

## ***Interactive comment on “A novel approach to calibrating a photo-acoustic absorption spectrometer using polydisperse absorbing aerosol” by Katie Foster et al.***

### **Anonymous Referee #2**

Received and published: 23 January 2019

Review of Foster et al., “A novel approach to calibrating a photo-acoustic absorption spectrometer using polydisperse absorbing aerosol”

Foster et al. presents a calibration method for an aerosol absorption photoacoustic spectrometer. This is important work that demonstrates the accuracy of photoacoustic measurements that will then be used for future analyses. This topic is specifically interesting in light of results of Bluvshstein et al. who found that ozone calibration were inaccurate by factor of 2 and the subsequent reports of the calibration of multipass photoacoustic spectrometers that found the ozone calibration to be accurate.

This topic is appropriate for AMT and should be published after the corrections listed

C1

below are addressed.

1) Typical analyses of photoacoustic data have included the effect of the acoustic frequency, quality factor of the acoustic cavity, and laser power. Even if these quantities are constant for these experiments, the authors should include them in their formalism. Generally some more formalism such as the photoacoustic equation relating microphone signal to absorption coefficient would be a benefit. 2) The typical style is to leave a space between quantity and the unit. Please check this, in particular when wavelengths are reported. 3) Some values and errors are reported with too many significant digits

Specific Comments: P3L1: The optical power in these multipass cells is not unknowable. It can be determined with few simple measurements. 1) Measure the transmission of the rear mirror. 2) place a calibrated optical power meter to measure the optical power leaking through the mirror. 3) account for the mirror transmission and a factor two for a similar amount of light leak through the front mirror to get the optical power in the acoustic cavity. The issue with a fundamental calibration is that the overlap integral of the laser, acoustic mode, and aerosol is not known accurately enough for calibrations. Or possibly the microphone sensitivity and/or the laser power are not known accurately enough for calibration purposes. P3L23: ‘area’ should be ‘are’ P4L11: extra space before ‘Lack’ P4L19: Because this acoustic cavity consists of two high coupled resonators, there are two “primary” eigenmodes. In one mode the pressures at center of both resonators are in-phase and in the other the pressures are 180 deg. out of phase. Please rewrite the sentence to clarify which mode is being used. P5L4: either “each cell’s resonant frequency” or “each cells’ resonant frequencies” would be appropriate. P5L5: please replace “whatever interval” with a more formal phrase P5L6: The microphone part number does not need to be repeated here. P5L15: track changes indicator on this line P6L2-6: If known please state the concentration of solution that is used. Even if it is not critical, it is a good starting point for future projects and replication. P6L21: in this sentence please replace the ‘extinction’ with ‘extinction channel’

C2

P7L25-30: Nigrosin has a complex absorption spectrum and is not appropriately modeled with an angstrom exponent model. P8L17: Use of the Allan deviation is common in the atmospheric community where it is implicitly presented as a detection limit as a function of averaging time. The Allan deviation is useful for identifying drifts, but detection limits and instrument stability are more accurately characterized using the standard deviation which can also be presented as a function of averaging time. I suggest the authors use the standard deviation instead of the Allan deviation. P9L10: Please remove one of the periods. P9L6: This manuscript should assess the overall measurement accuracy for ambient measurements. This section concludes that the accuracy of these calibrations is roughly +/- 6%. Is this the expected overall accuracy for ambient measurements? If yes, please state that explicitly. If no, please explain why. P10L23: please replace '3' with 'three' P11L4: There seem to be a few problems with some of the references. I suggest the authors look over all them carefully. P11L24: Both AMT and AMTD versions of Bluvstein are in the reference list P12L2: "K??rcher" P12L21: no journal listed P13L19&22: Initials for Lack should be capitalized P13L31: remove "(Julie)" P15L21: No Journal listed Figure 1: Could you re-arrange this figure so the flow goes from left to right. Maybe add arrows. Figure 2: Please change the vertical axis to 'nominal scattering' to indicate it is uncalibrated.

---

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-413, 2018.