

The Block is Hot!: A Spatial Pattern Analysis of Land Use, Population, Demographics, & Economic Activity at Motorcycle Crash Locations in Florida

Deja M. Jackson¹, Ruth L. Steiner, PhD., MBA², Siva Srinivasan, PhD.¹

¹ Department of Civil & Coastal Engineering, University of Florida, ² Department of Urban and Regional Planning, University of Florida

Introduction

According to the National Highway Traffic Safety Administration, US motorcycle injuries increased from 53,000 to 92,000 between 1997 and 2014. During the same period of time, motorcycle fatalities (Fig. 1), motorcycle crash fatality rates per 100,000 registered motorcycles, and motorcycle crash fatality rates per 100 million vehicle miles travelled also increased.

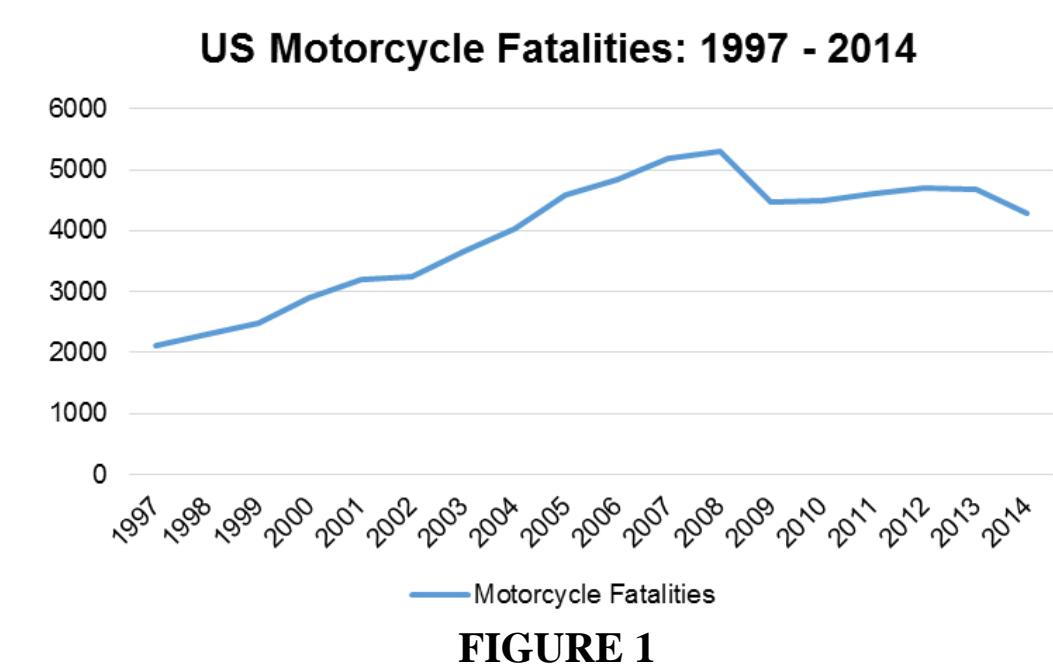


FIGURE 1

Despite Florida experiencing similar trends in the mentioned crash statistics within the same time period, rates amongst motorcyclists within the state remain significantly higher than national rates (Fig. 2).

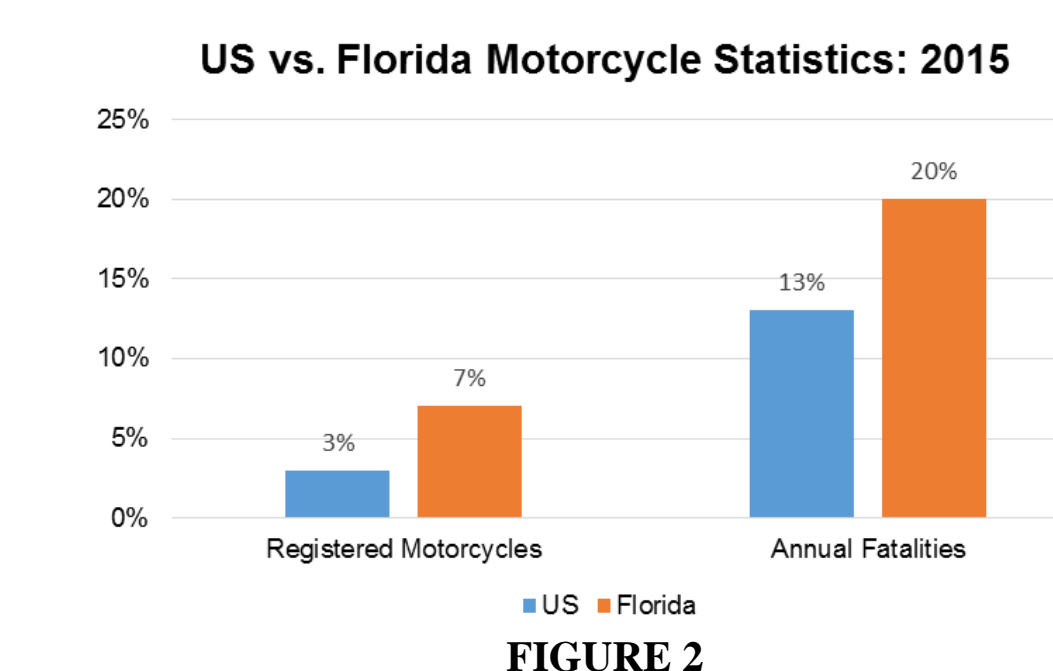


FIGURE 2

Florida Motorcycle Safety Policy

With a vision to promote a safer transportation system for motorcyclists and other members of the motoring community, an assessment of Florida's motorcycle safety efforts conducted by a multi-disciplinary team of experts from across the nation in 2008, led to the development of the Motorcycle Safety Strategic Plan (MSSP). All efforts were put forth to achieve the overarching goal of improving motorcycle safety in Florida by reducing the number of motorcycle fatalities, serious injuries and crashes beginning in 2009.

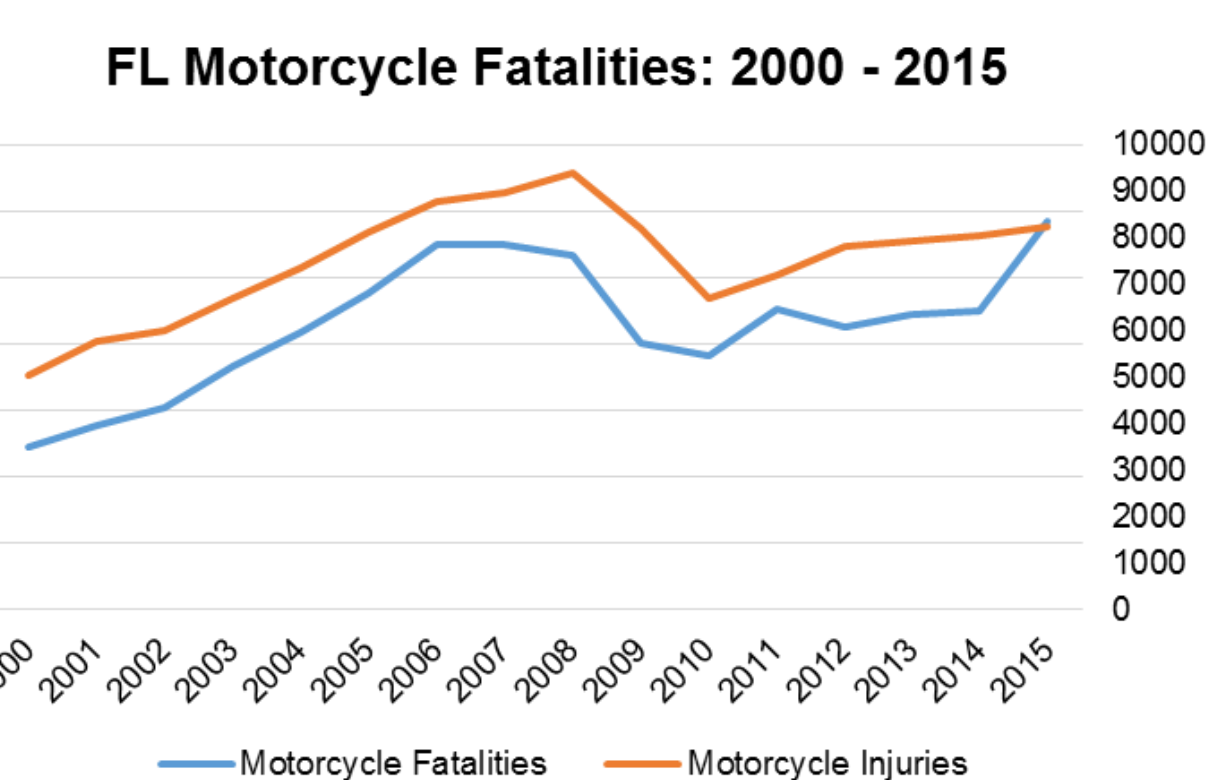


FIGURE 3

Although injuries and fatalities are lower than the 2008 statistics used to develop the MSSP,

- Motorcycle Crashes
- Motorcycle Injuries
- Motorcycle Fatalities

have steadily been increasing in Florida with the exception of years 2009 and 2010 (Fig. 3).

Research Objectives

This research attempts to pioneer motorcycle safety research at a census block group level of geography from a crash event standpoint by:

- Identifying geographic areas experiencing the most (hot) and least (cold) number of injury-producing motorcycle crashes.
- Providing insight on the influence of :
 - Land Use
 - Population
 - Demographics
 - Economic Activity

at the identified motorcycle crash locations.

Motorcycle Crash Data

To study the selected characteristics of injury-producing crash locations involving a motorcycle in Florida, crash locations at a precise geographic scale had to be assimilated. Florida crash data includes a crash event file that identifies contains the longitude and latitude points for each crash record. A list of crash locations involving a motorcycle from 2008 to 2014 was extracted from the crash event file obtained from the FDOT Safety Office.

Census Block Group Data



FIGURE 4 (Source: US Census Bureau)

For analysis purposes, 2010 census block group data was used as it is the smallest level of census data that retains detailed demographic and socioeconomic information such as:

- Median Household Net Income
- Population
- Housing Density

Block Group Analysis Findings

Motorcycle crashes over the seven-year period were aggregated to Florida census block group boundaries using a spatial overlay procedure in GIS. Initial groupings were then classified into categories using five manual breaks (L = Low; ML = Moderately Low; M = Moderate; MH = Moderately High; H = High) as shown in Table 1.

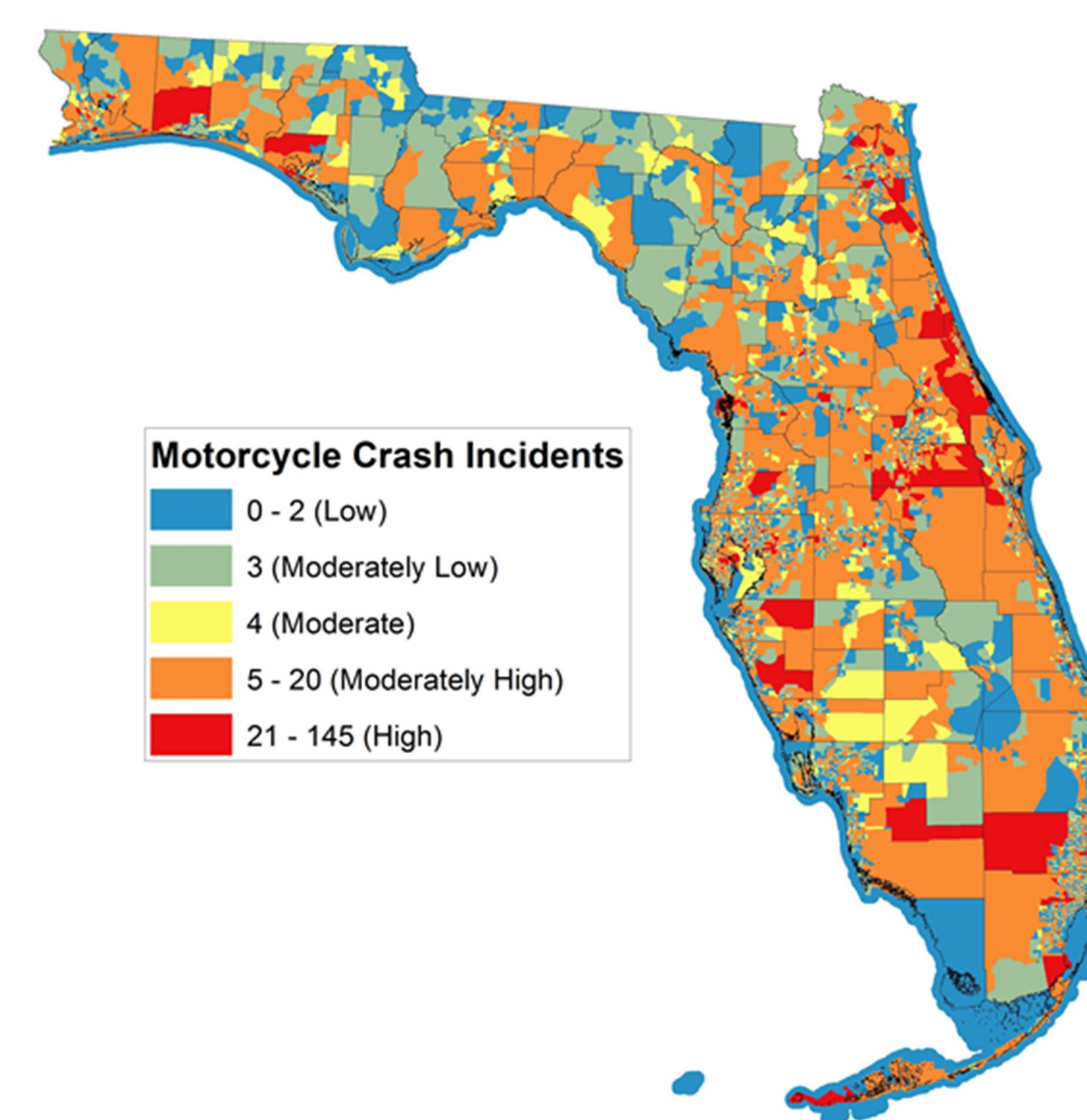


FIGURE 5

The initial grouping of block groups by crash incidents shown in Fig. 5. began to show concentrations of high and low counts of motorcycle crash locations within the state. Moderately high crash incident locations were evident throughout the state. Select demographics and socioeconomic characteristics for the groups are shown in Table 1.

TABLE 1 Block Group Findings

Category	L	ML	M	MH	H	Trend (↑↓)
Land Use						
Number of Block Groups	5,646	1,165	891	3,482	258	-
Total Crashes	5,146	3,495	3,564	30,297	8,483	-
Ave. # of Crashes per Block Group (BG)	0.9	3	4	8.7	32.9	↑
Population						
Total Area (Sq. Mi)	24,569.5	5,949.3	5,280.7	25,637.8	4,319.6	-
Ave. Residential Units	674	763	776	924	1509	↑
Occupied	81.8%	83.7%	83.9%	83.2%	78.6%	-
Ave. Civilian Labor Force	605	728	768	871	1300	↑
Demographics						
Total Population	7,756,941	1,894,621	1,510,548	6,843,503	795,697	-
Ave. Population Density	316	318	286	267	184	↓
Economic Activity						
Educational Attainment (Bachelor's or higher)	13.2%	11.4%	11.1%	10.8%	11.9%	-
Age 15 - 29*	18.1%	19.2%	19.4%	20.2%	25.9%	↑
Age 30 - 49	25.6%	26.5%	26.9%	26.8%	27.2%	↑
Age 50 and Above	39.3%	36.6%	35.8%	35.2%	30.2%	↓
White	76.3%	74.3%	74.9%	74.9%	74.8%	↑
Black	15.1%	17.7%	16.4%	16.2%	14.8%	-
Hispanic	21.8%	20.2%	19.8%	19.3%	19.5%	↓
Asian	1.9%	1.8%	2.0%	2.2%	3.4%	↑
Other	3.1%	3.3%	3.5%	3.5%	3.7%	↑
Economic Activity						
Ave. Household Income	\$53,818.06	\$50,675.47	\$50,978.99	\$48,534.89	\$45,209.69	↓
Poverty Level	12.9%	14.9%	15.4%	15.5%	15.8%	↑
Dependency Ratio*	57.5%	53.0%	51.1%	51.1%	42.3%	↓

Hot Spot Analysis Findings

An optimized hot spot analysis was then utilized for further analyses and although majority of the total area proved to be insignificant meaning that motorcycle crashes in these areas occur at random, the results (Fig. 6 and Table 2) showed similar trends to that of the initial block group analysis in terms of the areas of high and low concentration.

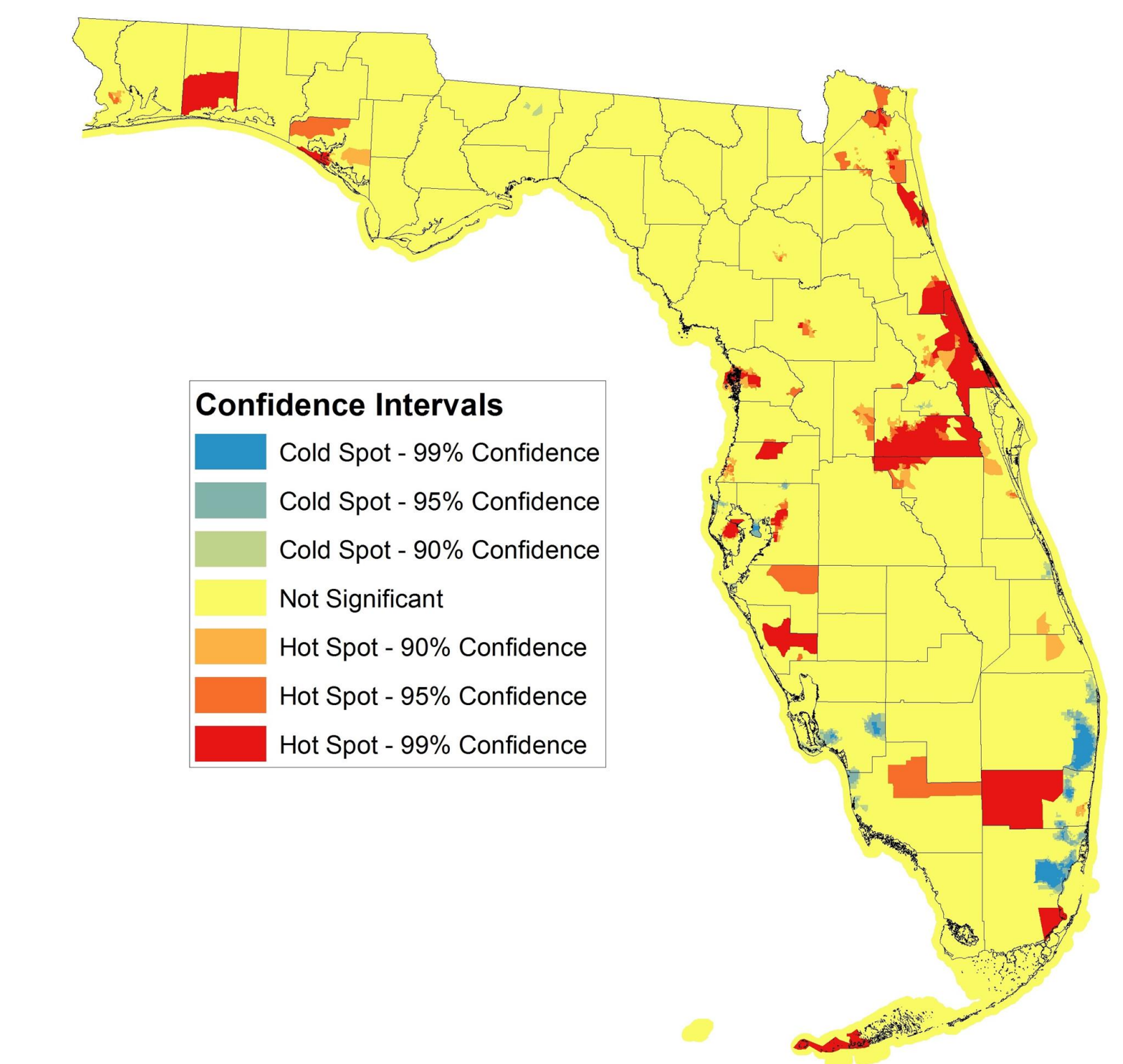


FIGURE 6

TABLE 2 Hot Spot Analysis Findings Compared to State Findings

Category	Cold	State	Hot	Trend (↑↓)
Land Use				
Number of Block Groups	2,103	11,442	1,016	-
Total Crashes	5,276	50,755	11,267	-
Population				
Total Area (Sq. Mi)	1,080.5	65,756.9	5,513.7	-
Ave. Residential Units	694	786	1073	↑
Occupied	84.7%	82.6%	82.0%	↓
Ave. Civilian Labor Force	703	727	1042	↑
Demographics				
Total Population	3,243,742	18,801,310	2,377,820	-
Ave. Population Density	3,002	286	431	-
Economic Activity				
Educational Attainment (Bachelor's or higher)	13.9%	11.9%	10.9%	↓
Age 15 - 29*	18.6%	19.5%	23.5%	↑
Age 30 - 49	27.1%	26.3%	27.3%	-
Age 50 and Above	37.0%	36.9%	31.5%	↓
White	76.5%	76.0%	74.9%	↓
Black	15.8%	16.0%	15.1%	-
Hispanic	37.9%	22.5%	21.1%	↓
Asian	2.0%	2.0%	3.3%	↑
Other	3.1%	3.3%	3.6%	↑
Economic Activity				
Ave. Household Income	\$55,557.06	\$51,475.14	\$46,287.57	↓
Poverty Level	12.9%	14.44%	16.0%	↑
Dependency Ratio*	55.3%	53.4%	44.9%	↓

Future Research

- Findings from the spatial analysis began to show interesting results such as:
 - Areas with higher "Asian" and "Other" populations are associated with higher incidences of motorcycle crashes, this is important because of cultural modes of travel.
- Based upon current findings, future research will further study the effect of such variables by analyzing specific crash types, building various econometric models and crash mapping the residential locations of riders involved in these specific crashes to their crash locations.