Anonymous Referee #2

Received and published: 26 October 2015

Author Response: We sincerely thank Referee #2 for their thoughtful and thorough comments that would greatly improve the first version of our paper. We have added statements in **blue** below that detail our response to each comment. We feel that most of the comments were relatively minor in nature and we have addressed things below to the best of our ability.

The authors of this paper explored DOC quantity and quality along the fluvial network of the artic Kolyma River and present interesting results about changing patterns in concentration, bioavailability, and optical character of DOC from soils to the river mouth. Overall, this paper is an interesting study that addresses an important aspect of carbon cycling in the artic. DOC release from permafrost soils and the processing of DOC in the aquatic network are precursors of large CO2 and CH4 evasions from these systems, and the presented study particularly sheds light on the geographically large variability in soil DOC in contrast to the rather uniform DOC patterns in the main river, emphasizing the great potential of in-stream processing of DOC during artic summer. An additional strength of the paper is the highlighted potential in applying simple optical measurements to assess DOC in these artic systems on a larger scale. Future studies might benefit and build up on these findings. Overall, the paper is based on a robust dataset, it is well written and has clear illustrations. A few minor revision remarks are listed in the following:

1. In agreement with reviewer #1, I suggest to clarify what the water retention time of the different systems is. It will help to provide an idea about the different timescales of soil-, stream-, and river DOC processing.

Unfortunately we did not determine residence times directly for our sampled sites. Accurate discharge/flow rate data for streams and tributaries throughout the region are scarce if not nonexistent and tracer experiments (i.e., to directly determine residence times from soil pore waters downstream) have not been performed at these sites. However, we can refer to some previous studies that include information regarding residence times in the region. For instance, Vonk et al. (2013) estimate that in higher relief areas near Duvannyi Yar (adjacent to the Kolyma River mainstem), the transport time from permafrost thaw to entry into the Kolyma River may be less than one hour. Our study sites with lower relief may of course have longer transport times to adjacent streams/rivers. Furthermore, with respect to the mainstem, it has been estimated that water residence times in the Kolyma River from Duvannyi Yar to the river mouth may be ~3–7 days, assuming average mainstem velocities of 0.5–1.5 m/s (Holmes et al., 2012; Vonk et al., 2013). As such, permafrost-derived C may not be easily detectable at the river mouth, as this time is likely comparable to the rapid removal rates of highly labile permafrost C determined through incubation experiments (e.g., Holmes et al., 2012; Vonk et al., 2013). These examples give a range of possible residence times that may be experienced at our sampling sites as well. We can add these types of examples to the text to give additional context to the potential residence times of waters in this study.

Holmes, R. M., et al. (2012), Seasonal and annual fluxes of nutrients and organic matter from large rivers to the Arctic Ocean and surrounding seas, *Estuaries Coasts*. doi:10.1007/s12237-011-9386-6.

Vonk, J. E., et al. (2013), High biolability of ancient permafrost carbon upon thaw, *Geophys. Res. Lett.*, 40, 2689–2693, doi:10.1002/grl.50348.

2. P12329 L19-22: It is stated twice here that no statistically significant results were found, however the p-value is given as <0.05. If you used the 0.05-level for significance, please check the results and correct either the p-value or the statement "...streams, rivers, and mainstem waters were not statistically different from one another ($p < 0.05$)....the percentage of bioavailable DOC....did not significantly decrease downstream (two-sample t tests, $p < 0.05$)".

The reviewer is correct and this is a mistype. Because these values were not statistically different from one another, we should refer to this with "(two-sample t-test, $p > 0.05$)". This typo can be easily corrected in these two locations.

3. P12330: L15-21: The enumeration of spectral slope values and other CDOM parameters is rather long, I suggest to present these values in a table instead.

This is an excellent suggestion by the reviewer and we agree that these values should be incorporated into an additional table that can simply be referred to in the text. This additional table would therefore be Table 2.

4. P12334: L13 & 16-18: The CDOM parameter a250:a365 is here mistakenly referred to as a254:a365, please correct.

The reviewer is correct that there are four locations in these lines in the text where the CDOM parameter a_{250}:a_{365} was mistakenly referred to as a_{254}:a_{365}. These typos can be easily corrected.

5. P12327 L16: doubble spelling "using a using a Thermo"

The typo "using a using a Thermo" can be easily changed to "using a Thermo".

6. P12329 L28: "(Figs. 3a)" only one figure

"(Figs. 3a)" can be easily changed to "(Fig. 3a)".

7. P12329 L17-18: missing blank in "(two samplet tests...)"

This typo can easily be changed to "two-sample t-tests"). This error was actually not in the original manuscript and must have been introduced during the reformatting process of the Discussion paper.