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Geoscientific
Model Development
Discussions

Interactive comment on "Upgrading photolysis in the p-TOMCAT CTM: model validation and assessment of the role of clouds" *by* A. Voulgarakis et al.

Anonymous Referee #2

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Review of manuscript gmdd-2008-0011 "Upgrading photolysis in the p-TOMCAT CTM: model validation and assessment of the role of clouds" by A. Voulgarakis et al.

1). General/Major comments:

This paper presented an updated version of the p-TOMCAT global 3-D chemical transport model that uses the Fast-JX photolysis code. The Fast-JX code was validated offline against observations. The authors showed that including Fast-JX in the model significantly improves the model's capability to capture both the spatial and temporal variations in photolysis rates and chemical constituents (e.g. OH and ozone). The conclusion with respect to the modest radiative effect of clouds on a global scale is

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consistent with the most relevant literature. This paper will be a useful reference for those who would like to implement similar photolysis code in their models and also for future studies of the radiative impact of clouds on tropospheric chemistry. This reviewer recommends publication after some (but important) revisions, as itemized below.

It is not clear whether or not cloud liquid/ice water contents taken from the ECMWF analyses are in-cloud or gridbox averaged values (line 15-17, p350). The authors stated on page 351 that "in this study, we use the gridbox average optical depth which is calculated by the Slingo equation" - does this mean that cloud water contents are gridbox averaged values? If so, how were they obtained from in-cloud water contents, which are predicted by the ECMWF cloud scheme? By linear average?

section 2.3 (p350) - equation (1) (Slingo and Schrecker, 1982) for the calculation of cloud optical depths applies to liquid clouds only, as the "LWC" variable in the equation indicates. But this study also used the equation to calculate ice cloud optical depths. Wouldn't it be more appropriate to take the total (water+ice) cloud optical depths (and cloud fractions) from the ECMWF reanalysis?

2). Specific comments:

Abstract (line 1-5) - Where did the photolysis rates observational data come from?

section 2.1 (line 18-19) - "At the upper boundary, ozone, methane and NOy are prescribed with climatological values from the Cambridge 2D-Model". However, this approach requires the meteorological field (ECMWF) used in this study represents the downward transport from the stratosphere reasonably well. Is this the case for this version of ECMWF? If so, cite relevant literature.

section 2.1 (line 20-21) - Here you said that "offline monthly mean aerosols were taken from the GOCART model output (Chin et al., 2002)". But later in section 2.3 (line 19), you said that "no aerosols have been considered in this study". Please explain.

section 2.3 (line 1-28, page 351) - The authors discussed and concluded about Fig.1

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before describing how the figure was produced. How about the other way around?

equation (2) and Fig.1 - Did you integrate equation 2 from surface to top and compare it to ISCCP values? Please clarify.

page 353, line 9 and 18 - For the multiple cloud layer case, your fig 2c looks very different than fig 12 in Tie et al, though.

Use "the standard scheme" or "the old scheme", but be consistent throughout the paper including Figure legends and captions (e.g. figs 3 & 4).

page 360, line 6-7 - You showed Fig.7 but did not comment on it at all.

page 360, line 19-20 - "subtracting A from B" - do you really mean "subtracting B from A"?

page 361, line 5-7 - Please comment on " a much larger effect on OH (80-88% for LIN) using FTUV by Tie et al. (2003b)". You found a ˜2.5% effect in this study. How can the difference so huge?

Fig.1 - this figure shows the total cloud optical depths, but one would expect that on a global scale the cloud impact on photolysis also depends on where the clouds are located in the vertical. What does the ECMWF cloud distribution (in the vertical) look like? Consider adding a figure. How does it relate to the results of this study?

3). Technical corrections:

section 2.3 (line 15-25) - change "optical depths" to "cloud optical depths".

section 2.3 (line 24) - what is "IFS"? Spell out.

p351: say "equation (1)" or "the Slingo and Schrecker equation", instead of "the Slingo equation".

p353: "comparable to those presented in Fig. 1a of Liu et al. (2006)" - did you mean Fig.7?

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p356, line 5: remove "is".

p357, line 20: Which figure are you referring to here? You just discussed Table 1 in the previous paragraph.

P362: change "improvemens" to "improvements".

Table 2: use "(20S, 20N)" instead of "(-20, 20)", etc.

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