The paper is well written, and in principle can be published as it is now.I have two minor questions:

Thank you for your positive review. We answer your specific questions below with our text in bold.

We tried to keep our text changes as short as possible to maintain the manuscript's flow. This response expands in more detail to provide context so you can confidently judge whether our streamlined text is clear & accurate.

Line 156: I am confused with the sentence, that LIDORT assumes semi-infinite atmosphere. What is the benefit in assuming semi-infinite atmosphere?

You're right to be confused, our phrasing was bad so we have changed it. The OCO-2 RT bolts together multiple codes. Multiple scattering is very important for us so we specifically mention LIDORT,[1] which uses an infinite-medium solution method for the radiative transfer equation particular integral. However, the OCO-2 code does not otherwise assume a semi-infinite atmosphere so we removed "semi infinite".

Single scattering is handled separately[2], then there's the second-order-of-scattering code[3] polarisation correction and also the low stream interpolator[4] (which is also 2OS corrected), based on a successive order of interaction[5] approach. ReFRACtor combines these as described in O'Dell et al. (2012)[6]. There are a lot of assumptions and caveats here, and many decisions and supporting evidence underlie the algorithm design. Reporting everything would be unwieldy, so we now point at O'Dell et al. (2012), from which interested readers can reconstruct the full methodology.

The new phrasing is:
"The forward RT simulations used to generate the LUTs are performed with the ReFRACtor RT code, which implements the methodology described in Section 2.2.4 of O'Dell et al. (2012). Of particular relevance for cloudy scenes, multiple-scattering is calculated using LIDORT with a polarisation correction for low orders of scattering (Natraj and Spurr, 2007; Spurr, 2006). This assumes a plane-parallel atmosphere with a correction to the direct beam to account for Earth's sphericity."

We have endeavoured to include all relevant information while maintaining brevity.

1. **Spurr, R. & Christi, M. The LIDORT and VLIDORT Linearized Scalar and Vector Discrete Ordinate Radiative Transfer Models: Updates in the Last 10 Years. in *Springer Seeries in Light Scattering* (ed. Kokhanovsky, A. A.) 1–62 (Springer Nature, 2019). doi:10.1007/978-3-030-03445-0_1**
2. **Nakajima, T. & Tanaka, M. Algorithms for radiative intensity calculations in moderately thick atmospheres using a truncation approximation. *J. Quant. Spectrosc. Radiat. Transf.* 40, 51–69 (1988).**
3. **Natraj, V. & Spurr, R. J. D. A fast linearized pseudo-spherical two orders of scattering model to account for polarization in vertically inhomogeneous scattering–absorbing media. *J. Quant. Spectrosc. Radiat. Transf.* 107, 263–293 (2007).**
4. **O'Dell, C. W. Acceleration of multiple-scattering, hyperspectral radiative transfer calculations via low-streams interpolation. *J. Geophys. Res.* 115, D10206 (2010).**
5. **Heidinger, A. K., O'Dell, C., Bennartz, R. & Greenwald, T. The Successive-Order-of-Interaction Radiative Transfer Model. Part I: Model Development. *J. Appl. Meteorol. Climatol.* 45, 1388–1402 (2006).**
6. **O'dell, C. W. *et al.* The ACOS CO 2 retrieval algorithm – Part 1: Description and validation against synthetic observations. *Atmos. Meas. Tech.* 5, 99–121 (2012).**

How do you determine the most meaningful wavelengths?

We think this is still referring to the text following L156 and specifically "Angular output is calculated for a handful of wavelengths". We have expanded on the description:

"Angular output is calculated with 8 streams for predefined bins in gas optical depth while single stream calculations are done for preselected wavenumbers at a mean separation $\Delta\nu$ ~0.04 cm^{-1}, with smaller separation within absorption bands. The high- and low-stream outputs are combined using O'Dell (2010)'s low-stream interpolation to rapidly and accurately reproduce high-stream output at all wavenumbers. These are then interpolated onto a uniform $\Delta\nu$=0.01 cm^{-1} grid and convolved with the instrument line shapes (ILS) to obtain channel radiances."

We used a standard configuration provided by the OCO-2 team based on their optimised sampling. We had wanted to keep all discussion in wavelength rather than wavenumber, but the code implements this part in wavenumber so we drop consistency for precision, i.e. "uniformly at $\Delta\nu$=0.01 cm^{-1}" over "close-to-uniformly at $\Delta\lambda$~0.00059 nm".