

Supplementary material of

GRUN: An observations-based global gridded runoff dataset from 1902 to 2014

Gionata Ghiggi^{1,3}, Vincent Humphrey^{1,2}, Sonia I. Seneviratne¹, Lukas Gudmundsson¹

¹ Institute for Atmospheric and Climate Science, ETH Zurich, Universitaetstrasse 16, 8092 Zurich, Switzerland

² Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, USA

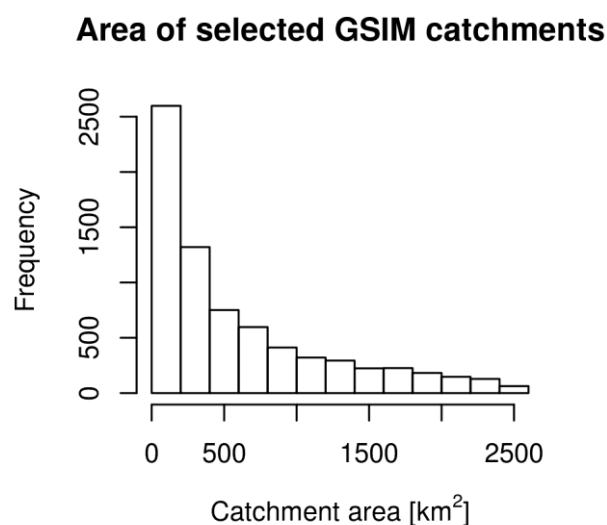
³ Environmental Remote Sensing Laboratory (LTE), EPFL, 1005 Lausanne, Switzerland

Correspondence to: Gionata Ghiggi (gionata.ghiggi@gmail.com)

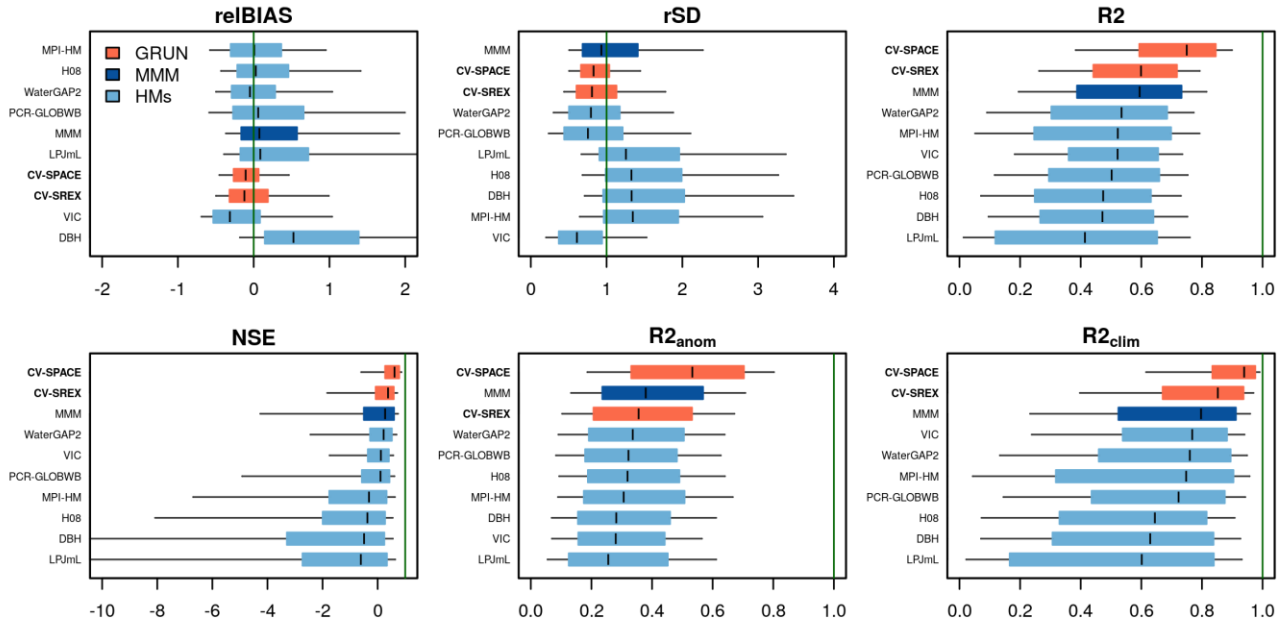
Supplementary Files

- GRUN: “[GRUN_v1_GSWP3_WGS84_05_1902_2014.nc](#)”
- 50 GRUN Realizations: “[Realizations_GRUN_v1_GSWP3_WGS84_05_1902_2014.zip](#)”
- CV-SPACE skill score for each Koppen Geiger climate zone: “KG_CV_SPACE_Skills.csv”
- CV-SPACE skill score for each SREX region: “SREX_CV_SPACE_Skills.csv”
- List of GSIM stations selected to retrieve grid cell runoff rates: “GSIM_training_stations.csv”

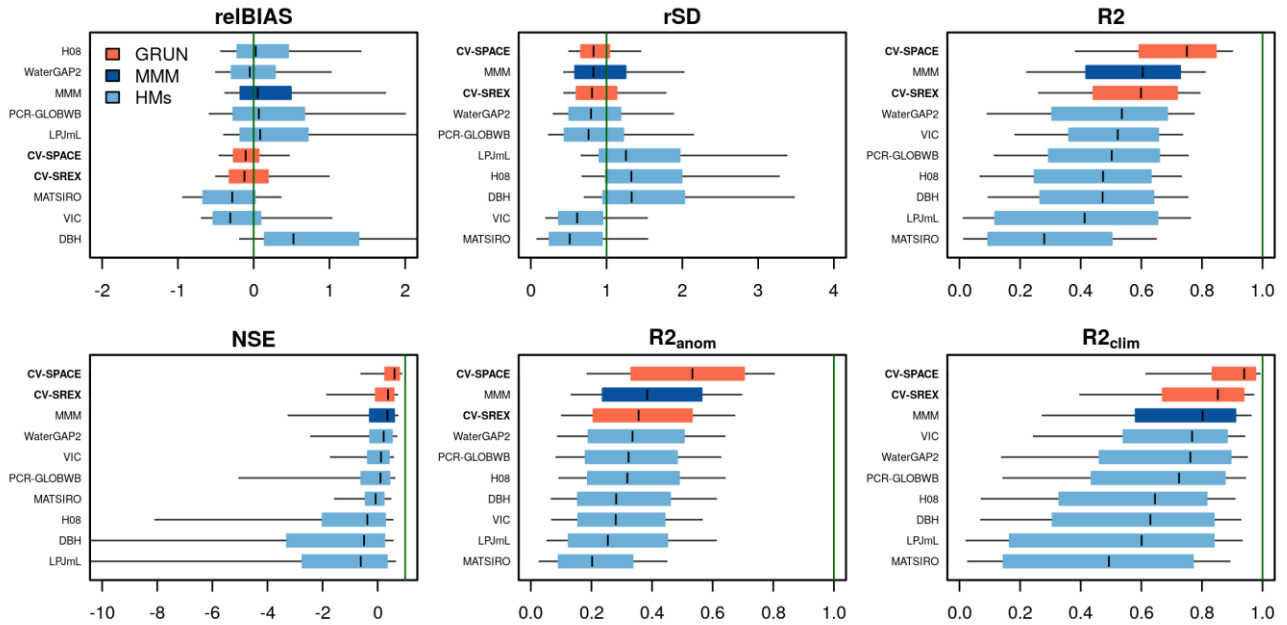
Supplementary Figures



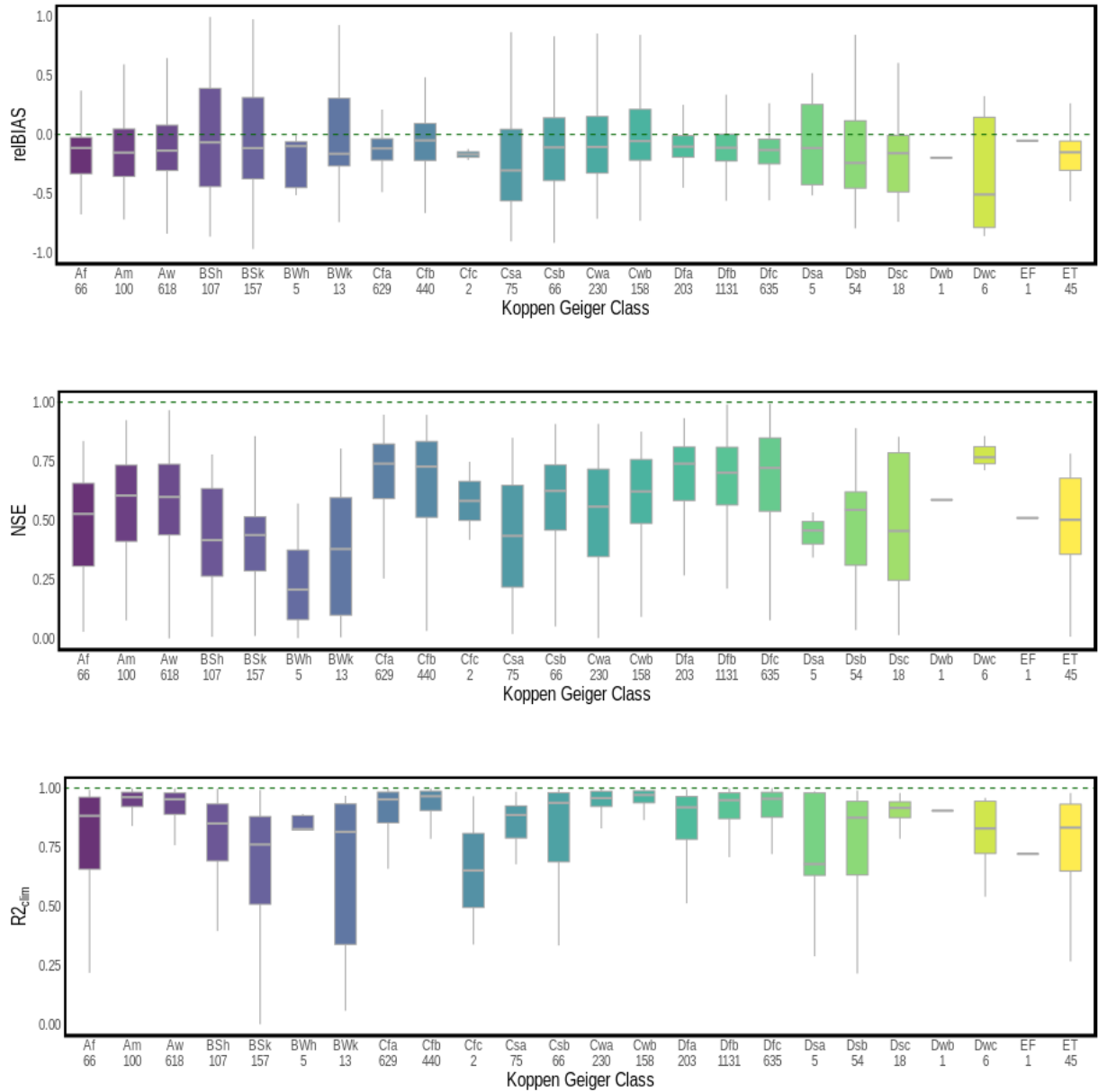
Supplementary Figure 1. Catchment area distribution of GSIM stations used to derive runoff rates at the grid cell level.



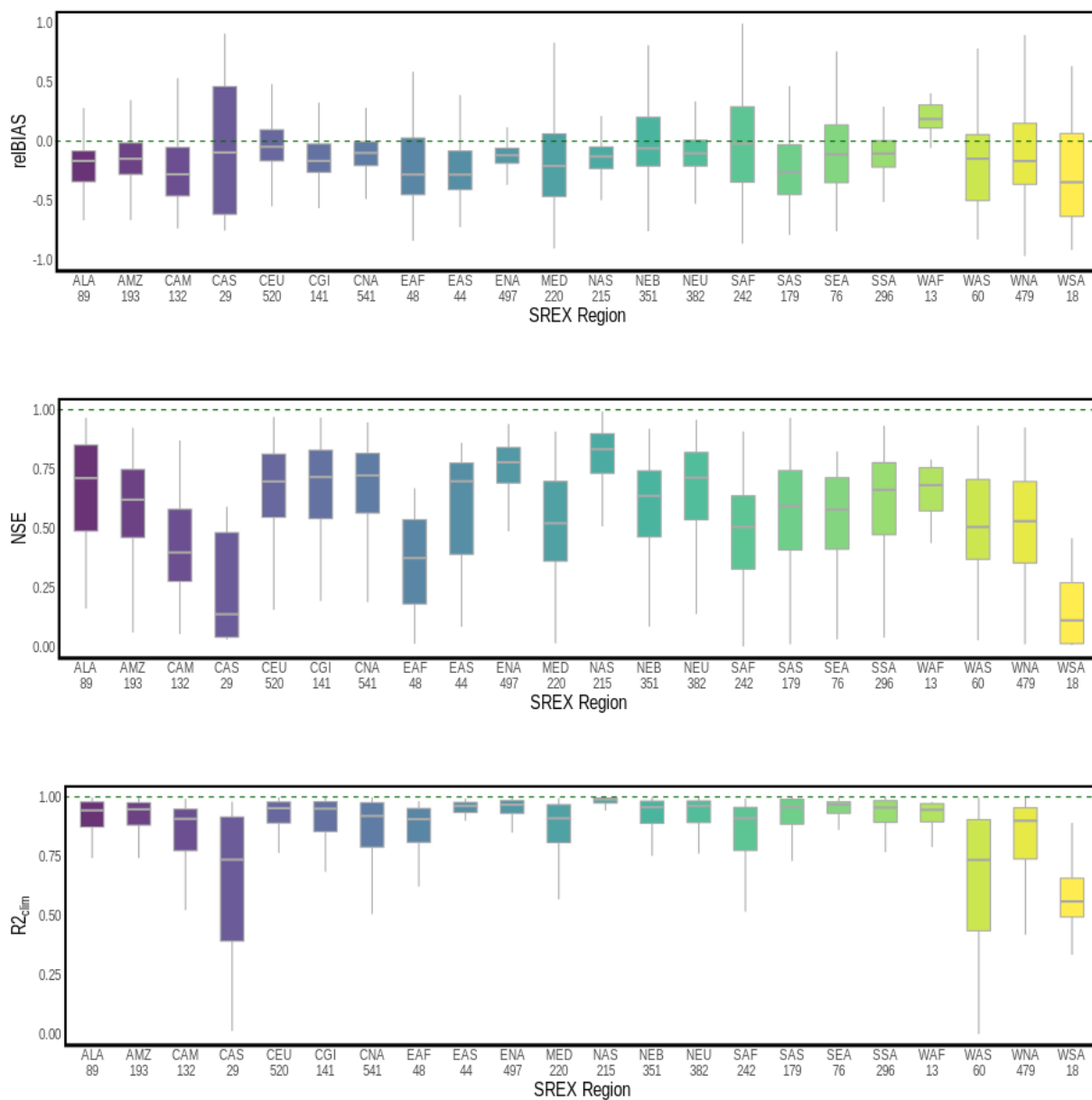
Supplementary Figure 2. Benchmarking the performance of GRUN against ISIMIP2a *pressoc* GHMs runoff simulations. Boxplot whiskers cover the 0.1 to 0.9 quantiles of the skill score distribution. The dark green vertical lines indicate the optimal score. GRUN cross-validation results are displayed in orange, while the multi model mean (MMM) of ISIMIP2a GHMs runoff simulations is displayed in dark blue. In most of the cases, the order of the boxes follows the rank of the median skill score. However, to avoid compensatory effect with $relBIAS$ and rSD scores, the individual boxes are ranked based on the absolute median value of the skill score minus the optimal score. The x-axis of $relBIAS$ is left and right truncated, of rSD it is right truncated and for NSE it is left truncated.



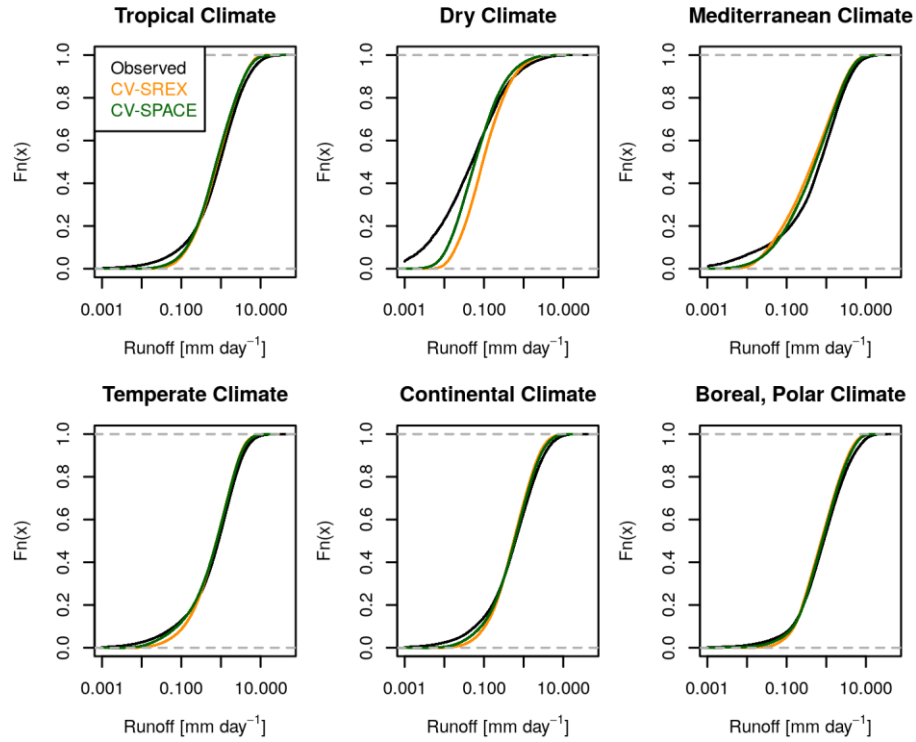
Supplementary Figure 3. Benchmarking the performance of GRUN against ISIMIP2a *varsoc* GHMs runoff simulations. Boxplot whiskers cover the 0.1 to 0.9 quantiles of the skill score distribution. The dark green vertical lines indicate the optimal score. GRUN cross-validation results are displayed in orange, while the multi model mean (MMM) of ISIMIP2a GHMs runoff simulations is displayed in dark blue. In most of the cases, the order of the boxes follows the rank of the median skill score. However, to avoid compensatory effect with $relBIAS$ and rSD scores, the individual boxes are ranked based on the absolute median value of the skill score minus the optimal score. The x-axis of $relBIAS$ is left and right truncated, of rSD it is right truncated and for NSE it is left truncated.



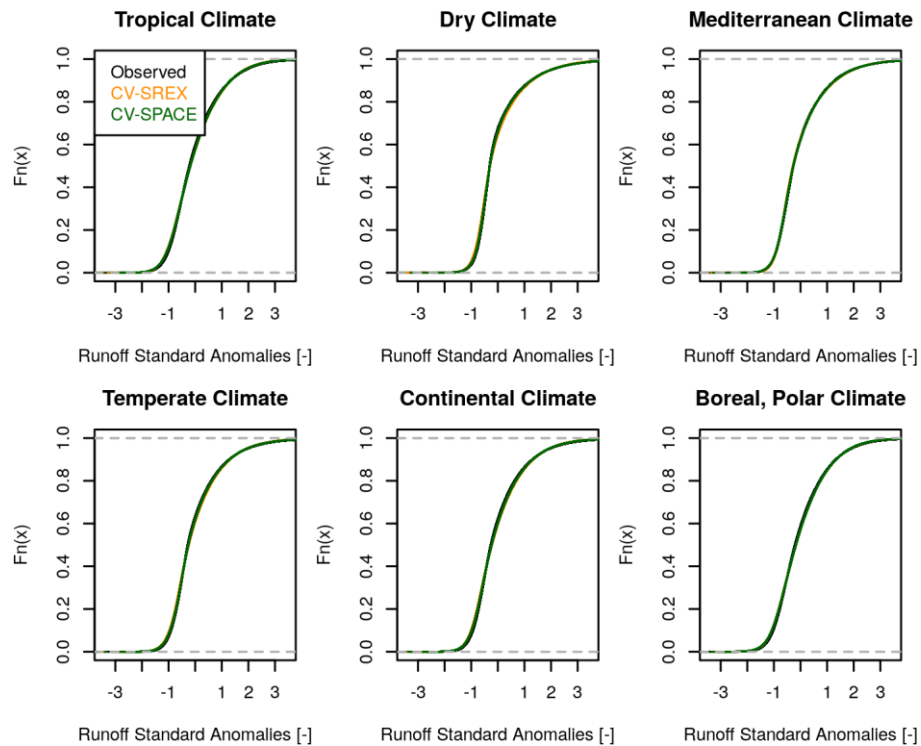
Supplementary Figure 4. CV-SPACE skill score for different Koppen Geiger climate zones. The green horizontal dashed line indicate the optimal skill value. The KG_CV_SPACE_Skills.csv file in the supplementary material provides the 25th, 50th and 75th quantiles of the skills distribution for the various climate zones.



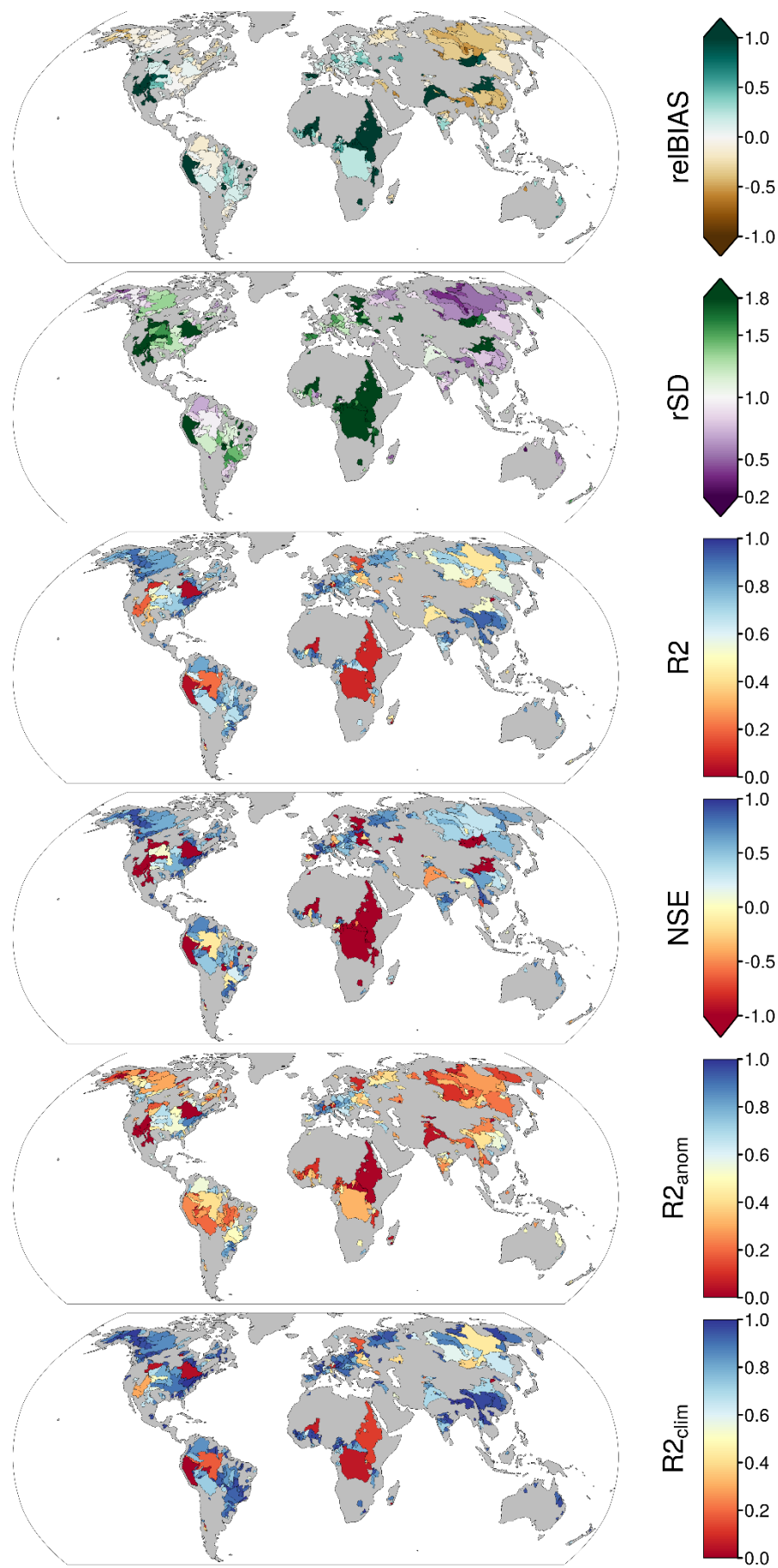
Supplementary Figure 5. CV-SPACE skill score for different SREX regions. The green horizontal dashed line indicate the optimal skill value. The SREX_CV_SPACE_Skills.csv file in the supplementary material provides the 25th, 50th and 75th quantiles of the skills distribution for the various regions.



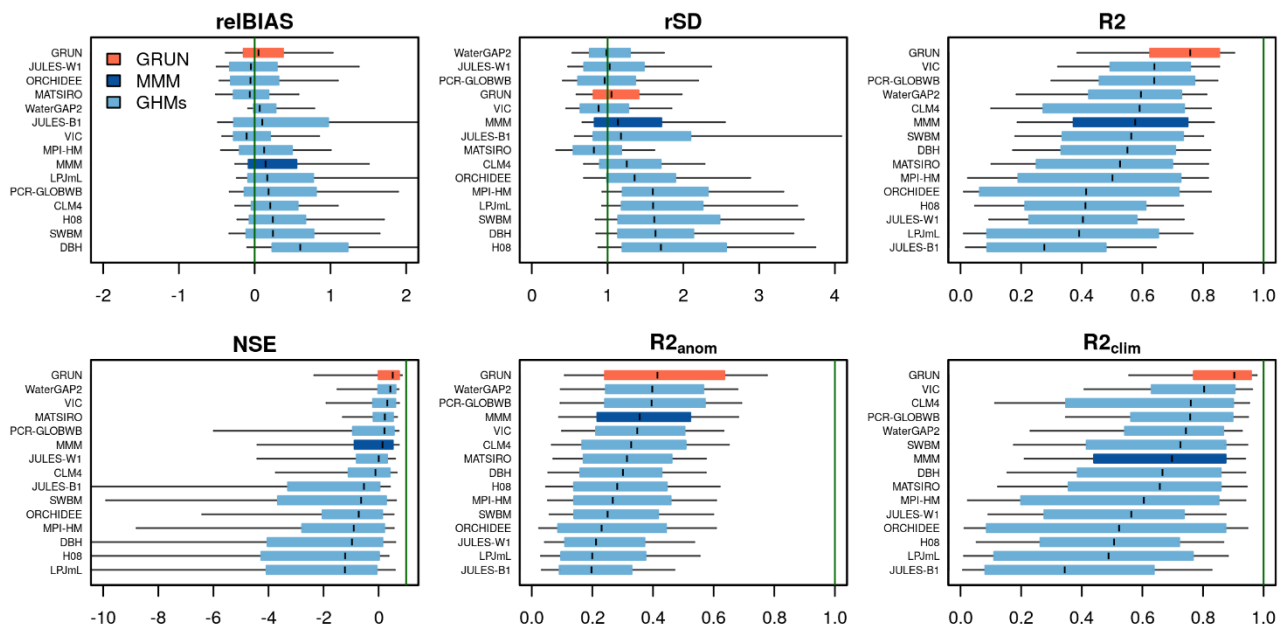
Supplementary Figure 6. Cumulative distribution function of runoff rates for different climate zones. The climate types are regrouped as follow: Tropical (KG Group A), Dry Climate (KG Group B), Mediterranean (KG Group Cs*), Temperate (KG Group Cf* and Cw*), Continental (KG Group D*a and D*b), Boreal and Polar Climate (KG Group D*c and D*d as well as Group E).



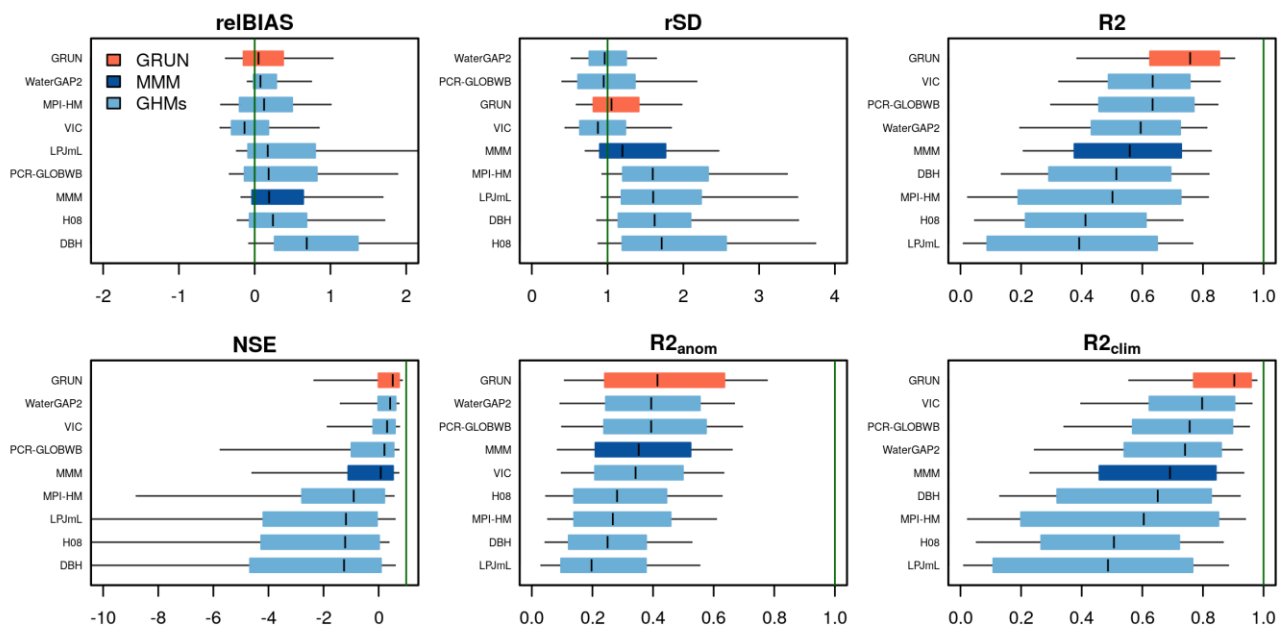
Supplementary Figure 7. Cumulative distribution function of runoff rates for different climate zones. The climate types are regrouped as follow: Tropical (KG Group A), Dry Climate (KG Group B), Mediterranean (KG Group Cs*), Temperate (KG Group Cf* and Cw*), Continental (KG Group D*a and D*b), Boreal and Polar Climate (KG Group D*c and D*d as well as Group E).



Supplementary Figure 8. Spatial distribution of the skills scores obtained through river discharge validation based on selected GRDC stations with catchment area larger than 10'000 km².

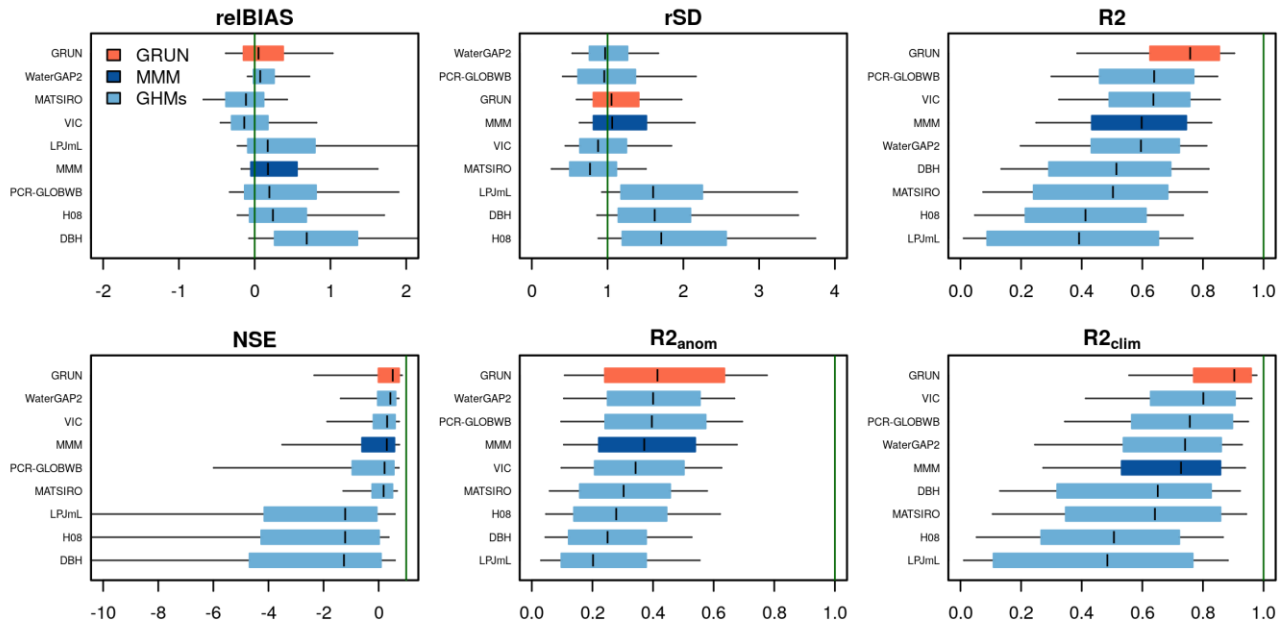


Supplementary Figure 9. Benchmarking the performance of GRUN against ISIMIP2a *nosoc* GHMs simulations over GRDC basins. Boxplot whiskers cover the 0.1 to 0.9 quantiles of the skill score distribution. The dark green vertical lines indicate the optimal score. The skills of the GRUN-derived river discharge are displayed in orange, while those of the multi model mean (MMM) of ISIMIP2a GHMs are displayed in dark blue. In most of the cases, the order of the boxes follows the rank of the median skill score. However, to avoid compensatory effect with relBIAS and rSD scores, the individual boxes are ranked based on the absolute median value of the skill score minus the optimal score. The x-axis of relBIAS is left and right truncated, of rSD it is right truncated and for NSE it is left truncated.

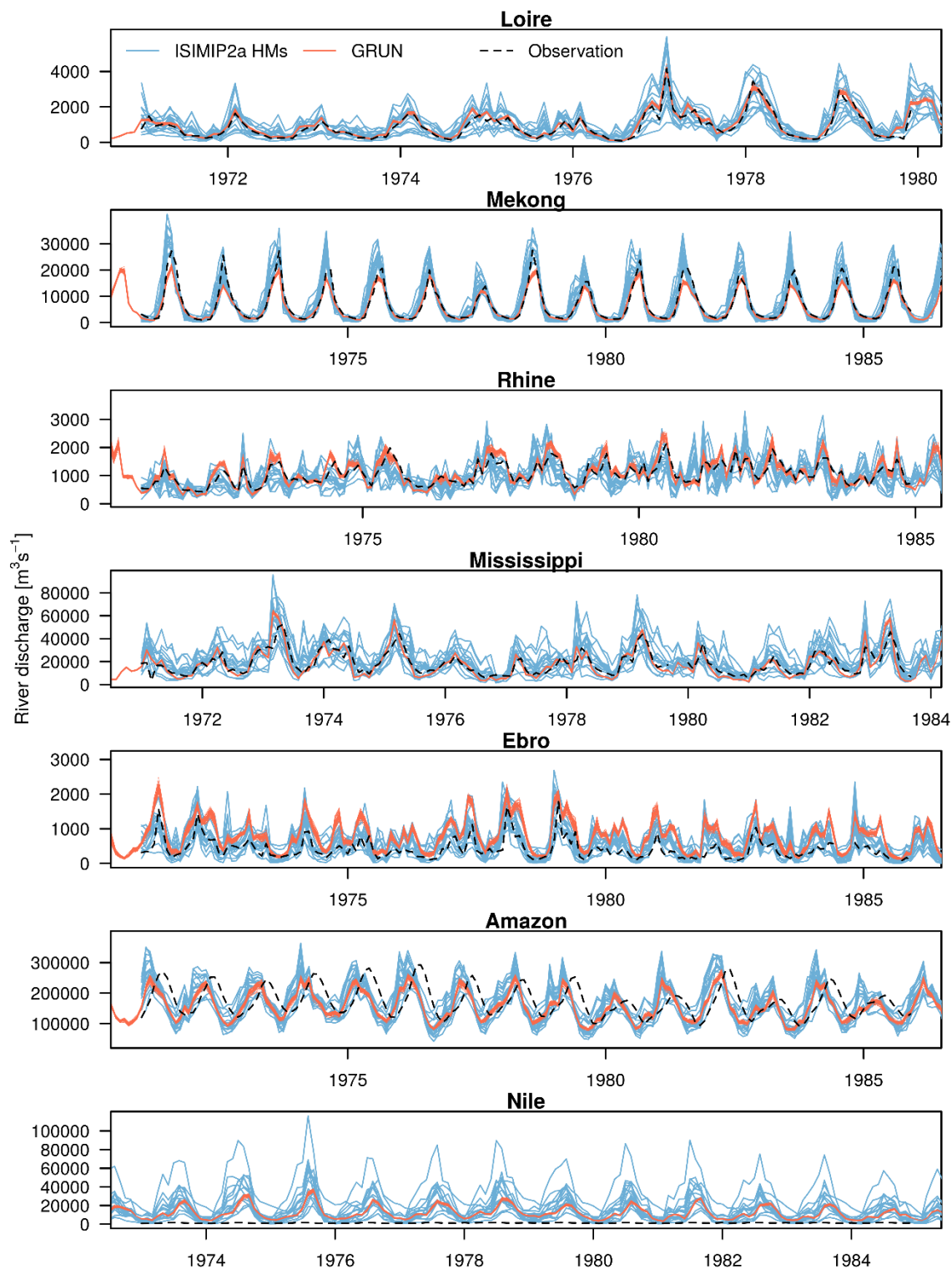


Supplementary Figure 10. Benchmarking the performance of GRUN against ISIMIP2a *pressoc* GHMs simulations over GRDC basins. Boxplot whiskers cover the 0.1 to 0.9 quantiles of the skill score distribution. The dark green vertical lines indicate the optimal

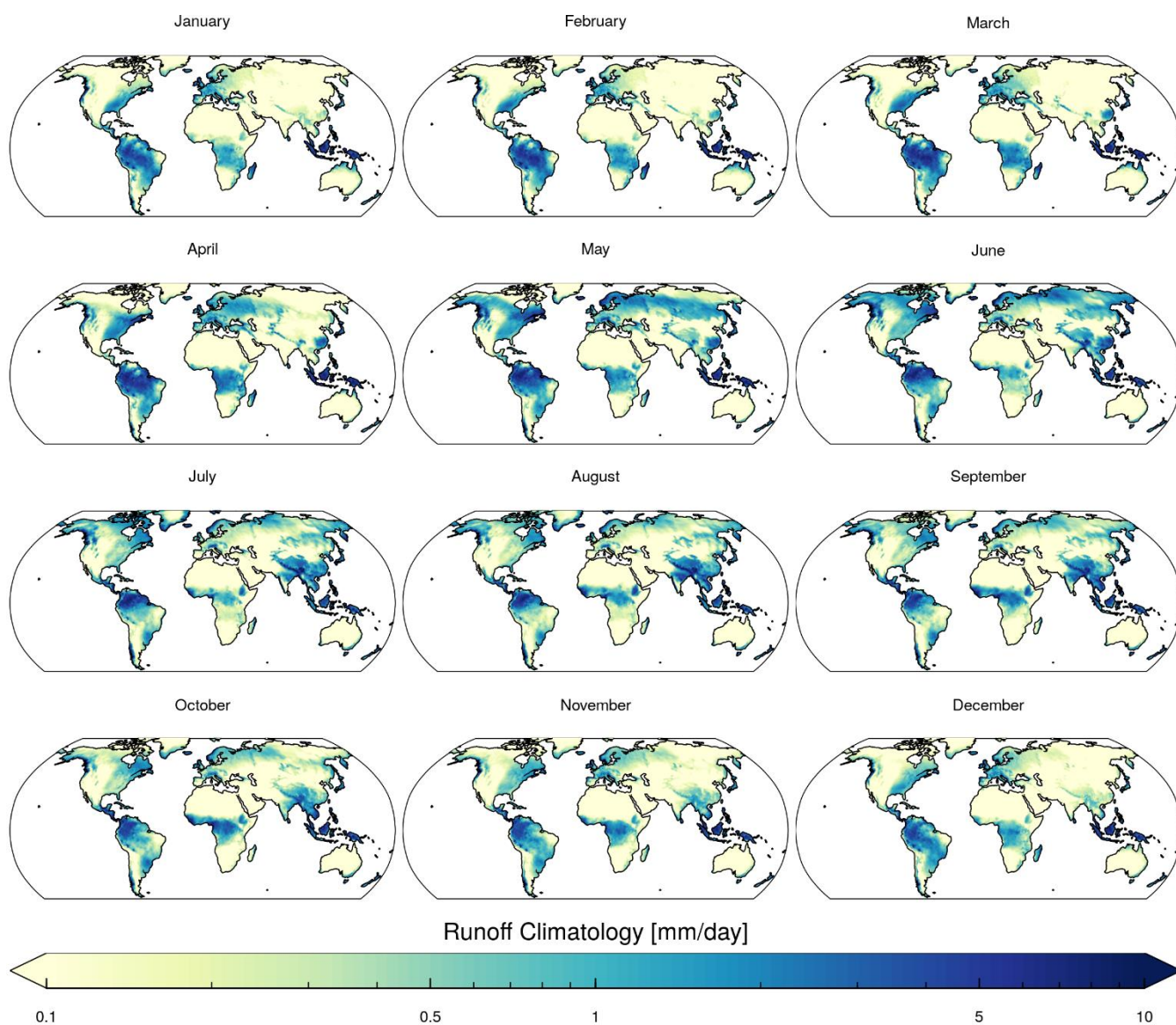
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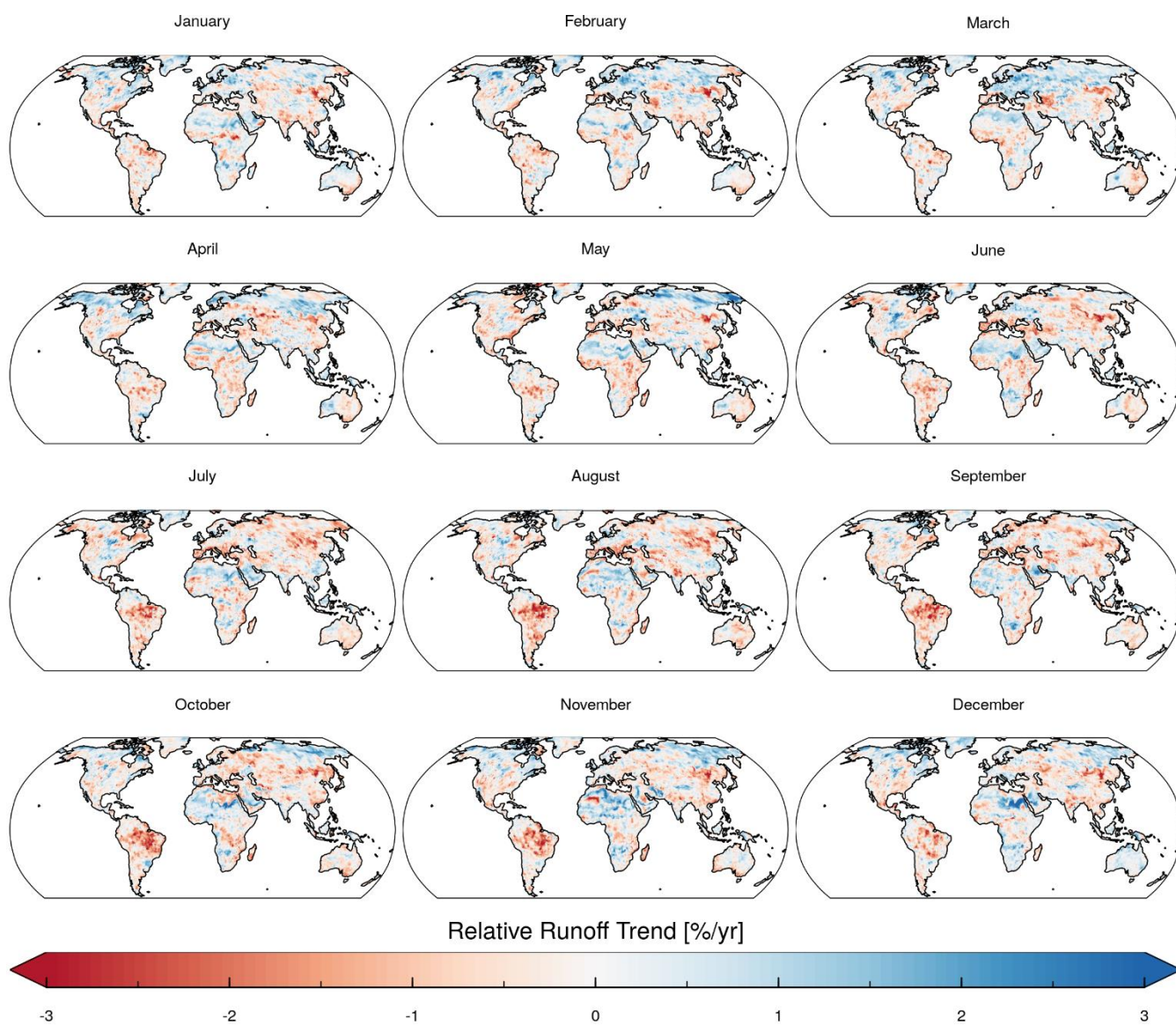
Supplementary Figure 11. Benchmarking the performance of GRUN against ISIMIP2a varsoc GHMs simulations over GRDC basins. Boxplot whiskers cover the 0.1 to 0.9 quantiles of the skill score distribution. The dark green vertical lines indicate the optimal score. The skills of the GRUN-derived river discharge are displayed in orange, while those of the multi model mean (MMM) of ISIMIP2a GHMs are displayed in dark blue. In most of the cases, the order of the boxes follows the rank of the median skill score. However, to avoid compensatory effect with relBIAS and rSD scores, the individual boxes are ranked based on the absolute median value of the skill score minus the optimal score. The x-axis of relBIAS is left and right truncated, of rSD it is right truncated and for NSE it is left truncated.



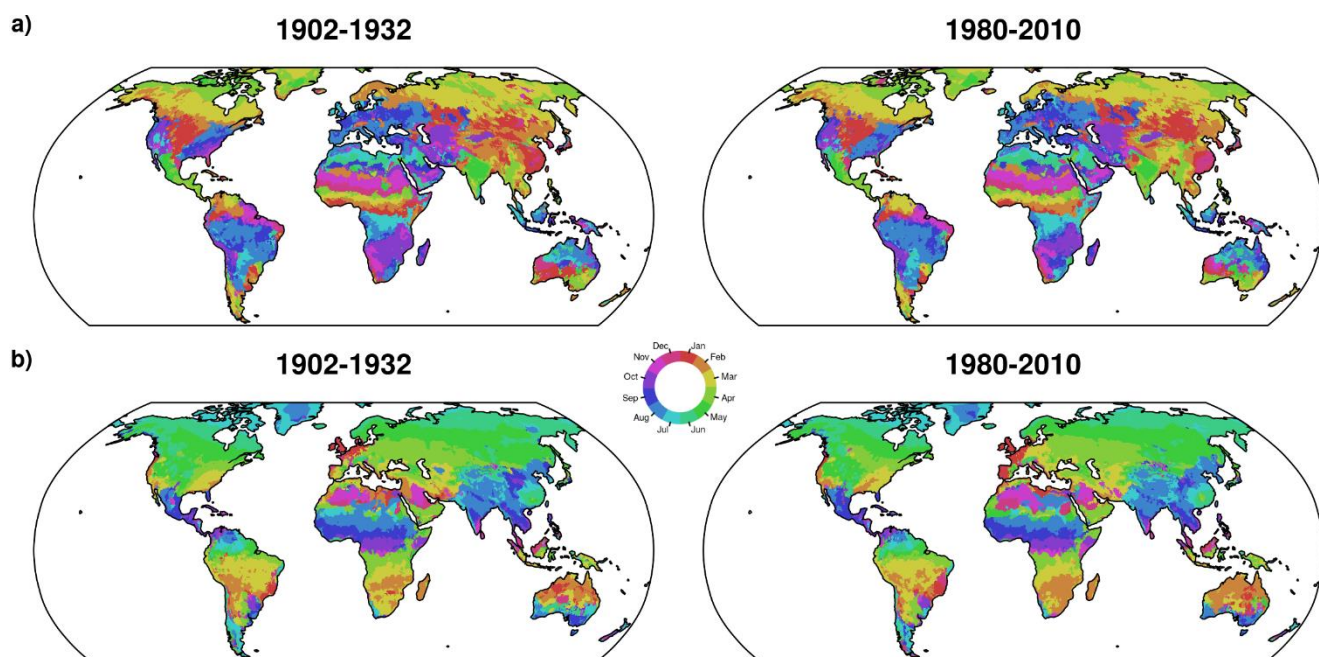
Supplementary Figure 12. Comparison of river discharge derived from 50 GRUN realizations (orange lines), ISIMIP2a nosoc GHMs runoff simulations (light blue lines) and GRDC observations (dashed black line).



Supplementary Figure 13. Runoff monthly climatology for the period 1971-2010.



Supplementary Figure 14. Runoff monthly trends for the period 1971-2010.



Supplementary Figure 15. Changes in runoff timing. a) Minimum runoff b) Maximum runoff.