

This manuscript (acp-2022-156) reports black carbon concentrations and physical properties in both urban and rural environments in Sweden. The study aims to investigate whether the rural air was influenced by traffic emissions and long-term aerosol transportation. I am glad to see that the authors have done various analyses using the available measurements (such as BC coating estimation, trajectory analysis, and OA source apportionment) and reported many observations. However, the Results and Discussion section missed many explanations, and the logic of some subsections is not clear (See my general comments below). I suggest a major revision and restructuring of the paper before being acceptable.

Major comments:

1. I understand that the authors had to move the SP2 between the two campaigns, and some instruments were not available during some periods of the study. But this experimental limitation significantly hinders the authors' goal to explore the influence of urban emissions on the rural air quality, because the two campaigns were not conducted simultaneously. The authors use Figure S1a to justify that the BC concentrations at the rural site did not change drastically from July to October, but this result is not enough to support the research's goal because, besides BC, many other atmospheric components and meteorology can be changed between the two campaigns. I am not against the author's effort to compare the urban against the rural environments, but the author should be careful to use asynchronous observations to explore how urban emissions affect rural background air and draw the conclusion that "local abatement strategies aimed towards reducing BC emissions from traffic sources will thus have an effect in reducing the BC mostly limited to the urban population." Overall, I strongly suggest revising the goal and the conclusion.
2. Section 3.6 (origins of BC in the rural background air) is not well structured. The authors presented a lot about the origins of aerosols at the urban site (lines 331 -360), but didn't really answer why the BC is from at the rural site. It seems that the answer is related to Figure 7, but the paragraph above Figure 7 is hard to understand. The authors should consider not using a histogram to present Figure 7, then rephrase the paragraph to better justify how wind directions and precipitation affect the rural background air.
3. The introduction section should include more details. First of all, the authors should add references to the statements in the first paragraph. Second, the second paragraph is not directly related to the research question. The paragraph is a very general description of BC measurements and properties. More details should be added, including how BC properties vary from different emission sources, how BC properties change after mixing with other organic compounds, and what the authors mean by the importance of the BC mixing state. Third, the authors should add another paragraph to introduce the

discrepancies between eBC and refractory BC measurements since the authors present such results in the Result and Discussion. Lastly, if the author wants to keep using the current title, an overview of the influence of long-range transportation of aerosols on BC properties from the other studies is necessary.

Specific comments:

1. Line 39: The authors should specify what kind of severe climate and public health effects can be introduced by BC.
2. Line 66: Describe what the two campaigns are. Actually, the rural site, rural campaign, urban site, urban campaign are very confusing. I suggest renaming the rural campaign and urban campaign. Maybe just Campaign #1 and #2.
3. Line 67: Is the results in Figure S1 for the rural or the urban site? The main text says rural, but the caption of Figure S1 says urban.
4. Line 71 and Line 78: The two sites either measures PM_{2.5} or PM₁₀. Does this affect any results?
5. Line 101: Was 10 and 1-5% of the data discarded or used in the analysis? Please specify.
6. Line 151: The authors should consider adding a time-series figure of BC and C₄H₉⁺ concentrations during a traffic plume, then label the three windows and their durations.
7. Line 186: I don't get how the authors concluded that "these corrected values are closer to the true values". What do the authors mean about "true values"? Please explain in the main text.
8. Line 216: Why does the greater concentration measured at the curbside suggest that these measurements are indicative of the city? Please explain in the main text.
9. Line 266: Show statistical results to justify "statistically significant".
10. Lines 275-293: Do the authors have any explanation about why 50 and 75 nm particles are unimodal, but 100 and 150 nm particles are bimodal?
11. Line 307: I don't find the results of HYSPLIT trajectories in the main text and SI.
12. Line 340: How do the authors draw the statement that "approximately half of the mass at the urban site is due to long-range transport"? First, how "half of the mass" is estimated? Second, what is the evidence for "long-range transport" in Figure 8? Please explain this sentence in more detail in the main text.
13. Figure 8: Why does panel d have a different y-axis label from panel c?
14. Line 353: The authors showed the strong correlation between non-refractory PM₁ concentration and thickly coated BC. What is the correlation between non-refractory PM₁ concentration and non-coated BC (i.e., fresh BC)? If the latter correlation is also strong, the statement "the BC coatings are similar in composition to non-refractory-PM₁" is over-interpreted.

15. Line 368: I don't think a factor of 2.2-4 between urban and rural environments is "surprisingly low". The authors should consider using another word.
16. Line 388: As I mentioned in the major comment #1, the authors should rephrase this sentence.