Atmos. Chem. Phys. Discuss.,
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Kinetics of the $OH + NO_2$ reaction: Effect of water vapour and new parameterisation for global modelling" *by* Damien Amedro et al.

Anonymous Referee #3

Received and published: 29 December 2019

See attached

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2019-1103/acp-2019-1103-RC3-supplement.pdf

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2019-1103, 2019.

Review of Amedro et al

This manuscript presents the first study of the effectiveness of H_2O as a third body on the recombination of OH with NO_2. This careful experimental study shows that water vapor is much more effective than N_2 or O_2 in causing recombination. It also presents a global modeling study of a new parameterization of the OH + NO_2 reaction as compared to the IUPAC and JPL recommendations; this parameterization uses the results of a previous study showing that O_2 and N_2 have different efficiencies in quenching the products of OH + NO_2. The modeling suggests that HOONO could be a non-negligible reservoir of NOx in some parts of the atmosphere. This is a very important paper that is clearly in the scope of ACP. There are no major problems with the manuscript, but a few of points should be clarification or emphasized more strongly before publication in ACP.

My major concern about this manuscript is actually rather minor: In the global modeling, it is not clear how much of the affects of the new parameterization, occurs due to water vapor and how much due to the use of the results of the author's previous paper on N_2 vs O_2 as colliders. This should be made clear.

The enhancement of the quenching of the energized HNO_3 intermediate (HNO_3*) due to H_2O vapor is presumably due to the strong hydrogen bonding between the two (stronger than OH-H_2O or NO_2-H_2O). It would be good to make this explicit and add some references to the literature on the $HONO_2$-HOH complex.

There must be previous field work measuring [NO2]/[$HONO_2$] and corresponding modeling work that did or did not find discrepancies. It seems that the authors should refer discuss a few of these, at least briefly.

Minor Issues:

Line 12: "molecule" is missing an "l"

Line 45: "being" should be "is"

Line 50-52. The sentence beginning "Theoretical calculations…" might better appear immediately after the discussion of the chaperone mechanism, rather than after the introduction of enhanced collider gases.

line 68 "prevented" should be "preventing"

line 75: "in Tables 1 and 2." might better be phrased as "in the notes to Tables 1 and 2."

It might help orient readers if the manuscript provided some idea of the conditions under which the OH + NO2 → HONO2 is nearly in the low-pressure limit and high-pressure limit.

Line 102: The manuscript states that the low vapor pressure of water prevents it from being used as a bath gas by itself, but 5 Torr of water vapor is roughly equivalent of 50 Torr of He. So I

Fig. 1.