Supplementary Information to: "Climate models lack decadal variability in precipitation because of a weak atmospheric response to sea surface temperature anomalies"

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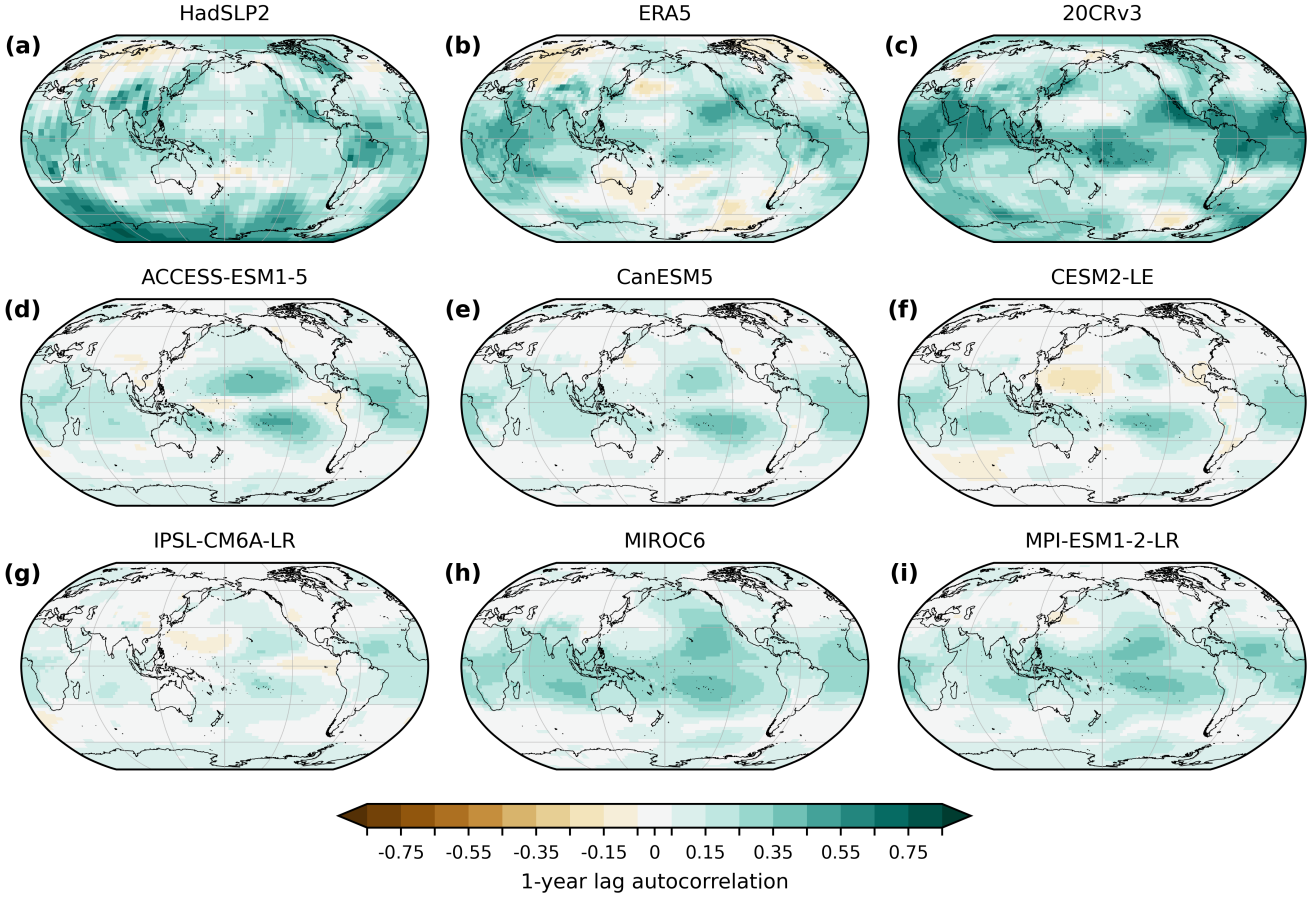


Figure S1. Autocorrelation of SLP. Spearman 1-year lag autocorrelation for SLP for one detrended observational dataset (**a**) HadSLP2 (1900-2004), two detrended reanalyses (**b**) ERA5 (1940-2024) and (**c**) 20CRv3 (1900-2015), and six large ensembles of climate models over the quasi pre-industrial period (1850-1900) (**d**) ACCESS-ESM1-5 (40 members), (**e**) CanESM5 (40 members), (**f**) CESM2-LE (100 members), (**g**) IPSL-CM6A-LR (33 members), (**h**) MIROC6 (50 members) and (**i**) MPI-ESM1-2-LR (50 members). Note that for GPCC there are no data over oceans.

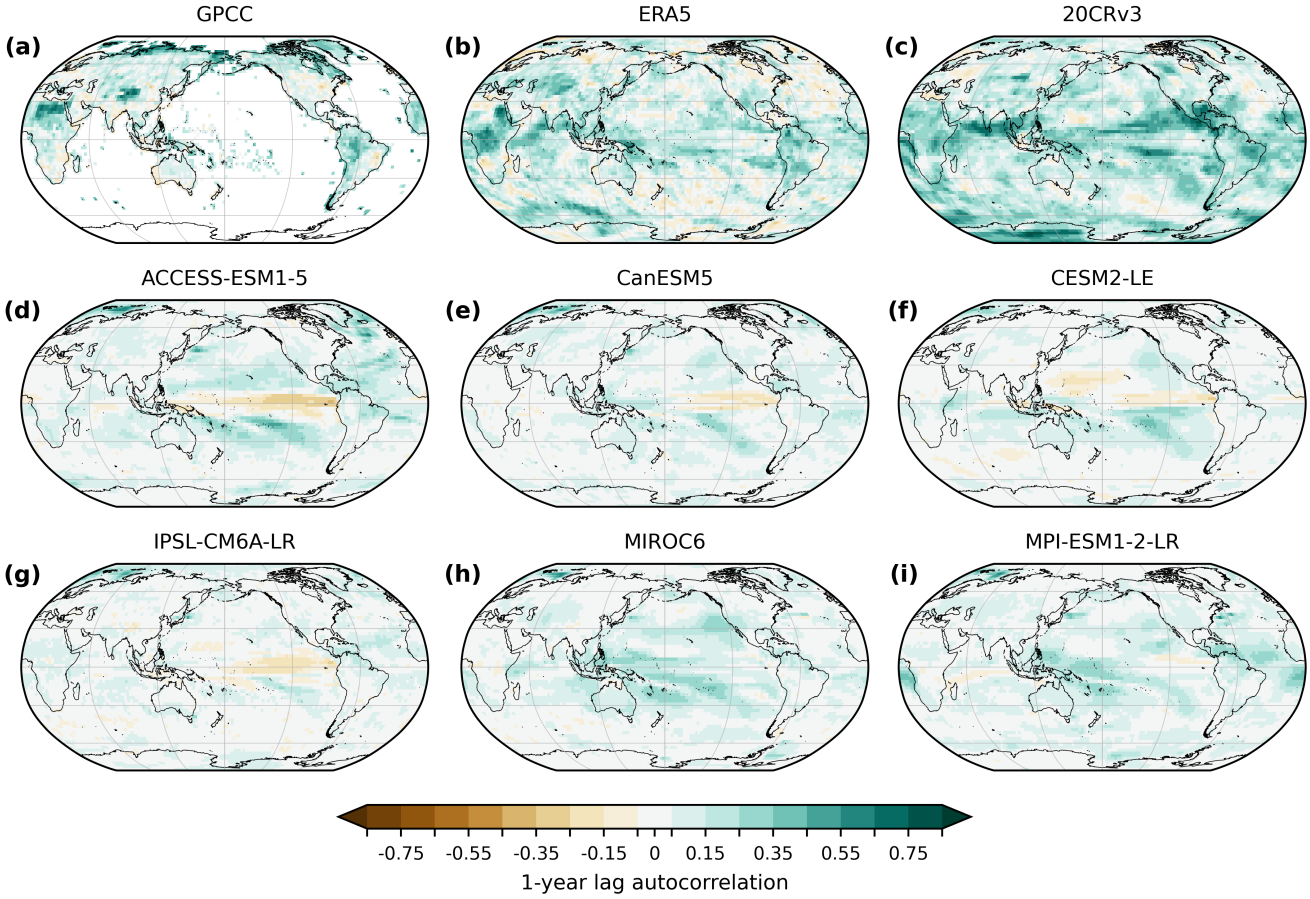


Figure S2. Autocorrelation of precipitation. Same as Figure S1 for precipitation. The observational dataset is GPCC (1900-2020).

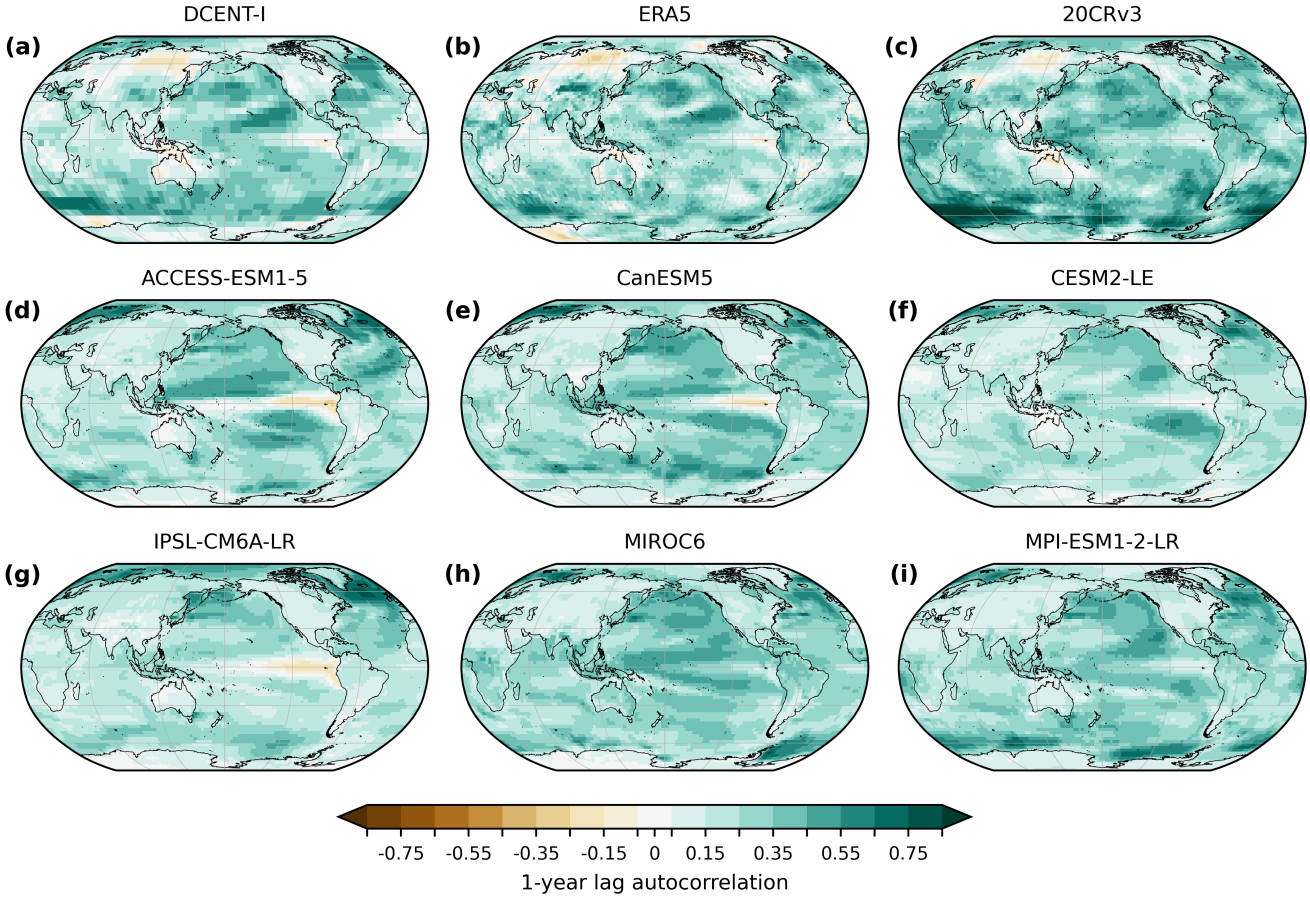


Figure S3. Autocorrelation of T2M. Same as Figure S1 for T2M. The observational dataset is DCENT-I (1900-2025).

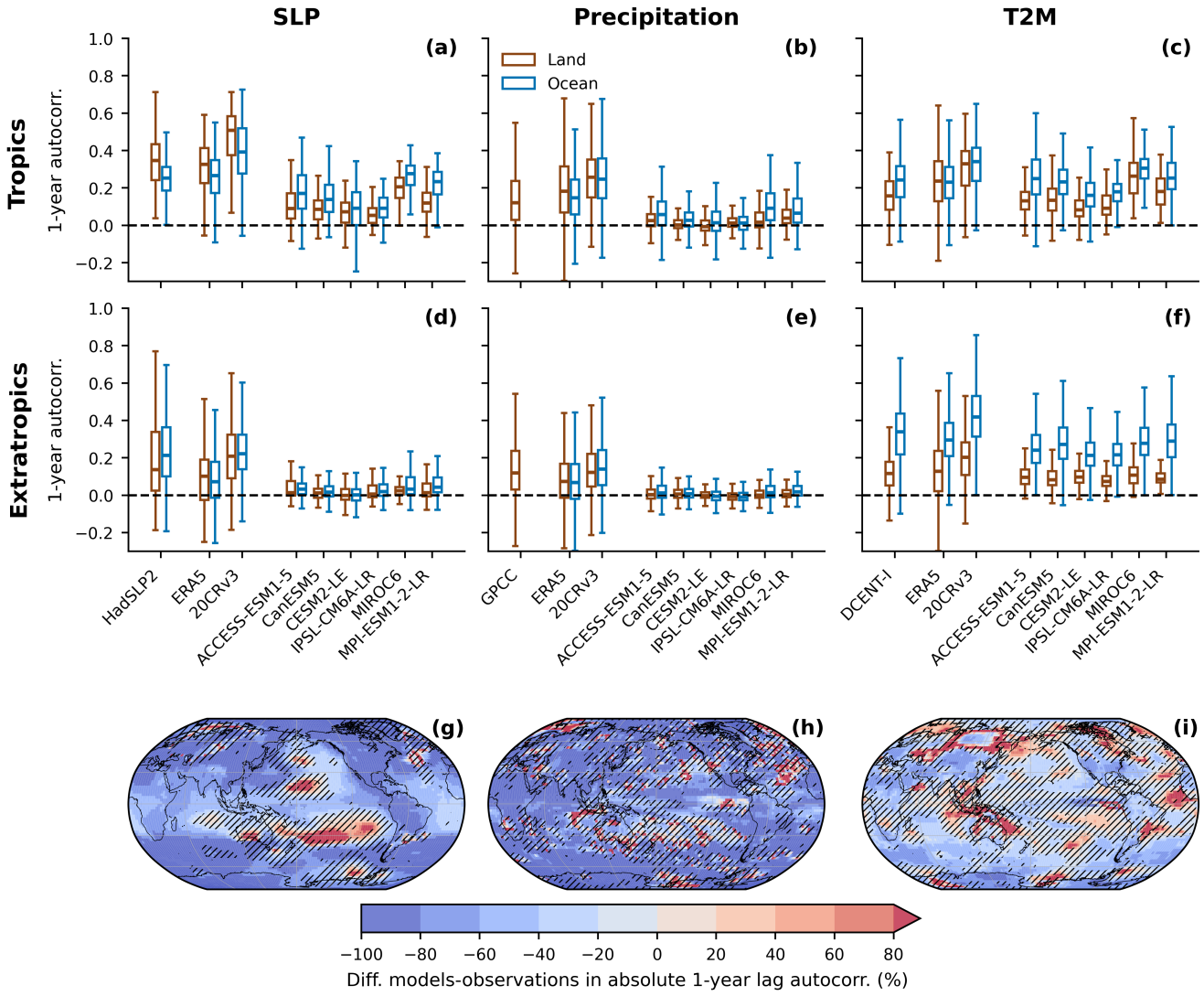


Figure S4. Autocorrelation of surface variables computed on individual members. Same as Figure 1 using autocorrelation computed independently member-by-member over the period 1930-2014 after self-detrending (see Methods). The boxplots show the distribution over grid points and members. For the maps, the model-observation differences are computed on the ensemble means.

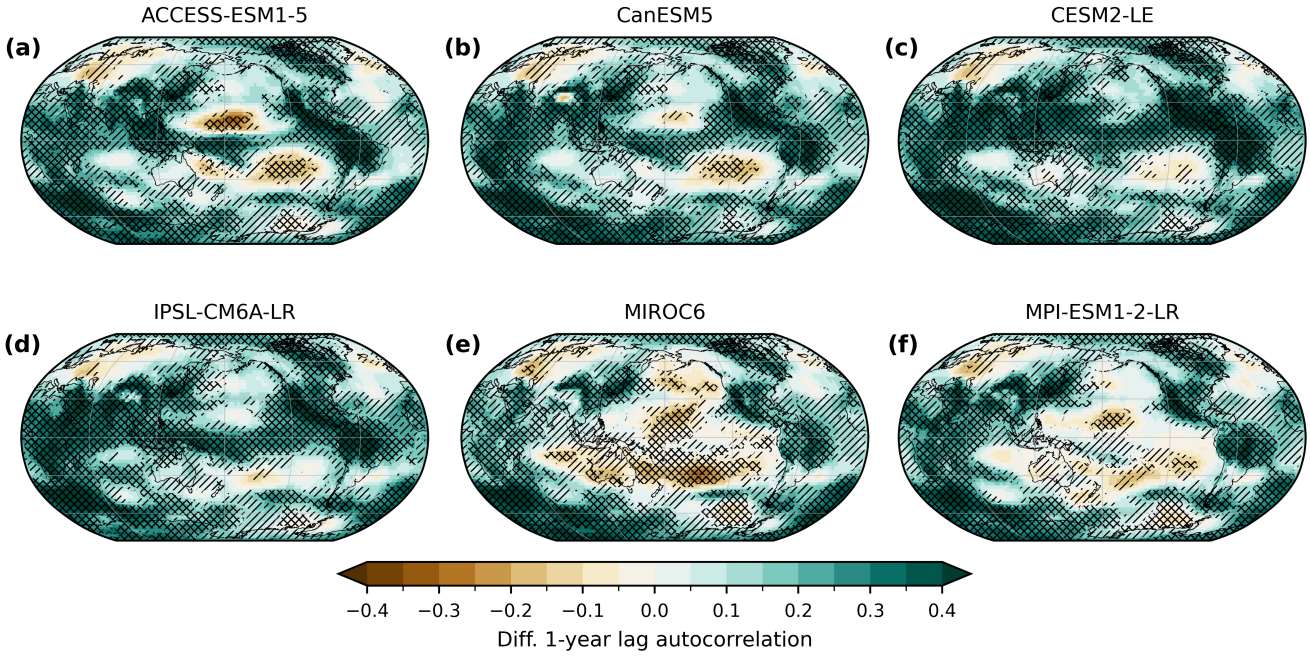


Figure S5. Difference in SLP autocorrelation between observations and models over the 20th century period. For the models, the Spearman autocorrelation is computed independently member-by-member over the period 1930-2014 after self-detrending (see Sect. 2). The difference in autocorrelation is computed as the difference between the ensemble mean autocorrelation and the average autocorrelation over the observational datasets. The stipplings show where the autocorrelation in at least one observational dataset is outside the 90% range of ensemble members. The crosses show where at least two observational datasets are outside the 90% range.

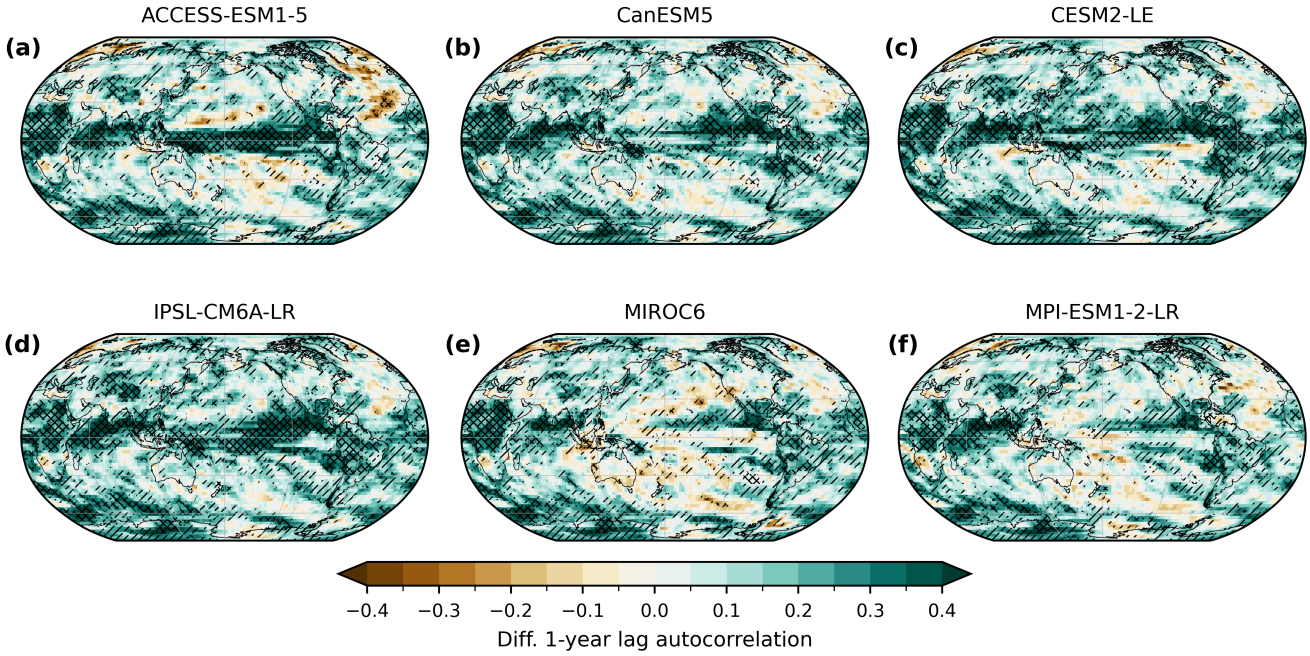


Figure S6. Difference in precipitation autocorrelation between observations and models over the 20th century period. Same as Fig. S5 for precipitation.

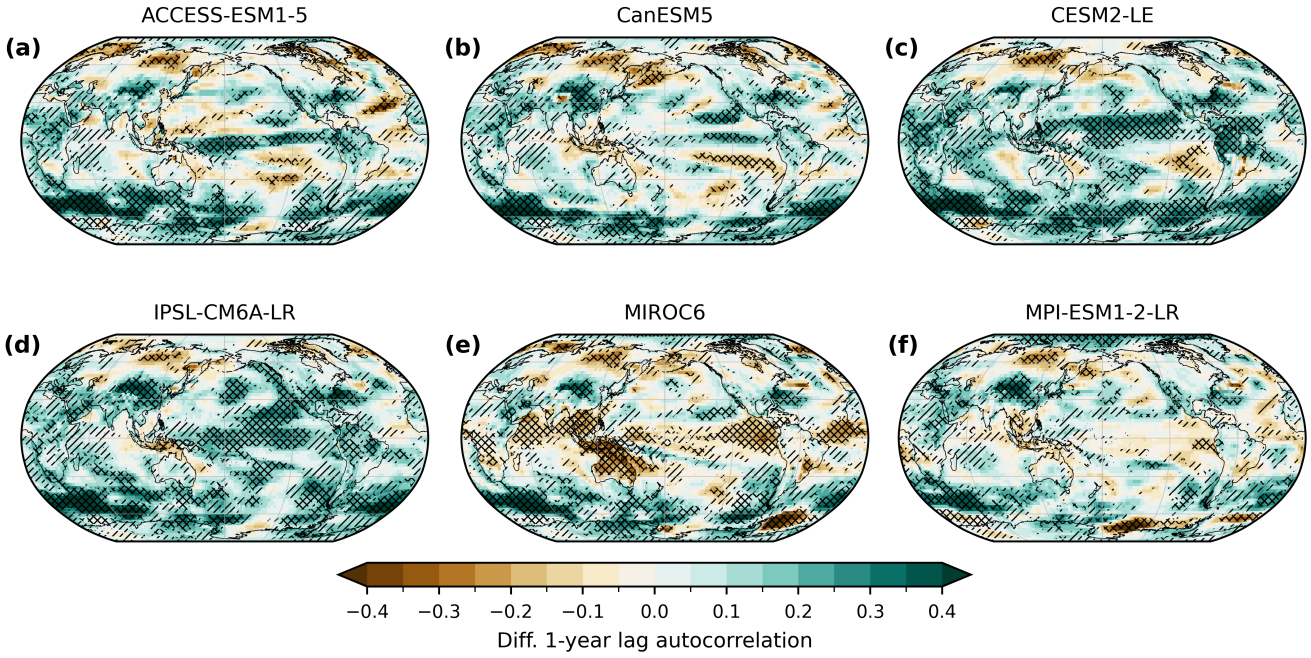


Figure S7. Difference in T2M autocorrelation between observations and models over the 20th century period. Same as Fig. S5 for T2M.

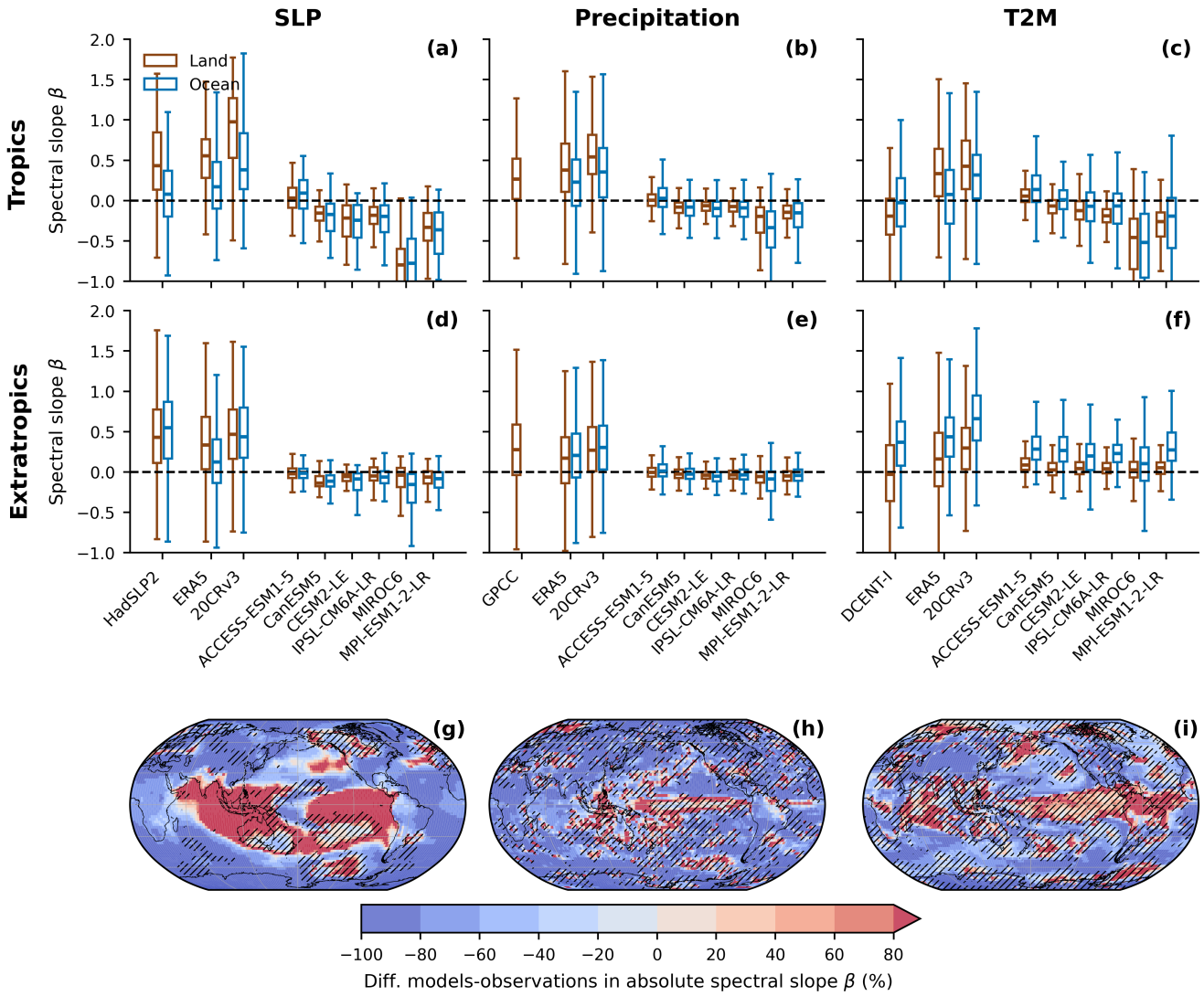


Figure S8. Spectral slopes of surface variables computed on individual members. Same as Figure S4 for spectral slopes.

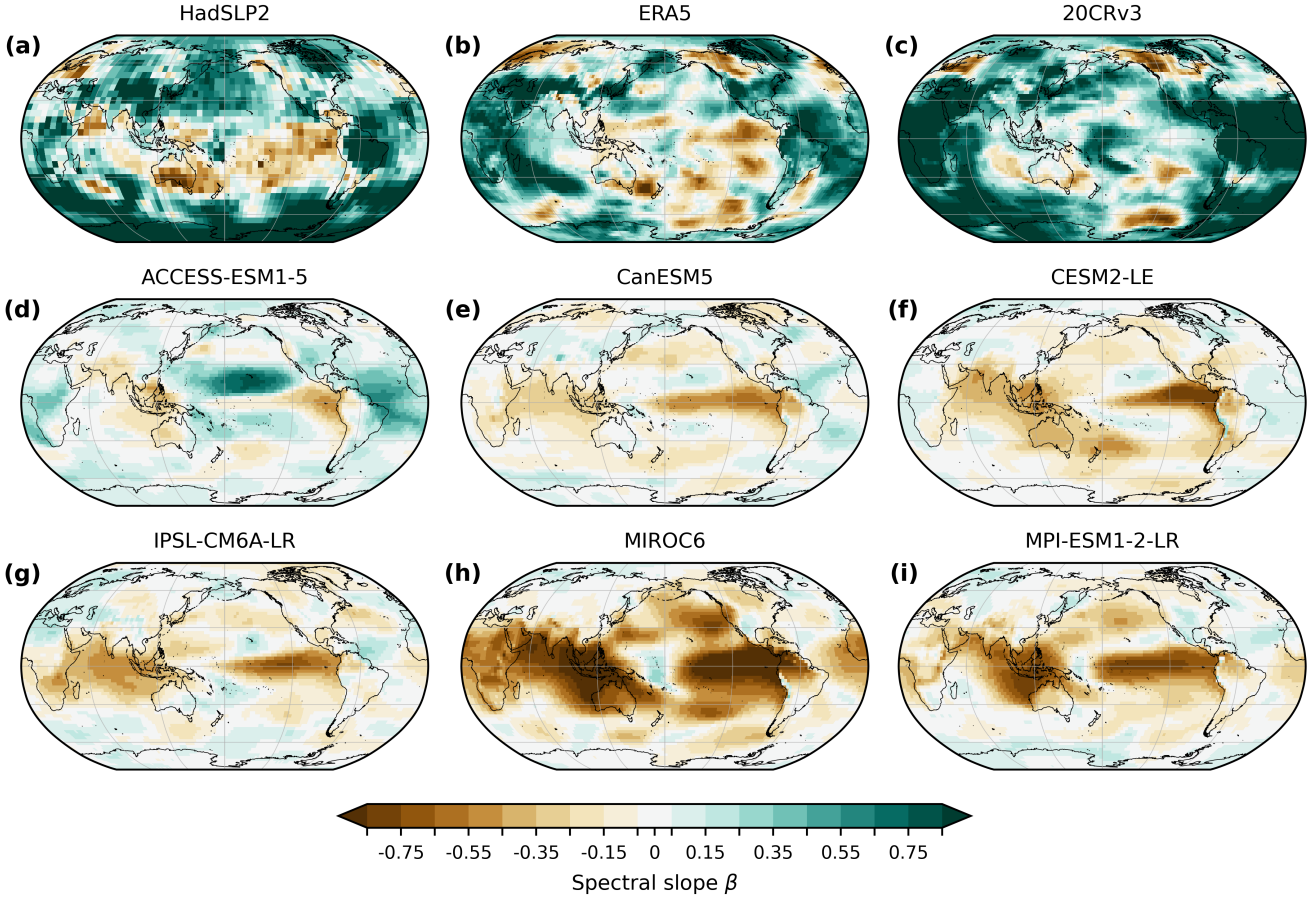


Figure S9. Spectral slopes for SLP. Same as Figure S1 for spectral slopes.

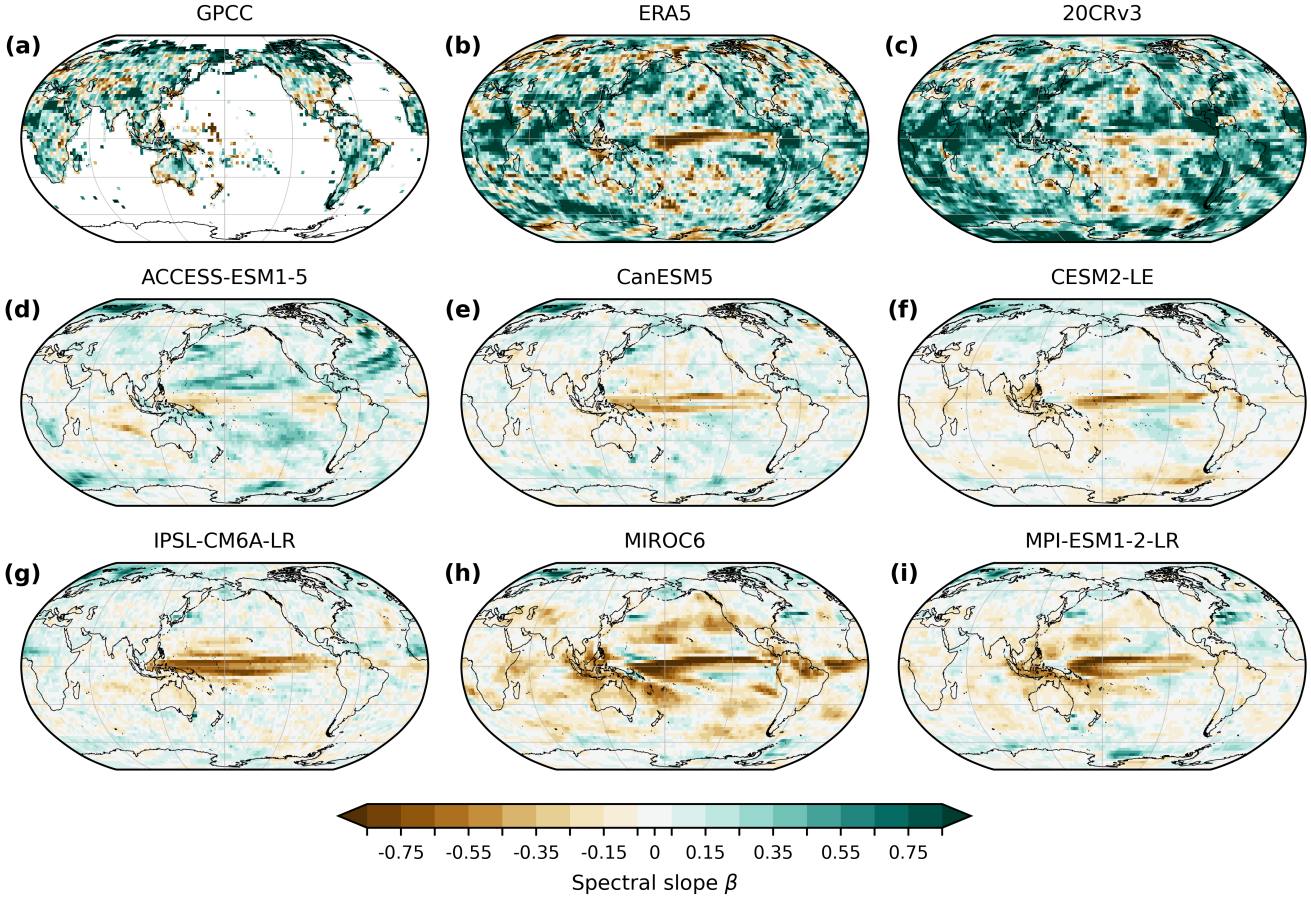


Figure S10. Spectral slopes for precipitation. Same as Figure S2 for spectral slopes.

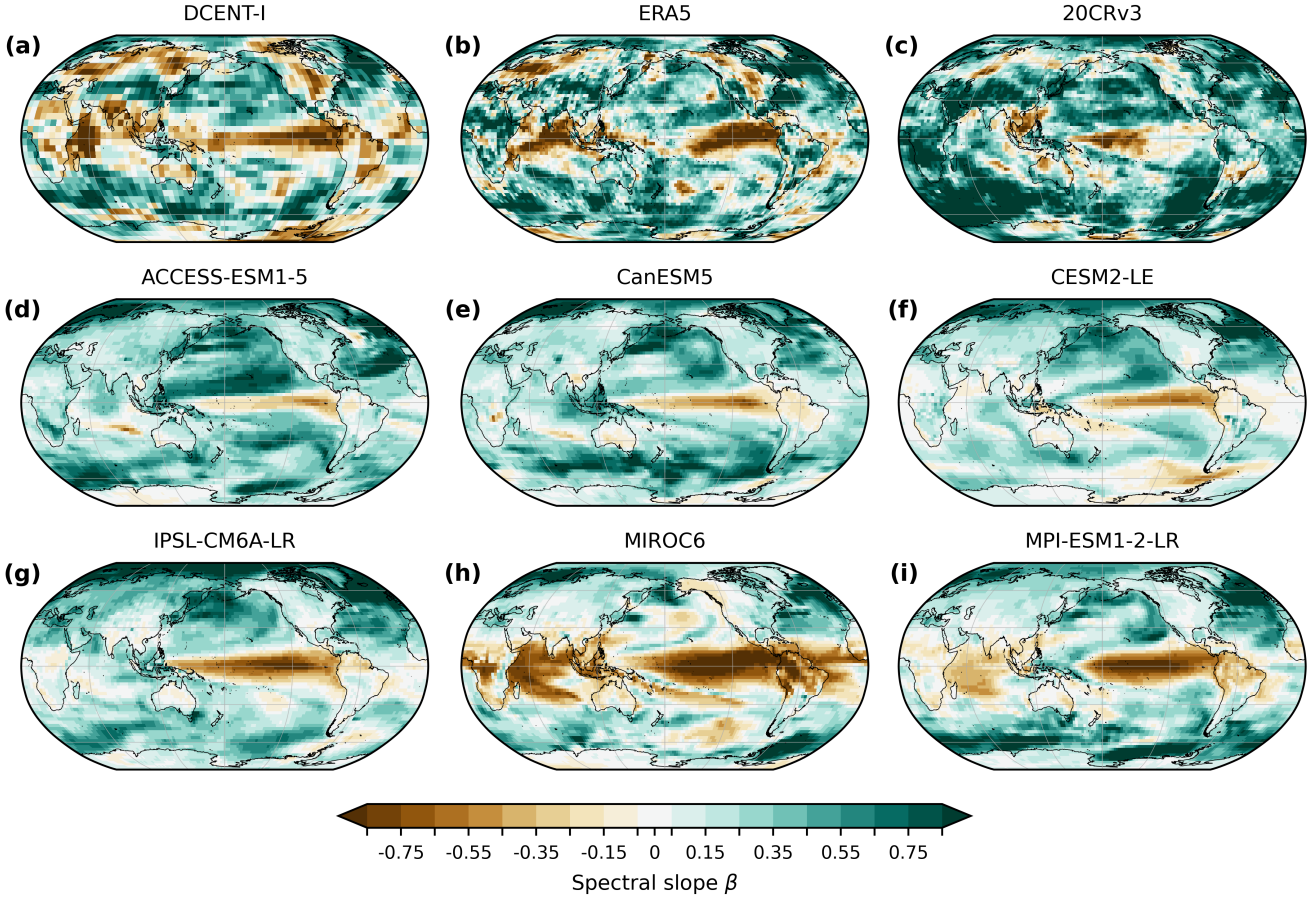


Figure S11. Spectral slopes for T2M. Same as Figure S3 for spectral slopes.

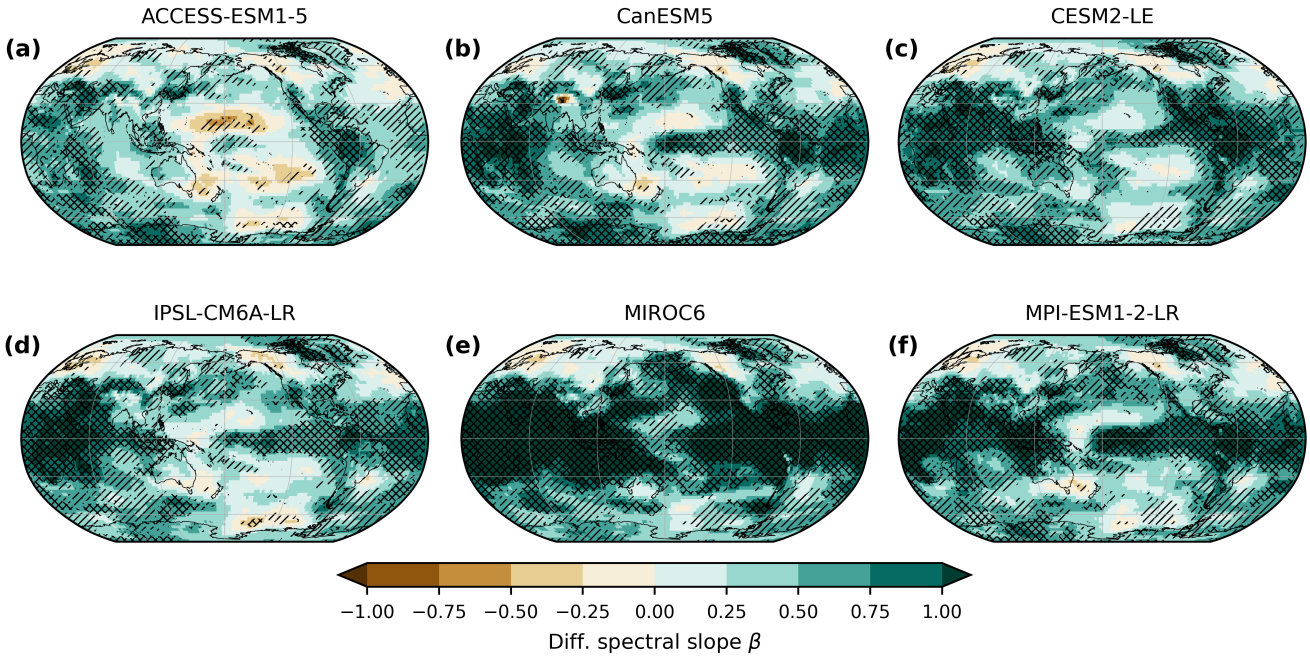


Figure S12. Difference in SLP spectral slopes between observations and models over the 20th century period. Same as Figure S5 for spectral slopes.

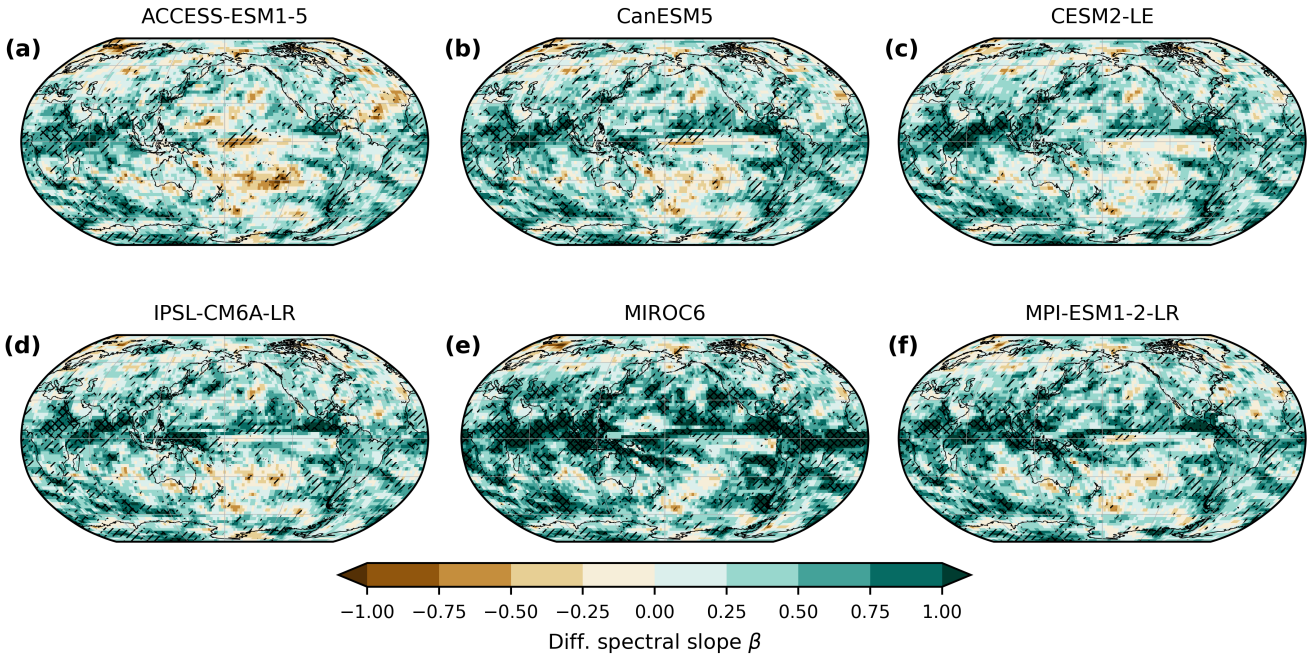


Figure S13. Difference in precipitation spectral slopes between observations and models over the 20th century period. Same as Figure S6 for spectral slopes.

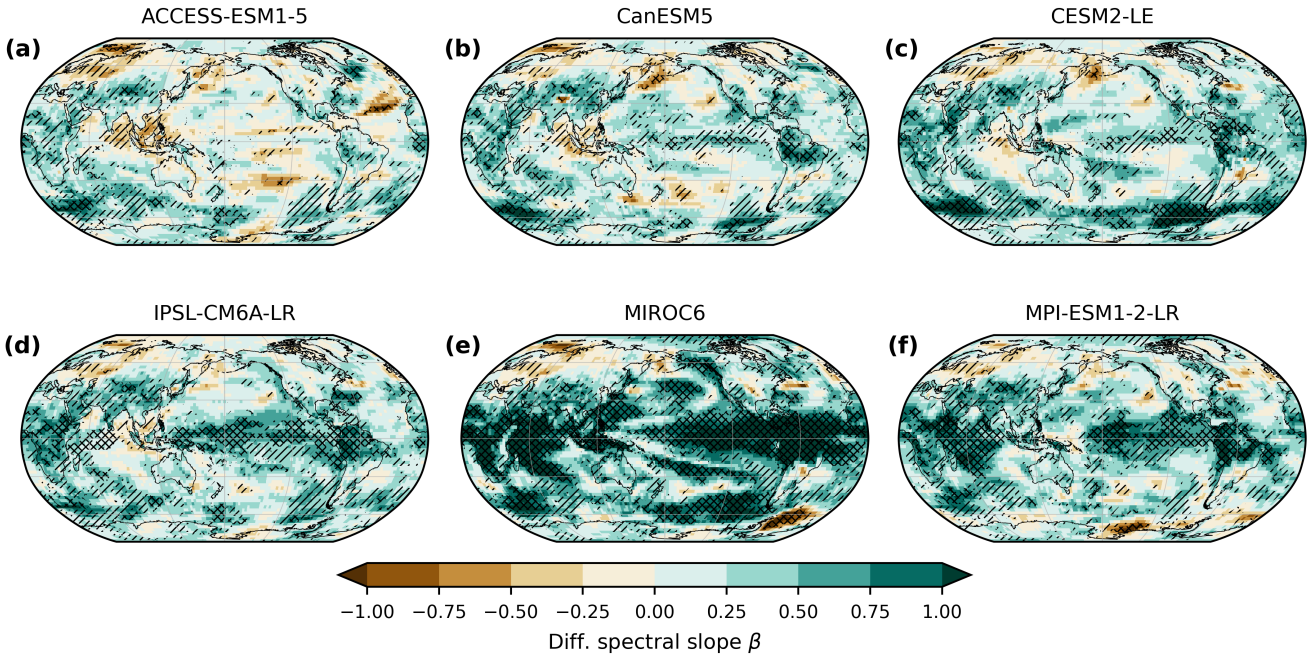


Figure S14. Difference in T2M spectral slopes between observations and models over the 20th century period. Same as Figure S7 for spectral slopes.