Alpha pinene + O_3 experiment protocol.

This protocol describes the a-pinene + O_3 experiment and the subsequent instrumentation configuration and practices used. The experiment is described based on the use of the following instrumentation: SMPS, AMS, PRMS, NO_x and O_3 monitors. Though, depending on the lab and instrumentation available other configurations can be used.

Design objectives:

- Constrain / eliminate contaminant SOA production
- Constrain vapor wall loss
- Constrain particle wall loss

Parameters:

- Aim for vapor collision frequency with (t=0) seeds ("condensation sink") = 3 x vapor collision frequency with walls ("vapor wall loss"). [goal < 1 ug/m3 contaminant SOA, or < 1%]
- Add experiment with 3 x seed surface area (i.e. 10:1 seed:wall)
- Blank experiment with seeds but no a-pinene (ozone + TME instead of a-pinene)

Extensions (optional)

- 3 x higher seeds again (i.e. 30:1)
- 3 x lower a-pinene

Procedure

1. Chamber cleaning: Chamber is flushed overnight with clean air (particle free, VOC free, NO_x and O_3 free air) with the UV lights turned 'ON'. This is not limiting if other cleaning practices are used in each lab.
2. UV lights are turned 'OFF'.
3. Chamber volume is optimized (filled).
4. Temperature inside the chamber is set to 22+/-2^{0}C.
5. Time and sampling time-step are adjusted to all instruments (to report the same time). Typical AMS, SMPS, PTRMS time cycles are optimized. (Depending on the instrumentation available).
6. When temperature is reached, all instrumentation used (AMS, PTRMS, SMPS, O_3 monitor, NO_x monitor, T & RH, etc.) start to sample from the chamber.
7. Particle number concentration (SMPS) should be less than 20 particles cm^{-3}. O_3 concentration should be less than 2 ppb. NO_x concentrations less than 2ppb. A-pinene concentration, measured by the PTRMS, should be less than 0.5ppb in m/z 137. AMS total concentration should

be less than 2 ug m^{-3} (these are maximum limits used to ensure that the chamber is 'clean' for the experiment).

8. Ammonium sulfate seeds are injected through an atomizer to reach a final concentration in the range of 85 ug m^{-3}. The mode diameter of the number of particles should be in the range of 100 nm.
9. After 20 min of sampling from the chamber (background measurement), 75 +/- 5 ppb of a-pinene is injected through the injection system. The inlet system is heated at 50+/- 10 ^{o}C. The flow rate of clean air used to flush the a-pinene from the injection system is 2-3 lpm. (If no heated inlet is available the a-pinene injection can be done in ambient temperature).
10. If a PTRMS is available, the values related to a-pinene (m/z 137 and m/z 81) are monitored. They should be stable within 5 minutes after the injection.
11. Another 10 minutes of sampling is implemented. (A-pinene should remain stable for this period).
12. 10 minutes after the a-pinene injection, O_3 is added through an O_3 generator to reach a final concentration of 250 +/- 50 ppb inside the chamber.
13. Mass increase is observed by the SMPS and a-pinene consumption is monitored through the PTRMS.
14. A-pinene's PTRMS concentration m/z 137 should return to 0.5 +/- 0.3 ppb within 40 minutes.
15. Sampling continues for 3 hours after the O_3 addition.
16. UV lights are turned 'ON' and the chamber is turned to flushing.