# Time-space Analysis of the Monthly Heating Degree Days in Iran

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## Extended Abstract:

## 1- INTRODUCTION

Climate change is the result of human activities. Recent research indicates an increase in global average temperature of 4/8 °C over the twentieth century. Temperature change affects agriculture, transportation, water resources, architecture, energy production, energy consumption for heating and cooling buildings, vegetation, flowering, and harvesting, melting snow, and etc. Parameters including days' degree, the energy required for heating and cooling, and other activities at intervals (monthly, quarterly, and annual) are calculated. In most parts of the world to calculate the heating degree daybase temperatures are of 10, 12, 14, 16, 18, and 20 °C.

## 2- THEORETICAL FRAMEWORK

Day heating and cooling degrees are factors which depend on average temperature during a day; therefore, these indicate values of proper increase or decrease in average temperature during a day to be suitable for human life, accordingly, how much energy should be spent on heating or cooling the air. Degree–day is considered as an indicator of heating and cooling energy consumption.

## 3- METHODOLOGY

In this study to analyze the process and its slope, the sum of the monthly heating degree days with threshold temperature of 18 ° C and a daily temperature mean of climate during the past 44 years (1383-1340) of Esfezar databases were used. The heating degree day with 15 × 15 km cells was interpolated for the whole area of Iran, resulting in a matrix of size 44 × 7187 (pixel × time). The Mann-Kendall trend test and the slope of heating degree day for each of the cells were calculated. Continuing the trend, the slope for each cell was calculated and its spatial-location distribution was demonstrated on the map.

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## 4- RESULTS & DISCUSSION

The sum of the monthly heating degree day at a significance level of 0.05 with temperature threshold of 18 ° C was calculated and maps were drawn. The negative trend for the heating season on April and May, with 35 percent of the size of the in nerhole of country, mountainous strip of Kerman, southern and northern slopes of the Zagros Mountains, Azerbaijan, and Tehran plateau strip can be seen, which reflects a positive trend for the temperature of these areas. The positive trend of need for heating in the Central Zagros, Birjand Heighlands East, West Bojnord, Mako, Northern, East Tehran Branch, and strip width by 4% in the month, reflects colder weather in these areas. It is observable that the negative need for heating in the cold months of a year is more than positive trend in a wider area. Width of areas in the second half is more than the first half of the year. The positive trend in the months of October, November, December, and March is observed. In the summer, 90% of the country area has no special trend. Maximum extent of areas with positive trends can be seen on December, March and April. On the negative trend, January and February, respectively, with 55 and 29 percent of the country have the highest during the months of the year. Slope of the aggregate monthly heating degree days in areas had a negative trend on April, May, and June; the negative slope was -1 to -3 degrees in the day. The positive slope of the heating in the cold months of the year encompasses more than 10 percent of the areas with positive trends. The negative slope of the heating needs of more than 60% has a negative trend in all the cold and temperate months at the rate of-1 to -3. The small peak in February in the central region reflects a negative trend at the rate of -5 to -7.

## 5- CONCLUSION & SUGGESTIONS

Analysis of the collected monthly heating degree days indicates a decrease of this parameter in the southern Zagros and internal holes in the months of April, May, November, December, January, and February. These results indicate warmer climate than the average climate temperature in hot areas of the country. Maximum negative spatial expansion trend of need for heating of January with the addition of the central Zagros foothills and strip of the country is 55 percent. The positive trend of warming on April, May, June, September, and December in the central Zagros mountain belt, East Alborz, Eastand West Bojnord can be seen that the maximum spatial expansion in March by the extent of 10% of the country, which signifies cooler a mountainous strip. The temperature of the hot areas of the country have had a positive trend, which increases consumption of energy for cooling and decreases consumption of energy for heating. The maximum slope of the positive trends in areas of high need for heating can be seen in the central Zagros Mountains and western Alborz mountain peak in February. The negative trend in terms of the spatial extent of heating in January shows that cold months are becoming shorter.

**Key Words**: Heating degree days, Trend, Mann-Kendall, Iran.

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