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Interactive comment on "Controls on dissolved organic matter (DOM) degradation in a headwater stream: the influence of photochemical and hydrological conditions in determining light-limitation or substrate-limitation of photo-degradation" *by* R. M. Cory et al.

Anonymous Referee #2

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General comments:

This study is a very interesting analysis of CDOM properties and DOM loss processes in an Alaskan flowing water system. Specifically the authors evaluate where this system lies on a continuum between two conditions: a) CDOM only partially absorbs the incoming, photochemically active solar radiation, and direct and/or indirect photodegradation rates are limited by CDOM concentration; b) CDOM concentrations are suffi-

ciently high to fully absorb all photochemically active radiation ('light'-limited degradation). They conclude that photo-degradation is the dominant process controlling DOM breakdown and therefore export in Imnavait Creek, and that this process is light-limited. The paper presents a large data set (including continuous in situ data), is well written and culminates in a model of broad interest that integrates residence time, irradiance and CDOM concentrations to predict DOM photodegradation.

Most of the interpretations seem reasonable although some of the logical arguments might need sharpening (see below).

Suggestions for minor revision:

P9795, Line 26: "We suggest that degradation, and thus export, of DOM in CDOM-rich streams or ponds similar to Imnavait is typically light-limited under most flow conditions."

This does not sound logically correct to me: if degradation reduces DOM export, then a factor that limits degradation should favor rather than limit DOM export.

P9081, Line 2: Optical measurements were at what time of day (zenith angle, used later as an important correction for a) and under what sky conditions (OVC, scattered, clear skies)?

The term UV exposure is used but not fully defined (e.g. P9797, Line 25). It would be interesting to distinguish exposure rate (spectrally integrated mol photons absorbed by CDOM m-2? s-1) and cumulative exposure or dose (exposure rate integrated over the time for a parcel of water to travel through a defined reach). Could the authors thereby combine in situ spectral UV absorption and residence time (treated separately in much of the Discussion) into a single equation = cumulative UV exposure or absorption. In this way 'light-limitation' could occur through a) low surface irradiance and light limitation at all depths; b) complete absorption of irradiance in the surface waters and light limitation at depth; or c) insufficient time (cumulative exposure) for complete

photochemical breakdown.

Fig. 2. It is interesting that Kd and the absorption coefficients (zenith angle adjusted) were so close – so no optical scattering in this environment? Or masked by the effects of having such high aCDOM. What was the range of suspended sediment concentrations and POC in this water?

P9806, Line 18 onwards: There is a long speculative section to discuss the outlier points in this graph – this could be contracted, transferred to the discussion or deleted. Also, could these outliers simply be the result of absorption and scattering by naturally suspended sediments on those dates?

P9811, Line 10: 'Because UV and PAR account for approximately 51% of the energy within the shortwave radiation portion of the spectrum (300–2500 nm), absorption of sunlight by CDOM contributes to the frequency and extent of stratification by restricting warming to the surface layers (Merck and Neilson, 2012).' See also: Caplanne S & Laurion I (2008) Effect of chromophoric dissolved organic matter on epilimnetic stratification in lakes. Aquatic Sciences 70 (2), 123-133.

Figs 3 and 4: The axis labels need to be checked- °C, m3/s. Also PxVA or 'vertical array' is not a variable – the pond labels could be, for example for Pond 5: P5T (°C). For these figures, it would be helpful to know what the measurement depths were for each pond. If this would make the caption too long, each probe depth for each pond could be spelled out in the Methods (at the moment it is only given as a broad range).

P9817, Line 14: 'but this stratification serves to protect DOM 1from UV light by isolating water masses in pool bottoms (e.g., Table 3, Fig. 5).' How does the river flow during these conditions – is water flowing across the surface of the stratified pond? In which case, stratification is reducing the 'light limitation' of the flowing water because its mean depth is shallower than under conditions of full water column mixing?

What is the volume of the water sequestered at the bottom of a typical pool relative to

the river flow – i.e. equivalent to how many seconds, minutes hours, days of average flow? Is it a major or minor component?

Interactive comment on Biogeosciences Discuss., 12, 9793, 2015.