Trend Analysis of Precipitation and Temperature Indices over Iran

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Abstract

Precipitation and temperature are two of the most important climate components that affect water consumption and supply. In this paper, potential trends in 27 climate indices over Iran are calculated and analyzed by Mann-Kendall and Linear trend analysis methods. The Asfezari dataset used in this research includes daily based gridded data of minimum, maximum, mean daily temperature, and daily precipitation. Spatial resolution of the data set is 15 by 15 kilometer and it covers the time period of 1961 to 2004. The analysis shows that during the past four decades, there have been significant increases in the temperature indices, particularly indices associated with minimum temperature, in vast parts of Iran. However, the results for precipitation indices are a bit more complicated. While most parts of the country do not experience significant changes in annual precipitation, there has been a considerable increase and decrease in annual precipitation of western and northern part of Iran, respectively. The analysis on Middle East indicates that similar climatic condition is dominant over the whole region. If the current climate trends continue, Iran will face warmer and warmer climate which associates with lesser and lesser available water. So, it seems that the water crisis is not a temporary issue resulted by some consecutive droughts.

Keywords: Trend Analysis, Asfezari data set, Precipitation, Temperature, Climate, Iran

1. INTRODUCTION

During the past century, global land temperature has increased by 0.07 degree Celsius per decade [1]. Relevant analysis in the global [2, 3, 4] and regional [5, 6, 7] scales agree on the fact that the increasing trend in minimum temperature is larger than the increasing trend in maximum temperature. Furthermore, temperature increase is reported to happen more in winter and spring in both global [4] and regional [6] scales. However, for Central and South America, temperature increase has happened to be higher in summer and fall [8]. In Spain, analysis has shown that the increasing trend in maximum temperature has been slightly larger than the minimum temperature [9]. For some regions like United States [10] and Iran [11], global warming has been associated with a decreasing trend in the number of cold days. In addition, number of colds nights in South-East Asia and southern parts of Pacific Ocean has decreased [12]. Global studies also show decreasing trend in the number of freezing days [13]. Furthermore, in most parts of Central America and north of South America, not only temperature and extreme temperatures particularly in summer and fall have increased, but also the diurnal temperature range has increased. This is in the case that precipitation trend in the same regions does not have a consistent spatial pattern and while precipitation has a decreasing trend in some parts, there is an increasing trend in other parts. The interesting point is that the trend in precipitation intensity has a higher spatial consistency which indicates precipitation has had an increase in most parts of the aforementioned region [8]. The same pattern is evident in southern and western parts of Africa. In these regions, despite the fact that the trend of total precipitation is not significant, precipitation intensity trend is positive [14]. Spatial inhomogeneity in precipitation trend is also reported in south and central Asia [15].

Although, lots of studies have been dedicated in the analysis of the trends in the mean of the distribution, due to the lack of long term high quality time series, the trend analysis of extreme values has become difficult [16]. Studies indicate that changes in the mean and changes in the extreme values are totally different from each other [17]. In addition, Regional Climate Models (RCMs) show different temporal and spatial patterns for temperature and precipitation. While with the increase in the density of carbon dioxide in the atmosphere, one could simply expect a positive trend toward warmer climate and consequently less rain, but precipitation patterns have more complex behavior. That is while some characteristics of precipitation