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## ***Interactive comment on “Quantifying sources, transport, deposition and radiative forcing of black carbon over the Himalayas and Tibetan Plateau” by R. Zhang et al.***

### **Anonymous Referee #1**

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This paper presents the results of a one-year’s model simulation of black carbon aerosols over the Tibetan Plateau. The authors use NCAR’s CAM5 model, implemented with a source tagging technique, to quantify the BC over different regions of the Tibetan Plateau from various geographical regions (the surrounding areas in particular) and two major source sectors (biofuel/biomass and fossil fuel). They also characterize the seasonal variations of BC concentrations, deposition and radiative forcing on the plateau as well as their source attribution, and analyze the model results in very detail. The paper is interesting and should be a welcome addition to the literature. I would suggest the paper to be published after the following questions/comments have

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been well addressed.

1) The tagging method used in this study is not well introduced. Although the title of Sect. 2.1 is written to comprise “the source-tagging method”, no content related to the method can be found in this subsection at all. In Sect. 2.2, several equations are given, but these equations are far away from the model tagging technique. The authors refer to Wang et al. (2014) for the source-receptor relationships. However, only the similar equations were presented in that work. I would suggest that the authors give much more detailed description about the treatment of BC in CAM5, especially the tagging method. For example, in which aerosol modes BC are taken into account? Are they all assumed to be hygroscopic and internally-mixed? How many tracers are added in the model to tag the BC from a specific region? Is there a tracer added for each mode? Is there a tracer for BC in snow? Is the tagged BC assumed to undergo the same dynamic and microphysical processes as the normal BC does in the model? Perhaps, you do not need adding a tracer to tag the BC, but it should be described clearly how to achieve that.

2) While the paper focuses mainly on the quantification of the contributions to BC on the Tibetan Plateau from different source regions, the analysis of various physical processes is relatively weak. It is stated that the study is to “characterize the fate of BC particles emitted from various geographical regions” in both the Abstract and Conclusions. However, the lifetimes of BC from different regions are not investigated as expected. With the definition given in Page 86 (the equation should be numbered), the authors investigate the efficiency of tagged sources in affecting the BC on the Tibetan Plateau (Fig. 7). In addition to the geographical distance or atmospheric transport pathway between the receptor and a source region, are there any other factors (e.g., aerosol chemistry, microphysical processes and dry/wet deposition) affect the estimated efficiency?

3) Comparisons with previous studies, e.g. the work of Kopacz et al. (2011) and Lu et al. (2012), are not sufficient in the current version of the paper. What advantages and

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limitations of the methods used in these studies, where the same topic are addressed?  
Are there any disagreements or uncertainties for the BC source contributions and radiative forcing over the Tibetan Plateau based on these studies?

## References

Kopacz, M., Mauzerall, D. L., Wang, J., Leibensperger, E. M., Henze, D. K., and Singh, K.: Origin and radiative forcing of black carbon transported to the Himalayas and Tibetan Plateau, *Atmos. Chem. Phys.*, 11, 2837-2852, 10.5194/acp-11-2837-2011, 2011.

Lu, Z., Streets, D. G., Zhang, Q., and Wang, S.: A novel back-trajectory analysis of the origin of black carbon transported to the Himalayas and Tibetan Plateau during 1996-2010, *Geophys. Res. Lett.*, 39, L01809, 10.1029/2011gl049903, 2012.

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