

## Supplementary materials:

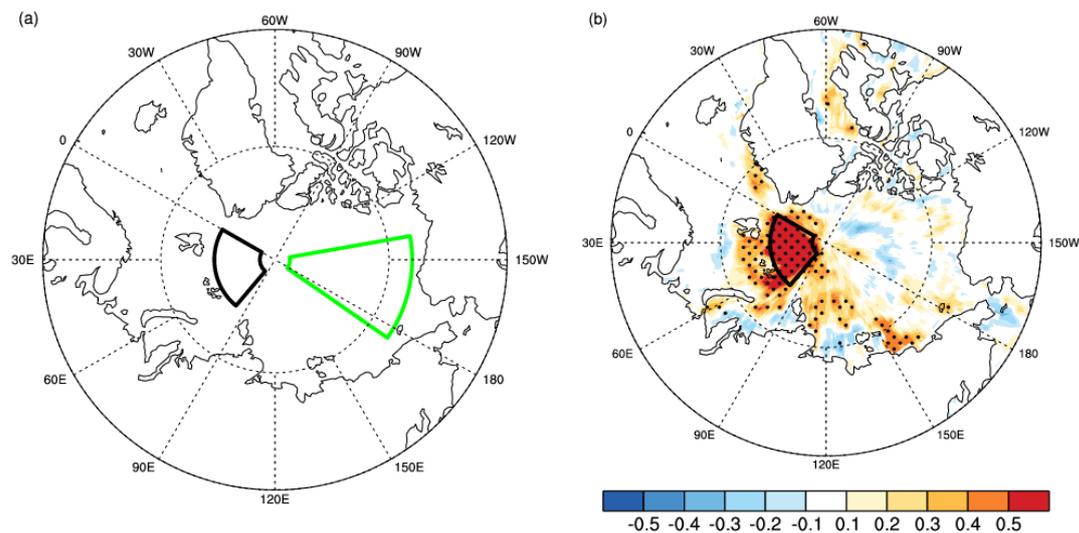
### Decadal Changes of Connections among Snow cover in West Siberia, Eurasia Teleconnection and O<sub>3</sub>-related meteorology in North China

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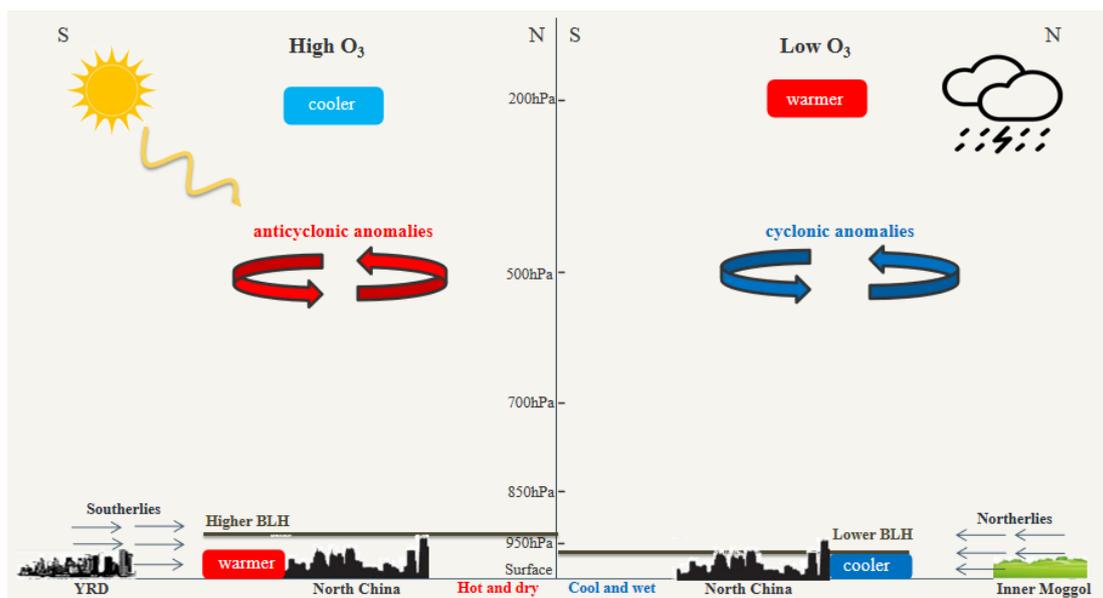
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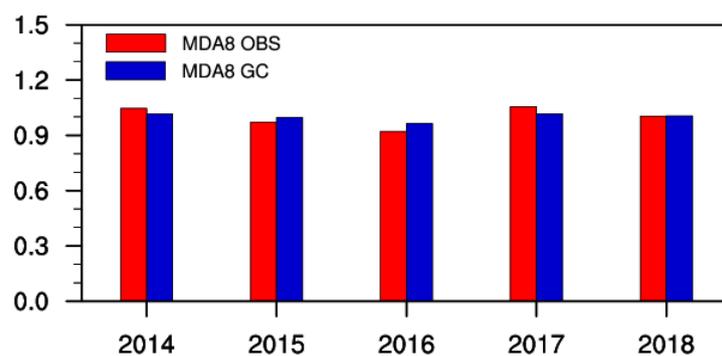
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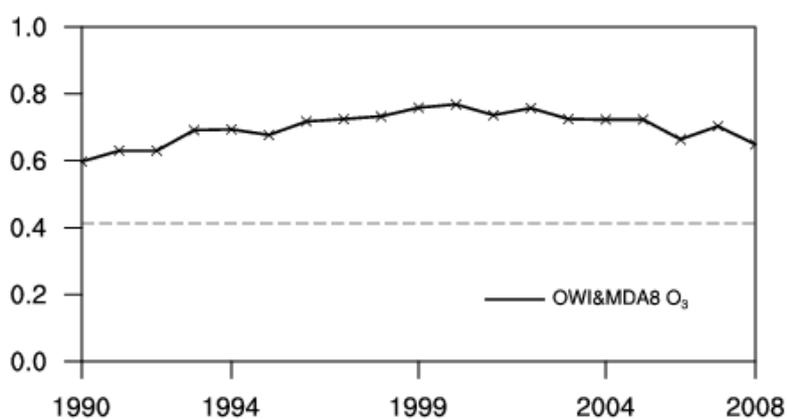
**Figure S1.** (a) The location of Gakkel Ridge (black box), and Canada Basin and Beaufort Sea (green box). (b) The correlation coefficients between the SI<sub>GR</sub> index and May sea ice concentrations from 1980 to 2018. The black dots indicate that the correlation coefficients exceeded the 95% confidence level (*t* test). The linear trend is removed.



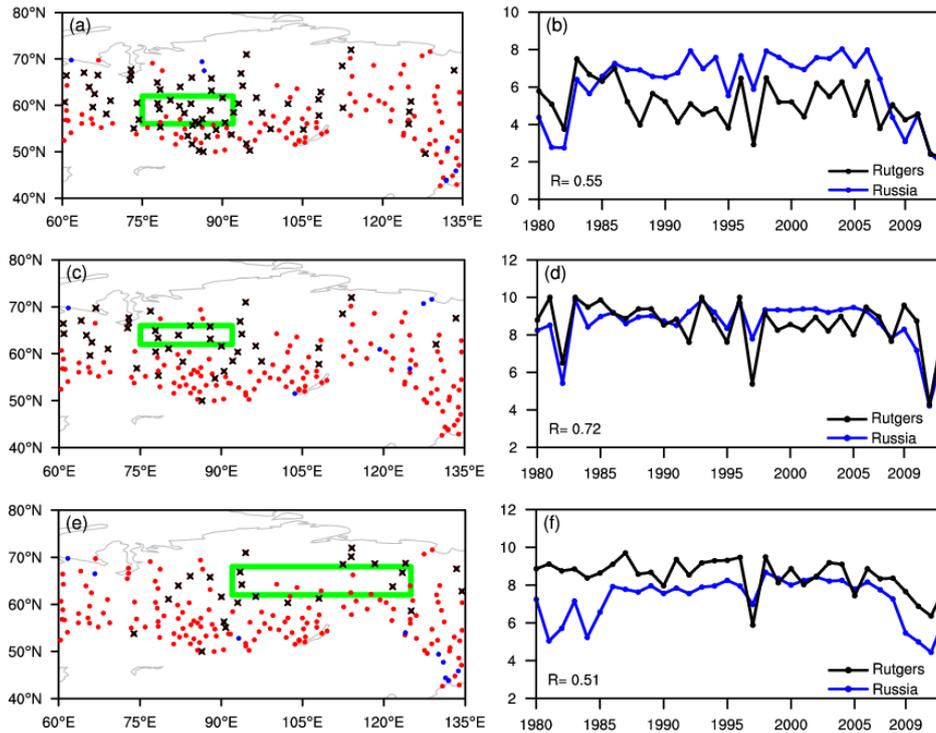
**Figure S2.** A schematic diagram of the physical meanings of the ozone weather index (OWI) in North China.



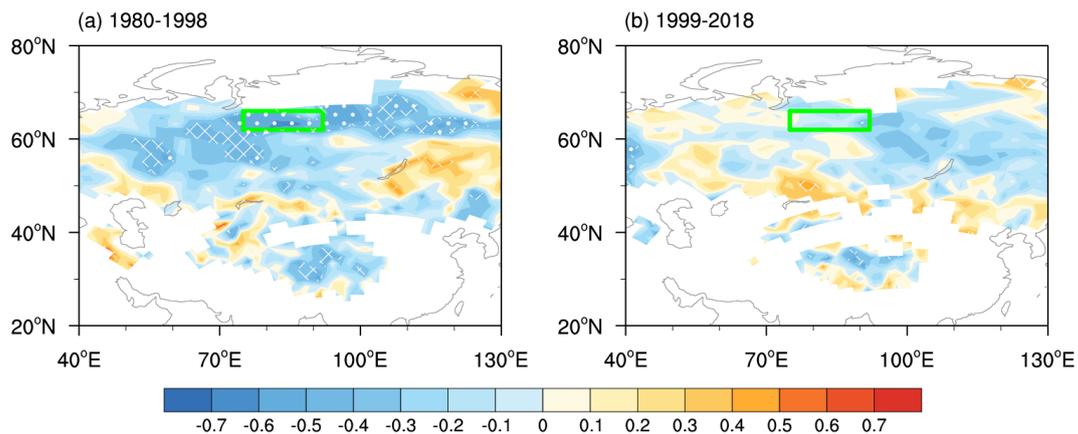
**Figure S3.** The normalized variation in the JJA-mean observed MDA8 O<sub>3</sub> (red) and the simulated MDA8 O<sub>3</sub> (blue) by the GEOS-Chem model from 2014 to 2018 after detrending.



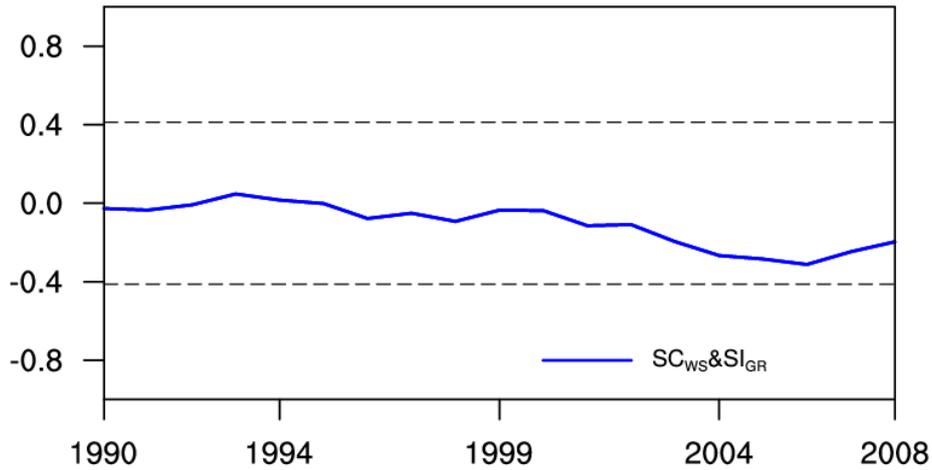
**Figure S4.** The 21-year sliding correlation coefficients between JJA-mean OWI and the MDA8 O<sub>3</sub> produced by the GEOS-Chem model. The black dotted line (crosses) indicates (exceeded) the 95% confidence level. The linear trend is removed.



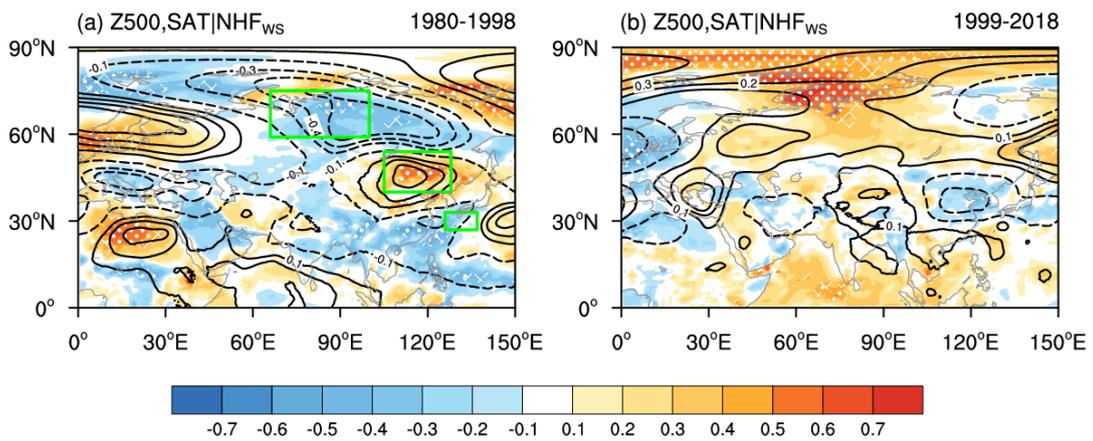
**Figure S5.** The correlation coefficients (a, c, e) between the observed snow cover extent and  $SC_{CS}$  (a),  $SC_{WS}$  (c) and  $SC_{NB}$  (e), which were calculated by reanalysis data provided by Rutgers University from 1980 to 2012. The red (blue) dots represent the positive (negative) correlation coefficients. The black crosses indicate the correlation coefficients exceeded the 99% confidence level. The green boxes in panel (a, c, e) represent the key areas used to calculate the index of  $SC_{CS}$ ,  $SC_{WS}$  and  $SC_{NB}$ , respectively. The variations in  $SC_{CS}$  (b),  $SC_{WS}$  (d) and  $SC_{NB}$  (f) calculated by reanalysis and observed data and their correlation coefficients are shown in panel (b, d, f) from 1980 to 2012.



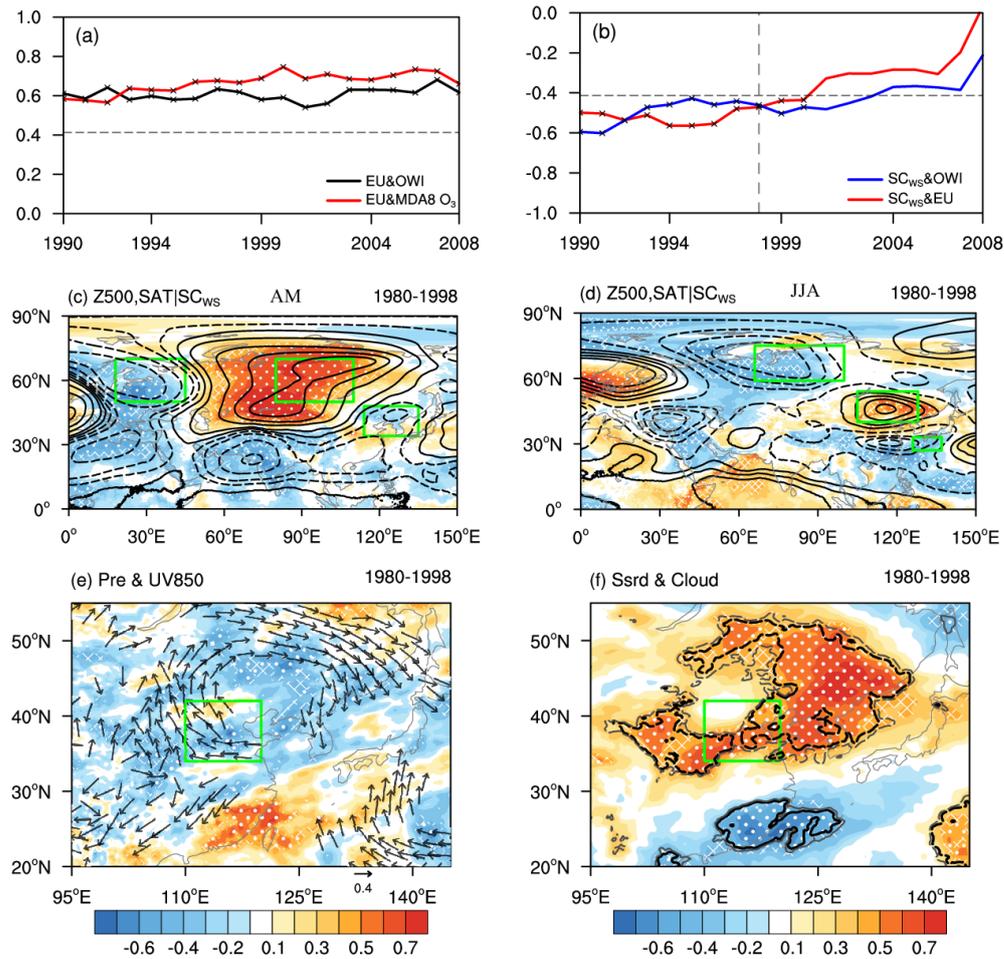
**Figure S6.** The correlation coefficients between the JJA-mean EU index and AM-mean snow cover concentration (a) from 1980 to 1998 and (b) from 1999 to 2018. The white dots (hatching) indicate that the correlation coefficients exceeded the 95% (90%) confidence level ( $t$  test). The green box represents the key area used to calculate the  $SC_{WS}$  index. The linear trend is removed.



**Figure S7.** The 21-year sliding correlation coefficients between  $SC_{WS}$  and  $SI_{GR}$ . The black dotted line indicates the 95% confidence level. The linear trend is removed.



**Figure S8.** The correlation coefficients between  $NHF_{WS}$  and JJA-mean surface air temperature (shading), and geopotential height at 500 hPa (contour) (a) from 1980 to 1998 and (b) from 1999 to 2018. The white dots indicate (hatching) that the correlation coefficients with surface air temperature exceeded the 95% (90%) confidence level ( $t$  test). The green boxes represent the key areas used to calculate the EU index. The linear trend is removed.



**Figure S9.** (a) The 21-year sliding correlation coefficients between MDA8 O<sub>3</sub> (red), OWI (black) and EU. (b) The 21-year sliding correlation coefficients between OWI (blue), EU (red) and SC<sub>WS</sub>. The black dotted line (crosses) indicates (exceeded) the 95% confidence level. The correlation coefficients between the SC<sub>WS</sub> × -1 and surface air temperature (shading) and geopotential height at 500 hPa (contour) in AM (c) and JJA (d) from 1980 to 1998. (e) The correlation coefficients between SC<sub>WS</sub> × -1 and precipitation (shading) and wind at 850 hPa (arrow); (f) surface incoming shortwave flux (shading), and the sum of low and medium cloud cover (contour) in JJA from 1980 to 1998. The white dots (hatching) in (c-f) indicate that the correlation coefficients represented with shading exceeded the 95% (90%) confidence level (*t* test). The gray (black) contours in (f) exceeded the 95% (90%) confidence level. The green boxes in (c,d) represent the anomalous cyclonic or anticyclonic centers. The green boxes in (e,f) represent the location of North China. The linear trend is removed. All of the meteorological data used here were ERA5 data.