Response to Anonymous Referee #2

We thank you for your careful reading of the manuscript and helpful comments and suggestions. We have made revisions according to your comments and suggestions, as described below.

General Comment

Using AERONET data at 3 stations located in the Himalayas, the authors discussed aerosol optical properties in this key region. Different diurnal variation of aerosol optical properties was revealed and potential causes were discussed. This is an interesting research and the data set was valuable. However, the manuscript needs further improvement and polish in language before it is accepted for publication.

Response

Thank you very much for your comments and suggestions. The comments and suggestions are valuable and very helpful for revising and improving our manuscript. We have revised our manuscript according to your comments and suggestions point by point (please see the revised manuscript and following answers).

Special Comment

1.Different AOD between QOMS_CAS/EVK2-CNR and Pokhaka is mostly due to quite different elevation instead of large scale atmosphere circulation. Pokhaka is a city and heavily impacted by anthropogenic activities, so aerosol loading and optical properties are quite different from those at QOMS_CAS and EVK2-CNR. I'm not sure what's the objective of using Pokhaka in the comparison. My understanding is that further analysis of difference in aerosol optical properties between QOMS_CAS and EVK2-CNR should be emphasized.

Response

Thank you for your comment and suggestion. Pokhara is located near the other two high altitude stations. Although Pokhara is heavily influenced by anthropogenic activities, the seasonal variations affected by large scale atmospheric circulation can be shown obviously. As pointed out in this study, smoke aerosols released from strong forest fires and dust also do have a big impact on Pokhara. The following literatures show the influences.

Vadrevu, K. P., Badarinath, K. V., and Anuradha, E.: Spatial patterns in vegetation fires in the Indian region, Environmental monitoring and assessment, 147, 1-13, doi:10.1007/s10661-007-0092-6, 2008.

Vadrevu, K. P., Ellicott, E., Giglio, L., Badarinath, K. V. S., Vermote, E., Justice, C., and Lau, W. K. M.: Vegetation fires in the himalayan region – Aerosol load, black carbon emissions and smoke plume heights, Atmospheric Environment, 47, 241-251, doi:10.1016/j.atmosenv.2011.11.009, 2012.

Liu, Z., Liu, D., Huang, J., Vaughan, M., Uno, I., Sugimoto, N., Kittaka, C., Trepte, C., Wang, Z., Hostetler, C., and Winker, D.: Airborne dust distributions over the Tibetan Plateau and surrounding areas derived from the first year of CALIPSO lidar observations, Atmos. Chem. Phys., 8, 5045-5060, doi:10.5194/acp-8-5045-2008, 2008.

Therefore Pokhara is used to analyze the aerosol optical properties in comparison with the other two stations in this paper. Surely we would like to emphasize further analysis of difference in aerosol optical properties between QOMS_CAS and EVK2-CNR at same time.

2. Some case studies are required to show how long-range transportation of dust and anthropogenic aerosols impact QOMS_CAS and EVK2-CNR.

Response

Thank you for your comment and suggestion. We appreciate your comment. We used the frequency plot in April in 2012 as case studies in the revised manuscript. Because the frequency plot in April in one year can represent the impacts of some events. And we used the frequency plot in July 2012 as an example to show the dust impact in Section 3.2. It can not only show the impact of long-range transportation of dust and anthropogenic aerosols, but also indicate the possible aerosol source region. So we consider it is better to use frequency plot rather than the back-trajectories of some special events.

3. How to calculate FMF.

Response

Fine mode fraction (FMF) at 500nm defined as the ratio of fine mode AOD to total AOD is a quantitative parameter. In this study, FMF is calculated by dividing the monthly median of total AOD by monthly median of fine mode AOD in each month.

4. Because most AODs at QOMS_CAS and EVK2-CNR were less than 0.15, calculation of AE under this condition should not be free of large uncertainty, so in my opinion, it is not suitable to calculate individual AE when you talk about the diurnal variation of AE, the best way is to calculate AE diurnal variation from multi-day mean individual AODs.

Response

Thank you for this comment and suggestion. There is really large uncertainty in the calculation of AE. You are right, it is better to calculate AE diurnal variation from multi-day mean individual AODs. However, it is difficult to ensure that the daily continuous observation data are available. If the available hourly means in a day are less than five hours, the day would be excluded in this study. The daily continuous observation data are less at three stations in our study. Thus, it is hard to calculate AE diurnal variations from multi-day mean individual AODs. In addition, there are some studies which use the method in the manuscript. The followings are the examples. Therefore we use the generally accepted method, and it is better for others to compare results.

Smirnov, A., Holben, B. N., Eck, T. F., Slutsker, I., Chatenet, B., and Pinker, R. T.: Diurnal variability of aerosol optical depth observed at AERONET (Aerosol Robotic Network) sites, Geophys. Res. Lett., 29, 2115, doi:10.1029/2002GL016305, 2002.

Wang, J., Xia, X., Wang, P., and Christopher, S. A.: Diurnal variability of dust aerosol optical thickness and Angström exponent over dust source regions in China,

Geophys. Res. Lett., 31, L08107, doi:10.1029/2004GL019580, 2004.
Zhang, Y., Yu, H. B., Eck, T. F., Smirnov, A., Chin, M., Remer, L. A., Bian, H. S., Tan, Q., Levy, R., Holben, B. N., and Piazzolla, S.: Aerosol daytime variations over North and South America derived from multiyear AERONET measurements, J. Geophys. Res.-Atmos., 117, D05211, doi:10.1029/2011JD017242, 2012
Therefore, we think we should keep our calculating method.

5. Figure 4 is misunderstanding.

Response

Thank you for your comment. Figure 4 in the ACPD manuscript is the box plots of Ångström exponent at 440-870 nm at the three sites. This figure indicates the seasonal variations of aerosol size. Figure 6 in the ACPD manuscript (Figure 4 in the previous version) is a frequency plot of five-day back trajectories for April using HYSPLIT model version 4.9. It shows the possible aerosol source. We also have added the frequency plot in July 2012 in Section 3.2 in the revised manuscript. It can show the impact of long-range transportation of dust and anthropogenic aerosols, and indicate the possible aerosol source region.

6.Validation of AOD in the Tibetan Plateau and impact of dust aerosols in the Taklimakan Desert on aerosol loading in the Tibetan Plateau were shown in following reference

Xia X., P. Wang, Y.Wang, Z. Li, J. Xin, J. Liu, and H. Chen, Aerosol optical depth over the Tibetan Plateauand its relation to aerosols over the Taklimakan Desert, Geophys. Res. Lett., 2008, 35,L16804, doi:10.1029/2008GL034981

Response

Thank you for your suggestion. We are grateful to your information of literatures shared with us. We appreciate your comment and suggestion that this reference shows the effects of dust aerosols in the Tibetan Plateau well. The reference has already been cited in the introduction (please see Page 4 line 2 in the revised manuscript).

7. Improvement of our understanding of aerosol optical properties in China during recent years should be reflected in the introduction. The authors can refer to following important review papers

Li Z., H. Chen, M. Cribb, R. Dickerson, B. Holban, C. Li, D. Lu, Y. Luo, H.Maring, G. Shi, S.C. Tsay, P. Wang, Y. Wang, X. Xia, F. Zhao, Overview of the East Asian Studies on tropospheric aerosols, an international regional experiment(EAST-AIRE), J. Geophys. Res., 2007, 112, D22S00,doi:10.1029/2007JD008853.

Li Z. et al., East Asian studies of tropospheric aerosols and their impact on regional climate (EAST-ARIC): an overview, J. Geophys. Res., 2011,doi:10.1029/2010JD015257.

Response

Thank you very much for your literature information. And we are grateful to the literatures shared with us. These papers really indicate the aerosol optical properties in

China. We have cited these papers, and believe that it is better to cite the papers in the introduction (please see Page 3 line 5 and Page 4 line 21 in the revised manuscript).

8.Language should be further polished; there are so many grammar errors.

Response

Thank you very much for your comment and suggestion. English writing has already been further polished in the new revised manuscript by one co-author (Prof. A. Panday, Department of Environmental Sciences, University of Virginia, Charlottesville, Virginia, USA) now.