ANSWERS TO REFEREE #1

First of all, we thank Referee Peter Koepke for his positive remarks on the manuscript. The authors believe that they have understood the concerns of the referee. His remarks have been taken into account for revising a part of the text following recommendations of the referee.

Comment 1. Why the number of sub-intervals has been set to four?

Thank you for this valuable remark. It is also a comment from the referee #3, hence the answer is the same.

We have selected 4 sub-intervals for KB #3 and 4 sub-intervals for KB #4. The question is why 4? Why not more or less?

It is understandable that the accuracy of the parameterization depends mainly on the choice of weight, number of sub-intervals and their position in the KB. The primary goal of this paper is to demonstrate that it is possible to obtain a better representation of the transmissivity due to ozone absorption with fairly simple changes to the Kato et al. method. We performed a few tests with two to five sub-intervals and this is now mentioned in the text together with your suggestion to perform an additional study.

We have replaced the following sentence in the paper:

One solution is obtained by setting n to 4 and adopting equal weights for the sub-intervals for both KB #3 and #4.

by

Many solutions are possible. No systematic scan of possible solutions in n, weight a_i and $\delta\lambda_i$ was made. This could be a further work that is computationally expensive and that requires setting up a protocol for selection of the best trade-off between accuracy and number of calculations. Here, a few tests were made with n ranging from 2 to 5. The best trade-off was found at n=4. A further study was performed for n=4 by adopting equal weights for the sub-intervals for both KB #3 and #4.

Technical points:

Comment 2. P1029, I.1: Mention the meaning of KB (explanation of the abbreviation)

We fully agree with this remark. We added Kato bands after the abbreviation KB. The sentence is now:

Hereafter, these spectral intervals are abbreviated in KB (Kato bands)

Comment 3. P. 1030, I.9: Repeat the meaning of IOΔλ or, even better, show Eq.2 as fraction of two integrals over Δλ, with spectral irradiance with attenuation as the numerator and without attenuation as the denominator.

We fully agree with this remark. Done as requested.

ANSWERS TO REFEREE #3

First of all, we thank Referee #3 for the positive remarks on this article. The authors believe that they have understood the concerns of the referee. The remarks have been taken into account for revising a part of the text following recommendations of the referee. Several comments and remarks have been grouped.

Comment 1. My main concern is if the manuscript is so convincing that the proposed parameterization will be used in practice instead of analytical radiative transfer calculations.
This paper proposes a parameterization of the transmissivity due to ozone only with a final goal of spending less computational resources than detailed calculations. We do not believe that both approaches oppose. They have their merits and drawbacks in every situation. Our parameterization takes place in the method of Kato et al. and aims at reducing errors in the KB #3 and #4. This is clearly written in the text at the end of Section 1: "…to improve the potential of Kato et al. method for estimating narrow band UV irradiances…".

Comment 2. First, I think that the analytical runs in the UV region are not so computationally expensive….
Thank you for this remark. We agree. The best estimate of the UV irradiance is made by a spectrally-resolved calculation of the radiative transfer for each wavelength followed by integration over the UV. It is all a matter of the number of times the operation must be repeated. For example, considering the range [283, 328] nm (KB #3 and KB#4), every 0.5 nm, 93 spectral calculations are necessary. It amounts to 8 spectral calculations only with the proposed parameterization, i.e. approximately 10 times less. The difference is 84 operations, i.e. a few seconds, and it is not a big deal for many researchers. But if this operation must be repeated a large number of times to construct time series or maps for example, then the number of operations may become an issue.

Comment 3. Solar zenith angles. Why calculations are not made for solar zenith angles greater than 80°?
Thank you for this remark. The new parameterization that we propose has been developed for solar zenith angles between 0° and 80°.
We have done again the assessment of the performance of the new parameterization but now for solar zenith angles between 0° and 89°. For computing reason, solar zenith angle 90° has

been replaced by 89°. These additional results are accounted for in the text which now deals with angles ranging from 0° to 89°. No relevant change was observed. The following sentence has been added:

In this validation step, the random selection of the solar zenith angles follows a uniform distribution in [0°, 89°].

Comment 4. The authors should highlight the fact that the proposed approximation provides very close results with the analytical runs and successively takes into account: 1. The variety of ozone and temperature vertical profiles. ... It is also recommended to explain/present:
1. The performance of the proposed method in calculating the UVB irradiance components (direct, downward, upward) at specific wavelengths and different altitudes

Thank you very much for this valuable remark. Building on the fact that the new parameterization has been included into libRadtran (Section 5), a new Section 6 has been added to answer this remark. It presents the performance of the proposed parameterization for computing irradiances in the two Kato bands for several altitudes taking into account the variety of ozone and temperature vertical profiles.

Comment 5. It is also recommended to explain/present: 2. The use of only 4 sub-intervals (what would be the difference in computation time/accuracy of calculations when using more/less intervals?) 3. The use of the specific wavelength intervals (table 1, 2nd column).
Thank you for this valuable remark. It is also a comment from the referee #1, hence the answer is the same.
We have selected 4 sub-intervals for KB #3 and 4 sub-intervals for KB #4. The question is why 4? Why not more or less?
It is understandable that the accuracy of the parameterization depends mainly on the choice of weight, number of sub-intervals and their position in the KB. The primary goal of this paper is to demonstrate that it is possible to obtain a better representation of the transmissivity due to ozone absorption with fairly simple changes to the Kato et al. method. We performed a few tests with two to five sub-intervals and this is now mentioned in the text together with the suggestion of Referee Peter Koepke to perform an additional study.
We have replaced the following sentence in the paper:

One solution is obtained by setting n to 4 and adopting equal weights for the sub-intervals for both KB #3 and #4.

by

Many solutions are possible. No systematic scan of possible solutions in n, weight a_i and $\delta\lambda_i$ was made. This could be a further work that is computationally expensive and that requires setting up a protocol for selection of the best trade-off between accuracy and number of calculations. Here, a few tests were made with n ranging from 2 to 5. The best trade-off was found at n=4. A further study was performed for n=4 by adopting equal weights for the sub-intervals for both KB #3 and #4.