Review of “Effect of temperature on the formation of Highly oxygenated Organic Molecules (HOM) from alpha-pinene ozonolysis” by QUÉLÉVER et al.

This study investigated the effect of temperature on HOMs formation from α-pinene oxidation. Experiments were conducted at three different temperatures (20, 0, and -15°C). It is found that HOMs formation considerably decreases as temperature decreases. It is also claimed that the distributions of HOMs at 20°C and 0°C are very similar, which is conjectured to be due to that the rate-limiting step forming these HOMs occurs before the products become oxygenated enough to be detected by NO_3^- CIMS. This work investigated the effect of temperature on HOMs formation, which is important to help us further understand the formation mechanism of HOMs. However, there are a number of issues that need to be addressed before the paper can be published.

The major issue involves the comparison of HOMs distribution between 20°C and 0°C. While the authors claim that the distributions are very similar between two temperatures, I beg to differ. Let’s start by looking at Figure 3. By eyeballing, the dominant monomer signal at 20°C ~308 amu, but it was ~325 amu at 0°C. There is also clear difference in the range 350-360 amu between two temperatures. As there are various HOMs formation pathways, it is likely that temperature has different effects on distinct pathways. This brings up one critical issue in the data interpretation - as there are both α-pinene+OH and α-pinene+O_3 and the isomerization rates of RO_2 from different oxidants are different, I suggest the authors to discuss the temperature effect on two channels separately.

To continue, the conclusion is drawn mainly based on Figure 6, and the authors noted that there is no clear trend in the yield change for any column. Again, I beg to differ. Take C10H16 column as an example. There is a weak increase in yield ratio (light green → blue) with more oxygen. For C18H28 column, there seems to be a decrease in yield ratio. One figure I suggest to make is a pie chart to show the fraction of each HOM in total HOMs. By comparing the pie charts between two temperatures, it would be easier to examine the temperature effect on HOMs distribution. Still in Figure 6, why are only five HOM monomers included? There are clearly more HOMs as shown in Figure 3 and Table A2. As a side note, because autoxidation would add two oxygen atoms, it is not proper to present the HOMs formation by +1 oxygen as shown in Figure 6.

Lastly, one thing to consider when discussing the temperature effect is the RO2 fate. As the temperature decreases, the RO2+RO2 and RO2+HO2 react rates will also decrease, which increase bimolecular lifetime and enhance the fraction that undergoes isomerization. It would be helpful to quantify the RO2 bimolecular lifetime (Line 435).

Other Comments

1. How is time-dependent d[HOM]/dt calculated?
2. It would be useful to show the equation to calculate the CS, even included in supplement.
3. Can the authors please describe the sampling lines and inlet? Some discussion of the losses in sampling line and inlet is warranted.
4. It would be useful to show the [SOA] under different temperature. Or a plot to compare the CS between different temperatures.