Atmos. Chem. Phys. Discuss., 15, C9664–C9666, 2015
www.atmos-chem-phys-discuss.net/15/C9664/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observed high-altitude warming and snow cover retreat over Tibet and the Himalayas enhanced by black carbon aerosols" *by* Y. Xu et al.

Anonymous Referee #2

Received and published: 23 November 2015

In this work, the authors estimate the role of BC increase in the tropospheric warming of the Tibetan Plateau region using a coupled AOGCM at high horizontal resolution, forced by observationally-based BC aerosol datasets.

Novelty: Use of High resolution coupled OAGCM with coupling between snow over land and BC deposition. I think this last improvement is crucial. This analysis is also based on a previous work where the BC forcing is re-estimated by using satellite + ground based optical depth, with a new methodology to separate the BC contribution to solar absorption from other aerosols and its direct rad forcing

I would recommend to publish the paper, after considering minor comments below:

Specific comments

Lines 21-25. What do the CMIP5 models simulate as surface warming on that region in their historical simulation? Any reference about it?

Line 15: I would suggest to add Lau et al. [2006] and Lau and Kim [2006] in the list of references

Methodology BC treatment in the model: If you may briefly summarise here in which consists the correction you applied by the Xu et al papers, that would be very useful for the reader

Model experiments

Could you please specify here that you increase separately BC, SO4 CO2 in the perturbed equilibrium 5 ensemble members simulations?

which preindustrial and present day emissions have you used?

Not clear, lines 21 on: in the perturbed simulations you impose BC, SO4 and GHG as concentrations or you apply emissions for BC and sulphur (as specified in lines 8-12) and specify CO2 concentration?

Section 3 It seems to me by looking at figs 1, and S1 that there is an important decadal modulation of the snowcover, more than a trend.

Would it be possible to look at the area averaged time series of snow cover from 1967 from dataset NSIDC? By averaging where there is a negative (blue) linear trend. Also applying a running mean could be useful in order to help in understanding the amplitude of such low-frequency variations.

How different is this variability simulated by the model (at decadal timescale) w.r.t. observations in snow cover (for the 40 years)?

you ascribe a better simulated snow cover to a high-resolution model (that may be ok

for the better simulated orography), is this really the only factor?

Is Figure 3 only over 80-100E or 0-360 longitude global average?

Section 4 Which is the role of water vapour feedback in the T change increase versus altitude? And which is the role of changes in clouds?

How realistic is the simulated mean state and variability of the model temperature in this region?

Role of natural variability: why the 80%, may you also show for consistency 90 and 95% ? If we use the ctrl simulation to estimate the natural variability, how different would be the estimate with a different model, i.e. for example another ctrl simulation coming from the CMIP5 or maybe all the CMIP5 simulations. Would also in this case the observed trends be significantly "outside" the natural variability?

Change in the UT temperature (for example as in Fig 2), do imply any significant change in convection and precipitation in the model?

How important is the indirect effect in the model? Is it a minor contributor to the simulated and discussed changes?

You never discuss if there is any role of the dust. Is there any change in the transported dust? For example is that possible that in the simulation with increased CO2 / BC the pathways of transport of dust are changed because for example there is a different El Nino (Kim et al., Climate Dynamics 2015)?

Fig S6 is missing!

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 19079, 2015.