Response to Referee #4

Thank you very much for your thoughtful and constructive comments on our manuscript. We have revised the manuscript accordingly. The detailed responses are given below point by point (in blue), and the revised manuscript is shown in red.

This paper entitled "One year monitoring of volatile organic compounds (VOCs) from an oil-gas station in northwest China" utilized a unique dataset to analyze the differences between the VOC concentrations, compositions, source contributions in an oil-gas station and other urban areas and industrials. The results seem to be interesting with unique characteristics of VOC compositions and sources in this kind of areas. Based on one-year online monitoring of VOC concentrations, the PMF model was successfully employed to source apportionment and the different timescale variations of different source contributions were discussed. The PSCF and CWT method were also employed to investigate the potential geographic origins of VOCs. A new method based on CWT was proposed to attempt to distinguish the local and regional contributions. I suggest this paper can be accepted after minor revision and addressing my questions.

We are very grateful to all important and helpful comments from the referee. The followings are our responses to each comment in detail.

The specific comments are listed as follows:

1. P1 Line 15 the sentence "the ambient VOCs from fifty-six Photochemical Assessment Monitoring Stations (PAMS) VOCs were continuously measured for an entire year (September 2014-August 2015) by a set of on-line monitor system from an oil-gas station in northwest China." confused me. Pls make it clear.

This sentence has been revised.

To understand the VOC levels, compositions and sources in such region, an oil and gas station in northwest China was chosen as the research site and fifty-seven VOCs designed as the photochemical precursors were continuously measured for an entire year (September 2014–August 2015) using an on-line monitoring system.

2. P1 Line 31: How about replace the keywords "source region and local-regional contribution" to local-regional contribution?

Thanks for your suggestion, and we have revised in the updated manuscript.

3. P2 Line 6: Insert references after "air quality."

We have added the reference

4. P2 Line 25 Insert references or link.

We have added the link, which the full-text of Air Pollution Prevention Control (APPC) can be found.

5. P4 Line 2∼5: Please check and make sure the analysis method is correct.

The VOCs analysis method has been checked and some technic errors have been corrected.

Briefly, two-channels were installed to analyze VOCs separately. The water and carbon dioxide in the sampled air was firstly removed at a cold trap maintaining at –80 ℃ and then concentrated at –150 ℃ at another cold trap. After the purification and concentration, the VOCs were desorbed by rapid heating to 100 ℃. The C_2–C_5 VOCs were separated with a PLOT column (diameter: 0.32 mm, thickness of membrane: 1.5 μm, length: 60 m) and were quantified by the gas chromatograph-flame ionization detector (GC-FID, Agilent 7890). C_5–C_{12} were separated by a DB-624 column (diameter: 0.25 mm, thickness of membrane: 3 μm and length: 60 m) and were quantified using mass spectrometer detector (MSD, Agilent 5975).

6. P4 Line 8. Technic errors. The PAMS standard gases contain 57 VOC species, including alkane (30), alkene (9), alkene (acetylene), and aromatic (17).

Thanks for your correction and we have revised it.

7. P6 Line 7: The author mentioned that the trajectories were mainly originated from the northwest during the whole sampling period. However, the wind rose (Fig. 1c) indicated the northeasterly winds prevailed in P5 Line 2. How to explain the difference?

The wind rose plot was drawn according the observation data at the sampling site, while the backward trajectory was analyzed using the National Center for Environmental Prediction's Global Data Assimilation System (GDAS) wind field re-analysis. In addition, the wind rose more reflects the instantaneous wind directions, while the back trajectories indicate the long-range transport in large spatial scale. The data source and spatial scale resulted the differences.

8. P7Line 15: You mean 33 ± 33ppbv?

Yes, we have corrected this error.

9. P9 Line 12: The concentrations of O_3 precursors decreased and O_3 increased?

This sentence is confusing and we have revised it in the manuscript. Actually, the O_3 precursors means VOCs and NO_2 in this study and we revised this sentence as below:

After sunrise, with the initiation of photochemical oxidation and the increasing of BLH, the concentrations of VOCs decreased while the O_3 increased rapidly.

10. P9 Line 16~23: When discuss the effects of BLH and photochemical reactions on VOC concentrations in summer and winter. I suggest more statistical method such as ANOVA analysis can be used to test the differences were significant or not.

Thanks for your suggestion. We conducted ANOVA analysis to discuss.

11. P11 Line 18-19 & P12 Line 8~10: The author compared the source contributions in different seasons using the percentage contributions (%) and volume contributions (ppbv) and it's paradoxical using both methods. For instance, in P12 Line 8~10, the percentage contribution in spring was the highest, however, the volume contribution was the lowest among the four seasons. How to explain or avoid?

Thanks for your reminder, we use the relative contribution (%) instead of both relative and absolute contribution (ppbv) to avoid the paradoxical expression.

12. P15 Line 18: Highest CPF values of oil refinery was found in the east direction (Fig. 14a, 14b, and 14d). This sentence confused me.

The CPF plot of this source was corresponding to Fig 14a, not referred to Fig. 14a, 14b, and 14d in the original manuscript. So, we have corrected this sentence.

The highest CPF value of oil refinery was found in east direction of the sampling site (Fig. 14a), which indicated the potential location of this source.

13. P25 Table 1: There are some mistakes such as an extra line under n-decane.

We have corrected this error.

14. P28 Table 3: I am wondering why the average value of four different seasons does not equal to annual value?

The average value of four different seasons does not equal to annual value which is due to the different calculation method. For instance, the local contribution of oil refining source in different seasons was calculated according to the raster analysis of each season, while the annual contributions were calculated according the whole year's CWT analysis. According to the equation 2, the C_{bi} in different seasons was different. So, the average value of four seasons does not equal to the annual contribution.

15. P35 Figure 7 and P41 Figure 13: Due to the time resolution of meteorological parameters, BLH are three hours, while the time resolution of trace gases is one hour as the author mentioned. I suggest that the Pearson correlation can be conducted to give a more statistical reliable relation between VOC concentrations, different source contributions and trace gases.

Thanks for your constructive suggestion, the Pearson correlation between the VOC concentrations and different source contributions and trace gases were conducted. The species which were not well correlated with the corresponding source contributions were deleted. The revised manuscript is shown as following:

3.5.1 Oil refinery

The diurnal pattern of this source contribution was well correlated to the methylcyclohexane ($r = 0.76$, $p < 0.01$) and characterized by a double wave profile with the first peak at 02:00 LT and second peak at 06:00 LT (Fig. 13a).

3.5.2 NG

The diurnal variation of the NG leakage was significantly correlated ($p < 0.01$) with the diurnal pattern of propane *n*-butanes and *i*-butane with Pearson coefficients as 0.94, 0.87 and 091, respectively (Fig. 13b), which was also reported by Baudic et al. (2016).

3.5.3 Combustion source

The diurnal variation of combustion source was in accordance with the diurnal pattern of ethylene and CO with Pearson correlation coefficients as 0.71 ($p < 0.05$) and 0.84 ($p < 0.01$), respectively.

3.5.4 Asphalt

The diurnal variation of asphalt was different from other sources and well followed the diurnal patterns of decane ($r = 0.76$, $p < 0.01$) and undecane ($r = 0.86$, $p < 0.01$).

3.5.5 Fuel evaporation

On the contrary, the source contribution followed the diurnal variations of fuel evaporation tracers such as *i*-pentane, *n*-pentane and methycyclohexane, with Pearson correlation coefficients being 0.86 ($p < 0.01$), 0.87 ($p < 0.01$) and 0.67 ($p <0.05$), respectively.