HERDADE DA COITADINHA

CLIMATE

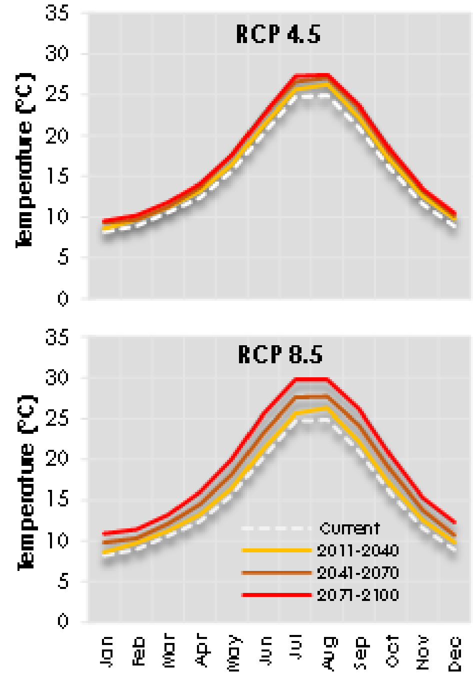
The climate of the region covering the "Herdade da Coitadinha" is classified as *Csa* in Koppen's climate classification [1]. It is characterised by mild temperatures with dry and hot summers; a wetter period is predominant throughout the rest of the year.

The Alentejo is one of the regions with the highest insolation in Europe, which can reach 3200 hours of sunshine per year and global solar radiation about 1700 kWh/m^2/year [2]. Note, however, that the irregularity of the property's relief provides a heterogeneous distribution of the solar radiation over the surface; see the figures on the right-hand side, namely, the orthophoto map, the orographic map, and the global annual mean solar radiation map.

Another climate variable, which has been a challenge to characterise its spatial and temporal distribution, is the precipitation; in particular, in the south of the country, it is characterised by strong intra- and interannual variability [3] [4]. Considering that the highest amount is usually measured from the autumn to the winter, critical periods of water deficit may occur in the property during the growing season, despite the eventual high amount of total annual precipitation. Another relevant aspect in the context of climate impacts is the occurrence of extreme events, defined by heavy rainfall. They are observed throughout the whole country, and their trends (both upward and downward) are highly variable in the space and time [5] [6]; in southern Portugal, these events are more often recorded in the autumn and early winter [7].

TEMPERATURE

The annual mean temperature of the property is around 15°C, ranging between 4 and 32°C, in January and in August, respectively. Over the last decades, the annual mean temperature followed an increasing trend; for example, records from 1941 to 2006, in Amareleja, and Beja, show a significant rise with a rate of 0.1-0.2°C per decade [8].

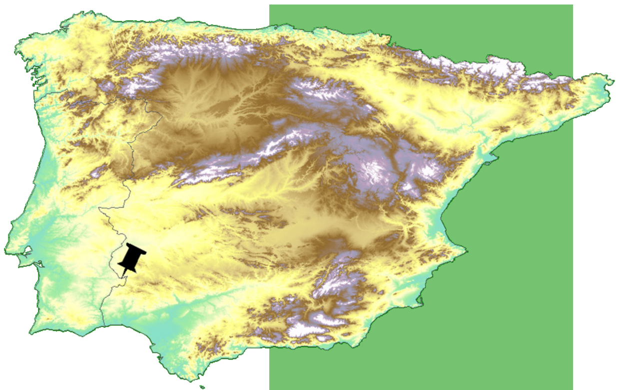


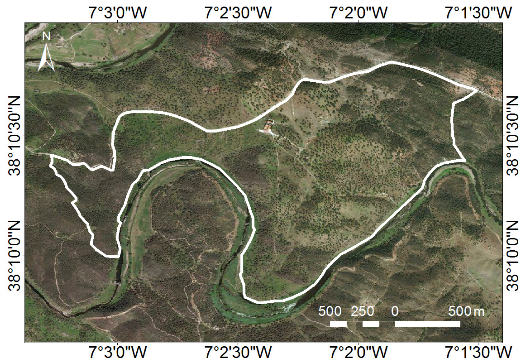
In the future, the projections obtained from climate models suggest the increase will be even more pronounced. Compared to the reference period (1971-2000), the projected anomalies of the annual mean temperature range between +0.9 and +4.0°C until 2100.

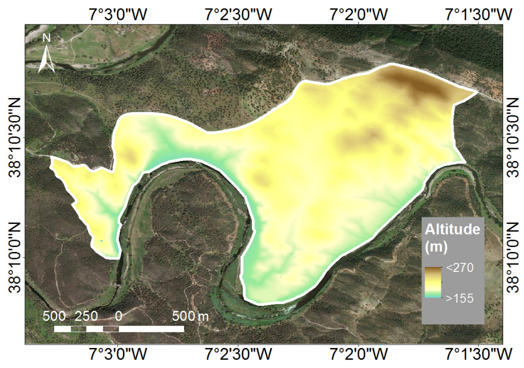
Regarding the monthly distribution (see figure on the left), August will remain the hottest month, immediately followed by July; on the other hand, it is expected that January remains the coldest month.

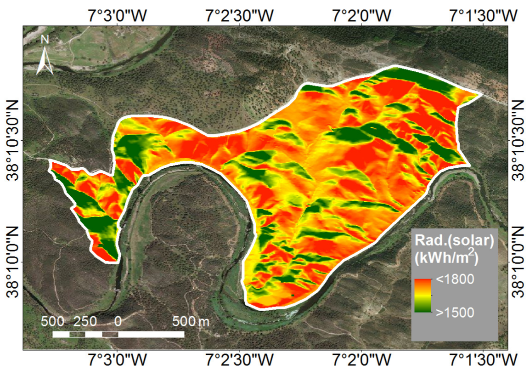
In the context of climate changes, the analysis of extreme events of temperature is also crucial; studies that consider historical trends and future projections have been pointing out their intensification in mainland Portugal [9] [10]. Note, however, that the increased frequency of these events will not be uniform throughout the year; indeed, in the winter, it is expected changes less abrupt in comparison to the rest of the seasons [11]. At the scale of the property, a sharp rise of the duration of the heat waves (up to +24 days) is expected, as well as a decline of the number of frost days (which can eventually stop occurring).

LOCATION









CLIMATE PROJECTIONS

Climate variables	Historical (1971-2000)	Scenarios	Anomalies (annual mean) 2011-2040	2041-2070	2071-2100
Temperature (°C)	15.3	RCP4.5	+0.9	+1.6	+2.1
		RCP8.5	+1.1	+2.3	+4.0
Maximum temperature (°C)	20.8	RCP4.5	+1.0	+1.7	+2.0
		RCP8.5	+1.1	+2.4	+4.2
Minimum temperature (°C)	9.7	RCP4.5	+0.8	+1.5	+1.9
		RCP8.5	+1.0	+2.2	+3.8
Heat wave duration index (days)	14	RCP4.5	+7	+7	+18
		RCP8.5	+7	+16	+24
Number of extremely hot days (T max. >= 35°C)	18	RCP4.5	+8	+19	+22
		RCP8.5	+10	+25	+48
Number of frost days (T min. < 0°C)	8	RCP4.5	-1	-3	-4
		RCP8.5	-3	-5	-8
Total precipitation (mm)	590	RCP4.5	-22	-45	-37
		RCP8.5	-46	-64	-107
Number of wet days (Pr > 1mm)	82	RCP4.5	-6	-8	-15
		RCP8.5	-12	-18	-25
Relative humidity (%)	67	RCP4.5	-0.7	-1.9	-1.6
		RCP8.5	-1.3	-2.3	-4.0
			Anomalies (monthly mean)		
August maximum temperature (°C)	32.2	RCP4.5	+1.4	+2.3	+2.7
		RCP8.5	+1.4	+2.9	+5.0
January minimum temperature (°C)	4.3	RCP4.5	+0.3	+1.2	+1.3
		RCP8.5	+0.8	+1.6	+2.5

Climate Projection | Simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases and aerosols, generally derived using climate models [12].

Climate Scenario | A plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change [12].

Here, two **Representative Concentration Pathways (RCPs)** (which are scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases and aerosols and chemically active gases, as well as land use) were selected: **RCP4.5** - intermediate stabilization pathways in which radiative forcing is stabilized at approximately 4.5 W/m^2; **RCP8.5** - one high pathway for which radiative forcing reaches greater than 8.5 W/m^2 by 2100 and continues to rise for some amount of time [13].

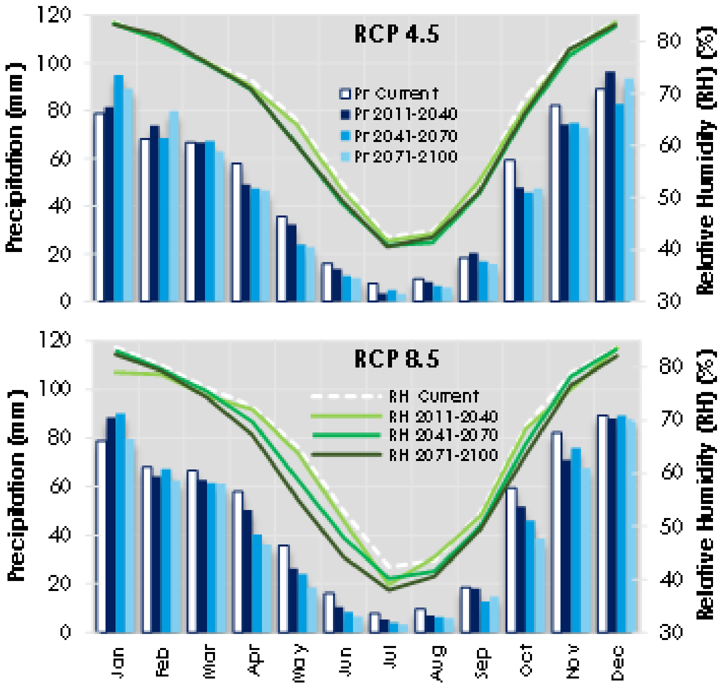
Heat Wave Duration Index | A period of at least 6 consecutive days in which the daily maximum temperature is 5°C higher than the daily average [14].

PRECIPITATION

The annual amount of precipitation in the property is roughly 590 mm. Over the last decades, a reduction of annual mean precipitation was observed around the whole country [15]. As regards to the monthly trends, several studies have been stating a common pattern over the south: in the spring, especially in March, a significant decrease of precipitation is evident [16] [17]; whereas, in October a positive trend is recognised, despite being less marked [8] [18].

In the future, the climate models also project a decline of the annual precipitation. Until the end of the XXI century, the reduction can reach 100 mm, and comprises less 25 wet days per year.

The monthly amounts do not show a clear trend, i.e. positive trends alternate with negatives depending on the scenario and time periods assumed (see the figure on the right). Nevertheless, considering a season scale, the results suggest from the spring to the autumn, the precipitation can drop, whereas in the winter, fluctuations between increases and decreases, indicate the total amounts will roughly remain near current levels.



This **factsheet** about the **climate** in the "Herdade da Coitadinha" provides an overview of **projected possible changes** for selected climate variables and time periods. All projected anomalies are with respect to the **reference period** from 1971 to 2000. The magnitude of potential future climate changes was averaged over the study area.

The information is based on currently available ensembles of **Regional Climate Models** (RCMs), which were used in the AR5 (Fifth Assessment Report) of the IPCC. These RCMs (entitled CLMcom-CCLM4-8-17, SMHI-RCA, DMI-HIRHAM, KNMI-RACMO22 and IPSL-INERIS-WRF331F) were forced by different Global Climate Models (GCMs) (entitled CNRM-CERFACS-CNRM-CM, ICHEC-EC-EARTH, IPSL-IPSL-CM5A-MR, and MPI-M-MPI-ESM-LR) and hence, involving a variety of institutions, parameters, and climate sensitivities. The simulations have a high horizon resolution, i.e. 0.11° x 0.11° (~12.5 km) and are then, interpolated to the property. For more information about the climate models, please visit the following websites at *http://www.cordex.org*, and *http://portaldoclima-dev.ipma.pt/en/*.

For the purposes of this study, each RCM and RCP scenario is considered to be **equally likely** as there is no clear way to assess their performance in a climate that has not yet happened.

The map of global mean solar radiation was created based on the solar radiation analysis tools in the ArcGIS Spatial Analyst extension - *software ArcGIS 10*.

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