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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Climate modulation of the Tibetan Plateau on haze in China" *by* X. Xu et al.

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The authors of this paper propose that meteorological conditions on the Tibetan Plateau are partly responsible for the deteriorating air quality in eastern China. They found a robust correlation between wintertime visibility in eastern China with the heating rate (Q1) on the plateau derived from a reanalysis model. An air quality model was used to attribute changes in air quality to emission changes and to changes in meteorology. They found that during years of negative Q1 anomalies, the surface wind was weakened, the air in the boundary layer became more stable, and more moisture was transported from the ocean. All these factors contributed to unfavorable dispersion conditions. I support publication of the paper in ACP.

The current manuscript style is not suited for the readership of ACP. Because literature review is mixed with methods, results and discussion, it is difficult to determine which statements describe past research by other people and which describe new results from this study. They should restructure the manuscript according to the standard template used by a technical journal, by separating the information clearly into different sections (introduction /literature review, methods, results, discussion, conclusions). Data and sources should be clearly explained. Model scenarios and their rationale should also be explained in the methods section.

The first name of all the authors should be spelled out completely. It is very difficult to distinguish Chinese names, and using initials only makes the job even more difficult.

Quality of the graphs should be improved. Some legends and axis labels are too small or too faint.

I understand that the authors have plan to continue to elucidate mechanisms underlying the Q1-air quality "teleconnection". Here I present several questions that arose from my reading of the manuscript. They do not need a response at this time but may be helpful to the authors in their future research:

1) Q1 is a quantity derived from atmospheric reanalysis. Given that meteorological observations are spare on the Tibetan Plateau, I wonder how robust this quantity is. The current research relies solely on one reanalysis product (NCEP?). Do other reanalyses show similar Q1 variabilities (both inter-annual and long-term trend)?

2) It has been known for some time that the eastern Asian monsoon has been weakening in the past three decades. As far as I know, there is no accepted theory for explaining why this is occurring. This study presents empirical evidence suggesting that the weakening trend is tied to changes in land cover on the plateau, as implicated by the strong correlation between Q1 and wind. In this regard, two questions are worth pursuing: a) what types of change on the surface (snow albedo change, glacier melt, desertification, shrinking of shrub land, etc) are responsible for the changing Q1 signal

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in the atmosphere? d) How do you test the TP hypothesis versus other competing hypotheses regarding the monsoon trend?

3) Related to my point 2 above, the author suggests that higher Q1 values are caused by contamination of snow cover by pollutants transported to the plateau, due to the fact that dirtier snow absorbs more solar energy. Can you find direct evidence for a declining trend in the snow albedo? If this proves true, the snow albedo effect constitutes a positive feedback on air quality at the regional scale, which may have contributed to the observed decline in visibility. However, the feedback mechanism cannot explain the large year-to-year variabilities in Q1. It is intriguing that Q1 and air quality are correlated both in terms of the decadal trend and in terms of interannual variabilities. Why does Q1 change rapidly from one year to the next?

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