

Solar Background Radiation Temperature Calibration of a Pure Rotational Raman Lidar, Jayaweera et al.

08.01.2025

Response to Reviewer 1

We would like to express our sincere gratitude for your thoughtful comments and insightful suggestions. We have addressed each of your points and revised the manuscript accordingly. Your feedback has been invaluable in refining the presentation and clarity of our findings.

Major Comments

- 1) I believe that the equation as written is incorrect. The number density $n(z)$ as used is the volume mixing ratio of both nitrogen and oxygen. But the scattering cross section of these molecules is different, and the current equation does not capture this. I suggest following a notation similar to what is used in either the numerator or denominator of eq 4 in Adam et al., "Notes on Temperature-Dependent Lidar Equations" JTECH, 2009 Vol 26, 1021-1039, (or the notation you use in your eq 8 below) where the number density of either N₂ or O₂ is now inside of the larger summation over the two different molecules.

We believe the lidar equation is correct and have updated the equation to include the volume mixing ratio term within the larger summation. Additionally, we have adjusted equation 8 (eq for $Q(t)$) to align with this modification in the lidar equation.

Please refer to equations 3 and 8 in the revised manuscript which tracks changes.

- 2) Also, I had some trouble reconciling the notation in equations 3 and 4. I think my trouble came from what appears to be mixed usage of the notation "RR". In equation 3, the notation RR usually stands for either the entire signal of JH or JL (as in the cases of NRR, CRR, BRR). However, the use of RR in τ_{RR} refers to just a single line and this is confusing. I suggest 1) dropping the RR subscript from τ and, in general, changing RR to J_x with the explanation that x can be either H or L referring to either the high or low RR channel. With this change in notation, equation 4 follows more naturally.

We agree with the suggestion and all instances of RR in the Lidar equation and subsequent equations have been replaced with JX, with X explicitly defined as either H or L.

Please refer to lines 130-137 in the revised manuscript with tracked changes.

- 3) Line 187, sentence starting "We tested ..." A variation of 0.2% is surely within the uncertainty of the technique. If so, this result implies that the solar background value is independent of SZA and the authors should so state. Such a result would make the technique more robust and easier to implement. Please add a sentence following the one

written something like “This result suggests that r_{solar} is independent of solar zenith angle as would be expected for the two closely spaced wavelength intervals.

We agree and have added explanatory sentences under subsection 2.5 and the conclusion section to emphasize the method's insensitivity to the variations in solar zenith angles.

Please refer to lines 180-181 and 272-274 in the revised manuscript with tracked changes.

- 4) Lines 284-293: Please be careful with this discussion. Four of the six comparisons presented do not differ beyond the uncertainty bars indicated (1-sigma?). Thus it would seem justified to state that the background and external methods yield similar results for those 4 metrics whereas for the other 2 metrics (mean bias 4-8 and mean IQR 1-8) the background method shows better agreement at the 1-sigma level of significance.

We agree with the recommendation and have revised the final paragraph of the results and discussion section.

Please refer to lines 250-265 in the revised manuscript with tracked changes.

Minor Comments

All minor comments have been addressed as per the suggestions provided.

Thanks again for your careful review of the manuscript.