The Cryosphere Discuss.,
doi:10.5194/tc-2016-233-RC1, 2016

The Cryosphere Discussions
Open Access
EGU

Interactive comment on "Properties of black carbon and other insoluble light-absorbing particles in seasonal snow of northwest China" *by* Wei Pu et al.

Anonymous Referee #1

Received and published: 21 December 2016

Review of "Properties of black carbon and other insoluble light-absorbing particles in seasonal snow of northwest China", by Pu et al

general comments:

This paper deals with light absorbing impurities and their sources in snow in northern China. As the authors clearly state, these impurities impact upon the radiative budget of snow and are therefore important climate agents. These are relevant scientific questions within the scope of TC. This study applies the same general method used in several previous studies (Hegg et al., 2010; Wang et al., 2013; Zhang et al., 2013), and expands geographically on these studies, reaching similar conclusions as to the different sources responsible for those impurities in snow.

The work is generally relevant to the scope of The Cryosphere and is worth publishing, once the authors take care of the following remarks.

My major issues with the manuscript in its current form areÂă:

- General lack of precision and clarity, making the reasoning of the authors very hard to follow.

- Methodological problems with the PMF analysis: Recently, studies have shown the importance of uncertainties evaluation on the results of PMF on aerosols (ex: (Waked et al., 2014)). This lead to the publication of general guidelines for PMF analysis (Belis et al., 2014), that should be adapted here with more clarity. The authors refer to (in particular) (Hegg et al., 2010) for details on the PMF, but as they do not take the same species into account, there is a clear lack of details. In particular, the author seem to be using in their PMF analysis some derived quantities such a Kbiosmoke. How does this concentration depend on assumption on seasalt and crust concentrations ratios ? And does it impact the PMF ?

- Uncertainties analysis: in general, I feel the authors should have done a more thorough uncerty analysis. This is particularly true concerning the retrieval of absorbances from iron oxyde, Brown carbon and black carbon from the ISSW measurements. The authors mention (Doherty et al., 2010) and (Grenfell et al., 2011) for error estimates on those measurements, but these references only took into account Black and Brown Carbon, so only partially apply here. See for example the discussion by (Lack and Langridge, 2013)

Specific Comments:

P3 L15: "radiative forcing I highly uncertain": di the authors mean radiative forcing in general, or more precisely in snowy places ? Please precise.

P5 L15: "dust is the main absorber in snow locations" : missing word, many ? Most ?

P6 L1: "quantify the source attribution" → "attribute the sources"

P7 L2: “we evaluated the chemical components to examine the potential emission sources”: quite vague

P7 L20-21: how does measuring the snow density and temperature help quantify the deposition flux of BC ?

P8 L7: “nuclepore filters were subjected to BC and OC analyses”: this sentence is overly misleading. BC analyses are optical measurements (see (Petzold et al., 2013) for nomenclature), which is actually what is done here. But OC generally refers to carbon measurements made from combustion methods, which is not the case here, and would anyway be impossible on nuclepore filters.

P12 L3-4: “quantify contributions from sources based on composition or fingerprints of the sources” : this seems ill-formulated as actually the PMF gives factors purely from statistical considerations, without any a priori knowledge of eventual “source fingerprints”. It is then up to the user to interpret the calculated statistical factors as sources, as the authors actually did

P12 L14-16: from this sentence, the choice of the number of factors seems pretty much to be an arbitrary decision from the user, whereas some “best practices” exist for this choice.

P14 L10-15: the authors mention a potential oulier. Is it the only one ? How were these accounted for in the PMF ?

P20 L15-20: the authors mention “considerable errors”: could they be more specific ?

P21 L10-15: it would be good to compare the number of factors to the total number of species taken into accounrt

P21 L16: does really the Figure show “measured mass concentrations” ? Or is it rather calculated masse concentrations (calculated by the PMF)

P23-24: I do not really understand the interest of §3.4.2. As I understand, it discusses

the contribution of a given source to each site, normalized by the average contribution. I do not really see what geochemical information this holds. On the opposite, I understand the following paragraph, where on each site, we have a picture of the origin of LAIs.

P25 L3-10: the authors point that their results differ largely (on the one common region) with previous results from (Zhang et al., 2013), then invoke differences in species taken into account and inconsisntecies in the PMF analysis. This needs to be precised: if results vary too much upon the species taken into account, then there need to be a clear discusion no why your species set is “nest”

P25 L15-20: the correlations showed in figure 9 do not seem very strong. Could the authors give some p-values for those ?

P26 L21: nitrate and sulfate are secondary aerosol, not primary

Belis, C. A., Favez, O., Harrison, R. M., Larsen, B. R., Amato, F., El Haddad, I., Hopke, P. K., Nava, S., Paatero, P., Prévôt, A., Quass, U., et al.: European guide on air pollution source apportionment with receptor models., Publications Office, Luxembourg. [online] Available from: http://dx.publications.europa.eu/10.2788/9307 (Accessed 21 December 2016), 2014.

Doherty, S. J., Warren, S. G., Grenfell, T. C., Clarke, A. D. and Brandt, R. E.: Light-absorbing impurities in Arctic snow, Atmos Chem Phys, 10(23), 11647–11680, doi:10.5194/acp-10-11647-2010, 2010.

Grenfell, T. C., Doherty, S. J., Clarke, A. D. and Warren, S. G.: Light absorption from particulate impurities in snow and ice determined by spectrophotometric analysis of filters, Appl. Opt., 50(14), 2037–2048, doi:10.1364/AO.50.002037, 2011.

Hegg, D. A., Warren, S. G., Grenfell, T. C., Sarah J Doherty and Clarke, A. D.: Sources of light-absorbing aerosol in arctic snow and their seasonal variation, Atmos Chem Phys, 10(22), 10923–10938, doi:10.5194/acp-10-10923-2010, 2010.

Lack, D. A. and Langridge, J. M.: On the attribution of black and brown carbon light absorption using the Ångström exponent, Atmos Chem Phys, 13(20), 10535–10543, doi:10.5194/acp-13-10535-2013, 2013.

Petzold, A., Ogren, J. A., Fiebig, M., Laj, P., Li, S.-M., Baltensperger, U., Holzer-Popp, T., Kinne, S., Pappalardo, G., Sugimoto, N., Wehrli, C., et al.: Recommendations for reporting "black carbon" measurements, Atmos Chem Phys, 13(16), 8365–8379, doi:10.5194/acp-13-8365-2013, 2013.

Waked, A., Favez, O., Alleman, L. Y., Piot, C., Petit, J.-E., Delaunay, T., Verlinden, E., Golly, B., Besombes, J.-L., Jaffrezo, J.-L. and Leoz-Garziandia, E.: Source apportionment of PM10 in a north-western Europe regional urban background site (Lens, France) using positive matrix factorization and including primary biogenic emissions, Atmos Chem Phys, 14(7), 3325–3346, doi:10.5194/acp-14-3325-2014, 2014.

Wang, X., Doherty, S. J. and Huang, J.: Black carbon and other light-absorbing impurities in snow across Northern China: LIGHT-ABSORBING IMPURITIES IN SNOW, J. Geophys. Res. Atmospheres, 118(3), 1471–1492, doi:10.1029/2012JD018291, 2013.

Zhang, R., Hegg, D. A., Huang, J. and Fu, Q.: Source attribution of insoluble light-absorbing particles in seasonal snow across northern China, Atmos Chem Phys, 13(12), 6091–6099, doi:10.5194/acp-13-6091-2013, 2013.

Interactive comment on The Cryosphere Discuss., doi:10.5194/tc-2016-233, 2016.