El Paso County, Colorado

Impervious Surface Change from

2001-2019

By Steven M. Giorgi

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University of Oklahoma

Professor Jennifer Koch

Abstract

The population increase of El Paso County Colorado over the past 10 years has surpassed the rest of the state of Colorado by almost 200,000. The population increased from 627,088 to 728,310 from 2010 to 2020. This increase in population requires the added infrastructure to accommodate the quality of life for those living in the county. The impervious surface area is the topic of this report and will be calculated to show potential impacts on water runoff throughout the local watershed. The increase of impervious surfaces will be shown through National Land Cover Data ArcGIS maps and using various analysis tools to calculate the change. At the end of the report, readers and researchers will be able to take the information and properly calculate runoff totals for future planning purposes of infrastructure upgrades or potential weak points of existing infrastructure. Each sub-county was calculated for additional pinpoint calculations to be made by smaller unincorporated municipalities.

Keywords

El Paso County, Colorado impervious surfaces

El Paso County, Colorado Land change raster files

El Paso County, Colorado watershed runoff totals

Data Requirements

Census Bureau County shape files – www.census.gov

NLCD raster files – www.mrlc.gov

Python Program of User's choice

Introduction

The motivation for this project was to see if it was possible to calculate the total change in land surface for a specified area. The NLCD data provided raster files to properly extract this information. If properly applied, the runoff created by heavy precipitation events can either be removed quickly and safely to the local watershed or stored for future purposes. The increase in major flooding events throughout the United States leads me to suspect that the change to urban areas has not been properly accounted for. Most infrastructure is decades old, and as shown with Colorado Springs, the population can increase in some areas almost by half. This process can be used throughout the entire county and ran quickly using python coding. Then the end user could select the area of interest by using a GEOID code. Saving hours of rendering time in ESRI ArcPro.

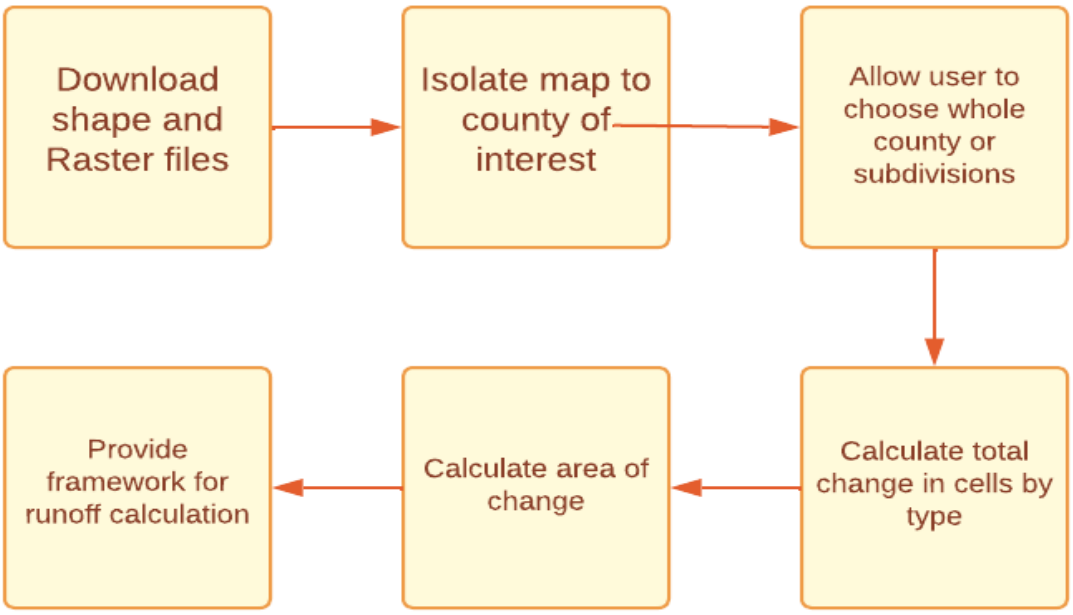
Process Description

The core process of this report will be the calculation of change in raster cells from 2001-2019. The ability to do so would aid in the future planning of watershed infrastructure. The raster file will be isolated to El Paso County, Colorado with subdivisions available for research. The user will be allowed to pick either to calculate for the entire county or a specific area of interest. Users could reference previous infrastructure plans to gauge the adequateness of the current infrastructure compared to the runoff for any given storm. Python will be used to expedite the process by not requiring a map to be rendered. Also, the files required to run the analysis can be openly downloaded by end users and the python file is of small size for sharing. This will allow for in-depth processing of loops and conditional statements by the end user. The project will be able to search for raster cells that have changed from undeveloped to developed. Depending on

development change, conditions could be met for the requirement of infrastructure to reduce flooding and damage to residential areas.

Materials and Methods

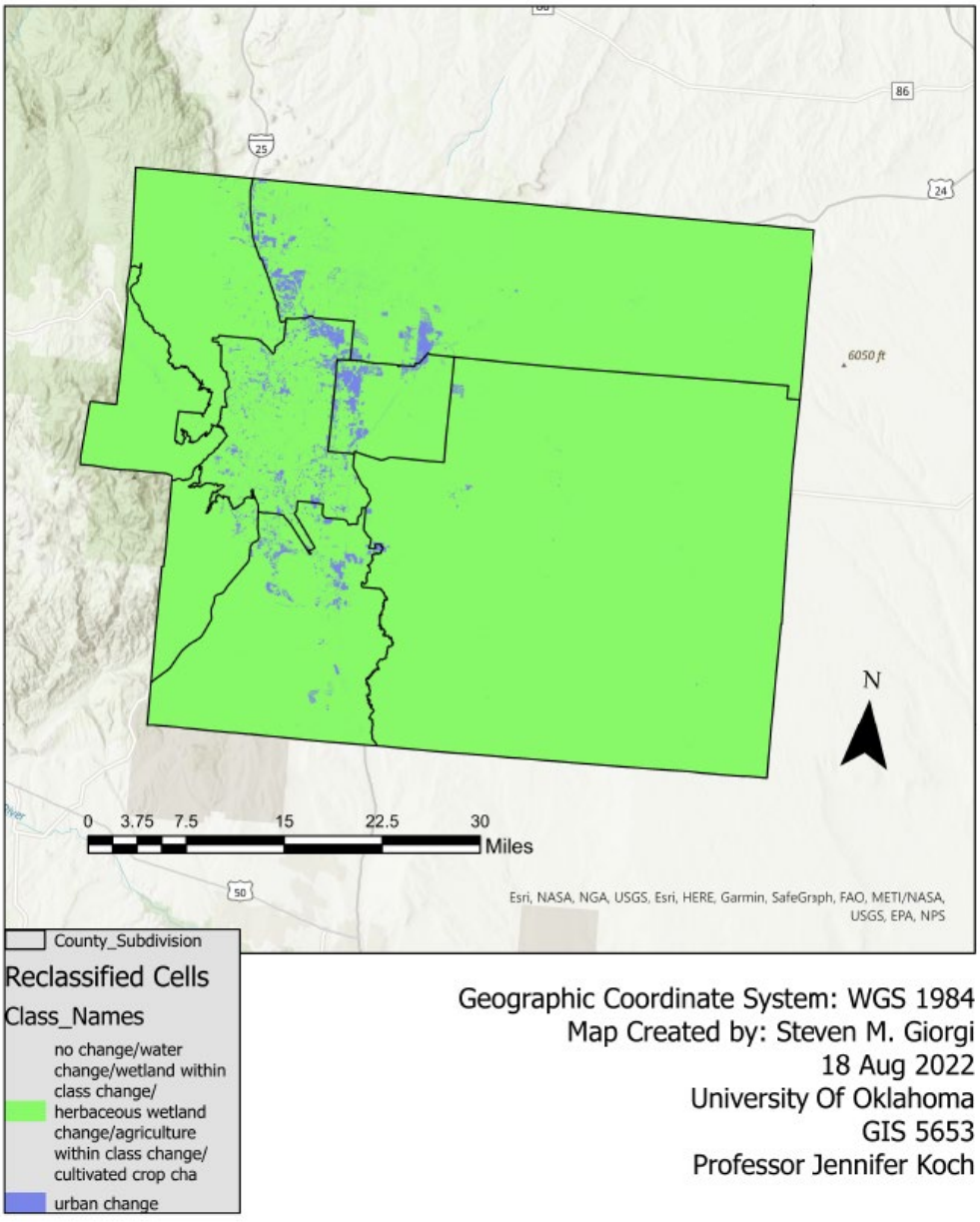
In addition to the data requirements, a process flow should be used to define the questions required for analysis. The below flow chart shows a logical progression. The files required should be inspected to ensure they portray the information in the correct layout. Raster files that show change but lack impervious surface data would serve no purpose for this type of report. A shape file for extracting a specific area of interest is required in addition to the raster file. This allows the user to select by GEOID. That falls into the isolation of area in the progression. These files are easily obtained from the Census Bureau. Additional data can be downloaded if a user wanted to encompass social data to areas most affected by flooding or required updating first. The third step is all user-defined. As this project is built to be universal for anyone familiar with python coding and how to retrieve required data. The fourth step begins to bring the data together by calculating the total number of changes, in raster cells, for the specified area. Reclassifying all types of changes together but urban changes help to differentiate as two defined groups. One group is important to the study and the other group is not. Depending on the linear measurement the user will use, a calculation can be made separately or further built into the code for automation. Having the total number of cells allows the user to get a total measurement. Average rain totals or estimates for storm intensity can be used to then calculate total runoff for any given watershed.



Results

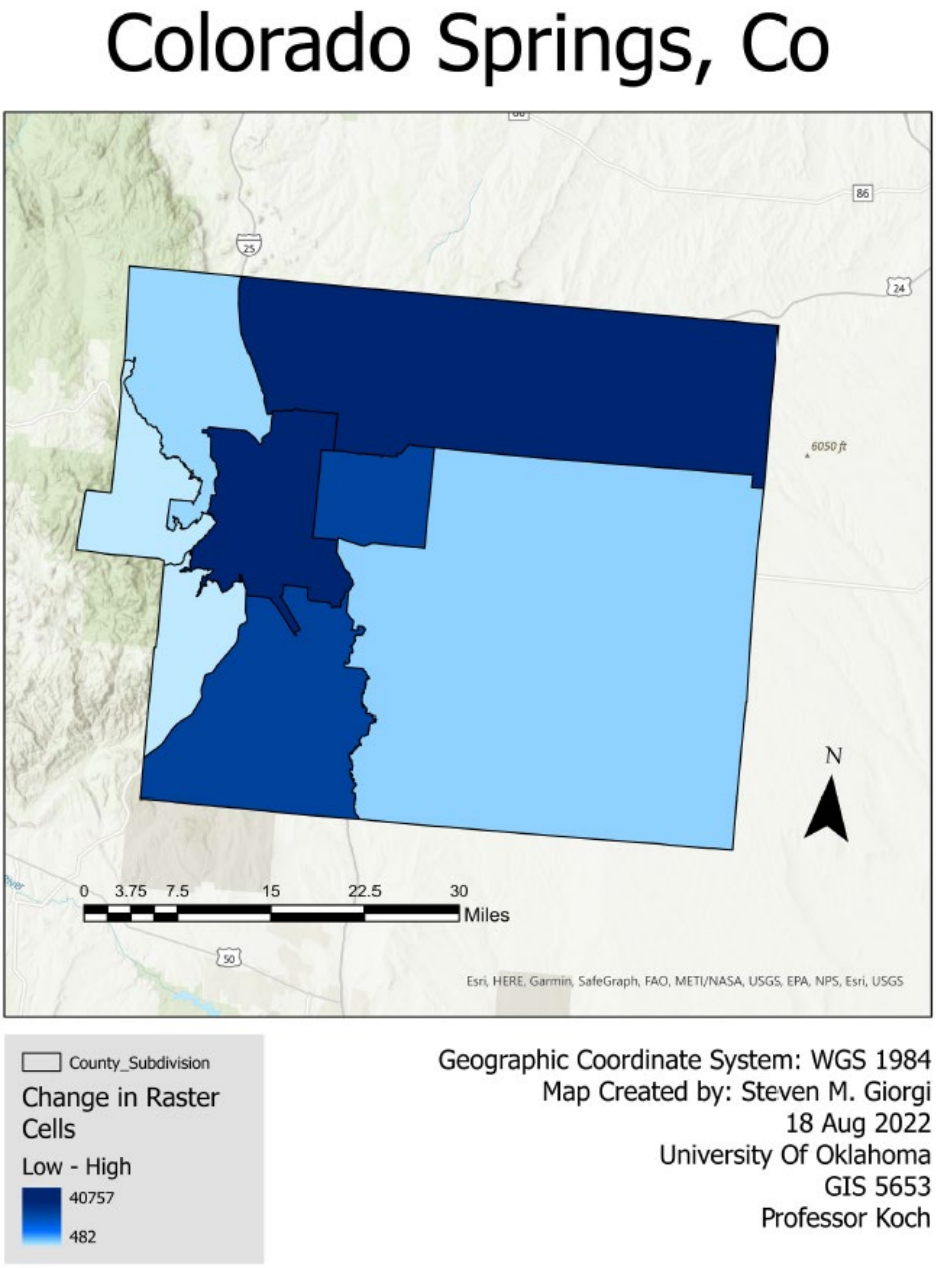
The results for Colorado Springs, Colorado are shown below in an illustrated map along with a total area of change for each subdivision. The first map shows reclassified raster cells to aid in this project. The original 14 class names were changed to displace only two: urban change and all other changes. Doing this allows the user to accurately account for and visually show the change within the county as a whole and the sub-counties.

Colorado Springs, Co



The map below is after zonal statistics have been applied to the reclassified class groups. It gives a visual distinction between the areas that have seen the highest change. It also shows the high and low counts distinguished through a blue color ramp.

The highest urban land change is through the city's epicenter and the north side of the county.



The findings indicate that serious changes are required for those two sub-counties. The hill shade gives an indication of elevation change to the west of the city. In addition to the runoff from impervious surfaces from urban change, the runoff from the mountainsides will add to an overabundance of flowing water that must be dealt with before infrastructure begins to erode.

The city and county currently have one flowing river that collects all runoff. This data provides civil engineers with the skills to propose future water collection and containments. This would also be a topic of weather changes and droughts that are seasonal for the area.

Conclusion

The foreseen limitations of this project are within the data used. A thorough inspection of multiple data sets would be required to formulate a conclusion on how to address runoff totals. The NLCD data provides a basis to start analysis, but urban change is less descriptive than desired. Homes are urban change but also provide yards with vegetation to recycle the water. Urban change due to reflectiveness could also be previously emplaced drainage systems and infrastructure for handling runoff. That would require a critical field survey along motor vehicle routes and possibly additional data from the city's civil engineering teams. Another aspect that plays into runoff total is the ground composition. Overlays of the area of interest should be used to identify where runoff totals are likely to be higher during the initial stages of a severe weather pattern. Areas of significance or higher need could be labeled with a priority indicator.

References

1. El Paso County, CO population by year, race, & more. USAFacts. (2022, July 31). Retrieved from July 31, 2022, from https://usafacts.org/data/topics/people-society/population-and-demographics/our-changing-population/state/colorado/county/el-paso-county