Impact of urbanization and climate change on streamflow

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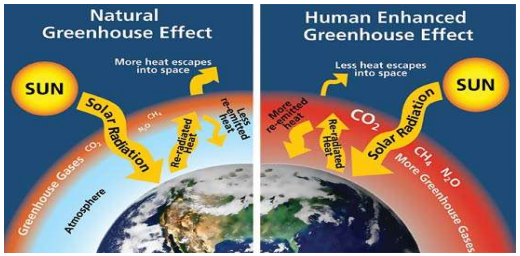
♦ Abstract

Streamflow or the surface runoff is the flow of **water** that occurs when excess **water** from rain, melt-water, or other sources flows over the earth's surface. The streamflow can be affected by different aspects. In this project we are focusing on how land cover change (urbanization) and Climate Change can affect the watershed response on streamflow. we focus our research on **Walnut Creek-Neuse River** watershed in North Carolina. The required data is found from a range of databases, including USGS stream flow, NCDC hourly precipitation, National Land Cover Database(NLCD) and National Hydrography Database. In the side of urbanization, we compare the land cover of the region over two decades and evaluate the statistics parameters in the streamflow from the USGS monitoring point. In the side of climate change we study the ratio of streamflow to rainfall in the region.

♦ Introduction

The presence of the atmosphere keeps the surface of the earth warmer than it would be without the atmosphere. The process by which the earth is warmed is called **greenhouse effect.** The sun send radiation to the earth. Some of that radiation is reflected by the atmosphere to the space and the rest is absorbed by the earth (land and water). The surface of the earth warmed up and give out the energy in different form called infrared radiation. This energy (infrared radiation) travel back to the space. Greenhouse gases (CO_2, H_2O, CH_4, N_2O, etc..) trap some of this energy in the atmosphere making the earth warmer and the rest of the energy is scraped in the space. Since the Industrial Revolution began around 1750, human activities have contributed to climate change by adding CO_2 and other greenhouse gases to the atmosphere. These augmentation of greenhouse gas has increased the greenhouse effect and caused Earth's surface temperature to rise. An increase in global temperatures will increase evaporation, and the level of water vapor in the atmosphere which will lead to more heavy precipitation. Heavy precipitation can increase **streamflow**. In the other hand, the nature of the soil can also affect the streamflow. The change in land due to the urbanization affect streamflow. Because of urbanization, green space (field, tree, wetland) are converted to black space (concrete and asphalt). An increase of concrete and asphalt will increase the runoff of streams after rains and snowmelt.

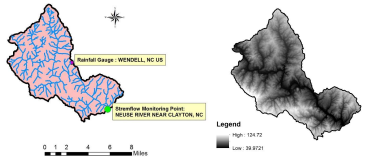


♦ Methodology

The main objective of this research was to evaluate the impact of urbanization, climate change(rainfall) on streamflow in **Walnut Creek-Neuse River** watershed in north Carolina. To achieve this objective we first download the following data:

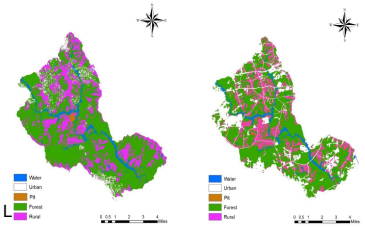
♦ Digital elevation model

The DEM (Digital Elevation Model) is a digital model or 3D representation of a terrain's surface, commonly for a planet (including Earth), moon, or asteroid, created from terrain elevation data. We used the DEM to represent the flow direction in the **Walnut Creek-Neuse River** watershed.



♦ Land cover data 1992 and 2011

The National Land Cover Database (NLCD) provides spatial reference and descriptive data for characteristics of the land surface such as thematic class (Urban, agriculture, and forest), percent impervious surface, and percent tree canopy cover. We compare the land cover map of our region **Walnut Creek-Neuse River** watershed of the years 1992 and 2011.

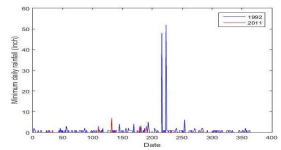


♦ Results & Conclusion

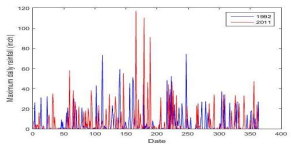
❖ Comparing the NLC map of **Walnut Creek-Neuse River** of the years 1992 and 2011 we see that on 2011 the region became more urbanized.

TYPE	NLC(1992)	NLC(2011)	change
Water	6460	5729	-731
Urban	7388	28488	21100
Pit	566	746	180
Forest	92121	77769	-14352
Rural	38086	31889	-6197

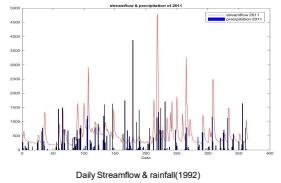
❖ Using rainfall data form USGS it has been seen that the maximum rainfall has increased. The maximum daily rainfall during 2011 is greater than the maximum rainfall during 1992.It has also seen that the minimum rain fall has decrease. This show that dry area and period have become more dry and wet area and period have become more wet.



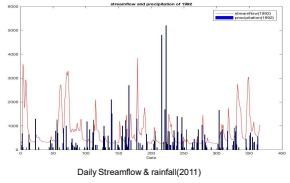
Daily aggregation of min hourly rainfall



Daily aggregation of max hourly rainfall

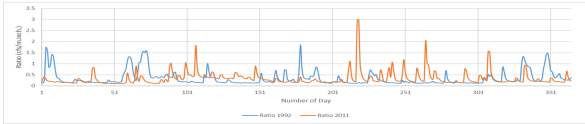


Daily Streamflow & rainfall(1992)



Daily Streamflow & rainfall(2011)

❖ The graph of the ratio (streamflow / rainfall) shows that the maximum portion of rainfall that is converted in to streamflow is higher in 2011 than 1992.



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