

Dear Editor

Our manuscript acp-2013-860 entitled " Lidar-observed enhancement of aerosols in UTLS over the Tibetan Plateau induced by the Nabro volcano eruption" has been revised according to the anonymous referee's comments.

We appreciated reviewer's suggestions and endeavor. In this version, we checked and corrected several key results carefully and also adjusted some paragraphs to improve the readability and consistency of this article.

In the following, we will give an item by item response to reviewer's comments.

Best wishes.

Qianshan He

This paper presented the vertical distribution of aerosols measured by a micro pulse lidar at a station over the Tibetan Plateau during the months of July and August in 2010. A layer with a relatively large concentration of aerosols in the UTLS was observed and discussed. The quality of the data is very good as indicated by the comparison with the CALIOP satellite measurements, probably due to the remoteness and high altitude of the station and the relatively clean environment. There were interesting comments from the previous reviewers in terms of the source of the aerosols. The authors accepted the reviewers' idea that the main source of the aerosols in the UTLS was due to the eruption of the Nabro volcano. Accordingly, the title of the paper was changed from "Enhancement of aerosols in UTLS over the Tibetan Plateau induced by deep convection during the Asian summer monsoon" to "Lidar-observed enhancement of aerosols in the UTLS over the Tibetan Plateau induced by the Nabro volcano eruption". The content of the manuscript was also revised to reflect the changes.

I agree with the other reviewers' comments in that eruption of the Nabro volcano was probably the major source of the enhanced aerosols in the UTLS observed in this paper. The transport of aerosols from the troposphere to the stratosphere due to deep convection is possible, but may not be as important as the eruption of the Nabro volcano. A recent study done by Devasthale & Fueglistaler (ACP, 10, 4573-4582, 2010) shows that very deep convection does occur over the Tibetan plateau during the summer monsoon season, particularly during July and August. However, they concluded that very deep convection over the Tibetan plateau is comparatively weak and it may only play a secondary role in troposphere-to-stratosphere transport. In my opinion, the revised version of the paper is acceptable for publication in ACP, and particularly suitable for the special issue: Study of ozone, aerosols and radiation over the Tibetan Plateau (SOAR-TP). There are still a few minor issues listed below that should be addressed before publication.

1. Page 1, line 25-29, "Daily averaged aerosol optical depths ... of the enhanced aerosol layers in total AOD."

There are two issues here. First, the observed AOD in UTLS varying from 0.075 to 0.142 is much larger than the numbers shown in previous version of the manuscript. I understand that the author revised the retrieval method for considering volcano aerosols and it might have changed the retrieved AOD. However, 0.075-0.142 still seems too large. Please verify these numbers. Secondly, 0.075-0.142 is not similar to the previous observed global average (0.017). It is much larger than the previous observations.

Please also check the AOD values on Page 8, line 25 and Page 11, line 28.

**R: We appreciated the reviewer's suggestions. It is an obvious negligence that the incorrect numbers were presented in this key conclusion. In fact, daily averaged AODs of the enhanced aerosol layers in UTLS over the Tibetan Plateau should vary from 0.007 to 0.030. We**

**miswrote the results of total AOD from sunphotometer as those of the enhanced aerosol layers. This sentence has been rewritten as follows,**

*Daily averaged aerosol optical depths (AODs) of the enhanced aerosol layers in UTLS over the Tibetan Plateau varied from 0.007 to 0.030, in agreement with globally averaged levels of  $0.018 \pm 0.009$  at 532 nm from previous observations, but the percentage contributions of the enhanced aerosol layers to the total AOD over the Tibetan Plateau are higher than those observed elsewhere.*

**The sentences on Page 8, line 25 and Page 11, line 28 have also been rewritten.**

*Fig.4 shows time series of total aerosol optical depth (AOD) and its daily averaged results, which varied from 0.075 to 0.142 with maximum of 0.214 at 11:27 LST on 25 Aug.*

2. Page 7, line 19, At night time (00:00-07:00 and 2100-2400 LST)  
Should be "00:00-07:00 UTC and 21:00-04:00 LST"

**R: This sentence has been rewritten as At nighttime (2100-0700 LST)**

3. Page 8, line 10-16

Could you please explain why Shanghai is included in Table 1?

**R: The reviewer's comments are very valuable. We moved the corresponding discussion about Table 1 to the end of manuscript and added more statement about the observation in Shanghai.**

*In order to verify further that the enhanced tropopause aerosol is dominantly induced by the eruption of Nabro volcano, the aerosol loadings in UTLS over the Tibetan Plateau are compared with those over East China, where the influence of the Asian monsoon anticyclonic circulation and deep convection transportation were weak significantly. Table 1 listed some statistical parameters of aerosol layer over Tibet and Shanghai (31.23 N, 121.53 E) for the same period. The aerosol parameters over Shanghai were also derived from an MPL with the same mode used in the Tibetan Plateau. The larger averaged extinction coefficient and higher AOD of the aerosol layer in UTLS over Shanghai demonstrate that the enhanced tropopause aerosol was dominated by the Nabro volcanic emissions with quickly circulation throughout the Northern Hemisphere at the end of August when the Asian monsoon anticyclone began to decay.*

4. Page 9, line 1-3, " when more aerosols entry the atmosphere ..."

The higher AOD during the daytime is mainly due to stronger emissions.  
Convection can change the vertical distribution of aerosols, but not total aerosol load.

**R: We completely agree with reviewer's concerns and revise the statement about the reason of higher AOD during the daytime.**

5. AODs shown in Figures 4 and 5 are not consistent:

- 1) AODs in Fig. 4 are much larger than those in Fig. 5
- 2) Fig. 5 shows that AOD during the first period (Aug. 6 – Aug. 12) is larger than that during the second period (Aug. 22 to 26), but Fig. 4 shows the opposite.

**R: Same as the response of the first comment.**