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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impact of cloudiness and cloud type on the atmospheric heating rate of black and brown carbon" *by* Luca Ferrero et al.

Anonymous Referee #2

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This study explores the effect of clouds on heating rates driven by absorbing aerosols. They do so using observations and measurements sorted per different cloud types and coverage, separating the effects of black vs. brown carbon.

The data is collected in U9 sampling site in Milan which is a superstation that contains instruments to measure radiation, filter collecting aerosols that are analysed for their optical properties, meteorological station and a Lidar.

The topic of the paper is important. Exploring heating rates for different aerosol types under different cloud conditions will provide a very important information for aerosol effect on climate, and clouds. As the authors pointed out direct measurements of heating rates in different cloud conditions are quite uncommon.

The basic cloud classification makes sense in particularly as they added Lidar information for the clouds base. The results clearly show how cloudiness can affect heating rates and the bland between the radiation types.

One drawback of the paper is that it is very technical and not always easy to follow. Even if one understands the radiative transfer concepts, the physical assumptions and results are buried in the technicalities. It contains many technical terms that may appeal only to the instrumentation experts. Being familiar with radiation transfer concepts, I'm sure that there is a better way to describe the measurements and analyses such that a non-expert in the instrumentation could better enjoy it. The concertation of acronyms is high. It is hard to remember all of them and some that appear again later in the text force the reader to look back for their meaning and it disturbs the reading. On the other hand, some basic concepts that are key in this study are not well explained. The authors send the reader to read many other references for the basic methods and the equations. I believe that such study could be more of a standalone in which the basic physics is explained in a better way using less technical jargon.

I list here two basic comments on the methods and assumptions that should be clarified:

1) The aerosols that are collected at the station level serve as the only aerosol measurement and the basic assumption is that the filters collected at the station represent the whole boundary layer and therefore the heating rate is uniform for the layer below the clouds. I wonder how general this assumption is? This is always a key question of any work that try to link measurements near the surface to the atmospheric column. Is it always well mixed? Can the authors show that there is no dependency on the time of the day or the winds or the meteorology in general? Is it true for all seasons? For all cloud types? Moreover, if they have Lidar there can't they validate this assumption using the Lidar information. It would be nice to see uniform backscatter below the clouds to strengthen this basic assumption.

2) The radiation measurements are collected in the station and are product of electromagnetic radiation interaction with the whole atmospheric column. What about the contribution of aerosols above the boundary layer. Is it assumed to be canceled by the proposed method? Or is it assumed to be negligible? If not, how such aerosols can affect the results?

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