Using the LandCast Model with Firm Maps for Population Distribution Estimation on a Local Scale in Houston, Tx

By
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Extended Abstract

Flooding is a significant problem in the United States. According to the Federal Emergency Management Agency (FEMA), "flooding is the most frequent and expensive disaster in the United States", with ninety percent of all natural disasters involving a flood (Flood Insurance Reform, 2017). At the same time, given climate change, large flooding events, such as Hurricanes Katrina, Harvey and Sandy, are likely to become more frequent. When coupled with growing population and development in coastal and flood-prone areas it is likely that the number of individuals and the amount of property and infrastructure affected by flooding will continue to increase. For planners, understanding flood risk, those areas most likely to flood and the current and future populations impacted by flood risk is an important consideration in development. The expense of recovery from flooding, the cost of repetitive flood losses, and the potential for loss of life with flooding are all concerns. Planners, with the view towards long-term considerations, are key players in ensuring that flood risk is a consideration with development. Therefore, it is important for planners to understand the dynamics of future population distribution and the impact that flood risk development exclusion can have on that dynamic.

To help with this understanding, this study is intended to provide a model for greater understanding of the future population distribution impact of flood risk consideration in planning and development. The study looks at how future population distribution in Houston/Harris County, Texas would change as a result of excluding the floodplain from future development.

For purposes of this study, the Flood Insurance Rate Map (FIRM) provided by FEMA is used to identify both the 100-year and the 500-year floodplains.

Houston/Harris County was selected as the location for this study for a number of reasons. The city has a long history of flooding, having suffered from eight major flooding events between 2000 and 2017. The city is also one of the fastest growing metropolitan areas in the country, with a population gain of 14.4 percent between 2010 and 2016 (City of Houston Planning and Development Department, 2017). The growth in land area has also been significant over the past forty years. Additionally, while Houston seems to have a hands-off approach to planning, many of the government regulations in place have actually encouraged a high degree of sprawl across the area (Lewyn, 2004). The resulting lack of open green space and natural water dispersal mechanisms, the significant coverage by impervious surfaces, along with the proximity to the Gulf of Mexico and the low, flat elevation, combine to exacerbate flood potential. Hurricane Harvey is only the most recent major flood event to impact the area and is an extreme example of the flood problem facing the area.

There are a number of models available to predict future population growth and distribution, LandCast is one such model available. The LandCast model was created in 2013 by researchers at the Oak Ridge National Laboratory (ORNL). LandCast is a dasymetric approach which takes various socio-economic and environmental factors into consideration when distributing the population projections over a specific geographic area. The original model was developed and applied to the contiguous United States, described in a paper published in the Proceedings of the National Academy of Sciences (McKee, Rose, Bright, Huynh, & Bhaduri, 2015). The model was developed with the idea of understanding population growth for the potential siting of future nuclear power generation facilities. However, while developing the

model the researchers intended that it would be locally adaptable for smaller geographic areas and specific policy inputs. This adaptability, along with the base information available for comparison from the original work, make LandCast useful for this study. The adaptability allows for a floodplain exclusion to be added to the model to come up with new population distribution scenarios for 2030 and 2050. The results of the original LandCast analysis is used for comparison with a revised analysis that excluded future development within the 100-year and the 500-year floodplain to better understand how population distribution changed with the inclusion of flood risk.

The study will highlight how future population could shift if floodplains were excluded from development in the Houston/Harris County area. This study is intended to be a visual analysis of population distribution and does not include a significant cost or feasibility component of a policy excluding the floodplain from future development. The visual analysis will look at changes in population numbers and density in Houston/Harris County to better understand the number of new individuals impacted by such a policy. A particular focus of the analysis will be where the population will be increasing if development is not allowed within the floodplains, in other words, where will the development occur. The intention of this study is not to propose specific solutions to the flooding propensity, but rather to look at how the population distribution would change if flood risk were a greater consideration in planning.

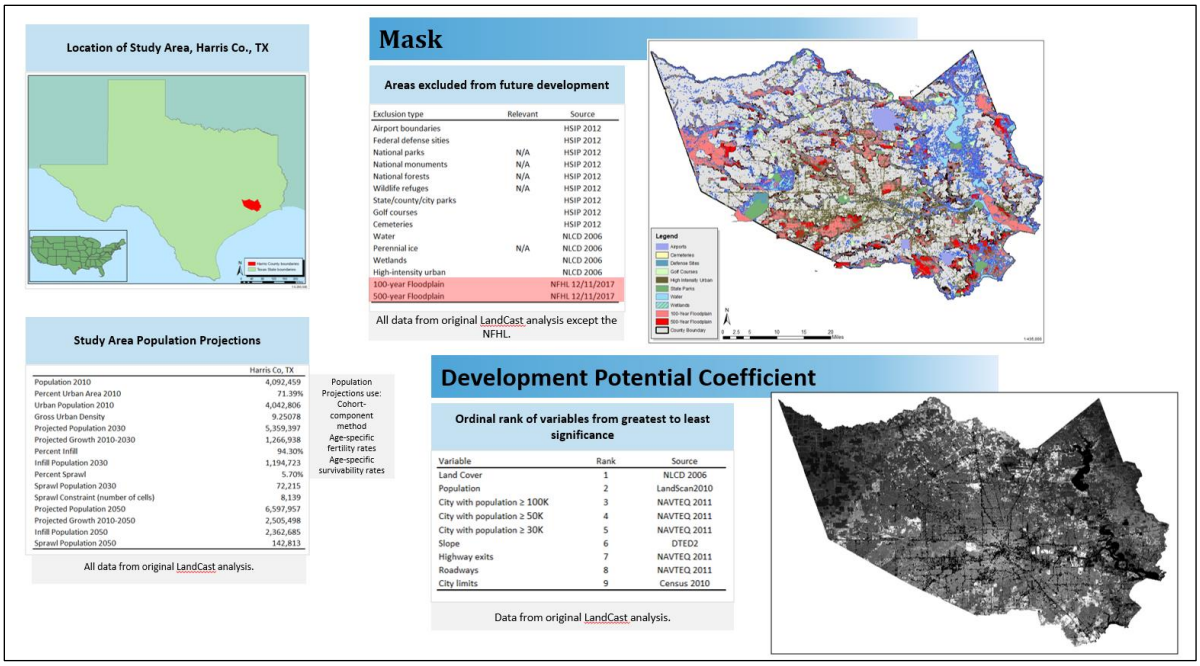


Figure1: Process Steps and Inputs – Mask & Development Potential Coefficient

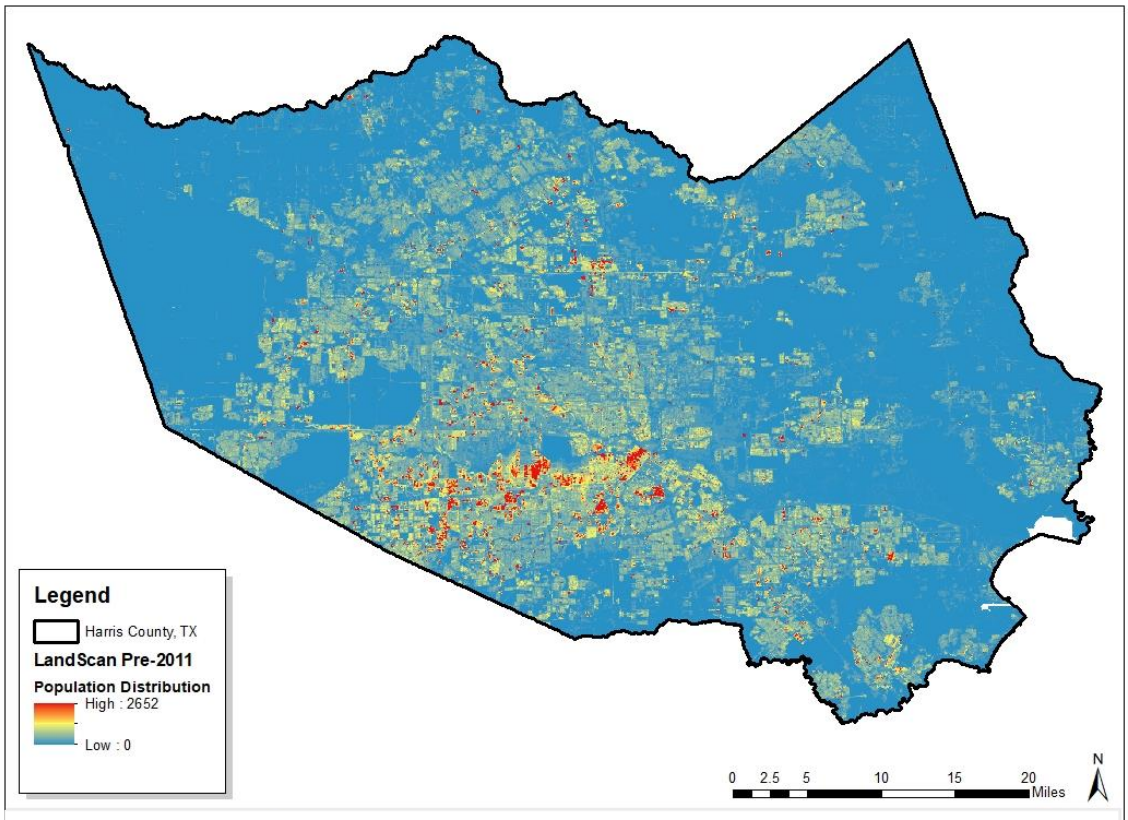
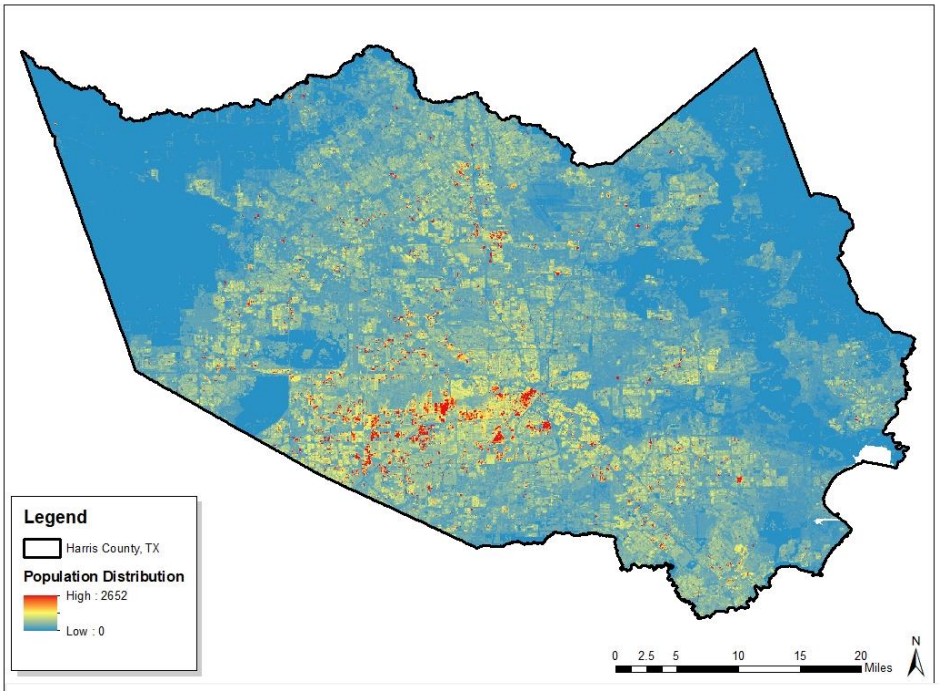
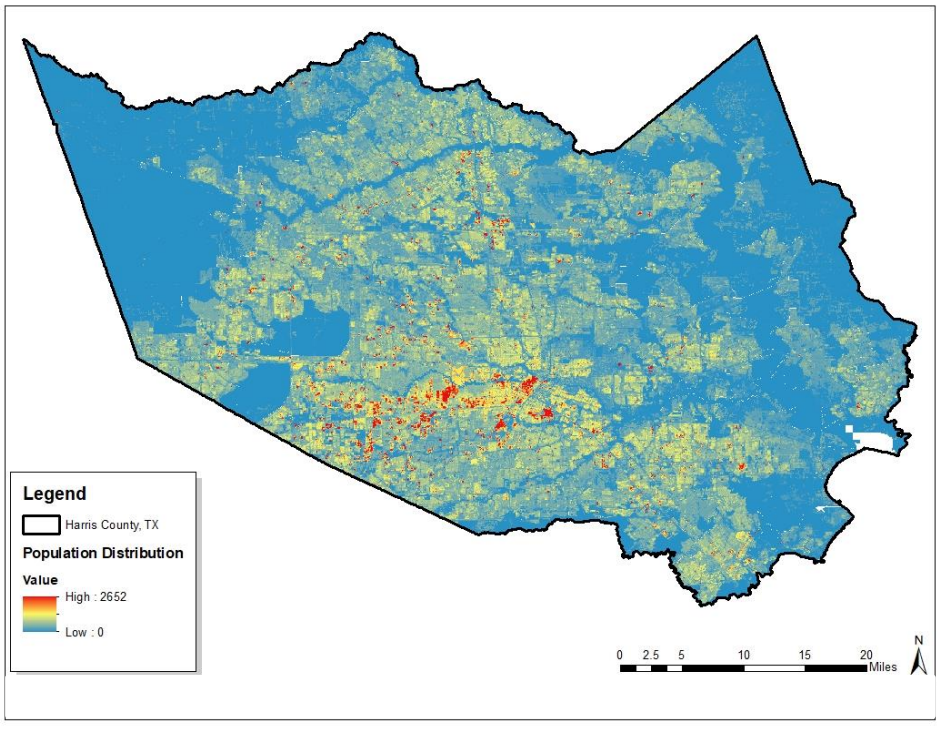


Figure 2 shows the **base** population distribution for Harris County in 2010. The available data at a finer resolution was completed in 2011, based on Census population information for 2010. The resolution is 1-arc-second.



Figures 3 and 4 show the population distribution in **2050** based on different scenarios. Figure 3 was done with the mask and development coefficient from the original LandCast model. Figure 4 shows the 2050 full population distribution (new and existing population) if the 500-year floodplain is excluded from new development. These maps are at a 1-arc second resolution to better highlight areas of greater and lower population density and population distribution.



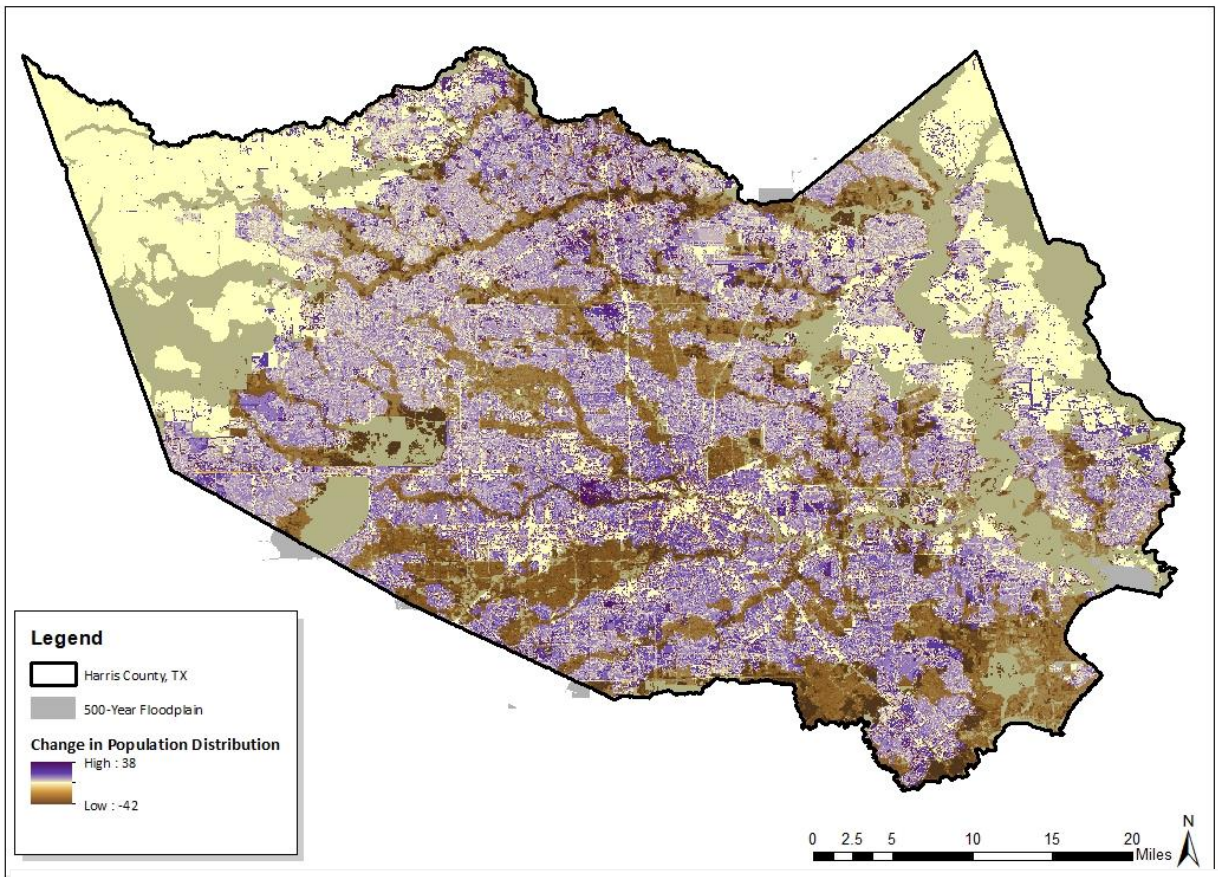


Figure 5 is intended to highlight the relationship between the decline in population and the 500-year floodplain. The floodplain is shown in transparent dark grey. The declining population is shown in brown and can be seen in most areas where the floodplain is shown.

LIST OF REFERENCES

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