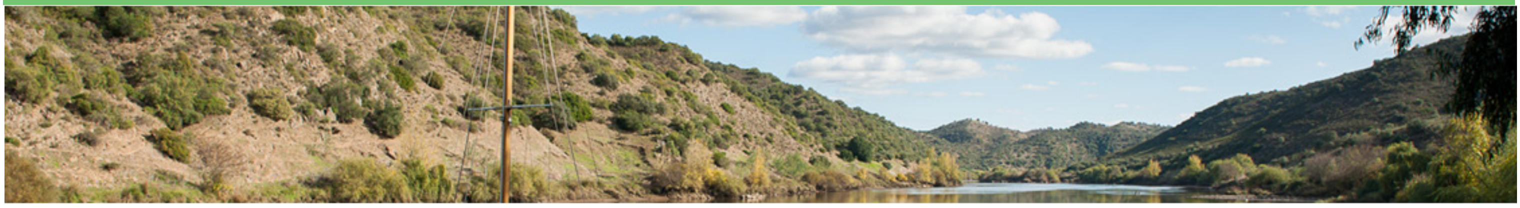
CLIMATE FACTSHEET -L9

Vale das Silvas



INTRODUCTION

The Mediterranean southern Europe is considered to be one of the climate change "hotspots" as more severe droughts are occurring (which increases the risks of forest fires, biodiversity loss, decline of crop yields, etc.); future changes in climate are there commonly reflected by drier conditions and changes in the frequency, duration, and/or magnitude of extreme events [1] [2] [3]. In order to minimise the risks of climate change, it is crucial to perform adaptation actions. The data provided by the climate models, however, implies certain limitations upon the spatial scale as it is generally coarser than required by impact studies. This factsheet provides tailored findings to the local climatic conditions of "Vale das Silvas". This information can help landowners consider what aspects of the property might be affected and take proper measures.

The climate of "Vale das Silvas" is classified as *Csa* under the Koppen's climate classification, which represents a warm temperate climate; the summers are hot and dry [4].

The intercepted radiation is a determining factor in crop development. Southern parts of Portugal, Spain, and Italy have the highest insolation in Europe, which can reach 2200 kWh/m^2 per year [5] [6]. Note, however, that the topographic parameters, such as the slope and altitude, provides an irregular distribution of the global solar radiation over the property (see figures 1, 2, 3 and 4), which can be relevant for the land-use planning.

TEMPERATURE

The mean temperature for the year in the property is around 16°C, ranging between 9°C in January, and 26°C in July/August.

Over the last decades, the annual mean temperature followed an increasing trend; for example, in Beja, records from 1941 to 2006 show a significant rise with a rate of 0.12°C per decade [7].

In the future, the projections obtained from climate models suggest that the increase will be even more pronounced. Compared to the reference period (1976-2005), the projected anomalies of the annual mean temperature range between +0.9 and +2.3°C until 2075, depending on the scenario and time period considered (see table in the next page).

Regarding the monthly distribution (figure 5), July and August will remain the hottest months, with a maximum temperature up to 36°C; on the other hand, it is expected that January remains the coldest month (lowest minimum temperature of 6°C).

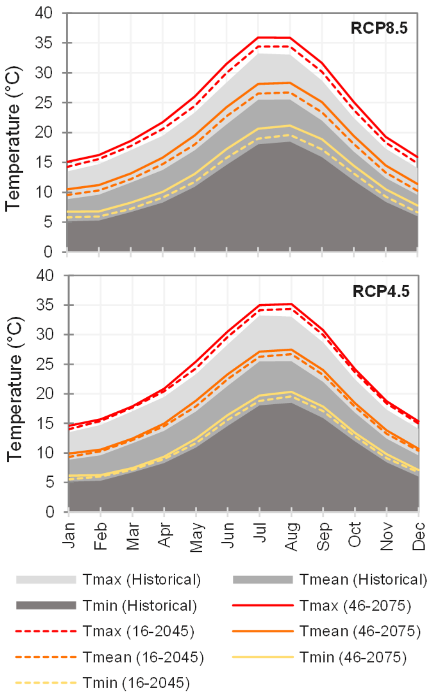


Figure 5 - Monthly temperatures: minimum, mean and maximum. Projections under scenarios RCP4.5 and 8.5 for short- and long-term.

Heat stress damage can be particularly costly when high temperatures occur during critical crop stages; increased attention has been paid to the analysis of extreme events; in mainland Portugal, some studies, which consider historical trends and future projections, showed an increase in extreme temperature events [8] [9]. At the scale of the property, there are indeed identifiable trends, a sharp rise of the number of extremely hot days (Tmax>35°C), up to +26 days, is expected.

LOCATION

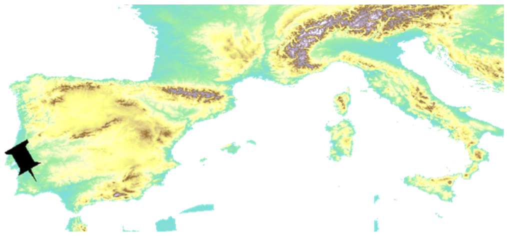


Figure 1 - Location of "Vale das Silvas".

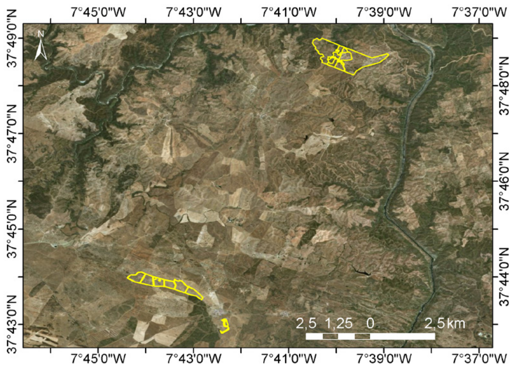


Figure 2 - Orthophoto map.

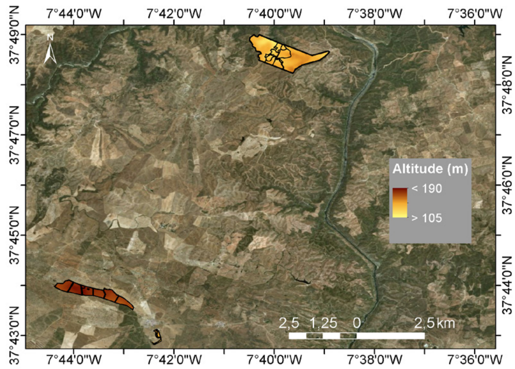


Figure 3 - Orographic map.

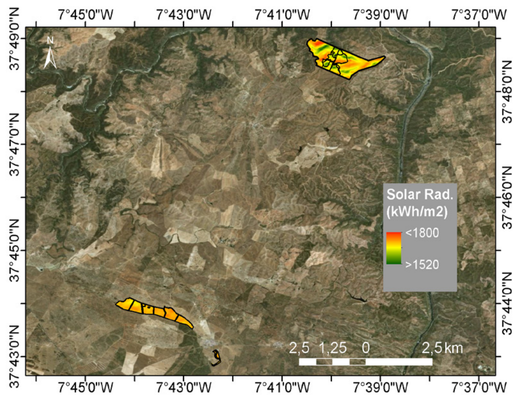


Figure 4 - Map of global annual mean solar radiation.

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Vale das Silvas

CLIMATE PROJECTIONS

Climate variables	Historical (1976-2005)	Scenarios	Anomalies – Time slice 2016-2045	Anomalies – Time slice 2046-2075
Temperature (°C)	16.2	RCP4.5	+0.9	+1.5
		RCP8.5	**+1.0**	**+2.3**
Maximum temperature (°C)	22.2	RCP4.5	+1.0	+1.6
		RCP8.5	**+1.1**	**+2.4**
Minimum temperature (°C)	10.8	RCP4.5	+0.8	+0.6
		RCP8.5	**+0.9**	**+1.3**
Number of extremely hot days (Tmax. >= 35°C)	26	RCP4.5	+8	+15
		RCP8.5	**+10**	**+26**
Ref. Evapotranspiration (mm/day)	3.7	RCP4.5	+0.1	+0.2
		RCP8.5	**+0.1**	**+0.3**
Total precipitation (mm)	456	RCP4.5	-21	-30
		RCP8.5	**-33**	**-51**
Number of wet days (Pr > 1mm)	67	RCP4.5	-6	-7
		RCP8.5	**-6**	**-11**
Relative humidity (%)	63	RCP4.5	-1	**-3**
		RCP8.5	**-1**	-2
Aridity index	0.35	RCP4.5	-0.02	-0.04
		RCP8.5	**-0.04**	**-0.06**

Table - Annual mean anomalies calculated relative to 1976–2005, for 30-year periods, short-term (2016-2045) and long-term (2046-2075), under scenarios RCP4.5 and 8.5.

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 [1].

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 [1].

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 [10].

Anomalies | Difference of a future climate (e.g. 2046-2075) compared to the reference period, which in this case, is 1976-2005.

Reference Evapotranspiration | estimates the evapotranspiration rate of a short green crop (grass), totally shading the ground, which has a uniform height, and with adequate water status in the soil profile. The formulation used was the FAO-56 Penman-Monteith, which is a function of wind speed, solar radiation, relative humidity, and temperature [11][12].

Aridity Index | a proxy measure of water availability. Following the UNEP (1992), the aridity index is defined as the ratio of precipitation to potential evapotranspiration on a yearly basis [13]; the latter is here considered equivalent to the reference evapotranspiration.

Climate is classified in hyper-arid (<0.03), arid (0.03-0.2), semi-arid (0.2-0.5), dry sub-humid (0.5-0.65), and humid (>0.65).

PRECIPITATION

The precipitation regimes in Mediterranean climate are characterised by the intra-annual variability with about 70 to 80% of the rainfall falling between October and March [14] [15]. In the property, the annual precipitation amount is about 460 mm (see table in the previous page), with the most rain occurring in December (~70 mm), and the least in July (~7 mm).

Over the last decades, a decrease of annual mean precipitation was registered around the entire country [16]. Regarding the monthly trends, several studies have shown a common pattern over the south: in the spring, especially in March, a significant decrease of precipitation is evident [17] [18]; whereas, in October a positive trend is recognised, despite being less marked [7] [19].

In the future, the climate models also estimate a reduction of the annual precipitation. The reduction can reach roughly 50 mm, and less 11 wet days per year. Negative anomalies are expected for most months, although the decline will not be at the same rate (figure 6). These changes in the seasonal precipitation distribution tend to amplify the negative impacts on the water availability, as an increase in precipitation concentration in winter is projected.

Drier conditions (lower values of Aridity index) are expected until the end of the 21st century in southern Europe [20] [21]. According to the long-term mean value of the aridity index, the property will remain semi-arid, even though this condition tends to be intensified.

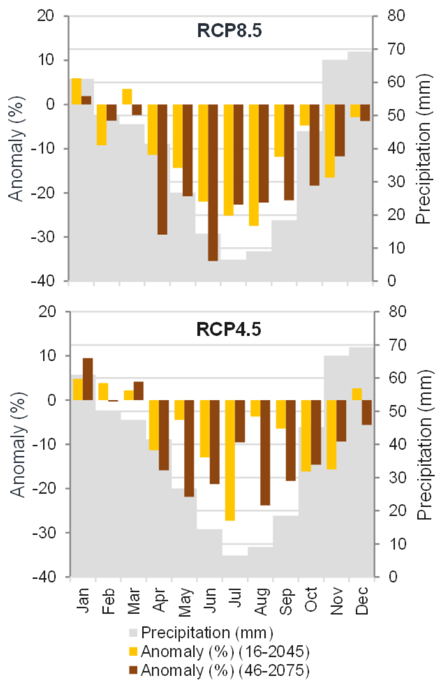

Figure 6 - Monthly mean precipitation for the historical period; Anomalies for short- and long-term, under scenarios RCP4.5 and 8.5.

The factsheet provides a summary of projected possible changes in the climate of "Vale das Silvas". The projections cover the period from 2016 to 2075, showing, however, 30-year averages, so that the climate change signal is identified, and not the natural climate variability. Anomalies are calculated with respect to the reference period from 1976 to 2005.

The information is based on currently available Regional Climate Models (RCMs) (specifically, CLMcom-CCLM4–8-17, CNRM-ALADIN53, SMHI-RCA4, DMI-HIRHAM5, KNMI-RACMO22E, IPSL-INERIS-WRF331F, MPI-CSC-REMO2009), which were used in the AR5 (Fifth Assessment Report) of the IPCC. These RCMs were forced by different Global Climate Models (GCMs) (namely, CNRM-CERFACS-CNRM-CM5, ICHEC-EC-EARTH, IPSL-IPSL-CM5A-MR, MPI-M-MPI-ESM-LR, NCC-NorESM1-M). The projected changes were therefore accomplished using the output of the simulations of a large *ensemble* (twelve RCM-GCM combinations) and thus, involving a variety of institutions, parameters, and climate sensitivities. The simulations have a spatial resolution of 0.11˚ x 0.11˚ (~12.5 km). For more information about the climate models, please visit http://www.cordex.org.

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 annual 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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