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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Black carbon record based on a shallow Himalayan ice core and its climatic implications" *by* J. Ming et al.

Anonymous Referee #1

Received and published: 18 October 2007

This paper presents a new record of black carbon (BC) measurements from a Himalayan glacier. Given the lack of published measurements of BC in snow and ice from this region and recent attention given to the climate impacts of BC in the atmosphere and snow, this paper should ultimately be published. There are several issues that should be addressed, however.

The primary concern I have is that the authors allude to important climate effects without quantifying radiative forcing or the magnitude of warming. Examples of this include the title ("and its climatic implications") and statements made in section 3.4 (e.g., "could be fatal to the Himalayas"). Inclusions of statements such as these are not justified unless the authors perform a more rigorous quantification of potential forcing in the atmosphere and snow, and/or estimation of warming effects from BC. While these

estimates certainly need to be performed at some time, they are not necessary in this paper because the presentation of novel data, by itself, is a sufficient contribution. Without quantification, however, inferences to climate implications should be toned down, including a change of title.

Another issue is that the paper's use of English is quite poor. In some cases I could not understand what was trying to be conveyed, and I have noted these cases below. Grammatical problems are too numerous to note. I am not sure what ACP's policy on this matter is, but the paper could be significantly improved with the proofreading of a colleague proficient in English.

Other important issues:

Uncertainties in the quantification of BC concentration in ice should be mentioned, as well as how the reported range (uncertainty) was estimated.

The derivation of atmospheric BC requires more explanation. Specifically, to justify your method you should discuss the importance of the relative magnitudes of wet- and dry-deposition (see comment below).

One of the main points of this article is that BC in this region originates from South Asia, on the other side of the Himalayas. I have raised some questions (see below) pertaining to sources. Specifically, is there any seasonal cycle discernible from the ice record, indicating higher BC concentrations during summer when (supposedly) more polluted air is being transported to this region? Or, if the time resolution of the measurements is insufficient to determine this, mention it. Also, are there any potential local sources? The distinction between "long distance" and non-long-distance" transport must also be made. (see comment below)

Specific comments:

Please identify, at least once, "Mt.Quomolangma" as "Mt. Everest". It is alright to refer to the mountain by its Tibetan name, but most readers of this journal will only know the

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mountain as "Mt. Everest", so you should associate the two names at least once.

p.14414, line ~25: A paper was recently published in Science by McConnell et al. (2007), describing a new technique for measuring BC in ice with far better resolution than previous methods. Please mention this new study in the description of previous studies.

p.14415, line 3: "Up to now there are only two reports on the historical records of carbonaceous particle concentrations in ice cores both extracted from Mt. Alps" - This is no longer true. Again, McConnell et. al. report a record from Greenland. I realize that McConnell et al. may not have been published before this manuscript was submitted.

p. 14415, line 12-14: "Himalayas may be an effective barrier to restrict the exchange of air masses carried by monsoons and by westerly between TP and the Indian subcontinent in summer and winter (Nieuwolt, 1977)." - This may be true, but this comment appears to counter one of your main conclusions: that particles deposited on the glacier are coming from the other side of the Himalayas. Place this comment in the context of your conclusions.

p. 14416, section 2.1: You discuss the bore hole temperatures. Is there ever surface melt at this location/elevation in the summer? If melt does occur, discuss any implications for dating and positioning of frozen particles.

p. 14416, line 25: "The seasonality of del O18 exhibits an amount effect." - This does not make sense. Please clarify.

p. 14418, line 1: What is "100-class"?

Section 2.3: What is the pore size of the filter? (i.e., what size of particles were allowed to pass through?) How much mass do you estimate was lost in the filtration process? (i.e., what fraction of the BC mass do you think was smaller than the pore size?) Could this have resulted in a significant under-estimation of the BC mass? If these issues are discussed in the references, only a couple of sentences are needed here.

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Section 2.4: Briefly mention sources of errors for these techniques and their potential magnitudes. Later, you report ranges for the measurements. How was the range quantified?

Section 3.2: In your estimation of atmospheric BC, you apply an equation that depends on the scavenging ratio. This would only seem to apply to BC that is wet-deposited, since dry deposition does not depend on the scavenging ratio. Describe how your derivation of atmospheric BC would be affected if a significant portion of the BC in ice was dry-deposited. Alternatively, explain why it is valid to apply this equation (perhaps by showing that nearly all of the BC in this ice was wet-deposited). Provide an estimate of uncertainty in deriving the atmospheric concentration from the ice concentration.

p. 14420: line 19: "No matter what season it is in, ERG is located in the downwind direction of South Asia." - Be more specific about source regions during different seasons, as the portions of 'South Asia' downwind of the ice core location may be very different during the seasons. If westerlies dominate during the winter and monsoonal flow during the summer, there is presumably an intra-annual dependence.

p. 14420, line 20: Provide a reference for the HYSPLIT model.

Section 3.3, last 2 sentences: Here, you are demonstrating that there is co-variability between the number of "non-long-distance" trajectories and the estimated atmospheric BC concentration. First, describe in more detail what constitutes "long-distance" and "non-long-distance" transports. Second, expand on your analysis: Presumably air masses coming from the south (or southwest?) during the monsoon season will be more polluted. Do you see a seasonal cycle in your timeseries? Is atmospheric BC greater (statistically significant) during non-long-distance transport times? If so, what are the likely "non-long-distance" sources that cause this effect? Must these sources come from the other side of the Himalayas? Are there any potential local BC sources (say, within 100km)?

p. 14422, lines 1-2: "ERG's BC concentration could not be neglected to consider its

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consequent climate effect after taking its enhancing atmospheric solar absorption over snow and ice surface into account" - Also mention the enhanced absorption by snow and ice, which may even be a greater source of warming over snow than the atmospheric BC, as supported by studies from Hansen and Nazarenko (2004), Jacobson (2005), and Flanner et al. (2007). While you do mention this effect later, it could be better tied in with this statement.

p. 14422, line 6: "this level of BC concentration in atmosphere and therefore black carbonaceous particles deposited in snow and ice could be fatal to the Himalayan glaciers" - This is an extreme statement and not supported by any quantifications conducted in this study. As alluded to at the beginning of my comments, subjective inferences such as these, if included, must be supported by some sort of estimate of the radiative forcing or warming effects.

Section 3.4: Needs grammatical and conceptual work to be more coherent,

Figure 2 caption: Describe the three variables plotted in this figure.

Figure 5: I do not understand the bottom portion of this figure. Describe it in the caption, including what the the x-axis is. The two curves seem to show a common point at 3666 meters. What does this altitude represent?

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 14413, 2007.