

Interactive comment on “Measurement report: Long-term variations in carbon monoxide at a background station in China’s Yangtze River Delta region” by Y. Chen et al.

We thank both referees for their very constructive comments and suggestions. We revised our manuscript according to their comments and suggestions and changes are highlighted in the revised version.

Response to comments by referee 1

Anonymous Referee #1

This manuscript reports a 12-years continuous measurement of CO at the GAW’s regional atmospheric background station in eastern China (Lin’an). Temporal variations, especially the long-term trend, as well as the causes and implications of the CO decline were analyzed. Long-term observations of atmospheric compositions are crucial for understanding the variation trends of atmospheric chemical processes, but are relatively limited in China. The data presented in the present study are thus much valuable, and the data analysis and interpretation of results are well. The organization and writing of the manuscript are also good. Hence, I would like to suggest that this manuscript can be accepted for publication after the following minor comments being properly addressed.

Specific Comments:

L62: from the perspective of atmospheric chemistry, intermediate is usually used to denote the ‘product’ of chemical reactions what may undergo further chemical reactions. So, I suggest the authors to change to another word, such as player?

Thanks, the word intermediate was changed to **player**.

L76-78: in general, the contribution of CO to ozone formation is not quite important in polluted atmospheres where the abundances of VOCs are high, but it may become important in the rural areas.

Thanks, we have double-checked the reference and modified this sentence as “**Moreover, CO can be an important precursor for the photochemical generation of ozone in the rural areas (Demerjian et al., 1972)**”.

L84-85: the time period from July 2008 to January 2009 is too short to derive a “trend”.

Thanks, we have deleted this inappropriate citation.

L99: have been emitted...

Thanks, corrected.

L114: Monitoring site...as you only have one site in this study.

Thanks, revised.

L127-134: it would be better if the authors could provide the standard deviations for the average values (if any).

Thanks, we have revised these sentences as “The highest and lowest temperatures occurred in July

(28.4 ± 1.5 °C) and January (4.1 ± 1.8 °C), respectively. In opposition to the seasonal change in temperature, the seasonal change in atmospheric pressure at the LAN station showed a concave shape, with the lowest and highest pressures occurring in July (989.51 ± 0.77 hPa) and January (1010.81 ± 1.54 hPa), respectively. The seasonal patterns of the WS and RH at the LAN station were not as clear as those of air temperature and pressure. The seasonal average WS was lowest in winter (1.9 ± 0.1 m/s) and highest in spring (2.1 ± 0.1 m/s). The RH was highest in summer (77 ± 3 %) and lowest in spring (68 ± 2 %).".

L140-141: rephrase "a one half of which is filled with CO and the other with nitrogen"

Thanks, this sentence was rephrased as "**Infrared radiation is chopped and passed through a rotating gas-filter lens, half of which is filled with CO and half with nitrogen**".

Fig. 1: the content in the figure is not consistent with that described in the figure caption. Please check and revise.

Thanks, figure 1 caption was revised as "**Fig. 1. Seasonal variations in (a) temperature, air pressure, (b) WS, (c) RH, and (d) WD frequency distribution**".

L240: delete the extra space between "Global" and "Fire"

Thanks, deleted.

L253: change "Nevertheless" to "In comparison" or "In contrast".

Thanks, "Nevertheless" was modified to "In comparison".

Fig. 4: please indicate the source of measurement data from Shanghai, Nanjing and Hangzhou. Are they also long-term data from 2006 to 2017?

Thanks, the measurement data in Shanghai, Nanjing and Hangzhou were from (Gao et al., 2017), Huang et al. (2013) and (Zhang et al., 2018), respectively. They are not as long as data from 2006 to 2017. Specifically, the data from Shanghai, Nanjing, and Hangzhou were from 2006 to 2015, from January 2011 to December 2011, and from January 2013 to December 2013, respectively. Fig.4 caption was revised as "**Fig. 4. Average diurnal variations in CO mixing ratios from 2006 to 2015 in Shanghai, from January 2011 to December 2011 in Nanjing, from January 2013 to December 2013 in Hangzhou, and from 2006 to 2017 at the LAN station**".

L343-352: I suggest the authors to move this discussion (comparison with other sites) to Section 3.1.

Thanks, we have moved the discussion (comparison with other sites) to Section 3.1.

Fig. 7: it is unclear why you show a number of "353" in the summer panel?

Thanks and sorry for the misplacement of the line numbers. We have deleted it and double-checked the manuscript.

L389-392: a direct comparison in the average CO concentrations is quite rough. What are the impacts from meteorological conditions on these differences?

Response: Yes, the differences in meteorological conditions sometime might weaken a direct

comparison in the average values especially in a short period and it's also challengeable to eliminate completely the effect. Fortunately, the data were long enough for the Shanghai Expo in 2010 (from 1 May to 31 October) and Hangzhou G20 in 2016 (from 24 July to 6 September), and we found that the meteorological conditions (the average values and standard deviations of temperature, air pressure, wind speed, and relative humidity) between the periods of Shanghai Expo and Hangzhou G20 and the same periods in the other years were quite close (Table S1), and the wind direction frequency distributions were very close to each other (Fig. S1.). Therefore, meteorology seemed not to be the main factor contributing to the descending trend of CO. We added the meteorological comparison result in the revised manuscript. Also, we have further discussed the impacts of meteorological conditions on CO concentrations in the following Section 3.5.2. **“Since the meteorological conditions (the average values and standard deviations of temperature, air pressure, wind speed, relative humidity, and the wind direction frequency, see Table S1 and Fig. S3) between the during the same periods of Shanghai Expo and Hangzhou G20 and the same periods in the previous year were quite close, the results indicated that...”** was added in the revised manuscript.

Table S1 Comparison of the meteorological conditions (mean or mean \pm 1 standard deviation) between the periods of Shanghai Expo and Hangzhou G20 from 2006 to 2017

Shanghai Expo	T (°C)	P (hPa)	WS (m/s)	RH (%)
2010	24.2	995.52	1.9	78
The other years	24.4 \pm 0.6	994.13 \pm 3.41	2.0 \pm 0.1	77 \pm 5
Hangzhou G20	T (°C)	P (Pa)	WS (m/s)	RH (%)
2016	28.6	990.11	2.0	73
The other years	27.6 \pm 1.2	991.25 \pm 6.70	2.0 \pm 0.2	76 \pm 7

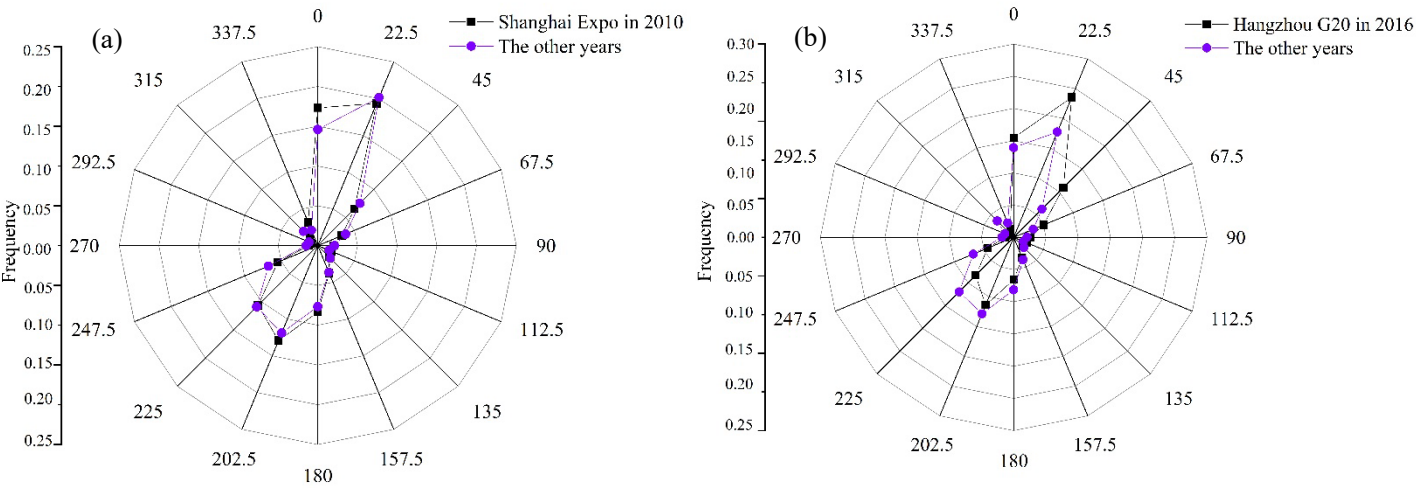


Fig. S1. Comparison of the wind direction frequency distributions between the periods of Shanghai Expo (a) and Hangzhou G20 (b) from 2006 to 2017

L402: “transmission capacity” is hard to follow. What do you mean by this?

Response: Here “transmission capacity” means the diffusion capability of CO, and we have revised this sentence as “**which influence the diffusion, generation, consumption, and lifetime of atmospheric CO**”.

L425: showed a convex shape...

Thanks, corrected.

L466: Fig. 11 displays the change...

Thanks, corrected.

L470: with an average decline...

Thanks, revised.

L500-501: rephrase this sentence.

Thanks, this sentence was rephrased as “The lowest average total OH reactivity ($5\text{ s}^{-1}\sim 6\text{ s}^{-1}$) around the world was observed in the rural areas”.

Data availability: the measurement data must be made available for the research community. The authors are encouraged to deposit their data to an accessible repository.

Thanks, we have deposited our measurement data to an accessible repository which was noted at the end of the manuscript (“**Data availability. Our measurement data are deposited to an accessible repository.**”). A URL or DOI to access the data will be given when published officially. Also, the measurement data in the excel form was uploaded in the zip-file along with AR1.