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Interactive comment on "A global 3-D CTM evaluation of black carbon in the Tibetan Plateau" *by* C. He et al.

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This paper presents simulations with the GEOS-Chem model to study BC in the atmosphere and in the snow over the Tibetan Plateau and the Himalayas. Current models exhibit enormous difficulties to correctly simulate the emission, transport, and deposition of BC in this region. Therefore, any advances on this suject are very welcome. To evaluate the simulations the authors perform comparisons with available observations not only for BC in the atmosphere, but also for BC in the snow.

Since their model does not explicitly simulate the snow cover, the BC in sow concentrations are derived from the ratio between simulated total BC deposition and total precipitation. I believe that this assumption introduces additional uncertainties for the

BC in snow concentrations that need to be discussed in more detail as is the case in the current manuscript.

Coarse resolution models like the one used for this study show biases in the simulation of the precipitation. Theses biases are somewhat improved in the study region using higher resolution models as shown in a recent study for the Himalayas using the regional climate model MAR (Ménégoz et al., 2013). Nevertheless, the bias in the total precipitation, which translates directly into a bias for the derived BC in snow concentrations, will probably remain high.

Moreover, the authors use the total precipitation without distinguishing between solid and liquid precipitation. However, rain has a two-fold impact on the BC in snow concentrations: first, rain should be subtracted from the total precipitation before calculating the snow concentrations, and, second, rain can lead to a significant melting of the snowpack further increasing the BC in snow concentrations. Even at altitudes as high as 5000 m a significant fraction of the precipitation can be in the form of rain (e.g. Bonasoni et al., 2010). Of course, the impact of rain becomes less important at higher altitudes. However, due to the averaging of the altitudes for the model grids coarse-scale models tend to "remove" high altitude regions from the model domain. As a result the model may simulate higher rain-to-snow ratios that actually occur. Considering all simulated precipitation as snow for the calculation of the BC in snow concentration introduces a further bias, which may be positive or negative depending on the altitude of the location relative to the altitude of the model grid. Finally, the model uses different parameterizations for the BC deposition in the case of rain or snow. Therefore, the model may generate cases when the BC is removed according to wet deposition by rain, while for the calculation of the BC in snow concentration the accumulated rain is then considered as snow.

I believe that these uncertainties in the derived BC in snow concentrations should be discussed in more detail. Since the impact of these different processes and parameterizations are probably variable and difficult to estimate, further sensitivity tests are pos-

sibly needed before a reliable comparison between the model-derived and observed BC in snow concentrations becomes possible.

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