

Some like it cold: The heterogeneous temperature-economy relationships of Europe - **SI**

October 21, 2024

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1 Data

Figure S1: Geographical distribution of annual mean temperature (2010-2019). Dashed line indicates area of study.

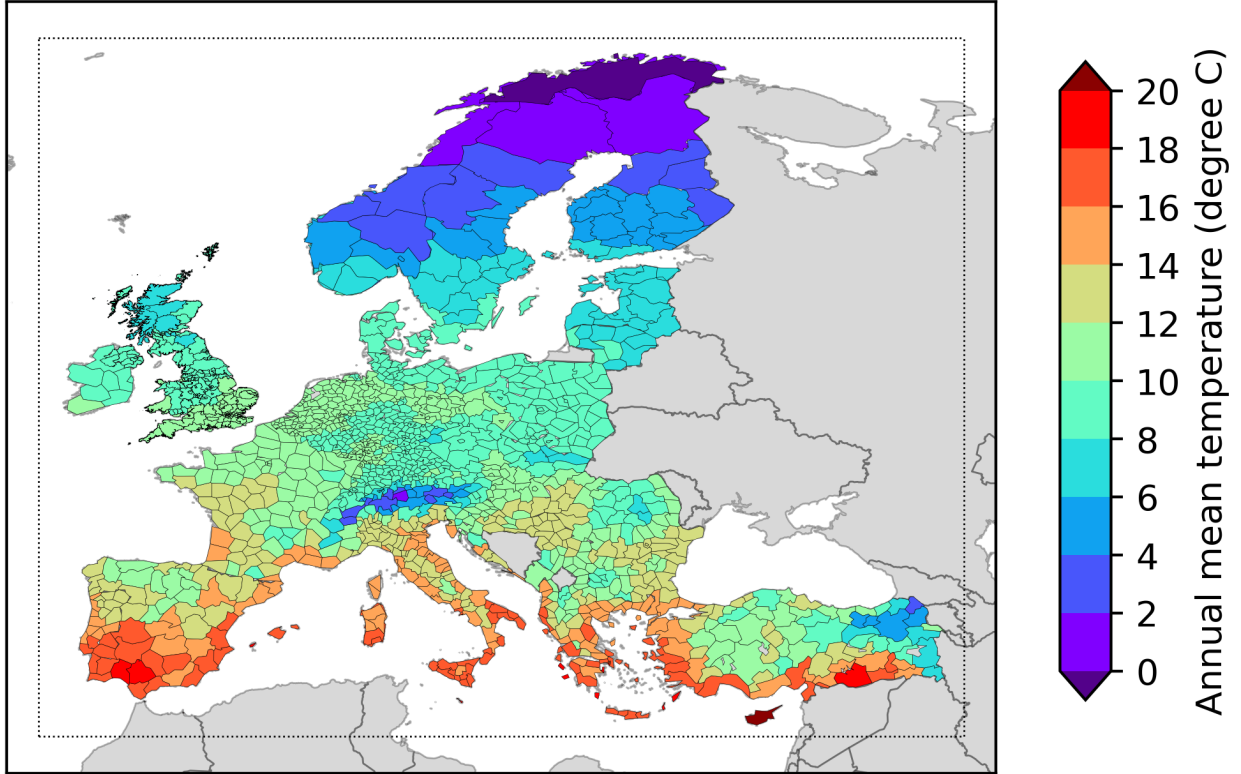


Figure S2: Geographical distribution of GDP in Europe in 2015.

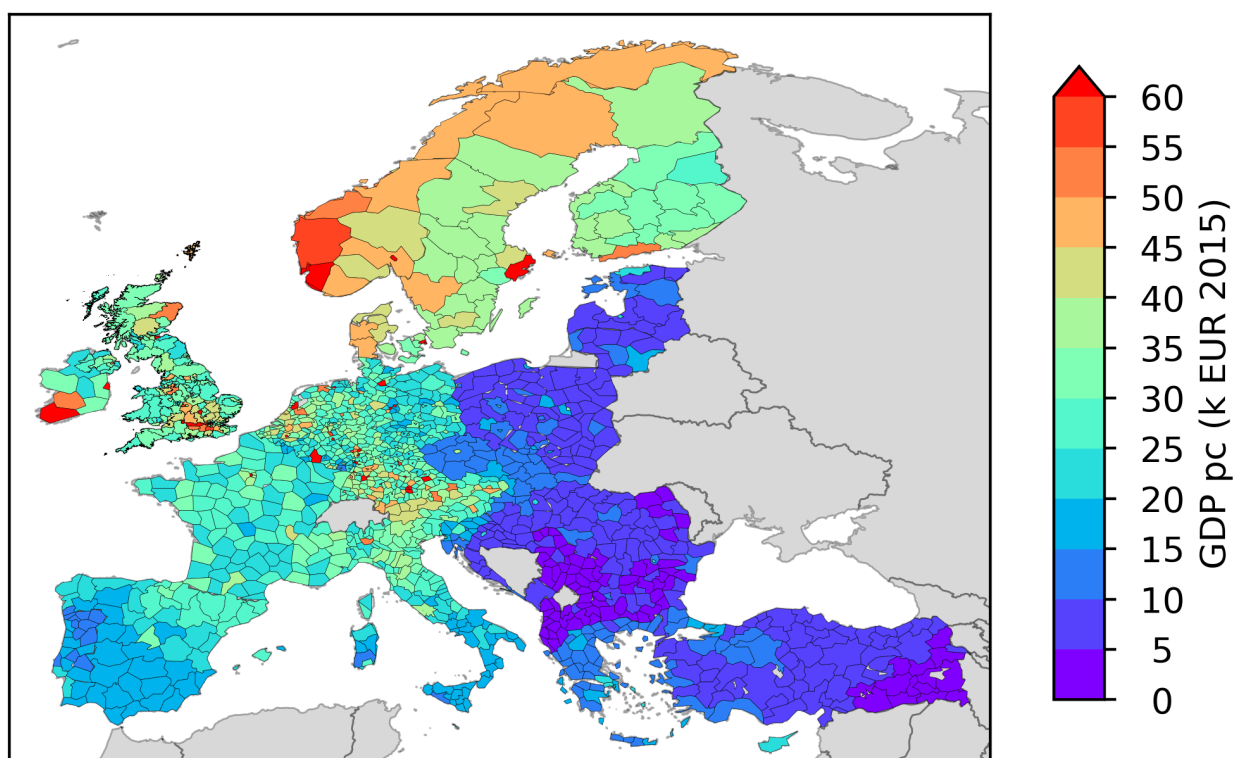


Figure S3: Length of time series of GDP growth rates.

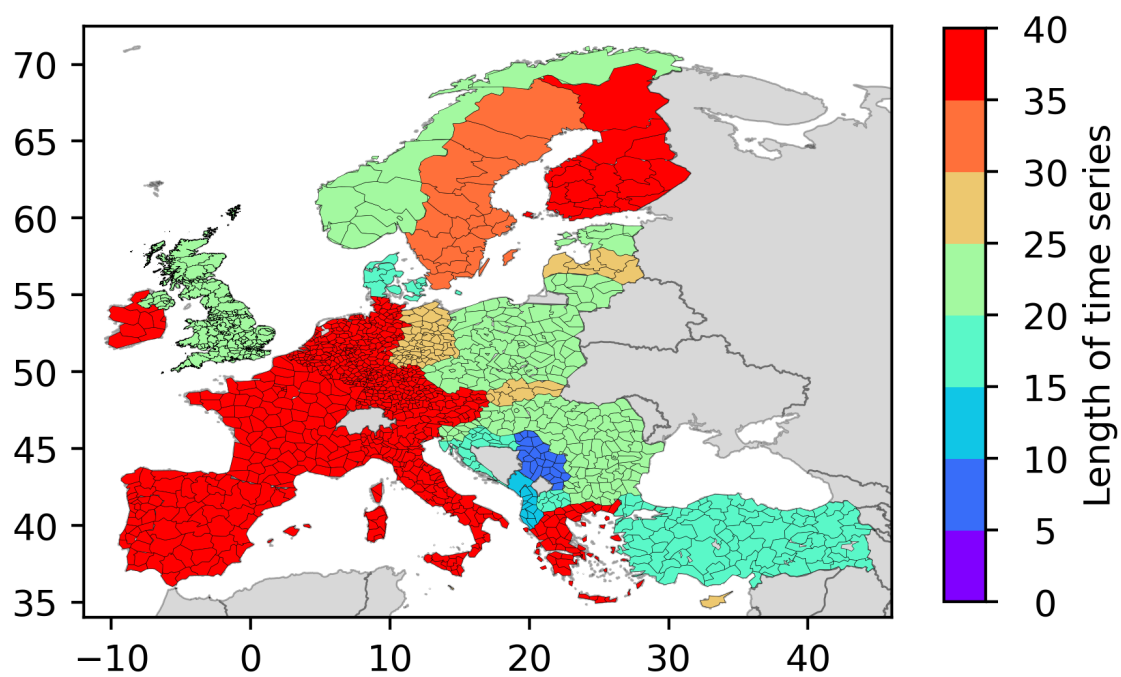


Figure S4: Time series of GDP growth rates. Dashed vertical lines indicates the beginning of the time period that is used for the analysis. See Methods for explanation.

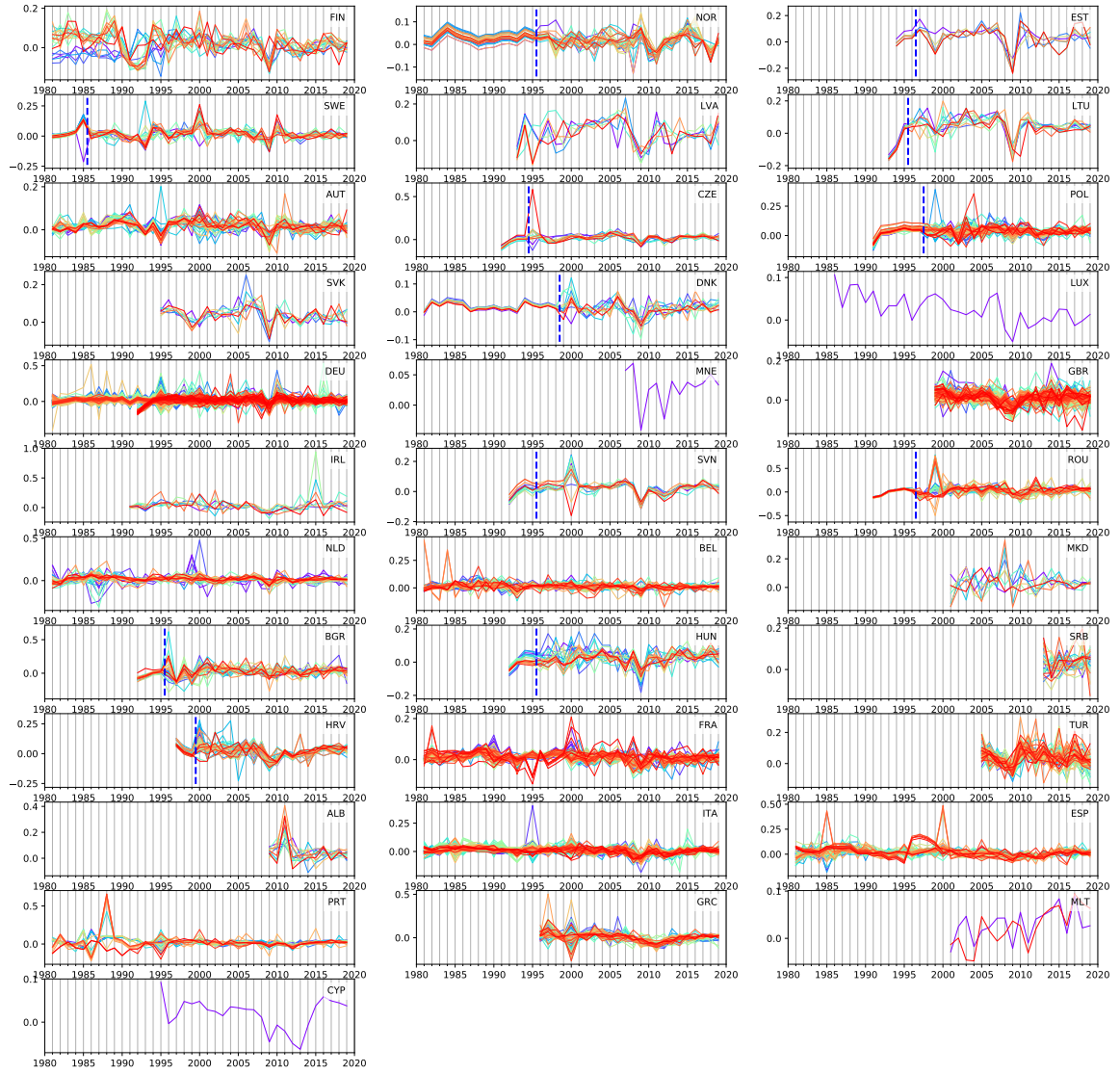


Figure S5: Histograms of daily mean temperature of all districts of a country 1980-2019. Country ISO3 codes with the mean temperature in brackets. Continued in SI Figures S6 and S7.

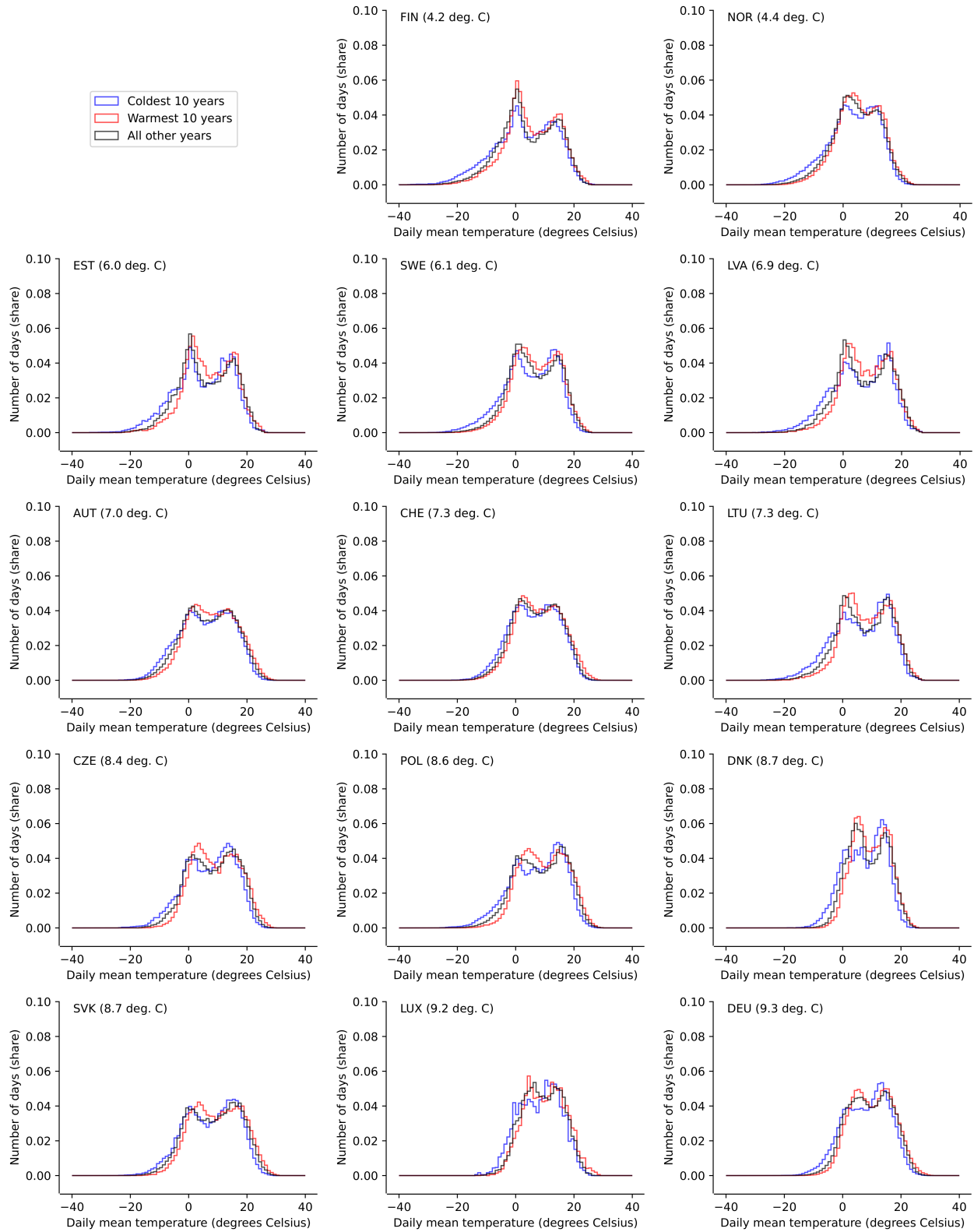


Figure S6: Histograms of daily mean temperature of all districts of a country 1980-2019. Country ISO3 codes with the mean temperature in brackets. Continuation of SI Figure S5. Continued in SI Figure S7.

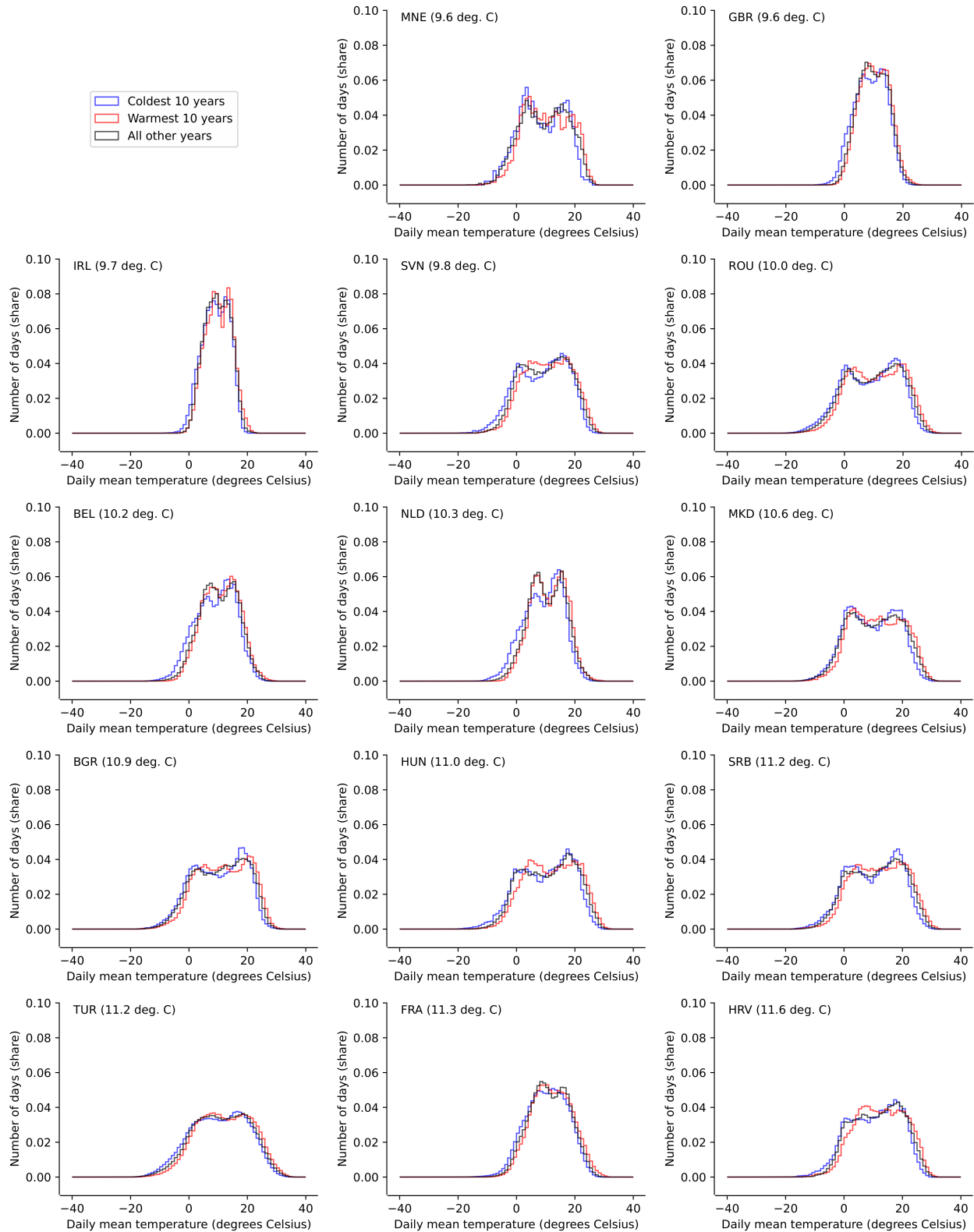
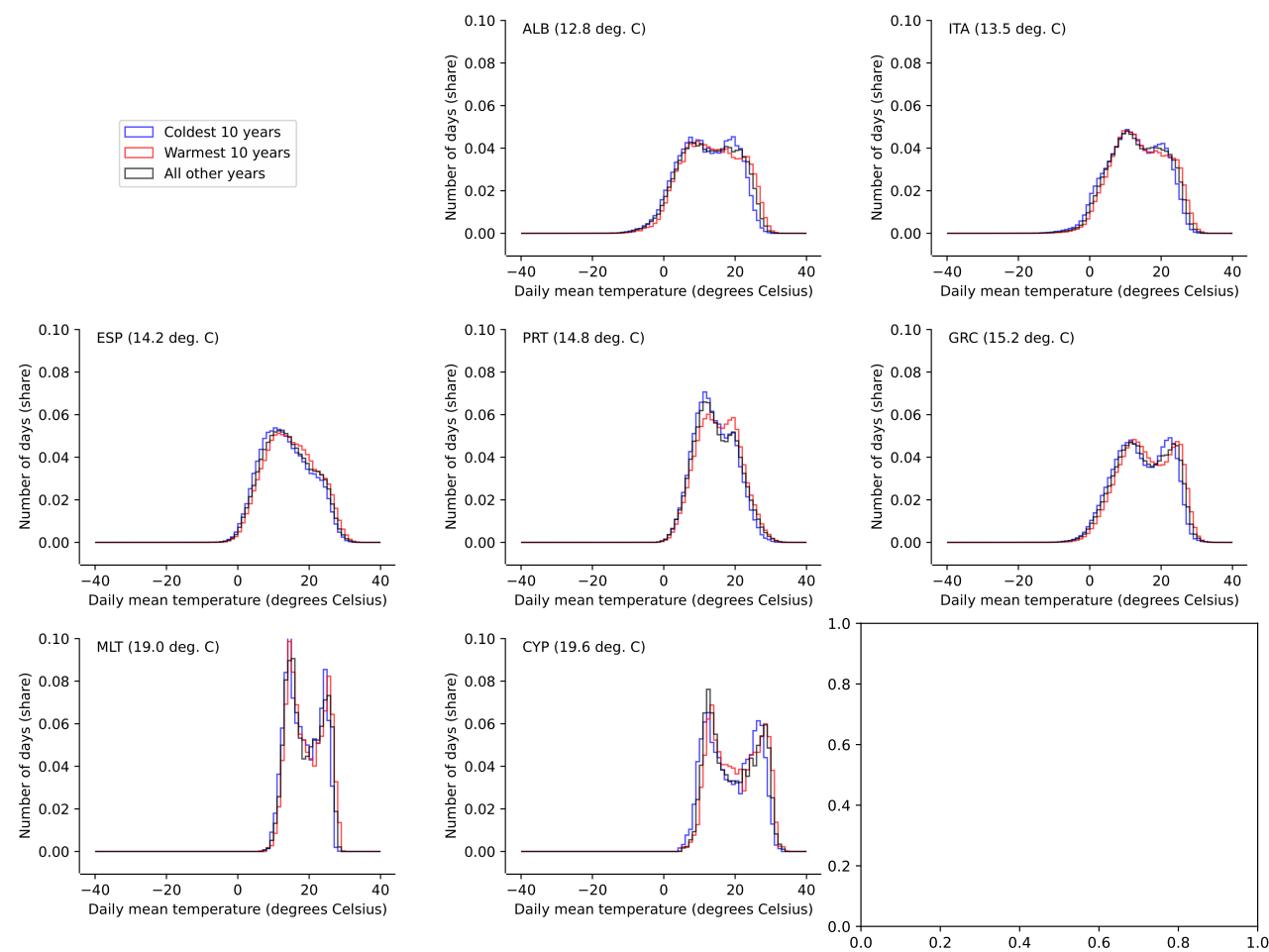


Figure S7: Histograms of daily mean temperature of all districts of a country 1980-2019. Country ISO3 codes with the mean temperature in brackets. Continuation of SI Figure S5 and S6.



Variable	Unit	Mean	Std.	Min.	Max.	No. obs.
Population	k	372.65	497.98	18.69	15293.41	48137
GDP per capita	k 2015 EUR	24.48	18.02	1.34	543.16	48041
Annual mean temperature	deg C	10.35	2.87	-3.67	20.90	54784
Annual total precipitation	m	0.00	0.00	0.00	0.01	54784

Table S1: Descriptive statistics.

2 Additional results

Figure S8: Predicted and marginal effect of annual mean temperature obtained from main specification using our subnational GVA data for Europe.

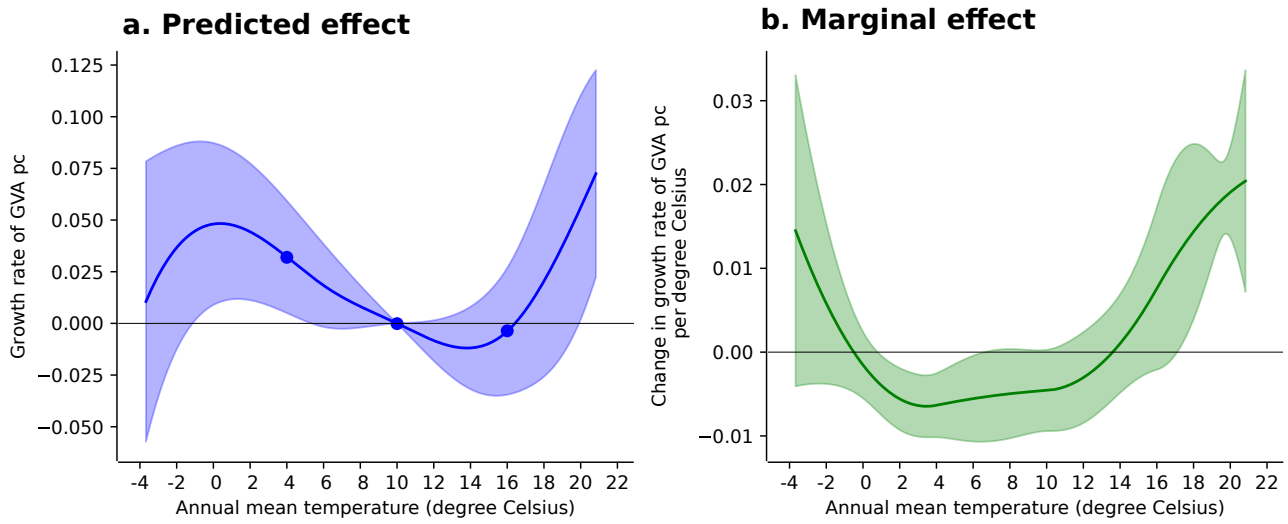


Figure S9: Results with models with different functional forms using our subnational GVA data for Europe.

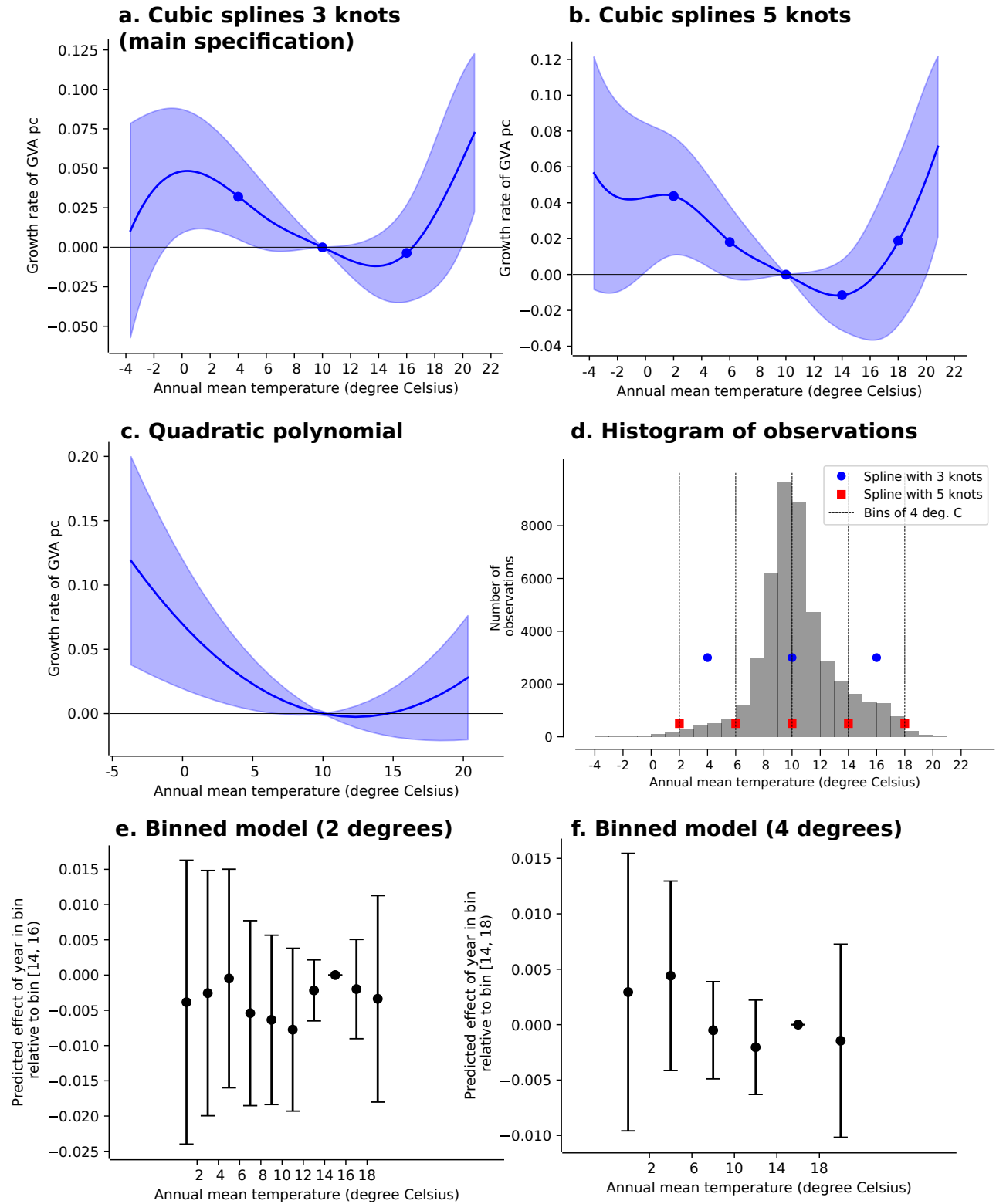


Figure S10: Robustness tests with replication data of Burke et al. 2015 (ref. 1). Dependent variable uses GDP per capita.

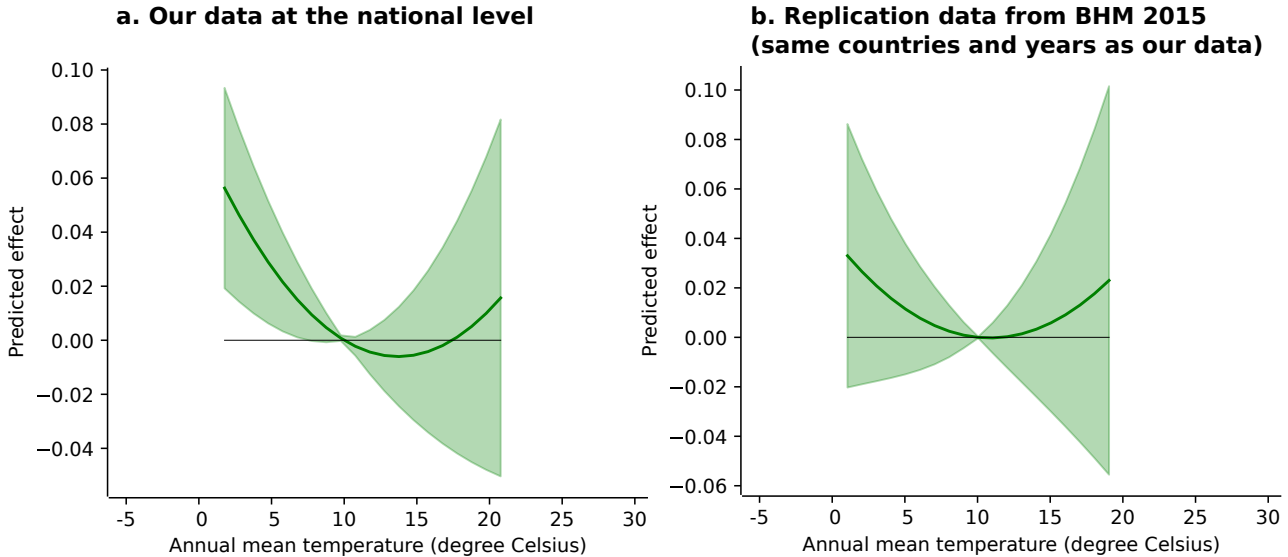


Figure S11: Robustness tests using our subnational data for Europe: GDP instead of GVA, and different time controls.

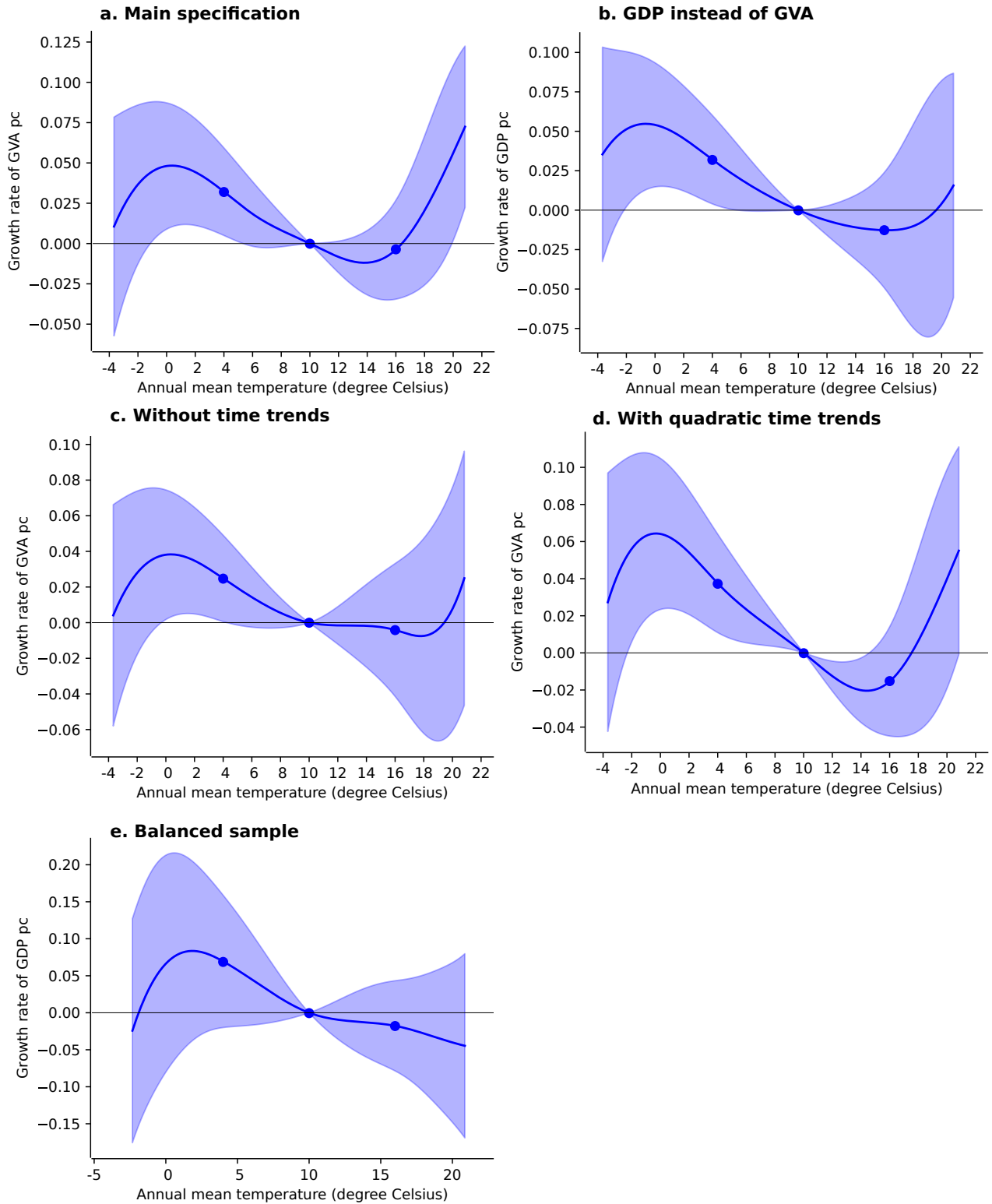


Figure S12: Robustness tests using our subnational data for Europe: main model specification but one estimation for each of 36 different rainfall variables as control.

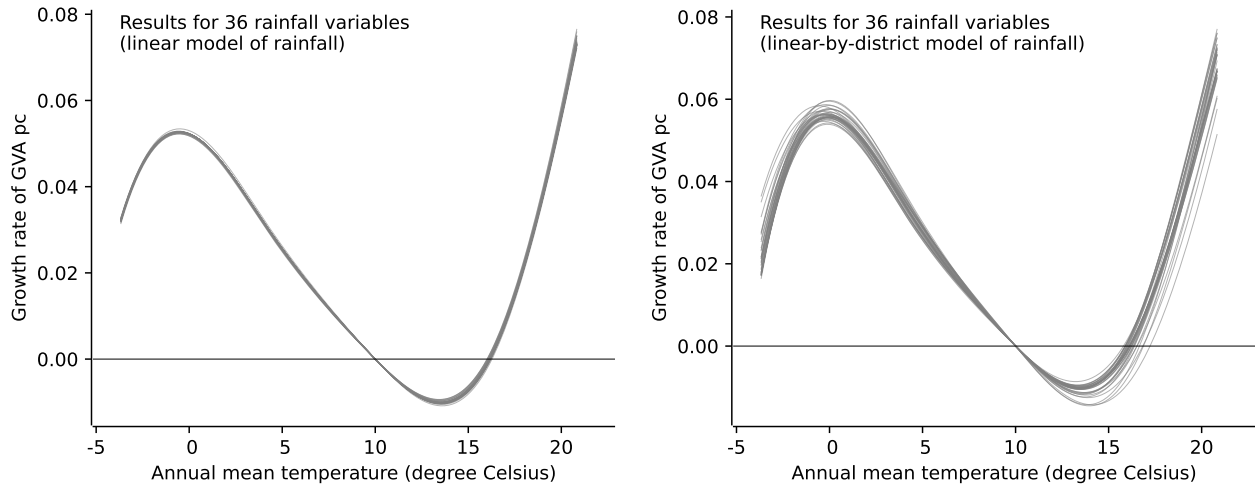


Figure S13: Total costs for Europe for the RCP4.5 scenario (2070-2099 versus 1985-2014). The figure shows the median estimate of the ensemble of climate models, see SI Table S3 for the results of individual climate models. The costs are quantified as the change in the average annual growth rate and expressed in percentage points. See also Figure 2a in manuscript.

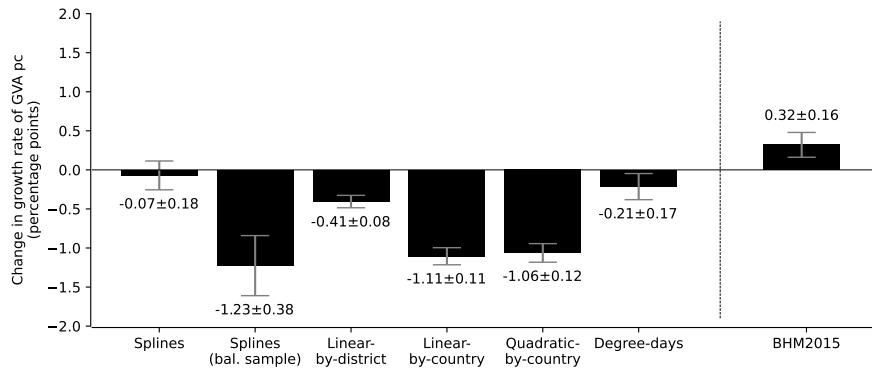
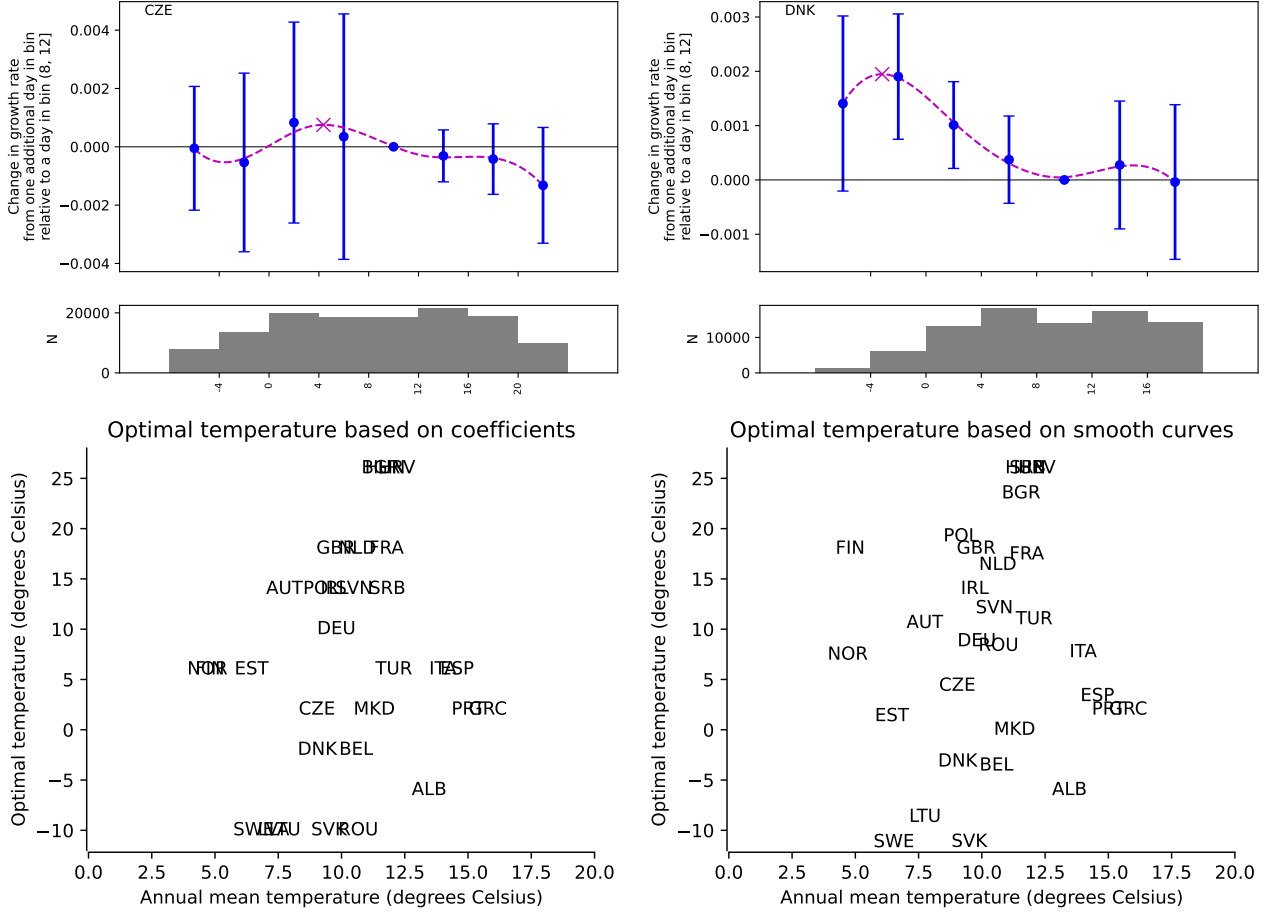


Figure S14: Estimated degree-day models by country (a, b) and extracted daily temperature level with the highest predicted growth rate (c, d). a. Degree-day model for Czech Republic. b. Degree-day model for Denmark. Notes: a. and b. The purple dashed line is a cubic spline fit to the estimated coefficients with weights set to the inverse of their standard errors.



Temperature [deg C]	Number of lags		
	0	2	5
5	-0.008 (0.004)	-0.023 (0.011)	-0.046 (0.021)
10	-0.005 (0.002)	-0.014 (0.007)	-0.027 (0.014)
15	-0.002 (0.003)	-0.005 (0.008)	-0.009 (0.015)
20	0.002 (0.004)	0.005 (0.011)	0.009 (0.023)

Table S2: Cumulative marginal effects based on a quadratic model using our subnational GVA data for Europe.

Model	Costs of future climate change in terms of the average annual growth rate (in percentage points)							
	Warming	Splines	Splines (balanced)	Linear-by-district	Linear-by-country	Quadratic-by-country	DD-by-country	BHM 2015
FGOALS-g3	1.51	-0.33	-0.92	-0.33	-0.80	-0.87	0.03	0.36
MRI-ESM2-0	1.67	-0.03	-0.93	-0.33	-0.81	-0.73	-0.66	0.23
NorESM2-LM	1.82	-0.01	-0.96	-0.34	-0.86	-0.79	-0.45	0.21
MPI-ESM1-2-HR	1.83	-0.18	-1.07	-0.34	-0.90	-0.85	-0.36	0.33
KIOST-ESM	2.03	-0.03	-1.08	-0.30	-0.94	-0.95	-0.13	0.26
MPI-ESM1-2-LR	2.03	-0.16	-1.09	-0.39	-1.00	-1.05	-0.23	0.31
GFDL-ESM4	2.11	-0.22	-1.21	-0.42	-1.08	-1.03	-0.21	0.37
GISS-E2-1-G	2.25	-0.10	-1.23	-0.45	-1.11	-1.08	-0.36	0.32
MIROC6	2.33	0.00	-1.26	-0.41	-1.12	-1.06	-0.58	0.28
BCC-CSM2-MR	2.36	-0.23	-1.25	-0.40	-1.13	-1.25	-0.20	0.37
MIROC-ES2L	2.72	-0.15	-1.40	-0.51	-1.36	-1.56	-0.30	0.35
ACCESS-ESM1-5	3.04	0.14	-1.50	-0.53	-1.46	-1.71	-0.13	0.25
GFDL-CM4	3.26	-0.07	-1.63	-0.64	-1.64	-1.96	0.05	0.37
CMCC-CM2-SR5	3.30	1.76	-1.25	-0.61	-1.52	-3.27	-0.02	-0.66
CMCC-ESM2	3.63	0.06	-1.77	-0.63	-1.74	-2.02	-0.14	0.34
Mean	2.39	0.03	-1.24	-0.44	-1.16	-1.35	-0.25	0.25
Median	2.25	-0.07	-1.23	-0.41	-1.11	-1.06	-0.21	0.32

Table S3: Projected costs of climate change for the RCP4.5 scenario (2070-2099 versus 1985-2014). The costs are quantified as changes in the average annual growth rate between the two periods and shown in percentage points. Notes: DD = degree days. Splines (balanced) refers to the balanced sample that uses only the last 14 years of data.

Figure S15: Projected changes in annual mean temperature for the RCP4.5 scenario. See SI Table S3 for the average warming projected by individual climate models.

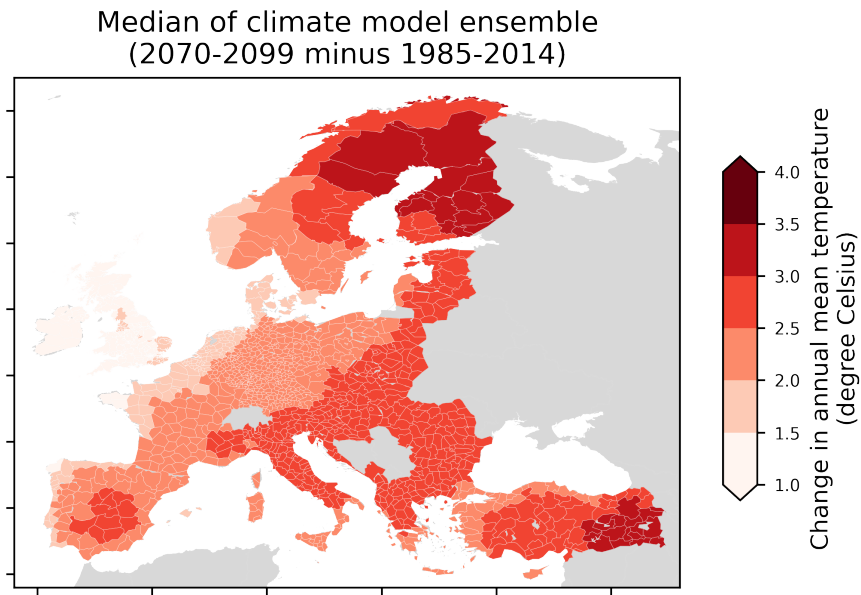


Figure S16: Projected changes in annual mean temperature for the RCP4.5 scenario for the two “coldest” (top row) and the two “warmest” (bottom row) climate models based on the projected average warming in Europe. Note the different scales. See SI Table S3 for the average warming projected by individual climate models.

