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Supplement of

Evaluation of Northern Hemisphere snow water equivalent in CMIP6 models during 1982–2014

Kerttu Kouki et al.

Correspondence to: Kerttu Kouki (kerttu.kouki@fmi.fi)

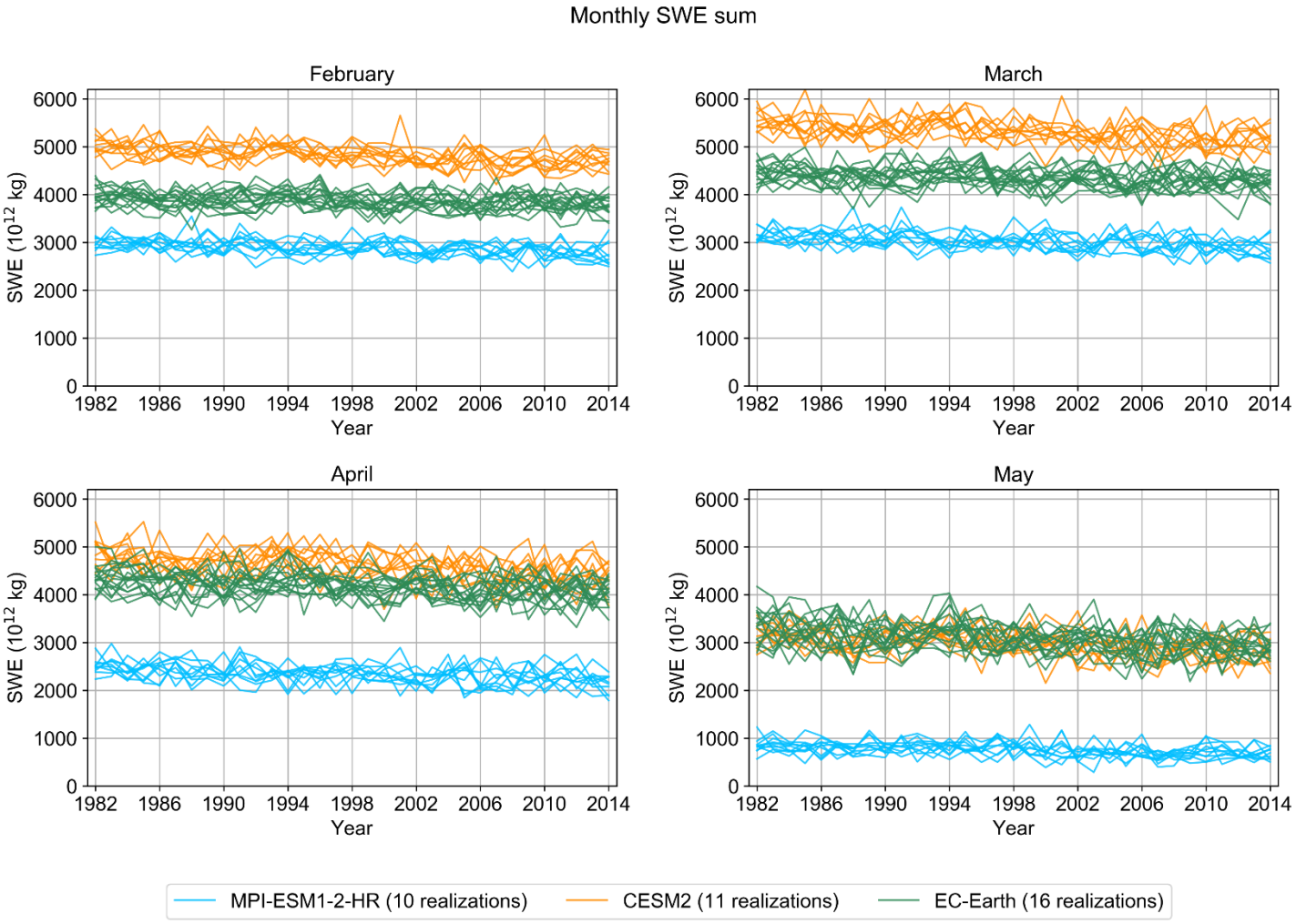

Figure S1. Monthly SWE sum over the entire study area in February, March, April, and May for all realizations of three CMIP6 models.

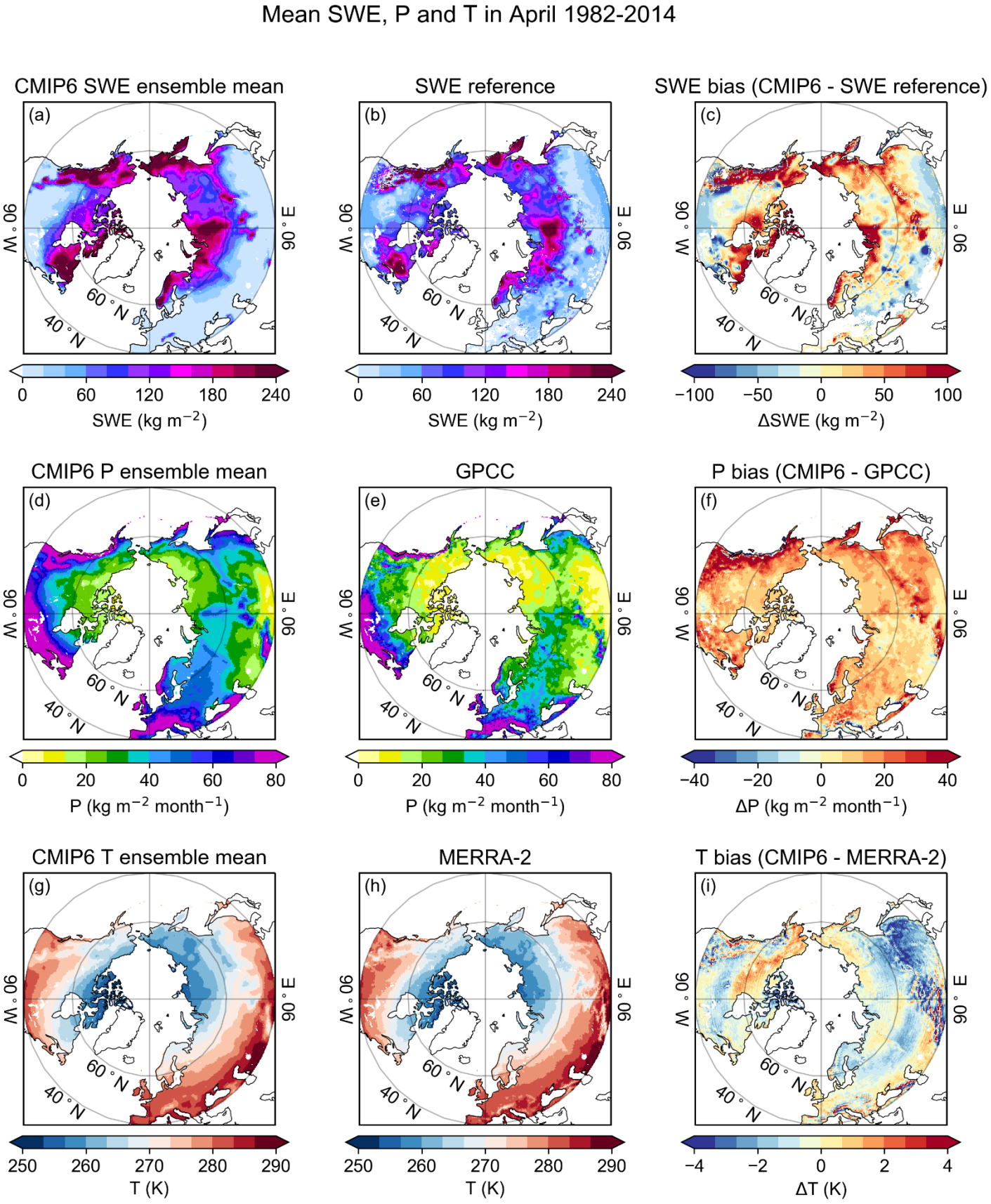

Figure S2. (top) Mean SWE in April for the CMIP6 high-resolution (100 km) multi-model ensemble mean and SWE reference data, and the model SWE bias (right) for the period 1982-2014. (middle) Mean P in April for CMIP6 high-resolution (100 km) multi-model ensemble mean, GPCC and the model P bias for the period 1982-2014. (bottom) Mean T in April for CMIP6 high-resolution (100 km) multi-model ensemble mean, MERRA-2 and the model T bias for the period 1982-2014.

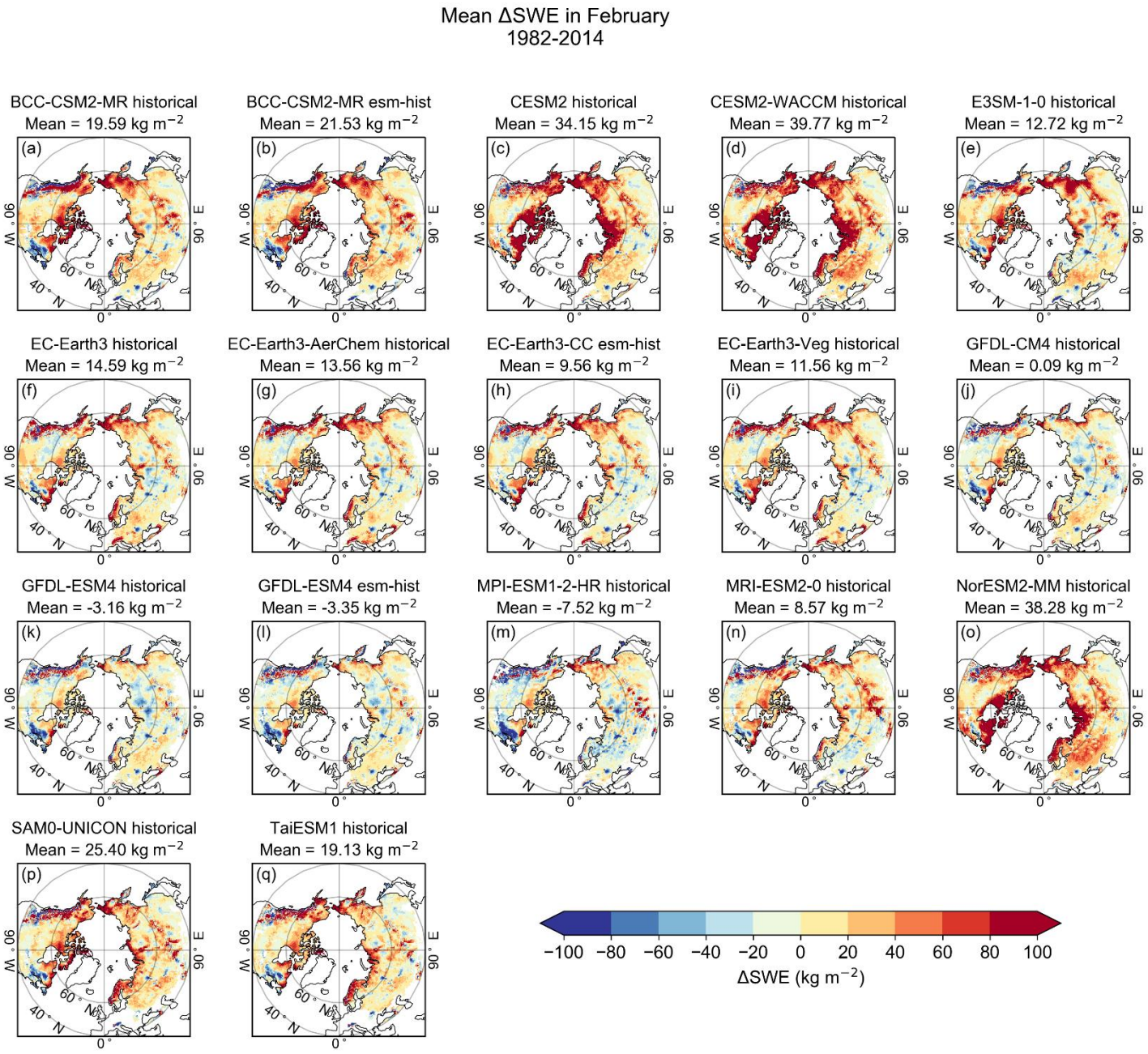

Figure S3. Mean SWE model bias (ΔSWE, model minus observation) in snow-covered areas in February 1982-2014.

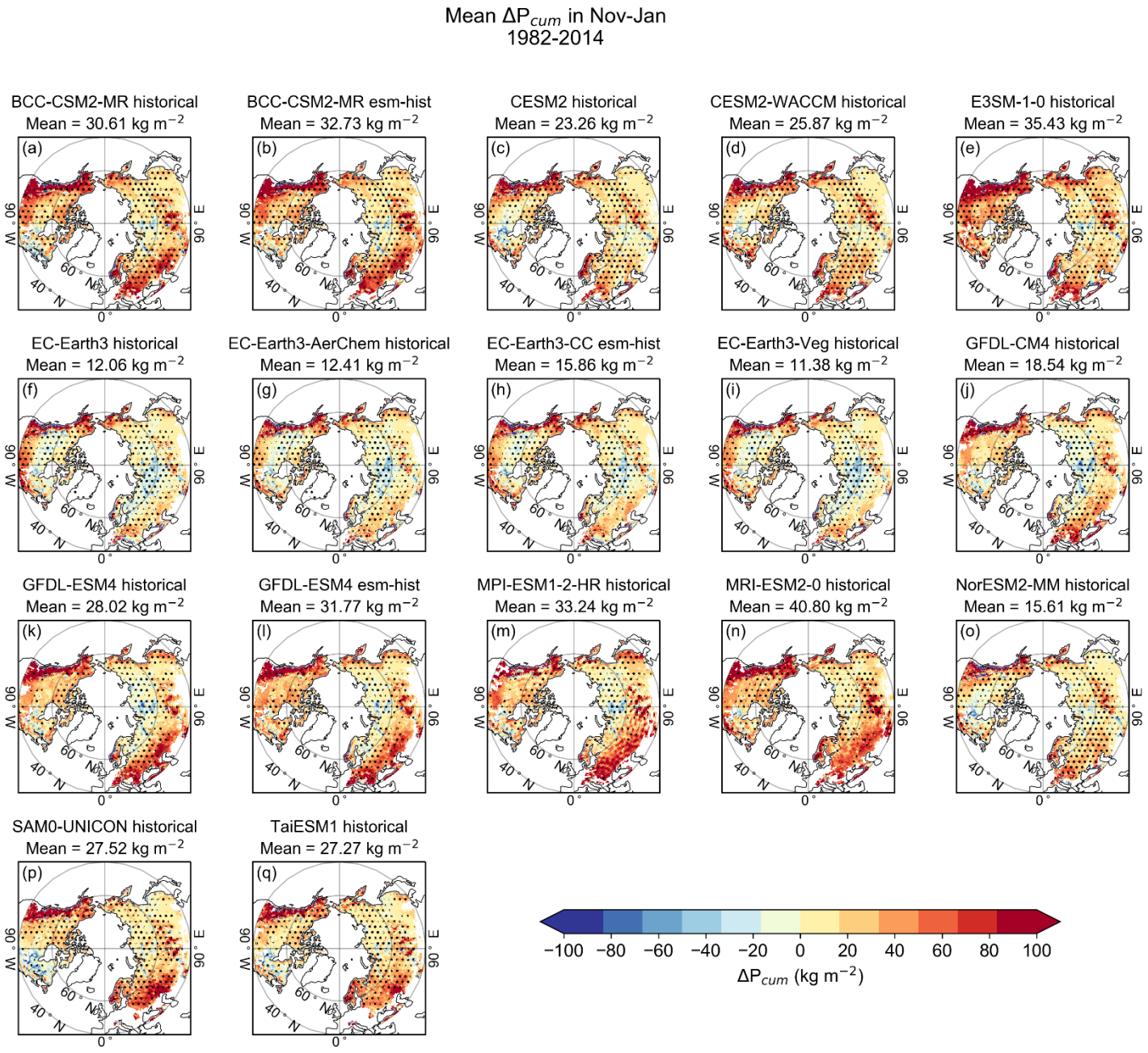

Figure S4. Mean P_{cum} bias (ΔP_{cum}, model minus observation) in snow-covered areas between each CMIP6 model and GPCC in winter 1982-2014. The dots indicate areas where the models either overestimate both SWE and P or underestimate both SWE and P.

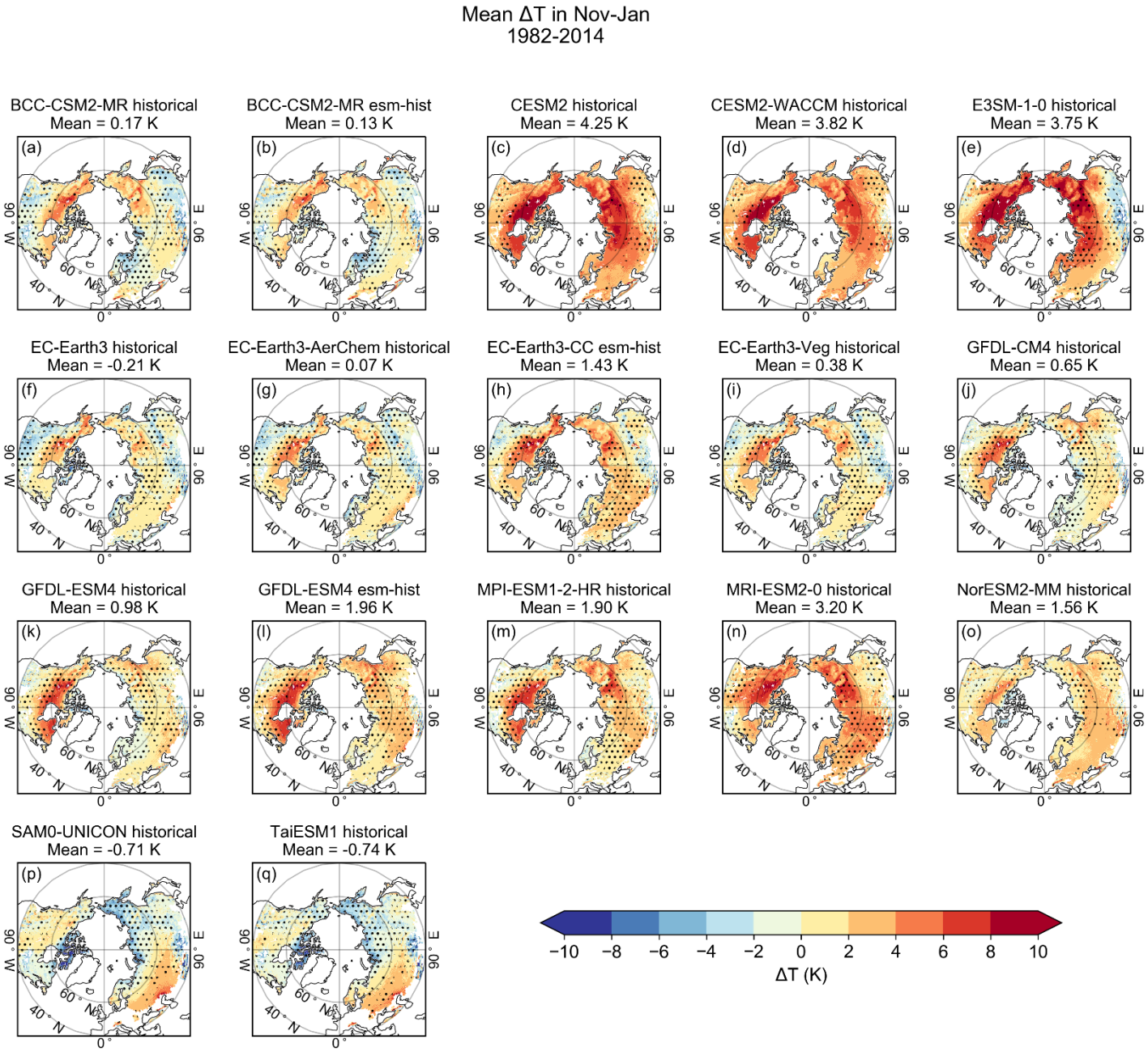

Figure S5. Mean model bias in T (ΔT, model minus observation) in snow-covered areas between each CMIP6 model and MERRA-2 in winter 1982-2014. We show ΔT (ΔT_{cum} divided by 3) instead of ΔT_{cum} so that the values are more intuitive and easier to interpret. The dots indicate areas with either cold bias and positive SWE bias or warm bias and negative SWE bias, i.e., the areas where T bias could logically explain the SWE bias.

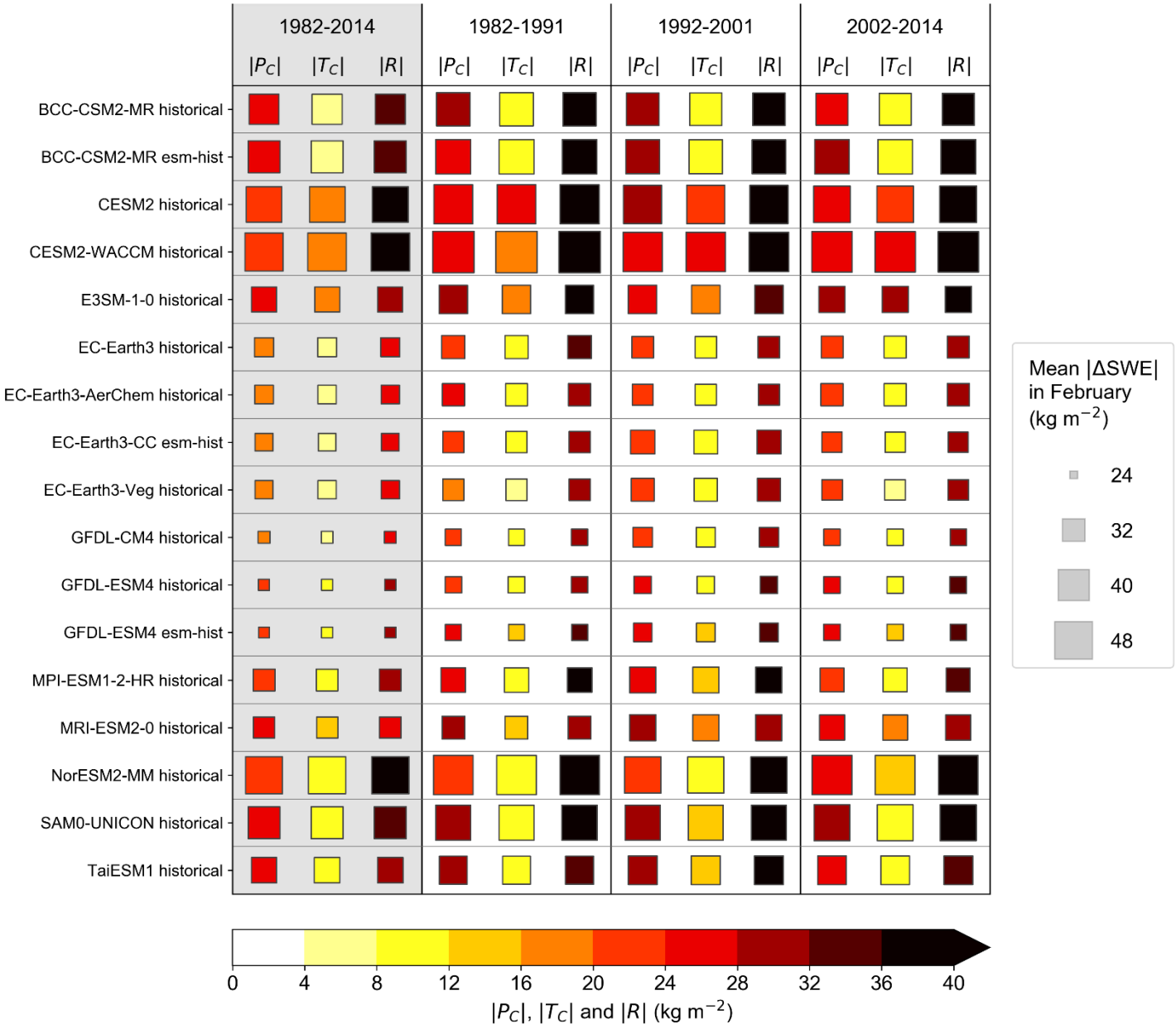

Figure S6. The areal-means of the absolute values of ΔSWE, P_C, T_C, and residual R calculated for the entire study period 1982-2014 (left column, shaded with grey) and for three shorter time periods (1982-1991, 1992-2001, and 2002-2014) for each model in winter. The size of the square indicates the absolute value of ΔSWE of that time period and model, and the color of the square indicates the absolute value of P_C, T_C, and R.

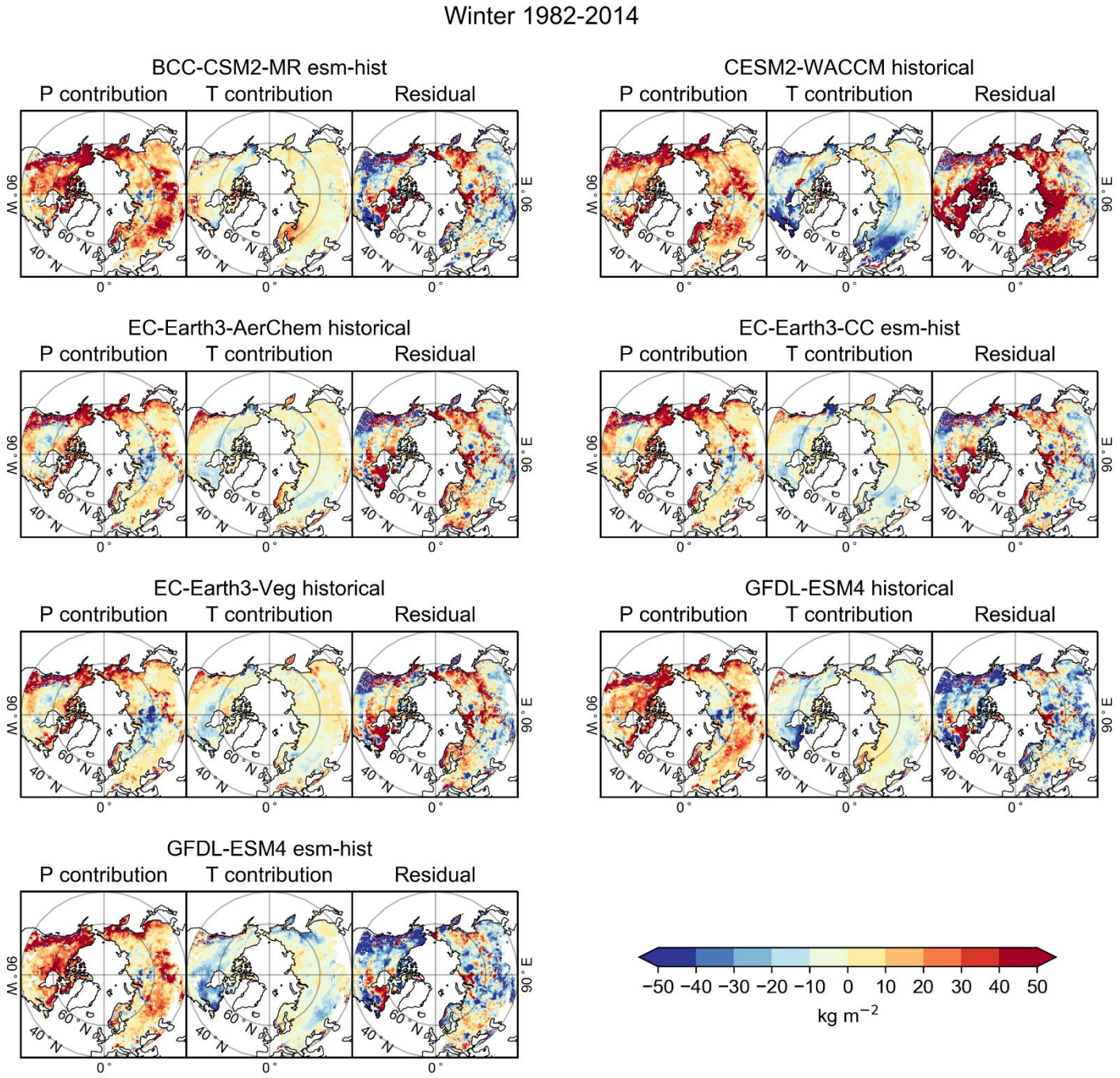

Figure S7. Spatial distribution of P contribution, T contribution and residual for those high-resolution CMIP6 models not included in Fig. 7.

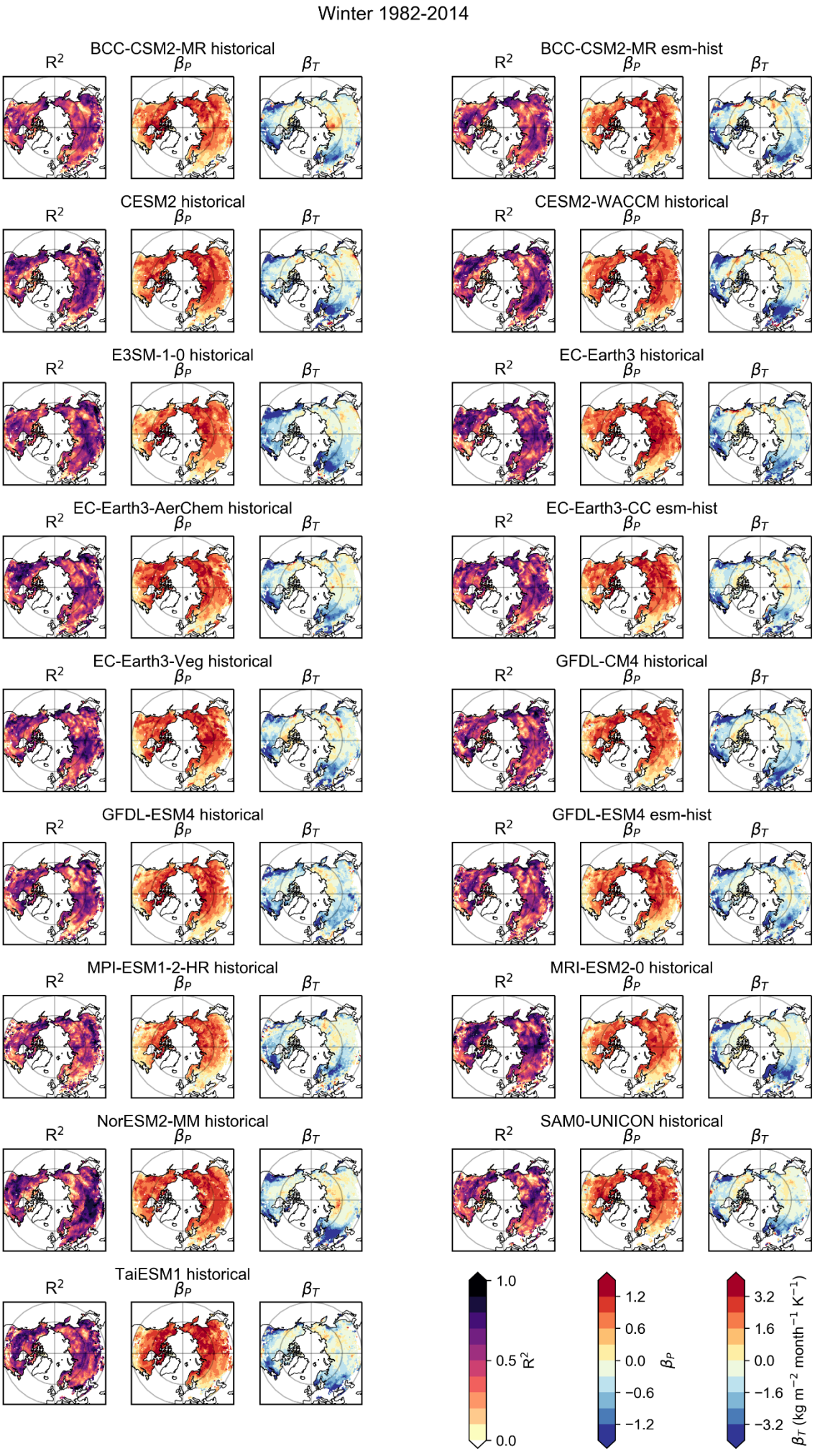

Figure S8. The spatial distribution of R^2, β_P and β_T in winter 1982-2014.

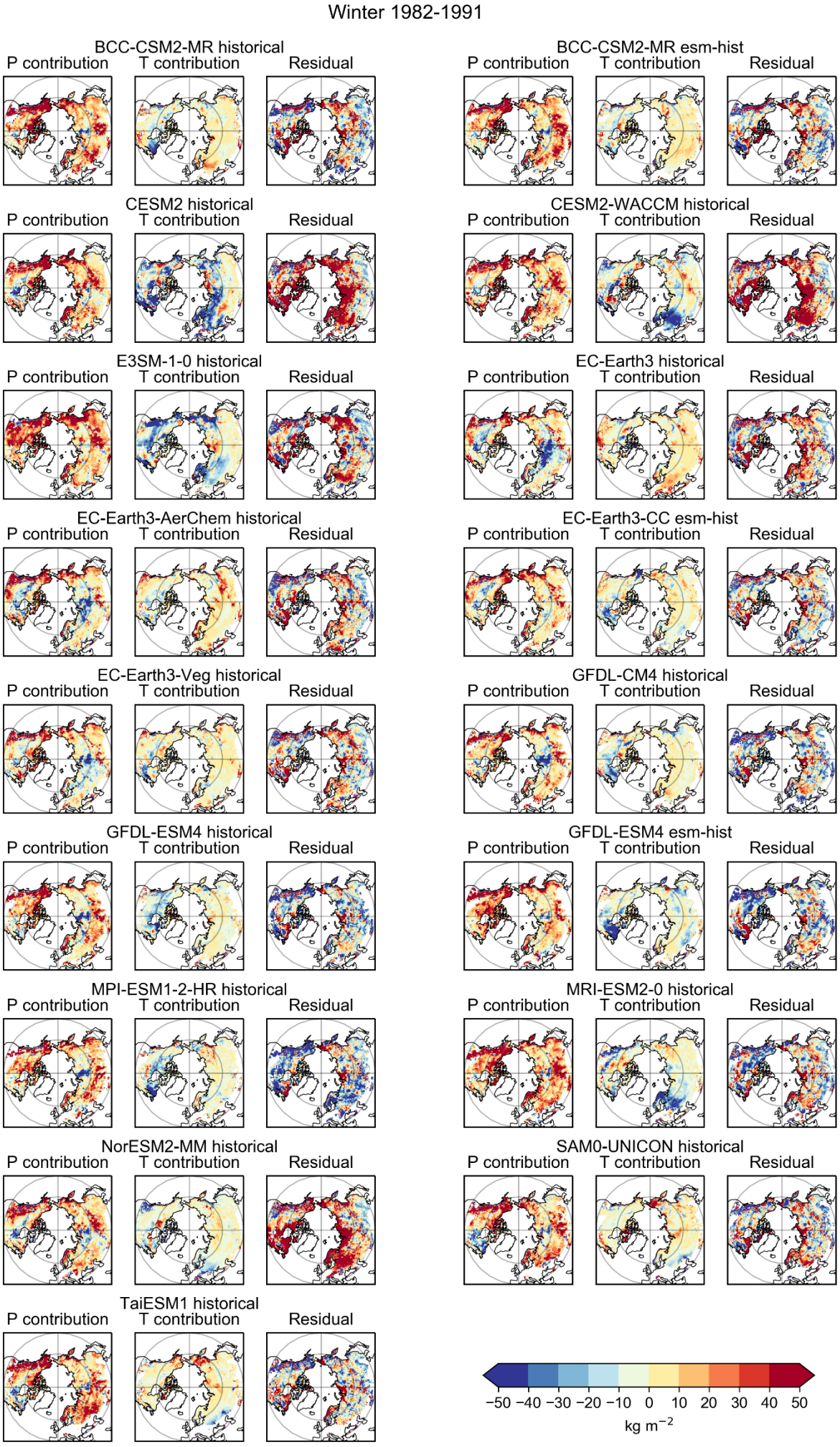

Figure S9. Spatial distribution of P contribution, T contribution and residual for each model in winter 1982-1991.

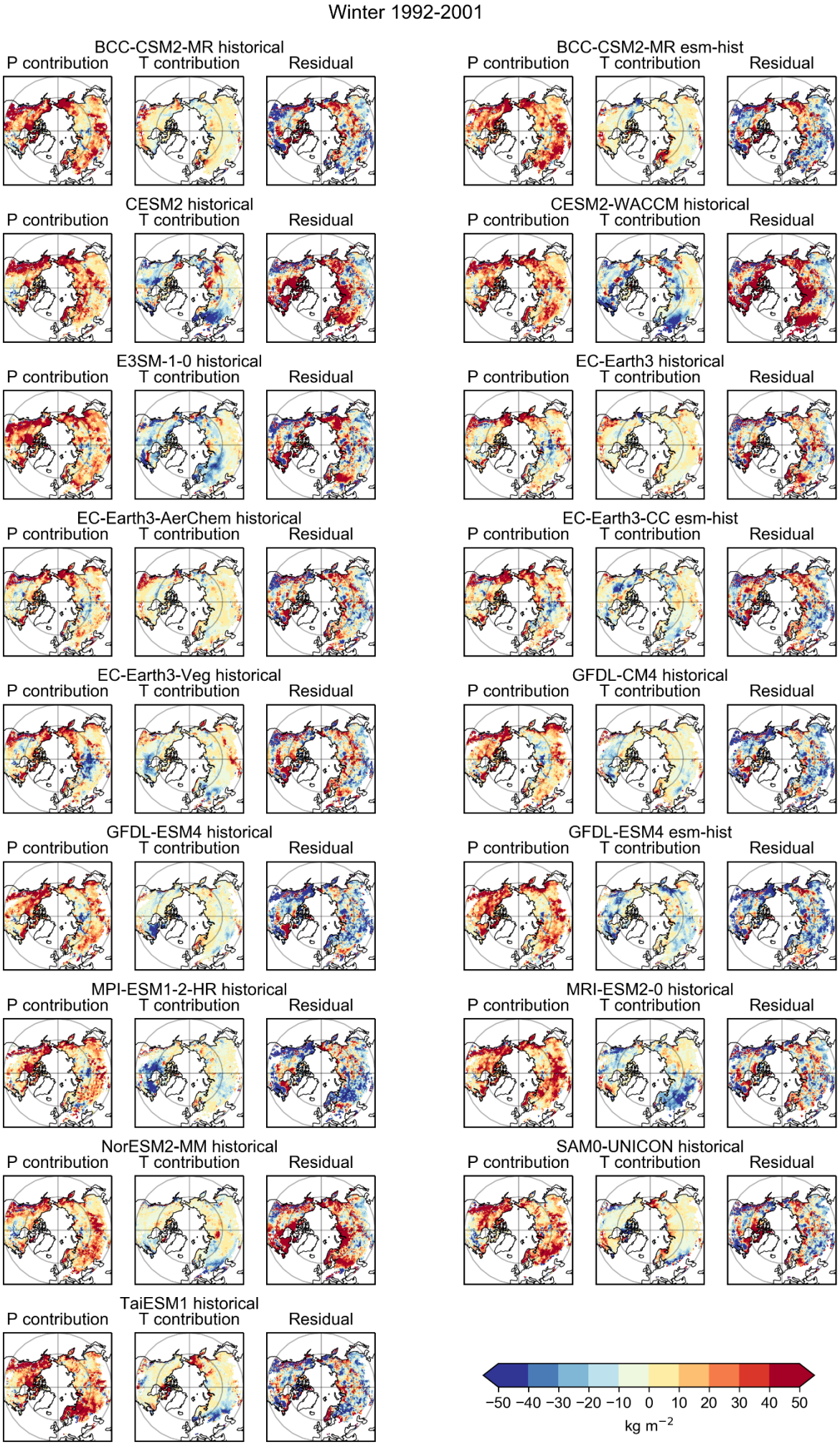

Figure S10. Spatial distribution of P contribution, T contribution and residual for each model in winter 1992-2001.

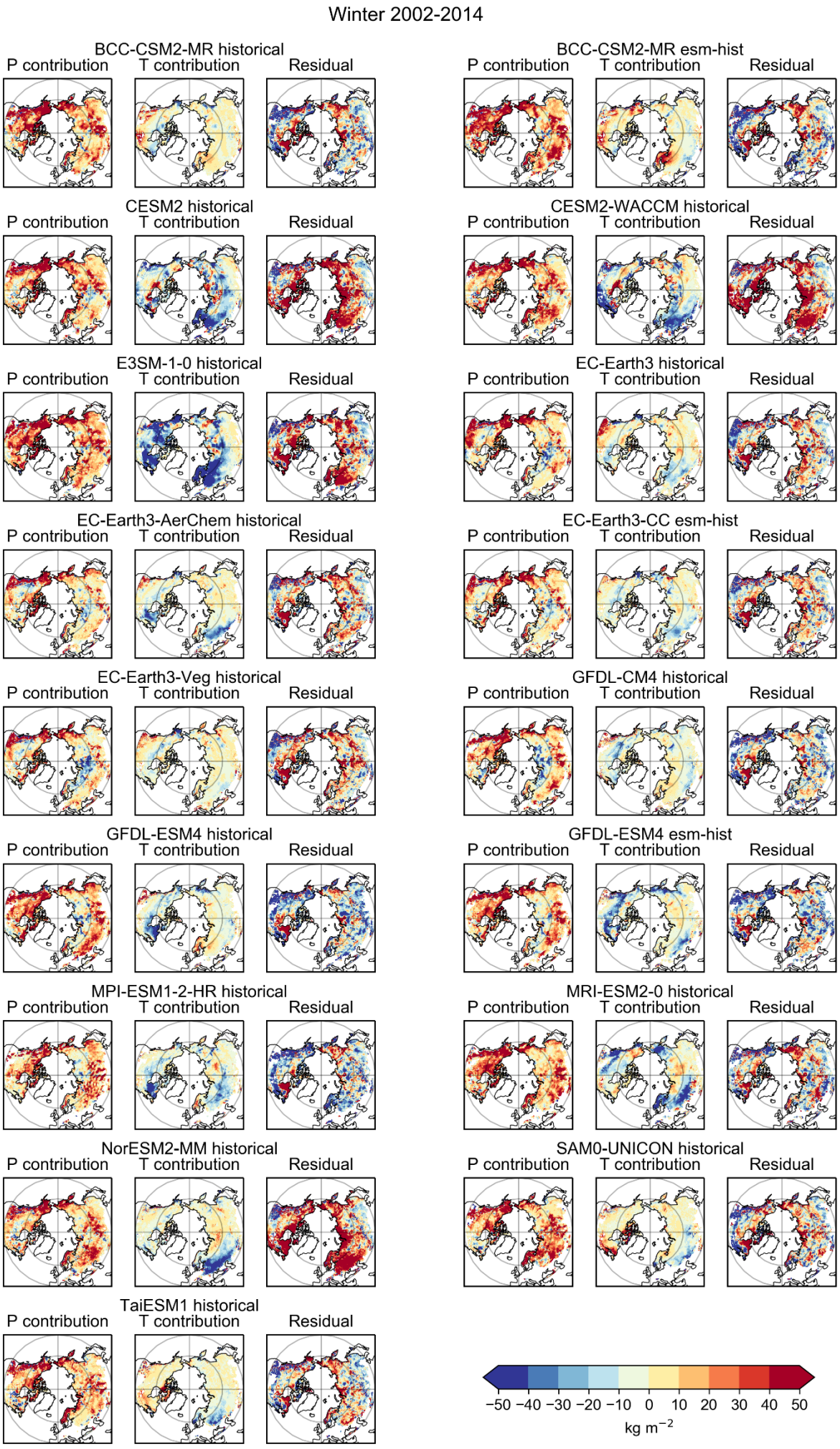

Figure S11. Spatial distribution of P contribution, T contribution and residual for each model in winter 2002-2014.

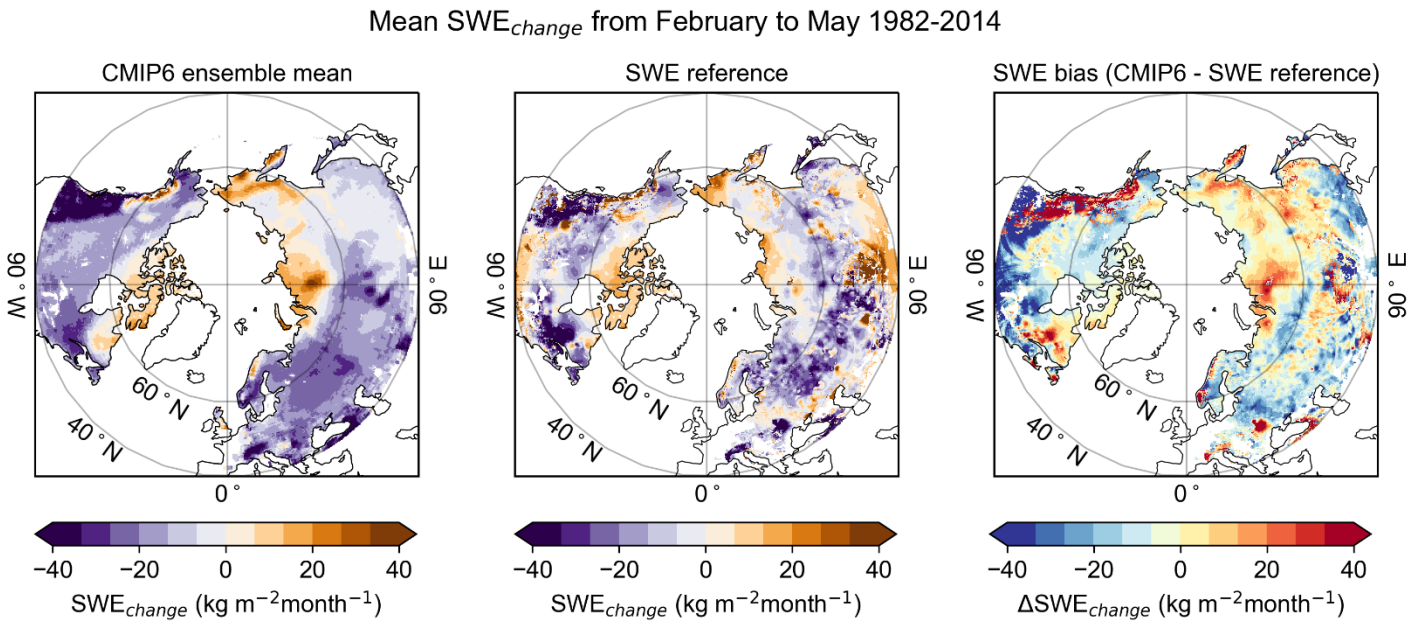

Figure S12. The monthly mean SWE$_{change}$ in snow-covered areas in spring 1982-2014.

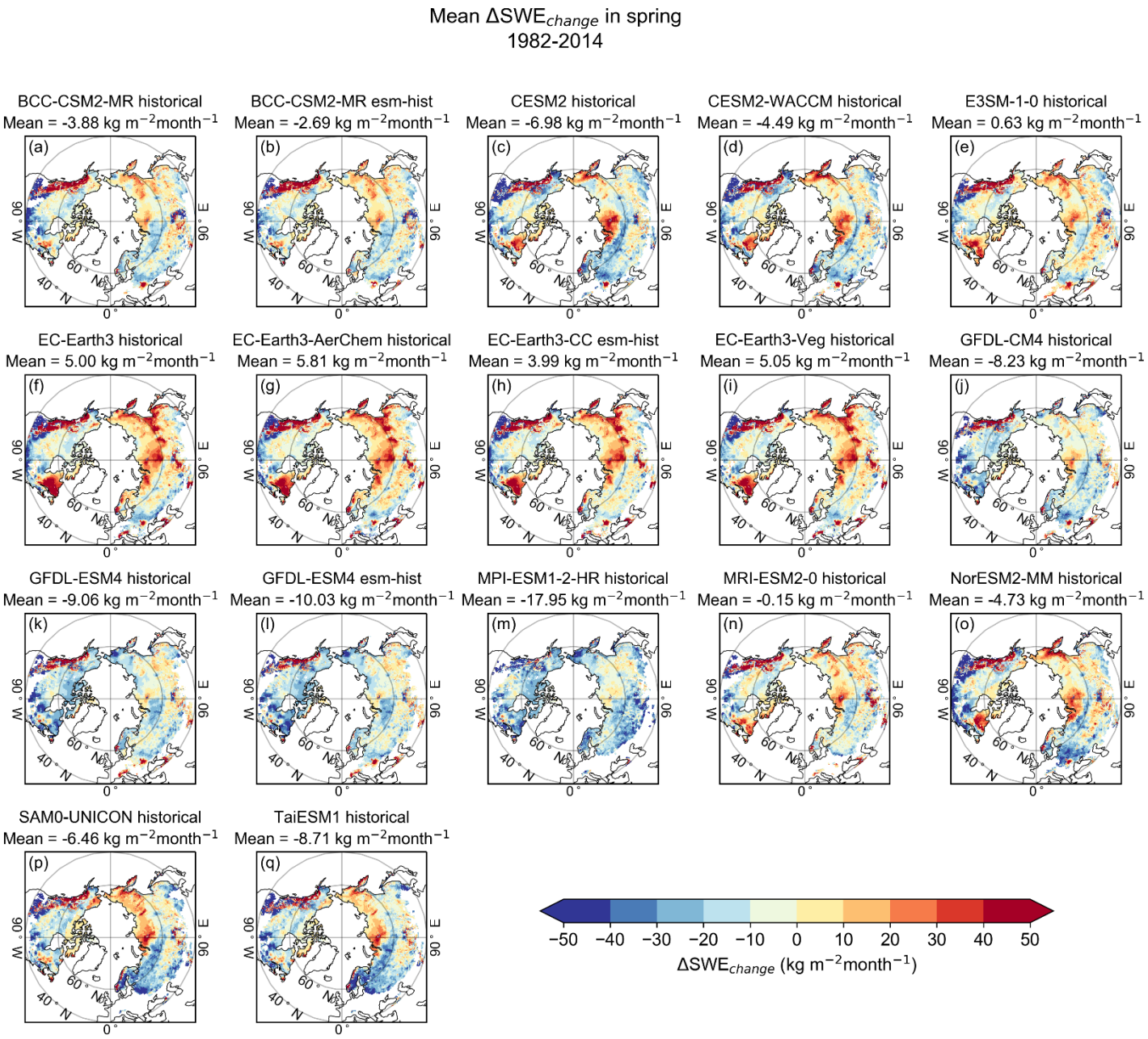

Figure S13. Mean SWE$_{change}$ model bias (ΔSWE$_{change}$, model minus observation) in snow-covered areas in spring 1982-2014.

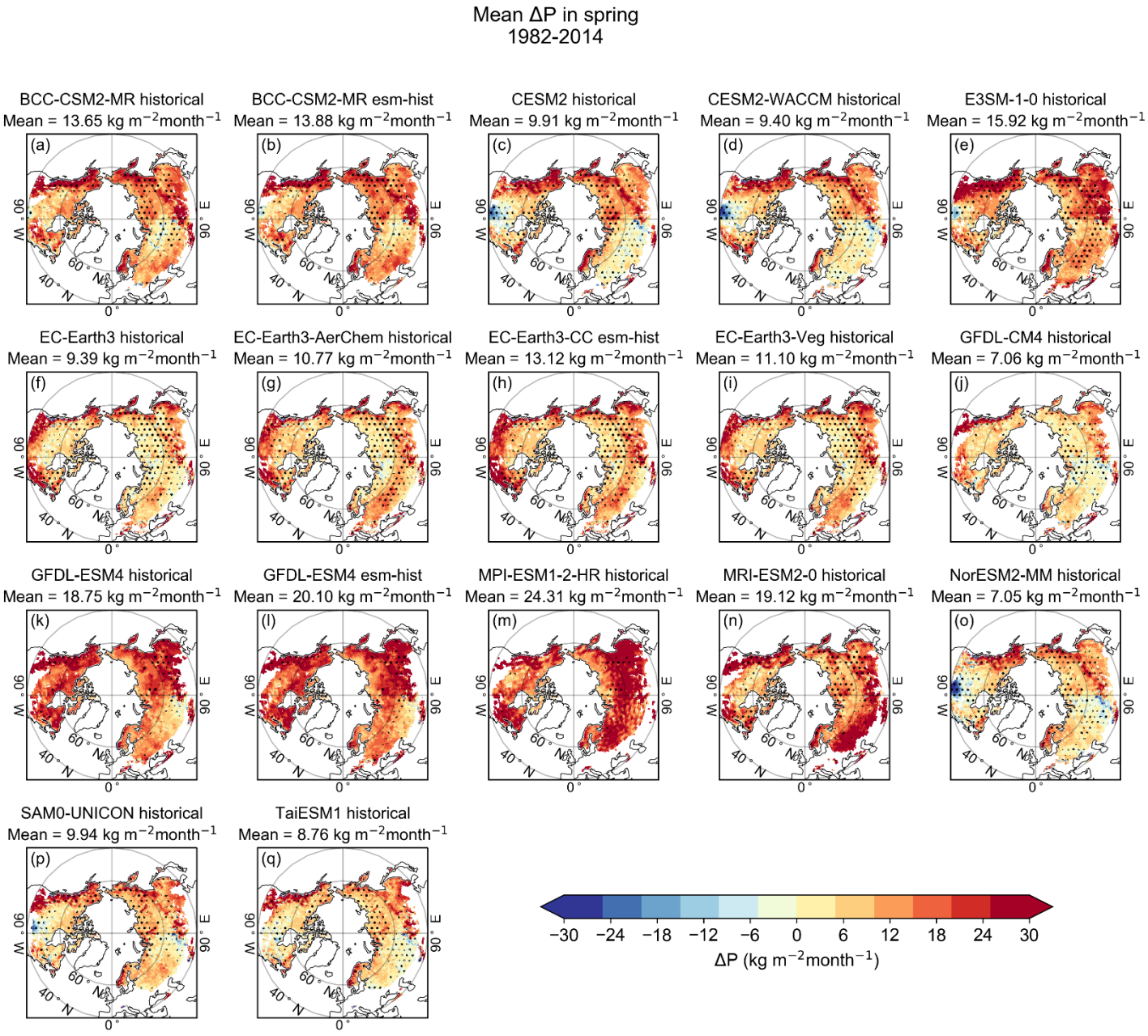

Figure S14. The mean P bias (ΔP, model minus observation) in snow-covered areas between each model and GPCC in spring 1982-2014. The dots indicate areas where models either overestimate both SWE_{change} and P or underestimate both SWE_{change} and P.

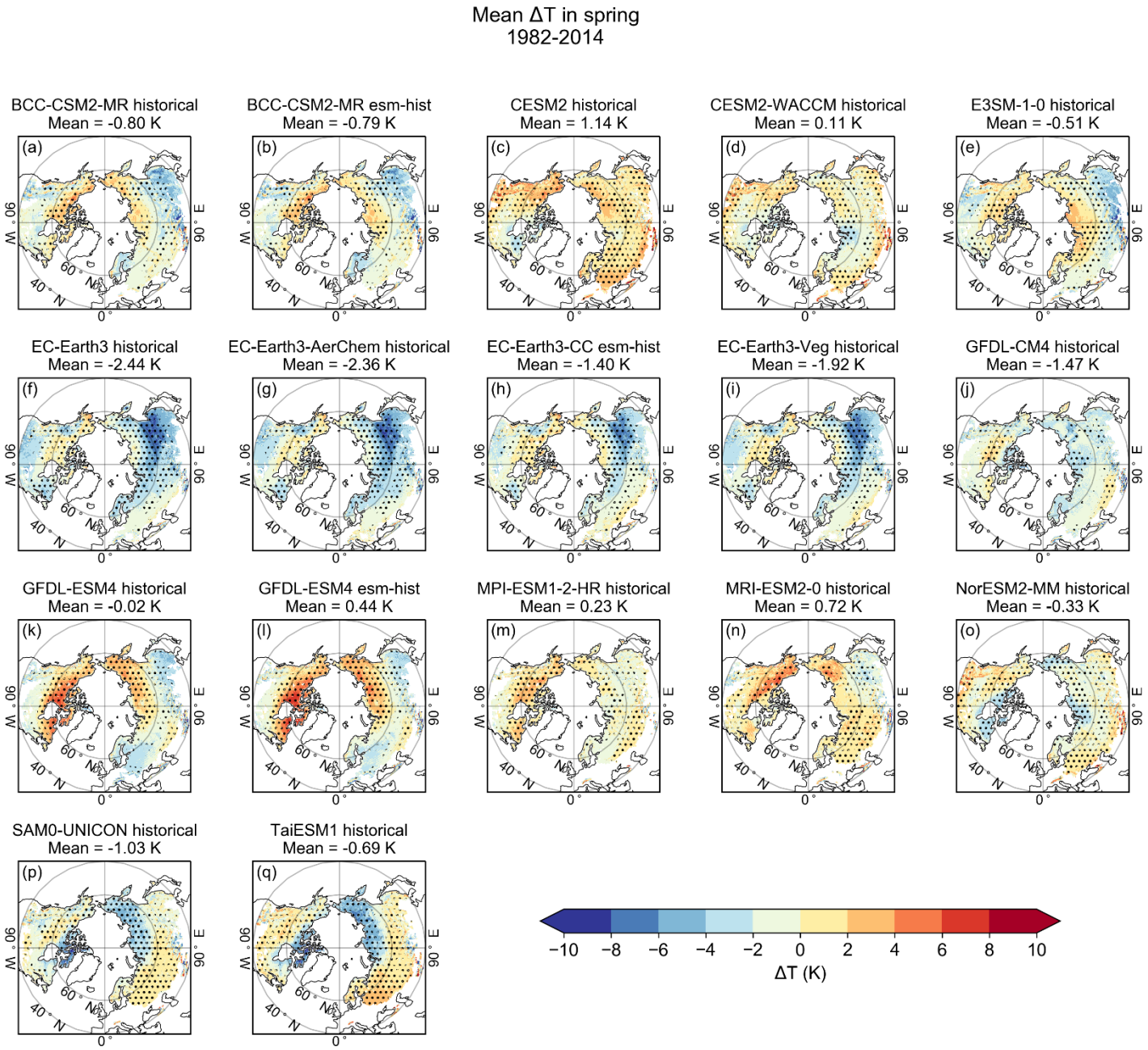

Figure S15. The mean T bias (ΔT, model minus observation) in snow-covered areas between each CMIP6 model and MERRA-2 in spring 1982-2014. The dots indicate areas with either cold bias and positive SWE bias or warm bias and negative SWE bias, i.e., the areas where T bias could logically explain the SWE bias.

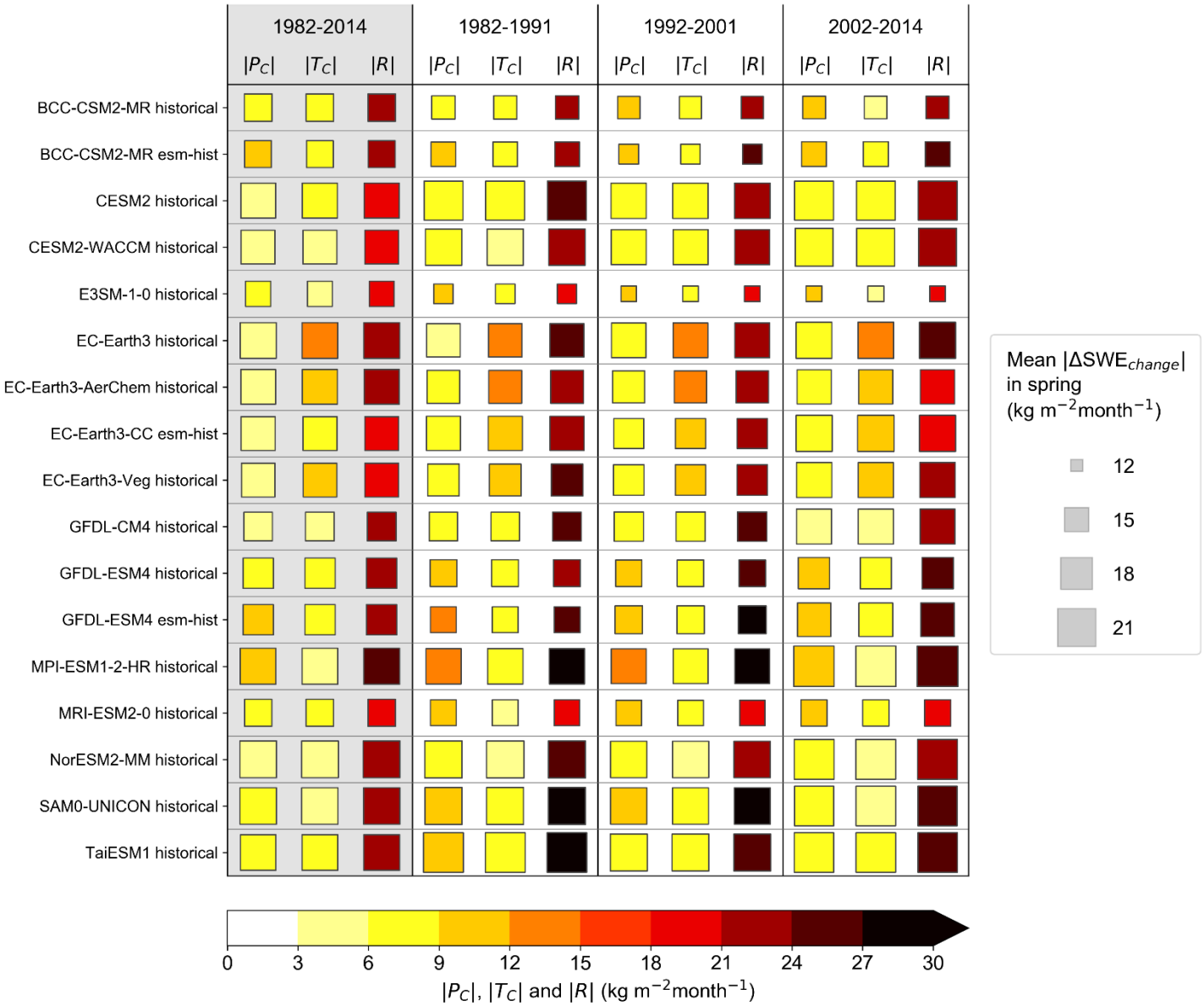

Figure S16. The areal-means of absolute values of ΔSWE_{change}, P_C, T_C, and residual R calculated for the entire study period 1982-2014 (left column, shaded with grey) and for three shorter time periods (1982-1991, 1992-2001, and 2002-2014) for each model in spring. The size of the square indicates the mean absolute value of ΔSWE_{change} of that time period and model, and the color of the square indicates the mean absolute value of P_C, T_C, and R.

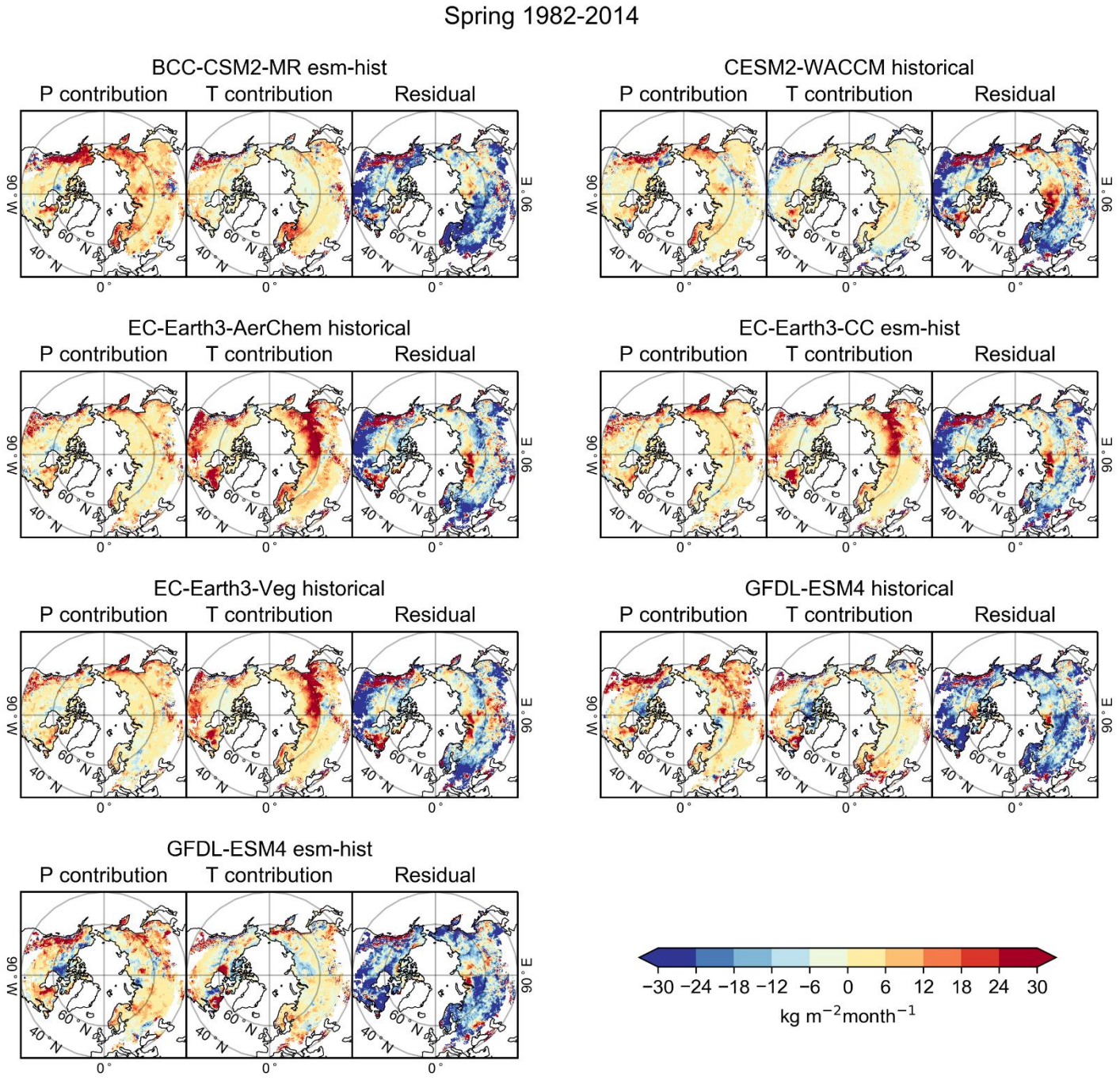

Figure S17. Spatial distribution of the P contribution, the T contribution, and the residual for those high-resolution CMIP6 models not included in Fig. 12.

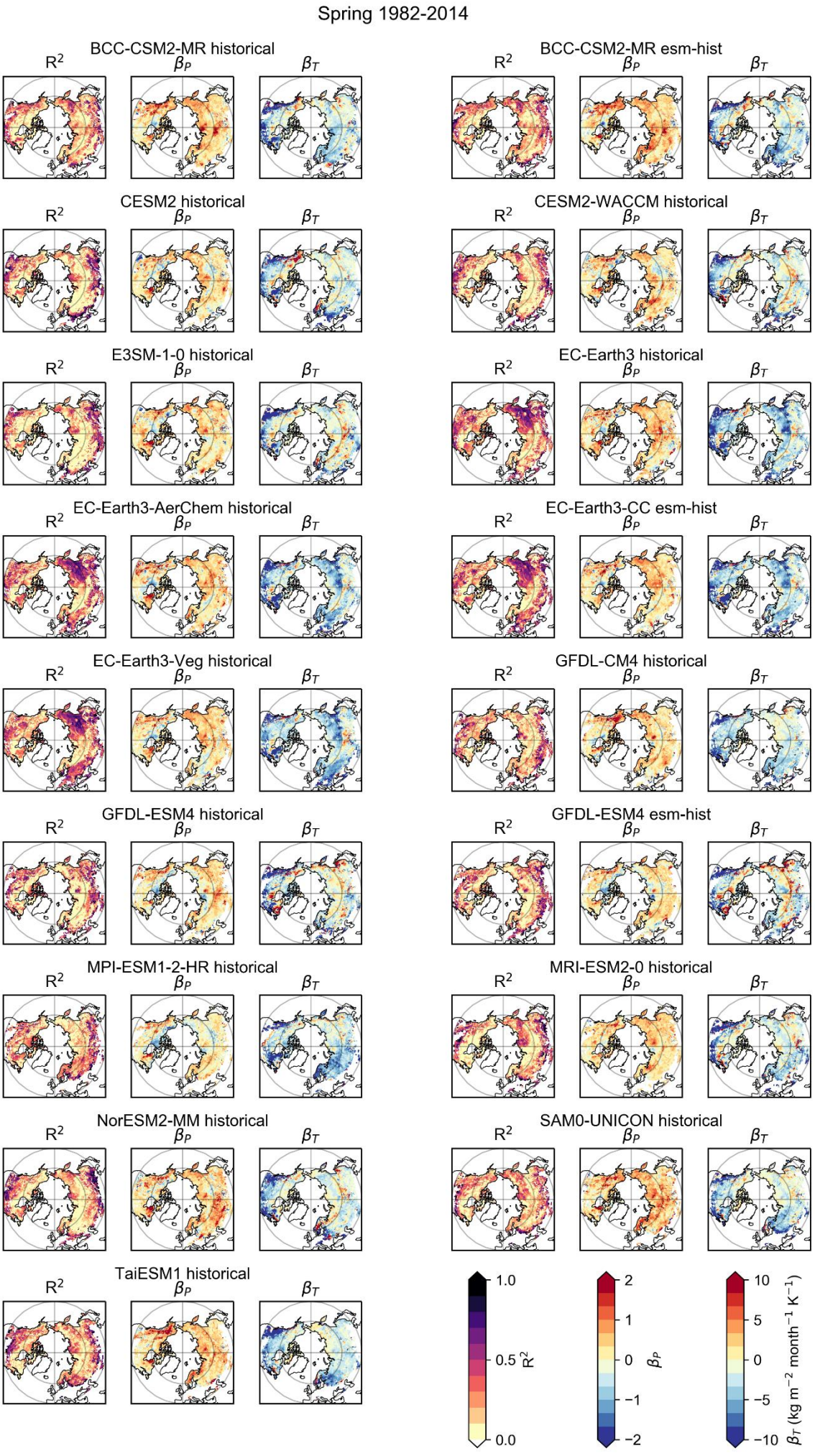

Figure S18. The spatial distribution of R^2, β_P and β_T in spring 1982-2014.

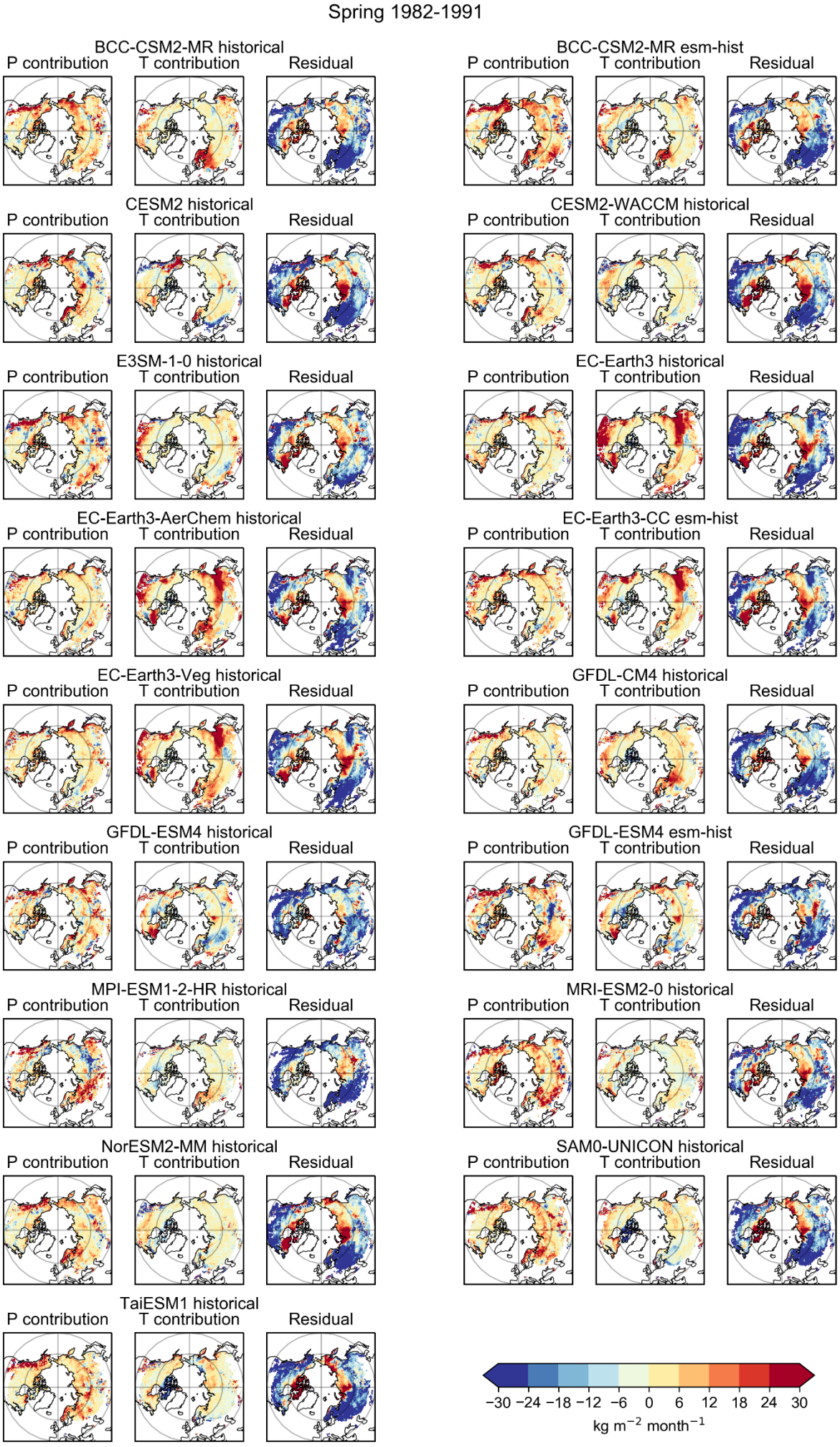

Figure S19. Spatial distribution of P contribution, T contribution and the residual for each model in spring 1982-1991.

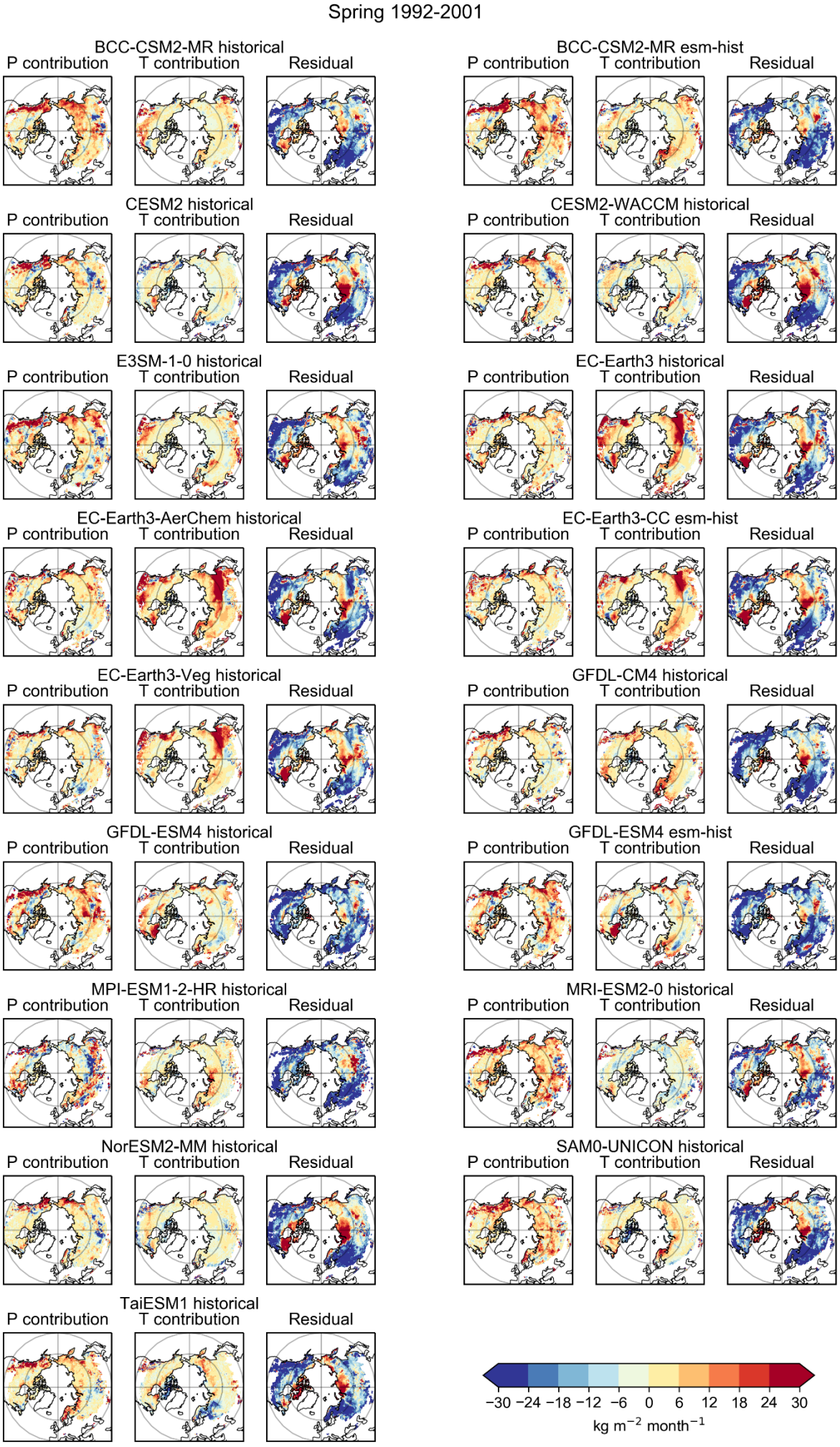

Figure S20. Spatial distribution of P contribution, T contribution and the residual for each model in spring 1992-2001.

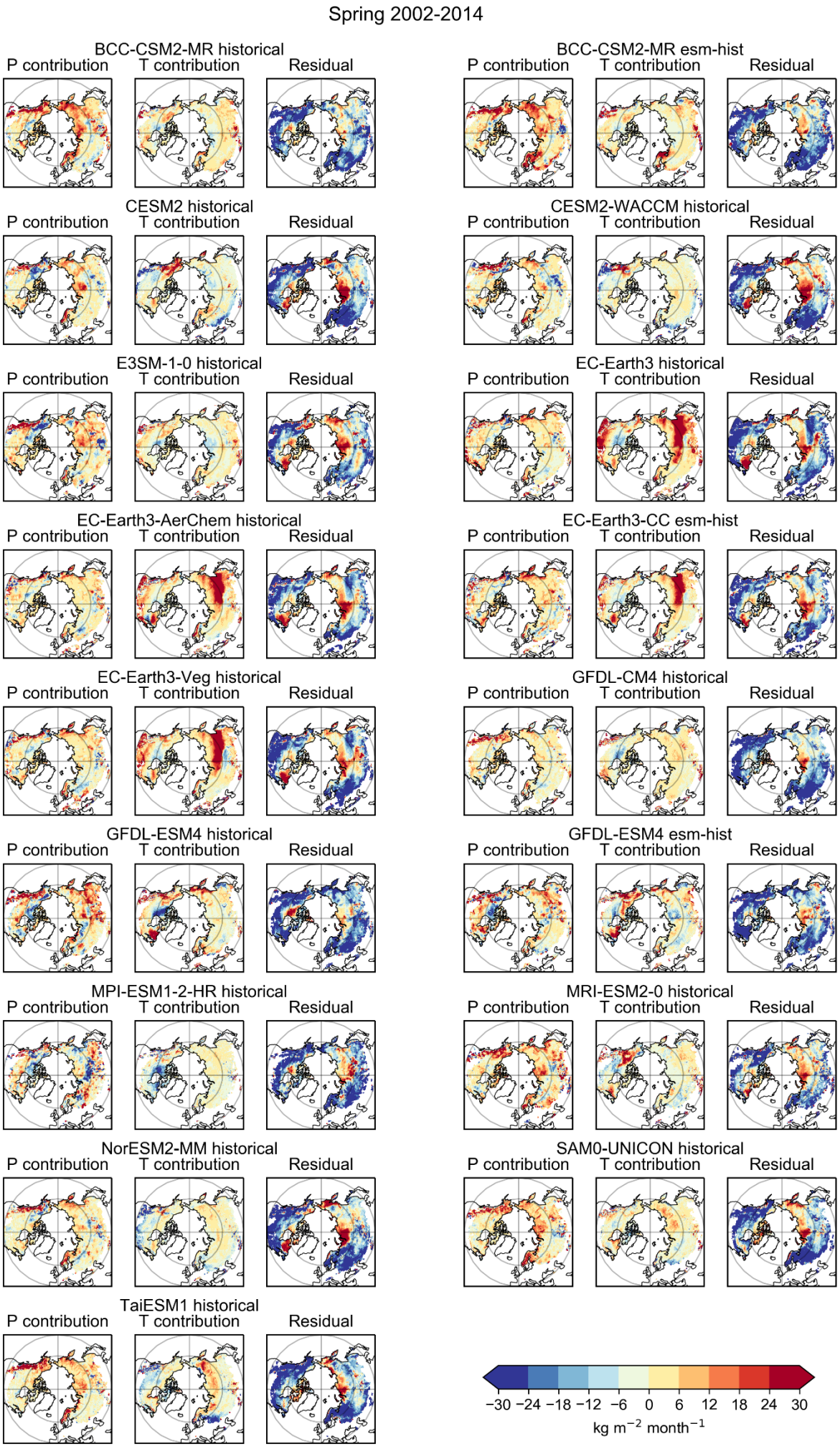

Figure S21. Spatial distribution of P contribution, T contribution and the residual for each model in spring 2002-2014.

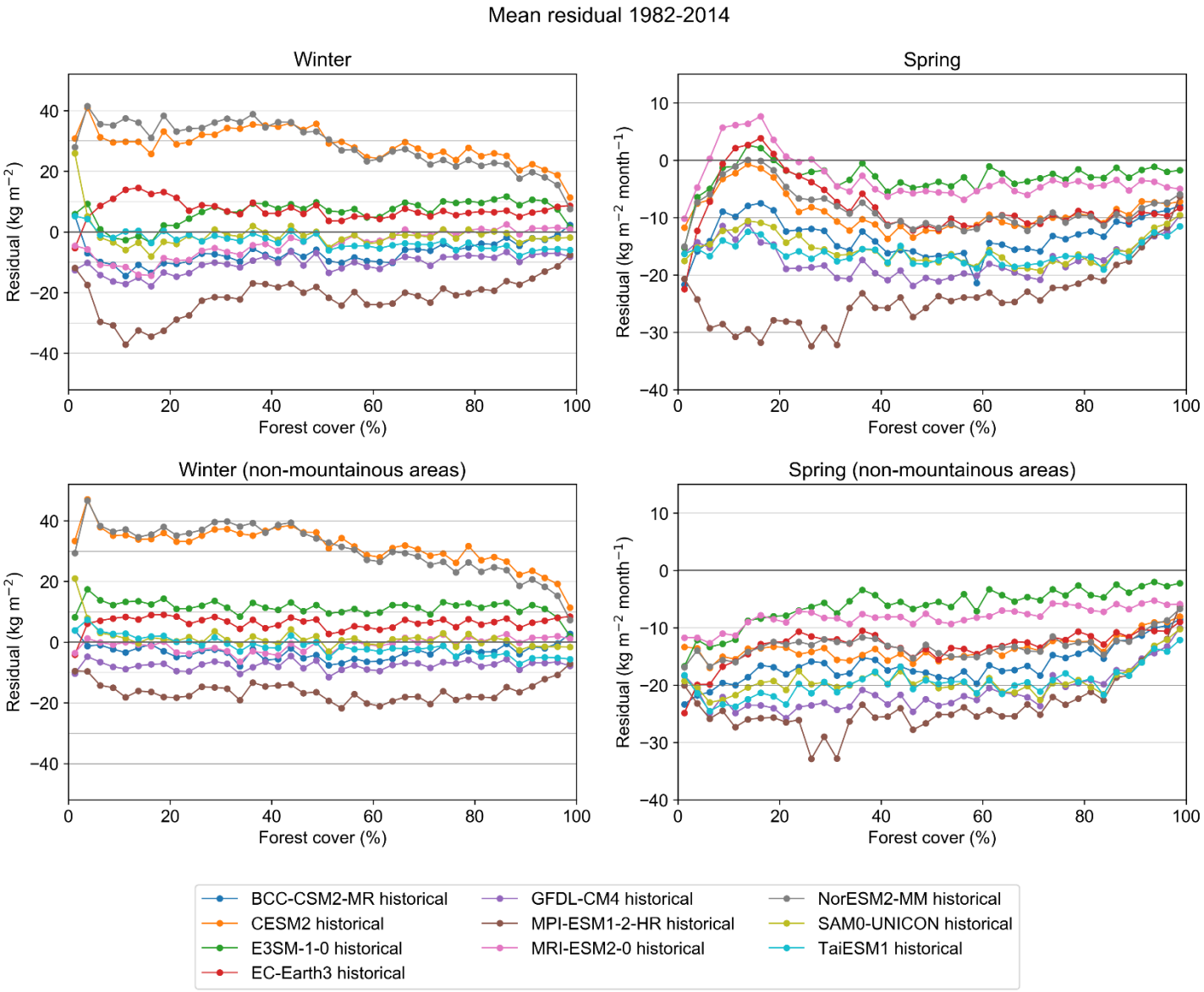

Figure S22. The dependency between the fractional forest cover and the residual term for the entire study area in winter (top left) and in spring (top right) and for the non-mountainous area in winter (bottom left) and in spring (bottom right).