Supplementary for: *The future of the El Niño-Southern Oscillation: Using large ensembles to illuminate time-varying responses and inter-model differences*

Nicola Maher^{1,2}, Robert C. Jnglin Wills³, Pedro DiNezio², Jeremy Klavans², Sebastian Milinski^{4,5}, Sara C. Sanchez², Samantha Stevenson⁶, Malte F. Stuecker⁷, and Xian Wu⁸

¹Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado at Boulder, Boulder, CO 80309, USA

²Department of Atmospheric and Oceanic Sciences (ATOC), University of Colorado at Boulder, Boulder, CO 80309, USA ³Department of Atmospheric Sciences, University of Washington, Seattle, WA 98195, USA

⁴ Climate and Global Dynamics Division, National Center for Atmospheric Research, Boulder, CO 80307, USA

⁵Cooperative Programs for the Advancement of Earth System Science, University Corporation for Atmospheric Research, Boulder, CO 80307, USA

⁶Bren School of Environmental Science and Management, University of California, Santa Barbara, Santa Barbara, CA 93106, USA

⁷Department of Oceanography International Pacific Research Center (IPRC), School of Ocean and Earth Science and Technology (SOEST), University of Hawai'i at Mānoa, Honolulu, HI, USA

⁸Climate and Global Dynamics Division, National Center for Atmospheric Research, Boulder, CO 80305, USA

Correspondence: Nicola Maher (nicola.maher@colorado.edu)



Figure S1. Longitude-time sections of the difference of equatorial Pacific ($5^{\circ}S-5^{\circ}N$) SST anomalies ($^{\circ}C$; shading) composited for El Niño events during 1950-2014 in 14 models and the multi-ensemble mean compared to observations. The SST anomalies for observed El Niño events during 1950-2014 are overlaid ($^{\circ}C$; contours at intervals of $0.4^{\circ}C$; zero contours thickened and negative contours dashed). El Niño events are defined when the Niño3.4 index exceeds exceeds 0.75 standard deviations in Dec0 but not in Dec-1. The standard deviation of Niño3.4 is calculated separately for each calendar month from October to February.



Figure S2. As in Figure S1, but for La Niña



Figure S3. As in Figure 2, but for the period 2021-2050 compared to 1951-1980.



Figure S4. As in Figure 3, but for the difference between 2021-2050 and 1951-1980.



Figure S5. As in Figure 3, but for La Niña



Figure S6. As in Figure 3, but for the difference between 2021-2050 and 1951-1980 and for La Niña



Figure S7. As in Figure 6, but for the period 1950-2014.