Corrigendum to the PhD thesis "Investigation of photon path length distributions derived from oxygen A-band measurements of the GOSAT satellite instrument"

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In the chapter 9 of the PhD thesis (*B. Kremmling, Investigation of photon path length distributions derived from oxygen A-band measurements of the GOSAT satellite instrument, Mainz, 2018*), two cloud free scenarios were investigated.

The first measurement was taken over ocean and is identified by the scanid F140708102829172601, the second measurement was over desert and has the scanid F100603105923182701.

In the framework of a detailed follow-up study on clear sky scenarios of GOSAT measurements, both measurements were investigated again with an improved algorithm. Here, it was discovered that the obtained fit parameters B_{fit} show large differences to those obtained in chapter 9 of the PhD thesis. In order to understand these discrepencies, the analysis was repeated using the original simulation settings. The results presented in the PhD thesis could only be reproduced by adding a cloud layer between 3 and 4 km altitude, with a cloud optical depth of 1. This setting was verified by close inspection of the ancillary output files of the original simulations. In conclusion, the original simulations were not performed for a clear model atmosphere but a small cloud structure was included within. Most probably, the reason was a non-functioning command in the written code for selecting the necessary simulation configuration files.

Selecting a clear sky model atmosphere, the analysis was then performed with the settings used in the PhD thesis which led to the following results:

F140708102829172601	original	new
determined surface albedo	0.078	0.092
fit parameter B	1.058	0.956

F100603105923182701	original	new
determined surface albedo	0.523	0.533
fit parameter B	0.934	1.019

For the water measurement (F140708102829172601), a fit parameter B_{fit} smaller than 1 is observed, which indicates an overestimation of the simulated O_2 absorption. The determined surface albedo of the ocean measurement is still higher than expected. However, this can be explained by a positive sunglint flag within the FTS SWIR L2 CO2 data product. The parameter B_{fit} of the desert measurement (F100603105923182701) is closer to the expected value of unity, a small underestimation of the simulated O_2 absorption is observed.

The general conclusions of the PhD thesis do not change, especially as the results of the clear sky measurements were stated to be poorly understood.

Acknowledgements: I am grateful to the GOSAT team at NIES for accepting the request and processing the FTS SWIR L1B data into FTS SWIR L2 data for the above mentioned scenarios.

The detailed corrections are as follows:

page 5, section 1

Original: *Interestingly, a similar overestimation for the O_2 absorption has been observed for a clear sky case over a bright surface. A clear-sky case over a dark surface, however, shows the opposite effect, suggesting an underestimation of the O_2 absorption. It is interesting to note that the corresponding radiance spectrum shows many negative values, indicating possible calibration problems.*

Corrected: Interestingly, a similar overestimation for the O_2 absorption has been observed for a clear sky case over a *dark* surface. A clear-sky case over a *bright surface, however, shows a less pronounced but* opposite effect, suggesting an underestimation of the O_2 absorption. It is interesting to note that the *radiance spectrum over dark surface* shows many negative values, indicating possible calibration problems.

page 6, section 2

Original: *Interessanterweise wurde für eine Messung mit wolkenlosem Himmel und heller Oberfläche eine ähnliche Überschätzung der Sauerstoffabsorption festgestellt. Die Analyse einer Messung mit wolkenlosem Himmel über einer dunklen Oberfläche wiederum zeigt das Gegenteil, nämlich eine Unterschätzung der simulierten Sauerstoffabsorption. Hier ist die Feststellung interessant, dass das zugehörigen Messspektrum viele negative Radianzen aufweist, was ein Indiz für mögliche Probleme der Kalibrierung ist.*

Corrected: Interessanterweise wurde für eine Messung mit wolkenlosem Himmel und *dunkler* Oberfläche eine ähnliche Überschätzung der Sauerstoffabsorption festgestellt. Die Analyse einer Messung mit wolkenlosem Himmel über einer *hellen* Oberfläche wiederum zeigt das Gegenteil, nämlich eine *schwache* Unterschätzung der simulierten Sauerstoffabsorption. Hier ist die Feststellung interessant, dass das Messspektrum *über dunkler Oberfläche* viele negative Radianzen aufweist, was ein Indiz für mögliche Probleme der Kalibrierung ist.

page 78, section 9.1:

Original: *Here, the surface albedo is derived by comparing radiances within the wavelength continuum, which leads to an albedo $a_s = 0.078$ for the ocean measurement.*

Corrected: Here, the surface albedo is derived by comparing radiances within the wavelength continuum, which leads to an albedo $a_s = 0.092$ for the ocean measurement.

page 78, section 9.1:

Original: *The resulting parameter $B_{fit} \approx 1.058$ suggests an underestimation of the O_2 absorption during the simulation by about 6%*

Corrected: The resulting parameter $\mathrm{B}_{fit} \approx 0.956$ suggests an *overestimation* of the O_2 absorption during the simulation by *4-5%*.

page 79, section 9.2:

Original: *From the comparison of measured and simulated radiances in the continuum wavelength region, an albedo of 0.523 is found, which defines a slightly less reflective surface.*

Corrected: From the comparison of measured and simulated radiances in the continuum wavelength region, an albedo of *0.533* is found, which defines a slightly less reflective surface.

page 79/80, section 9.2:

Original: *The derived parameter $B_{fit} \approx 0.934$ indicates an overestimation of the O_2 absorption by 6-7%. The fit leads to a better agreement of the radiances in wavelength regions of intermediate absorption but higher disagreement at the first strong absorption structure at about 759.95 nm. The RMS of the comparison is reduced from 0.0034 to 0.0024 by allowing a B_{fit} different from unity.*

Corrected: The derived parameter $\mathrm{B}_{fit} \approx 1.019$ *indicates a weak underestimation of the O_2 absorption by about 2%*. The RMS of the comparison is reduced from *0.00276 to 0.00269* by allowing a B_{fit} different from unity.

page 81, section 9.3:

Original: *In the case of the measurement over water (dark surface), an underestimation of the O_2 absorption is identified. The contrary results for the measurement over desert which is a highly reflective surface.*

Corrected: In the case of the measurement over water (dark surface), an *overestimation* of the O_2 absorption is identified. The *contrary but less pronounced effect* results for the measurement over desert which is a highly reflective surface.

page 81, section 9.3:

Original: *The fit results of the case study of the clear sky measurement over desert show an overestimation of the O_2 absorption by approx. 6%.*

Corrected: The fit results of the case study of the clear sky measurement over *ocean* show an overestimation of the O_2 absorption by *4-5%*.

page 86, section 10.3:

Original: *Interestingly, a similar overestimation has been found for the clear sky measurement over a bright surface (desert, see section 9.2).*

Corrected: Interestingly, a similar overestimation has been found for the clear sky measurement over a *dark surface (ocean, see section 9.1).*

page 125/126, section 13:

Original: *The subsequent fit on the complete radiance spectrum shows an underestimation of the simulated O_2 absorption of about 6%.*

Corrected: The subsequent fit on the complete radiance spectrum shows an *overestimation* of the simulated O_2 absorption of *4-5%*.

page 126, section 13:

Original: *In contrast to the measurement over dark surface, an overestimation of the simulated O_2 absorption results from the fit, leading to a parameter B_{fit} around 0.94.*

Corrected: In contrast to the measurement over dark surface, *a weak underestimation* of the simulated O_2 absorption results from the fit, leading to a parameter B_{fit} around *1.02*.

page 127, section 13:

Original: *If the focus is set on the smallest fit RMS, both one-layer cloud cases as well as the clear sky measurement over a bright surface show a systematic overestimation of the O_2 absorption within the radiative transfer simulations to best fit the measurements.*

Corrected: If the focus is set on the smallest fit RMS, both one-layer cloud cases as well as the clear sky measurement over a *dark* surface show a systematic overestimation of the O_2 absorption within the radiative transfer simulations to best fit the measurements.

page 129, section 13:

Original: *A larger number of clear sky cases over surfaces with different albedos a_s should be compared to radiative transfer simulations to examine the discrepancy between the so-far detected under- and overestimation of the O_2 absorption for a dark and a bright surface, respectively.*

Corrected: A larger number of clear sky cases over surfaces with different albedos a_s should be compared to radiative transfer simulations to examine the discrepancy between the so-far detected under- and overestimation of the O_2 absorption for *a bright and a dark surface*, respectively.

The corrected figures 56 (page 79) and figure 57 (page 80) are:

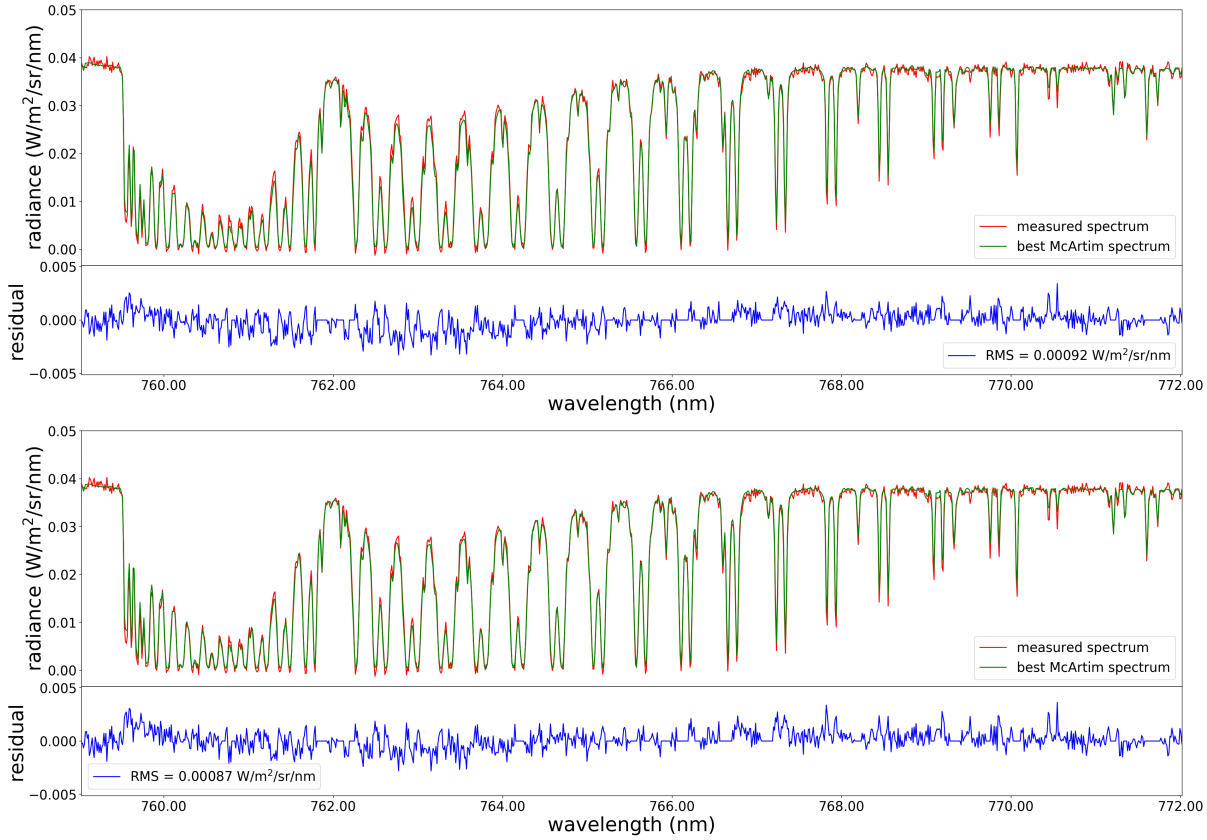

Figure 56: Top: Wavelength-aligned comparison of the simulation (green) and the measurement (red) with the residual directly below (blue) in the case of a clear-sky scenario over dark surface. Bottom: Fit of the simulation to the measurement also considering a parameter B_{fit} (same color scheme as above).

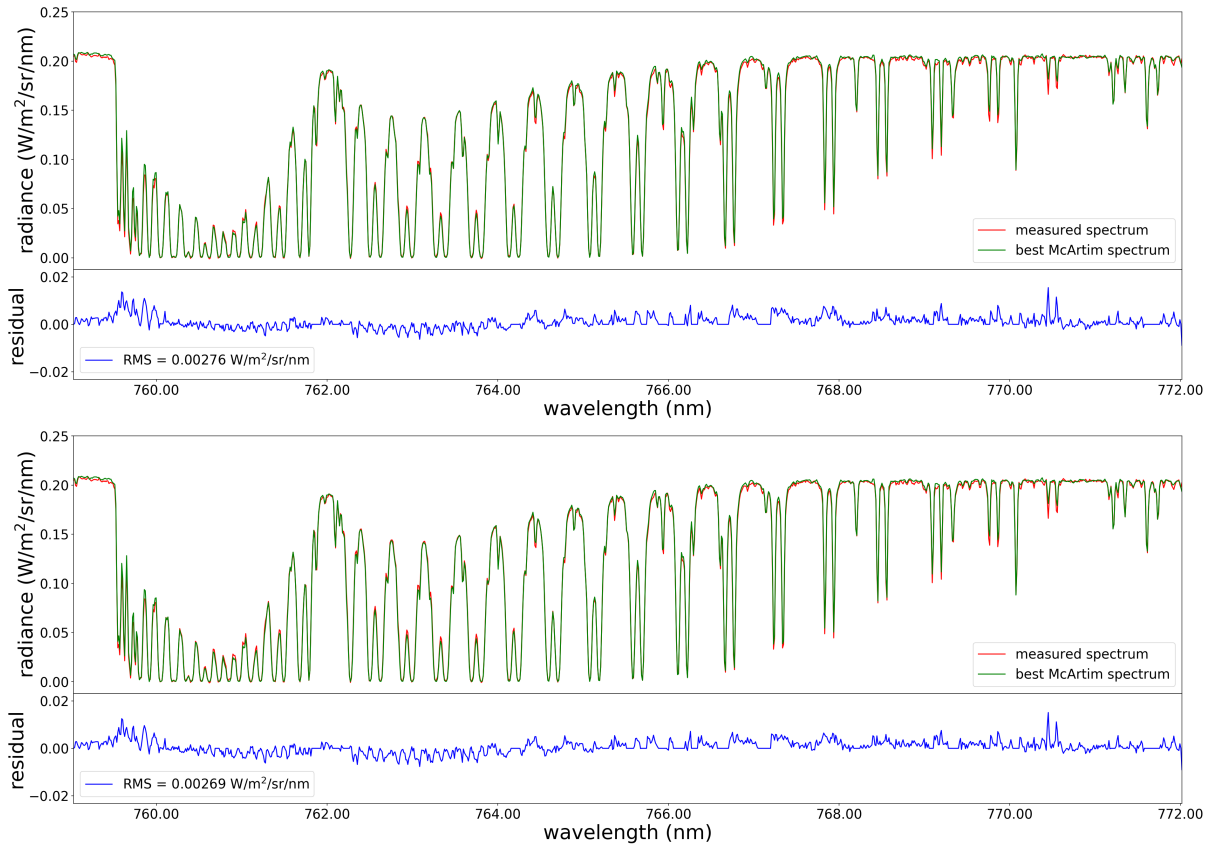

Figure 57: Top: Wavelength-aligned comparison of the simulation (green) and the measurement (red) with the residual directly below (blue) in the case of a clear-sky scenario over bright surface. Bottom: Fit of the simulation to the measurement also considering a parameter B_{fit} (same color scheme as above).