

# The Mediterranean Climate

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## ABSTRACT

The Mediterranean is a region with strongly seasonal climate due to variably dominant high and low pressure systems. This seasonality is inclusive of both temperature as well as precipitation. In addition much of the climate in the region is affected by mountainous terrain. Though seasonal and rugged the region lends itself to intensive, in some cases year-round agriculture as well as a number of unique species of flora and fauna. The information found creates the Csb climate zone defined by the Koeppen Classification System.

## 1. Introduction

The Mediterranean region can be defined by the countries bordering the Mediterranean Sea and the sea itself. The climate over the area varies by the geographic location. It can be broken down into four subsections – North, South, East, and West. These subsections contain information on the vegetation, temperature, precipitation, geography, and wind patterns.

## 2. Northern Mediterranean

### *a. Vegetation*

The Northern Mediterranean consists of the countries from Italy to Bulgaria. It is characterized by bright, sunny skies that are almost cloudless in the summer and have only a few clouds in the winter. This large amount of sunshine is beneficial for the growth of vegetation, but the lack of water and low humidity of the region inhibits it. Due to the summer drought the primary growing season is in winter, while summer is the resting season. Because the growing season is the cold season, the vegetation tends to grow slower and be smaller in size than that of the rest of Europe, which has the warm season as the growing

season. In addition, there is a pause in plant growth mid-winter due to the cold temperatures, which leads to a great outburst of energy and growth in the spring.

The summer drought causes plants to store water through adaptations, such as thickened stems, thick bark, waxy coatings, small leaves, and growth of hair in order to succeed. The plants known as succulents thrive here. Forest is the natural vegetation but its growth, as well, is limited causing evergreens to predominate, since they retain their leaves – a characteristic of plants needing to preserve nutrients. Evergreens also have very long plant roots enabling them to reach water deep in the ground.

Kendrew (1937) presents the idea that “perhaps the best indication of the actual extension of the Mediterranean climate is given by the distribution of the olive-tree, one of the most characteristic elements in the Mediterranean vegetation.” Olive trees, and other hardy plants, grow very well in this environment. This climate allows for the cultivation of fruits, vegetables, durum wheat and for the production of olive oil and wine, especially in Italy. Greece, in particular, grows barley, wheat, corn, sugar, beans, tomatoes, tobacco, olives, and potatoes while producing wine, beef, and dairy products.

### *b. Temperature and Precipitation*

Autumn is the warmest season, which may be affected by the Mediterranean's maritime location. One cause of the autumn warmth is the tendency for high pressure zones to form over the southern part of the former Soviet Union, which draws southerly to southerly-east flow from the Gulf of Sidra to the central Mediterranean (Maheras 1999). The Balkans part of this section is affected by a deep depression over Denmark and southern Norway, which causes westerly to southwesterly flow to the Balkans. These two flows are warm temperature airflows over the sea that heat up the land. *Figure 1* and *Figure 2* are examples of the temperature and precipitation fluctuations in Rome, Italy.

### *c. Topographical, geographical effects*

The northern part of the Mediterranean is made up of many chains of mountains. Overall, it has a rugged terrain with valleys and basins. Even the numerous peninsulas and islands are hilly and mountainous. These mountain chains create distinct climatic divides, one of them being between the Mediterranean and the rest of Europe. *Figure 3* shows the terrain of the mountain range, the Alps, that creates the aforementioned climatic divide. The Po Basin and the Trieste Gap (on the border between the former Yugoslavia and Austria) are key locations for the development of the local wind patterns. *Figure 4* shows the rugged terrain of the Balkan Peninsula.

### *d. Latitudinal and longitudinal patterns*

A few of the local wind patterns affecting the northern Mediterranean are the Bora winds, the Mistral, and the Sirocco wind which all occur at different times of the year. The Bora is a dry wind causing clear skies that begins in autumn from a cold wind source. This cold air builds up above the Balkan Peninsula until it reaches the height of the mountain passes. The reservoir of air then pours over the coastal mountain ranges toward the sea. It blows northeasterly over the Adriatic Sea and then adjusts to the mountains and valleys until it

reaches the sea, where it blows northerly to northeasterly. Trieste, located by the border between Austria and former Yugoslavia, has the strongest winds since it is a basin channeling the airflow. The Bora wind decreases in intensity southward and its greatest intensity is at peaks at least 2000 feet above sea level and no more than 2-3 miles inland. The Mistral is a strong north wind that comes in the winter with the power to overturn trains (Kendrew 1937). It occurs when there is a deep depression over the Gulf of Genoa in Italy plus an anticyclone in Western Europe. This wind blows from the snow-covered Alps using the Rhone Valley as a funnel to the Mediterranean Sea. It is cold and dry and can cause widespread crop damage. Another wind pattern is the Sirocco wind, a southeasterly to southwesterly wind blowing from North Africa in the spring. It can reach the Adriatic Sea, but it is stronger closer to Africa. As it crosses the Mediterranean Sea, the lower layers saturate with clouds and become foggy or drizzly.

## **3. Southern Mediterranean**

### *a. Geography*

The southern part of the Mediterranean climate zone includes the countries of Algeria, Tunisia, Libya, and Egypt as seen in *Figure 5*. The Mediterranean climate zone in this area vanishes between 10-100 miles inland, turning into the Sahara desert. The coastline of North Africa close to the Mediterranean Sea is more fertile, since it has discontinuous coastal plains that the southern parts of these countries do not have. The coastal plains are separated by mountains in the western part of North Africa and there is also a gradual plateau region switching from grassland to sand. In the western area, precipitation ranges from about 50 – 100 cm annually, increasing in amount eastward through Algeria. Further eastward, precipitation decreases in amount on the coast east to only 200mm of rain in the wettest parts of Egypt (Coutsoukis 2004).

### *b. Temperature*

Temperatures of North Africa consist of a very hot summer and mild winter. Inland, the

temperatures increase in magnitude. The difference between high and low temperatures increases tremendously towards the Sahara desert. The coastal regions of North Africa have a dry summer with most all precipitation occurring in the winter months. The precipitation vanishes from the winter months in the Sahara. Typical summer average maximum temperatures range from 21-24 degrees Celsius in Algeria to 30 degrees Celsius in Egypt along the coast of the Mediterranean Sea. *Figures 6 - 9* show average temperatures and precipitation for the cities of across the southern part of the Mediterranean. Inland towards the Sahara desert, the temperatures soar to above 40 degrees with little rainfall. Average winter minimum temperatures range from 10-12 degrees Celsius in Algeria to a minimum of 14 degrees Celsius in Egypt (Coutsoukis 2004).

#### *c. Vegetation*

The only areas suitable for agriculture are along the coast of the Mediterranean Sea. This region decreases in size from west to east. Further to the south yields grassland that gradually turns into the sandy Sahara desert. Around the coast mostly evergreen trees and small shrubs with a hardy grass or dry soil exposed to the surface makes it similar to a steppe climate. Evergreen roots descend deep into the soil to retrieve water to sustain life in an area that varies in precipitation (Tett 2003). Little land is able to be used for agriculture. Only three percent of Algeria is deemed fit for agricultural use with only two percent in Libya. Most all agricultural activity in Egypt takes place in the Nile River Valley. Into Egypt, the Nile River becomes the one of the most fertile oases known. Within this oasis lies most of Egypt's agricultural production, which depends heavily on flooding to deposit silt and minerals essential for agricultural growth (AETBI 2006). Wheat and barley are the two main crops farmed across the north part of Africa with other minor crops such as citrus fruits, vegetables, olives, tobacco, and dates also grown (Coutsoukis 2004). To maximize the amount of crops produced, deforestation takes place to make land suitable, at a loss of the natural environment (Tett 2003).

#### *d. Latitudinal/Longitudinal Patterns*

The previously mentioned phenomenon known as the Sirocco affects all of North Africa. The sirocco is a very hot dry wind that blows from south to north in the spring months. The winds form from a strong small surface low pressure system over the Isthmus of Suez associated with an upper-level low-pressure system (Naval Research Laboratory 2003). The winds from the low pull up the hot dry air from the southern Sahara desert to the north. The wind can bring speeds of 140 km/hr or greater and stir up sandstorms lasting for up to a few days. The sirocco causes many health problems in humans as well as animals. The wind can also cause crop damage as well.

### **4. Eastern Mediterranean**

The eastern Mediterranean (*Figure 10*) is uniquely positioned to create a climate with strongly seasonal precipitation, but is not continental. This climate is due to the position of this region between the subtropical high pressure belt and the westerly air circulation to the north, and its positioning on the Mediterranean Sea itself (Segal et al.1992). These factors are compounded by the rugged terrain of the east Mediterranean. region.

#### *a. Geography*

The Eastern Mediterranean is very rugged. Mountains brush up against the coastline for nearly the entire length of the region. South near Haifa, the Mount Carmel range rises 1,800 feet and extends for fifteen miles north to south. The Golan Heights flows out of the Mount Carmel range and covers the border region of Syria, Lebanon, and Israel rising to the same height as Mount Carmel. At the border between Turkey and Syria a bowl shaped depression extends several miles inland interrupting the mountainous coast. At the west end of this depression the Taurus Mountains begin. These mountains are much larger than the Golan Heights of Mount Carmel. Inland peaks can reach 12,000 feet and the range itself extends the length east to west of the Turkish coast, as shown in *Figure 11*. The combination of these

ranges creates an extensive rain shadow effect on this area of the Mediterranean.

#### *b. Rainfall*

The rainfall patterns of this area can vary by 500mm per year but are always seasonal. Haifa, a port city in northern Israel averaged 25 rainy days per year with about 550mm of rain during those events (EuroWEATHER; ClimateZone). This trend does not extend far however, Beirut, the capital of Lebanon averages a more moderate 42 rainy days a year with 855mm of rain. Finally, the coastal city of Antalya, Turkey averages 1000mm of rain on a yearly basis as shown in *Figure 12* (Turkish Meteorological Service). The values for rain events are based upon eight year averages for the area (ClimateZone), and the rainfall averages for Haifa and Beirut are based upon 1961-1990 averages (EuroWEATHER). Though rainfall is variable, these same three cities tend to have moderate temperatures throughout the year. The greatest average high is 31 Celsius in Haifa for the months of both July and August. None of the cities generally experience below freezing conditions during the year.

#### *c. Seasonality*

The rainfall in this area has a strongly seasonal pattern as shown in *Figure 13*. Throughout the three sample cities, from an eight year average, little rain fell from June until August. In Haifa little rain fell from May until September. This rainfall trend is highly variable however, and though the summer months are nearly always dry, the beginning of rains in the fall is very hard to predict. Some of this unpredictability is due to a seasonal trough that approaches the Mediterranean in October. The exact position of the trough is highly variable falling north to south from Turkey to the Sinai Peninsula during one year and falling in the Bay of Biscayne and the Iberian Peninsula during the next (Krown 1966). When this autumnal trough falls over the central Mediterranean near Corsica the rains in the eastern Mediterranean tend to be more intense, while when the front falls near Turkey the winter rains tend to be delayed (Krown 1966). Even with this

variability the region tends to experience its greatest rains in the month of January, with large precipitation events dwindling by April. The predominant cause of this seasonality is very similar to other regions, such as the Californian coast in the US. The summer months experience strong and dry offshore winds passing over the Middle Eastern desert regions creating extremely dry conditions through the summer, even though temperature is moderated by the ocean. Additionally, orographic effects due to the area's rugged terrain sap the remaining moisture from the atmosphere.

#### *d. Agriculture Flora & Fauna*

Though little rain falls in this region, it is none the less extensively farmed with the aid of modern irrigation systems. Israel, in particular, grows a wide variety of crops. During the warm dry summer months orchards of figs, pears, tomatoes, and citrus dominate production along with a variety of vegetables. During the cool winter the largest crop is wheat followed by barley. Native flora is largely variable with the amount of rainfall a given region receives. North in Turkey where there is sufficient rain, native species are not as tolerant of dry conditions. The trees and understory tend to be evergreens. South into Syria and Israel, the coastal regions are dominated by species tolerant of extended dry periods and warmer temperatures. Previously, these regions were covered with deciduous forests of hearty oak species, though most of these have been destroyed. Areas without forest are inhabited by tough scrub bushes like wormwood and thyme. The fauna of this area has also diminished greatly due to urbanization; species of ibex, boar, deer, jackal, wolf, and predatory cat were once abundant but are now mostly relegated to wildlife refuges.

## **5. The Western Mediterranean**

#### *a. Geography*

The Western Mediterranean consists of the countries France, Spain, and Morocco. The climate in this region is created by a persistent subtropical high in summer and westerly flow. The high creates sinking air that creates a stable

atmosphere (Ritten, 2006). There are two dominant air masses over the Western Mediterranean, continental tropical and maritime tropical (Robinson, 1999). Both air masses being of the tropical variety help us to better understand the relatively mild average temperatures of this region, as well as the wet and dry season. Continental air is drier than maritime air. The westerlies that dominate the flow bring the warm dry air into the region. In the winter months, as the high recedes, precipitation increases due to the moist maritime air.

Valencia, Spain has a pronounced dry season accompanying its summer season and a cooler moist winter season as defined by the Koeppen classification system as shown in *Figures 14A*.

Subsiding air accompanies the persistent high pressure that controls the summer climate of this region yields nearly cloudless conditions. The heating and cooling cycle over a day creates a very large temperature range in summer as much as eight to ten degrees Celsius, hot days and cool nights (Ritten 2006). *Figures 14B-C* show the average daily high and low temperatures for each month in Valencia, Spain.

### *b. Agriculture*

The Western Mediterranean climate allows for the growth of various crops, including: wheat, barley, rice, alfalfa (most important), sugar beets, olives, legumes, and various fruits. Also, areas like Spain are some of the largest wine producers in the world. However, despite the plethora of goods grown in Spain, much of its land has been lost to erosion, and desertification likely caused by human interaction and drought conditions (Encyclopedia Britannica Online, 2006). Due to the arid summer season, the lack of rainfall creates little run off and there is high evapotranspiration. The imbalance created is offset by the large amount of water that flows into the Mediterranean from the Atlantic through the Strait of Gibraltar. This increases the salinity above that in the North Atlantic (Trewartha 1961).

## **6. Summary**

We have shown the primary climate patterns of the Mediterranean and how they affect the four major regions of the Mediterranean Basin. Temperature and precipitation variations, as well as topographical and geographical effects all weigh heavily into the formation of what is known as a mid-latitude warm climate. Due to these variations, we have also shown the vegetation and agriculture of these regions to be as variable as the factors creating the climate, as well as how the hydrologic cycle and energy balance play a role in the climate of these regions.

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## Figures

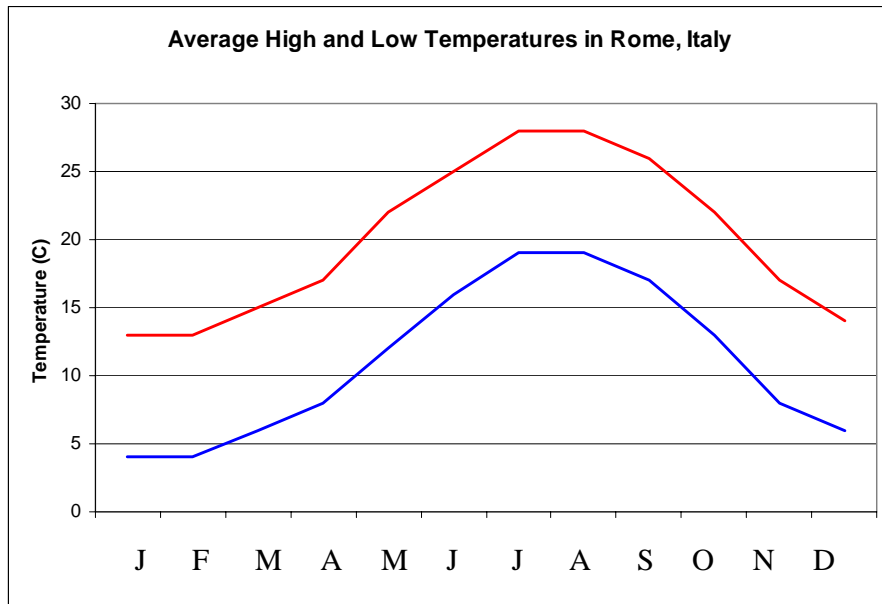


Figure 1. Average high and low for Rome, Italy

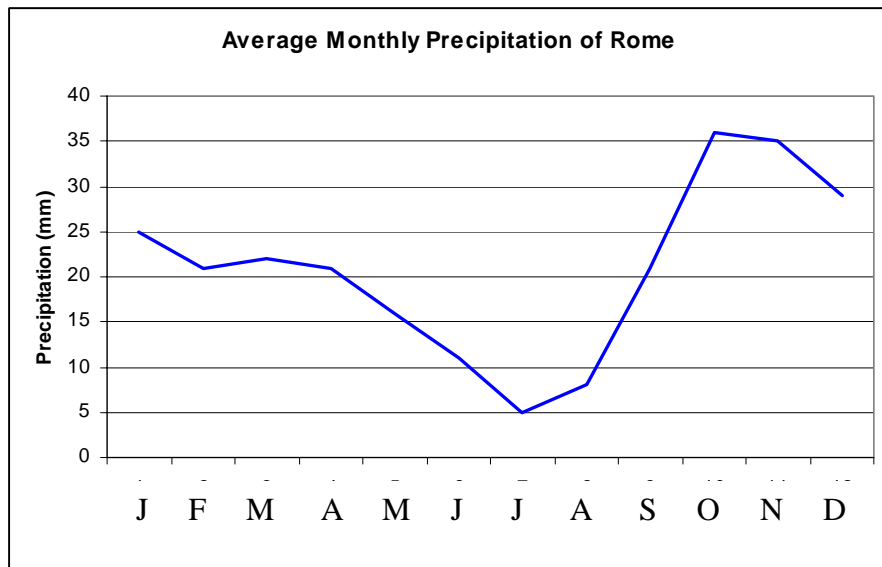


Figure 2. Average Monthly Precipitation. For Rome, Italy

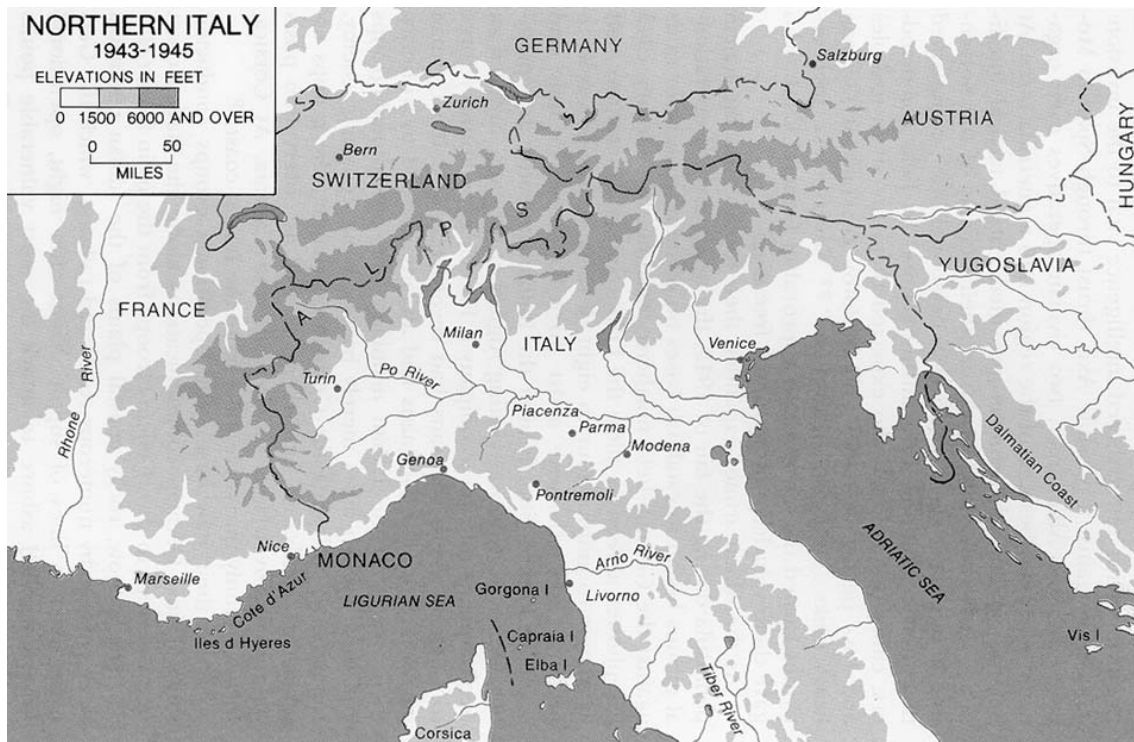


Figure 3. Topographic map of Northern Mediterranean (<http://www.army.mil/cmh-pg/books/wwii/70-42/map3.JPG>)



Figure 4. The topography of the Balkan region Atlas de Poche, Philippe Rekacewicz, Le Livre de Poche, Paris; August 1996. ([http://maps.grida.no/go/graphic/balkans\\_topography\\_and\\_borders](http://maps.grida.no/go/graphic/balkans_topography_and_borders))





Figure 5. North African Mediterranean Region  
 (<http://www.nationalgeographic.com/resources/ngo/maps/view/images/medregm.jpg>)

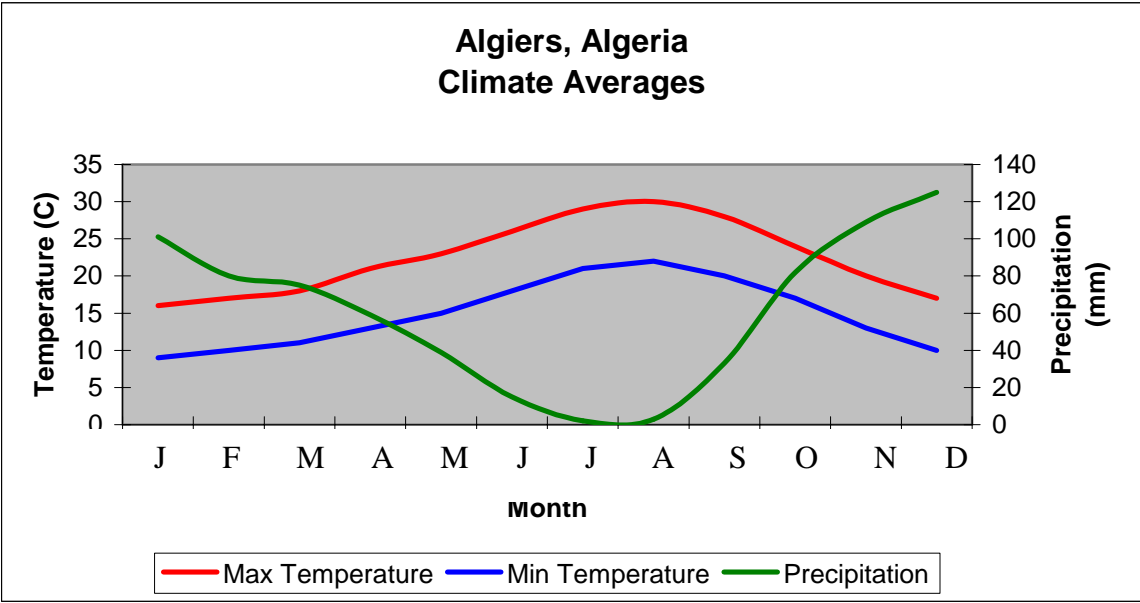


Figure 6. Climograph of Algiers, Algeria.

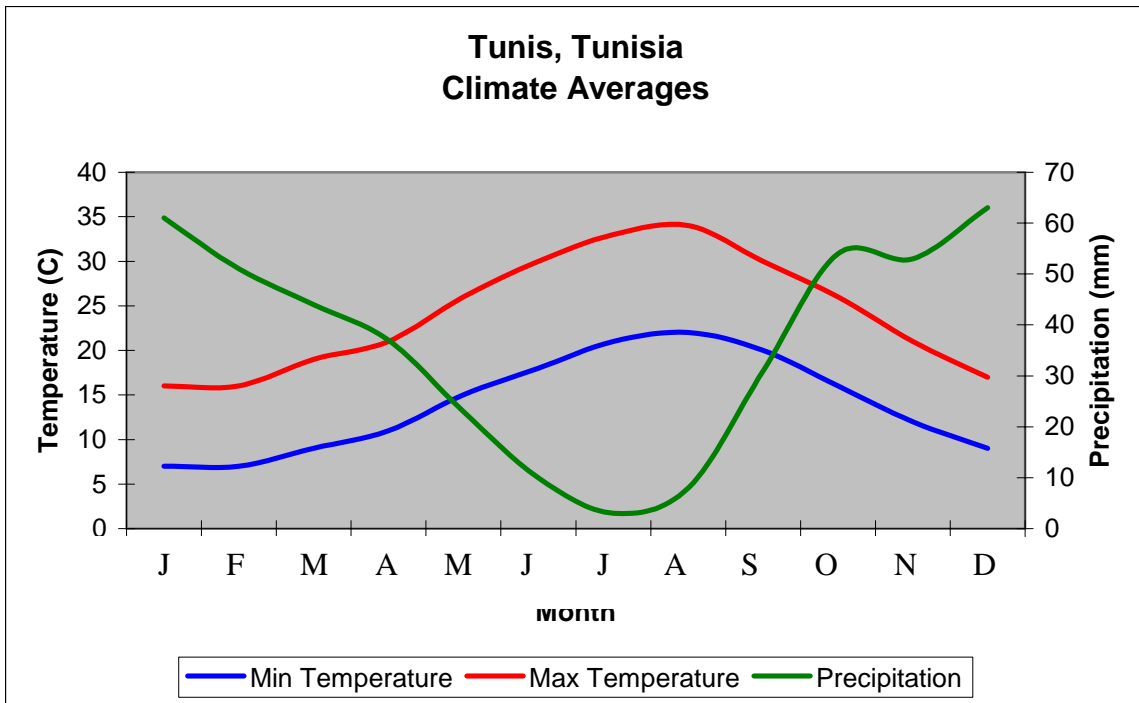


Figure 7. Climograph of Tunis, Tunisia.

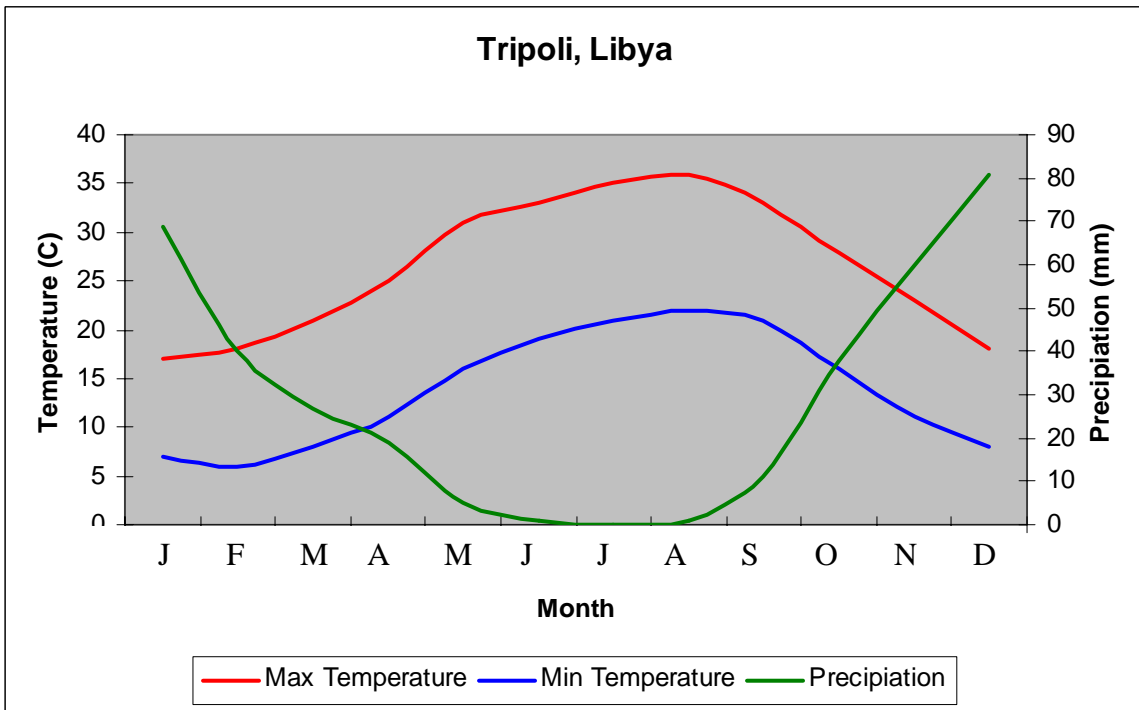


Figure 8. Climograph of Tripoli, Libya.

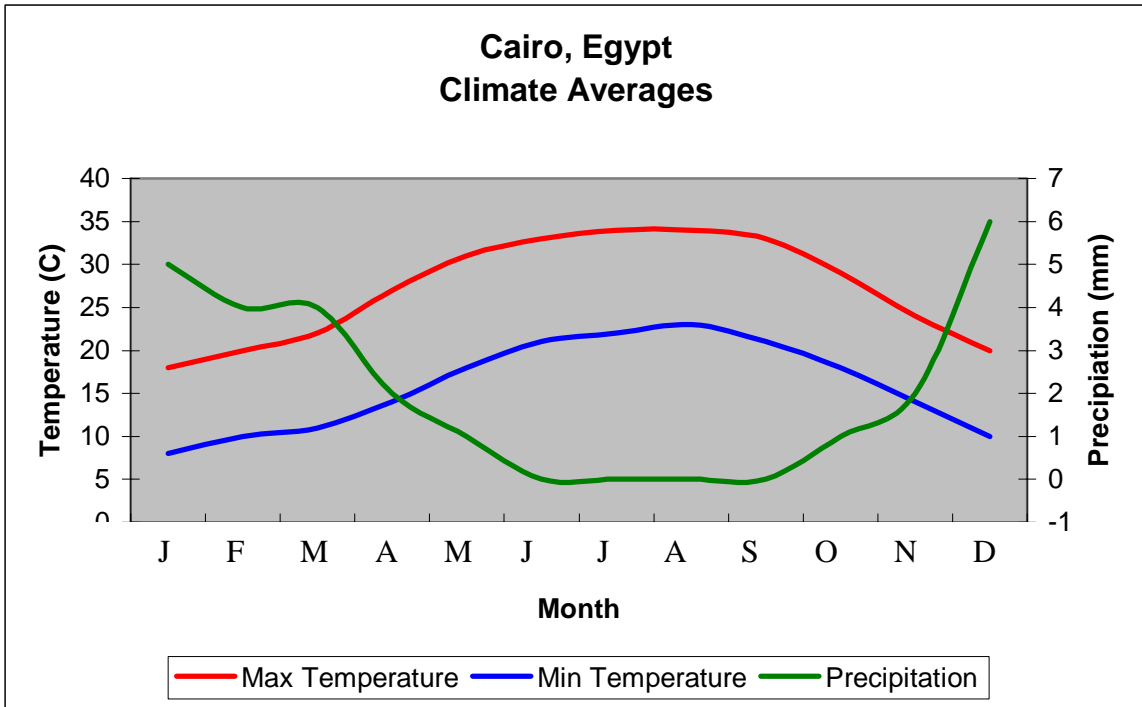


Figure 9. Climograph of Cairo, Egypt.



Fig. 10. Map of the Eastern Mediterranean region. (www.2goglobal.com)



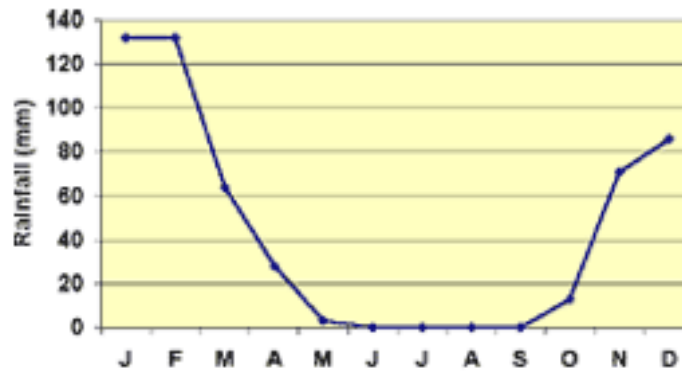


Figure 13. Monthly Rainfall of Israel.  
 ([http://www.bbc.co.uk/radio1/onelife/travel/images/charts/israel\\_rain.gif](http://www.bbc.co.uk/radio1/onelife/travel/images/charts/israel_rain.gif))

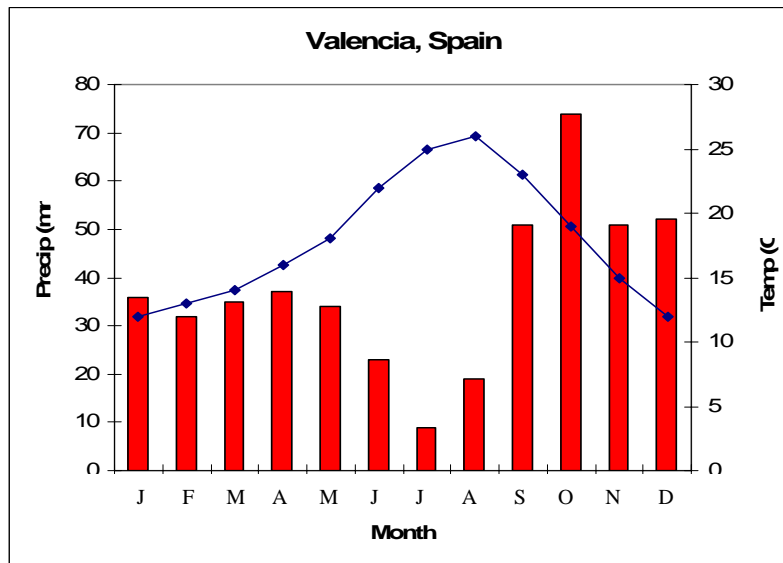
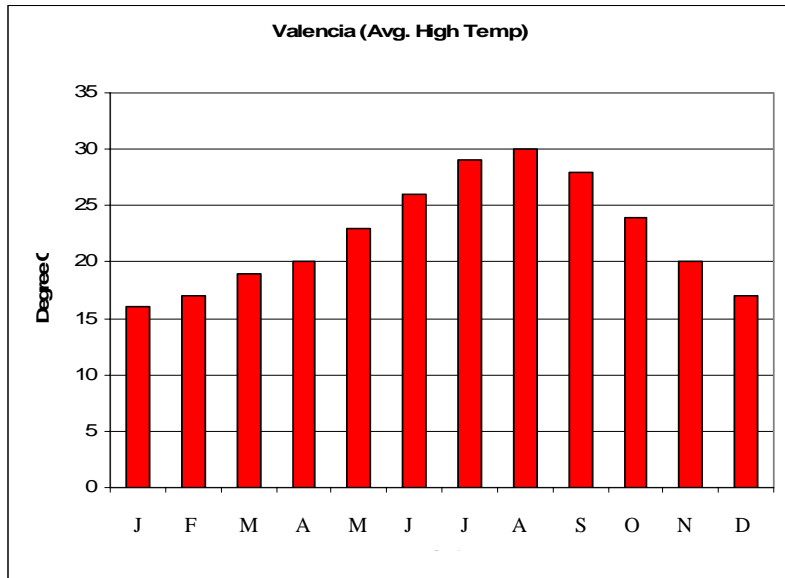
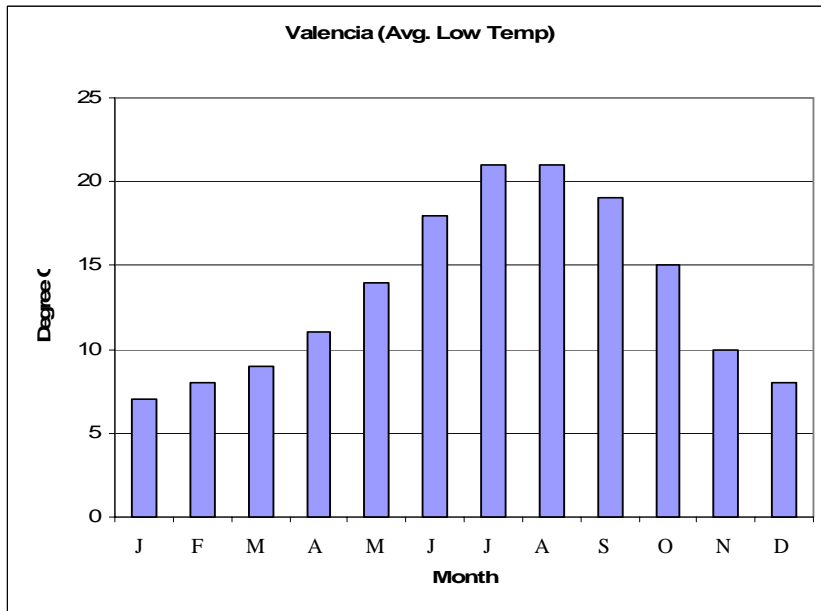


Figure 14:A) Climate Chart for Valencia, Spain (Original diagram, data from Eurometeo.com, 2006).



B) Average daily high temperature for Valencia, Spain (Original diagram, data from Eurometeo.com, 2006).



C) Average daily low temperature for Valencia, Spain (Original diagram, data from Eurometeo.com, 2006).