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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Differentiating local and regional sources of Chinese urban air pollution based on effect of Spring Festival" *by* Chuan Wang et al.

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Large reduction in emissions of anthropogenic pollutants in a mega city during the week-long holiday gives an opportunity to investigate how the urban air quality reacts to reductions in emission. This study conducted a systematical examination of the "Spring Festival effect" over three consecutive winters in Shenzhen with a population of greater than ten million, and the difference in the concentrations of various air pollutants between the Spring Festival (SF) and non-Spring Festival (NSF) periods was exploited to indicate that the origins of pollutants are primarily local or regional.

Although "holiday effect" has been discussed in a large number of studies in recent

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Discussion paper

decades, the rich and comprehensive dataset provided in this study is informative and helpful for understanding of sources of a large array of species with considerable differences in properties. The authors clearly show their own contribution in the study of Spring Festival effect. In the present form, the authors focus on exploiting the percent change in the concentrations of various air pollutants to differentiate contribution from local and regional sources. The value of this paper could be further enhanced if the authors can make more in-depth discussion on the species (e.g., PM0.8–2.5 and O3), which had a small difference between the SF and NSF periods. It is interesting to know that these species revealed only a small difference when traffic flow dropped by âĹij50% and the industrial plants were almost entirely shut down. It is well known that PM has numerous and complex constituents contributed from diversified sources (primary and secondary, anthropogenic and natural), and O3 is a secondary photochemical product with nonlinear relation with its precursors NOx and VOCs (anthropogenic and natural). I encourage the author to strengthen the link between their observation results and the possible causes (composition, property, sources, transport, physical and chemical processing, meteorology, etc.). In general, the manuscript was well written and organized. The subject of the paper is well within the scope of ACP. The paper is suitable for publication provided the general comments and following points are addressed.

REPLY: We have looked for new useful evidence to explain the small decrease of SO2 and PM0.8–2.5 in Group SD, and have given new information as below in section 3.1:

“On the other hand, a piece of evidence for the regional origin of SO2 is from the newly established 356 m meteorological and environmental monitoring iron tower in Shenzhen. The ambient SO2 concentrations were similar at the highest platform (ave.=7.4 ppbv@325 m) and the lowest platform (ave.=7.2 ppbv@60 m) during January–February, 2017, indicating that SO2 was already well mixed in the atmosphere and the local contributions should be minor. In contrast, the concentrations of NOx, which belongs to Group LD, had a 56% higher concentration at the lowest platform

than at the highest platform (Zhuang, 2017). The small decrease of SO2 is thus a reasonable result of the stable emissions during the SF periods and the primarily regional origin."

"In terms of chemical composition of PM0.8–2.5, implications can be found in our previous size distribution measurement of aerosol chemical composition, using a ten-stage micro orifice uniform deposit impactor (MOUDI), during the fall to winter in Shenzhen (Lan et al., 2011). The results clearly indicate that smaller fine particles (e.g., 0.18–0.56 μm) contains relatively more BC (BC/SO42-=0.83), while larger fine particles (e.g., 1.0–1.8 μm) contained a higher proportion of SO42- (BC/SO42-=0.17). The SO42- in PM2.5 in Shenzhen has been well proved to be mostly a regional pollutant, with similar concentrations at various sites including both urban and rural sites (Huang et al., 2014). Therefore, the very small decrease of PM0.8–2.5 during SF should be closely related to its enrichment of secondary regional species like SO42-."

As to the unique variation of O3, it is clearly related to the nonlinear relation with its precursors NOx and VOCs, as stated by this reviewer. The other reviewer also pointed out that, based on limited VOCs measured, we cannot achieve a conclusion that whether the O3 formation is VOCs-sensitive or NOx sensitive. Therefore, in the revised manuscript, we only pointed out the idea as below in section 3.2:

"...As a result, although the reduction in emissions of urban anthropogenic sources leads to a large decline of NOx and VOCs, this reduction does not mitigate the average ambient O3 concentration, which implies that the concentration ratio VOCs/NOx play an important role in controlling O3 concentration."

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