# Application of Köppen Climate Classification of Two Remote Regions in Turkey

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## Abstract

This paper presents the application of the Köppen climate classification system for two remote regions in Turkey. The author describes the Köppen system and the history of climate classification briefly. The author uses the meteorological data of Mersin province in the Mediterranean region and Sinop province in the Black Sea region. The author compares the results with the existing classification in the conclusion.

## 1.  Introduction

Köppen system for climate classification is the most widely used climate classification since its development in the last century (1). Köppen's climate classification, based on the global vegetation map of Grisebach, was reasonable since there were few weather stations collecting temperature and precipitation data. Köppen's 1923 map is still comparable with global climate model outputs. Köppen classification is considered adequate for assessing regional long-term mean climate conditions although assessing yearly variability can also be useful.

## 2.  Köppen Climate Classification

Köppen climate classification divides the world into five bioclimatic regions. Köppen further subdivides these fve bioclimatic regions based on the vegetation characteristics. The descriptions of the climate regions, selection criteria and indicators used for classification are in Table 1.

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Table 1. Description of Köppen climate symbols

| 1st | 2nd | 3rd | Description | Criteria* |
|---|---|---|---|---|
| A | | | Tropical | $T_{cold} \geq 18$ |
| | f | | - Rainforest | $P_{dry} \geq 60$ |
| | m | | - Monsoon | Not (Af) & $P_{dry} \geq 100-MAP/25$ |
| | w | | - Savannah | Not (Af) & $P_{dry} < 100-MAP/25$ |
| B | | | Arid | $MAP < 10 \times P_{threshold}$ |
| | W | | - Desert | $MAP < 5 \times P_{threshold}$ |
| | S | | - Steppe | $MAP \geq 5 \times P_{threshold}$ |
| | | h | - Hot | $MAT \geq 18$ |
| | | k | - Cold | $MAT < 18$ |
| C | | | Temperate | $T_{hot} > 10$ & $0 < T_{cold} < 18$ |
| | s | | - Dry Summer | $P_{sdry} < 40$ & $P_{sdry} < P_{wwet}/3$ |
| | w | | - Dry Winter | $P_{wdry} < P_{swet}/10$ |
| | f | | - Without dry season | Not (Cs) or (Cw) |
| | | a | - Hot Summer | $T_{hot} \geq 22$ |
| | | b | - Warm Summer | Not (a) & $T_{mon10} \geq 4$ |
| | | c | - Cold Summer | Not (a or b) & $1 \leq T_{mon10} < 4$ |
| D | | | Cold | $T_{hot} > 10$ & $T_{cold} \leq 0$ |
| | s | | - Dry Summer | $P_{sdry} < 40$ & $P_{sdry} < P_{wwet}/3$ |
| | w | | - Dry Winter | $P_{wdry} < P_{swet}/10$ |
| | f | | - Without dry season | Not (Ds) or (Dw) |
| | | a | - Hot Summer | $T_{hot} \geq 22$ |
| | | b | - Warm Summer | Not (a) & $T_{mon10} \geq 4$ |
| | | c | - Cold Summer | Not (a, b or d) |
| | | d | - Very Cold Winter | Not (a or b) & $T_{cold} < -38$ |
| E | | | Polar | $T_{hot} < 10$ |
| | T | | - Tundra | $T_{hot} > 0$ |
| | F | | - Frost | $T_{hot} \leq 0$ |

*MAP = mean annual precipitation, $T_{hot}$ = temperature of the hottest month, $T_{cold}$ = temperature of the coldest month, $T_{mon10}$ = number of months where the temperature is above 10, $P_{dry}$ = precipitation of the driest month, $P_{sdry}$ = precipitation of the driest month in summer, $P_{wdry}$ = precipitation of the driest month in winter, $P_{swet}$ = precipitation of the wettest month in summer, $P_{wwet}$ = precipitation of the wettest month in winter, $P_{threshold}$ = varies according to the following rules (if 70% of MAP occurs in winter then $P_{threshold} = 2 \times MAT$, if 70% of MAP occurs in summer then $P_{threshold} = 2 \times MAT + 28$, otherwise $P_{threshold} = 2 \times MAT + 14$). Summer (winter) is defined as the warmer (cooler) six month period of ONDJFM and AMJJAS.

## 3.    Climate Classification Studies in Turkey

Turkey's climate classification, based on the seven climate regions, is not only based on their bioclimatic properties. The social and economic characteristics of the climate regions are also considered (2). Ünal et al. (3) performed five hierarchical clustering methods for mean, minimum and maximum air temperature and total precipitation. Türkeş and Tatli (4) used the spectral clustering method for classifying the Turkish precipitation series. Fahmi et al. (5) studied the climate regions of Turkey using monthly air temperature data from 65 stations between 1950 and 2006. Iyigun et al. (6) used Ward's minimum clustering method for two consecutive 30 year periods to determine the climate regimes in Turkey.

## 4.    Methodology and Results

In this paper, the author assesses the long-term monthly temperature and precipitation values of two remote regions of Turkey using the Köppen climate classification method. Mersin province is in the Mediterranean region and characterized by hot-arid summers and warm-moist winters. Sinop province is in the Black Sea region and characterized by relatively cool summers and warm or cold

weather depending on the altitude in winters with moist weather all year. The mean temperature and precipitation values are in Figure 1 (7).

Figure 1. Long-term mean temperature and precipitation values in Mersin and Sinop
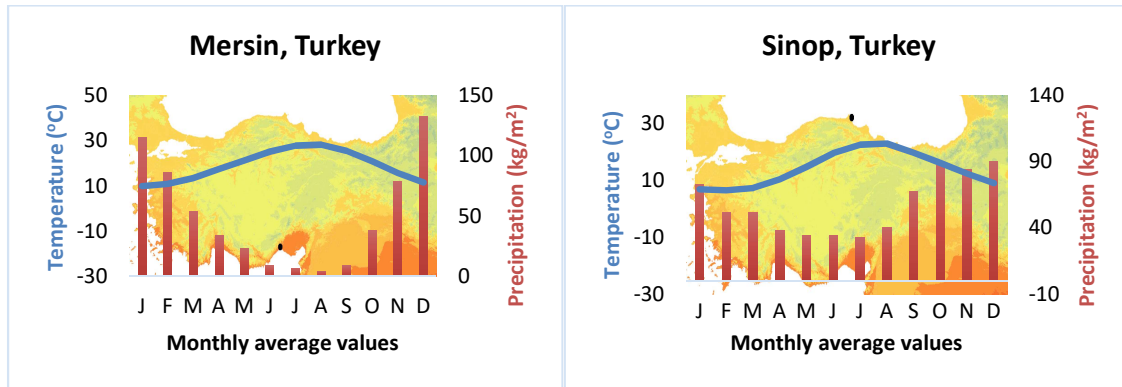


Converting the precipitation values to mm and applying Köppen's first criteria, the author determines the climate classification for Mersin and Sinop as temperate (C). With the sub-regions criteria, the author identifies the climate classification, Mersin as temperate-dry summer (Cs) and Sinop as temperate-without dry season-hot summer (Cfa).

## 5.     Conclusion

Mersin and Sinop regions have geographically both coastlines and mountains with high elevations, which have an additional impact on their climate classification. The meteorological data of Mersin and Sinop provinces provides reasonable results, but keeping in mind the micro-climates based on different elevation levels.

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