We much appreciate that Dr. Duan spent time on reading the manuscript and giving constructive comments. We have replied to all comments and revised the manuscript. Please see the replies below. The original comments are in black italic font, and the replies to the comments are in blue normal font.

A forward modelling is essential for understanding the physics behind radiation measurements, it is also the base of building accurate algorithm for remote sensing, DISAMAR is of a such important tool for retrieving atmospheric gases and particles, and it has been used for TROPOMI and SP4/SP5 observations. This model introduces several numerical techniques such as layer-based SOS method, semi-analytical derivatives etc. to improve its computation efficiency as well as its computational accuracy. I agree its publication in GMD after minor revision, and I'm looking forward its application for more space-born instruments in future.

1. *Around line 280, it is not clearly to see how can we get EQ. 25 from EQ 24, please add more description.*

We have added some explanations close to line 298 as follows:

First, replace k_{ext} with $k_{sca} + k_{abs}$ in Eq. 24 and separate terms having k_{abs} and k_{sca}. Then calculate partial derivative of the reflectance w.r.t. k_{abs} and k_{sca}, respectively. All k_{sca} terms disappear in Eq. 25, while Eq. 26 has no k_{abs} terms.

2. *For the convolution of the ISRF around Line 109. "If there is a strong absorption line in the interval, the interval is reduced until the position of the strong line is reached, so this interval is smaller than the FWHM", this is easy to do for O2-A band which is regular spaced, for irregular spaced absorption band, say, water vapor band, is this method easy to apply this algorithm?*

The method is applied to all absorption bands, including water vapor bands. The interval in DISAMAR is irregular, so it does not matter whether the absorption band is regular or irregular spaced. We have revised the description of the wavelength grid, see lines 115-125 in the revised manuscript. It is easier to understand now.

3. *Line 114,"Typically the number of Gaussian division points is between 3 and 30 per wavelength interval in the O2 A-band for a FWHM of 0.5 nm." Is there a rule for the reader to know how to choose the number between 3 and 30.*

We do not have a rule for the reader to choose the number of Gaussian division points. The choice of the Gaussian points is based on experiences. It is a combination of accuracy and computation time. We have added more explanations on the construction of the wavelength grid in the revised version.

4. *“only the adding of different layers and the subsequent calculation of the internal field is replaced by the successive orders of scattering method.” Please add several sentences to make clear how to calculate the internal field?*

The text close to line 348 has been revised as follows:

Only the adding of different layers and the subsequent calculation of the internal field is replaced by the successive orders of scattering method (see Eqs. 35 – 38).

Added text close to line 359:

In order to calculate the total internal fields U and D (see Eqs. 33-38), we first need to calculate local internal fields U^{local} and D^{local}. (see Eqs. 31-32).