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The relations between north Atlantic oscillation and minimum temperature in Turkey

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Abstract

It has been observed that there is a significant negative correlation between the average temperature values taken from the 32 stations chosen across Turkey and the North Atlantic Oscillation. However, more interestingly the reaction of the stations to the North Atlantic Oscillation and the degree of the significance of the correlations become weaker as we move in a west-east direction. The factors of continentality-oceanity have also obvious effects on the correlation values. This effect is more clearly seen between the temperature values and the atmospheric oscillations. The North Atlantic Oscillation is particularly effective on the temperatures from the stations located in areas where continental climate prevails. On the other hand, this effect is either too weak or gives an insignificant correlation in the stations located in areas where maritime climate prevails.
There isn't a significant correlation between the temperature values from the stations that are in lower longitudes and the North Atlantic Oscillation. When we take the negative years into account separately from a statistical standpoint, we see that there is a more significant correlation between the North Atlantic Oscillation and the temperature values than that of the positive years. Generally there is a negative correlation between the minimum temperature values of the stations and the index value in those years in which the North Atlantic Oscillation index values are negative. In other words, as the index values of the North Atlantic Oscillation decrease, the minimum temperatures in Turkey increase. The reason for this can be said to be the westerly winds carry a great amount of humid and warm air masses to the Mediterranean basin and make the climate there milder.

Keywords: North Atlantic oscillation; minimum temperature; negative years; positive years; Turkey.

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1. Introduction

The Earth's climate system has a very delicate and fragile structure. It has been approximately 4,5 billion years since the formation of the Earth. The Earth has been subject to a number of gradual changes within this period and it is still subject to such changes. These changes that our world has experienced and is still experiencing have been classified into geological times and a geological time chart has been created by means of combining these geological times. When these geological periods have been examined, it has been identified with the help of the findings of scientific studies that significant changes and oscillations have occurred in the Earth's climate system. The results of these studies demonstrate that the leading factor that has the most significant impact on the Earth's climate system in general is the solar activities. After this factor, the most influential component and factor on the climate is the ocean-current system. Particularly, as a consequence of the studies they have carried out within the last quarter of the 20th century, climatologists have found out that the ocean current system is much more influential on the climate system than it was previously thought. These current systems make a number of oscillations with the wind systems and the most popular of these is the el nino-la nina, which is also called southern oscillation. Later in the 21st century, it has been suggested that not only the southern oscillations, but particularly certain changes in the North Atlantic with regard to determining the climatic conditions in the northern hemisphere have impact on the climate system; in fact, as a result of the studies carried out, it has been discovered that the Mediterranean Basin, the northeast of North America and principally the European continent are affected by this oscillation. This oscillation has been named as the North Atlantic Oscillation. The studies conducted later were focused on the Arctic Oscillation, which also has a great impact on the climate system as well as the abovementioned oscillations.

Some climate elements such as temperature, pressure and precipitation show changes each year depending on the changes in the atmospheric circulation in the Earth and some relations have been identified between the regions that have been thought to be different in terms of these climatic parameters.

Simultaneous changes in spots distributed across a wide area in the world have long been recorded in meteorology literature **(**Hurrel, 2003**)**. These simultaneous changes are generally called Teleconnection, or large-scale connection. In addition to this, while temperatures in a particular part of the world are below the seasonal averages from time to time, in another part of the world, milder conditions prevail. One of the large-scale connection models that have impact on the temperate and high latitudes in the Northern Hemisphere is the North Atlantic Oscillation. The North Atlantic Oscillation affects a region from the north-eastern coasts to the Siberian region and similarly from the Arctic region to the subtropical Atlantic region **(**Hurrel, Kushnir, Visbeck, 2001**)**.

On the other hand, the North Atlantic Oscillation is also called regional reflection of the large-scale (hemispheric) form of the variability known as the Arctic Oscillation **(**Hurrel, 2003**)**. The most important point to pay attention at this point is that the effect of The Arctic Oscillation on the North Atlantic Oscillation is undeniably great.

2. Material and Method

2.1. Data Collection Techniques

In this study, the minimum temperature data of the years from 1975 to 2012 belonging to 32 stations which have been chosen for sampling in Turkey have been used. Afterwards, annual average temperature values have been calculated on the basis of these data. When the stations were being chosen, some important points were taken into consideration. In order to identify the variations that might occur in the temperature values more clearly, the stations were intentionally chosen in the east-west direction and also north –south direction of Turkey. We have aimed at determining the relation between the temperature and precipitation data from the stations and the North Atlantic Oscillation, taking the North Atlantic Oscillation and the air masses that affect Turkey and the geographical surface features as well as the oceanity - continentality into consideration.

The index values of the North Atlantic Oscillation have been obtained from National Oceanic and Atmospheric Research Centre. In order to be able to relate these index values to the temperature data from the 32 stations chosen in Turkey, the data have been selected from the same period of time (1975-2012). Then, the relation between the North Atlantic Oscillation and the minimum temperatures by their location and by correlation analysis.