



## Supplement of

## Analysis of 24 years of mesopause region OH rotational temperature observations at Davis, Antarctica – Part 2: Evidence of a quasi-quadrennial oscillation (QQO) in the polar mesosphere

W. John R. French et al.

Correspondence to: W. John R. French (john.french@aad.gov.au)

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## Supplementary Figures

- 2 French, Klekociuk and Mulligan Analysis of 24 years of mesopause region OH
- 3 rotational temperature observations at Davis, Antarctica. Part 2: Evidence of a quasi-
- 4 quadrennial oscillation (QQO) in the polar mesosphere.
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Figure S1. (a) OH layer equivalent temperatures (black) calculated from SABER VER
weighted temperature profiles and the centroid altitude of a Gaussian fit to the SABER
VER profiles (red) for the years 2002 to 2018 (day 106-259 of each year). The values are
the average of all profiles measured by SABER within a 500 km radius of Davis station.
(b) A scatter plot of the OH layer equivalent temperatures and the corresponding altitude
of the OH layer shown in panel (a).





Figure S2. Additional pressure levels to compliment Figure 2b showing time series of
 Aura/MLS [AMJJAS] polar cap (65-85°S) averages at the native pressure levels indicated.

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Figure S3. Composites of the ERA5 [AMJJAS] zonal wind anomaly, for cold, mid and warm years of the Davis detrended winter average QQO signal. Pressure levels are indicated on the right hand colour bar. The colour scales are in m/s. Hashed areas on the plots are significant at the 90% level.





Figure S4. Time series of Sea Surface Temperature (SST) anomalies for the regions marked
 A, B, C and D on Fig. 5 compared to the Davis OH and Aura/MLS residual temperatures.
 Correlation coefficients for each series are provided in the legend caption.

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Figure S5. Davis OH winter mean residual temperatures (K) (black line; 1995-2018), and the corresponding 10 hPa (blue) and 30 hPa (yellow) standardized monthly averaged zonally averaged zonal wind (m/s) at the equator (known as the Quasi-Biennial Oscillation (QBO). QBO data were obtained from the 30 hPa and 10 hPa Singapore QBO data (https://www.geo.fu-berlin.de/en/met/ag/strat/produkte/qbo/).



Figure S6. Davis OH winter mean residual temperatures (K) (black line; 1995-2018), and the corresponding values of the Multivariate El Nino Southern Oscillation Index (MEIv2).

38 The time series is bimonthly so the Jan value represents the Dec-Jan value and is centered

39 between the months. Details and current values were obtained from NOAA ESRL (Earth

40 System Research Laboratory) Physical Sciences Division (PSD) MEI webpage

41 (https://www.esrl.noaa.gov/psd/data/correlation/meiv2.data).





48 Figure S7. Detrended Davis OH winter mean temperatures compared to the Annual Indian

49 Ocean (blue line; R=-0.51) and Amundsen-Bellinghausen Sea Region (green line; R=-

50 0.24) Sea Ice Area (Mkm<sup>2</sup> from Parkinson, 2019). Note inverted scale for sea ice area.

-0.3



51 52 Figure S8. Wavelet spectra of CESM-WACCM Ref-C2 runs for CCMI-1 of polar cap

53 average (65°S - 85 °S) temperature for AMJJAS. Shown are spectra for each of 3 ensemble 54 members (columns) at three pressures (rows; 0.15 hPa, 0.5 Pa (0.005 hPa) and 0.01 Pa 55 (0.0001 hPa)).