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Atmospheric Measurement Techniques Discussions

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Interactive comment

Interactive comment on "Radiative transfer acceleration based on the Principal Component Analysis and Look-Up Table of corrections: Optimization and application to UV ozone profile retrievals" *by* Juseon Bak et al.

Anonymous Referee #1

Received and published: 12 October 2020

This manuscript presents principal component analysis (PCA)-Look Up Table (LUT) framework to speed up the radiative transfer calculation in the remote sensing of gases using hyperspectral spectrometers. The method would benefit retrieval algorithms that need full radiance to be calculated iteratively and current space-based instrument with large data volume to be processed (like OMI and TROPOMI), especially the upcoming geostationary satellite instruments (TEMPO and GEMS). The method described in this paper is clear and the paper is generally well written.

General Comments:

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Discussion paper

1. The improved fast RT calculation does improve the forward model accuracy, as a consequence, the ozone profile retrieval is improved, but it is unclear about the effect of errors in the previous radiative transfer calculation (as in Fig. 3) on the released ozone profile product, https://avdc.gsfc.nasa.gov/index.php?site=1620829979&id=74. There might be systematic error that varies with ozone profile and geometries (solar zenith, viewing zenith and relative azimuth angel), and thus depends on season, latitude and cross-track position. It is helpful to give a general assessment of these errors to data users.

2. The PCA-RT and LUTs considered the Rayleigh scattering atmosphere, however, for ozone profile retrieval, in the stratosphere the effect of scattering of aerosol is small or can be account for by fitting additional 1st or 2nd-order term of albedo or cloud fraction, but for tropospheric ozone, the effect of aerosol would be significant. What is the consideration about the scattering or absorption by particles (aerosol and optical thin cloud) in the model?

Specific Comments:

1. The improved PCA-RT aims to simulate radiance to an accuracy better than 0.05%, to what extent, the ozone retrieval accuracy would be achieved?

2. In section 3.1.2, each term of EOFs would relates to the specific optical properties of scattering and absorption in the atmosphere, please explain more about: what are the 1-3 EOFs relates to?

3. One more concern is: it seems that only absorption of ozone is considered in the RT calculations, how about the effect of other trace gases like SO2, HCHO, and NO2? Do we need to apply more EOF if other gases are included, especially when there is large SO2 amount?

4. Which model is used to generate LUTH and LUTL ? please make it clear in section 3.2 .

Technical Corrections:

Line 124: better to use “converged” instead of “optimized”

In Fig.2b and 2c: legend (may be 0.05) in yellow are hard to see. Please change to other distinct color.

Line 147: The sentence “around 310 nm if there is no error after undersampling correction to 0.05 nm.” Is hard to understand, does it mean “around 310 nm and there is no error after undersampling correction is set to 0.05 nm.”?

Line 180: “simulation” should be simulate

Line 370: “Fig. c” should be Fig. 7c

Line 236ïijŽTo be more clear, “the VLIDORT and FO Q/U values” should be “Q/U values calculated by VLIDORT and FO” .

In eq. 7 and 8, what does the ξ denote?

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