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Geoscientific Model Development Discussions

Interactive comment on "Evaluating and improving the treatment of gases in radiation schemes: the Correlated K-Distribution Model Intercomparison Project (CKDMIP)" *by* Robin J. Hogan and Marco Matricardi

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We thank Anonymous Referee #1 for these positive and helpful comments.

1. The revised version of the manuscript will start the introduction with the point that there is substantial room to improve the accuracy of RT codes, citing some of the papers suggested by the reviewer. We will then point out that differences between codes can be due to differences in underlying spectroscopic datasets and/or errors in formulating a CKD model based on a particular spectroscopic dataset. We stress that

CKDMIP is concerned only with the second of these problems; we attempt to sidestep the first problem by providing CKDMIP participants with the spectroscopy that they should use.

2. It is true that it is shocking how old some RT models in CMIP6 are, but the reviewer's Comment 1 indicates that this has already been reviewed in the literature. CKDMIP is not really concerned with the problems associated with old spectroscopy, but rather it uses an up-to-date spectroscopy to focus on the algorithmic challenge of formulating CKD schemes. CKDMIP's contribution to the problem of very old schemes in current climate models will be to improve the efficiency, accuracy and availability of CKD models in future, so hopefully they can be more easily plugged into climate models. This point is made in the conclusions of the revised paper.

3, 4. This ought to be mitigated by the fact that participants are advised to use the same water vapour spectroscopy, but we recognise that in practice not all will. We now make the point in the conclusions that additional cases could be added later in the project if it becomes apparent when the first submissions are received that more are needed. Unfortunately the "Idealized" dataset is not suitable for use directly in radiative transfer because it uses constant water vapour mixing ratios with height, so sensible values near the surface would correspond to unphysical supersaturations higher in the atmosphere.

5. The impact of different assumptions and methods for constructing CKDs on their accuracy will be explored in a later CKDMIP results paper, and this would be the place for a more detailed review of the various methods. However, we have added to the introduction a list of references to the CKD models/tools of the CKDMIP participants so far.

6. This is now mentioned in the conclusions.

7. We do log information from each group, but more in terms of the formulation of their CKD tool rather than the spectroscopy, which is a dataset provided to partici-

pants (see https://confluence.ecmwf.int/display/CKDMIP/How+CKD+tools+work). This is now mentioned in section 4.2.

Minor comments

1. Many CKD models, possibly most, do not use a unique mapping from k intervals to parts of the spectrum, but use a separate mapping at different pressures and temperatures. It therefore doesn't seem appropriate to mandate the provision of this data, at least not unless mapping is identified as an important source of differences between CKD models later in the project.

2. The intention is that the text in the first paragraph of the introduction is clear for the widest possible audience, and leads into the discussion of the accuracy-efficiency trade-off. This is best served by talking in terms of reordering and discretization rather than Laplace transforms. If this text implies exponential sum fitting to the reviewer then it simply reflects the fact that the ESFT and CKD share some common features.

3. This is now mentioned in the conclusions.

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