

Interactive comment on “Long-term trends of surface ozone and its influencing factors at the Mt. Waliguan GAW station, China, Part 2: Variation mechanism and links to some climate indices” by Wanyun Xu et al.

Anonymous Referee #2

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This manuscript presents a detailed analysis on the interannual variability and long-term trends of surface ozone at the Mt. Waliguan (WLG) station for the period of 1994-2013. A number of approaches including backward trajectory, chemical transport model simulations, tropospheric ozonesonde dataset, correlations with multiple climate modes, and multi-variable regression are applied to address this issue. The results identify the importance of stratosphere-troposphere exchange to the observed ozone increases at WLG in spring, and increasing influences of anthropogenic pollution from Southeast Asia in summer.

C1

This study provides valuable information to better understand the long-term changes of surface ozone at a background station in western China. I also feel difficult to follow while reading the manuscript, and I understand the attempts to combine together all these different approaches and difficulty in assessing their inconsistency quantitatively. I have a few comments listed below for helping authors to clarify the manuscript.

Specific comments

1) Page 5, Line 5:

It is not clear how you clustered the trajectory directions into 45-degree bins. It shall be helpful to plot and define these bins on a figure, such as on a panel of Figure 1.

2) Page 8, Line 5:

For the statement “During summer, when air-masses from the east occur most frequently, the entire eastern sector reveals low PSCF”, I suggest add “(as will be shown in Figure 2)” after “from the east occur most frequently”, so that readers understand how you make the statement.

3) Page 8, Line 26:

Why do you state “the anthropogenic influence is negligible in all seasons except summer”? From Figure 1, we can also see high anthropogenic influences from Sichuan in spring and fall.

4) Page 11, Line 17-18:

You have argued above that the ozone trend in spring at WLG is driven by stratosphere-troposphere-exchange. If so, shall we expect filtering for the East Asian anthropogenic influences, i.e., air masses with lower stratospheric influences, would show a lower trend? However, the results here show nearly no change in the springtime trend. Can you explain?

5) Page 11, Line 20-30:

This section has showed that stratospheric influences explained two thirds of the ozone trend in spring. How about the rest one third? Would changes in anthropogenic emissions be the cause?

C2

6) Page 12, Sect. 3.3:

The TOST dataset are monthly averages from 1994 to 2012. Does that mean the dataset already account for ozone changes associated with increases in East Asian anthropogenic emissions? And then the direct tropospheric ozone transport as calculated in this section (Figure 8 and 9) has considered the tropospheric ozone changes associated with increases in precursor emissions. Please clarify.

7) Page 13, Line 16-22:

In this paragraph, CO measurements at WLG are used to analyze the influences of anthropogenic emissions. The results show statistically significant increasing trends only in summer. How about the trend in autumn? The previous section showed that the ozone trend in autumn was driven by anthropogenic pollution, but this did not seem to be supported by the CO analysis. Can you please clarify? As for the contribution from precursor emissions, can the model simulation with fixed anthropogenic emissions provide a better estimate?

8) Page 13, Line 23:

I feel confused about the discussion on ozone trends based on different trajectories in this paragraph. It reported the largest ozone trend associated with the SE direction, and the lowest trend with the NW direction. However, back on Page 9, Line 25-30, the trajectory analysis showed that the NW trajectories associated with high ozone concentrations had increasing occurrence frequencies, while the SE trajectory frequencies were decreasing. Are they consistent?

9) Page 26, Table 5:

How do you estimate the ozone transported from East Asia, Europe, and North America? Please clarify.

Some other comments

1) Page 3, Line 30:

“GOES-Chem” should be “GEOS-Chem”?

2) Page 8, Line 25:

C3

“and least so in summer”. Need to remove “so”?

3) Page 9, Line 19:

Here alpha is used to denote statistical significance, while in a few other places, such as Page 10, Line 12, ‘p’ is used. Please make them consistent.

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