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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Clouds, photolysis and regional tropospheric ozone budgets" *by* A. Voulgarakis et al.

Anonymous Referee #2

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This is a scientifically sound paper, presenting global model simulations with a chemistry transport model to investigate the impact of clouds on tropospheric chemistry with focus on the photolysis of ozone and nitrogen dioxide, on ozone budget and on hydroxyl radical concentrations. It also investigates the importance of clouds relative to other parameters that affect photolysis rates in the atmosphere.

The results are thoroughly discussed and improve our current understanding of the tropospheric processes. They point to the higher importance of the changes in downward ozone transport from the free troposphere to the boundary layer ozone increase than of the reduction in the ozone chemical loss rates below clouds. They also point to the cloud spatial distribution as a stronger driver for tropospheric composition changes than the cloud water content.

The paper is worth publication in ACP after improvements in the following points : For the ozone budget terms regional breakdown the authors use 20 N and 20 S as boundaries for the tropics and not the 30N, 30S where the subtropics are located? Could the authors explain their choice?

Page 13890, line 17: via which procedure clouds affect isoprene – needs to be mentioned in the abstract.

Page 13890, lines 21-23: rephrase: large sensitivity of what.

Page 13892, line 10: clarify difference between 'net chemical production of ozone' term commonly used in chemical modeling and 'net chemical tendency of ozone' used here throughout the manuscript.

Page 13891, line18: difference: explicitly mention if it is positive or negative.

Page 13891, Line 19: remove 'existing'

Page 13891, line21: what about the role of precipitation?

Page 13893, Line 222 (title of section 3): is it only the shortwave radiative effect that is investigated?

Page 13894, lines 21-22: Conditions under which this direct link between the photolysis rate of ozone to oxygen 1D and hydroxyl radical is observed needs to be mentioned since recent publications by Lelieveld et al. (2008) and Hofzumahaus et al. (2009) have shown that other pathways can also be important for hydroxyl radical formation.

Page 13896, line 8: 'reflections occur' move it earlier after 'where'

Page 13900, line 21: ' the the'

Page 13901, line 17: briefly explain why the scenario of total overhead ozone reduction has been chosen for investigation and not of an increase.

Page 13902, line 10: 'changes . . . is' correct

Table 2 caption: last line: is the percent difference (REF-NOCL) to the REF case ? clarify.

References:

A. Hofzumahaus, F. Rohrer, Keding Lu, B. Bohn, T. Brauers, C.-C. Chang, H. Fuchs, F. Holland, K. Kita, Y. Kondo, X. Li, S. Lou, M. Shao, L. Zeng, A. Wahner, Y. Zhang, 2009: Amplified Trace Gas Removal in the Troposphere, Science: Vol. 324. no. 5935, pp. 1702 – 1704 DOI: 10.1126/science.1164566

J. Lelieveld, T. M. Butler, J. N. Crowley, T. J. Dillon, H. Fischer, L. Ganzeveld, H. Harder, M. G. Lawrence, M. Martinez, D. Taraborrelli & J. Williams, 2008: Atmospheric oxidation capacity sustained by a tropical forest, Nature 452, 737-740 | doi:10.1038/nature06870.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 13889, 2009.