Supplement to: Balanced estimate and uncertainty assessment of European climate change using the large EURO-CORDEX regional climate model ensemble

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1 Characteristics of the scenarios

Table S1. Characteristics of the scenarios of the EURO-CORDEX climate projection ensemble.

RCP	GCM	Member	RCM	Version
rcp85	CanESM2	r1i1p1	CCLM4-8-17	v1
rcp85	CanESM2	r1i1p1	REMO	v1
rcp26	CNRM-CM5	r1i1p1	ALADIN53	v1
rcp45	CNRM-CM5	r1i1p1	ALADIN53	v1
rcp85	CNRM-CM5	r1i1p1	ALADIN53	v1
rcp26	CNRM-CM5	r1i1p1	ALADIN63	v2
rcp45	CNRM-CM5	r1i1p1	ALADIN63	v2
rcp85	CNRM-CM5	r1i1p1	ALADIN63	v2
rcp26	CNRM-CM5	r1i1p1	ALARO-0	v1
rcp45	CNRM-CM5	r1i1p1	ALARO-0	v1
rcp85	CNRM-CM5	r1i1p1	ALARO-0	v1
rcp45	CNRM-CM5	r1i1p1	CCLM4-8-17	v1
rcp85	CNRM-CM5	r1i1p1	CCLM4-8-17	v1
rcp85	CNRM-CM5	r1i1p1	HIRHAM5	v2
rcp26	CNRM-CM5	r1i1p1	RACMO22E	v2
rcp45	CNRM-CM5	r1i1p1	RACMO22E	v2
rcp85	CNRM-CM5	r1i1p1	RACMO22E	v2
rcp45	CNRM-CM5	r1i1p1	RCA4	v1
rcp85	CNRM-CM5	r1i1p1	RCA4	v1
rcp85	CNRM-CM5	r1i1p1	REMO	v1
rcp85	CNRM-CM5	r1i1p1	WRF381P	v2
rcp26	EC-EARTH	r12i1p1	CCLM4-8-17	v1
rcp45	EC-EARTH	r12i1p1	CCLM4-8-17	v1
rcp85	EC-EARTH	r12i1p1	CCLM4-8-17	v1
rcp85	EC-EARTH	r12i1p1	HIRHAM5	v1
rcp26	EC-EARTH	r12i1p1	RACMO22E	v1
rcp45	EC-EARTH	r12i1p1	RACMO22E	v1
rcp85	EC-EARTH	r12i1p1	RACMO22E	v1
rcp26	EC-EARTH	r12i1p1	RCA4	v1
rcp45	EC-EARTH	r12i1p1	RCA4	v1
rcp85	EC-EARTH	r12i1p1	RCA4	v1
rcp26	EC-EARTH	r12i1p1	REMO	v1
rcp85	EC-EARTH	r12i1p1	REMO	v1
rcp85	EC-EARTH	r12i1p1	WRF361H	v1
rcp26	GFDL-ESM2G	r1i1p1	REMO	v1
rcp85	HadGEM2-ES	r1i1p1	ALADIN63	v1
rcp45	HadGEM2-ES	r1i1p1	CCLM4-8-17	v1
rcp85	HadGEM2-ES	r1i1p1	CCLM4-8-17	v1
rcp85	HadGEM2-ES	r1i1p1	HadREM3-GA7	v1
rcp45	HadGEM2-ES	r1i1p1	HIRHAM5	v2
rcp85	HadGEM2-ES	r1i1p1	HIRHAM5	v2
rcp26	HadGEM2-ES	r1i1p1	RACMO22E	v2
rcp45	HadGEM2-ES	r1i1p1	RACMO22E	v2
rcp85	HadGEM2-ES	r1i1p1	RACMO22E	v2
rcp26	HadGEM2-ES	r1i1p1	RCA4	v1
rcp45	HadGEM2-ES	r1i1p1	RCA4	v1
rcp85	HadGEM2-ES	r1i1p1	RCA4	v1
rcp26	HadGEM2-ES	r1i1p1	RegCM4-6	v1
rcp85	HadGEM2-ES	r1i1p1	RegCM4-6	v1
rcp26	HadGEM2-ES	r1i1p1	REMO	v1
rcp85	HadGEM2-ES	r1i1p1	REMO	v1
rcp85	HadGEM2-ES	r1i1p1	WRF361H	v1
rcp85	HadGEM2-ES	r1i1p1	WRF381P	v1
rcp85	IPSL-CM5A-MR	r1i1p1	RACMO22E	v1
rcp45	IPSL-CM5A-MR	r1i1p1	RCA4	v1
rcp85	IPSL-CM5A-MR	r1i1p1	RCA4	v1
rcp45	IPSL-CM5A-MR	r1i1p1	WRF381P	v1
rcp85	IPSL-CM5A-MR	r1i1p1	WRF381P	v1
rcp26	MIROC5	r1i1p1	CCLM4-8-17	v1
rcp85	MIROC5	r1i1p1	CCLM4-8-17	v1
rcp26	MIROC5	r1i1p1	REMO	v1
rcp85	MIROC5	r1i1p1	REMO	v1
rcp85	MIROC5	r1i1p1	WRF361H	v1
rcp26	MPI-ESM-LR	r1i1p1	CCLM4-8-17	v1
rcp45	MPI-ESM-LR	r1i1p1	CCLM4-8-17	v1
rcp85	MPI-ESM-LR	r1i1p1	CCLM4-8-17	v1
rcp85	MPI-ESM-LR	r1i1p1	COSMO-crCLIM	v1
rcp85	MPI-ESM-LR	r1i1p1	HIRHAM5	v1
rcp85	MPI-ESM-LR	r1i1p1	RACMO22E	v1
rcp26	MPI-ESM-LR	r1i1p1	RCA4	v1a
rcp45	MPI-ESM-LR	r1i1p1	RCA4	v1a
rcp85	MPI-ESM-LR	r1i1p1	RCA4	v1a
rcp85	MPI-ESM-LR	r1i1p1	RegCM4-6	v1
rcp26	MPI-ESM-LR	r1i1p1	REMO	v1
rcp45	MPI-ESM-LR	r1i1p1	REMO	v1
rcp85	MPI-ESM-LR	r1i1p1	REMO	v1
rcp26	MPI-ESM-LR	r1i1p1	WRF361H	v1
rcp85	MPI-ESM-LR	r1i1p1	WRF361H	v1
rcp85	NorESM1-M	r1i1p1	COSMO-crCLIM	v1
rcp45	NorESM1-M	r1i1p1	HIRHAM5	v2
rcp85	NorESM1-M	r1i1p1	HIRHAM5	v2
rcp85	NorESM1-M	r1i1p1	RACMO22E	v1
rcp26	NorESM1-M	r1i1p1	RCA4	v1
rcp85	NorESM1-M	r1i1p1	RCA4	v1
rcp26	NorESM1-M	r1i1p1	REMO	v1
rcp85	NorESM1-M	r1i1p1	REMO	v1
rcp85	NorESM1-M	r1i1p1	WRF381P	v1

2 Detailed description of the QUALYPSO method

In the QUALYPSO approach, each climate projection is decomposed into a smooth signal (the climate response) and a noise (internal variability). This so-called "time-series" approach (Hawkins and Sutton, 2009; Hingray and Saïd, 2014) first consists in extracting the climate response of each climate experiment from the raw projection. In QUALYPSO, cubic smoothing splines are used to extract the climate response for each simulation chain. Deviations from these climate responses are considered to be the result of internal variability. For each chain, the climate change response function is obtained from the differences between the climate responses obtained for different future periods and a reference period. The ensemble of climate change responses obtained for the different chains is used to assess the grand ensemble mean of projected changes and associated uncertainties. For further details on the method, we refer the reader to Evin et al. (2019). The four sequential steps can be summarized as follows:

1. The first step is related to the extraction of the climate responses and the estimation of the internal variability.

2. The second step is related to the computation of the climate change responses (i.e. anomalies).

3. The third step is an ANalysis Of VAriance (ANOVA): the ensemble of climate change responses is decomposed using an additive model composed of a grand mean and main effects.

4. The fourth step further decomposes the remaining variability into interaction effects and residual variability.

In this study, we consider an ensemble of simulation chains where each chain corresponds to a given GCM/RCM combination for a given emission scenario (RCP). For a RCM i, GCM j and scenario k, $Y_{i,j,k}(t)$ denotes the raw climate projections of the climate variable (temperature, precipitation) for a given time t. The EURO-CORDEX climate projection ensemble described in Table S1 is made of $n_o = 87$ experiments corresponding to different simulation chains. The number of available experiments is smaller than the total number of possible climate "experiments" (denoted by n), that would correspond to all possible combinations of the different scenarios/models considered here. In this study, there are $n = 351$ possible combinations ($I = 13$ different RCMs times $J = 9$ different GCMs times $K = 3$ different RCPs), and $n_m = 264$ combinations are thus missing.

2.1 Step 1: Extraction of the climate responses

For each simulation chain, the raw climate projections $Y_{i,j,k}(t)$ can be expressed as:

$$Y_{i,j,k}(t) = \phi_{i,j,k}(t) + \eta_{i,j,k}(t), \tag{S1}$$

where $\phi_{i,j,k}(t)$ is the climate response for this simulation chain and $\eta_{i,j,k}(t)$ is the deviation from the climate response, as a result of internal variability. In this paper, the climate response $\phi_{i,j,k}(t)$ is obtained by fitting a cubic spline to the time series $Y_{i,j,k}(t)$ (Evin et al., 2019).

2.2 Step 2: Computation of the change variables

As in most climate impact studies, uncertainty sources are quantified from change variables, obtained as differences between a future and a reference period. The change variable can be defined in terms of absolute changes $Y^*_{i,j,k}(t) = Y_{i,j,k}(t) - \phi_{i,j,k}(c)$ (e.g. for temperature), or in terms of relative changes $Y^*_{i,j,k}(t) = Y_{i,j,k}(t)/\phi_{i,j,k}(c) - 1$ (e.g. for precipitation), where $\phi_{i,j,k}(c)$ is the value of the climate response for the reference period $c = 1981 - 2010$. In both cases, the change variable $Y^*_{i,j,k}(t)$ can be split up into $Y^*_{i,j,k}(t) = \phi^*_{i,j,k}(t) + \eta^*_{i,j,k}(t)$ where $\phi^*_{i,j,k}(t)$ is the climate change response for this simulation chain and time t, and $\eta^*_{i,j,k}(t)$ is the deviation from the climate change response, as a result of internal variability.

2.3 Step 3: Decomposition of the climate change responses

This study aims at applying an ANOVA decomposition to the climate change response $\phi^*_{i,j,k}(t)$ in order to obtain the part of its variability corresponding to the different components (RCMs, GCMs, etc.). In QUALYPSO, the climate change response is expressed as the sum of the grand mean, the main effects, and a residual term, i.e.:

$$\phi^*_{i,j,k}(t) = \mu(t) + \alpha_i(t) + \beta_j(t) + \gamma_k(t) + \xi_{i,j,k}(t), \tag{S2}$$

where

- $\mu(t)$ is the ensemble mean climate change response, shared by all simulation chains,
- $\alpha_i(t)$, $\beta_j(t)$ and $\gamma_k(t)$ are the main effects corresponding to the type of RCM, GCM and emission scenario, respectively,
- $\xi_{i,j,k}(t) = \phi^*_{i,j,k}(t) - \mu(t) - \alpha_i(t) - \beta_j(t) - \gamma_k(t)$ is a residual term which represents the part of the climate change response that cannot be explained by the sum of the ensemble mean and the main effects.

The QUALYPSO approach (Evin et al., 2019) consists in estimating the different terms of Eq. S2 (grand mean $\mu(t)$ and the main effects $\alpha_i(t)$, $\beta_j(t)$ and $\gamma_k(t)$) using a Bayesian framework and data augmentation. Missing climate projections are part of the inference and the posterior distributions of all unknown quantities (grand mean, main effects and missing climate projections) are sampled sequentially using the Gibbs algorithm. In this study, the mean of the posterior distributions are taken as estimates and are denoted by $\hat{\mu}(t)$ for the grand mean, and $\hat{\alpha}_i(t)$, $\hat{\beta}_j(t)$ and $\hat{\gamma}_k(t)$ for the main effects. The mean expected change BM_k for each scenario k and time t is the sum of the ensemble mean climate change response $\hat{\mu}(t)$ and the scenario effect:

$$BM_k = \hat{\mu}(t) + \hat{\gamma}_k(t). \tag{S3}$$

2.4 Step 4: Residual variability and interaction effects

The residual term $\xi_{i,j,k}(t)$ in Eq. (S2) characterizes the part of the climate change response which is not the result of a systematic effect of RCM and GCM models, or of the emission scenario (so-called main effects). This variability can be due to interactions between the emission scenarios and the climate models (RCP/GCM, RCP/RCM) or between the climate models (GCM/RCM). For complete ensembles, these interactions can be estimated using all simulation chains corresponding to a specific combination (see, e.g. Déqué et al., 2007; Yip et al., 2011). The last remaining variability is related to interactions RCM/GCM/RCP, which can be estimated using different replicates of the simulation chains (Yip et al., 2011) or by making additional assumptions, e.g. by considering residual terms corresponding to successive years as replicates (Christensen and Kjellström, 2020). Northrop and Chandler (2014) note that direct estimates of these interactions are often biased. In our case, only one member of each simulation chain is available, and the QUALYPSO approach cannot be considered to estimate the very large number of possible interaction effects. For example, the data augmentation approach would consist in estimating $I \times J = 117$ additional terms for GCM/RCM interactions, which is not feasible considering that only $n_o = 87$ simulation chains are available.

In this study, we assess the variability related to the three types of interactions (RCM/GCM, RCM/RCP, GCM/RCP) by applying an additional decomposition of residual terms $\xi_{i,j,k}(t)$. The remaining variability (interactions RCM/GCM/RCP) is considered as the residual variability. Heuristic estimates of interaction effects and residual variability are obtained as follows:

- For all available simulation chains, we first obtain residual terms as

$$\hat{\xi}_{i,j,k}(t) = \phi^*_{i,j,k}(t) - \hat{\mu}(t) - \hat{\alpha}_i(t) - \hat{\beta}_j(t) - \hat{\gamma}_k(t).$$

- When at least $K_{ij} = 2$ simulation chains are available for a RCM i and a GCM j (i.e. at least for two emission scenarios), the interaction effect is estimated by

$$\hat{\kappa}_{ij}(t) = \frac{1}{K_{ij}} \sum_{k=1}^{K_{ij}} \hat{\xi}_{i,j,k}(t)^2.$$

  We can thus estimate $n_{IJ} = 27$ RCM /GCM interaction effects corresponding to different combinations of RCM and GCM models. Similarly, we estimate $n_{IK} = 18$ RCM /RCP interaction effects $\hat{\psi}_{ik}(t)$ and $n_{JK} = 19$ GCM /RCP interaction effects $\hat{\omega}_{jk}(t)$. If only one simulation chain is available, the interaction effect is not estimated and is set to zero.

- Finally, remaining residual terms are obtained as

$$\hat{\nu}_{i,j,k}(t) = \hat{\xi}^*_{i,j,k}(t) - \hat{\kappa}_{ij}(t) - \hat{\psi}_{ik}(t) - \hat{\omega}_{jk}(t).$$

It must be acknowledged that these estimates of interaction effects suffer from several limitations. First, these estimates rely on a few simulation chains. Second, we can only estimate a small proportion of all possible interactions (for example $n_{IJ} = 27$ RCM /GCM interaction effects among the $I \times J = 117$ possible GCM/RCM combinations). However, it provides an interesting approximation of the magnitude of these interactions relatively to the other ones.

2.5 Total variance and variance components

In this study, we aim at characterizing the total variance and its decomposition as a function of time. For each time t, since $Y^*_{i,j,k}(t) = \phi^*_{i,j,k}(t) + \eta^*_{i,j,k}(t)$, if $\phi^*_{i,j,k}(t)$ and $\eta^*_{i,j,k}(t)$ are assumed to be independent, the total variance of the change variable

$Y^*_{i,j,k}(t)$ is:

$$\mathbb{V}ar\left[Y^*_{i,j,k}(t)\right] = \mathbb{V}ar\left[\phi^*_{i,j,k}(t)\right] + \mathbb{V}ar\left[\eta^*_{i,j,k}(t)\right], \tag{S4}$$

where $\mathbb{V}ar\left[\phi^*_{i,j,k}(t)\right]$ is the total variance related to the climate change response and $\mathbb{V}ar\left[\eta^*_{i,j,k}(t)\right]$ characterizes the internal variability of the change variable. Internal variability $\mathbb{V}ar\left[\eta^*_{i,j,k}(t)\right]$ is considered constant and does not depend on time (see Eq. S10 below).

The variance of the climate change response $\phi^*_{i,j,k}(t)$, for any given time t, is the sum of the variance of the different uncertainty components in Eq. (S2):

$$\mathbb{V}ar\left[\phi^*_{i,j,k}(t)\right] = \mathbb{V}ar\left[\alpha_i(t)\right] + \mathbb{V}ar\left[\beta_j(t)\right] + \mathbb{V}ar\left[\gamma_k(t)\right] + \mathbb{V}ar\left[\xi_{i,j,k}\right], \tag{S5}$$

where $\mathbb{V}ar\left[\alpha_i(t)\right]$, $\mathbb{V}ar\left[\beta_j(t)\right]$ and $\mathbb{V}ar\left[\gamma_k(t)\right]$ describe the dispersion between the main RCM, GCM and RCP effects and are estimated by:

$$\widehat{\mathbb{V}ar}\left[\alpha_i(t)\right] = \frac{1}{I}\sum_i [\hat{\alpha}_i(t)]^2, \tag{S6}$$

$$\widehat{\mathbb{V}ar}\left[\beta_j(t)\right] = \frac{1}{J}\sum_j [\hat{\beta}_j(t)]^2, \tag{S7}$$

$$\widehat{\mathbb{V}ar}\left[\gamma_k(t)\right] = \frac{1}{K}\sum_k [\hat{\gamma}_k(t)]^2. \tag{S8}$$

The variability $\mathbb{V}ar\left[\xi_{i,j,k}\right]$ (so-called residual variability in Evin et al., 2019) is estimated by

$$\widehat{\mathbb{V}ar}\left[\xi(t)\right] = \frac{1}{n_o}\sum_{\{i,j,k\}^o} \hat{\xi}_{i,j,k}(t)^2,$$

where $\{i,j,k\}^o$ is the ensemble of available simulation chains. This variability will be further decompose below using estimates of interaction effects.

For each scenario k and time t, the following scenario-excluded uncertainty BU can be used to assess the uncertainty related to the mean expected change BM_k:

$$BU = \sqrt{\widehat{\mathbb{V}ar}\left[Y^*_{i,j,k}(t)\right] - \widehat{\mathbb{V}ar}\left[\gamma_k(t)\right]}. \tag{S9}$$

Finally, the variability $\mathbb{V}ar\left[\xi_{i,j,k}\right]$ is the variability of the climate change response that cannot be explained by the variability of the main RCM, GCM and RCP effects. It is further discomposed into the uncertainty components $\widehat{\mathbb{V}ar}\left[\kappa_{ij}(t)\right]$, $\widehat{\mathbb{V}ar}\left[\psi_{ik}(t)\right]$, $\widehat{\mathbb{V}ar}\left[\omega_{jk}(t)\right]$ corresponding to the interaction effects RCM/GCM, RCM/RCP and GCM/RCP respectively, and a residual variability $\widehat{\mathbb{V}ar}\left[\nu(t)\right]$:

$$\widehat{\mathbb{V}ar}\big[\kappa_{ij}(t)\big] = C \times \text{var}[\hat{\kappa}_{ij}(t)],$$
$$\widehat{\mathbb{V}ar}\big[\psi_{ik}(t)\big] = C \times \text{var}[\hat{\psi}_{ik}(t)],$$
$$\widehat{\mathbb{V}ar}\big[\omega_{jk}(t)\big] = C \times \text{var}[\hat{\omega}_{jk}(t)],$$
$$\widehat{\mathbb{V}ar}\big[\nu(t)\big] = C \times \text{var}[\hat{\nu}_{i,j,k}(t)],$$

where var is the standard empirical variance and C is a constant term that weights the different variance terms so that $\widehat{\mathbb{V}ar}\big[\kappa_{ij}(t)\big] + \widehat{\mathbb{V}ar}\big[\psi_{ik}(t)\big] + \widehat{\mathbb{V}ar}\big[\omega_{jk}(t)\big] + \widehat{\mathbb{V}ar}\big[\nu(t)\big] = \widehat{\mathbb{V}ar}\big[\xi(t)\big]$. This scaling is applied in order to preserve the variability $\mathbb{V}ar\big[\xi_{i,j,k}\big]$ obtained with QUALYPSO. Indeed, due to the limitations in the estimates of the interaction effects (limited number of terms, unequal number of climate chains for each estimate, not centered on zero), C is generally less than one, and without this scaling, it would result to an inflation of the total uncertainty.

Internal variability of each climate chain corresponds to the variance of the deviations $\eta^*_{i,j,k}(t)$ from the climate change response, obtained for each simulation chain. The internal variability component of the ensemble is estimated as the multi-chain mean (over the n_o available chains) of the variances :

$$\widehat{\mathbb{V}ar}\big(\eta^*_{i,j,k}\big) = \frac{1}{n_o} \sum_{\{i,j,k\}^o} \frac{1}{n_t} \sum_t \eta^*_{i,j,k}(t)^2, \tag{S10}$$

where n_t corresponds to the length of the simulation chain. In Eq. (S10), internal variability is averaged over time and the resulting estimate $\widehat{\mathbb{V}ar}\big(\eta^*_{i,j,k}\big)$ is thus considered constant. This assumption could be easily relaxed in case of evidences toward an increase/decrease of the internal variability in the ensemble.

3 Interactions and residual variability

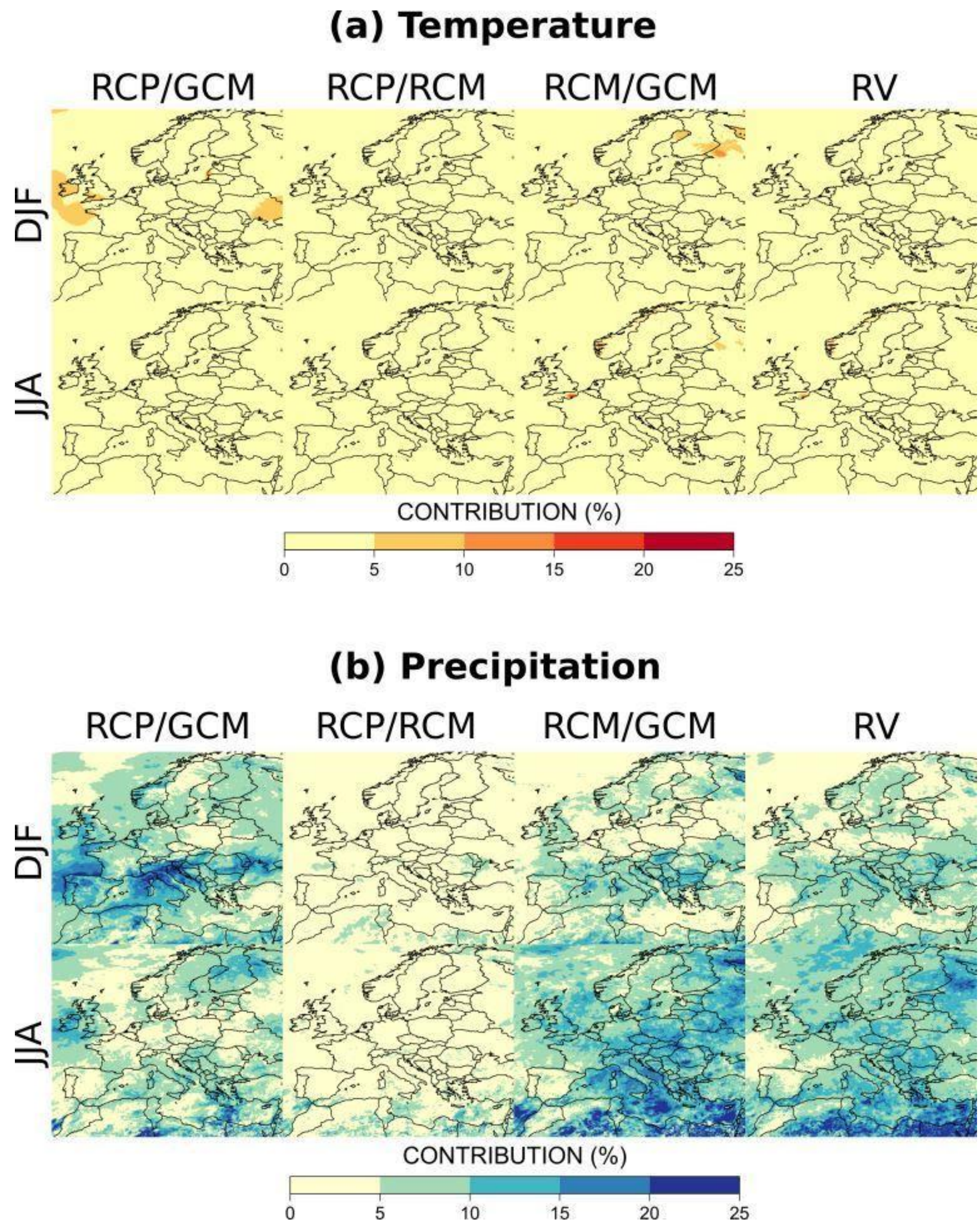

Figure S1. Fraction of total variance explained by interactions: RCP/GCM, RCP/RCM and RCM/GCM, and residual variability (RV) for (a) absolute temperature changes and (b) relative precipitation changes, at the end of the twenty-first century (2071-2099) compared to the period 1981-2010.

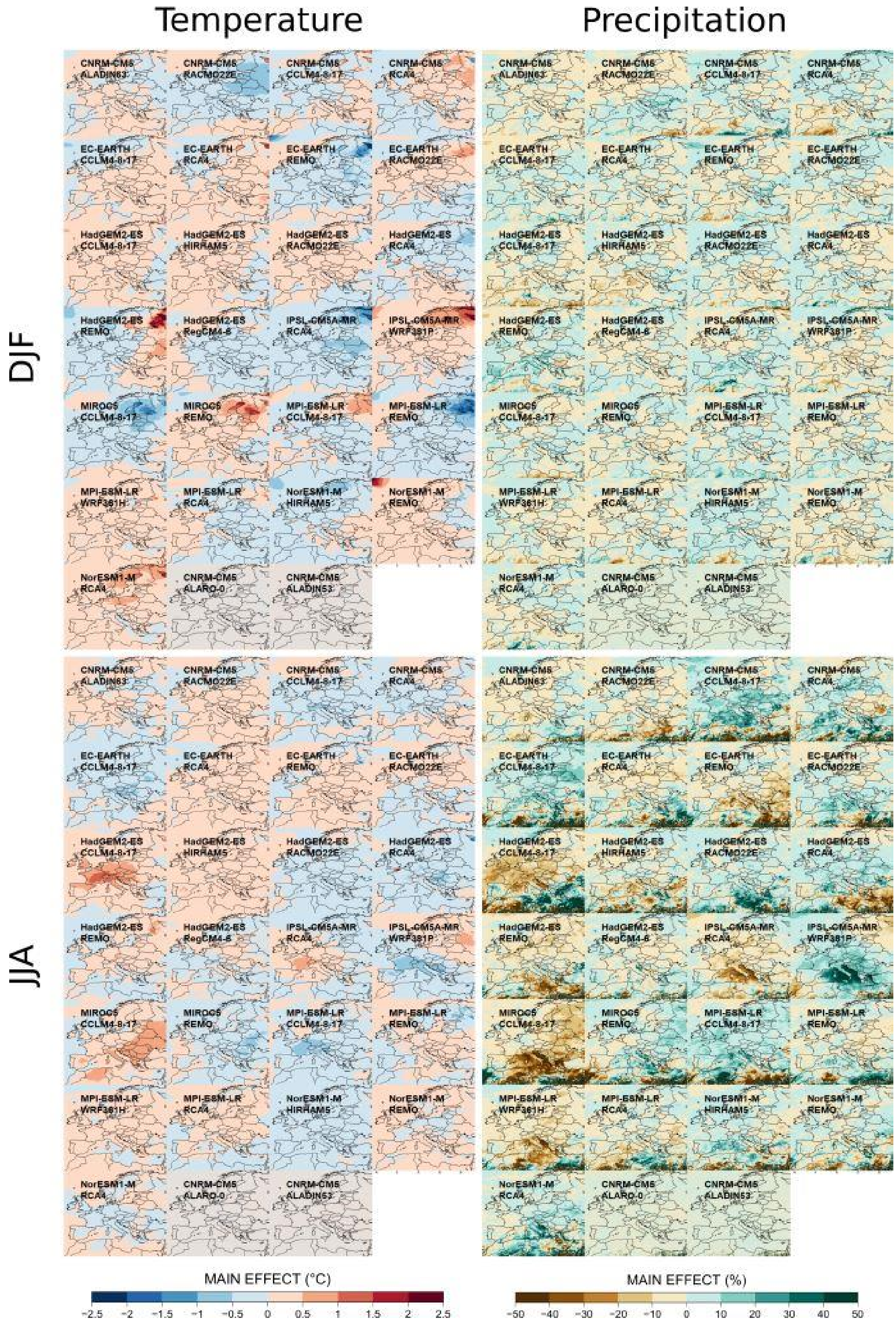

Figure S2. Estimated GCM/RCM interaction effects for absolute temperature (left) and relative precipitation changes (right) in winter (DJF) and summer (JJA), at the end of the twenty-first century (2071-2099) compared to the period 1981-2010.

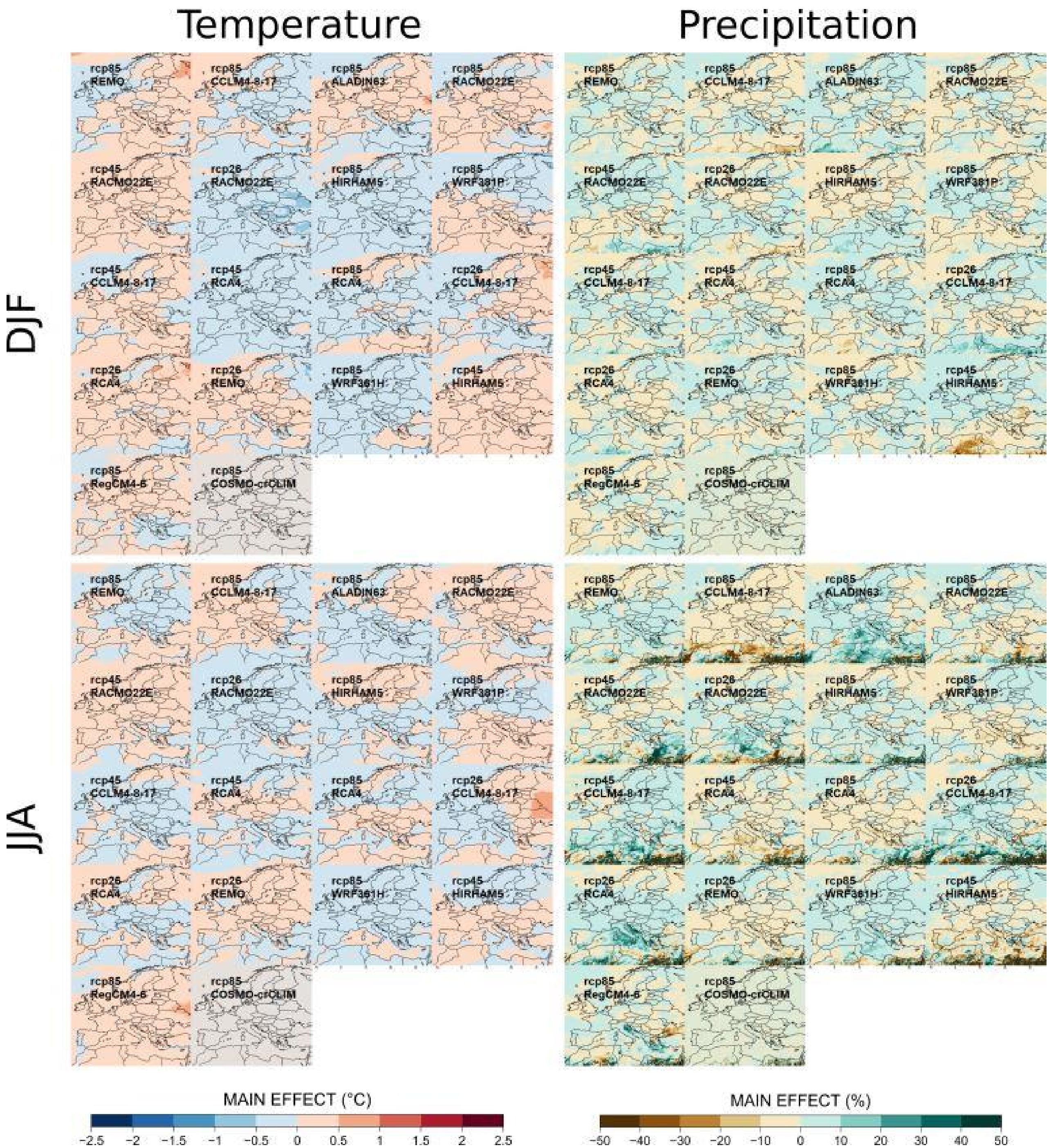

Figure S3. Estimated RCP/RCM interaction effects for absolute temperature (left) and relative precipitation changes (right) in winter (DJF) and summer (JJA), at the end of the twenty-first century (2071-2099) compared to the period 1981-2010.

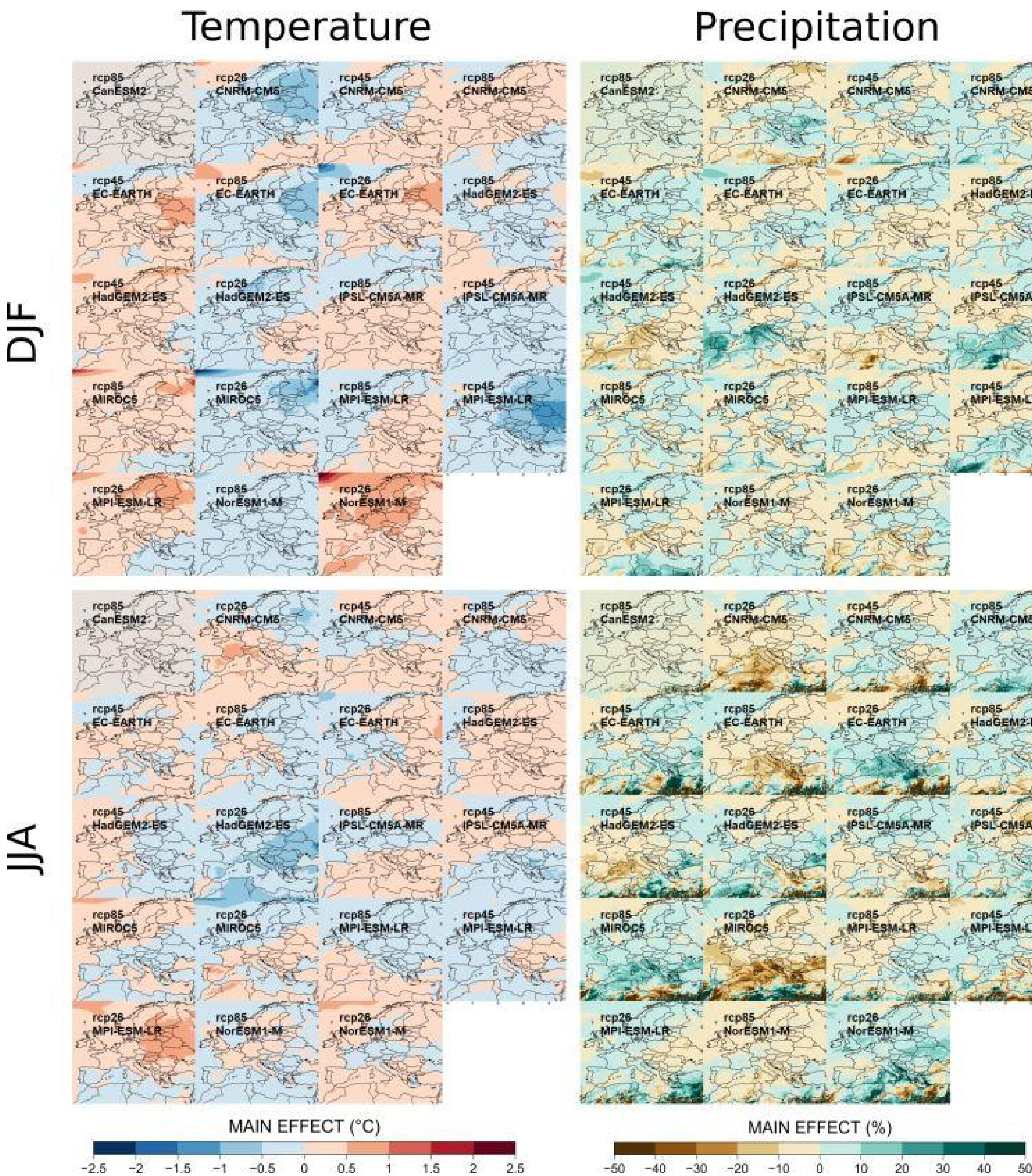

Figure S4. Estimated RCP/GCM interaction effects for absolute temperature (left) and relative precipitation changes (right) in winter (DJF) and summer (JJA), at the end of the twenty-first century (2071-2099) compared to the period 1981-2010.

4 Main results for the countries of the domain

Table S2. Mean expected change response BM_k, scenario-excluded uncertainty BU and partition of the total uncertainty for the countries of the domain, for absolute changes of mean temperature in winter (DJF) in the near future (2021-2050) compared to the period 1981-2010. I1, I2 and I3 refer to interactions RCM/GCM, RCP/RCM and RCP/GCM, respectively. IV and RV refer to internal and residual variability, respectively. Absolute mean expected changes greater than the uncertainty ($|BU/BM| > 1$) are indicated in bold font.

BM_k and BU (°C)					% Total variance							
Country	RCP			BU	Main effects			Inter.				
	2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3	IV	RV
Algeria	**0.8**	**1.0**	**1.3**	0.3	21	24	39	2	1	4	7	2
Albania	**0.8**	**1.1**	**1.3**	0.4	13	47	21	1	1	6	9	2
Bosnia and H.	**0.9**	**1.2**	**1.4**	0.4	16	37	21	3	1	7	11	3
Bulgaria	**0.8**	**1.1**	**1.4**	0.4	15	35	21	2	1	9	13	3
Cyprus	**0.8**	**0.9**	**1.2**	0.3	3	52	27	1	1	6	8	1
Denmark	**0.6**	**0.9**	**1.1**	0.3	4	44	29	5	1	4	12	1
Ireland	**0.4**	**0.6**	**0.8**	0.3	8	50	27	2	0	2	10	1
Estonia	**1.1**	**1.3**	**1.7**	0.6	13	42	15	8	1	4	14	3
Austria	**0.8**	**1.1**	**1.4**	0.4	13	40	24	5	1	5	9	3
Czech Rep.	**0.8**	**1.1**	**1.4**	0.4	11	35	25	7	1	6	12	3
Finland	**1.5**	**1.9**	**2.4**	0.7	14	47	18	8	0	3	8	2
France	**0.6**	**0.9**	**1.1**	0.3	7	42	30	4	0	5	10	2
Germany	**0.7**	**1.0**	**1.2**	0.4	4	42	26	7	1	6	11	3
Greece	**0.8**	**1.0**	**1.2**	0.3	8	50	22	1	1	7	10	2
Croatia	**0.8**	**1.1**	**1.4**	0.4	13	38	22	5	1	7	12	3
Hungary	**0.9**	**1.2**	**1.4**	0.4	19	30	22	5	1	6	13	3
Israel	**0.9**	**1.0**	**1.2**	0.3	7	55	23	1	1	4	8	1
Italy	**0.8**	**1.0**	**1.3**	0.3	11	47	27	2	1	4	7	2
Jordan	**0.9**	**1.0**	**1.3**	0.3	10	54	22	1	1	4	7	1
Lebanon	**1.0**	**1.1**	**1.4**	0.4	8	55	20	1	1	5	9	1
Latvia	**1.0**	**1.3**	**1.6**	0.5	10	37	18	8	1	5	17	3
Belarus	**1.0**	**1.3**	**1.6**	0.5	10	35	19	8	1	5	18	3
Lithuania	**0.9**	**1.2**	**1.5**	0.5	9	40	17	8	2	5	16	3
Slovakia	**0.9**	**1.2**	**1.5**	0.4	19	29	25	6	1	6	12	3
Macedonia	**0.8**	**1.1**	**1.4**	0.4	17	37	22	2	0	8	11	3
Morocco	**0.8**	**1.0**	**1.4**	0.3	10	34	43	1	1	4	7	2
Netherlands	**0.6**	**0.8**	**1.1**	0.3	5	41	26	6	1	7	12	3
Norway	**1.0**	**1.3**	**1.7**	0.5	10	44	28	3	1	4	9	1
Poland	**0.8**	**1.1**	**1.4**	0.4	7	38	22	8	2	6	14	3
Portugal	**0.6**	**0.8**	**1.0**	0.2	4	47	33	2	1	3	8	1
Romania	**0.9**	**1.2**	**1.5**	0.4	20	28	23	3	1	7	14	4
Moldova	**1.0**	**1.3**	**1.5**	0.4	19	25	22	5	2	6	18	4
Slovenia	**0.8**	**1.1**	**1.4**	0.4	12	37	24	6	1	6	11	3
Spain	**0.7**	**0.9**	**1.1**	0.2	6	47	34	2	1	2	7	1
Sweden	**1.1**	**1.4**	**1.8**	0.5	12	45	24	5	1	4	8	2
Switzerland	**0.8**	**1.1**	**1.3**	0.4	13	43	25	4	1	4	8	2
Tunisia	**0.8**	**1.0**	**1.2**	0.3	12	42	31	2	1	4	8	1
Turkey	**1.0**	**1.2**	**1.4**	0.4	14	50	18	1	1	5	9	1
UK	**0.5**	**0.7**	**0.9**	0.3	7	45	31	4	0	3	9	1
Ukraine	**1.0**	**1.3**	**1.5**	0.4	13	35	18	4	1	6	19	3

Table S3. Absolute changes of mean temperature in winter (DJF) at the end of the century (2071-2099) compared to the period 1981-2010 (see legend of Table S2 for further details).

BM_k and BU (°C)					% Total variance							
Country	RCP			BU	Main effects			Inter.				
	2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3	IV	RV
Algeria	**1.2**	**1.8**	**3.5**	0.6	6	15	75	1	1	1	1	1
Albania	**1.3**	**2.0**	**3.4**	0.8	5	33	57	1	1	1	1	1
Bosnia and H.	**1.4**	**2.2**	**3.7**	0.8	5	31	56	1	1	2	2	1
Bulgaria	**1.4**	**2.1**	**3.7**	0.8	6	26	60	1	1	3	2	1
Cyprus	**1.2**	**1.8**	**3.3**	0.6	1	29	67	0	0	1	1	0
Denmark	**0.7**	**1.8**	**3.1**	0.7	2	22	68	2	0	4	1	1
Ireland	0.4	**1.2**	**2.2**	0.5	3	17	70	2	1	5	1	1
Estonia	1.2	**2.7**	**4.5**	1.3	7	31	52	2	1	4	2	2
Austria	**1.1**	**2.1**	**3.6**	0.8	5	22	65	2	1	2	1	1
Czech Rep.	**1.1**	**2.1**	**3.7**	0.8	6	21	64	2	1	3	1	2
Finland	**1.9**	**3.6**	**5.7**	1.6	8	38	47	2	0	2	1	1
France	**0.8**	**1.6**	**2.9**	0.5	3	16	73	1	1	4	1	1
Germany	**0.9**	**1.9**	**3.3**	0.7	3	22	66	2	1	4	1	1
Greece	**1.3**	**1.9**	**3.3**	0.7	3	33	60	0	1	2	1	1
Croatia	**1.3**	**2.1**	**3.6**	0.8	5	27	60	1	1	3	2	1
Hungary	**1.3**	**2.2**	**3.7**	0.8	8	24	59	2	1	3	2	2
Israel	**1.4**	**1.9**	**3.5**	0.7	3	31	63	0	0	1	1	1
Italy	**1.1**	**2.0**	**3.4**	0.6	3	25	67	1	1	1	1	1
Jordan	**1.5**	**2.0**	**3.8**	0.7	4	29	64	0	0	1	1	1
Lebanon	**1.5**	**2.2**	**3.8**	0.8	3	34	59	0	0	1	1	1
Latvia	1.1	**2.5**	**4.4**	1.2	6	29	54	2	1	5	2	2
Belarus	**1.2**	**2.5**	**4.5**	1.2	8	25	57	2	1	4	2	2
Lithuania	1.1	**2.4**	**4.3**	1.2	6	28	55	2	1	5	2	2
Slovakia	**1.2**	**2.2**	**3.8**	0.9	8	23	61	2	1	2	1	2
Macedonia	**1.4**	**2.1**	**3.6**	0.8	7	28	59	1	1	2	1	1
Morocco	**1.1**	**1.9**	**3.6**	0.5	4	11	81	0	0	2	1	1
Netherlands	**0.7**	**1.6**	**2.9**	0.6	3	17	70	2	1	4	1	1
Norway	**1.2**	**2.6**	**4.3**	1.0	6	29	60	1	0	2	1	1
Poland	**1.0**	**2.1**	**3.8**	1.0	5	26	59	2	1	4	2	2
Portugal	**0.7**	**1.4**	**2.6**	0.4	2	14	79	1	0	2	1	1
Romania	**1.4**	**2.2**	**3.9**	0.8	9	22	61	1	1	3	2	1
Moldova	**1.5**	**2.4**	**4.2**	0.9	11	19	59	2	1	4	2	2
Slovenia	**1.1**	**2.1**	**3.6**	0.8	5	22	64	2	1	3	1	1
Spain	**0.8**	**1.6**	**2.9**	0.4	3	13	80	1	0	2	1	1
Sweden	**1.3**	**2.7**	**4.6**	1.2	6	33	55	2	0	2	1	1
Switzerland	**1.0**	**2.1**	**3.5**	0.7	6	19	68	2	1	3	1	1
Tunisia	**1.2**	**1.8**	**3.3**	0.6	4	23	69	1	0	1	1	1
Turkey	**1.6**	**2.2**	**4.0**	0.8	7	27	61	1	1	1	1	1
UK	0.5	**1.4**	**2.4**	0.5	3	17	71	2	1	4	1	1
Ukraine	**1.5**	**2.4**	**4.3**	0.9	9	17	62	2	1	5	2	1

Table S4. Relative changes of total precipitation in winter (DJF) in the near future (2021-2050) compared to the period 1981-2010 (see legend of Table S2 for further details).

BM_k and BU (%)					% Total variance							
Country	RCP			BU	Main effects			Inter.				
	2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3	IV	RV
Algeria	-6	**-8**	**-14**	6	10	25	23	2	1	3	34	2
Albania	4	1	1	5	10	28	7	6	1	7	38	4
Bosnia and H.	4	4	3	5	20	23	1	5	1	7	40	3
Bulgaria	3	1	3	5	16	22	2	8	1	8	38	5
Cyprus	-4	-6	**-9**	7	12	38	10	5	1	5	25	4
Denmark	2	**5**	**7**	5	28	18	15	4	1	3	28	3
Ireland	1	2	**5**	4	36	16	11	4	2	9	19	3
Estonia	1	3	**6**	5	30	20	13	4	2	3	24	3
Austria	3	3	**6**	5	17	43	5	3	1	3	24	4
Czech Rep.	3	5	**8**	6	27	33	13	2	1	3	19	2
Finland	3	4	**7**	5	26	24	12	5	1	4	25	2
France	3	**4**	**5**	3	14	17	2	2	1	4	58	2
Germany	2	4	**7**	5	18	28	13	2	1	6	30	2
Greece	1	-2	-2	5	11	38	7	2	1	4	35	3
Croatia	**6**	**5**	**5**	5	10	18	1	7	1	13	47	4
Hungary	5	**7**	**8**	6	12	33	4	8	1	5	33	4
Israel	-5	-5	**-7**	7	21	28	2	5	1	9	31	3
Italy	**5**	2	1	5	6	17	12	6	1	10	44	4
Jordan	-6	-7	**-10**	8	13	22	6	6	2	10	38	4
Lebanon	-4	-6	**-8**	7	14	36	4	4	1	7	32	3
Latvia	2	3	**6**	5	25	22	14	3	2	3	27	3
Belarus	3	4	**7**	4	18	30	18	2	0	2	28	2
Lithuania	2	4	**7**	4	22	20	18	3	2	2	30	4
Slovakia	5	**6**	**8**	5	16	28	6	5	1	3	37	3
Macedonia	3	1	2	5	19	25	2	6	1	5	39	4
Morocco	-4	**-11**	**-18**	8	17	13	33	2	0	5	30	1
Netherlands	3	4	**7**	5	25	18	13	3	1	4	33	2
Norway	0	1	4	5	29	27	9	3	1	4	24	2
Poland	2	4	**8**	5	20	37	18	1	1	2	20	2
Portugal	2	0	-4	6	8	23	14	3	1	7	42	2
Romania	4	5	**6**	5	24	29	3	3	1	7	27	5
Moldova	4	3	7	7	13	28	5	3	3	6	35	6
Slovenia	**7**	5	**6**	6	12	16	3	5	1	12	48	4
Spain	1	-1	-4	5	12	15	17	3	1	9	41	2
Sweden	2	**4**	**7**	4	26	16	25	4	1	2	23	3
Switzerland	4	**5**	**6**	5	9	28	3	4	1	7	44	3
Tunisia	-5	-8	**-9**	8	14	41	6	3	2	2	30	4
Turkey	0	-2	-1	5	8	54	2	3	0	4	26	3
UK	1	3	**5**	4	38	11	14	4	2	7	21	2
Ukraine	3	4	**6**	5	9	42	7	4	1	6	29	3

Table S5. Relative changes of total precipitation in winter (DJF) at the end of the century (2071-2099) compared to the period 1981-2010 (see legend of Table S2 for further details).

	BM_k and BU (%)				% Total variance							
	RCP				Main effects			Inter.				
Country	2.6	4.5	8.5	BU	RCM	GCM	RCP	I1	I2	I3	IV	RV
Algeria	-8	**-17**	**-31**	11	10	21	46	3	3	8	8	2
Albania	7	0	1	9	18	26	9	11	1	16	12	7
Bosnia and H.	**9**	7	**9**	9	27	21	2	10	1	20	12	7
Bulgaria	6	1	8	11	20	33	6	12	2	11	10	7
Cyprus	-9	**-15**	**-24**	14	14	51	17	4	2	4	5	4
Denmark	2	**10**	**18**	10	35	16	29	4	2	6	5	3
Ireland	1	6	**12**	9	34	23	21	3	2	11	4	3
Estonia	1	7	**17**	10	31	17	31	3	2	7	5	4
Austria	5	7	**13**	9	17	50	13	3	2	2	7	6
Czech Rep.	3	9	**18**	10	24	34	27	2	1	4	5	3
Finland	5	**10**	**20**	10	24	27	28	4	2	7	5	3
France	**6**	**6**	**11**	6	26	25	11	4	2	7	19	6
Germany	3	**9**	**17**	8	22	22	36	2	1	8	8	2
Greece	2	-7	-6	10	14	48	13	3	1	8	9	5
Croatia	**13**	**10**	**13**	10	18	18	3	11	2	27	12	9
Hungary	11	**12**	**20**	11	16	31	12	11	2	13	8	8
Israel	-12	-10	**-21**	13	17	48	11	4	2	7	8	3
Italy	**12**	2	3	10	12	21	20	8	2	21	10	7
Jordan	-14	-14	**-27**	15	12	43	14	6	2	9	10	4
Lebanon	-11	-13	**-22**	14	14	55	11	3	1	5	8	3
Latvia	2	8	**17**	9	29	18	33	3	2	7	5	3
Belarus	5	**10**	**19**	8	23	25	36	2	1	5	6	3
Lithuania	3	**9**	**18**	8	26	18	35	2	1	5	6	5
Slovakia	9	**10**	**17**	10	18	38	13	6	2	7	9	6
Macedonia	5	-1	4	9	26	26	7	9	1	11	12	9
Morocco	-3	**-24**	**-41**	14	14	13	56	2	1	6	7	1
Netherlands	4	8	**19**	9	28	18	32	3	1	8	8	2
Norway	-1	3	10	11	28	35	17	3	1	6	5	3
Poland	2	9	**17**	9	22	35	31	1	1	3	5	3
Portugal	7	-1	-13	13	12	30	28	4	2	14	8	3
Romania	6	9	**14**	10	28	26	10	5	3	12	7	8
Moldova	7	4	**16**	12	12	26	14	6	6	16	11	9
Slovenia	**17**	8	**15**	12	15	25	9	8	1	23	12	8
Spain	6	-4	**-11**	10	15	24	33	4	1	13	8	3
Sweden	3	**8**	**19**	8	24	18	44	3	1	4	4	2
Switzerland	6	**9**	**13**	8	14	41	13	4	2	6	14	6
Tunisia	-9	**-15**	**-23**	14	14	45	14	3	5	5	9	5
Turkey	-1	-5	-5	10	11	69	3	3	0	3	6	5
UK	2	7	**13**	8	39	18	21	3	2	9	5	2
Ukraine	5	7	**15**	9	13	42	18	5	1	9	8	5

Table S6. Absolute changes of mean temperature in summer (JJA) in the near future (2021-2050) compared to the period 1981-2010 (see legend of Table S2 for further details).

	BM_k and BU (°C)				% Total variance							
Country	RCP			BU	Main effects			Inter.				
	2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3	IV	RV
Algeria	**1.2**	**1.5**	**1.9**	0.4	5	50	38	2	0	2	3	1
Albania	**1.2**	**1.6**	**1.9**	0.5	16	52	22	3	1	2	4	1
Bosnia and H.	**1.1**	**1.5**	**1.8**	0.6	24	51	15	3	1	1	4	1
Bulgaria	**1.2**	**1.5**	**1.9**	0.6	20	54	18	3	0	1	3	1
Cyprus	**1.1**	**1.3**	**1.7**	0.4	3	57	34	1	1	1	3	0
Denmark	**0.8**	**0.9**	**1.1**	0.4	14	62	13	2	0	2	6	1
Ireland	**0.6**	**0.7**	**0.9**	0.3	14	59	13	2	1	4	6	1
Estonia	**1.0**	**1.2**	**1.5**	0.4	19	54	15	3	0	1	6	1
Austria	**1.0**	**1.3**	**1.5**	0.5	27	47	13	4	1	1	5	2
Czech Rep.	**1.0**	**1.2**	**1.4**	0.6	34	45	9	4	1	1	5	2
Finland	**1.1**	**1.3**	**1.6**	0.4	13	53	21	2	0	2	7	1
France	**0.9**	**1.2**	**1.4**	0.5	26	42	14	6	1	2	6	2
Germany	**0.9**	**1.1**	**1.3**	0.5	29	47	10	5	1	1	6	2
Greece	**1.2**	**1.5**	**1.9**	0.5	16	51	25	3	0	1	3	1
Croatia	**1.1**	**1.5**	**1.7**	0.6	30	46	12	4	1	1	5	1
Hungary	**1.1**	**1.4**	**1.6**	0.6	36	42	10	3	1	1	5	2
Israel	**1.1**	**1.3**	**1.7**	0.4	4	63	27	1	0	1	3	0
Italy	**1.1**	**1.5**	**1.7**	0.5	18	52	18	4	1	2	4	1
Jordan	**1.2**	**1.5**	**1.9**	0.4	5	58	31	1	0	1	3	0
Lebanon	**1.2**	**1.4**	**1.9**	0.4	5	60	29	1	0	1	3	0
Latvia	**1.0**	**1.1**	**1.4**	0.5	24	52	12	4	0	1	6	2
Belarus	**1.1**	**1.2**	**1.5**	0.6	35	45	8	4	0	1	4	2
Lithuania	**1.0**	**1.1**	**1.4**	0.5	30	48	9	4	0	1	5	2
Slovakia	**1.1**	**1.3**	**1.5**	0.6	36	44	9	3	1	1	4	2
Macedonia	**1.3**	**1.6**	**2.0**	0.6	18	54	20	2	0	1	3	1
Morocco	**1.0**	**1.3**	**1.6**	0.4	5	52	34	1	0	3	5	2
Netherlands	**0.8**	**0.9**	**1.1**	0.4	17	57	10	4	1	2	6	2
Norway	**1.0**	**1.2**	**1.5**	0.4	13	50	27	1	0	2	6	1
Poland	**1.0**	**1.1**	**1.4**	0.5	35	45	8	3	0	1	5	2
Portugal	**1.0**	**1.3**	**1.6**	0.4	9	46	30	2	1	4	7	2
Romania	**1.1**	**1.4**	**1.8**	0.6	27	50	14	3	0	1	4	1
Moldova	**1.1**	**1.4**	**1.7**	0.6	28	50	12	3	0	1	4	2
Slovenia	**1.1**	**1.4**	**1.6**	0.6	30	46	12	4	1	1	5	2
Spain	**1.0**	**1.4**	**1.7**	0.4	10	52	27	2	1	2	5	2
Sweden	**0.9**	**1.2**	**1.4**	0.4	14	54	22	1	1	2	6	1
Switzerland	**1.0**	**1.3**	**1.5**	0.5	21	48	15	5	1	1	5	2
Tunisia	**1.1**	**1.4**	**1.7**	0.4	7	55	29	3	1	2	4	1
Turkey	**1.3**	**1.6**	**2.0**	0.5	11	54	30	1	0	1	3	0
UK	**0.7**	**0.8**	**1.0**	0.4	15	59	14	3	1	3	6	1
Ukraine	**1.2**	**1.3**	**1.7**	0.6	32	47	12	3	0	1	4	2

Table S7. Absolute changes of mean temperature in summer (JJA) at the end of the century (2071-2099) compared to the period 1981-2010 (see legend of Table S2 for further details).

BM_k and BU (°C)					% Total variance							
Country	RCP			BU	Main effects			Inter.				
	2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3	IV	RV
Algeria	**1.7**	**2.9**	**5.4**	0.8	2	18	77	0	0	1	0	0
Albania	**1.6**	**3.0**	**5.2**	1.1	11	20	64	2	0	1	0	1
Bosnia and H.	**1.6**	**2.8**	**4.9**	1.3	18	24	52	2	1	1	0	1
Bulgaria	**1.7**	**3.0**	**5.2**	1.2	12	25	60	1	0	1	0	1
Cyprus	**1.4**	**2.5**	**4.5**	0.7	1	18	79	0	0	1	0	0
Denmark	**1.1**	**1.8**	**3.0**	0.7	9	33	53	1	0	2	1	1
Ireland	**0.7**	**1.4**	**2.7**	0.7	6	31	59	1	0	1	1	1
Estonia	**1.5**	**2.4**	**3.8**	1.0	18	26	49	1	1	2	1	1
Austria	**1.5**	**2.5**	**4.3**	1.2	20	23	49	3	1	1	1	2
Czech Rep.	**1.4**	**2.3**	**3.9**	1.2	26	25	43	3	1	1	1	2
Finland	**1.6**	**2.6**	**4.1**	0.9	11	26	58	1	0	2	1	1
France	**1.1**	**2.2**	**4.1**	1.0	17	17	58	3	1	2	1	1
Germany	**1.2**	**2.1**	**3.6**	1.0	22	24	47	3	1	1	1	1
Greece	**1.7**	**3.0**	**5.2**	1.0	9	19	68	1	0	1	0	1
Croatia	**1.5**	**2.7**	**4.8**	1.3	21	22	51	3	1	1	1	1
Hungary	**1.5**	**2.7**	**4.5**	1.3	23	22	48	3	1	2	1	2
Israel	**1.5**	**2.6**	**4.5**	0.8	2	24	71	1	0	1	0	0
Italy	**1.4**	**2.7**	**4.9**	1.1	12	21	60	2	1	1	0	1
Jordan	**1.6**	**2.9**	**5.2**	0.8	3	19	76	0	0	1	0	0
Lebanon	**1.6**	**2.8**	**4.9**	0.8	2	20	75	0	0	1	0	0
Latvia	**1.5**	**2.3**	**3.8**	1.0	23	25	45	2	1	2	1	2
Belarus	**1.6**	**2.5**	**4.1**	1.2	31	21	40	2	1	2	1	2
Lithuania	**1.5**	**2.3**	**3.8**	1.1	27	24	42	2	1	2	1	2
Slovakia	**1.5**	**2.6**	**4.3**	1.3	27	22	44	2	1	1	1	2
Macedonia	**1.7**	**3.1**	**5.4**	1.2	11	23	62	1	0	1	0	1
Morocco	**1.3**	**2.6**	**4.6**	0.6	2	14	82	0	0	1	0	1
Netherlands	**1.0**	**1.8**	**3.1**	0.8	12	28	53	2	1	1	1	1
Norway	**1.4**	**2.4**	**3.9**	0.7	8	23	65	0	0	1	1	1
Poland	**1.4**	**2.3**	**3.8**	1.2	28	25	41	2	0	2	1	2
Portugal	**1.1**	**2.5**	**4.4**	0.7	5	10	81	1	0	1	1	1
Romania	**1.7**	**2.9**	**4.9**	1.3	20	23	52	2	1	2	0	1
Moldova	**1.8**	**2.8**	**4.8**	1.3	23	23	48	2	1	2	1	1
Slovenia	**1.5**	**2.6**	**4.6**	1.4	23	24	46	3	1	1	1	2
Spain	**1.3**	**2.7**	**4.8**	0.8	6	15	75	1	0	1	0	1
Sweden	**1.4**	**2.3**	**3.7**	0.8	12	24	61	1	0	1	1	1
Switzerland	**1.4**	**2.5**	**4.5**	1.2	16	22	55	3	1	1	1	2
Tunisia	**1.5**	**2.7**	**4.9**	0.8	3	20	73	1	0	1	0	1
Turkey	**1.8**	**3.1**	**5.4**	1.0	5	23	70	0	0	1	0	0
UK	**0.8**	**1.6**	**2.9**	0.7	9	27	59	1	0	1	1	1
Ukraine	**1.8**	**2.8**	**4.7**	1.2	24	22	48	1	1	2	1	1

Table S8. Relative changes of total precipitation in summer (JJA) in the near future (2021-2050) compared to the period 1981-2010 (see legend of Table S2 for further details).

BM_k and BU (%)					% Total variance							
	RCP				Main effects			Inter.				
Country	2.6	4.5	8.5	BU	RCM	GCM	RCP	I1	I2	I3	IV	RV
Algeria	-5	-10	-8	17	17	57	2	3	0	2	15	4
Albania	-4	-10	**-13**	11	13	39	11	8	2	7	14	5
Bosnia and H.	-3	-7	-8	9	17	39	5	10	2	6	16	5
Bulgaria	-3	-8	**-11**	9	9	39	12	9	1	6	20	6
Cyprus	-8	-19	-16	21	4	41	5	8	1	3	33	5
Denmark	-1	0	-1	7	41	24	0	5	1	4	19	5
Ireland	-4	**-5**	**-7**	4	25	20	8	5	2	10	27	4
Estonia	-1	2	4	7	19	36	6	7	1	4	19	8
Austria	0	-1	0	6	28	31	1	14	2	2	16	6
Czech Rep.	0	0	1	6	25	28	1	13	1	2	22	8
Finland	2	4	**5**	5	18	29	9	7	1	5	24	6
France	-3	-6	**-8**	7	25	34	9	9	2	4	13	4
Germany	-1	-1	-1	6	35	27	0	11	1	3	15	8
Greece	-4	-9	**-14**	11	10	35	13	10	1	8	17	5
Croatia	-2	-6	-6	9	24	31	4	10	2	5	18	5
Hungary	-1	-4	-3	7	21	27	4	9	2	4	27	7
Israel	-12	-22	-18	28	7	21	2	16	1	7	39	7
Italy	-0	-5	-6	8	19	39	9	9	2	6	12	3
Jordan	-14	-8	-6	37	19	25	1	6	1	3	42	3
Lebanon	-8	-18	-17	22	8	29	4	9	2	4	38	6
Latvia	-0	2	3	7	23	33	3	10	1	4	19	7
Belarus	-2	0	0	8	16	43	1	13	1	3	17	6
Lithuania	-1	1	2	8	23	34	2	11	1	3	19	6
Slovakia	-1	-3	-2	7	17	36	2	11	2	2	23	7
Macedonia	-4	-9	**-12**	9	12	38	12	6	1	7	19	5
Morocco	-7	-10	-12	18	9	73	1	2	0	2	11	1
Netherlands	-3	-3	-3	7	36	23	0	10	2	3	18	8
Norway	2	3	**4**	4	35	29	6	3	1	3	19	4
Poland	-0	0	1	7	29	33	1	11	1	2	16	8
Portugal	-6	**-14**	**-18**	10	15	29	21	3	2	5	21	3
Romania	-1	-5	-6	7	11	37	7	11	2	4	22	7
Moldova	0	-3	-4	8	17	32	5	8	2	2	29	4
Slovenia	-2	-5	-5	8	26	30	4	9	2	3	20	6
Spain	-3	-9	**-12**	9	14	51	15	2	1	3	12	3
Sweden	2	4	5	5	21	42	5	5	1	5	16	4
Switzerland	-1	-2	-3	7	26	37	2	14	2	3	11	4
Tunisia	-5	-13	-15	17	13	44	6	10	1	5	17	4
Turkey	-5	**-12**	**-14**	9	14	39	14	6	1	3	20	3
UK	-2	-3	**-5**	5	37	19	4	9	1	7	20	4
Ukraine	-2	-4	-4	8	15	47	2	9	1	3	19	4

Table S9. Relative changes of total precipitation in summer (JJA) at the end of the century (2071-2099) compared to the period 1981-2010 (see legend of Table S2 for further details).

BM_k and BU (%)					% Total variance							
Country	RCP			BU	Main effects			Inter.			IV	RV
	2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3		
Algeria	-14	-20	-22	33	14	68	1	4	1	4	4	5
Albania	-4	-18	**-30**	20	18	23	23	11	3	9	4	8
Bosnia and H.	-3	-13	**-20**	17	22	32	13	10	2	8	4	8
Bulgaria	-4	-16	**-26**	16	12	38	23	8	1	6	5	8
Cyprus	-14	-31	**-39**	38	4	42	7	11	5	7	10	14
Denmark	-3	0	-4	15	46	30	1	5	2	5	4	7
Ireland	-7	**-11**	**-18**	9	24	21	20	7	3	14	6	5
Estonia	-2	4	8	15	24	40	6	8	1	6	4	11
Austria	2	-1	-2	13	29	39	1	13	3	3	3	7
Czech Rep.	1	0	0	14	25	41	0	13	2	4	5	9
Finland	2	7	**12**	11	23	31	11	8	2	11	5	9
France	-5	-14	**-23**	15	27	35	18	7	2	5	2	4
Germany	-2	-3	-5	15	38	37	1	9	2	4	3	8
Greece	-6	-18	**-34**	19	11	29	27	9	2	10	5	7
Croatia	-1	-9	-16	17	32	26	11	10	2	8	4	7
Hungary	1	-7	-8	15	24	28	8	13	2	9	6	10
Israel	-14	-19	-37	41	5	30	5	19	2	13	17	9
Italy	2	-10	-17	17	25	33	16	10	2	7	3	5
Jordan	-21	10	-3	71	26	38	3	11	2	3	11	6
Lebanon	-22	-25	**-43**	36	8	39	6	13	5	8	14	8
Latvia	-2	3	5	16	28	42	3	9	1	5	4	7
Belarus	-4	-3	-2	18	24	49	0	11	1	4	4	6
Lithuania	-2	2	3	17	31	43	2	9	1	4	4	6
Slovakia	0	-5	-7	15	19	41	4	14	2	6	5	9
Macedonia	-7	**-18**	**-29**	16	13	33	24	6	2	9	5	8
Morocco	-13	-23	-30	33	11	74	4	2	0	4	3	2
Netherlands	-3	-5	-9	16	42	29	2	7	2	4	4	10
Norway	2	6	**9**	9	40	29	11	3	2	4	3	6
Poland	0	-1	1	16	35	39	0	12	1	3	3	8
Portugal	-11	**-31**	**-46**	17	13	31	42	1	2	2	5	4
Romania	-2	-10	**-15**	14	15	39	13	11	2	4	5	10
Moldova	-1	-6	-11	16	18	41	7	11	4	4	8	8
Slovenia	-1	-7	-14	16	35	27	9	10	2	5	4	7
Spain	-7	**-20**	**-34**	18	14	46	28	2	1	4	3	3
Sweden	3	7	10	11	28	43	7	5	1	7	3	6
Switzerland	-0	-5	-9	16	30	41	5	11	2	4	2	5
Tunisia	-10	-26	**-40**	30	20	40	15	8	1	6	5	5
Turkey	-11	**-25**	**-35**	17	12	42	25	5	2	5	5	4
UK	-4	-6	**-12**	10	40	22	12	7	2	9	4	4
Ukraine	-3	-9	-12	15	23	50	5	8	2	4	5	4

5 Main results for the capitals of the domain

Table S10. Mean expected change response BM_k, scenario-excluded uncertainty BU and partition of the total uncertainty for the capital cities of the domain, for absolute changes of mean temperature in winter (DJF) in the near future (2021-2050) compared to the period 1981-2010. I1, I2 and I3 refer to interactions RCM/GCM, RCP/RCM and RCP/GCM, respectively. IV and RV refer to internal and residual variability, respectively. Absolute mean expected changes greater than the uncertainty ($|BU/BM| > 1$) are indicated in bold font.

		BM_k & BU (°C)				% Total variance							
		RCP				Main effects			Inter.				
Capital city	Country	2.6	4.5	8.5	BU	RCM	GCM	RCP	I1	I2	I3	IV	RV
Amman	Jordan	**0.9**	**1.0**	**1.3**	0.4	7	60	19	1	1	4	7	1
Algiers	Algeria	**0.7**	**0.8**	**1.1**	0.3	2	58	29	2	0	2	6	1
Amsterdam	Netherlands	**0.6**	**0.8**	**1.1**	0.3	4	44	27	5	1	6	10	3
Andorra la Vella	Andorra	**0.8**	**1.1**	**1.4**	0.4	21	32	32	4	1	2	6	2
Ankara	Turkey	**1.0**	**1.3**	**1.5**	0.5	33	33	14	4	1	4	9	2
Athens	Greece	**0.8**	**0.9**	**1.2**	0.3	5	55	21	1	1	7	9	1
Bayrut	Lebanon	**0.8**	**0.9**	**1.2**	0.3	2	56	25	1	1	6	8	1
Belgrade	Serbia and M.	**0.9**	**1.3**	**1.5**	0.4	22	31	20	4	1	7	12	3
Berlin	Germany	**0.7**	**1.0**	**1.3**	0.4	6	41	24	7	1	6	12	3
Bern	Switzerland	**0.8**	**1.1**	**1.3**	0.4	8	41	26	6	1	5	10	3
Bratislava	Slovakia	**0.9**	**1.2**	**1.5**	0.5	17	32	23	7	1	5	11	3
Brussels	Belgium	**0.6**	**0.9**	**1.1**	0.3	7	32	30	7	1	8	11	3
Bucharest	Romania	**1.0**	**1.3**	**1.6**	0.5	26	28	18	4	1	6	13	5
Budapest	Hungary	**0.9**	**1.2**	**1.5**	0.4	22	27	24	6	1	5	12	3
Cairo	Egypt	**0.8**	**0.9**	**1.2**	0.3	14	45	27	1	1	4	6	1
Chisinau	Moldova	**1.0**	**1.4**	**1.6**	0.4	20	24	22	5	2	6	18	4
Copenhagen	Denmark	**0.7**	**1.0**	**1.2**	0.4	7	45	26	4	1	4	10	2
Damascus	Syria	**0.9**	**1.1**	**1.4**	0.3	7	57	22	1	1	5	7	1
Douglas	Isle of Man	**0.4**	**0.6**	**0.8**	0.3	10	47	29	3	0	2	8	1
Dublin	Ireland	**0.4**	**0.6**	**0.8**	0.3	7	49	30	2	0	2	9	1
Gibraltar	Gibraltar	**0.6**	**0.7**	**1.0**	0.2	6	49	30	2	1	4	6	3
Helsinki	Finland	**1.2**	**1.5**	**1.9**	0.7	13	46	14	9	1	4	10	3
Jerusalem	Israel	**0.9**	**1.0**	**1.3**	0.3	4	58	24	1	1	4	8	1
Kiev	Ukraine	**1.0**	**1.3**	**1.6**	0.5	15	30	18	7	2	6	19	3
Lisbon	Portugal	**0.6**	**0.8**	**0.9**	0.2	7	47	30	2	1	4	8	1
Ljubljana	Slovenia	**0.9**	**1.2**	**1.4**	0.4	13	36	24	6	1	6	11	3
London	UK	**0.5**	**0.7**	**0.9**	0.3	8	42	29	5	1	5	9	2
Luxemburg	Luxembourg	**0.6**	**0.9**	**1.1**	0.3	6	38	27	7	1	8	10	3
Madrid	Spain	**0.7**	**0.9**	**1.1**	0.3	11	43	33	2	1	2	7	1
Minsk	Belarus	**1.0**	**1.3**	**1.6**	0.5	10	34	20	9	2	5	17	4
Monaco-Ville	Monaco	**0.7**	**0.9**	**1.2**	0.3	6	51	30	2	0	3	6	2
Nicosia	Cyprus	**0.8**	**1.0**	**1.2**	0.3	5	50	29	1	1	7	8	1
Oslo	Norway	**0.8**	**1.2**	**1.5**	0.5	13	44	21	5	1	4	10	2
Paris	France	**0.6**	**0.8**	**1.1**	0.3	9	36	27	5	1	9	10	3
Prague	Czech Republic	**0.8**	**1.1**	**1.4**	0.4	12	36	23	6	1	7	12	3
Rabat	Morocco	**0.6**	**0.8**	**1.0**	0.2	7	39	33	2	1	4	9	3
Riga	Latvia	**1.0**	**1.3**	**1.6**	0.6	12	37	17	9	1	5	15	3
Rome	Italy	**0.8**	**1.0**	**1.2**	0.3	12	50	23	1	0	4	8	2
Saint Helier	Jersey	**0.5**	**0.7**	**0.9**	0.3	3	61	23	2	0	4	6	1
Saint Peter Port	Guernsey and A.	**0.5**	**0.6**	**0.8**	0.3	3	62	23	2	0	3	6	1
San Marino	San Marino	**0.8**	**1.0**	**1.3**	0.4	10	47	23	3	1	5	9	2
Sarajevo	Bosnia and H.	**0.9**	**1.2**	**1.5**	0.5	22	35	19	3	1	7	10	3
Skopje	Macedonia	**0.9**	**1.2**	**1.4**	0.4	19	35	21	3	1	7	10	3
Sofia	Bulgaria	**0.9**	**1.2**	**1.4**	0.4	19	31	22	2	0	9	13	4
Stockholm	Sweden	**0.9**	**1.2**	**1.6**	0.5	16	36	22	8	1	5	10	3
Tallinn	Estonia	**1.1**	**1.3**	**1.7**	0.6	14	44	14	9	1	3	12	3
Tirana	Albania	**0.8**	**1.0**	**1.2**	0.3	11	48	22	1	1	5	9	2
Torshavn	Faroe Islands	0.4	**0.6**	**0.8**	0.5	4	80	11	0	0	1	3	1
Tripoli	Libya	**0.8**	**0.9**	**1.2**	0.3	10	44	30	2	1	4	7	1
Tunis	Tunisia	**0.8**	**0.9**	**1.2**	0.3	8	51	29	1	0	2	7	1
Vaduz	Liechtenstein	**0.8**	**1.1**	**1.3**	0.4	15	42	22	6	1	3	9	2
Valletta	Malta	**0.7**	**0.9**	**1.1**	0.3	3	57	28	1	0	4	7	1
Vatican City	Vatican City	**0.8**	**1.0**	**1.2**	0.3	12	50	23	1	0	4	8	2
Vienna	Austria	**0.8**	**1.2**	**1.4**	0.4	16	34	23	6	1	6	11	3
Vilnius	Lithuania	**1.0**	**1.3**	**1.6**	0.5	9	34	21	8	2	5	17	4
Warsaw	Poland	**0.9**	**1.2**	**1.5**	0.5	10	37	20	9	2	6	13	4
Zagreb	Croatia	**0.9**	**1.2**	**1.5**	0.4	18	29	23	8	1	6	11	4

Table S11. Absolute changes of mean temperature in winter (DJF) at the end of the century (2071-2099) compared to the period 1981-2010 (see legend of Table S10 for further details).

		BM_k & BU (°C)				% Total variance							
Capital city	Country	RCP			BU	Main effects			Inter.				
		2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3	IV	RV
Amman	Jordan	**1.5**	**2.0**	**3.7**	0.8	3	34	59	0	0	1	1	1
Algiers	Algeria	**0.9**	**1.6**	**2.8**	0.4	1	20	75	0	0	2	1	0
Amsterdam	Netherlands	**0.7**	**1.6**	**2.8**	0.6	2	17	71	2	1	4	1	1
Andorra la Vella	Andorra	0.8	**2.0**	**3.8**	0.8	12	11	70	1	1	2	1	1
Ankara	Turkey	**1.5**	**2.2**	**3.9**	1.0	22	20	51	2	2	1	1	1
Athens	Greece	**1.2**	**1.8**	**3.2**	0.7	2	39	56	0	0	2	1	0
Bayrut	Lebanon	**1.3**	**1.8**	**3.2**	0.6	1	31	65	0	0	1	1	0
Belgrade	Serbia and M.	**1.4**	**2.2**	**3.7**	0.8	8	26	56	2	1	3	2	2
Berlin	Germany	**0.8**	**1.9**	**3.4**	0.8	4	22	65	2	1	4	1	2
Bern	Switzerland	**1.0**	**2.0**	**3.4**	0.7	5	19	66	2	2	4	1	1
Bratislava	Slovakia	**1.3**	**2.3**	**3.8**	0.9	9	22	60	2	1	3	2	2
Brussels	Belgium	**0.7**	**1.6**	**2.8**	0.6	4	18	68	2	1	5	1	2
Bucharest	Romania	**1.5**	**2.4**	**4.2**	0.9	12	19	58	2	2	4	2	2
Budapest	Hungary	**1.4**	**2.2**	**3.8**	0.9	11	21	59	2	1	3	2	2
Cairo	Egypt	**1.2**	**1.8**	**3.4**	0.7	6	27	64	1	1	1	1	1
Chisinau	Moldova	**1.5**	**2.3**	**4.2**	1.0	12	19	58	2	1	4	2	2
Copenhagen	Denmark	**0.9**	**1.9**	**3.2**	0.7	3	26	64	2	0	3	1	1
Damascus	Syria	**1.4**	**2.1**	**3.8**	0.7	3	29	64	0	0	1	1	1
Douglas	Isle of Man	0.4	**1.2**	**2.3**	0.5	3	16	73	2	0	4	1	1
Dublin	Ireland	0.4	**1.2**	**2.2**	0.5	3	16	71	2	1	5	1	1
Gibraltar	Gibraltar	**0.7**	**1.4**	**2.5**	0.4	2	17	76	1	0	2	1	1
Helsinki	Finland	**1.4**	**2.9**	**4.7**	1.3	7	33	50	2	1	4	2	2
Jerusalem	Israel	**1.4**	**2.0**	**3.6**	0.7	2	32	63	0	0	1	1	1
Kiev	Ukraine	**1.4**	**2.4**	**4.5**	1.0	9	19	60	2	1	5	2	2
Lisbon	Portugal	**0.8**	**1.4**	**2.5**	0.4	2	17	76	1	0	2	1	1
Ljubljana	Slovenia	**1.2**	**2.2**	**3.7**	0.7	4	20	66	2	1	3	1	2
London	UK	**0.6**	**1.4**	**2.5**	0.5	4	16	70	2	1	5	1	2
Luxemburg	Luxembourg	**0.8**	**1.7**	**3.0**	0.6	4	20	67	2	1	4	1	1
Madrid	Spain	**0.8**	**1.6**	**2.9**	0.5	5	14	76	1	1	2	1	1
Minsk	Belarus	**1.2**	**2.5**	**4.6**	1.2	6	25	58	2	1	4	2	2
Monaco-Ville	Monaco	**1.0**	**1.8**	**3.1**	0.5	3	21	71	1	1	2	1	1
Nicosia	Cyprus	**1.3**	**1.9**	**3.4**	0.6	1	27	69	0	0	1	1	0
Oslo	Norway	0.9	**2.3**	**4.0**	1.1	7	31	54	2	0	3	1	1
Paris	France	**0.7**	**1.6**	**2.8**	0.5	3	15	71	2	1	5	1	1
Prague	Czech Republic	**1.0**	**2.0**	**3.6**	0.8	8	21	62	2	1	3	2	2
Rabat	Morocco	**0.8**	**1.4**	**2.7**	0.4	3	11	80	1	1	2	1	1
Riga	Latvia	1.0	**2.5**	**4.4**	1.3	6	28	55	2	1	5	2	2
Rome	Italy	**1.2**	**1.8**	**3.2**	0.6	3	31	61	1	1	1	1	1
Saint Helier	Jersey	**0.6**	**1.2**	**2.3**	0.5	1	23	68	1	1	4	1	1
Saint Peter Port	Guernsey and A.	**0.6**	**1.2**	**2.3**	0.5	1	22	69	1	1	4	1	1
San Marino	San Marino	**1.2**	**2.0**	**3.4**	0.7	5	27	61	1	1	2	1	1
Sarajevo	Bosnia and H.	**1.5**	**2.3**	**3.9**	0.9	10	29	53	2	1	2	2	2
Skopje	Macedonia	**1.3**	**2.1**	**3.7**	0.8	8	24	60	2	1	2	1	1
Sofia	Bulgaria	**1.5**	**2.2**	**3.9**	0.9	8	27	56	1	1	3	2	1
Stockholm	Sweden	1.1	**2.3**	**3.9**	1.1	6	35	51	2	0	3	1	1
Tallinn	Estonia	1.2	**2.7**	**4.4**	1.3	7	32	51	2	1	4	2	2
Tirana	Albania	**1.3**	**1.9**	**3.2**	0.7	5	34	56	1	1	1	1	1
Torshavn	Faroe Islands	0.4	**1.2**	**2.0**	0.9	2	59	34	1	0	2	1	1
Tripoli	Libya	**1.2**	**1.8**	**3.3**	0.6	3	26	67	1	0	2	1	1
Tunis	Tunisia	**1.1**	**1.8**	**3.1**	0.5	2	24	70	0	0	2	1	1
Vaduz	Liechtenstein	**1.0**	**2.0**	**3.5**	0.8	8	20	62	3	1	3	1	2
Valletta	Malta	**1.1**	**1.7**	**3.0**	0.6	1	32	64	0	0	1	1	0
Vatican City	Vatican City	**1.2**	**1.8**	**3.2**	0.6	3	31	61	1	1	1	1	1
Vienna	Austria	**1.2**	**2.2**	**3.7**	0.8	7	21	62	2	1	3	2	2
Vilnius	Lithuania	1.1	**2.4**	**4.4**	1.2	7	27	55	2	1	5	2	2
Warsaw	Poland	1.0	**2.2**	**4.0**	1.1	7	29	53	3	1	4	1	2
Zagreb	Croatia	**1.2**	**2.2**	**3.8**	0.9	8	23	60	2	2	3	2	2

Table S12. Relative changes of total precipitation in winter (DJF) in the near future (2021-2050) compared to the period 1981-2010 (see legend of Table S10 for further details).

		BM_k & BU (%)				% Total variance							
		RCP				Main effects			Inter.				
Capital city	Country	2.6	4.5	8.5	BU	RCM	GCM	RCP	I1	I2	I3	IV	RV
Amman	Jordan	-8	**-9**	**-11**	9	10	24	3	7	1	10	40	5
Algiers	Algeria	-2	-6	**-8**	6	11	19	9	4	2	8	41	6
Amsterdam	Netherlands	3	4	**8**	5	26	19	13	3	1	4	30	3
Andorra la Vella	Andorra	3	1	-2	8	20	19	8	8	2	6	31	5
Ankara	Turkey	2	0	1	7	15	40	1	4	1	4	33	2
Athens	Greece	0	-3	-2	9	6	56	3	2	1	2	27	3
Bayrut	Lebanon	-2	-3	-4	8	15	39	1	6	0	8	29	3
Belgrade	Serbia and M.	5	6	7	7	17	34	2	11	1	6	24	6
Berlin	Germany	1	4	**8**	6	23	28	17	2	1	4	22	3
Bern	Switzerland	4	**6**	**8**	6	3	39	7	6	1	6	34	5
Bratislava	Slovakia	6	6	**10**	8	17	32	6	9	1	3	26	5
Brussels	Belgium	3	4	**7**	5	24	17	12	3	1	5	36	2
Bucharest	Romania	5	5	7	9	25	18	1	9	3	8	30	5
Budapest	Hungary	5	6	**8**	7	14	28	2	10	1	7	34	4
Cairo	Egypt	-10	-3	-10	14	19	20	5	9	2	8	31	6
Chisinau	Moldova	4	3	7	8	17	27	4	4	3	6	33	7
Copenhagen	Denmark	2	4	**7**	5	23	10	12	11	2	3	31	9
Damascus	Syria	-4	-5	-7	9	19	27	3	4	2	7	33	5
Douglas	Isle of Man	3	4	**7**	4	22	8	14	11	4	9	27	5
Dublin	Ireland	4	4	6	6	43	11	3	12	3	4	20	5
Gibraltar	Gibraltar	0	-6	**-13**	9	20	9	25	7	0	3	33	3
Helsinki	Finland	1	3	**6**	5	20	26	11	3	2	4	31	4
Jerusalem	Israel	-8	**-10**	**-11**	8	23	14	2	6	2	9	39	4
Kiev	Ukraine	3	4	**7**	6	12	39	6	6	0	4	28	4
Lisbon	Portugal	1	-2	-7	8	7	28	15	2	1	7	37	2
Ljubljana	Slovenia	7	5	**8**	7	11	16	4	7	1	11	44	5
London	UK	3	4	**7**	5	24	15	13	5	1	5	34	3
Luxemburg	Luxembourg	4	5	**7**	5	32	16	7	2	1	4	35	3
Madrid	Spain	3	1	-4	8	8	25	12	3	1	9	40	2
Minsk	Belarus	3	5	**8**	5	25	21	15	4	1	2	28	4
Monaco-Ville	Monaco	9	5	1	10	9	19	10	5	1	14	36	5
Nicosia	Cyprus	-3	-5	**-9**	7	9	18	10	8	2	8	40	5
Oslo	Norway	2	5	**9**	5	13	20	18	5	2	5	34	3
Paris	France	4	5	**8**	5	30	17	10	2	1	2	34	3
Prague	Czech Republic	4	7	**11**	7	26	33	13	2	1	5	18	3
Rabat	Morocco	0	**-10**	**-16**	9	12	12	31	4	1	6	32	3
Riga	Latvia	1	3	**6**	5	26	19	13	5	2	2	28	5
Rome	Italy	6	0	1	7	10	25	11	5	1	6	38	4
Saint Helier	Jersey	1	2	**5**	5	12	23	10	5	1	2	42	5
Saint Peter Port	Guernsey and A.	2	3	**6**	4	11	23	10	5	1	3	43	3
San Marino	San Marino	2	0	2	9	17	17	2	13	1	7	34	10
Sarajevo	Bosnia and H.	3	4	5	8	42	23	2	4	3	4	19	2
Skopje	Macedonia	4	2	5	9	27	26	2	10	1	2	27	5
Sofia	Bulgaria	2	2	5	7	25	15	5	11	1	5	33	5
Stockholm	Sweden	2	4	**6**	5	29	25	10	3	2	2	27	3
Tallinn	Estonia	2	3	6	6	37	24	8	5	1	2	20	3
Tirana	Albania	4	1	1	6	10	25	4	7	2	8	40	4
Torshavn	Faroe Islands	-2	0	-1	6	29	38	1	7	2	3	16	3
Tripoli	Libya	-6	-8	-8	13	14	56	1	3	1	2	19	3
Tunis	Tunisia	-3	-6	-7	9	12	37	3	7	1	3	32	6
Vaduz	Liechtenstein	2	4	6	7	9	37	4	8	1	6	30	5
Valletta	Malta	-3	-7	-7	9	28	30	5	4	1	2	26	4
Vatican City	Vatican City	6	0	1	7	10	25	11	5	1	6	38	4
Vienna	Austria	4	4	**9**	8	21	31	7	7	1	2	24	6
Vilnius	Lithuania	2	3	**7**	4	25	16	21	3	1	2	29	3
Warsaw	Poland	2	4	**8**	5	22	29	17	3	1	2	23	4
Zagreb	Croatia	**8**	**7**	**10**	7	11	27	4	6	1	9	36	6

Table S13. Relative changes of total precipitation in winter (DJF) at the end of the century (2071-2099) compared to the period 1981-2010 (see legend of Table S10 for further details).

		BM_k & BU (%)				% Total variance							
		RCP			BU	Main effects			Inter.				
Capital city	Country	2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3	IV	RV
Amman	Jordan	**-19**	**-18**	**-29**	15	13	40	10	8	2	9	12	6
Algiers	Algeria	-1	-12	**-17**	14	11	31	19	5	3	17	9	6
Amsterdam	Netherlands	5	9	**20**	10	28	22	28	3	2	7	7	4
Andorra la Vella	Andorra	9	2	-8	14	24	17	21	9	4	11	8	7
Ankara	Turkey	3	0	0	12	19	53	2	6	1	3	10	6
Athens	Greece	1	-8	-8	16	4	62	7	3	4	4	9	6
Bayrut	Lebanon	-7	-6	-13	15	19	56	4	5	1	5	7	3
Belgrade	Serbia and M.	7	11	**15**	14	21	36	5	11	1	9	7	9
Berlin	Germany	1	9	**19**	10	23	21	34	3	1	7	6	5
Bern	Switzerland	7	**13**	**18**	10	4	44	18	5	2	7	11	9
Bratislava	Slovakia	11	9	**22**	14	13	42	13	10	1	6	7	7
Brussels	Belgium	5	**9**	**19**	9	26	13	34	4	2	10	10	2
Bucharest	Romania	10	8	16	18	28	20	3	13	5	15	8	8
Budapest	Hungary	12	9	**19**	14	14	34	8	12	3	13	8	8
Cairo	Egypt	-23	-9	**-26**	24	17	26	9	13	4	12	11	9
Chisinau	Moldova	7	3	**14**	14	15	22	11	8	5	17	11	11
Copenhagen	Denmark	4	9	**18**	11	26	11	23	13	3	6	6	12
Damascus	Syria	-11	-14	**-21**	16	22	40	7	3	5	6	9	9
Douglas	Isle of Man	6	**10**	**17**	9	21	17	22	11	5	11	6	6
Dublin	Ireland	8	9	**14**	13	51	12	5	14	3	5	5	6
Gibraltar	Gibraltar	4	**-15**	**-32**	13	15	7	55	5	1	6	9	3
Helsinki	Finland	2	7	**16**	9	21	24	28	2	2	9	7	6
Jerusalem	Israel	**-20**	**-20**	**-30**	14	20	36	9	8	3	6	12	6
Kiev	Ukraine	6	6	**15**	11	14	38	14	8	1	8	9	8
Lisbon	Portugal	6	-4	**-19**	15	6	33	31	3	2	14	8	4
Ljubljana	Slovenia	**18**	9	**20**	13	12	24	13	11	1	19	12	8
London	UK	5	7	**17**	9	31	17	23	5	2	9	9	3
Luxemburg	Luxembourg	6	**10**	**18**	10	38	18	19	3	1	8	9	4
Madrid	Spain	11	0	-12	15	13	34	27	3	2	8	10	3
Minsk	Belarus	5	9	**20**	10	31	15	31	3	2	6	6	5
Monaco-Ville	Monaco	**23**	8	-1	20	11	23	19	7	2	22	9	8
Nicosia	Cyprus	-9	**-15**	**-24**	14	15	35	16	7	3	7	10	7
Oslo	Norway	5	**10**	**21**	9	18	19	34	5	3	7	10	4
Paris	France	7	**11**	**19**	9	32	20	22	3	2	7	9	5
Prague	Czech Republic	5	12	**24**	13	26	31	26	3	1	4	5	5
Rabat	Morocco	6	**-23**	**-38**	15	11	7	59	4	1	9	7	3
Riga	Latvia	2	7	**17**	10	38	13	28	3	2	5	6	5
Rome	Italy	12	-4	0	13	16	22	21	8	2	15	10	7
Saint Helier	Jersey	4	4	**13**	8	17	26	20	6	2	9	12	8
Saint Peter Port	Guernsey and A.	5	5	**13**	8	13	33	16	6	2	13	12	6
San Marino	San Marino	7	0	4	16	21	23	4	14	1	14	11	13
Sarajevo	Bosnia and H.	3	6	12	15	46	21	7	5	6	7	5	4
Skopje	Macedonia	9	3	12	17	37	26	5	12	1	3	7	9
Sofia	Bulgaria	4	3	12	13	29	27	8	14	1	6	8	7
Stockholm	Sweden	3	7	**16**	10	32	26	23	4	2	4	6	3
Tallinn	Estonia	1	7	**18**	13	40	19	24	3	2	5	4	2
Tirana	Albania	7	2	4	11	20	25	3	12	2	16	12	8
Torshavn	Faroe Islands	-3	-1	-1	11	23	52	1	10	3	4	4	4
Tripoli	Libya	-14	-15	-20	26	16	67	1	3	2	4	5	3
Tunis	Tunisia	-8	-12	-16	16	13	51	4	7	3	7	9	6
Vaduz	Liechtenstein	0	8	**13**	13	10	41	15	12	1	6	9	7
Valletta	Malta	-6	-13	**-19**	17	31	36	9	5	2	6	7	5
Vatican City	Vatican City	12	-4	0	13	16	22	21	8	2	15	10	7
Vienna	Austria	7	5	**20**	15	18	40	16	7	1	5	6	9
Vilnius	Lithuania	2	7	**18**	8	31	13	37	3	1	4	6	5
Warsaw	Poland	3	**10**	**18**	10	27	27	29	2	1	3	6	5
Zagreb	Croatia	**17**	12	**24**	13	15	24	13	8	1	19	10	10

Table S14. Absolute changes of mean temperature in summer (JJA) in the near future (2021-2050) compared to the period 1981-2010 (see legend of Table S10 for further details).

		BM_k & BU (°C)				% Total variance							
Capital city	Country	RCP			BU	Main effects			Inter.				
		2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3	IV	RV
Amman	Jordan	**1.2**	**1.5**	**1.9**	0.5	6	60	28	1	0	1	3	0
Algiers	Algeria	**0.9**	**1.1**	**1.3**	0.3	3	66	23	1	0	1	4	1
Amsterdam	Netherlands	**0.8**	**0.9**	**1.1**	0.4	12	62	11	4	1	2	6	1
Andorra la Vella	Andorra	**1.1**	**1.5**	**1.8**	0.5	18	44	24	5	1	2	4	2
Ankara	Turkey	**1.3**	**1.6**	**2.1**	0.5	14	52	27	2	1	1	3	1
Athens	Greece	**1.2**	**1.5**	**1.9**	0.5	18	49	25	2	0	1	3	1
Bayrut	Lebanon	**1.0**	**1.1**	**1.5**	0.3	3	63	28	1	0	1	3	0
Belgrade	Serbia and M.	**1.2**	**1.5**	**1.9**	0.7	29	46	14	4	0	1	4	1
Berlin	Germany	**0.9**	**1.1**	**1.3**	0.5	30	47	8	4	1	1	6	3
Bern	Switzerland	**1.0**	**1.3**	**1.5**	0.5	29	44	12	6	1	1	5	2
Bratislava	Slovakia	**1.1**	**1.3**	**1.5**	0.6	35	43	10	3	1	1	5	2
Brussels	Belgium	**0.8**	**1.0**	**1.2**	0.5	26	47	10	5	1	2	7	2
Bucharest	Romania	**1.2**	**1.5**	**1.9**	0.7	27	49	16	3	0	1	3	1
Budapest	Hungary	**1.1**	**1.4**	**1.6**	0.7	38	42	9	3	1	1	5	2
Cairo	Egypt	**1.2**	**1.4**	**1.8**	0.4	4	61	30	1	0	1	2	0
Chisinau	Moldova	**1.2**	**1.4**	**1.8**	0.7	30	47	13	3	0	1	4	2
Copenhagen	Denmark	**0.9**	**1.0**	**1.3**	0.4	17	59	13	2	1	1	6	1
Damascus	Syria	**1.3**	**1.6**	**2.0**	0.4	5	56	33	1	0	1	3	0
Douglas	Isle of Man	**0.6**	**0.7**	**0.9**	0.4	12	66	10	2	0	3	5	1
Dublin	Ireland	**0.6**	**0.7**	**0.9**	0.4	16	57	14	2	1	3	6	2
Gibraltar	Gibraltar	**0.7**	**0.9**	**1.1**	0.3	18	38	28	3	1	3	5	2
Helsinki	Finland	**1.1**	**1.2**	**1.6**	0.4	15	55	18	2	1	2	6	1
Jerusalem	Israel	**1.2**	**1.4**	**1.8**	0.4	8	60	27	1	0	1	3	1
Kiev	Ukraine	**1.1**	**1.2**	**1.7**	0.7	34	45	10	4	0	1	4	2
Lisbon	Portugal	**0.8**	**1.0**	**1.2**	0.3	10	48	26	2	1	3	8	2
Ljubljana	Slovenia	**1.1**	**1.4**	**1.7**	0.6	31	45	12	4	1	1	4	2
London	UK	**0.8**	**0.9**	**1.1**	0.4	18	52	14	4	1	3	6	2
Luxemburg	Luxembourg	**0.9**	**1.1**	**1.3**	0.5	33	42	10	6	1	1	6	2
Madrid	Spain	**1.1**	**1.6**	**1.9**	0.5	13	46	29	2	1	3	4	2
Minsk	Belarus	**1.1**	**1.2**	**1.5**	0.6	37	43	8	4	0	1	4	2
Monaco-Ville	Monaco	**1.1**	**1.4**	**1.6**	0.5	12	54	20	5	1	2	5	2
Nicosia	Cyprus	**1.1**	**1.4**	**1.8**	0.4	3	54	37	1	1	1	3	0
Oslo	Norway	**0.9**	**1.0**	**1.4**	0.4	22	48	19	2	1	2	6	1
Paris	France	**0.9**	**1.1**	**1.3**	0.5	29	40	11	6	1	3	7	3
Prague	Czech Republic	**1.0**	**1.2**	**1.4**	0.6	32	45	9	5	1	1	5	3
Rabat	Morocco	**0.7**	**0.8**	**1.1**	0.3	12	44	21	6	1	4	8	3
Riga	Latvia	**1.0**	**1.1**	**1.4**	0.5	16	57	14	3	0	1	6	2
Rome	Italy	**1.1**	**1.5**	**1.7**	0.4	15	46	24	5	1	2	5	2
Saint Helier	Jersey	**0.7**	**0.9**	**1.1**	0.4	10	66	14	1	1	3	5	1
Saint Peter Port	Guernsey and A.	**0.7**	**0.8**	**1.0**	0.3	2	73	15	1	0	3	5	1
San Marino	San Marino	**1.1**	**1.5**	**1.7**	0.6	20	51	16	4	1	2	4	1
Sarajevo	Bosnia and H.	**1.2**	**1.5**	**1.8**	0.6	25	51	16	3	1	1	3	1
Skopje	Macedonia	**1.3**	**1.6**	**2.0**	0.6	19	55	19	2	0	1	3	1
Sofia	Bulgaria	**1.2**	**1.6**	**2.0**	0.6	18	54	20	3	0	1	3	1
Stockholm	Sweden	**1.0**	**1.2**	**1.5**	0.4	21	52	16	3	1	2	6	1
Tallinn	Estonia	**1.1**	**1.3**	**1.6**	0.4	11	60	18	2	1	1	6	1
Tirana	Albania	**1.2**	**1.6**	**1.9**	0.5	18	47	22	4	1	2	4	1
Torshavn	Faroe Islands	**0.5**	**0.7**	**0.9**	0.3	5	66	17	1	0	3	7	1
Tripoli	Libya	**1.1**	**1.2**	**1.7**	0.4	6	51	34	2	1	1	4	1
Tunis	Tunisia	**1.1**	**1.3**	**1.6**	0.4	8	53	29	2	0	2	4	1
Vaduz	Liechtenstein	**1.0**	**1.3**	**1.5**	0.5	23	45	15	7	1	1	6	2
Valletta	Malta	**1.1**	**1.3**	**1.6**	0.3	8	56	29	1	0	1	3	0
Vatican City	Vatican City	**1.1**	**1.5**	**1.7**	0.4	15	46	24	5	1	2	5	2
Vienna	Austria	**1.0**	**1.3**	**1.5**	0.6	33	45	10	4	1	1	5	2
Vilnius	Lithuania	**1.1**	**1.2**	**1.5**	0.6	34	45	9	4	0	1	5	2
Warsaw	Poland	**1.0**	**1.2**	**1.4**	0.6	38	44	7	2	0	1	5	3
Zagreb	Croatia	**1.1**	**1.5**	**1.7**	0.6	33	43	12	4	1	1	5	2

Table S15. Absolute changes of mean temperature in summer (JJA) at the end of the century (2071-2099) compared to the period 1981-2010 (see legend of Table S10 for further details).

		BM_k & BU (°C)				% Total variance							
Capital city	Country	RCP			BU	Main effects			Inter.			IV	RV
		2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3		
Amman	Jordan	**1.6**	**2.8**	**5.0**	0.8	3	20	74	1	0	1	0	0
Algiers	Algeria	**1.2**	**2.1**	**3.6**	0.7	2	29	67	0	0	1	0	0
Amsterdam	Netherlands	**1.0**	**1.7**	**3.0**	0.8	9	30	56	2	0	1	1	1
Andorra la Vella	Andorra	**1.4**	**2.8**	**5.1**	1.1	13	17	64	2	1	2	0	1
Ankara	Turkey	**1.9**	**3.2**	**5.7**	1.1	7	23	67	0	0	1	0	0
Athens	Greece	**1.6**	**2.8**	**5.0**	0.9	10	19	68	1	0	1	0	1
Bayrut	Lebanon	**1.3**	**2.1**	**3.7**	0.6	1	22	75	0	0	1	0	0
Belgrade	Serbia and M.	**1.7**	**2.9**	**5.0**	1.3	18	22	52	3	1	2	1	1
Berlin	Germany	**1.2**	**2.0**	**3.5**	1.0	24	24	45	3	0	2	1	2
Bern	Switzerland	**1.3**	**2.4**	**4.3**	1.3	22	22	48	4	1	1	1	2
Bratislava	Slovakia	**1.5**	**2.5**	**4.3**	1.3	25	24	44	2	1	2	1	2
Brussels	Belgium	**1.0**	**1.9**	**3.4**	0.9	17	22	53	3	1	1	1	1
Bucharest	Romania	**1.7**	**3.0**	**5.2**	1.2	16	21	57	2	1	2	0	1
Budapest	Hungary	**1.6**	**2.7**	**4.6**	1.4	27	22	44	2	1	2	1	2
Cairo	Egypt	**1.6**	**2.7**	**4.7**	0.8	2	25	71	1	0	1	0	0
Chisinau	Moldova	**1.8**	**2.8**	**4.9**	1.3	22	23	49	2	1	2	1	1
Copenhagen	Denmark	**1.2**	**2.0**	**3.3**	0.8	13	30	52	1	0	2	1	1
Damascus	Syria	**1.6**	**3.0**	**5.3**	0.8	2	18	77	0	0	1	0	0
Douglas	Isle of Man	**0.8**	**1.5**	**2.7**	0.7	7	34	54	1	0	2	1	1
Dublin	Ireland	**0.7**	**1.5**	**2.8**	0.7	8	29	59	1	0	1	1	1
Gibraltar	Gibraltar	**0.9**	**1.8**	**3.0**	0.5	7	12	76	1	0	1	1	1
Helsinki	Finland	**1.6**	**2.5**	**4.0**	0.9	15	26	52	1	1	2	1	2
Jerusalem	Israel	**1.5**	**2.7**	**4.8**	0.8	4	22	71	1	0	1	0	0
Kiev	Ukraine	**1.7**	**2.6**	**4.5**	1.3	29	20	43	2	1	2	1	2
Lisbon	Portugal	**0.9**	**1.9**	**3.3**	0.4	4	9	83	1	0	1	1	1
Ljubljana	Slovenia	**1.5**	**2.7**	**4.7**	1.4	23	24	46	3	1	1	1	2
London	UK	**0.9**	**1.8**	**3.3**	0.8	13	22	59	2	0	2	1	1
Luxemburg	Luxembourg	**1.2**	**2.1**	**3.8**	1.1	24	18	50	3	1	1	1	2
Madrid	Spain	**1.4**	**3.0**	**5.6**	1.0	8	16	72	1	0	1	0	1
Minsk	Belarus	**1.7**	**2.5**	**4.1**	1.3	34	20	39	2	1	2	1	2
Monaco-Ville	Monaco	**1.3**	**2.6**	**4.6**	0.9	7	20	67	2	1	1	0	1
Nicosia	Cyprus	**1.5**	**2.6**	**4.6**	0.7	1	18	79	0	0	1	0	0
Oslo	Norway	**1.3**	**2.2**	**3.6**	0.9	19	23	55	1	0	1	1	1
Paris	France	**1.0**	**2.0**	**3.8**	1.0	19	17	56	3	1	2	1	2
Prague	Czech Republic	**1.4**	**2.3**	**3.9**	1.2	26	26	41	3	1	1	1	2
Rabat	Morocco	**0.8**	**1.7**	**2.9**	0.5	6	10	76	2	1	2	1	2
Riga	Latvia	**1.5**	**2.3**	**3.8**	1.0	17	28	48	2	1	2	1	2
Rome	Italy	**1.4**	**2.7**	**4.7**	0.9	8	16	69	2	0	1	0	1
Saint Helier	Jersey	**0.9**	**1.7**	**3.0**	0.6	7	26	64	1	0	1	1	0
Saint Peter Port	Guernsey and A.	**0.8**	**1.6**	**2.8**	0.6	1	27	69	0	0	1	1	0
San Marino	San Marino	**1.4**	**2.8**	**4.9**	1.3	16	22	56	3	1	2	0	1
Sarajevo	Bosnia and H.	**1.6**	**2.8**	**5.0**	1.4	19	25	51	2	0	1	0	1
Skopje	Macedonia	**1.7**	**3.1**	**5.5**	1.3	11	25	60	1	0	1	0	1
Sofia	Bulgaria	**1.7**	**3.1**	**5.4**	1.3	12	25	59	1	0	1	0	1
Stockholm	Sweden	**1.4**	**2.3**	**3.7**	0.9	16	26	52	2	0	2	1	1
Tallinn	Estonia	**1.6**	**2.5**	**3.9**	0.9	12	30	51	1	1	2	1	1
Tirana	Albania	**1.6**	**3.0**	**5.3**	1.1	12	18	64	2	1	1	0	1
Torshavn	Faroe Islands	0.5	**1.4**	**2.2**	0.6	2	34	59	1	0	2	1	1
Tripoli	Libya	**1.5**	**2.5**	**4.5**	0.8	2	22	72	1	0	2	0	1
Tunis	Tunisia	**1.4**	**2.5**	**4.4**	0.8	4	20	73	1	0	1	0	1
Vaduz	Liechtenstein	**1.4**	**2.5**	**4.4**	1.2	19	22	51	4	1	1	1	2
Valletta	Malta	**1.5**	**2.5**	**4.3**	0.7	4	23	71	1	0	1	0	0
Vatican City	Vatican City	**1.4**	**2.7**	**4.7**	0.9	8	16	69	2	0	1	0	1
Vienna	Austria	**1.4**	**2.4**	**4.2**	1.3	25	25	44	3	1	1	1	2
Vilnius	Lithuania	**1.6**	**2.4**	**4.0**	1.2	30	24	39	2	1	2	1	2
Warsaw	Poland	**1.5**	**2.4**	**3.9**	1.3	31	24	38	2	1	2	1	2
Zagreb	Croatia	**1.5**	**2.7**	**4.8**	1.4	23	20	49	3	1	1	1	2

Table S16. Relative changes of total precipitation in summer (JJA) in the near future (2021-2050) compared to the period 1981-2010 (see legend of Table S10 for further details).

		BM_k & BU (%)				% Total variance							
		RCP			BU	Main effects			Inter.				
Capital city	Country	2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3	IV	RV
Amman	Jordan	-16	-18	-13	43	11	23	0	9	1	3	49	6
Algiers	Algeria	2	3	-4	21	8	33	2	13	3	5	30	6
Amsterdam	Netherlands	-1	-2	-2	8	31	17	0	14	3	3	22	9
Andorra la Vella	Andorra	-1	-7	-8	8	12	33	12	9	4	6	19	6
Ankara	Turkey	-8	-12	-13	14	17	23	3	13	2	7	29	6
Athens	Greece	-3	-6	-17	19	15	17	9	12	3	7	32	6
Bayrut	Lebanon	-4	-7	-13	38	4	22	1	14	1	6	41	11
Belgrade	Serbia and M.	-1	-5	-7	10	21	26	5	10	1	5	25	7
Berlin	Germany	-0	0	1	9	28	25	0	6	3	3	22	13
Bern	Switzerland	-1	-3	-5	8	25	41	3	11	2	2	13	3
Bratislava	Slovakia	-0	-2	0	8	17	29	1	8	2	4	31	8
Brussels	Belgium	-4	-5	-6	8	32	29	1	11	2	1	17	5
Bucharest	Romania	-2	-6	-7	12	6	41	4	11	1	4	24	7
Budapest	Hungary	-1	-3	-2	9	19	27	1	11	3	3	30	7
Cairo	Egypt	-17	-8	-20	108	7	13	0	13	1	8	44	13
Chisinau	Moldova	-1	-5	-6	9	14	30	5	7	3	3	33	4
Copenhagen	Denmark	-1	1	1	9	26	36	1	6	1	4	20	5
Damascus	Syria	2	-24	0	139	7	3	1	9	3	4	55	18
Douglas	Isle of Man	-2	-2	-5	7	40	16	4	10	2	5	17	5
Dublin	Ireland	-4	-3	**-6**	6	20	22	4	10	1	8	27	8
Gibraltar	Gibraltar	5	-3	-9	21	26	14	7	7	3	5	33	6
Helsinki	Finland	1	6	7	9	24	30	7	5	1	6	21	6
Jerusalem	Israel	-18	-19	-13	42	17	19	0	9	1	7	39	7
Kiev	Ukraine	-1	-2	-2	11	19	37	0	13	1	2	24	4
Lisbon	Portugal	-6	**-18**	**-24**	14	10	12	22	6	4	8	33	5
Ljubljana	Slovenia	-2	-5	-5	9	25	33	2	7	1	4	22	7
London	UK	-1	-3	-4	8	32	23	3	10	1	5	22	5
Luxemburg	Luxembourg	-4	-4	-6	7	22	30	1	12	2	4	22	7
Madrid	Spain	-2	-7	-12	14	17	40	8	6	1	2	22	4
Minsk	Belarus	-3	1	1	9	12	35	3	13	1	3	23	9
Monaco-Ville	Monaco	-0	-8	-8	14	19	31	7	10	2	5	21	5
Nicosia	Cyprus	-6	-21	-11	44	4	20	2	9	1	3	49	11
Oslo	Norway	-1	1	1	9	43	25	1	4	1	3	19	4
Paris	France	-4	-5	-7	8	36	20	2	9	3	2	21	7
Prague	Czech Republic	1	1	2	8	19	27	0	12	2	3	26	12
Rabat	Morocco	1	0	-3	26	6	42	0	5	0	3	41	3
Riga	Latvia	2	4	5	9	26	32	2	7	1	4	20	8
Rome	Italy	-0	-10	-12	15	20	30	10	9	1	6	18	5
Saint Helier	Jersey	-2	-4	-6	8	26	14	5	17	2	4	24	8
Saint Peter Port	Guernsey and A.	-1	-3	-6	8	30	12	6	13	3	5	25	7
San Marino	San Marino	1	-5	-6	14	17	39	4	11	2	6	16	6
Sarajevo	Bosnia and H.	-2	-7	-9	10	22	25	7	11	1	5	22	6
Skopje	Macedonia	-4	-9	-11	14	22	21	5	10	1	4	28	10
Sofia	Bulgaria	-4	-8	**-11**	10	13	34	8	9	1	6	21	8
Stockholm	Sweden	1	2	3	9	27	32	1	7	1	6	20	6
Tallinn	Estonia	1	5	6	9	23	31	6	8	1	4	19	8
Tirana	Albania	-2	-11	-13	13	16	25	11	15	3	8	18	5
Torshavn	Faroe Islands	-0	1	-1	6	36	28	3	7	2	2	18	3
Tripoli	Libya	7	-4	-13	27	17	6	9	14	6	3	38	8
Tunis	Tunisia	-3	-13	-16	19	19	28	8	10	2	5	25	3
Vaduz	Liechtenstein	-2	-3	-3	8	23	40	1	13	2	3	14	5
Valletta	Malta	2	-9	-12	24	12	20	6	12	2	3	41	5
Vatican City	Vatican City	-0	-10	-12	15	20	30	10	9	1	6	18	5
Vienna	Austria	-1	0	1	8	13	35	1	10	3	2	32	5
Vilnius	Lithuania	-1	0	1	8	20	32	1	12	2	4	20	8
Warsaw	Poland	0	1	2	9	27	32	1	9	1	2	20	8
Zagreb	Croatia	-3	-5	-6	9	20	34	2	8	1	4	26	5

Table S17. Relative changes of total precipitation in summer (JJA) at the end of the century (2071-2099) compared to the period 1981-2010 (see legend of Table S10 for further details).

		BM_k & BU (%)				% Total variance							
Capital city	Country	RCP			BU	Main effects			Inter.			IV	RV
		2.6	4.5	8.5		RCM	GCM	RCP	I1	I2	I3		
Amman	Jordan	-24	-5	-24	85	6	33	1	25	2	5	12	15
Algiers	Algeria	5	8	-16	40	10	43	7	11	4	10	8	7
Amsterdam	Netherlands	-1	-4	-9	16	44	17	3	10	3	5	5	13
Andorra la Vella	Andorra	-5	-13	**-25**	16	16	35	20	8	4	6	4	6
Ankara	Turkey	-14	-20	**-33**	25	10	37	9	14	3	10	8	9
Athens	Greece	2	-8	**-40**	31	9	15	25	7	10	11	10	13
Bayrut	Lebanon	-24	-3	-32	67	8	35	3	20	3	6	13	12
Belgrade	Serbia and M.	-1	-9	-17	18	26	23	11	11	3	7	7	10
Berlin	Germany	-1	0	1	19	31	37	0	6	2	6	5	13
Bern	Switzerland	-0	-5	-12	17	30	39	8	11	2	4	3	4
Bratislava	Slovakia	2	-3	-1	17	21	39	1	13	2	6	8	10
Brussels	Belgium	-4	-10	-14	18	39	30	5	9	3	2	4	8
Bucharest	Romania	-2	-11	-17	20	12	38	9	11	3	6	8	13
Budapest	Hungary	0	-5	-7	18	20	31	3	14	3	9	8	13
Cairo	Egypt	-9	-1	-35	242	9	19	0	19	3	16	9	25
Chisinau	Moldova	-4	-8	-15	18	13	46	6	8	4	4	9	9
Copenhagen	Denmark	-2	2	1	19	29	42	0	9	2	5	5	8
Damascus	Syria	35	2	44	392	14	6	0	16	7	7	7	43
Douglas	Isle of Man	-1	-3	-12	14	45	12	10	10	5	6	5	7
Dublin	Ireland	-6	-8	**-14**	11	23	25	9	13	2	10	7	11
Gibraltar	Gibraltar	6	-16	-30	37	19	22	14	6	6	13	10	9
Helsinki	Finland	1	11	15	19	31	34	9	4	1	7	5	8
Jerusalem	Israel	-33	-12	-20	73	16	37	1	8	2	10	13	12
Kiev	Ukraine	-2	-6	-6	20	25	41	1	15	2	4	7	5
Lisbon	Portugal	-11	**-36**	**-58**	22	11	17	43	4	3	6	10	7
Ljubljana	Slovenia	-3	-8	-16	19	35	29	8	9	2	6	5	8
London	UK	-1	-8	-12	15	42	22	9	8	2	5	6	7
Luxemburg	Luxembourg	-8	-11	-16	16	29	40	3	8	4	4	4	7
Madrid	Spain	-6	-16	**-34**	25	18	44	18	7	1	2	7	4
Minsk	Belarus	-6	-1	-1	18	24	40	2	13	2	4	6	9
Monaco-Ville	Monaco	4	-17	-24	27	26	23	17	11	2	7	5	8
Nicosia	Cyprus	-7	-40	-24	101	8	19	2	14	6	8	9	34
Oslo	Norway	-2	1	2	18	49	30	1	5	2	4	4	6
Paris	France	-6	-12	**-19**	17	39	25	9	8	4	3	4	8
Prague	Czech Republic	1	1	1	15	26	35	0	12	2	5	6	14
Rabat	Morocco	2	1	-17	38	10	41	5	4	4	8	19	10
Riga	Latvia	1	5	8	18	28	45	3	7	1	4	5	8
Rome	Italy	5	-16	**-30**	29	25	25	20	10	3	7	4	7
Saint Helier	Jersey	-1	-9	**-20**	17	30	20	16	12	2	5	5	10
Saint Peter Port	Guernsey and A.	0	-6	**-18**	17	32	18	18	11	3	4	5	8
San Marino	San Marino	4	-6	-17	26	23	31	9	13	4	7	4	9
Sarajevo	Bosnia and H.	-3	-13	**-22**	19	28	23	14	12	2	6	5	9
Skopje	Macedonia	-6	-13	**-25**	23	30	17	10	13	2	5	10	12
Sofia	Bulgaria	-7	**-19**	**-27**	18	13	37	17	9	1	6	6	11
Stockholm	Sweden	2	5	6	18	35	35	1	7	1	6	5	9
Tallinn	Estonia	-2	6	12	21	27	40	6	7	1	5	4	10
Tirana	Albania	-1	-21	**-34**	25	20	18	22	15	3	10	4	7
Torshavn	Faroe Islands	-2	2	-3	12	42	33	4	6	2	3	5	5
Tripoli	Libya	17	-14	-44	44	19	4	24	14	10	6	12	11
Tunis	Tunisia	-6	-22	**-40**	33	21	26	14	12	2	10	8	7
Vaduz	Liechtenstein	-3	-5	-10	17	28	43	3	12	3	3	3	5
Valletta	Malta	10	-16	-30	39	13	19	16	14	6	6	13	14
Vatican City	Vatican City	5	-16	**-30**	29	25	25	20	10	3	7	4	7
Vienna	Austria	1	0	-1	15	19	44	0	12	4	3	9	9
Vilnius	Lithuania	-5	-1	0	18	27	43	1	10	2	5	5	7
Warsaw	Poland	2	0	2	20	30	43	0	10	1	3	4	9
Zagreb	Croatia	-4	-8	-16	17	30	34	7	7	2	7	6	6

6 Differences between "balanced" and direct estimates of mean projected changes

Table S18. Difference between "balanced" estimates BM_k of mean expected change response (in °C), and corresponding direct estimates M_k for the three regions taken from the IPCC SREX report (Seneviratne et al., 2012), for absolute changes of mean temperature in winter (DJF) and summer (JJA) at the end of the century (2071-2099) compared to the period 1981-2010.

Season	DJF			JJA		
Country	BM_k-M_k			BM_k-M_k		
	2.6	4.5	8.5	2.6	4.5	8.5
NEU	-0.1	-0.2	-0.3	0.1	0.1	-0.1
CEU	-0.2	-0.2	-0.4	0.5	0.5	0.2
MED	0.1	-0.1	-0.2	0.2	0.3	-0.0

Table S19. Difference between "balanced" estimates BM_k of mean expected change response (in %), and corresponding direct estimates M_k for the three regions taken from the IPCC SREX report (Seneviratne et al., 2012), for relative changes of total precipitation in winter (DJF) and summer (JJA) at the end of the century (2071-2099) compared to the period 1981-2010.

Season	DJF			JJA		
Country	BM_k-M_k			BM_k-M_k		
	2.6	4.5	8.5	2.6	4.5	8.5
NEU	-0	-2	-2	-2	-4	-3
CEU	0	-2	-2	-4	-9	-4
MED	-0	-3	1	-4	-7	-3

Table S20. Difference between “balanced" estimates BM_k of mean expected change response (in $^\circ$C), and corresponding direct estimates M_k for the countries of the domain, for absolute changes of mean temperature in winter (DJF) and summer (JJA) at the end of the century (2071-2099) compared to the period 1981-2010.

Season	DJF			JJA		
Country	BM_k-M_k			BM_k-M_k		
	2.6	4.5	8.5	2.6	4.5	8.5
Algeria	0.1	-0.1	-0.2	0.2	0.1	-0.0
Albania	0.1	-0.1	-0.2	0.3	0.4	0.1
Bosnia and H.	0.0	-0.1	-0.3	0.5	0.6	0.2
Bulgaria	0.1	-0.1	-0.2	0.5	0.5	0.2
Cyprus	0.1	-0.1	-0.1	0.1	0.1	-0.1
Denmark	-0.1	-0.2	-0.4	0.2	0.3	-0.1
Ireland	-0.1	-0.3	-0.3	0.1	0.0	-0.1
Estonia	-0.4	-0.2	-0.5	0.4	0.3	0.0
Austria	-0.1	-0.2	-0.4	0.4	0.5	0.1
Czech Rep.	-0.1	-0.2	-0.4	0.4	0.6	0.2
Finland	-0.2	-0.1	-0.3	0.3	0.3	-0.0
France	-0.1	-0.2	-0.4	0.2	0.3	0.0
Germany	-0.1	-0.2	-0.5	0.3	0.4	0.1
Greece	0.1	-0.1	-0.2	0.3	0.4	0.1
Croatia	0.0	-0.1	-0.3	0.5	0.6	0.2
Hungary	-0.0	-0.1	-0.3	0.6	0.7	0.2
Israel	0.2	-0.2	-0.1	0.3	0.3	-0.0
Italy	0.0	-0.1	-0.3	0.3	0.4	0.1
Jordan	0.2	-0.1	-0.1	0.3	0.3	-0.0
Lebanon	0.2	-0.2	-0.1	0.3	0.3	-0.0
Latvia	-0.4	-0.2	-0.5	0.5	0.4	0.1
Belarus	-0.4	-0.2	-0.5	0.6	0.6	0.2
Lithuania	-0.4	-0.2	-0.5	0.5	0.4	0.1
Slovakia	-0.1	-0.3	-0.4	0.6	0.7	0.3
Macedonia	0.1	-0.2	-0.2	0.4	0.5	0.2
Morocco	-0.0	-0.2	-0.2	0.1	0.1	-0.2
Netherlands	-0.1	-0.3	-0.4	0.2	0.2	-0.1
Norway	-0.1	-0.2	-0.3	0.3	0.2	-0.1
Poland	-0.3	-0.3	-0.5	0.5	0.6	0.2
Portugal	-0.0	-0.1	-0.3	-0.1	0.2	-0.1
Romania	-0.0	-0.1	-0.3	0.6	0.7	0.3
Moldova	-0.1	-0.1	-0.3	0.6	0.7	0.3
Slovenia	-0.1	-0.2	-0.4	0.5	0.6	0.2
Spain	-0.0	-0.1	-0.3	0.1	0.2	-0.1
Sweden	-0.3	-0.3	-0.4	0.3	0.2	-0.0
Switzerland	-0.1	-0.2	-0.4	0.3	0.3	0.1
Tunisia	0.0	-0.1	-0.2	0.2	0.1	-0.0
Turkey	0.2	-0.2	-0.1	0.3	0.4	0.1
UK	-0.1	-0.3	-0.4	0.1	0.1	-0.1
Ukraine	-0.1	-0.1	-0.3	0.6	0.6	0.3

Table S21. Difference between “balanced" estimates BM_k of mean expected change response (in %), and corresponding direct estimates M_k for the countries of the domain, for relative changes of total precipitation in winter (DJF) and summer (JJA) at the end of the century (2071-2099) compared to the period 1981-2010.

Season	DJF			JJA		
Country	BM_k-M_k			BM_k-M_k		
	2.6	4.5	8.5	2.6	4.5	8.5
Algeria	2	2	6	-9	-4	-2
Albania	2	0	3	-3	-6	-3
Bosnia and H.	1	-0	3	-4	-8	-2
Bulgaria	3	-1	4	-4	-8	-6
Cyprus	-5	-5	-1	-4	-16	-8
Denmark	-1	-2	-3	-1	-6	-5
Ireland	-3	-3	-2	-1	-5	-4
Estonia	-2	-2	-3	-5	-9	-5
Austria	-1	-4	-2	-1	-5	0
Czech Rep.	-1	-2	-2	-2	-6	-2
Finland	1	-3	-2	-2	-4	-3
France	1	-2	-0	-3	-6	-4
Germany	1	-1	-2	-3	-8	-4
Greece	2	-0	5	-4	-4	-5
Croatia	1	-0	2	-3	-8	-2
Hungary	-0	-3	-1	-3	-11	-2
Israel	-9	-2	0	-10	-39	-13
Italy	1	-5	3	-1	-7	-2
Jordan	-6	-1	2	-24	11	-15
Lebanon	-8	-3	-0	-7	-15	-7
Latvia	-1	-2	-3	-4	-9	-6
Belarus	-1	-2	-3	-7	-13	-6
Lithuania	-1	-1	-3	-5	-10	-7
Slovakia	-1	-4	-1	-4	-10	-3
Macedonia	3	-1	5	-4	-5	-3
Morocco	-1	-5	2	-5	7	4
Netherlands	0	-2	-2	-3	-8	-5
Norway	-2	-4	-4	-2	-3	-1
Poland	-2	-2	-3	-3	-10	-6
Portugal	-1	-8	-4	-1	-6	-1
Romania	1	-1	1	-4	-10	-5
Moldova	-2	-7	1	-5	-13	-6
Slovenia	1	-3	1	-2	-8	-1
Spain	-1	-8	-3	-4	-5	-0
Sweden	-1	-5	-3	-0	-4	-2
Switzerland	1	-1	-1	-1	-7	-3
Tunisia	-1	-4	2	-7	-10	-6
Turkey	-1	-3	0	-4	-9	-4
UK	-2	-3	-2	0	-4	-3
Ukraine	-1	-3	-1	-6	-13	-6

Table S22. Difference between “balanced" estimates BM_k of mean expected change response (in °C), and corresponding direct estimates M_k for the capital cities of the domain, for absolute changes of mean temperature in winter (DJF) and summer (JJA) at the end of the century (2071-2099) compared to the period 1981-2010.

Season		DJF			JJA		
Capital city	Country	BM_k-M_k			BM_k-M_k		
		2.6	4.5	8.5	2.6	4.5	8.5
Amman	Jordan	0.3	-0.1	-0.0	0.3	0.4	0.1
Algiers	Algeria	0.0	-0.1	-0.2	0.2	0.2	-0.1
Amsterdam	Netherlands	-0.1	-0.3	-0.4	0.2	0.2	-0.0
Andorra la Vella	Andorra	-0.3	-0.4	-0.5	0.2	0.2	0.1
Ankara	Turkey	0.1	-0.3	-0.1	0.5	0.6	0.3
Athens	Greece	0.1	-0.1	-0.1	0.4	0.3	0.1
Bayrut	Lebanon	0.1	-0.1	-0.1	0.1	0.2	-0.1
Belgrade	Serbia and M.	0.1	-0.0	-0.2	0.6	0.7	0.4
Berlin	Germany	-0.2	-0.2	-0.4	0.4	0.5	0.1
Bern	Switzerland	-0.0	-0.2	-0.4	0.3	0.4	0.2
Bratislava	Slovakia	-0.0	-0.1	-0.3	0.5	0.7	0.2
Brussels	Belgium	-0.1	-0.3	-0.4	0.2	0.3	0.1
Bucharest	Romania	0.0	-0.1	-0.2	0.5	0.6	0.3
Budapest	Hungary	0.0	-0.1	-0.3	0.6	0.7	0.3
Cairo	Egypt	0.1	-0.2	-0.1	0.4	0.4	0.1
Chisinau	Moldova	-0.1	-0.1	-0.3	0.6	0.7	0.3
Copenhagen	Denmark	-0.1	-0.1	-0.3	0.2	0.3	-0.0
Damascus	Syria	0.2	-0.1	-0.0	0.2	0.3	0.0
Douglas	Isle of Man	-0.1	-0.3	-0.3	0.1	0.1	-0.1
Dublin	Ireland	-0.1	-0.3	-0.3	0.0	0.1	-0.1
Gibraltar	Gibraltar	-0.0	-0.1	-0.2	0.1	0.2	-0.0
Helsinki	Finland	-0.4	-0.1	-0.4	0.3	0.3	0.0
Jerusalem	Israel	0.2	-0.1	-0.0	0.3	0.4	0.1
Kiev	Ukraine	-0.2	-0.2	-0.3	0.6	0.6	0.3
Lisbon	Portugal	0.0	-0.1	-0.2	-0.0	0.1	-0.1
Ljubljana	Slovenia	-0.0	-0.1	-0.3	0.5	0.6	0.3
London	UK	-0.1	-0.3	-0.4	0.1	0.2	-0.0
Luxemburg	Luxembourg	-0.1	-0.3	-0.4	0.3	0.5	0.2
Madrid	Spain	0.0	-0.0	-0.2	0.2	0.3	0.0
Minsk	Belarus	-0.3	-0.2	-0.4	0.7	0.6	0.3
Monaco-Ville	Monaco	0.1	-0.1	-0.2	0.2	0.4	0.1
Nicosia	Cyprus	0.1	-0.1	-0.1	0.1	0.2	-0.1
Oslo	Norway	-0.3	-0.4	-0.5	0.3	0.3	0.1
Paris	France	-0.1	-0.3	-0.4	0.1	0.3	0.1
Prague	Czech Republic	-0.1	-0.2	-0.4	0.4	0.6	0.2
Rabat	Morocco	-0.0	-0.2	-0.2	-0.0	0.1	-0.1
Riga	Latvia	-0.5	-0.2	-0.4	0.4	0.3	0.0
Rome	Italy	0.1	0.0	-0.2	0.2	0.3	0.0
Saint Helier	Jersey	-0.1	-0.3	-0.3	0.1	0.1	-0.1
Saint Peter Port	Guernsey and A.	-0.1	-0.3	-0.3	0.0	0.0	-0.2
San Marino	San Marino	0.0	-0.1	-0.3	0.4	0.5	0.2
Sarajevo	Bosnia and H.	0.0	-0.2	-0.2	0.5	0.5	0.2
Skopje	Macedonia	0.0	-0.2	-0.2	0.4	0.6	0.2
Sofia	Bulgaria	0.1	-0.1	-0.2	0.5	0.6	0.3
Stockholm	Sweden	-0.3	-0.3	-0.4	0.3	0.3	0.0
Tallinn	Estonia	-0.4	-0.1	-0.4	0.3	0.2	-0.0
Tirana	Albania	0.1	-0.1	-0.2	0.4	0.5	0.2
Torshavn	Faroe Islands	-0.2	-0.3	-0.3	0.0	-0.0	-0.2
Tripoli	Libya	0.1	-0.1	-0.1	0.2	0.1	0.0
Tunis	Tunisia	0.1	-0.1	-0.2	0.2	0.2	-0.0
Vaduz	Liechtenstein	-0.1	-0.2	-0.4	0.3	0.4	0.2
Valletta	Malta	0.1	-0.0	-0.1	0.3	0.3	0.0
Vatican City	Vatican City	0.1	0.0	-0.2	0.2	0.3	0.0
Vienna	Austria	-0.0	-0.1	-0.3	0.5	0.6	0.2
Vilnius	Lithuania	-0.4	-0.2	-0.4	0.6	0.6	0.2
Warsaw	Poland	-0.3	-0.2	-0.5	0.6	0.7	0.2
Zagreb	Croatia	0.0	-0.1	-0.3	0.5	0.6	0.3

Table S23. Difference between "balanced" estimates BM_k of mean expected change response (in %), and corresponding direct estimates M_k for the capital cities of the domain, for relative changes of total precipitation in winter (DJF) and summer (JJA) at the end of the century (2071-2099) compared to the period 1981-2010.

Season		DJF			JJA		
Capital city	Country	BM_k-M_k			BM_k-M_k		
		2.6	4.5	8.5	2.6	4.5	8.5
Amman	Jordan	-11	-2	-1	-24	-0	-30
Algiers	Algeria	-0	-3	4	0	8	8
Amsterdam	Netherlands	0	-1	-1	-2	-6	-5
Andorra la Vella	Andorra	3	-2	4	-7	-8	-2
Ankara	Turkey	-0	-2	1	-5	-8	-3
Athens	Greece	3	1	8	-3	-1	-10
Bayrut	Lebanon	-7	-2	-0	-15	-38	-12
Belgrade	Serbia and M.	1	-1	2	-6	-10	-7
Berlin	Germany	-0	0	-2	-5	-9	-8
Bern	Switzerland	1	0	-2	1	-6	-4
Bratislava	Slovakia	-1	-4	-0	-5	-11	-3
Brussels	Belgium	1	-1	-1	-4	-8	-6
Bucharest	Romania	4	1	6	-6	-12	-8
Budapest	Hungary	-1	-7	-3	-6	-12	-3
Cairo	Egypt	-8	5	0	-9	-12	-157
Chisinau	Moldova	-2	-7	0	-8	-13	-7
Copenhagen	Denmark	0	-1	-0	-5	-7	-7
Damascus	Syria	-8	-5	-1	53	-90	52
Douglas	Isle of Man	1	-1	1	1	1	-3
Dublin	Ireland	-2	-4	-1	-1	-4	-5
Gibraltar	Gibraltar	2	-6	-1	0	-4	-2
Helsinki	Finland	-2	-2	-4	-4	-4	-3
Jerusalem	Israel	-14	-8	-4	-20	18	-20
Kiev	Ukraine	-1	-6	-1	-9	-12	-7
Lisbon	Portugal	-1	-9	-4	3	-15	-7
Ljubljana	Slovenia	1	-3	0	-3	-10	-3
London	UK	-2	-7	-3	2	-2	-3
Luxemburg	Luxembourg	2	-3	-1	-6	-8	-6
Madrid	Spain	0	-9	-4	-6	-6	2
Minsk	Belarus	-3	-4	-3	-8	-14	-6
Monaco-Ville	Monaco	7	-9	2	-1	-12	-4
Nicosia	Cyprus	-5	-9	-4	3	-28	-9
Oslo	Norway	-0	-5	-1	-1	-6	-3
Paris	France	3	-2	1	-4	-6	-5
Prague	Czech Republic	-2	-3	-3	-2	-6	-3
Rabat	Morocco	-1	-7	1	15	18	6
Riga	Latvia	-1	-2	-3	-3	-9	-5
Rome	Italy	1	-5	4	-1	-11	-6
Saint Helier	Jersey	-1	-5	-2	0	-4	-5
Saint Peter Port	Guernsey and A.	-2	-6	-2	1	-4	-4
San Marino	San Marino	-3	-4	8	-2	-10	-3
Sarajevo	Bosnia and H.	-2	-5	-3	-4	-9	-4
Skopje	Macedonia	4	-3	4	1	-4	-4
Sofia	Bulgaria	1	-2	2	-5	-8	-4
Stockholm	Sweden	-1	-5	-2	-3	-7	-7
Tallinn	Estonia	-3	-2	-4	-7	-10	-8
Tirana	Albania	2	1	2	-1	-10	-5
Torshavn	Faroe Islands	1	-3	-1	-2	-1	-1
Tripoli	Libya	-8	-4	-3	9	9	-8
Tunis	Tunisia	-5	-7	0	-11	-12	-5
Vaduz	Liechtenstein	-2	-2	-4	-4	-8	-4
Valletta	Malta	-3	-4	3	1	-10	4
Vatican City	Vatican City	1	-5	4	-1	-11	-6
Vienna	Austria	-3	-7	-2	-5	-8	-2
Vilnius	Lithuania	-2	-3	-3	-7	-12	-8
Warsaw	Poland	-3	-2	-2	-2	-10	-6
Zagreb	Croatia	2	-2	3	-4	-9	-4

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