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Impact of the new HNO_3-forming channel of the HO_2+NO reaction on tropospheric HNO_3, NO_x, HO_x and ozone

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Abstract. We have studied the impact of the recently observed reaction $NO+HO_2 \rightarrow HNO_3$ on atmospheric chemistry. A pressure and temperature-dependent parameterisation of this minor channel of the $NO+HO_2 \rightarrow NO_2+OH$ reaction has been included in both a 2-D stratosphere-troposphere model and a 3-D tropospheric chemical transport model (CTM).

Significant effects on the nitrogen species and hydroxyl radical concentrations are found throughout the troposphere, with the largest percentage changes occurring in the tropical upper troposphere (UT). Including the reaction leads to a reduction in NO_x everywhere in the troposphere, with the largest decrease of 25% in the tropical and Southern Hemisphere UT. The tropical UT also has a corresponding large increase in HNO_3 of 25%. OH decreases throughout the troposphere with the largest reduction of over 20% in the tropical UT. The mean global decrease in OH is around 13%, which is very large compared to the impact that typical photochemical revisions have on this modelled quantity. This OH decrease leads to an increase in CH_4 lifetime of 5%. Due to the impact of decreased NO_x on the OH:HO_2 partitioning, modelled HO_2 actually increases in the tropical UT on including the new reaction. The impact on tropospheric ozone is a decrease in the range 5 to 12%, with the largest impact in the tropics and Southern Hemisphere. Comparison with observations shows that in the region of largest changes, i.e. the tropical UT, the inclusion of the new reaction tends to degrade the model agreement. Elsewhere the model comparisons are not able to critically assess the impact of including this reaction. Only small changes are calculated in the minor species distributions in the stratosphere.

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