

Supplementary Materials

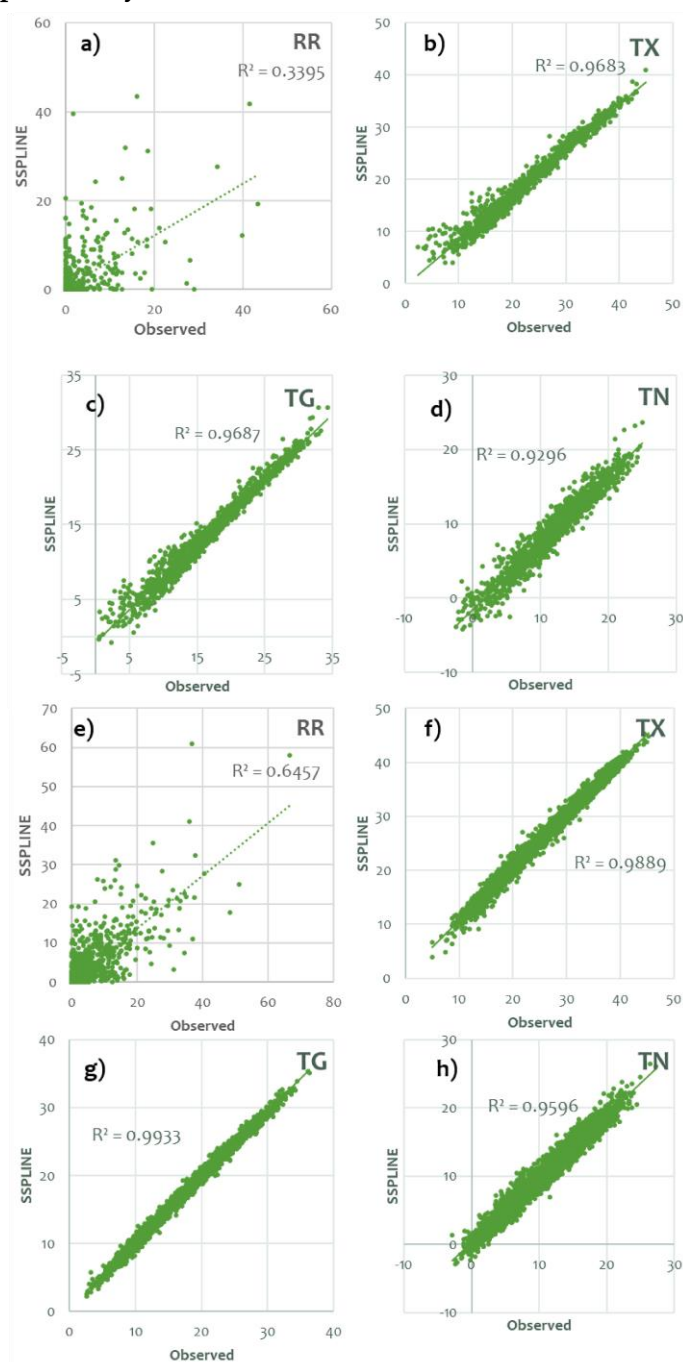


Figure S1. Scatterplots of precipitation (RR, in mm), maximum temperature (TX, in °C), mean temperature (TG, in °C) and minimum temperature (TN, in °C), of observed data and smoothing splines derived from quantile mapping for Quinta do Bomfim (QB) (a, b, c, d) and Herdade do Esporão (HE) plots (e, f, g, h), respectively.

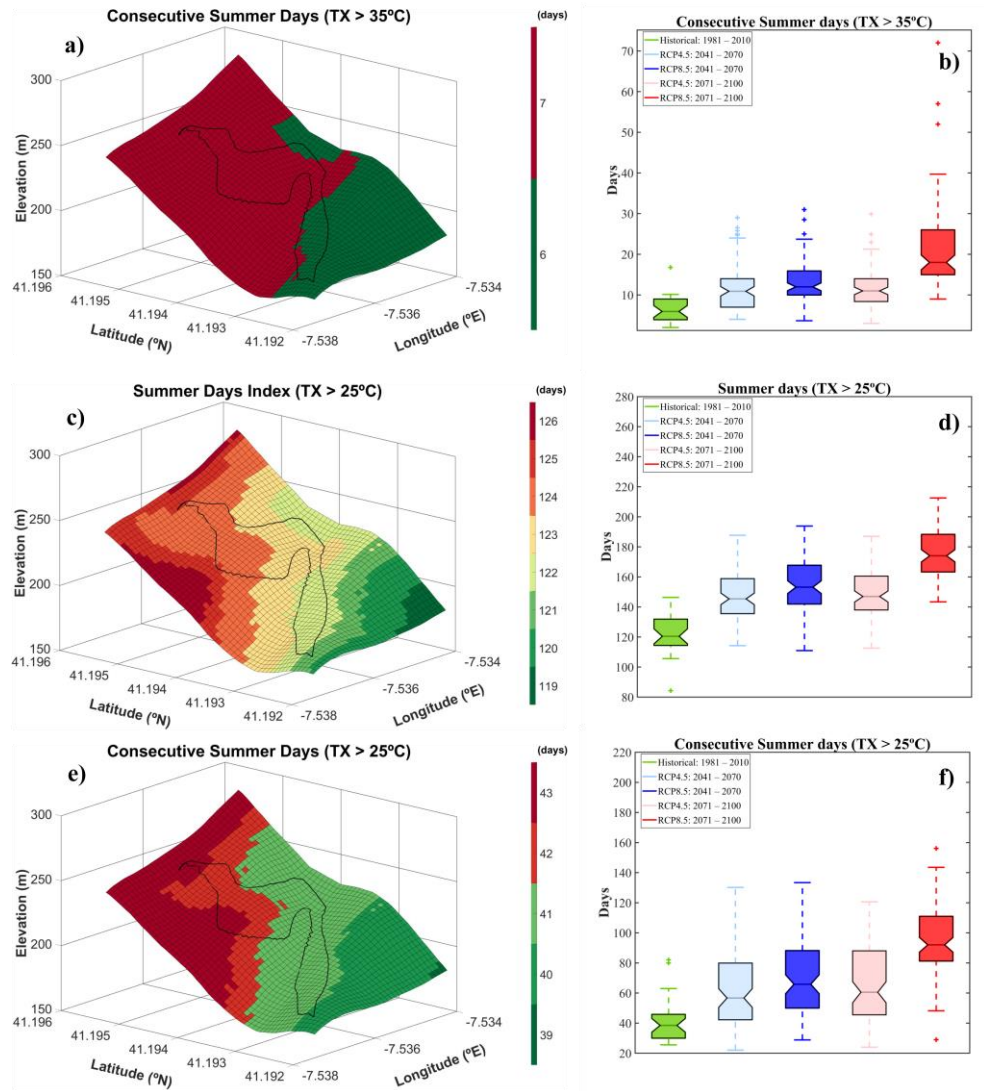


Figure S2. Spatial variation for the historical (a, c, e) and boxplots for the historical and future periods (b, d, f) of Consecutive Summer Days (TX > 35 °C) (a, b), Summer Days Index (c, d), and Consecutive Summer Days (TX > 25 °C) (e, f) in Quinta do Bomfim (QB) vineyard plot.

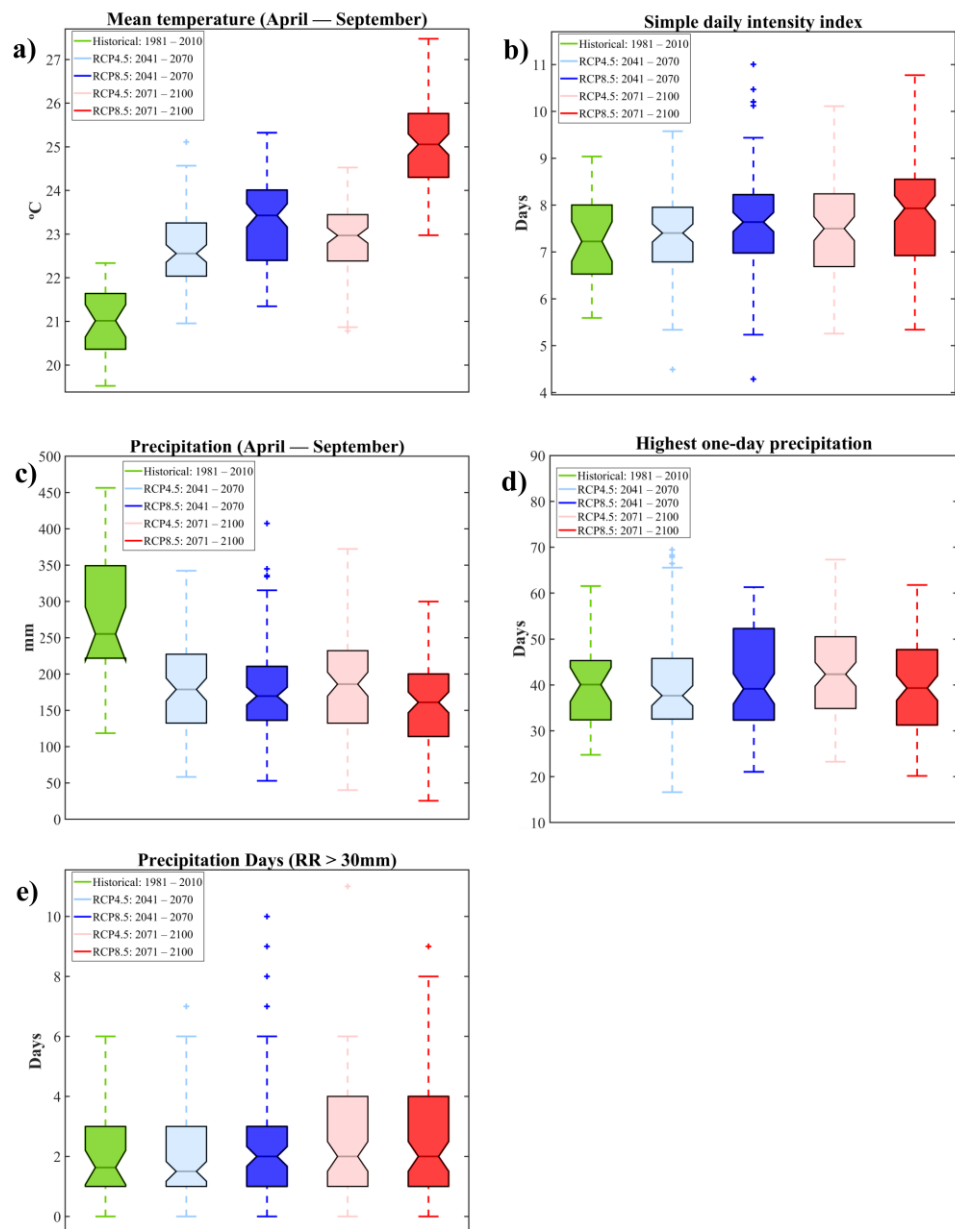


Figure S3. Boxplots for the historical and future periods under RCP4.5 and RCP8.5 of (a) Mean temperature (April—September), (b) Simple daily intensity index, (c) Precipitation (April—September), (d) Highest one-day precipitation and (e) Precipitation days above 30 mm in Quinta do Bomfim (QB) vineyard plot.

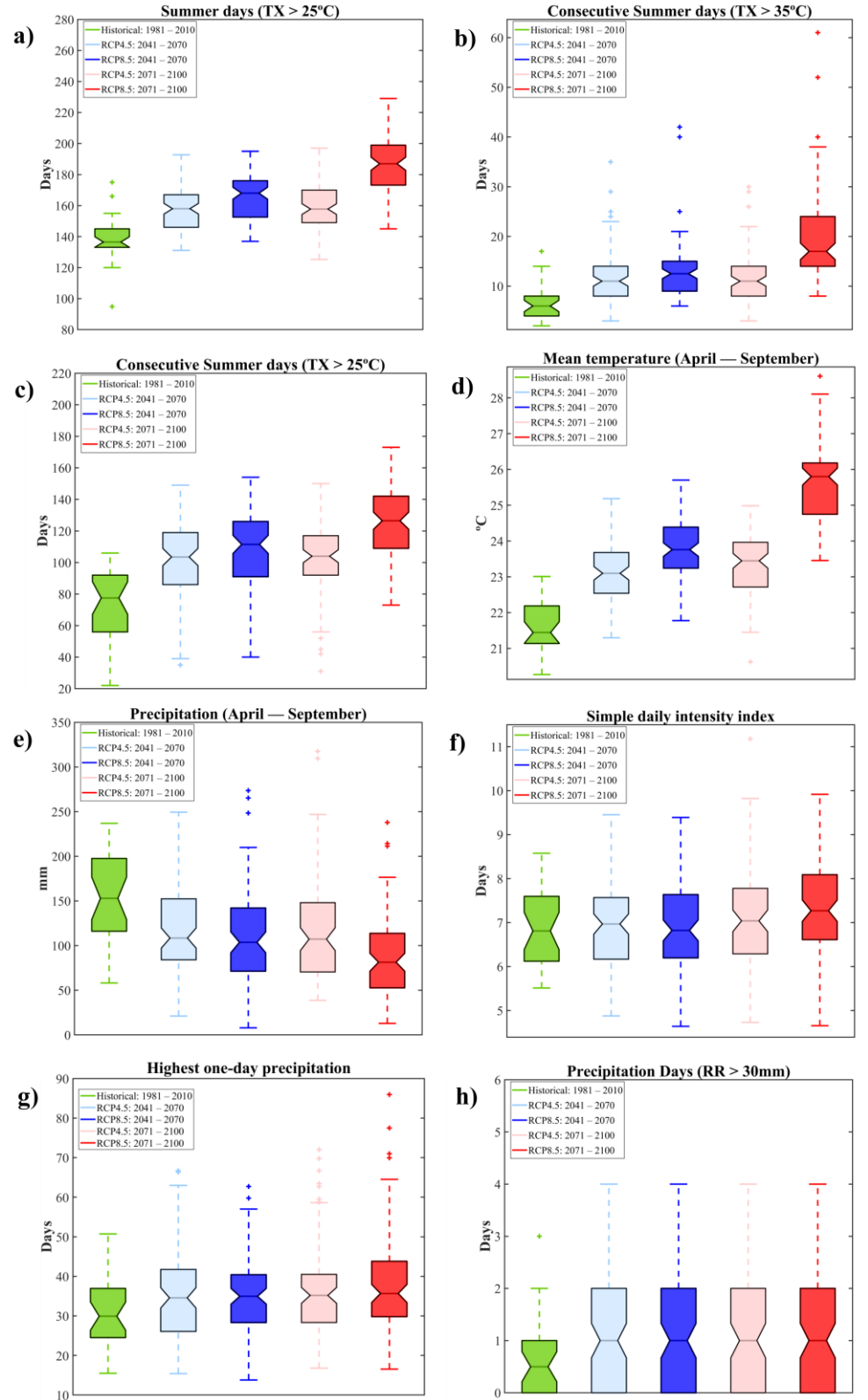


Figure S4. Boxplots for the historical and future periods under RCP4.5 and RCP8.5 of (a) Summer days ($TX > 35^{\circ}C$), (b) Consecutive Summer days ($TX > 35^{\circ}C$), (c) Consecutive Summer days ($TX > 25^{\circ}C$), (d) Mean temperature (April–September), (e) Precipitation (April–September), (f) Simple daily intensity index, (g) Highest one-day precipitation and (h) Precipitation Days above 30 mm of Herdade do Esporão (HE) vineyard plot.

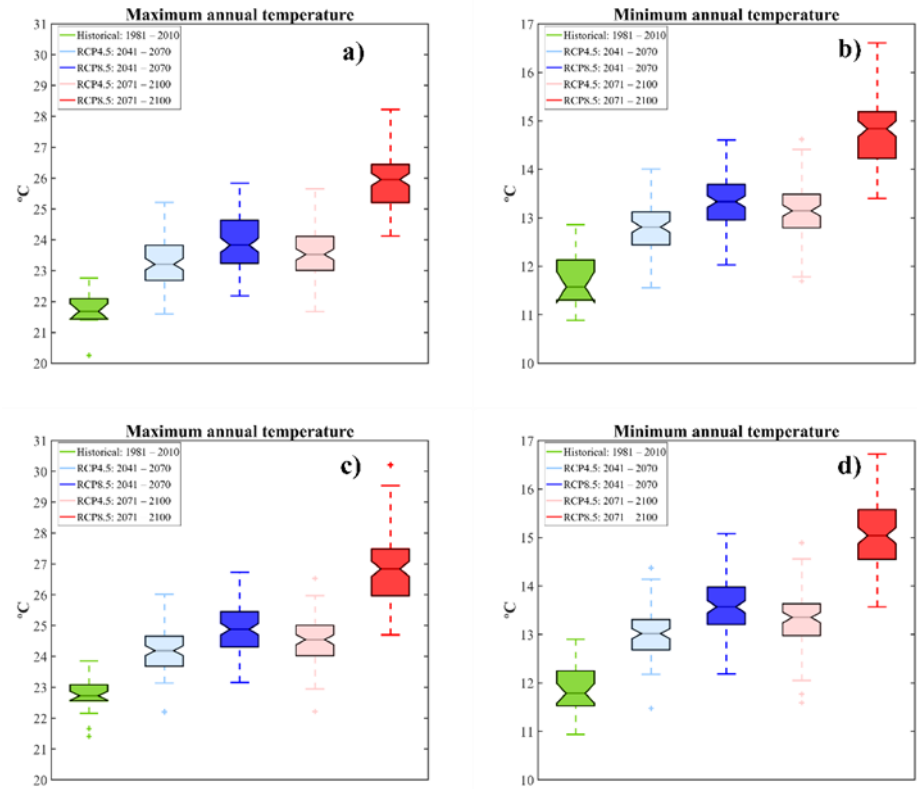


Figure S5. Boxplots of maximum annual temperature (a, c) and minimum annual precipitation (b, d) for the historical and future periods for (a, b) Quinta do Bomfim (QB) and (c, d) Herdade do Esporão (HE) vineyard plots.

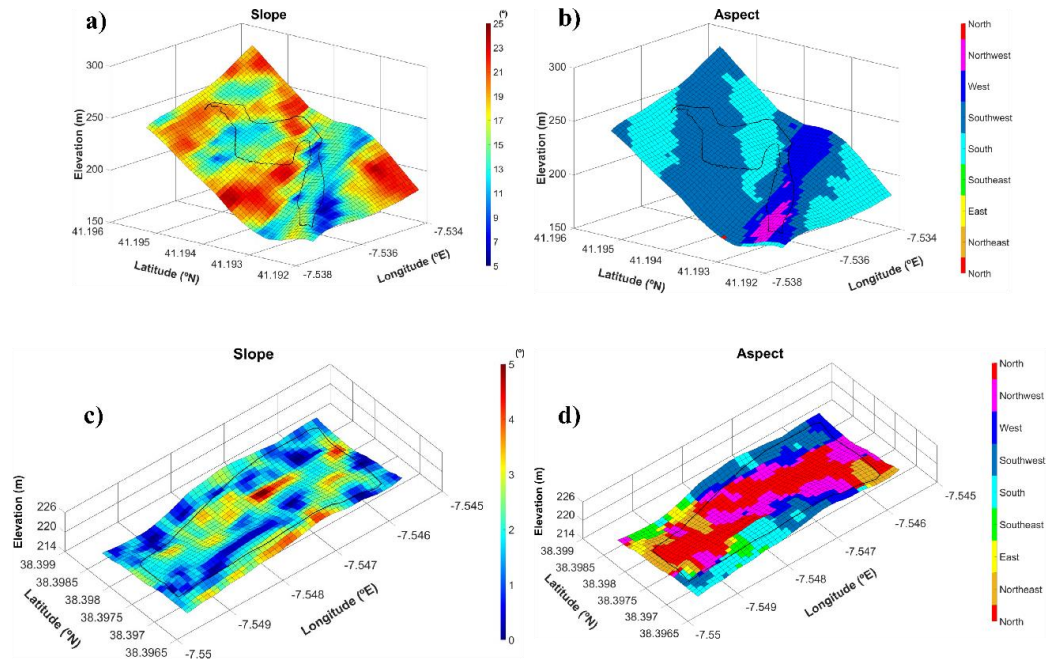


Figure S6. Spatialized slope (**a, c**) and aspect (**b, d**) of Quinta Bomfim (QB) (**a, b**) and Herdade do Esporão (HE) (**c, d**) vineyard plots, respectively.

Table S1. Description of global climate models and regional climate models used in this study.

Regional	Institution
DMI-HIRHAM5	Danish Climate Centre at the Danish Meteorological Institute
SMHIRCA4	Swedish Meteorological and Hydrological Institute
CLMcom-CCLM4-8-17	Climate Limited-area Modelling Community
Global	Institution
ICHEC-EC-EARTH	Irish Centre for High-End Computing Centre National de Recherches Meteorologiques;
CNRM-CERFACS-CNRM-CM5	Centre Europeen de Recherche et Formation Avancees en Calcul Scientifique
MPI-M-MPI-ESM-LR	Max Planck Institute Earth System Model; Coupled Model Intercomparison Project Phase 5

Table S2. List of the bioclimatic indices computed for this study, their corresponding mathematical definitions, units and classes.

Bioclimatic Index	Mathematical definition	Units	Classes
Dryness Index (DI)	$\sum_{April}^{September} (W_0 + P - T_v - E_s)$ <p> W_0 - Initial soil water reserve (mm) on the first month / DI on the following months; P - Precipitation (mm); T_v - Potential vineyard transpiration (mm); E_s - Direct evaporation from the soil (mm); T_v; E_s are assessed using the Thornthwaite method. </p>	mm	Excessively dry: < -100 Moderately dry: [-100, 50[Sub-Humid: [50, 150[Humid: ≥ 150
Huglin Index (HI)	$\sum_{April}^{September} \frac{(T - 10) + (T_{max} - 10)}{2} d$ <p> T - Mean air temperature (°C); T_{max} - Maximum air temperature (°C); d - Length of day coefficient, from 1.02 to 1.06 </p>	°C	Unsuitably Cool: < 900 Too Cool: [900, 1200[Very Cool: [1200, 1500[Cool: [1500, 1800[Temperate: [1800, 2100[Warm/Temperate: [2100, 2400[Warm: [2400, 2700[Very Warm: [2700, 3000[Too Hot: ≥ 3000
Hydrothermic index of Branas, Bernon and Levandoux	$\sum_{April}^{August} (T \times P)$ <p> T - Mean air temperature (°C); P - Precipitation (mm) </p>	°C×mm	Low risk of contamination: < 2500 Medium risk of contamination: [2500, 5100[High risk of contamination: [5100, 7500[Very high risk of contamination: > 7500
Growing season accumulated precipitation	$\sum_{April}^{September} (P)$ <p>P - Precipitation (mm)</p>	mm	—
Growing season mean temperature	$\sum_{April}^{October} (T)$ <p>T - Mean air temperature (°C)</p>	°C	Too cool: < 12 Cool: [12, 15[Intermediate: [15, 17[Warm: [17, 19[Hot: [19, 21[Very Hot: [21, 22[

Table S3. List of the climatic indices computed for this study and their definition.

Index	Definition
Summer days (TX > 25 °C)	Days in a year with maximum temperature above 25 °C
Consecutive summer days	Number of consecutive days where maximum temperature is above a threshold (25 °C or 35 °C)
Mean temperature (Apr-Sep)	Mean temperature in a year from April through September
Precipitation (Apr - Sep)	Total precipitation in a year from April through September
Simple daily intensity index	Mean precipitation amount on wet days (above 1 mm)
Precipitation days (RR > 30 mm)	Days with precipitation above 30 mm in a daily time series for a determined period (usually a year)
Highest one-day precipitation	Maximum daily precipitation amount of a time series (usually a year)

Table S4. ANOVA results for all temperature variables (maximum, mean and minimum) for both Quinta do Bomfim (QB) and Herdade do Esporão (HE).

	Sum Squares	Degrees of Freedom	Mean Square	F- statistic	p- value
Groups	1213360	5	242672	5731	0.00
Error	2783360	65736	42		
Total	3996720	657541			

Table S5. Tukey-Kramer test for multiple comparisons.

Group*	Group	Difference	Lower bounds	Upper bounds	p-Value
TG-QB	TG-HE	-0.99	-0.74	-0.49	0.00
TG- QB	TN-QB	4.57	4.82	5.07	0.00
TG- QB	TN-HE	4.28	4.53	4.78	0.00
TG- QB	TX- QB	-5.47	-5.22	-4.97	0.00
TG- QB	TX-HE	-6.63	-6.38	-6.13	0.00
TG-HE	TN- QB	5.31	5.56	5.81	0.00
TG-HE	TN-HE	5.02	5.27	5.52	0.00
TG-HE	TX- QB	-4.73	-4.48	-4.23	0.00
TG-HE	TX-HE	-5.89	-5.64	-5.39	0.00
TN- QB	TN-HE	-0.54	-0.29	-0.04	0.01
TN- QB	TX-QB	-10.29	-10.04	-9.79	0.00
TN- QB	TX-HE	-11.45	-11.20	-10.95	0.00
TN-HE	TX- QB	-10.00	-9.75	-9.50	0.00
TN-HE	TX-HE	-11.16	-10.91	-10.66	0.00
TX- QB	TX-HE	-1.41	-1.16	-0.91	0.00

*(TG – mean temperature; TN – minimum temperature; TX – maximum temperature; QB – Quinta do Bomfim; HE – Herdade do Esporão).