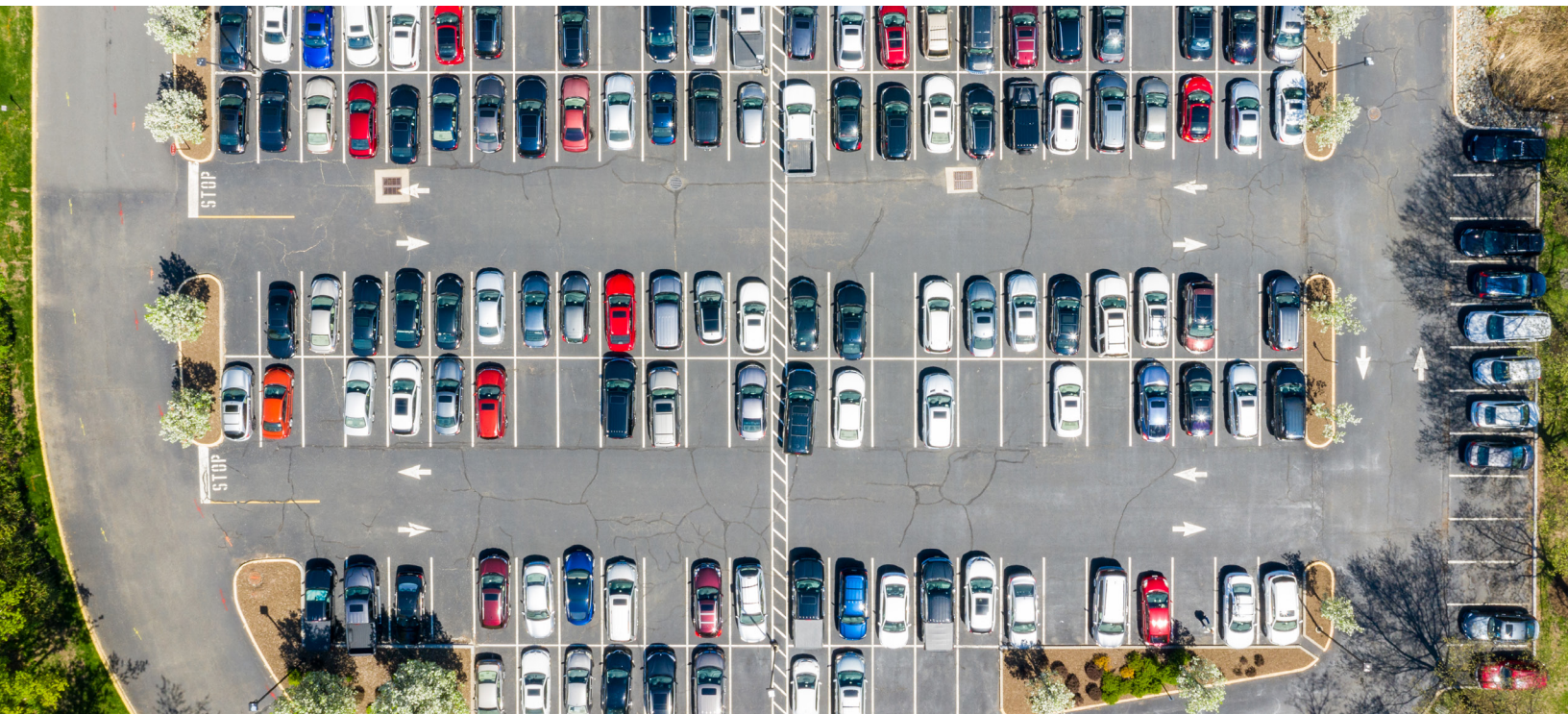


Impervious Surfaces from High Resolution Aerial Imagery: Cities in Fresno County

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Introduction

Car-centric urban development patterns have given over vast swathes of land to multilane highways, congested arterials, and sprawling parking lots. These impervious surfaces are perceived as unsightly and alienating to many residents and have negative environmental impacts including the magnification of the urban heat island effect and reduction of downstream water quality. As urbanization increases, the areas of impervious surfaces in cities are increasing. As a result, many cities are implementing measures to reduce impervious surface coverage and more sustainable land use practices, ensuring long term socio-economic and environmental development.

This research explores the use of various image classification methods on high-resolution aerial imagery to quantify the percentage of urban areas covered by impervious surfaces. Traditional pixel- and object-based classification methods are compared to novel deep learning classification tools. The results are compared to past studies of impervious

coverage in Fresno/Clovis and similar cities using other methodologies. Policymakers can use this information to inform future land use planning.

Study Methods

Stretching from the fertile San Joaquin Valley to the crest of the Sierra Nevada, Fresno County is the sixth largest county in California by area and the tenth largest by population. However, cities in Fresno County often are not the focus of research and studies, and in this case of California impervious surface analysis.

Therefore, high resolution aerial photography covering the fifteen incorporated cities in Fresno County was acquired from a commercial vendor. Census block, parcel, street, and city boundary GIS layers were retrieved from public data sources for this study. For pixel-based and object-based image classification, three image tiles were selected to represent high-, medium-, and low-density development

patterns. Each tile was classified using built-in functions in the ArcGIS platform. For deep learning classification, all forty-nine tiles covering the fifteen cities of Fresno County were classified using the deep learning tools in ArcGIS. Post-processing was conducted to extract and tabulate the impervious cover results for each city.

Finally, an accuracy assessment was conducted for all three classification methods to evaluate the validity of the results. The results were compared to previous work conducted by the US EPA as part of their Meter Scale Urban Land Cover (MULC) program.

The average impervious cover across all of the cities of Fresno County using the deep learning method is estimated to be 45%.

Findings

- The average impervious cover across all the cities of Fresno County using the deep learning method is estimated to be 45%.
- For the Fresno/Clovis city area, the percent of impervious surfaces increased from 53% in 2010 (EnviroAtlas) to 63% in 2020. This 10% increase in 10 years is aligned well with the population increase.
- The percentage of impervious cover is not strictly related to city size. For example, the highest percentage of impervious cover in Fresno County is found in the city of Kerman (pop. 16,000).
- Deep learning classification provided more accurate results than pixel-based and object-based classification methods.

Policy/Practice Recommendations

Future classification studies should consider the use of deep learning when practical because it provides more accurate results than traditional pixel- or object-based methods in an off-the-shelf software package. City codes and land use planning should consider the negative impacts of excessive impervious cover on the urban fabric. While impervious cover may be perceived traditionally as a “big city” problem, small city planners also need to reckon with the negative impacts of excessive concrete and asphalt.

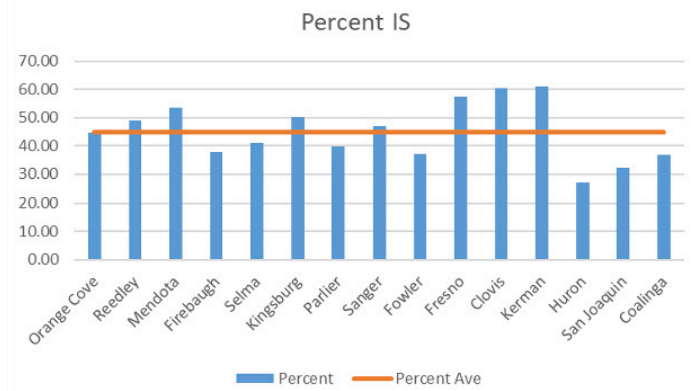


Figure 1. Percent Impervious Surface of Cities in Fresno County

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To Learn More

For more details about the study, download the full report at transweb.sjsu.edu/research/2257



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