Response to interactive comments from Referee #1

Below the comments from Referee #1 are given in italic font. Our responses to the comments are shown in roman font.

General comments

- *On page 9, lines 15-19. How far from clouds must one go to have the AMF bias to be less than 20%? This would be a useful rule of thumb approximate value for the user community to learn and remember. The authors have the opportunity to educate the general research community in regard to the general quantitative importance of 3D radiative transfer effects, and its impact on NO2 retrievals, and I encourage the authors to do so in this paper.*

  This is an interesting question that unfortunately does not have a simple answer, but depends on solar zenith angle, cloud top height, pixel size and more. To address the comment we have added the following:

  > For a solar zenith angle around 40° most pixels will have an AMF bias below 20% if the distance to the cloud edge is more than about 10 km. For a solar zenith angle of 60° this distance increase to about 20 km. The distance depends on a number of factors such as cloud top height, cloud optical depth and surface albedo. This is further discussed and quantified for box clouds in the accompanying paper by Yu et al. (2021).

- *On page 23, line 2, the authors state that cloud shadow effects are not important for background NO2 conditions.. Please clarify why this is the case.*

  We have clarified this by changing the sentence to:

  > Profiles of NO_2 for polluted conditions, with increased NO_2 in the lower atmosphere below cloud tops, were considered as cloud shadow effects are not important for background NO_2 conditions where the amount of NO_2 below the cloud top is relatively small compared to the total column.

Specific comments

- *Page 2, lines 31-32. Rephrase to The retrieved NO2 using standard 1D algorithms was compared to the input to the 3D radiative transfer simulations and possible 3D radiative effects were identified and quantified.*

  The sentence has been changed as suggested.

- *Page3, line 24. Rephrase to Note that each simulated sensor pixel includes 36 cloud pixels, hence the simulations include*

  The sentence has been changed as suggested.

- *Page 4, line 11. Rephrase to Combining the sun-sensor geometries ..*

  Correction made as suggested.

- *Page 9, line 1. Rephrase to The bias decreases to 0% when the CFw is between 1-3%.*

  Correction made as suggested.

- *Page 17, line 2. Rephrase to satisfied this criteria and therefore no data is shown*

  Correction made as suggested.

- *Page 21, lines 5-6. Rephrase to the cloud shadow fraction increases because generally the cloud shadow within a pixel geometrically increases with cloud height.*

  Corrections made as suggested.

Bibliography

Yu, H., Emde, C., Kylling, A., Veihelmann, B., Mayer, B., Stebel, K., and van Roozendael, M.: Impact of 3D Cloud Structures on the Atmospheric Trace Gas Products from UV-VIS Sounders - Part II: impact on NO 2 retrieval and mitigation strategies, Atmospheric Measurement Techniques, submitted, 2021.