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Original Article

A Study of Initial, Final and Growing Season Length in West of Iran

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A B S T R A C T

Objective: An increasing number of studies have reported on shifts in timing and length of the growing season, based on phonological, satellite and climatologically studies. Changes in the timing and length of the growing season (GSL) may not only have far reaching consequences for plant and animal ecosystems, but persistent increases in GSL may lead to long-term increases in carbon storage and changes in vegetation cover which may affect the climate system. With the aim of these study is an investigation the trend of time changes of starts and end season growing length in west of Iran. **Methods:** This investigation has presented 49 years inputs of temperature from 8 synoptic stations in west of Iran. Homogenize the series using run-test experiment were determined and accomplished in the way of auto regression from rebuilding of missed data by way of man-Kendal test the randomness of data was examined and the series that had change or trend with %5 confidence interval were recognized then with graphically man-Kendal test and moving mean of 5 year, circumstances and the start time of trend or changes were determined and the values of changes were calculated. **Results:** The results show more changes in series associating with start and end of temperatures.

1.INTRODUCTION

It is now widely accepted that the concentration of greenhouse gases (GHG) of the Earth's atmosphere have increased in recent decades. The main effect of increase in the (GHG) concentration has been the increase in air temperature (Tayanc et al., 1997; Zhang et al., 2001; Kahya and Kalayci, 2004; Lins and Slack, 1999, 2005; Partal and Kahya, 2006; Aziz and Burn, 2006; Burn, 2008; Basistha et al., 2009; Jhajharia et al., 2009; Sahoo and Smith, 2009; Deni et al., 2010).
Over the 20th century, the global average surface temperature has increased by 0.6 _ 0.2 8C, where most of the warming occurred between 1976 and 2000, and is projected to increase by 1.4–5.8 8Cover the period 1990–2100 (IPCC, 2001). In the context of global warming, an increasing number of studies based on phenological, meteorological and satellite data have reported a lengthening of the growing season related to air temperature increases for most of the Northern Hemisphere during the twentieth century (Chmielewski and Rötzer, 2001; Robeson, 2002; Chen et al., 2005; Linderholm et al., 2008; Song et al., 2010; Jeong et al., 2011). The growing-season length (GSL) is the period between bud burst and leaf fall, which is expected to lengthen, especially at higher latitudes (EEA, 2004). A decrease in GSL could result, for example, in alteration of planting dates determining lower yields of traditionally

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planting crops, which may not fully mature. Increasing GSL, however, may provide opportunities for earlier planting, ensuring maturation and even possibilities for multiple cropping (depending on water availability). This is in agreement with the idea that warmer temperatures promote increases in plant growth in summer and/or respiration in winter. Most recent studies have utilized three main techniques to determine growing season change in the 20th century; phonology, the normalized difference vegetation index (NDVI) from satellite data, and surface air temperatures.

Menzel and Fabian (1999) analyzed phonological data from 1959 to 1993 in Europe and found that spring events, such as leaf unfolding, have earlier by 6 days, whereas autumn events, such as leaf coloring, have been delayed by 4.8 days. Using NDVI satellite data, Karlsen et al. (2009) reported that there was a linear increase in the growing season of 0.64 day/year for the whole Fennoscandia during 1982–2006. Menzel et al. (2001) analyzed phonological seasons in Germany of more than four decades (1951–1996) and found clear advances in the key indicators of earliest and early spring (_0.18 to _0.23 days/year) and notable advances in the succeeding spring phenophases such as leaf unfolding of deciduous trees (_0.16 to _0.08 days/year). Schwartz and Chen (2002) found that the onset of spring growth in China had no apparent change over 1959–1993, which is in contrast to findings in North America and Europe. However, during that time last spring frost dates had become earlier (6 days), especially in the north eastern part of the country, and first frost dates had become later (4 days, especially in north-central China), resulting in an increase in the frost free period of 10 days, mainly over the northern part of the country. Beck et al. (2005) use MODIS NDVI data to map the onset of the spring 2000–2004 in Fennoscandia. During this short analysis period, they found large temporal and spatial difference within the area in the arrival of spring, varying by more than 2 months within the study area and more than a month between the years.

Brinkmann (1979) for defined growing seasons at four stations in Wisconsin, USA, over an 80-year period, using freeze criteria as well as temperatures averaged over a number of days as definitions of the growing season. The results showed that depending on definition, a variety of trends were obtained for one single station, meaning that the trend in the GSL is sensitive to the particular definition used. Jones et al. (2002) examined extreme temperatures, GSL and degree-days for four meteorological records, which extend back into the eighteenth century (Central England, Stockholm, Uppsala and Petersburg). They found that in northern Europe (Fennoscandia) growing seasons were clearly warmer before 1860.

2. Materials and methods

2.1. Data

A data set of 8 synoptic stations in west of Iran with long-term minimum air temperatures data for the period 1961–2009 were analyzed in this study. The daily data were provided by the Islamic Republic of Iran Meteorological Organization (IRIMO, 2012). The station choice was based on the desire to have a widespread and availability of data.

2.2. Growing season

there is no universal method for defining the thermal growing season (Linderholm, 2006). Robeson (2002) defined the growing season length as the period between the date of the last spring freeze (i.e., daily minimum temperature below 0 ◦C) and the first autumn freeze. Others have defined the start and end of the growing season based on temperature thresholds in a pride-fined number of days (Carter, 1998; Frich et al., 2002; Walther and Linderholm, 2006; Linderholm et al., 2008). In this study, we utilized the definition of the growing season length used by Linderholm et al. (2008), namely, that the growing season start (GSS) is defined as the first day of the first 5-day period with a daily min temperature greater than 5 ◦C or 10 ◦C after the last spring frost, and growing season end (GSE) is defined as the first day of the first 5-day period with a min temperature of less than 5 ◦C or 10 ◦C. The growing season length (GSL) was the number of days from GSS to GSE.

2.3. Trend analysis

A large number of tests can be used for trend detection in long time series of meteorological and hydrological records. In the present study, were used non-parametric (Mann–Kendall) methods to detect the temperature trends. Non-parametric methods have the advantage of not assuming any distribution form for the data and have the power similar to its parametric competitors (Zhang et al., 2008). The brief descriptions of the used statistical methods are as follows:

2.3.1. Mann–Kendall test

The Mann–Kendall test is a non-parametric test for identifying trends in time series data. The test compares the relative magnitudes of sample data rather than the data values themselves (Gilbert, 1987). One advantage of this test is that the data need not conform to any particular distribution. The second advantage of the test is its low sensitivity to abrupt breaks due to inhomogeneous time series (Jaagus, 2006). Mann (1945) originally used this test and Kendall (1975) subsequently derived the test statistic distribution.

3. Results

3.1. Growing season start (GSS)

Outputs of man-Kendal trend tests for the start and end of growing season Series were summarized in Table 1. Trends are considered statistically significant at the 95% confidence level. results, showed a significant decreasing trend in GSS; in some of these 8 stations, 1 stations had trends that were significance at the 0.05 level with 5 ◦C threshold and two stations were significant with 10 ◦C threshold and two station(Saghez and Khoramabad) had a positive trend in GSS at the 0.01 level with two thresholds. The spatial distribution of the rates of change in the GSS for two thresholds displayed in Fig. 1 during 1961–2009.

3.2. Growing season end (GSE)

During the last 50 years, the man-Kendal test in the GSE for most areas in west of Iran, showed a significant positive trend with most of these stations, these trends were significant at the 0.05 level in 2 of these stations and were significant at the 0.01 level at 1 stations with 10 ◦C threshold and there were any significant 0.05 with 5 ◦C threshold but four stations (Saghez, Khoramabad and Oromyeh) had a positive trend in GSE.

3.3. Growing season length (GSL)

Growing season length had been increase in Tabriz with 5 ◦C threshold and in Tabriz, Khoy anf Kermanshah with 10 ◦C threshold and in Saghez and Khoramabad Growing season length Had been decrease with two thresholds and had been decrease in Oromyeh with 10 ◦C threshold.

Table 1 . Man-kendal trends

Growing season end with10 ◦C threshold			Growing season start with10 ◦C threshold			Growing season end with5 ◦C threshold			Growing season start with5 ◦C threshold			stations
Changes (day)	Changes time	trend	Changes (day)	Changes time	trend	Changes (day)	Changes time	trend	Changes (day)	Changes time	trend	
-10	CD 1970	-0.207*	_	_	0/015	_	_	-0/039	_	_	-0/022	oromyeh
_	_	0.136	-12.1	CD 2000	-0/196*	_	_	-0/015	-11/5	CD 1968	-0/23*	tabriz
4.2	CI 1999	0/199*	_	_	-0/105	_	_	-0/003	_	_	-0/134	khoy
_	_	-0/153	_	_	0/073	_	_	0/009	_	_	0.01	zanjan
-4.7	CD 1995	-0/19*	19.9	CI 1992	0/338**	_	_	-0/128	17/2	CI 1996	0/28**	saghez
10	CI 1990	-0/199*	-7.2	CD 1978	-0/216*	_	_	0/107	_	_	-0/105	kermanshah

-19.6	CD 1970	-0/325**	12.5	CI 1980	0/27**	-11.8	CD 1976	-0/269**	18/9	CI 1975	0/315**	khoramabad
_	_	0/163	_	_	-0/063	_	_	0/179	_	_	-0/134	hamadan

*95% confidence level. **99% confidence level

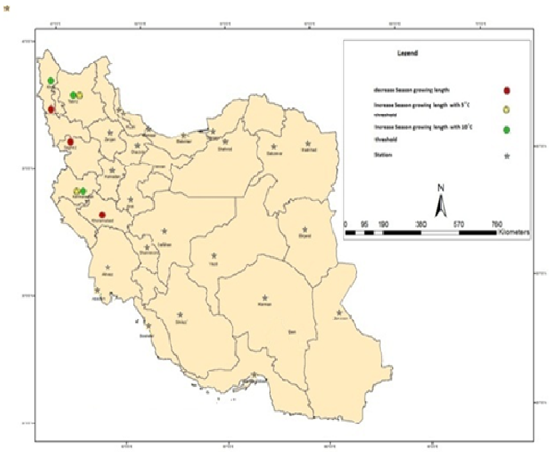

Fig 1: Growing season changes

CONCLUSION

The majority of phenological studies suggest that significantly advancing spring, as a consequence of warmer winters and springs and earlier last frosts, has been responsible for the most of the reported changes in the growing season. Phenological observations, NDVI from satellites and climatological data suggest links between recently observed changes in natural systems and 20th century climate change but in these study some stations had been decrese in growing season lenght.

REFERENCES

J.T., Ding, Y., Griggs, D.J., Noguer, M., van der Linden, P.J., Dai, X., Manskell, K., Johnson, C.A. (2001), Climate Change: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the International Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom, p. 881.

Chmielewski, F.-M., Rötzer, T., 2001. Response of tree phenology to climate change across Europe. Agric. For. Meteorol. 108, 101–112.

Robeson, S.M., 2002. Increasing growing-season length in Illinois during the 20th century. Climatic Change 52, 219–238.

Chen, X.Q., Hu, B., Yu, R., 2005. Spatial and temporal variation of phenological growing season and climate change impacts in temperate eastern China. Global Change Biol. 11, 1118–1130.

Linderholm, H.W., Walther, A., Chen, D.L., 2008. Twentieth-century trends in the thermal growing season in the Greater Baltic Area. Climatic Change 87, 405–419.

Song, Y.L., Linderholm, H.W., Chen, D.L., Walther, A., 2010. Trends of the thermal growing season in China, 1951–2007. Int. J. Climatol. 30, 33–43.

Jeong, S.J., Ho, C.H., Gim, H.J., Brown, M.E., 2011. Phenology shifts at start vs end of growing season in temperate vegetation over the Northern Hemisphere for the period 1982–2008. Global Change Biol. 17, 2385–2399.

Tayanc, M., Karaca, M., Yenigun, O., 1997. Annual and seasonal air temperature trend patterns of climate change and urbanization effects in relation to air pollutants in Turkey. Journal of Geophysical Research 102 (D2), 1909–1919.

Zhang, X., Harvey, K.D., Hogg, W.D., Yuzyk, T.R., 2001. Trends in Canadian streamflow. Water Resources Research 37 (4), 987–998.

Kahya, E., Kalaycı, S., 2004. Trend analysis of streamflow in Turkey. Journal of Hydrology 289, 128–144.

Lins, H.F., Slack, J.R., 1999. Streamflow trends in the United States. Geophysical Research Letters 26 (2), 227–230.

Lins, H.F., Slack, J.R., 2005. Seasonal and regional characteristics of US streamflow trends in the United States from 1940 to 1999. Physical Geography 26 (6), 489–501.

Partal, T., Kahya, E., 2006. Trend analysis in Turkish precipitation data. Hydrological Processes 20, 2011–2026.

Aziz, O.I.A., Burn, D.H., 2006. Trends and variability in the hydrological regime of the Mackenzie River basin. Journal of Hydrology 319, 282–294.

Burn, D.H., 2008. Climatic influences on streamflow timing in the headwaters of the Mackenzie River basin. Journal of Hydrology 352, 225–238.

Basistha, A., Arya, D.S., Goel, N.K., 2009. Analysis of historical changes in rainfall in the Indian Himalayas. International Journal of Climatology 29, 555–572.

Jhajharia, D., Shrivastava, S.K., Sarkar, D., Sarkar, S., 2009. Temporal characteristics of pan evaporation trends under the humid conditions of northeast India. Agricultural Forest Meteorology 149, 763–770.

Sahoo, D., Smith, P.K., 2009. Hydroclimatic trend detection in a rapidly urbanizing semi-arid and coastal river basin. Journal of Hydrology 367, 217–224.

Deni, S.M., Suhaila, J., Zin, W.Z.W., Jemain, A.A., 2010. Spatial trends on dry spells over Peninsular Malaysia during monsoon seasons. Theoretical and Applied Climatology 99, 357–371.

EEA 2004. Impacts of Europe's Changing Climate—An Indicator

Based Assessment. European Environment Agency Report No. 2/2004. 107 pp.

Menzel, A., Fabian, P., 1999. Growing season extended in Europe. Nature 397, 659.

Karlsen, S.R., Høgda, K.A., Wielgolaski, F.E., Tolvanen, A., Tømmervik, H., Poikolainen, J., Kubin, E., 2009. Growing-season trends in Fennoscandia 1982–2006, deter-mined from satellite and phenology data. Climate Res. 39, 275–286.

Menzel, A., Estrella, N., Fabian, P., 2001. Spatial and temporal variability of the phenological seasons in Germany from 1951 to 1996. Global Change Biol. 7, 657–666.

Fitter and Fitter (2002) noted a major shift in first flowering date (FFD) in British plants from the 1980s after four decades of little variation. On average, FFD of the studied 385 plant species had advanced by 4.5 days; 16% showed an average advancement of 15 days. As the FFD is sensitive to temperature, the change in the 1990s was attributed to climate warming.

Schwartz, M.D., Chen, X., 2002. Examining the onset of spring in China. Climate Res. 21, 157–164.

Beck, P.S.A., Karlsen, S.R., Skidmore, A., Nielsen, L., Høgda, K.A., 2005. The onset of the growing season in northwestern Europe, mapped using MODIS NDVI and calibrated using phonological ground observations. In: Proceedings of the 31st International Symposium on Remote Sensing on Environment—Global Monitoring for Sustainability and Security, 20–24 June, St. Petersburg, www.isprs.org/publications/related/ISRSE/html/welco me.html.

Brinkmann, W.A.R., 1979. Growing season length as an indicator of climatic variations? Climatic Change 2, 127–138.

Jones, P.D., Briffa, K.R., Osborn, T.J., Moberg, A., Bergstro¨m, H., 2002. Relationships between circulation strength and the variability of growing-season and cold-season climate in northern and central Europe. The Holocene 12, 643–656.

IRIMO, 2012. Iranian Meteorological Office. Data Processing Center, Tehran, Iran.

Zhang, Q., Xu, C.Y., Zhang, Z., Chen, Y.D., 2008. Changes of temperature extremes for 1960–2004 in Far-West China. Stoch. Environ. Res. Risk Assess. doi:10.1007/s00477-008-0252-4.

Gilbert, R.O., 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, New York.

Jaagus, J., 2006. Climatic changes in Estonia during the second half of the 20th century in relationship with changes in large-scale atmospheric circulation. Theor. Appl. Climatol. 83, 77–88.

Kendall, M.G., 1975. Rank Correlation Measures. Charles Griffin, London.

Linderholm, H.W., 2006. Growing season changes in the last century. Agric. For. Meteorol. 137, 1–14.

Robeson, S.M., 2002. Increasing growing-season length in Illinois during the 20th century. Climatic Change 52, 219–238.

Carter, T.R., 1998. Changes in the thermal growing season in Nordic countries during the past century and prospects for the future. Agric. Food. Sci. Finland 7, 161–179.

Frich, P., Alexander, L.V., Della-Marta, P., Gleason, B., Haylock, M., Klein-Tank, A.M.G., Peterson, T., 2002. Observed coherent changes in climatic extremes during the second half of the twentieth century. Climate Res. 19, 193–212.

Walther, A., Linderholm, H.W., 2006. A comparison of growing season indices for the Greater Baltic Area. Int. J. Biometeorol. 51, 107–118.

Linderholm, H.W., Walther, A., Chen, D.L., 2008. Twentieth-century trends in the thermal growing season in the Greater Baltic Area. Climatic Change 87, 405–419.