



## Supplement of

## Spatially separate production of hydrogen oxides and nitric oxide in lightning

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**Figure S1.** The average NO<sub>x</sub> measured for the full 10-spark packet at each position in the flow tube for the experiments with no added NO. Error bars are the standard deviation from averaging the multiple measurements. Distance to the inlet is the distance from the opening of the Teflon tube that leads to the NO<sub>x</sub> analyzer to the discharge in the flow tube.



**Figure S2.** Laboratory decays of OH (A,B),  $HO_2$  (C,D), and net  $HO_x$  (E,F) at 770 hPa (A,C,E) and 570 hPa (B,D,F). The markers are the averaged data points containing 3 or 6 measurements from 1 or 2 decays in the laboratory experiments, respectively. The markers at time zero are the averaged extrapolated values from the decays. The lines on A,B,C,D are the linear fits to the individual decays. Error bars are the standard deviation from averaging the multiple laboratory measurements.



**Figure S3.** Average slopes for the OH (A) and  $HO_2$  (B) decays from the NO addition experiments at different pressures.



**Figure S4.** Average LNO<sub>x</sub> generated per spark in the laboratory experiments at different pressures and added NO amounts. Error bars are the standard deviations from multiple (19-20) measurements.



**Figure S5.** Comparison of measured OH (A,C) and HO<sub>2</sub> (B,D) laboratory decays and two model decays at 970 hPa and (A,B) 0 ppbv of added NO and (C,D) 50 ppbv of added NO. The dashed purple lines are the model decay with only the added NO, and includes no NO<sub>x</sub> from the spark, and the dotted green lines are the model decay with the added NO and all of the spark NO<sub>x</sub>. The blue circles are the average laboratory measurements and average extrapolated value at time zero, while the dashed-dotted blue lines are the individual extrapolated linear fits to the laboratory data. Error bars are the standard deviation from averaging multiple measurements.



**Figure S6.** Comparison of measured OH (A,C,E,G) and HO<sub>2</sub> (B,D,F,H) laboratory decays and two model decays at 570 hPa and (A,B) 0 ppbv of added NO, (C,D) 50 ppbv of added NO, (E,F) 100 ppbv of added NO, and (G,H) 250 ppbv of added NO. The dashed purple lines are the model decay with only the added NO, and includes no NO<sub>x</sub> from the spark, and the dotted green lines are the model decay with the added NO and all of the spark NO<sub>x</sub>. The blue circles are the average laboratory measurements and average extrapolated value at time zero, while the dashed-dotted blue lines are the individual extrapolated linear fits to the laboratory data. Error bars are the standard deviation from averaging multiple measurements.



**Figure S7.** Comparison of measured OH (A,C,E,G,I) and HO<sub>2</sub> (B,D,F,H,J) laboratory decays and two model decays at 360 hPa and (A,B) 0 ppbv of added NO, (C,D) 50 ppbv of added NO, (E,F) 100 ppbv of added NO, (G,H) 250 ppbv of added NO, and (I,J) 250 ppbv of added NO. The dashed purple lines are the model decay with only the added NO, and includes no NO<sub>x</sub> from the spark, and the dotted green lines are the model decay with the added NO and all of the spark NO<sub>x</sub>. The blue circles are the average laboratory measurements and average extrapolated value at time zero, while the dashed-dotted blue lines are the individual extrapolated linear fits to the laboratory data. Error bars are the standard deviation from averaging multiple measurements.



**Figure S8.** Comparison of measured OH (A,C,E,G) and HO<sub>2</sub> (B,D,F,H) laboratory decays and two model decays at (A,B) 970hP, (C,D) 770 hPa, (E,F) 570 hPa, and (G,H) 360 hPa. The dashed purple lines are the model decay including no NO<sub>x</sub> from the spark, and the solid yellow lines are the model decay including 3% the spark NO<sub>x</sub>. The blue circles are the average laboratory measurements and average extrapolated value at time zero, while the dashed-dotted blue lines are the individual extrapolated linear fits to the laboratory data. Error bars are the standard deviation from averaging multiple measurements.



**Figure S9.** Comparison of measured OH (A,C,E,G) and HO<sub>2</sub> (B,D,F,H) laboratory decays and two model decays at (A,B) 970hP, (C,D) 770 hPa, (E,F) 570 hPa, and (G,H) 360 hPa. The dashed purple lines are the model decay including no NO<sub>x</sub> from the spark, and the solid yellow lines are the model decay including 5% (970, 770, 570 hPa) or 10% (360 hPa) of spark NO<sub>x</sub>. The blue circles are the average laboratory measurements and average extrapolated value at time zero, while the dashed-dotted blue lines are the individual extrapolated linear fits to the laboratory data. Error bars are the standard deviation from averaging multiple measurements.



**Figure S10.** Comparison of measured OH (A,C,E,G) and HO<sub>2</sub> (B,D,F,H) laboratory decays and two model decays at (A,B) 970hP, (C,D) 770 hPa, (E,F) 570 hPa, and (G,H) 360 hPa. The dashed purple lines are the model decay including no NO<sub>x</sub> from the spark, and the solid yellow lines are the model decay including 3% the spark NO<sub>x</sub> and 10 s<sup>-1</sup> of OH reactivity. The blue circles are the average laboratory measurements and average extrapolated value at time zero, while the dashed-dotted blue lines are the individual extrapolated linear fits to the laboratory data. Error bars are the standard deviation from averaging multiple measurements.