Geoscientific
Model Development
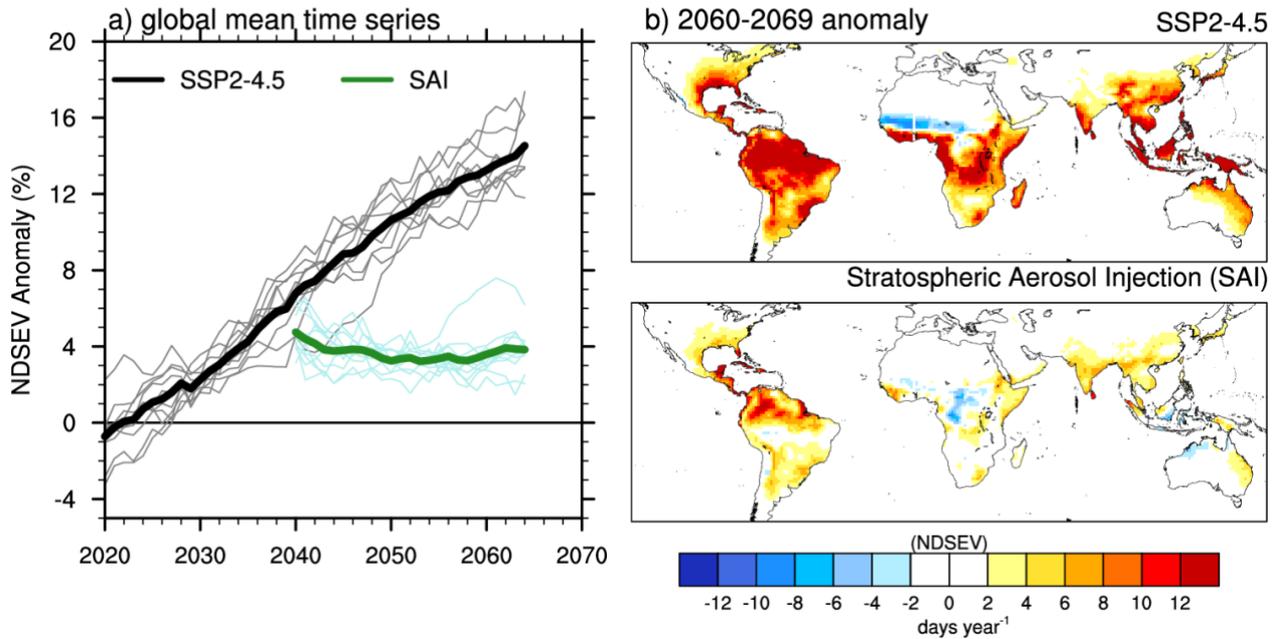
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EGU

Supplement of

Assessing the impact of solar climate intervention on future U.S. weather using a convection-permitting WRF model

Lantao Sun et al.

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Severe thunderstorm environment days

a) global mean time series

b) 2060-2069 anomaly   SSP2-4.5

Stratospheric Aerosol Injection (SAI)

(NDSEV)

-12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12

days year^{-1}

Figure S1. Changes in the number of days with a severe thunderstorm environment (NDSEV) in the ARISE SSP2-4.5 projection and stratospheric aerosol injection (SAI) simulations using CESM2-WACCM6. (a) Global land mean (50°S–50°N) NDSEV anomaly time series, expressed as a percentage relative to the 2015–2024 baseline mean. Gray curves represent individual members, and the thick black curve represents the ensemble mean of SSP2-4.5 simulations. Light green curves represent individual members, and the thick green curve represents the ensemble mean of SAI simulations. An 11-year running mean was applied for smoothing. (b) NDSEV anomalies (days year^{-1}) averaged over 2060–2069 for (top) SSP2-4.5 and (bottom) SAI simulations. NDSEV is defined based on Hoogewind et al. (2017), using a threshold of 10,000 m³s^{-3} for the combined proxy of CAPE and bulk vertical wind shear (S06).
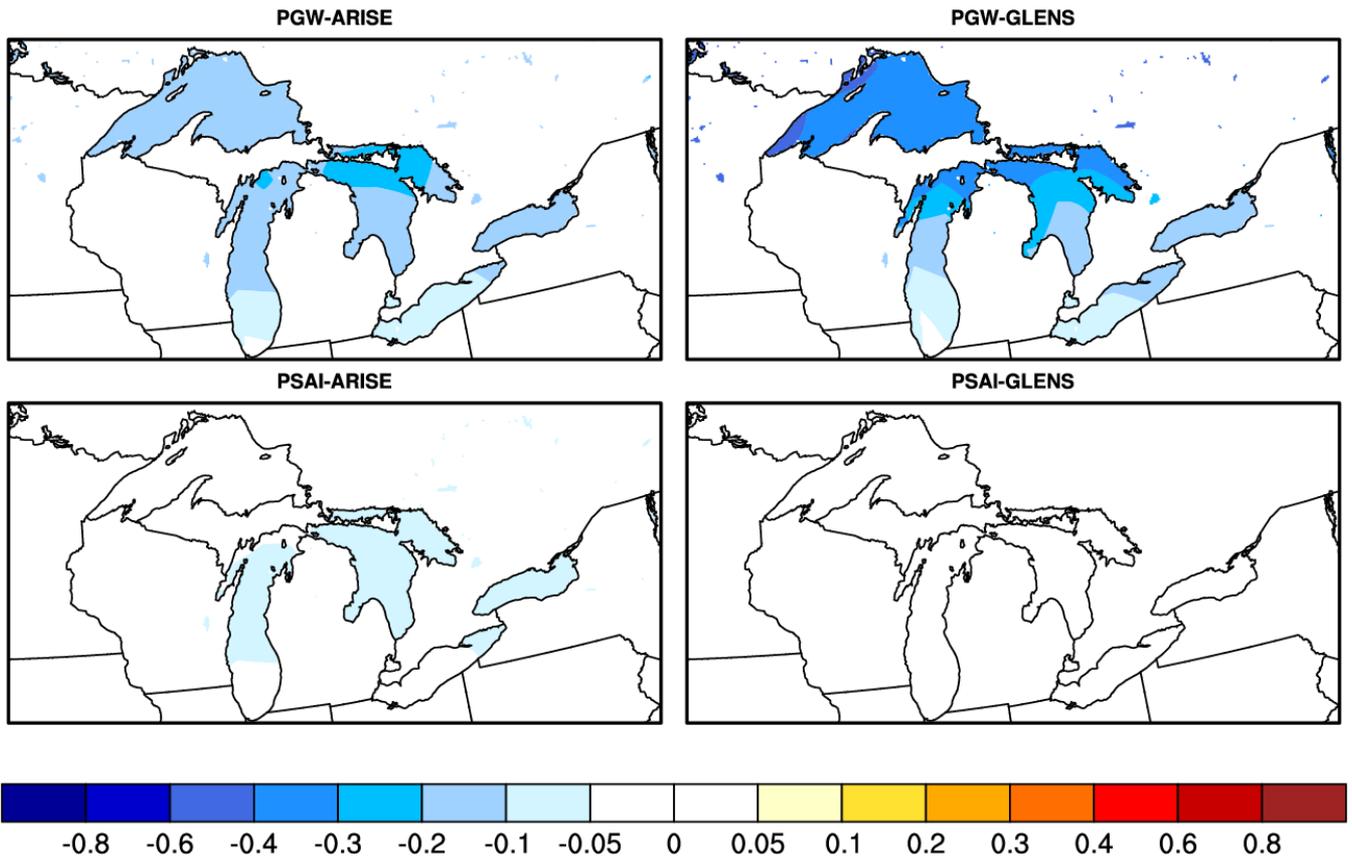
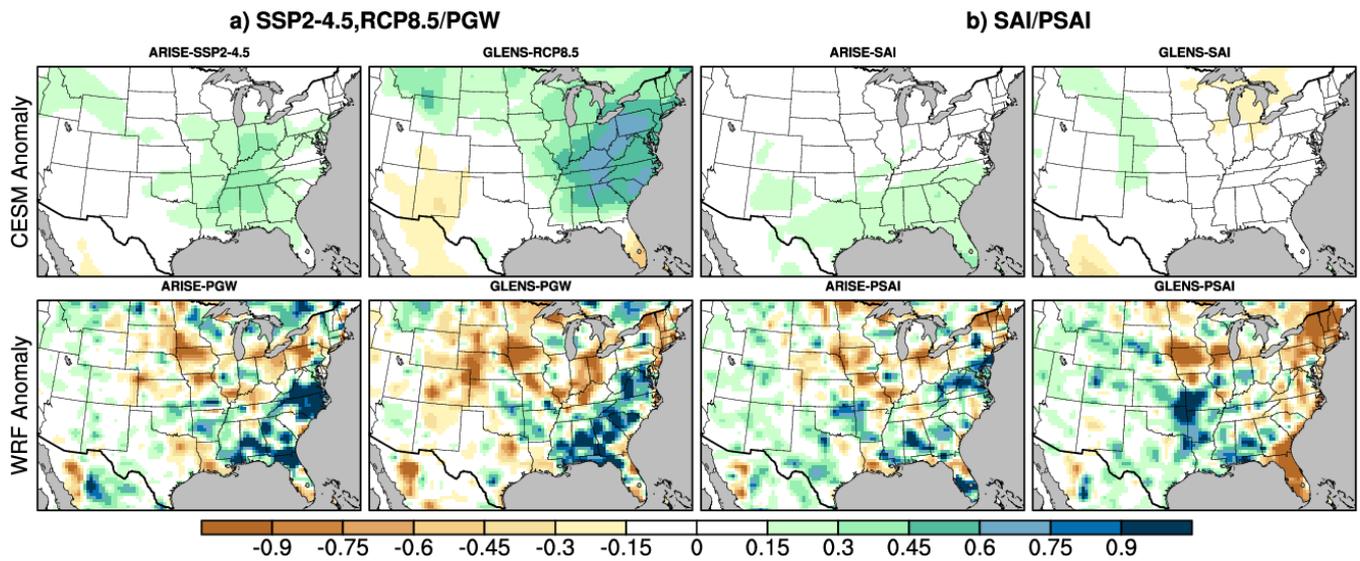**Figure S2**: Prescribed delta lake ice concentration used in the WRF PGW and PSAI simulations.
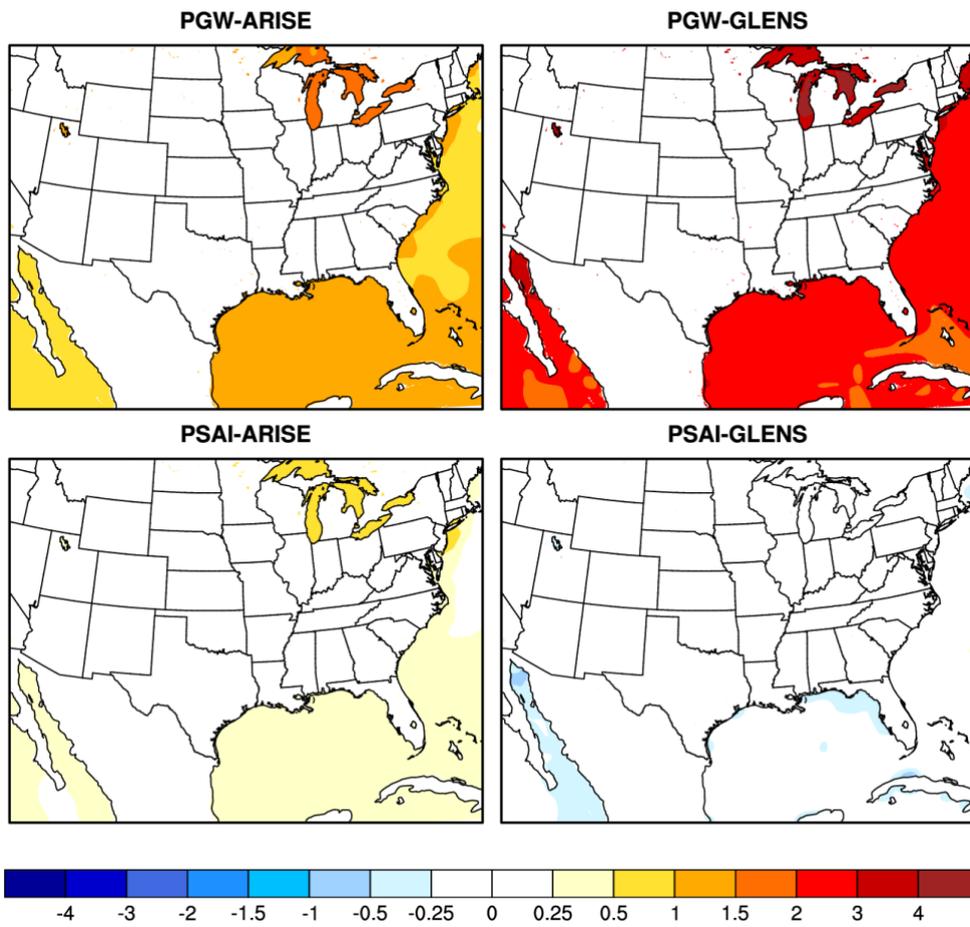
Figure S3: Prescribed delta sea-surface temperature and lake temperature (unit of °C) in the WRF PGW and PSAI simulations.

Figure S4: a) precipitation anomalies (mm/day) for 2060–2069 relative to the 2015–2024 baseline climatology from (top) CESM2-WACCM SSP2-4.5 and CESM1-WACCM RCP8.5 simulations, and (bottom) the corresponding ARISE-PGW and GLENS-PGW WRF simulations. b) Surface air temperature anomalies for 2060–2069 relative to the 2015–2024 baseline from (top) ARISE-SAI and GLENS-SAI simulations, and (bottom) the corresponding ARISE-PSAI and GLENS-PSAI WRF simulations. WRF anomalies are regridded to the CESM grid for comparison.

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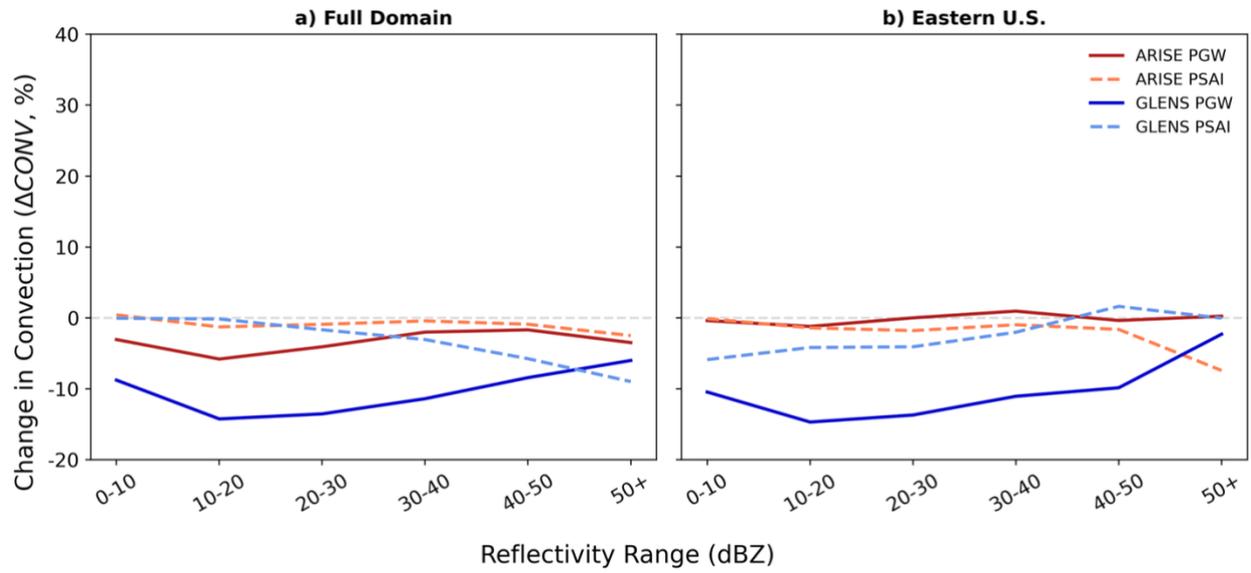
Figure S5: June-July-August changes in the occurrence of each reflectivity range over the full domain (left) and the Eastern U.S. (right). The total number of occurrences within each reflectivity bin is summed over each domain, and ΔCONV is computed following Eqs. (1) and (2). This metric represents the percentage change in convective population in the PGW and PSAI simulations relative to the control simulation, shown as a function of radar reflectivity range (dBZ).