OMICS Group Conferences
Accelerating Scientific Discovery

2nd International Conference on
Hydrology & Groundwater Expo
August 26-27, 2013 DoubleTree by Hilton, Raleigh, NC, USA

Effects of climate change on water availability in diyala basin in Iraq

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Introduction: Climate change is going to be the biggest environmental threat in the world. Climate change effects on availability and quality of water in space and time and the frequency of floods and drought. The increment in temperature has great regional effects some beneficial but most detrimental.

Iraq has two Rivers namely: Tigris and Euphrates Rivers and depends mainly on surface water for irrigation; there are about 120 irrigation projects in Iraq (developed and undeveloped projects) and about 15% of Iraq is irrigable area, any changes on water surface availability will have very bad consequences on the agricultural activates (type and amount of crops) and also on the farmers life quality.

In view of Turkey's commissioning of several dams upstream in these rivers basins, the future of the water supplies to Iraq is a major concern to the country due to that and due to the climate change

Objectives:

1. Study the climate trend in the last fifty years in Diyala basin (1960-2010).
2. Modeling the rainfall-runoff in Diyala basin for the same period.
3. Study the effects of the climate change on the generated runoff from precipitation.
4. Investigate the best solutions to overcome on climate change effects on available water.

Methodology: Climate change data for temperature, humidity, wind speed, and sunshine duration were analyzed after estimation the missing data in the stations in whole and around Iraq to find the trend in them. Then, a hydrological model (HEC-HMS software) was implemented for the last fifty years (1960 to 2010) to simulate the precipitation-runoff relationship in in Diyala basin, which located in eastern part of Iraq (33,010 km^2); by using Soil Moisture Account formula.

Geographical Information System (GIS) technique was used to delineate the watershed depending on Digital Elevation Model (DEM). HEC-GeoHMS was used to create the geometry of the watershed depending on Digital Elevation Model (DEM).

Calibration process based on observed flow time series will be performed until the Nash-Sutcliffe test gives the best results.

A hydrological model was implemented by using HEC-HMS software for the last fifty years (1960 to 2010) with daily time step to simulate the rainfall-runoff relationship in Diyala basin, which located in eastern part of Iraq (33,010 km^2) by using Soil Moisture Account formula. GIS technique was used to delineate the watershed depending on DEM. HEC-GeoHMS was used to create the geometry of the watershed depending on Digital Elevation Model (DEM).

Manual calibration was performed until the Nash-Sutcliffe test gave the best results. Then, the climate data (temperature, humidity, wind speed, and sunshine duration) were analyzed to conclude its effects on the generated runoff from precipitation.

Results and Discussion: Historical data in the last fifty years of temperature, humidity, wind speed, and sunshine duration, were analyzed after estimation missing data. Average monthly data for them were plotted versus time; trendlines were drawn which showed an increment, while humidity showed a decrement. These changes have an effect on the evapotranspiration (ET) and thus on the generated runoff water. Penman equation was used to calculate the ET; the range of its monthly increment is 4% to 13%. The trends were removed to show the effect of climate change on the generated runoff from precipitation. The incremental of the generated runoff was found 4.7% in the last 20 years. More efficient irrigation systems and more adaptable cropping patters should be implemented to minimize these effects.

Conclusions:

1. The range of incremental of average monthly data in the study period for wind speed is 1% to 20%, for sunshine duration is 1.3% to 6.2%, and for temperature is 0.2° to 0.6°.
2. The range of reduction of average monthly data in humidity is 1.9% to 9.7%.
3. The range of increment in the monthly calculated evapotranspiration is 4% to 13%.
4. The calculated runoff has decreased by 4.7 % due to climate change in the last 20 years in Diyala basin due to climate change.

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