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Comment

## ***Interactive comment on “Fast time-resolved aerosol collector: proof of concept” by X.-Y. Yu et al.***

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Thanks very much for your comments and suggestions that improve our paper! We made corrections to respond to your comments. They are listed below.

1. On page 2520, I'm not sure I understand how laminar flow is maintained. I'm not even sure in what direction the flow should be laminar. Through the grid, or over it?

Reply: We added a few sentences to clarify on page 2520 line 22. “The Reynolds number for the flow needs to be less than 2300 for the flow to be laminar. Using 1 l/min of air flow, over a 2.5 mm substrate, with a Quantifoil grid of 50% open area and 2.5 micron openings, then the Reynolds number for the tube flow leading to the grid is about 500 (characteristic length  $\approx$  2.5 mm). When the air is passing around

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the Quantifoil grid elements, the Reynolds number is about 1 (characteristic length  $\approx$  2.5 micron). So in both locations the flow should be laminar, especially in the most important region, near the grid.”

2. On page 2521 I find the description of diffraction limit of the particle image a bit vague. What is actually meant by “about diffraction limited”?

Reply: As per below, we improved our mention of the particle image size and diffraction limit as well as the text just above it, describing the detectability of the particles. We also described observing smaller particles in section 4.3. “The peak height to background noise is about 80. A Gaussian fit to the 200 nm particle image gives a full width half maximum of 600 nm. This is about a wavelength of light (orange). The nominal resolution of the objectives used on the microscope is 340 nm to 550 nm (20X and 50X), suggesting that the imaging is near but not quite optimal (we should be able to do better yet). When the line scan width is reduced to 4 pixels (600 nm), to better match a single particle image size, the peak to background ratio increases to about 120. This shows that we can detect 200 nm particles with excellent signal to noise. 100 nm are also routinely detected, as discussed later.”

3. In outdoor measurements under urban Sub Sahara African conditions we have measured particles in the size range 300 to 450 nm. Occasionally we found more than  $10E7$  particles/second. Comparing these numbers to the ones that the Fast-TRAC can manage, I doubt the device can be used to measure in industrial pollution plumes as suggested by the authors. I think care must be taken not to overload the device.

Reply: The reviewer made a very valid point. We do have a lot of reserve capacity to deal with overloading, see the new text below that was added in the manuscript on page 2521, line 28: “The maximum number of particles on the substrate must be kept low enough to prevent confusion in identifying which particle landed at what time, to make it easier to detect the smaller particles, and to make the subsequent single particle analysis straight forward. This means that the average particle spacing should

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be at least several times a typical particle diameter, as well as several times the optical resolution. This works out to about the same limit, making the maximum permitted number density of particle about  $10^{11}/\text{m}^2$ . For a 2.5 mm substrate, at 1 l/min of airflow, and a particle collection efficiency of  $E$ , then for a particle loading in the air of  $X$  (per  $\text{m}^3$ ), the time to reach this surface loading is:  $10^{11}/\text{m}^2 / (X * (0.001 \text{ m}^3/60\text{s}) * E / ((0.0025 \text{ m})^2 * 3.14/4)) = 2.9 * 10^{10} / (X * E) \text{ s m}^{-3}$ . For  $X = 10^{11} \text{ m}^{-3}$  and  $E = 0.1$  (typical for our Quantifoil grids), this loading is reached in 2.9 s. This is a fairly short time, for what would be a heavily loaded plume. However, our TRAC sampler has over 500 substrates in its cartridge. So we could, in real-time, simply move to a new substrate based upon the observed particle density. This would allow about one-half hour of sampling under this condition. If such high loadings were to be typical, it would be useful to dilute the sample flow to extend the substrate lifetime.”

4. Page 2518, line 9 it's a bit much of that. Reply: the extra “that” is deleted.

5. P 2523, l 11. Should the reference really be to Fig 5? Reply: Yes, we do refer to the bottom left panel of Fig 5 here. However, looking at both the top panel and the bottom left panel together make more sense. A correction is made to clarify this point.

6. P 2527, l 12. “part.” Repeated. Reply: This journal is Particle & Particle Systems Characterization (Part. Part. Syst. Charact.) by Wiley InterScience. No change.

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Interactive comment on Atmos. Meas. Tech. Discuss., 3, 2515, 2010.

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