Authors' response to reviewer comments

The authors thank the reviewer for his/her time and positive comments on their manuscript. These comments are addressed below. The necessary tracked changes, which hopefully will improve on the previous version, have been made to the paper. These comments are addressed on a point-by-point basis with his responses in red.

RC1

This manuscript evaluates how different shortwave water vapor continuum models impact the calculation of clear-sky shortwave radiative feedback, computed using ECMWF's ecRad radiative transfer code. The authors test three versions of the MT_CKD continuum model (v2.5, 3.2 and 4.1.1) as well as one version of the CAVIAR continuum model applied to ecRad. It is known that the strength of the SW water vapor continuum differs greatly across continuum models, but the impact of this on SW feedbacks has not been tested before (while such analysis has been done for the LW). Results presented here show that at a baseline temperature of 288K, the choice of MT-CKD continuum model version has a negligible effect on SW feedback. CAVIAR leads to a relatively stronger SW feedback than MT_CKD, but still only by a few percent. At moderately warmer baseline temperatures the differences in SW feedback across continuum models is larger. The manuscript is well written and fills a gap in the literature that will interest multiple groups of ACP readers. However, I think the importance of the results can be better motivated and there are some areas of the text where some minor clarifications would be helpful. I therefore recommend a minor revision.

- These positive comments and suggestion from the reviewer are highly appreciated.

General: My biggest concern with the manuscript is, to a reader coming from the GCM user community, the uncertainty in SW feedback associated with the different continuum models is quite small relative to other sources of uncertainty and to the overall spread in these feedbacks across GCMs, and certainly relative to overall net LW+SW feedback spread. Should the reader's takeaway be that continuum choice doesn't really matter, relatively speaking? Or is there a reason to care? The authors should spend some time addressing this in order to improve motivation of the work. In my mind, this work matters because the continuum is rooted in fundamental physics and observations. Therefore, in some respects, this is a source of feedback uncertainty that we can constrain. That is not true for many other sources of uncertainty.

- The authors thank the reviewer for these important questions and constructive discussion.
- We agree with the reviewer that the continuum induced uncertainty in shortwave feedback obtained in this work is small relative to other sources of uncertainty in 1D RCE computations (e.g,, vertical relative humidity profile). However, this uncertainty is non-negligible because the treatment of the water vapour continuum is of fundamental importance for the correct computation of atmospheric radiative fluxes (and by extension, radiative feedback). Thus, the choice of the water vapour continuum model matters.
- We also agree with reviewer that the uncertainties obtained in this work is relatively smaller than the overall spread of feedbacks across comprehensive climate models.
- As discussed in our manuscript (Section 1), there are still relatively significant uncertainties in characterising continuum absorption at some SW spectral regions. In

the concluding section of our manuscript, we pointed out that constraining water vapour continuum absorption in the shortwave will contribute to reduce the discrepancies in estimated shortwave feedbacks from 1D RCE models. We have now revised this section of the manuscript to put our results in a broader context as suggested by the reviewer.

Abstract: The result in Figure 4b and c, showing the varying dependency on surface temperature, and the author's spectral explanation of this result, is really interesting. I think some summary of this is worthy of inclusion in the abstract. The result is much more nuanced than just "uncertainty is larger at warmer temperatures" as I assumed before reading this.

- We thank the reviewer for this recommendation. The abstract has been revised accordingly.

Line 91-92: The authors should briefly summarize the results of the studies that investigated the effect of contiuum on LW feedback. It would help put this work into context. My sense is LW feedback is similarly insensitive to continuum magnitude at present-day temps (288K). Also, it would be helpful to understand how the range of continuum strength studied here compares to, for instance, the variations in continuum used by Koll et al. 2023.

- The introductory section has been revised as recommended by the reviewer.

Figures 2 and 3 and surrounding text seem unnecessary and a bit out of place. They are used to show that ecCKD is an accurate radiative transfer model, but that doesn't really have any baring on the main focus of the paper: the impact of continuum model on LW feedback.

- Thank you for this comment. The main focus of this paper is the impact of shortwave continuum on SW feedback and not LW feedback as stated by the reviewer.
- The figures and text the reviewer has referred to are in Sec 2.2 of the manuscript. The aim of this section is to help the reader understand how the correlated-*k* tables for different continuum models were computed since the details of these computations have not been published elsewhere and there is no manuscript in preparation. We think that without this section, it would be difficult to understand how various continuum models were implemented in ecRad.
- Despite the importance of this section, we agree with the reviewer that it is a bit out of place at this portion of the manuscript. We have now moved it to an appendix. Additional we have limited our discussion to the shortwave only, as that is the focus of our paper.

Line 351: I'm not a fan of using the term "error" relative to 4.1.1, implying 4.1.1 is truth. The authors could use "difference" like fig 4 does

- The text has been corrected as recommended.

Line 354-356: This qualitative explanation of why SW feedback is stronger at warmer temperatures isn't clear. This same argument – increased moisture reduces upwelling radiation – could be said for lower temperatures. A rewrite with a little more detail would be helpful here.

- This portion of the manuscript has been re-written to clarify it.