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Atmospheric Chemistry and Physics Discussions
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Interactive comment on "Characterizations and source analysis of atmospheric inorganic ions at a national background site in the northeastern Qinghai-Tibet Plateau: insights into the influence of anthropogenic emissions on a high-altitude area of China" *by* Bin Han et al.

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First, I would like to show my appreciation to Dr. Merched Azzi for his comments on this paper. I drafted my response as follows: The paper is well written and covers an important topic relevant to air pollution in China. Before being published I have the following comments and suggestions related to the manuscript:

1- " Researches" should be changed to "Research" because it is plural (lines 90, 159).

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You can also use "Studies". Line 30: change understand to identify Line 152: include reference All downloaded equations couldn't be checked (not clear) Response: We will revised all of these above if we need to do further revision on this manuscript.

Line 216 add data after observations Response: All the data from our observation is shown in the first line of Table 2 Comparisons of WSIs concentrations with other high altitude and urban sites (mean, μg/m3). So if we need to do further revision, we will add "(as shown in Table 2)" after "observation".

Fig 4: Why high ozone peaks at hours 1 to 2 in Fig 4? Why does the ozone value at night increase to a value greater than that during the day? Response: To prove the diurnal change of ozone in our study, we referred to other publications. If we have chance to do further revision, we will add these two references and give a more detailed discussion on ozone diurnal variations. Wang et al. (2006) found ozone exhibited low levels in the morning and enhanced levels in the late afternoon and at nighttime during spring and summer time at Mount Waliguan (WLG, 36.28°N, 100.90°E, 3816 m above sea level), about 150 km south of our monitoring site. The diurnal trends of ozone in two seasons are shown in Fig.1. He explained that the lower morning values may be due to the depositional loss of ozone in stagnant air during the nighttime and early morning hours, and its enhancement in the afternoon could be due to the in situ photochemical production of ozone. Shen et al. (2014) monitored the ozone concentrations in Qinghai lake area (36°58âĂš37âĂšâĂšN, 99°53âĂš56âĂšâĂšE, and 3200 m above sea level), about 140km southwest of our monitoring site. As shown in Fig 2, a unimodal distribution was found for ozone concentrations in autumn time, with high levels in the afternoon and nighttime, and decreased level in the morning. The lower morning values might be due to the depositional losses in stagnant air during the nighttime and early morning hours, and its enhancement in the late afternoon and night could be due to downward transport of the free troposphere air.

Fig 4 SO4 displays wide fluctuation between hrs 12 and 20 with hour to hour fluctuations of about 2μ/m3, or about 15% of the absolute value. An explanation regarding the

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possible origins of these transients would be useful. Is this variance the true measure of the uncertainty of the SO4 ion concentration? If so, then the findings and conclusions should be recast in the context of the uncertainty of these data variabilities. If these data are averages over a number of days then correlation with wind direction etc. could be useful in identifying the origins of such variations and may aid in apportioning sources. Fig 4 NO3 exhibits similar variability over the period of hour 12 to 18 with again wide fluctuations. Hours 14, 15 and 17 tend to be small while 16 is much higher. Again is this the true uncertainty of these data or are there other factors driving or pertaining to the variability (In both SO4 and NO3). A correlation plot with the prevailing wind direction and speed could be useful as these fluctuations may be a results of wind direction changes and may provide additional data regarding sources. In addition, these fluctuation will have significant influence on the NOR and SOR, at least an uncertainty value should be assigned to the NOR and SOR. If the above points are considered in the context of the scatter of data displayed in figure 5. Since ozone and RH data trends shown in figure 4 appear to be relatively well defined, then the scatter in these data in figure 5 are consequently driven by the variability of the SOR and NOR. Following further, since SO2 and NO2 are also well defined in fig 4, then the variability in SOR and NOR is driven by the concentration of the respective WSI species. A careful analyses of this variability and a discussion with regards to the implications of these uncertainties to the conclusion drawn from figure 5 would be useful to the reader. Response: We have noticed this problem. However, we believe it might be caused by some extremely high or low observations during the campaign. Also we did the correlation analysis between concentrations of sulfate or nitrate and wind direction or speed separately in each time period, and the correlation coefficients are shown in Table 1. The bold and colored figures are the questionable time period in Dr. Azzi's comments. Actually we cannot find any clue from this table. Therefore, our primary conclusion is that the existence outliers are believed to be the potential reason to cause the large variations of averaged sulfate and nitrate during afternoon and early evening. We will go to find the outliers and evaluate the reliability of these data. If not reliable, we will

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delete them in our future revision. If reliable, we will add some explanations on how to interpret the large variations, and how it will influence the trend of SOR and NOR.

Reference: Shen, Z.X., Cao, J.J., Zhang, L.M., Zhao, Z.Z., Dong, J.G., Wang, L.Q., Wang, Q.Y., Li, G.H., Liu, S.X., Zhang, Q., 2014. Characteristics of surface O-3 over Qinghai Lake area in Northeast Tibetan Plateau, China. Science of the Total Environment 500, 295-301. Wang, T., Wong, H.L.A., Tang, J., Ding, A., Wu, W.S., Zhang, X.C., 2006. On the origin of surface ozone and reactive nitrogen observed at a remote mountain site in the northeastern Qinghai-Tibetan Plateau, western China. J. Geophys. Res.-Atmos. 111.

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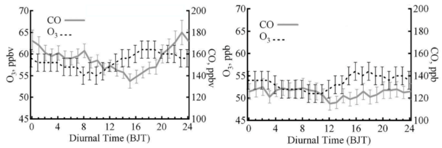

(a) spring (b) summer

Fig. 1 Average diurnal patterns of O3, CO at WLG for (a) spring and(b) summer; error bars indicate standard errors

Fig. 1.

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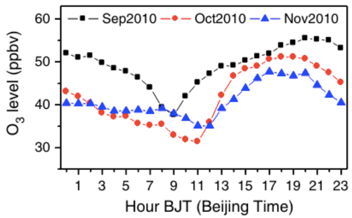

Fig 2. Diurnal cycle of O3concentration in Qinghai Lake area

Fig. 2.

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Table 1 Correlation coefficients between concentrations of sulfate or nitrate and wind direction or speed

Time	Nitrate-Wind Direction	Nitrate-Wind Speed	Sulfate-Wind Direction	Sulfate-Wind Speed
0:00	0.14	-0.16	-0.23	0.52
1:00	0.16	0.21	-0.74	0.69
2:00	0.00	0.45	-0.08	0.59
3:00	-0.12	0.45	-0.74	0.89
4:00	0.45	0.05	-0.41	0.86
5:00	0.45	-0.18	-0.36	0.82
6:00	-0.26	0.03	0.01	0.68
7:00	0.17	0.22	-0.11	0.55
8:00	-0.08	0.53	-0.30	-0.02
9:00	-0.10	0.34	0.38	0.31
10:00	-0.39	0.36	-0.51	-0.14
11:00	**-0.03**	**0.22**	**-0.43**	**0.55**
12:00	**-0.63**	**0.35**	**-0.20**	**0.33**
13:00	**0.36**	**0.72**	**0.53**	**-0.16**
14:00	**-0.09**	**0.06**	**0.28**	**0.74**
15:00	**0.05**	**-0.07**	**-0.03**	**0.17**
16:00	**0.56**	**0.21**	**0.18**	**0.11**
17:00	**0.29**	**-0.28**	**0.37**	**0.05**
18:00	-0.51	-0.35	**0.73**	**0.56**
19:00	0.15	-0.12	**-0.68**	**-0.07**
20:00	-0.50	0.07	0.34	-0.57
21:00	-0.07	-0.04	-0.29	-0.59
22:00	0.34	-0.31	0.19	-0.05
23:00	-0.32	-0.02	-0.50	0.74

Fig. 3.

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