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Supplement of

Future Arctic ozone recovery: the importance of chemistry and dynamics

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As noted in Sect. 2.2 of the manuscript, our UMUKCA REFC2 ensemble of integrations consists of 2 full 1960-2099 integrations (ENS1-2) and 5 shorter runs covering November 1980 to December 2080 (ENS3-7). For technical reasons, data from 5 six-year-long intervals were excluded from the analysis, in particular:

- July 2025 – June 2031 in member number 5 (ENS5)
- 5 - April 2074 – March 2080 in member number 5 (ENS5)
- April 1996 – March 2002 in member number 6 (ENS6)
- April 2043 – March 2049 in member number 6 (ENS6)
- August 1982 – July 1988 in member number 7 (ENS7)

An example of the resulting timeseries is shown in Fig. S2 for 65-90°N March total ozone column.

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Supplementary Tables and Figures

Reaction	NAT PSCs	ICE PSCs
$\text{HCl} + \text{ClONO}_2 \rightarrow 2 \times \text{Cl} + \text{HNO}_3$	$\gamma = 0.3$	$\gamma = 0.3$
$\text{ClONO}_2 + \text{H}_2\text{O} \rightarrow \text{HOCl} + \text{HNO}_3$	$\gamma = 0.006$	$\gamma = 0.3$
$\text{N}_2\text{O}_5 + \text{H}_2\text{O} \rightarrow 2 \times \text{HNO}_3$	$\gamma = 0.0006$	$\gamma = 0.03$
$\text{N}_2\text{O}_5 + \text{HCl} \rightarrow \text{Cl} + \text{NO}_2 + \text{HNO}_3$	$\gamma = 0.003$	$\gamma = 0.03$
$\text{HOCl} + \text{HCl} \rightarrow \text{H}_2\text{O} + 2 \times \text{Cl}$	$\gamma = 0.3$	$\gamma = 0.3$

Table S1. Heterogeneous chemical reactions on NAT and ICE PSCs in the model and their reactive uptake coefficients, γ .

	65-90°N	PV _{850K} ≥ 600 PVU	PV _{450K} ≥ 30 PVU	PV _{450K} ≥ 35 PVU
2063	39	44	46	43
2060	18	23	23	6

Table S2. Cumulative halogen induced ozone loss [DU] (1 Nov-30 Mar, 1-25 km) for the two case study model years 2063

15 and 2060, calculated for the 65-90°N mean and a number of polar vortex edge definitions.

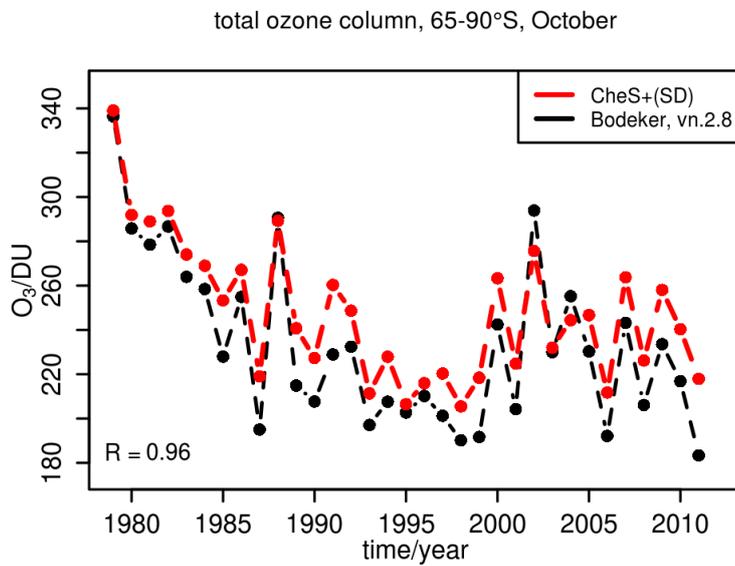
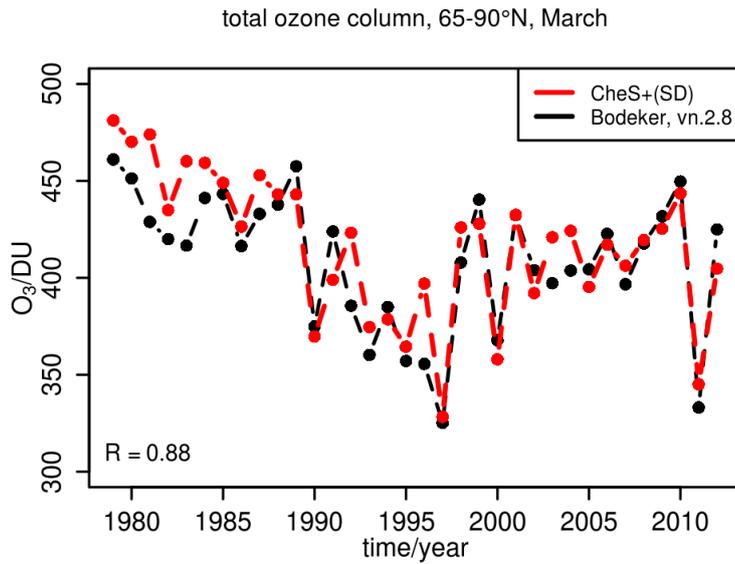


Figure S1. The evolution of total ozone column [DU] over 1979-2012 for 65-90°N March (top) and over 1979-2011 for 65-90°S October (bottom) in the nudged UMUKCA CCM1 REFC1 CheS+(SD) integration (red) and observations (black, Bodeker total ozone column dataset: Bodeker et al., 2005; Müller et al., 2008). See Sect. 2.1 for details.

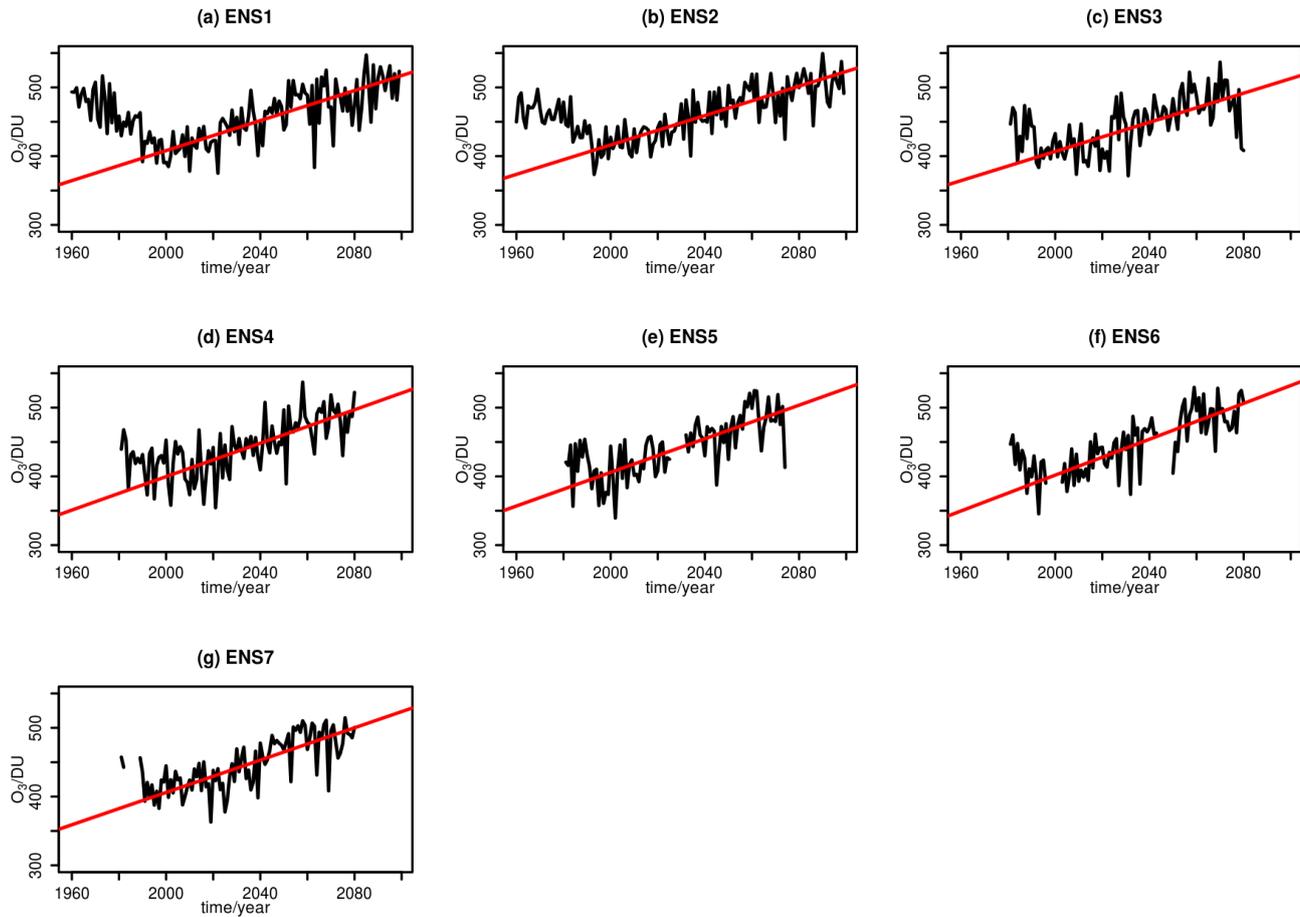


Figure S2. (a-g) Timeseries of 65-90°N March total column ozone [DU] for individual ensemble members as labelled (black). Red lines show the corresponding linear trends over the 2000-2080 period.

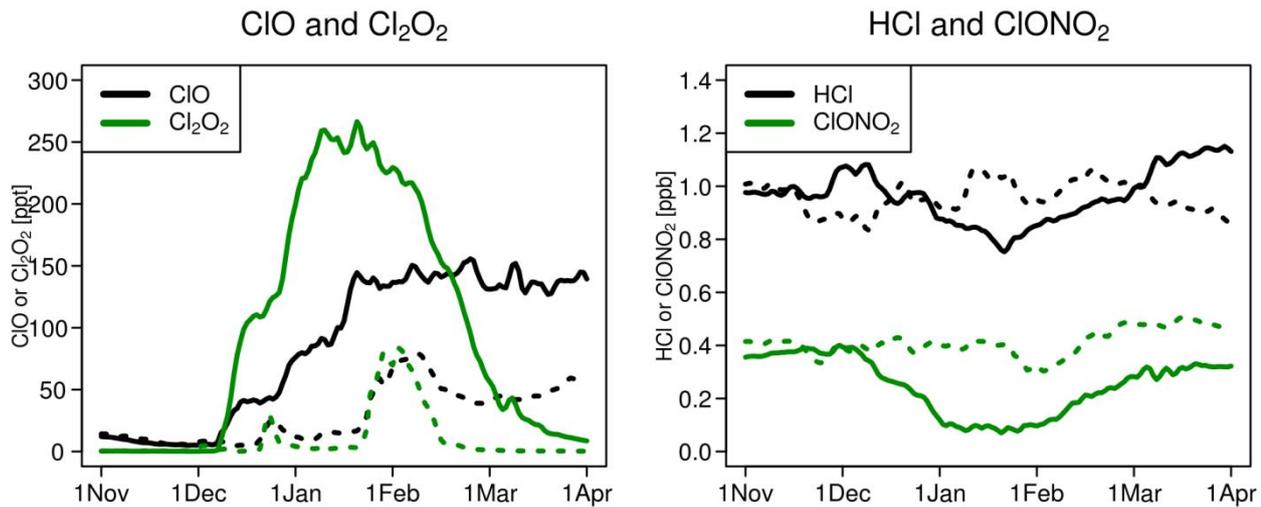


Figure S3. Timeseries of 65-90°N daily mean ClO and Cl₂O₂ [ppt] (left) and HCl and ClONO₂ [ppb] (right) at 21.5 km for the model case study years 2063 (solid lines) and 2060 (dashed lines).

1 March, 2060

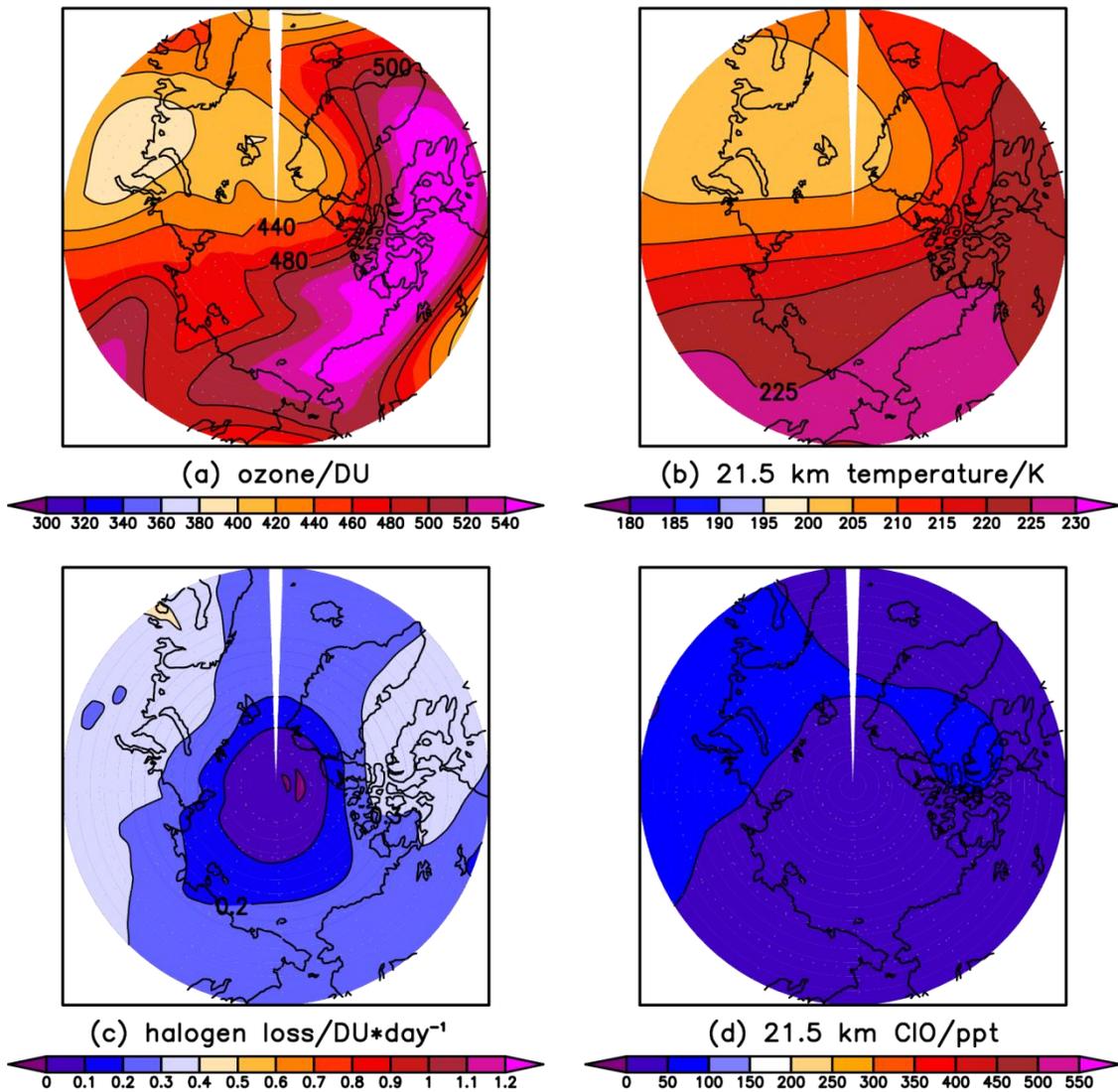


Figure S4. Daily mean total ozone column [DU] (a), temperature at 21.5 km [K] (b), halogen induced ozone loss in the 1-25 km layer [DU/day] (c) and ClO [ppt] at 21.5 km (d) simulated on 1 March in the case study model year 2060.

1 March, 2063

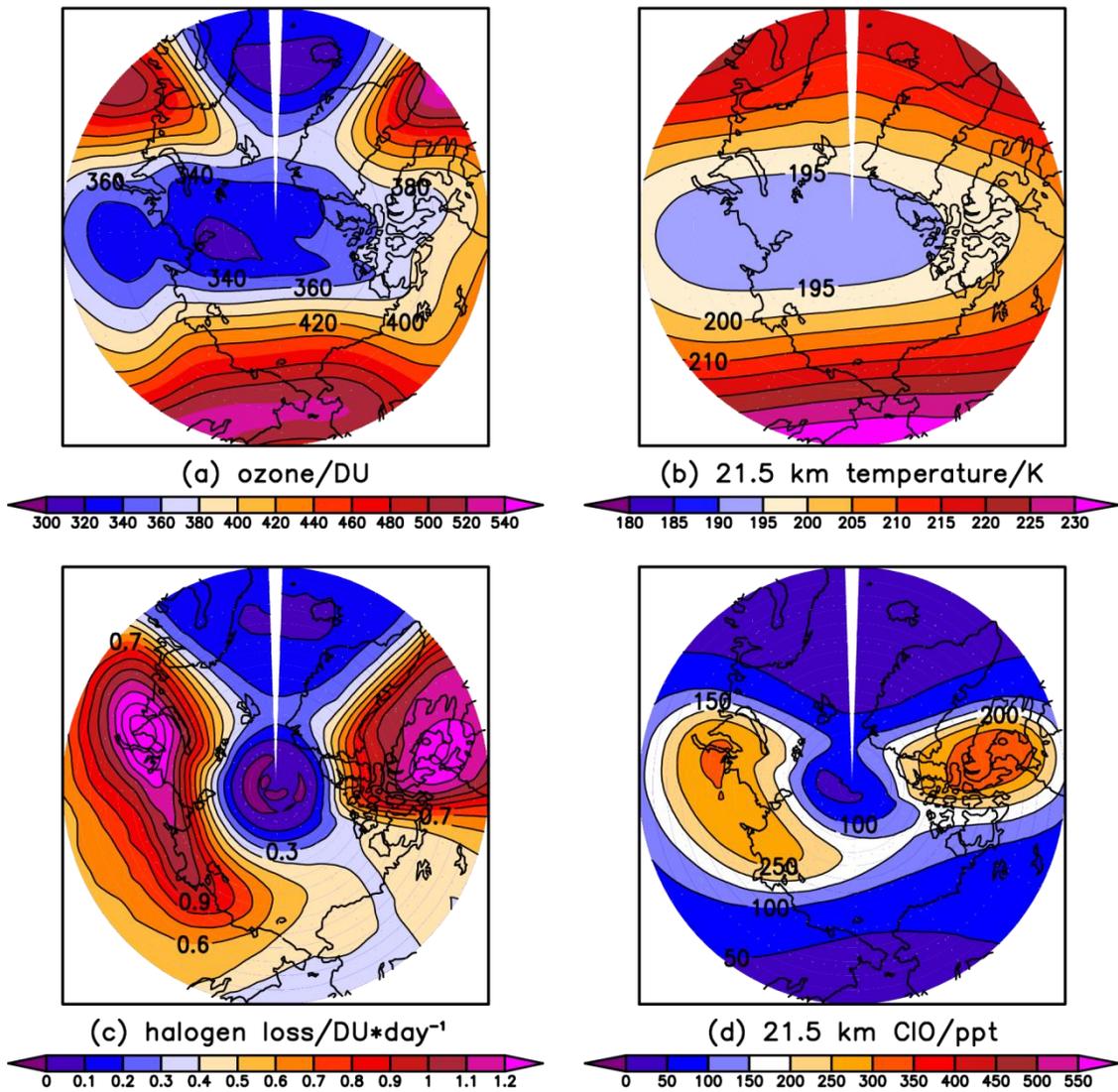


Figure S5. As in Fig. S4 but for the case study model year 2063.