

Supplementary Information for Chapter 4

List of Figures

S1.1	Flight plans of summer RONOCO flights	3
S1.2	Flight plans of SeptEx flights.....	4
S1.3	Flight plans of winter RONOCO flights	5
S1.4	Time series of altitude, HO ₂ , O ₃ , and NO ₃ during flight B534 (summer RONOCO)	6
S1.5	As above, for flight B535.....	6
S1.6	As above, for flight B536.....	7
S1.7	As above, for flight B537.....	7
S1.8	As above, for flight B538.....	8
S1.9	As above, for flight B539.....	8
S1.10	As above, for flight B541.....	9
S1.11	Time series of altitude, HO ₂ , OH, and O ₃ during flight B545 (SeptEx).....	9
S1.12	As above, for flight B546.....	10
S1.13	As above, for flight B547a.....	10
S1.14	As above, for flight B547b.....	11
S1.15	As above, for flight B548.....	11
S1.16	As above, for flight B549.....	12
S1.17	As above, for flight B550a.....	12
S1.18	As above, for flight B550b.....	13
S1.19	As above, for flight B552.....	13
S1.20	Time series of altitude, HO ₂ , O ₃ , and NO ₃ during flight B564 (winter RONOCO)..	14
S1.21	As above, for flight B565.....	14
S1.22	As above, for flight B566.....	15
S1.23	As above, for flight B567.....	15
S1.24	As above, for flight B568.....	16
S1.25	As above, for flight B569.....	16
S1.26	As above, for flight B570.....	17
S1.27	As above, for flight B571.....	17
S1.28	Schemes for reactions of O ₃ with alkenes.....	18–21

S1.29	Reaction schemes of O ₃ -initiated RO ₂ radicals yielding prompt HO ₂	22
S1.30	Reaction schemes of O ₃ -initiated RO ₂ radicals not yielding prompt HO ₂	23
S1.31	Rates of instantaneous production of HO ₂ from reactions of O ₃ and NO ₃ with alkenes during summer RONOCO flights	24
S1.32	Rates of instantaneous production of HO ₂ from reactions of O ₃ with alkenes during SeptEx flights	25
S1.33	Rates of instantaneous production of HO ₂ from reactions of O ₃ and NO ₃ with alkenes during winter RONOCO flights	26
S1.34	HO ₂ versus instantaneous rate of production of HO ₂ from reactions of O ₃ during winter RONOCO flights	27
S1.35	HO ₂ versus instantaneous rate of production of HO ₂ from reactions of NO ₃ during winter RONOCO flights	28

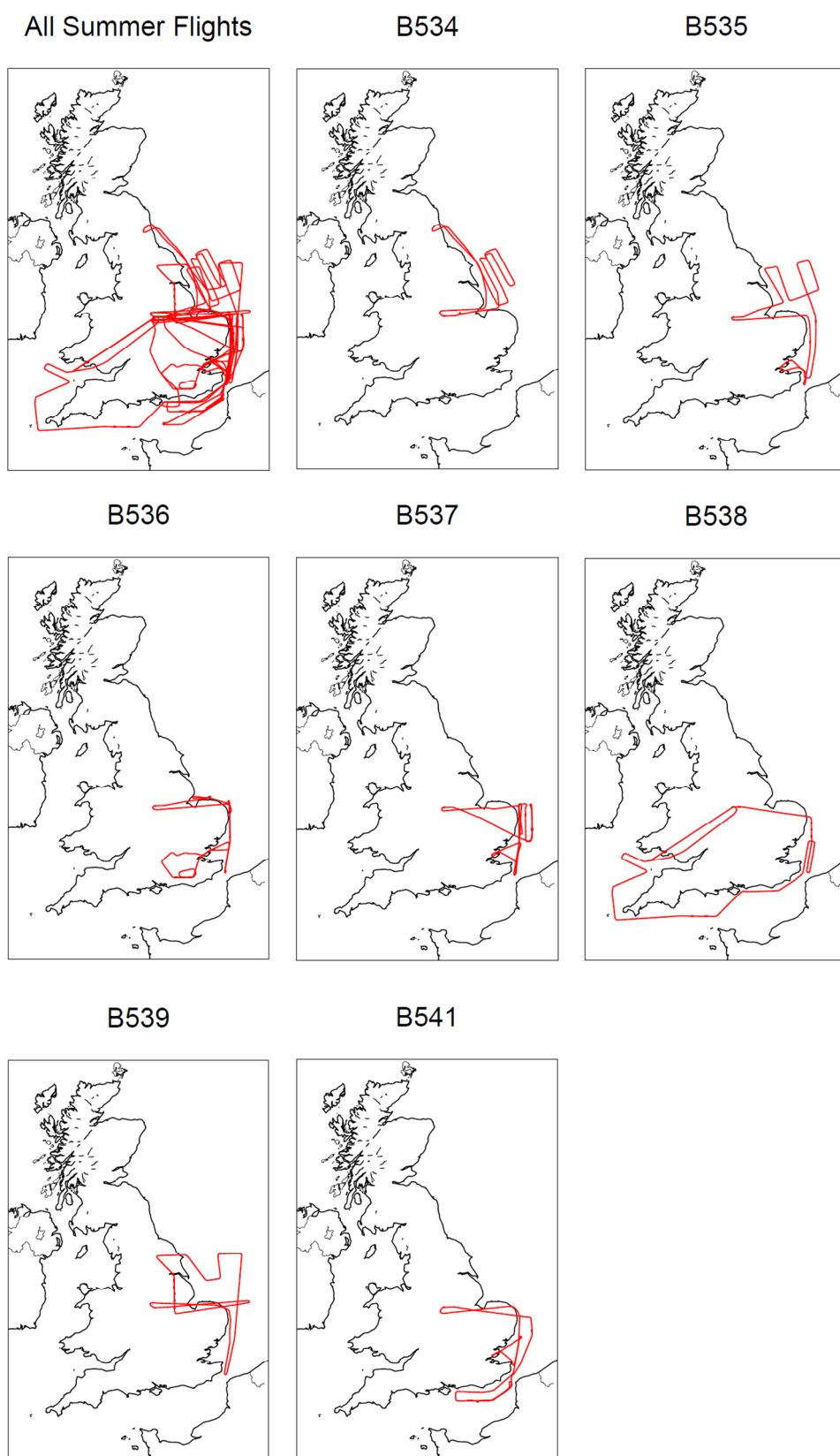


Figure S1.1. Flight plans of summer RONOCO flights. For details of each flight, see Table A1 in Appendix A.

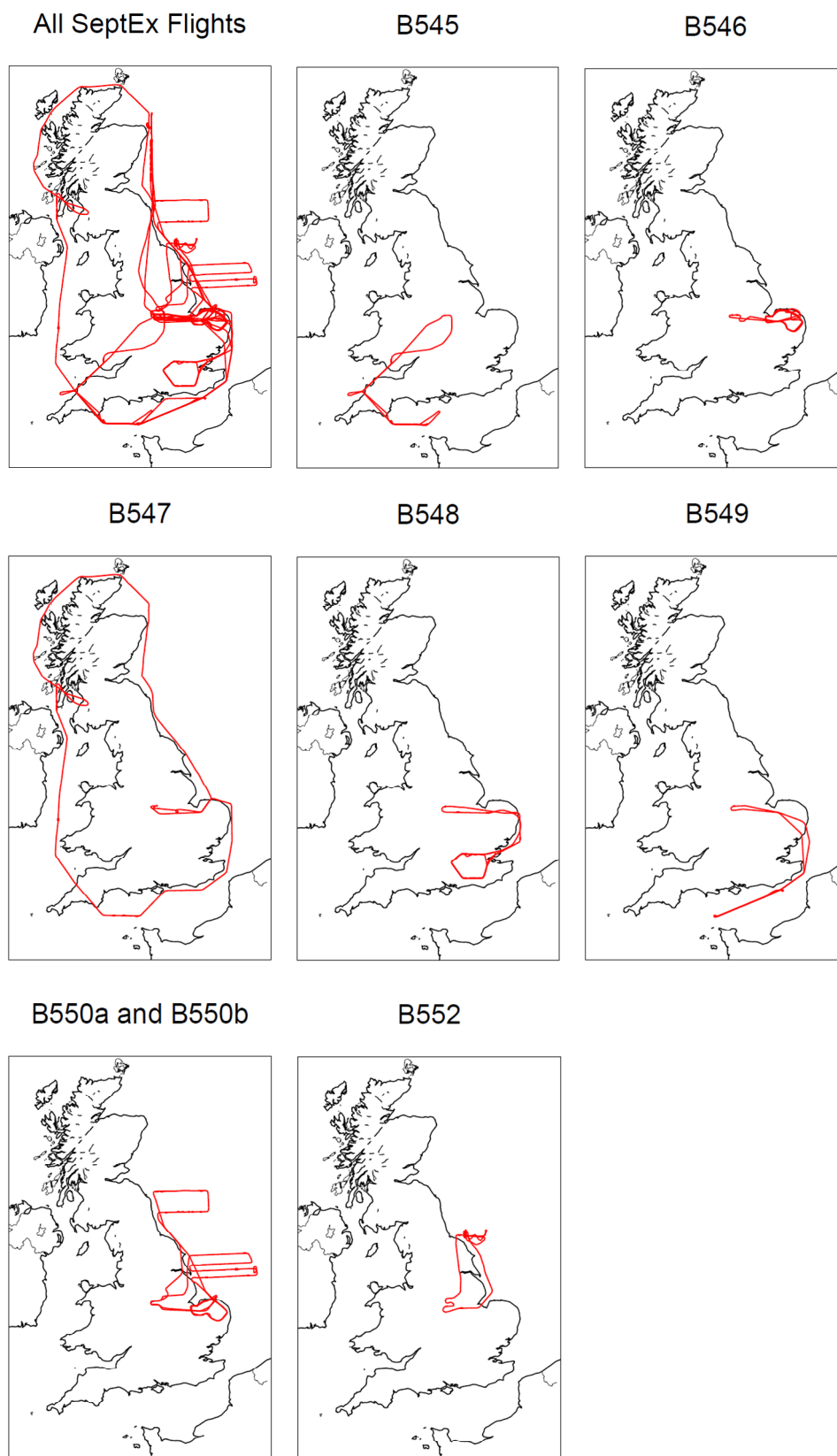


Figure S1.2. Flight plans of SeptEx flights. For details of each flight, see Table A2 in Appendix A.

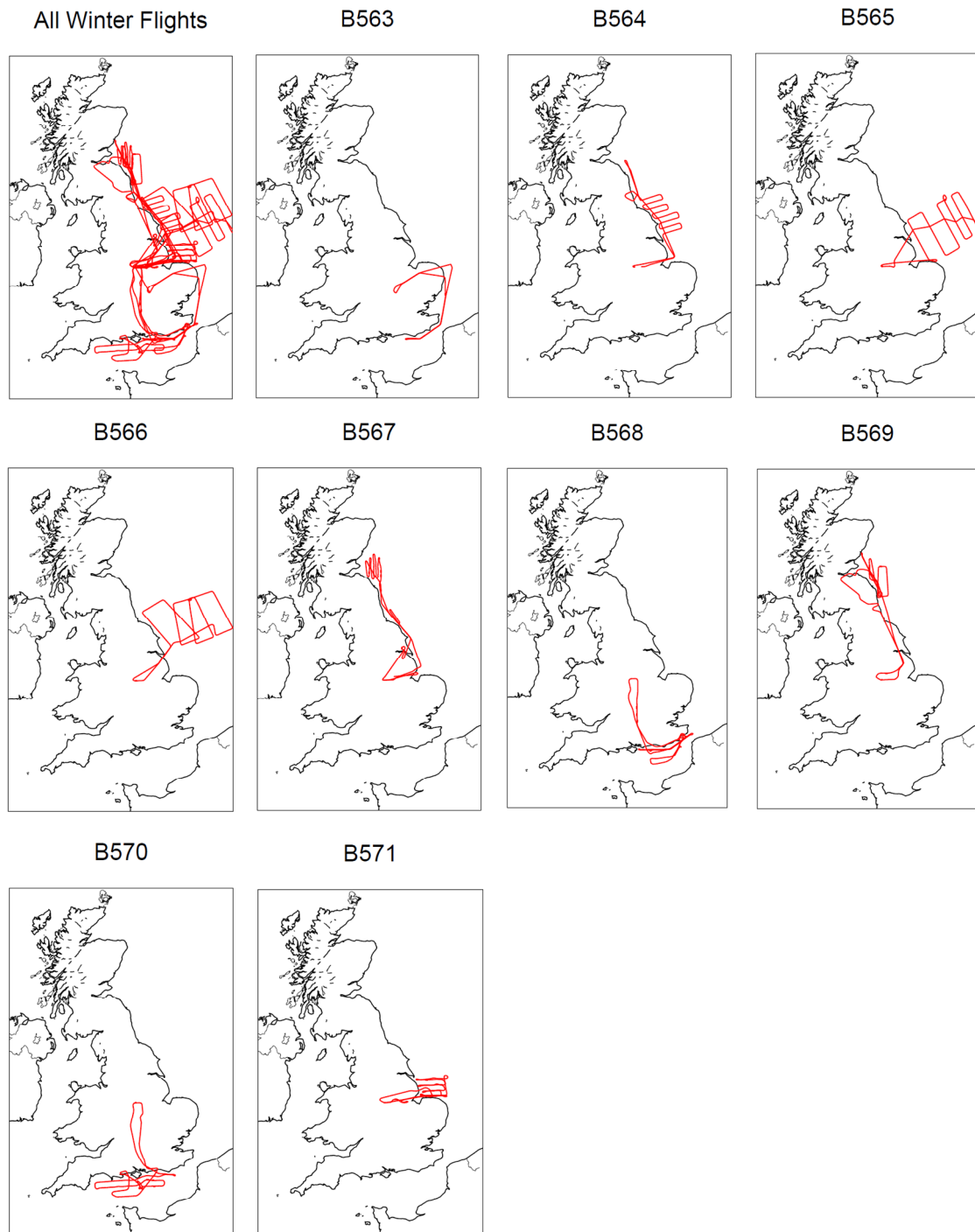


Figure S1.3. Flight tracks of winter RONOCO flights. For details of each flight see Table A3 in Appendix A.

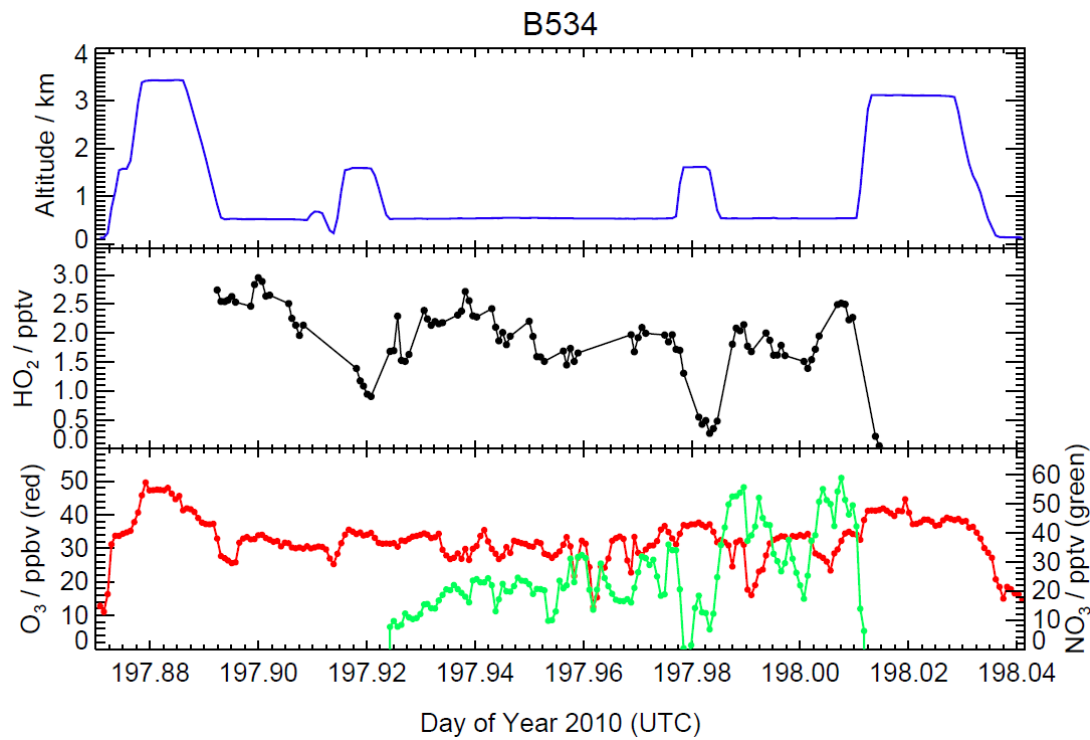


Figure S1.4. Flight B534 on 16th July 2010. HO₂ times series (middle panel, black) with altitude (top panel, blue), O₃ (bottom panel, red), and NO₃ (bottom panel, green).

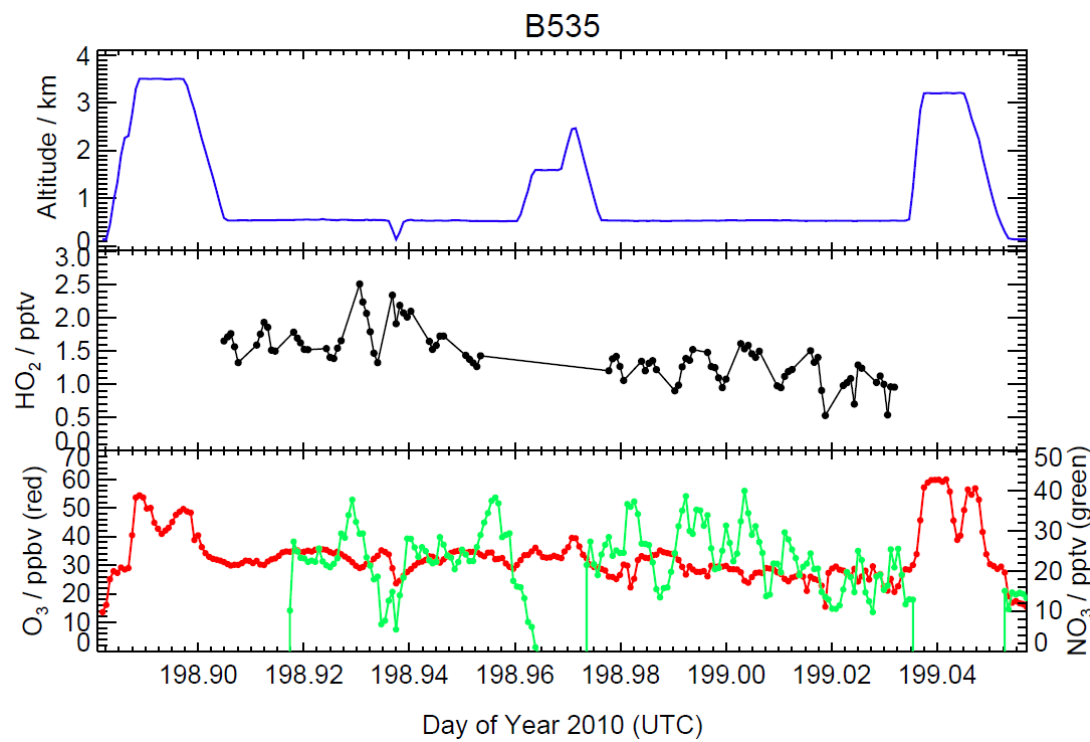


Figure S1.5. Time series as in Figure S1.4, for Flight B535 on 17th July 2010.

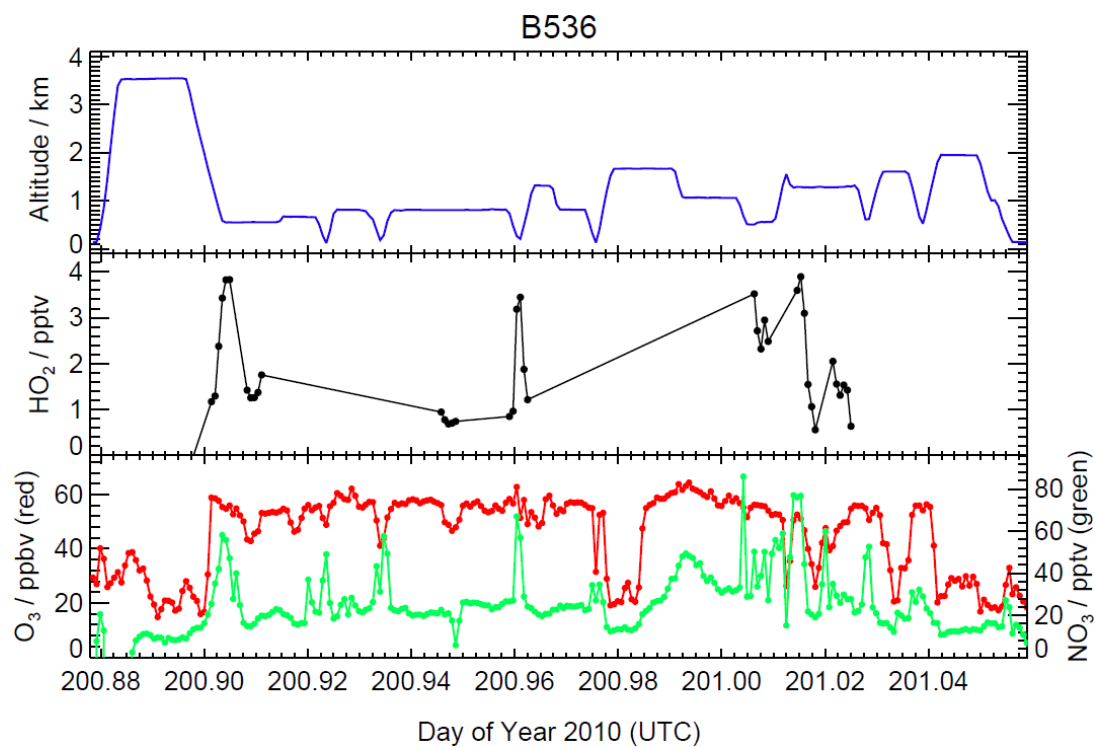


Figure S1.6. Time series as in Figure S1.4, for Flight B536 on 19th July 2010.

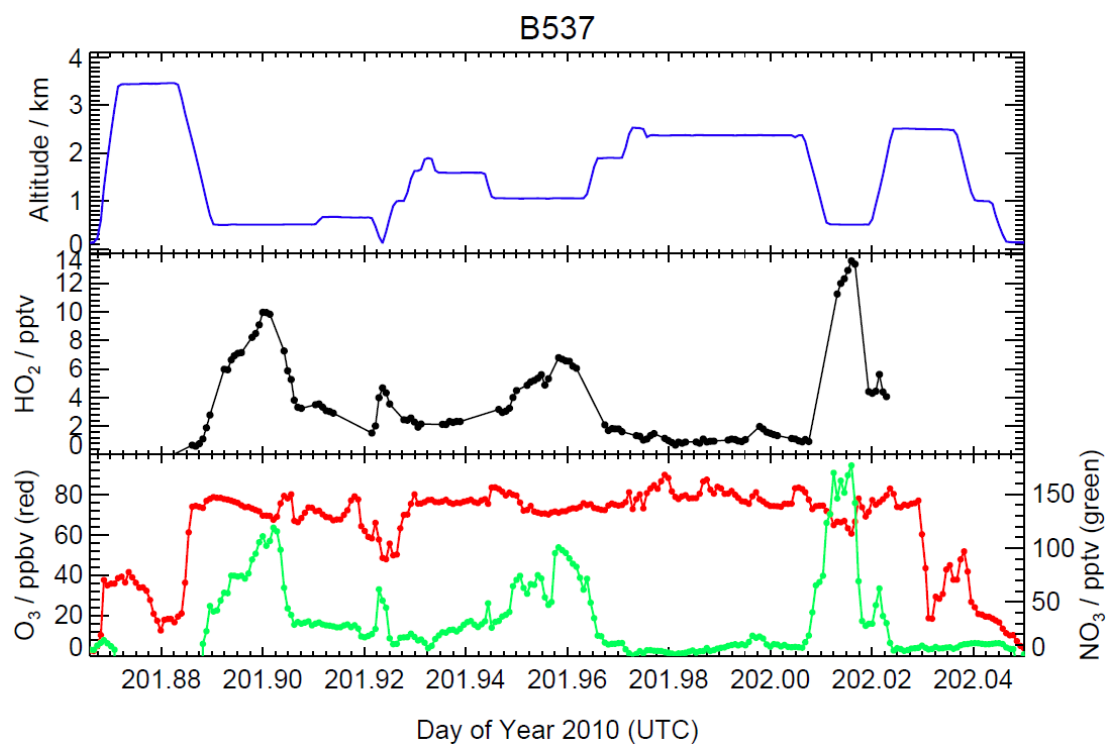


Figure S1.7. Time series as in Figure S1.4, for Flight B537 on 20th July 2010.

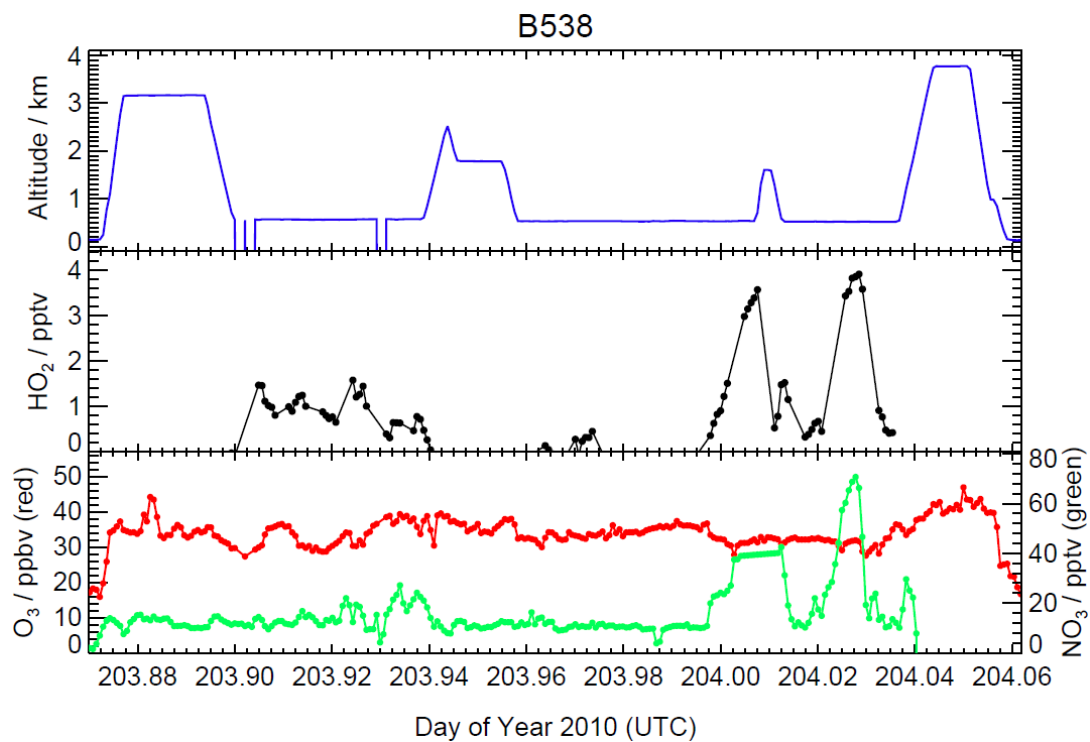


Figure S1.8. Time series as in Figure S1.4, for Flight B538 on 22nd July 2010.

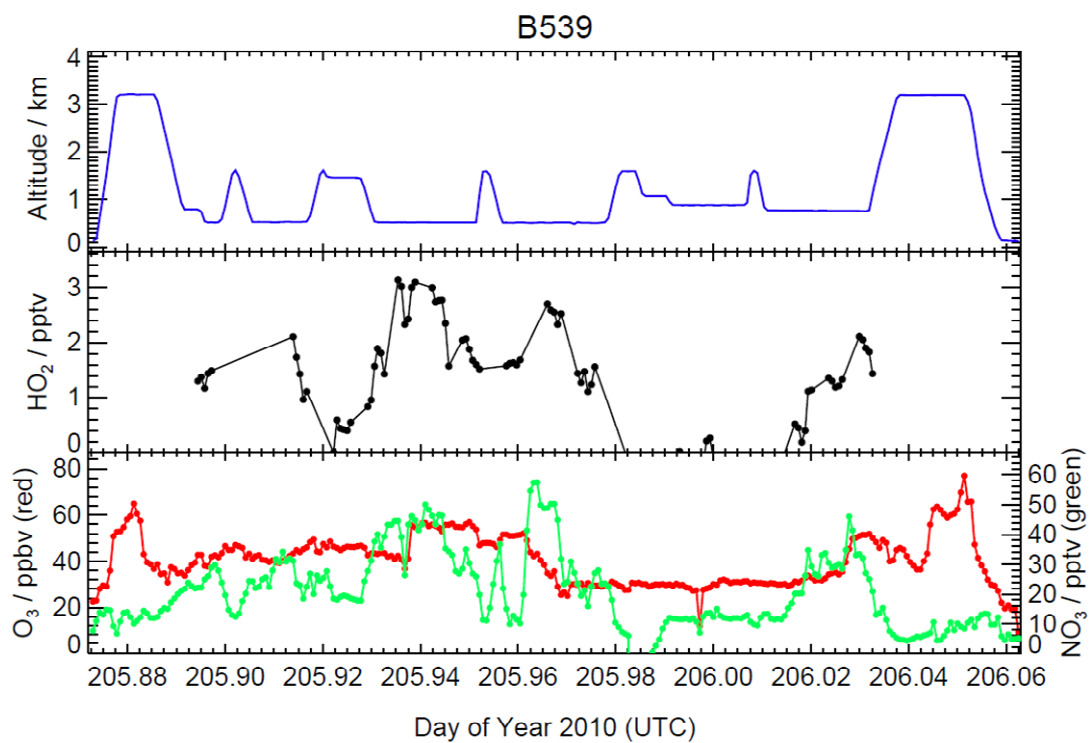


Figure S1.9. Time series as in Figure S1.4, for Flight B539 on 24th July 2010.

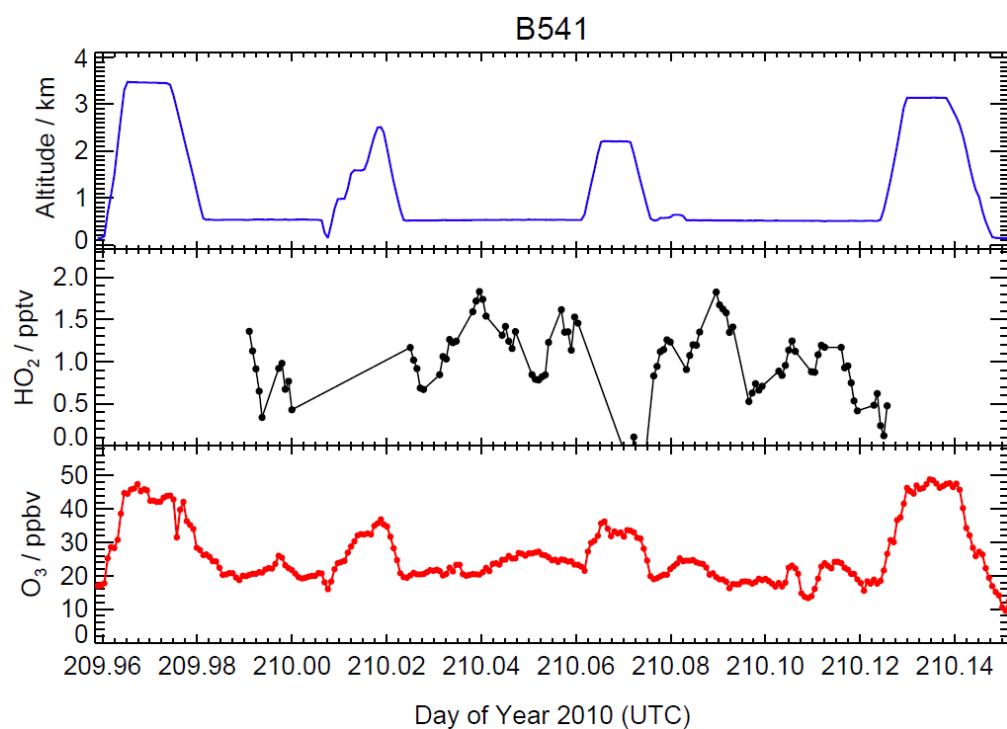


Figure S1.10. Flight B541 on 28th July 2010. HO₂ time series (middle panel, black) with altitude (top panel, blue), O₃ (bottom panel, red). NO₃ was not detected during this flight.

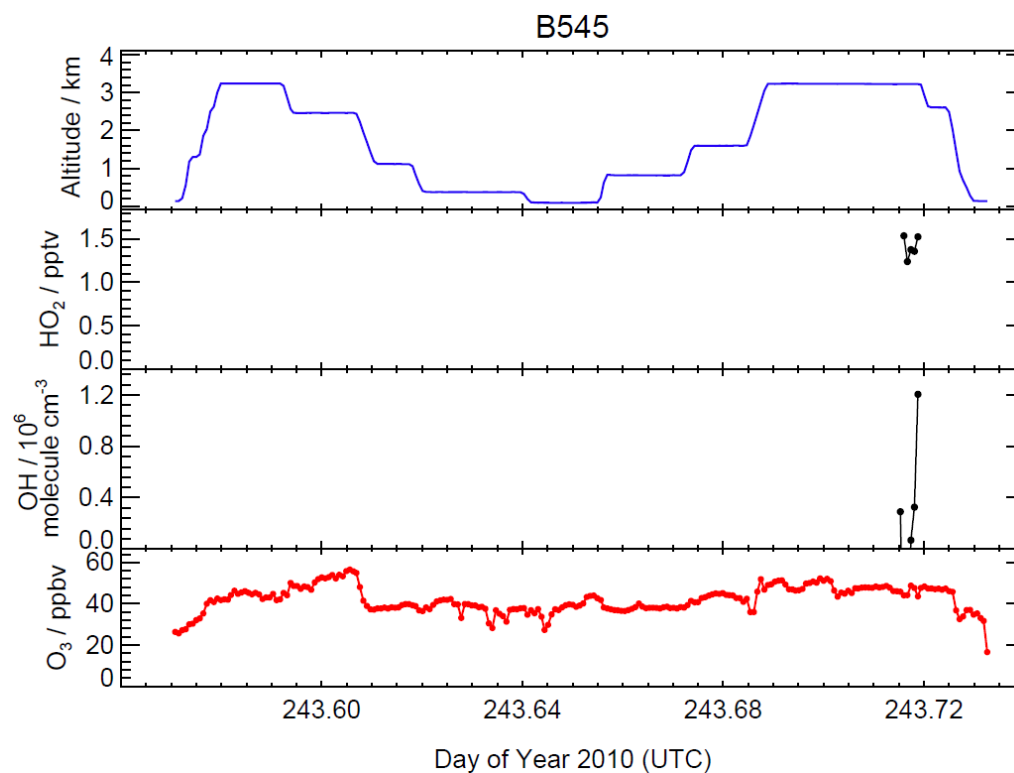


Figure S1.11. Flight B545 on 31st August 2010. HO₂ and OH time series (middle panels, black) with altitude (top panel, blue) and O₃ (bottom panel, red).

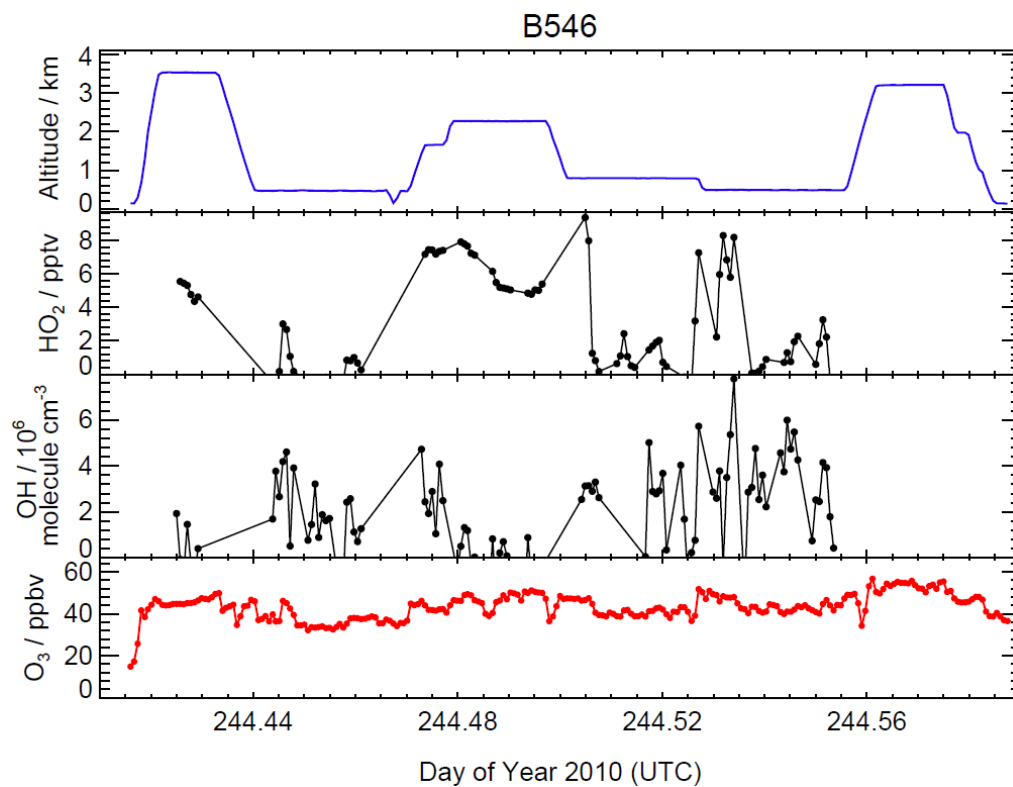


Figure S1.12. Time series as in Figure S1.11, for flight B546 on 1st September 2010.

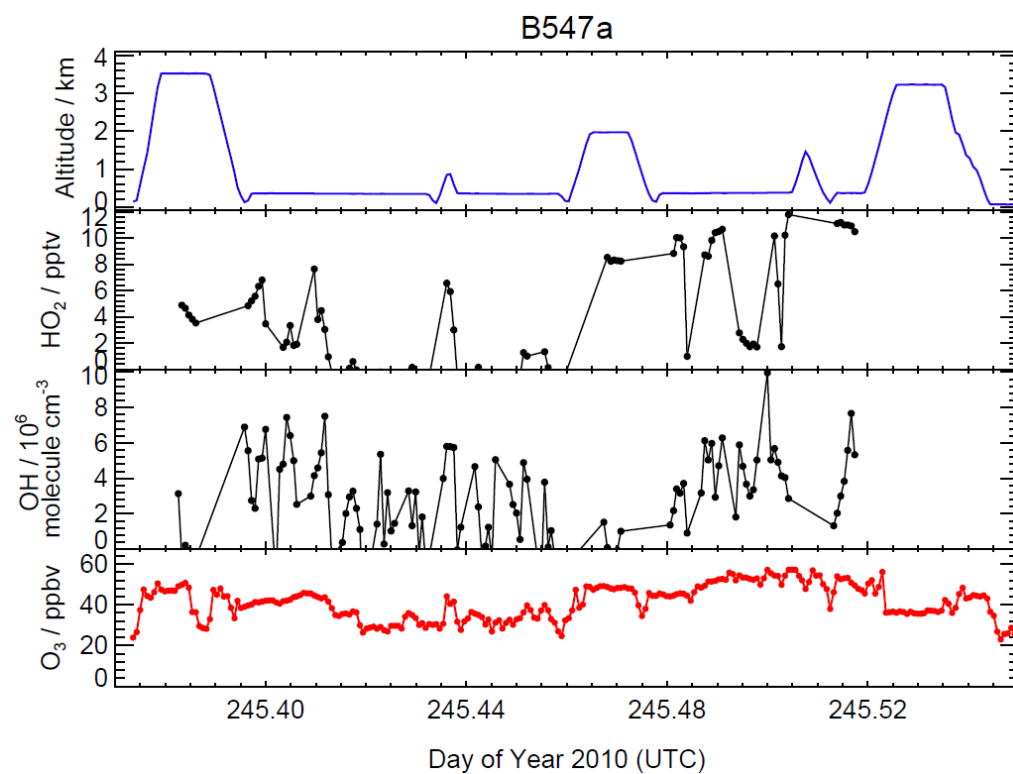


Figure S1.13. Time series as in Figure S1.11, for flight B547a on 2nd September 2010.

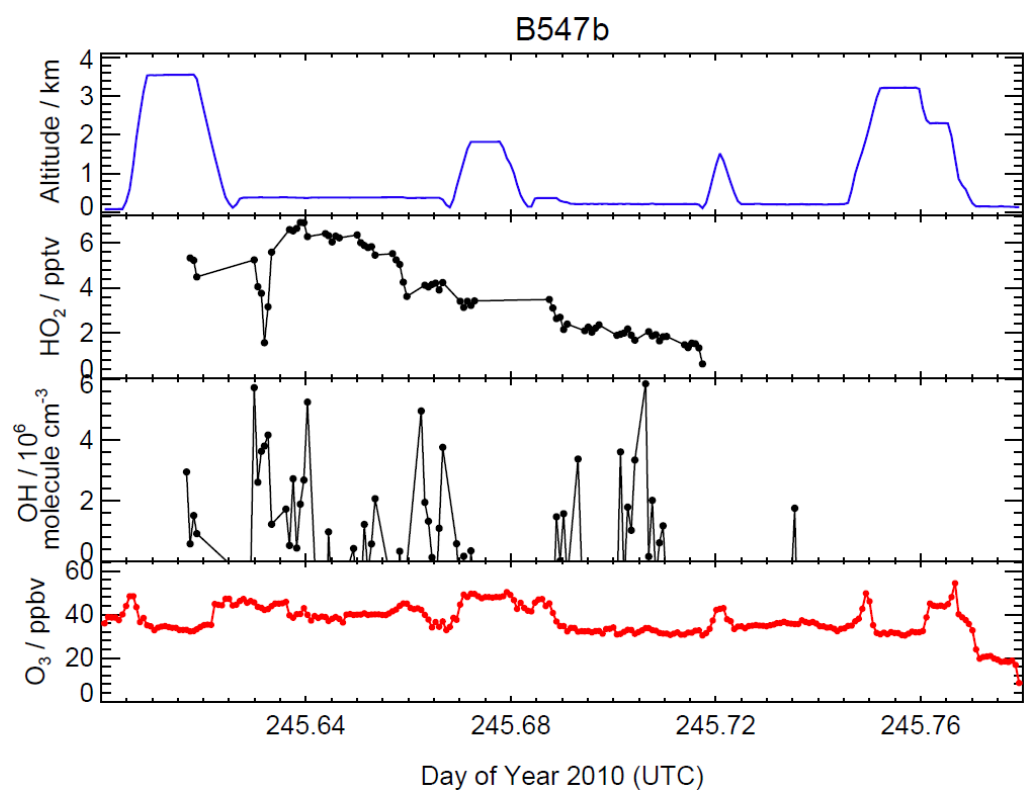


Figure S1.14. Time series as in Figure S1.11, for flight B547b on 2nd September 2010.

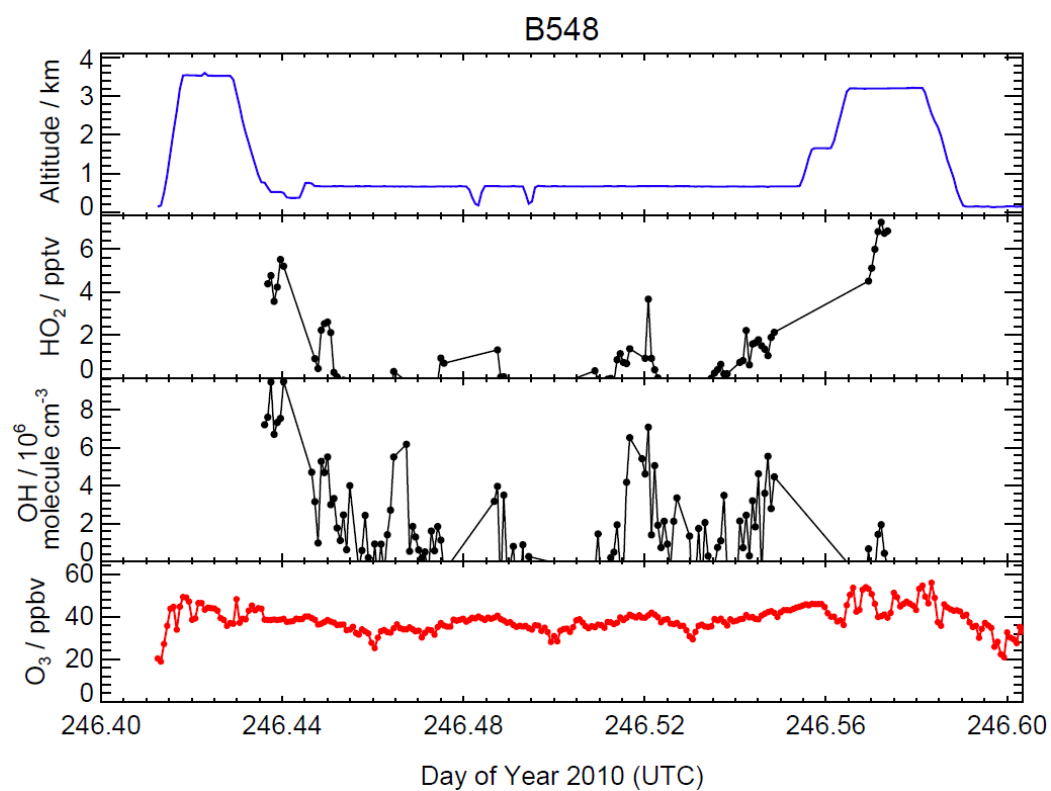


Figure S1.15. Time series as in Figure S1.11, for flight B548 on 3rd September 2010.

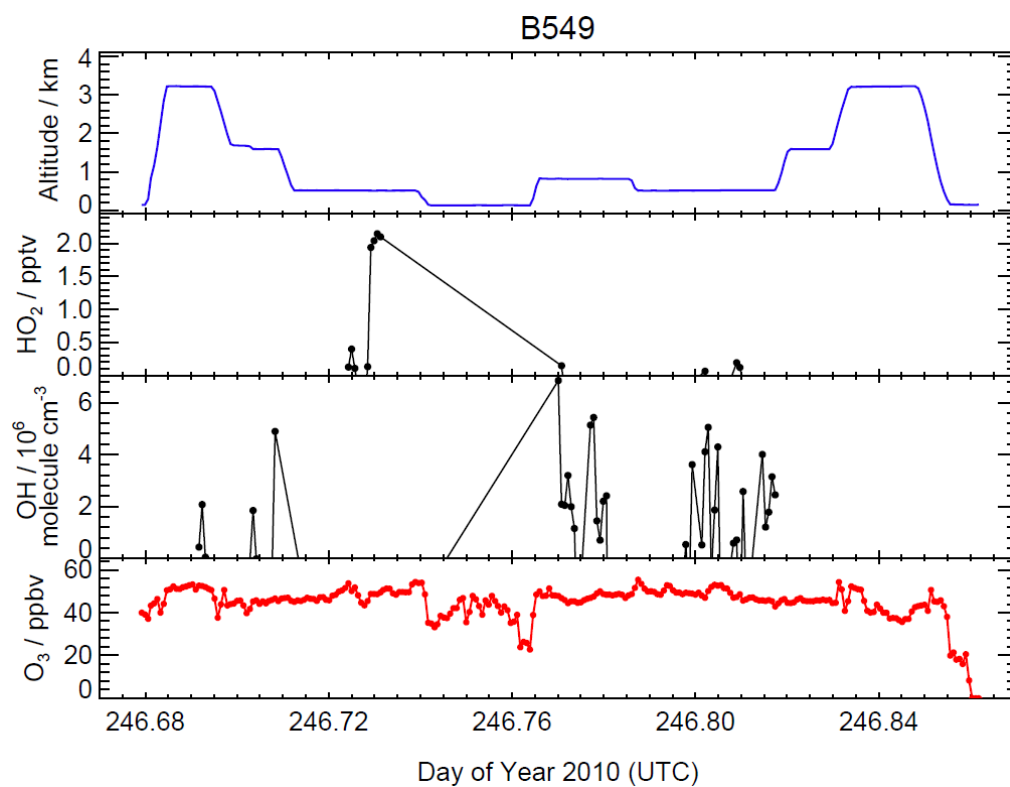


Figure S1.16. Time series as in Figure S1.11, for flight B549 on 3rd September 2010.

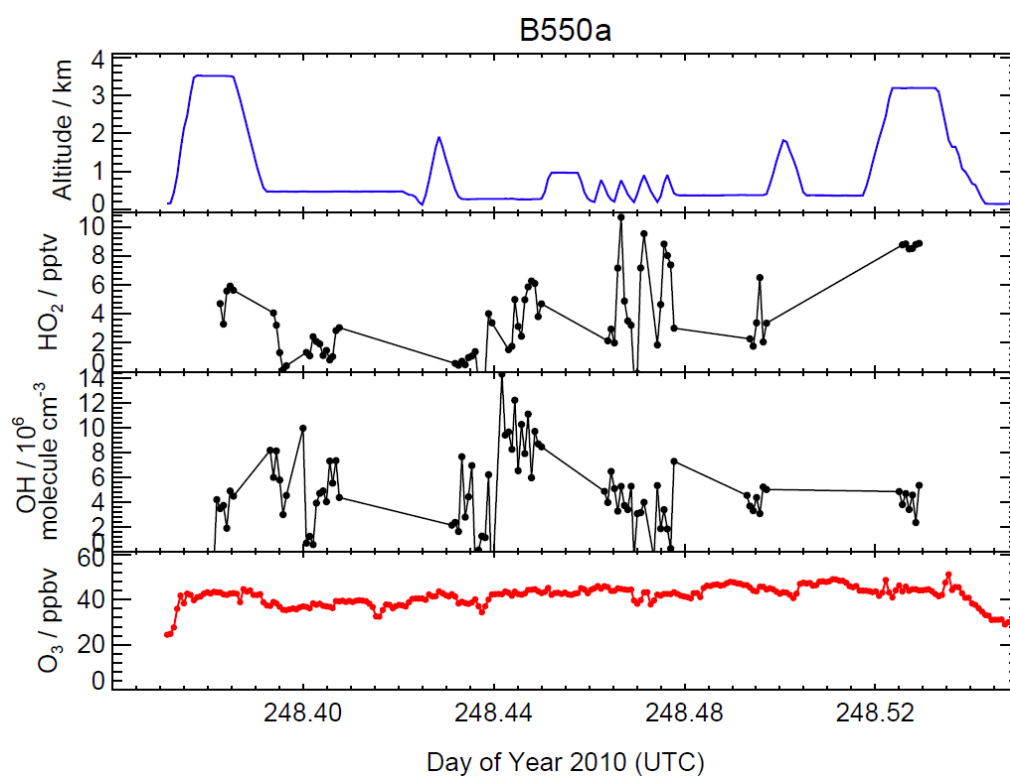


Figure S1.17. Time series as in Figure S1.11, for flight B550a on 5th September 2010.

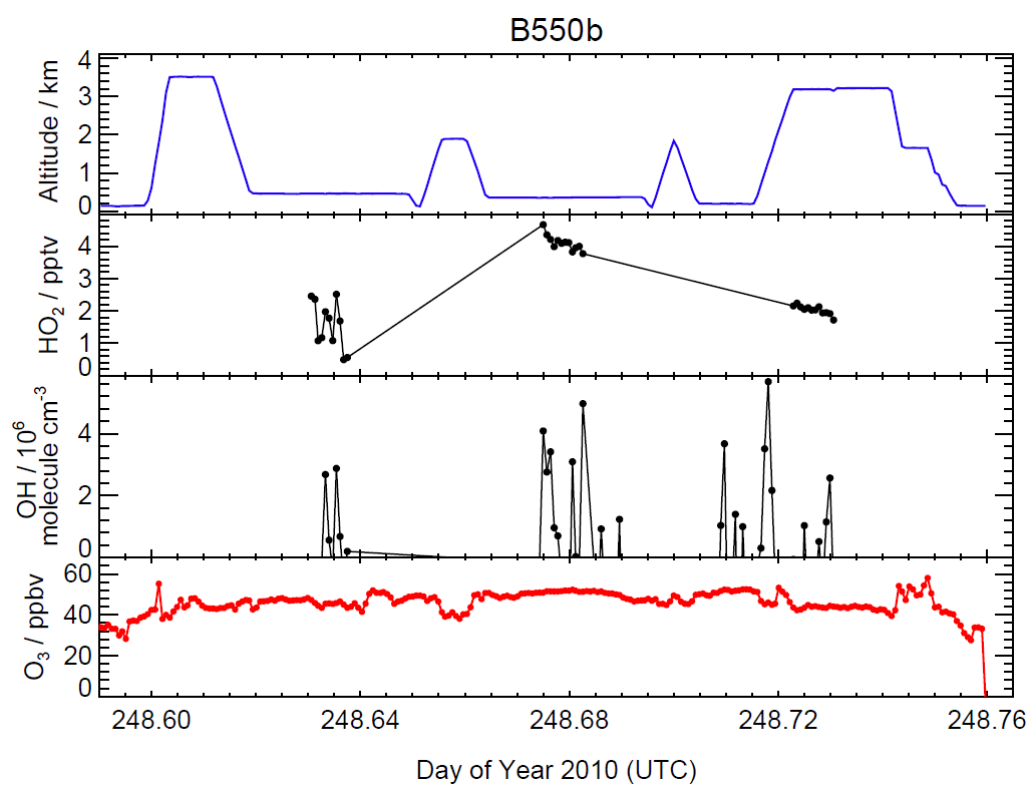


Figure S1.18. Time series as in Figure S1.11, for flight B550b on 5th September 2010.

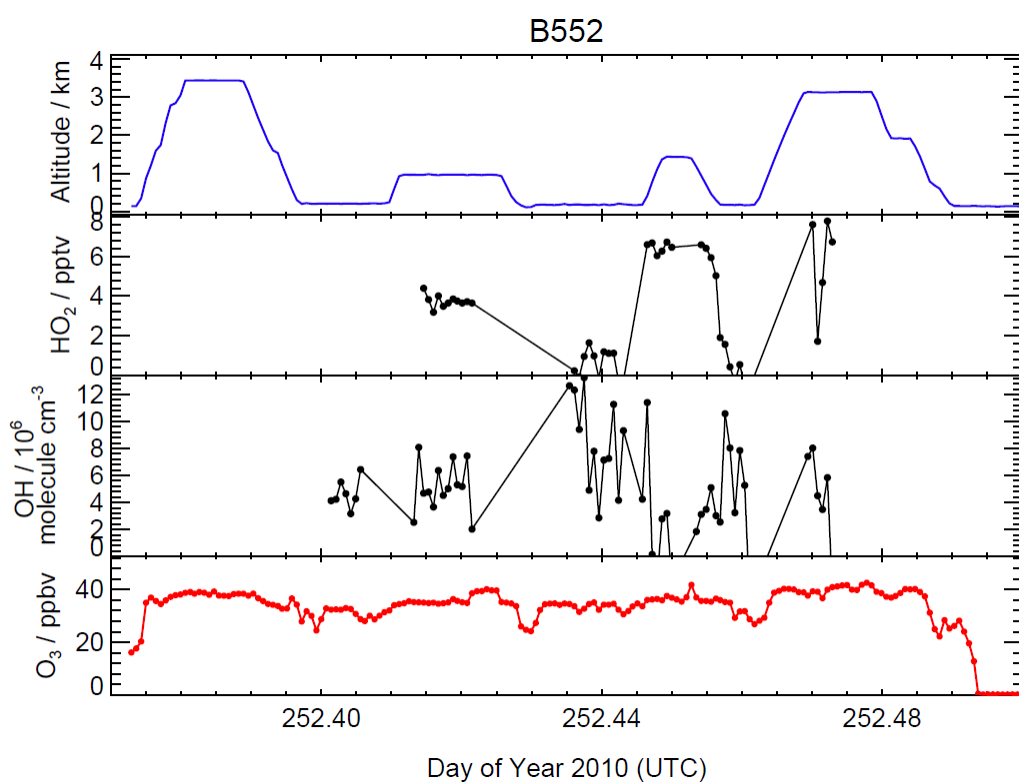


Figure S1.19. Time series as in Figure S1.11 for flight B552 on 9th September 2010.

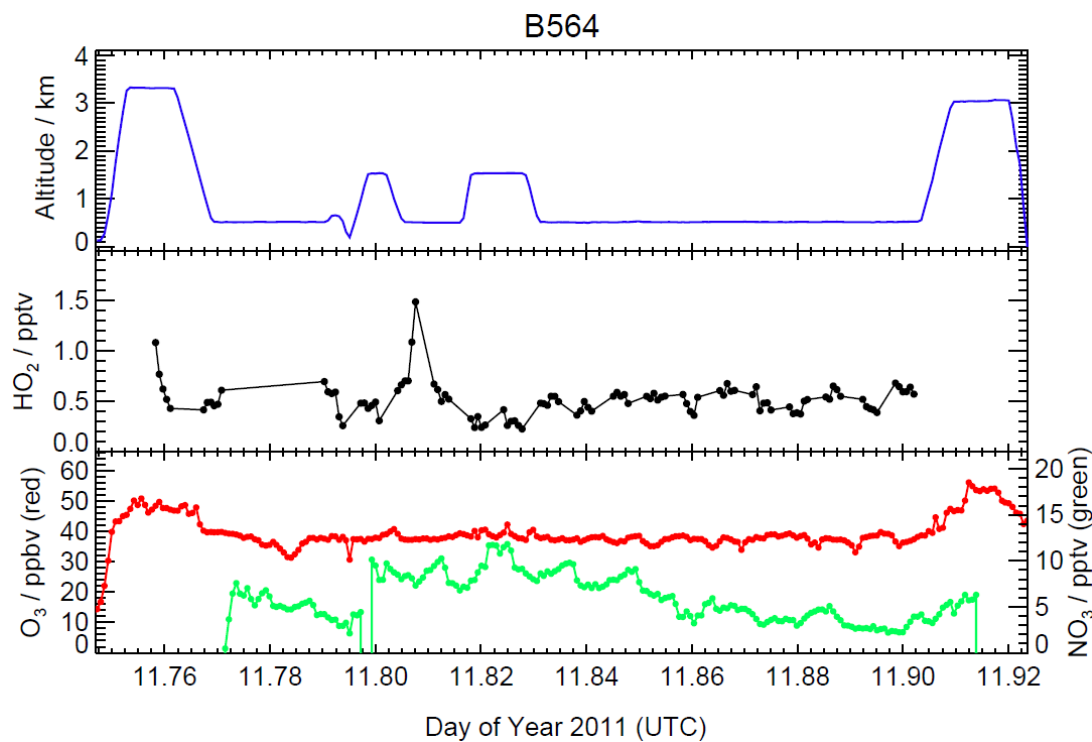


Figure S1.20. Flight B564 on 11th January 2011. HO₂ time series (middle panel, black) with altitude (top panel, blue), O₃ (bottom panel, red) and NO₃ (bottom panel, green).

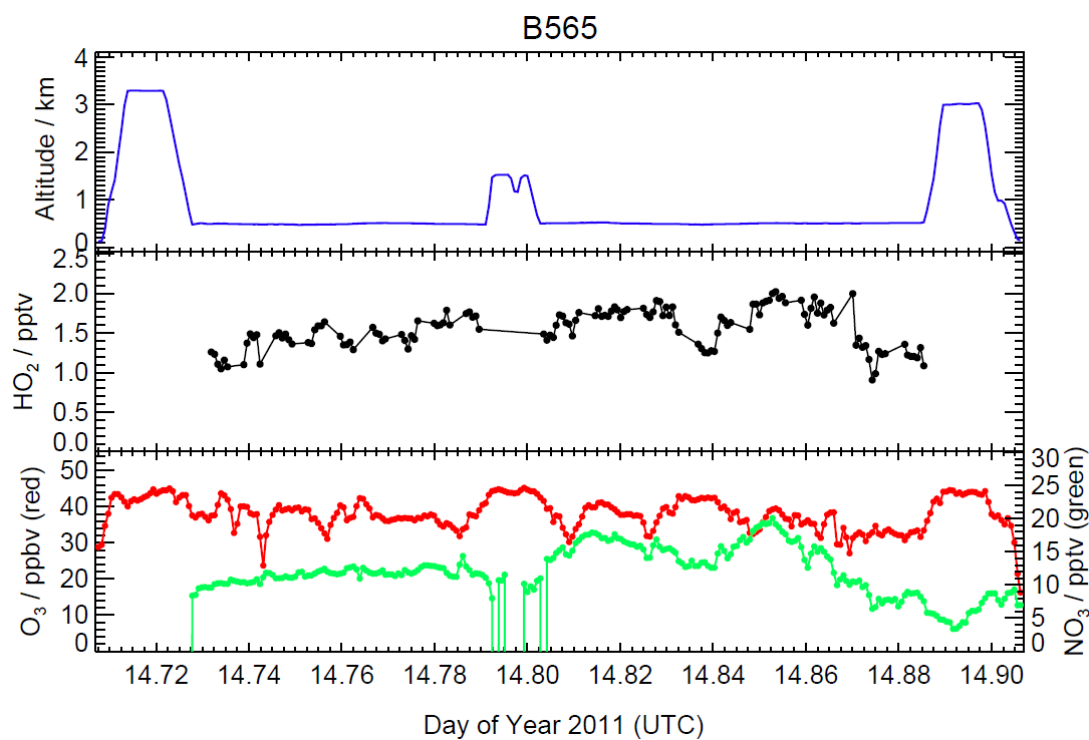


Figure S1.21. Time series as in Figure S1.20, for flight B565 on 14th January 2011.

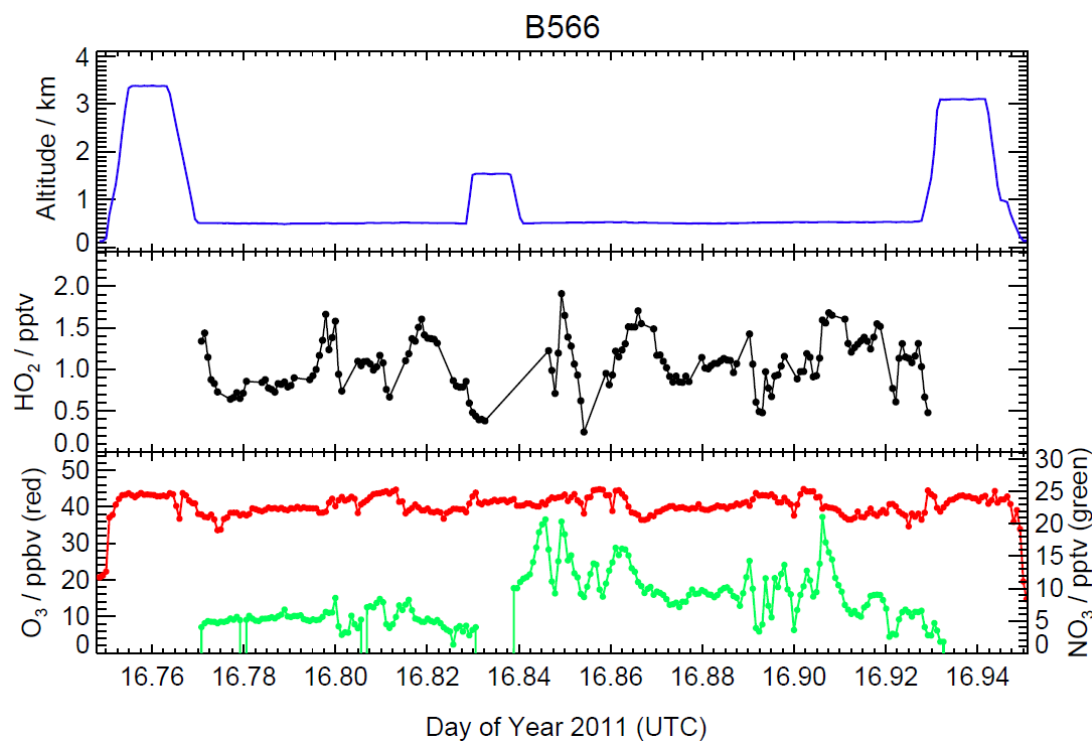


Figure S1.22. Time series as in Figure S1.20, for flight B566 on 16th January 2011.

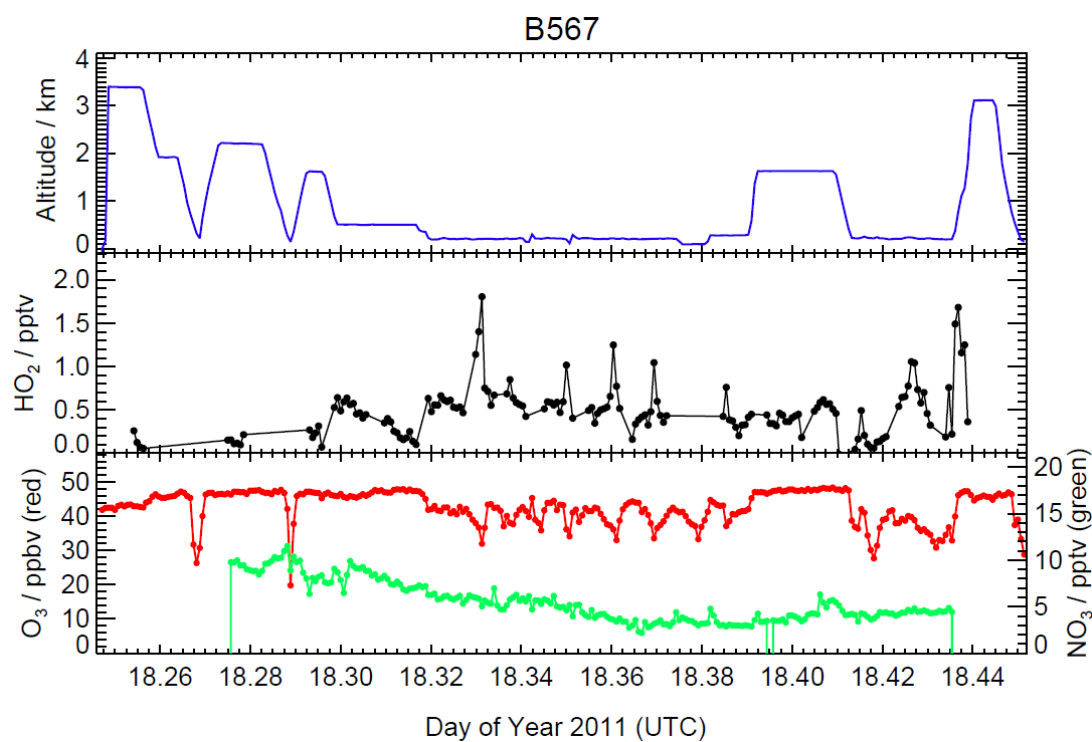


Figure S1.23. Time series as in Figure S1.20, for flight B567 on 18th January 2011.

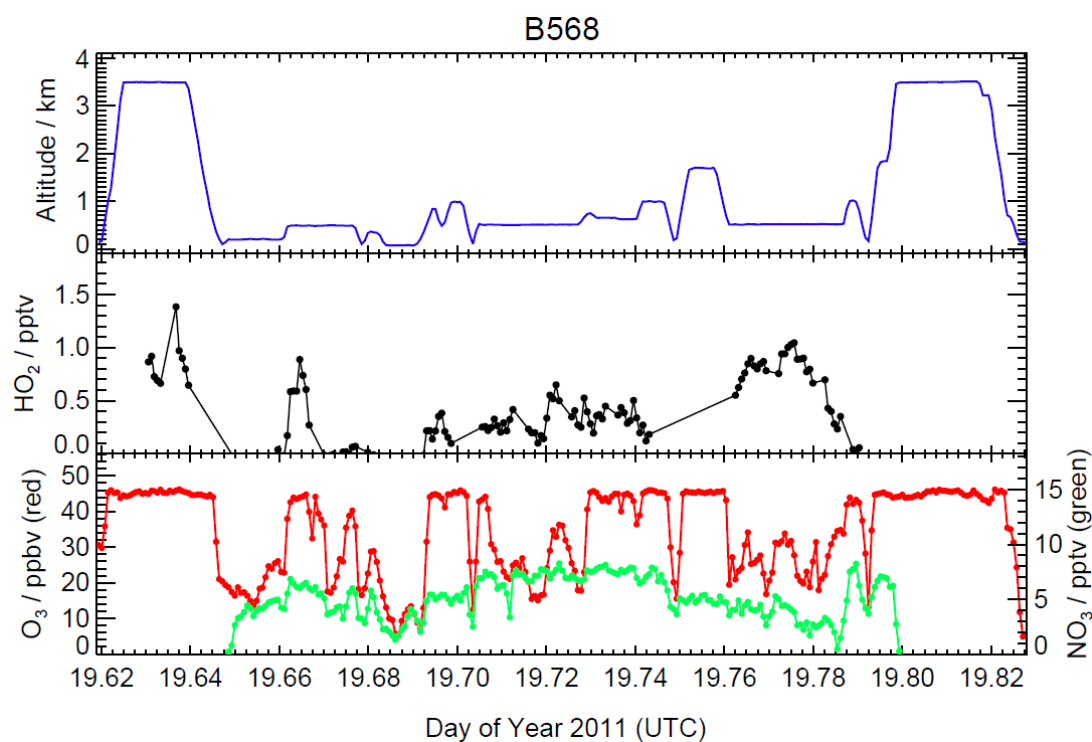


Figure S1.24. Time series as in Figure S1.20, for flight B568 on 19th January 2011.

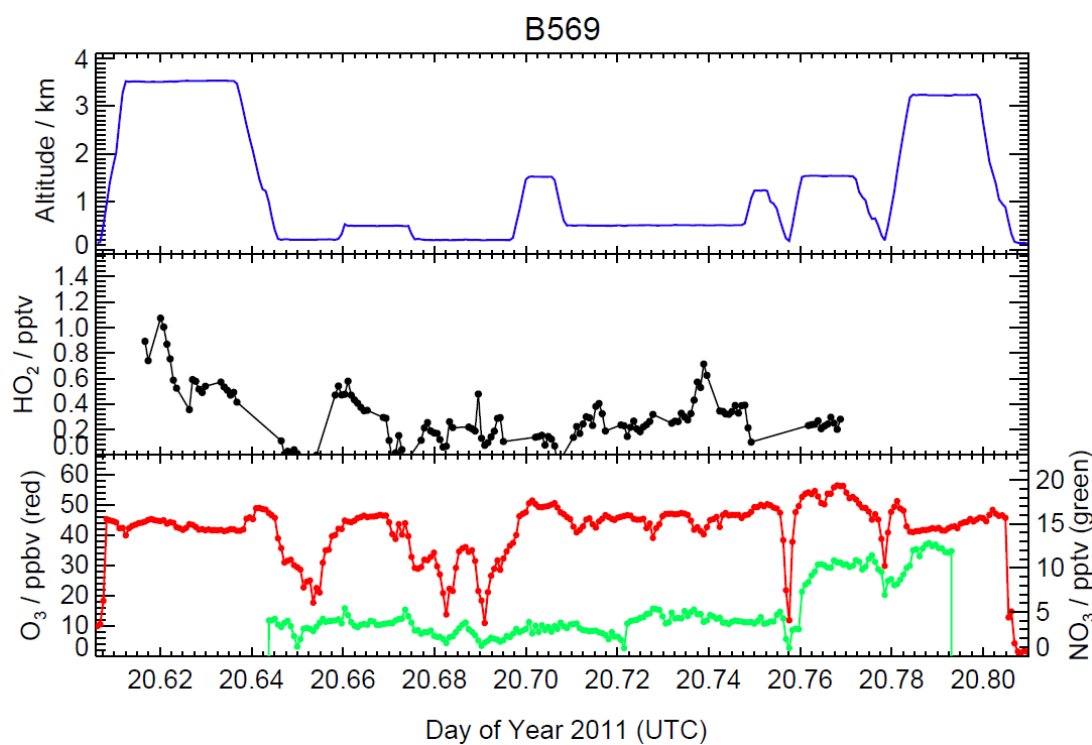


Figure S1.25. Time series as in Figure S1.20, for flight B569 on 20th January 2011.

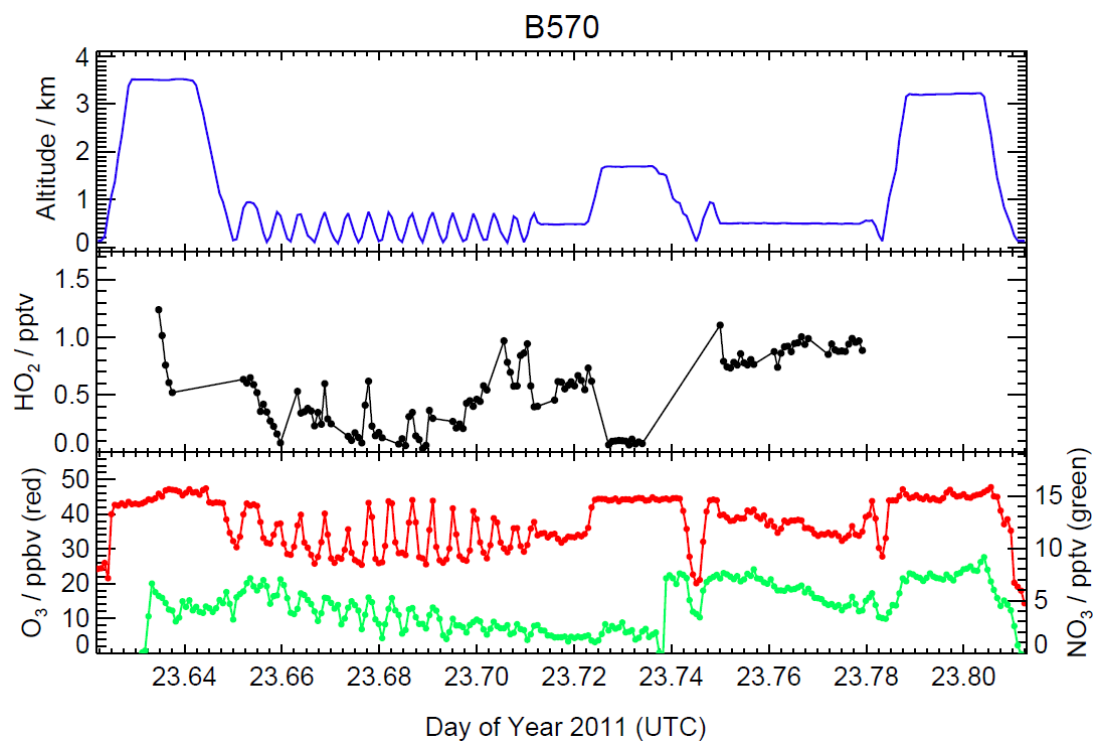


Figure S1.26. Time series as in Figure S1.20, for flight B570 on 23rd January 2011.

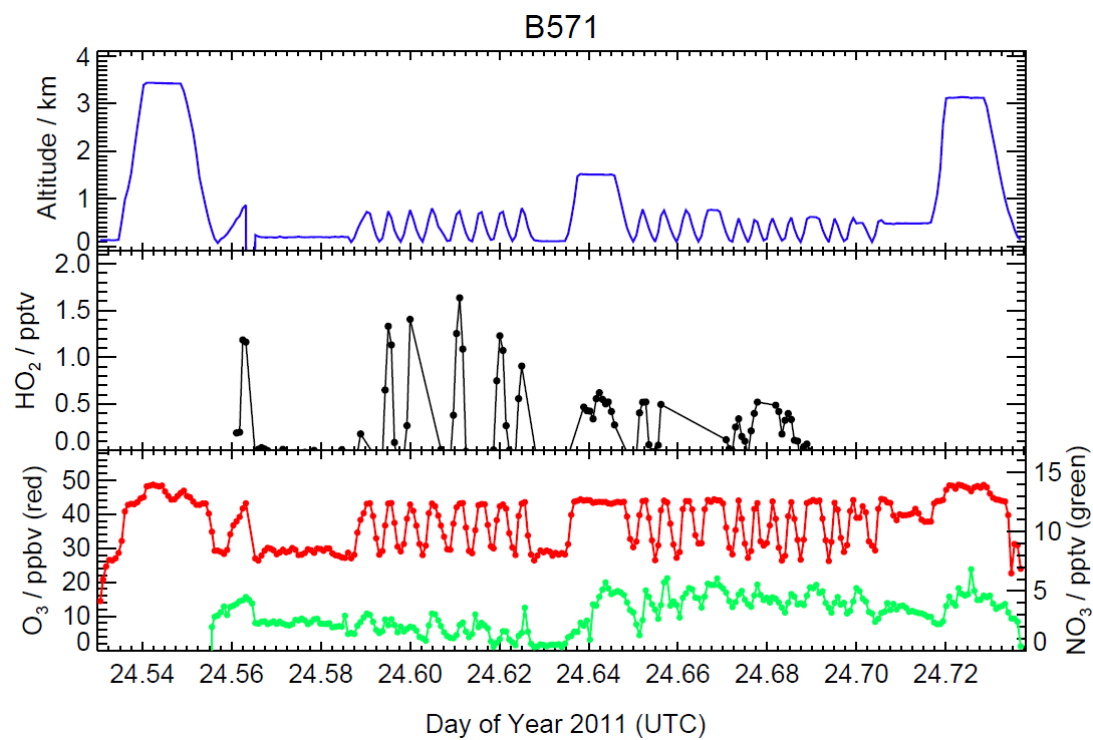
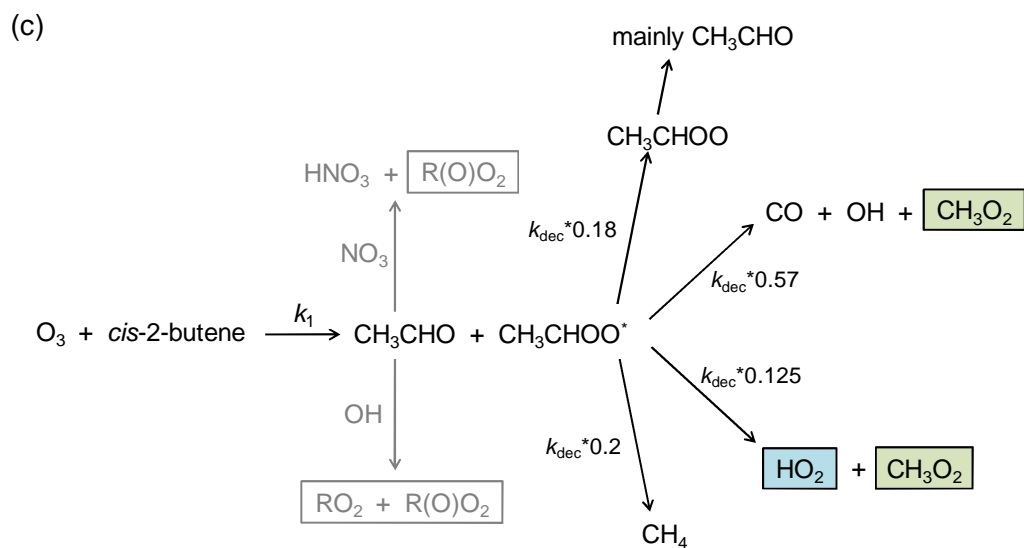
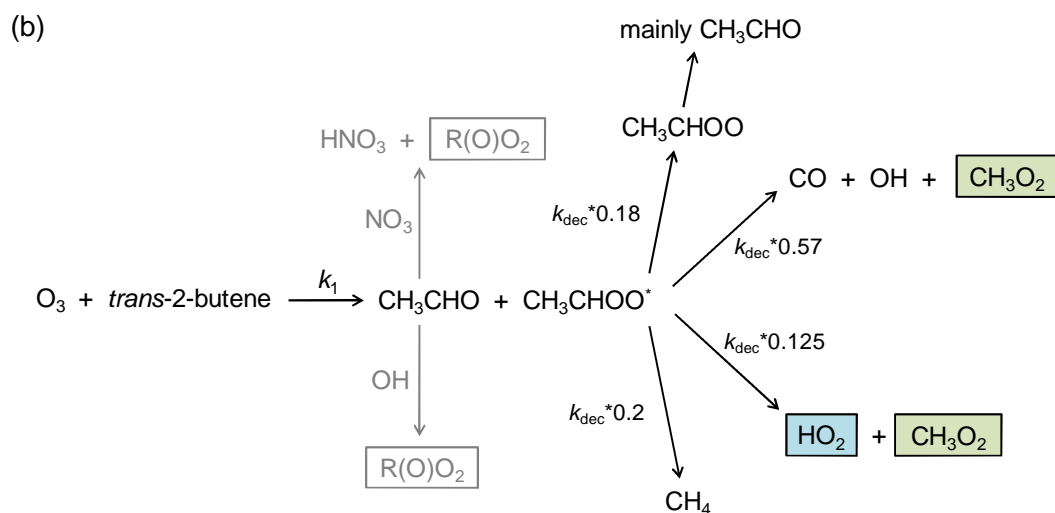
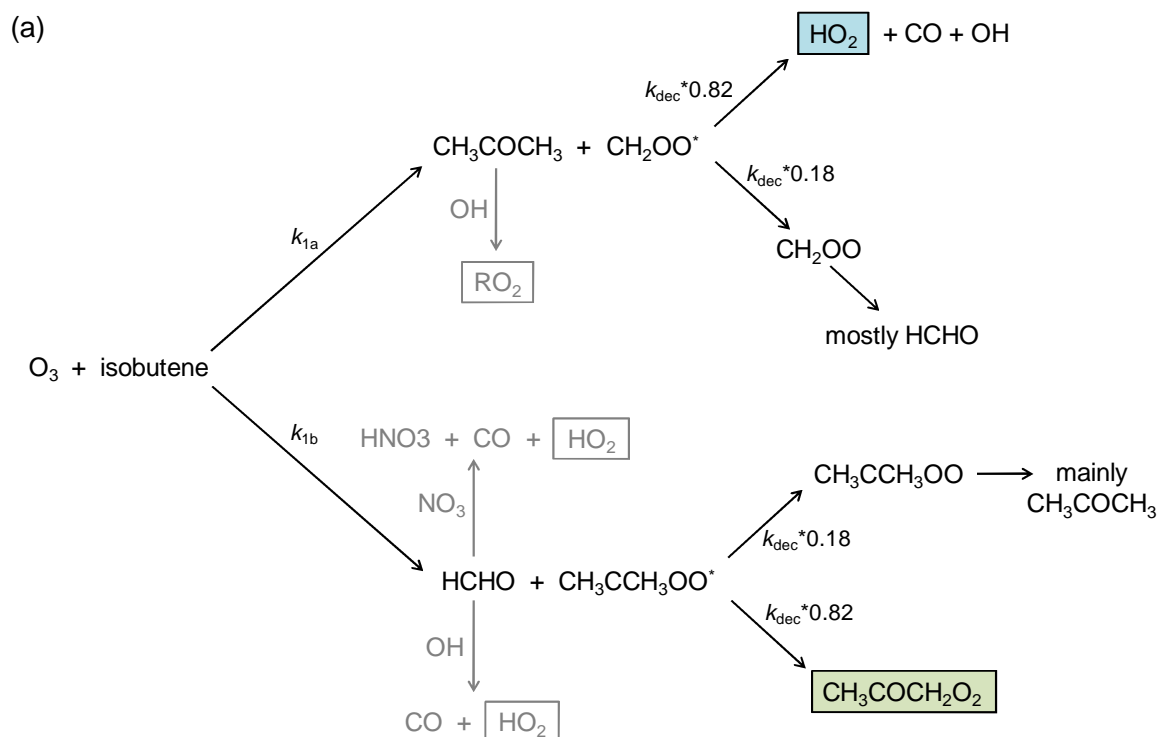
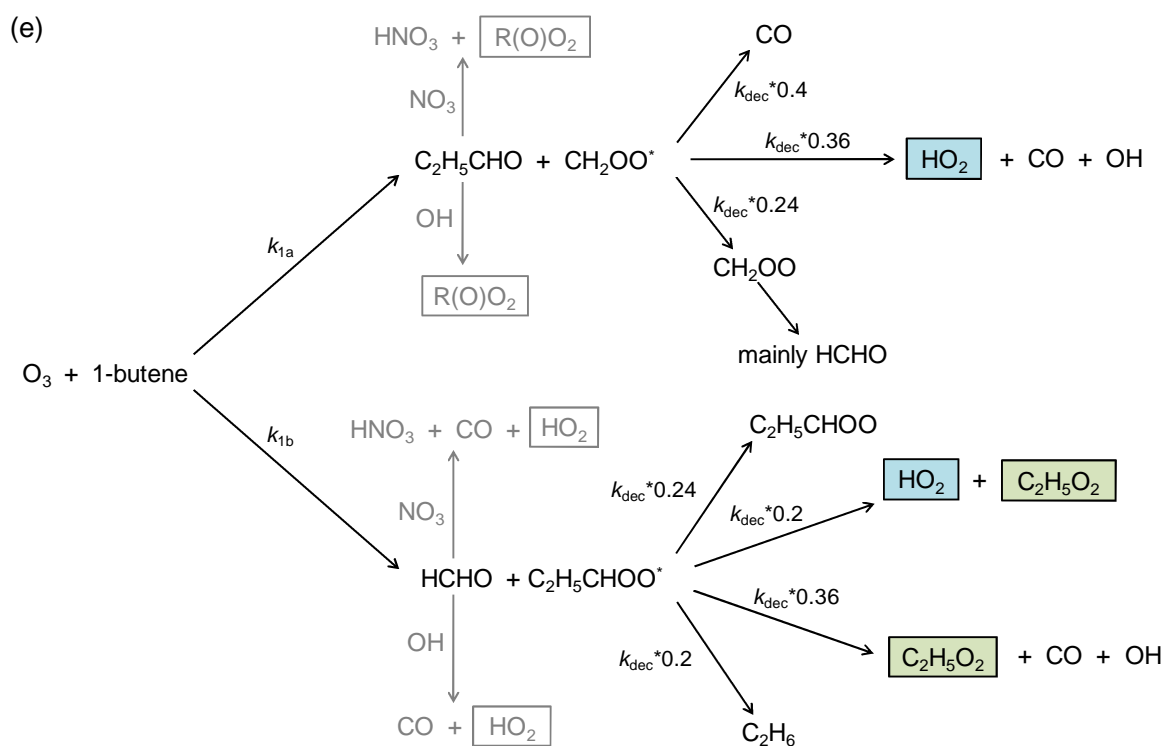
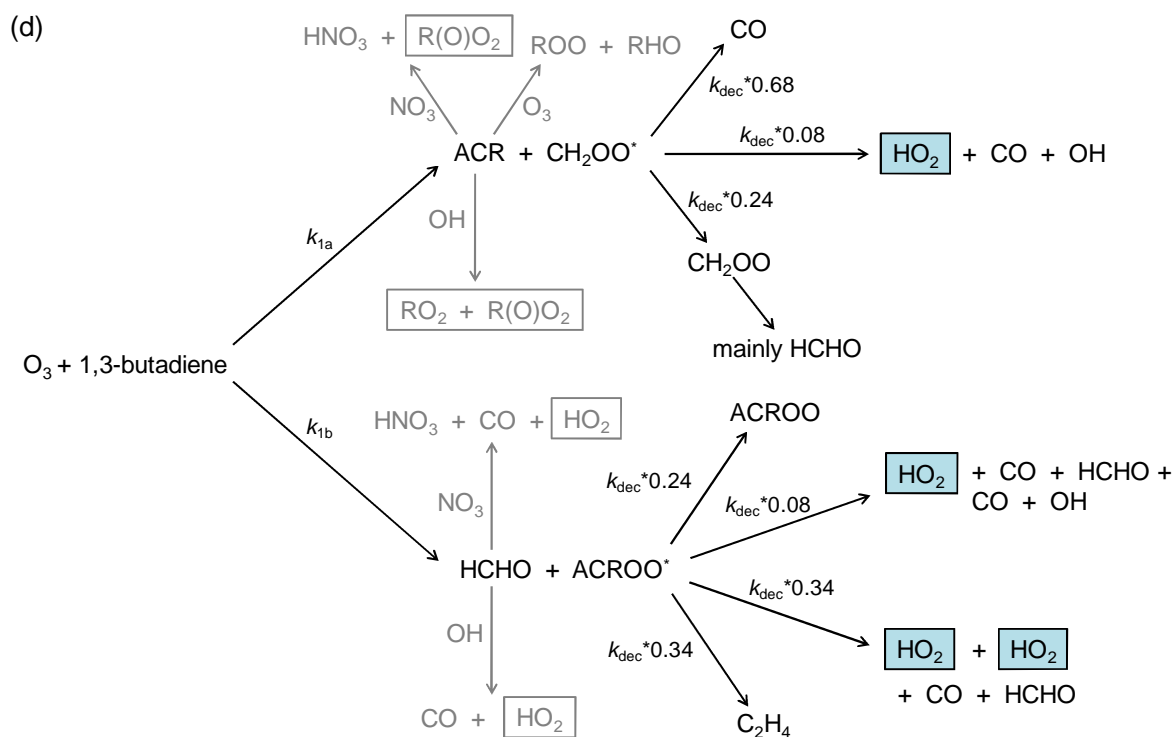
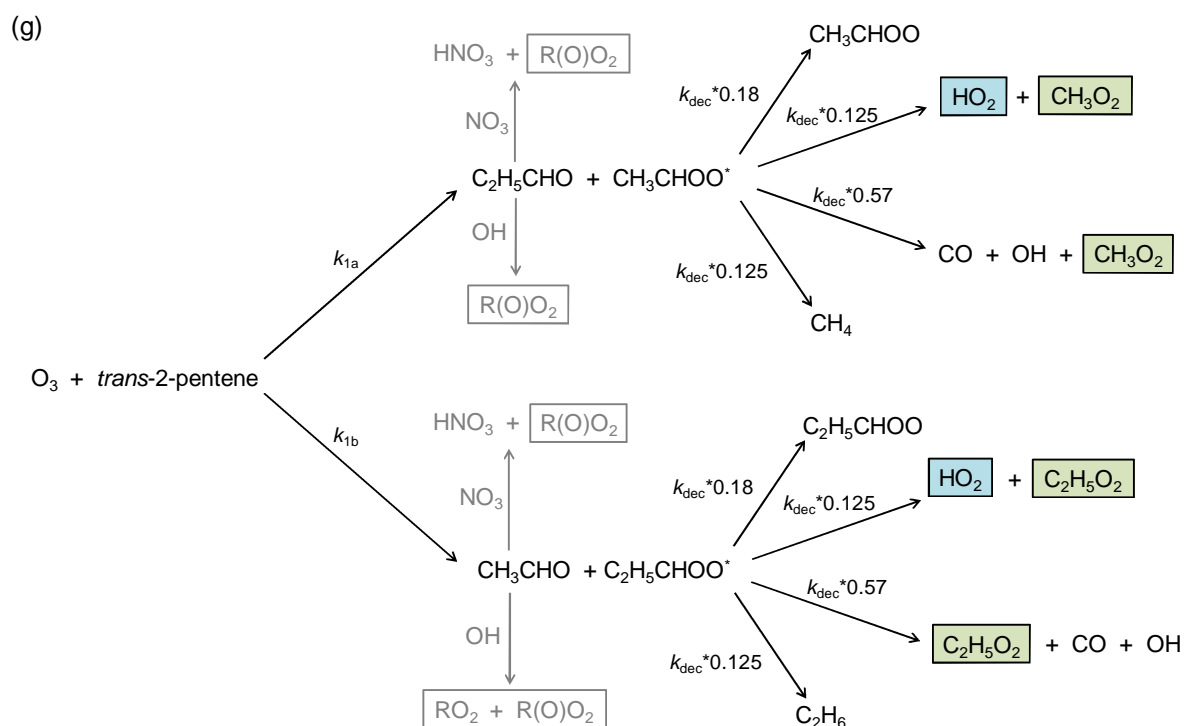
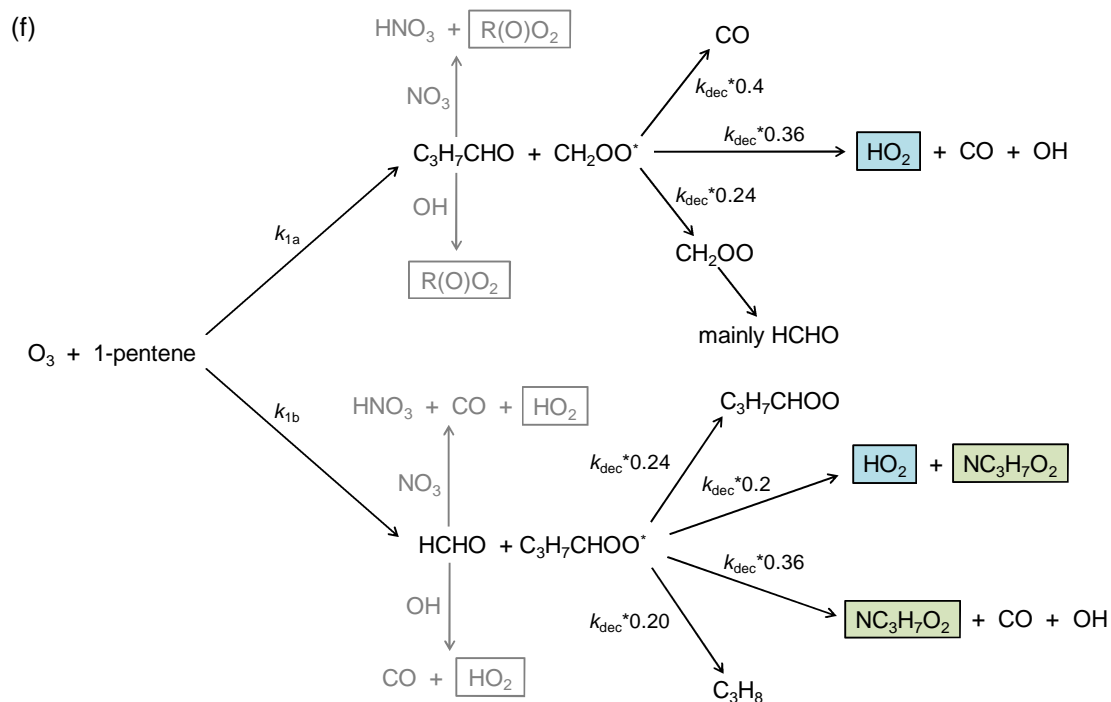


Figure S1.27. Time series as in Figure S1.20, for flight B571 on 24th January 2011.







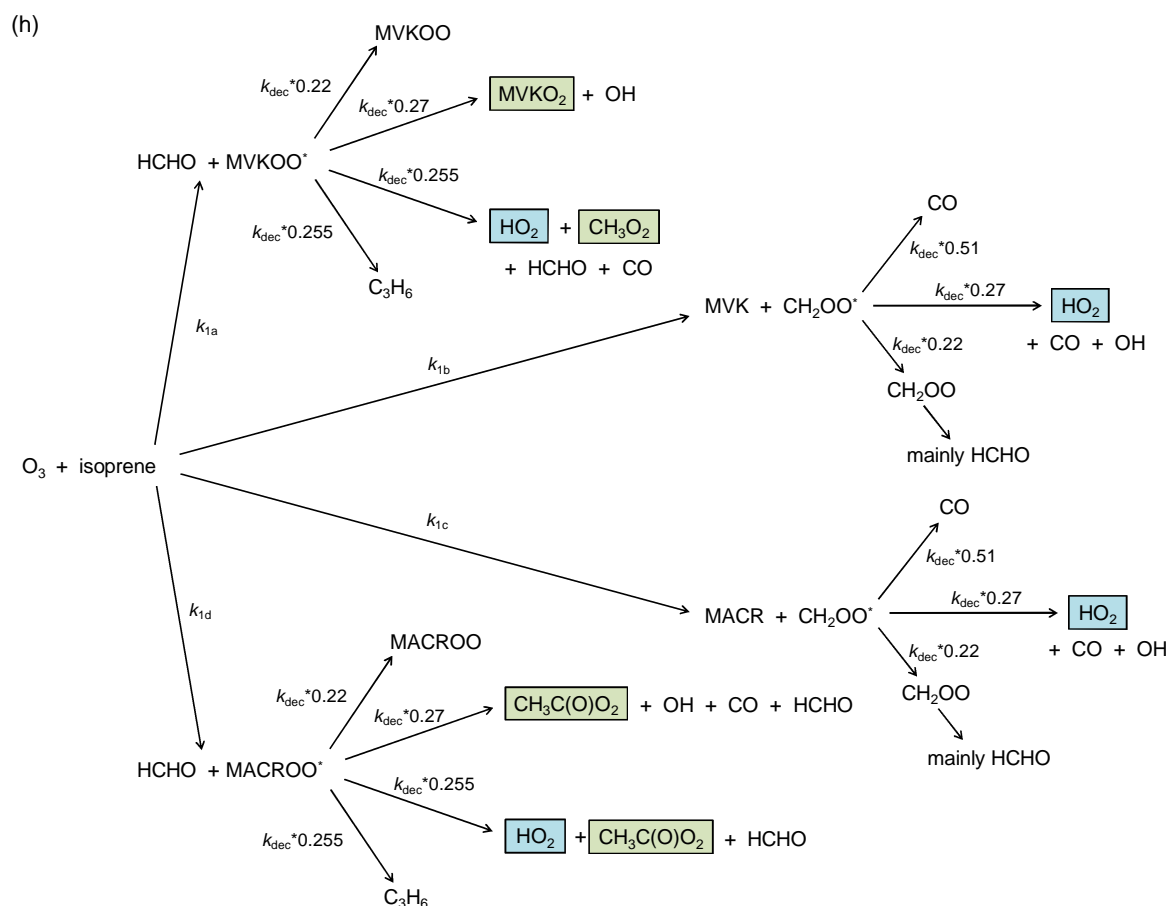


Figure S1.28. Schemes for reaction of O_3 with a) isobutene; b) *trans*-2-butene; c) *cis*-2-butene; d) 1,3-butadiene; e) 1-butene; f) 1-pentene; g) *trans*-2-pentene; h) isoprene. Reaction schemes adapted from the MCM v3.2 (Jenkin *et al.*, 1997, Saunders *et al.*, 2003). The rate constant for decomposition of the Criegee radical is $k_{dec} = 1.0 \times 10^6 \text{ molecule}^{-1} \text{ cm}^3 \text{ s}^{-1}$ (MCM v3.2, Jenkin *et al.*, 1997, Saunders *et al.*, 2003). Channels which are insignificant or unimportant have been shown in grey.

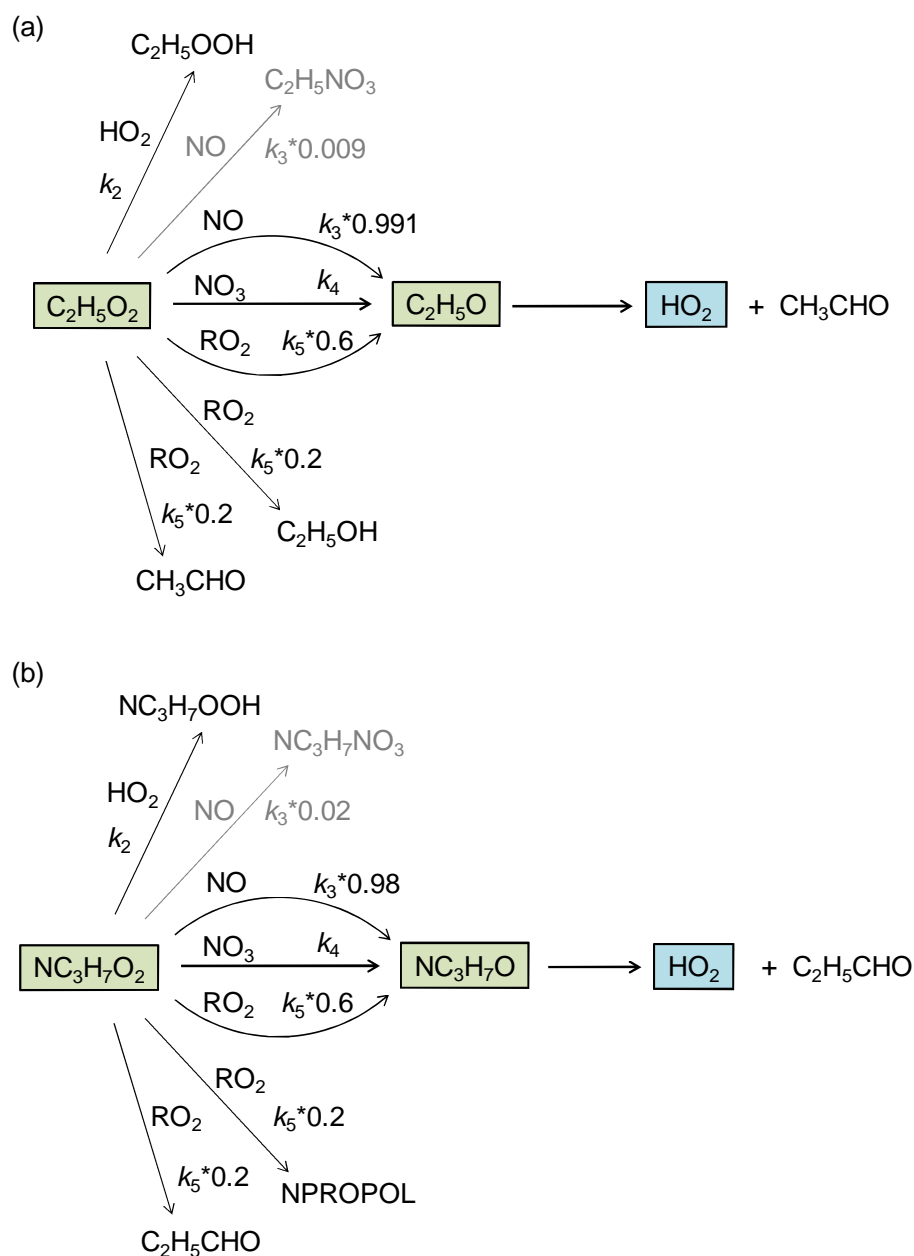


Figure S1.29. Reaction schemes of O_3 -initiated RO_2 radicals which do produce prompt HO_2 : a) $C_2H_5O_2$ produced by reactions of O_3 with propene (channel 'b'), *trans*-2-butene, *cis*-2-butene, *trans*-2-pentene (channel 'a'), and isoprene (channel 'a'); b) $NC_3H_7O_2$ produced by reactions of O_3 with 1-pentene (channel 'b') (see Figure S1.28). Reaction schemes adapted from the MCM v3.2 (Jenkin *et al.*, 1997, Saunders *et al.*, 2003). Channels which are insignificant or unimportant have been shown in grey. The reaction scheme for CH_3O_2 is given in Chapter 4.

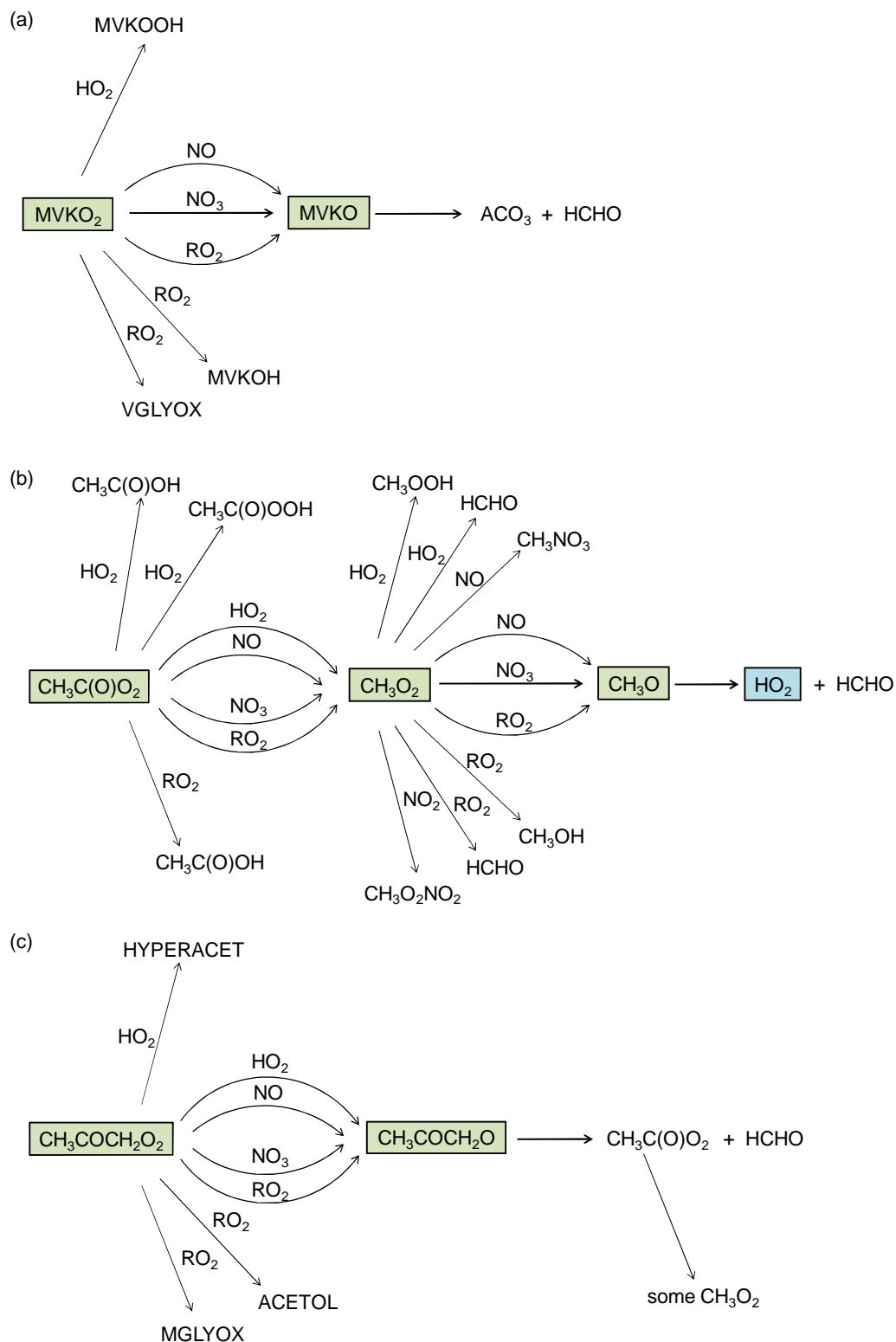


Figure S1.30. Reaction schemes for O_3 -initiated RO_2 radicals which do not yield prompt HO_2 , and are therefore not included in the analysis: a) $MVKO_2$ produced by O_3 + isoprene, channel 'a' (see Figure S1.28 (g)); b) acyl peroxy radical $CH_3C(O)O_2$ produced by O_3 + isoprene, channel 'd' (see Figure S1.28 (g)): HO_2 is not produced until the third step in the reaction scheme, so this process is considered to be too slow; c) $CH_3COCH_2O_2$ produced by O_3 + isobutene, channel 'b' (see Figure S1.28 (b)). Reaction schemes adapted from the MCM v3.2 (Jenkin *et al.*, 1997, Saunders *et al.*, 2003).

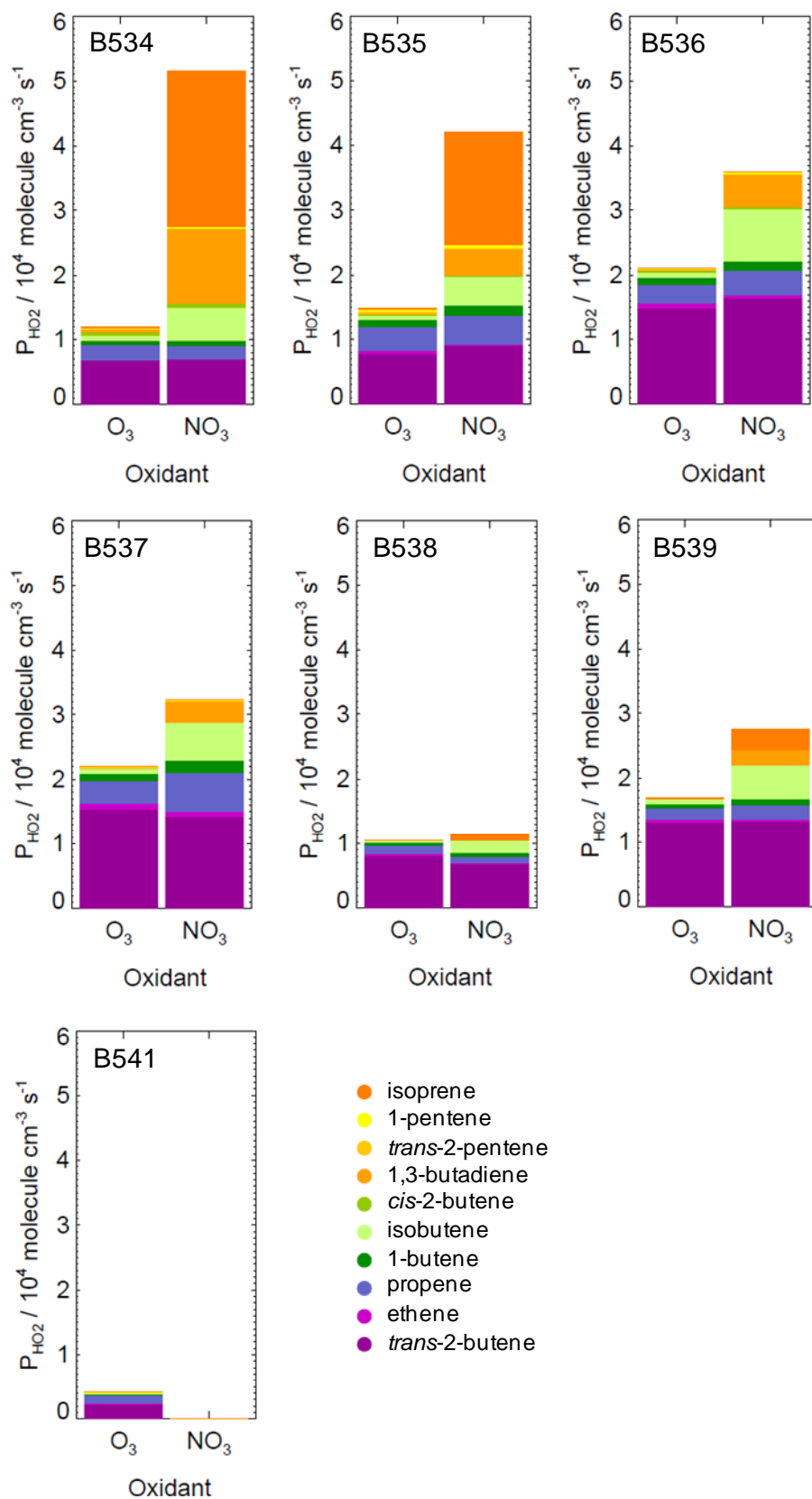


Figure S1.31. Rates of instantaneous production of HO₂ from reactions of O₃ and NO₃ with alkenes, for RONOCO summer flights. Flight numbers are given in each plot.

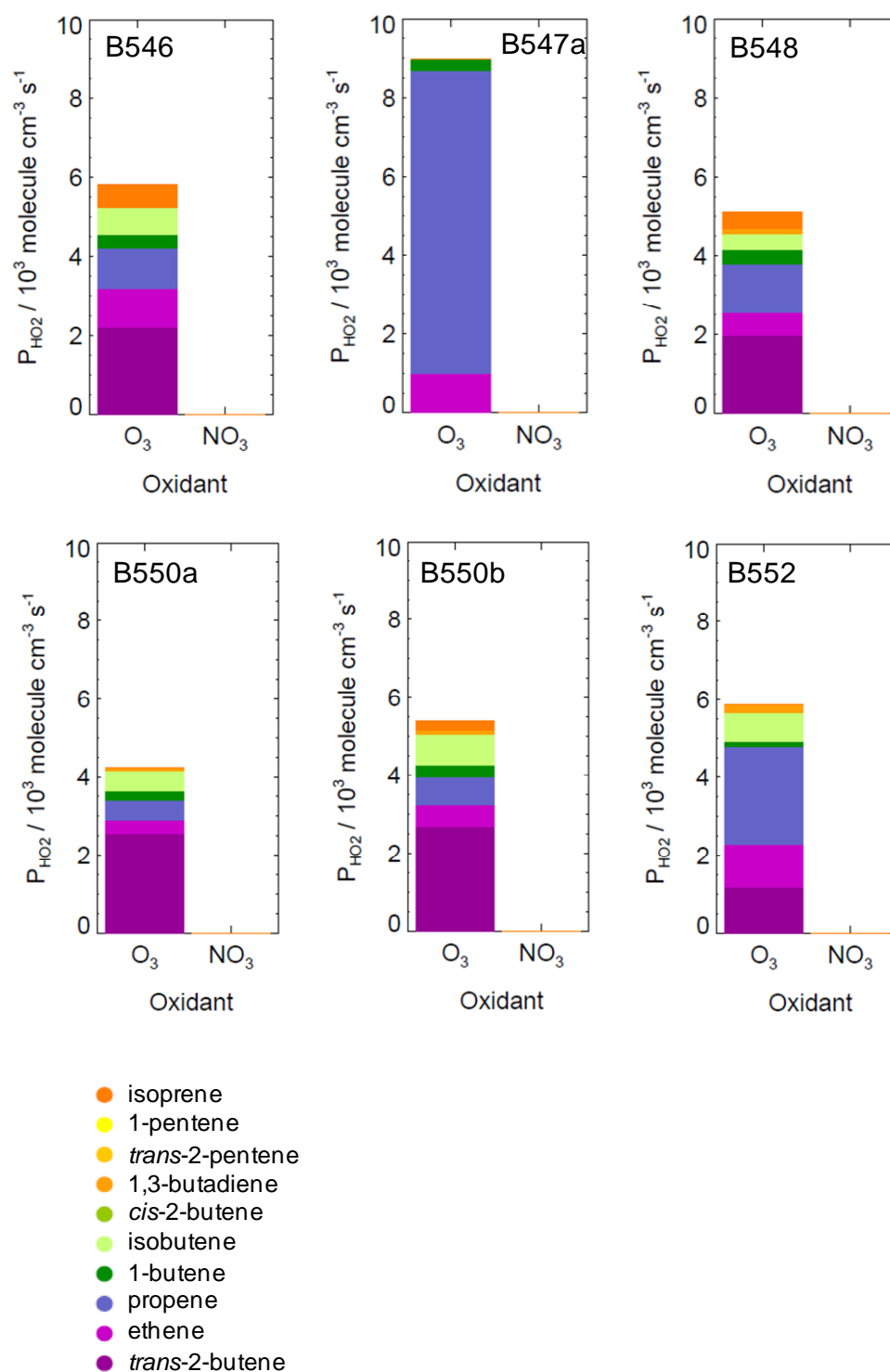


Figure S1.32. Rates of instantaneous production of HO_2 from reactions of O_3 with alkenes during SeptEx flights. NO_3 was not detected during SeptEx. Insufficient alkene data were available for flight B547b.

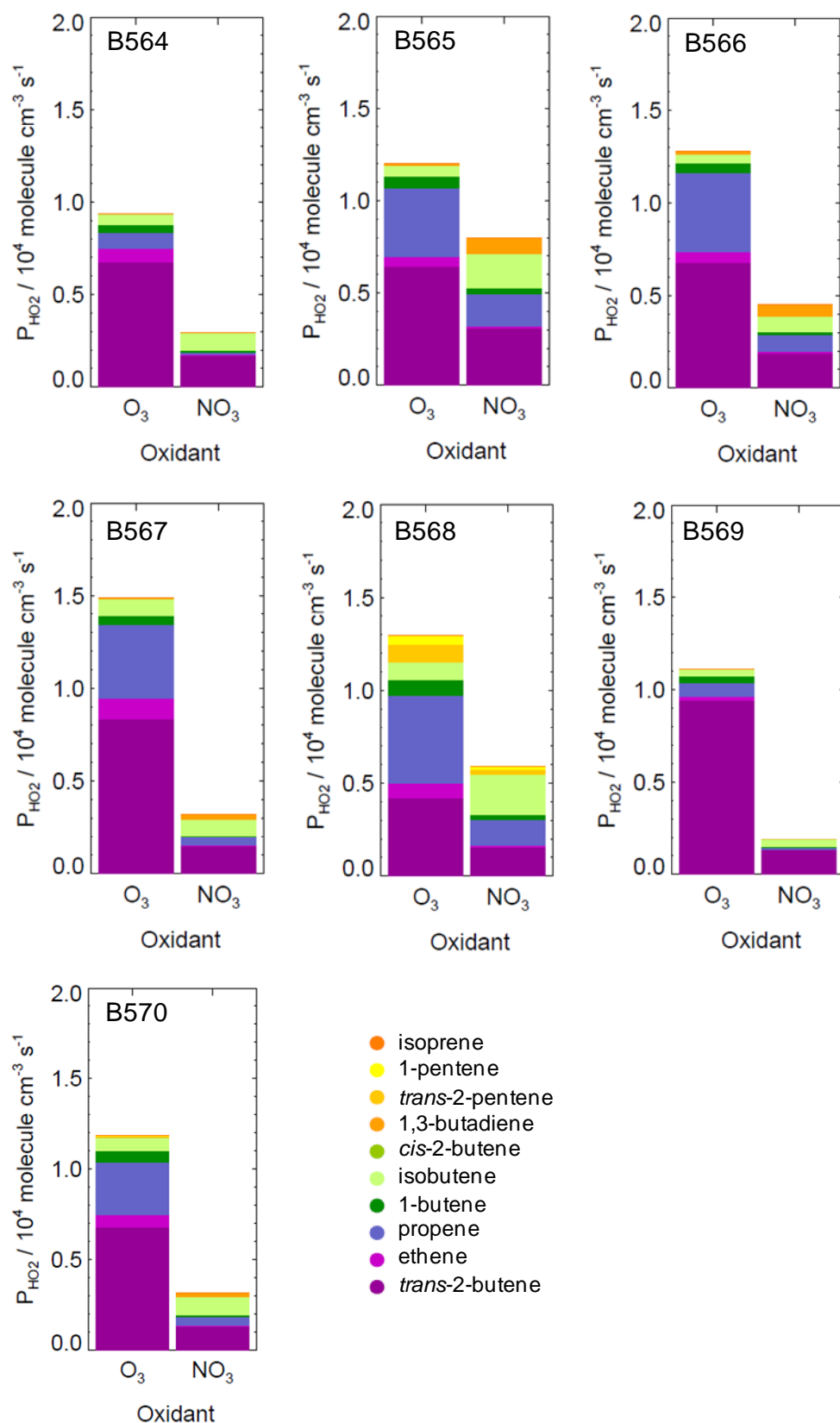


Figure S1.33. Rates of instantaneous production of HO_2 from reactions of O_3 and NO_3 with alkenes during the RONOCO winter flights. Flight numbers are given in each plot.

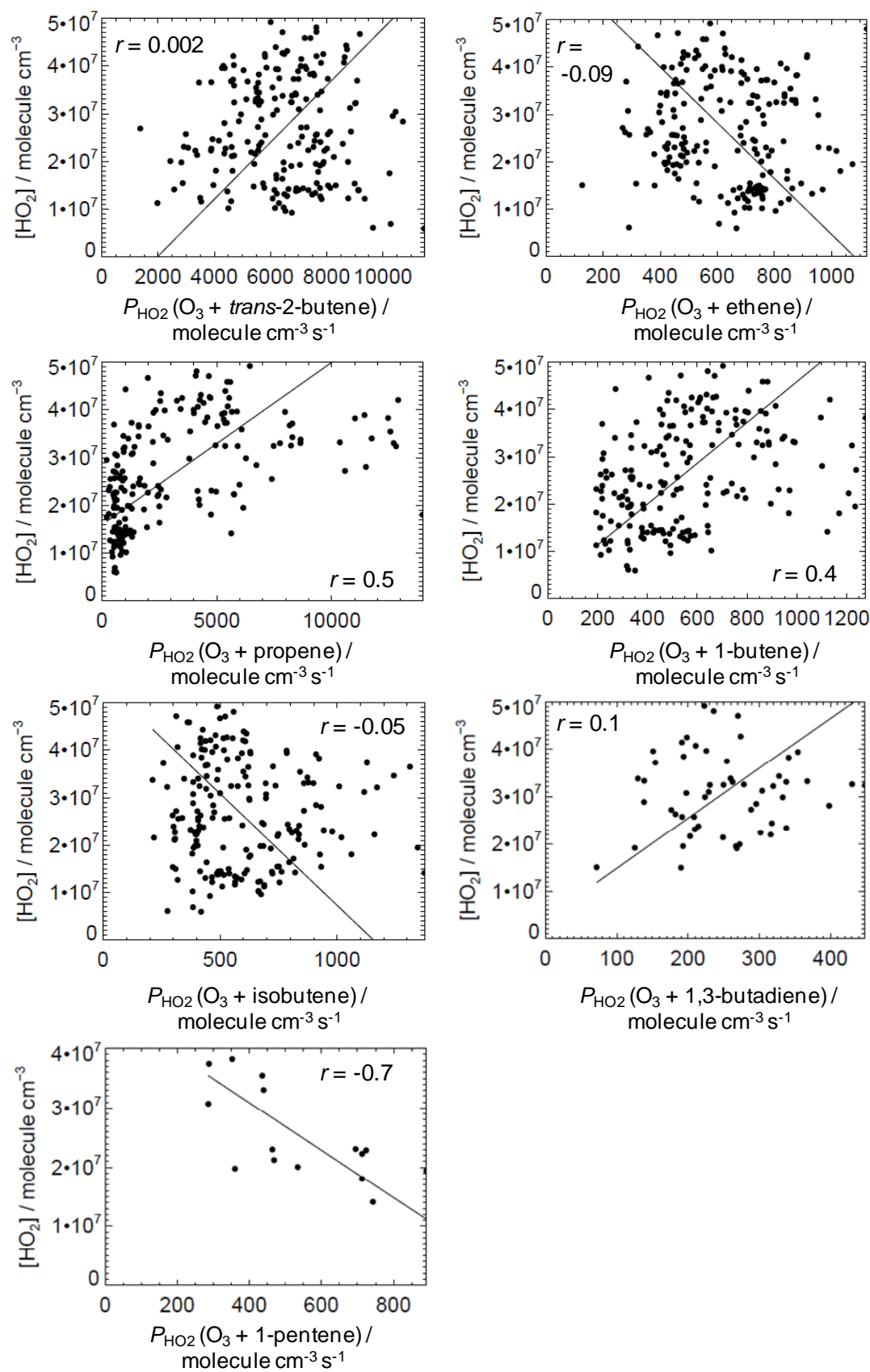


Figure S1.34. HO_2 versus rates of instantaneous production of HO_2 from reactions of O_3 with alkenes during winter nighttime RONOCO flights. Correlation coefficients (r) are given in each plot. Solid lines are lines of best fit to the data.

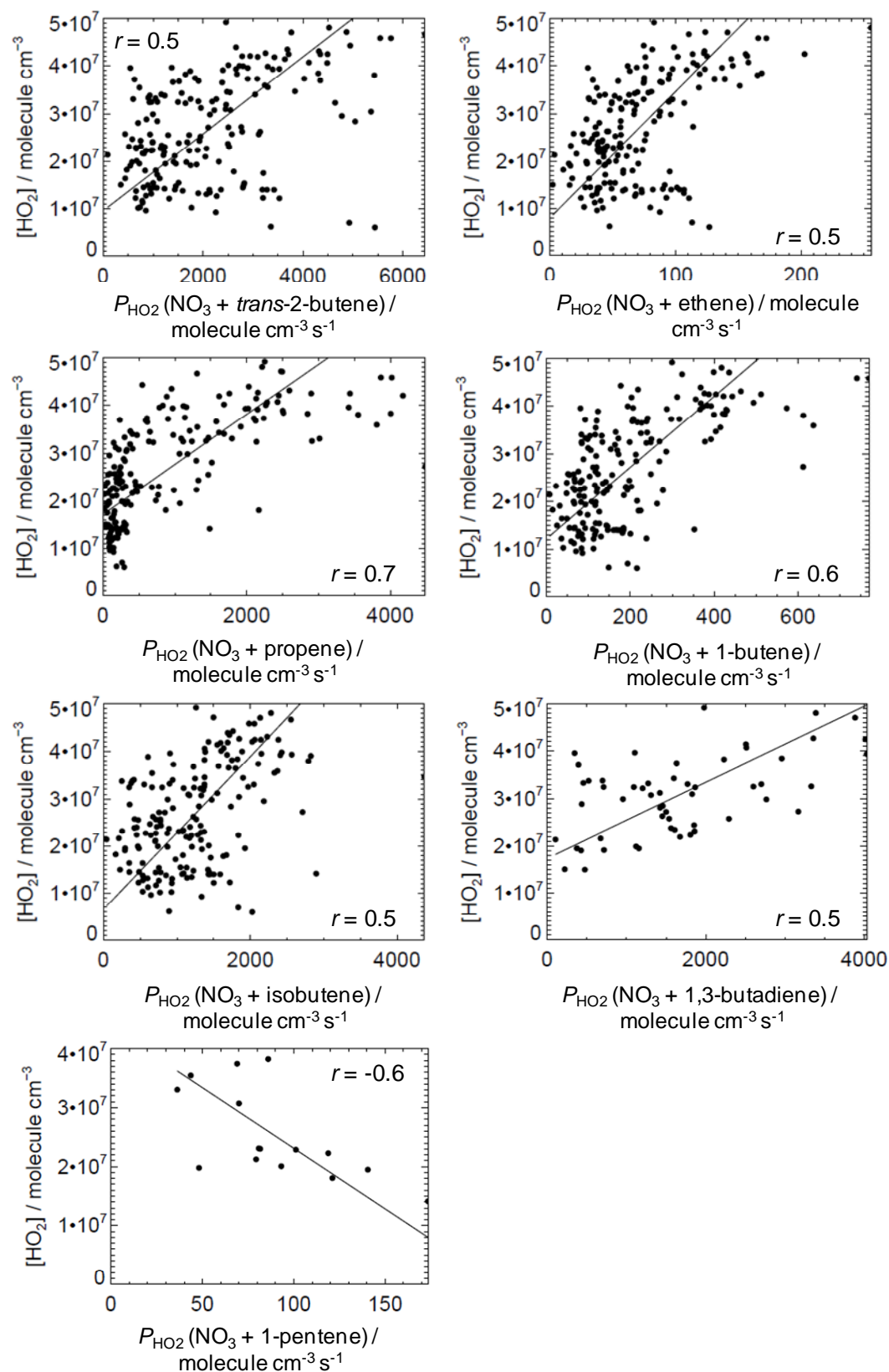


Figure S1.35. HO_2 versus rates of instantaneous production of HO_2 from reactions of NO_3 with alkenes during winter nighttime RONOCO flights. Correlation coefficients (r) are given in each plot. Solid black lines are lines of best fit to the data.