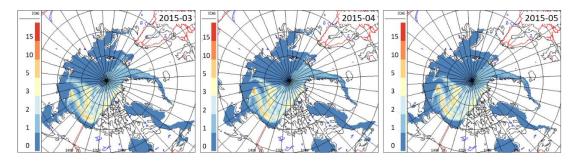
Supplementary Materials for

Modelling Arctic Lower Tropospheric Ozone: processes controlling seasonal variations

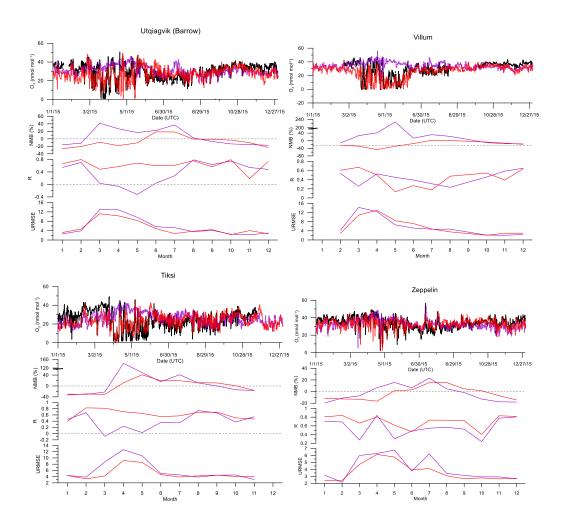
Wanmin Gong et al.

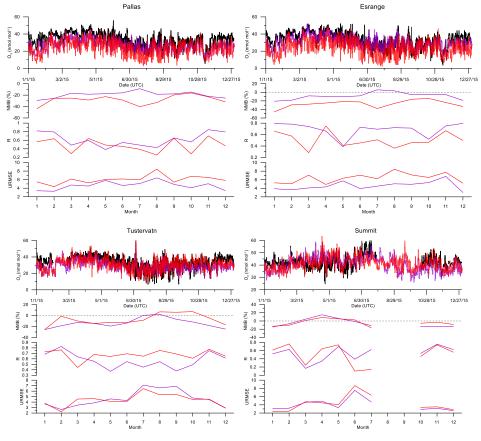
Correspondence: Wanmin Gong (wanmin.gong@ec.gc.ca)

Figures (SF.1 to SF.10)

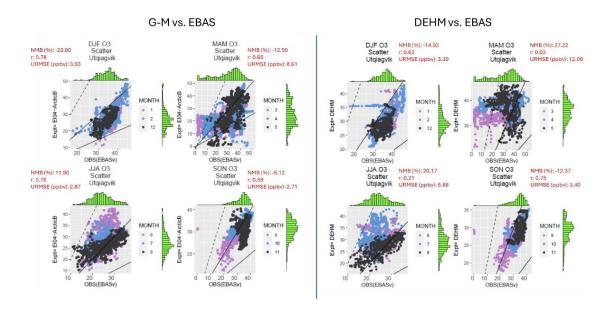


SF.1 Monthly mean sea ice age (year), for March, April, and May 2015, from the EASE-Grid Sea Ice Age Version 4 dataset used by GEM-MACH.



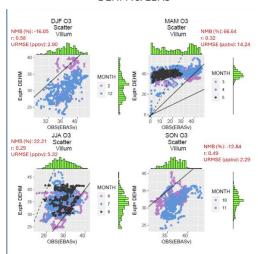


SF.2 O_3 time series comparisons between models (GEM-MACH and DEHM) and observations at Arctic surface sites accompanied by monthly evaluation statistical metrics (NMB, R, URMSE).

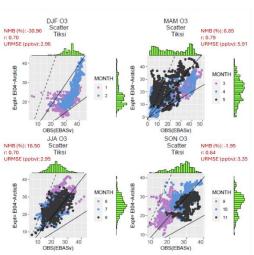


G-M vs. EBAS

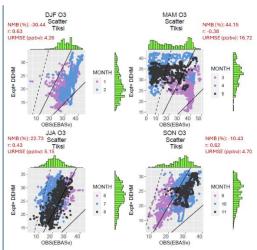
DEHM vs. EBAS



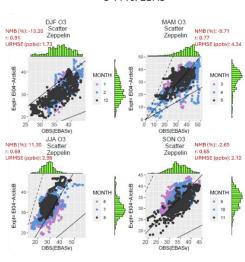
G-M vs. EBAS



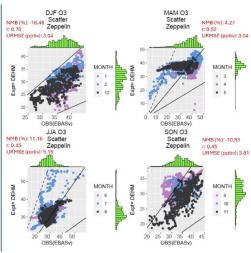
DEHM vs. EBAS



G-M vs. EBAS

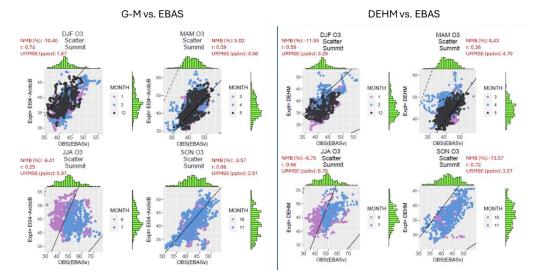


$\mathsf{DEHM}\,\mathsf{vs}.\,\mathsf{EBAS}$

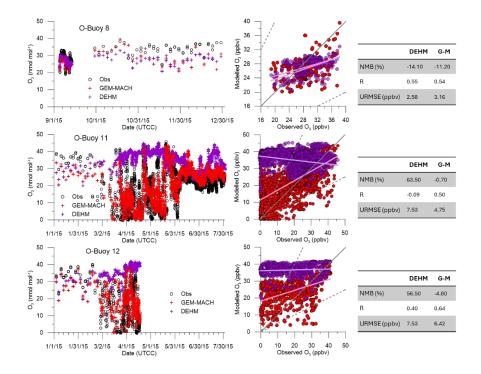


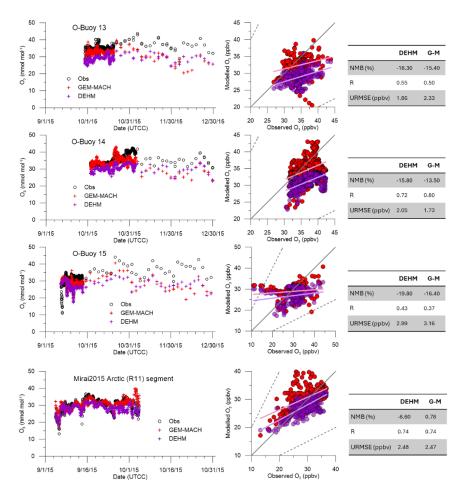
G-M vs. EBAS DEHM vs. EBAS MAM O3 MAM O3 NMB (%): -25.60 r: 0.56 URMSE (ppbv): 4.24 NMB (%): -17.51 r: 0.52 URMSE (ppbv): 5.08 JJA O3 NMB (%): -14.58 Scatter r: 0.55 URMSE (ppbv): 5.62 m SON 03 Scatter Pallas SON 03 NMB (%): -34.20 r: 0.35 URMSE (ppbv): 5.15 NMB (%): -20.00 r: 0.61 URMSE (ppbv): 4.94 NMB (%): -18.04 r: 0.73 URMSE (ppbv): 4.75 G-M vs. EBAS DEHM vs. EBAS DJF O3 NMB (%):-19.33 Scatter r: 0.82 Esrange URMSE (ppbv): 3.54 MAM 03 Scatter Esrange MAM 03 Scatter Esrange NMB (%): -24.80 r: 0.51 URMSE (ppbv): 4.57 NMB (%): -9.36 r: 0.64 URMSE (ppbv): 4.78 MONTH MONTH UBS(EBAS) JJA O3 NMB (%): -29.00 Scatter r: 0.44 Esrange URMSE (ppbv): 5.51 JJA O3 NMB (%):-0.12 r: 0.70 URMSE (ppbv): 4.88. SON O3 SON O3 NMB (%): -18.30 r: 0.57 URMSE (ppbv): 5.94 NMB (%): -5.28 r: 0.70 URMSE (ppbv): 5.73 Scatter Esrange MONTH MONTH G-M vs. EBAS DEHM vs. EBAS DJF O3 NMB (%): -14.20 Scatter r: 0.78 Tustervatn URMSE (ppbv): 2.12 MAM O3 Scatter Tustervatn MAM O3 Scatter Tustervatn NMB (%): -15.24 r: 0.60 URMSE (ppbv): 4.09 NMB (%); -12,00 r: 0.66 URMSE (ppbv); 3.34 MONTH Expt= DEHM OBS(EBASV) SON O3 Scatter Tustervatn : 0.77 URMSE (ppbv): 3.35 SON O3 Scatter Tustervatn JJA O3 NMB (%): -4.80 Scatter r: 0.77 URMSE (ppbv): 3.36 JJA O3 NMB (%): -12.39 r: 0.52 URMSE (ppbv): 5.69 MONTH 20 40 6 OBS(EBASV)

20 40 60 OBS(EBASv)

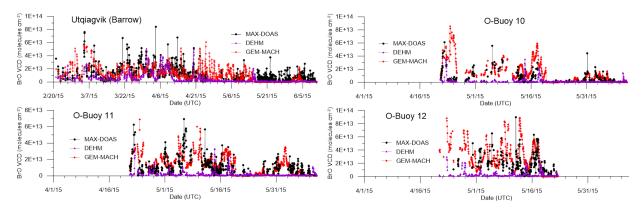


SF.3 Seasonal statistical evaluation (NMB, R, URMSE) based on 2015 hourly model and observational O_3 data at Arctic surface sites for GEM-MACH and DEHM, respectively.

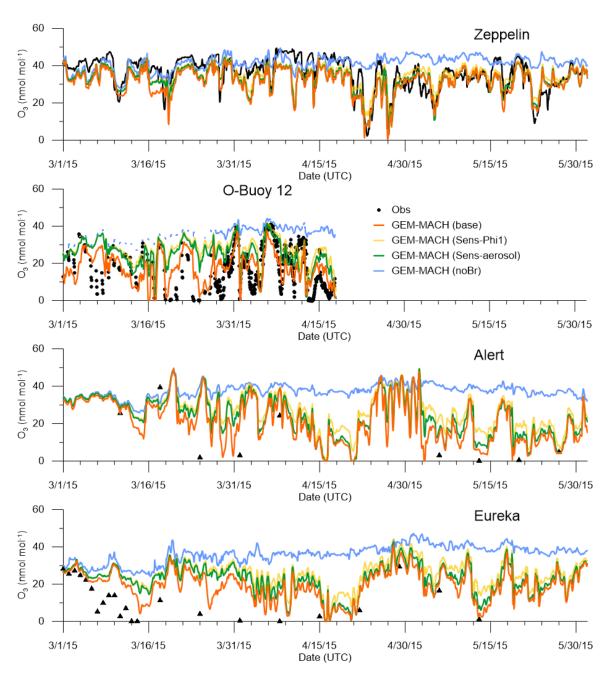




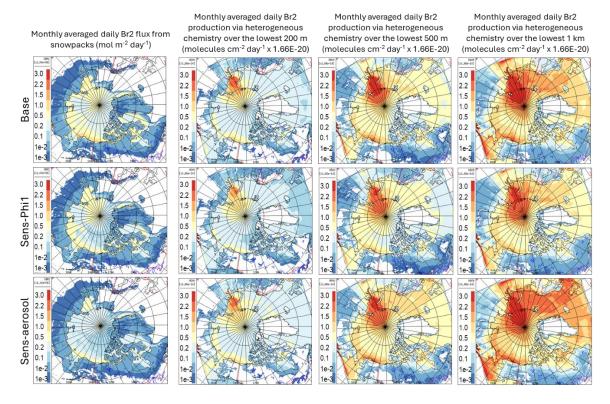
 $\mathbf{SF.4}\ O_3$ time series comparison between model and observation for individual O-buoy deployment and Mirai cruise during 2015.



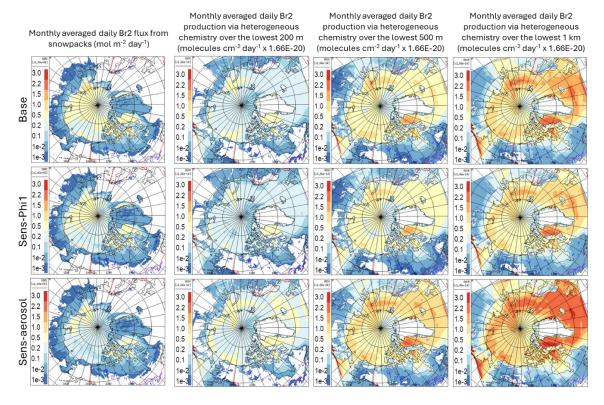
SF.5 Comparison of modelled BrO (GEM-MACH in red, DEHM in purple) against MAX-DOAS observations (black) at Utqiagvik and on O-buoys during 2015.



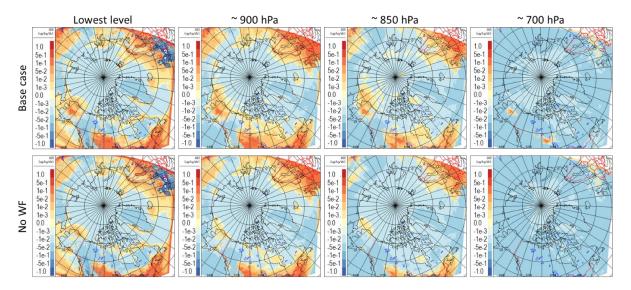
SF.6 GEM-MACH simulated O_3 time series from the base (red) and sensitivity runs, Sens-Phi1 (turquoise) and Sens-aerosol (green), compared with observations (black) over Beaufort Sea (O-Buoy 12) and at coastal sites: Zeppelin, Alert, and Eureka. Also plotted are the modelled O_3 timeseries from the No-bromine run (blue).



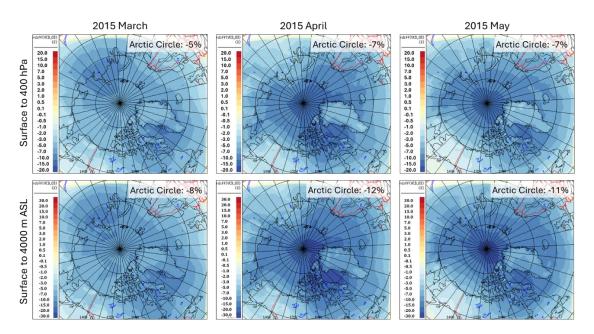
SF.7 GEM-MACH modelled monthly mean (2015 April) Br_2 daily flux from snowpacks (leftmost column) and Br_2 daily production from aerosol heterogeneous reaction over the lowest 200 m (2nd column from left), the lowest 500 m (3rd column from left), and the lowest 1 km (rightmost column), all in moles m^{-2} , from the base (top), Sens-Phi1 (middle), and Sens-aerosol runs (bottom).



SF.8 Same as SF.7 but for 2015 May.



SF.9 July monthly net O_3 chemical tendency at model levels (from left to right): lowest surface level, ~ 900 hPa, ~850 hPa, and ~ 700 hPa, from the GEM-MACH base annual simulation (with wildfires) (top row) and the GEM-MACH simulation without the wildfire emissions in the model LAM domain (bottom row).



SF.10 Reduction in monthly mean O_3 partial columns due to snowpack bromine in GEM-MACH, surface to 400 hPa (top row) and surface to 4000 m ASL (bottom row), shown in relative difference (%): (Base-noBr)/noBr*100. The corresponding reductions in pan-Arctic (> 66.5°N; "Arctic Circle") integrated monthly mean O_3 partial columns due to snowpack bromine are indicated in each plot.