We like to thank Referee #1 for a positive review and comments. Below, Referee's comments are in blue and our responses in black.

Anonymous Referee #1, 29 Jun 2022
General comments

This paper presents the algorithm details employed for retrieving total columns of O3 and SO2 from DSCOVER EPIC UV measurements with the direct vertical column fitting method. The paper is well structured and written. For general readers, the author kindly describes the radiative transfer process of incoming UV photons and forward model calculations along with the comprehensive sensitivity tests. The inverse process from spectral measurements and geophysical variables are specified with error analysis. And then, retrievals are validated using brewer measurements/MERRA-2 for O3 and OMPS products for SO2. I agree with the conclusion of this paper, the maturity level of the presented algorithm is very high and the EPIC hourly measurements are very promising.

I would like to recommend this article for the publication of ATM after revising serval minor aspects.

Minor comments

1. I think that this article is a good textbook for students who just step into the atmospheric remote sensing area. But, this manuscript needs to be tightened in the format of research article, especially for section 2.

   Response:

   This paper is for a broad range of readers, from novices to experts in the field. The included contents are needed to elucidate the theoretical basis and fully describe the algorithm. We detail all assumptions and approximations implemented to make the algorithm practical and their impacts on retrieval accuracy. These understandings point to future algorithm advances. Besides, significantly shortening the paper requires extensive effort to keep it coherent and readable. A minor revision is unlikely to get it done. We like to keep the contents and structures as-is.

2. Section 7.1: have you any suspects about distinct scatters/less correction between EPIC O3 and brewer at Paramaribo compared to other stations? I am wondering if it comes from either Brewer measurement uncertainties or algorithm retrieval artifacts in tropics. You shoud check this issue by performing the additional evaluation at stations adjacent to Paramaribo.

Response:

We show in Figure AC1 the EPIC-vs-Brewer O_3 scatter plot at the Mauna Loa station, which is in the tropic and provides measurements coincident with EPIC. Additionally, we include scatter plots between EPIC and MERRA-2 O_3 and between Brewer and MERRA-2 O_3 at the selected ground stations.

Figure AC1 shows lower O_3 correlations between EPIC and Brewer at Paramaribo and Mauna Loa. At these stations, O_3 correlations between EPIC and MERRA-2 and between Brewer and MERRA-2 are also low compared to those mid and high latitudes, indicating that the low correlation is likely common in the tropics and not specific to a particular station.

Correlations between MERRA-2 and EPIC are generally higher than between Brewer and EPIC and between Brewer and MERRA-2 at almost all the stations (except the South Pole station) shown in Figure AC1. MERRA-2 O_3 may be considered as improved OMI O_3. Therefore, MERRA-2 is more similar to EPIC as both are from the top of the atmosphere observations and have close spatial resolutions. Brewers are ground-based measurements, with different IFOVs and different measurement sensitivities that contribute to discrepancies between satellite and ground-based observations.

The lower correlations in the tropics than in other latitude bands are primarily due to its smaller dynamics O_3 range than those in higher latitude zones. The random EPIC O_3 error due to instrument noise is independent of the total column (see section 6.2.1). Adding this random component to O_3 with a narrower range degrades the correlation with the actual O_3 more than adding it to O_3 with a broader range. Furthermore, the random error in EPIC O3 decreases with higher viewing zenith angles when VZA < 70° (see section 6.2.1). Higher zenith angles are associated mainly with observations at higher latitudes. Thus, adding a smaller random component causes less degradation in correlation with actual O_3 at high latitudes. The lower correlations in the tropics do not represent higher uncertainties (i.e., lower precision and lower accuracy) of EPIC, as the biases and standard deviations in the low latitudes are smaller than those at high latitudes (see Figure AC1).

In short, both errors in EPIC O_3 and discrepancies in observations between EPIC and Brewer degrade their correlations in the tropics.

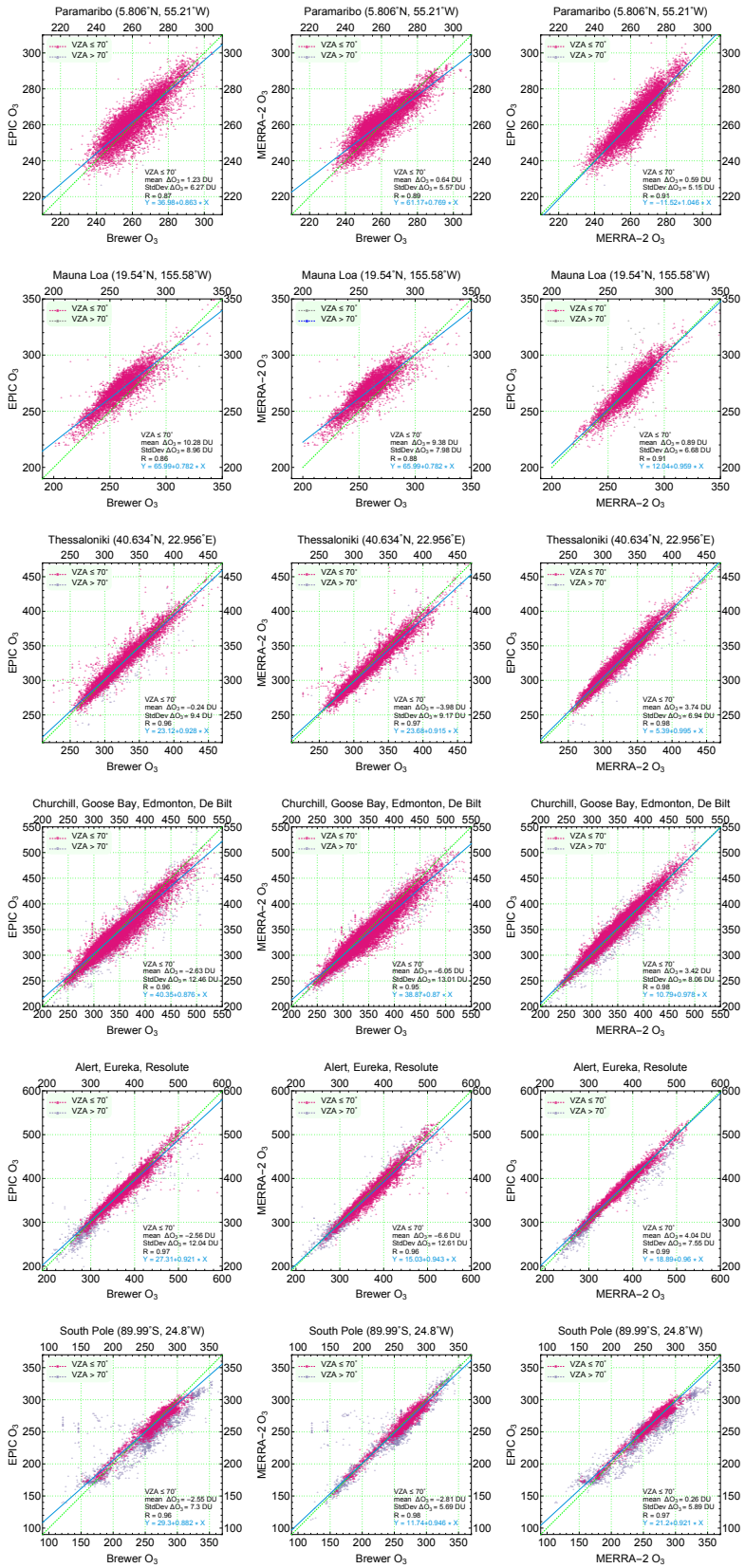

Figure AC1: Inter-comparison of total O_3 from EPIC, MERRA-2 (assimilated from OMI and MLS), and the ground-based Brewer spectrophotometers at 11 selected ground stations with high-cadence measurements.