Supporting information for

Exceptional loss in ozone in the Arctic winter/spring 2020

Jayanarayanan Kuttippurath[1]*, Wuhu Feng[2,3], Rolf Müller[4], Pankaj Kumar[1], Sarath Raj[1],

Gopalakrishna Pillai Gopikrishnan[1], Raina Roy[5]

[1]CORAL, Indian Institute of Technology Kharagpur, Kharagpur–721302, India.

[2] National Centre for Atmospheric Science, University of Leeds, Leeds, LS2 9PH, UK

[3] School of Earth and Environment, University of Leeds, Leeds, LS2 9JT, UK

[4]Forschungszentrum Jülich GmbH (IEK-7), 52425 Jülich, Germany

[5]Department of Physical Oceanography, Cochin University of Science and Technology, Kochi, India

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This document provides Supporting Information for the main ACP paper. This information consists of four supplementary figures, which provide further information about the stratospheric meteorological conditions since 1979 to 2020 or present results for additional ozone and N_2O correlation, ozone loss and observed ozone evolution from ozonesonde measurements.

Figure S1 shows the time series of area of PSC (APSC) and volume of PSC (VPSC) at 460 K (~50 hPa) in the Arctic winters from 1979 to 2020, estimated from the MERRA-2 reanalysis dataset. APSC and VPSC are calculated using the definition from Rex et al. [2005]. Shaded range is their standard deviation from the mean.

Figure S1b is the temporal evolution of Dec-Feb (black line) and Dec-March (grey line) averaged temperature, zonal winds, vortex area, and heat flux in the Arctic winters from 1979 to 2020, as estimated using the MERRA-2 data. The linear trend values for these variables are calculated and given in the corresponding panels.

Figure S2 shows the time evolution correlation between observed ozone and N_2O inside the polar vortex for two cold Arctic winter/spring 2010/11 and 2019/20.

Figure S3 is the derived monthly averaged ozone loss with its standard deviation (horizontal bars) from 350-700 K inside the polar vortex based on the tracer descent method.

Figure S4 shows the temporal evolution of observed minimum ozone above 400 K by the ozonesonde at Eureka and Alert stations.

Table 1 lists total days when the observed total column ozone value is less than 220 DU anywhere inside the polar vortex from OMPS satellite measurement and MERR-2 reanalysis dataset.

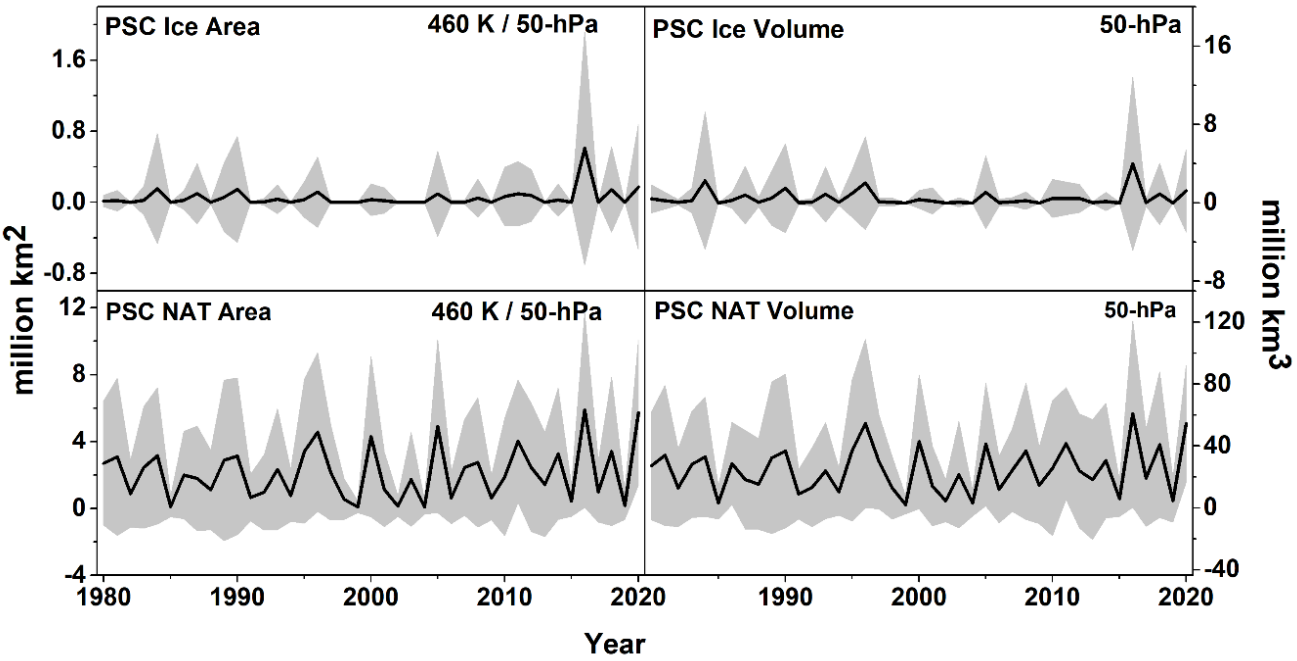

Figure S1: The temporal evolution of area of PSC and volume of PSC in the Arctic winters from 1979 to 2020, as estimated using the MERRA-2 data. The shaded area is the standard deviation from the mean.

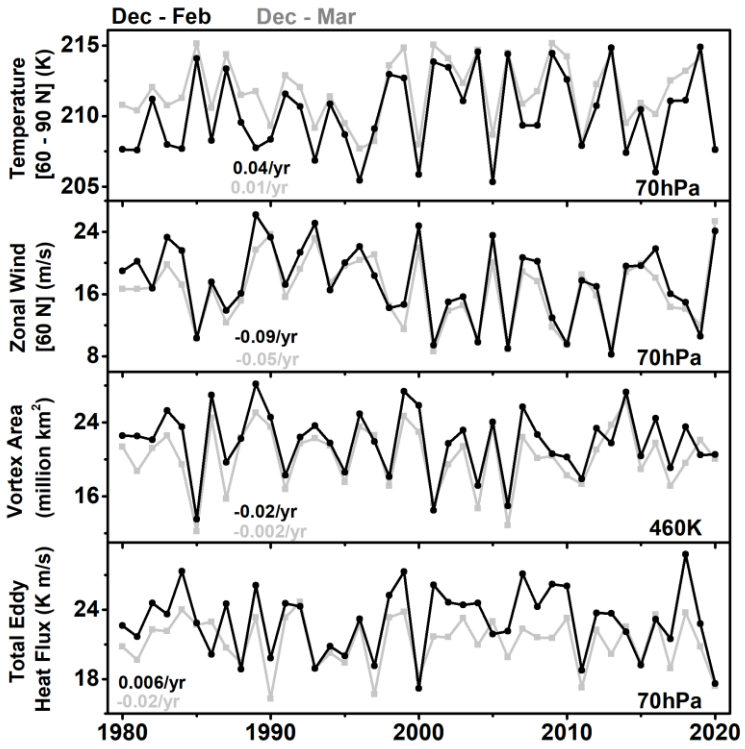

Figure S1b: The temporal evolution of temperature, zonal winds, vortex area, and heat flux in the Arctic winters from 1979 to 2020, as estimated using the MERRA-2 data.

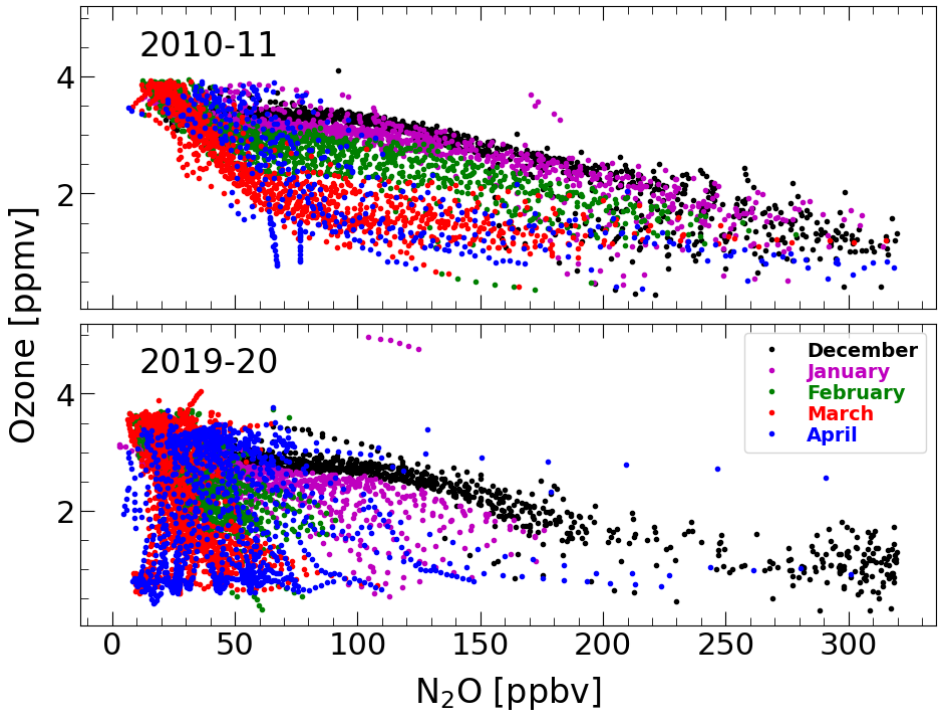

Figure S2: The time evolution correlation between ozone and N_2O in the Arctic winter 2020. The measurements selected inside the vortex.

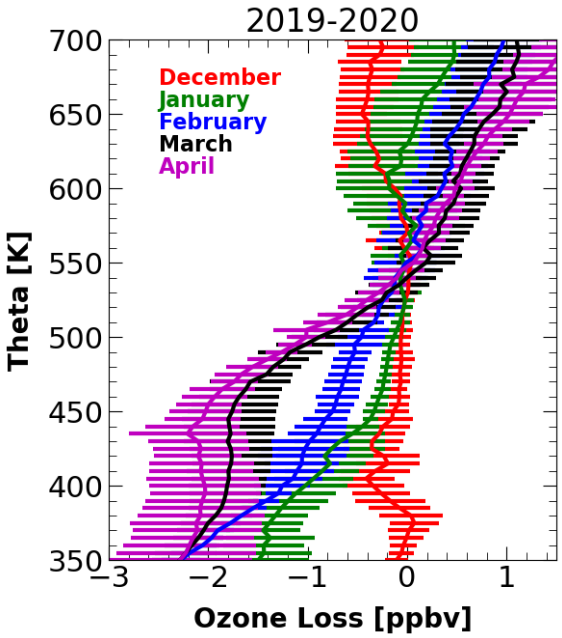

Figure S3: The monthly averaged ozone loss and the standard deviation (horizontal bars) computed using the tracer descent method.

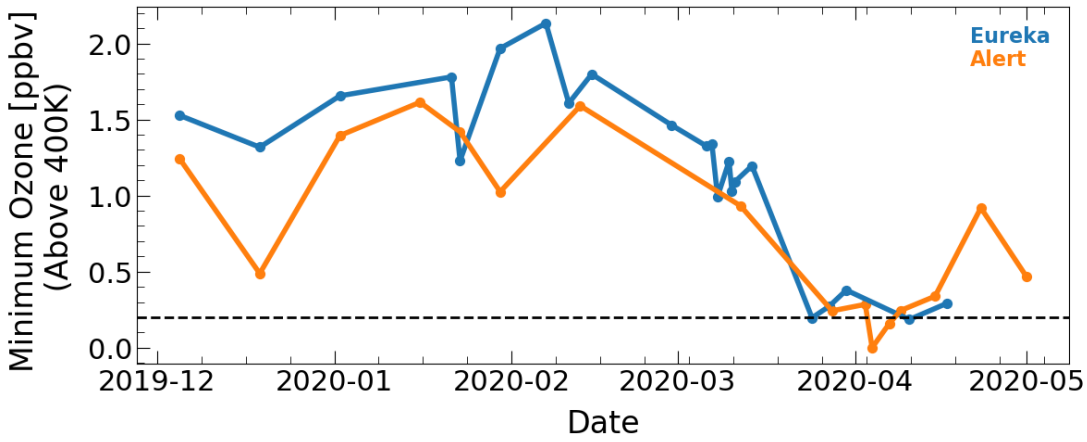

Figure S4: The temporal evolution stratospheric ozone as observed by the ozonesonde at Eureka and Alert stations.

Table 1: Total days when the observed total column ozone value is less than 220 DU anywhere inside the polar vortex

OMPS (24 Days)

- Dec 01 – 05 (5 Days)
- Jan 01 – 02 (2 Days)
- Jan 23, 25 – 30 (7 Days)
- Mar 05, 12 – 19, 28 (10 Days)

MERRA-2 (19 Days)

- Dec 01 – 05 (5 Days)
- Jan 25 – 26 (2 Days)
- Mar 05, 12, 17 – 22 (8 Days)
- Apr 06 – 07 (2 Days)