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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

**Anonymous Referee #2**

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Referee comment on a manuscript:

"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

GENERAL COMMENTS

The manuscript describes CKDMIP project, whose main goal is to improve gas optics in weather and climate models using correlated k-distribution (CKD) method, which is



nowadays a predominant choice for making efficient yet accurate calculation of broadband atmospheric radiative transfer. Desired improvement should arise from an optimal trade-off between efficiency and accuracy, controlled by a choice of spectral bands and associated quadrature points (g-points). First step towards defined goal is an intercomparison of existing CKD models in a unified framework, and understanding how the specific CKD choices affect the quality. For this purpose, a set of atmospheric profiles was created, sampling the range of conditions characterizing current as well as past and anticipated future climate. Nine most radiatively active gases are considered, and the influence of additional 38 trace gases is approximately included via CFC-11-equivalent. For each profile, benchmark radiative fluxes and heating rates were calculated using line-by-line model. Profiles are divided in two indepenent evaluation datasets, so that cross validation of obtained results can be done. Input profiles, benchmark results for evaluation dataset 1, necessary software tools and instructions are available via CKDMIP web page, where the results of intercomparison are being published as well.

Participants to the intercomparison are invited to make either a full submission of the results obtained with their CKD scheme, or a partial submission according to their area of interest. The latter option was enabled given the fact that the full submission is very demanding, requiring generation of 36 configurations (models) of given CKD scheme. Accuracy of results is evaluated with respect to benchmark line-by-line calculations. Efficiency is judged only from the total number of g-points, so it does not reflect the fact how optimally the different CKD schemes are coded. In order to make the intercomparison free of aspects unrelated to CKD method, participants submit clear-sky layer optical depths delivered for each k-term by their CKD models (plus necessary additional information), and the radiative fluxes are then calculated by the CKDMIP software. In this way it is ensured that all submissions will use the same set of approximations in solving the radiative transfer equation. Another interesting aspect is that although participants submit only the clear-sky results, it is possible to make an a posteriori inclusion of clouds. Influence of non-grey clouds on accuracy will thus be evaluated centrally by the CKDMIP authors.

In final part of the manuscript, CKDMIP approach is applied to a widely used model RRTMG, revealing its strengths and weaknesses. This is very persuasive demonstration of capabilities and usefulness of CKDMIP.

The manuscript is written very clearly, reflecting a thoroughly designed CKDMIP concept. There are hardly any critical comments I can raise, therefore I recommend the manuscript to be accepted for publication, after correcting the typos listed in technical corrections part. I would like to congratulate authors to a nice article, and thank them for investing their time and energy into activity beneficial for a wide community using CKD method. I wish them many CKDMIP submissions and fruitful evaluation of the results, followed by desired improvement of routinely used CKD models.

SPECIFIC COMMENTS

line 304: Even if irrelevant for CKDMIP itself, can you make a comment about relevance of assuming local thermodynamic equilibrium in a pressure range 0.02-4hPa?

TECHNICAL CORRECTIONS

line 52: that it the includes => that it includes

line 104: O2 and N2 have constant mole fractions => O2 and N2 have constant dry air mole fractions

line 153: grid not sufficient => grid is not sufficient

line 214: mean sea level pressure => average mean sea level pressure

lines 243-245: It would be nice to add also information about wavelength ranges. In shortwave spectrum wavelengths are used more frequently than wavenumbers.

Table 4: two significant figures are shown => two significant digits are shown There is missing information that tabulated values are in W/mˆ2.



line 466: spectrally surface albedo => spectrally varying sufrace albedo

line 506: and 0.15W/mˆ2 at TOA => and 0.15W/mˆ2 at the surface

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