

Table S1. Comparison of ranked trans-basin floods from Uhlemann et al. (2010) with ranked trans-basin floods detected in this study.

Rank (Uhlemann et al., 2010)	Rank (this study)	Season	Rank (Uhlemann et al., 2010)	Rank (this study)	Season
1	1	winter	41	37	winter
2	3	winter	42	26	summer
3	2	winter	43	21	winter
4	4	winter	44	80	winter
5	5	winter	45	68	summer
6	6	winter	46	25	winter
7	10	winter	47	51	winter
8	13	winter	48	48	winter
9	15	winter	49	32	winter
10	8	winter	50	38	winter
11	9	winter	51	81	summer
12	30	summer	52	24	winter
13	7	winter	53	-	summer
14	50	summer	54	56	summer
15	35	summer	55	72	summer
16	11	winter	56	97	winter
17	14	winter	57	53	summer
18	33	winter	58	36	winter
19	18	winter	59	67	summer
20	40	winter	60	85	summer
21	17	winter	61	66	winter
22	23	winter	62	-	summer
23	49	winter	63	92	summer
24	43	winter	64	-	summer
25	-	winter	65	29	winter
26	45	winter	66	-	winter
27	16	winter	67	-	summer
28	42	winter	68	91	winter
29	19	winter	69	64	summer
30	12	winter	70	73	winter
31	78	summer	71	58	winter
32	34	winter	72	-	summer
33	27	winter	73	-	summer
34	47	winter	74	-	summer
35	22	winter	75	-	summer
36	61	summer	76	89	summer
37	41	winter	77	71	winter
38	28	winter	78	-	winter
39	-	summer	79	-	summer
40	-	summer	80	-	summer

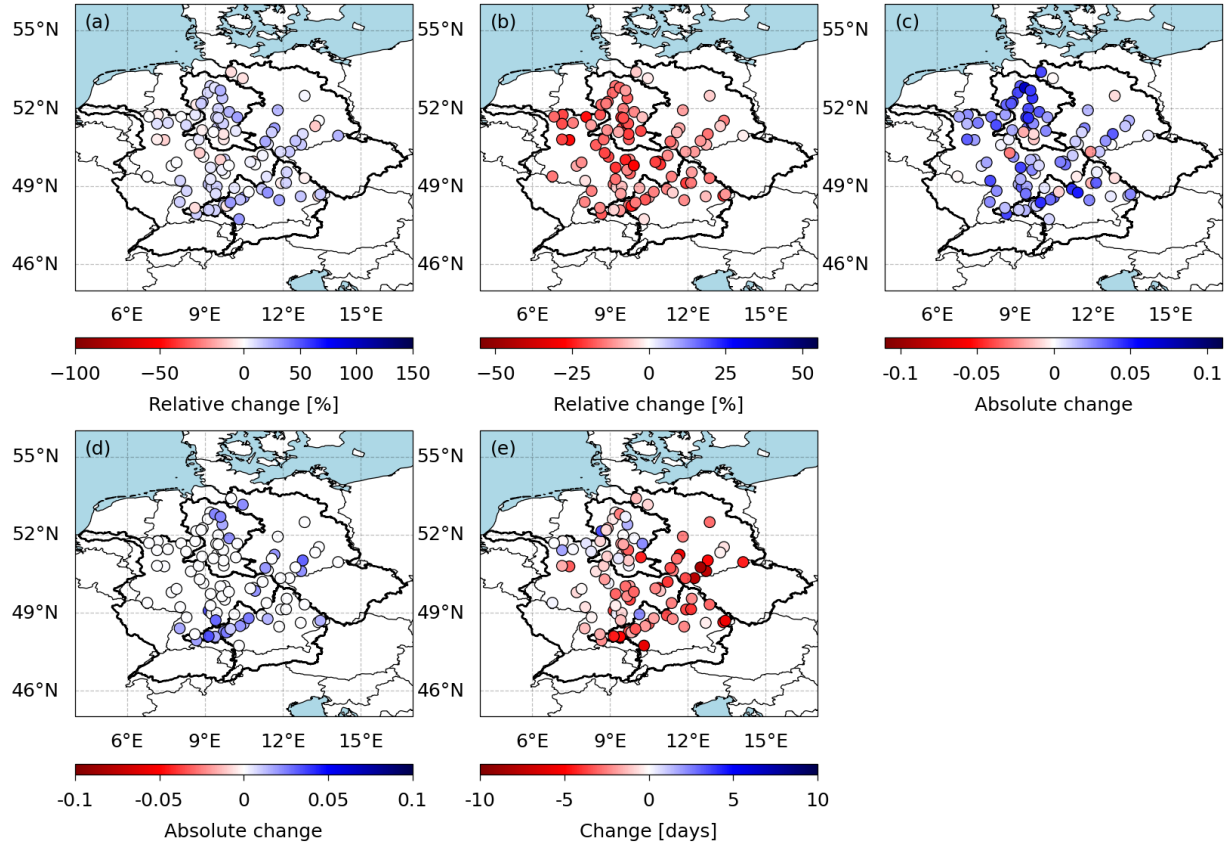


Figure S1. Changes in the number of ROS floods (a), the IG_{ROS} (b), the mean normalized rank (c), the maximum normalized rank (d) and the mean date (e) at all gauges for the GCM-RCM ensemble for the future period 1981-2040 with regard to the reference period.

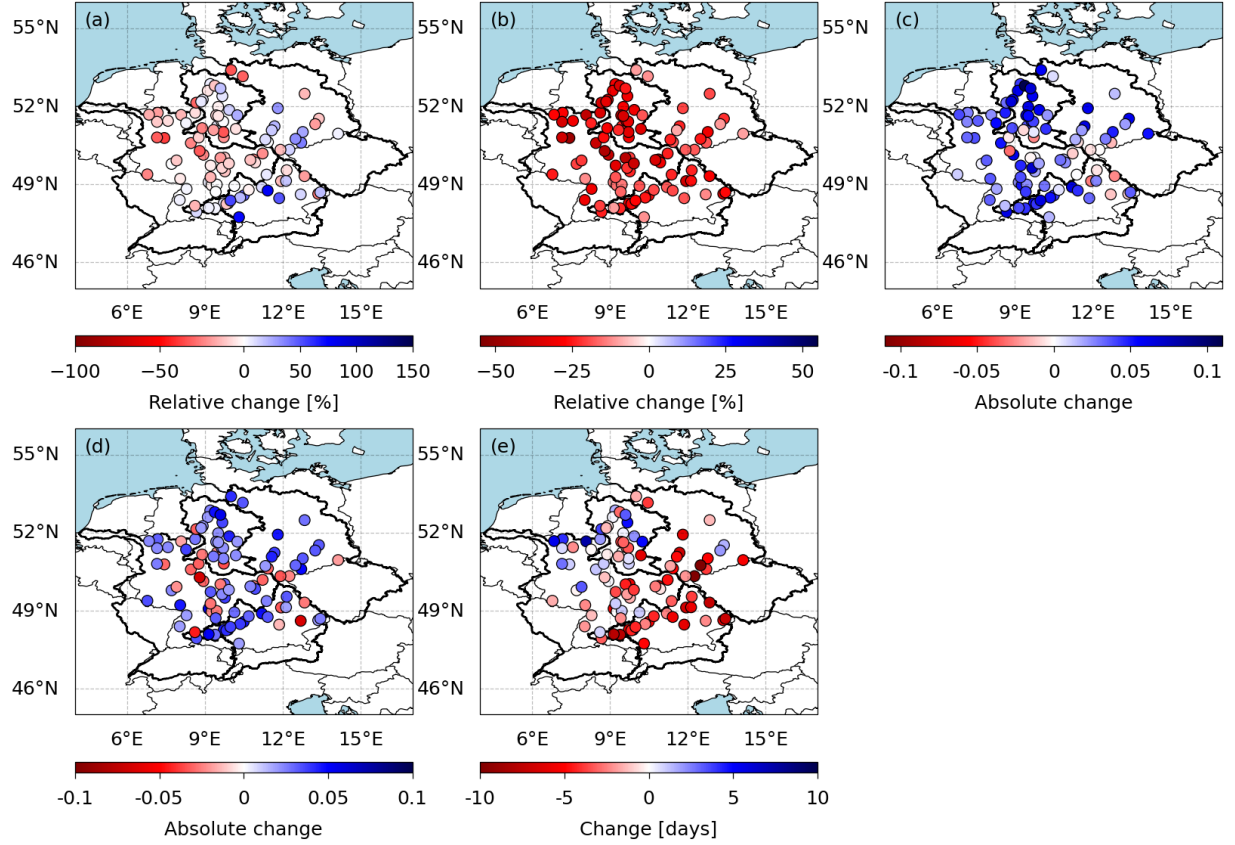


Figure S2. Changes in the number of ROS floods (a), the IG_{ROS} (b), the mean normalized rank (c), the maximum normalized rank (d) and the mean date (e) at all gauges for the GCM-RCM ensemble for the future period 2011-2070 with regard to the reference period.

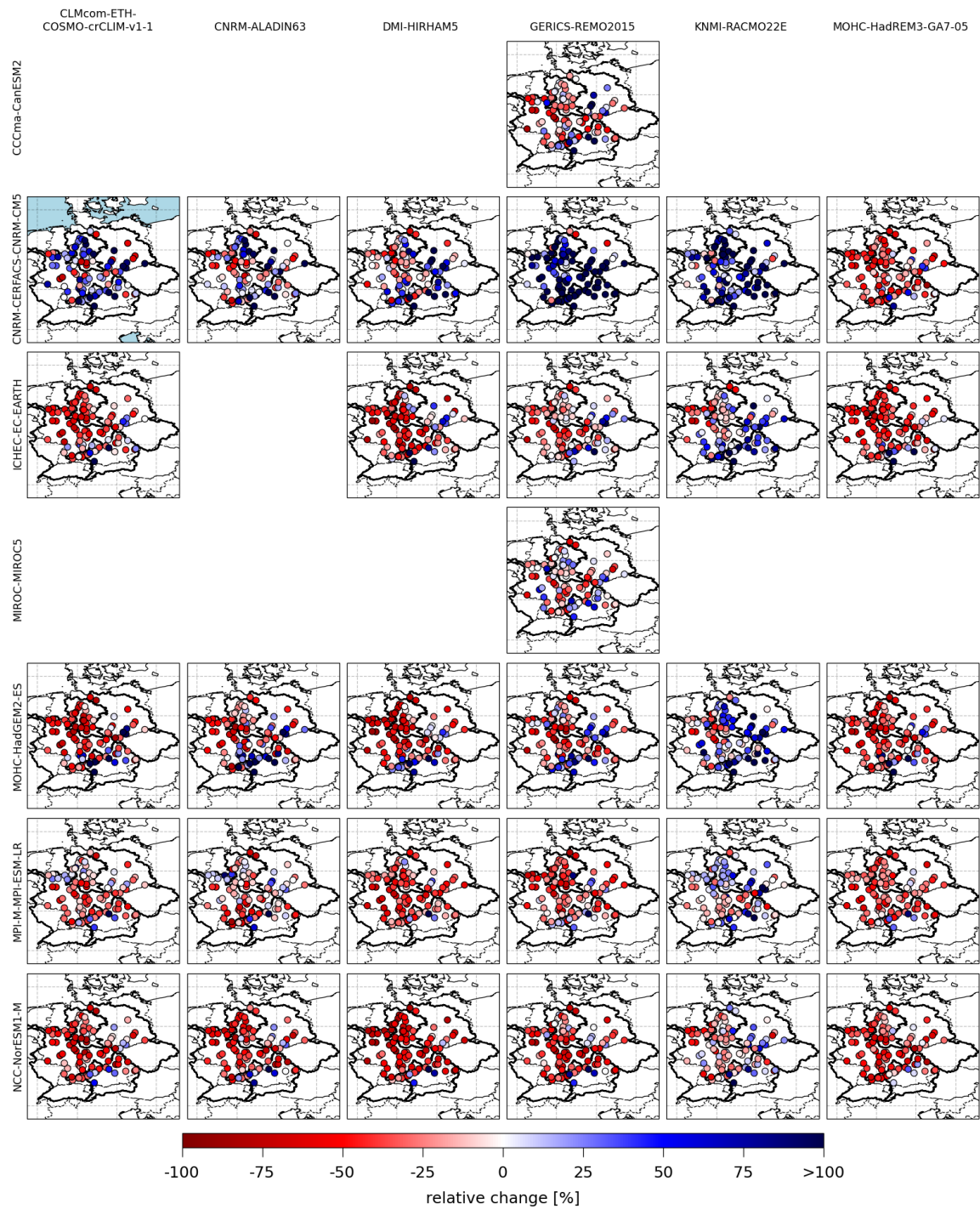


Figure S3. Changes in the number of ROS floods at all gauges for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

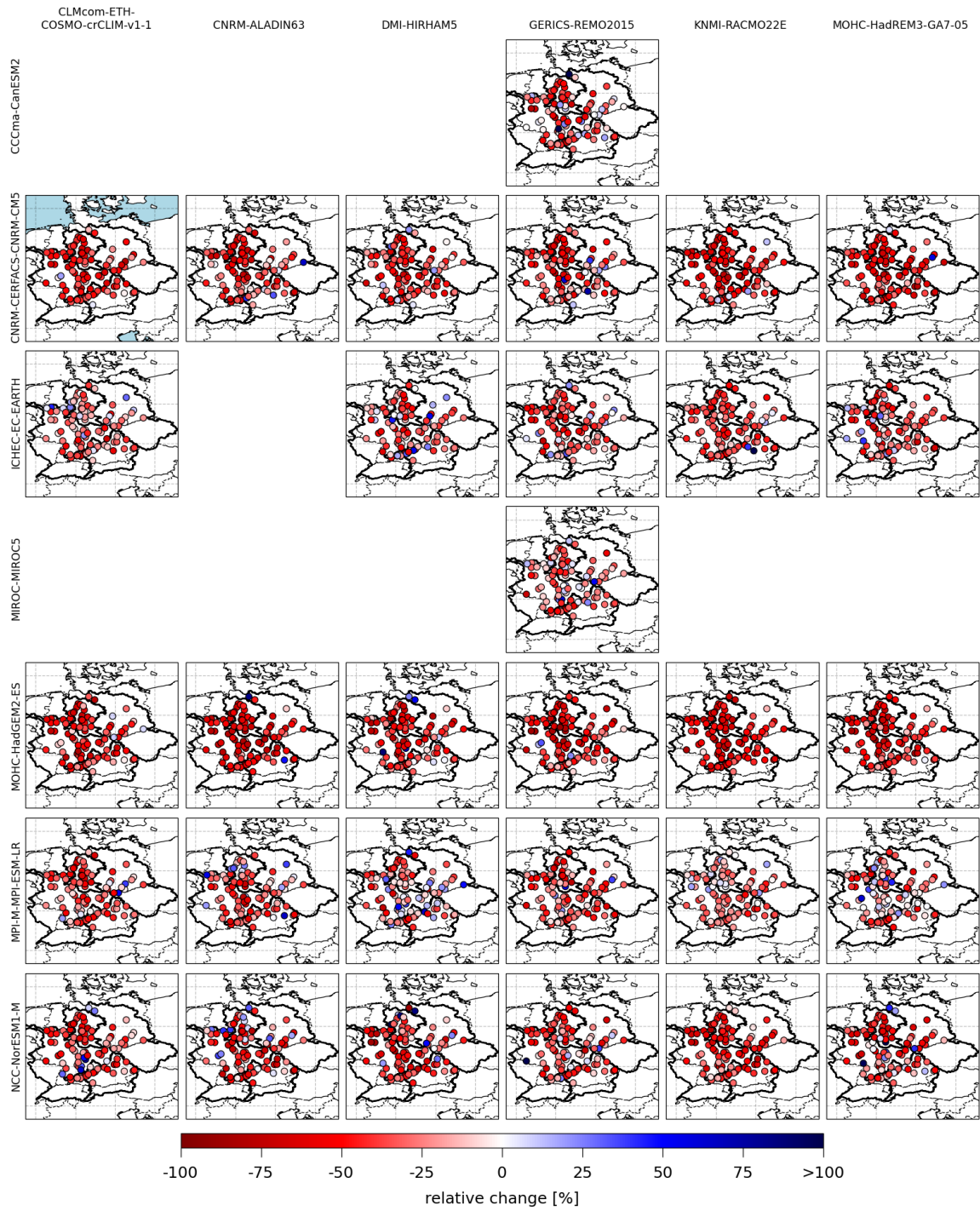


Figure S4. Changes in the IG_{ROS} of ROS floods at all gauges for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

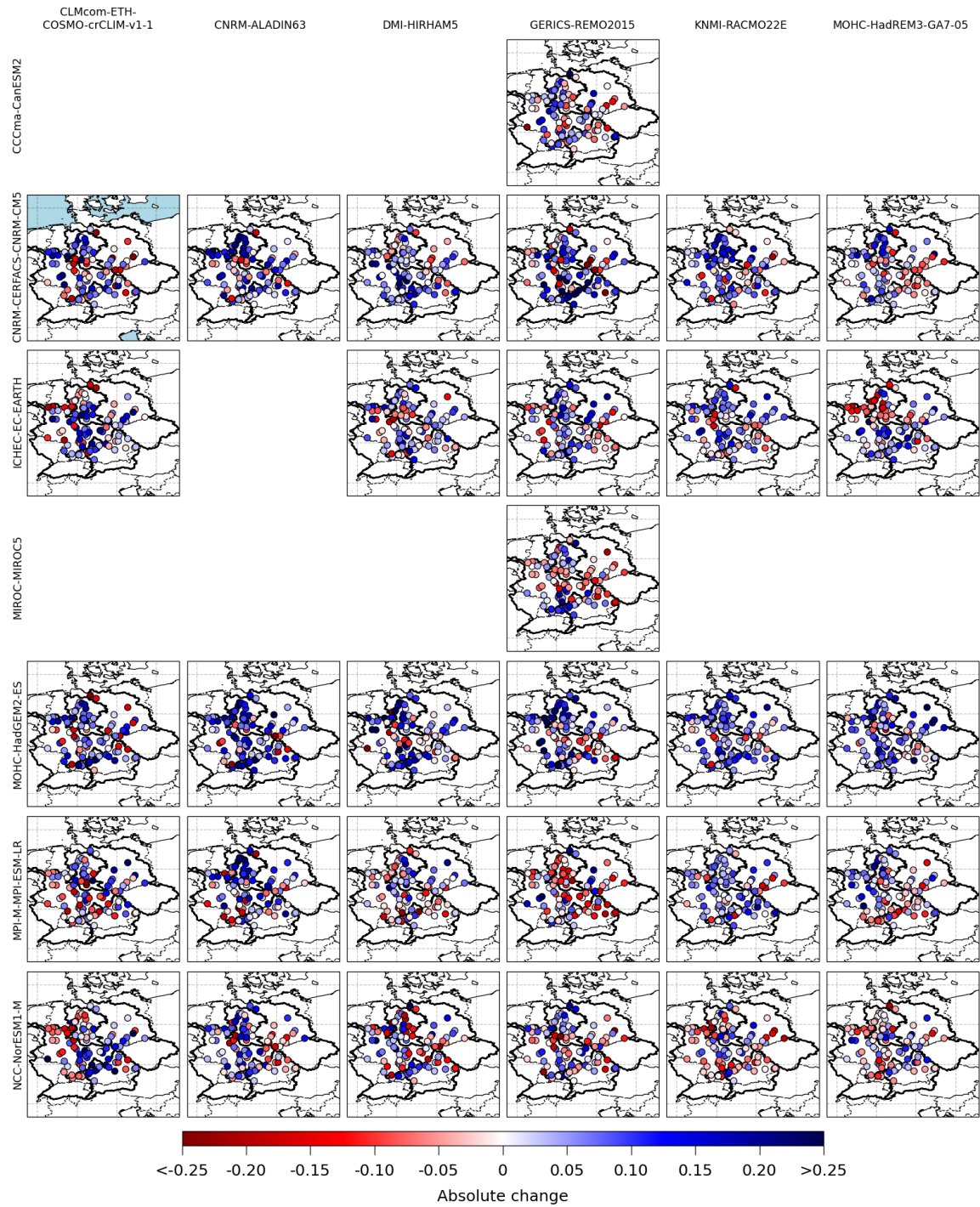


Figure S5. Changes in the mean normalized rank of ROS floods at all gauges for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

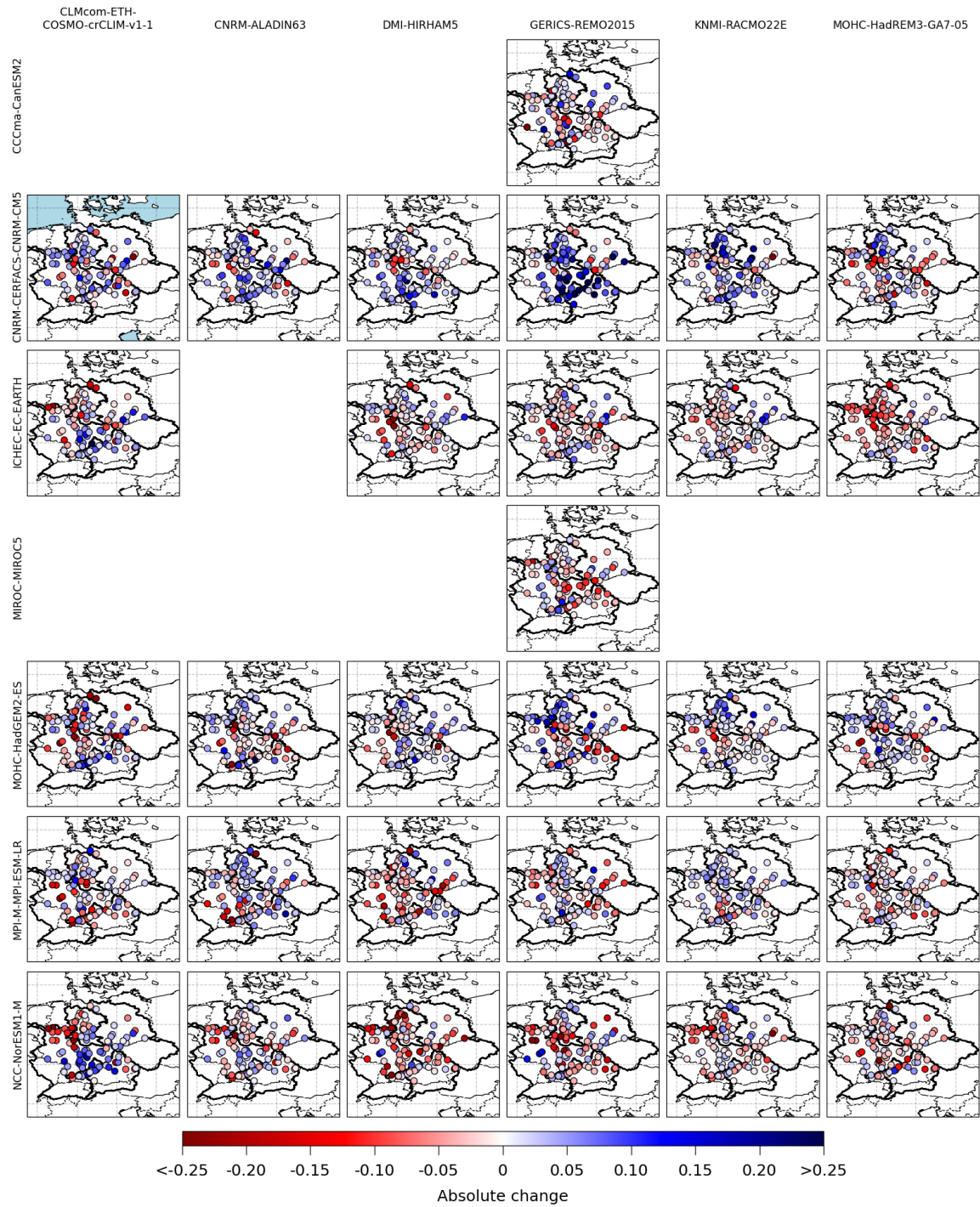


Figure S6. Changes in the maximum normalized rank of ROS floods at all gauges for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

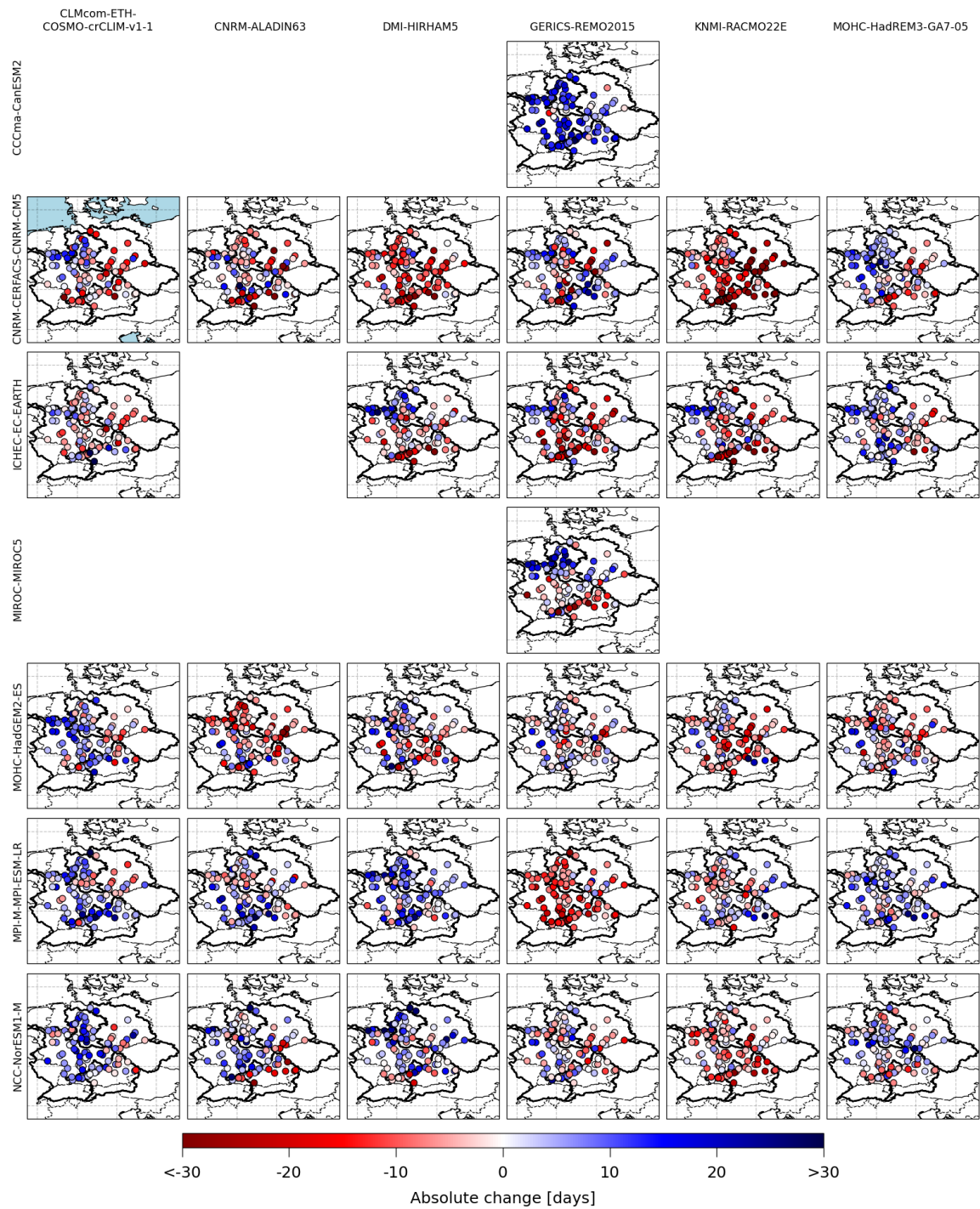


Figure S7. Changes in the mean date of ROS floods at all gauges for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

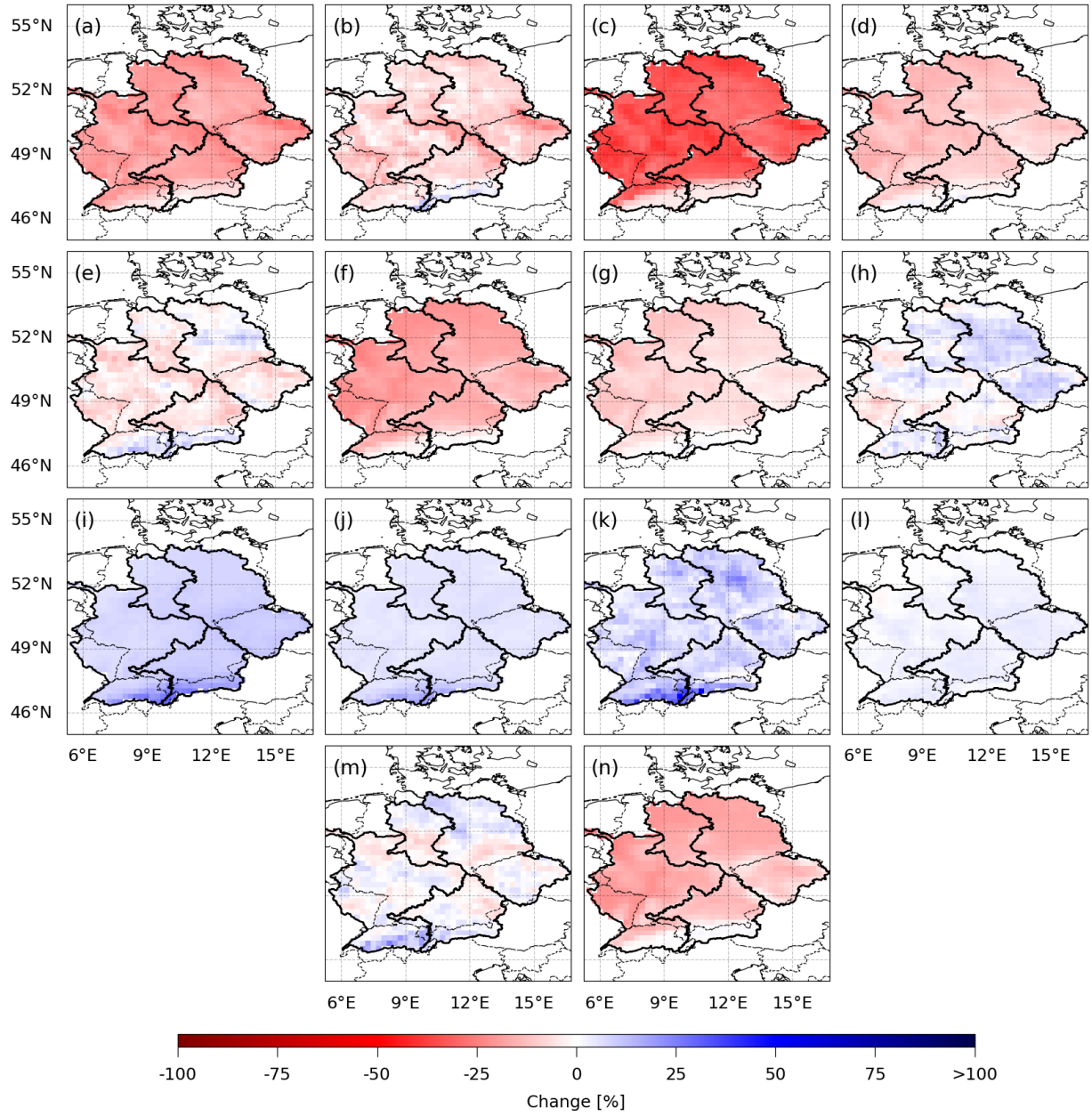


Figure S8. Ensemble mean of relative changes of selected atmospheric variables for 1981-2040 compared to the REF period. Mean annual maximum snow amount (a), maximum snow amount (b), mean annual snow days (snow amount > 15 mmSWE) (c), mean October to May maximum 5-day snowmelt (d), maximum October to May 5-day snowmelt (e), mean October to May snowfall amount (f), mean October to May maximum 5-day snowfall amount (g), maximum October to May 5-day precipitation amount (h), mean October to May liquid precipitation amount (i), mean October to May maximum 5-day liquid precipitation amount (j), maximum October to May 5-day precipitation amount (k), mean ROS water (5-day sum of liquid precipitation and snowmelt if ROS conditions are met) (l), maximum ROS water (5-day sum of liquid precipitation and snowmelt if ROS conditions are met) (m) and the number of times the ROS conditions are met (n). The ROS conditions are met if both ratios of the 5 day sum of liquid precipitation and snowmelt are smaller than 0.1.

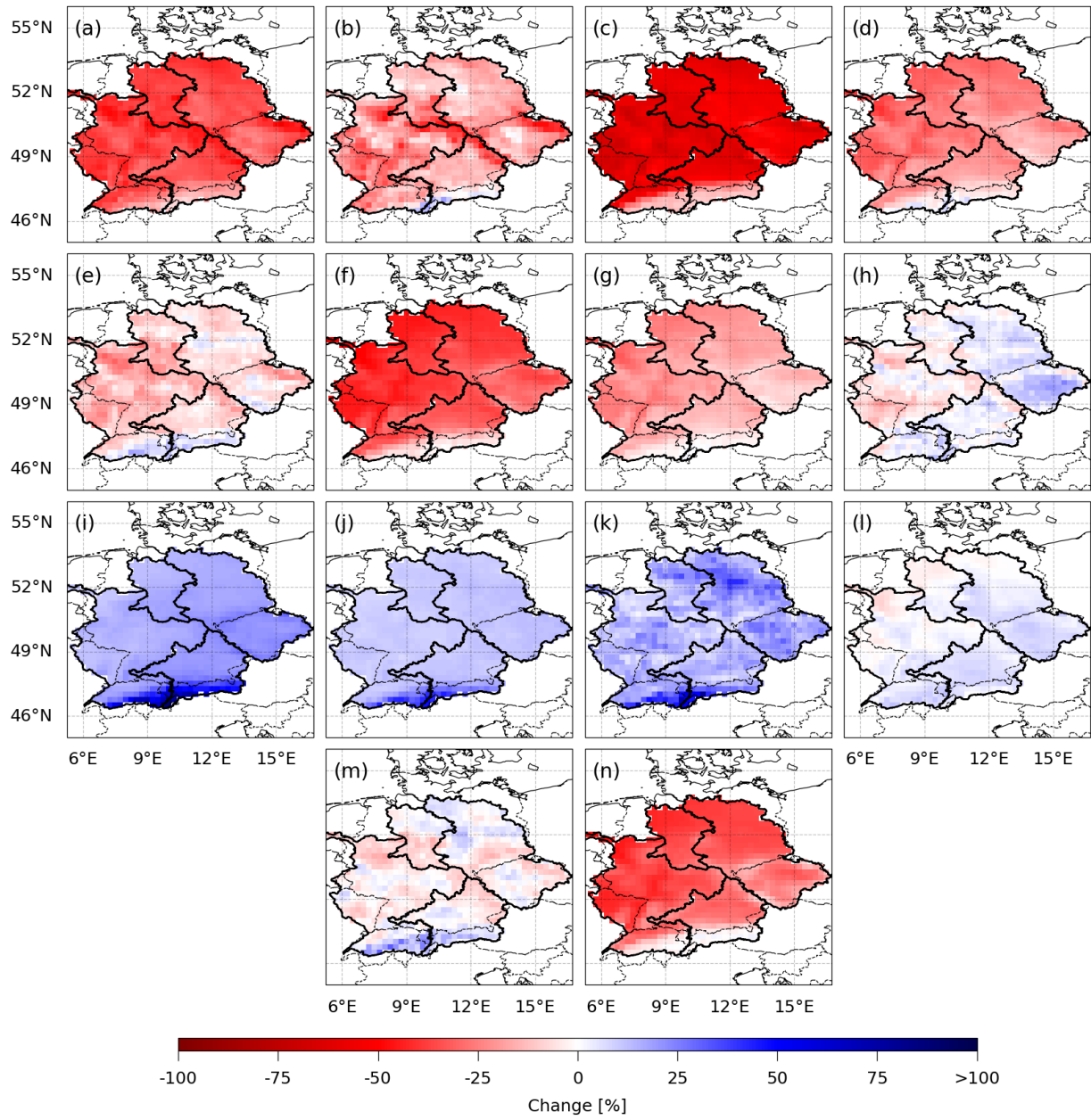


Figure S9. Ensemble mean of relative changes of selected atmospheric variables for 2011-2070 compared to the REF period. Mean annual maximum snow amount (a), maximum snow amount (b), mean annual snow days (snow amount > 15 mmSWE) (c), mean October to May maximum 5-day snowmelt (d), maximum October to May 5-day snowmelt (e), mean October to May snowfall amount (f), mean October to May maximum 5-day snowfall amount (g), maximum October to May 5-day precipitation amount (h), mean October to May liquid precipitation amount (i), mean October to May maximum 5-day liquid precipitation amount (j), maximum October to May 5-day precipitation amount (k), mean ROS water (5-day sum of liquid precipitation and snowmelt if ROS conditions are met) (l), maximum ROS water (5-day sum of liquid precipitation and snowmelt if ROS conditions are met) (m) and the number of times the ROS conditions are met (n). The ROS conditions are met if both ratios of the 5 day sum of liquid precipitation and snowmelt are smaller than 0.1.

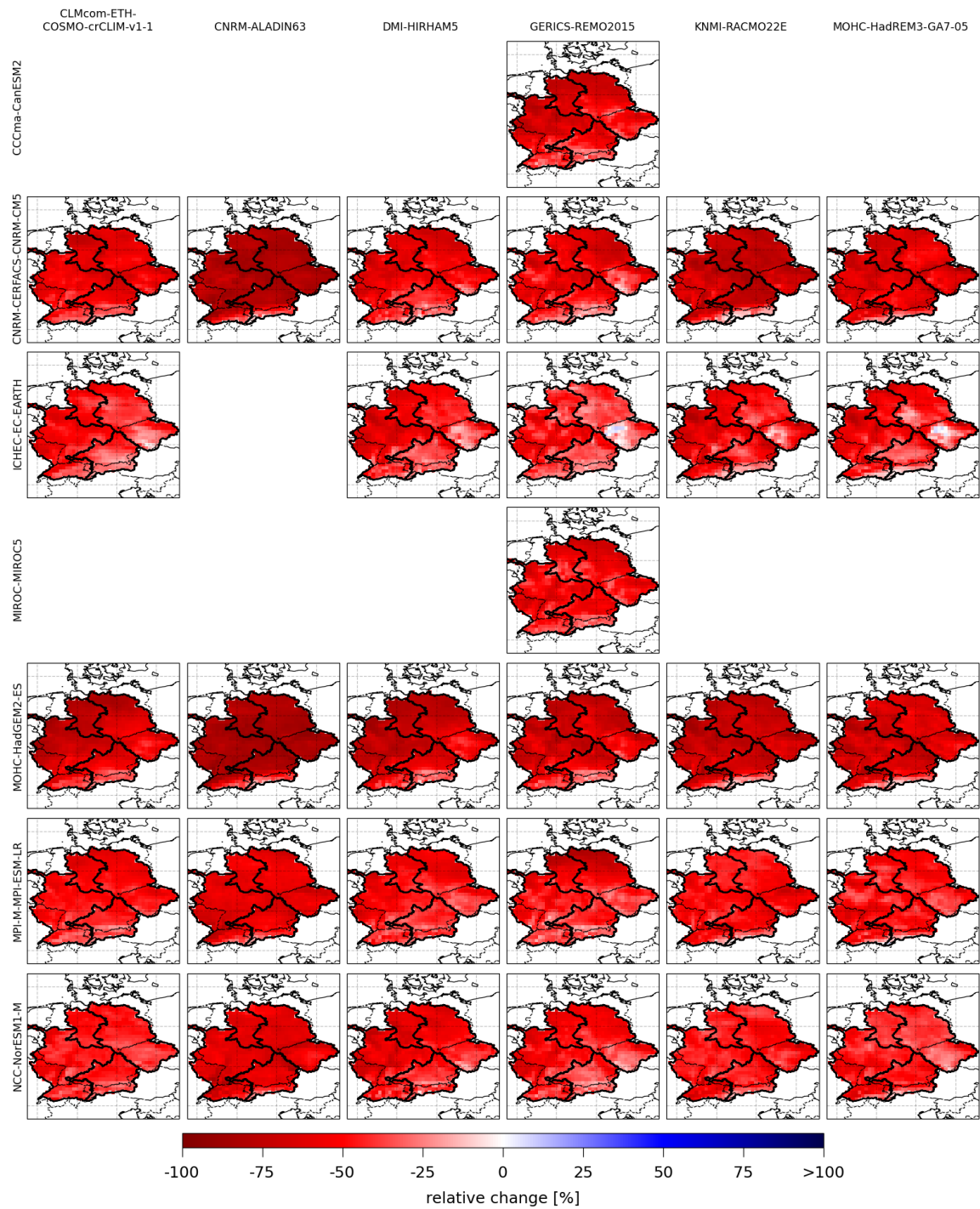


Figure S10. Changes in the mean annual maximum snow amount for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

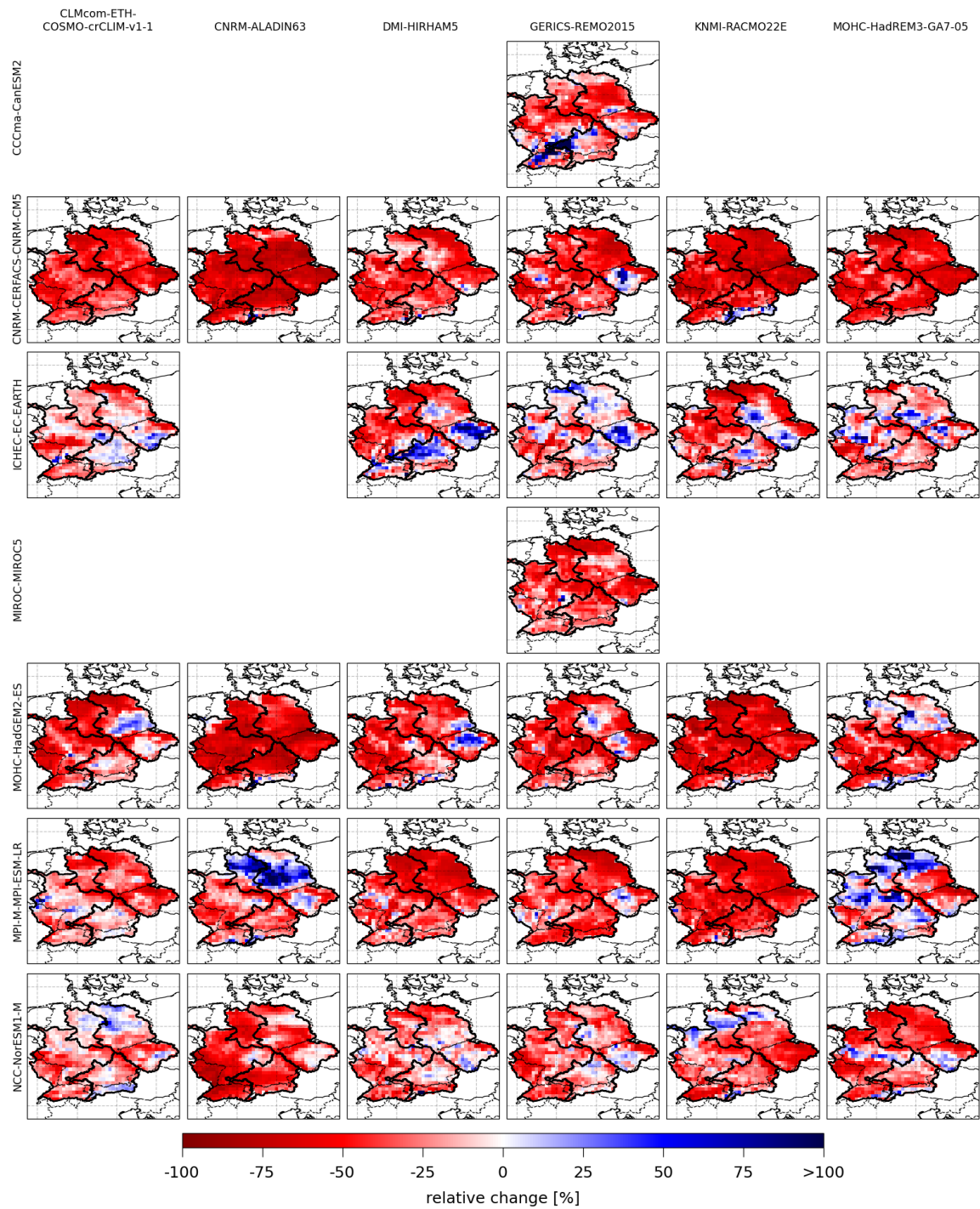


Figure S11. Changes in the maximum snow amount of the period for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

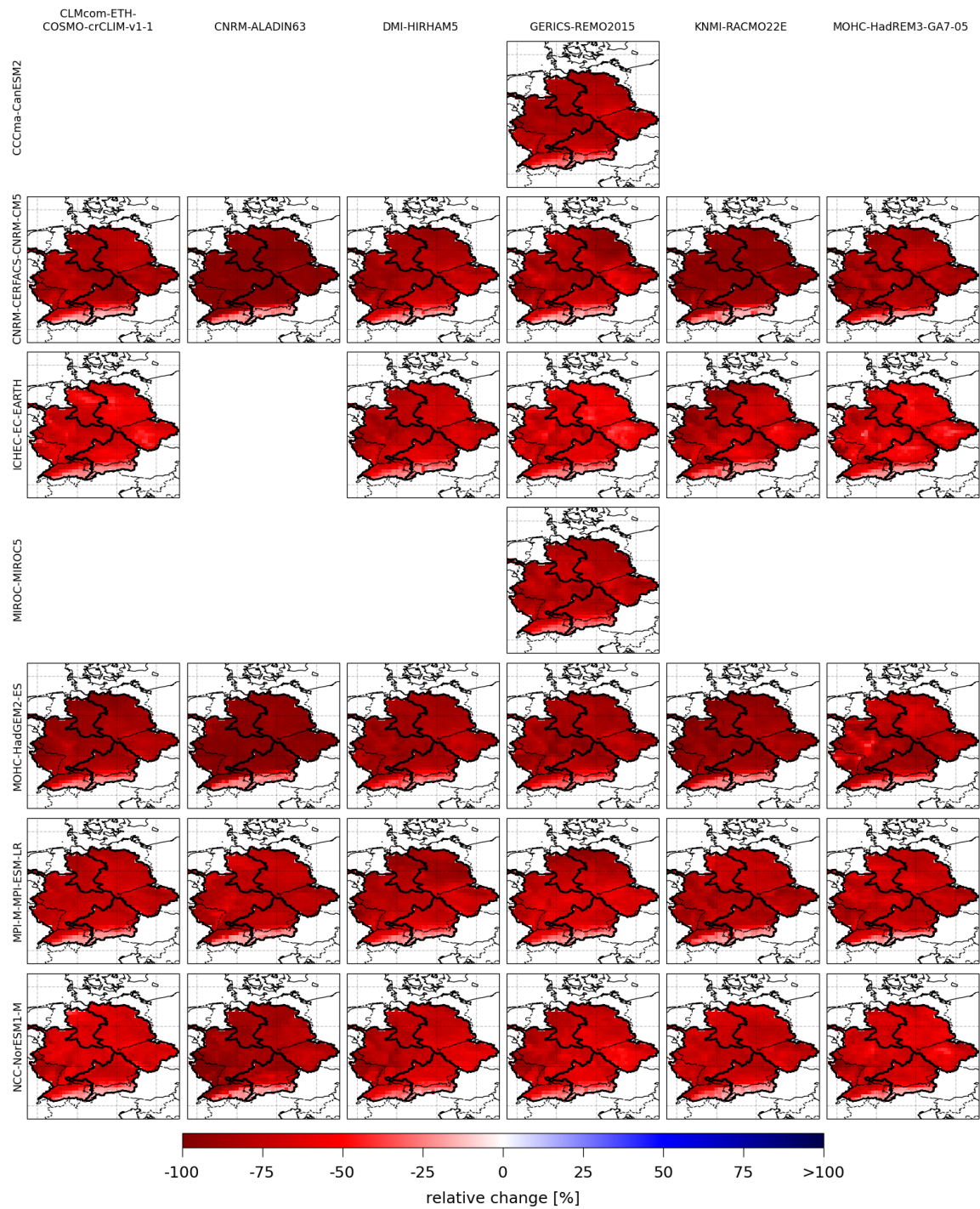


Figure S12. Changes in mean annual snow days (snow amount > 15 mmSWE) for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

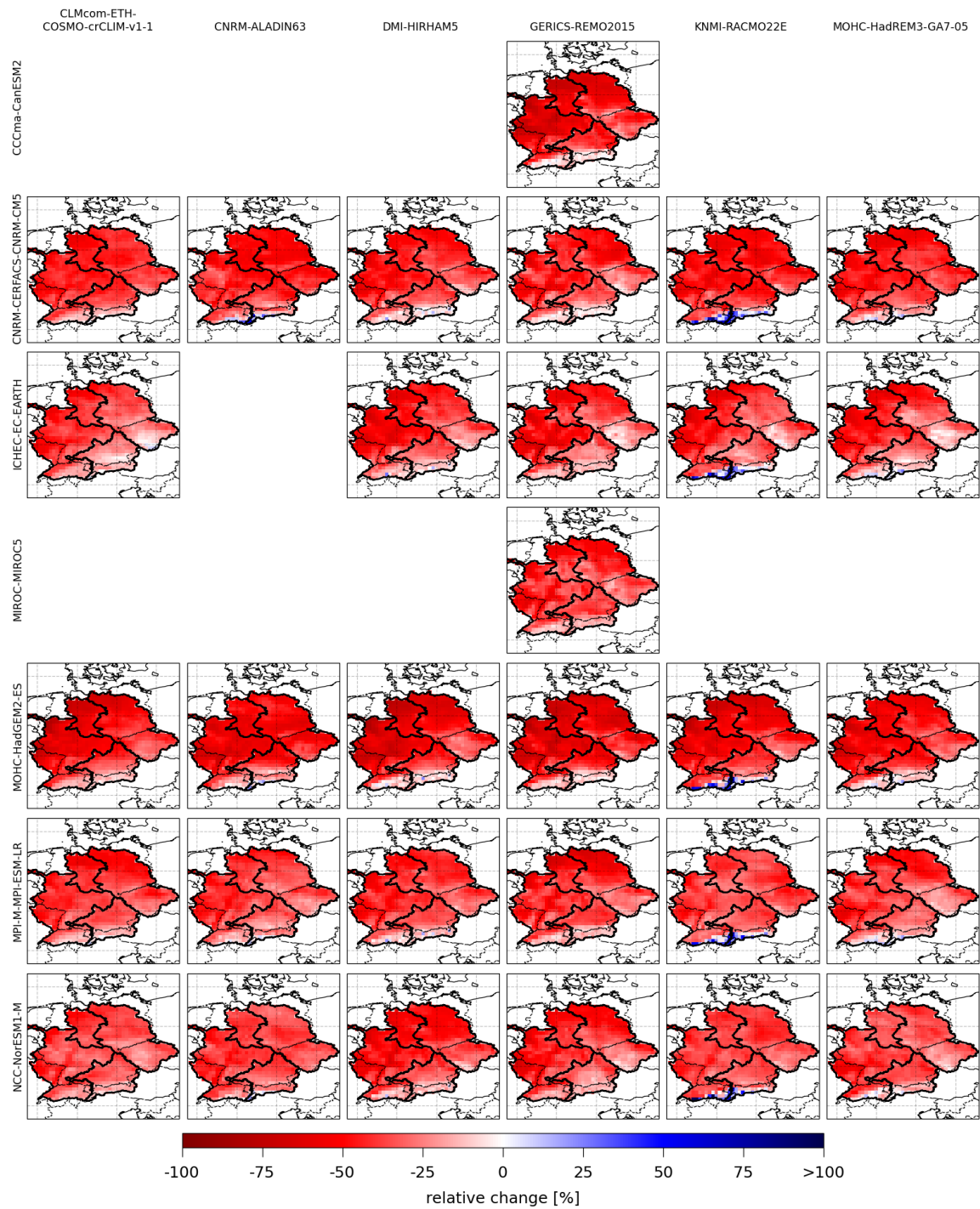


Figure S13. Changes in the mean annual maximum 5-day snowmelt sum for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

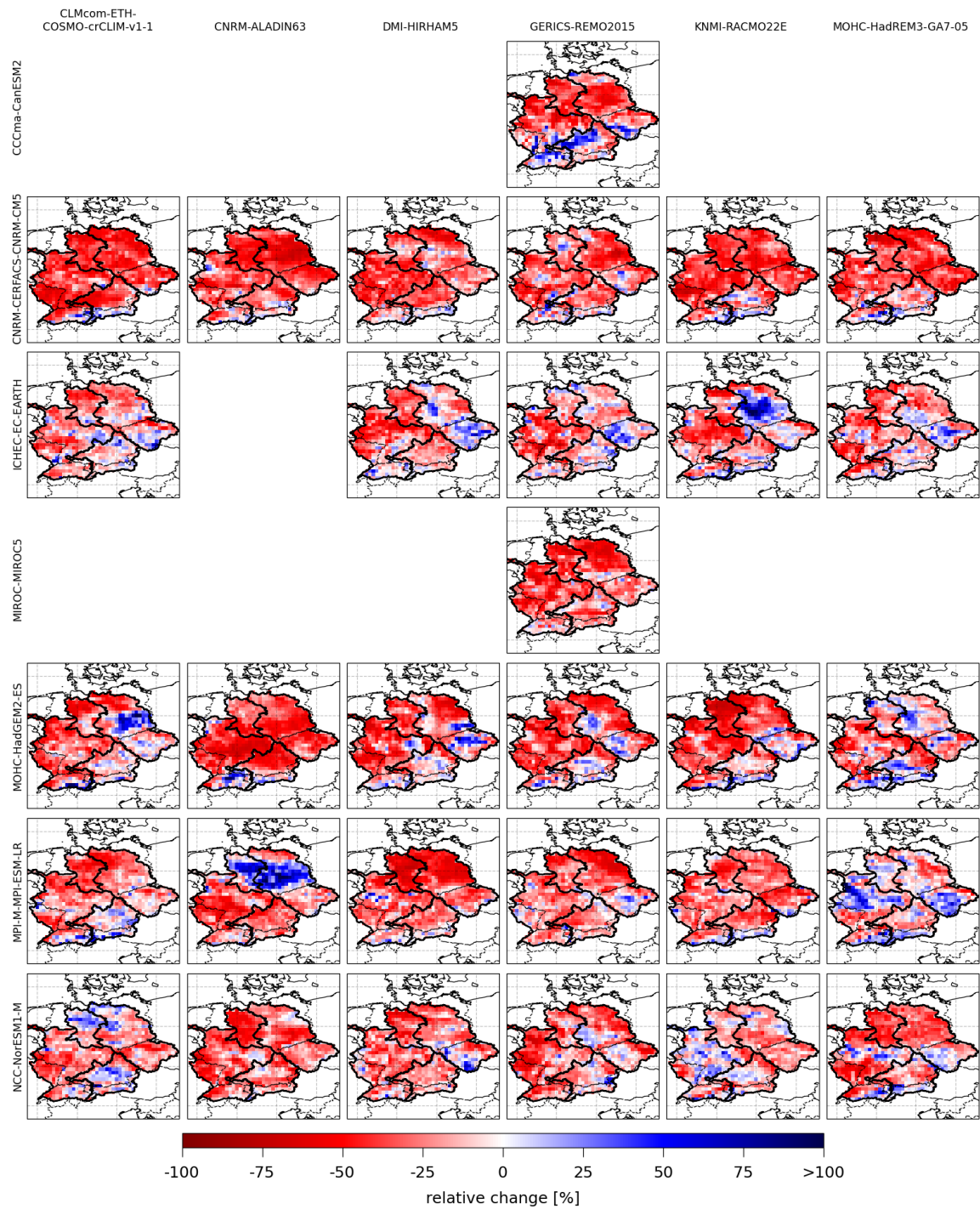


Figure S14. Changes in the maximum 5-day snowmelt sum of the period for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

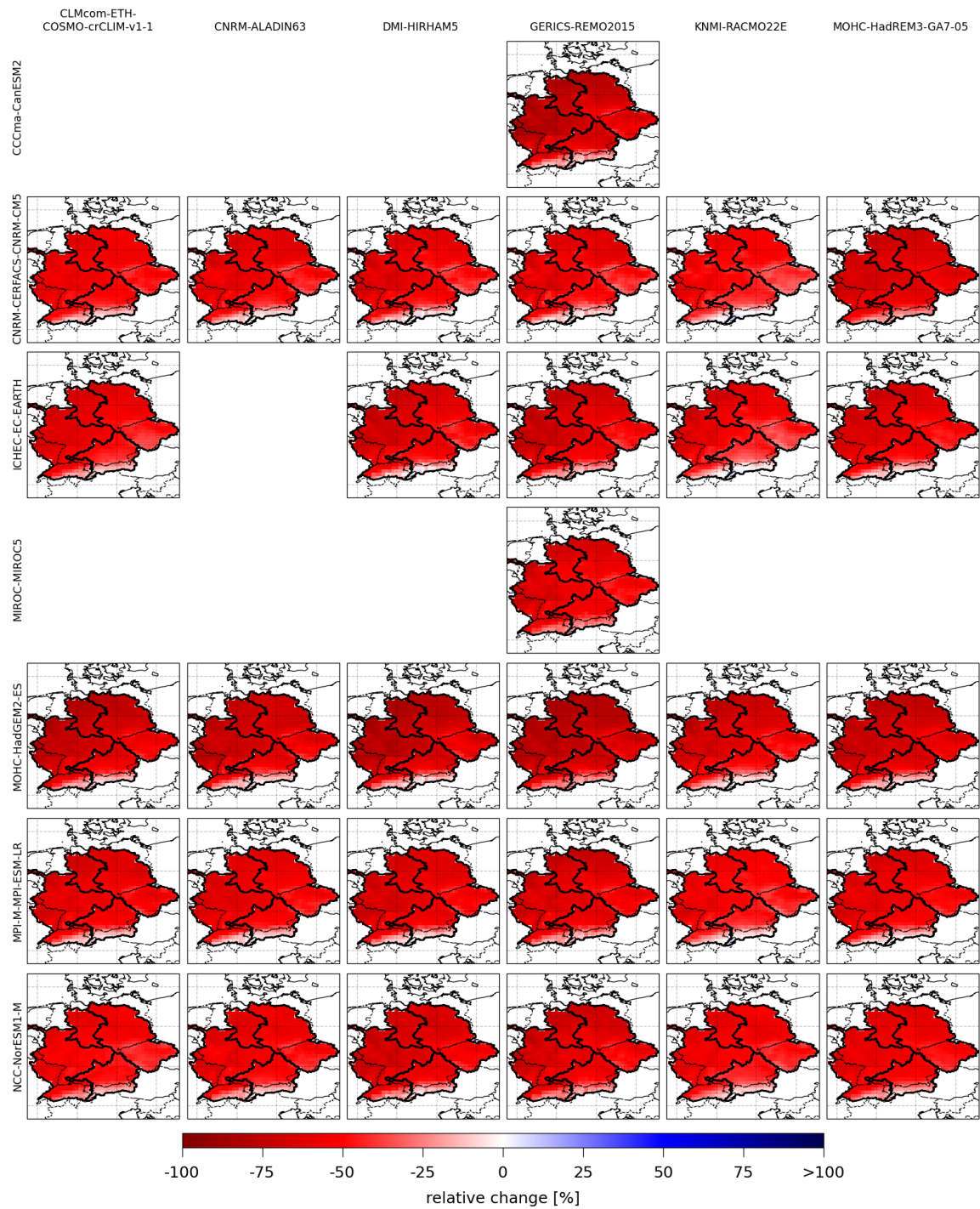


Figure S15. Changes in the mean October to May snowfall sum for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

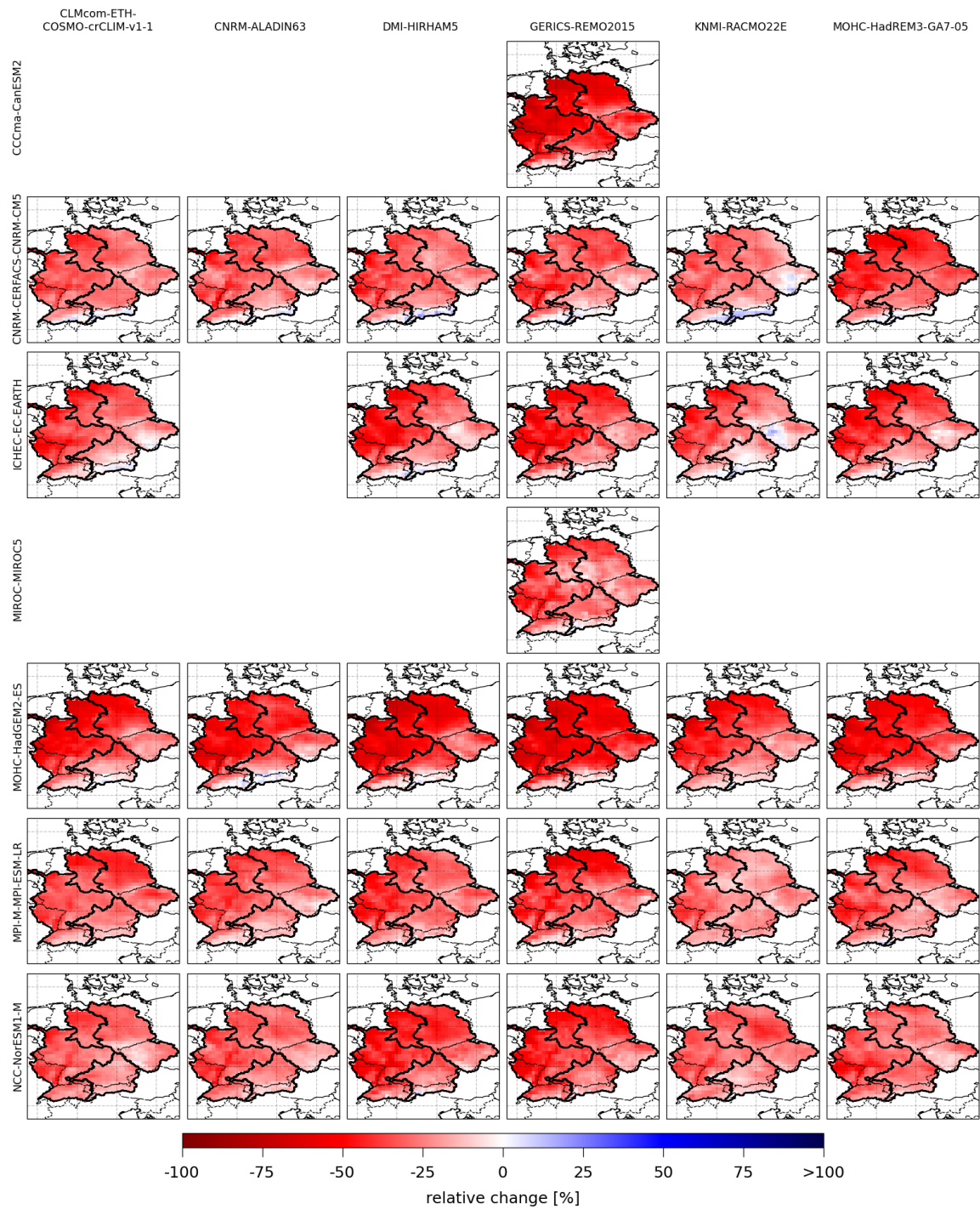


Figure S16. Changes in the mean maximum October to May 5-day snowfall sum for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

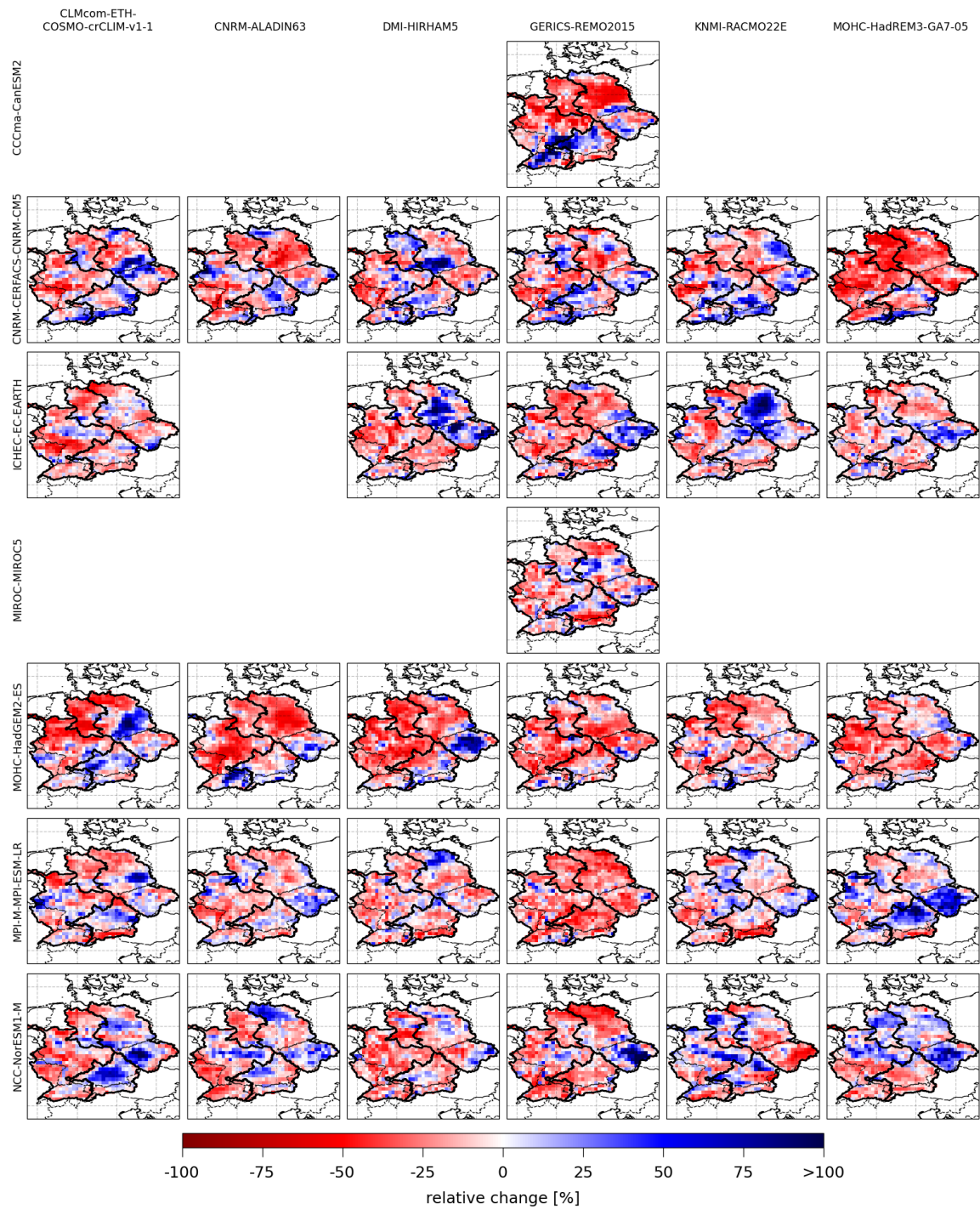


Figure S17. Changes in the maximum October to May 5-day snowfall sum of the period for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

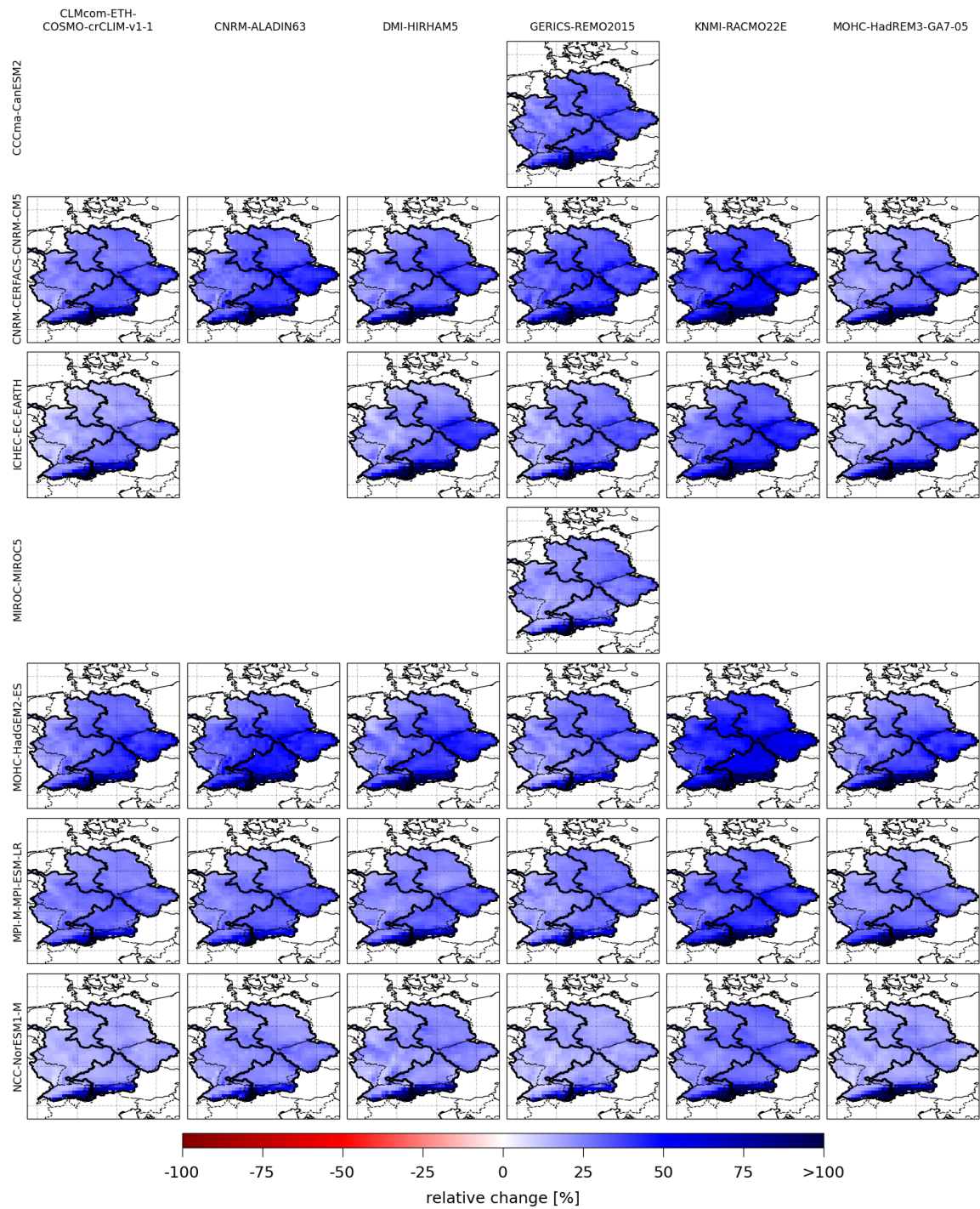


Figure S18. Changes in the mean October to May liquid precipitation sum for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

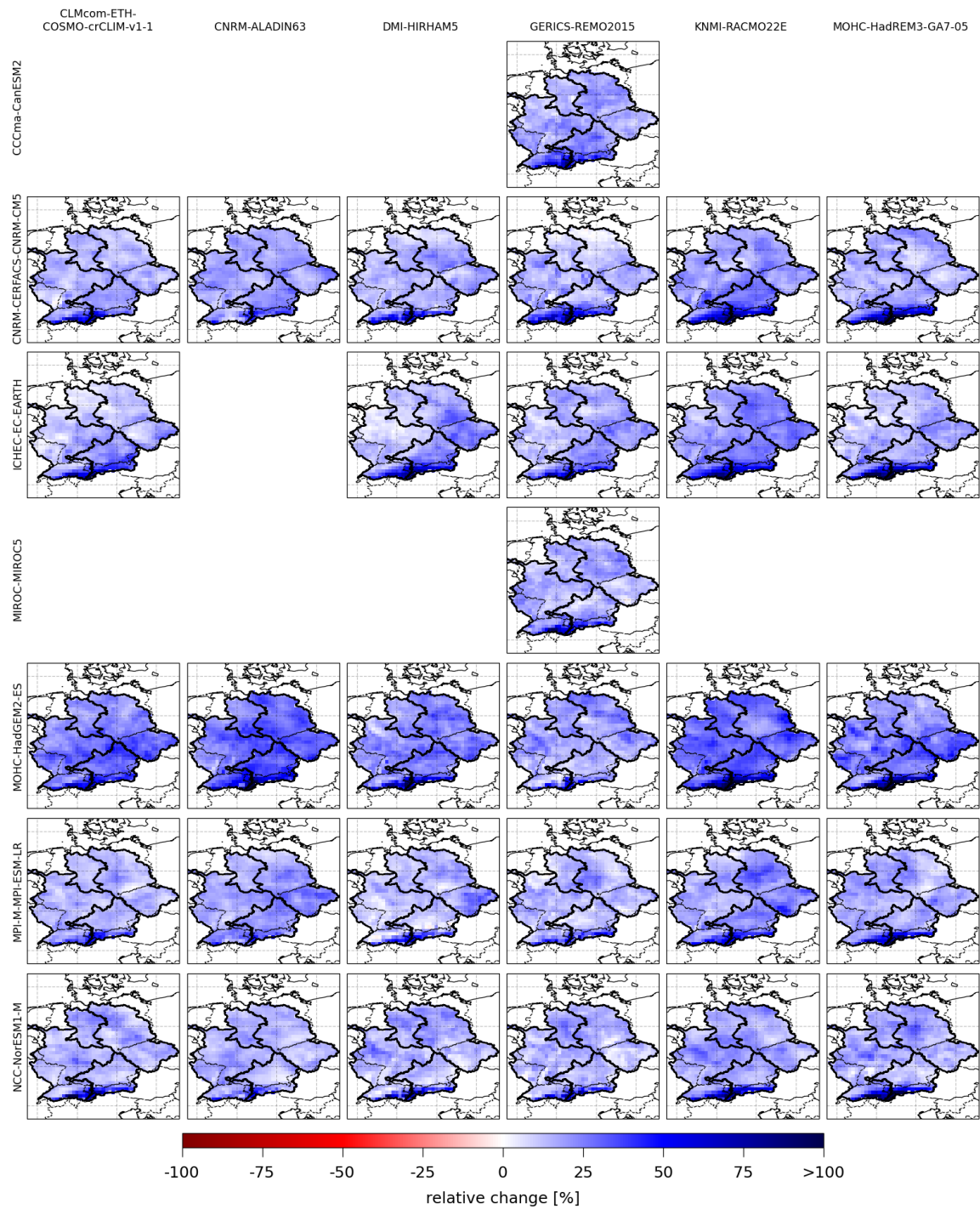


Figure S19. Changes in the mean maximum October to May 5-day liquid precipitation sum for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

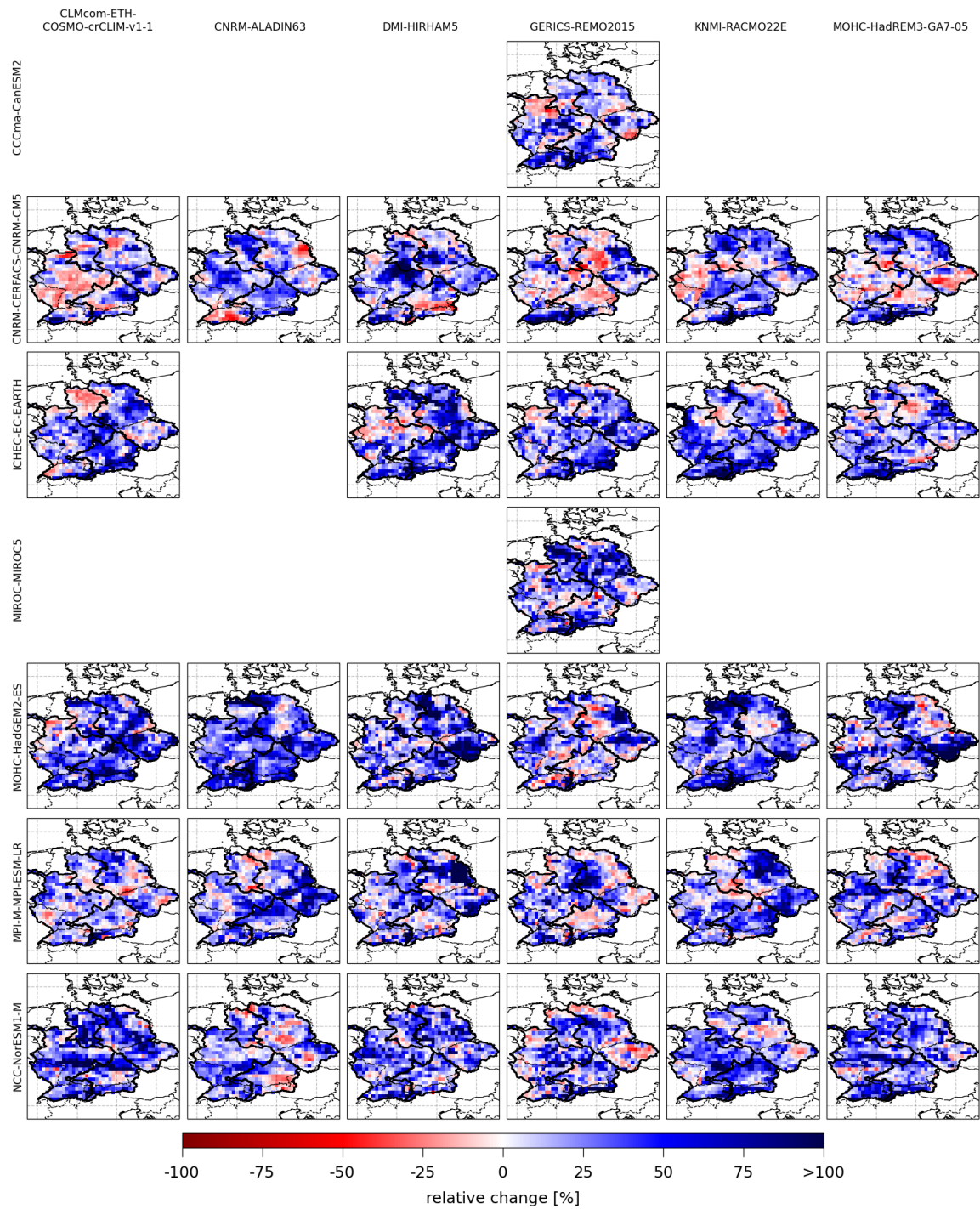


Figure S20. Changes in the maximum October to May 5-day liquid precipitation sum of the period for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period.

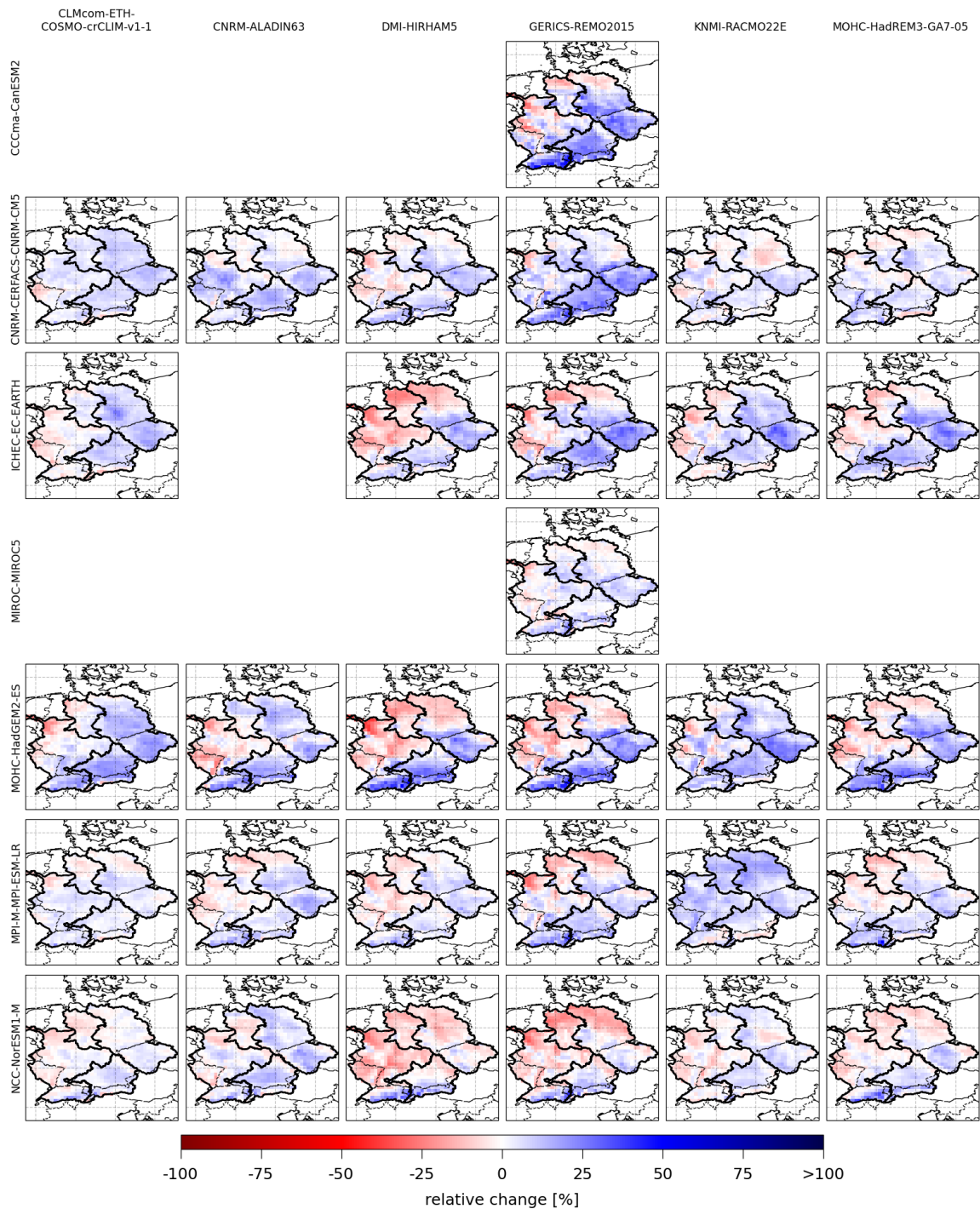


Figure S21. Changes in the mean ROS water (5-day sum of liquid precipitation and snowmelt if ROS conditions are met) of the period for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period. The ROS conditions are met if both ratios of the 5 day sum of liquid precipitation and snowmelt are smaller than 0.1.

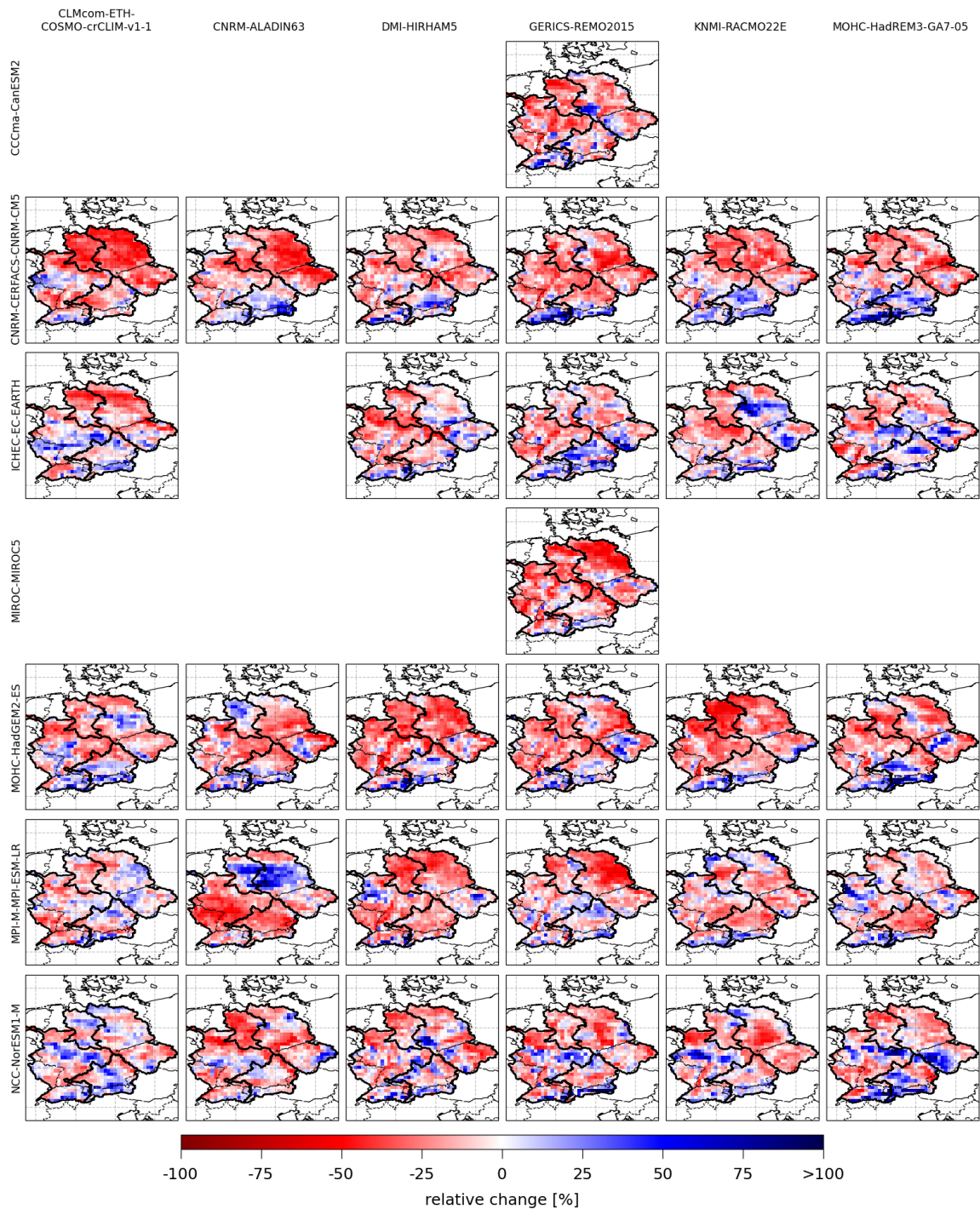


Figure S22. Changes in the mean ROS water (5-day sum of liquid precipitation and snowmelt if ROS conditions are met) of the period for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period. The ROS conditions are met if both ratios of the 5 day sum of liquid precipitation and snowmelt are smaller than 0.1.

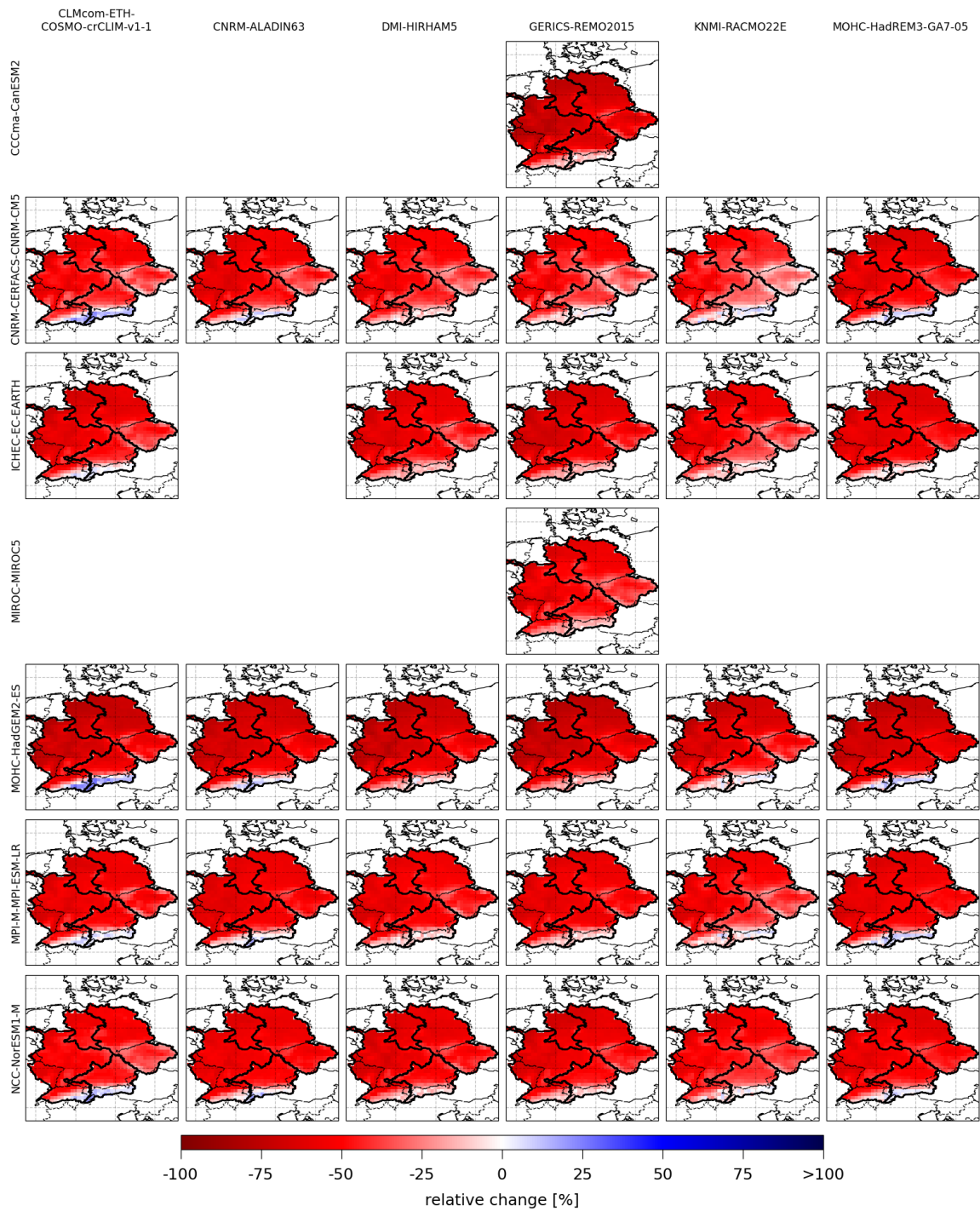


Figure S23. Changes in the the annual mean number of times the ROS conditions are met for all GCM-RCM combinations for the future period 2041-2100 with regard to the reference period. The ROS conditions are met if both ratios of the 5 day sum of liquid precipitation and snowmelt are smaller than 0.1.

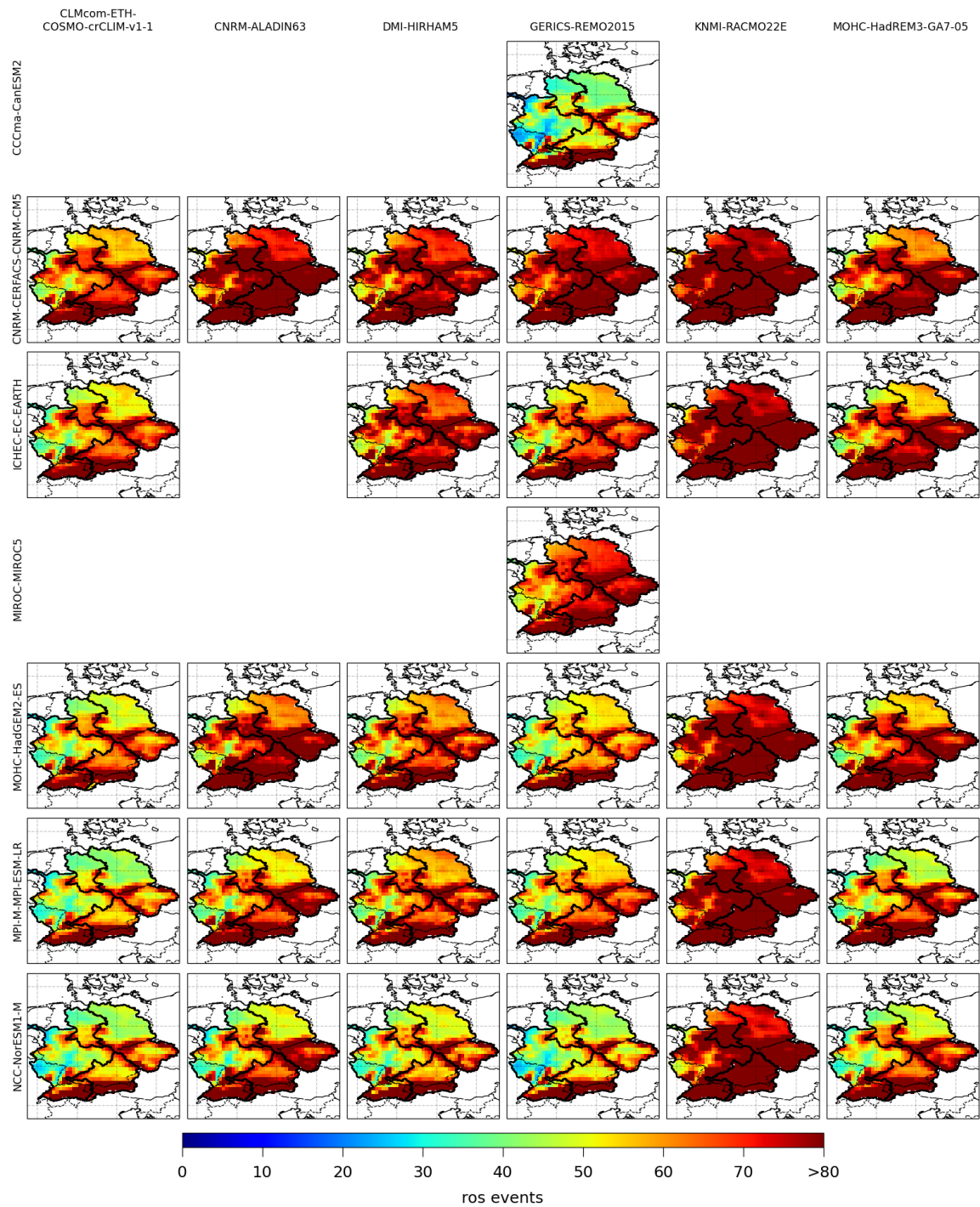


Figure S24. Annual mean number of times the ROS conditions are met for all GCM-RCM combinations for the reference period 1951-2011. The ROS conditions are met if both ratios of the 5 day sum of liquid precipitation and snowmelt are smaller than 0.1.

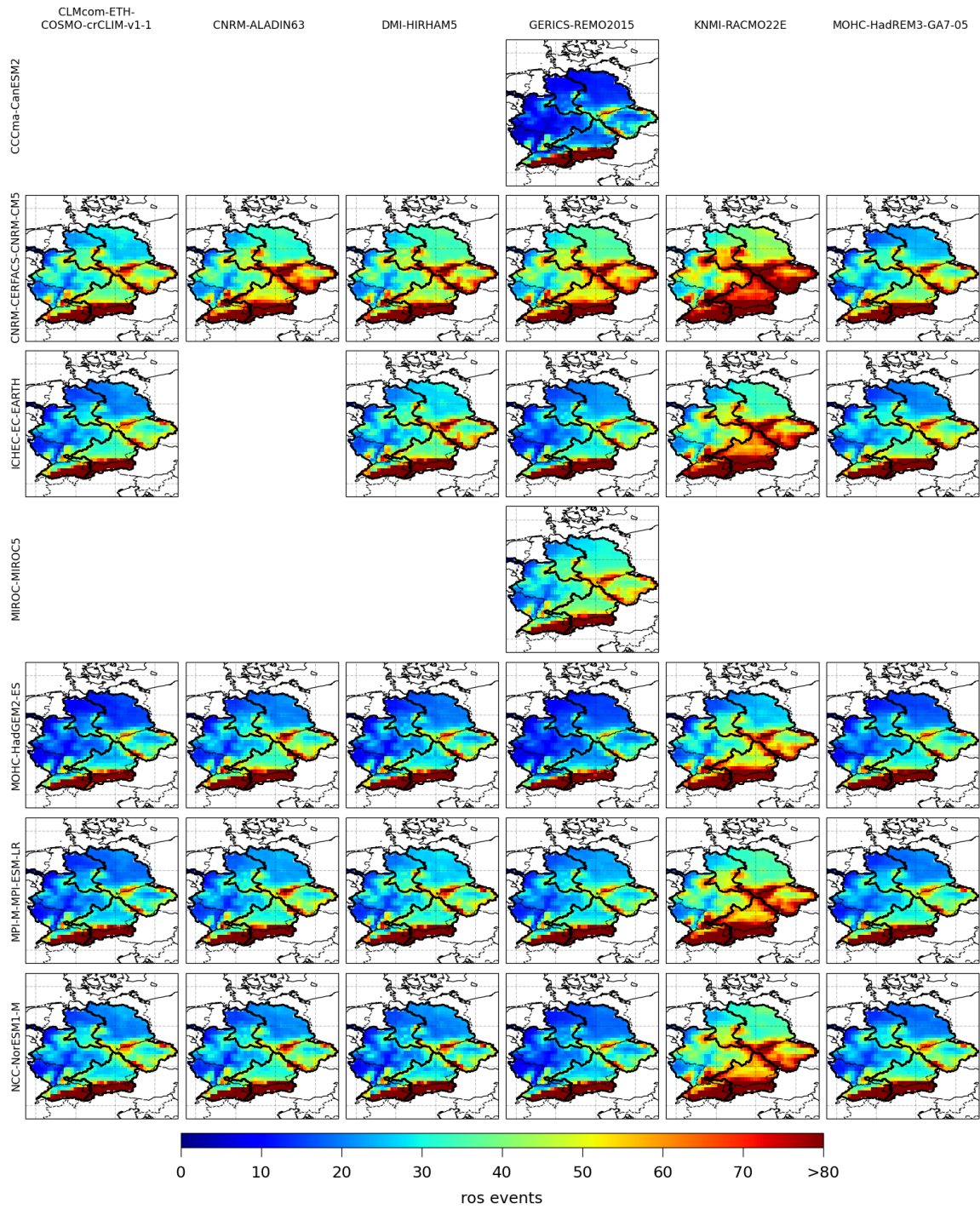


Figure S25. Annual mean number of times the ROS conditions are met for all GCM-RCM combinations for the future period period 2041-2100. The ROS conditions are met if both ratios of the 5 day sum of liquid precipitation and snowmelt are smaller than 0.1.

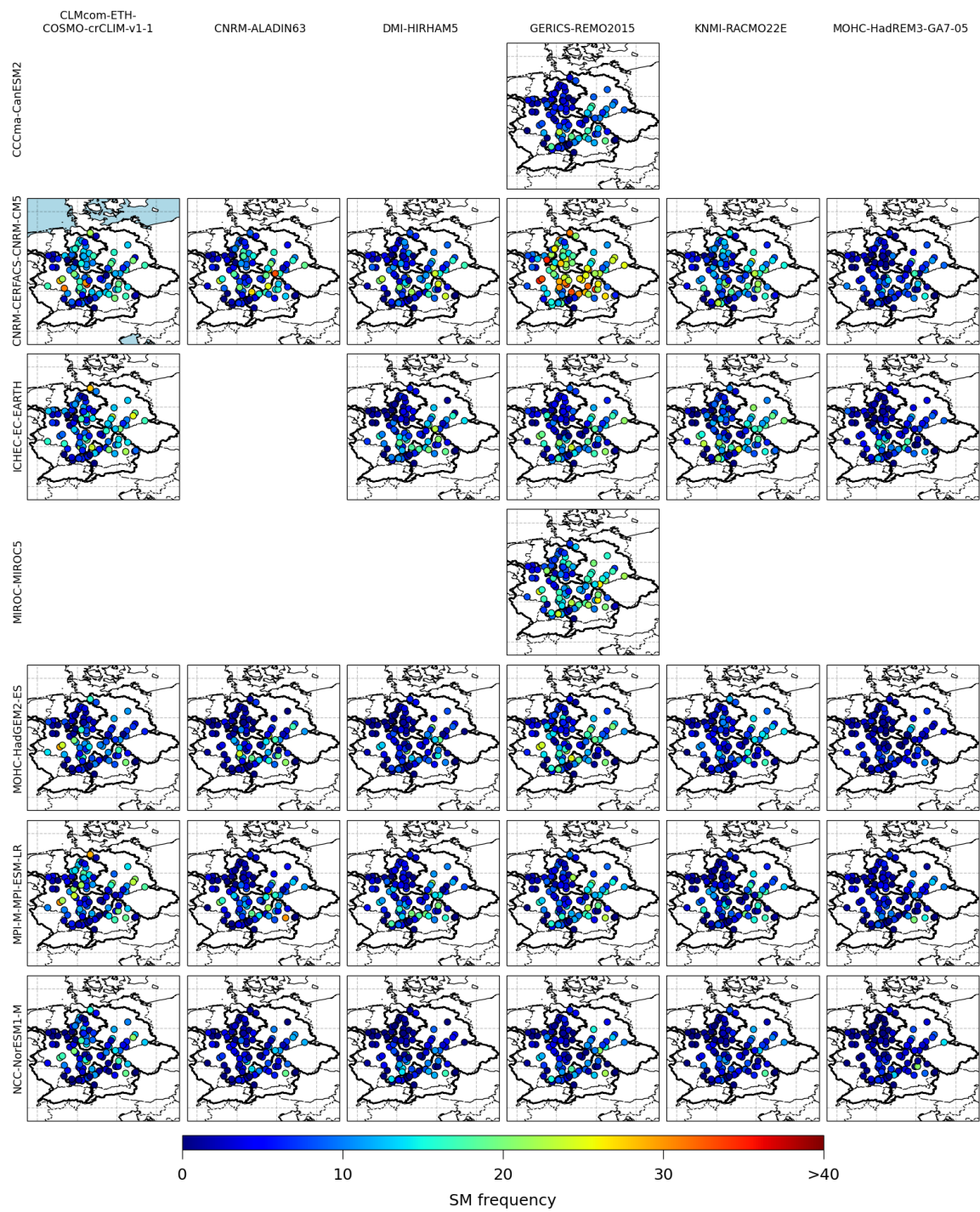


Figure S26. Number of snowmelt floods at all gauges for all GCM-RCM combinations during the reference period 1951-2011.

References

Uhlemann, S., Thielen, A. H., and Merz, B.: A consistent set of trans-basin floods in Germany between 1952–2002, *Hydrology and Earth System Sciences*, 14, 1277–1295, <https://doi.org/10.5194/hess-14-1277-2010>, 2010.