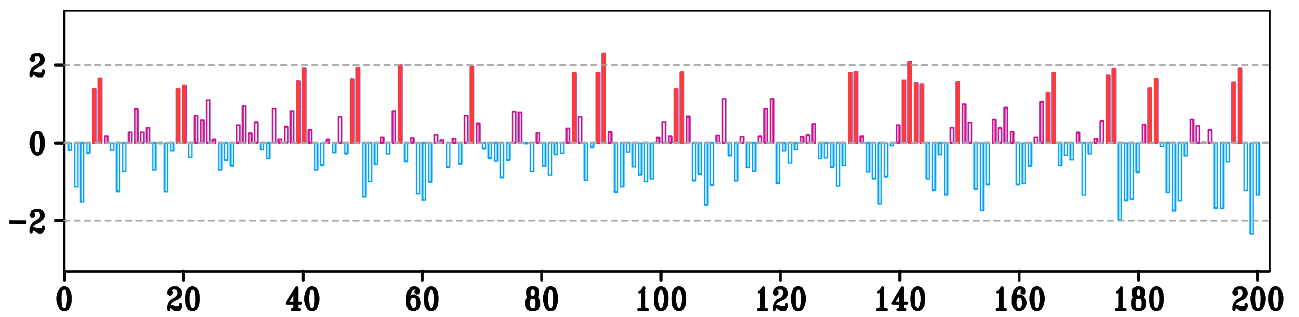## Control Experiment


noWNP Experiment

Figure S1. Normalized DJF Niño-3.4 in the control and noWNP experiments. El Niño (La Niña) events are in red (blue) outlines. An El Niño is said to occur if the Niño-3.4 index (3-month running mean of SST in the region 170°W–120°W to 5°S – 5°N) averaged over DJF exceeds 1 standard deviation. Composites are based on the the 30 El Niño years delineated by the filled red bars. Units are in °C.
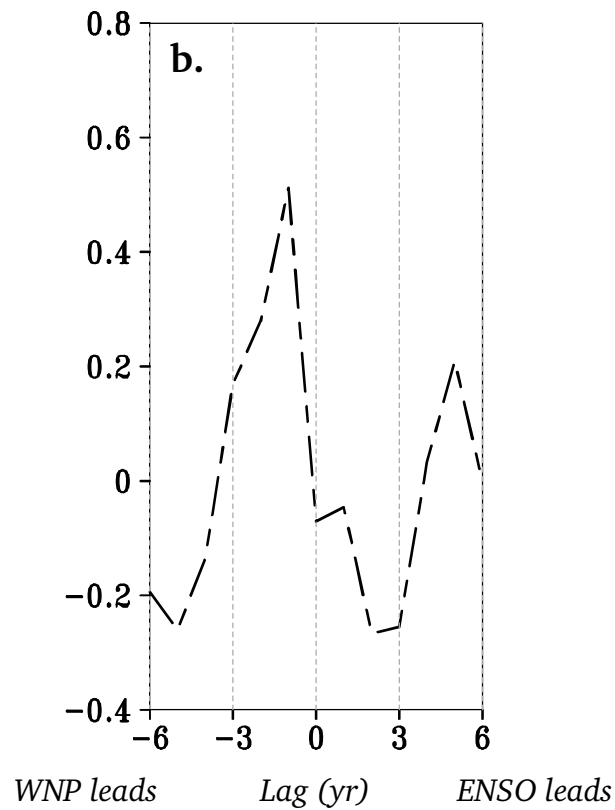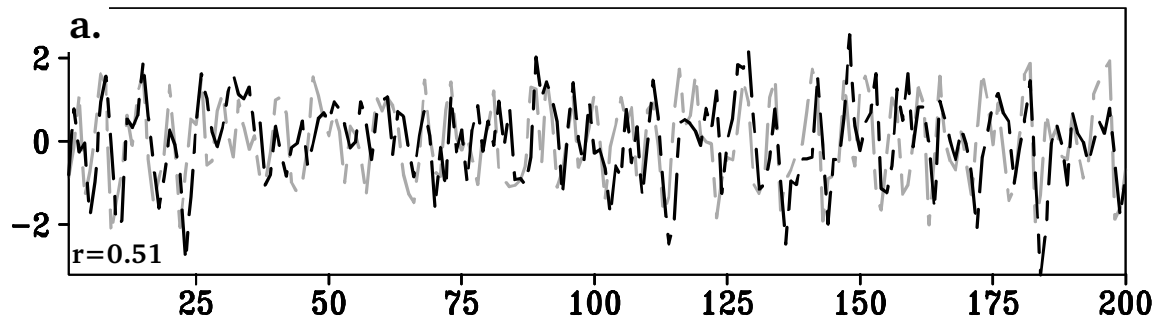
Figure S2. WNP-ENSO relationship in the last 200 years of the control. **(a)** Normalized DJF averaged time series of the WNP (black) and the Niño-3.4 index in DJF $_{yr+1}$ (gray). Their correlations is displayed at the lower left corner. **(b)** The cross correlation between lag-0 DJF averaged Niño-3.4 index and DJF averaged WNP, computed for 6 year lag to 6 year lead.
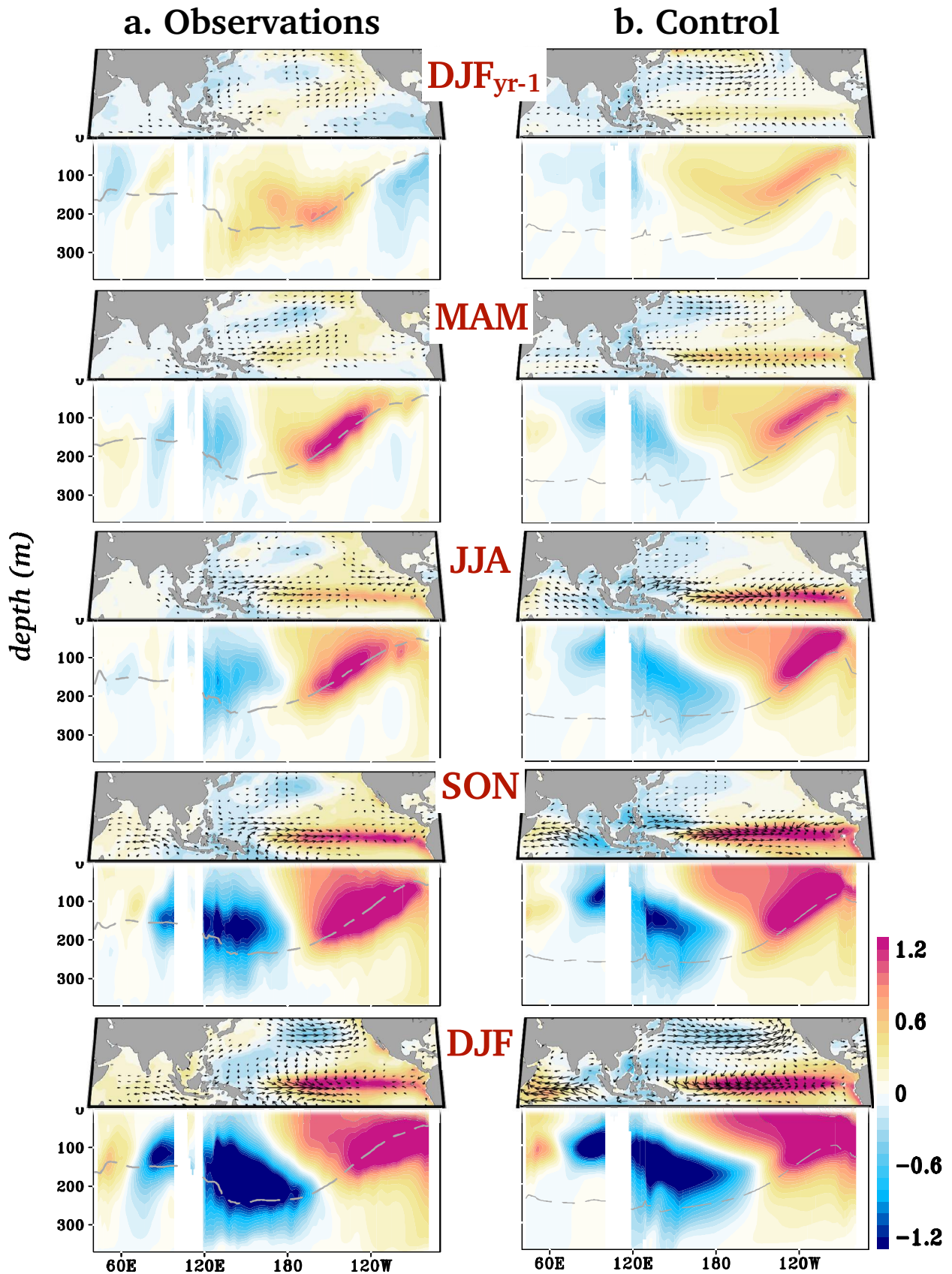
Figure S3. Regression of SSTa (shading, °C), surface winds (vectors, ms⁻¹) and the cross section of 2S-2N averaged subsurface potential temperature anomalies (0-350 meters depth) on the DJF Niño 3.4 index. The mean 20°C isothermal depth of each season is superimposed in the dashed gray line. Results are based on the last 200 years of the simulation in the control and 1950 – present in observations, except for subsurface temperature anomalies, which is for 1980–present.