

## Investigation of the Relationship between Soil Temperature and Climate Parameters in the Northwest of Iran (1992-2015)

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### Extended Abstract

#### 1. Introduction

Soil temperature, as an important meteorological parameter, is essential for a variety of scientific studies. Soil temperature is one of the major physical parameters of soil. Plant growth and soil tillage processes depend on it. Soil temperature study at different depths is important in meteorology, and especially, in the micro scale, climatology, agriculture and industry, and its changes are also dependent on air temperature. Soil temperature and soil humidity are important factors that influence organic matter decomposition and water cycle and plant growth. Access to soil temperature data at different depths of the soil is important for environmental purposes, agriculture, urban management, and building, and its lack is a major challenge. Researchers have always tried to determine the relationship between soil temperature and important climate parameters in different depths to estimate this important feature using different models. Therefore, soil temperature, its changes and its effects on the ecosystems and human activities cannot be ignored in the studies of climate change.

#### 2. Theoretical Framework

Climate can be defined as the dominant (long-term) atmospheric conditions that are said to be in one place. Climate elements are phenomena describing the weather (e.g., radiation, temperature, precipitation, humidity, pressure and wind) and are measured at the meteorological station. Climatic elements are exacerbated, reduced or moderated by climatic factors. Soil temperature is one of the major physical parameters of soil, and plant growth, and complete soil formation processes depend on its changes. Soil temperature study at different depths is important for meteorology, especially in micro scale, climatology, agriculture and industry.

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### **3. Methodology**

The climatic data used in this study are average temperature, minimum and maximum temperature, precipitation, relative humidity, sunshine, wind speed, station pressure and soil temperature in 5, 20, and 100 Cm depth. Data of these parameters for 31 synoptic stations in daily scale were obtained from the Iranian Meteorological Organization during the statistical period 1992-2015. Soil temperature at the stations were recorded at 6:30, 12:30 and 18:30 (local time). The average of daily temperature at different depths of the soil was measured by average of three times. In order to identify the effective parameters on the soil temperature, Pearson correlation and multiple regressions were used. Using the simultaneous regression model, the most suitable multivariate regression model was used to estimate the soil temperature at different depths.

Various methods are used to study trends and climate change from a statistical point of view. Trend procedure methods are divided into two categories: parametric and nonparametric. The method used in this research is non-parametric, i.e., Mann-Kendal method. In Mann-Kendal method, the zero assumption implies randomness and lack of trend in the data series, and acceptance of the research hypothesis (the rejection of the zero assumption) indicates the existence of trends in the data series.

### **4. Results and Discussion**

Minimum temperature, maximum temperature, mean temperature, sunshine hours and relative humidity have a significant relationship with soil temperature at stations. Also, with increasing depth, the correlation of climate parameters with soil temperature decrease. The results of statistical analysis with Pearson correlation coefficient and multiple regressions showed that the average temperature of air is most related to soil temperature changes in all stations. Based on the results of validation of all stations, regression equations have a higher accuracy at depths of 5 and 20 cm. Investigations showed that the determination coefficient in the depths of 5 and 20 cm was more than 0.95. In average, in all stations, the average RMSE was between 2 and 3. As the depth increases, the error rate also increases.

### **5. Conclusion and Suggestions**

The purpose of this study was to investigate the process of soil temperature changes and to provide a model for estimating soil temperature using climatic parameters. Given the very low soil temperature fluctuations that represent climate change and the surface temperature of the soil, which indicates short-range variations, it can be seen that the phenomenon of climate change is occurring and has a significant effect on the temperature of the soil temperature. Many factors affect soil temperature, such as soil profiles, soil texture, snow cover, soil moisture changes, thermal conductivity, specific heat, evaporation, and solar radiation, all of which can lead to changes in soil temperature; therefore, using models that can include all factors is not possible. The studies carried out at the stations showed that multiple linear regressions is a suitable model for predicting soil temperature, and the  $R^2$  obtained for the depth of 5-100 cm at the stations is validated by the

model. Multivariate regression can be used as an indirect numerical method with high accuracy and reliability to estimate soil temperature

**Keywords:** Soil temperature, Climate parameters, Multiple Regressions, Northwest of Iran.

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