Supplement of

A regional modelling study of halogen chemistry within a volcanic plume of Mt Etna's Christmas 2018 eruption

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1 Figures

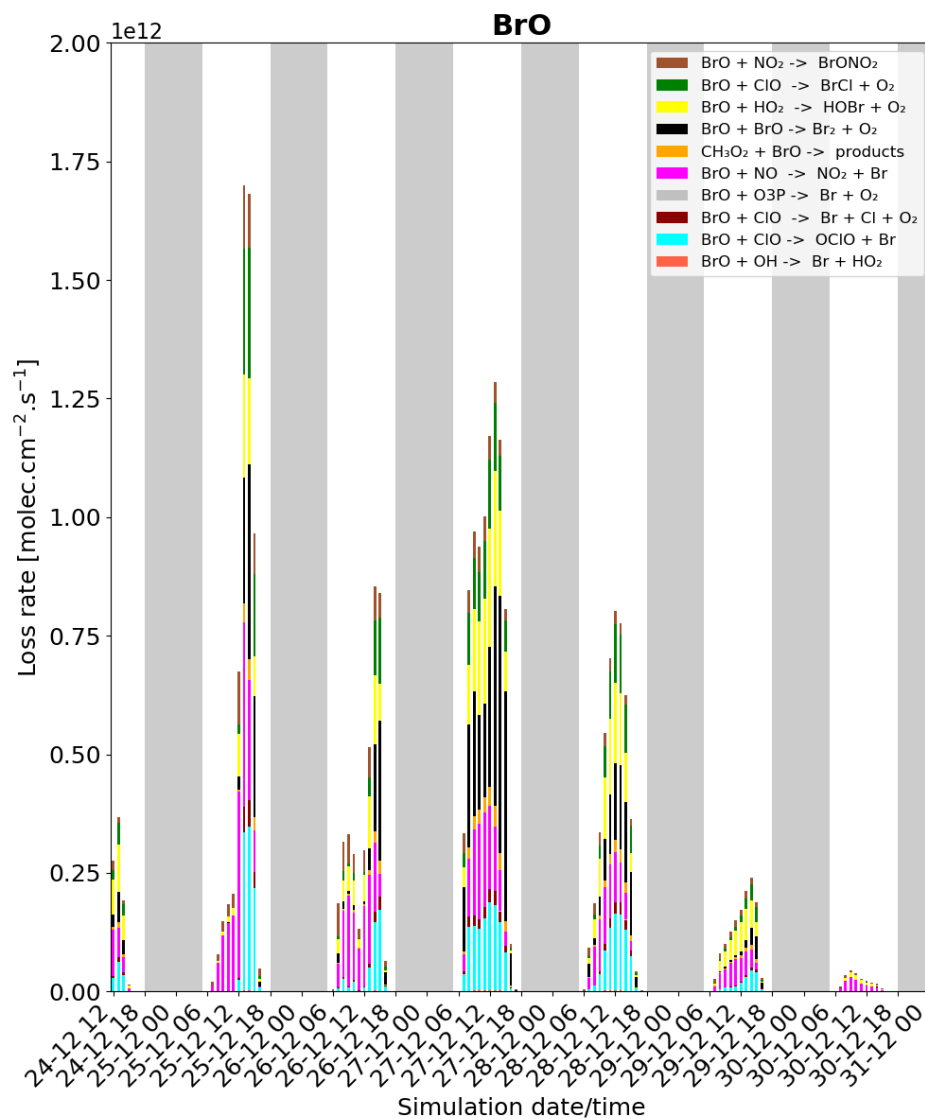



Figure S1. Time evolution of BrO loss rates in [molec.cm^{-2}.s^{-1}] without the photolysis of BrO and the BrO + BrO $\rightarrow$ Br + Br + O$_2$ reaction, from 24 December at 12:00 to 31 December 2018 at 00:00 UTC in the near volcano plume.

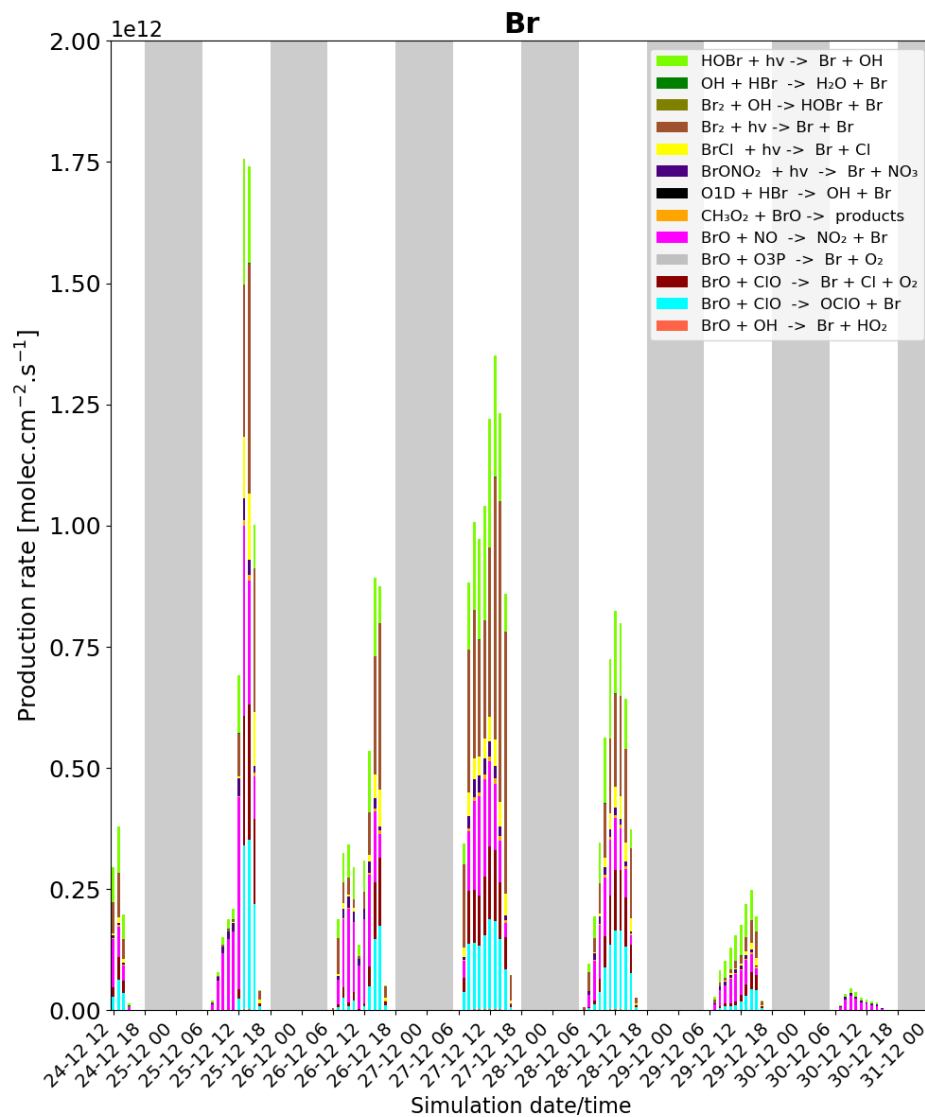



Figure S2. Time evolution of Br production rates in [molec.cm^{-2}.s^{-1}] without the photolysis of BrO and the BrO + BrO → Br + Br + O$_2$ reaction, from 24 December at 12:00 to 31 December 2018 at 00:00 UTC in the near volcano plume.

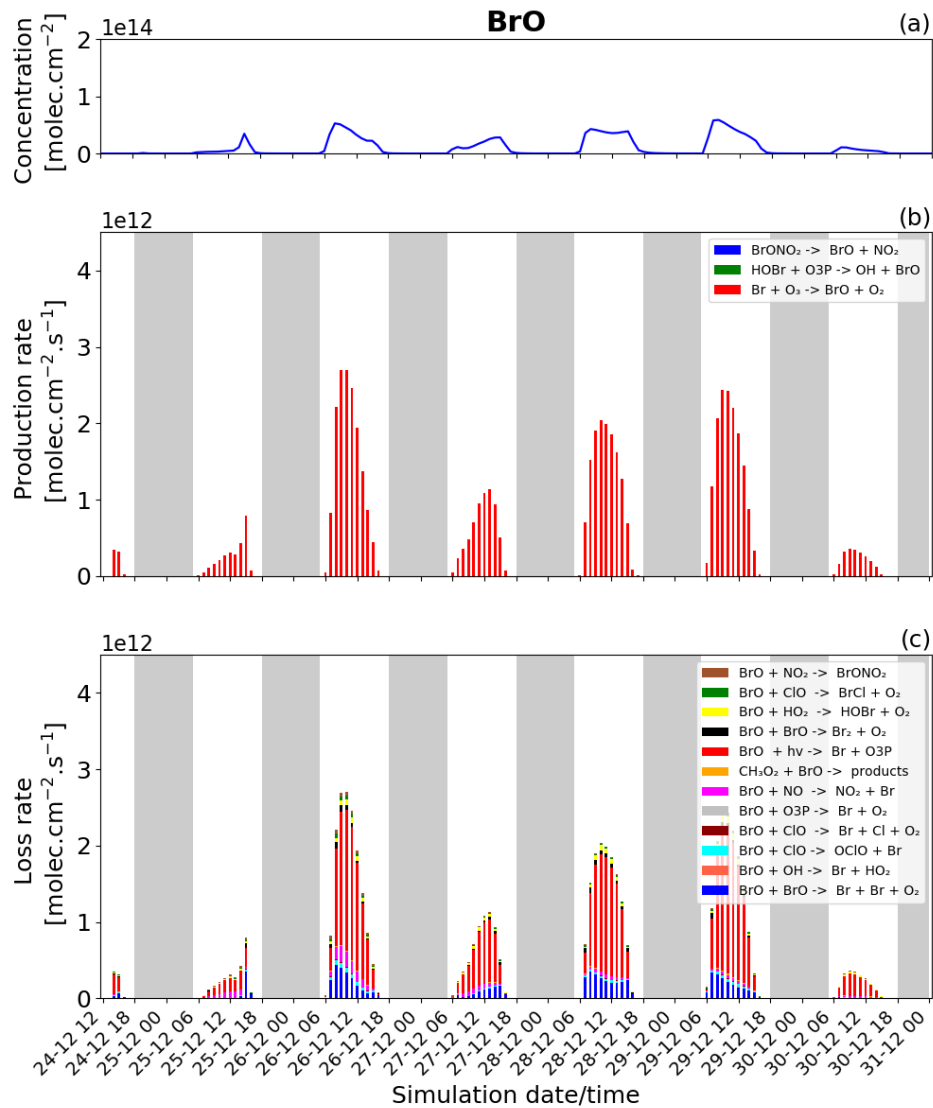



Figure S3. Time evolution of : (a) BrO column concentration in [molec.cm^{-2}], (b) production rates and (c) loss rates for BrO both in [molec.cm^{-2}.s^{-1}] from 24 December at 14:00 to 31 December 2018 at 00:00 UTC in the young plume.

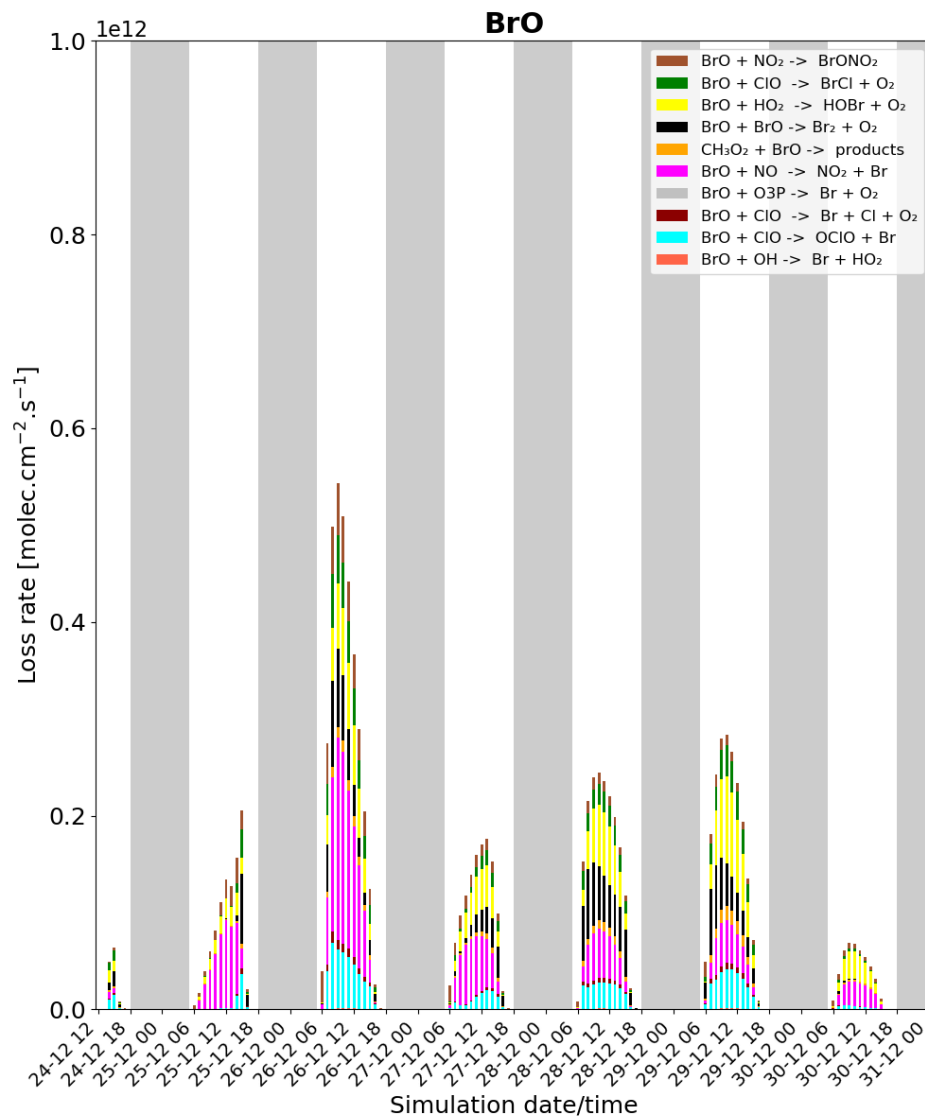



Figure S4. Time evolution of BrO loss rates in [molec.cm^{-2}.s^{-1}] without the photolysis of BrO and the BrO + BrO → Br + Br + O$_2$ reaction from 24 December at 14:00 to 31 December 2018 at 00:00 UTC in the young plume.

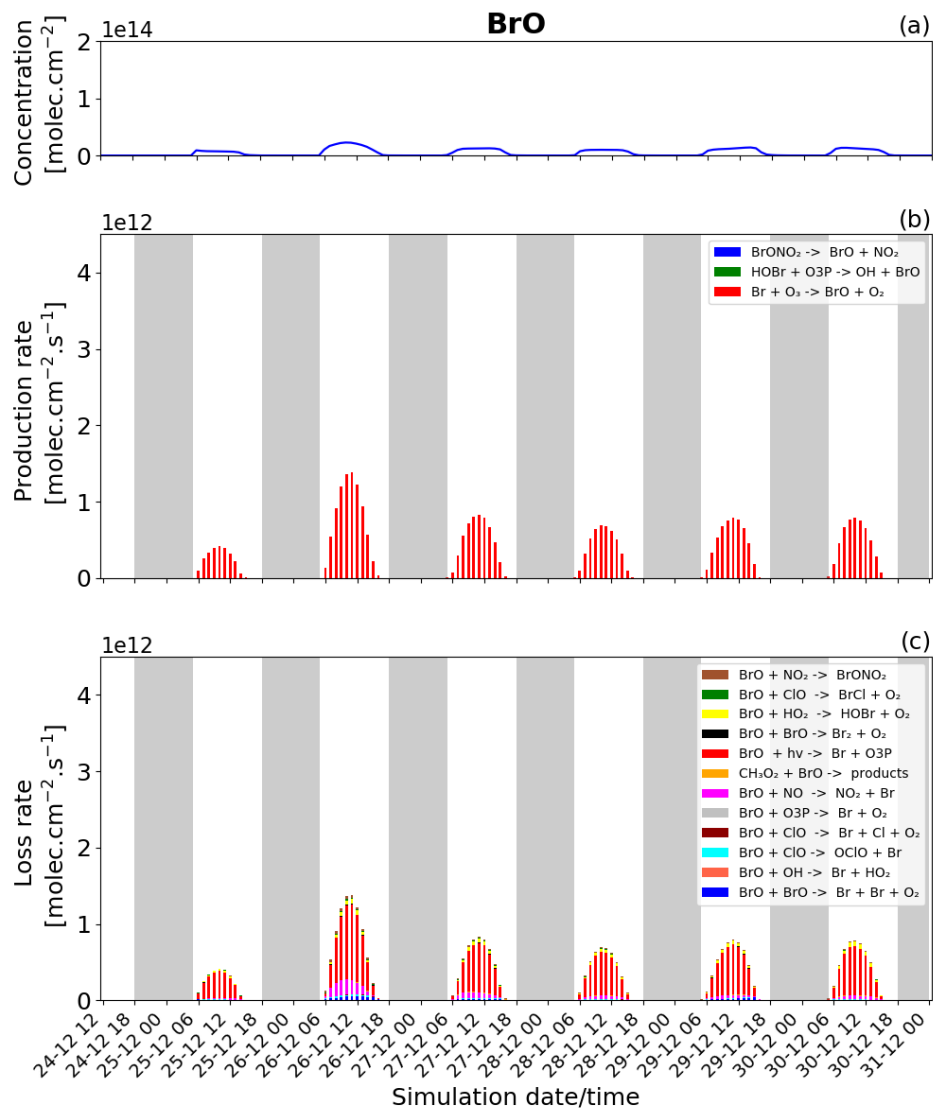



Figure S5. Time evolution of : (a) BrO column concentration in [molec.cm^{-2}], (b) production rates and (c) loss rates for BrO both in [molec.cm^{-2}.s^{-1}] from 24 December at 20:00 to 31 December 2018 at 00:00 UTC in the aged plume.

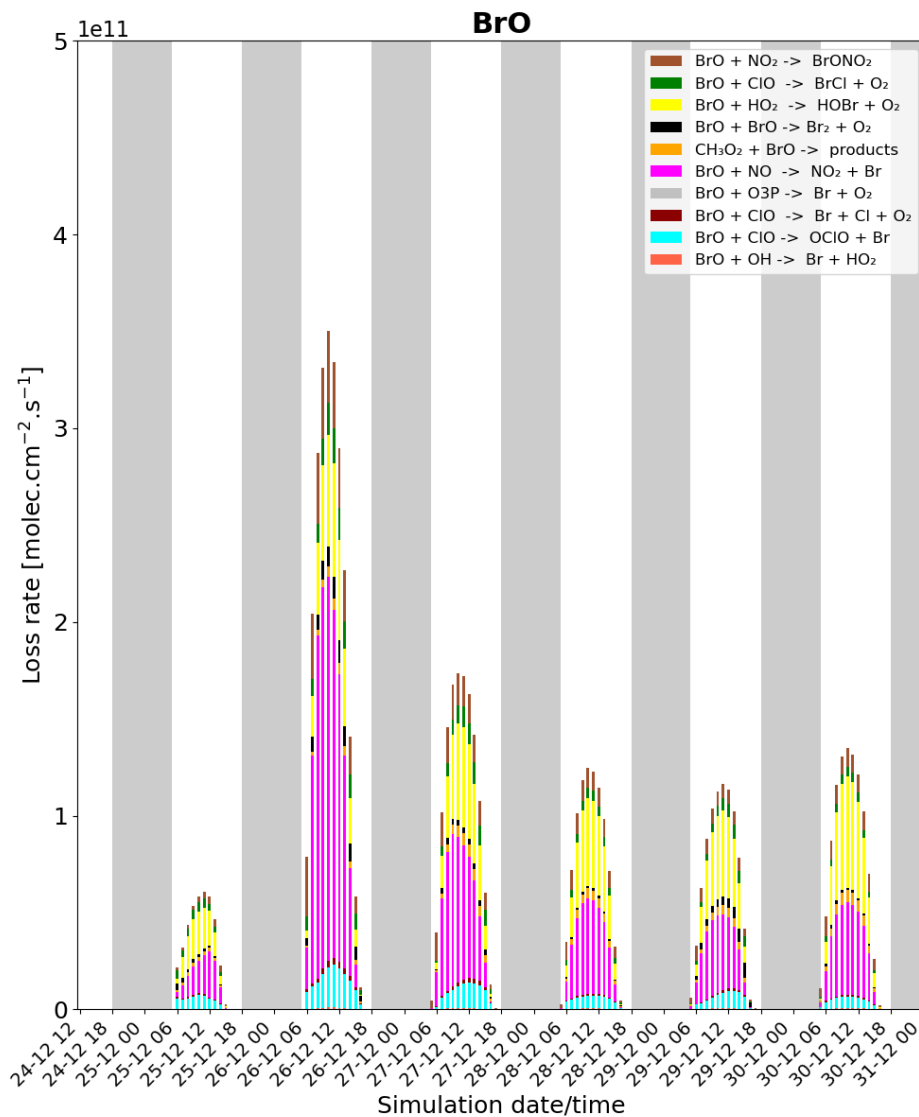



Figure S6. Time evolution of BrO loss rates in [molec.cm^{-2}.s^{-1}] without the photolysis of BrO and the BrO + BrO → Br + Br + O$_2$ reaction, from 24 December at 20:00 to 31 December 2018 at 00:00 UTC in the aged plume.

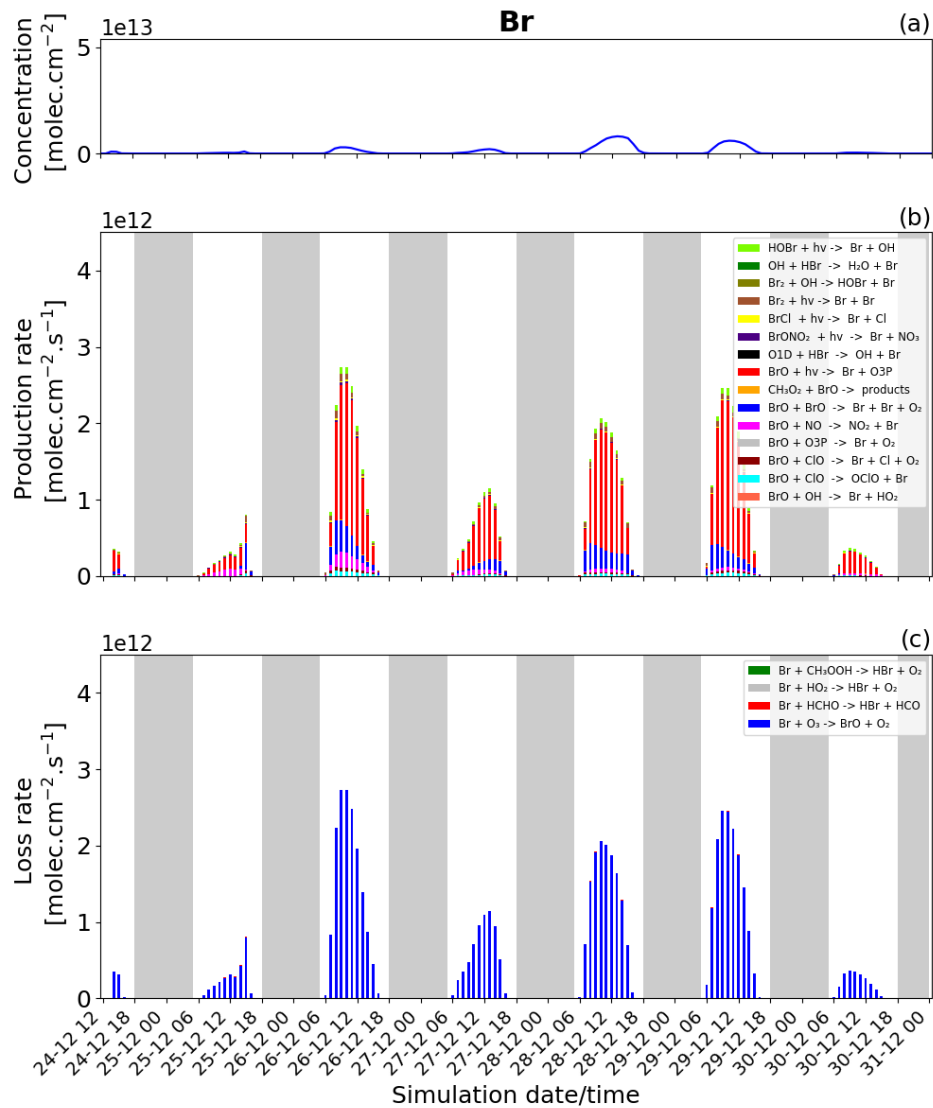



Figure S7. Time evolution of : (a) Br column concentration in [molec.cm^{-2}], (b) production rates and (c) loss rates for Br both in [molec.cm^{-2}.s^{-1}] from 24 December at 14:00 to 31 December 2018 at 00:00 UTC in the young plume.

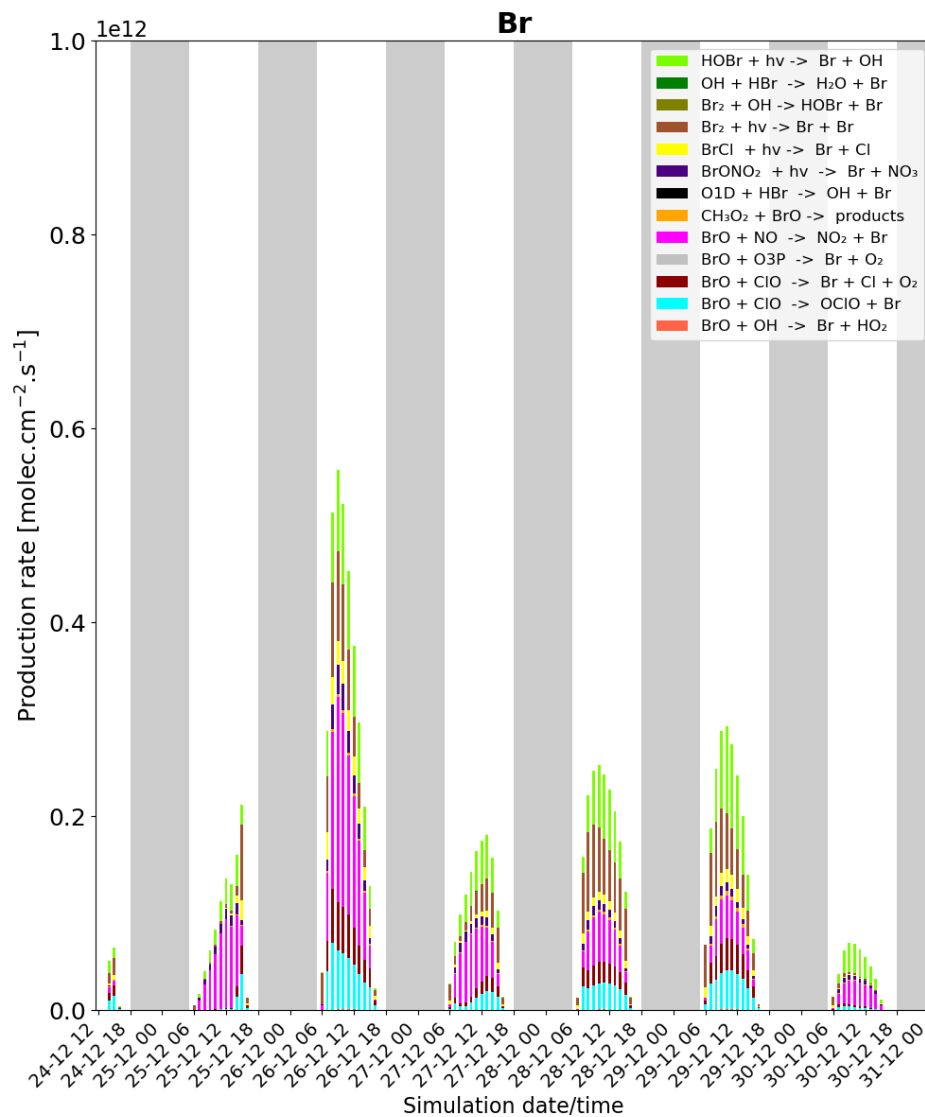



Figure S8. Time evolution of Br production rates in [molec.cm^{-2}.s^{-1}] without the photolysis of BrO and the BrO + BrO $\rightarrow$ Br + Br + O$_2$ reaction, from 24 December at 14:00 to 31 December 2018 at 00:00 UTC in the young plume.

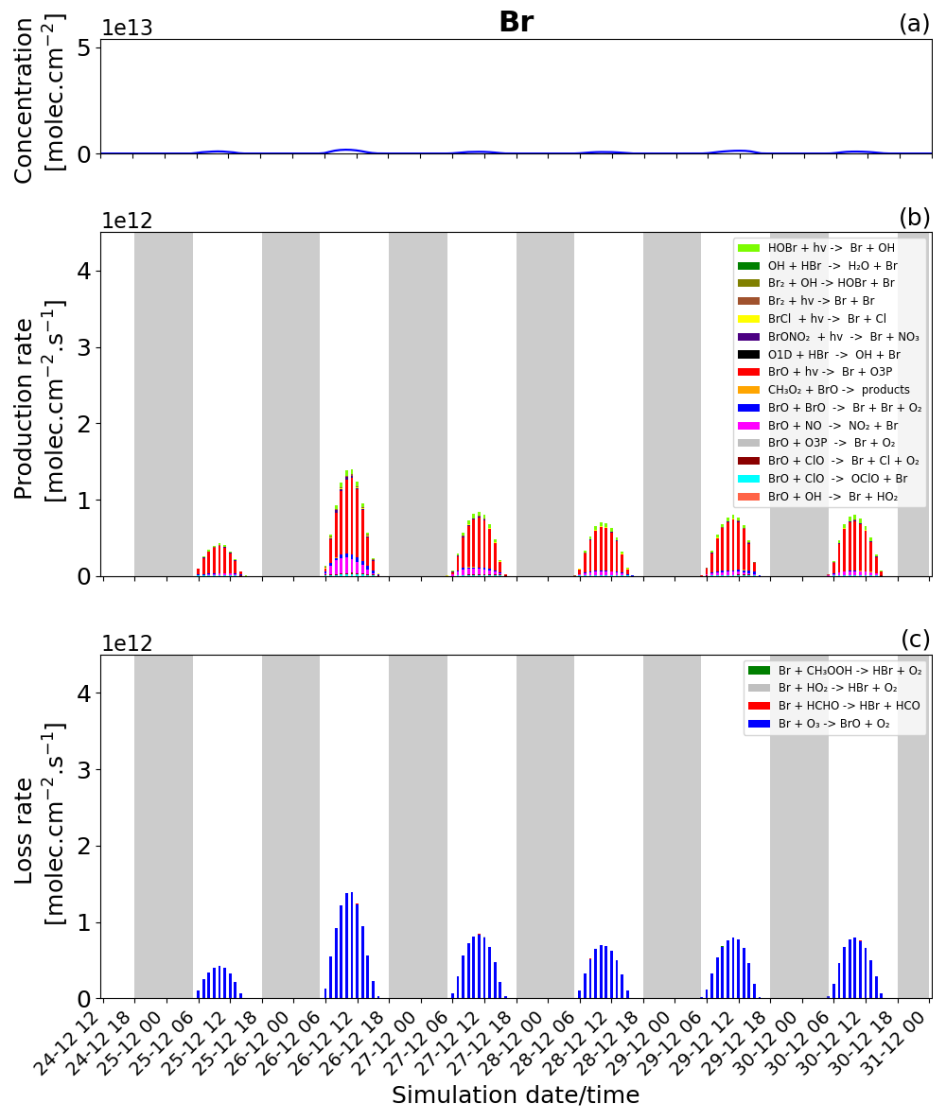



Figure S9. Time evolution of : (a) Br column concentration in [molec.cm^{-2}], (b) production rates and (c) loss rates for Br both in [molec.cm^{-2}.s^{-1}] from 24 December at 20:00 to 31 December 2018 at 00:00 UTC in the aged plume.

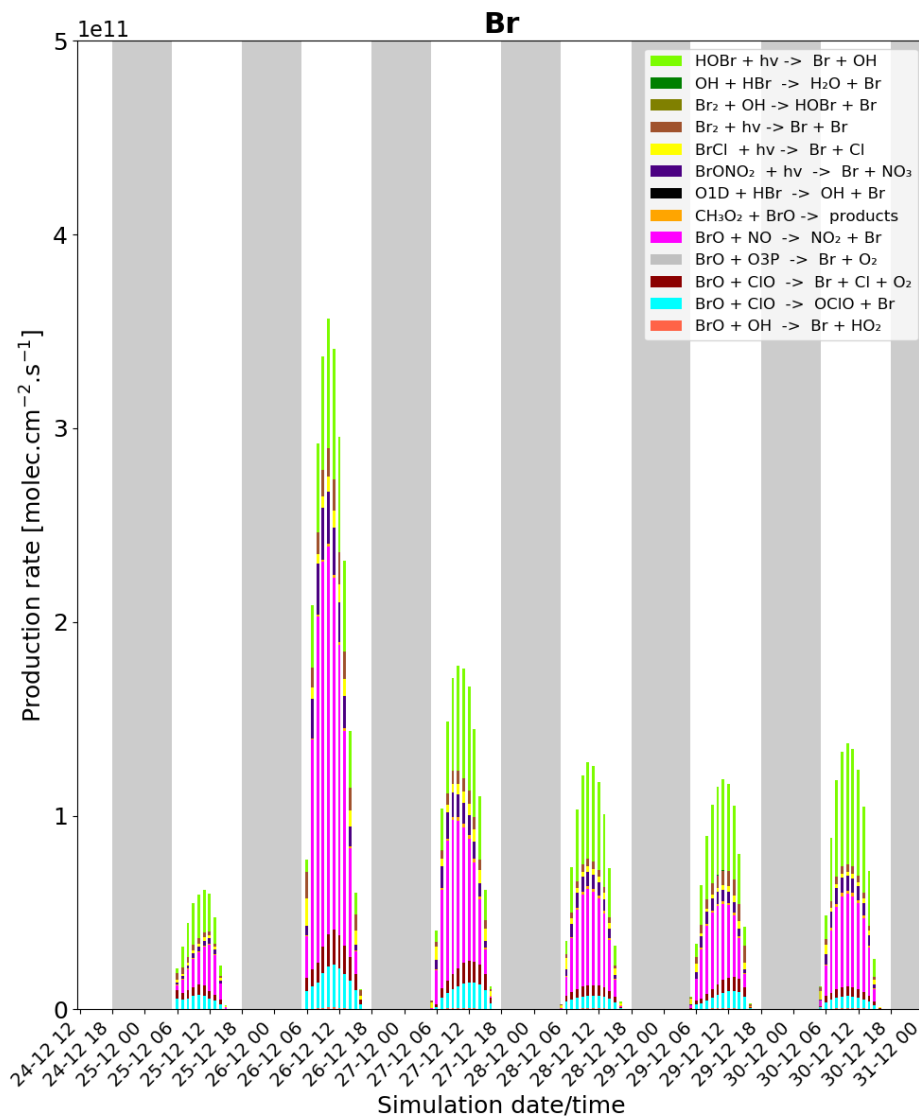



Figure S10. Time evolution of Br production rates in [molec.cm^{-2}.s^{-1}], without the photolysis of BrO and the BrO + BrO → Br + Br + O$_2$ reaction from 24 December at 20:00 to 31 December 2018 at 00:00 UTC in the aged plume.

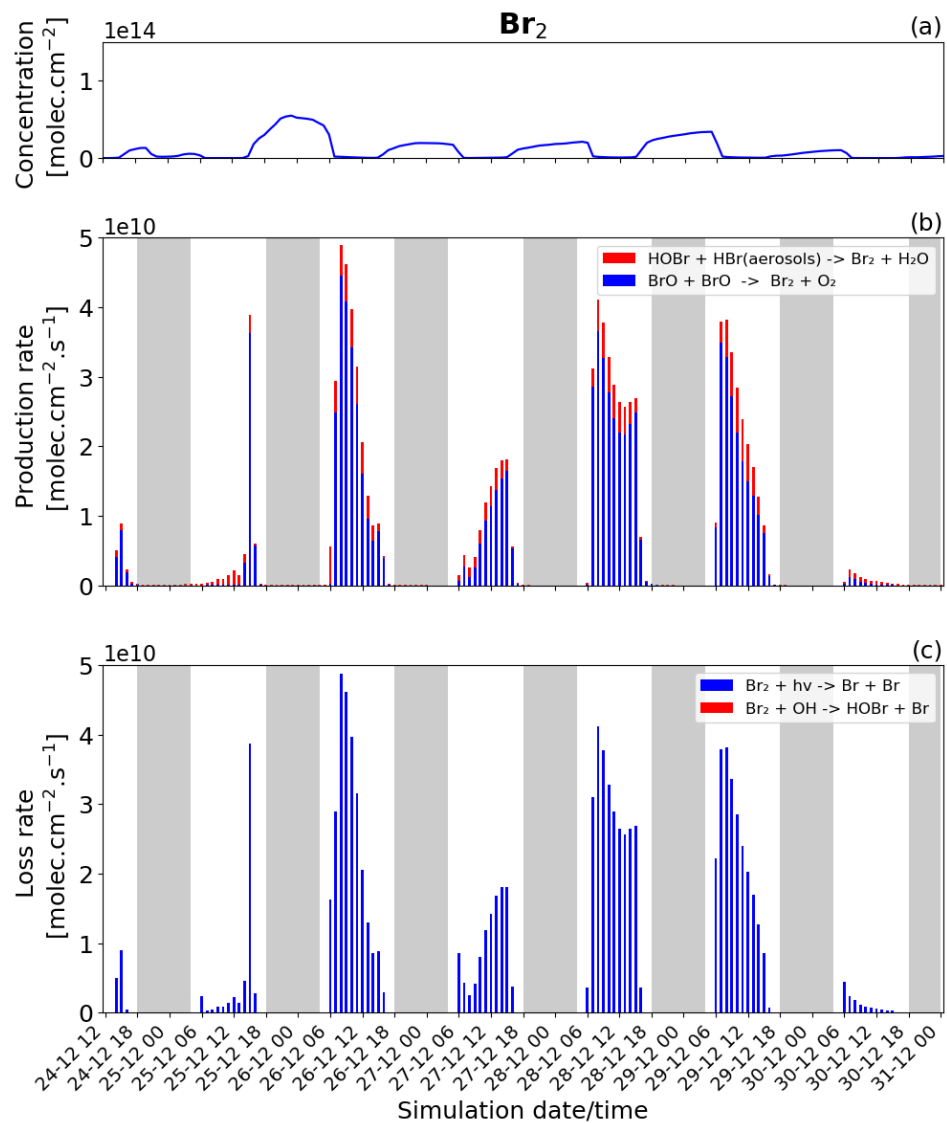



Figure S11. Time evolution of : (a) Br_2 column concentration in [molec.cm^{-2}], (b) production rates and (c) loss rates for Br_2 both in [molec.cm^{-2}.s^{-1}] from 24 December at 14:00 to 31 December 2018 at 00:00 UTC in the young plume.

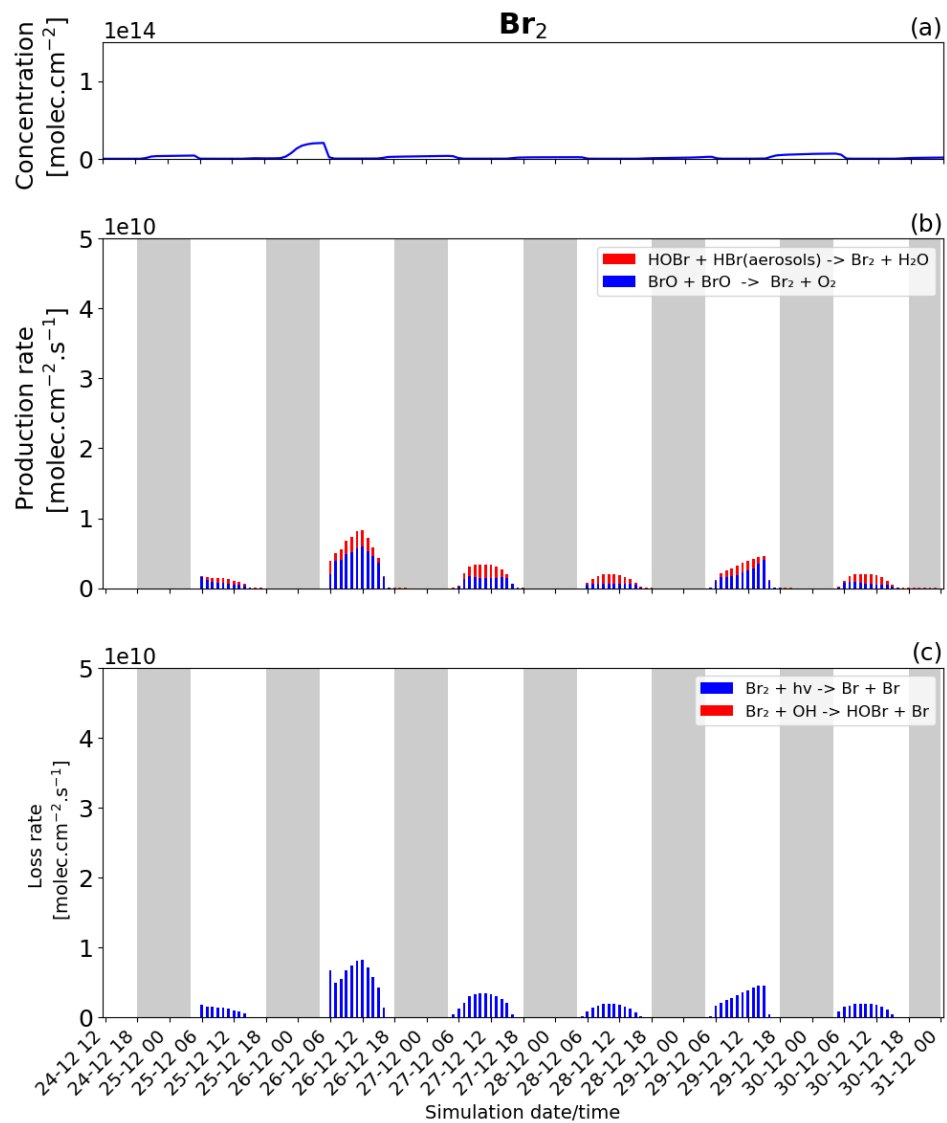
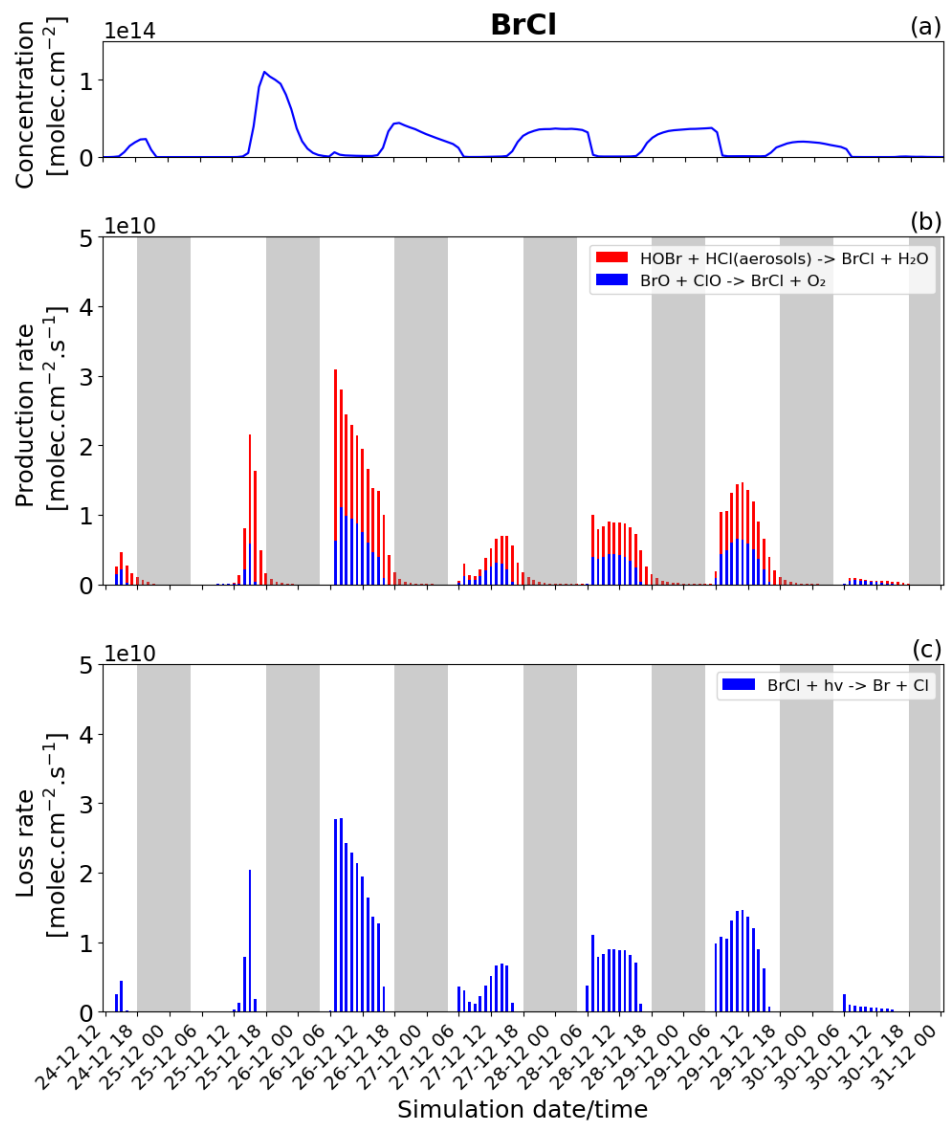



Figure S12. Time evolution of : (a) Br_2 column concentration in [molec.cm^{-2}], (b) production rates and (c) loss rates for Br_2 both in [molec.cm^{-2}.s^{-1}] from 24 December at 20:00 to 31 December 2018 at 00:00 UTC in the aged plume.

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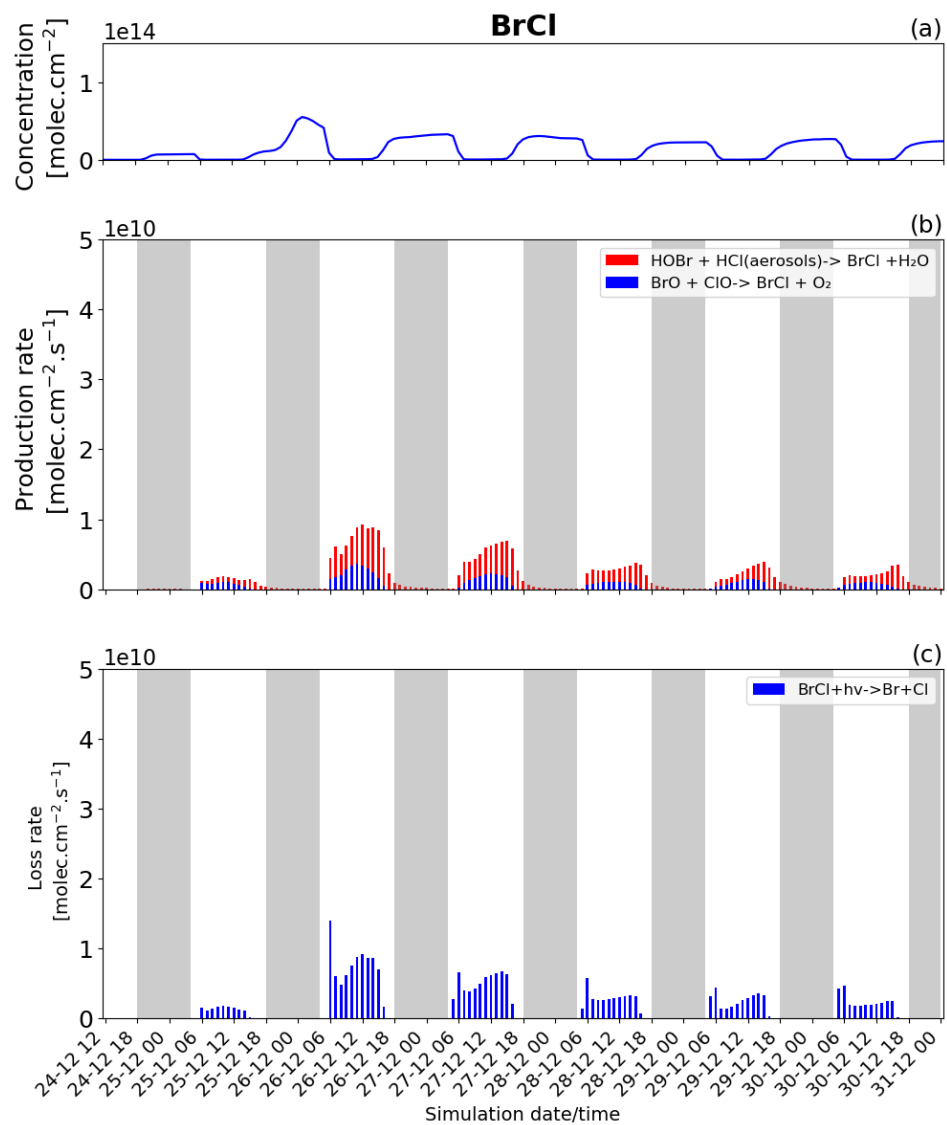


Figure S14. Time evolution of : (a) BrCl column concentration in [molec.cm^{-2}], (b) production rates and (c) loss rates for BrCl both in [molec.cm^{-2}.s^{-1}] from 24 December at 20:00 to 31 December 2018 at 00:00 UTC in the aged plume.

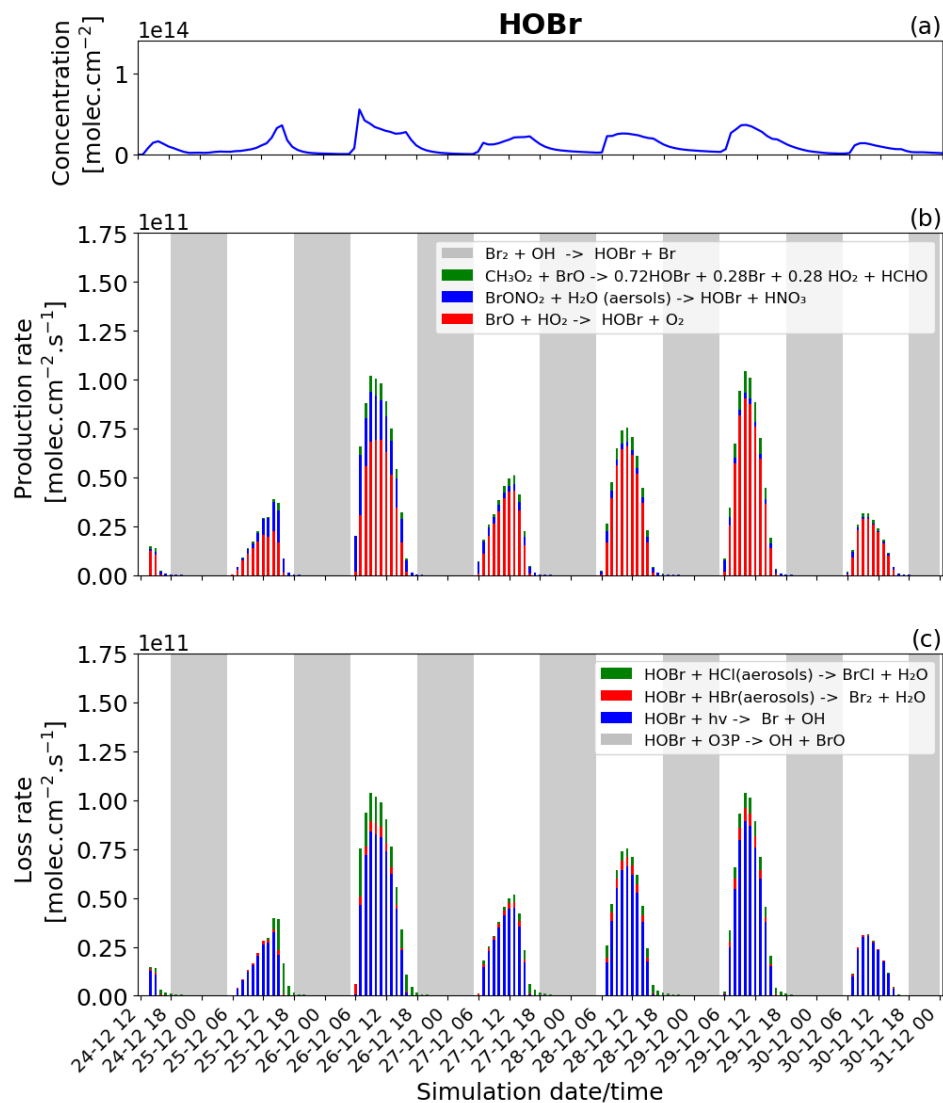



Figure S15. Time evolution of : (a) HOBr column concentration in [molec.cm^{-2}], (b) production rates and (c) loss rates for HOBr both in [molec.cm^{-2}.s^{-1}] from 24 December at 14:00 to 31 December 2018 at 00:00 UTC in the young plume.

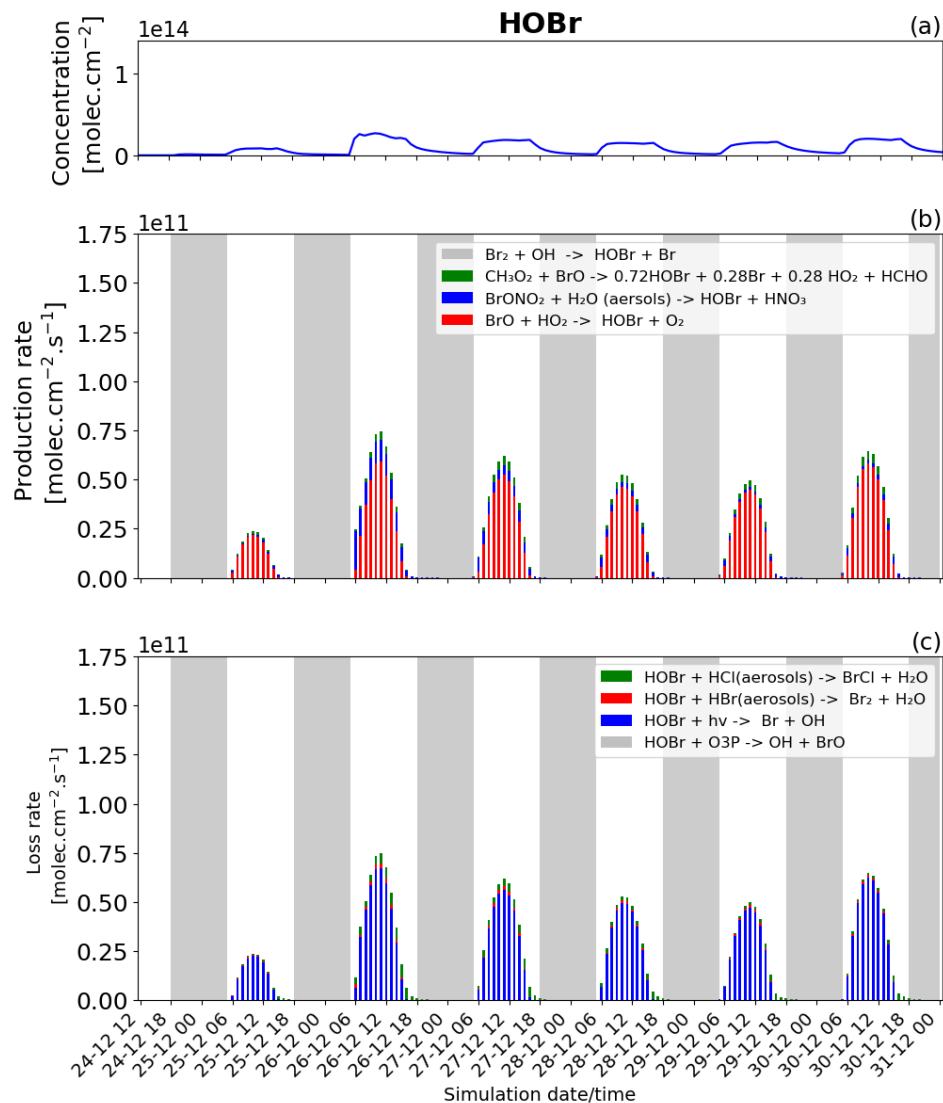
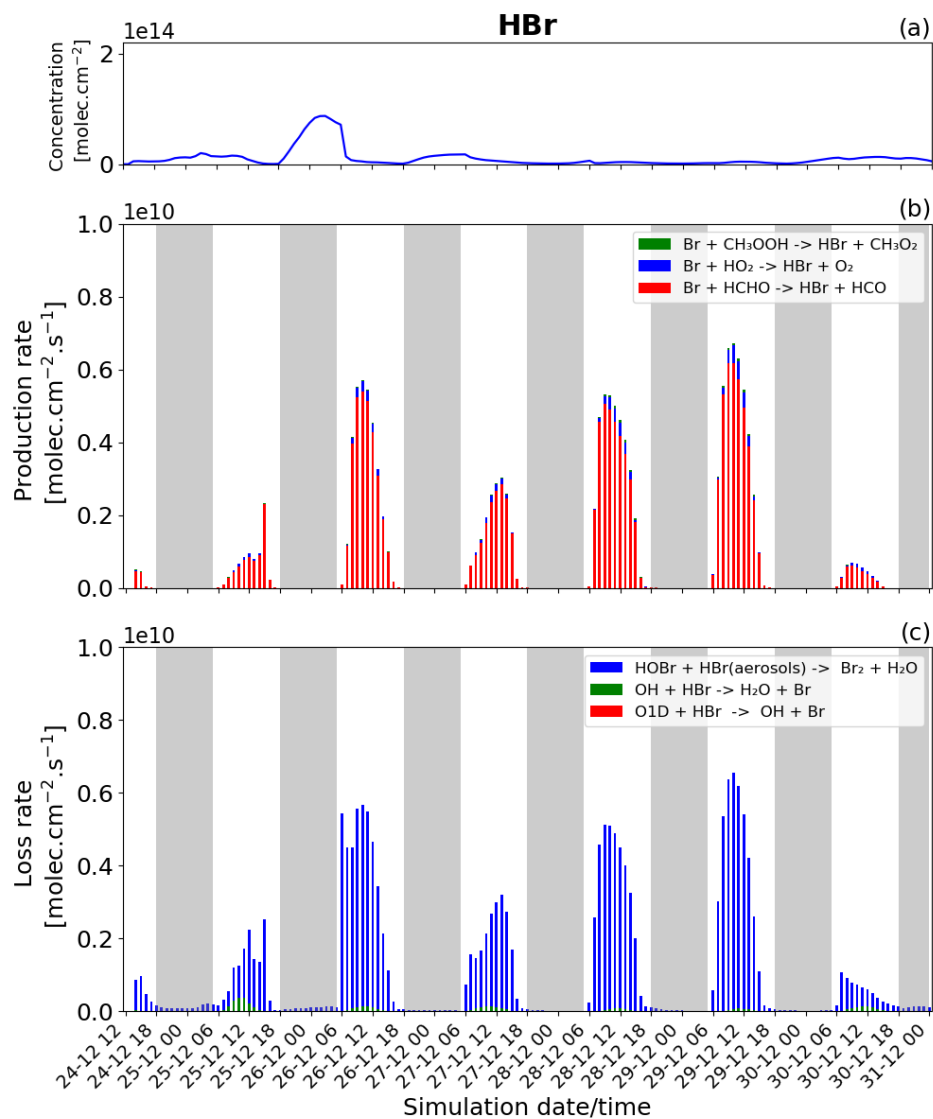



Figure S16. Time evolution of : (a) HOBr column concentration in [molec.cm^{-2}], (b) production rates and (c) loss rates for HOBr both in [molec.cm^{-2}.s^{-1}] from 24 December at 20:00 to 31 December 2018 at 00:00 UTC in the aged plume.

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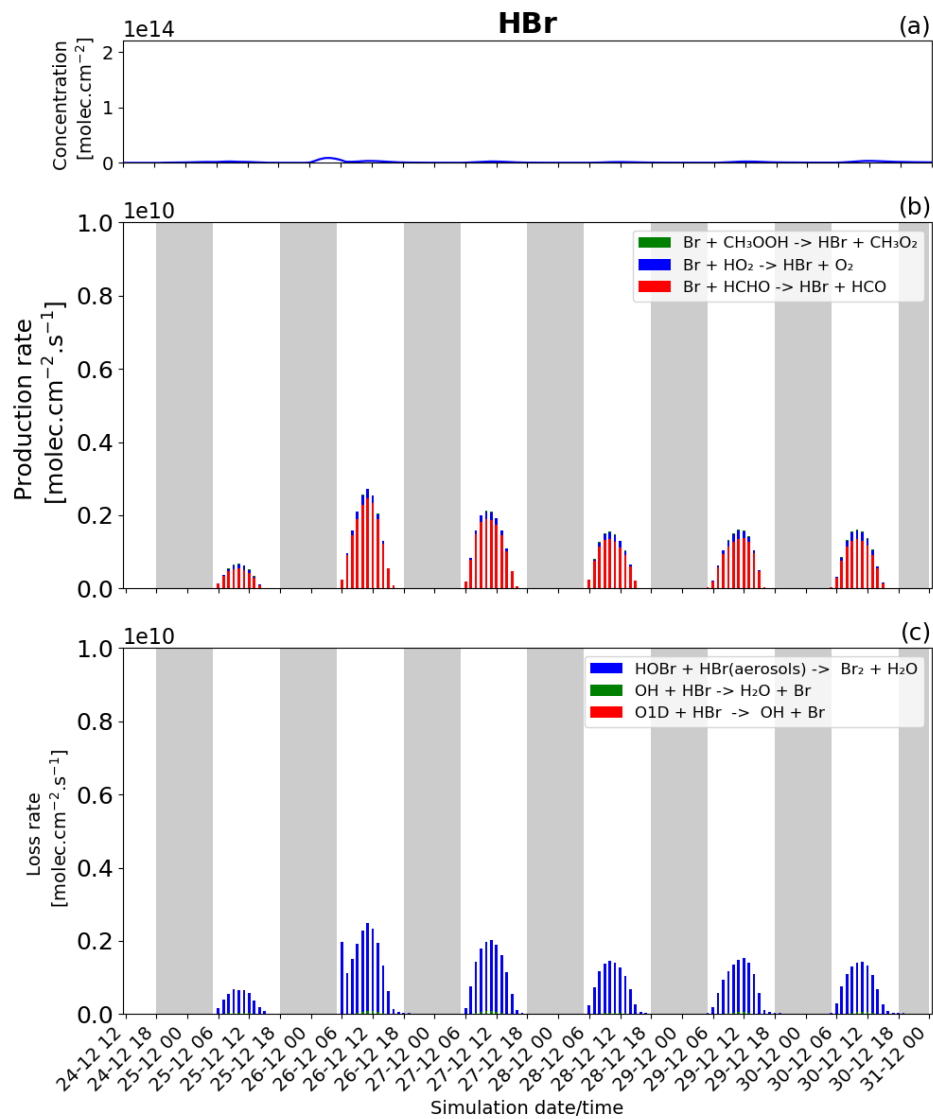
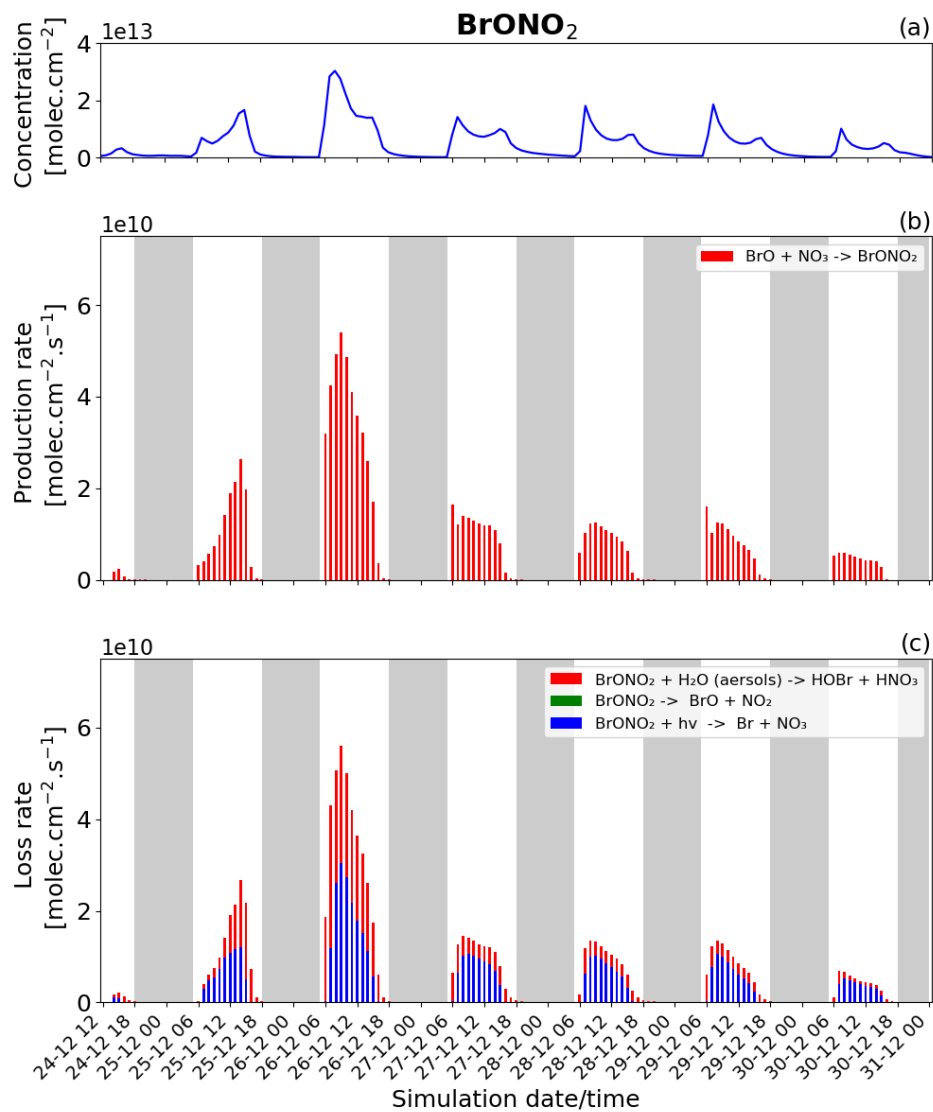


Figure S18. Time evolution of : (a) HBr column concentration in [molec.cm^{-2}], (b) production rates and (c) loss rates for HBr both in [molec.cm^{-2}.s^{-1}] from 24 December at 20:00 to 31 December 2018 at 00:00 UTC in the aged plume.

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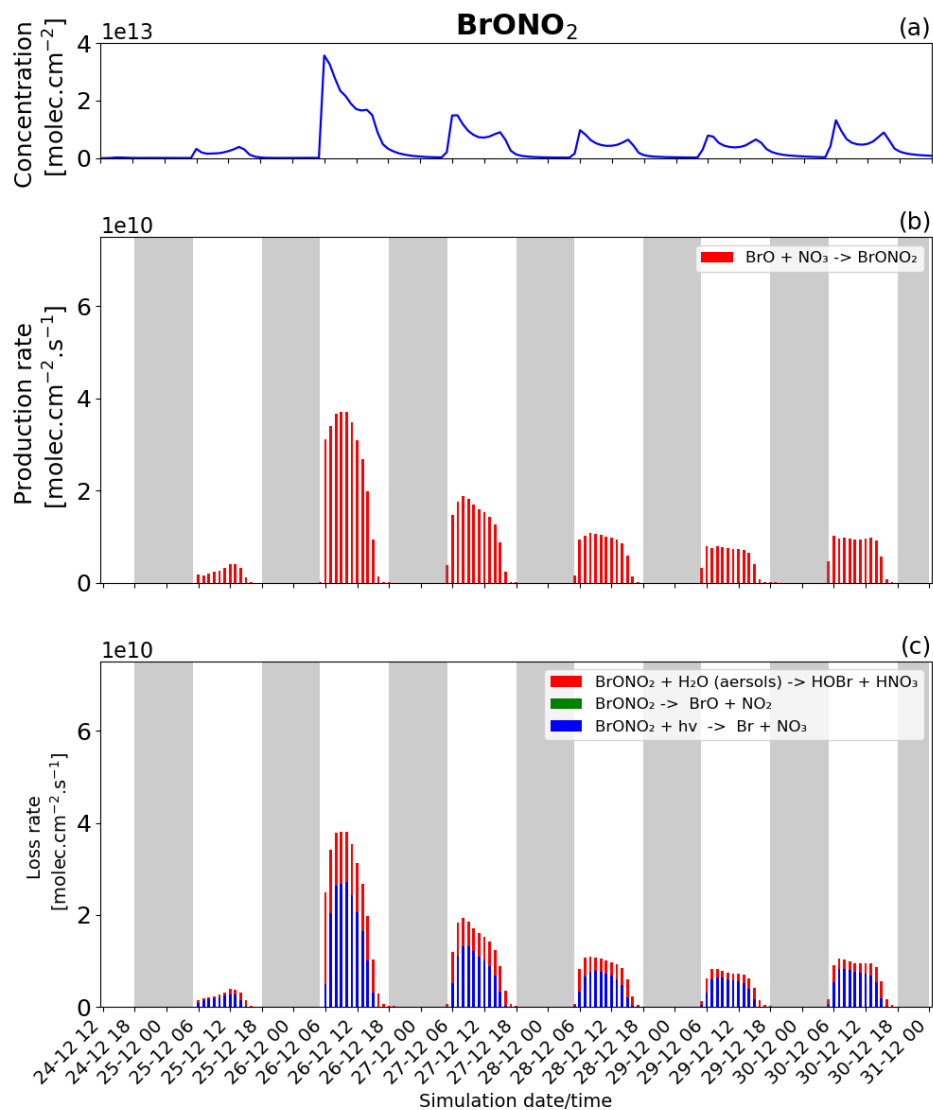
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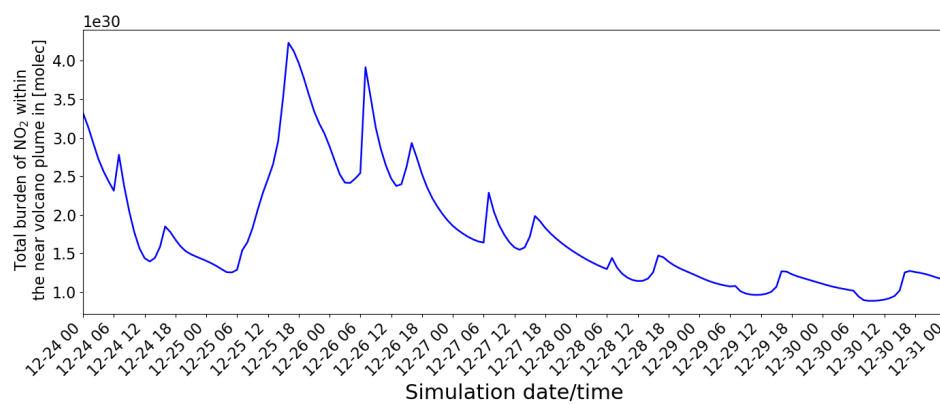
Figure S21. Time evolution of the total burden of the NO$_2$ within plume in [molec] from 24 December at 12:00 to 31 December 2018 at 00:00 UTC in the near volcano domain.