

Review of “First simultaneous measurements of peroxyacetyl nitrate (PAN) and ozone at Nam Co in the central Tibetan Plateau: impacts from the PBL evolution and transport processes” by Xu et al.

Xu et al. presented simultaneous measurements of two important atmospheric gases, peroxyacetyl nitrate (PAN) and ozone, at Nam Co in central Tibetan Plateau. Distinct diurnal cycles of PAN and ozone were found. Possible causes from evolutions of planetary boundary layer and long-range transport were explored. I think this is an important measurement and study, given the relatively few remote observational sites for PAN globally, which will be a valuable addition to our literature and an important reference for global model validation. The topic is well within the subject of ACP and the conclusions are generally supported by the data, with sound measurement method. However, the paper can not be accepted at the present form, which needs to be substantially improved by solving my following comments, both scientifically and technically.

Major comments:

1. Fischer et al. (2014) reported that biomass burnings were also important sources for PAN, which could transport to remote regions through the penetration of planetary boundary layer height, thus efficiently arriving at higher altitude, such as Nam Co. Therefore, biomass burnings from forest fires and agriculture residues over South and southeastern Asia could be sources for PAN at Nam Co. The authors in this paper have not touched the discussions of this possible source. I recommend that this should be explored in the discussion part. For instance, the authors could use OMI product to examine the fire frequency occurring over South and southeastern Asia, such as in Bangladesh, during June 1-6, 2012. With this examination, probably we could have better ideas what kinds of plumes affecting the spikes of PAN at Nam Co.

Fischer, E. V., Jacob, D. J., Yantosca, R. M., Sulprizio, M. P., Millet, D. B., Mao, J., Paulot, F., Singh, H. B., Roiger, A., Ries, L., Talbot, R. W., Dzepina, K., and Pandey Deolal, S.: Atmospheric peroxyacetyl nitrate (PAN): a global budget and source attribution, *Atmos. Chem. Phys.*, 14, 2679-2698, doi:10.5194/acp-14-2679-2014, 2014.

2. The authors employed KNMI monthly mean tropospheric NO₂ column density product to infer the abundance of NO_x sources over northern India. I recommend that the authors use the daily NO₂ product to show the day-to-day variability of tropospheric NO₂ column densities from June 1-12, 2012. NASA recently released its tropospheric NO₂ standard product version 3 with global gridded daily product at the resolution of 0.25° latitude x 0.25° longitude degree resolution (<https://daac.gsfc.nasa.gov/datasets>).
3. Other possible in-situ sources for NO_x and PAN are the photolysis of nitrate in the snowpack, with deposited nitrogen sources coming from long-range transport. Since the sea level of Nam Co is over 4 km, which is similar to Summit, Greenland in the Arctic (Huang et al., 2017), I am wondering whether there is snow deposited during wintertime, and slightly melt during summer? If yes, this should be discussed as well.

Huang, Y., S. Wu, L. J. Kramer, D. Helmig, and R. E. Honrath, Tropospheric ozone and its precursors at Summit, Greenland: comparison between model and observations, *Atmos. Chem. Phys. Discuss.*, doi:10.5194/acp-2017-463, 2017.

Technical comments:

Page 1 Line 19: PAN is an oxidant precursor. Only the peroxyacyl radical out of PAN decomposition can be as oxidant.

Page 1 Line 21: the number and unit of tropospheric ozone radiative forcing are incorrect. Please double check.

Page 1 Lines 25-26: change NO_x as “nitrogen oxides (NO_x)” because it appears for the first time in the text. Same thing for NO₂ and other chemical species.

Page 1 Lines 29-32: Kramer et al. (2015) have presented 2-year in-situ measurements of PAN at Summit, Greenland whose sea level height is over 3km. I suggest the authors including this reference here, demonstrating the long lifetime of PAN and the consequences of long-range transport.

Kramer, L. J., Helmig, D., Burkhardt, J. F., Stohl, A., Oltmans, S., and Honrath, R. E.: Seasonal variability of atmospheric nitrogen oxides and non-methane hydrocarbons at the GEOSummit station, Greenland, *Atmos. Chem. Phys.*, 15, 6827-6849, doi:10.5194/acp-15-6827-2015, 2015.

Page 9 Line 21: change “calculated of” to “calculated for”.

Page 12: consider changing the title of Section 3.4 as “O₃/PAN abundance from UT/LS”

Page 12 Line 7: delete “respectively” here.

Page 12 Lines 27-30: The transport of ozone from Stratosphere-Troposphere Exchange (STE) always accompanies with high ozone and low water vapor events, which have been illustrated in Helmig et al. (2007) and Huang et al. (2017). The authors should discuss these two previous studies, although in different locations, but in similar altitude and mechanism.

Helmig, D., Oltmans, S. J., Morse, T. O., and Dibb, J. E.: What is causing high ozone at Summit, Greenland?, *Atmos. Environ.*, 41, 5031-5043, doi:10.1016/j.atmosenv.2006.05.084, 2007.

Huang, Y., S. Wu, L. J. Kramer, D. Helmig, and R. E. Honrath, Tropospheric ozone and its precursors at Summit, Greenland: comparison between model and observations, *Atmos. Chem. Phys. Discuss.*, doi:10.5194/acp-2017-463, 2017.

Page 13 Line 16: what is omega mentioned here? Please explain clearly.

Page 15 Line 6: change “Fadnavis et al., (2014” to “Fadnavis et al., 2014”.

Page 16 Lines 11-14: there is some grammar issue here. Re-organize this sentence.

Page 16 Line 15: change “wind” to “winds”.

Page 16 Line 22: what does “photochemical pollution” mean here? Please be specific.

Page 17 Lines 15-16: there is grammar error in this sentence.

Page 35: there is a typo for Y-axis title in Fig. (g). Changed “wiind” to “wind”. Also, I suggest to use the consistent local time, not BJT.

Page 36: what Group 1 and Group 2 represent in the figure? This need to be clearly clarified.

Page 38: what is the color bar unit? I suggest the authors making the colors of specific humidity bolder, which is so light and can not be seen clearly here. Perhaps change the two boxes for case 1 and case 2 in black color.

Page 39: in Fig. 8b, change the Y-axis label for ozone as “O₃ (ppbv)” to be consistent across the whole manuscript.

Pages 40-41: Figures 9 and 10 need to be substantially improved in quality: (1) all the fonts are so light; (2) change the BJT as LT; (3) change the caption of Figure 10 as “Same as Figure 9, but for August 22-23, 2011.”

Page 43: for Figure 12, what is the color bar unit? Also, I suggest to plot the country border because it helps us to identify the origins of air masses from HYSPLIT backward trajectory.