

## Additional material

CMIP5 GCM	run	EURO-CORDEX RCM	version	Resolution
CNRM-CERFACS-CNRM-CM5	r1	SMHI-RCA4	v1	0.44
CNRM-CERFACS-CNRM-CM5	r1	SMHI-RCA4	v1	0.11
CNRM-CERFACS-CNRM-CM5	r1	HMS-ALADIN52	v1	0.44
CNRM-CERFACS-CNRM-CM5	r1	CNRM-ALADIN53	v1	0.44
CNRM-CERFACS-CNRM-CM5	r1	CNRM-ALADIN53	v1	0.11
CNRM-CERFACS-CNRM-CM5	r1	CNRM-ALADIN63	v2	0.11
CNRM-CERFACS-CNRM-CM5	r1	RMIB-UGent-ALARO-0	v1	0.44
CNRM-CERFACS-CNRM-CM5	r1	RMIB-UGent-ALARO-0	v1	0.11
CNRM-CERFACS-CNRM-CM5	r1	CLMcom-CCLM5-0-6	v1	0.44
CNRM-CERFACS-CNRM-CM5	r1	CLMcom-CCLM4-8-17	v1	0.11
CNRM-CERFACS-CNRM-CM5	r1	KNMI-RACMO22E	v2	0.11
CNRM-CERFACS-CNRM-CM5	r1	DMI-HIRHAM5	v1	0.11
CNRM-CERFACS-CNRM-CM5	r1	DMI-HIRHAM5	v2	0.11
ICHEC-EC-EARTH	r1	KNMI-RACMO22E	v1	0.44
ICHEC-EC-EARTH	r1	KNMI-RACMO22E	v1	0.11
ICHEC-EC-EARTH	r1	NUIM-WRF341E	v1	0.44
ICHEC-EC-EARTH	r1	DMI-HIRHAM5	v1	0.11
ICHEC-EC-EARTH	r3	DMI-HIRHAM5	v1	0.44
ICHEC-EC-EARTH	r3	DMI-HIRHAM5	v1	0.11
ICHEC-EC-EARTH	r3	DMI-HIRHAM5	v2	0.11
ICHEC-EC-EARTH	r3	SMHI-RCA4	v1	0.11
ICHEC-EC-EARTH	r3	KNMI-RACMO22E	v1	0.11
ICHEC-EC-EARTH	r12	SMHI-RCA4	v1	0.44
ICHEC-EC-EARTH	r12	SMHI-RCA4	v1	0.11
ICHEC-EC-EARTH	r12	CLMcom-CCLM5-0-6	v1	0.44
ICHEC-EC-EARTH	r12	CLMcom-CCLM4-8-17	v1	0.11
ICHEC-EC-EARTH	r12	KNMI-RACMO22E	v1	0.11
ICHEC-EC-EARTH	r12	DMI-HIRHAM5	v1	0.11
MPI-M-MPI-ESM-LR	r1	SMHI-RCA4	v1	0.44
MPI-M-MPI-ESM-LR	r1	SMHI-RCA4	v1a	0.11
MPI-M-MPI-ESM-LR	r1	CLMcom-CCLM4-8-17	v1	0.44
MPI-M-MPI-ESM-LR	r1	CLMcom-CCLM4-8-17	v1	0.11
MPI-M-MPI-ESM-LR	r1	MPI-CSC-REMO2009	v1	0.44
MPI-M-MPI-ESM-LR	r1	MPI-CSC-REMO2009	v1	0.11
MPI-M-MPI-ESM-LR	r1	CLMcom-CCLM5-0-6	v1	0.44
MPI-M-MPI-ESM-LR	r2	MPI-CSC-REMO2009	v1	0.11
MOHC-HadGEM2-ES	r1	SMHI-RCA4	v1	0.44
MOHC-HadGEM2-ES	r1	SMHI-RCA4	v1	0.11
MOHC-HadGEM2-ES	r1	KNMI-RACMO22E	v2	0.44
MOHC-HadGEM2-ES	r1	KNMI-RACMO22E	v2	0.11

MOHC-HadGEM2-ES	r1	CLMcom-CCLM5-0-6	v1	0.44
MOHC-HadGEM2-ES	r1	ICTP-RegCM4-3	v1	0.44
MOHC-HadGEM2-ES	r1	CLMcom-CCLM4-8-17	v1	0.11
MOHC-HadGEM2-ES	r1	DMI-HIRHAM5	v1	0.11
MOHC-HadGEM2-ES	r1	DMI-HIRHAM5	v2	0.11
IPSL-IPSL-CM5A-MR	r1	SMHI-RCA4	v1	0.44
IPSL-IPSL-CM5A-MR	r1	SMHI-RCA4	v1	0.11
IPSL-IPSL-CM5A-MR	r1	IPSL-IMERIS-WRF331F	v1	0.44
IPSL-IPSL-CM5A-MR	r1	IPSL-IMERIS-WRF331F	v1	0.11
IPSL-IPSL-CM5A-MR	r1	GERICS-REMO2015	v1	0.11
NCC-NorESM1-M	r1	SMHI-RCA4	v1	0.44
NCC-NorESM1-M	r1	SMHI-RCA4	v1	0.11
NCC-NorESM1-M	r1	GERICS-REMO2015	v1	0.11
NCC-NorESM1-M	r1	KNMI-RACMO22E	v1	0.11
NCC-NorESM1-M	r1	DMI-HIRHAM5	v2	0.11
NCC-NorESM1-M	r1	DMI-HIRHAM5	v3	0.11
NOAA-GFDL-GFDL-ESM2M	r1	SMHI-RCA4	v1	0.44
NOAA-GFDL-GFDL-ESM2G	r1	GERICS-REMO2015	v1	0.11
MIROC-MIROC5	r1	SMHI-RCA4	v1	0.44
MIROC-MIROC5	r1	CLMcom-CCLM5-0-6	v1	0.44
CCCma-CanESM2	r1	SMHI-RCA4	v1	0.44
CCCma-CanESM2	r1	UCAN-WRF341I	v2	0.44
CSIRO-QCCCE-CSIRO-Mk3-6-0	r1	SMHI-RCA4	v1	0.44

Table S1: Full list of EURO-CORDEX simulation data used, including institutions and detailed RCM model version.

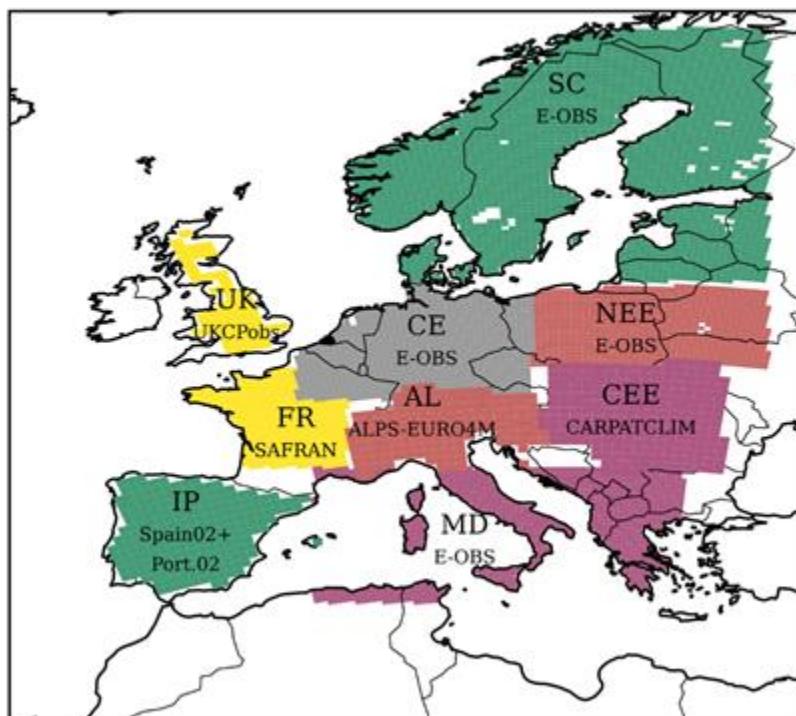


Figure S1: map showing the European regions used in this study. For the British Isles (BI), Iberian Peninsula (IP), France (FR), the Alps (AL) and the Carpathians (CA), we used the

national datasets (Table 3). The regions are therefore defined following the observations coverage. For the other regions, we used E-OBS and defined the regions following the PRUDENCE regions.

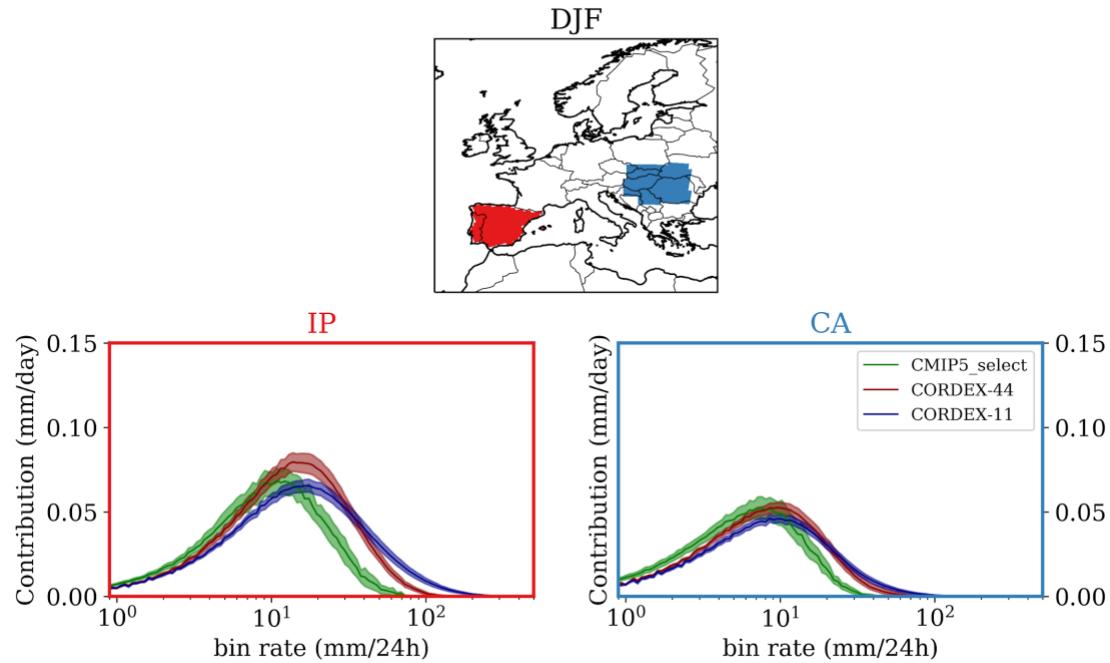


Fig. S2: Daily precipitation distribution in DJF over Iberian Peninsula (IP), Carpathians (CA) for a selection of CMIP5 GCMs (green), CORDEX-44 (red), CORDEX-11 (blue). All data are plotted on the models native grid.

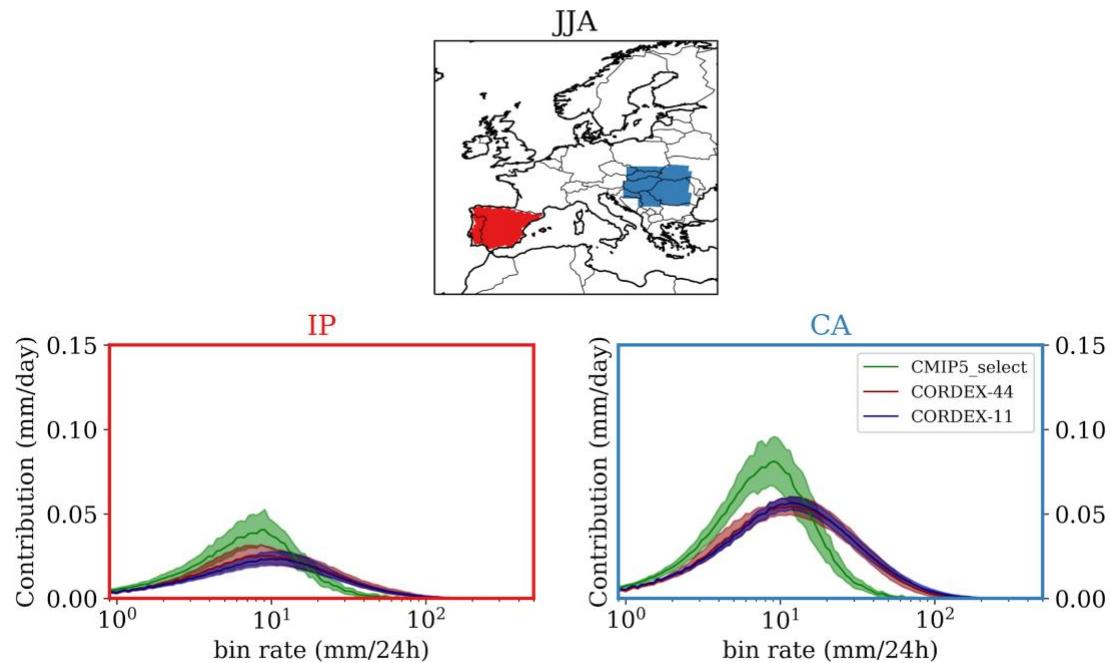


Fig. S3: Similar to Fig. S2 for JJA

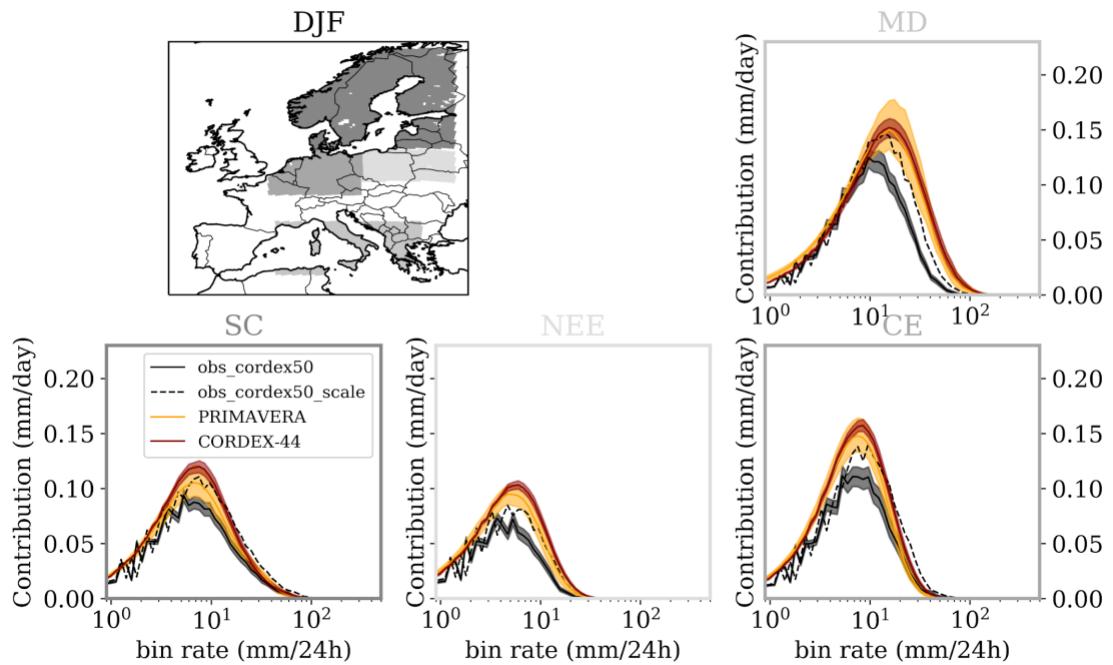


Figure S4: Same as Fig. 4 but for different sub-regions: Mediterranean (MD), Scandinavia (SC), North-eastern Europe (NEE), Central Europe (CE).

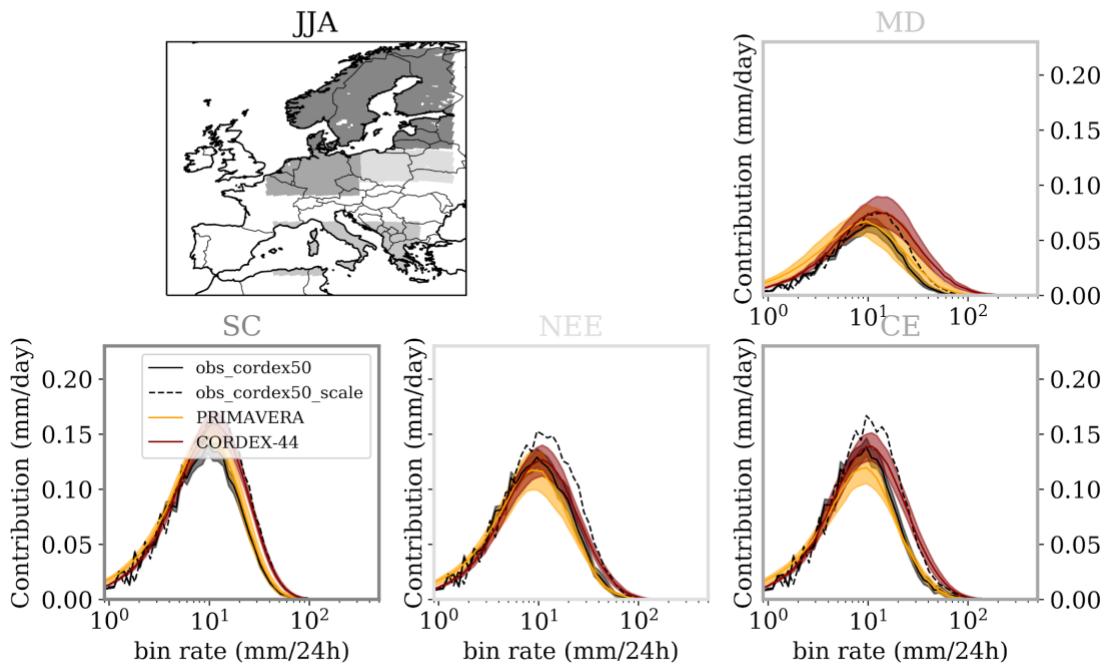


Figure S5: Same as Fig. S4 for June-August.

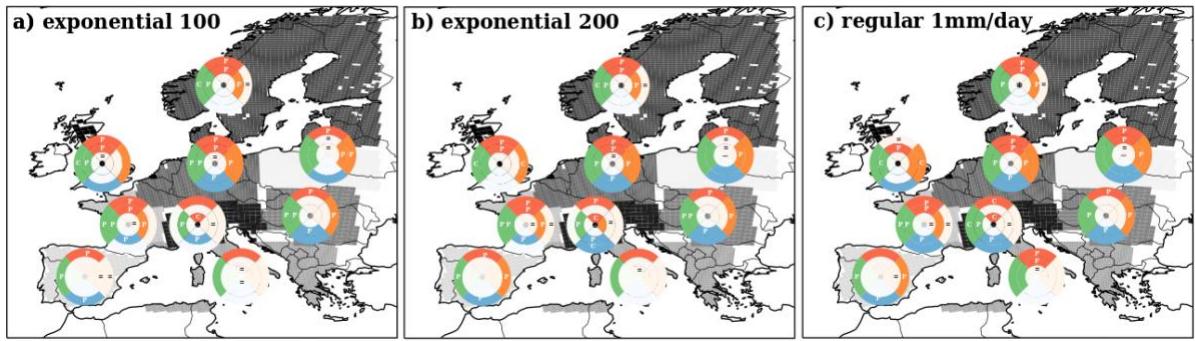


Figure S6: Sensitivity of the pie charts to the bin distribution. a) 100 exponential bins (method used in this study), b) 200 exponential bins, c) 1 mm/day regular bins.

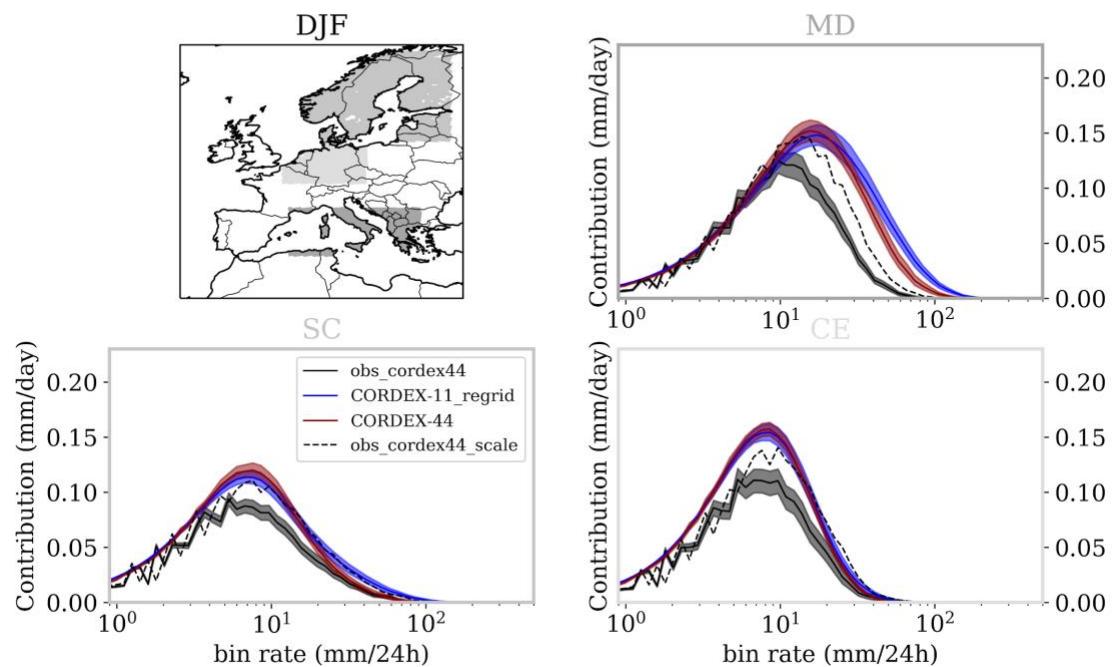


Fig. S7: Daily precipitation distribution in DJF over France (FR), Central Europe (CE), Mediterranean (MD), Scandinavian (SC) for CORDEX-44 (red), CORDEX-11 (blue) and observations. All data are computed on the CORDEX-44 grid.

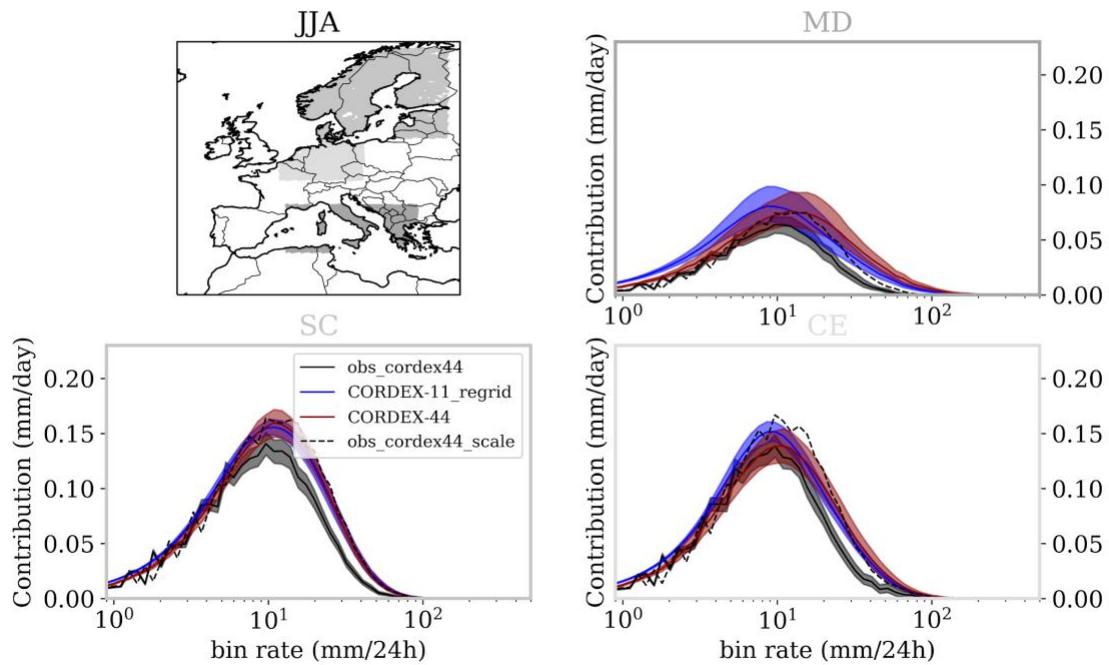


Fig. S8: Same as Fig S7 for JJA.

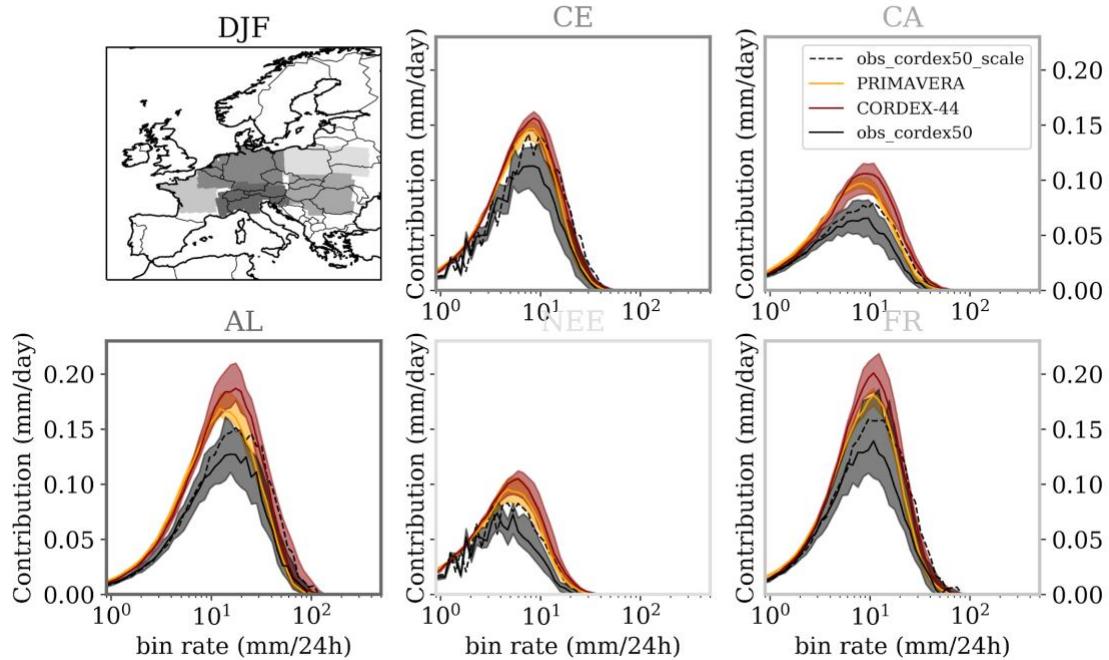


Figure S9: Precipitation contribution (frequency x bin rate) per rain rate in DJF over Central Europe (CE), Carpathians (CA), Alps (AL), North eastern Europe (NEE), France (FR) for CORDEX-44 (red, reduced ensemble), PRIMAVERA (orange, reduced ensemble), observations regridded on CORDEX-44 (black) and a synthetic observational dataset taking into account an additional 20% undercatch error (dashed line). The thick lines show the model ensemble median, the shaded colours show the ensemble spread based on an interquartile (25th-75th percentile) method.