

Abstract

This project provides an updated estimate of climate change in Iran after quality controlling of data, discovery and modification of non-climatic inhomogeneities on temperature, precipitation, humidity, radiation, cloudiness, wind and sunshine at 27(115 for decadal mean) weather stations of Iran during the 60-year period of 1958-2017. The results showed that the mean decadal temperature of Iran during 1958-1987, 1988-2017 and 2008-2017 are 18.2, 19.1, 19.5oC, respectively; meaning that the mean of country's temperature in the recent decade of 2008-2017 has been increased by 1.2oC(±0.4)comparing to 1958-1988 reference period. In the same period mean annual precipitation of Iran are approximately 250, 235 and 210mm, meaning that mean annual precipitation of Iran in the recent decade of 2008-2017 has been decreased by about 40mm(15%) comparing to the reference period of 1958-1988. Results also confirmed that, air temperature increasing rate in the country over the recent 30 years is about 2 times faster than the past 60 years and yearly precipitation in recent 30 years has been decreasing four times faster than the past 60 years period.

Methodology and data

Among all stations of Iran, 27 stations have 60 year data in the period of 1958-2017. In this research the changes in temperature, precipitation, humidity, radiation, cloudiness and wind during the period of 2017-1958 (for sunshine: 1992-2017) were investigated. At first, the data were checked for quality controlling; then their non-climatic inhomogeneities were adjusted. The slope of the trend was determined using the least squares method and the Sen's slope estimator and their significance was assessed using nonparametric Man-Kendal test and regression.

Results

Temperature: Most recent decadal (2008-2017) mean, minimum and maximum temperature of Iran have been increased by 1.2(±0.4)oC, 1.5(±0.3)oC, 0.7(±0.4)oC, respectively comparing to the base period of 1958-1988. The highest rate of minimum temperature rise has been detected to be in Tehran by 0.4oC per decade. In general, the increase in minimum temperature was detected at all stations and seasons, especially in autumn and winter. The annual maximum temperature trend is also increasing, but its rate is less than minimum temperature (Fig. 1).

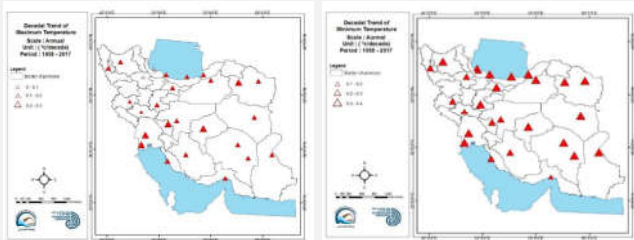


Fig 1. The decadal trend of minimum temperature (right) and maximum temperature (left) in the period 1958-2017 (solid red triangles are significant in 0.05)

Table 1: Mean, minimum and maximum temperature in the base period of 1958-1988 and recent decade(2008-2017) (oC)

Period	Mean	Minimum	Maximum
30-years base period(1958-1987)	17.1(±0.5)	9.6(±0.5)	24.6(±0.8)
Recent decade(2008-2017)	18.3(±0.4)	11.6(±0.3)	25.6(±0.4)

Precipitation: Mean annual precipitation of Iran are 238.2, 223.4 and 199.3mm in three periods of 1958-1987 (base period), 1988-2017 and the most recent decade of 2008-2017. Decreasing rate of the most recent 30 years period (1988-2017) is 4 times greater than whole 60 years period of 1958-2017.

However, during the recent 30 years (1988-2017), the average precipitation of the country has been decreased by 2.0 millimeter per year (20 mm per decade), which is significant in 95% confidence level; meaning that precipitation reduction rate in the most recent 30 years is about four times greater than that of past 60 years period.

In the Figures 2 and 3, all-country time series of rainfall and temperature changes rate are shown in the 60- and 30-yearly basis.

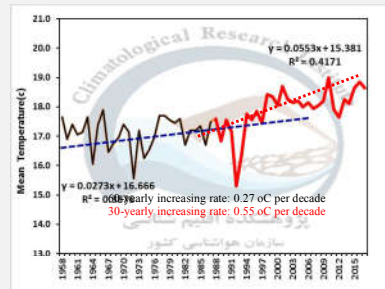


Fig 2. The rate of temperature increase of Iran in two periods of 60 (1958-2017), which is shown by black dashed line, and the rate of increase of the temperature during the most recent 30 years (2017-1988), red dashed line.

The rate of air temperature increase in the recent 30-year has almost doubled when comparing to 60 years.

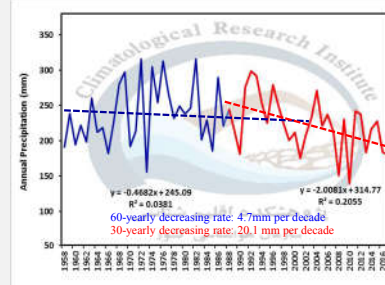


Figure 3. Rate of precipitation decline in the two periods of 60 (1958-2017), represented by blue-dashed line, and the recent 30 years (2017-1988), represented by red-dashed line. The decline in rainfall over the most recent 30 years has been around 4 times more than most recent 60 years.

The rapid decline in country's precipitation over the past 30 years, which is significant in 95% level, is consistent with the intensification of global warming in the most recent 30 years period.

Other parameters: The average wind speed in many parts of the country has been increased, which is significant in many stations located in the west, center, and northern part of the country. Average relative humidity has decreased in many regions of the country. The most decreasing trend was observed in southwest and west of the country. Of course, in a few cases such as Gorgan and Rasht, there was an increase, which was not statistically significant. Sunny hours trend was calculated in the period of 1992-1992; seasonal and annual trends at most stations indicate an increase in the number of sunny hours. The total number of days with sky overcast in the west of the Caspian Sea, western part of the country, and stations such as Kerman, Sabzevar and Shahrood has decreased significantly.

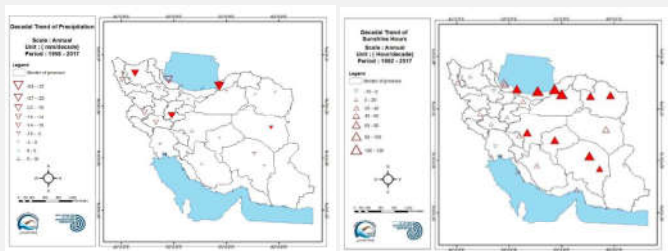


Fig 4. The decadal trend of average sunny hours (right) and total precipitation in the period of 1958-2017 (left) (solid red triangles are significant in 95% level).

Climate change detection update over Iran during 1958-2017

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