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Assessment of Climate Change Impact on Irrigation Water Requirement of Sugar Beet and its Growth Period Length in Kermanshah Province

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Abstract

Today climate change is one of the most important human concerns This fact affected human life in different ways . one of the most important impacts of climate change is on crops yield so that change in temperature regime particularly maximum and minimum temperatures is noticeably change plants production . in this research , is considered to impact of climate change on water requirement and growth period length of Sugar beet in Kermanshah province .it is used by climatic model outputs CGCM3 and HADcm3 named scenario A2 . assessment of water requirement is established by Fao, Penman , Mantis equitation .for minimizing scales of climatic model outputs of data was used SDSM .results showed that by increasing of temperature resulting from climate change in the future , decreased growth period length of Sugar beet. Also water requirement of Sugar beet in future period based on increasing temperature resulting from climate change is noticeably increased .

Key words : SDSM, Climate change , Kermanshah province , Water requirement of plant .

Introduction

Growing Industries and companies at the beginning of industrial revolution and increasing consumption of fossilized fuels in one hand and , de forestation and changing usage practice agricultural lands on the other hand led to increasing of green house gases specially $C0_2$ in decade , so that , concentration of this kind of gas by end of century 21_{th} will be reached to 600ppm. Increasing of green house gases made changes in the earth climate . that in scientific articles is called(climate change) (1). By changing of the earth climate , other systems like water resources , agriculture ,environment , health, industry , and so on .., affected these kind of changes . so , climate change phenomenon can be considered the most challenges of human in the next future . global warming led to increasing air evapotranspiration and as a results reference evapotranspiration and increasing of water consumption in agriculture section . also climate changes are effective on rain fall , temperature , and air humidity that all of them are effective on evapotranspiration and water requirement of plant. So, about Iran as a dry and semi dry country that is always faced with lack of water in the agriculture developing, studying of consequences of climate change on water requirement in agriculture is very essential .sue Tupco et al (2008) estimated future

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climate and impacts of climate change on water resources and needed water for agriculture in potamic range of seyhan in Mediterranean area in Turkey . they used from data of average temperature and 30 years rain fall (1961-1990) . for predicting of future weather used regional – climatic model Regcm3 for period (2071-2100) based on A2 plan . moat of the crops which cultivated in this region are wheat , and corn . results showed that temperature about 3/4 to 4/8° c in 2071-2100 and evapotranspiration 24/3mmin 2071 and 10/8 in 2100 increased and rain fall rate about 16/3 decreased. Rodriguez Diaz et al (2007)by studying of climate change impacts on water requirement in potamic range in Goddalkavir in Spain showed that water requirement in a agricultural season in 2050will be increased 15- 20 %. On the other hand , a period of agricultural season which is done irrigation due to reducing spring rain fall is longer . also, period and rate of water requirement is more and longer that should be noticed in designing of irrigation systems in future . Petraddel (2002)was established research about impacts of climate change on water requirement . he by using of global irrigation model (GIM) and simulation of cultivation model and growth season , measured that how water requirement of plants affected by climate change in 2070-2020 . he for predicting of weather data in future used 2 climatic model ECHAM4,Hadcm3 . based on given results global irrigation requirement is increased about %3/3 IN 2020 AND 5/5 in 2070 . based on his measurement , irrigation net requirement in 2020 in 66% and in 2070 in 62%from region which irrigated in 1995 will be increased .

Shan yue et al(2002) established impacts of climate change on evapotranspiration of paddy field in Taiwan by using of revised penman equitation and 2 scenarios of climate change , their studies showed that evaporation in paddy field in the both scenarios increased and by 2050 about 3 to 5 %will be increased.

Material and method

Studied region

Kermanshah province with 24640 km area is the seventh expanded province in Islamic Republic of Iran . its geographical situation on the earth is between 33 to 35 °latitude in the north and 45 to 47 °longitude in the east .kermanshah province formed 1/5 area of country which is considered west province that having common border with Iraq . Kermanshah due to geographical situation and locating between Zagros ranges having various weather , so that called four seasoned province . generally , Kermanshah is divided in to 3 weather regions based on temperature , rain fall, and un smoothness .

A – **cold region**

this kind of weather is seen in the range regions . parts of kangavar , saghez , paveh, javanrood and also parts of salas babajani having this kind of the weather . mild to hot summers and cold to very cold winter are the most important traits of weather . average temperature in summer and winter is 6/24 and 4/3 °c respectively . and average rain fall is 835mm that most of the time is in snow .

B – **tropical region**

unsmooth areas which is located in west of province including ghasr shirin, soumar , sarpul zahab andgillan gharb are considered tropical regions of province . low height and locating near dry deserts in Iraq are most effective factors for hot weather in province . this kind of the weather has very hot summers and mild winters. Average temperature in summer and winter is 5/32, 11° c respectively . this region has 385 mm rainfall and snow is rarely seen in this region .

C – **moderate region**

regions which is located between west tropical and east cold areas and north of the province , having mild to cold winters and hot summers . average temperature in the summer and winter is 1/26,1/4 ° c respectively. And average rain fall is 441 mm most parts of province like , Islam Abad ,Ravansar ,

Sahneh Harsin , and pert of dalahu are located in this kind of the weather. Mediterranean humid air flow is most important reason for rain in province

Characteristics of Sugar beet

One of the primary plants in Kermanshah is Sugar beet. Temperature need for this plant is equal to 2900 degree day . this plant needs long growth period . Sugar beet is cultivated in different climates and germinating is possible in 5 °c during growth period temperature more than 30 is noticeable decreased yield. Plant coefficients at the primary , middle , and final steps based on Fao measurement method for Sugar beet after breeding is equal to 31/33, 1/0, %83-1 respectively (7) and for step between primary , middle and also middle and final is linear .

Combined methods

In 1948 , penman ,a British scientist by combining of Airo dynamic methods and energy power presented a method for measuring evapotranspiration that is known as combined or penman method , during next years, other persons revised penman equitation that it can pointed to combined methods like , penman –Fao , penman – wrights , penman –Bosgino and penman – Mantis(Alizadeh 2005) .fao-penman equitation presented by experts Fao organization . and still is used as a practical equitation in measuring evapotranspiration of reference plant but due to that it is noted in this equitation , evapotranspiration is only controlled by weather factors and is considered the role of plant , so , lost its importance and alternated by other equitation .one of the equitation is fao-penman-Mantis that is more practical now . in this research by using of (crop water) application and based on following equitation the rate of potential evapotranspiration is measured for each of the studied stations

Fao –penman –Mantis equitation

Fao –penman –Mantis equitation is one of the reliable methods for estimating ETo that is used by experts . this equitation is :

$$ET_o = \frac{0.408\Delta(R_n - G) + [890/(T+273)]U_2(e_a - e_d)}{\Delta + \gamma(1 + 0.34U_2)}$$

That :

ET0- evapotran spiration of reference plant (mm/day)

R_n- net radiation in plant covering level $(MJm^{-2}d^{-1})$

T –average of temperature in 2m from land level (^oc)

U_2-wind speed in 2m height from land level (ms^{-1})

$e_a - e_d$ -lack of steam pressure in 2 m height (kpa)

Δ-curved slope of steam pressure (KPa^oc^{-1})

γ -humidity coefficient (KPa^oc^{-1})

G-heat in to soil $(MJm^{-2}d^{-1})$

Growth period length

Growth period length is measured by degree- day index (GDD)

-T_{BS}GDD=$\frac{Tmax+Tmin}{2}$

If T_{min} T_{bas}→T_{min} =T_{bas}

If If T_{max}> 30 → T_{max} =30

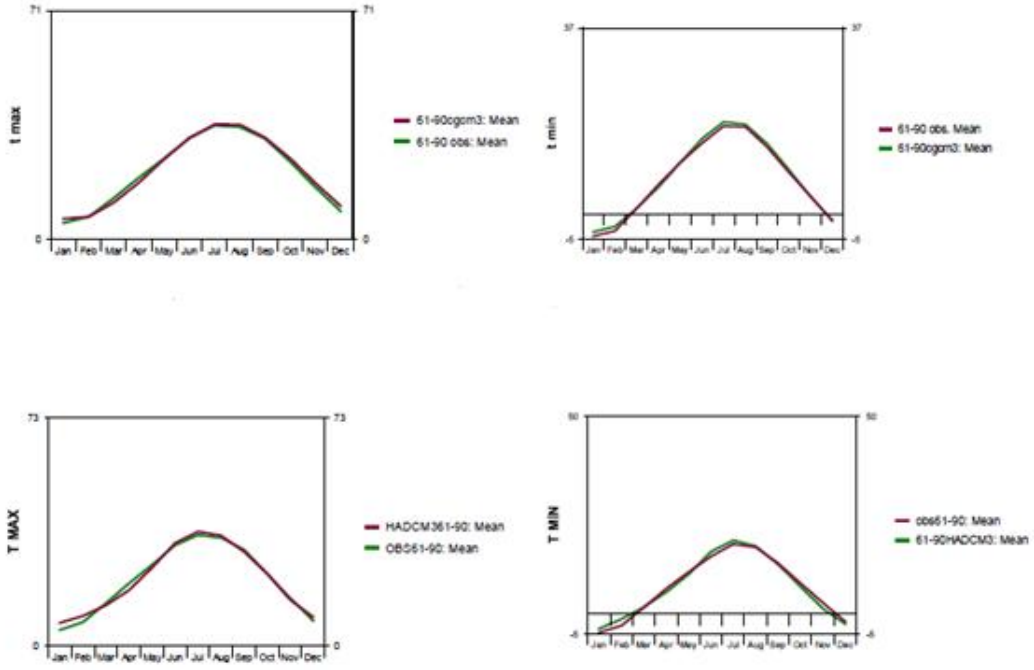
In this relation ship T_{max}, T_{min} is maximum and minimum temperature respectively and Tbas is essential basis temperature for growing plant that is 5 °c for Sugar beet .
Models of AOGCM for climatic scenario production
For doing this research used 2 kinds of model CGCM3 ,hadcm3 under scenario A2

Table 1. characteristics of used GCM models

Reference	Atmospheric division power	Simulated scenario	Models name AOGCM-AR4
Pope et al (2000)	2.5°-3.75°	A1F1,A2,B1	HadCM3
Kim et al(2002,2003)	3.75°-3.75°	A2,b1	CGCM3

Model SDSM
Model SDSM is a statistical minimizing scale model that having capacity fast developing and low charge minimizing data in station scale daily , monthly , season , or yearly the first version of this model presented under named SDSM-2.2 in 2001, up to now this model revised fourth times . the last version was SDSM-4.2 in August , 2007 , model SDSM used regression statistical and stochastic methods to minimize scale . in this kind of model ,at
first relations are analyzed between estimating model (output models SDSM)and date data of weather stations and determined empirical relations between them and introduced to user . other factors which model itself introduced to user , are correlation , standard deviation of data , standard error . user based o its experience and presented comparisons by model choose estimating variants for model and in the next step , model based on chosen variants by user is calibrated and then validity of calibrated model with production date data and its comparing with observed data is established and if the validity o data is verified, used in future for producing of climatic data. In fig1 minimum and maximum temperature of simulated model and observed minimum and maximum temperature for different months in basis period (61-90)showed in fig , as seen , this application performed simulation very well and so it can used for temperature simulation in future.

A – comparing simulated maximum and minimum temperature with observed temperature in model CGCM3



B -comparing simulated maximum and minimum temperature with observed temperature in model HadCM3

Results and Discussion

maximum and minimum temperature changes with 2 models CGCM3 , HADCM3

Based on the graph , maximum and minimum temperature changes in next period in all of the months showed increased trend . about minimum temperature., model CGCM3 to HADCM3 showed high temperature in some months , about maximum temperature, estimating model CGCM3 is more than HADCM3 but increase isn't high.

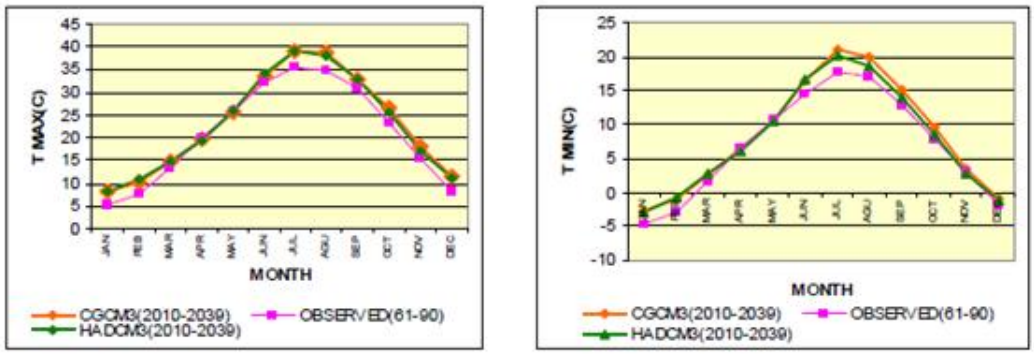


Fig 3. maximum temperature changes in basis and future , fig2 minimum temperature changes in basis and future period

changes of growth period length and water requirement of Sugar beet during growth season

According to table 2 , growth period length of sugar crane in the future years due to climate change phenomenon and high temperature is reduced and this decrease in model cgcm3 is more . and based on table 3 water requirement of Sugar beet during next period is noticeably increased and this increase is more in hadcm3 .

Table 2 changes of plant growth period length

Date of period cultivation	Basis period (1961-1990)		Next period (2010-2039)	
	CGCM3	HADCM3	CGCM3	HADCM3
11 farvardin	176 days	176 days	167 days	170 days

Table 3 changes of water requirement of plant

Date of period cultivation	Basis period (1961-1990)		Next period (2010-2039)	
	CGCM3	HADCM3	CGCM3	HADCM3
11 farvardin	1145 days	1145 days	1211 days	1319 days

Conclusion

Growth period length of Sugar beet in next period to basis period is decreased out of a definite cultivation date and reason of decrease , is increase of temperature in next period that led to thermal requirement is provided earlier and as results growth period length is earlier but , because model CGCM3 predicted daily temperature a little more than HADCM3 , so, growth period length in this model is shorter . water irrigation requirement based on increase temperature in future is more , but model HADCM3 to CGCM3 showed noticeable increase that based on same coefficient of plant , the reason of this fact is the estimating model structure of reference water requirement . (fao =penmen – mantis) Because temperature difference in measuring water requirement is effective in this equitation and in model HADCM3 is more noticeable , so estimating water requirement by this model is more .

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