

Weather extremes in an ensemble of downscaled CMIP5 simulations for Germany from 1971-2100

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1. Background

Contributing to the EURO-CORDEX Ensemble on 12 km horizontal resolution, additional 21 simulations for the RCP8.5 scenario were carried out within the framework of the ReKliEs-De Project. Dynamical and statistical downscaling methods are applied leading to in total 37 Ensemble members for Germany. This large Ensemble enables to capture the complete spread of climate change signals furthermore, estimations of robustness are improved.

A huge effort of analysing special climate indices (Fig.1) based on the new Ensemble was made in the Project. An increasing number of climate extremes in the future based on the RCP8.5 and RCP2.6 scenario (see Oral: EGU2018-12882) was detected in the analysis of ReKliEs-De. The results of the project (simulations and climate indices) are also published via the Earth System Grid Federation (ESGF).

Task for this study:

- Evaluating the new EURO-CORDEX Ensemble against the gridded observational dataset HYRAS from 1971-2000.
- Identifying extremes in simulation and observation.

For more details on the ReKliEs-De project, see poster EGU2018-1311, Oral: EGU2018-12882 and <http://reklies.hlnug.de>.

2. Evaluation Method

Probability density functions (PDFs) of the daily temperature (tas) and precipitation (pr) distribution in Germany are analyzed for HYRAS and the Model Ensemble of 12 km. We indicate extreme values by the lower and upper 10% of the temperature distribution and by the upper 10%, 5% 1% and 0.1% for the precipitation distribution. We analyzed the PDFs for the historical and two future periods (Fig. 2 and 3) for summer (JJA) and winter (DJF) season.

3. Results and Conclusion

- Good agreement of Ensemble mean and HYRAS for tas in the reference period.
- The median of the temperature distribution in the far future (2071-2100) is located close to the upper 10% of the historical distribution.
 - Today's extreme temperatures will be normal in future.
- Good agreement of Ensemble PDF and HYRAS for pr up to precipitation amounts of about 30 mm/day.
- Rare extreme events (>0.1% of all precipitation events) are slightly overestimated by the Ensemble.
- Increasing extreme pr values towards the end of the 21. century.
- Smaller precipitation amounts (up to 10 mm) reveal a decrease during JJA and increase in DJF in the future.

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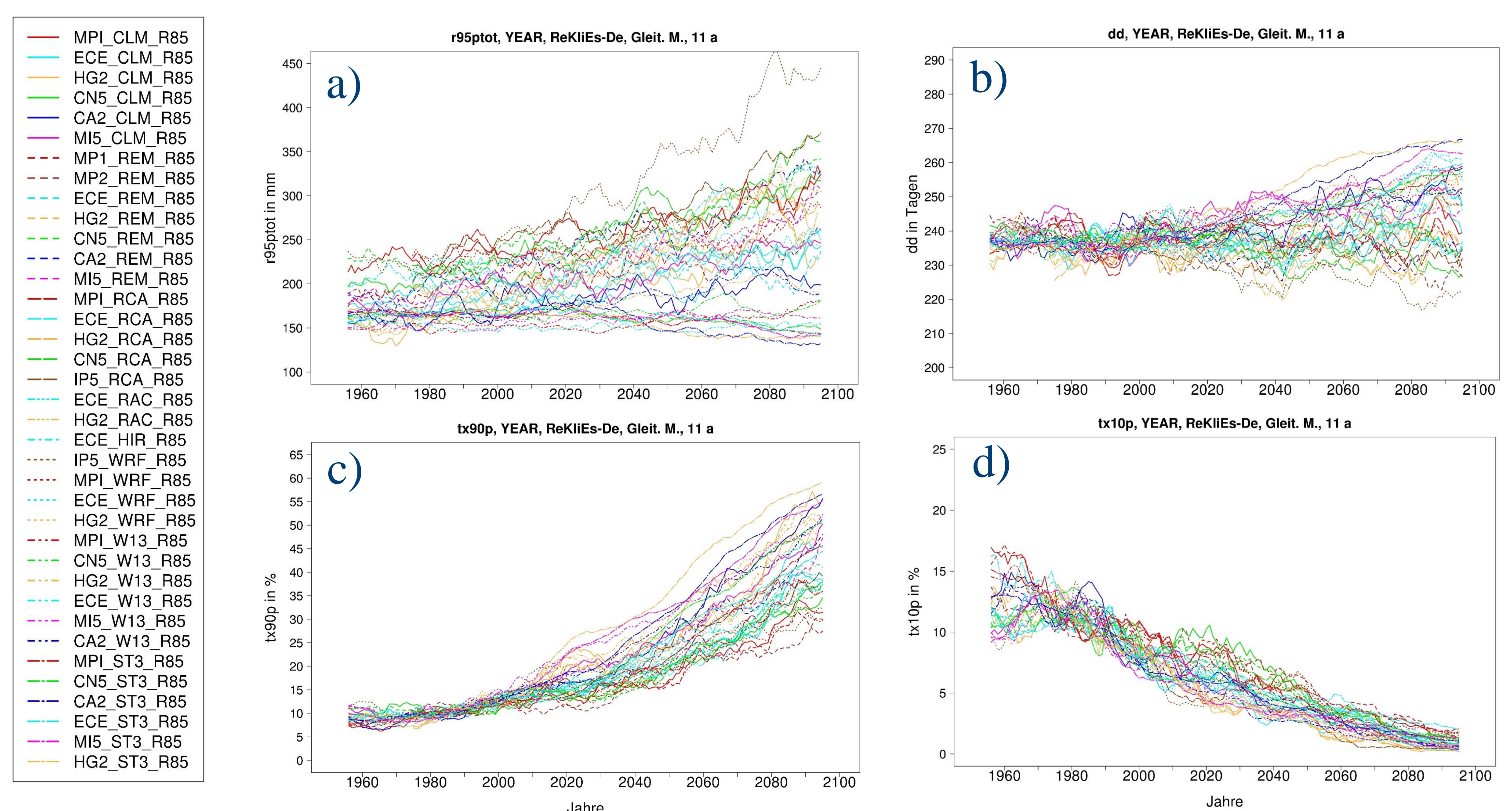


Figure 1: Climate indices based on pr (a and b) and tas (c and d) for different Ensemble members of RCP8.5 scenario for Germany with 11 yr running mean, compared to reference period 1971-2000. a) strong precipitation amount (daily precipitation above 95th percentile threshold in ref. period), b) number of dry days (days with precipitation < 1mm), c) frequency of warm days (percentage of days tasmax > 90th percentile of daily max. temp. In ref. period), d) frequency of cold days (same as c) but tasmax < 10th percentile).

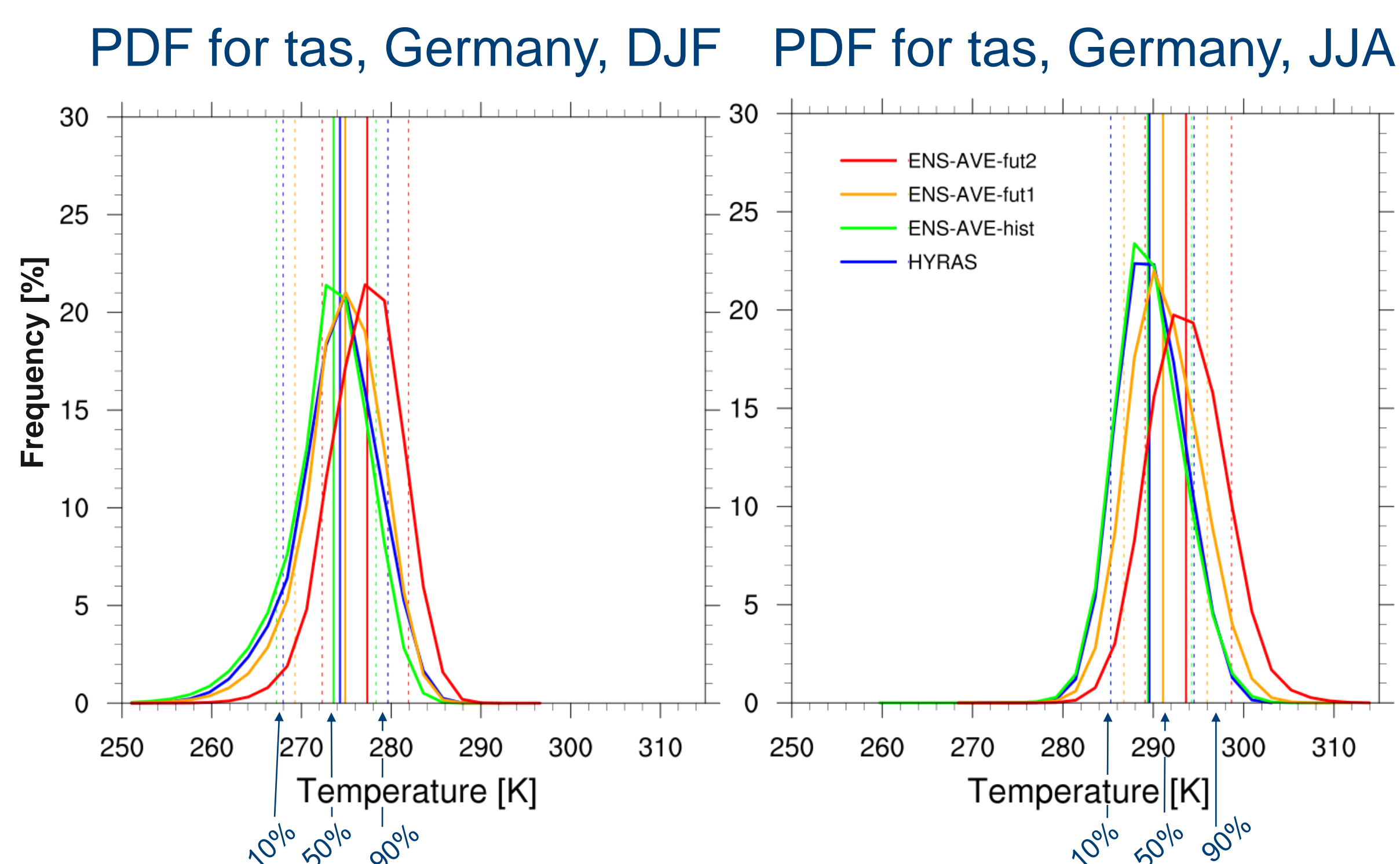


Figure 2: Probability density functions for temperature (tas) DJF (left) and JJA (right) for 1971-2000 from HYRAS (blue) and Model Ensemble mean PDF (green), and RCP8.5 Ensemble PDF for 2021-2050 (orange) and 2071-2100 (red). Median (solid) and the upper and lower 10% (dashed) indicated in respective colors.

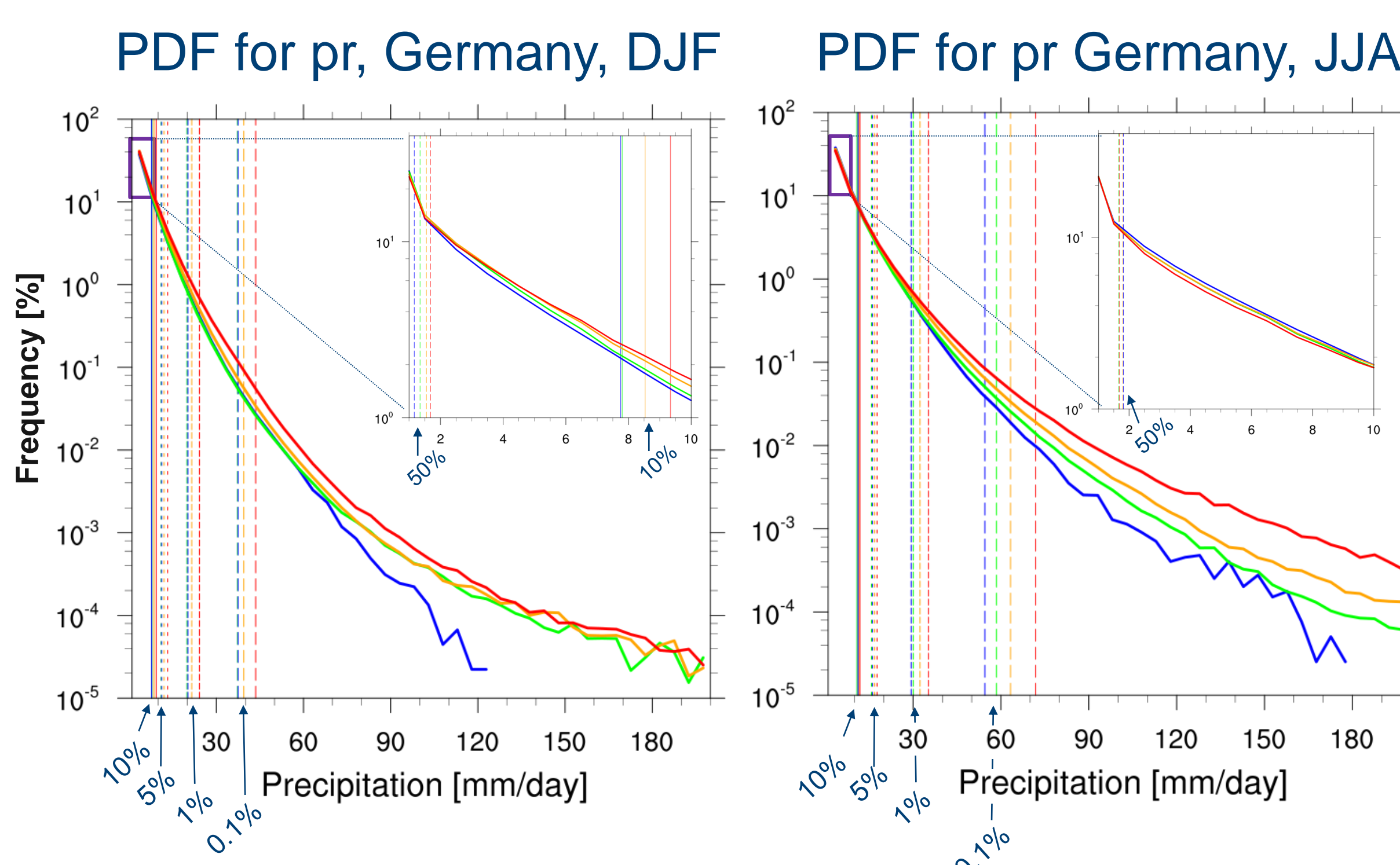


Figure 3: Probability density functions for precipitation (pr) DJF (left) and JJA (right) for 1971-2000 from HYRAS (blue) and Model Ensemble mean PDF (green), and RCP8.5 Ensemble PDF for 2021-2050 (orange) and 2071-2100 (red). 10% (solid), followed by 5%, 1% and 0.1% (dashed) indicated in respective colors.