Supplemental Material

Revisiting the relationship between the North Pacific high and upwelling winds along the coast of North America in the present and future climate

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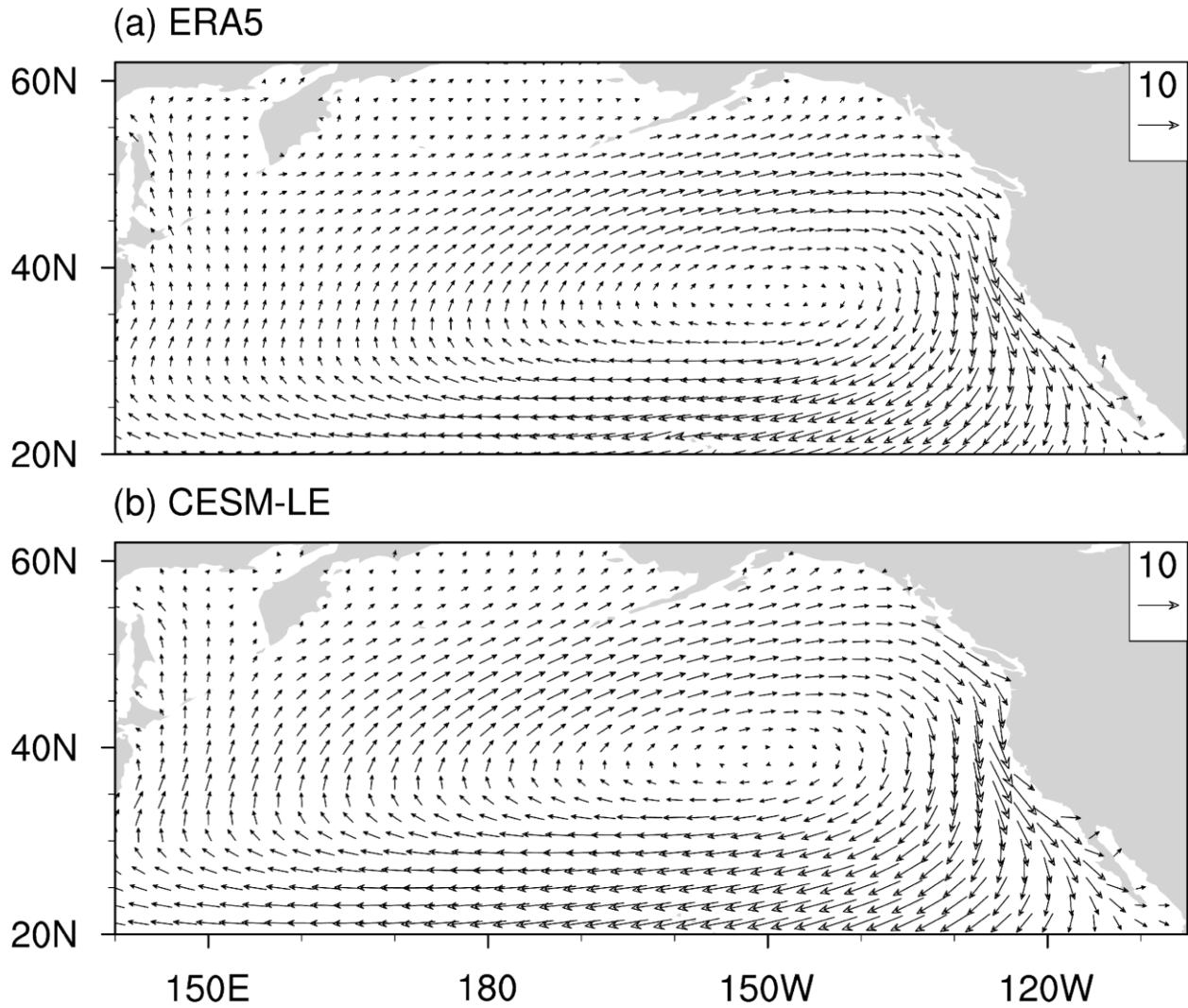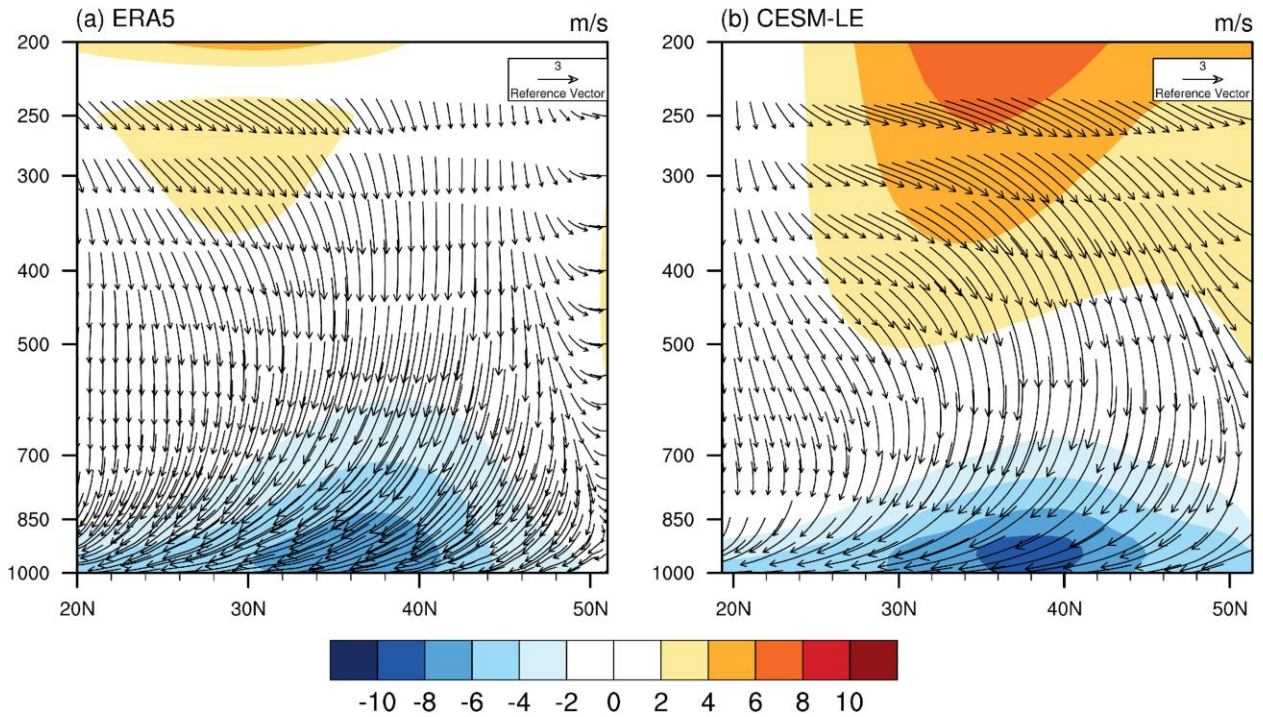3. Columbia University

Figure S1. Climatological mean 1000hPa wind fields during boreal summer (JJA) calculated from ERA5 (a) and the CESM-LE (b).

At a fixed longitude of 130W

Figures S2. Summer mean meridional wind and pressure vertical velocity (omega) at a Height/pressure and latitude along a fixed longitude of 130°W, calculated from (a) ERA5 and (b) the CESM-LE. And omega is scaled by the formula of $-1 * \frac{max\ value(v)}{max\ value(omega)}$ calculated from the ERA5, which approximately equals 97. The longitude of 130°W is close to centroid position of 500hPa pressure vertical velocity (See Table 1).
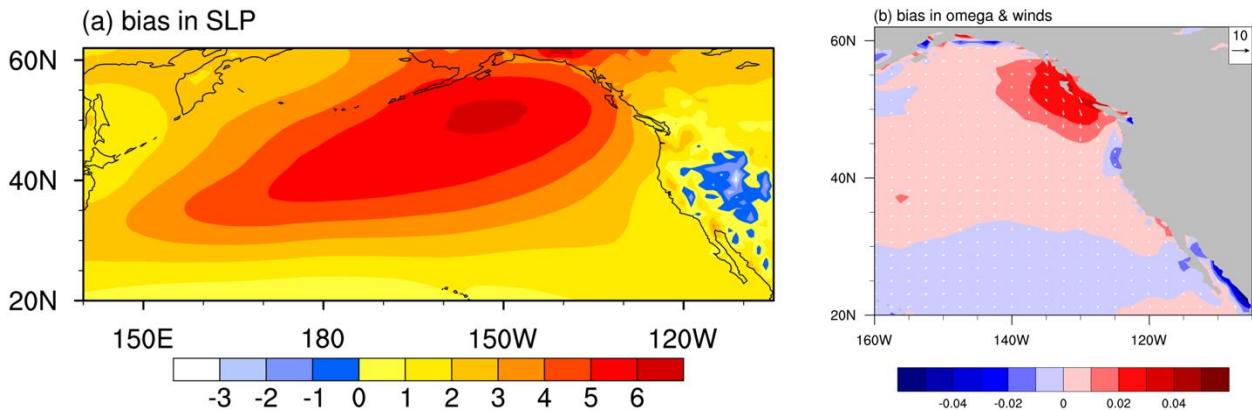

Figure S3. The CESM-LE summer bias is shown in (a) SLP and (b) 500 hPa pressure vertical velocity with the units of hPa and Pa s^{-1}, respectively.
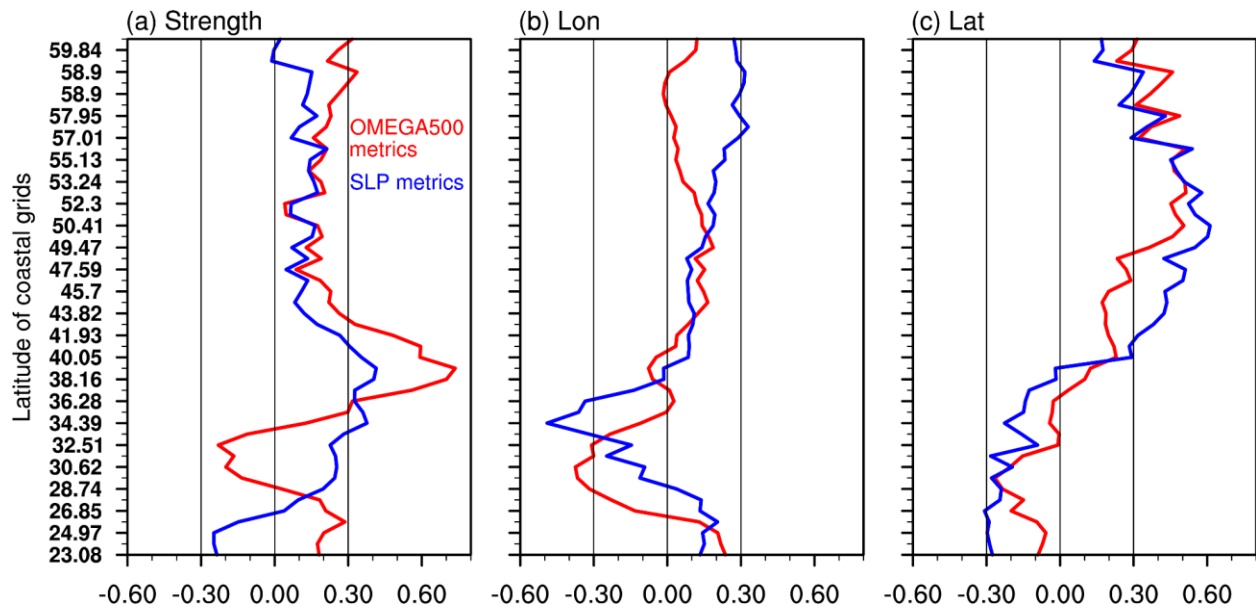
Figure S4. Anomaly correlation between the two NPH metrics and the upwelling-favorable components of surface 10-m alongshore winds from the ERA5. The surface winds are extracted from the first offshore grid cell. Three consecutive grid cells are used to obtain an estimate of the angle of the coastline, on which zonal and meridional winds are projected to obtain the upwelling-favorable component. Ordinate indicates the actual latitude of coastal grids. The three vertical straight lines are zero line and 95% significance, respectively. Red and blue lines indicate NPH metrics defined by 500hPa pressure vertical velocity and SLP, respectively. All data are detrended prior to calculating correlation.
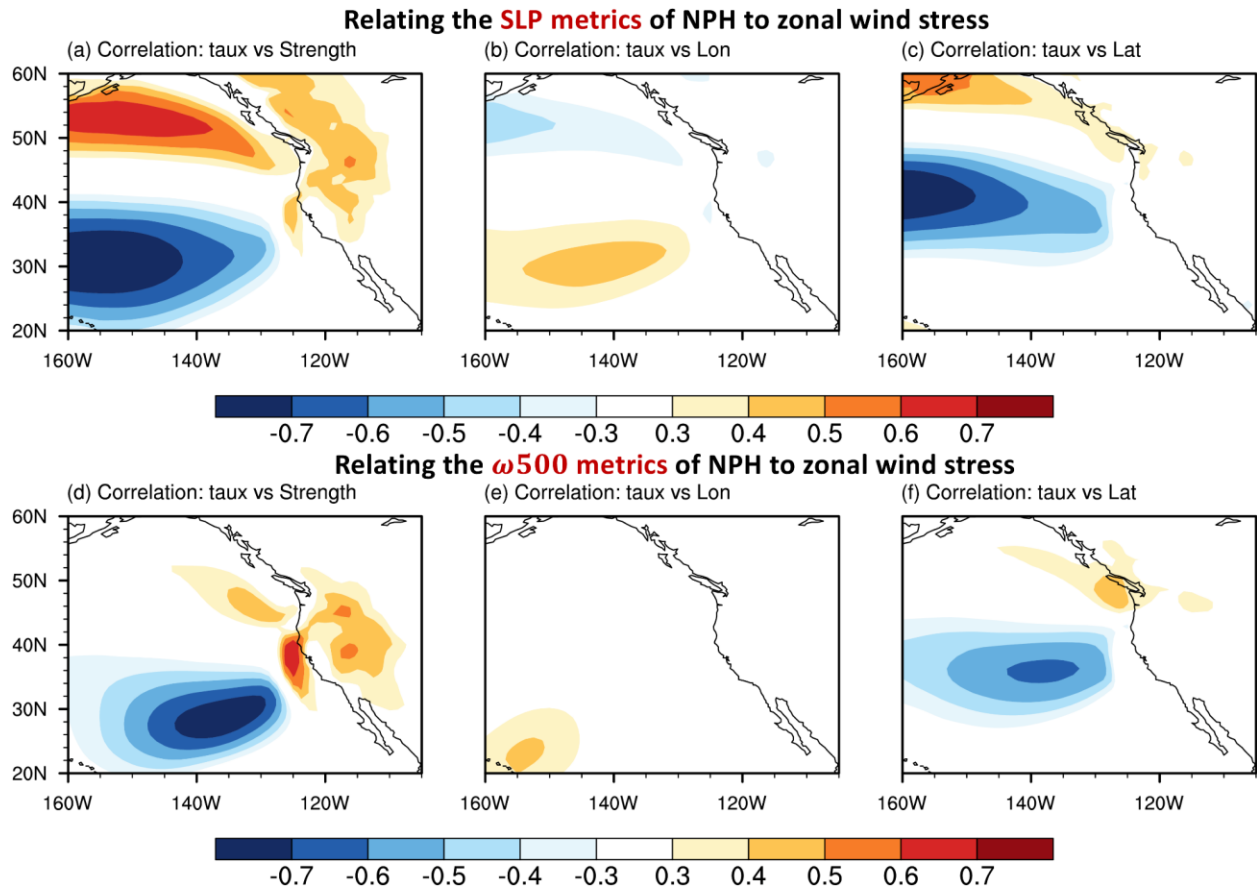
Figure S5. Anomaly correlation between zonal wind stress and the strength, longitude and latitude of the SLP metric (a, b, c) and of the omega500 metric (d, e, f), calculated from the CESM-LE. Data are detrended prior to calculating correlation.
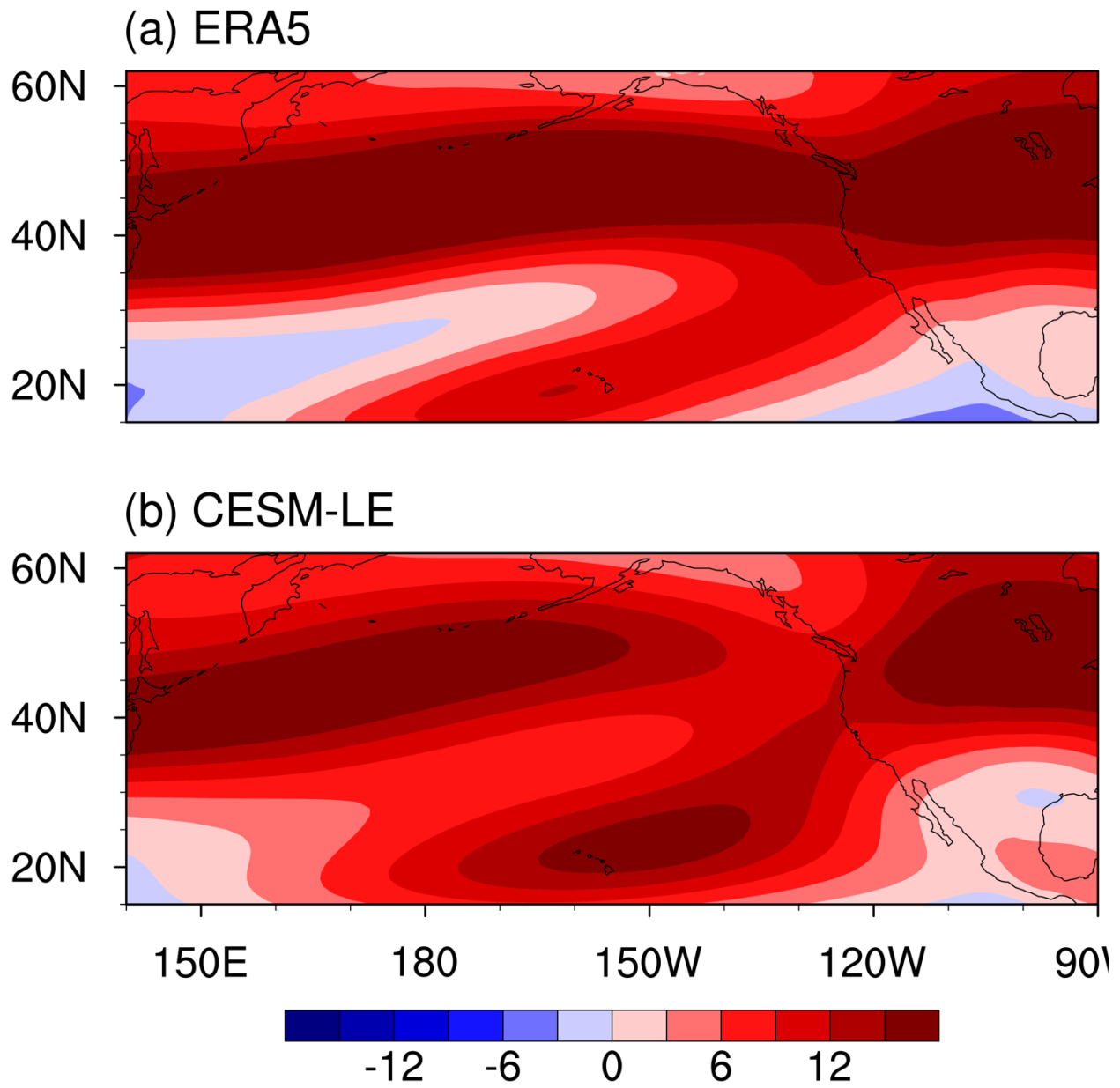
Figure S6. Summer mean zonal wind at 250hPa, calculated from (a) ERA5 and (b) the CESM-LE. The unit is m/s. Data over the years 1979-2020 are used.