Response to Reviewer 2 comments

The authors thank the reviewer for the positive overview response to the manuscript and constructive comments. *We have responded below and believe these changes have improved upon the paper. (Lines numbers below refer to the original submitted version of the manuscript with tracked change (All Markup) unless otherwise noted).*

Brown carbon (BrC) plays an important role in climate and atmospheric chemistry, but determining the mass concentration and absorption of BrC is still challenging. This manuscript reports the first direct, aircraft-based online measurements of water-soluble BrC in wildfire plumes by three methods based on liquid waveguide capillary cell and different aerosol collection techniques. The three methods are introduced in detail and a comprehensive evaluation of the measurement uncertainties are given. The authors also established new algorithms for the correction of hysteresis effect owing to the retention of liquid on the internal components of the system. This study provides a good example of online water-soluble BrC measurements and is of great value for similar measurement in the future. I therefore recommend the publication of the manuscript on AMT. I only have some minor comments as list below:

1. L357: The presence of Abs_700nm is attributed to BC particles passing through the filter (diameter<0.22 um). Since there is SP2 measurement in parallel, it is possible to have an estimate of the BC mass concentration in particles smaller than 0.22 um. Is it true that a higher R2 will be obtained for the correlation between Abs_700nm and the mass concentration of tiny BC?

Response: *We have used BC from SP2 and size distribution measured by a Laser Aerosol Spectrometer (LAS) to estimate the BC mass under 0.22 um in FIREX-AQ (the DC-8), but the R^2 did not improve (new R^2=0.57). In WE-CAN, the size distribution was measured by a Scanning Mobility Particle Sizer (SMPS), and the new R^2 ranged between 0.14-0.58. The main reason the R^2 does not increase is that the hysteresis effect has not been removed at this step, so in some cases, large Abs700nm was observed, but only small BC was observed.*

2. L375: I think the equation given in L379 is always correct assuming an AAE_BC=1. Why do the authors use a simplified equation (L381) with larger overestimation for the correction of CSU PILS-LWCC?

Response: *As can be seen in Figure 5c, the slope of Abs365nm to Abs700nm is larger than ~25, except for data points in orange, which have a slope of ~6. The simplified method will only overestimate BrC by less than 4%. We are reporting 12% uncertainty for the BrC absorption with the CSU PILS-LWCC, so 4% isn't necessarily negligible. Additionally, the absorption observed at 700 nm may also be due to the insoluble S-BrC, which has been proposed by Saleh (2020), but we consider this class of BrC as insoluble BC.*

3. L415: The statement is a bit confusing, seems not consistent with Eq. 4.

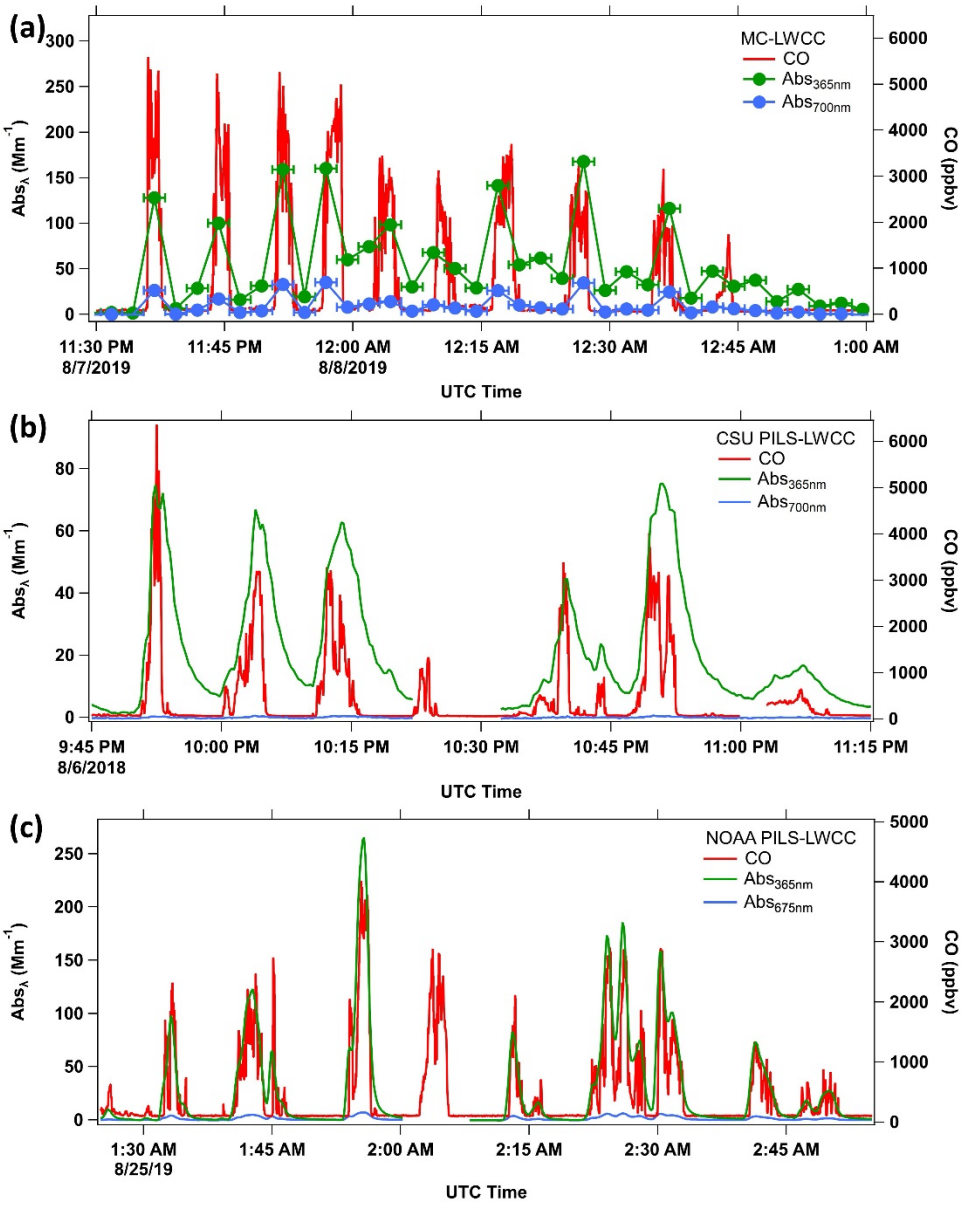
Response: *The sentence in Line 427 has been changed to "We assume the observed WS BrC absorption at the i-th sample is due to a% of the real WS BrC during the time period of the i-th sample, b% due to (i-1)-th sample from the tubing, and c% due to (i-2)-th sample from the MC."*

4. L390: The correction of hysteresis effect seems to strongly rely on the contrast between measurement in plume with high BrC concentration and in background with nearly no BrC. Is the method also suitable for the correction of BrC measurements with much lower temporal variability in BrC concentration?

Response: *Yes, the correction method provided in the manuscript is suitable for other measurements with lower variability in BrC concentration, but new coefficients may need to be obtained. Additionally, it is hard to find a sharp cut when the aircraft transitions between smoke to background air when the CO or BrC has less variability, and the hysteresis effect would not be that obvious in a weaker plume. In FIREX-AQ, we did not encounter any good plume transects that had a sharp cut exiting the plume with CO less than 1000 ppbv to obtain these coefficients. However, these coefficients obtained from plumes with CO mixing ratios ranging from 1500 ppbv to 5000 ppbv in this study did not change significantly, implying other factors (tubing length and mist chamber shape) have a stronger effect on these coefficients than the concentration.*

5. Fig. 4C: At 2:05 there is a strong peak of CO. I am wondering why there is no BrC measured.

Response: *Thanks for pointing out this mistake. There is a data gap from 8/25/2019 02:00:23 to 8/25/2019 02:08:05 explaining the cause of higher CO, but no BrC in the original plot. Figure 4 has been modified to correct this.*


(a)
MC-LWCC
CO
Abs365nm
Abs700nm
Abs$_\lambda$ (Mm^{-1})
CO (ppbv)
11:30 PM
8/7/2019
11:45 PM
12:00 AM
8/8/2019
12:15 AM
12:30 AM
12:45 AM
1:00 AM
UTC Time
(b)
CSU PILS-LWCC
CO
Abs365nm
Abs700nm
Abs$_\lambda$ (Mm^{-1})
CO (ppbv)
9:45 PM
8/6/2018
10:00 PM
10:15 PM
10:30 PM
10:45 PM
11:00 PM
11:15 PM
UTC Time
(c)
NOAA PILS-LWCC
CO
Abs365nm
Abs675nm
Abs$_\lambda$ (Mm^{-1})
CO (ppbv)
1:30 AM
8/25/19
1:45 AM
2:00 AM
2:15 AM
2:30 AM
2:45 AM
UTC Time