Review of Impact of 3D Cloud Structures on the Atmospheric Trace Gas Products from UV-VIS Sounders - Part III: bias estimate using synthetic and observational data by Arve Kylling et al

This paper is one of a set of three papers that discusses a) a publicly available synthetic dataset of 3D radiances, b) the sensitivity of vertical column density NO2 retrieval errors near box-clouds and observations, and c) 3D cloud biases and metrics. The reviewed paper is part b) of the full set of papers.

The paper is well written, concise, clear, and informative. The paper is well organized, and the figures are thoughtfully chosen and carefully presented. The text lines on page 8 (lines 13-16), page 13 (lines 10-13), and the Conclusions (pages 21-24) are especially well written. Since there are relatively few papers which discuss 3D radiative transfer and its impact on satellite retrievals, the paper is fairly unique.

The paper should be published after minor revision.

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.

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.

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."

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

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

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

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

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".

Criteria

1. Does the paper address relevant scientific questions within the scope of AMT? Yes

2. Does the paper present novel concepts, ideas, tools, or data? There are relatively few papers than discuss 3D radiative transfer, so the paper is fairly unique.

3. Are substantial conclusions reached? Yes

4. Are the scientific methods and assumptions valid and clearly outlined? Yes

5. Are the results sufficient to support the interpretations and conclusions? Yes

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes

8. Does the title clearly reflect the contents of the paper? Yes

9. Does the abstract provide a concise and complete summary? Yes

10. Is the overall presentation well structured and clear? Yes

11. Is the language fluent and precise? Yes

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? The General Comments section above points out a few places (on pages 9 and 23) where clarifications are suggested.

14. Are the number and quality of references appropriate? Yes

15. Is the amount and quality of supplementary material appropriate? Yes