

## ***Interactive comment on “Dominance of brown carbon in aerosol emissions from burning of boreal peatlands” by R. K. Chakrabarty et al.***

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This is a very interesting study on results from biomass burning of boreal peat material from Alaska and Siberia with emphasis on brown carbon. It is very knowledgeable as for the derived radiative quantities and a possible contribution of carbonaceous particles to surface temperature increase at high northern latitudes.

The manuscript title does not make fully clear that this study is indeed concerned with peat burning. The authors may consider to make this more clear in their manuscript title. I have a number of specific points to be addressed, see below. I think the manuscript should be revised, at a level somewhere between minor and major revision.

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### Details

Abstract: I find the abstract quite condensed. Is this really all which should be mentioned here?

Response: The abstract has now been revised and elaborated in scope. It also highlights the major finding regarding the sensitivity of forcing as a function of surface albedo.

P 28796, I 8: Why will the Siberian peatland burning increase so much 'in response to climate change' - a few words to explain would be good.

Response: Thanks for pointing this out. The reasoning behind this statement is that drying as a result of climate change lowers the water table in peatlands and increases the frequency and extent of peat fires. A new sentence has been added to the end of this paragraph "Climate change would result in drying and lowering of the water table in peat lands, which in turn would increase the frequency and intensity of peat fires"

P 28796, I 11 ff: This paragraph very well addresses past studies of boreal forest fires. Because the study really is about peat burning, please reference former such studies right here in the section - this is fully missing now.

Response: The following sentence with appropriate references have now been added about peat burning in the revised manuscript "Past field observations and laboratory studies have also shown burning of peat lands—both tropical and boreal—to emit large quantities of greenhouse gases (Christian et al., 2003; Iinuma et al., 2007; Page et al., 2002; Stockwell et al., 2014; Turetsky et al., 2015)"

P 28798, I 27: This estimate must be rough. It means BrC from this study is an upper limit because EC has to be subtracted. This should be mentioned everywhere and an estimate of the size of this error should be given.

Response: While we agree that approximating EC with BC might involve a conversion factor, this shouldn't affect the findings of this study. This is because EC determined

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in this study via the IMPROVE-A TOR and TOR analyses method (industry standard) in our filter samples were trace in amount. For most of the samples, EC was less than 1% by mass. So, one could safely attribute the absorption coefficients measured by multi-wavelength photoacoustic spectrometers to only the OC mass content of the particle. That is what we did. Further, it would be erroneous to say that BrC mass absorption efficiencies (MAE) calculated in this study is an upper limit. Since we didn't have to subtracted any BC mass and that we used first-principle aerosol absorption technique, we feel the BrC MAE values are not upper limits as one would expect from a filter based absorption measurement approach.

P28799, I 12: Results of previous studies could be incorporated into Table 1.

Response: We feel that incorporating emission factor measurements of peat fires from lower-latitude peatlands, like those found in Indonesia and Germany, into Table 1 might lead to confusion among the readers. The focus of this paper is peat land fires from higher-latitude Boreal region, and there is a lack of data on primary greenhouse gases and particulate matter. On the contrary, there is substantial amount of research conducted on the nature of pollutants from Indonesian and other low-latitude peat fires. Additionally, the composition of peat lands could vary significantly between the low and high latitudes. Change in composition impacts the pollutant profile as well. Hence, we are not of the opinion to include emission factors of gaseous and particulate pollutants from low-latitude peat burning in Table 1.

P 28800, I12ff: Can you nevertheless document the results of the varying humidity experiments ? What could be a possible explanation of the differing trends?

Response: We do not have a convincing and straight forward explanation to explain the effects of humidity on the particle optical properties. With increasing fuel moisture content, the BrC mass absorption efficiency of Alaskan peat increased; while for the Siberian peat, the opposite trend was observed. A detailed understanding of this phenomenon might involve investigating the nature of the chromophores constituting the

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particles, which is beyond the scope of this study.

In the revised manuscript, we have added the following statement to address this point "However, the trend for MAE values with varying levels of fuel moisture content was not very clear. With increasing moisture content, the MAEs of aerosols from Alaskan peat samples increased; while the opposite trend was observed for aerosols from Siberian peat samples. A more detailed study on the optical characteristics of chromophores constituting both aerosol types might be necessary toward explanation this trend (Laskin et al., 2015). Such a study is beyond the scope of this current work."

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