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## ***Interactive comment on “The HNO<sub>3</sub> forming branch of the HO<sub>2</sub>***

***+NO reaction : pre – industrial – to –***

***present trends in atmospheric species and radiative forcings” by O. A. Svdeet al.***

### **Anonymous Referee #1**

Received and published: 6 July 2011

#### General comments:

The authors explore the implications of including the HNO<sub>3</sub> forming branch of the reaction HO<sub>2</sub>+NO, using the Oslo CTM2. The results are broadly similar to those published by Cariolle et al, 2008. In addition to Cariolle et al, the authors calculate the impact of including this reaction channel on radiative forcing due to changes in O<sub>3</sub> since pre-industrial times. The study demonstrates the significance of including this branch in their 3D chemistry-transport model, and suggests that further studies should be carried out to assess the impacts. However the validity of this HNO<sub>3</sub> forming branch will have to be confirmed by more laboratory studies before any certain conclusions can

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be drawn. I think this study will be suitable for publication in ACP after improvements to the manuscript and analysis, and modifications of appropriate texts. My suggestions/comments are as detailed below.

Specific comments:

(1) This paper is lacking a detailed analysis of the ozone budget (i.e., the global annual chemical production and loss, STE, the tropospheric ozone burden – as the impact seems to be mainly in the troposphere). Hopefully, by obtaining this information more light will be shed on the interplay between different processes under the scenarios with and without including the HNO<sub>3</sub>-forming branch, and on certain differences between the results presented in this study and those of Cariolle et al (2008). This may also help to explain why the Oslo CTM2 has a high-ozone bias in the upper troposphere.

(2) The budget calculations should apply to not only the runs for 2000 but also to those for pre-industrial times. Assessing the response of including the HNO<sub>3</sub>-forming branch in the pre-industrial condition will provide valuable information on how such a change impacts a very different atmosphere in terms of NO<sub>x</sub> loading, and to explain the impact on the ozone trend.

(3) In section 4.1 on “Modelled and measured O<sub>3</sub>”, the authors display comparisons between modelled monthly mean total ozone columns from R2\_2000 run and TOMS (fig. 5); the agreement seems reasonable. However the authors should also display the same plots from REF\_2000 run (or the difference between R2\_2000 and RE\_2000) to show the effect of including the HNO<sub>3</sub>-forming branch.

(4) The figure caption of Fig 5 is wrong; it should be “monthly mean total column of ozone”.

(5) At the end of Section 4.1, the authors should be specific about which region the “significant improvement in the model’s ability . . .” occur in.

(6) Page 14814, line 15: please rephrase the sentence ‘. . . and concluded without

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much discussion . . .” I guess, in this case, the authors of Cariolle et al (2008) might not want to speculate on what they are not sure about.

(7) The last 3 paragraphs of Section 4.2 should be deleted or rewritten. For example, There is no basis for the assertion that small increases of surface or lightning NO<sub>x</sub> emissions would change significantly the conclusion of the Cariolle study. This is pure speculation as there is no sensitivity study even with the authors’ own model. There are many processes that could potentially make model results “worse” or “better”. Model evaluations should not be based on including/excluding one parameter, especially when the models have certain biases (often they do). Here the authors should prompt a more comprehensive model-intercomparison study to understand different responses and interactions between and within the models.

(8) In section 5 on “Radiative forcing”, the authors only displayed modified changes of ozone and RF between PI and 2000, as a result of including the HNO<sub>3</sub> forming branch. It would be useful to also show the differences in RF between REF\_PI and REF\_2000 or R2\_PI and REF\_PI.

(9) In conclusion, the authors should point out that a multi-model study would be useful to determine the effect of including the HNO<sub>3</sub> forming branch.

Technical corrections:

p14802, line 2: change “atmospheric O<sub>3</sub>” to “tropospheric O<sub>3</sub>”

p14802, line 6: it is unclear how this can affect the climate significantly. Suggest to replace “climate” with “radiative forcing”.

In the abstract, please also state how much the modelled ozone changes due to the inclusion of the HNO<sub>3</sub> forming branch.

p14802, line 24: replace “major source of O<sub>3</sub>” with “major source of photochemically produced ozone in the troposphere”

p14806, line 20: should be “new reaction”, typo

p14810, line 6: delete one “the”

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 14801, 2011.

ACPD

11, C6029–C6032, 2011

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