

Interactive comment on “Concentration, sources and light absorption characteristics of dissolved organic carbon on a typical glacier, the northeastern Tibetan Plateau” by F. Yan et al.

Anonymous Referee #2

Received and published: 30 June 2016

This study examines radiative forcing of dissolved organic carbon in snow and ice and its contribution to carbon flux returned to the atmosphere using samples collected from the Laohugou glacier No. 12 (LHG glacier) in the north-eastern Tibetan Plateau. Radiative forcing is very small ($0.1 \pm 0.1\%$) in comparison with black carbon in ice but constitutes about 10% of the black carbon forcing in snow although the uncertainty on this estimation is close to the estimation itself. I suggest that the authors comment on the importance of this forcing carefully given that these are not large figures. Figure 6S and text given in lines 256-258 are confusing as they suggest much higher radiative forcing of dissolved organic carbon. This should be explained more clearly. I also suggest that the two themes – radiative forcing and release of carbon from the glacier

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into the atmosphere should be given more distinct separation in the text and the latter given more prominence than it has now (a very short section 3.4). Nevertheless it is a novel and interesting study which justifies publication in The Cryosphere with minor corrections.

Specific comments: Lines 82-83 and lines 102-107: I suggest that Supplement Table 1 should be given together with Fig. 1 in the main text. Both snow pits should be shown on Fig. 1. Or were they in the same place? If yes, clarify in the text (line 103). Lines 82-83 and Section 2.2: How did you measure discharge? Explain. Line 105 and Fig. 1: What is the ‘eastern tributary’? Is it a tributary of the glacier or of the stream? It is not clear from Fig. 1. Line 105: How did you collect ice samples? How did you store them? Crushed or melted before placing in a bottle? Line 105: Were your samples collected from the surface? Line 105: Please clarify how many samples of snow or ice collected. You currently give one number for all. Lines 110-111: ‘Clean Hands – Dirty Hands’ procedure: Please explain in plain English, avoiding jargon, what it is. Lines 115-119: Your number of samples from the deserts are low and sand may not make a useful comparison as it is not the material to undergo long-range transport (too large particles). Please comment on the spatial homogeneity / heterogeneity of mineral and elemental composition of desert material. Line 117: Is Dunhuang a desert location? Please clarify. Line 147: Provide references supporting your first sentence. Line 161: Use ‘pre-combusted’ instead of ‘pre-burned’ Lines 188-189: In the text you state “Therefore, the distributions of DOC concentrations in the glacier surface snow and ice were influenced by complicated factors, such as the terrain, surface moraine and atmosphere circulation”. (i) In which way does the ‘terrain’ (whatever it means here) influence DOC? (ii) What is the impact of atmospheric circulation? I suppose you can’t make quantitative conclusions in the absence of continuous measurements but you should at least comment and refer to literature. (iii) In Section 2.2 you refer to the collection of samples from deserts so I assume that ‘mineral dust’ implies ‘desert dust’. If this is the case, make it clear. How can you tell input of desert dust in DOC concentrations from input of material from local moraines? Lines 210-211: Concentra-

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tions of Ca²⁺ in desert dust. Have you compared your desert dust samples with the samples from the local moraines? What other tracers can you use? Do you have absorption spectra for material from local moraines and how is it different from those for your desert material samples? Section 3.2: You should bring Supplement Figure 1 into this section and add comments on the profiles of DOC in your snow pits highlighting differences between the layers containing dust and the relatively clean layers. Lines 256-258 and Fig. 6S : Please explain the elevation dependence of DOC relative to BOS more clearly. Add more detailed comments on Fig. 6S. Equation 3 show that radiative forcing depends on concentration and Fig. 6S shows the ratios between black carbon and dissolved carbon but a couple of sentences would be required to clarify and strengthen you message. Section 3.3.3: Too many abbreviations (BrC, WSOC) make reading this section difficult. Line 287: Provide references after "...the European Alps and Alaska" Section 3.4 is very brief. Can you expand it and give it more prominence? Section Conclusions (Lines 291-293) and Abstract: radiative forcing of DOC is $0.1 \pm 0.1\%$ of BC in ice and $9.5 \pm 8.4\%$ for snow. So this in effect is an almost zero addition in case of ice and might be close to zero addition for snow. I suggest that you should convert this into Wm⁻² using data from literature to be more convincing.

Figures and Tables Tables 1 and 2: Why are your references in parentheses? Combine Fig. 1 with Table 1 in the Supplement and show both snow pits. Fig. 2: Show error bars both ways and add the number of samples in each category. Fig. 3: Why do you need exponential fit here? Linear regression describe this relationship well. Your standard deviation bars are impossible to see. Fig. 4: What is 'desert' and what is 'dust'? Fig. S1: Use the same scales on X and Y axes for both profiles for an easier comparision. Move this figure to the main text. Fig. 6S: Are these average ratios for all samples?

Interactive comment on The Cryosphere Discuss., doi:10.5194/tc-2016-53, 2016.