

The paper has been significantly improved. A second review round indicates minor, but numerous, editing corrections. In addition to those changes, the following three issues should be addressed.

1. The abstract contains too many technical details. It should be re-written including only high level conclusions. The technical details should be moved to conclusions section and supplement.
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2. The units of the sensor output and calibration constant (V_0) need to be defined and indicated on V_0 plots and captions. Plotting $\ln(V_0)$ on Y axis in Figs. 4-5 and 8-9 is suggested.
3. Additional justification should be given to support the use of the improved Langley Method. The IML involves complex iterative inversion scheme, implemented in SKYRAD retrievals package, which requires single and multiple scattering radiative transfer calculations to iteratively estimate particle column volume size distribution, and calculate single scattering albedo and phase function. These inversions require assumptions about particle sphericity, fixed complex refractive index, and surface reflectance. It is difficult to estimate the accuracy of the retrieved effective aerosol parameters. For example, retrieved single scattering albedo could exceed unity (Line 558 and Fig. 9b). The authors admit that the fixed value of column effective refractive index ($1.5 - 0.001i$) used in SKYRAD inversion “may not be appropriate” (L641). Moreover, these parameters are irrelevant if the goal is simply estimation of the calibration constant (V_0), which requires only knowledge of the aerosol extinction optical depth and surface pressure, assuming gaseous absorption is negligible. Figure 8 clearly shows much higher noise of the IML method compared to calibration transfer from co-located reference instrument. The authors should justify using IML compared to the traditional calibration methods (e.g., transferring calibration from the reference POM-02, using calibrated light source), and estimate its uncertainties, e.g., in case of non-spherical dust particles.

A major concern is that the SKYRAD package combines calibration procedure with the optical inversion scheme, which involves many highly uncertain a-priori assumptions. It is always preferable to keep the calibration step (i.e., determining V_0) independent from the inversion step.

Minor Technical suggestions:

L27,28. Indicate, which wavelengths?

L48-49: add references for health effects of aerosols

51-54 : re-word

77: Add V_0 after “calibration constant, V_0 , ...”. Provide units for the calibration constant here, e.g. counts/sec, voltages, etc.

98: Add: precision of the calibration constant [transfer] obtained from ...

122 Add units: is located at an elevation of 3397.0 [meters]

157 where $V(T)$ is the sensor output [voltage] - ?

159 Therefore, the measured $V(T)$ is corrected [using equation (1)]

161: equation (2) is the same as equation (1) and could be deleted.

218 “.. is large? for this POM-02” – the temp sensitivity numbers are roughly the same or smaller than for the calibration reference POM-02 given in previous paragraph.

223 The temperature dependence of the detector sensitivity – suggest: detector response

224 specifications of the detector – which specifications? Provide reference.

241 comparing the side-by-side – remove “the”

254 When the extinction coefficient is divided? - is defined?

256 Introducing the normal? optical thickness (or optical depth). – replace with vertical optical thickness

262 is the airmass for the i -th - “th” should be subscript

290, Remove the first part of Eq (10), which is the same as Eq (9)

304 depth[s]

305 If the sensor output [voltage]

357 is proportional to the sum of the line absorption strength[s]

417 measurements for the calibration at MLO were being conducted. – remove “being”

436 Figure 5 shows the annual [multiyear] variation of the calibration constants - in what units?

450: annual variation -> interannual variations?

451 from 2009 to 2016 - There is no 2016 in the plots

484-485: "The results of the comparison showed that the JMA's POM-02 met the WMO criterion (WMO 2005)." Please state the accuracy criteria of the WMO here.

498 The single scatter[ed radiance] ...

518 Equation 25 is the same as Equation (15)

520 "If m , $m\tau$, and $m\tau_{\text{scat}}$ can be obtained ..." – If this is the case, $\ln(V_{0i})$ can be simply calculated using equations (25)-(26) for each individual measurement (V_i) and averaged for any time period.

526-529: The SKYRAD retrieved/assumed effective parameters, such as single scattering albedo (SSA) and scattering aerosol optical thickness are irrelevant if the goal is determination of the calibration constant (V_0), which requires only knowledge of the aerosol extinction optical depth and surface pressure, assuming gaseous absorption is negligible.

540-552: Clarify if SKYRAD inversion procedure assumes spherical particles only?

550 "...procedure, the complex refractive indexes for each channel are fixed" – clarify what ref. index values are assumed? How they compare with the AERONET retrieved values?

554: "Comparing this equation with eq. (26)," - Why not using simpler equation (25) directly?

577: " In Fig. 8, the calibration constants .." – Explain V_0 units. Change to as Y-axis $\ln(v_0)$ to express % changes directly and comparable across all spectral channels.

Fig. 8 shows much higher noise of the IML method compared with calibration transfer method (red points).

This should be clearly stated in conclusions and abstract.

733. pwv is PWV – explain abbreviation

743. "V is the measurement value" – clarify the units, i.e., voltage , count rate, etc.

749 be fitted by a linear function of m_b – Left hand side also includes m

755 " $2.2973 \times 10^{-4} A$ ". – what is A?

761 $(2.2973 \times 10^{-4} / 2.3364 \times 10^{-4} - 1 = -0.0167)$ – delete

762 $(2.2954 \times 10^{-4} / 2.3157 \times 10^{-4} - 1 = -0.0087)$ – delete

Lines 780-782: "...the calibration constant of the 940 nm channel could be determined by applying the above-mentioned method on a suitable stable and fine day at the observation site." Please define how stable the water vapor needs to be over the interval of Langley observations for this technique to be accurate to within ~1%.

894. The changes in the 340 nm channel were -10% per year" – this is very large degradation rate and requires recommendations for upgrading this channel

1195-1198: Define units of V/V_0

1208: Define V_0 units

1214: 9(c): Define V0 units

Table 2: (unit is A) – Explain meaning of A (Ampere?)