Supplement of: Morphology and Mixing of BC Particles Collected in Central California During the CARES Field Study

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Correspondence to: Ryan C. Moffet (rmoffet@pacific.edu)**Abstract.** Please use only the styles of this template (MS title,

1 Transmission Efficiency of the TRAC Sampler

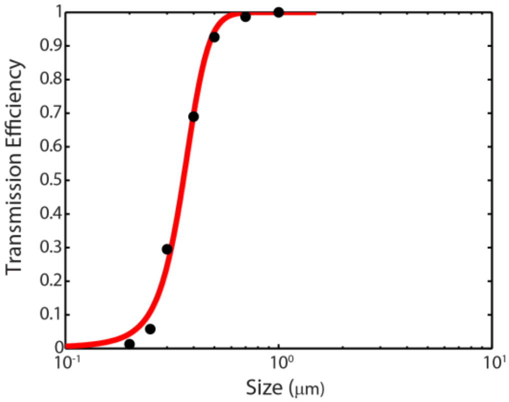

Figure S1. Transmission efficiency of the TRAC sampler (black dots) fit to a sigmoidal function (red line).

The size distribution of particles collected on a substrate with the TRAC sampler is not representative of the size distribution of the airborne particles. The TRAC sampler has a 50% cut-point of 350 nm (Laskin et al., 2003). However, due to the large number of smaller (<350 nm) particles present in the atmosphere, these particles are still routinely detected by STXM analysis. To correct for the size bias of the TRAC sampler, the transmission efficiency data from Laskin et al. was used to correct the relative numbers of particles as a function of size (Laskin et al., 2003). The TRAC transmission efficiency was fit to a sigmoidal curve as shown in **Figure S1**. The best fit function obtained was $Transmission\ Efficiency = \frac{1}{1+e^{7.01-19.6D_p}}$. The sigmoidal function was then used to calculate the corrected number concentrations for the size distributions shown in

Figure 4b-c. Possible uncertainties in this correction procedure arise due to particle deformation and evaporation upon sampling. However, without knowledge of the physical properties of the particles, these uncertainties are difficult to quantify.

2 Location of BC Inclusions

For the projection of the particle onto the substrate, an inclusion having a fixed relative distance R_{inc}/R_{max} from the center can lie anywhere on a circle defined by the top and bottom of the cylinder in **Figure S2**. In this case, the probability of finding a particle at a value of R_{inc}/R_{max} would be twice the circumference of the circle divided by the total surface area of the spherical particle:

$$P_{surface} = \frac{2 \times Circumference}{Surface\ area\ of\ sphere} = \frac{R_{inc}/R_{max}}{\left(\frac{R_{max}}{R_{max}}\right)^2} = R_{inc}/R_{max}$$

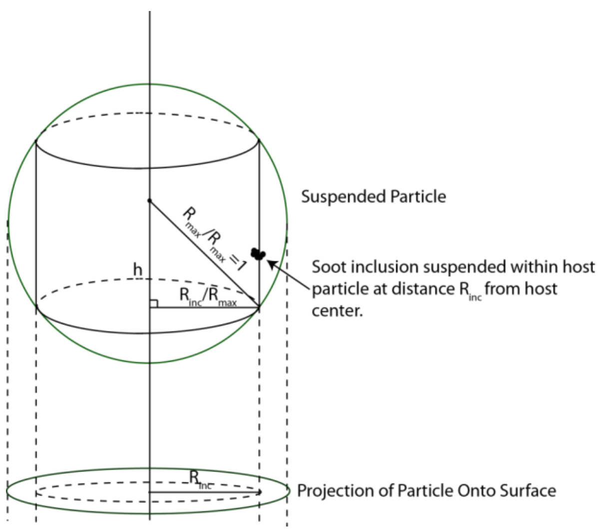

Figure S2. Particle geometry used to derive probability distributions.

Thus, if inclusion is located on the surface of the spherical particle, the probability density increases linearly with R_{inc}. The probability density ($P_{surface}$) of finding the BC inclusion on the surface at a relative distance from the center (R_{inc}/R_{max}) of the projection of this particle onto the substrate is calculated as $P_{surface} = C_1 R_{inc}/R_{max}$ where C_1 is a constant.

Alternatively, it can be assumed that the BC inclusion is located randomly within the volume of the host particle. For the projection of the particle onto the substrate, the probability of finding the inclusion at a relative distance R_{inc}/R_{max} from the center can be determined by the ratio of the surface area of an open cylinder having radius R_{inc}/R_{max} to the volume of the particle:

$$P_{included} = \frac{Area\ of\ Open\ Cylinder}{Volume\ of\ Host\ Particle} = \frac{2 \times 2\pi \frac{R_{inc}}{R_{max}} h}{\frac{4}{3}\pi \left(\frac{R_{max}}{R_{max}}\right)^3} = 3\frac{R_{inc}}{R_{max}}\sqrt{1-\left(\frac{R_{inc}}{R_{max}}\right)^2}$$

As shown in **Figure 7**, when $P_{surface}$ and $P_{included}$ are plotted as a function of the distance from the particle center (R_{inc}/R_{max}), the number of BC inclusions close to the particle center is under predicted. There are several possibilities for this under prediction:

1. The 2D particle projections are not circular, so normalizing by R_{max} can result in an erroneously low number of BC inclusions at the "edge", or, R_{max} n.
2. Upon impaction the BC inclusion is "pinned" to the surface, and the other material in the particle spreads past the inclusion upon impaction.
3. The BC inclusion is preferentially located at the center due to the condensation of organic and inorganic materials.

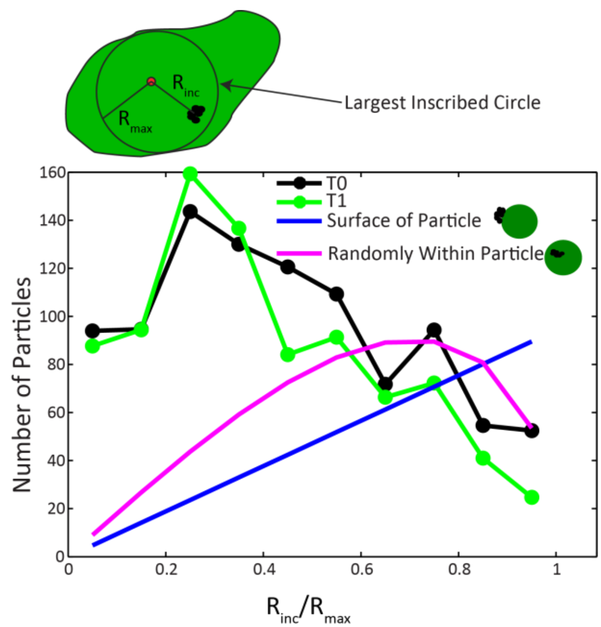

Figure S3. Distance of the BC inclusions from the center the host particle for the CARES field study at the T0 (black) or T1 (green) sites. The distance of the BC inclusion (R_{inc}) is normalized to the distance from the particle center of mass to the edge of the largest inscribed circle (R_{max}, see illustration above plot). Modeled locations of BC inclusions are shown assuming the inclusion was on the surface (blue) or randomly within the host particle (magenta) before impaction.

The first possibility can be addressed by normalizing by the radius of the largest inscribed circle R_{max} of the non-spherical particle as shown in **Figure S3**. Using the radius of the largest inscribed circle, the distance from the center can be normalized as $R_{inc}/R_{max.}$ However, when this normalization is done, simple models fail to fit either of the modeled distributions as shown in **Figure S3**. Note that compared to **Figure 7,** the distributions in **Figure S3** are slightly skewed towards the edge due to the nonsphericity of the particles. Thus, we can conclude that the observed distributions are not an artifact of the normalization of R_{inc} to R_{max}.

References:

Laskin, A., Iedema, M. J., and Cowin, J. P.: Time-resolved aerosol collector for CCSEM/EDX single-particle analysis, Aerosol Sci Tech, 37, 246-260, 2003.