

**Supplemental Material for “Stronger decadal variability of the Kuroshio Extension under simulated future climate change”**

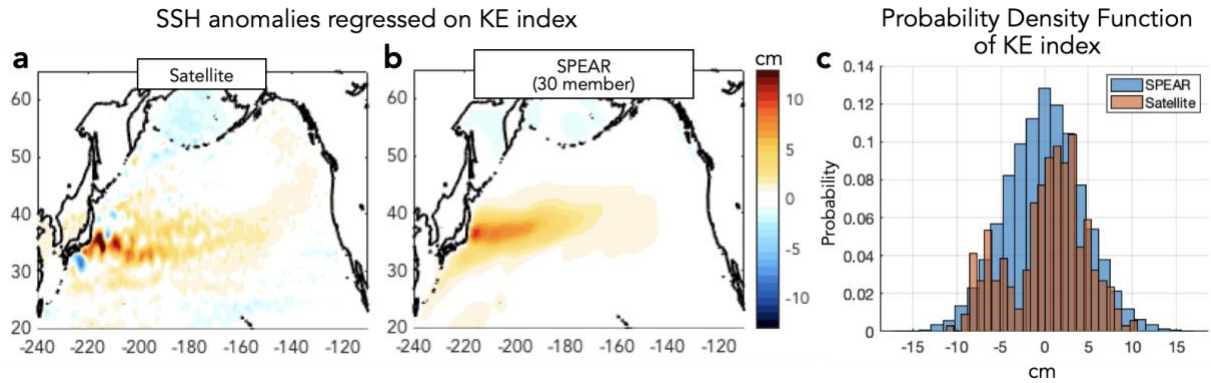
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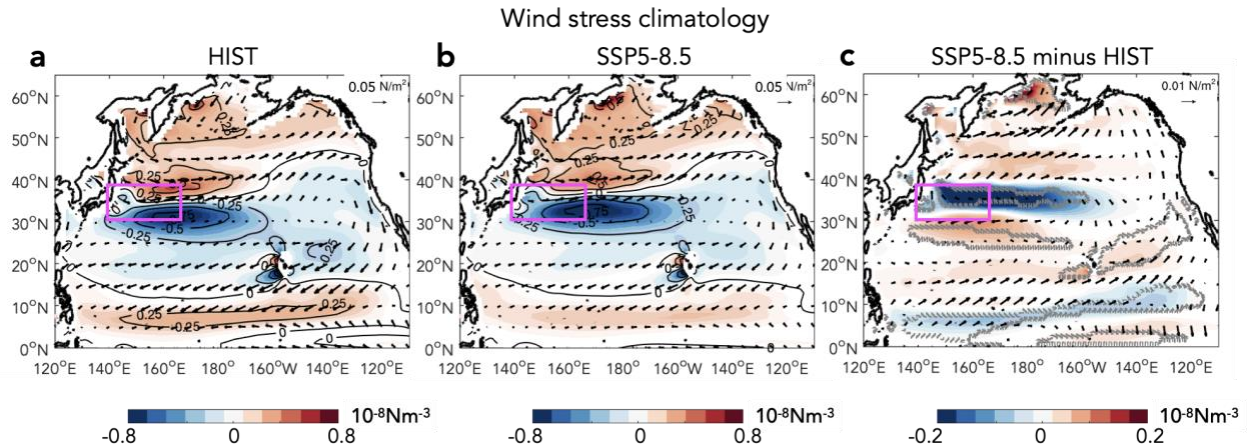
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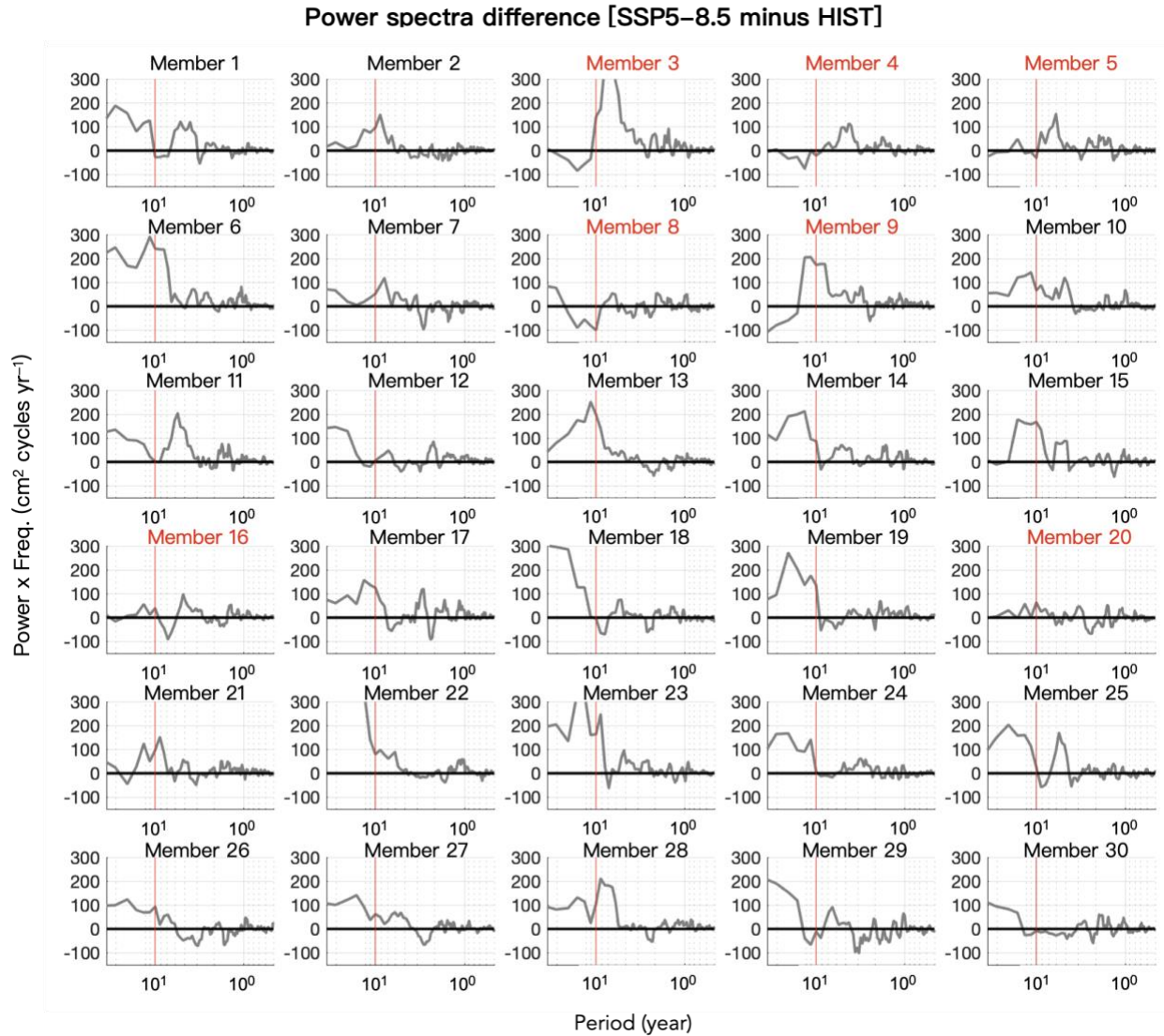
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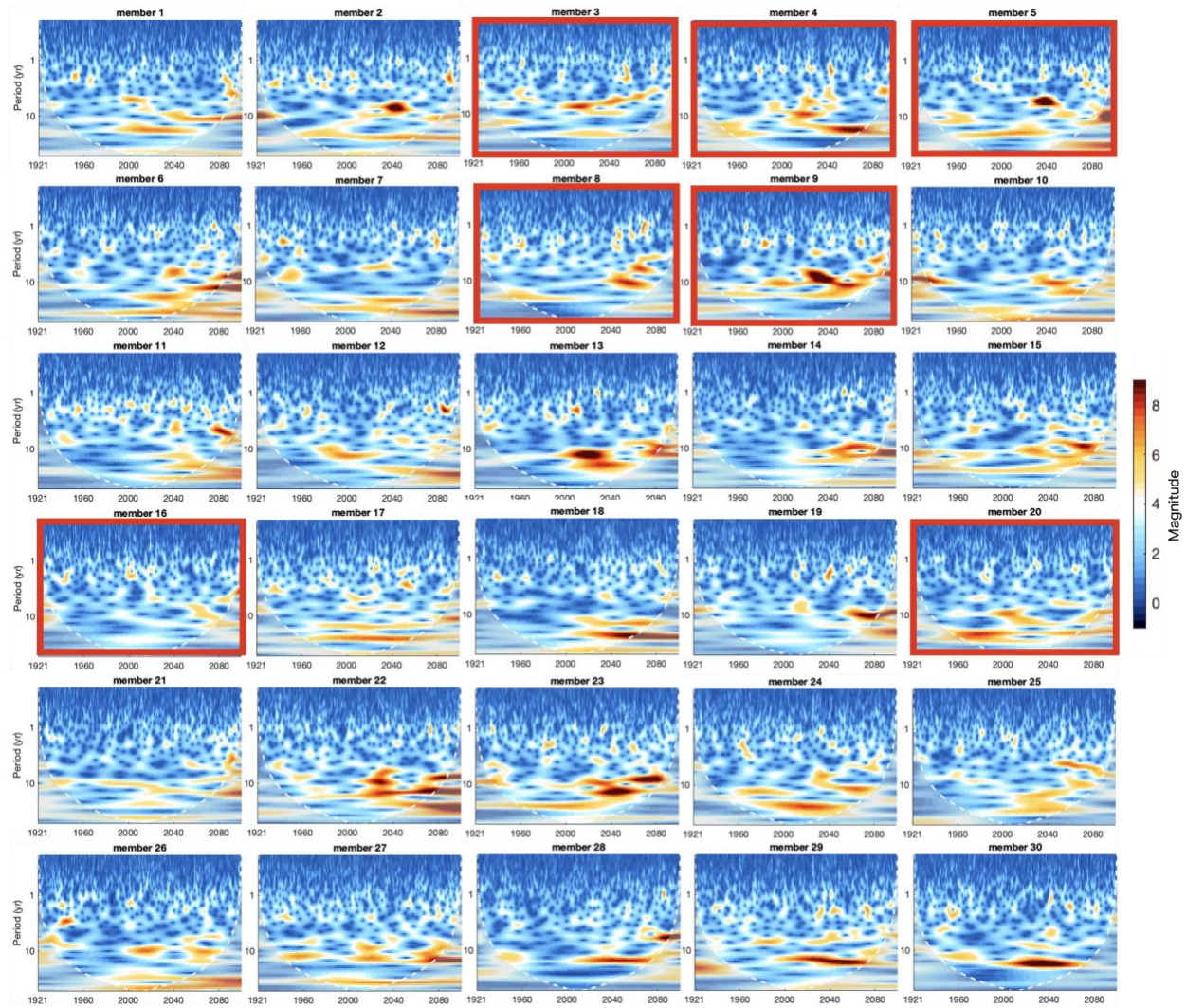
**Supplementary Figure 1. A comparison of historical KE variability between observations and SPEAR model a-b**, KE patterns obtained by SSH anomalies regressed onto the KE index (normalized) from the observational satellite (**b**) and SPEAR ensemble mean (30-members) (**c**). **c**, Probability Density Functions of KE index for the historical period of 1993-2021 from the observational satellite (orange) and SPEAR simulation (HIST+SSP5-8.5 simulation) (blue).



**Supplementary Figure 2. Annual-mean climatological wind stress ( $\text{Nm}^{-2}$ ) and wind stress curl ( $10^{-8}\text{Nm}^{-3}$ ) from a, HIST (1921-2014) and b, SSP5-8.5 (2015-2100) simulation and c, their difference (SSP5-8.5 minus HIST). Pink box is the KE region ( $33^{\circ}$ - $40^{\circ}\text{N}$ ,  $140^{\circ}$ - $165^{\circ}\text{E}$ ). The wind stress and wind stress curl are plotted as vectors and shadings. Contours are the region where the difference between two simulations are statistically significant with the p-value larger than 0.05.**



**Supplementary Figure 3. Changes in spectral power of upstream KE SSH.** Power spectra difference in the upstream KE SSH between SSP5-8.5 [2031-2100] and HIST [1921-1990] for individual members. The title of each panel is the model member number. The red title is the member, where the difference in decadal variance of upstream KE SSH between two periods is not significant or reduced from HIST to SSP5-8.5. The discrete Fourier transform using a fast Fourier transform algorithm is computed and shown by MATLAB function named “*fft*”.



**Supplementary Figure 4. Wavelet power spectra of upstream KE SSH from SPEAR simulations.** The period of [1921-2100] on the x-axis is from combined HIST + SSP5-8.5 simulations. The continuous wavelet transform is computed and shown by MATLAB function named “*cwtfilerbank*”. The filter bank uses approximately 10 wavelet bandpass filters per octave (10 voices per octave).