

Interactive comment on “Measurement report: Diurnal and temporal variations of sugar compounds in suburban aerosols from the northern vicinity of Beijing, China: An influence of biogenic and anthropogenic sources” by Santosh Kumar Verma et al.

Anonymous Referee #1

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Comments on “Measurement report: Diurnal and temporal variations of sugar compounds in suburban aerosols from the northern vicinity of Beijing, China: An influence of biogenic and anthropogenic sources” by Verma et al., October 2020.

General Comments:

In this manuscript the authors report observations of sugar compounds (SCs) in air at a rural site about 40 km north of Beijing from Aug 15- Oct 5, 2007. Diurnal variability

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is examined, and meteorological parameters are considered as explanatory variables. The SC time series were analyzed with positive matrix factorization to identify sugar aerosol types and the relative contributions of the sugars and aerosol types to organic aerosol mass are reported. Overall this is a useful contribution of measurements to a topic that is still not well-understood. The differentiation between daytime and nighttime samples is rightly recognized as important by the authors. However, the manuscript often reads like a laundry list of observations interspersed with comparisons to previous observations, and insufficient analysis to support some claims.

Some inferences made about the observations are provided as speculations with little explanation or supporting analysis. In fact there are a few claims made in the manuscript (noted below) that don't even seem to clearly follow from the evidence presented. The logic behind the claims needs to be clarified or the claims need to be changed or removed. A major driver of this issue is that day-night differences were also differences in temperature and humidity, and differences in air mass origin. How can these effects be disentangled to draw inferences? For example, sucrose is interpreted to be controlled by local emission related to temperature and radiation on the basis of correlation with those variables, and transport is not considered. But arabitol and mannitol correlate very closely with local RH- why in the Abstract is it claimed that these are related to transport from Beijing? Perhaps this would be clearer if a more comprehensive table of correlation coefficients were shown for the relevant quantities, for daytime, nighttime, and overall, but some more textual clarification would also help. Also, would be really nice to have some proxy of transport there too, e.g. average magnitude of the wind in the direction between Beijing and the site.

A major limitation is the lack of any air mass trajectory analysis. The authors state that there was a typical diurnal pattern to the wind direction, with daytime winds from the south and the large cities, and nighttime winds from more rural areas to the north. It would help the reader to see how consistent this pattern was in order to evaluate some of the claims made. I suggest at least a time series plot of wind speed and

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wind direction, perhaps as a sub-plot to Figure 2, or a wind rose diagram. A couple of representative air mass back trajectories could be instructive as well.

The results section should have more description of the present data set, with more of the previous observations moved to the Introduction. In particular, the description of the PMF results could be expanded, perhaps with a figure showing the time series of the PMF factors.

Throughout the manuscript, the authors should to be more careful in their descriptions of how the SCs get into the atmosphere. They frequently state that a process or an organism “emits” a sugar compound, which reads somewhat ambiguously (i.e. are gas phase compounds being released?). I think it’s OK to use this language, but there first needs to be a clear statement in the Introduction about how SCs get into the atmosphere, or at least the state of the science on that question. How are SCs are released into the air, as fragments of organisms, as whole fungal spores, as individual molecules, etc?

A further issue that needs to be resolved before this is publishable is the extremely sparse description of the methods. Specific questions are raised below.

At this point this manuscript is essentially a descriptive account of measurements made at a particular location, with some interpretive claims that seem a bit ambiguous. The measurements themselves are of value, but I think for publication, it needs 1) a much more thorough method description section and 2) either a) a scale-back of the claims made, or b) additional analysis in support of the claims.

Specific comments:

There are several grammatical issues of subject-verb agreement and lack of pluralization throughout the manuscript. They don’t usually impede understanding, but the manuscript would benefit from a thorough grammar check.

It would be very helpful to view the data in Figure 2 directly as a part of Figure 3.

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Line 66: “SCs are emitted from algae, microbes, pollen, suspended soil particle[s], and associated biota into the atmosphere” This statement reads to me a bit like sugar compounds might be released into the air as individual gas phase molecules, which I don’t think is the case (?). Maybe it could be phrased “SCs are emitted as part of aerosols formed from algae...”? Same thing at line 72: I don’t think mannitol and arabitol are mostly emitted as individual gases, but are a part of fungal material that gets into the atmosphere. What is physically meant here needs to be a little clearer. Are these SCs usually part of biological fragments, or is this unknown?

Section 2.2:

Please provide more details of the sampling apparatus and methodology. Were these samples collected with a high-volume sampler? Where was it installed specifically, and at what height? What aerosol sizes were collected? Were there any measures to avoid the sampling of gas phase components? Did the 3-hr and 9-hr samples overlap in time? What times were the samples started? Perhaps a table of sample collection times would be helpful.

Furthermore, what were the methods for determining the WSOC and total OC? How was Ca(2+) concentration determined? Was the filter cut into sections for each analysis?

Line 132: What is meant by C13 n-alkane? Is this an isotope standard of one n-alkane? Which one? Or do you mean C13H28, n-tridecane?

Line 157: “Hence, it is evident that increased BB activities at nighttime are associated with cool temperature (Fig. 2).” Is this saying that because it’s cool at night, it makes sense that there’s more BB aerosol at night? Isn’t it equally likely that the different air mass origins in the day and at night are the reason?

Line 209: “the meteorological conditions”. Is this referring to the strong daytime winds and convective activity? It would be clearer to state that directly.

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Line 254: “northeasterly (99.5%)”. Does this mean 99.5% of the nighttime hours the wind was northeasterly? Please clarify in the text.

Line 255: What would cause sugar emissions to decrease with lower temperature? Is there supporting literature for this?

Line 268: Trehalose paragraph. Trehalose didn't show a strong diurnal cycle, but the authors point out a correlation between trehalose and mannitol and arabitol at night, and between trehalose and Ca(2+) in the day. It would be helpful to at least report the corresponding correlation coefficients for the day and night, respectively, for comparison, and possibly to include the corresponding figures in Figure 5.

Line 272: Why would nighttime low RH and temp cause microorganisms to emit more trehalose? Please cite a reference. Again, the use of “emit” here can be confusing. Is it the release of spores that prefers these conditions?

Line 310: Aren't the Mt. Tai measurements higher than Mangshan, not lower?

Lines 315-319: I don't understand the reasoning here. How does RH relate to transport from megacities as an explanation for fungal aerosol?

Line 350: Separate the Factor 3 and Factor 4 descriptions into separate paragraphs.

Line 352: “The PMF results are very well supported by the fact that anhydrosugars are associated with BB in the Mangshan site.” Is this referring to results from a previous study? Please cite it.

Line 410: “Our results also denote that secondary production of OC and WSOC from BB-derived organic precursors was crucial during nighttime at the Mangshan site.” What evidence shows this? And do you mean that organic compounds went through chemical changes to form aerosol OC and WSOC, or simply that organics produced during biomass burning were incorporated into aerosol after the burning? In either case, I don't see how we know that.

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