

## ***Interactive comment on “Light-absorbing impurities in Arctic snow” by S. J. Doherty et al.***

### **Anonymous Referee #1**

Received and published: 15 September 2010

This detailed and well written paper presents the results of an extensive field study to measure black carbon concentrations in snow and ice in multiple locations in the Arctic. The authors conscientiously acknowledge the limitations in their measurement methods, which include both uncertainties in the method as well as those induced by outside variables that often interfere with measurements. Given that recent modeling studies show that BC in snow and ice may have impacts on both radiative forcing and snow melt, these measurements are an important first step in determining how accurate the model results may be. I have only a few minor requests for clarification and edits, before recommending publication.

#### Minor Comments:

Page 18810, line 29 “reduce the broadband albedo of snow by much as 0.04” . . . please specify the wavelengths referred to here.

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Page 18811, line 5, “is significant for climate.” ... needs an appropriate citation for study that shows significance to climate.

Page 18811, line 25, citation of Conway et al 1996 for soot concentrating in the surface of snow is not an appropriate reference for this statement. Conway et al showed that the soot particles deposited on the snow surface were quickly flushed into the snow pack, which then brightened after application. They did show that BC persisted in the surface, but did not show substantial concentration of soot in the surface. This theory has often been hypothesized, but to my knowledge has not yet been shown conclusively.

Page 18812, line 1, “Soil dust is about a factor of 50 less effective at reducing snow albedo.” ... this needs a citation, unless the Painter et al 2007 also refers to this statement. If so it needs to be clarified.

Page 18818, line 18, Use of the Angstrom exponent of 5, for non-BC light absorbing aerosol should be explained/justified a little further, given that the Grenfell 2010 paper is still under review. Hadley et. al. (2008) also found and used an Angstrom exponent of 5 for brown carbon, but I have not seen that number used elsewhere.

Page 18826, line 10, typically typed twice.

Page 18827, line 15, The cited Bond papers discussing industrial emissions with Angstrom exponents greater than 2 are specific to inefficiently burned coal and not all fossil fuels. This should be specified here.

Page 18841, line 7-11. A very excellent point.

Page 18841, line 15 -20, although larger snow grains lead to a greater decrease in albedo, the same amount of BC in larger grains relative to smaller grains has a much greater potential to lower albedo. (Flanner et al 2007). This probably should also be mentioned.

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