Reviewing Teakles et al. "Impacts of the July 2012 Siberian Fire Plume on Air Quality in the Pacific Northwest"

The manuscript by Teakles et al. looked at the impact of the July 2012 Siberian wildfires on air quality in the Pacific Northwest regions using various resources such as surface in-situ and satellite remote observing observations, HYSPLIT air trajectory model and a chemical transport model. I find this study is valuable as it tries to provide a full scope of the impact of long-range transport of wildfire plume with using the combination of existing observation dataset and numerical models. It covered from its trajectory and chemical analysis to assessment of impact on air quality standards over Pacific Northwest regions. The manuscript is well within the scope of ACP. However, the manuscript requires some revisions before publishing. I have listed my major and minor comments below. When these comments are addressed in the manuscript, I recommend this to be published in ACP.

Major comments:

1. **How well does the AURAMS model capture the observed air quality?** This study used the AURAMS model simulation without Siberian wildfire influence as a baseline, which is a reasonable approach. My main concern is how well the model simulates the observed air quality. Any model deficiency would influence the main results in this study. Please provide statements about the model performance regarding O3, speciated PM and total PM2 in Section 2.2. In addition, I strongly encourage providing an evaluation of model for the period where the Siberian wildfire doesn't impact the Pacific Northwest regions (maybe July 01 to 05?).
2. The manuscript was overall well written. However, some figures and legend should be improved. Particularly, it was hard to follow the discussion on some individual observation sites and geographical impact analysis, as I am not familiar with most of the site/region name. Also, I found several acronyms are used without definition or defined but not used later (e.g., BC in the abstract, AGL, ASL, LFV, CWS). Please improve throughout the manuscript. Please try to improve them throughout the manuscript.

Minor comments:

Table 1:

1) For individual site, please provide lat/lon/alt information.
2) Please either provide a full name of network or change the legend to tell where in texts to find them.
3) it would be helpful if the order of network/site in Table 1 follows the text in Section 2. It would be even more helpful if it were ordered by country and region.
4) For Mr. Rainier, is it Teledyne-API 400 or Teledyne-API T400?
5) In the last row, the second column about SMPS size range is incorrect. It should be 14 m to 572 nm (to be consistent with the texts) or 0.14 um to 0.57 um.

Table 2 :

1) The legend says " used in the study", but the main text (P5; L13-14) says CWS for O3 were not used in this study. Please fix the inconsistency.
2) Please put reference in new column and get rid of footnote.

Table 3 – Please provide lat/lon/alt for each sties.
Table 4 –The current version is not easy to read due to multiple lines in "area of interest". I understand the table may look different for the published version. Please check the table readability again for published version.
Table S1- please try to use the same full/acronym name for network/sites as Table 1.

Figure 1

1) Please use numbering for each site in a map and provide a list of full and short name for each site. The main texts often use full site names but Fig 1 shows short name only.
2) Provide wildfire location in Fig 1a.
3) Please improve figure legend; including the black outlined area (LFV); changing "Lower Fraser Valley" to "Lower Fraser Valley (LFV)"; explaining the symbol type.
4) Please include all the sites that are used in the texts in Figure 1. The main texts uses more sites than presented in Fig 1. I was quite confused which site they are talking about. Also, please provide lat/lon/height for each site when it is first mentioned in the texts.
5) Regarding the Section 3.3 to 3.6, it would be helpful to see where they are located in a map.

Figure 2

1) The MODIS true color image is hard to see. Not sure where (a) is over exactly.
2) Please consider moving the second sentence to acknowledgements.
3) I'd like to see the AOD plots like (b)-(d) but from July 1st to 6th as a consecutive order in supplementary materials. That would be more convincing to show the plume transport.

Figure 3

1) This figure needs much improvement. It is really hard to see the smoke plume.
2) What is the light blue circle near the KFS site?
3) For 24-hr PM2.5, is it just daily mean? Similarly for Fig 4, what do you mean by "maximal" enhancement of 24-hr PM2.5?

Figure 4

1) Please provide the temporal period used in the figure.
2) Similarly to Fig 1, I strongly recommend to put a number in each site.

Figure 5

3) I don't see the two sites in Fig 1. Please show them in Figure 1. Also, please put lat/lon/alt information for each site here. The texts explaining Fig 5 uses height but the figure shows pressure. Please provide a pressure level for the height discussed in the main texts.

4) In the legend, “dry bulb” to “dry bulb temperature”.

Figure 6

1) Please explain WHI1 and WHI2 in the legend.
2) In the legend (3rd line), “a horizontal blue line” should be “a horizontal white line”. I see white line.
3) “(d)” must be shown in the PM figure. “ACSM” line is not explained in the legend.

Figure 7

1) Why is the hourly organics lower than OC(TOT) some period?
2) Is there any particular reason to use “particle SO4” instead of just “so4”? Here is all about aerosol chemistry, so it sounds a bit odd to call “particle SO4”.

Figure 8

3) Related to my first major comment, the model doesn’t seem to capture the observed PM2.5 before July 8th. Please see if the model has systematic biases in PM simulations. Given that, please provide how it may affect the results.

Figure 9 – Unless what the text explains about Fig 9c (P9;L28-31), I don’t see any clear increase in O3 episode in Figure 9c.

Figure 10 – Please provide lat/lon/alt for each site.

Figure S1- Please mark the wildfire locations.

Figure S2 – What period is it? And please put time and location information for the wildfires.

Figure S3- Please use full name of MSLP.

Figure S5 – I don’t understand why this figure reflects the OC dominance.

Figure S6 – I am not sure the plot and legend are consistency. Please check the legend again and consider rewrite it.

Main texts

P2 L29-30 – Please provide a reference

P2 L30 – Please add year (2012) after “July and August”

P2 L31 - Please add year (2012) after “August

P3 L5 – Please explain more what you mean by “noted entrainment signature”.

Section 2.1.1 – Please keep the same order as Table 1 and provide lat/lon/alt information.

Section 2.1.2 – Table 1 shows CORALNet, which is not mentioned in the text here.

Section 2.1.3 – Isn’t this part of Ambient AQ monitoring data? If so, perhaps move to Section 2.1.2.

P5 L6 – Is there any good reason for choosing 10m, 2.5km, 5km, and 7.5km? It seems too big jump from 10 m to 2.5km.

P5 L9 – Are all 72 sites shown in Figure 1?

P5 L27-28 – What do you mean by interpolate weather into the AURAMS domains? Not dynamically computed? Does it mean it is subject to a potentially large bias?

P6 L1 – What is the size range covered in AURAMS?

P6 L3-8 – This is related to my first major comment. Can you comment on any expected bias when using climatology as boundary condition? Again, the model evaluation should be presented in this study.

P6 L23-25 – how far were the Siberian wildfire plumes rise?

P7 L3 –please provide the NA wildfire period.
P7 L4-7 – It is hard to understand what Figure S3 shows.
P7 L11 – I am not sure if I missed something, but I don't see PM increase for Whisler High Elevation site. Please put numbers for each site in Figure 4. It should help to understand the texts better.
P7 L15 and L17 – Please provide pressure level for that height.
P7 L10-11 – I don't understand why Figure S5 reflects that OC is dominant during that period. Any explanation?
P8 L11 – What is "1 hour data"? hourly mean?
P9 L18 – "High O3 concentration" ➔ "High O3 concentrations"
P9 L18-19 – Is this also due to the Siberian fires?
P11 L3-7 – These parts leaved me more questions than answer. Can you explain more about the surface PM2.5 analysis and impact analysis?
P11 L15-16 –If I understood this correctly, " the additional" is better to be removed.
P11 L23-25 – To be consistent, please don't use bracket.
P11 L32 – I believe most CTM simulations include wildfire emissions. The recommendation doesn't sounds useful. Please clarify it if necessary.