

Supplementary Material

Initialization shock in the ocean circulation reduces skill in decadal predictions of the Atlantic subpolar gyre

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1 Supplementary Figures

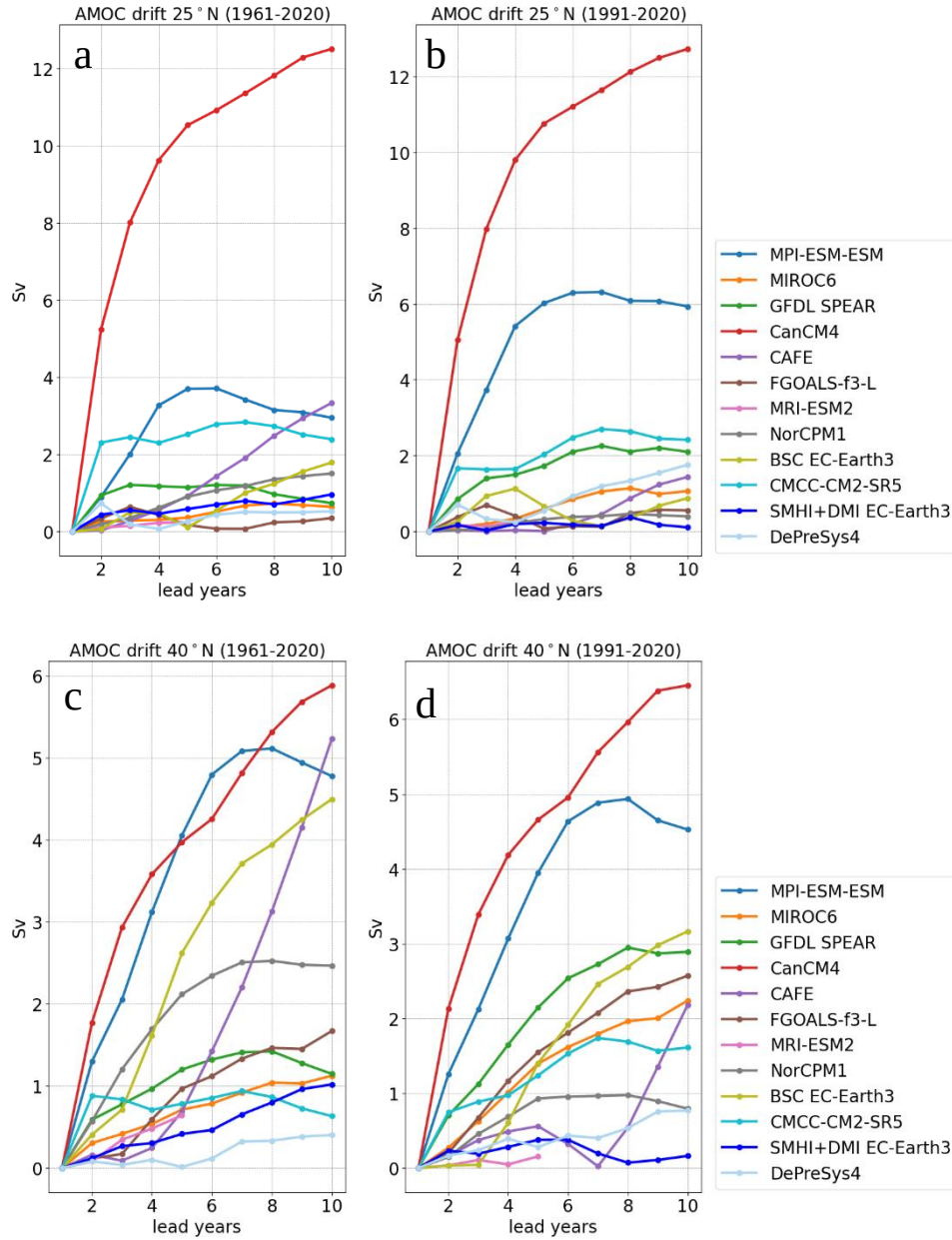


Fig S1. The AMOC drifts at 25°N (a, b) and at 40°N (c, d) and 1000 m depth calculated as absolute difference between AMOC climatology at each lead year and AMOC climatology at the 1st lead year. Drift for the period 1961-2020 (a, c) and 1991-2020 (b, d).

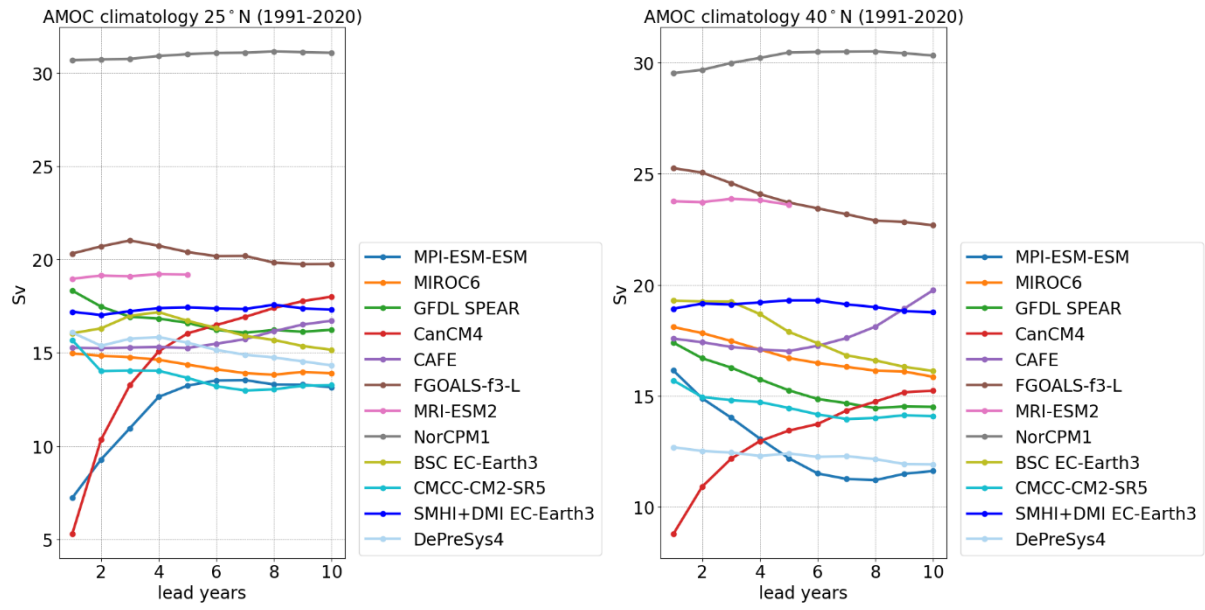


Fig S2. The AMOC leadtime-dependent climatology from DCPs at 25°N (left) and 40°N (right).

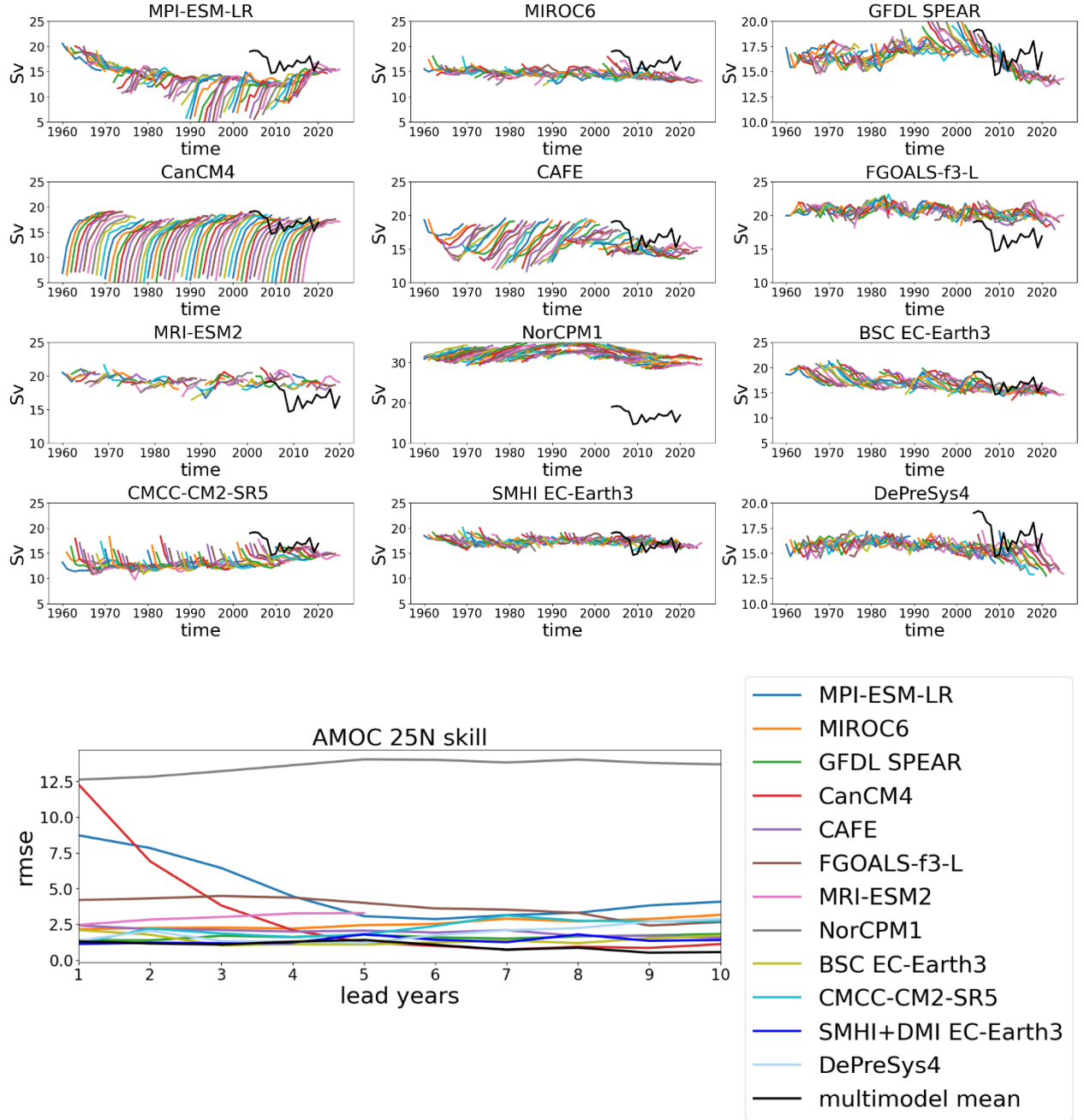


Fig S3. The AMOC time-series at 25°N and 1000 m depth (upper) and its root-mean-square error (rmse; lower). Due to the short length of RAPID data, for the 1st lead year, the rmse is calculated over 13 data points and for the lead year 10 over 4 data points. AMOC was not bias-corrected. Models that have low SPG residual skill at years 6-10, have either large drift in AMOC (MPI-ESM-LR and CanCM4) or large bias (FGOALS-f3-L and NorCMP1).

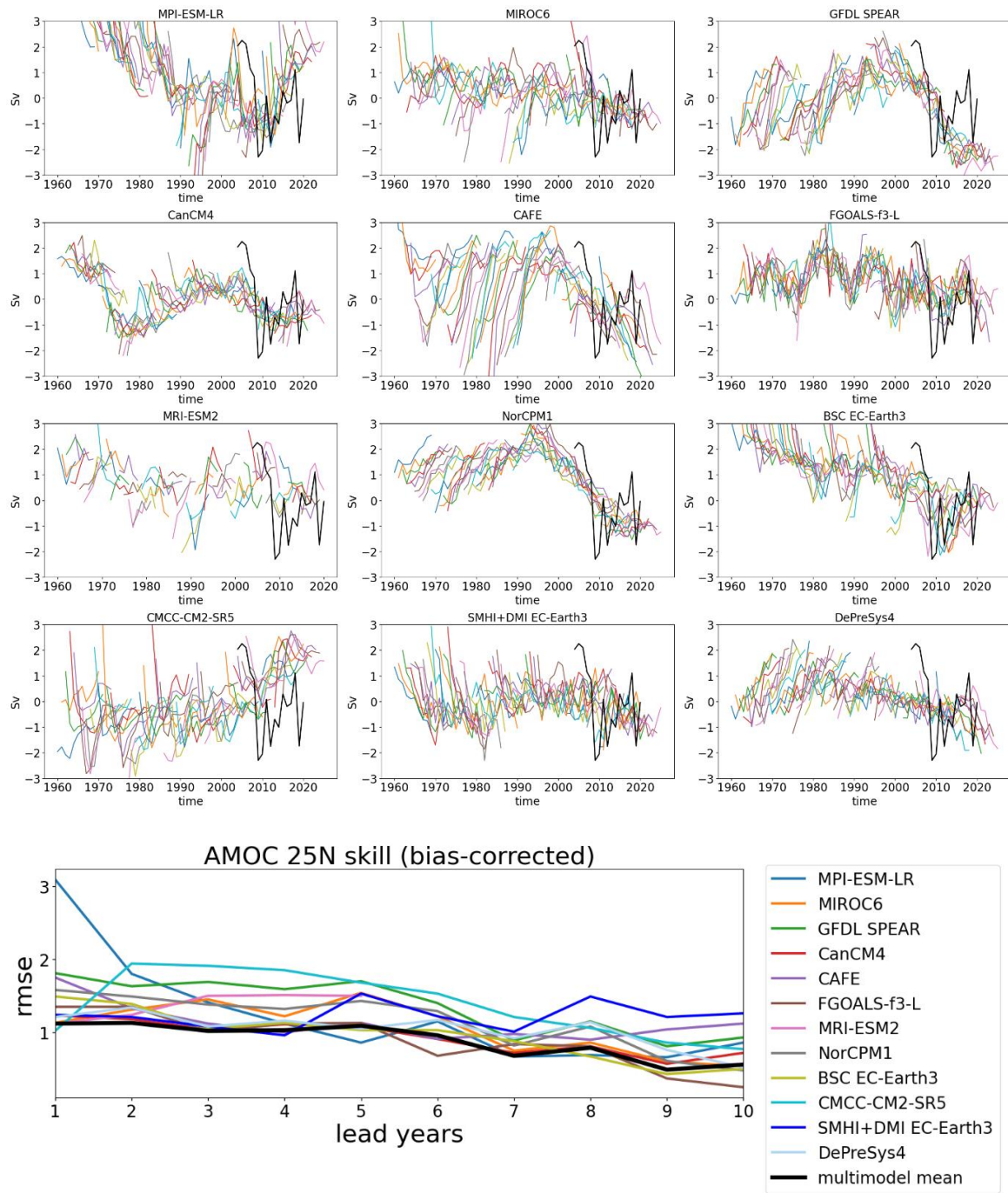


Fig S4. Same as Fig. S6 but for the AMOC time-series from which the lead-time dependent climatology is removed.

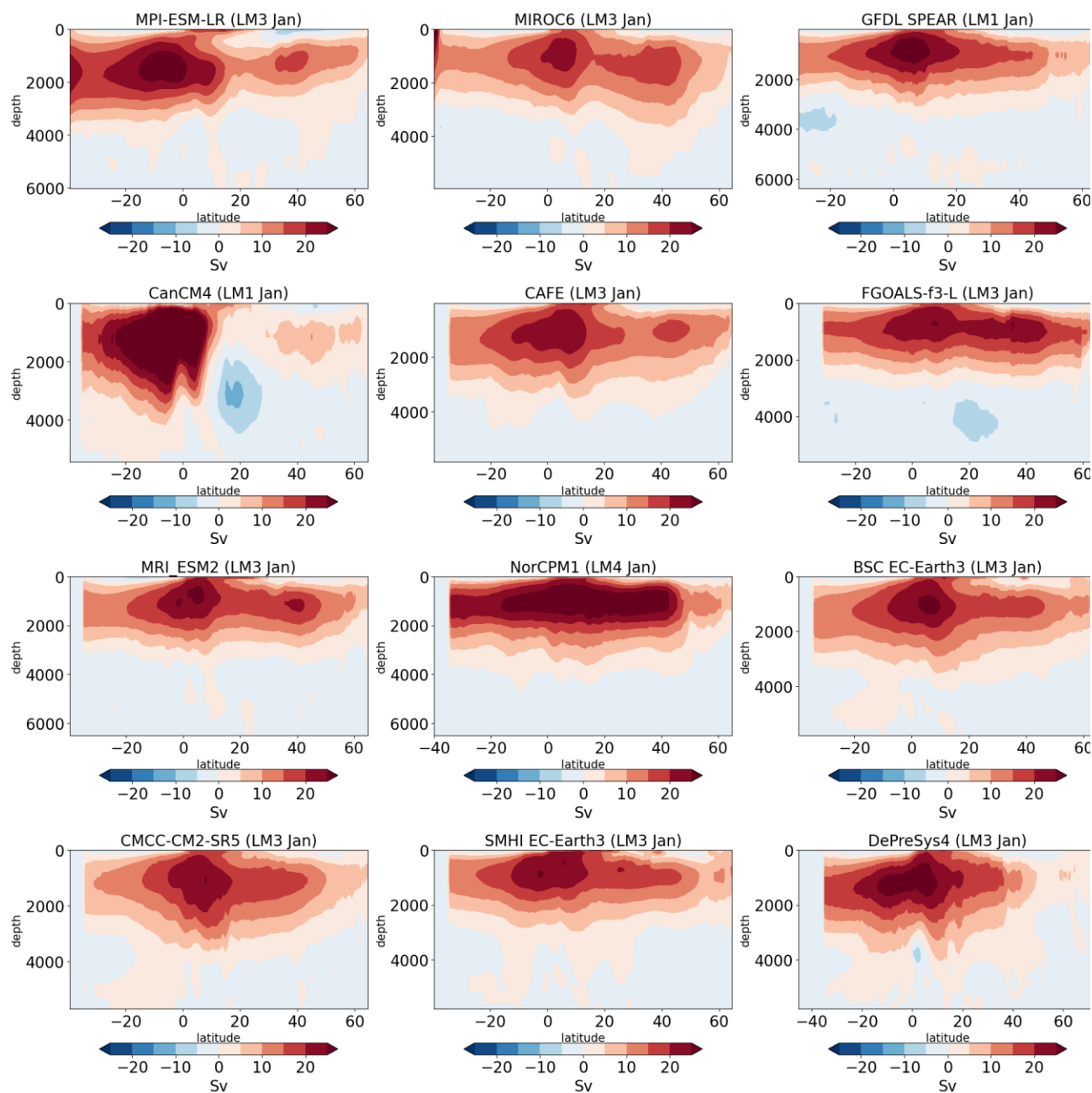


Fig S5. The AMOC cell for January of the 1st lead year averaged over 1991-2020.

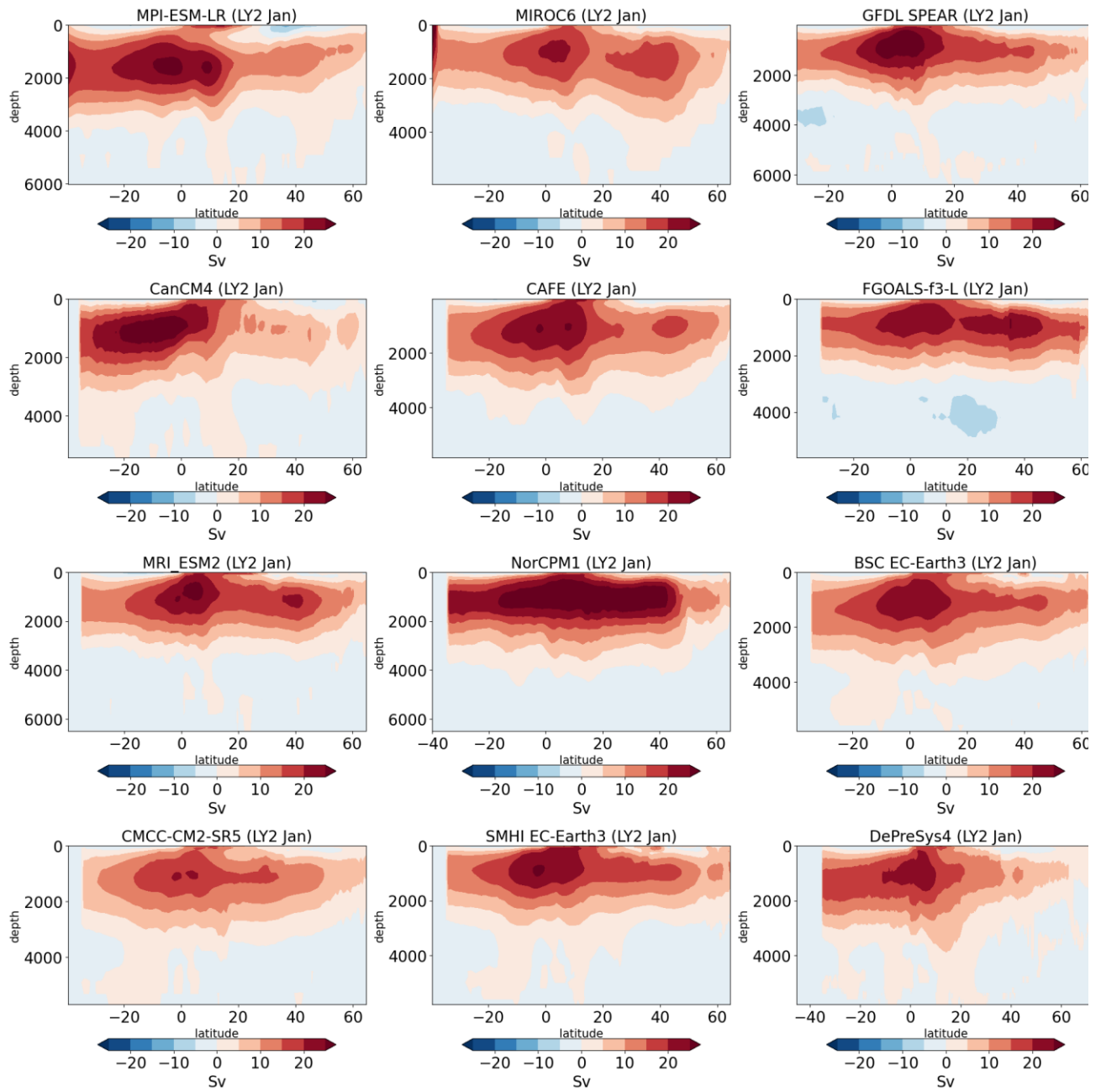


Fig S6. The AMOC cell for January of the 2nd lead year averaged over 1991-2020.

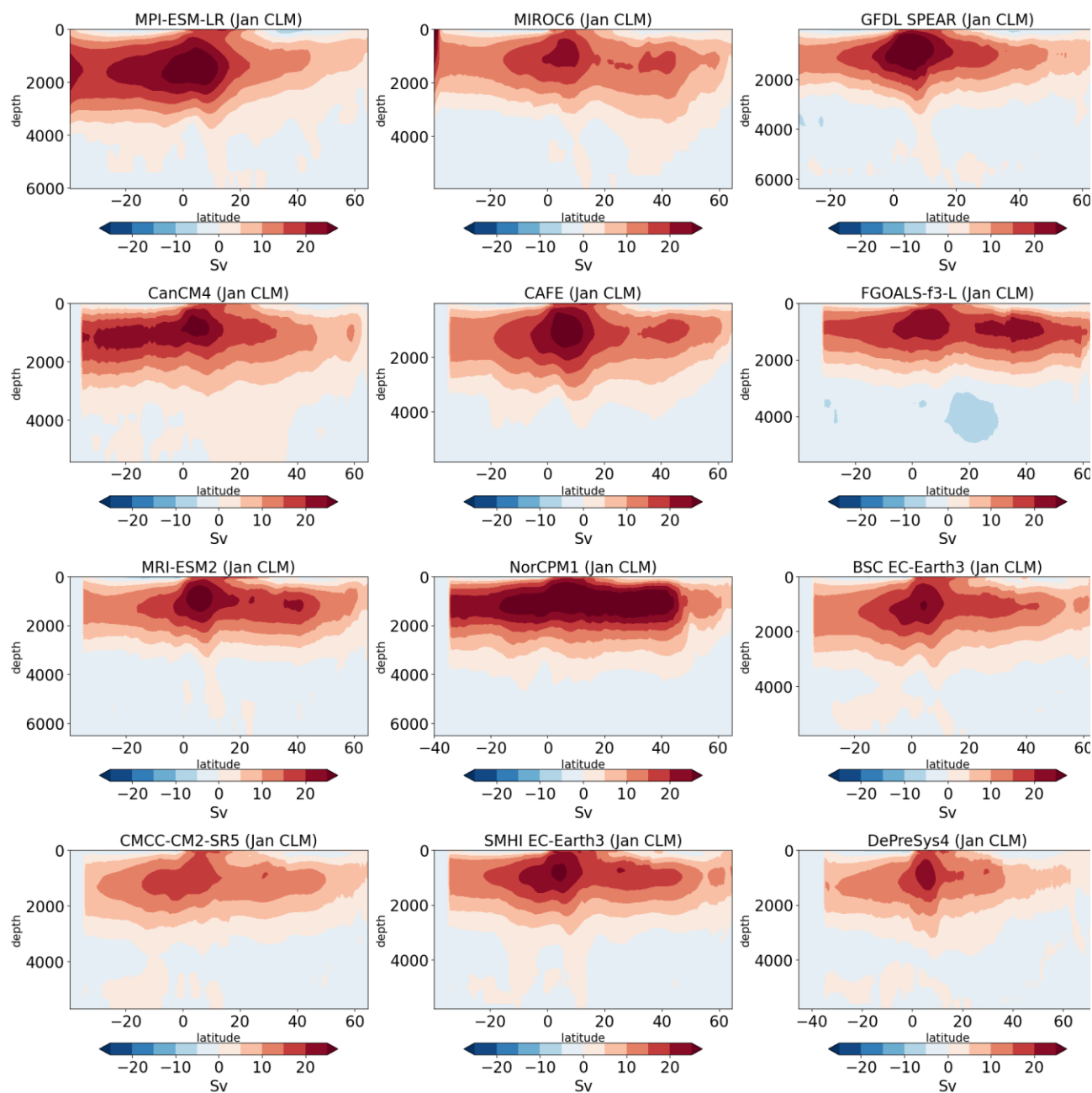


Fig S7. The AMOC cell for January climatology over lead years 2-10 and the period 1991-2020.

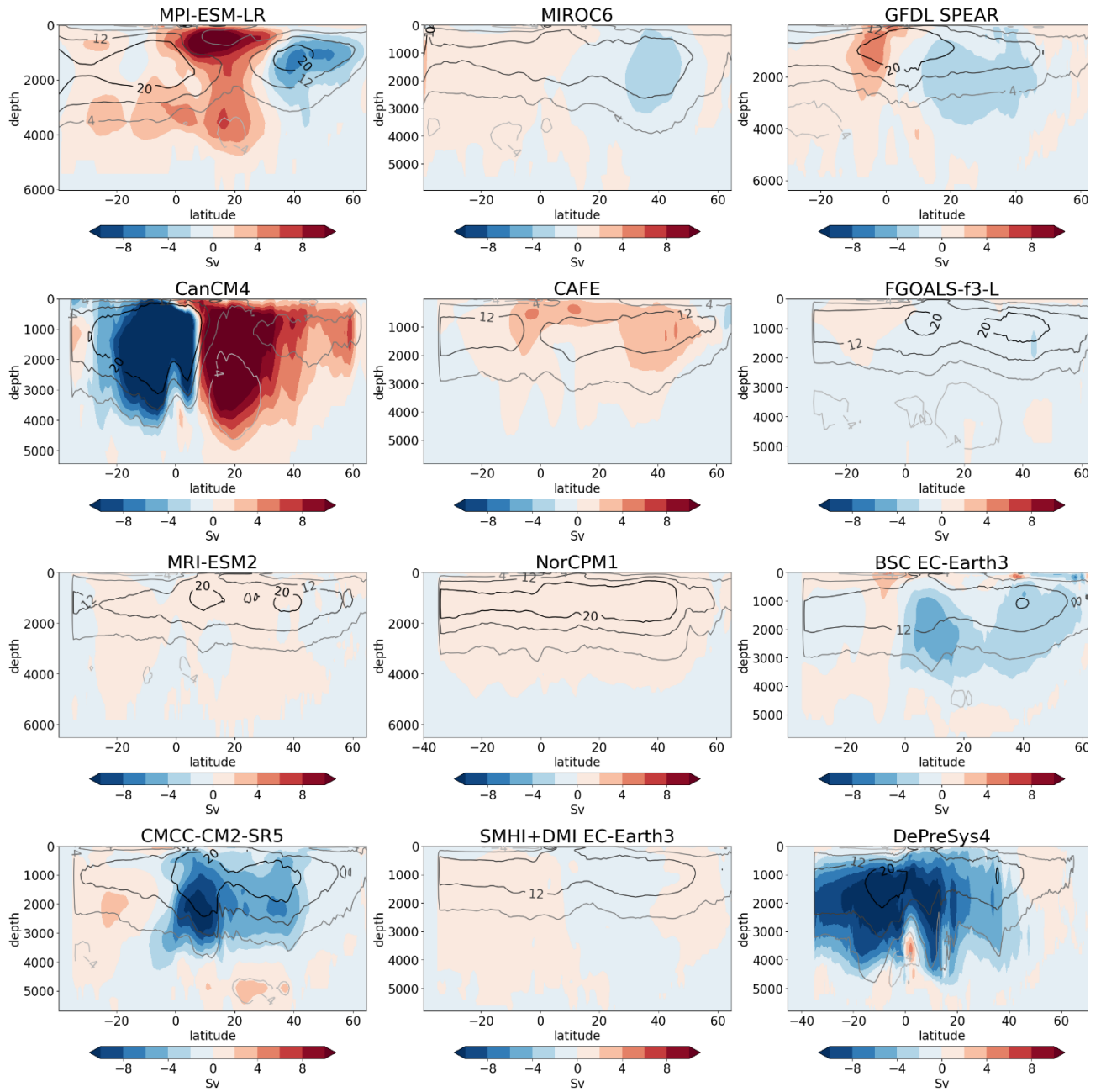


Fig S8. Difference between the January AMOC climatology at lead year 10 and 1 (shading). Mean AMOC at the 1st lead month (contour). Climatology is calculated over the period 1991-2020. The overturning structure is being recovered in the predictions; they have more (less) overturning in regions where the cell was too weak (too strong) at the initialization step. The speed of recovery is different among prediction systems and at different latitudes.

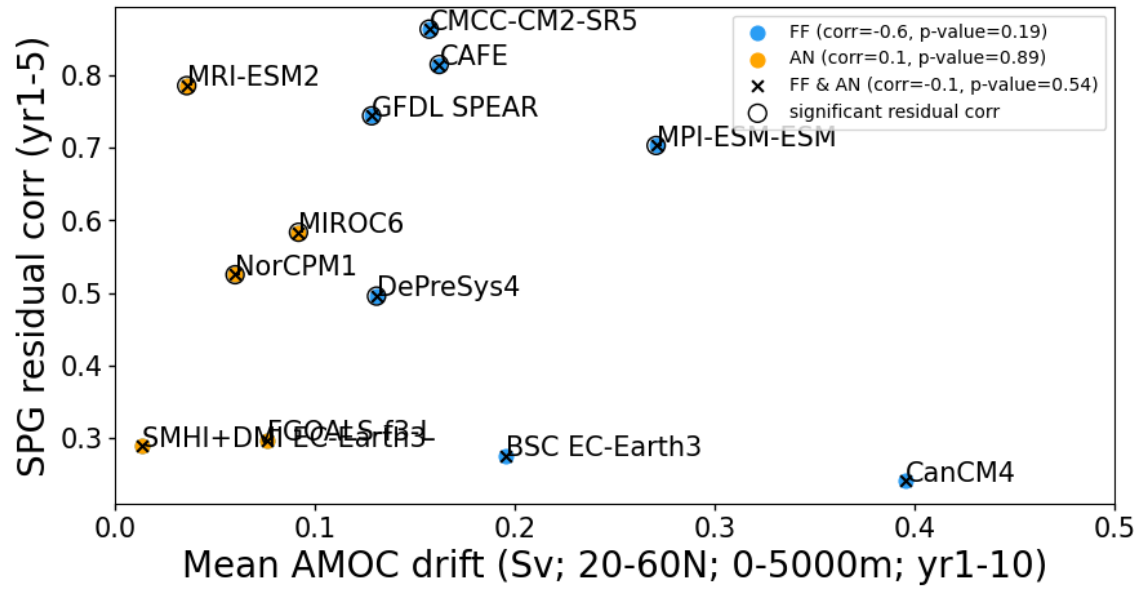


Fig S9. Mean AMOC drift (Sv/year) versus the SPG residual correlation for lead years 1-5. The significant SPG residual correlation (in black circles) is estimated with the t-test (p -value < 0.05). The drift is diagnosed as the slope of the linear regression fitted into ten lead years of the leadtime-dependent AMOC climatology. Climatology is estimated for the period 1991-2020. Then horizontally (cosine of latitude) and vertically (level thickness) weighted average of the AMOC drift is calculated for the region 20-60°N and 0-5000m depth. Orange marker - anomaly initialized DCPs, blue marker - full field initialized.

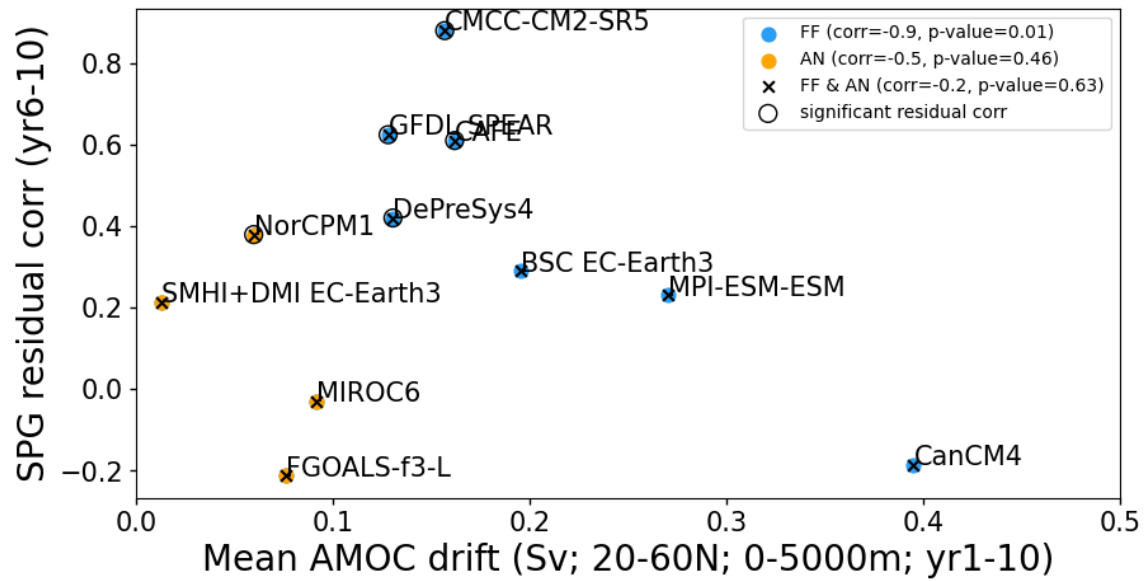


Fig S10. Mean AMOC drift (Sv/year) versus the SPG residual correlation for lead years 6-10. The significant SPG residual correlation (in black circles) is estimated with the t-test (p -value < 0.05). The drift is diagnosed as the slope of the linear regression fitted into ten lead years of the leadtime-dependent AMOC climatology. Climatology is estimated for the period 1991-2020. Then horizontally (cosine of latitude) and vertically (level thickness) weighted average of the AMOC drift is calculated for the region 20-60°N and 0-5000m depth. Orange marker - anomaly initialized DCPs, blue marker - full field initialized.

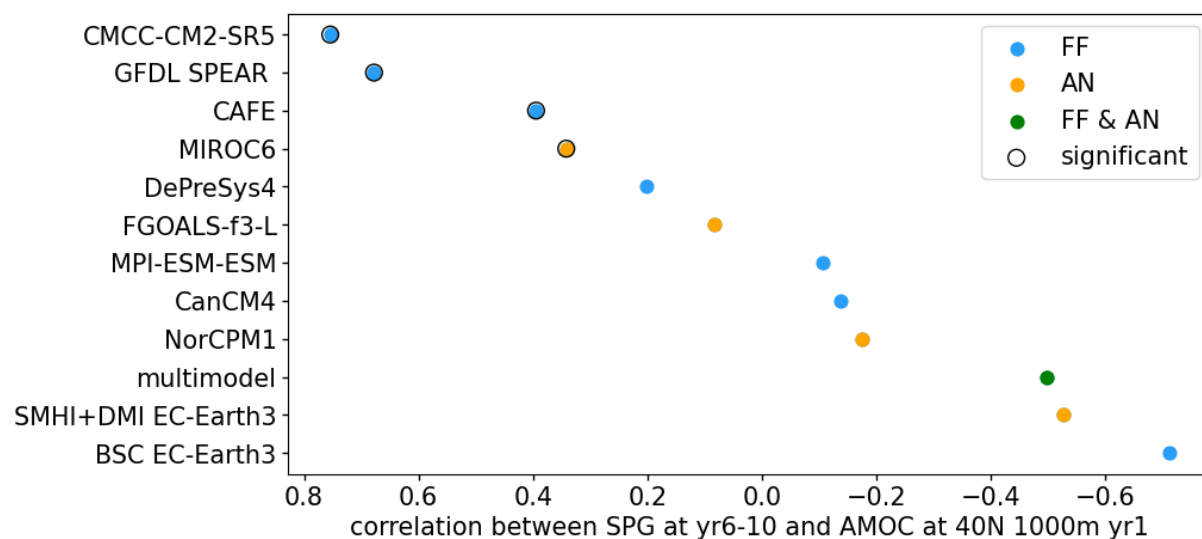


Fig S11. Correlation between the time-series of the AMOC at 40°N latitude at lead year 1 and the time-series of the SPG index at lead years 6-10. Significant correlations with p-value < 0.05 are shown in black circles.

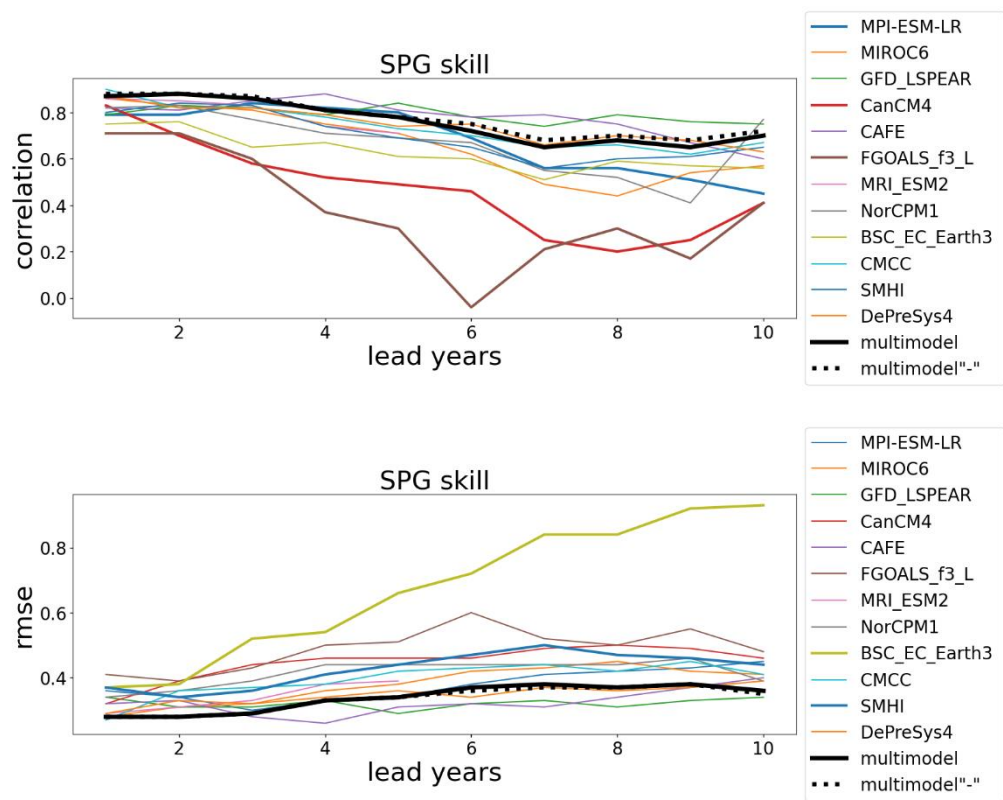


Fig S12. Prediction skill excluding the period 1961-1980.