will not allow comparison of rivers of different watershed size and thus will preclude to analyze the processes in the soil profile depending on the size and the latitude. As an example, we can calculate the annual DOC export fluxes (Mt C yr^{-1}) by Ob, Taz, Pur and Nadym rivers, equal to 3.59, 0.285, 0.235 and 0.282, respectively. This order strongly reflects the size of the corresponding watershed rather than the specific processes of permafrost-bearing and permafrost-free zones.
Regardless of these arguments, we removed the part on fluxes from revised paper.

I am also concerned about using mean monthly discharge as the basis for calculating fluxes or yields, particularly since it appears that discharge data for northern regions is from 1973-1992. Basing flux or yield estimates largely on discharge data that is decades old while constituent concentration data is only from the past few years, and using that to make conclusions about future possible climate scenarios is difficult. There have been significant increases in discharge in many Siberian rivers over that time frame. I would be more reassured if there were data available or cited showing how discharge from recent years compares to older data, even if just for a subset of sites. Even without discharge, and subsequently flux or yield data, this is an important dataset of concentrations that should be published. We addressed this very important remark in details (with tables and figures) in our response to comment 3 of reviewer No 1. Because we could rigorously calculate the fluxes only for southern rivers, where the hydrological data for 2013-2014 are available, we removed the part on fluxes from revised version and we keep working on flux calculation based on more extensive hydrological and hydrochemical dataset.

Also, the paper, while presenting a great deal of data, is rather long and not all the data presented necessarily strengthens the paper. For instance, the PCA presented in supplemental materials and discussed in section 3.1 does not explain a great deal of the variation (PC1 only 6-7%, for instance) and is not explicitly referenced again in Discussion sections. Given the relatively small explanatory power of the PCA, I do not think including it is necessary or improves the paper. We agree and removed the PCA analysis from revised paper.

There are a large number of graphics, some of which present the same data in different forms, which could be consolidated. For instance, Figures 6a and 7 a-c are presenting the same data (pH, DOC, DIC, 13dDIC) from figures 2 – 5, only showing all seasons for

each chemical parameter together, with color coding for permafrost extent. If tick marks, lines or shading were added to figures 2-5 to differentiate permafrost zones, the latter figures might not be necessary. Even if the figures are kept as is, the color scheme is difficult to see – please change it so that the discontinuous and continuous permafrost symbols are less similar. We generally agree with this comment and moved figures 6 and 7 to Supplement, also following the recommendation of 1st reviewer. We also changed the color of the symbols to better distinguish continuous and discontinuous permafrost zone. However, the interest of having these figures in the Supplement is that (i) all seasons are shown simultaneously (including October) and (ii) adding ticks to X axis (latitude) in figures 2-5 to distinguish different type of permafrost is not possible: as it is seen in Fig 1, the permafrost boundary are not parallel to the latitude.

Throughout the text, the authors cite significant differences between rivers, based on permafrost, season, latitude or watershed size. For instance, the first paragraph of section 4.3 discusses the significant "contrast in DOC concentrations among permafrost-free, discontinuous and continuous permafrost zones". Given the number of such tests, it would be useful to include a table summarizing the statistics, and highlighting which relationships are significant. This is useful remark and we added a Supplementary Table S2 where all statistically significant relationships are listed.

In grouping seasons, were October samples included in summer or winter? Or only included in analyses that grouped all seasons together? October samples were included in the analyses that grouped all seasons together (L226-228)

Section 2.2: Were DOC samples stores frozen, cool or acidified? No details on how UV absorbance samples were stored or measured. We provided all missing details in revised section 2.2, L 166-169

P 10631, L 14-25: I found the PCA explanation unclear. If this analysis in included, a biplot of how the variables are explained by PC1 and PC2 would be helpful. See Connelly, T.L et al. (2015) in Marine Ecological Progress Series as a good example. In revised version, we removed the PCA part because of too low number of variables. Much more complete PCA treatment is given in our recently submitted paper (Pokrovsky et al., 2015, BGD, Trace elements in western Siberian rivers)

P10632 L 18-27: The optical characteristics are described briefly, then not referenced again. Figure 8 could be moved to supplemental materials or removed completely. The results from other supplemental figures are discussed in more detail than the UV absorbance. This result is important because it demonstrates high similarity of the degree of humification of DOM over large territory and different seasons. We explained the significance of this result in revised discussion (section 4.3) (L 430-434), but, following the recommendation of reviewer, moved Fig. 8 to Supplement.

P10643 L20-21: Are the Taz and Nadym rivers in discontinuous or continuous permafrost? Unclear why they are contrasted with the Pur and Ob rivers. The Taz and Nadym Rivers are located in discontinuous permafrost zone, similar to the Pur River. Here, we focused on the contrast in DOC fluxes between the Ob River, only partially affected by permafrost, and the other 3 rivers of the WSL (Taz, Pur and Nadym), located essentially within the permafrost zone. The part of the text on DOC fluxes was removed from revised version and will be presented in future work.
We thank Reviewer No 2 for constructive comments.