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Atmospheric Measurement Techniques Discussions

Interactive comment on "Total column water vapor retrieval for GOME-2 visible blue observations" *by* Ka Lok Chan et al.

Ka Lok Chan et al.

ka.chan@dlr.de

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We thank reviewer #3 for the useful comments. We have addressed the reviewer's comments on a point to point basis as below for consideration. All page and line numbers refer to the marked-up version of the manuscript.

The manuscript presents a new total column water vapor retrieval algorithm in the visible blue spectral band for the GOME-2 satellite instruments. The blue band algorithm has an advantage over the traditional red band algorithm that allows retrieval of water vapor from sensors which do not cover longer wavelengths, such as OMI and TROPOMI. One of the new features of the algorithm is the dynamic optimization of the a priori water vapor profile, which make use of the fast that the vertical distribution

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of water vapor is strongly correlated with the total columns. So the retrieval does not dependent on a priori information from model forecast and better suit for climate study. This paper presented a novel method to retrieve TCWV from satellite observations. Overall, the objective of the study is clear, and the results are validated properly. The presentation of the paper is well structured and easy to follow. Therefore, I suggest publishing the paper after clarifying the minor issues listed below.

1) Please add a summary of the evaluation strategy in section 2 describing why these data are used.

Response: We have supplemented an overall evaluation strategy in the beginning of section 2 (page 4, line 20-24).

2) The Level 1 data issue is still not clear to me, usually satellite measurement quality is decaying over time, why the data after 2015 is fine but the data before 2015 is contaminated? Is there any recalibration done in 2015? If the recalibration improves the data quality, will there be any reprocessing?

Response: This is related to the switch of level 1B processor in 2015. The level 1B processor has been update from version to 6.0 to 6.1 in 2015. This update mainly improved the spectral artefacts in the GOME-2 on-ground calibration key data. The spectral artefact in the level 1B data is due to incomplete removal of Xenon line in the GOME-2 calibration key data. The calibration key data was taken during the preflight on-ground calibration and the calibration key data are used as input for the level 0 to level 1B data processing. Therefore, the update of the processor improved the level 1B data and subsequently improved the TCWV data. We have further clarified this in the manuscript (page 5, line 25-28). The level 1B data is processed at EUMETSAT, and we cannot tell if there will be any reprocessing in the future.

3) The error due to surface albedo listed in table 3 is 3%, while the bias over vegetation, e.g., Amazon and Central Africa, seems to be much larger. Please clarify.

Response: The value listed in the Table is for typical cases, while the uncertainty of surface albedo over vegetation, e.g., Amazon and Central Africa, are larger, and therefore, resulting in larger uncertainty over these areas. We have further clarified in the manuscript that the values list on the Table are typical values while exceptional cases might exceed these values (page 20, line 16-17).

4) Why the absorption cross section of NO2 is not âĹij290k

Response: It is because most of the NO2 is in the stratosphere where the temperature is much lower than 220k. Therefore, NO2 cross section with lower temperature is used in the retrieval. NO2 Cross section measured with lower temperature is typically used also for the retrieval of NO2 columns, e.g., Liu et al., 2019.

Liu, S., Valks, P., Pinardi, G., De Smedt, I., Yu, H., Beirle, S., and Richter, A.: An improved total and tropospheric NO2 column retrieval for GOME-2, Atmospheric Measurement Techniques, 12, 1029–1057, https://doi.org/10.5194/amt-12-1029-2019, 2019.

5) Some of the references are inconsistence in format.

Response: We have carefully gone through the references, some of the references are technical report which doi number is not available. We have supplemented the doi number to the references if it is available. In addition, some of the references include url while some of the references did not. In order to keep it consistence, we have deleted the url for all references.

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