On the Ozone Variations at Mt. Waliguan Observatory

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Mt. Waliguan Observatory (WLG) is an inland Global Atmosphere Watch baseline station, located at the northeastern edge of the Tibetan plateau (36°17′N, 100°54′E, 3816 m a.s.l.). It is a remote high elevation site, influenced mainly by Central and West Asian and European outflow and representing the baseline atmosphere of the Eurasia continent. Continuous long-term measurements of atmospheric composition have been performed at WLG since 1994, and similar seasonal and diurnal variation patterns of surface ozone are found to occur regularly each year. Although great efforts were made, the causes of seasonal and diurnal variations of surface ozone at WLG have not been fully understood.

Ma et al. (2002a) showed that ozone at WLG is chemically destroyed during summertime and its diurnal variation is controlled mainly by meteorological dynamics. In contrary, Xue et al. (2013) showed that there is net ozone production from in situ photochemistry at WLG in summer. Note that both studies applied the chemical box models constrained by measurements, which had been made in 1996 and 2003, respectively, and had shown large difference in noon-time NO levels (8–19 pptv vs. 40–50 pptv). It is still not quite clear if such an increase in NO did occur over that period or there were large uncertainties in the measurements and/or modeling. Recently, Xu et al. (2016) further confirmed that the mountain-valley breeze plays an important role in the diurnal cycle of surface ozone at Waliguan, resulting in higher ozone values during the night and lower ones during the day.

Different mechanisms have been proposed to explain why there is a summer peak for surface ozone at WLG, including, e.g., transport from eastern central China, Central/South Asia and even Europe (Zhu et al., 2004; Li et al., 2009; Xue et al., 2011), downward transport from the upper troposphere associated with enhanced convection (Ma et al., 2002a, 2002b, 2005; Wang et al., 2006) and more frequent stratospheric intrusions (Ding and Wang, 2006). Regional chemical transport models were used to simulate ozone at WLG and attribute its concentrations to the main sources with tagging technique. Ma et al. (2002c) showed that surface ozone at WLG comes predominately from outside China in the W-NW-N direction. However, Li et al. (2009) showed that the chemical production in China is responsible for the ozone maximum in summer. The reasons for such large discrepancy between the two model results are not clear and need to be investigated further.

![Fig. 1. The site location (Left), average seasonal-diurnal variation (Middle) and month-to-month time series (Upper-Right) of surface ozone at WLG during 1995-2013 (Xu et al., 2016).](image1)

![Fig. 2. The local chemical budget for ozone at WLG for the year 1996 (Ma et al., 2002) (Left) and for the year 2003 (Xue et al., 2013) (Right).](image2)

References