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Interactive comment on "Dissolved organic matter composition and bioavailability reflect ecosystem productivity in the Western Arctic Ocean" *by* Y. Shen et al.

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We thank reviewer #4 for the valuable suggestions and comments. The reviewer raised concerns about the usage of the term "bioavailability" (Lines 4-25 on page 9574). We defined "bioavailability" as used in this manuscript to improve the clarity of this section of the manuscript (see below).

DOM is often categorized into three pools of reactivity, labile, semi-labile and refractory, which have broadly defined turnover times of hours to weeks, months to years and centuries to millennia, respectively (Kirchman et al., 1993, Carlson and Ducklow, 1995). Labile DOM is often operationally defined using bioassay experiments, but

this approach has limited utility for defining semi-labile and refractory DOM (Ogura, 1975; Søndergaard and Middleboe 1995; Del Giorgio and Davis, 2002; Benner 2003). The inherent biochemical properties of DOM shape its bioavailability, which in combination with environmental conditions and microbial community composition, determine the turnover time of labile and semi-labile DOM. Herein, we use amino acids as molecular indicators of the bioavailability of DOM (Benner 2003). Amino acids are the building blocks of peptides and proteins, and they are abundant in plankton and plankton-derived DOM (Lee et al. 2004; Davis and Benner, 2007). They are bioreactive components of labile and semi-labile DOM, making them good indicators of the bioavailability of DOM in aquatic systems (Amon et al., 2001; Davis and Benner, 2007; Davis et al., 2009).

High concentrations of bioavailable DOM, as indicated by high concentrations and DOC-normalized yields of total dissolved amino acids (TDAA), are observed in the Chukchi Sea (Davis and Benner, 2005, 2007). It is speculated that bioavailable DOM produced in the Chukchi shelf is entrained into the halocline of the Canadian Basin and fuels oxygen utilization there (Walsh et al., 1997; Davis and Benner, 2007). It is unclear whether a similar process is active in the Beaufort Sea due to a paucity of data for this region. In addition, despite the fact that the Chukchi Sea is more productive than the Beaufort Sea, differences in surface-water concentrations of DOC are not apparent (Davis and Benner, 2005; Guéguen et al., 2005; Mathis et al., 2005). In the present study, the concentrations of DOC and TDAA in the Chukchi and Beaufort Seas were compared to investigate the composition and bioavailability of DOM in these adjacent but quite different systems. Our results reveal that the contrasting productivity between the Chukchi and Beaufort Seas is reflected in DOM bioavailability, as indicated by the concentrations and yields of TDAA.

The method section (Page 9577, lines 6-9) was revised accordingly (see below):

In this study, DOM with TDAA yields >0.70 %DOC is considered bioavailable, and increasing yields of TDAA reflect increasing concentrations of bioavailable DOM.

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Reviewer #4 also suggested other possible processes (i.e., AA adsorption to particles) that led to the depressed microbial loop. We appreciated the suggestions. However, the accumulation of bioavailable DOM occurred in the Chukchi Sea, which receives much less river runoff compared to the Beaufort region. We examined the TDAA composition in the Mackenzie River plume and did not observe any evidence of sorption and partitioning of amino acids in those particle-rich areas. So we don't consider adsorption as a major factor controlling bioavailable DOM.

Additional references:

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