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# An overview of climatic features of the Ermenek River Basin

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**Abstract**

Ermenek River is one of the two rivers that constitute the upper basin of Göksu River, one of the most important rivers which flow into the Mediterranean Sea in South Turkey. This research was conducted in order to identify the climatic features of the aforementioned basin. The climatic observations obtained from the three meteorological stations in the basin form the basic data of the study. These data were analyzed and converted to maps and charts. Planetary and geomorphological factors shape the climatic features in the research area. The Mediterranean climate, with its hot and dry summers and rainy winters, prevails over the basin. However, because the study area is between Central Anatolia and the Mediterranean region, and a large part of the area is at least 1500 meters above sea level, Mediterranean mountain climate is seen especially in higher regions. Rainfall effectiveness decreases from the west to the east. As Mediterranean climate prevails in the lower parts of the basin, Mediterranean mountain climate is dominant in higher areas.



*Keywords*: Climatic features; Ermenek River; Goksu River; Mediterranean, Turkey

## 1. Introduction

Climate is an important factor determining human activities according to location, time and period, in addition to its effect on geomorphology, hydrology, soil characteristics and natural vegetation. Climatic effect on physical factors can take a long time (Atalay and Efe, 2010; Efe, 1998; Efe, 2010). But it is a fact that current climatic conditions, particularly vegetation, are influential on the physical geography of an area such as hydrography and soil

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(Atalay and Efe, 2007; Efe et al., 2008). On the other hand, climate affects human geography along with physical factors directly and in a much shorter time (Bahadır, 2011; Arseni-Papadimitriou and Maheras, 1991; Global warming and climate change is important issue for the future projects especially on the coastal areas (Brochier and Ramieri, 2001; Xoplaki et al., 2003; Lionello, 2013; Metaxas et al., 1991; Kutiel and Maheras, 1998; Bozkurt, 2011; Perry 2000; Poulos et al., 1997).

## 2. Materials and Methods

Ermenek River Basin is a part of the Göksu River Basin in the middle region of the Taurus Mountains (Fig 1). This research was initiated with primarily reviewing the literature on the subject and study area, the sources procured were examined and compiled. Later, the observations of the Ermenek, Göktepe and Kazancı meteorological stations, which are within the boundaries of the study area, were obtained. Because the observation spans of these Meteorological stations are different from each other and even within the same station, the observation spans of precipitation and temperature are inconsistent, data from the meteorological stations near the study area, Hadim, Mut, Gülnar, Gazipaşa and Gündoğmuş, were also used. Furthermore, the climatic features of the study area which is located in a transit zone were compared to the meteorological data from Konya which is in a continental climate area and Mersin which represents Mediterranean climate, and their approximation and dissimilarity to these climates have been propounded. All data were analyzed and converted to tables from different angles such as average, maximum and minimum rates and multi-annual changes. The data from the tables were used in order to create charts and maps. Thornthwaite classification (Thornthwaite, 1948) was preferred in determining the climatic type.

## 3. Findings and Discussion

There are two main factors determining the climatic features of the Ermenek river basin. These are planetary factors and landforms.

### *3.1. Planetary Factors*

Air circulations which are prevalent on the region determine the climatic features of the study area. These air circulations are a part of the "Westerlies" system which is dominant in the Northern Hemisphere. The study area and its vicinity are under the effect of two important air masses. These are polar (P) air mass which usually comes from the north in winter and tropical (T) air mass, which comes via Africa and the Mediterranean and effects Turkey in summer. Both these air masses can have marine (m) or continental (c) features based on where they have originated (Erol, 1993; Kadıoğlu, 2000; Karabörk et al., 2007). Annual precipitation and temperature conditions in the study area are under the control of these two air masses. The geographical position and geomorphological features of the Ermenek river basin somewhat alter the effects of these two different air masses (Atalay, 2010).

The area falls under the influence of the tropical air mass coming from the south and the southeast at the beginning of summer. When the tropical (cT) air mass which is dehumidified when passing over the Mediterranean is effective, air temperature rises and precipitation does not occur. Along with this air mass that affects the area from the south and the southeast, at the same period; high pressure systems originating from Europe pass the Anatolian plateau and reach the study area at times. These cold polar air masses gets warmer while passing through Western Anatolia in summer period and reach the study area and its vicinity having lost their humidity. These air masses which occasionally create winds blowing from the northwest to the southeast, while scarcely causing precipitation, mitigate the effect of hot weather. Therefore, there is a long period of drought during the summer that ranges between 4-6 months in the study area.

From September onwards, the area falls under the influence of the polar air mass coming from the north and the tropical air masses coming from the south. Frontal activities caused by the encounter of these two air masses cause precipitation in the area. The continental polar (cP) air mass which is dominant in Central Anatolia throughout winter occasionally moves south and affects the study area. The polar air mass which creates high pressure causes a fall in temperature; but scarcely leads to precipitation. When the polar air mass is influential, the weather is clear

and temperature increases during the day but decreases during the night. The tropical air mass moving from the south to the north in winter becomes humid when passing the Mediterranean basin, especially in the bottom layers. It rises by crashing into the Taurus Mountains that extend from the east to the west and creates plenteous precipitation in the south-facing slopes of the mountains. However, as the same air mass reaches the interior parts of the Taurus, the amount of precipitation decreases drastically because the air mass has lost its humidity. Because fronts coming from Central Anatolia to the same area also do not carry humidity and therefore do not cause precipitation, parts of the study area that are in the interior Taurus region have marginal amounts of precipitation.

### *3.2. Effects of Landforms*

Ermenek river basin, which is in the interior part of the Taurus Mountains, is surrounded with high mountains. Geyik Mountains in the northwest divide into two branches starting from the upper basin. The mountains which are located in the east-west direction of the basin constitute the watershed of the Ermenek River and Gökçay basins. The other branch moves in the southeast direction and creates the high ridges that separate the Alara and Dim stream basins from one another. The first branch borders the area from the northeast and the east, and the other branch from the west and the southwest. Elevation which reaches 2500 m in the upper basin continues eastward with summits exceeding 2000 m in both the north and the south. Both branches are interrupted by Gökçay and Göksu which roughly flow along the north-south direction (Efe, 1998).

These geomorphological features have very important effects on the climate. Humid air masses which bring precipitation to the area come from the northwest and the southwest. This mountainside that surrounds the Ermenek river basin substantially obstructs the air masses that bring precipitation to the basin. Because of this, parts of the Ermenek river valley that lies along the east-west direction and the Mut basin is fully under 'rain shadow'. These mountainsides which enclose the study area in the north prevent the marine (mP) and continental (cP) cold air masses that come from the north entering the basin. As a result of this, in the lower parts of the basin, under 1000 m, temperature does not fall very much and heavy snowfall does not occur. The air masses that cause a fall in the temperature and snowfall come from the north. Therefore, whereas snow can be seen in the north-facing slopes of the mountains, snowfall is not very effective in the south-facing slopes.

## 4. Climatic Factors and Features

The effects of climatic factors in the basin, which consist of pressure, wind, humidity, temperature and precipitation, differ according to elevation and planetary factors.

### *4.1. Pressure and Wind*

Pressure is high in winter and low in summer in the area which is affected by different air masses throughout the year. Beginning from September, temperature falls and pressure increases in the area which falls under the influence of polar air masses. This situation changes in April with the rise in temperature. As of April, Tropical air mass starts to settle, hence temperature rises and pressure decreases. In winter months, winds blowing from the high pressure Anatolian plateau to the low pressure Mediterranean are seen in the study area. In summer, winds blowing from the cool and humid Mediterranean Sea to the hot and dry Anatolian territory are dominant. The winds blowing from the Mediterranean Sea to the north in summer gets warmer while passing across lands and change into scorching winds. The winds called "*samyeli"* in Anatolia cause herbaceous plants to wither up and foliage of shrubs' and trees' turn yellow.

Between May and November, temperature increases with the effects of the Tropical air masses (cT, mT) coming from the south and falls under the influence of low pressure. Winds originating from the south are seen depending on the tropical air originating from North Africa and passing over the Mediterranean and moving towards Turkey. In wintertime, frontal activities increasing while high and low centers of pressure change places cause frequent precipitation in the area. These changes of pressure start in November lasts until April with occasional interruptions.

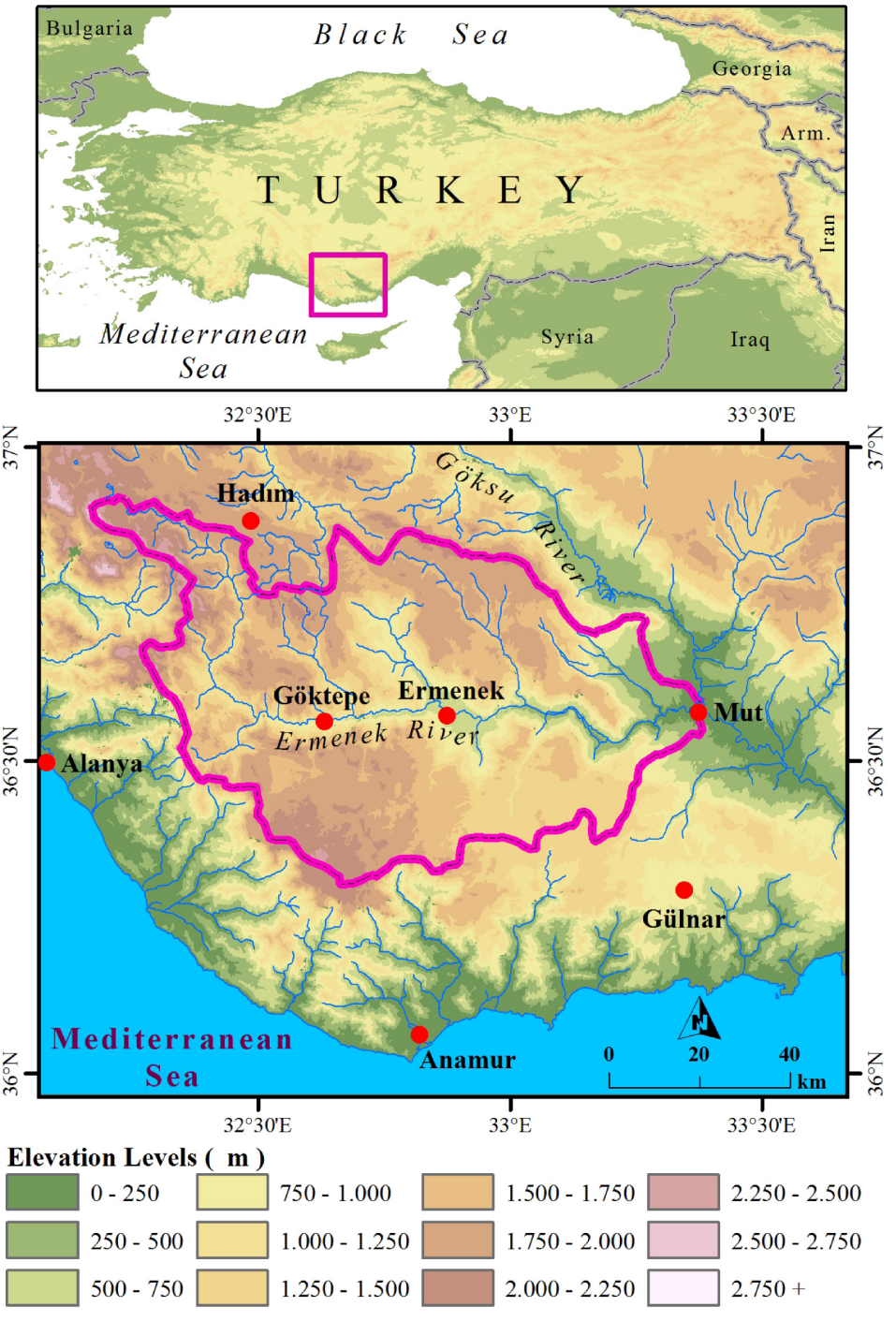


Fig. 1. Location map of the study area

Wind directions change according to the season and place in the basin. While southern winds are dominant almost throughout the year in Ermenek, winds originating from the northwest are observed to be more effective in Göktepe. In Hadim, winds originating from the northeast, southwest and west blow more frequently. In the study area, northeastern winds are more dominant in the summer and western winds are more dominant in the winter. In Mut and Gülnar, the dominant wind direction is northwest and in Mut, the influence of winds blowing from the southwest is greater in April and May. The spread of the Göksu valley is the most important factor determining wind direction in the Mut basin. Therefore, winds blowing from any other direction than northwest and southeast are nor very effective.

Table 1. Most frequently blowing wind directions by month

| Stations | MONTHS | | | | | | | | | | | | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | |
| Ermenek | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Göktepe | NW | NW | NW | NW | NW | NW | NW | NW | NW | NW | SE | NW | NW |
| Gülnar | NW | NW | NW | NW | NW | NW | NW | NW | NW | NW | NW | NW | NW |
| Hadim | NE | W | SW | SW | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| Mut | NW | NW | NW | SE | SE | NW | NW | NW | NW | NW | NW | NW | NW |

Most frequently blowing wind directions are also related to the location of the meteorological stations the observations were held in. While in Ermenek, which is surrounded by high mountains in the north, the effect of southern winds are observed, in Göktepe, which is to the west of the area, northern winds are effective throughout the year.

The centers of pressure that affect the study area changing places and frontal activities are the primary reasons of wind. The frequency of these pressure systems changing places is effective on the frequency, direction and pace of wind blow. Along with the pressure systems dominant in the basin, relief forms play an important role on the direction and pace of the wind. The high mountainside that surrounds the study area from three sides except east reduces the effect of winds coming from these directions. But the valleys which cut through this mountain side and lie in different directions canalize the wind and increase the gale force.

The effects of daily and seasonal winds on human activities are can be seen in the study area. Especially in the summer, the current of air coming from the Taurus and reaching the Mediterranean cause the formation of föhn and suffocating dry weather in the coastal area.

### *4.2. Temperature Conditions*

Mean yearly temperatures in the basin vary between 9.6°C and 17.4°C. The altitude above sea level of the meteorological stations the mean yearly temperature values were collected from are Hadim 1500 m, Ermenek 1250 m, Gülnar 925 m, Göktepe 1500 m, Gündoğmuş 930 m, Mut 274 m and Gazipaşa 21 m. According to these values, altitude usually plays a part in temperature distribution. While Gazipaşa, which is closest to sea level, has the highest value in comparison with the other stations, in Hadim, which is 1500 m above sea level and is the northern most station latitudinally, temperature decreases. The difference of 5.3°C between the mean yearly temperatures of Mut and Ermenek is caused by the 1000 m difference in their altitudes. While this situation is explained by the decrease in temperature as altitude increases, it is striking that the subsequent numbers are parallel to the method practiced.

The temperature which is approximately 18.5°C in the east of the basin, decreases as altitude increases to the west and becomes 6°C in the mountainside surrounding the upper Ermenek river basin. In the mean yearly temperatures map, it is observed that these values decrease as isotherms indicate high values in the valley or as altitude increases.

In the area, temperature decreases in winter months, but it is very high during summer. Minimum temperature in

January is -1.2°C in Hadim, 1.4°C in Göktepe, 3.3°C in Ermenek, 2.6°C in Gülnar, 5.8°C in Gündoğmuş, 6.1°C in Mut and 10.8° in Gazipaşa. Temperature difference which is greater in the winter diminishes in the summer (Fig. 2).

Table 2. Average temperatures.

| Stations | Elevation | Observation Period | MONTHS | | | | | | | | | | | | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | |
| Alanya | 6 | 38 | 11,4 | 11,6 | 13,3 | 16,4 | 20,2 | 24,2 | 26,8 | 26,9 | 24,4 | 20,2 | 15,4 | 12,8 | 18,6 |
| Anamur | 4 | 43 | 11,4 | 1,6 | 13,4 | 16,9 | 20,7 | 24,9 | 27,9 | 27,9 | 25,1 | 20,9 | 16,5 | 13 | 19,2 |
| Ermenek | 1250 | 19 | 3,3 | 3,6 | 5,5 | 9,8 | 13,7 | 19,5 | 22,7 | 22,5 | 18,6 | 13,1 | 7,5 | 4,2 | 12,1 |
| Gazipaşa | 21 | 21 | 10,8 | 11 | 12,4 | 15,7 | 19,6 | 24,1 | 26,8 | 26,4 | 24 | 19,4 | 14,8 | 12 | 18,1 |
| Göktepe | 1500 | 6 | 1,4 | 1,7 | 4,8 | 11,2 | 14,5 | 18,9 | 22,7 | 22,7 | 19,5 | 11,8 | 6,8 | 3,4 | 11,6 |
| Gülnar | 925 | 12 | 2,6 | 3,1 | 6,5 | 10,7 | 14,6 | 19,4 | 22,3 | 21,9 | 18,9 | 12,6 | 8,2 | 4,6 | 12,1 |
| Gündoğmuş | 930 | 4 | 5,8 | 5,5 | 8,5 | 14,6 | 16,5 | 21,2 | 25 | 24,5 | 21,4 | 15,3 | 9,5 | 6,1 | 14,5 |
| Hadım | 1500 | 26 | -1,2 | -0,3 | 3,1 | 8,5 | 13,2 | 17,3 | 20,6 | 20,2 | 16,6 | 10,6 | 5,4 | 0,8 | 9,6 |
| Mut | 275 | 22 | 6,1 | 7,6 | 11,6 | 15,7 | 20,9 | 26,1 | 29,1 | 28,5 | 24,6 | 18,5 | 12,1 | 7,6 | 17,4 |
| Silifke | 15 | 42 | 10,1 | 10,9 | 13,4 | 17,1 | 21,1 | 25,1 | 27,7 | 27,9 | 25,5 | 21,2 | 16 | 11,7 | 19 |

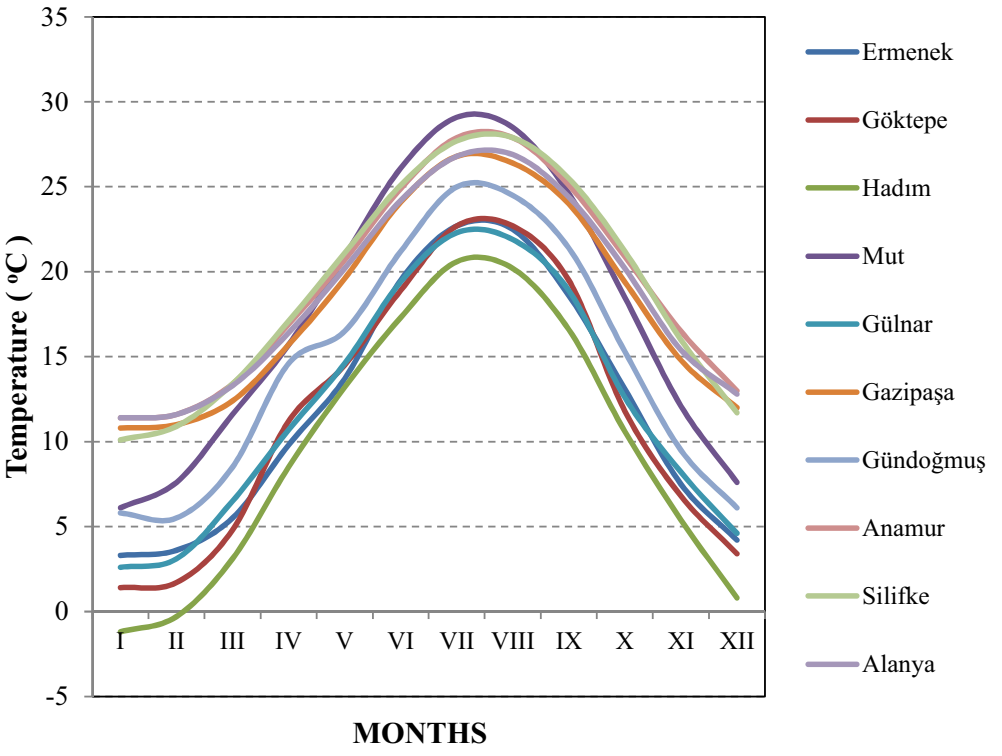


Fig. 2. Temperature graph

Fig. 3. Snowfall occurs during winter on highlands

Fig. 4. Mediterranean climate prevails in the area and pinus brutia is typical tree species in the area

Temperature is very high during summer in the east of the basin, in the Mut depression. July mean temperature which is 29.1°C in Mut has close values such as 22.7°C in Ermenek and Göktepe and 22.3°C in Gülnar. Because of its aspect and altitude Hadim is the station with the minimum temperature in July with 20.6°C.

The effect of elevation is also observed in mean low temperature. It is 4.7°C in Hadim which is the northernmost station and is 1500 m high, 8.1°C in Ermenek, 6.6°C in Göktepe, 7.7°C in Gülnar, 10.8°C in Mut (Table 2).

Annual mean high temperatures are 14.5°C in Hadım, 17.2°C in Ermenek, 17.5°C in Göktepe, 18.3°C in Gülnar, 23.5°C in Mut. The reason that Gazipaşa, which has a value 1.5°C higher than Mut in mean low temperatures, has a lower value than Mut in mean low temperatures is because Gazipaşa is under the effect of the Mediterranean.

As for extreme temperatures; highest and lowest temperatures are -13.5°C (February), 39.0°C (July) in Ermenek, -13.8°C (February), 35.5°C (August) in Göktepe, -19.4°C (January), 35.0°C (July) in Hadim, -10°C (January), 43.3°C (August) in Mut, -11.8°C (February), 36.9°C (July) in Gülnar.

An increase in the low temperature frequency is observed from the south to the west. In Hadim, temperatures lower than -15°C have been recorded 38 times until 1994. However, in Göktepe, which is in the same elevation as Hadim, temperature does not fall below -15°C. This indicates that, aside from elevation, latitude and aspect are also very influential on low temperatures in the field.

In winter, temperatures drop below 0°C in a large portion of the basin, and frost occurs as a result. The number of frost days in the study area increases beginning from the valley bottoms to mountainous areas.

In low areas of the basin, frost days are within the plant growing period while they occur out of this period on high plateaus and in mountainous areas. Plants are not damaged during frost days outside the growing period (Efe et al., 2009, Efe and Greenwood, 2007).

### *4.3. Humidity and Precipitation*

Humidity: Average annual relative humidity is 51% in Ermenek, 59% in Hadim, 56% in Mut, 52% in Göktepe, 61% in Gülnar. Relative humidity increases in winter and decreases in summer. Reaching its peak in January, relative humidity rises to 66% in Ermenek while it is about 70% in other stations. In summer, it drops to 35% in high areas, and it is higher in low areas. A striking decrease in humidity is observed in summer from the Mediterranean shores to inner and higher areas. Humidity is 70% in Alanya in August, yet it decreases in the higher part of the study area. In August, relative humidity is 45% in Ermenek and 32% in Göktepe (Table 3).

### *4.4. Distribution of Precipitation*

Elevation and aspect are the factors that have an effect on the distribution of precipitation. While lower areas of the basin receive less precipitation, it gradually increases towards higher areas. Humid air masses coming from the

southwest, cause precipitation to increase in areas where these masses run vertically against the position of the mountains. For this reason, humid air masses coming from the Gulf of Mediterranean and running into the Taurus Mountains in the northeast of Gündoğmuş, Alanya, and Gezipaşa cause the amount of precipitation to exceed 1400 mm here. Thus, the amount of precipitation is high near the watershed, in the west of the study area. From the west to the north, a decrease in precipitation occurs. In the higher areas of the slopes of the Ermenek river valley, particularly near the watershed separating the basin of the Ermenek river from the basins of the Alara and Dim streams in the west, precipitation reaches 1500 mm. On the other hand, precipitation drops to 300 mm in the Mut depression, which is the east of the basin and located within the rain shadow.

Table 3. Average relative humidity rates (%).

| Stations | MONTHS | | | | | | | | | | | | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | |
| Alanya | 67 | 68 | 69 | 72 | 73 | 70 | 70 | 70 | 66 | 66 | 68 | 67 | 69 |
| Anamur | 71 | 70 | 70 | 70 | 71 | 69 | 66 | 66 | 64 | 63 | 67 | 70 | 68 |
| Ermenek | 66 | 64 | 58 | 49 | 46 | 39 | 34 | 35 | 41 | 48 | 59 | 65 | 51 |
| Gazipaşa | 68 | 68 | 72 | 72 | 69 | 65 | 63 | 65 | 65 | 65 | 67 | 68 | 67 |
| Göktepe | 71 | 71 | 58 | 47 | 47 | 41 | 32 | 30 | 37 | 53 | 64 | 69 | 52 |
| Gülnar | 72 | 69 | 66 | 63 | 62 | 54 | 49 | 51 | 51 | 61 | 68 | 69 | 61 |
| Gündoğmuş | 72 | 67 | 63 | 58 | 54 | 47 | 36 | 39 | 44 | 47 | 61 | 62 | 54 |
| Hadim | 72 | 71 | 66 | 58 | 55 | 51 | 45 | 45 | 49 | 60 | 68 | 73 | 59 |
| Mut | 69 | 65 | 61 | 57 | 53 | 46 | 44 | 44 | 48 | 57 | 66 | 71 | 56 |
| Silifke | 59 | 61 | 60 | 63 | 65 | 65 | 66 | 64 | 58 | 56 | 58 | 60 | 61 |

Table 4. Distribution of seasonal precipitation (mm).

| Stations | Winter | | Spring | | Summer | | Autumn | | Annual |
|---|---|---|---|---|---|---|---|---|---|
| | mm | % | mm | % | mm | % | mm | % | mm |
| Ermenek | 272 | 52 | 133 | 25 | 31 | 6 | 90 | 17 | 526 |
| Gazipaşa | 446 | 55 | 162 | 20 | 6 | 1 | 190 | 24 | 804 |
| Göktepe | 476 | 56 | 180 | 21 | 20 | 2 | 179 | 21 | 854 |
| Gülnar | 565 | 63 | 145 | 16 | 16 | 2 | 165 | 19 | 891 |
| Gündoğmuş | 792 | 56 | 298 | 21 | 48 | 3 | 263 | 19 | 1401 |
| Hadim | 332 | 50 | 169 | 25 | 38 | 6 | 126 | 19 | 665 |
| Kazancı | 483 | 60 | 182 | 23 | 21 | 3 | 118 | 14 | 806 |
| Konya | 114 | 34 | 114 | 34 | 36 | 11 | 69 | 21 | 333 |
| Mersin | 331 | 56 | 117 | 20 | 22 | 4 | 122 | 20 | 592 |
| Mut | 230 | 56 | 86 | 21 | 20 | 5 | 80 | 19 | 414 |
| Silifke | 372 | 61 | 108 | 18 | 9 | 2 | 122 | 20 | 612 |

High areas and the western side receive more precipitation than low depressions in the area where precipitation is not equally distributed. The total annual amount of rain is 526 mm in Ermenek, 806 mm in Kazancı, 854 mm in Göktepe, 414 mm in Mut in the east, 665 mm in Hadim in the north, 891 mm in Gülnar in the south, 1402 mm in Gündoğmuş (Table 4). Located in the area where Göksu flows into the Mediterranean Sea, Silifke receives 612 mm, Anamur in the south of Silifke 970 mm, and Mersin in the east 592 mm of precipitation. It can be inferred from

these data that the amount of precipitation changes based on elevation, the direction of humid air masses, and geomorphological obstacles in front of these masses (Atalay and Mortan 2007; Efe 2010).

The distribution of seasonal precipitation is quite irregular. The highest amount of precipitation falls in winter, the lowest amount in summer. The amount of precipitation that falls in winter covers 50-60% of the total amount. In spring, this amount equals to 20-25%. In fall, the amount of precipitation is 14-21%, and it ranges between 2 and 6% in summer. In winter, the basin receives more precipitation than half the total amount, yet it is rather dry in summer (Table 4).

The distribution of monthly precipitation is as irregular as that of seasonal precipitation. The month receiving the highest amount of precipitation is January, and the driest month is August (Table 4). Snowfall has no considerable impact on lower areas, but it is more influential in higher areas.

As indicated in the section of planetary factors, cold air masses that affect the basin come from the north. Hence, cold air masses penetrating into the area from the north between December and March lead to snowfall in the higher areas and on the north-facing part of the study area. Valleys where elevation decreases and depressions do not receive much snowfall. Cold air masses that are influential in winter mostly affect high areas, surface of plateaus, summits, and the north-facing slopes of mountains. Aspect factor and elevation are important in terms of snowfall. The impact of aspect is so striking that event at an elevation of 1800-1900 meters, the south-facing slope of valley might receive no snowfall unlike the north-facing slope.

Due to low temperatures, an increase in the number of snow-covered days occurs in areas with abundant snowfall. The number of snow-covered days on average equals to 4.6 in Gülnar, 21.6 in Ermenek, 40.1 in Göktepe, 54.3 in Hadim, and only 0.7 in Mut, which is located on the depression in the east of the area.

Based on the precipitation and temperature regimes, it is possible to say that the Mediterranean climate prevails in the study area. The amount of precipitation that falls in Ermenek and Hadim in spring is 25%. If this amount is compared with those of the continental and Mediterranean climates, it is understood to be closer to that of the latter. In Konya, 114 mm (34%) of the annual amount of precipitation falls in spring. In Mersin, the annual amount of precipitation equals to 592 mm, and 117 mm (20%) of this amount falls in the same season. The 25% precipitation rate that occurs in the basin in spring is thus closer to the precipitation rate recorded on the Mediterranean coast in spring (Table 4).

According to the formula that is applied in Thornthwaite (1948) climate classification, climate types observed in the Ermenek basin are arid, semi-arid, semi-humid, and humid climates which are represented with the letters B, C, and D. Ermenek has a climate which is ‘arid and has low humidity, is first degree mesothermal, has very strong excess water in winter and has conditions close to those of seas’. This climate type is represented with $C_1\ B'_1\ s_2\ b'_3$. Gülnar and Göktepe have a climate which is ‘second degree humid, first degree mesothermal, and severely lacks water in summer’, and this climate type is represented with $B_2\ B'_1\ s_2\ b'_3$. Hadim ($C_2\ B'_2\ s_2\ b'_3$) has a climate type which is ‘semi-humid, second degree mesothermal, and severely lacks water in summer’. Mut is different from others in that it has a semi-arid ($D\ B'_3\ s\ b'_3$) climate. A lack of water occurs in whole basin for four months between June and September. In Mut, water shortage begins in May and lasts until November. During a half of the year, drought prevails. In Hadim, Gülnar, and Ermenek, there is an oversupply of water lasting for four months between December and April. Oversupply of water in Göktepe continues between November and April, which is a longer period. Precipitation begins in Mut after long-lasting summer drought, but not until January that does the ground become saturated. However, a lack of water arises in May again.

*4.4.1. Possible Precipitation*

The amount of precipitation recorded by different meteorological stations in the Ermenek river basin greatly varies. The highest amount falls in the summit area, separating the Alara and Dim stream basins in the west from the Ermenek river basin. Here, the maximum amount of annual precipitation exceeds 2000 mm. The lowest amount was recorded in the east of the area, where the Mut depression is located.

The lowest and highest amount of precipitation recorded by the meteorological stations is 286-931 mm in Ermenek, 475-1091 mm in Kazancı, 492-1590 mm in Gülnar, 464-1067 mm in Hadim, and 135-608 mm in Mut. When elevation and orographic features are taken into consideration, it is possible to say that extreme precipitation exceeds 2000 mm in the west. Based on 135 mm of total amount of precipitation recorded in Mut in 1973, one can

say that this amount falls below 100 mm in the areas close to the valley bottom, in the Mut depression. This indicates that summer drought is very severe in Mut depression in some years.

Table 5. Index values of monthly precipitation according to the Erinç formula (Erinç, 2009)

| Stations | MONTHS | | | | | | | | | | | | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | |
| Ermenek | 176 | 125 | 78 | 29 | 20 | 8.7 | 3 | 2 | 2.3 | 19 | 55 | 174 | 31 |
| Göktepe | 326 | 207 | 106 | 39 | 20 | 6 | 2 | 2 | 3 | 40 | 105 | 272 | 49 |
| Gülnar | 398 | 188 | 75 | 37 | 17 | 6 | 1 | 1 | 2 | 30 | 94 | 283 | 49 |
| Gündoğmuş | 385 | 218 | 146 | 58 | 33 | 15 | 3 | 3 | 10 | 46 | 124 | 308 | 71 |
| Hadim | 391 | 145 | 108 | 44 | 30 | 14 | 3 | 2 | 4 | 39 | 77 | 279 | 46 |
| Mut | 93 | 52 | 27 | 13 | 9 | 5 | 2 | 1 | 2 | 14 | 29 | 85 | 17 |

Downpours are calculated to occur on average one day in every year in Hadim, Mut, and Ermenek (Calculated by taking into consideration the precipitations exceeding 25mm daily which constitute more than half of the monthly amount of precipitation). Downpour frequency in the west of the basin, in mountainous areas, and in the northern part is lower. Daily precipitation that is above 25 mm and exceeds 50% of the total amount of monthly precipitation was recorded for 33 times in 45 years. During this period, at least one downpour occurred in all months except July. In Mut, 41 downpours were recorded in 41 years. There is an imbalance in the monthly distribution of downpours. Downpours, which are not very frequent in summer, occur more often in spring and winter. Yet, the frequency of downpours increases in October and May.

*4.4.2. Precipitation Effectiveness*

According to the Erinç formula (Erinç, 1965; Erinç, 2009), which is applied based on the annual amount of precipitation and average annual temperature, high areas in the west of the basin are very humid; plateaus in the north and the south are humid, and Ermenek and its vicinity are semi-humid. The Mut depression is a semi-arid area. Results of the water balance carried out according to the Thornthwaite method bear resemblance to those obtained through the Erinç formula. As for monthly precipitation, areas outside the Mut depression in the east are very humid during the 5-month period that incorporates the months between November and March. In April and March, precipitation leads to different results in various parts of the basin. However, a large portion of the study area is arid, and a part of it is completely dry during the period between June and September. In October, humid conditions show up again, and this condition prevails until April.

According to the Erinç formula, not many important differences are observed in the area aside from the station outside Mut. The area, which displays the features of a humid climate, has a completely arid condition in summer. In July and August, index values range between 0.4 and 3.2. The same goes for September except for the high mountainous area in the southwest.

Results obtained according both to the Erinç and Thornthwaite formulas demonstrate that precipitation effectiveness reduces from west to east and almost a half of the year is humid while the other half is arid.

Winter is the season when most of precipitation occurs. Yet, due to the effect of continentality, the amount of precipitation in this season decreases to some extent in the north of the basin. The south of the study area is dominated by the *Mediterranean climate* while the *Mediterranean Mountain climate* prevails in the north.

Some wrong results are obtained when the amount of downpours are calculated in places where the amount of monthly precipitation exceeds 50 mm if the daily 25 mm limit is taken into account. For instance, in Hadim where 27.6 mm of precipitation was recorded on 8 January 1966, the total amount of precipitation in January equals to 294 mm. This amount constitutes only 10.6% of the total amount of monthly precipitation. The total amount of precipitation that fell in Mut in December 1968 is 205.3 mm. In the same year, 33.0 mm of precipitation recorded on 29 December makes up 16% of the total. Therefore, daily precipitation is not regarded as downpour as long as it does not exceed the half of the monthly total. This also applies to 50 and 75 mm of daily precipitation. For example,

although 81 mm of precipitation was recorded in Hadim on 2 February 1965, it is not considered a downpour as it did not exceed the half of the total amount of precipitation of that month (249 mm).

## 5. Conclusion

The Ermenek River basin is dry and hot in summer, and warm and rainy in winter. It is under the impact of the Mediterranean climate. As the study area is located between Central Anatolia and the Mediterranean Sea, and a great portion of it is situated at least 1500 meters above sea level, the Mediterranean Mountain climate particularly dominates high areas. The area is under year-round influence of both tropical and polar air masses that have an impact on Turkey. In summer, the area is influenced by tropical air masses coming from the south while in winter it is affected by both tropical and polar air masses coming from the north. Hot and cold fronts, formed by the both air masses in the study area, frequently cause weather changes in winter. The varying topography of the basin has also climate to be different. Precipitation effectiveness decreases from west to east. While the Mediterranean climate dominates the lower areas, the Mediterranean Mountain climate prevails in the higher areas.

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