"Health Opportunities Across the Commonwealth"

Getting to the root cause of health inequity…

Health Begins Where We Live, Learn, Work, and Play

Virginia Health Equity Report 2012 Appendices

Appendix A

Methodology

Demographic and Health Disparities Methodology

Population, Immigration, and Socioeconomic Status

For this report, Nielson Claritas 2009 population estimates for counties, cities, zip codes and census tracts have been used.

Data for the current state of the population, its immigration patterns, and the socio-economic status of individuals, was obtained from the U.S. Census Bureau "American Community Survey" (ACS). ACS differs from the decennial census in that ACS collects and produces population information every year rather than every ten years, and provides more up-to-date information. Additional information on ACS methodology and all publicly available data can be found online at: http://www.census.gov/acs/www/.

Statewide Life Expectancy Calculations

This report uses the abridged method for calculating statewide life expectancy. The abridged method calculating findings using 5 yr. age groups from census population data. It is noted that this method results in an artificially increase life expectancy for the population group 85+ years. The small numbers of Asians, Latinos and Native American Virginians necessitated use of the abridged life table in order to have sufficient numbers to make the calculation. However, even using abridged life tables, the numbers were too small to be reliable; therefore, life expectancy is not presented for Native Americans, Asians, or Latinos.

Note: This report does not use the single year method (complete or unabridged) as this method uses Medicare data instead of census numbers for the 85+ group and is more accurate. However, the single year method can only be used with a sufficiently large population, i.e. for Virginia – White and Black.

Cautionary Note on Interpretation of Numbers/Rates Pertaining to Outcomes

In some cases, the numbers of events or the size of the population are very small and is thus subject to random fluctuations. Such random fluctuations can result in rates that are misleading. Rates are only considered reliable in the following situations:

- When there are at least 200 live births in the designated group (denominator)
- When there are at least 20 events (e.g. pregnancies, births, deaths) in the numerator

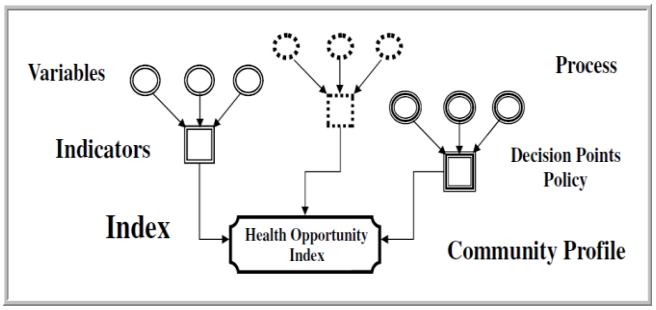
The appendix contains maps for each indicator within the HOI and its association with life expectancy. To use these maps:

1. First identify the life expectancy for the census tract(s) of interest;
2. Then use the map for the HOI indicator to determine the score (color) for the degree to which the indicator is present or absent;
3. Then use the map showing the association (color) between the indicator and life expectancy to determine how strong the relationship is.

HOI Methodology

Another new feature of this report is the Health Opportunity Index (HOI) which is designed to identify those areas and populations that are most vulnerable to adverse health outcomes. In other words, the HOI identifies the impact of a set of social determinants that are important for assessing community health. The development of a healthy community is as much a process as developing other resources and opportunities that add value to a neighborhood. A healthy neighborhood is one that provides its residents a range of opportunities to be healthy. The goal of the HOI is to provide a baseline assessment of social, economic, demographic and environmental factors that support good health outcomes and a healthy community.

The indicators in the Health Opportunity Index (HOI) were obtained by reviewing the SDOH that are known to strongly influence health (e.g. race, socioeconomic status, urban-rural residence). Then variables that represent the processes by which these SDOH influence health were identified. Significant social, economic, environmental and demographic variables were selected. They represent basic processes that have consequences for a community's development and embody many health consequences and outcomes. Finally, indicators were constructed that correlate with global health outcomes (especially life expectancy), and represent processes that occur within communities and are distributed across populations at the neighborhood level.



The HOI is composed of **ten indicators** that reflect a broad array of social determinants of health: (1) Education (2) EPA Environmental Hazards (3) Affordability of transportation and housing, (4) Household Income Diversity, (5) Job Participation, (6) Population Density, (7) Racial Diversity, (8) Population Churning, (9) Material Deprivation, and (10) Local Commuting Patterns. Each indicator is clearly defined and structured (over 30 variables are used in their construction) to further understanding of a clear social, economic or environmental process.

<u>MAPPING</u>

Each indicator was measured in all census tracts indentified in the state. This process allows demographic data and health data to be overlaid and analyzed to determine how health outcomes may differ due to a particular factor. In order to come up with a measurable scale, the HOI used a Z-score that was combined and weighted using Principal Component Analysis to find and summarize local patters. The z-score is like a common yard stick for all types of data. It describes how much a point deviates from a mean or specification point. By using this form of measurement, the interactions, similarities and dissimilarities for each area have been described and an opportunity score for each census tract was obtained.

SUMMARY

The HOI is designed to take into account a number of potentially "intervening mechanisms" to better describe the interactions that often explain the more traditional SDOH indicators (such as

poverty and race). As the fundamental cause theory (Phelan et al., 2004; Link and Phelan, 1995) suggests, the social context in which behaviors occur "embody access to important resources, affect multiple disease outcomes through multiple mechanisms, and consequently maintain an association with disease even when intervening mechanisms change."

The spatial statistics (geospatial weighted regression) used to evaluate the HOI suggest that it is a good predictor of life expectancy. The HOI is useful in urban and rural communities (but it still appears to have a relatively better fit for metropolitan areas of the state). Even in areas where the HOI does not fit as well, the findings can be useful for community level analysis. Communities can then ask, "What is different in our community that results in a higher or lower life expectancy than we would predict from the HOI? And how can we and other communities use this information to promote health equity?"

The HOI is also of benefit at the state level for two reasons. It helps practitioners and policy makers at the state level decide where to focus funds and resources that are distributed locally. The HOI also identifies the importance of broad state level policies that influence HOI variables across all localities. Ultimately, the HOI supports the conclusion that "place matters" when it comes to health equity.

Note: The HOI does not necessarily "explain" life expectancy in all census tracts across Virginia because local dynamics and interactions are likely to differ and have varying impacts across communities. The HOI was developed with the understanding that complex systems are at work at the community level to shape health. Nonetheless, these systems are strongly influenced by the opportunities to be healthy that are included in the HOI. A more detailed description of the conceptual basis for the HOI can be found at www.vdh.virginia.gov/healthpolicy.

Variables and Indicators within the Health Opportunity Index

Affordability Indicator

The poverty measure used by U.S. Census Bureau assumes that the cost-of-living is the same everywhere in the United States. The Affordability Indicator takes into account the significant cost-of-living differentials within the Commonwealth, which poverty estimates overlook (Jolliffe 2006). It identifies the most significant expenses families incur (transportation and housing costs) and suggests the impact of such costs on disposable income.

How it is measured. The affordability indicator is composed of three variables. (1) housing cost, (2) transportation cost and (3) total income. The indicator measures the proportion of income spent on housing and transportation. The indicator clearly shows that housing and transportation costs vary significantly across Virginia.

What it means. The higher the indicator, the higher the percent of income spent on housing and transportation.

Population Churning Indicator

Churning is measured by the sum of the number of in- and out-migrants of an area expressed as a ratio of the entire population (in and out/ total population). For the HOI, churning has been estimated on an annual basis for each Census Tract. As researchers have noted, churn may be viewed as both a threat and as an opportunity. Population churning can provide a useful measure of the potential disruption to local services such as health services and education but it can also facilitate the development of social capital by increasing the number of social networks an individual or community may have as new neighbors arrive and by increasing the access to opportunities through social connections (Forbes-Edelen 2009, Bailey & Livingston 2007). It is also possible that high levels of churning could interfere with the development of social capital if population turnover occurs at a rate to prevent the development of new social networks.

How it is measured. Population churning is a measure that takes into account total population movements in relation to the underlying population at risk in a way that net migration does not. Net migration will only indicate the balance of movement (either in or out) in relation to the

population; this shows if an area is gaining or losing population, and the relative level of this gain or loss. Population churning will not give an indication of the balance of movement, but will give a standardized measure of the amount of movement in relation to the population at large. Population churning rates assist in quantifying the stability of a population in an area. The index uses the census mobility data that shows the mobility for 5 years by census tract.

What it means. The index is measured as a percentage and therefore, the lower the value, the lower the population churns. When churning is associated with shorter life expectancy, the characteristics of the populations that churn in and out of a community should be evaluated in more detail.

Education Indicator

Life expectancy in the United States has increased, but this increase has been largely concentrated among individuals with more than 12 years of education. There is strong evidence that limited education not only limits employment opportunities but is also associated with poorer health status (Woolf et al., 2010).

How it is measured. The Educational Attainment Indicator measures the overall level of education achieved by the adult population. This indicator is commonly used by the United Nations and American Human Development Project.

The Education Indicator is composed of 2 factors:

- Attainment- calculated by adding the percentage of the population twenty-five and older with at least a high school diploma or equivalent, the percentage with at least a bachelor's degree, and the percentage with an advanced degree. Those who have earned an associate's degree or those who have completed some college without earning a degree are counted in the "at least high school" category.

- Enrollment- calculation that takes into account the total number of students enrolled in school (of any age at any level) divided by the total school-aged population of 3 to 24 year-olds (inclusive).

The two portions of the indicator are weighted (Attainment is weighted 2/3 while Enrollment is weighted 1/3) and summed together to get a composite education indicator score.

What it means. The higher the number, the higher the education attainment of an area.

Environmental Protection Agency (EPA) Environmental Indicator

It has been estimated by the American Lung Association (2011, 6) that approximately half the citizens (50.3%) of the United States live in areas that have unhealthful levels of air born environmental pollutants. The American Heart Association's statement on "Air Pollution and Cardiovascular Disease" concluded that exposure to particulate matter (PM) air pollution contributes significantly to cardiovascular morbidity and mortality: "…current evidence supports the findings …. that demonstrated that short term elevations in daily PM levels lead to a greater absolute risk for CVD-related mortality than for all other causes" (Brook et al., 2010, 2337).

How it is measured. The environmental indicator was computed using EPA National Air Toxics Assessments (NATA) Environmental Data (http://www.epa.gov/nata/) to evaluate the magnitude of air pollution by Census Tract. This Database contains, three risk variables-- cancer risk, respiratory risk and neurological risk. All these variables were standardized to Z-Scores and summed to construct the hazard quotients of the toxic compounds that adversely affect health outcomes.

What it means. The higher the hazard indicator, the greater the exposure to environmental conditions that may result in adverse health outcomes.

Household Income Diversity Indicator

The suggested connection between household income diversity and mortality is best known from the work of Richard Wilkinson. He has argued that income distribution is related to health where it serves as a measure of the scale of social class differences in a society (Wilkinson, 2005). Others have also documented that income inequality is consistently linked to population health in United States, compared to all the industrialized countries in the world. The health impact of household income diversity is most relevant when there is low diversity and the average income is low; this signifies that there is a high concentration of low income individuals. Such concentrations may lead to "poverty traps" (Bowles et al. 2007). Conversely, it is believed that economically integrated communities are likely to provide greater opportunities (including health) for residents across different incomes (Shroder 2004).

How it is measured. Income diversity is a broader concept than poverty in that it is defined over the whole distribution; it is not simply the individuals or households below a certain poverty line. Diversity, therefore, refers to the difference in household income within the same Census Tract. The index was measured by using all 10 census income ranges; namely annual incomes of less than $15,000; $15,000 to $24,999, $25,000 to $34,999, $35,000 to $49,999, $50,000 to $74,999,

$75,000 to $99,999, $100,000 to $149,999, $150,000 to $249,999, $250,000 to $499,999, and $500,000 or more.

What it means. A lower index indicates that the area has a more homogeneous household income. This means that if you select two houses at random, the chance that both houses will belong to different income levels is less. A higher index means that an area has a greater mix of household incomes. The health impact of household income diversity is most relevant when there is low diversity and the average income is low; this signifies that there is a high concentration of low income individuals.

Local Commute of Workers Indicator

A spatial job mismatch exists when there are more or less jobs in an area than the number of people with the appropriate training required to fill those jobs. Spatial mismatch can lead, therefore, to job sprawl which may in turn be related to urban sprawl where transportation requirements lead to car or public transportation dependency. Typically certain types of jobs may become concentrated in the inner city and others concentrated outside the central city leaving some workers stranded. It is measured by the inflow of workers to an area compared to the outflow from that same area. When mismatch becomes highly distorted it may lead to the channeling of employees into a position of underemployment, i.e., employment of the overskilled and overeducated into sectors requiring lower training levels or unskilled workers unable to access jobs that are located a distance from where they live. Spatial job mismatch can also cause individuals with the means to move to locations with more desirable job opportunities to leave an area. Limited access to jobs for which someone is qualified is associated with unemployment and low income and the resulting challenges, which are strongly associated with poor health outcomes.

How it is measured. Commuting pattern based on Census Transportation Planning Package (CTP) data (http://www.fhwa.dot.gov/ctpp/) can be used to indicate in flow and outflow of workers of an area. This is the ratio of inflow plus outflow divided by total resident work force in the area in question. This is an indicator of the mismatch between the labor force and employment opportunity inside an area and outside an area. This mismatch between labor force and employment can increase commuting cost for individuals.

What it means. The higher the indicator the more job rich the area.

Job Participation

Job participation rates measure the percent of population 16 years of age through 64 who are either employed or unemployed and seeking work. Because job participation rates are sensitive to a number of local community attributes (e.g., educational attainment, disability, household composition, car ownership, job availability), the measure can provide a sensitive indicator to the unique employment profile of a community. Job participation rate is often used by economists as an indicator of economic development and growth (Mosisa & Hipple 2006). Employment, which affects income, is strongly associated with health status (Raphael 2006, Raphael 2009).

How it is measured. This indicator is composed of three variables:

1.Number employed,
2.Number unemployed, and
3.The civilian non-institutionalized population, between 16 and 64 years.

The average labor participation rate for Virginia is currently 68.4 percent (http://www.bls.gov/lau/lalfprderr.pdf).

What it means. A high index means that a high percentage of the active labor force is employed or seeking work, which suggests a healthy labor market.

Population Density

The primary reason for including population density in our model is to help understand the spatial differences between urban and rural populations.

How it is measured. Population density is often used as an indicator of land use patterns (spatial accumulation, which indicates high or low concentration of population of an area) associated with urban, sub-urban, and rural developments. The index is calculated by dividing the total population by the square miles in the area of interest.

What it means. A high value indicates a higher concentration of people per square mile.

Racial Diversity Indicator

Several studies have documented the relationship between socioeconomic characteristics, residential environment and health. It has been shown that residential isolation (segregation) of minority populations is strongly associated with poor health, including total life expectancy. Racial residential segregation has been termed a fundamental cause of health disparities (Williams & Collins 2001).

How it is measured. The Diversity Indicator identifies the probability that two persons, chosen at random from the street will belong to different race or ethnic groups. The calculation of this indicator accommodates up to seven racial groups: six single-race groups (White, Black, American Indian, Asian, Pacific Islander, Some Other Race) and one multiple-race group (two or more races).

What it means. The Diversity Index ranges from 0 to 1. If an area's entire population belongs to one racial group, then an area has zero diversity (homogeneous population). An area's diversity index increases to 1 when the population is evenly divided into two or more race/ethnic groups (heterogeneous). Because an area can have low racial diversity and either be predominantly White or non-White, low diversity would not necessarily be consistently associated with poor health. Based on the segregation literature, low diversity should be considered an important association with poor health, when the area is predominantly non-White.

Townsend Material Deprivation Indicator

The Townsend deprivation indicator measures economic deprivation. According to Townsend, "Material deprivation entails the lack of goods, services, resources, amenities and physical environment which are customary, or at least widely approved in the society under consideration" (Townsend, et al.,1988). As discussed previously, more general measures of material deprivation (low income, limited education) are strongly associated with poor health outcomes. The Townsend Indicator provides a process whereby low SES may translate into limited opportunity.

How it is measured. The index uses four equally weighted variables to calculate the score. These four variables are:

(1) percent economically active residents aged 16-64 who are unemployed,
(2) percent private households who do not possess a car or van,
(3) percent private households not owner occupied and
(4) percent private households overcrowded (more than one person per room).

In calculating this indicator, first, percent unemployment and percent private household overcrowding are log transformed and then a Z score is calculated for the four variables and they are summed up to get composite indicator for deprivation.

What it means. The higher the Townsend Index score, the more an area lacks access to resources within one or more of the variables of the indicator.

Spotlight on Priority Disease-Specific Inequities

HIV/AIDS

The five-year average HIV rate at the census tract level in Virginia is used in this report. In order to calculate the crude HIV rate per census tract, the addresses at HIV disease diagnosis for all of the cases diagnosed in Virginia between 2005-2009 were geocoded to the census tract level using Centrus Desktop software. Subsequently, age-specific crude average rates of new HIV diagnoses between 2005-2009 at the census tract level were calculated, then multiplied by the percent (weight) that specific age group represents out of the total Virginia population. This was done to better allow populations to be compared when the age profiles of the populations are quite different at the census tract level and avoid obscuring high rates of HIV disease among younger age groups in census tracts with higher numbers of older individuals.

There were 5,103 cases of HIV disease diagnosed between 2005-2009. Of these, 294 cases did not geocode to the census tract level and were excluded; an additional 150 cases were diagnosed in correctional facilities and were excluded as well. There were 4,659 cases used to calculate the HIV incidence rates. The 5-year average rate for each census tract was computed for all the 1,530 Virginia census tracts. Sixteen census tracts with particularly high HIV rates based on less than 12 cases were excluded, so the final analysis was conducted on 1,517 census tracts.

Variables within the Health Opportunity Index were analyzed using the same methodology as that for life expectancy to determine which were associated with higher rates of HIV at the

census tract level. Census tract level population estimates for 2005-2009 were obtained from Geolytics.

Additional methodological detail can be found in the description of the analyses used for the HOI at www.vdh.virginia.gov/healthpolicy.

BIRTH OUTCOMES

To calculate the rate of infant mortality, certificates of live birth to Virginia residents from 2005-2009 were obtained from VDH's Division of Health Statistics and compiled by the Office of Family Health Services. Infant mortality rate is the total number of infant deaths in a year divided by the total number of births in that year multiplied by 1000 to get rate per 1000.

To calculate the percent of low birth weight infants, certificates of live birth to Virginia residents from 2005-2009 were obtained from VDH's Division of Health Statistics and compiled by the Office of Family Health Services. The percent of low birth weight was then calculated by the number of resident live births in a specified geographic area (in this case Census Tract) with a birth weight of less than 2,500 grams, divided by the number of resident live births for the same geographic area and multiplied the outcome by 100 to get percent

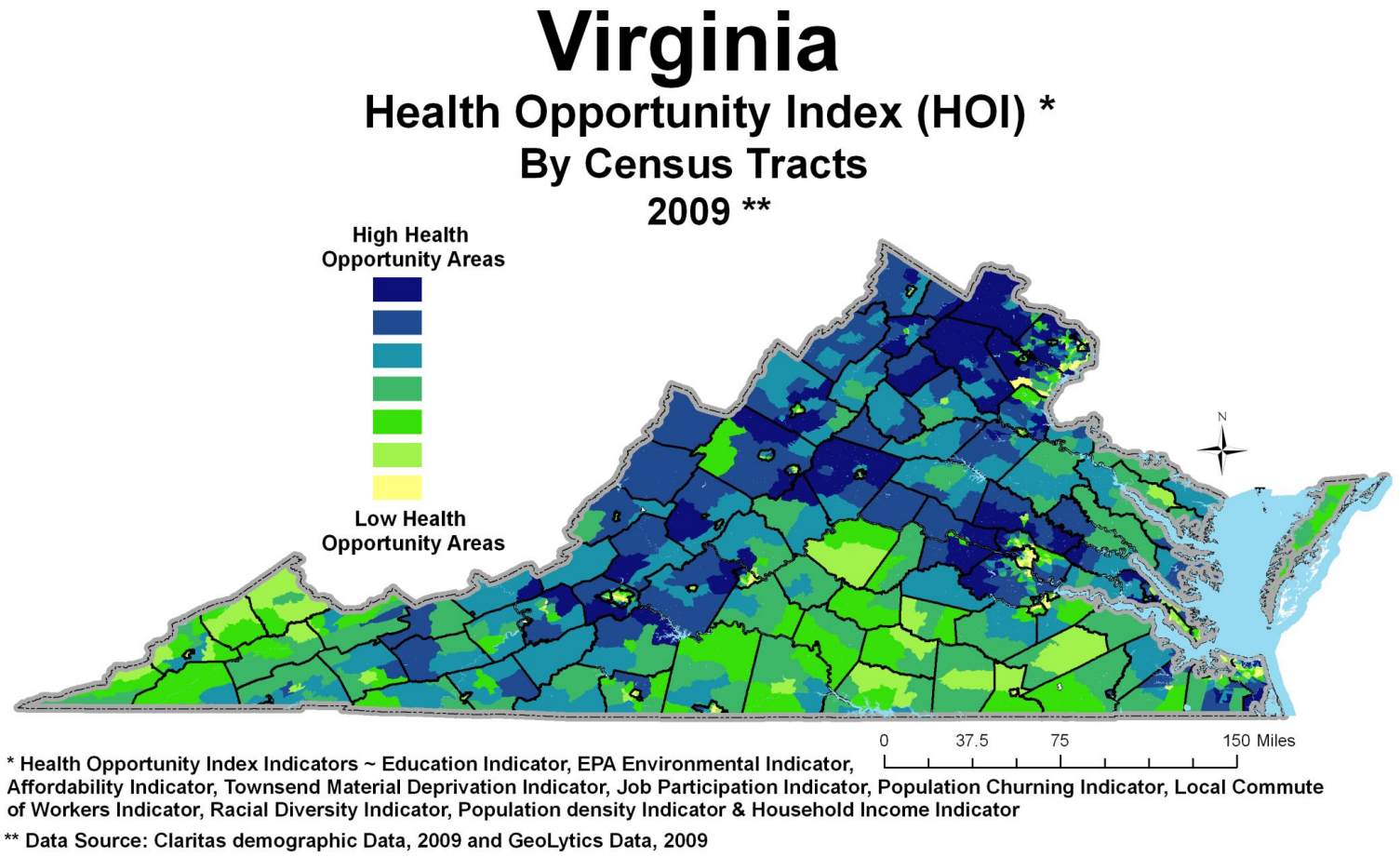
The same methodology used to determine the association between the HOI and life expectancy was also used for birth outcomes. Because many census tracts with limited population have few or no infant deaths in the time period analyzed, most of the current analyses use low birth weights, which had a sufficient number or events during the time period.

Additional methodological detail can be found in the description of the analyses used for the health opportunity index at www.vdh.virginia.gov/healthpolicy

Appendix B

Health Opportunity Index (HOI) Indicators

The Health Opportunity Index is a multi-dimensional measure that gives a true picture of the presence of healthy promoting opportunity and the need for policies to create opportunities that are currently absent.
The HOI is computed to assess the health landscape of an area been studied. These indicators were analyzed using Principal Component Analysis (PCA) to identify factors that explain the pattern of correlation with the variables.
The darker color areas are indicated to have high health opportunity while, the yellow color areas have low health opportunity.



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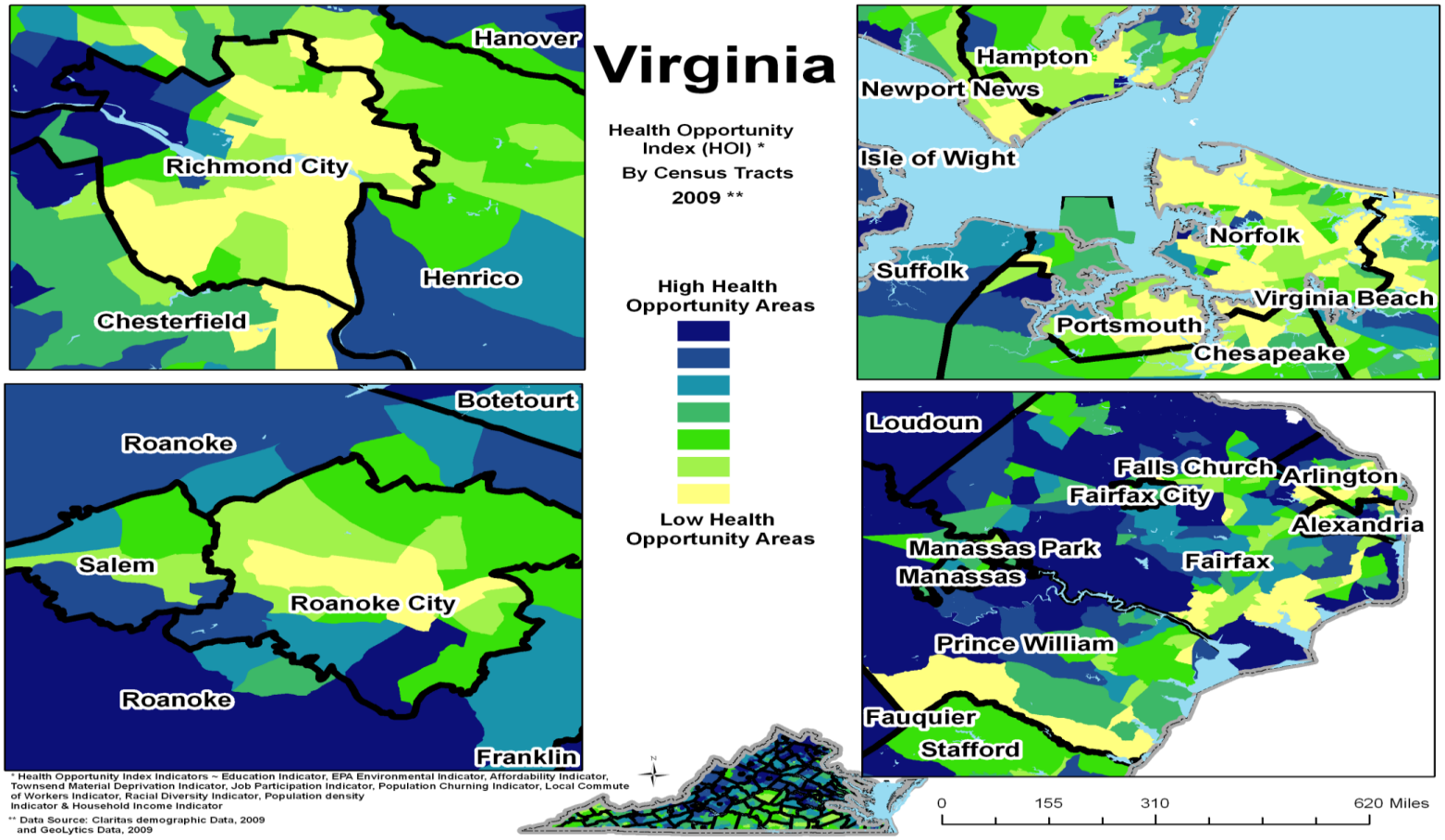

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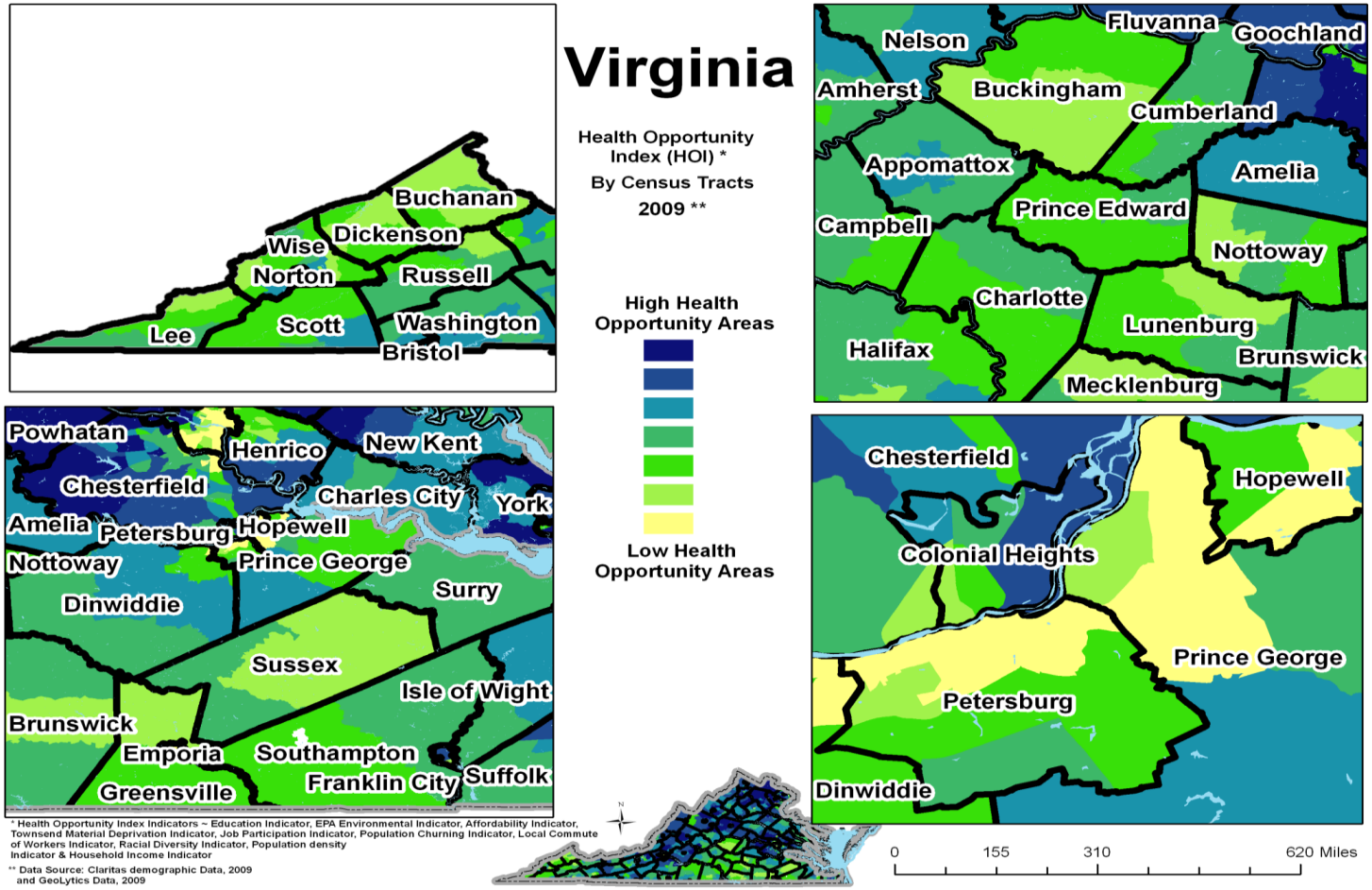

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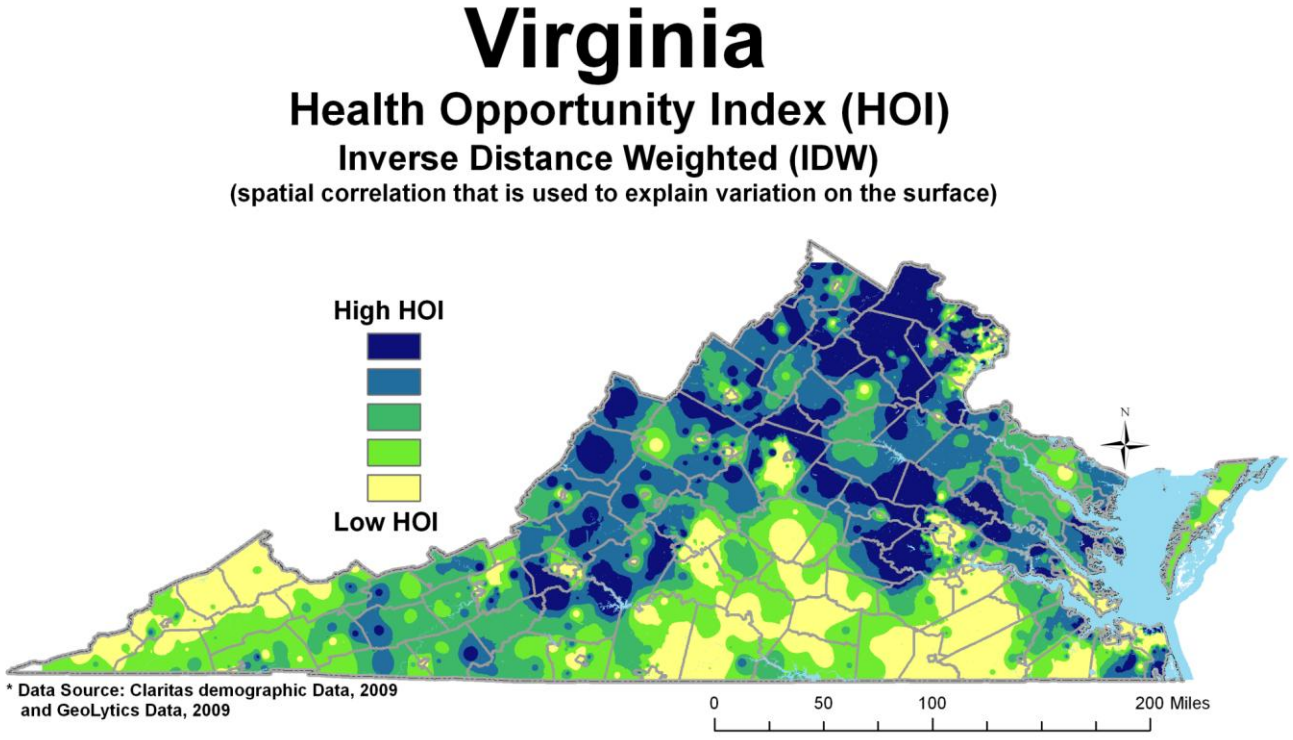

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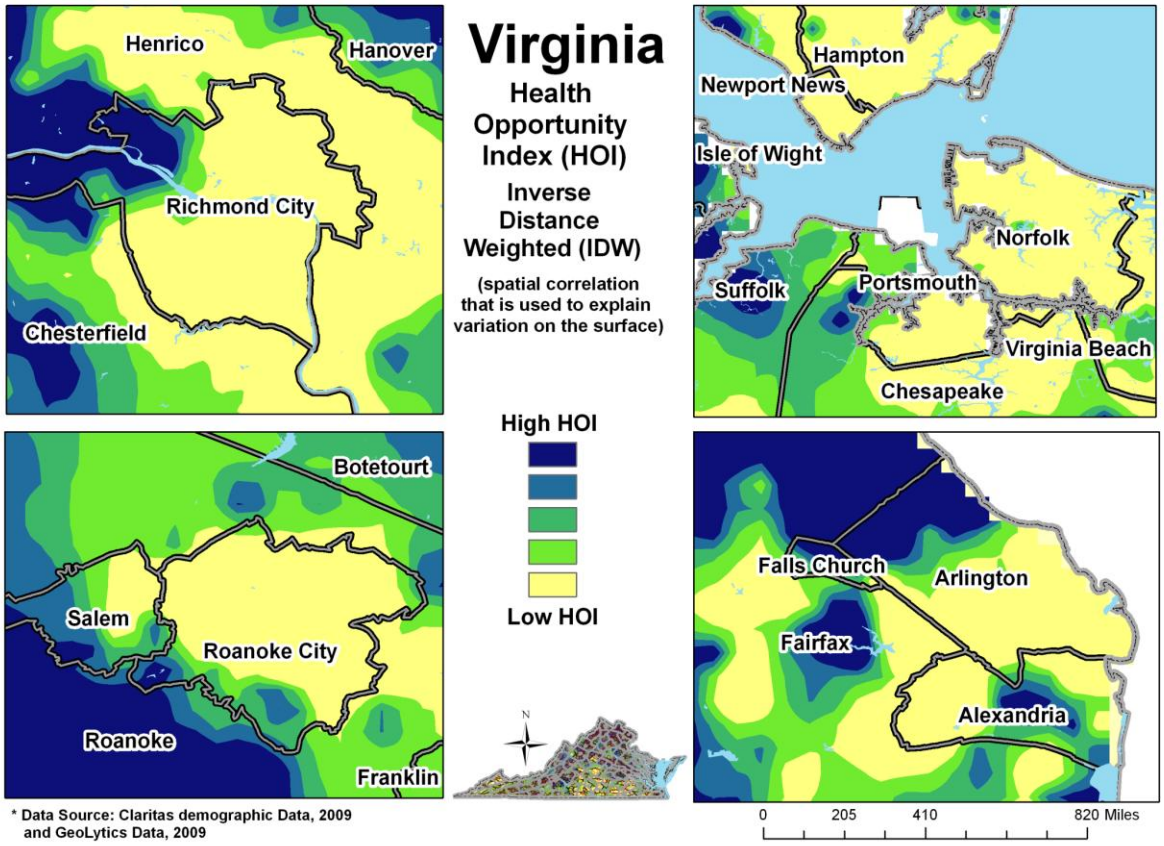

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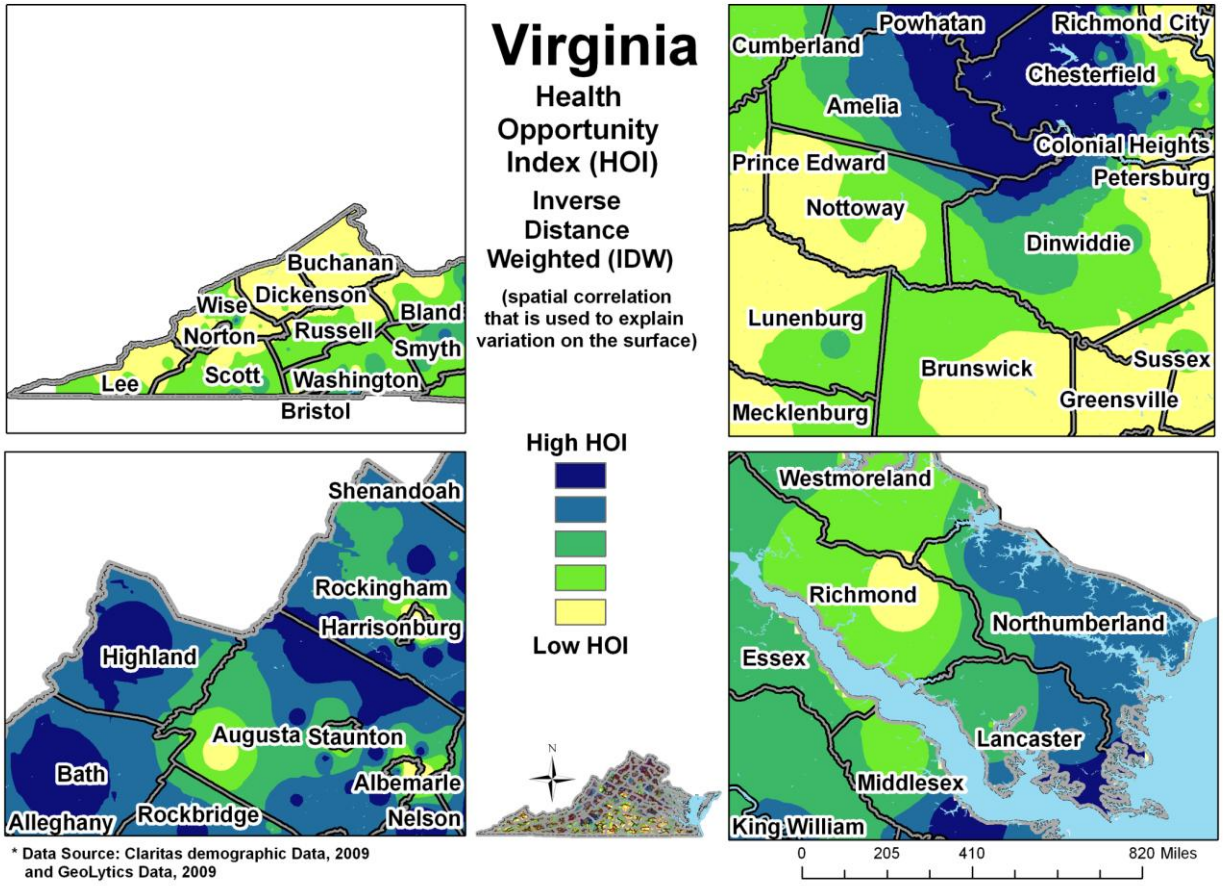

Indicator: Affordability

The indicator of affordability is calculated by combining housing and transportation costs in a neighborhood and dividing that number by income. The indicator shows that housing and transportation costs vary significantly across Virginia. Affordability indicator is composed of three variables. (1). Housing cost, (2) transportation cost and (3) total income. ***The indicator measures housing and transportation as a percent of the total income and so the higher the index, the higher the percent of income spent on housing and transportation.***

For example the yellow areas means, persons in these areas spend more of their total income on transportation and housing. The dark areas mean that persons in these areas spend less of their total income on housing and transportation. This map shows the Richmond metro area (upper left corner), Hampton Roads area (Upper right corner), Roanoke metro (Lower left corner) and Northern Virginia (lower right corner).

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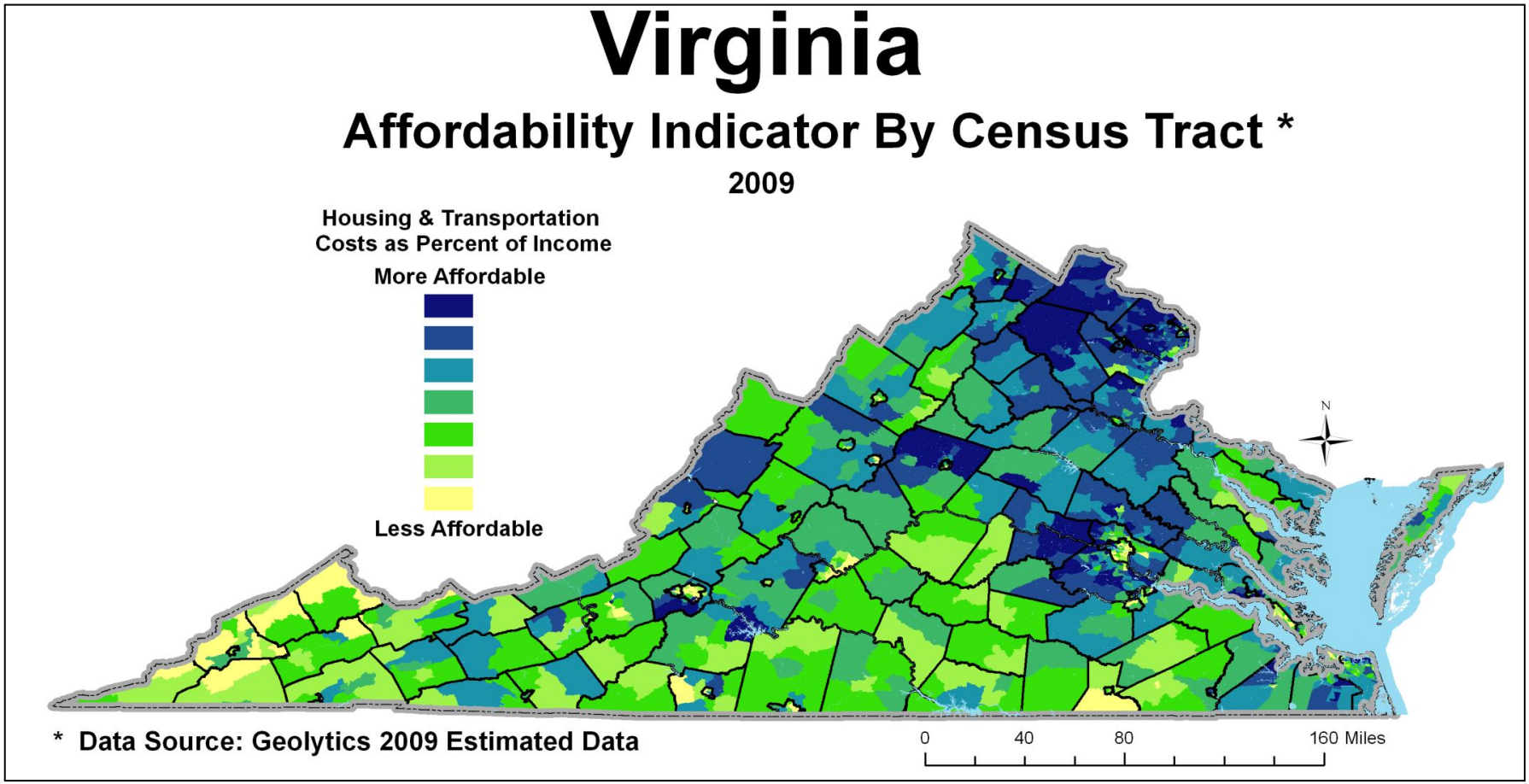

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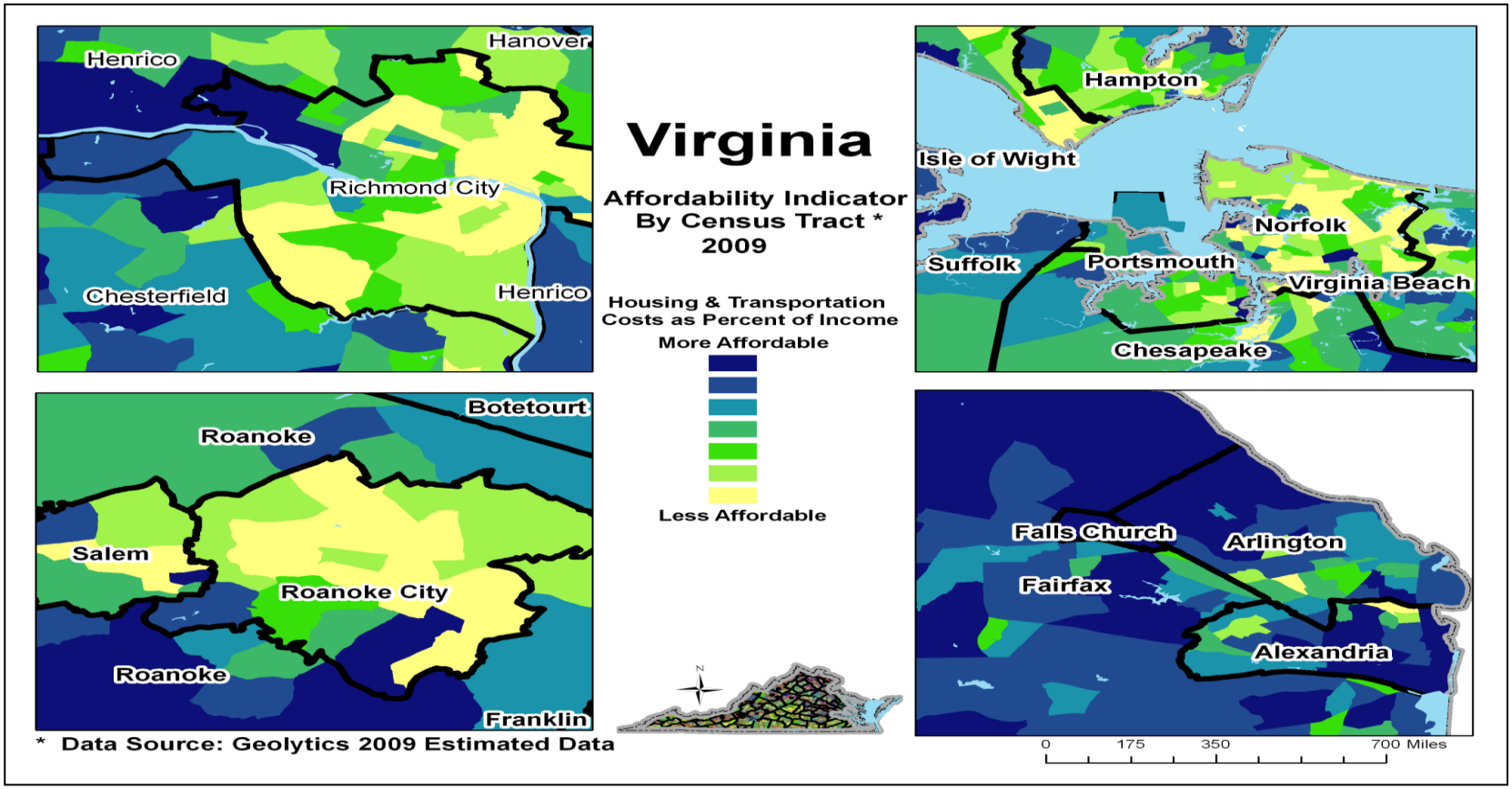

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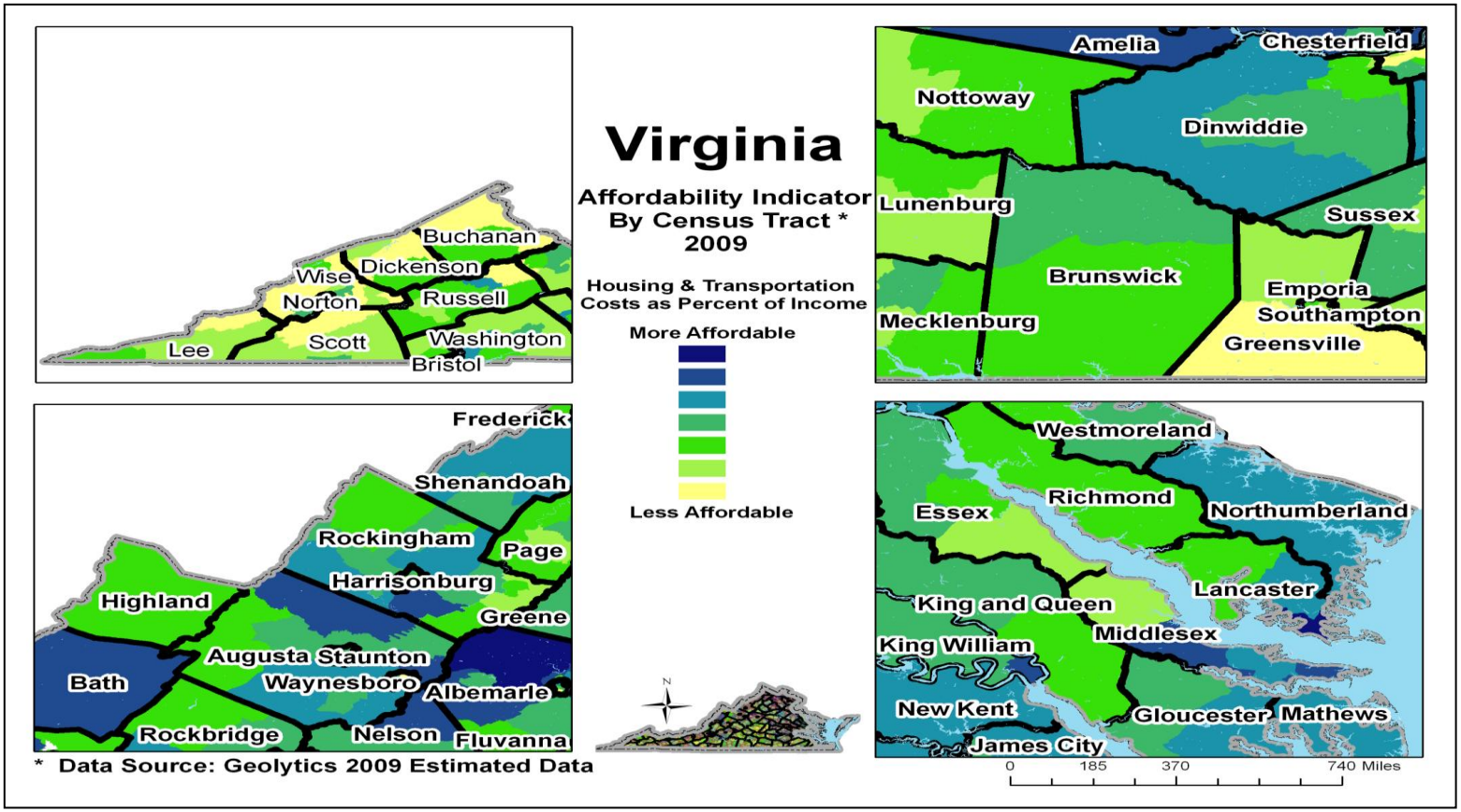
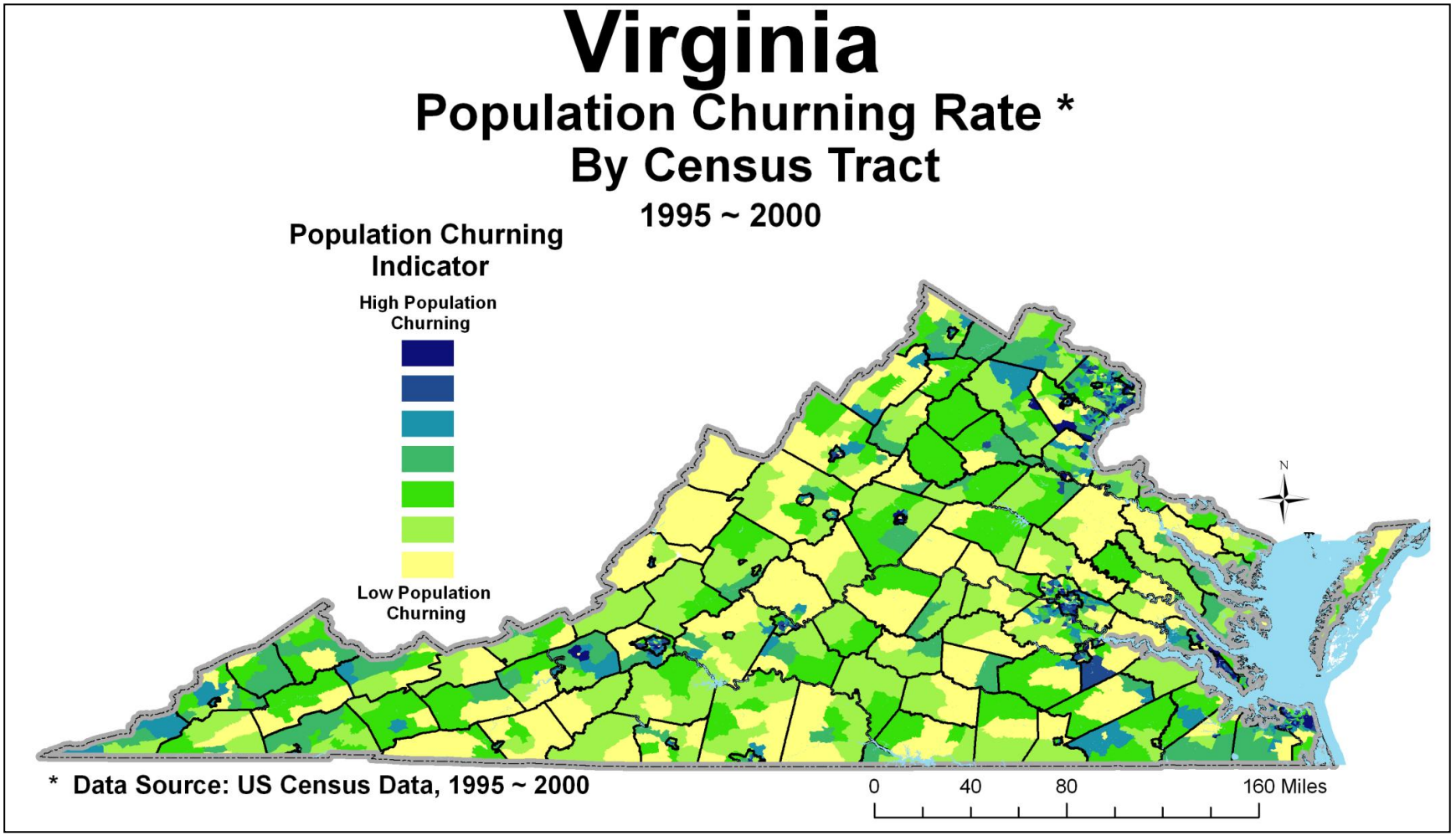


Indicator: Population Churning Rate

Population churning rates relate the combined inflow and outflow for an area to the resident population and help to quantify the stability of a population in an area. The indicator uses the census mobility data that shows the mobility for 5 years by census tract.

The scale shows an annual churning rate by census tract. The darker areas indicate that such areas experienced more population turn-over compared to the yellow areas



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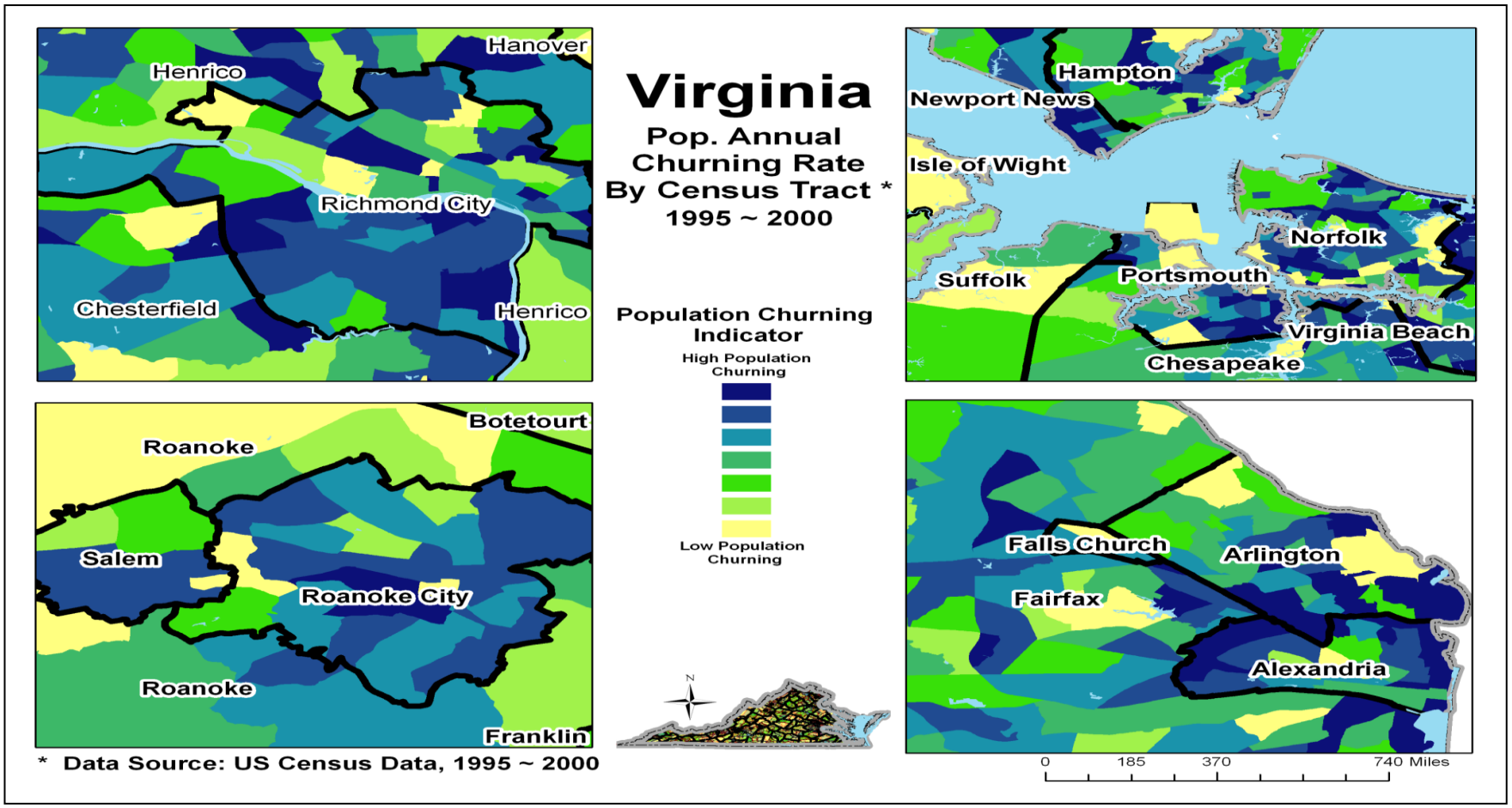
The scale shows an annual churning rate by census tract. The darker areas indicate that such areas experienced more population turn-over compared to the yellow areas.



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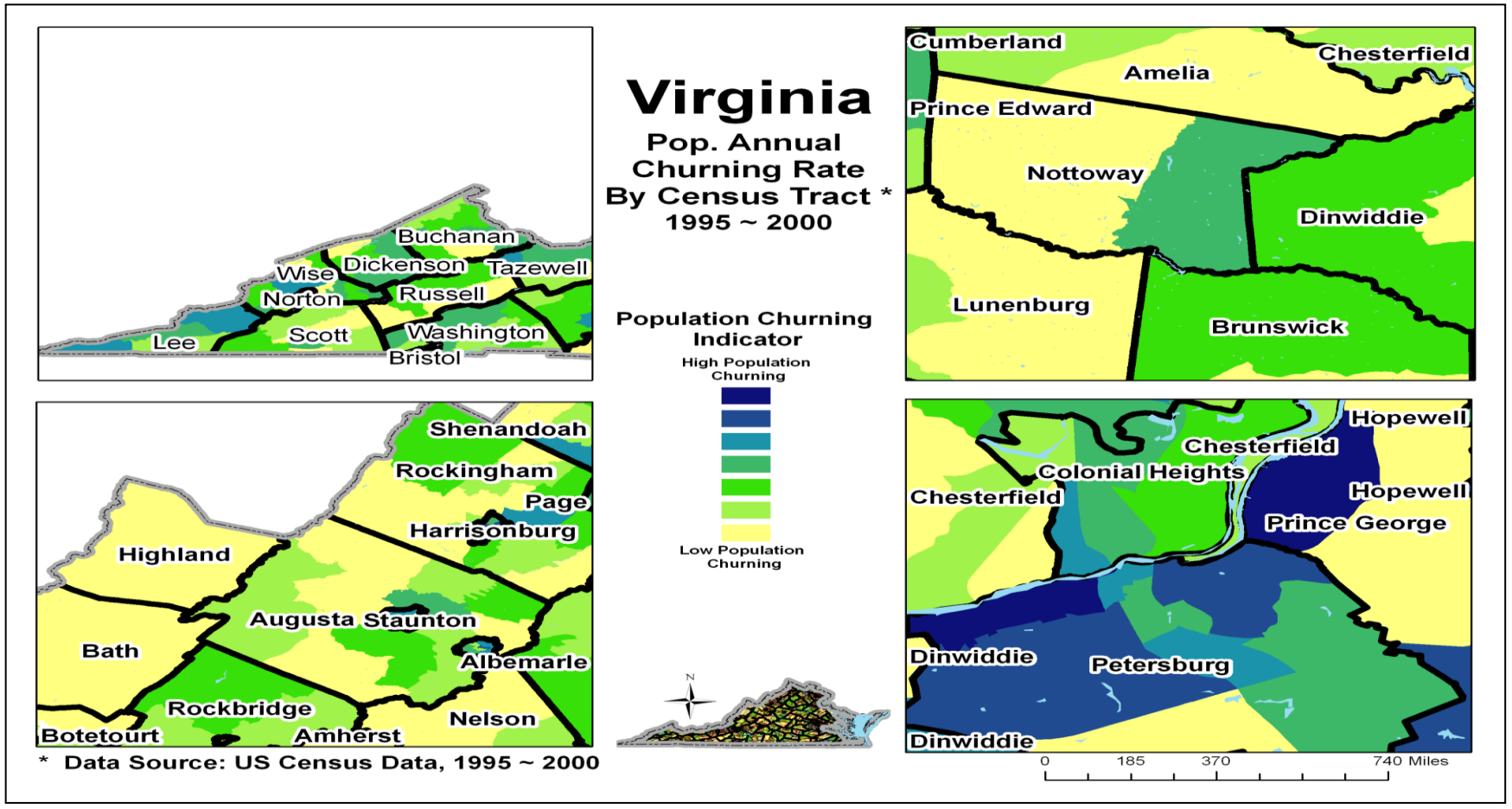
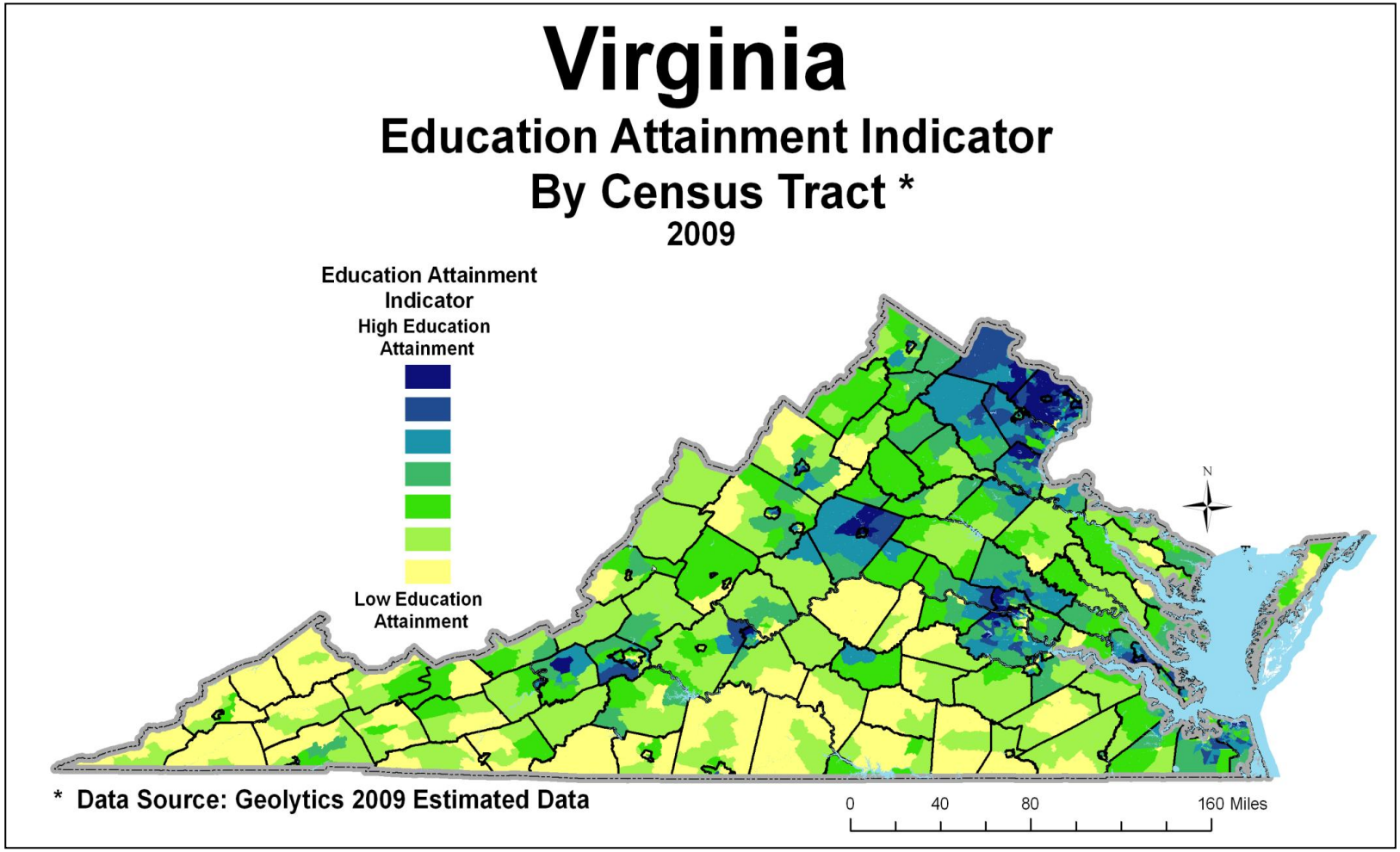


Indicator: Education Attainment

This indicator is composed of literacy rate (ability of read and write) and gross enrollment ratio (from kindergarten to postgraduate education).

These two sub-indices are weighted (Attainment is weighted 2/3 while Enrollment is weighted 1/3) and sum together to get a composite education indicator.

This indicator is scale-less and therefore darker areas indicate perfect education attainment while the yellow areas indicate less education attainment.



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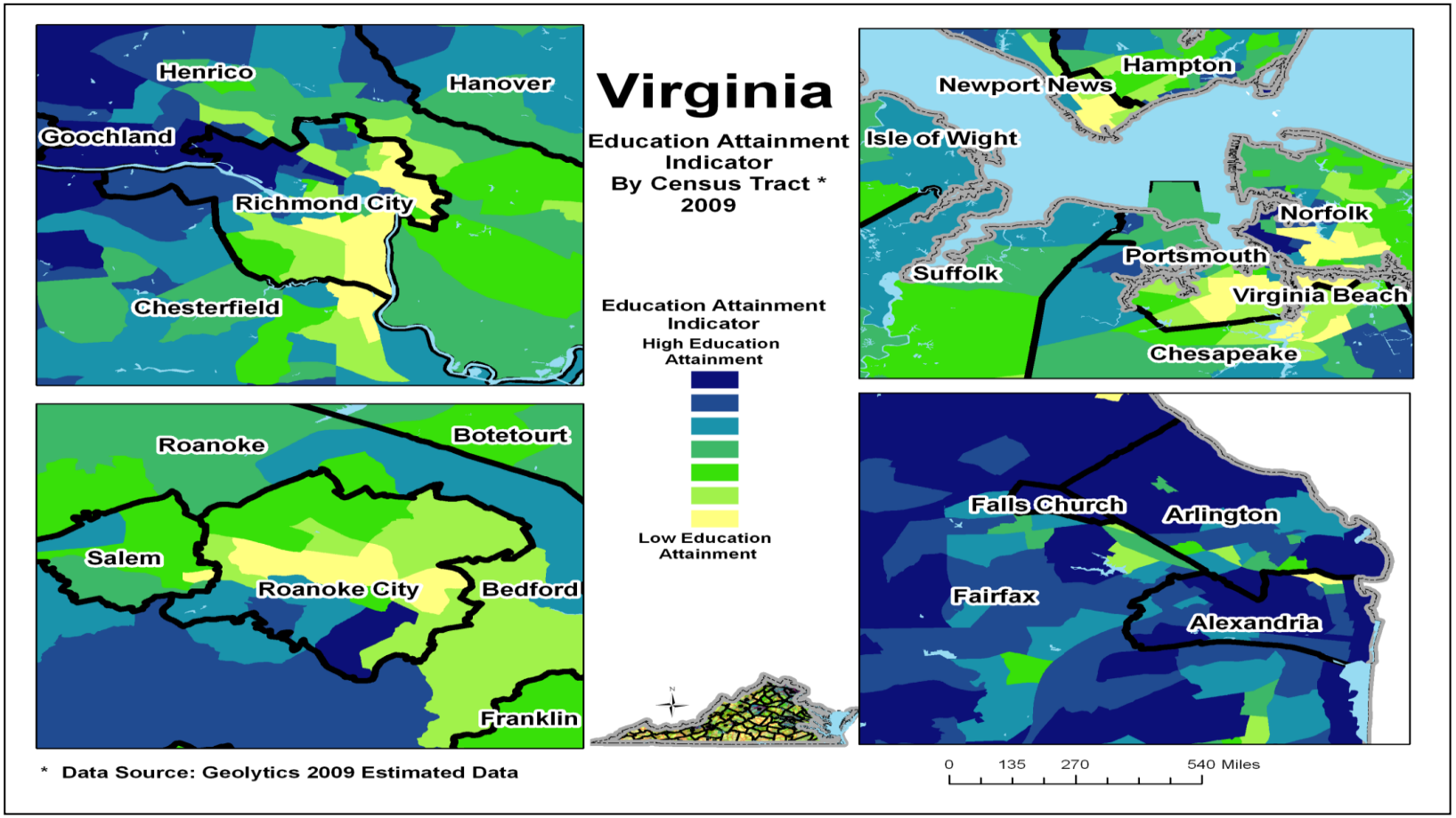

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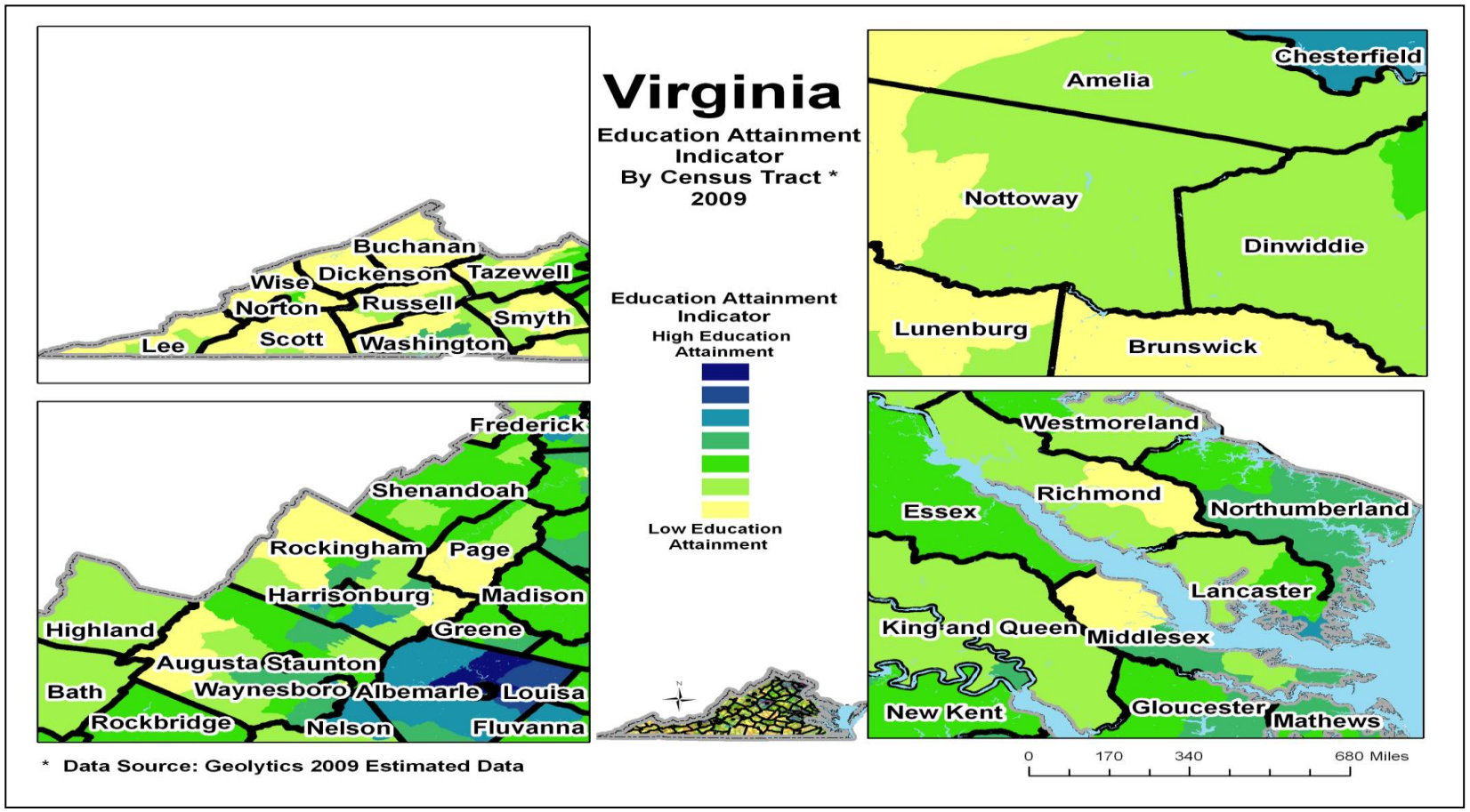
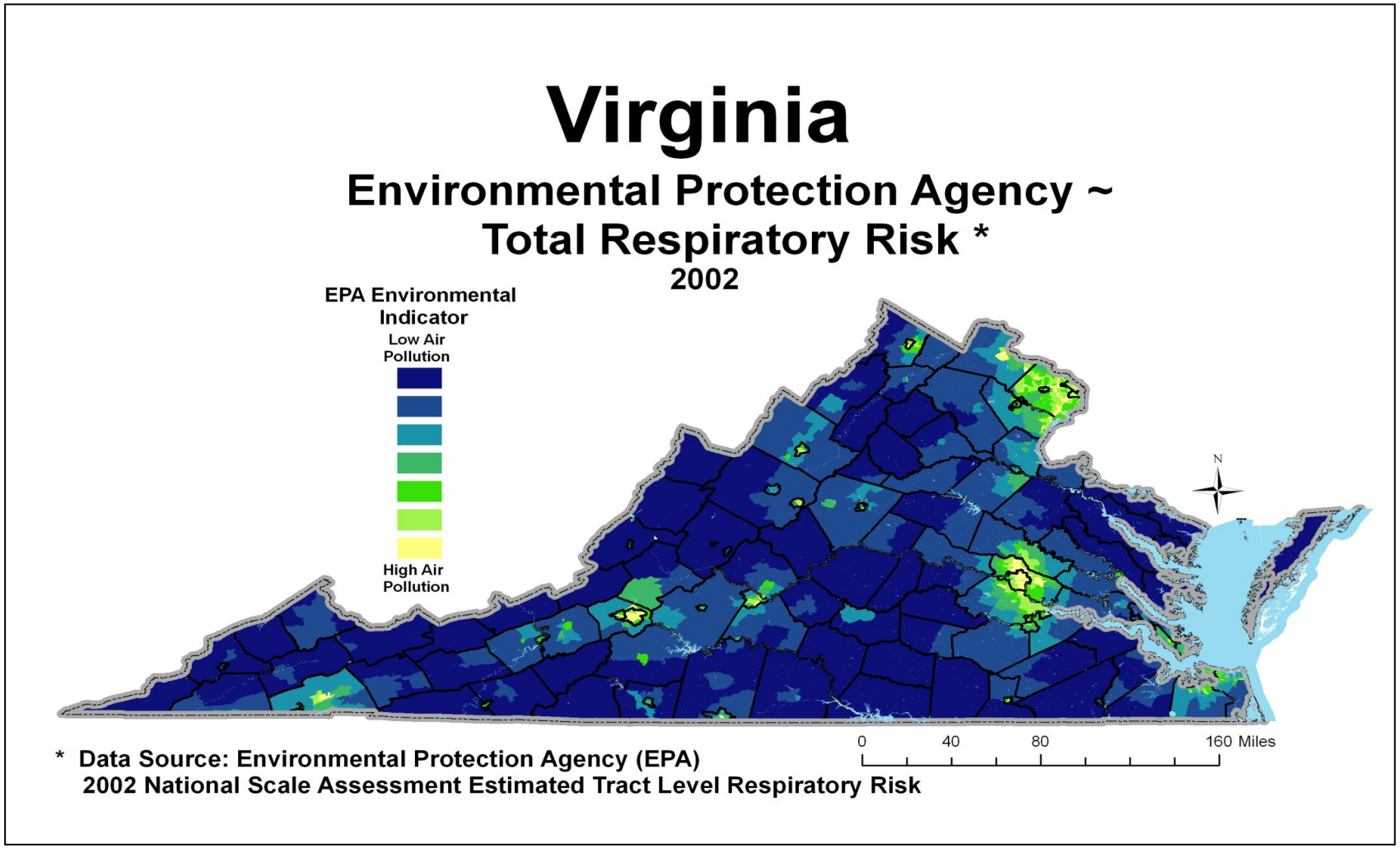


Indicator: Environmental Risks

The environmental indicator was computed using EPA NATA Environmental Data to evaluate the magnitude of air pollution by census tract. This Database contains, three risk variables, namely cancer risk, respiratory risk and neurological risk. All these variables were standardized to Z-Score and summed up to construct the hazard quotients of the air toxics compounds that affect the respiratory or nervous system.

The dark areas are least environmental polluted while the yellow areas are more environmental polluted area.



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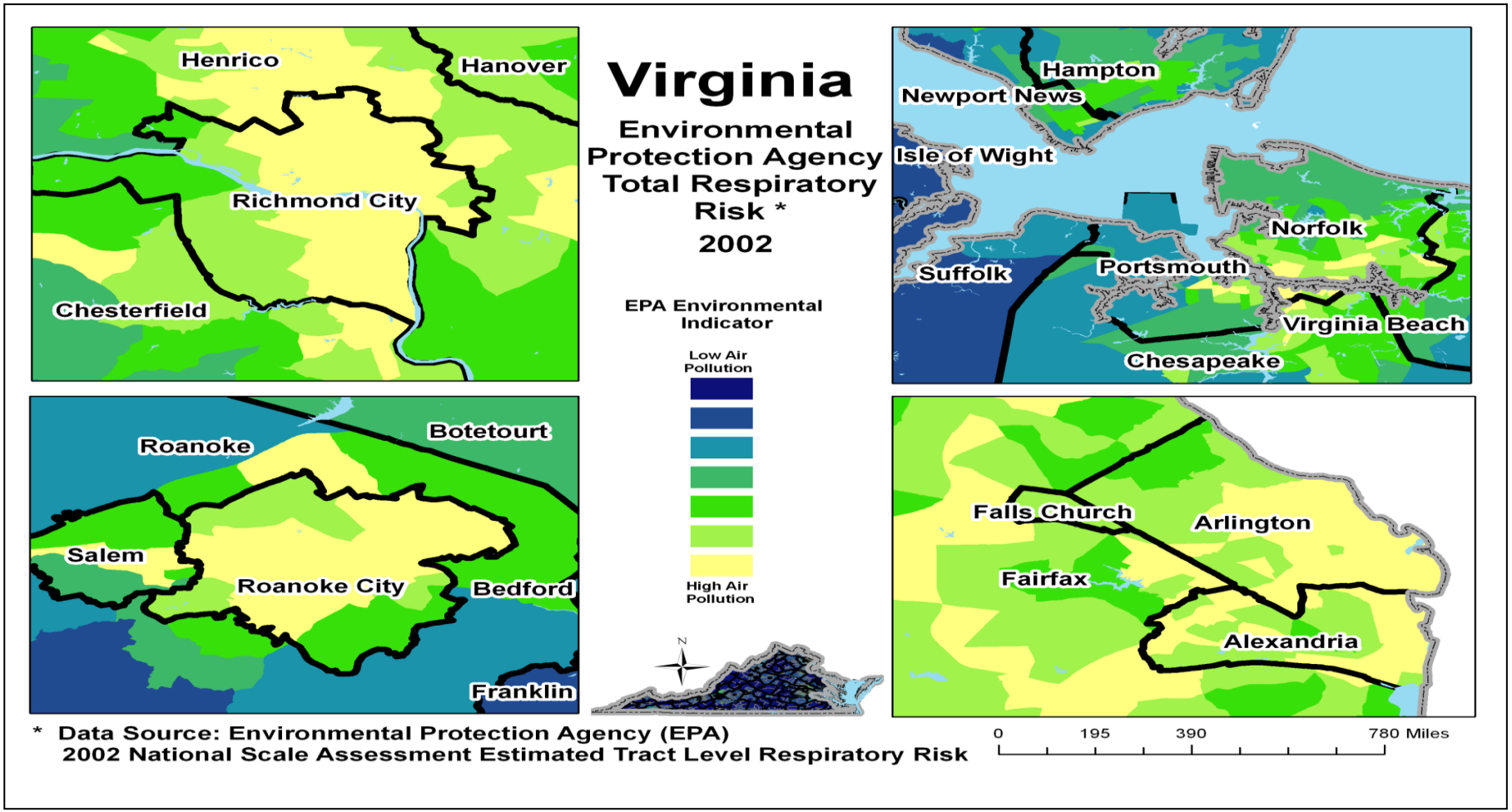

* Data Source: Environmental Protection Agency (EPA)
2002 National Scale Assessment Estimated Tract Level Respiratory Risk

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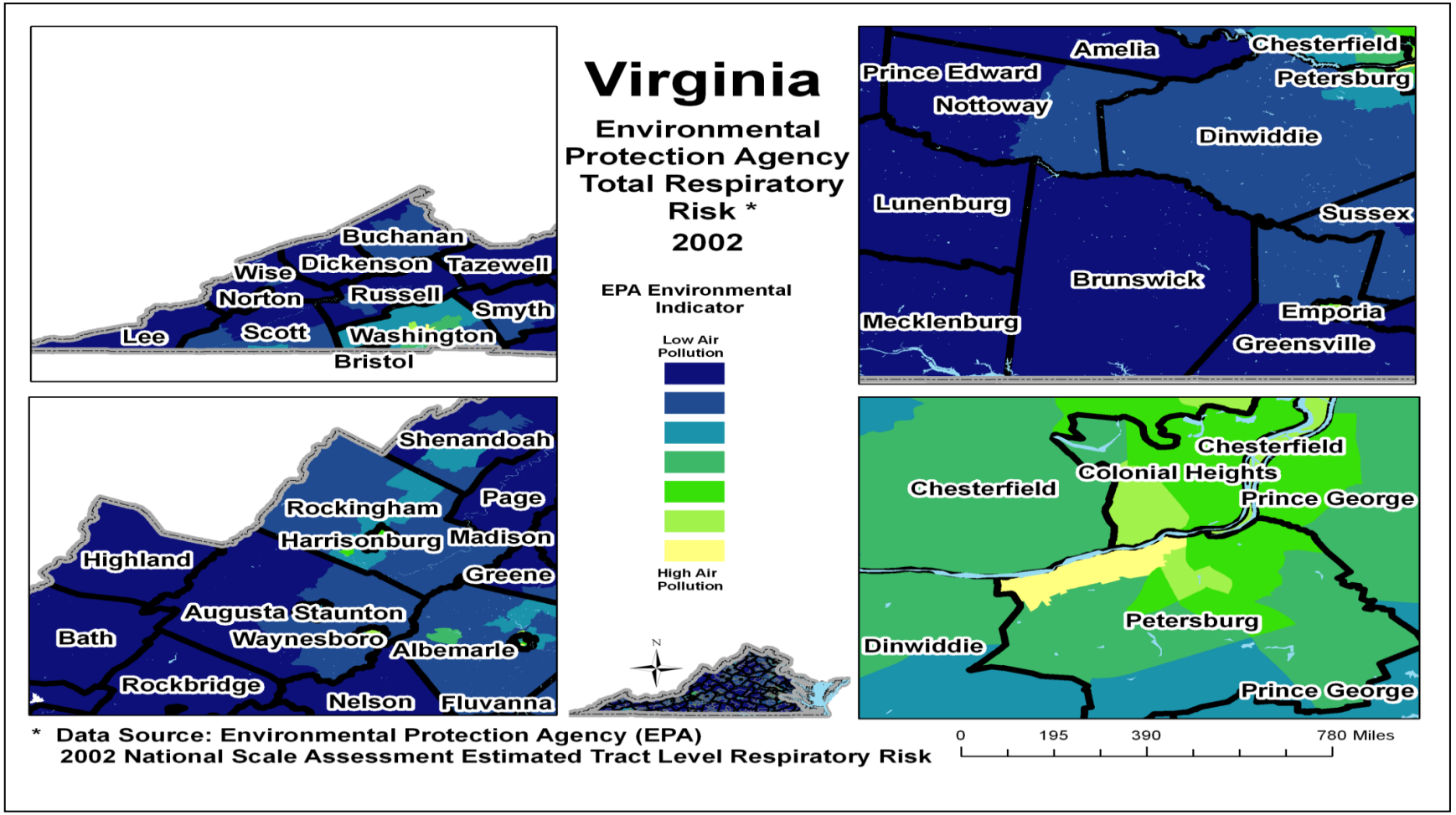
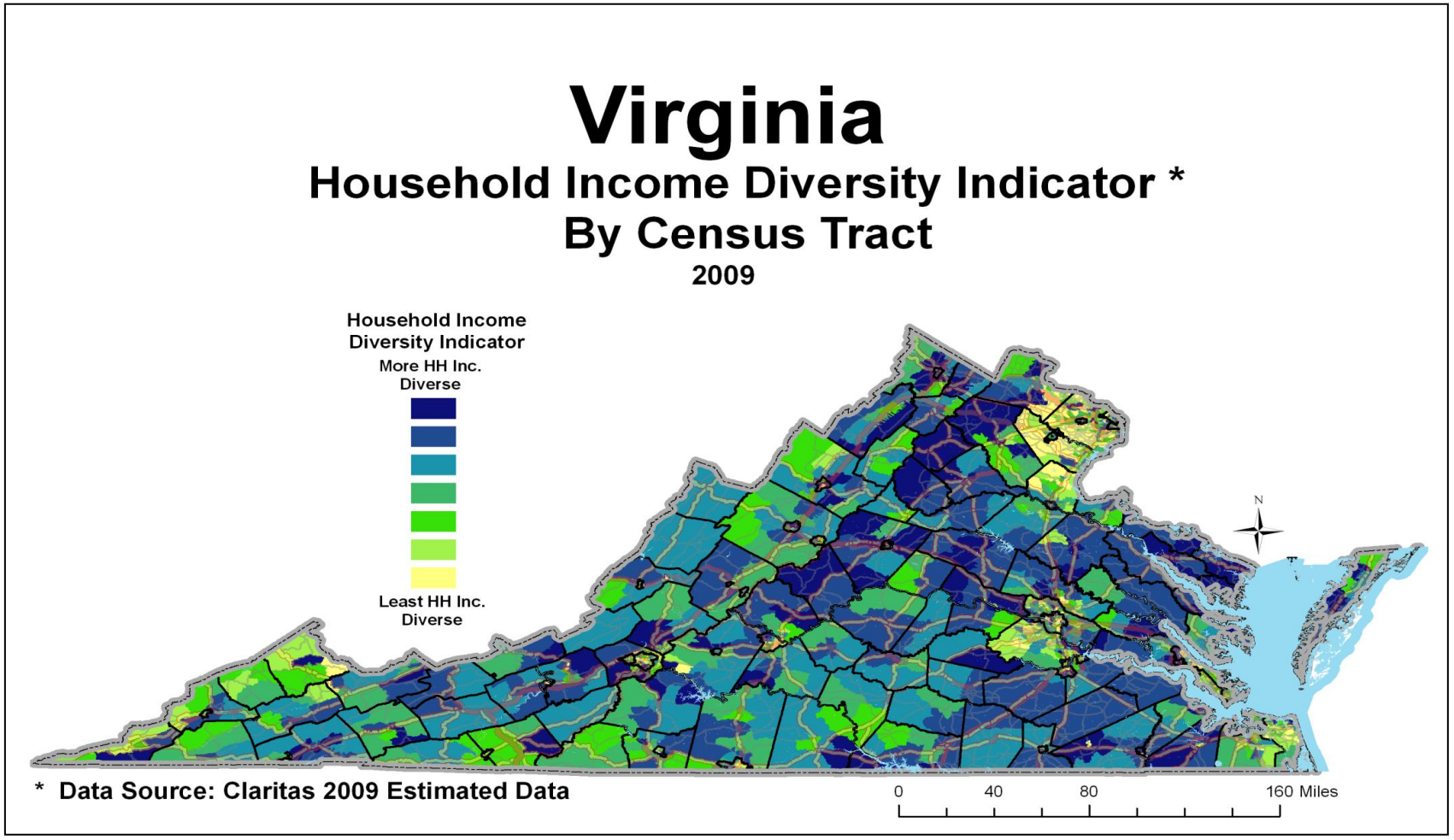


Indicator: Household Income Diversity

This aspect of diversity refers to a variance in household economic status within the same census tract. The indicator was measured by using all the 10 income ranges in census data comprising households with annual incomes of less than $15,000, $15,000 to $24,999, $25,000 to $34,999, $35,000 to $49,999, $50,000 to $74,999, $75,000 to $99,999, $100,000 to $149,999, $150,000 to $249,999, $250,000 to $499,999, and $500,000 or more. ***A yellow color indicates that the area is more homogeneous in terms of household income and vice versa. What this means is that, if you select two houses at random, the probability (chance) that both houses will belong to different income levels is less***



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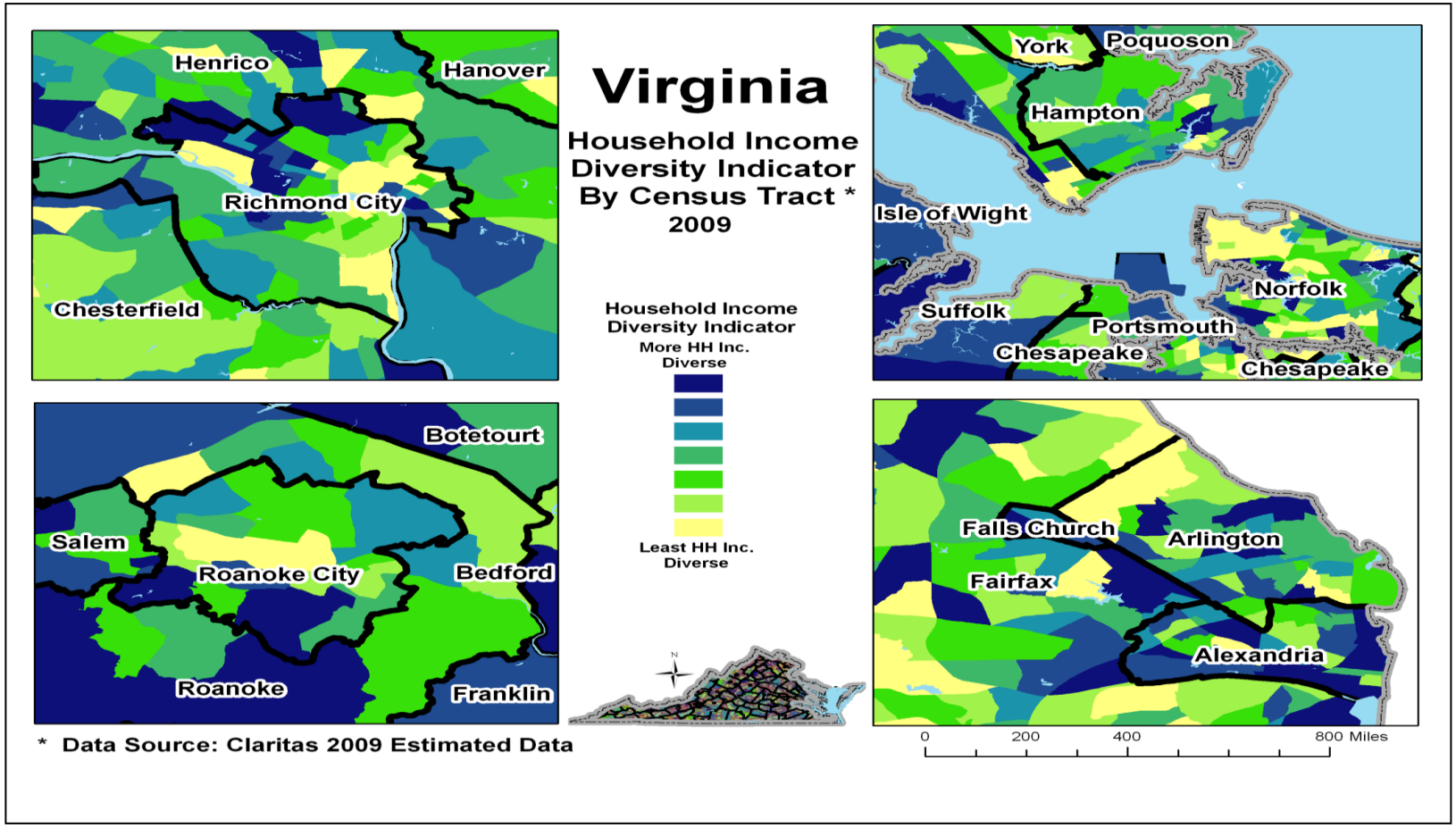

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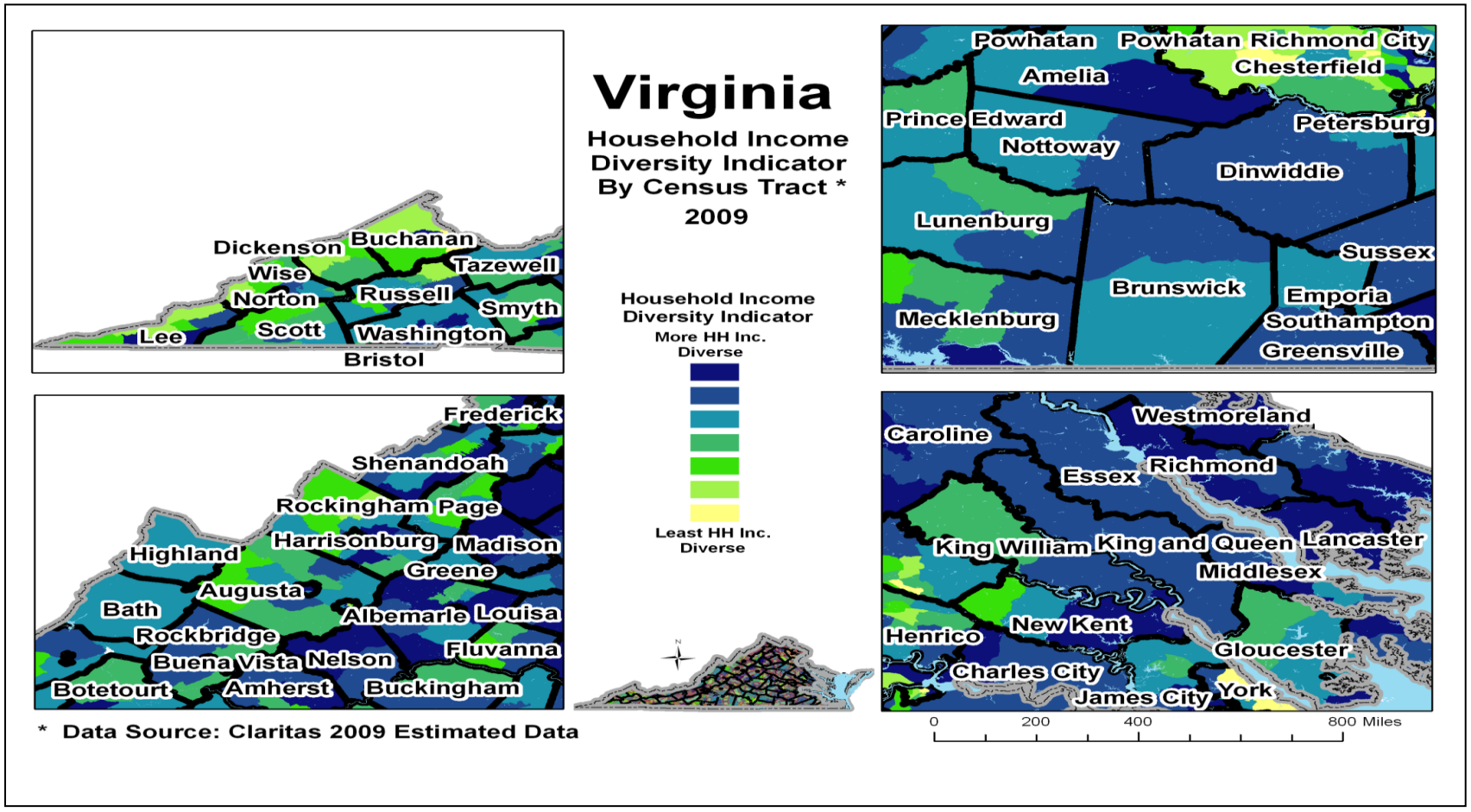
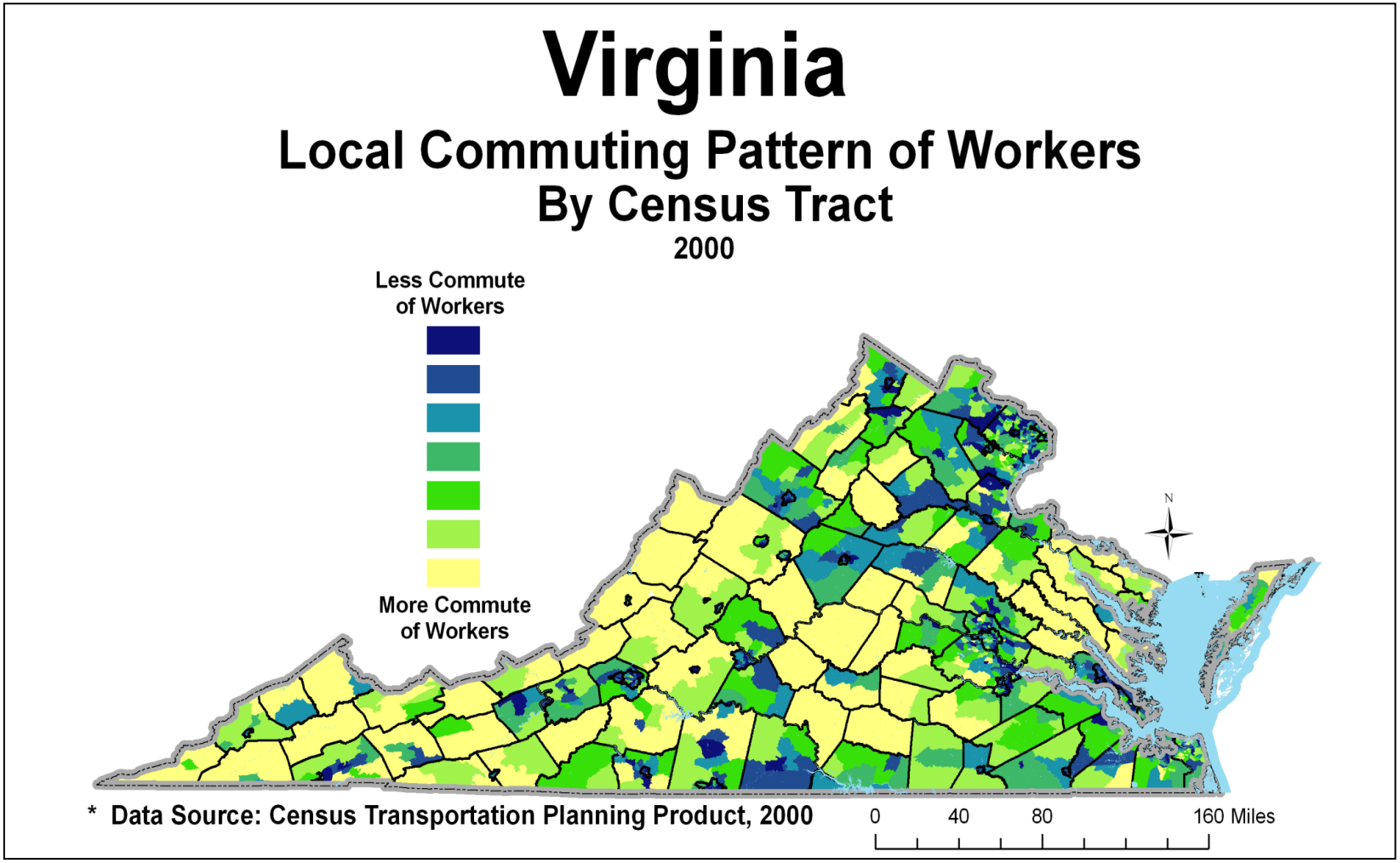


Indicator: Local Commuting Patterns of Workers

Commuting pattern based on Census Transportation Planning Package (CTPP) data can be used to indicate in flow and outflow of workers of an area. This is the ratio of inflow plus outflow divided by total resident work force in the area in question. This is an indicator of the mismatch between the labor force and employment opportunity inside an area and outside an area. This mismatch between labor force and employment can increase commuting cost for individuals.

The darker areas indicator the more job rich the area and therefore less commute while the yellow areas indicate majority of persons in these areas commute to work in other census tracts.



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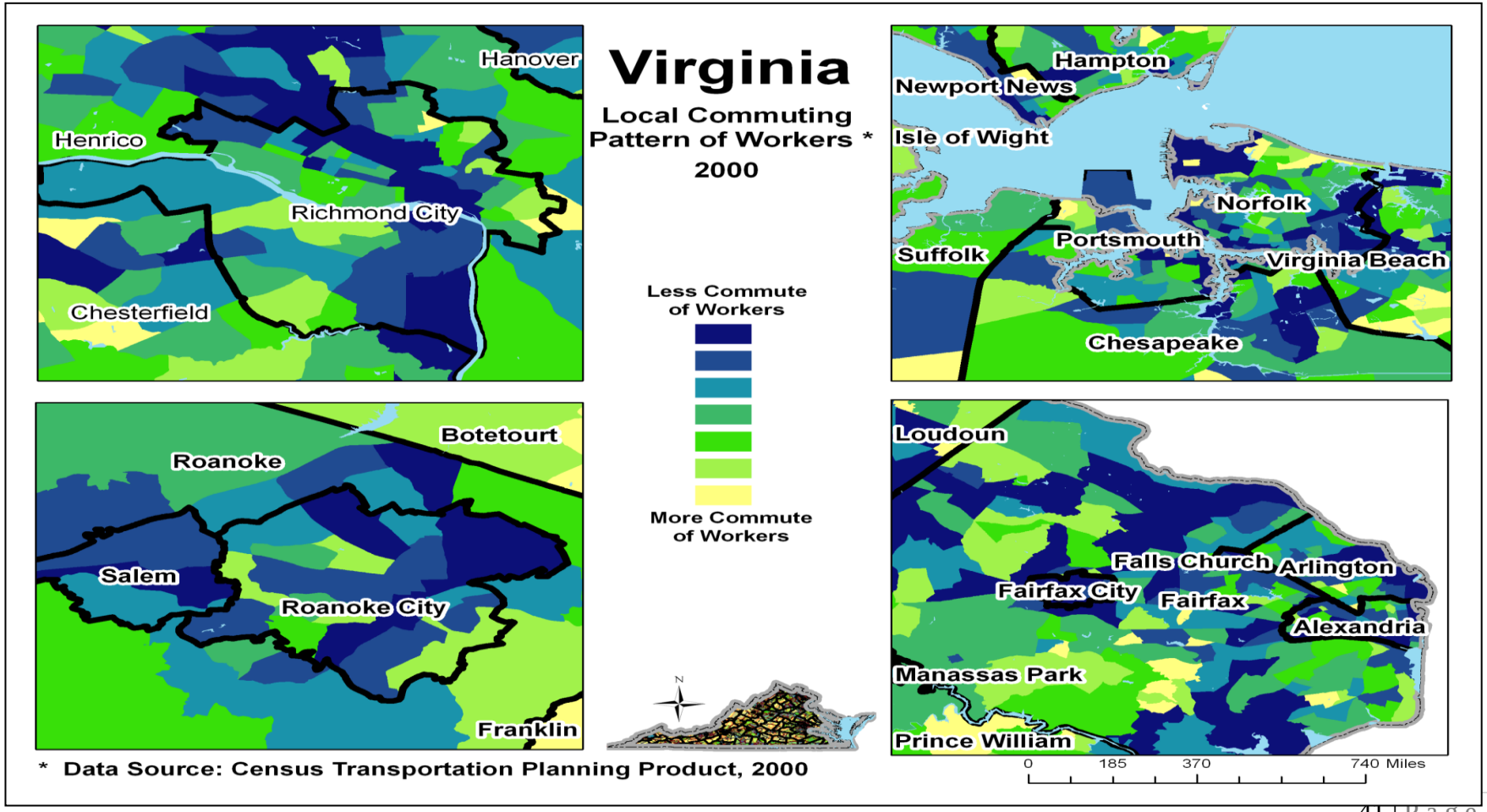

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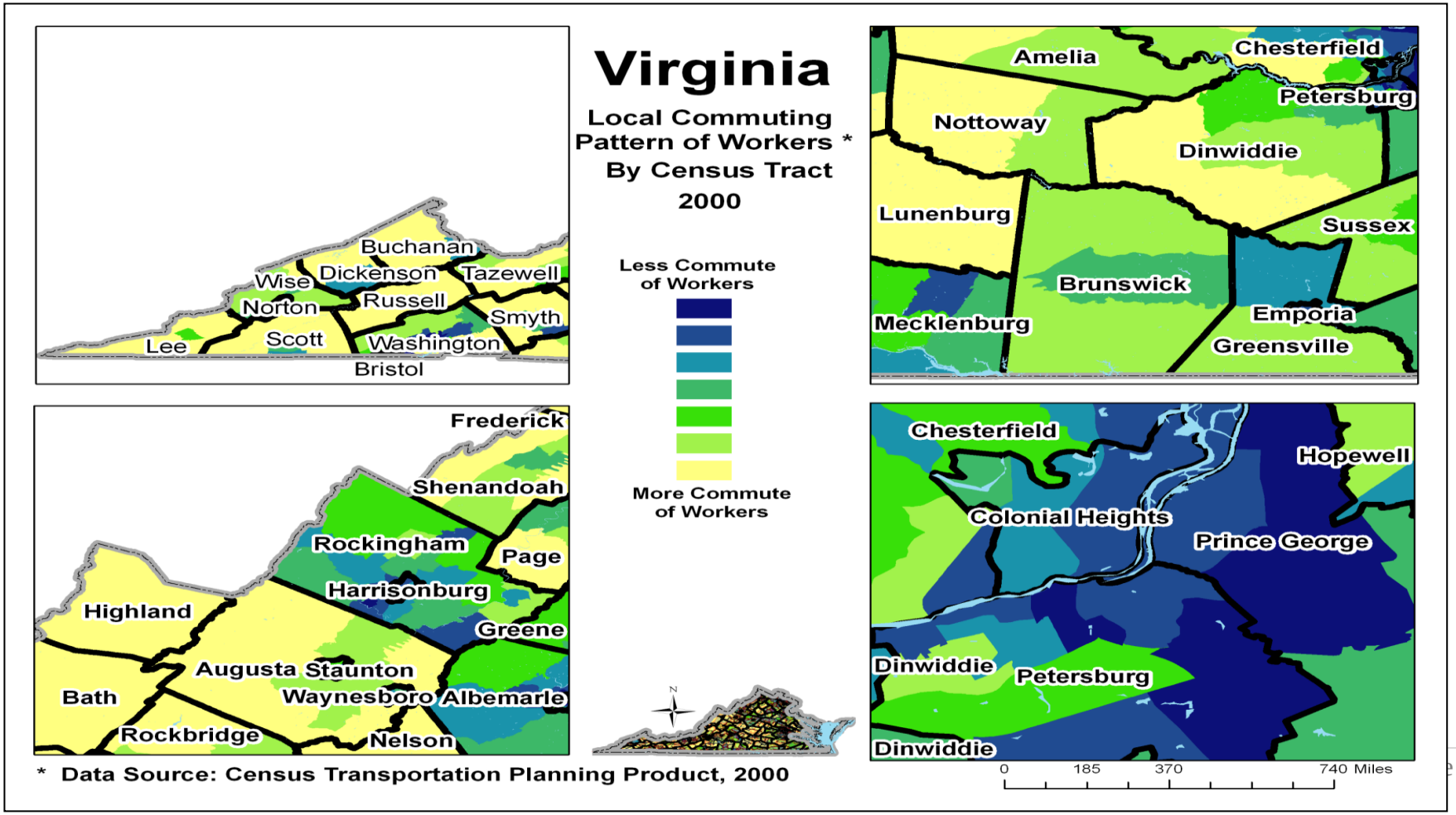
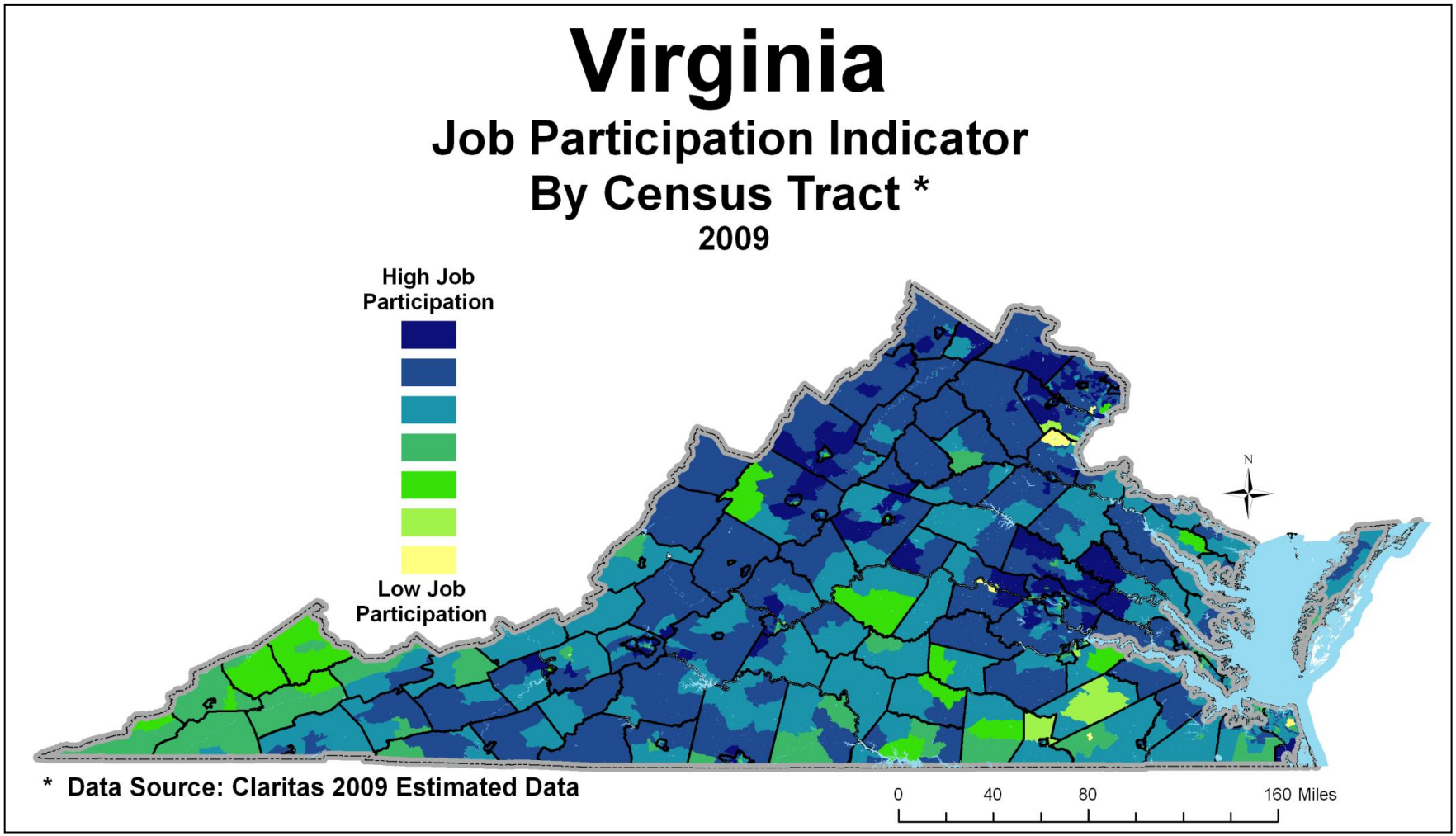


Indicator: Job Participation

Job participation rates measure the percent of population over 16 years of age to 64 who are either employed or unemployed and seeking work. Because job participation rates are sensitive to a number of local community attributes, e.g., educational attainment, disability, household composition, car ownership, the measure can provide a sensitive indicator to the unique employment profile of a community. Job participation rate is often used by economists as an indicator for economic development and growth.

The darker area means that, there is high percentage of active labor force of the area.



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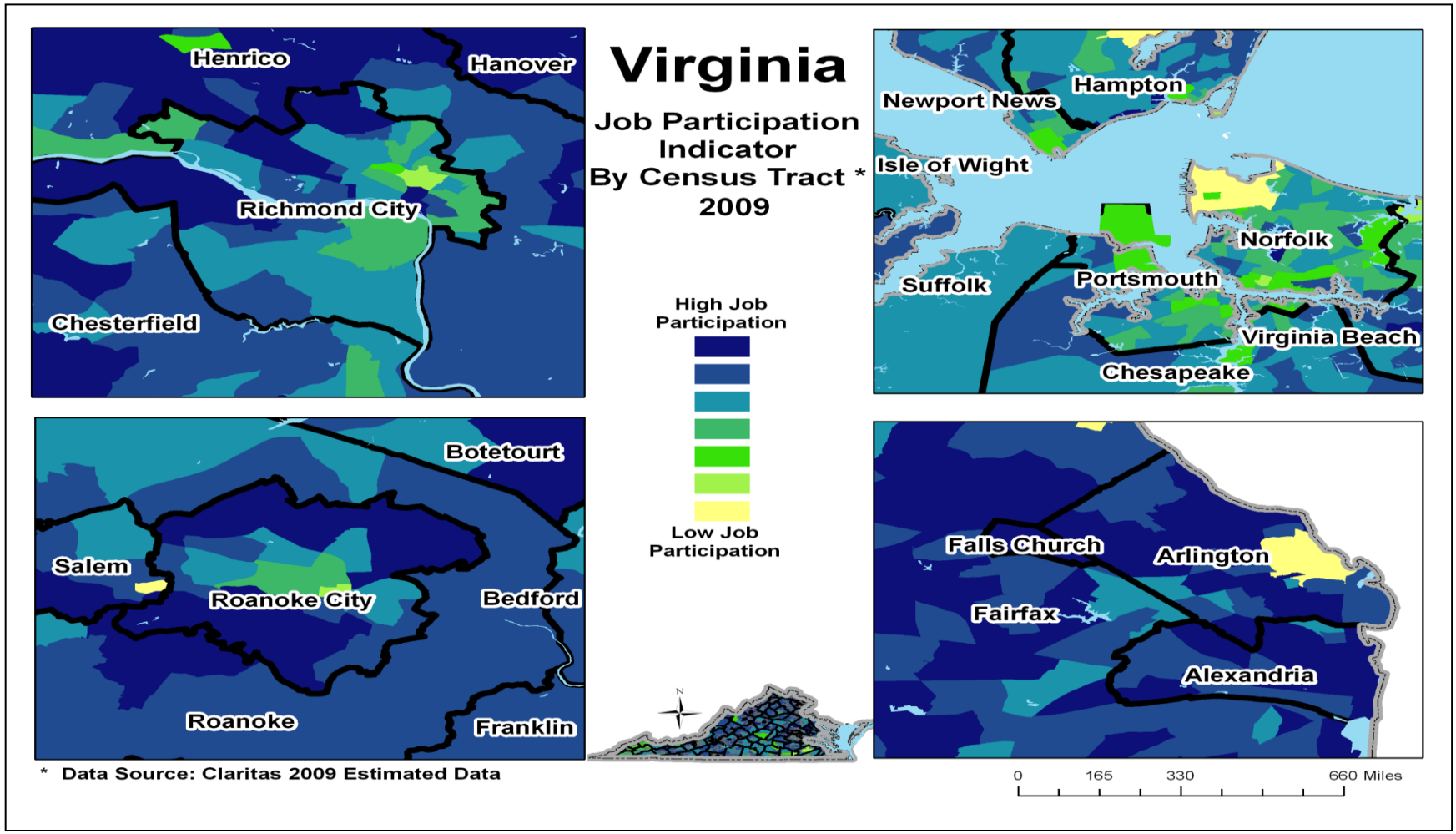

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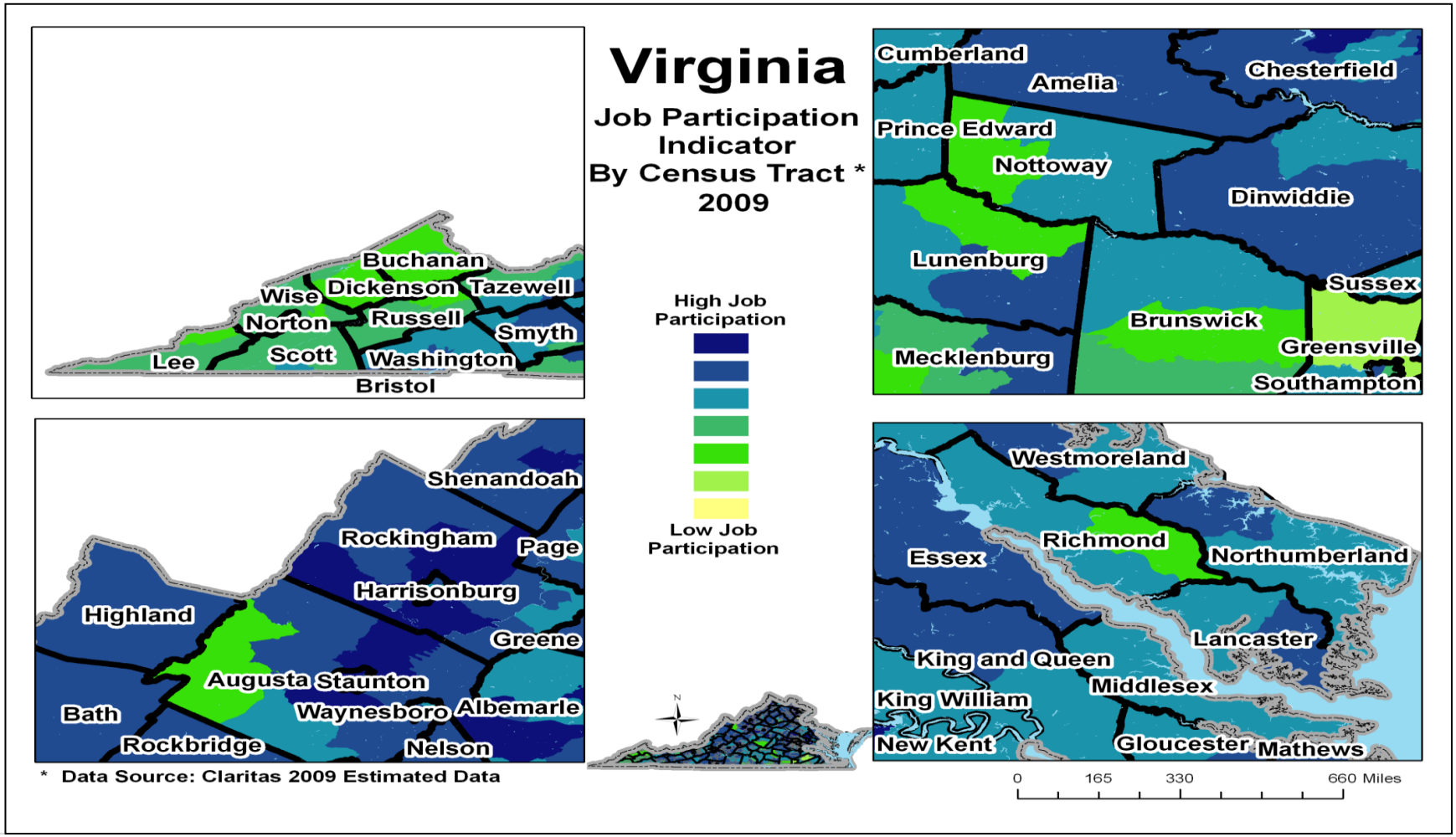
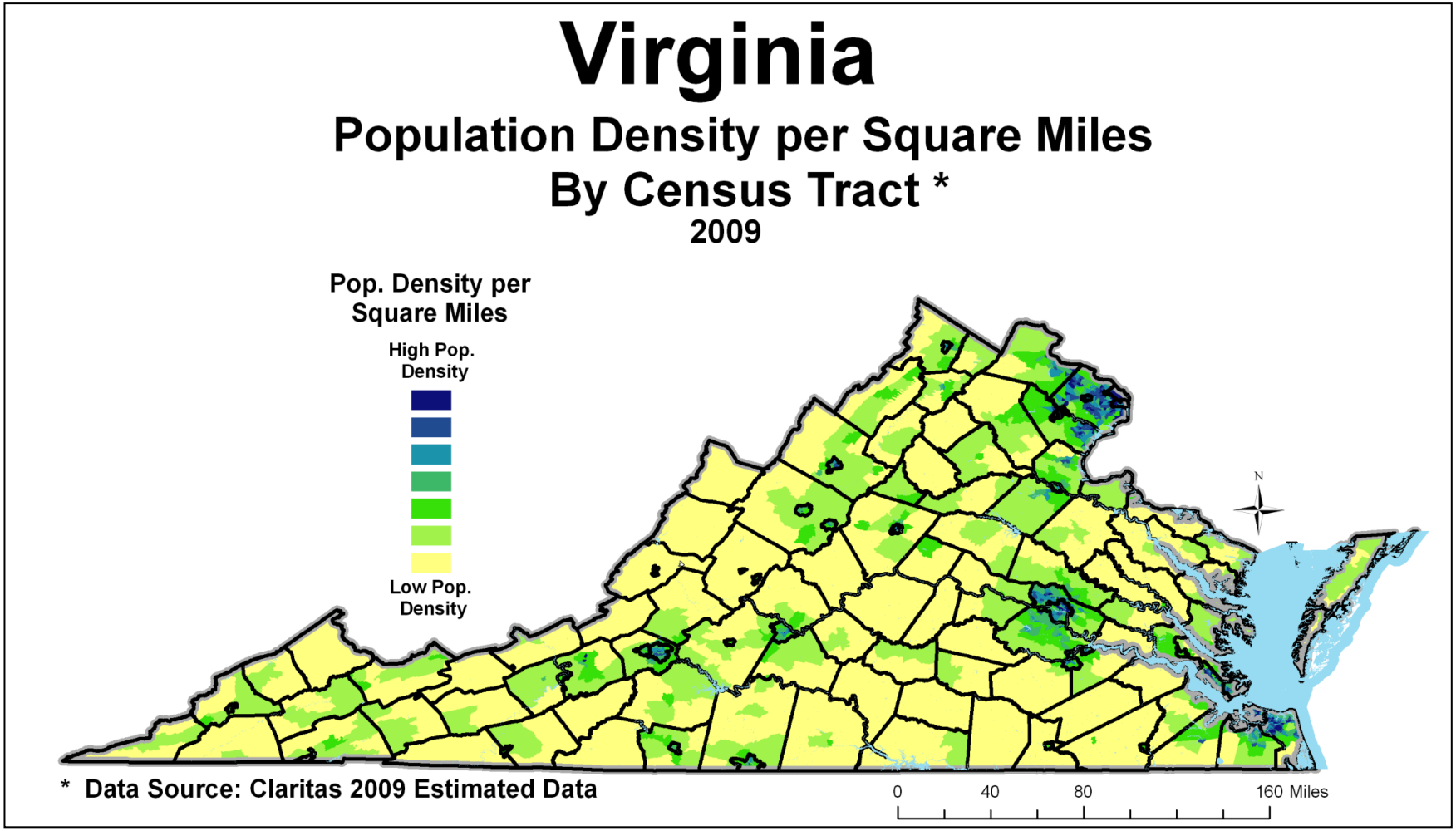


Indicator: Population Density

This indicator is calculated by dividing the total population by the square miles in the area under study. ***The darker areas indicate high population concentration per square miles, while the yellow areas indicate low population concentration.***



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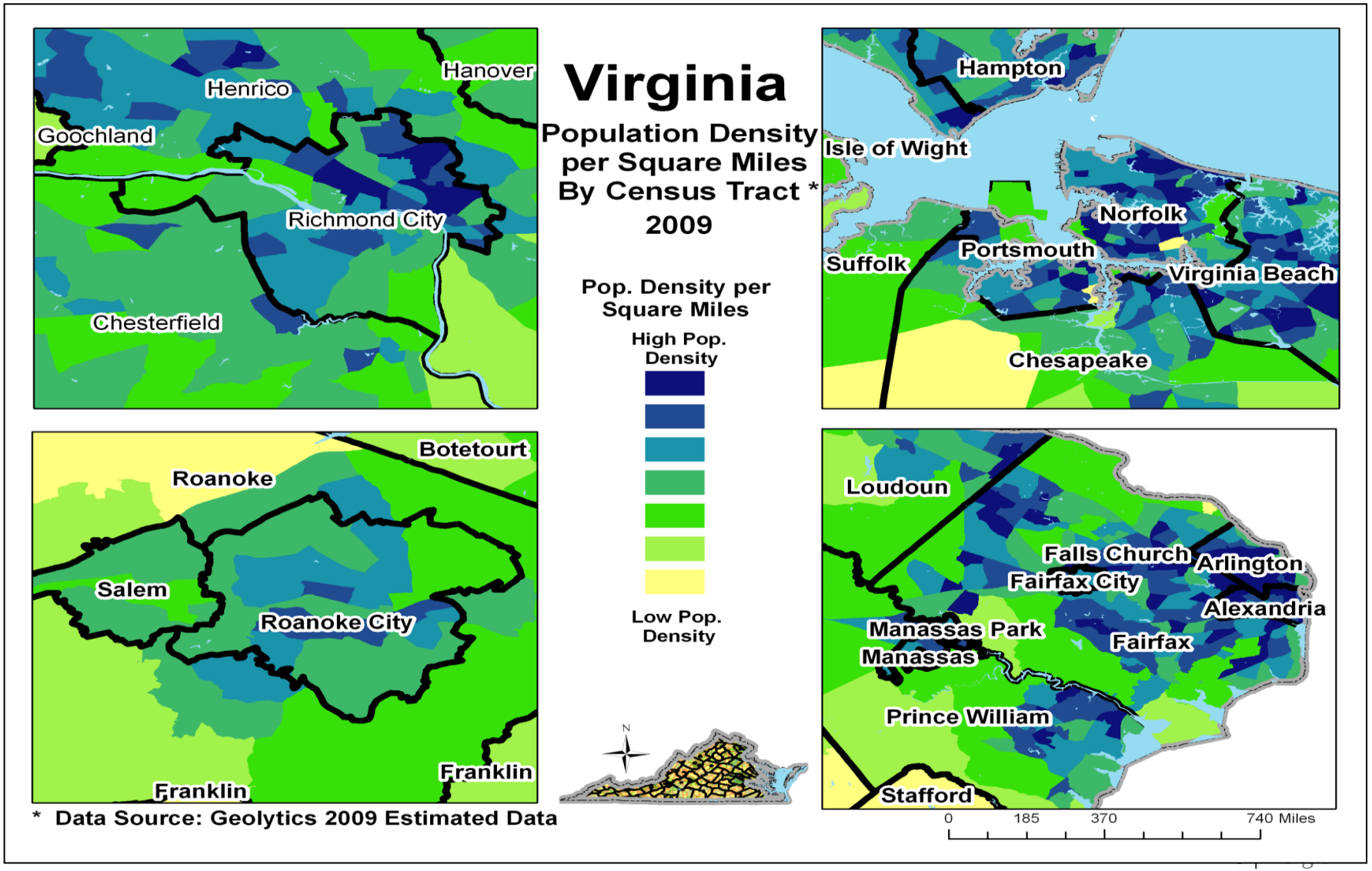

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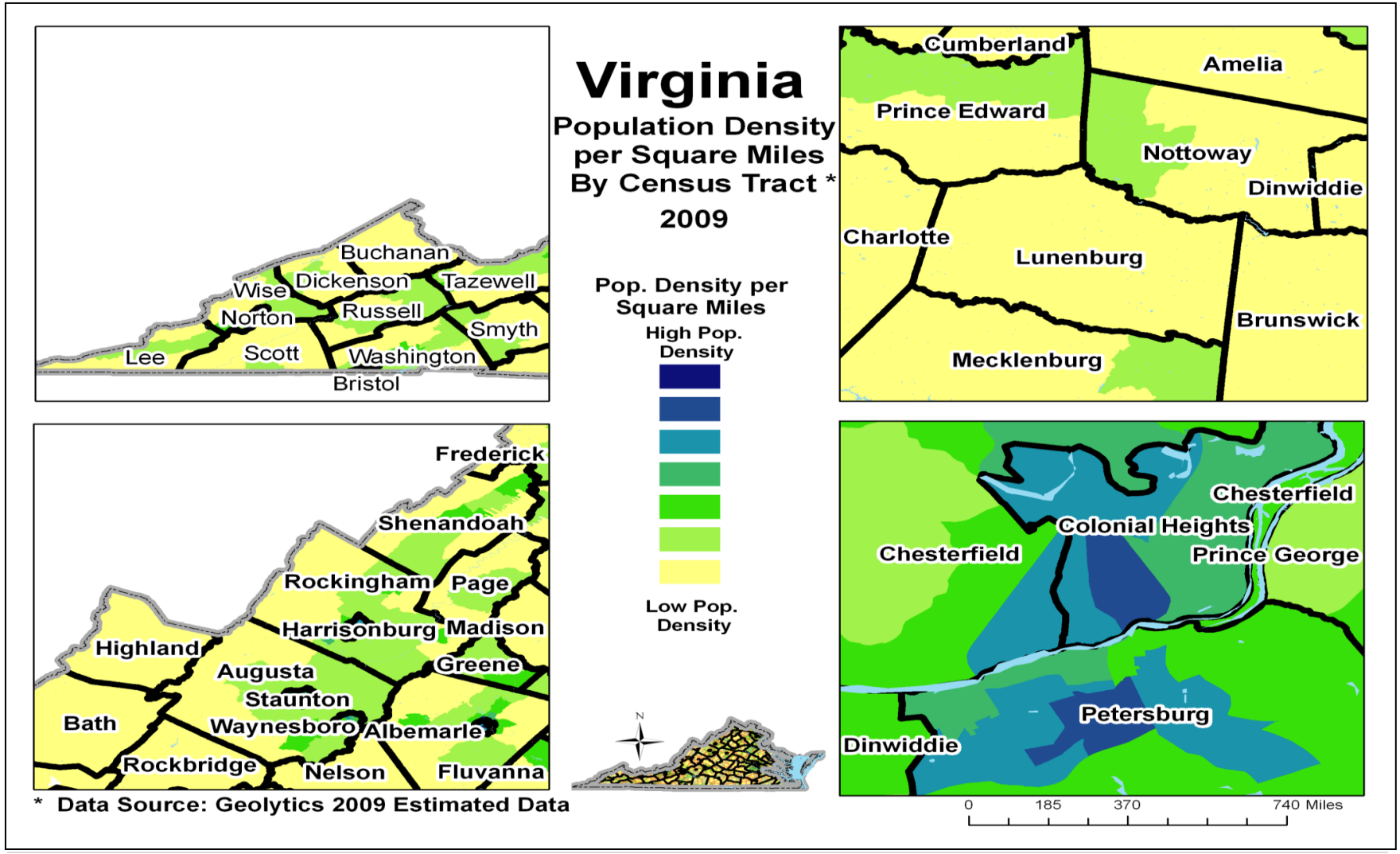

Indicator: Racial Diversity

The Diversity Indicator identifies the probability that two persons, chosen at random from the street will belong to different race or ethnic groups. The calculation of this index accommodates up to seven race groups: six single-race groups (White, Black, American Indian, Asian, Pacific Islander, Some Other Race) and one multiple-race group (two or more races). The Diversity Indicator is bounded and ranges from 0 to 1. Zero indicates no diversity (homogeneous population) while 1 signifies that there is complete diversity (heterogeneous population). ***If an area's entire population belongs to one race group, then an area has zero diversity. An area's diversity index increases to 1 when the population is evenly divided into two or more race/ethnic groups.***

This is probabilistic model and the yellow areas means that, if two persons are selected at random on the street, there is less probability that these persons will belong to different racial groups. Meanwhile, the darker areas indicate that there is high probability that, these two persons will belong to different racial groups.
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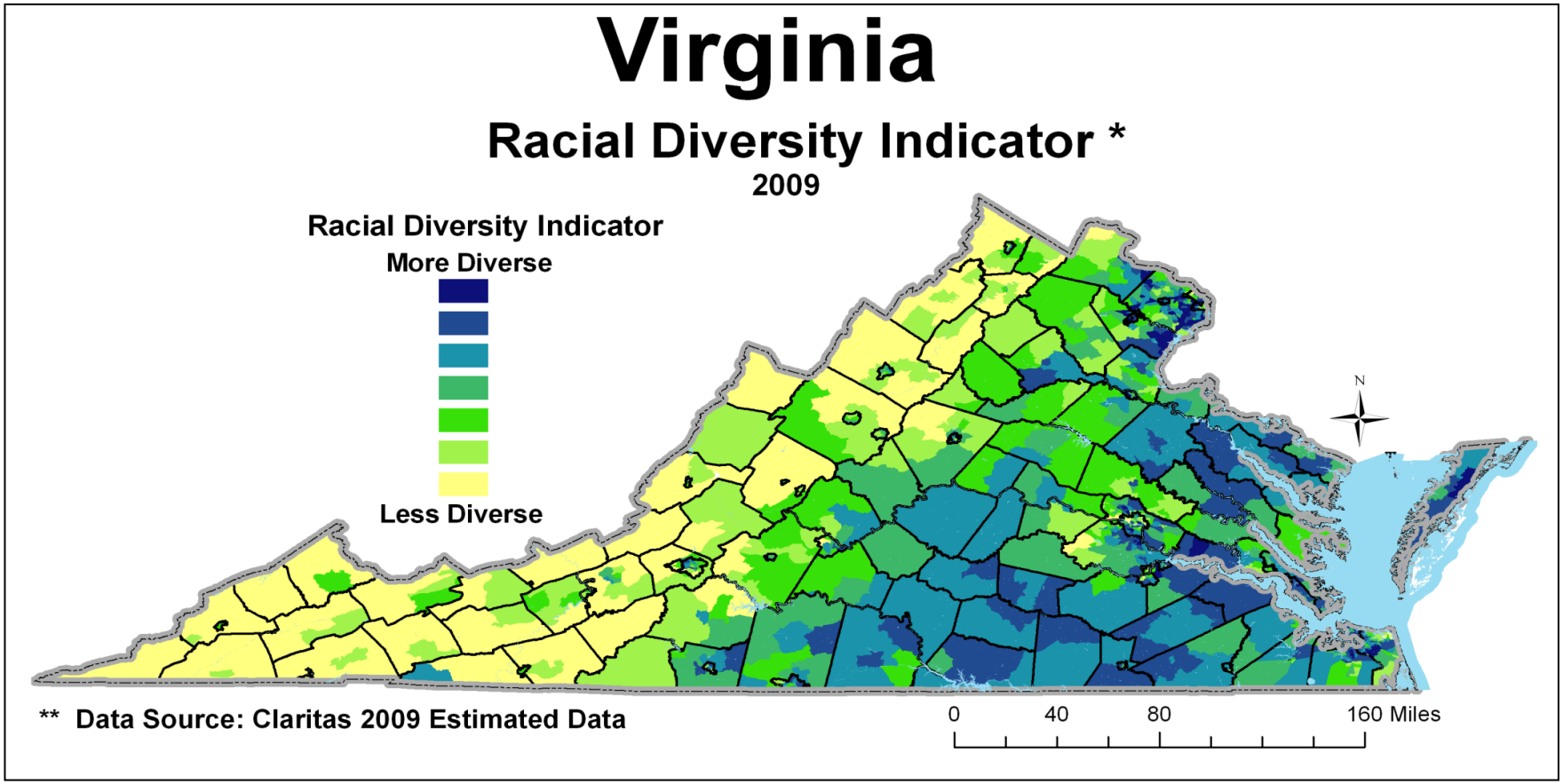

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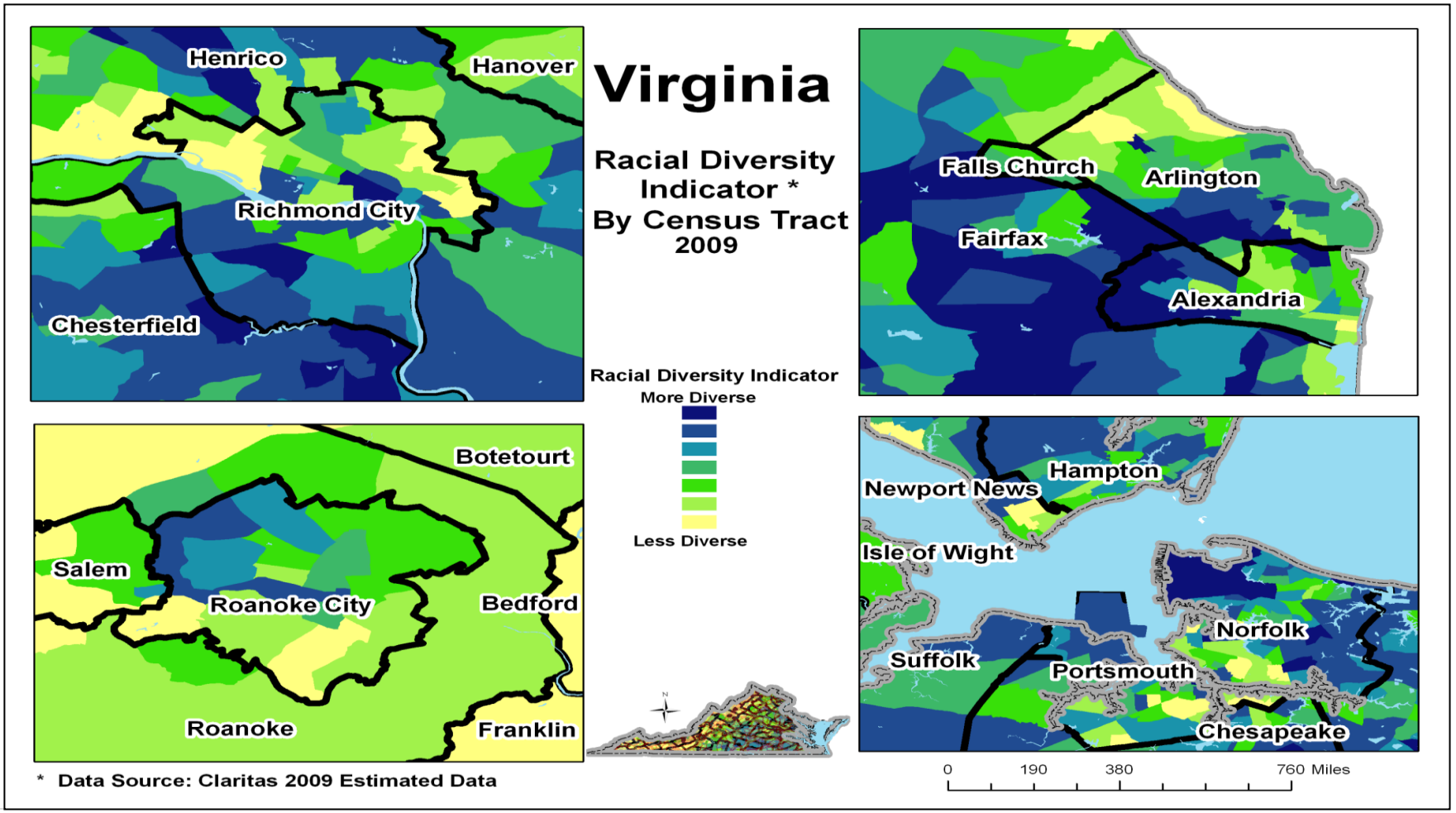

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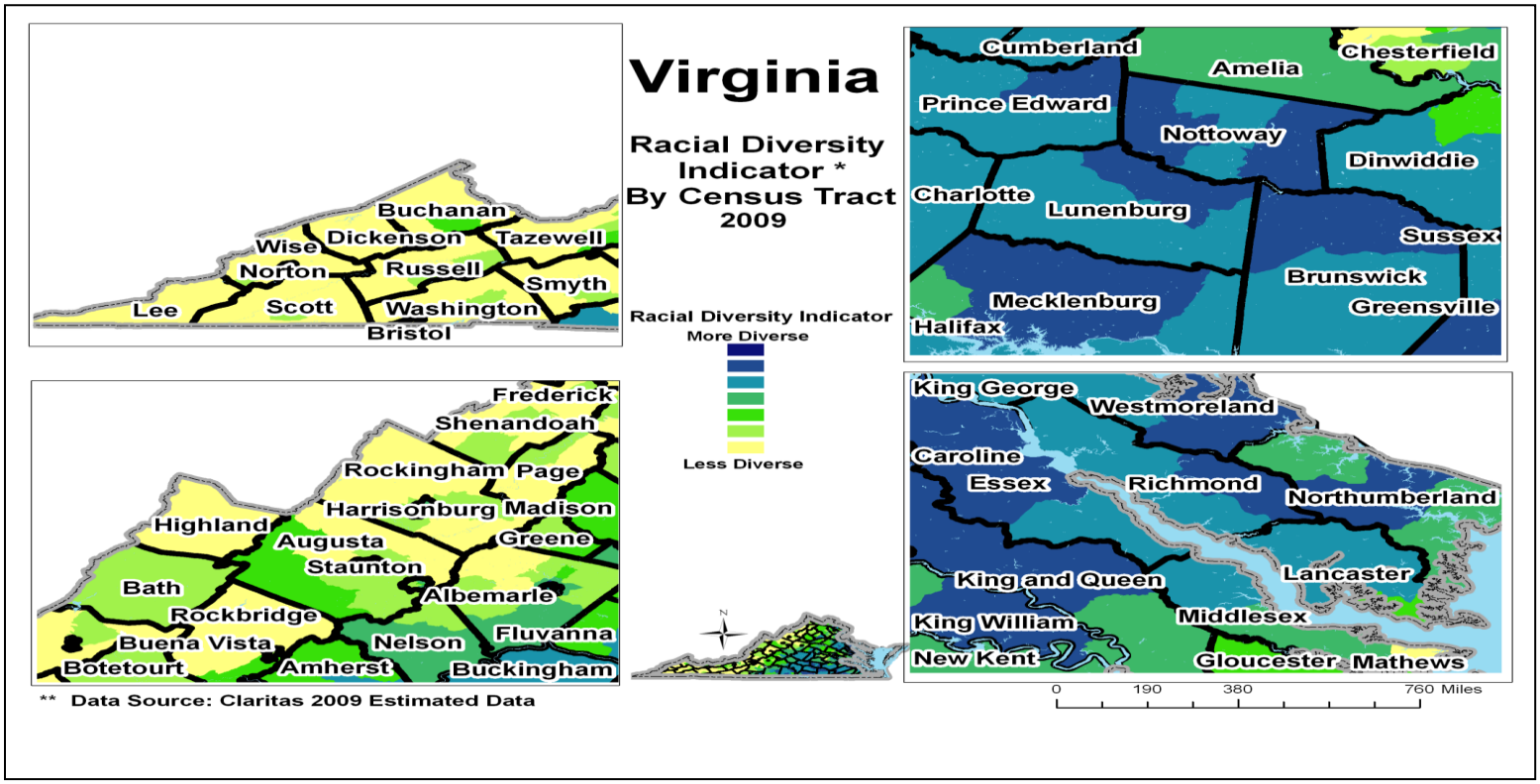

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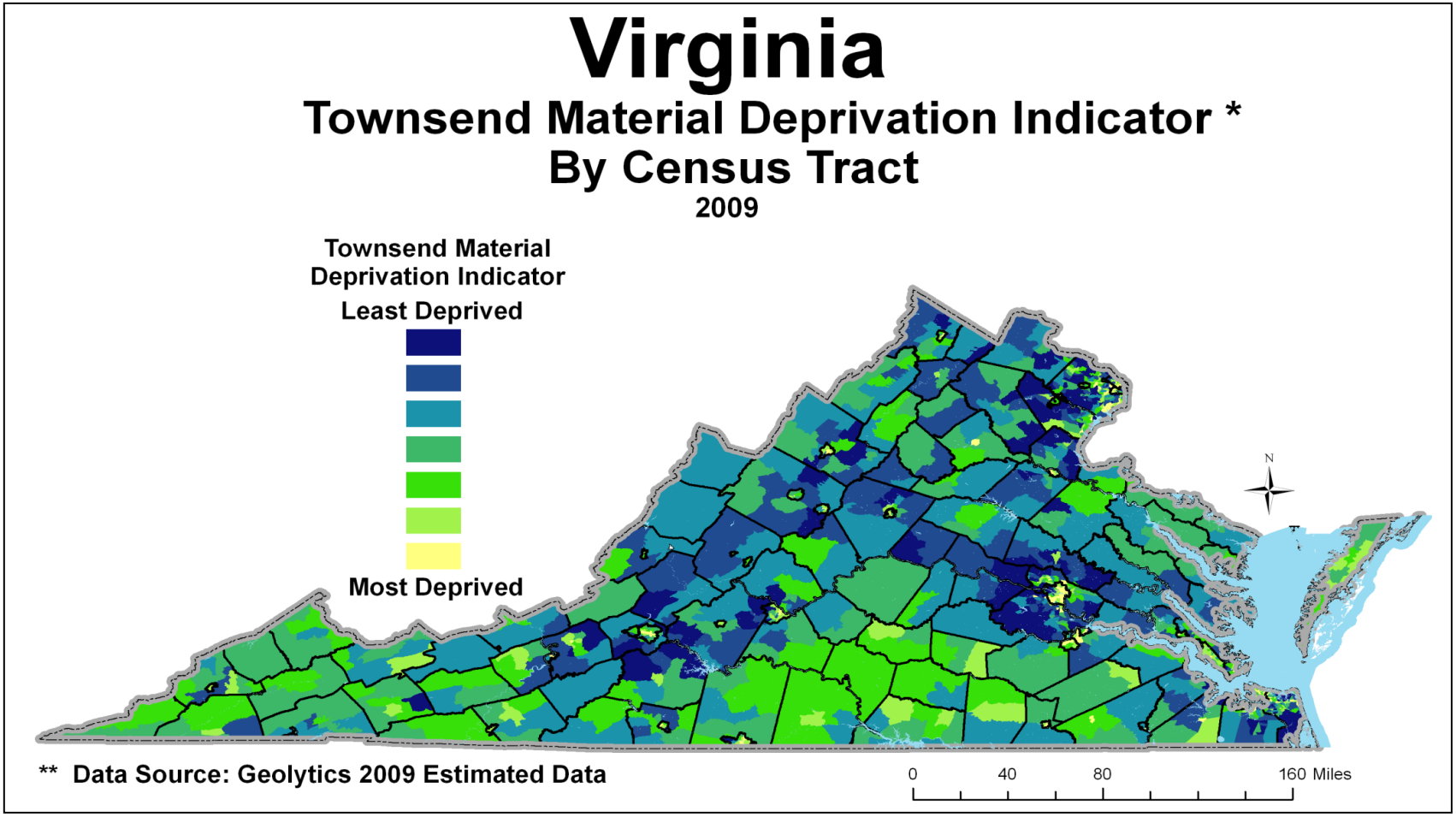
Indicator: Townsend Material Deprivation

Townsend deprivation index is a measure of material deprivation. The index uses four equally weighted variables to calculate the score. These four variables are: (1) percent of economically active residents aged 16-59/64 who are unemployed, (2) percent of private households who do not possess a car or van, (3) percent of private households not owner occupied and (4) percent of private households overcrowded (more than one person In calculating this index, first, percent unemployment and percent private household overcrowded are log transformed and after that, a Z score is calculated for the four variables and they are summed up to get composite index for deprivation. ***The higher the Townsend Index score, the more deprived and disadvantaged an area is thought to be***.

The Dark areas are least deprived while the yellow areas are more deprived



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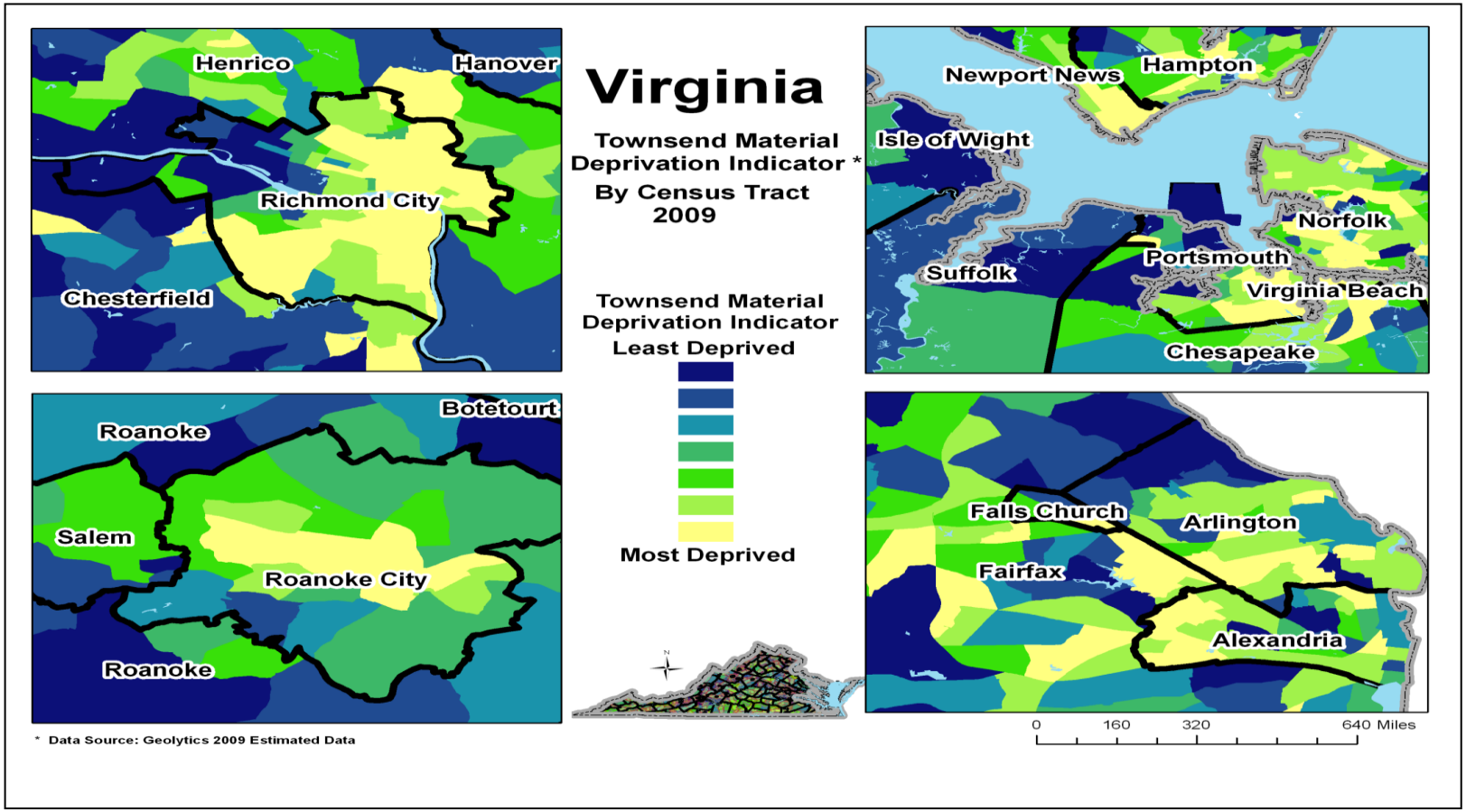

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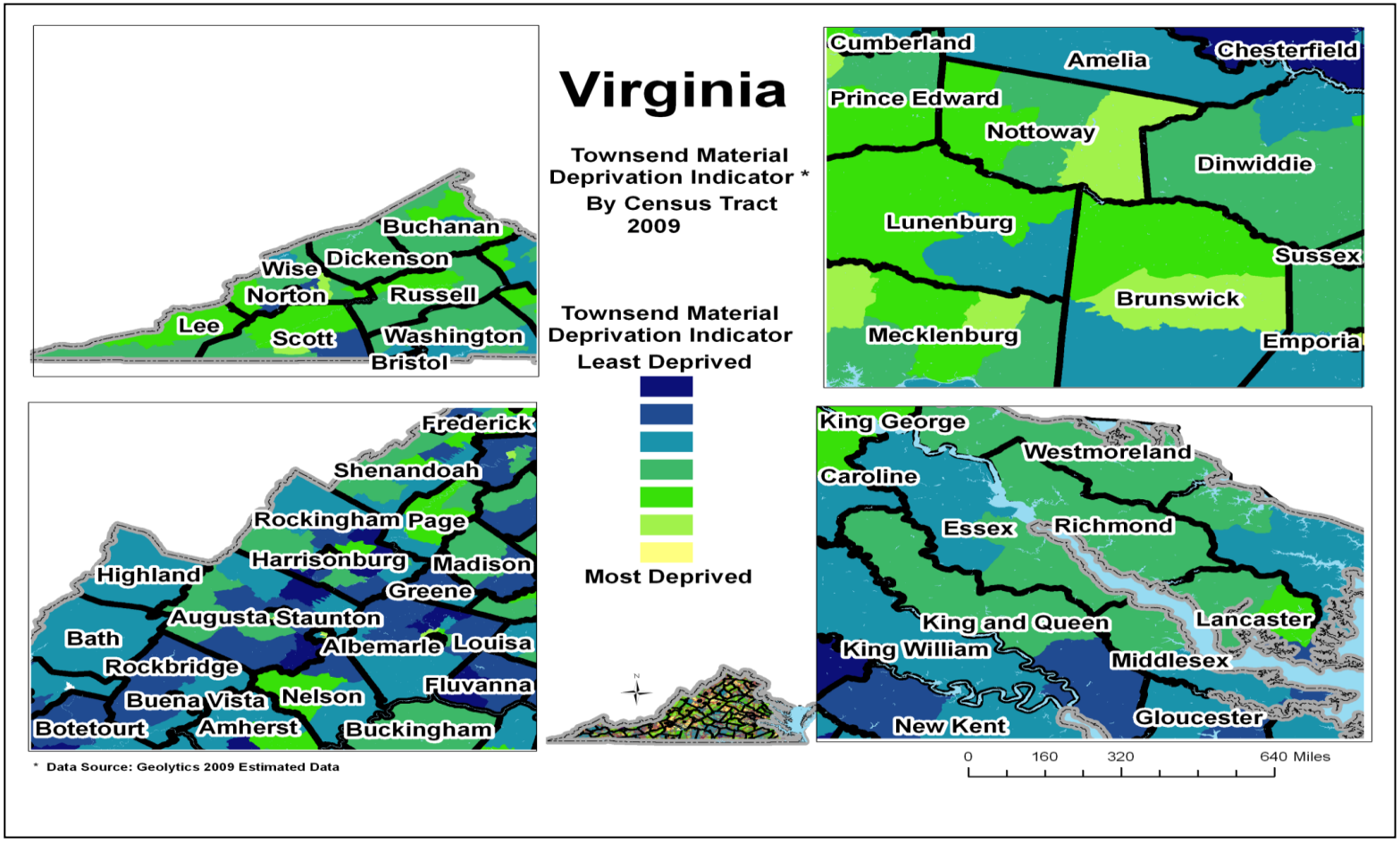
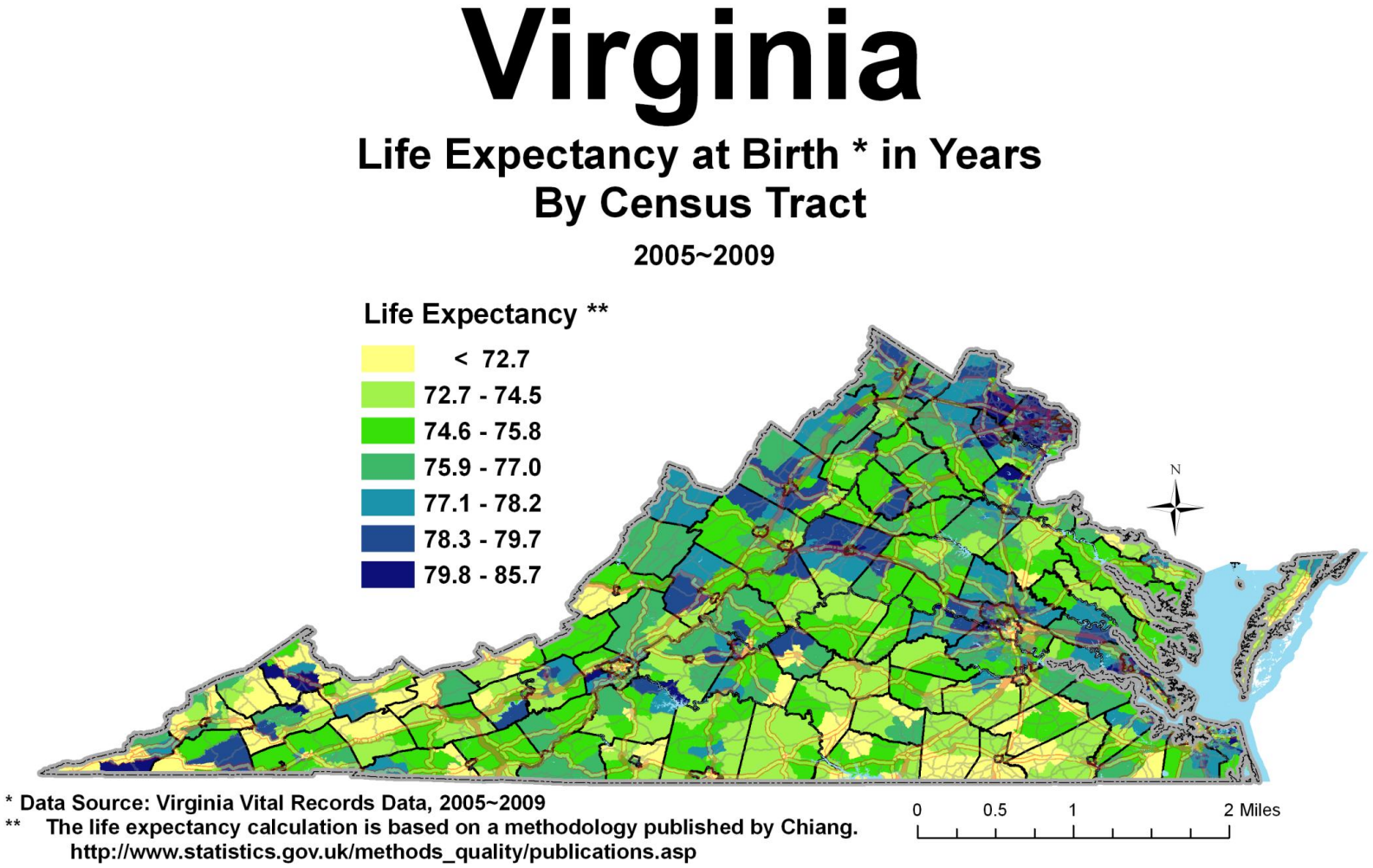


Appendix C
Life Expectancy & HOI Relationship

This map shows life expectancy at birth by census tract. It is an average number of years that a person can expect to live after birth. The yellow color areas indicate that a person born is expected to live less than 72.7 years which is six years below the State average. Meanwhile, the darker color areas indicate that persons born in these areas are expected to live up to 79.8 to 85.7 years before they die. Compare to the State average, these areas have life expectancy above the State average.



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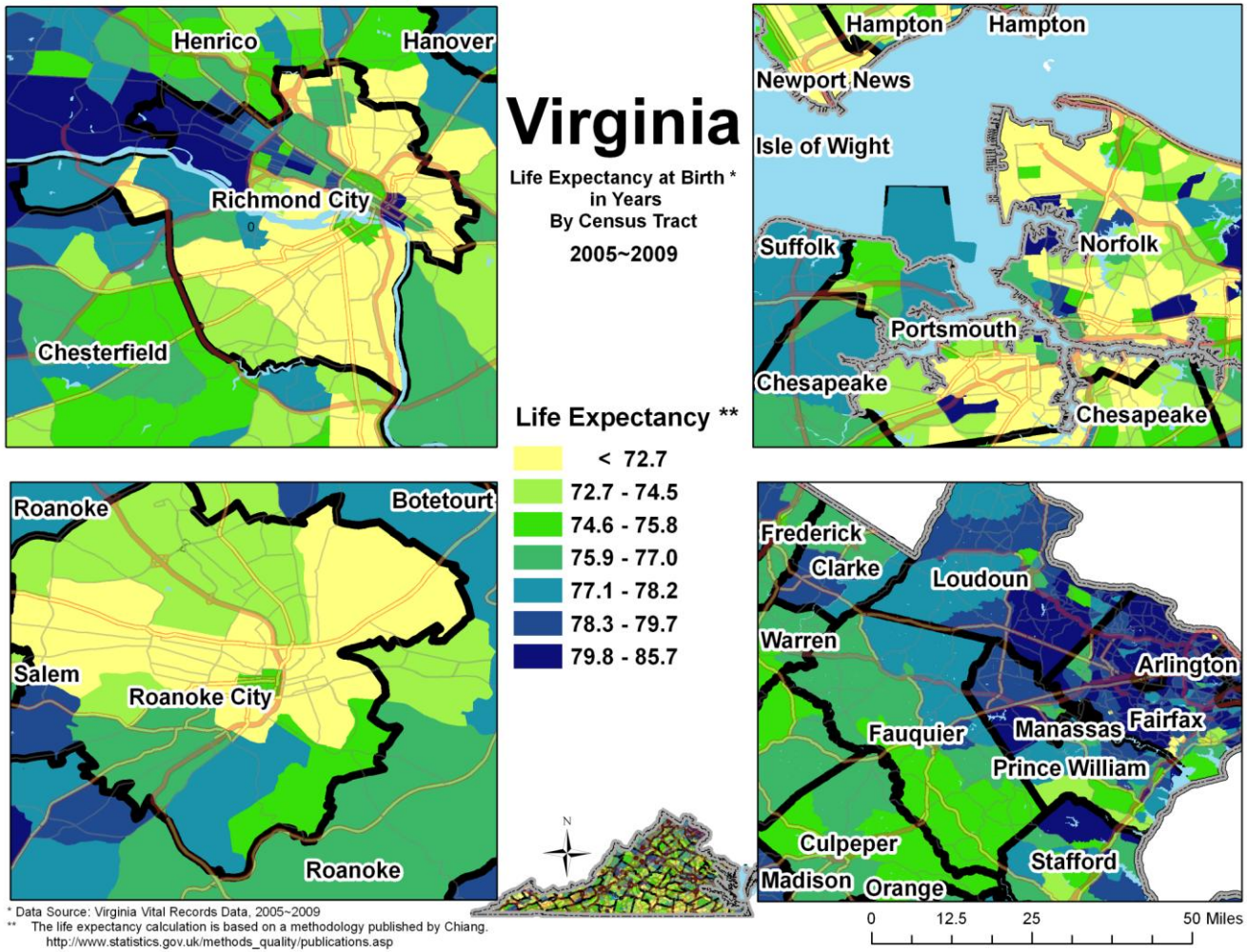
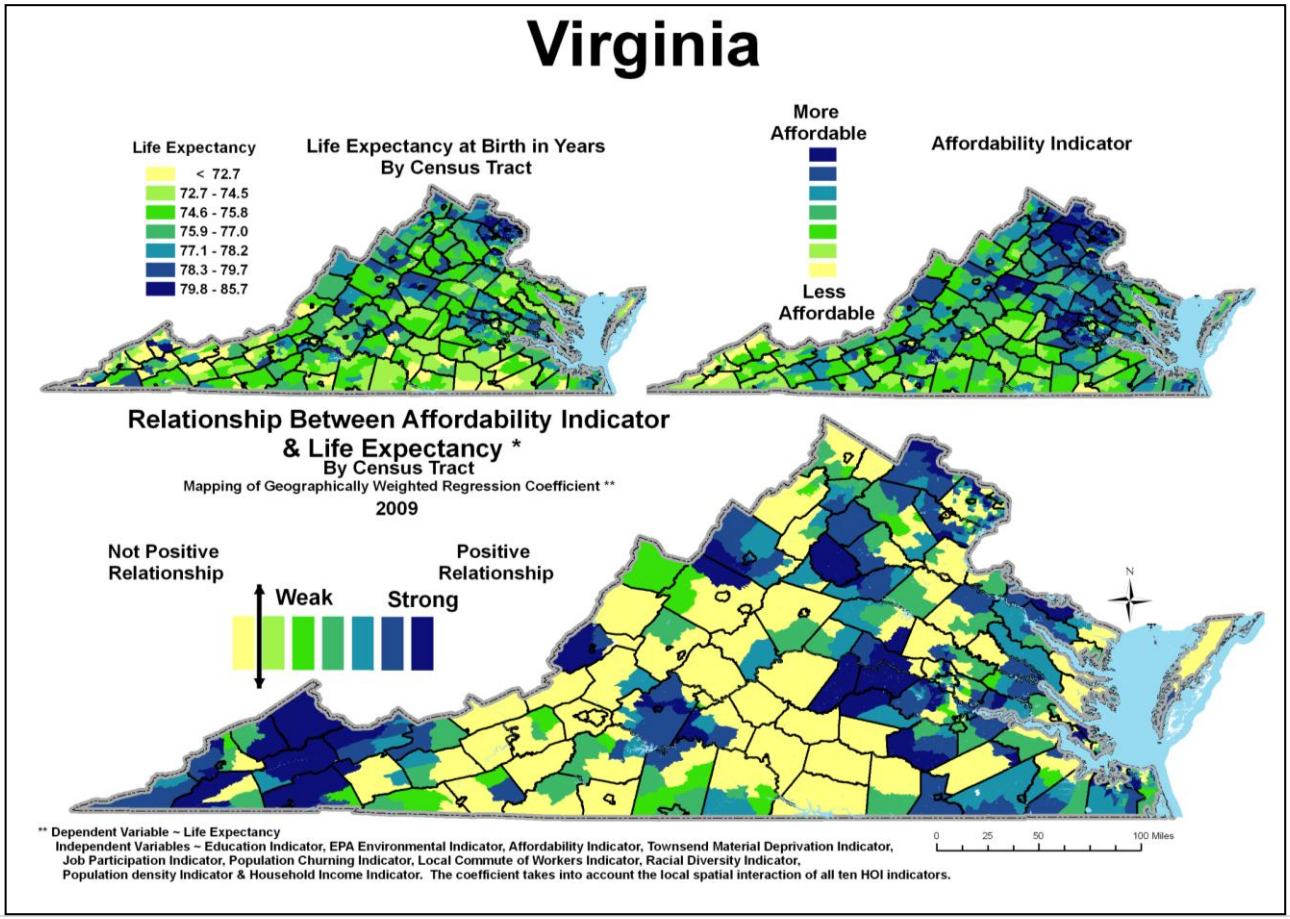


* Data Source: Virginia Vital Records Data, 2005~2009
** The life expectancy calculation is based on a methodology published by Chiang.
http://www.statistics.gov.uk/methods_quality/publications.asp

The right corner map shows the Affordability Indicator and the indicator of affordability is calculated by combining housing and transportation costs in a neighborhood and dividing that number by income. The indicator shows that housing and transportation costs vary significantly across Virginia. Affordability indicator is composed of three variables. (1). Housing cost, (2) transportation cost and (3) total income. ***The indicator measures housing and transportation as a percent of the total income and so the higher the index, the higher the percent of income spent on housing and transportation.***
For example the yellow areas means, persons in these areas spend more of their total income on transportation and housing. The dark areas means that persons in these areas spend less of their total income on housing and transportation the darker areas indicate that, persons in these areas spend less proportion of their total

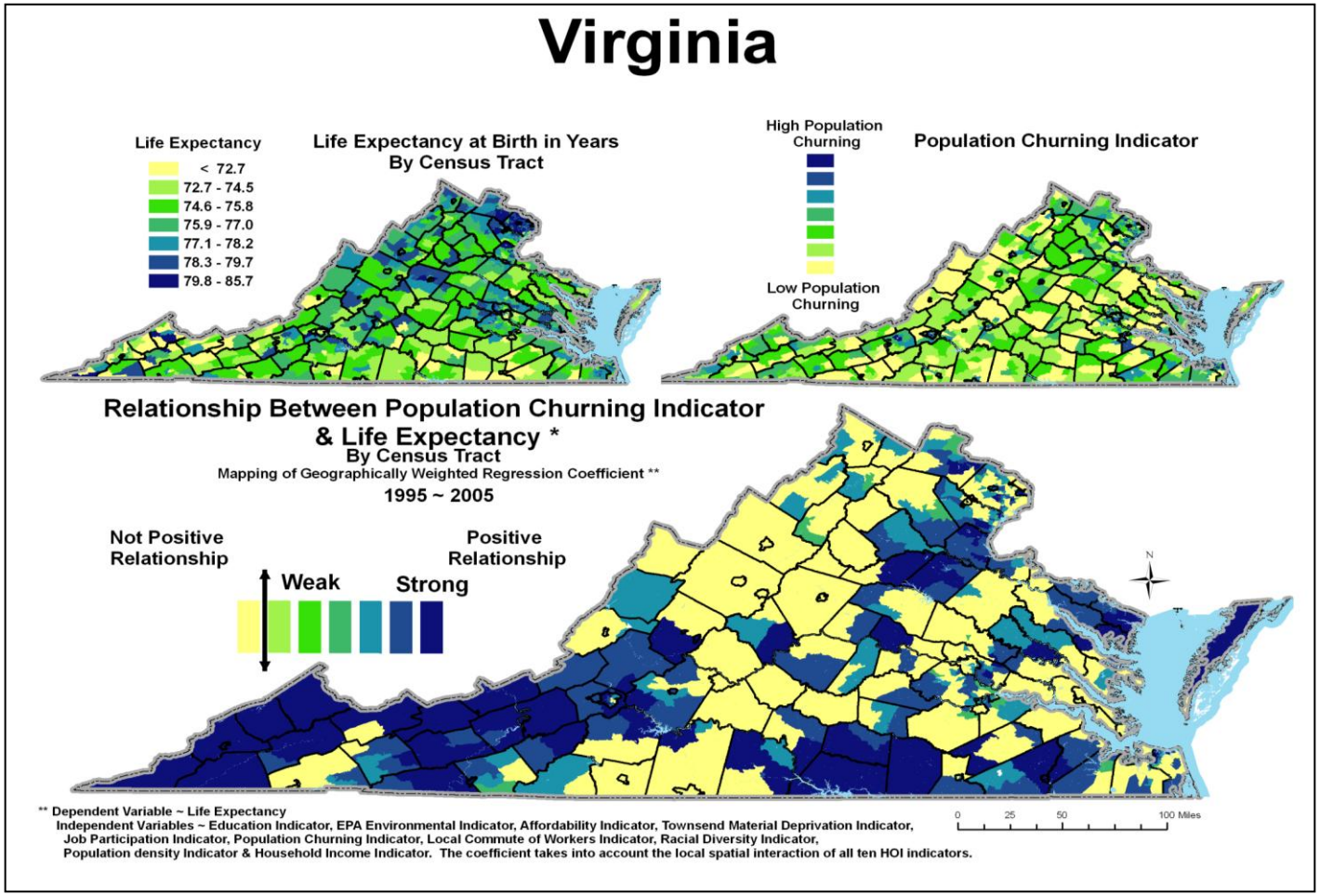
The left corner map shows the life expectancy at birth between 2005~2009
The base map shows the coefficient of the interaction between life expectancy and affordability indicator and the dark areas show positive relationship while the yellow



The right corner map shows the Population churning rates which relate the combined inflow and outflow for an area to the resident population and help to quantify the stability of a population in an area. The indicator uses the census mobility data that shows the mobility for 5 years by census tract.
The scale shows an annual churning rate by census tract. The darker areas indicate that such areas experienced more population turn-over compared to the yellow areas

The left corner map shows the life expectancy at birth between 2005~2009

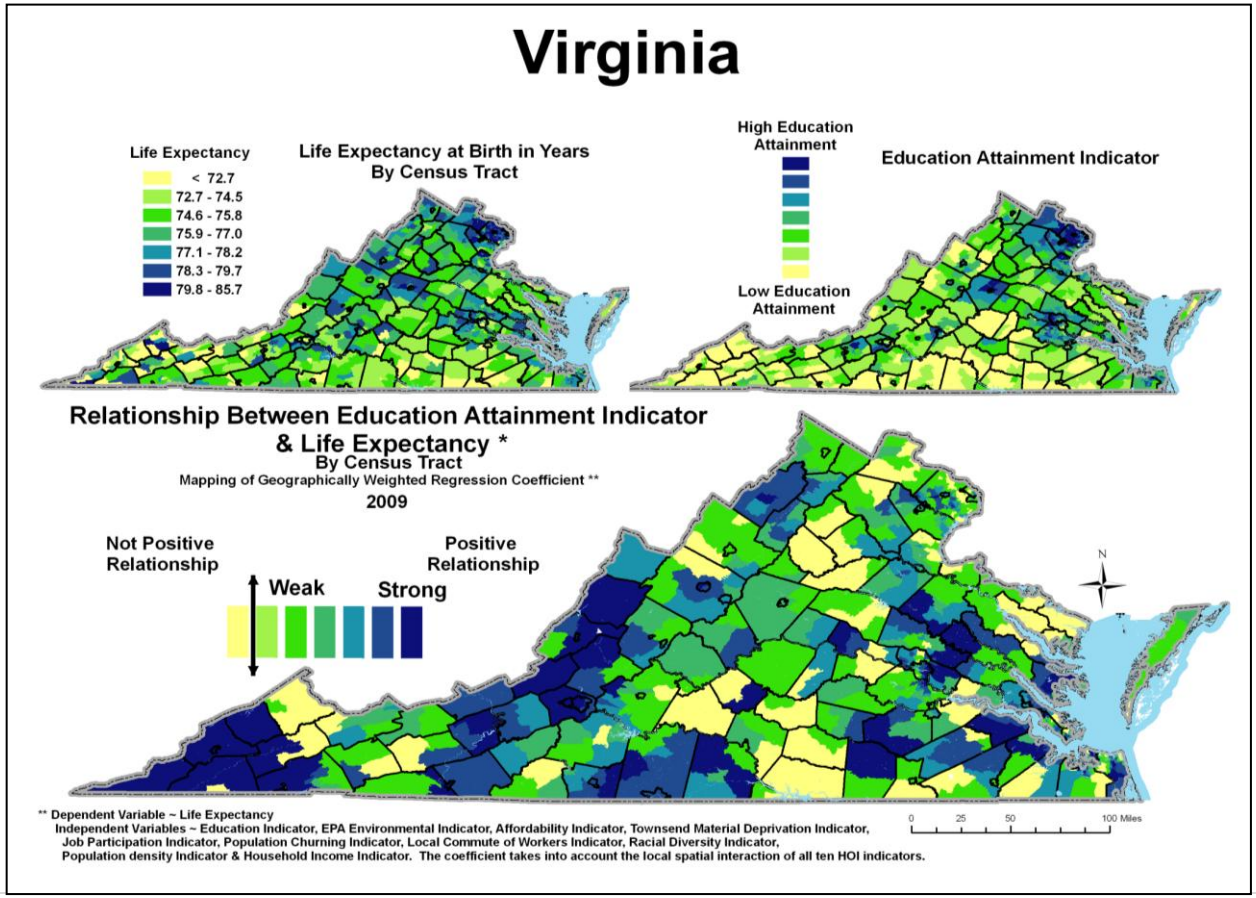
The base map shows the coefficient of the interaction between life expectancy and population churning and the dark areas show positive relationship while the yellow areas show no positive relationship.



The right corner map shows the Education Attainment indicator which is composed of literacy rate (ability of read and write) and gross enrollment ratio (from kindergarten to postgraduate education).
These two sub-indices are weighted (Attainment is weighted 2/3 while Enrollment is weighted 1/3) and sum together to get a composite education indicator.
This indicator is scale-less and therefore darker areas indicate perfect education attainment while the yellow areas indicate less education attainment.

The left corner map shows the life expectancy at birth between 2005~2009

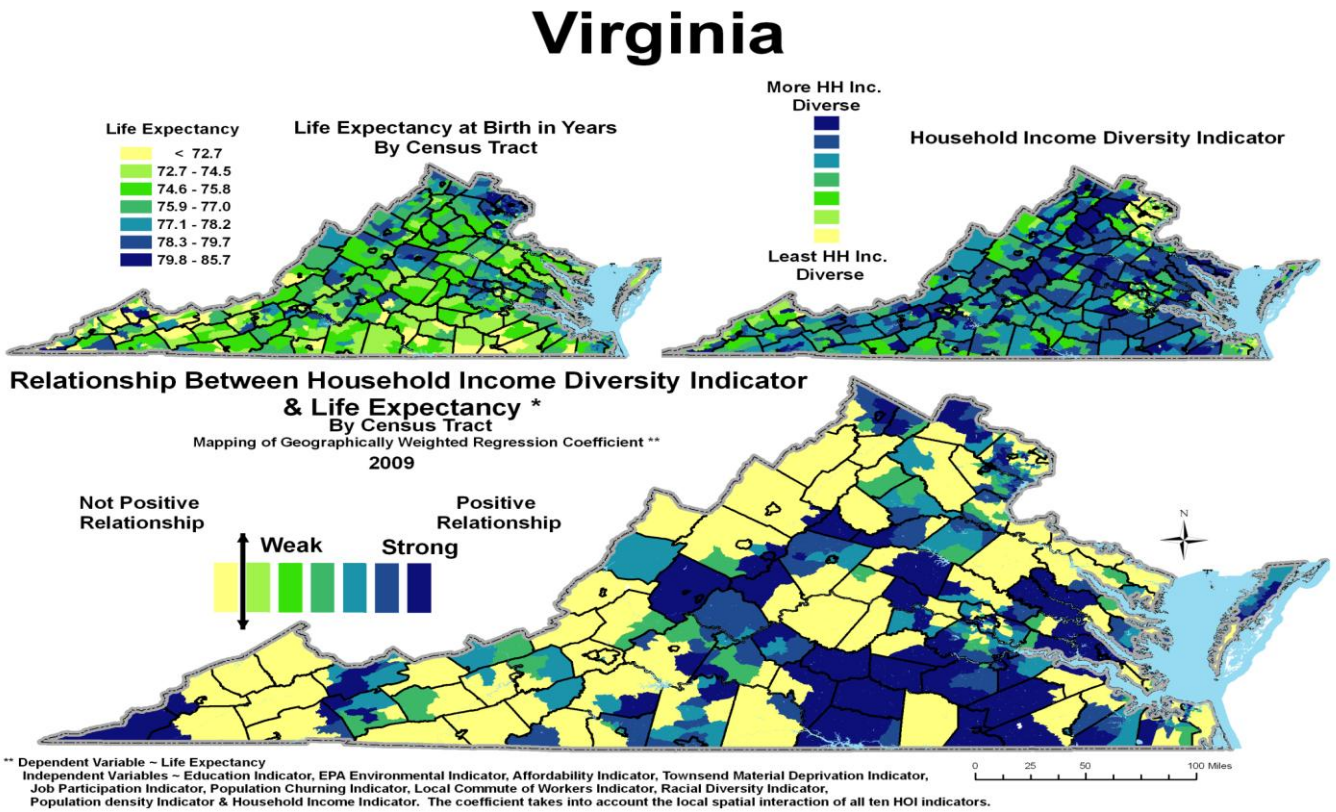
The base map shows the coefficient of the interaction between life expectancy and Education Attainment indicator and the dark areas show positive relationship while the yellow areas show no positive relationship.



The right corner map shows the Household Income Diversity. This aspect of diversity refers to a variance in household economic status within the same census tract. The indicator was measured by using all the 10 income ranges in census data comprising households with annual incomes of less than $15,000, $15,000 to $24,999, $25,000 to $34,999, $35,000 to $49,999, $50,000 to $74,999, $75,000 to $99,999, $100,000 to $149,999, $150,000 to $249,999, $250,000 to $499,999, and $500,000 or more. ***A yellow color indicates that the area is more homogeneous in terms of household income and vice versa. What this means is that, if you select two houses at random, the probability (chance) that both houses will belong to different income levels is less.***

The left corner map shows the life expectancy at birth by census tract from 2005~2009

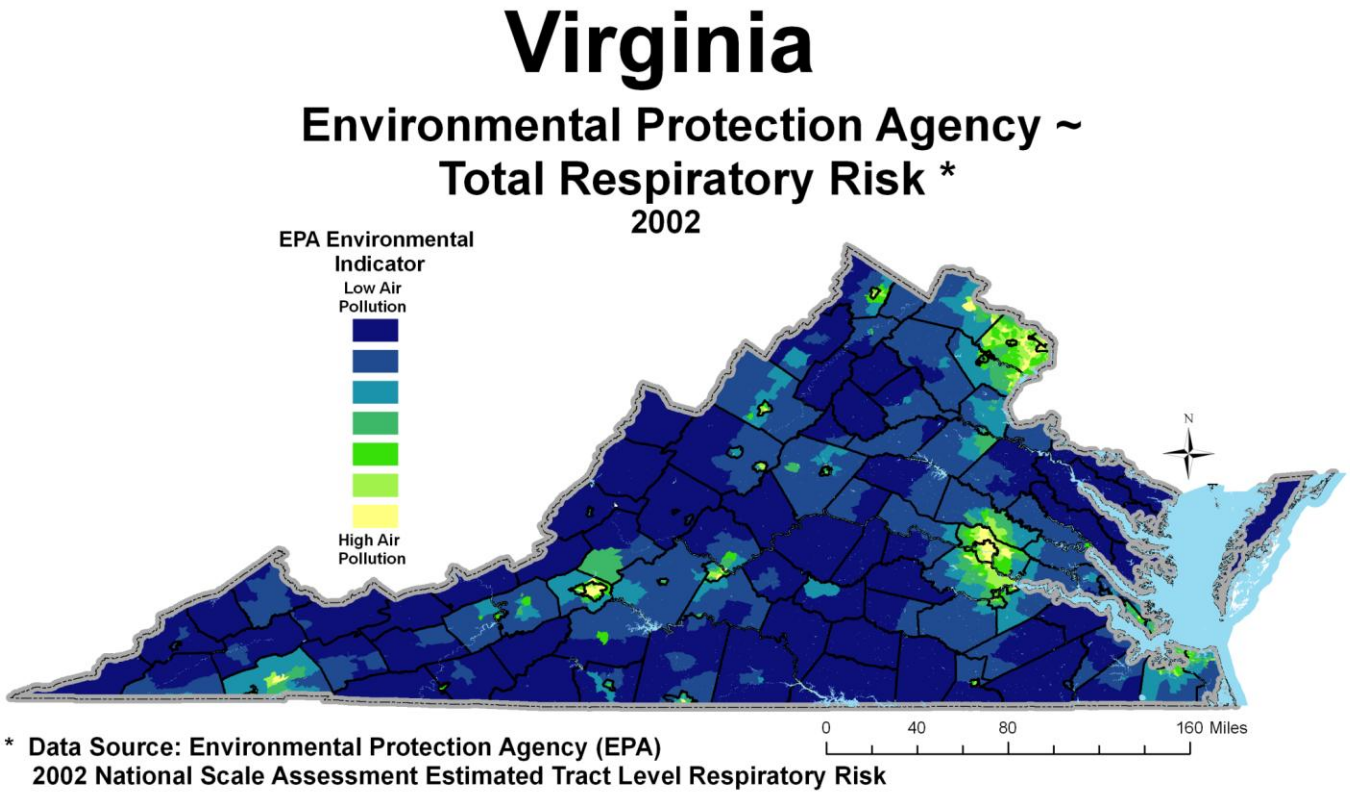
The base map shows the coefficient of the interaction between life expectancy and Household Income Diversity and the dark areas show positive relationship while the yellow areas show no positive relationship.



The right corner map shows the environmental indicator which was computed using EPA NATA Environmental Data to evaluate the magnitude of air pollution by census tract. This Database contains, three risk variables, namely cancer risk, respiratory risk and neurological risk. All these variables were standardized to Z-Score and summed up to construct the hazard quotients of the air toxics compounds that affect the respiratory or nervous system.
The dark areas are least environmental polluted while the yellow areas are more environmental polluted area

The left corner map shows the life expectancy at birth by census tract from 2005~2009

The base map shows the coefficient of the interaction between life expectancy and EPA environmental indicator and the dark areas show positive relationship while the yellow areas show no positive relationship.

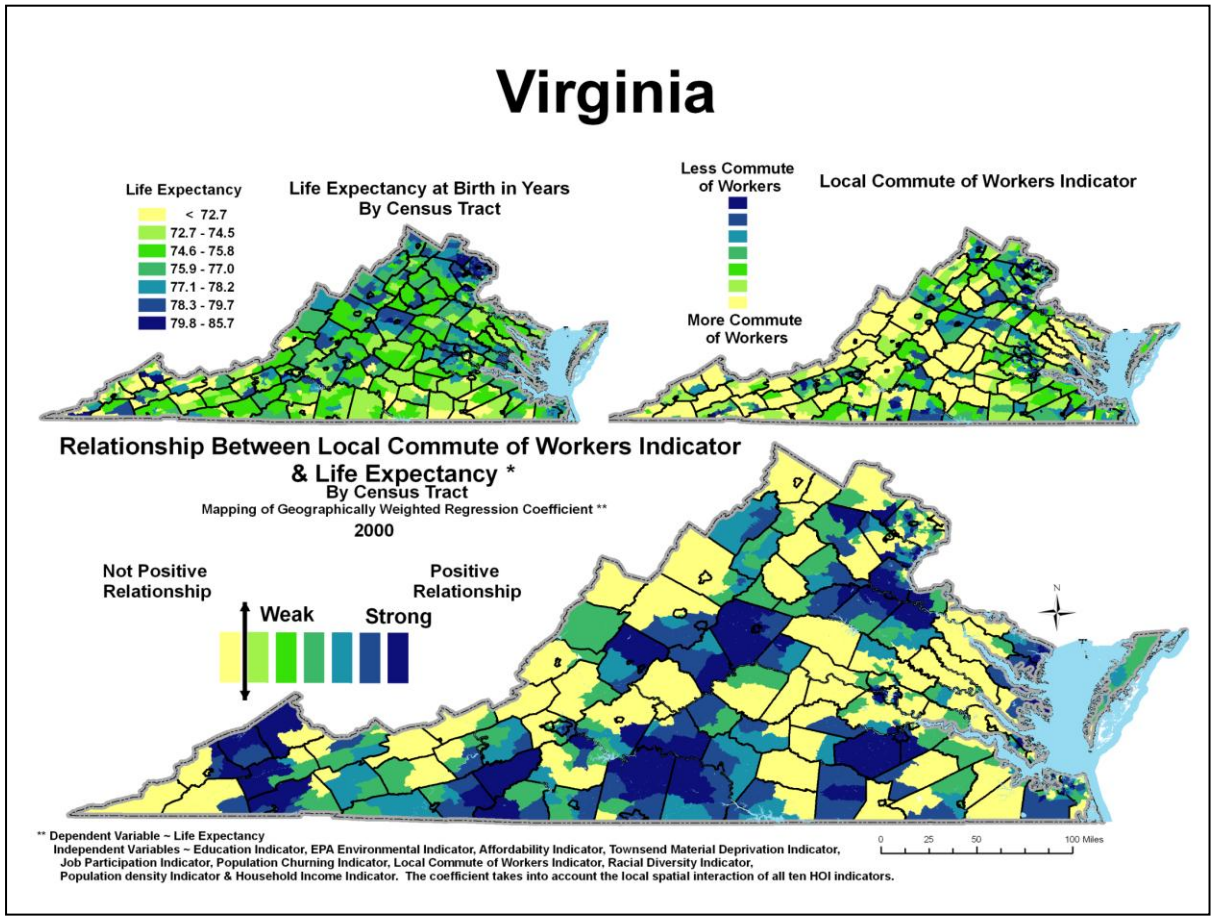


The right corner map shows the Commuting pattern based on Census Transportation Planning Package (CTPP) data which is used to indicate in flow and outflow of workers of an area. This is the ratio of inflow plus outflow divided by total resident work force in the area in question. This is an indicator of the mismatch between the labor force and employment opportunity inside an area and outside an area. This mismatch between labor force and employment can increase commuting cost for individuals.

Interpretation: The darker areas indicate the more job rich the area and therefore less commute while the yellow areas indicate majority of persons in these areas commute to work in other census tracts.

The left corner map shows the life expectancy at birth by census tract from 2005~2009

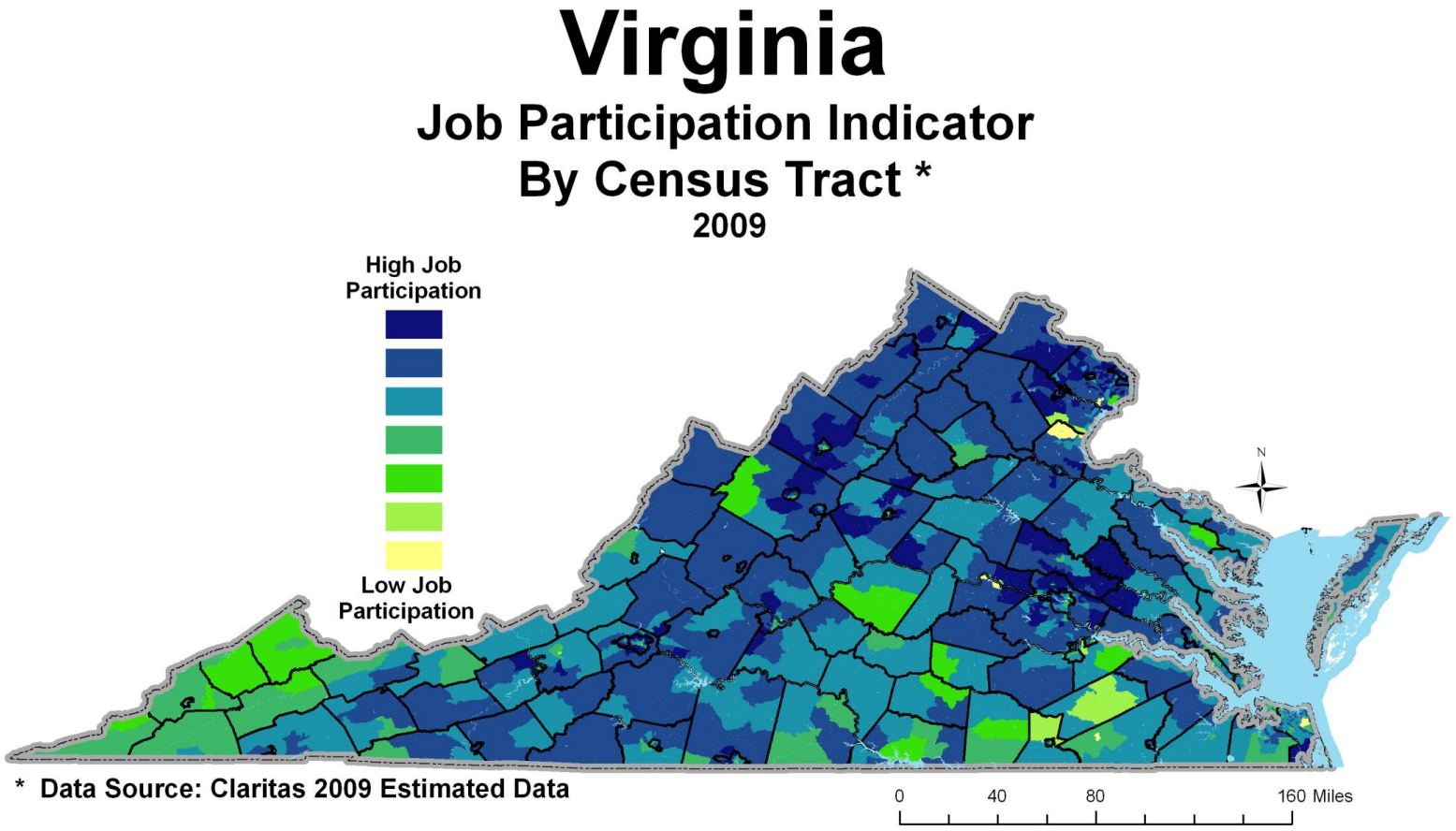
The base map shows the coefficient of the interaction between life expectancy and Commuting pattern and the dark areas show positive relationship while the yellow areas show no positive relationship.



The right corner map shows Job Participation Rate which measures the percent of population over 16 years of age to 64 who are either employed or unemployed and seeking work. Because job participation rates are sensitive to a number of local community attributes, e.g., educational attainment, disability, household composition, car ownership, the measure can provide a sensitive indicator to the unique employment profile of a community. Job participation rate is often used by economists as an indicator for economic development and growth.
The darker area means that, there is high percentage of active labor force of the area.

The left corner map shows the life expectancy at birth by census tract from 2005~2009

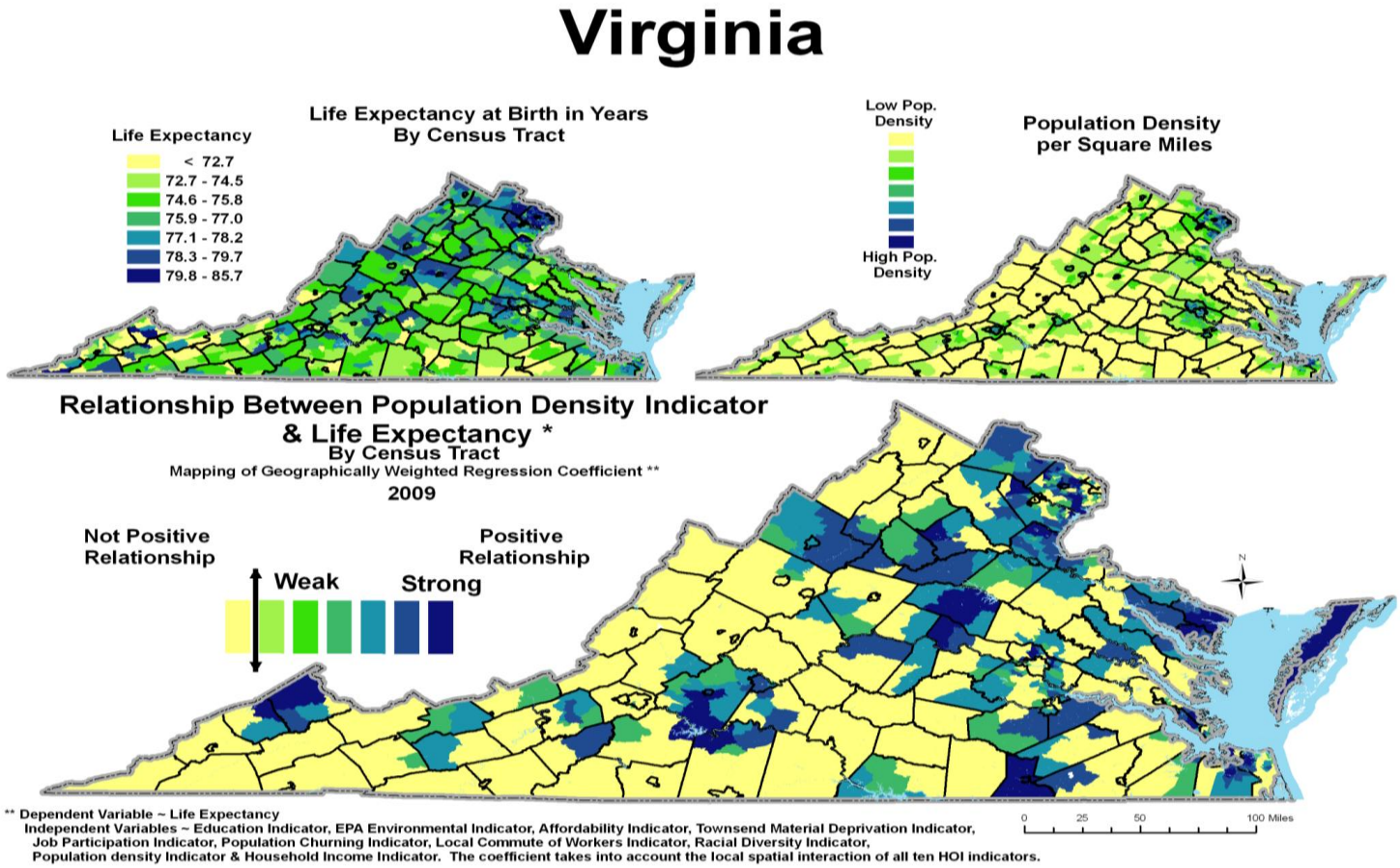
The base map shows the coefficient of the interaction between life expectancy and job participation rate and the dark areas show positive relationship while the yellow areas show no positive relationship.



The right corner map shows population density indicator and this indicator is calculated by dividing the total population by the square miles in the area under study. ***The darker areas indicate that, high population concentration per square miles. While the yellow areas indicate low population concentration***

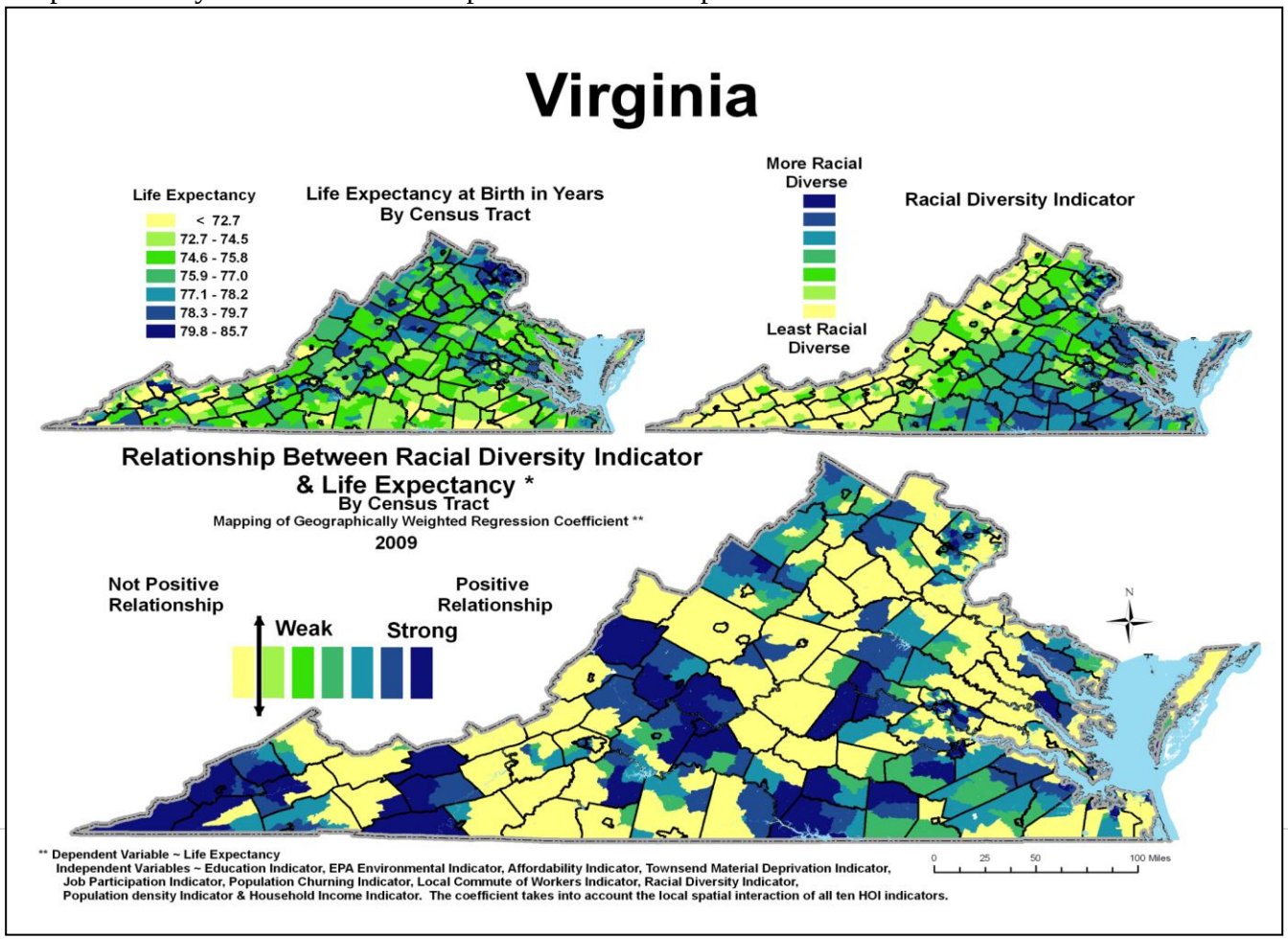
The left corner map shows the life expectancy at birth by census tract from 2005~2009

The base map shows the coefficient of the interaction between life expectancy and population density and the dark areas show positive relationship while the yellow areas show no positive relationship. This indicator differentiates the urban from rural areas as well as land use.



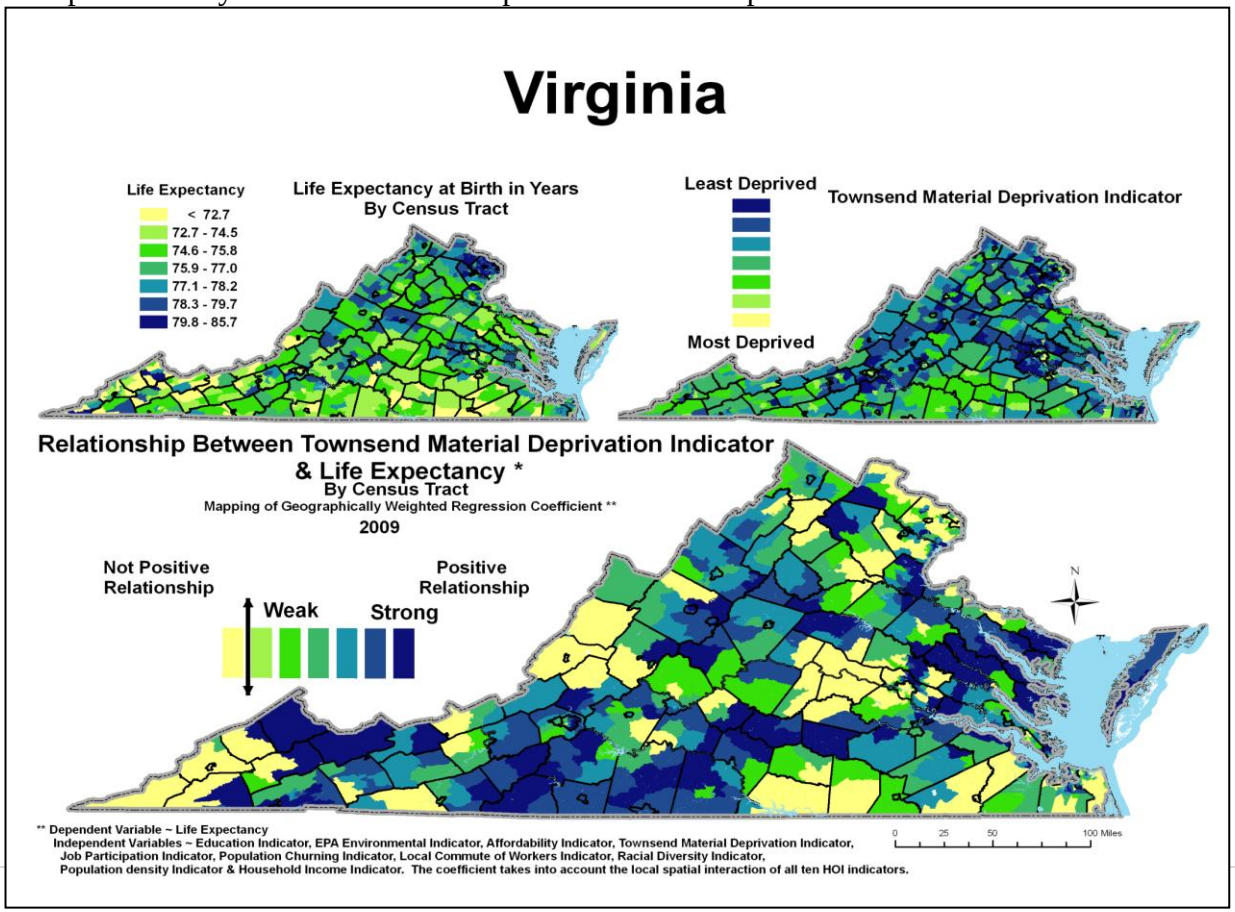
The right corner map shows the Racial Diversity Indicator which identifies the probability that two persons, chosen at random from the street will belong to different race or ethnic groups. The calculation of this index accommodates up to seven race groups: six single-race groups (White, Black, American Indian, Asian, Pacific Islander, Some Other Race) and one multiple-race group (two or more races). The Diversity Indicator is bounded and ranges from 0 to 1. Zero indicates no diversity (homogeneous population) while 1 signifies that there is complete diversity (heterogeneous population). ***If an area's entire population belongs to one race group, then an area has zero diversity. An area's diversity index increases to 1 when the population is evenly divided into two or more race/ethnic groups.***
This is probabilistic model and the yellow areas means that, if two persons are selected at random on the street, there is less probability that these persons will belong to different racial groups. Meanwhile, the darker areas indicate that there is high probability that, these two persons will belong to different racial groups

The left corner map shows the life expectancy at birth by census tract from 2005~2009
The base map shows the coefficient of the interaction between life expectancy and racial diversity indicator and the dark areas show positive relationship while the yellow areas show no positive relationship.



The right corner map shows Townsend deprivation index which is a measure of material deprivation. The index uses four equally weighted variables to calculate the score. These four variables are: (1) percent economically active residents aged 16-59/64 who are unemployed, (2) percent private households who do not possess a car or van, (3) percent private households not owner occupied and (4) percent private households overcrowded (more than one person per room). In calculating this index, first, percent unemployment and percent private household overcrowded are log transformed and after that, a Z score is calculated for the four variables and they are summed up to get composite index for deprivation. ***The higher the Townsend Index score, the more deprived and disadvantaged an area is thought to be***.
The Dark areas are least deprived while the yellow areas are more deprived.
In the Health Opportunity Index it can be seen that, Southwest and Southside Virginia, have low health opportunity (green areas) compared to the darker areas.
The left corner map shows the life expectancy at birth by census tract from 2005~2009

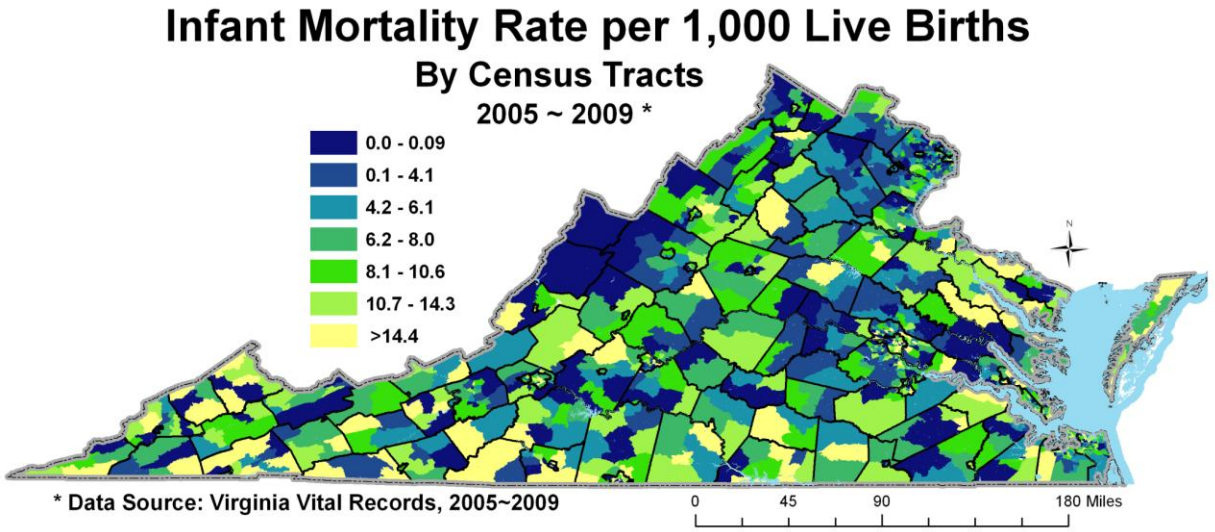
The base map shows the coefficient of the interaction between life expectancy and Townsend deprivation indicator and the dark areas show positive relationship while the yellow areas show no positive relationship.



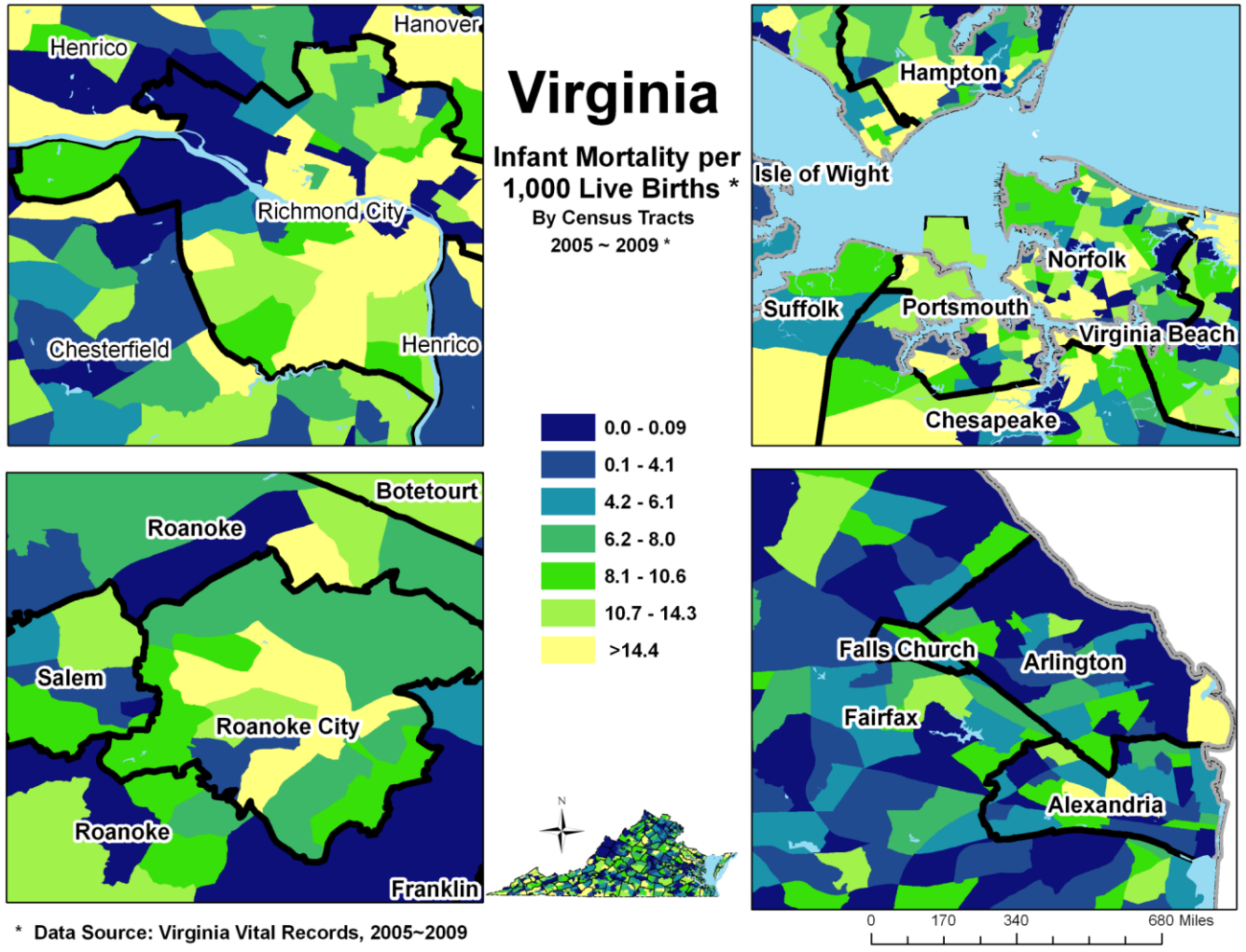
Appendix D

Birth Outcomes: Infant Mortality and LowBirth Weight

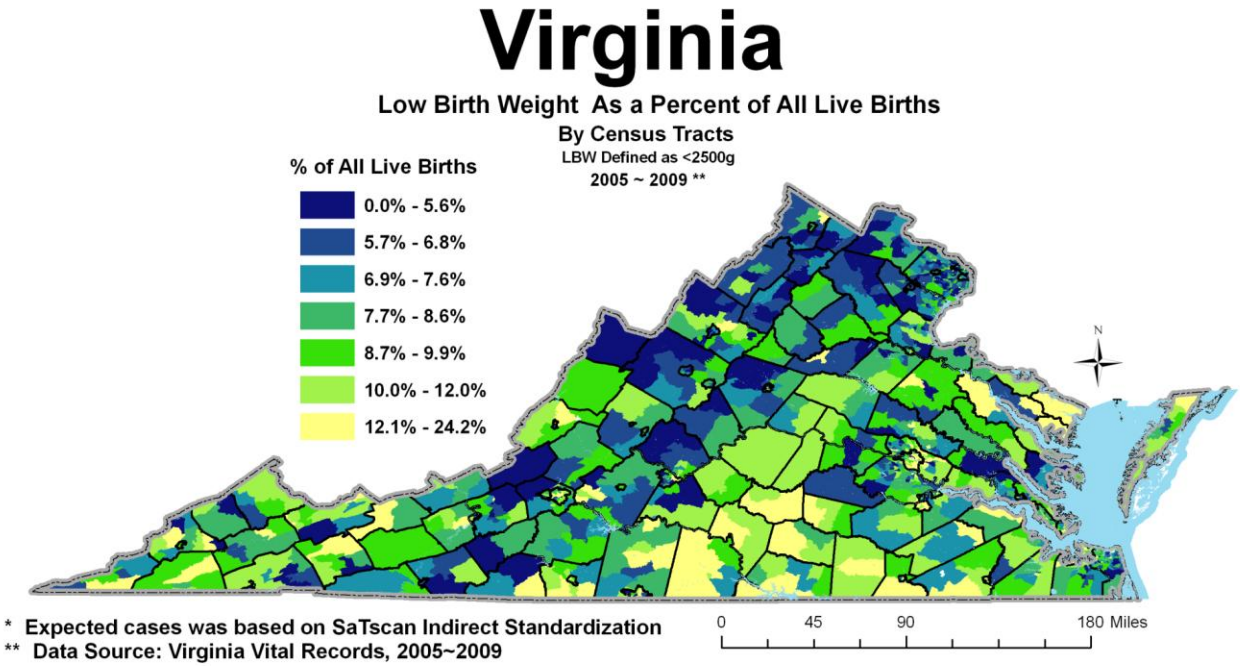
The map shows Infant Mortality Rate per 1000 live births by census tract for a period between 2005~2009 in Virginia. The darker areas show low rate per 1000 live births while the light areas show high infant mortality rate per 1000 live births.
It can be seen that the high rates are found in the Southwest, Hampton Roads, Northern Neck and Southside areas of the State. Low rates are found in parts of Northern Virginia, Highland~Bath~Augusta Counties and Gloucester~Middlesex areas.



This map shows the Richmond metro area (upper left corner), Hampton Roads area (Upper right corner), Roanoke metro (Lower left corner) and Northern Virginia (lower right corner).
The map shows Infant Mortality Rate per 1000 live births by census tract for a period between 2005~2009 in Virginia. The darker areas show low rate per 1000 live births while the light areas show high infant mortality rate per 1000 live births.
High rate of infant mortality are concentrated in Richmond area, Roanoke City, Hampton Roads and part of Arlington in Northern Virginia.



The map shows the Low Birth Weight as a percent of all live births by census tract for a period between 2005~2009 in Virginia. The darker areas show low percent of all live births while the light areas show high percent of all live births.
High rates are found in the Southwest, Northern Neck and Southside areas of the State. Low rates are found in Northern Virginia, Highland Counties and Shenandoah areas.



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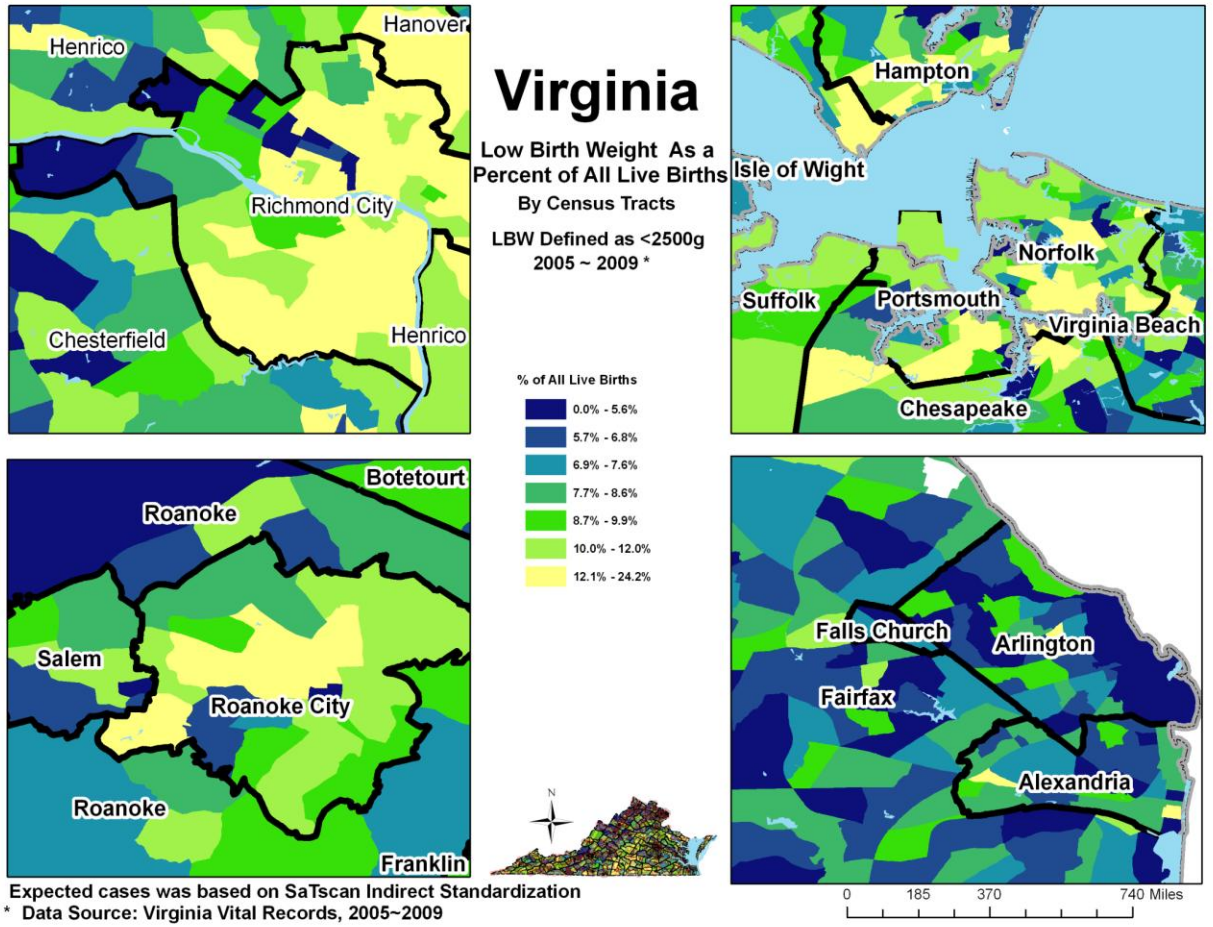
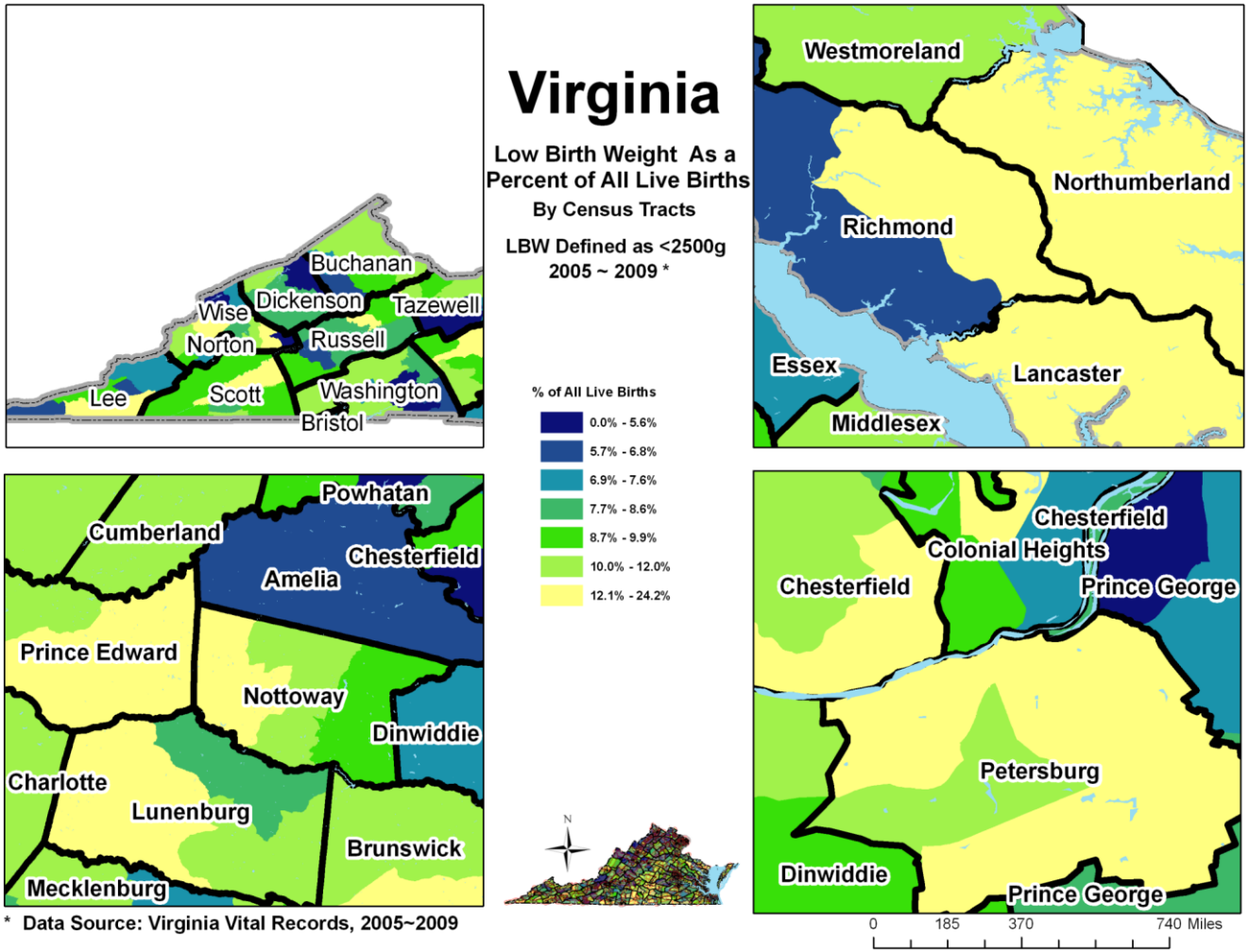
The map shows the Low Birth Weight as a percent of all live births by census tract for a period between 2005~2009 in Virginia. The darker areas show low percent of all live births while the light areas show high percent of all live births.
High rate of Low Birth weight are concentrated in Richmond City, Roanoke City and Hampton Roads areas.

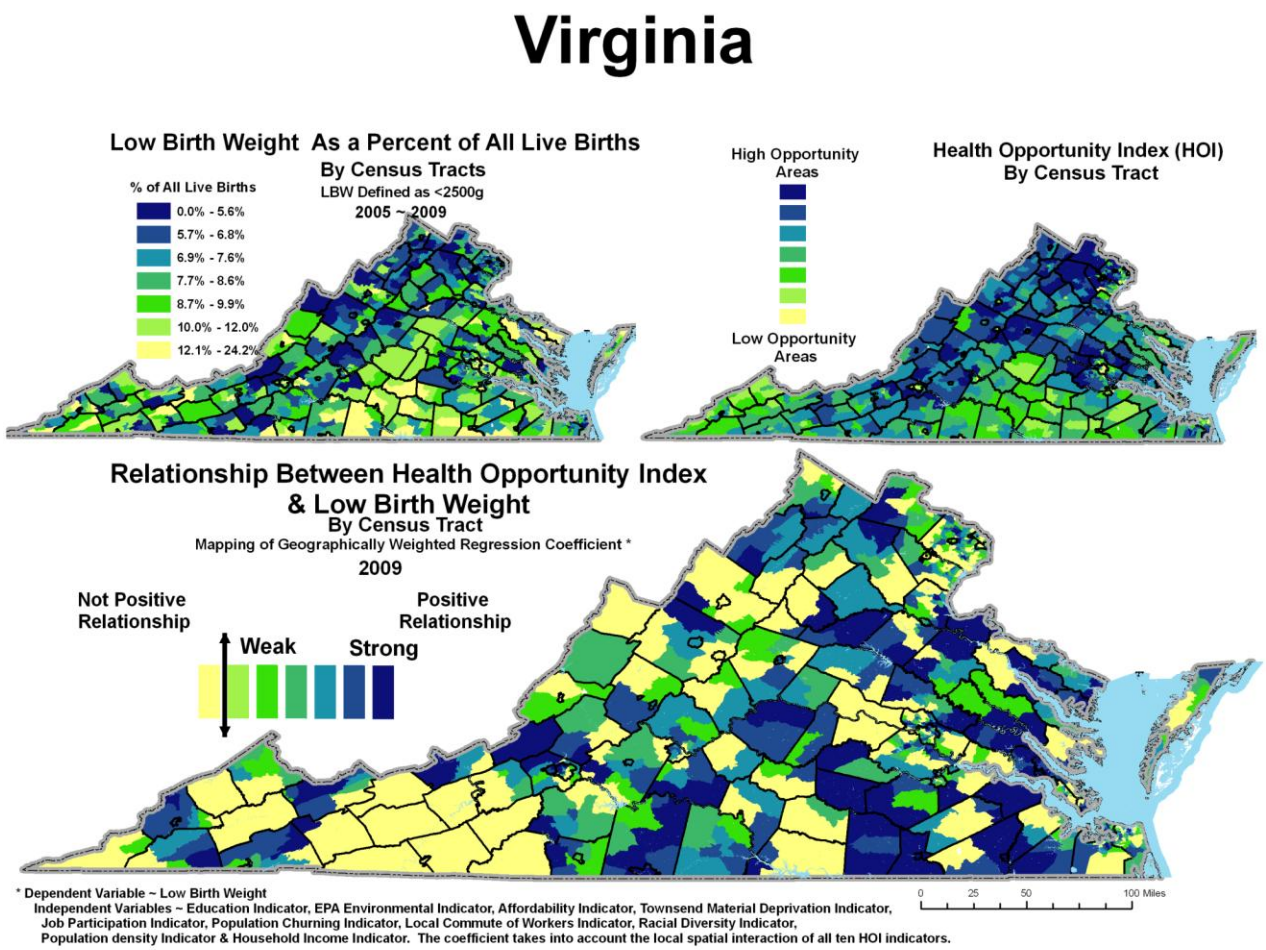


This map shows the Southwest Virginia (upper left corner), Southside Virginia (Upper right corner), Northern Neck counties area (Lower left corner) and Colonial Heights~Petersburg (lower right corner).
The map shows the Low Birth Weight as a percent of all live births by census tract for a period between 2005~2009 in Virginia. The darker areas show low percent of all live births while the light areas show high percent of all live births.
High rate of Low Birth Weight are found in Northern Neck, Petersburg City, and part of Prince Edward~Lunenburg Counties.



The right corner map shows the Health Opportunity Index and it can be seen that, Southwest and Southside Virginia, have low health opportunity (green areas) compared to the darker areas.

The left corner map shows the low birth weight as a percent of all live births by census tract and again it can seen that Southwest and Southside Virginia area have high percent of low birth weight.
The base map shows the coefficient of the interaction between the low birth weight and HOI and the dark areas show positive relationship while the yellow areas show no positive relationship.



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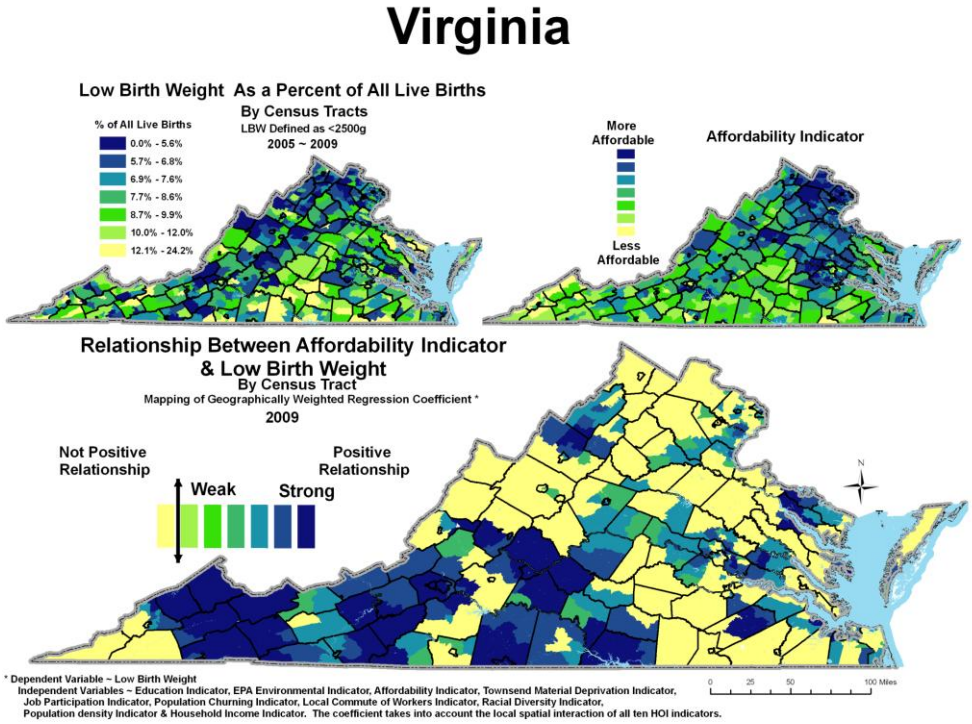
For example the yellow areas means, persons in these areas spend more of their total income on transportation and housing. The dark areas means that persons in these areas spend less of their total income on housing and transportation the darker areas indicate that, persons in these areas spend less proportion of their total

The left corner map shows the low birth weight as a percent of all live births by census tract and low birth weight is defined as children born with weight less than 2500g.
The base map shows the coefficient of the interaction between the low birth weight and affordability indicator and the dark areas show positive relationship while the yellow areas show no positive relationship.



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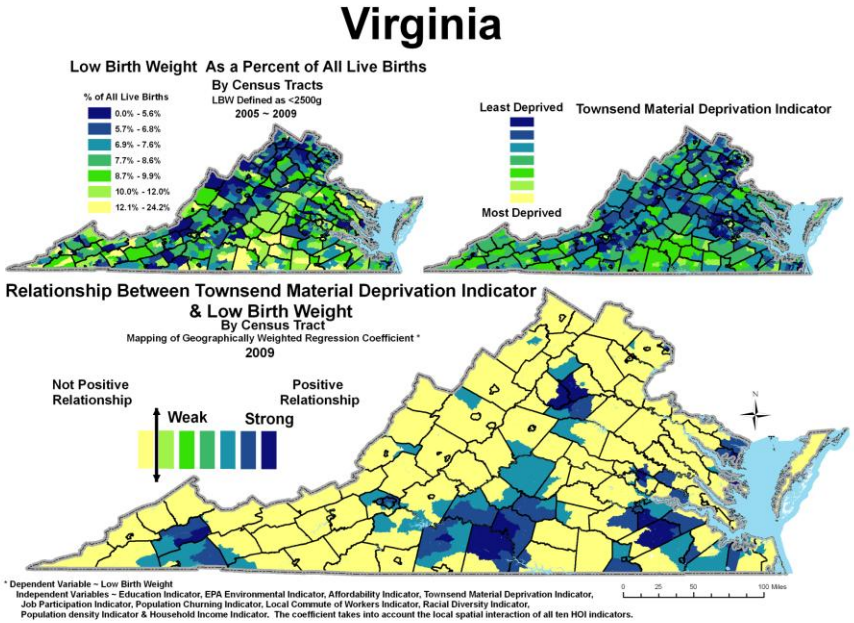
The Dark areas are least deprived while the yellow areas are more deprived.
The Health Opportunity Index can show that Southwest and Southside Virginia have low health opportunity (green areas) compared to the darker areas.

The left corner map shows the low birth weight as a percent of all live births by census tract and low birth weight is defined as children born with weight less than 2500g.
The base map shows the coefficient of the interaction between the low birth weight and Townsend deprivation indicator and the dark areas show positive relationship while the yellow areas show no positive relationship.



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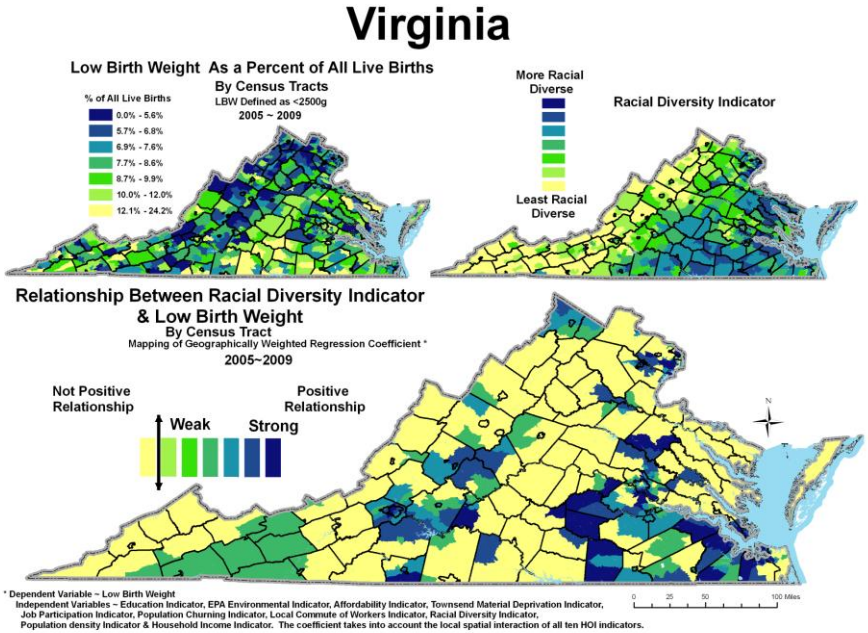
This is probabilistic model and the yellow areas means that, if two persons are selected at random on the street, there is less probability that these persons will belong to different racial groups. Meanwhile, the darker areas indicate that there is high probability that, these two persons will belong to different racial groups

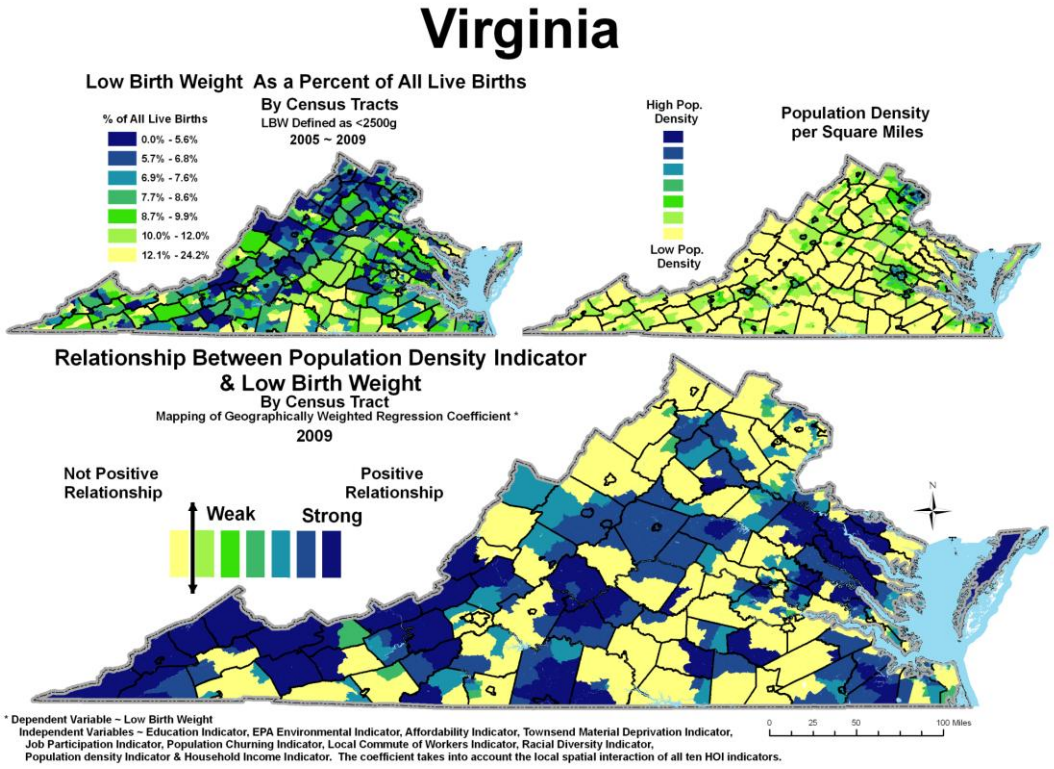
The left corner map shows the low birth weight as a percent of all live births by census tract and low birth weight is defined as children born with weight less than 2500g.

The base map shows the coefficient of the interaction between the low birth weight and racial diversity indicator and the dark areas show positive relationship while the yellow areas show no positive relationship.



The right corner map shows this indicator is calculated by dividing the total population by the square miles in the area under study. ***The darker areas indicate that, high population concentration per square miles. While the yellow areas indicate low population concentration***

The left corner map shows the low birth weight as a percent of all live births by census tract and low birth weight is defined as children born with weight less than 2500g.
The base map shows the coefficient of the interaction between the low birth weight and population density and the dark areas show positive relationship while the yellow areas show no positive relationship. This indicator differentiates the urban from rural areas as well as land use.



The right corner map shows Job Participation Rate which measures the percent of population over 16 years of age to 64 who are either employed or unemployed and seeking work. Because job participation rates are sensitive to a number of local community attributes, e.g., educational attainment, disability, household composition, car ownership, the measure can provide a sensitive indicator to the unique employment profile of a community. Job participation rate is often used by economists as an indicator for economic development and growth.
The darker area means that, there is high percentage of active labor force of the area.

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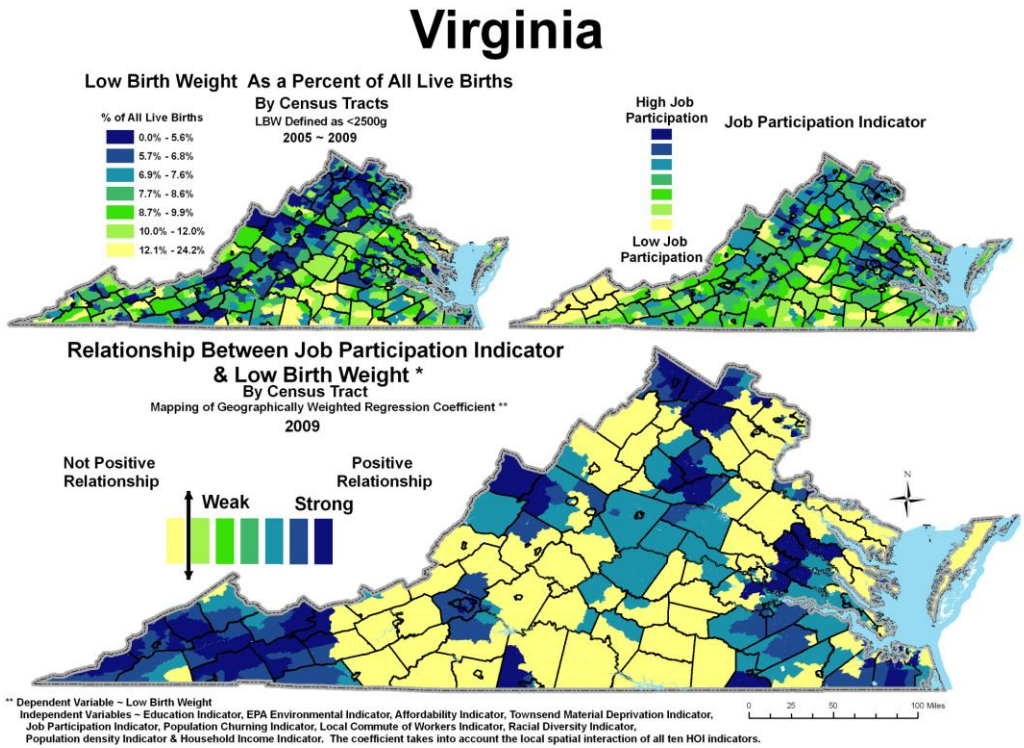

The right corner map shows the Commuting pattern based on Census Transportation Planning Package (CTPP) data which is used to indicate in flow and outflow of workers of an area. This is the ratio of inflow plus outflow divided by total resident work force in the area in question. This is an indicator of the mismatch between the labor force and employment opportunity inside an area and outside an area. This mismatch between labor force and employment can increase commuting cost for individuals.

Interpretation: The darker areas indicator the more job rich the area and therefore less commute while the yellow areas indicate majority of persons in these areas commute to work in other census tracts.

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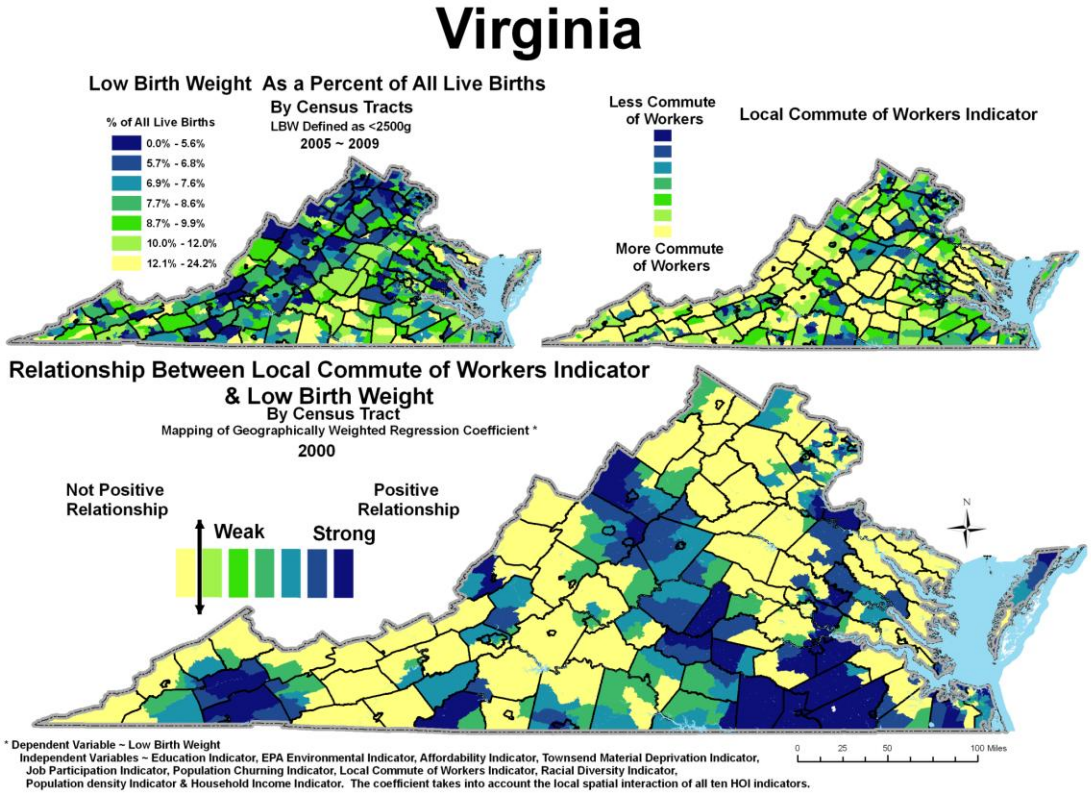

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The dark areas are least environmental polluted while the yellow areas are more environmental polluted area

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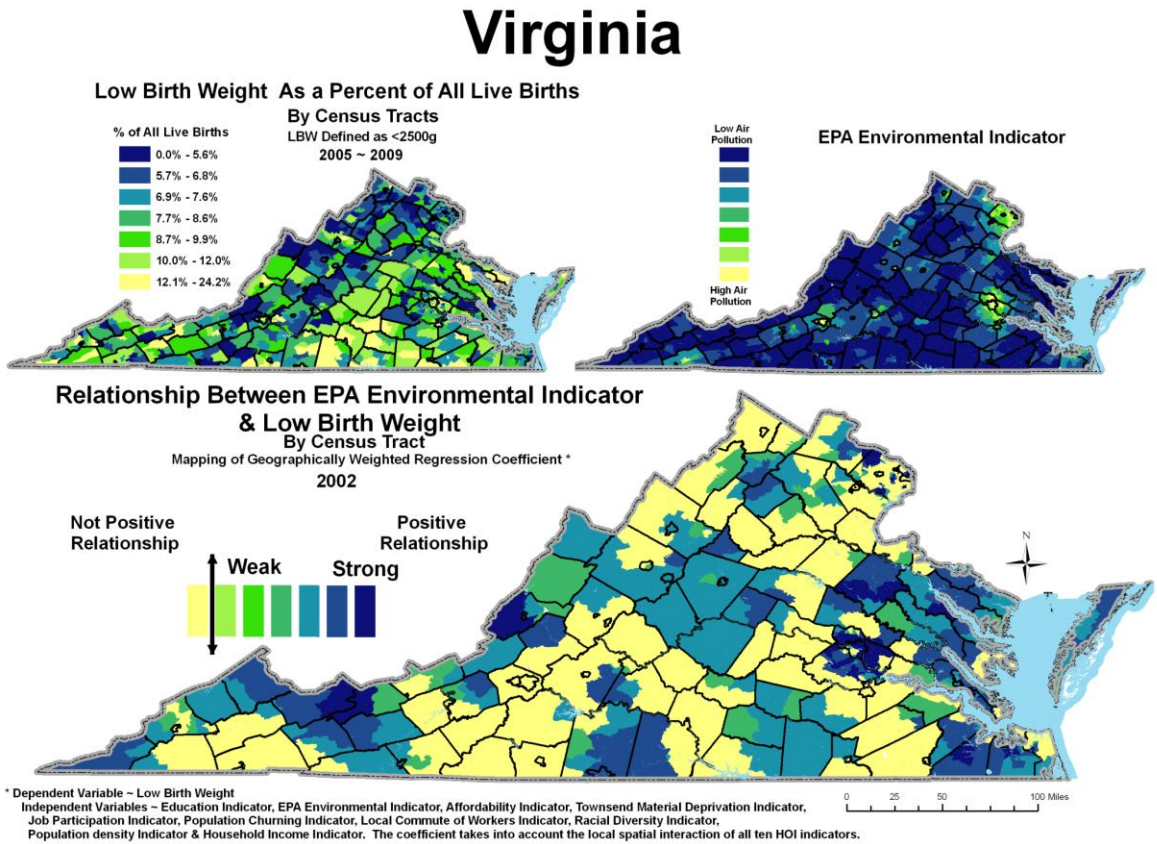
The base map shows the coefficient of the interaction between the low birth weight and EPA environmental indicator, and the dark areas show positive relationship while the yellow areas show no positive relationship.



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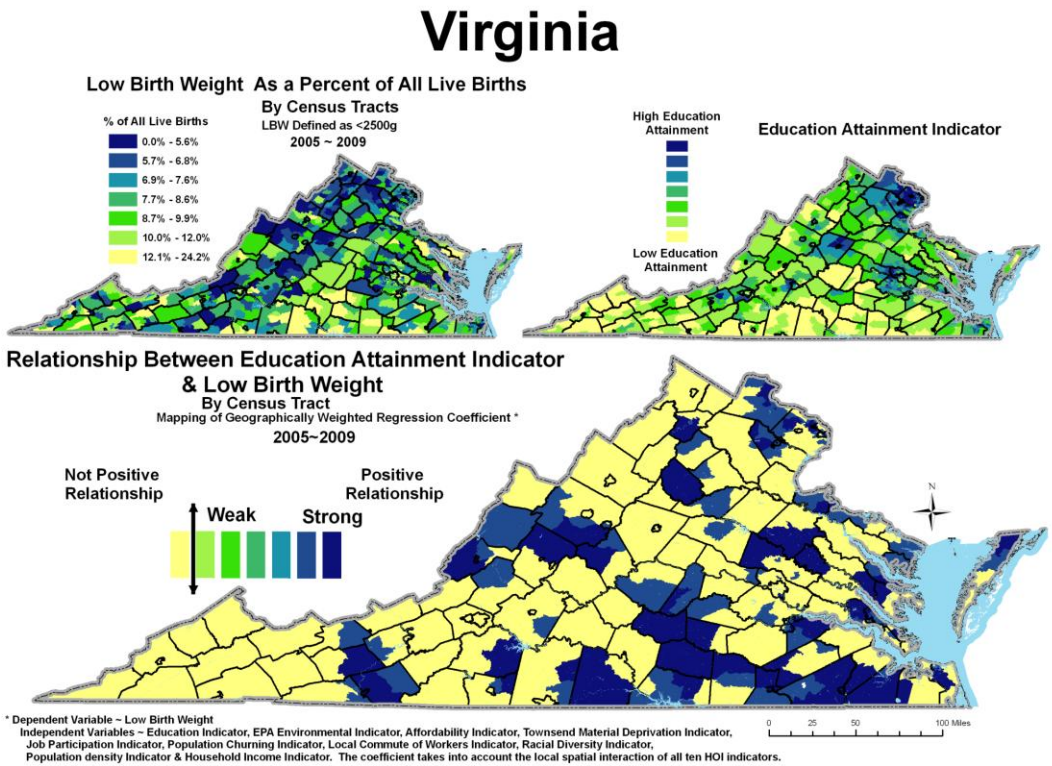
The base map shows the coefficient of the interaction between the low birth weight and Education Attainment indicator and the dark areas show positive relationship while the yellow areas show no positive relationship.



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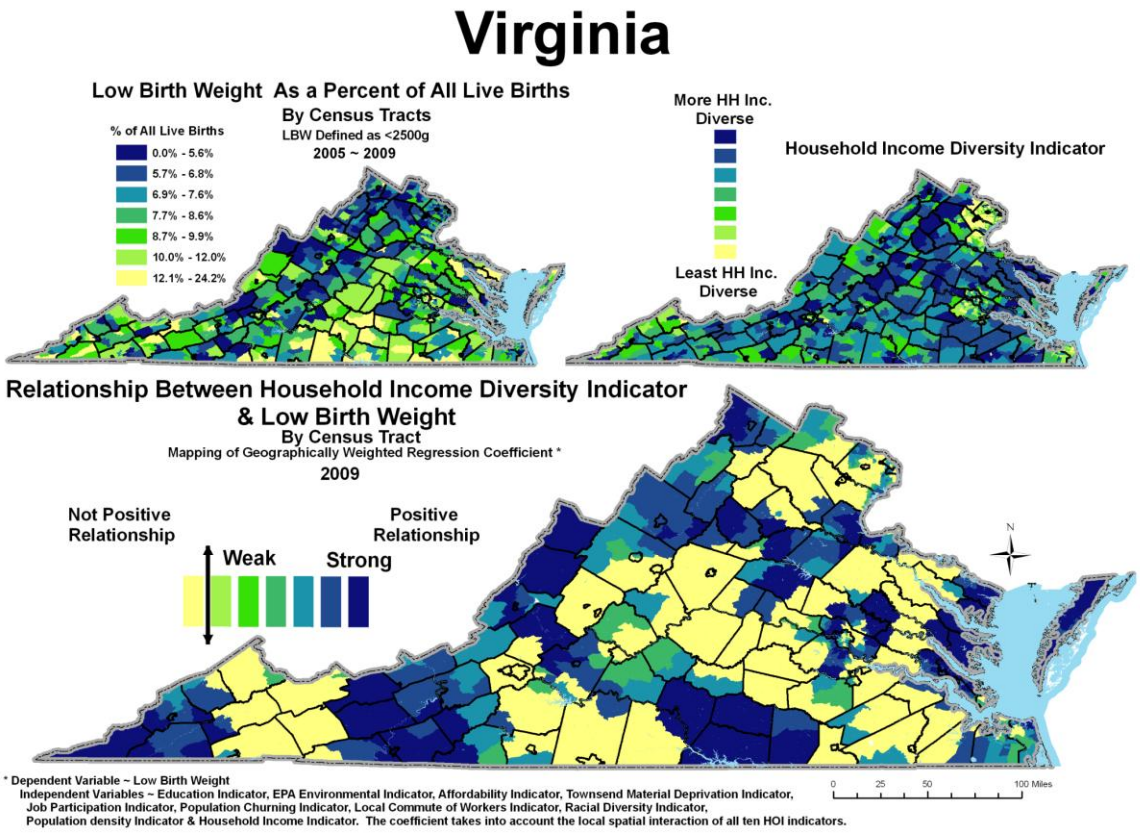
The left corner map shows the low birth weight as a percent of all live births by census tract and low birth weight is defined as children born with weight less than 2500g.

The base map shows the coefficient of the interaction between the low birth weight and Household Income Diversity and the dark areas show positive relationship while the yellow areas show no positive relationship.



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The scale shows an annual churning rate by census tract. The darker areas indicate that such areas experienced more population turn-over compared to the yellow areas

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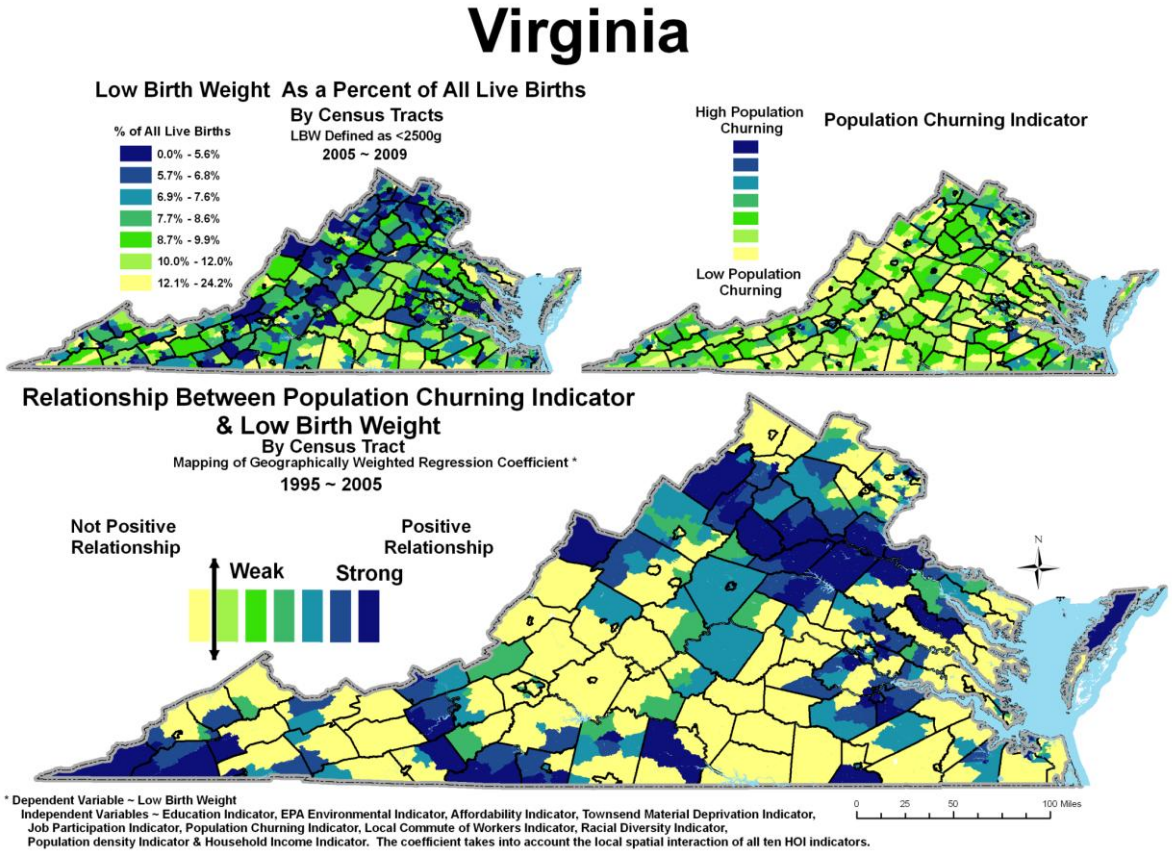
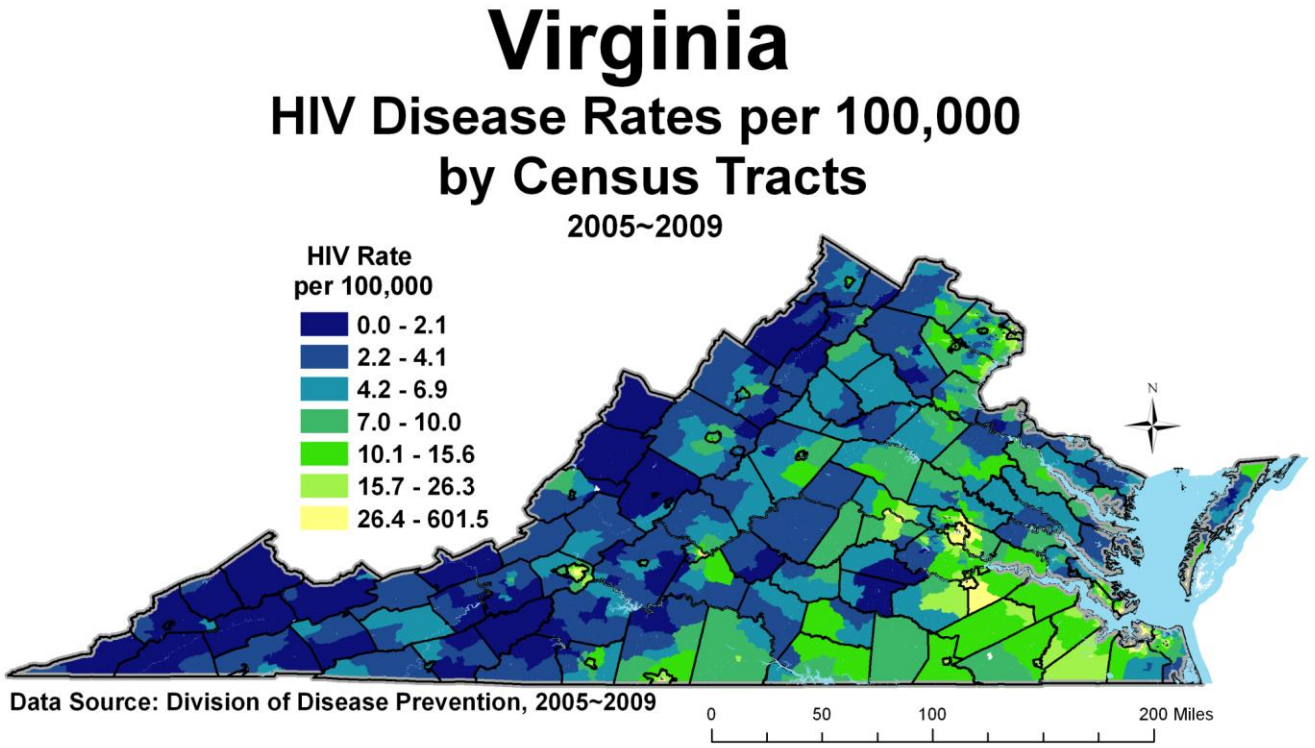


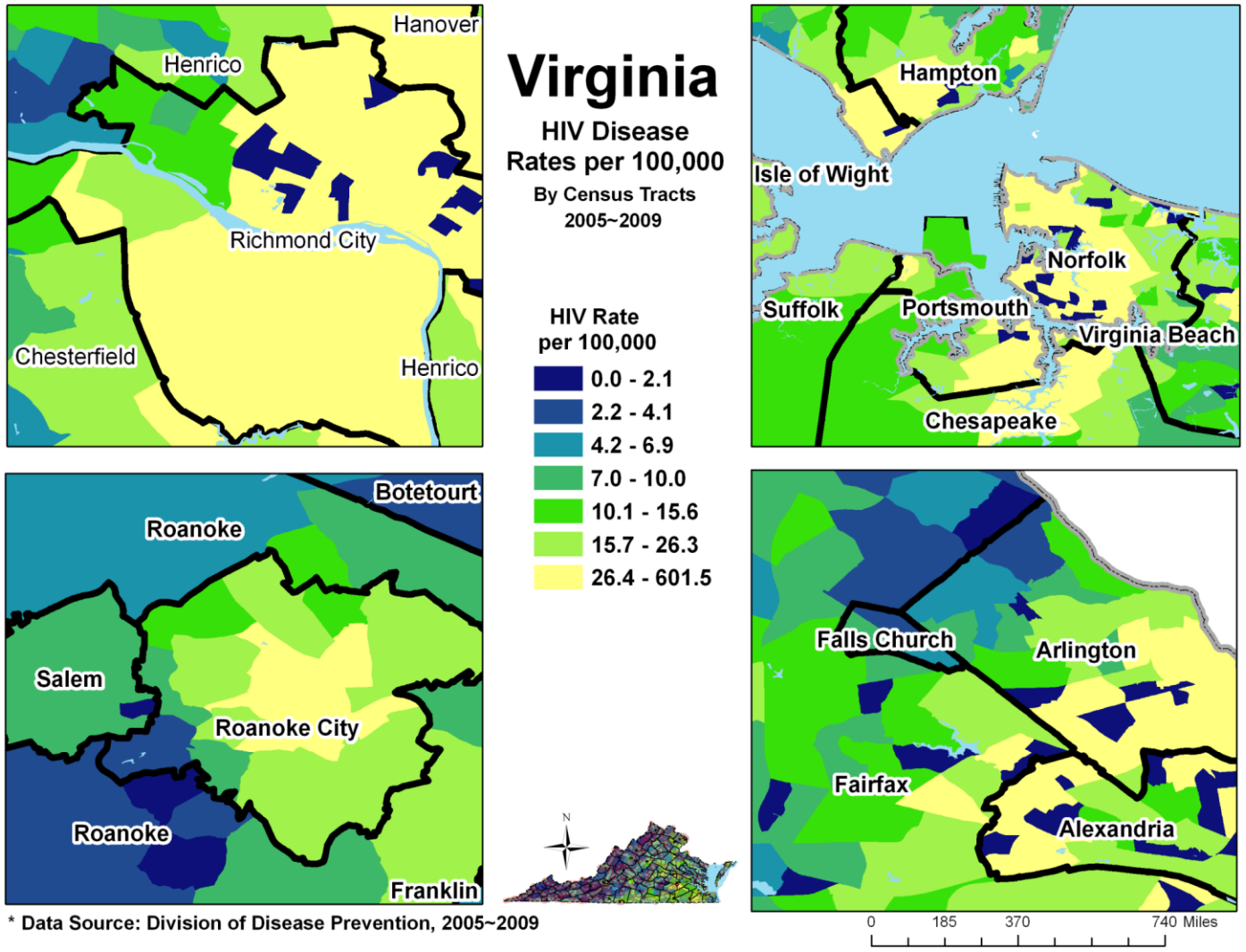
Appendix E

HIV/AIDS

The map shows HIV rate per 100,000 by census tract. The darker areas show low rate of HIV while the green areas show high rate of HIV.
There is high concentration of high HIV rate in the Southside Virginia, Eastern Shore, and Northern Virginia

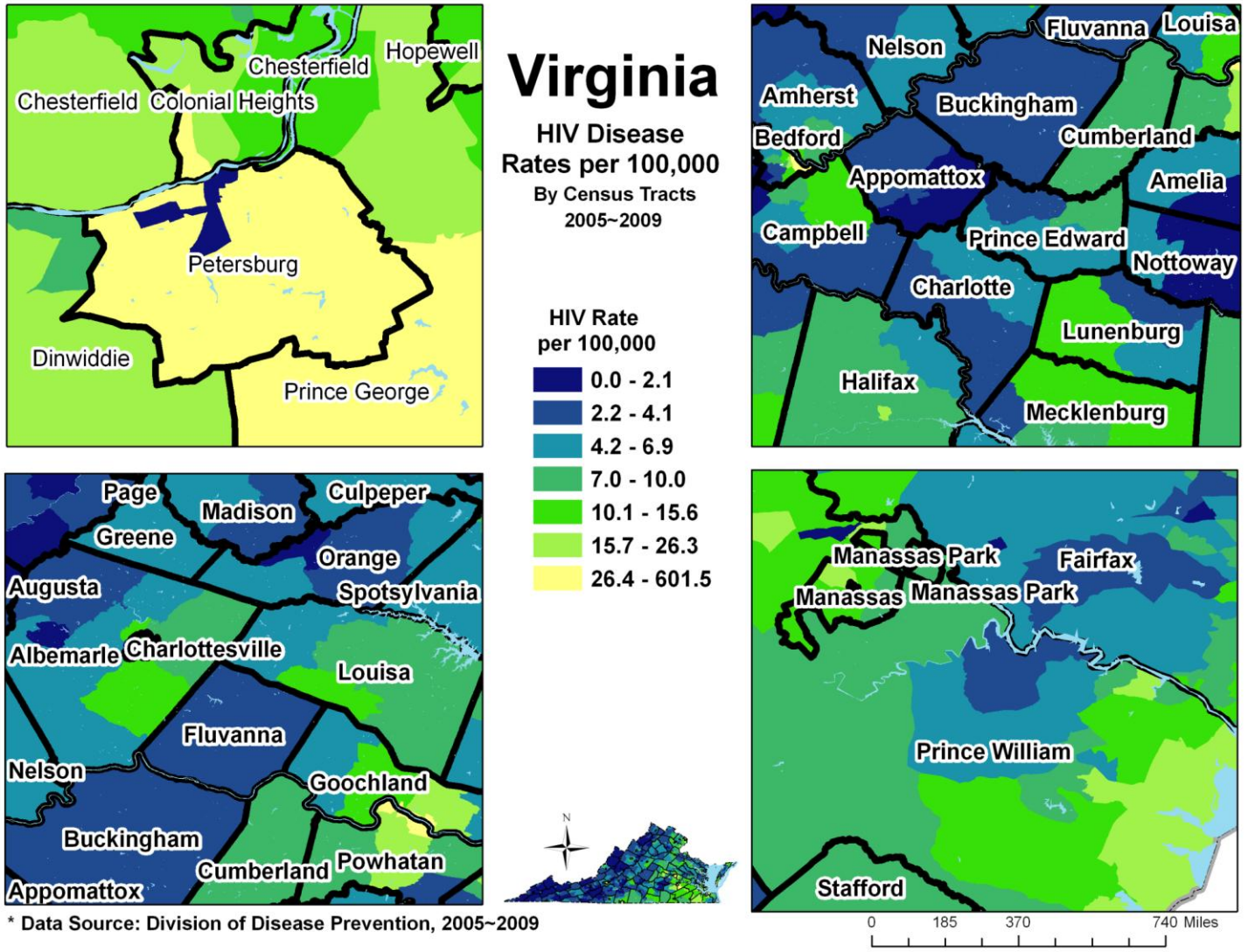


This map shows the Richmond metro area (upper left corner), Hampton Roads area (Upper right corner), Roanoke metro (Lower left corner) and Northern Virginia (lower right corner).
There is high concentration of high HIV rate in the Richmond City, Eastern shore, Roanoke City and Northern Virginia.



* Data Source: Division of Disease Prevention, 2005~2009

This map shows the Petersburg~Prince George area (upper left corner), Southside Virginia (Upper right corner), Cumberland~Goochland areas (Lower left corner) and Manassas in Prince William County (lower right corner). There is high concentration of high HIV rate in the Petersburg~Prince George area compared to the other areas on the slide.



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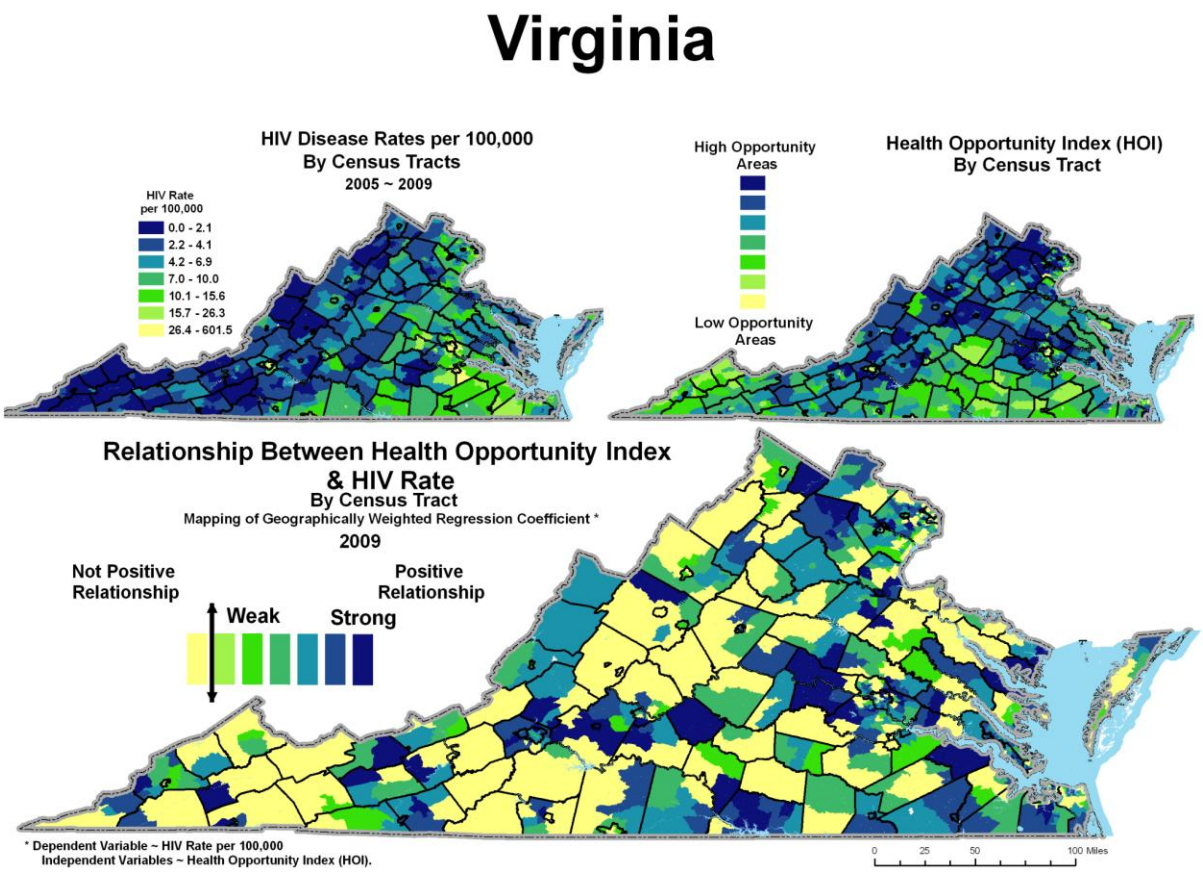
The right corner map shows the Health Opportunity Index and it can be seen that, Southwest and Southside Virginia, have low health opportunity (green areas) compared to the darker areas.

The left corner map shows the HIV Rate by census tract and again it can seen that Southside Virginia area have high rate of HIV compared to the Southwest Virginia.
The base map shows the coefficient of the interaction between the HIV rate and HOI and the dark areas show positive relationship while the yellow areas show no positive relationship.
Again, it is seen that, there is strong positive relationship between HOI and High HIV rate Southside area of the State.



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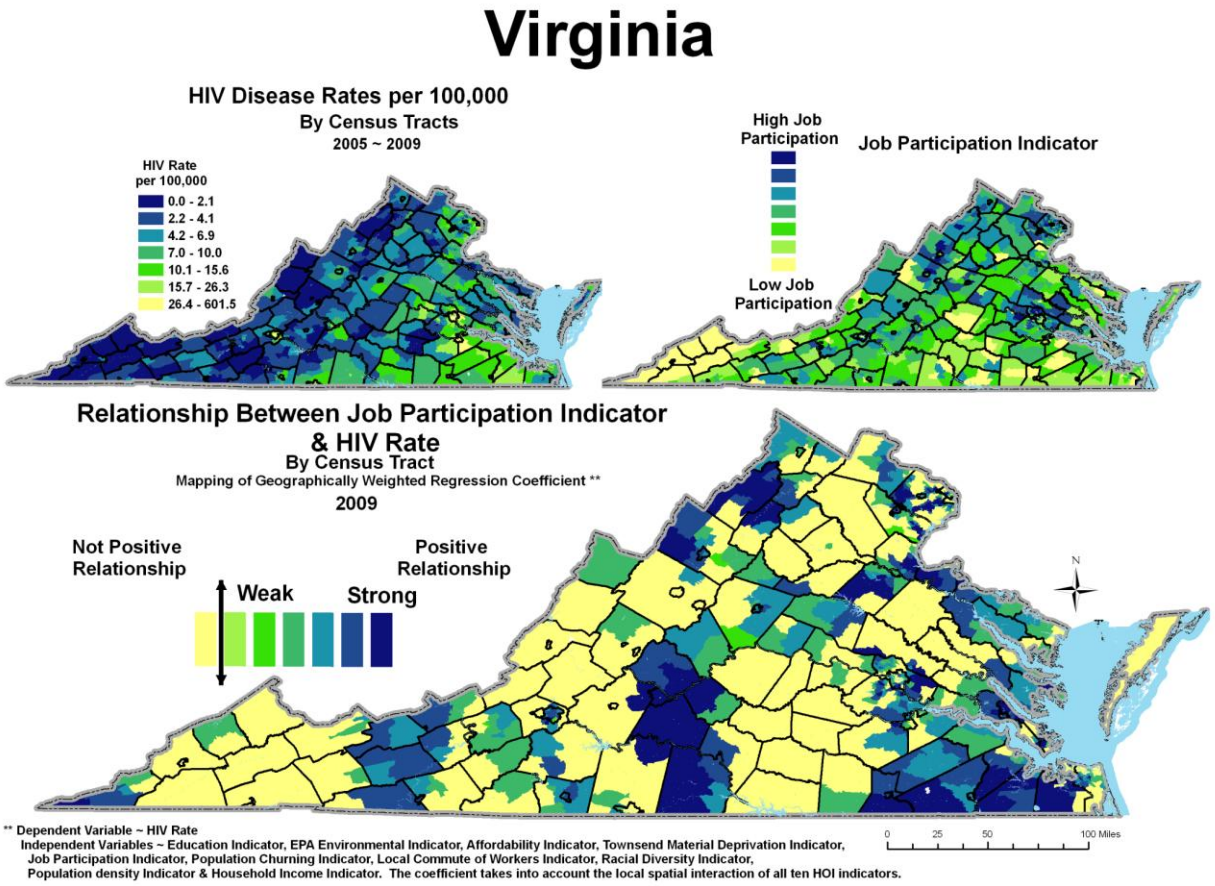
The base map shows the coefficient of the interaction between the HIV rate and Job Participation and the dark areas show positive relationship while the yellow areas show no positive relationship.



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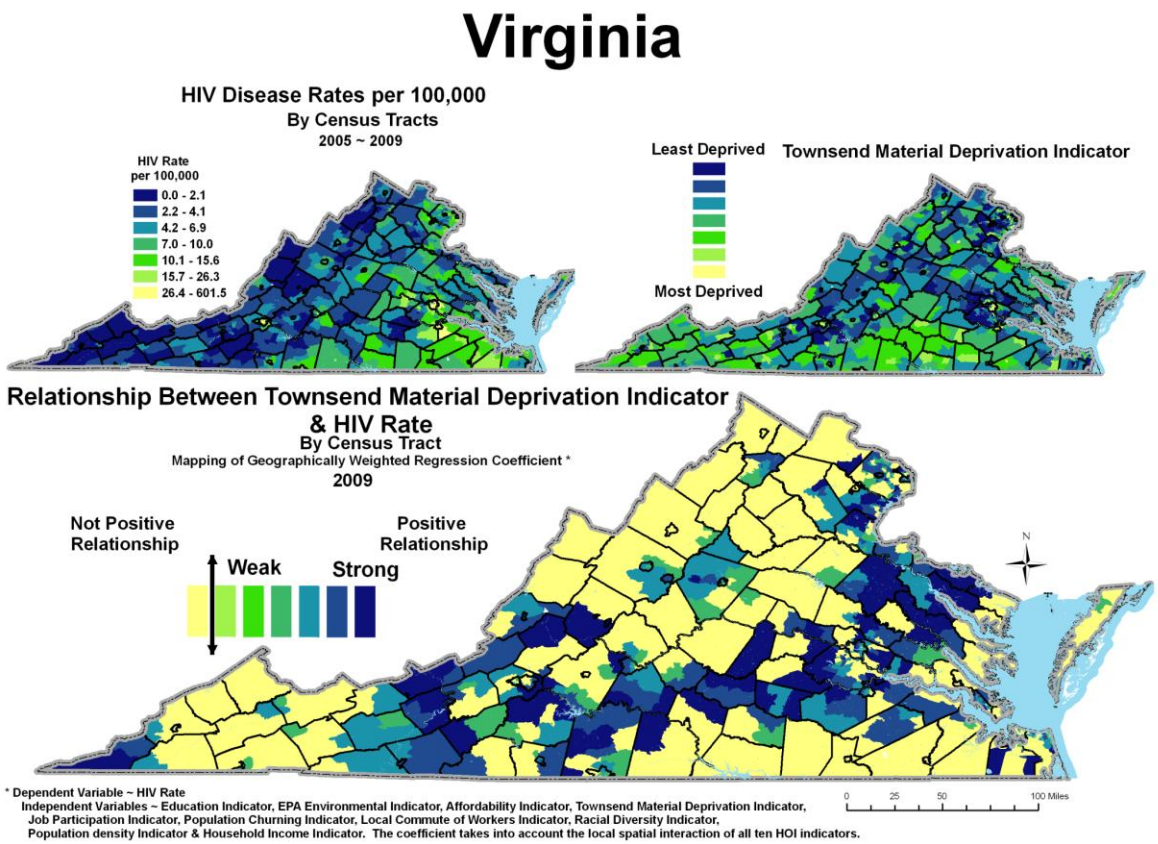
The base map shows the coefficient of the interaction between the HIV rate and Townsend Material Deprivation and the dark areas show positive relationship while the yellow areas show no positive relationship.



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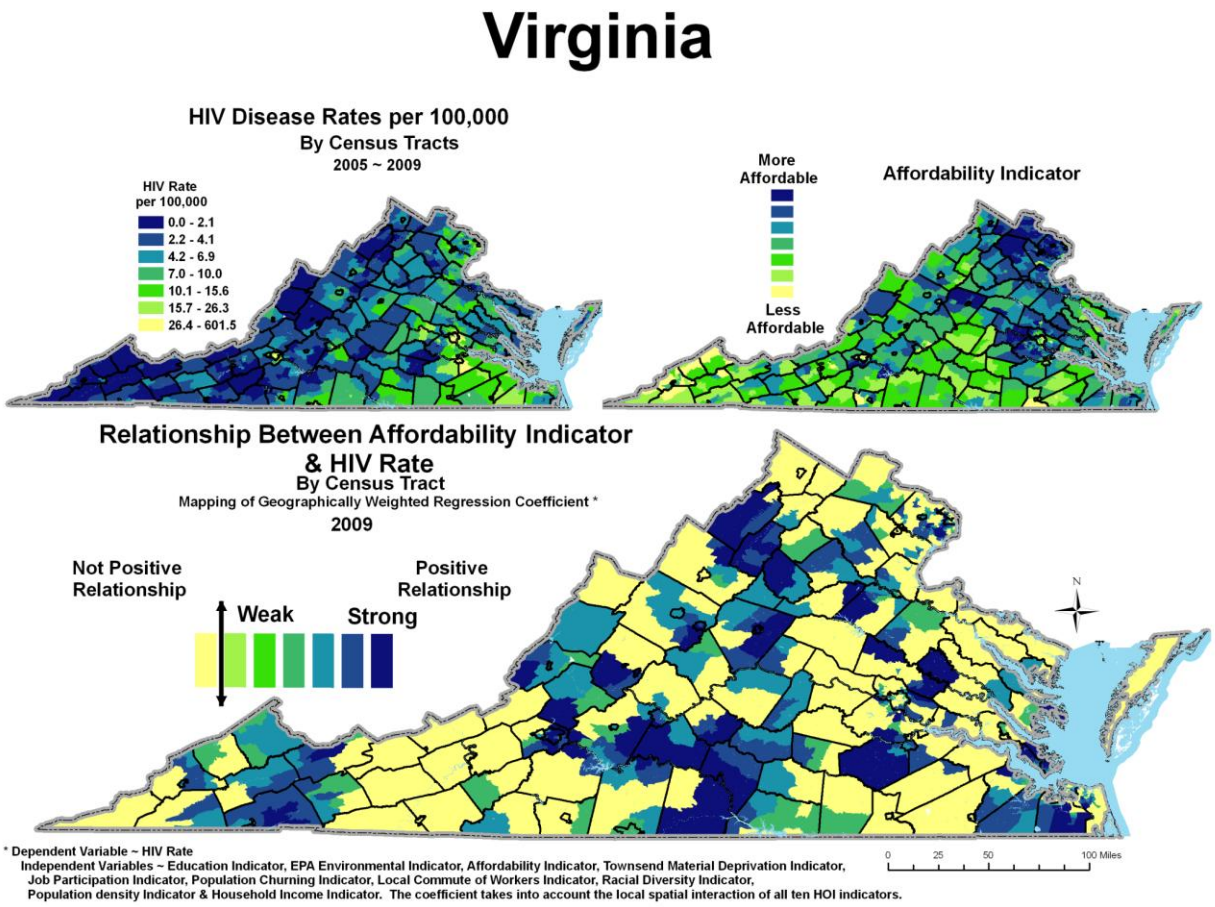

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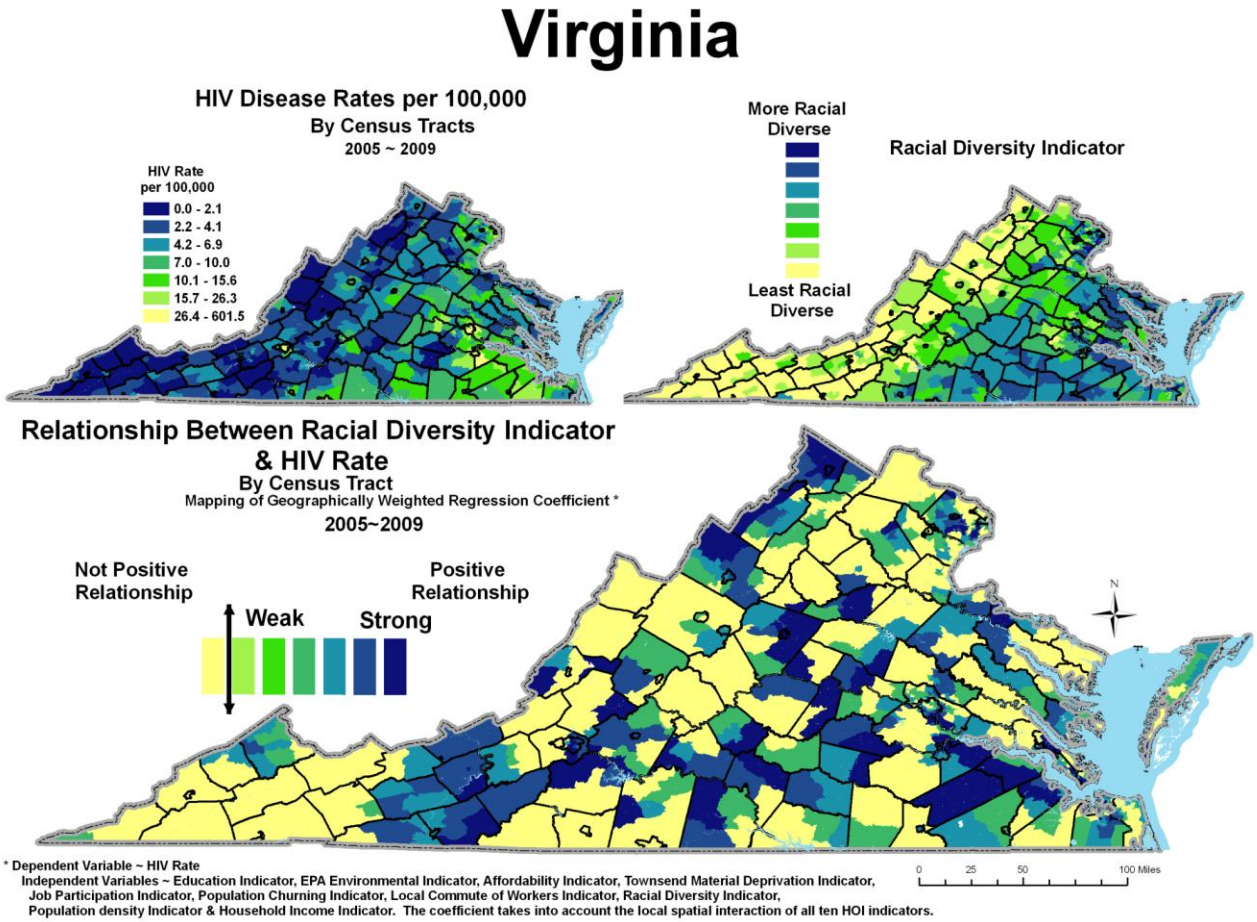
The base map shows the coefficient of the interaction between the HIV rate and Racial Diversity and the dark areas show positive relationship while the yellow areas show no positive relationship.



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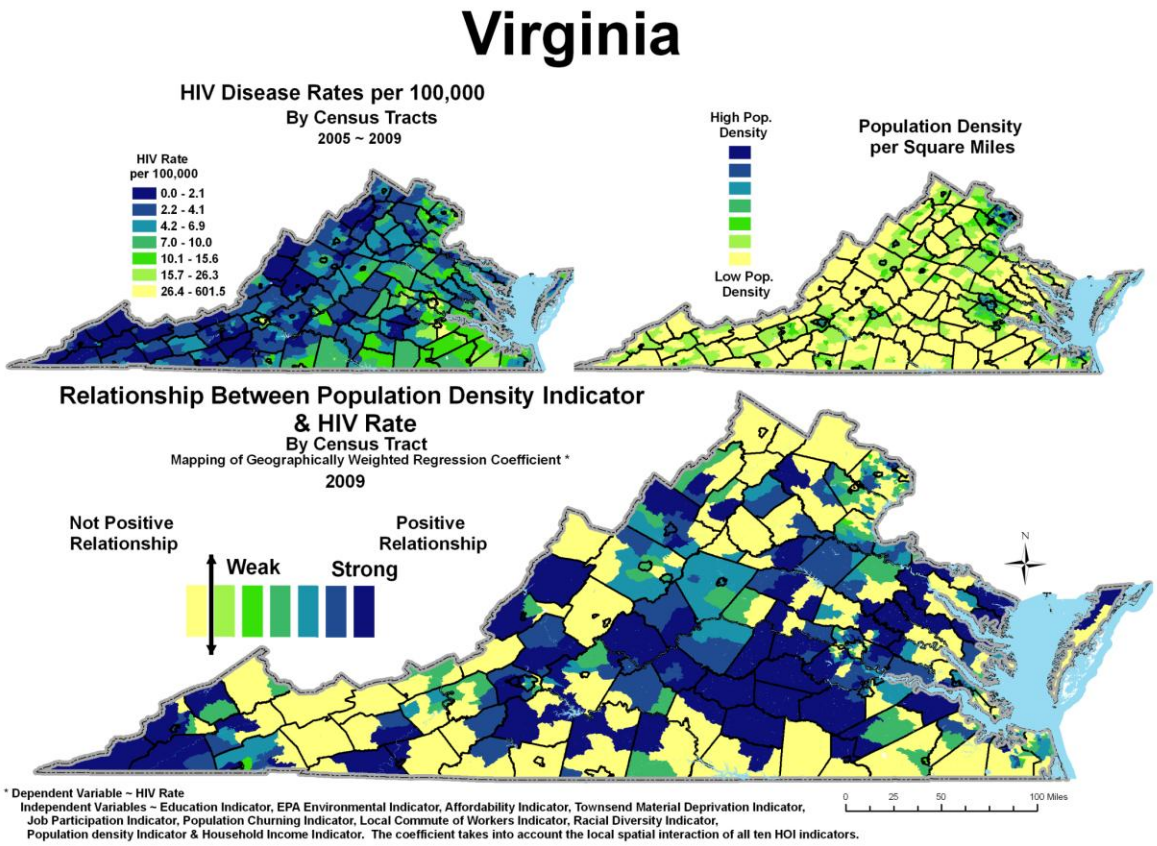

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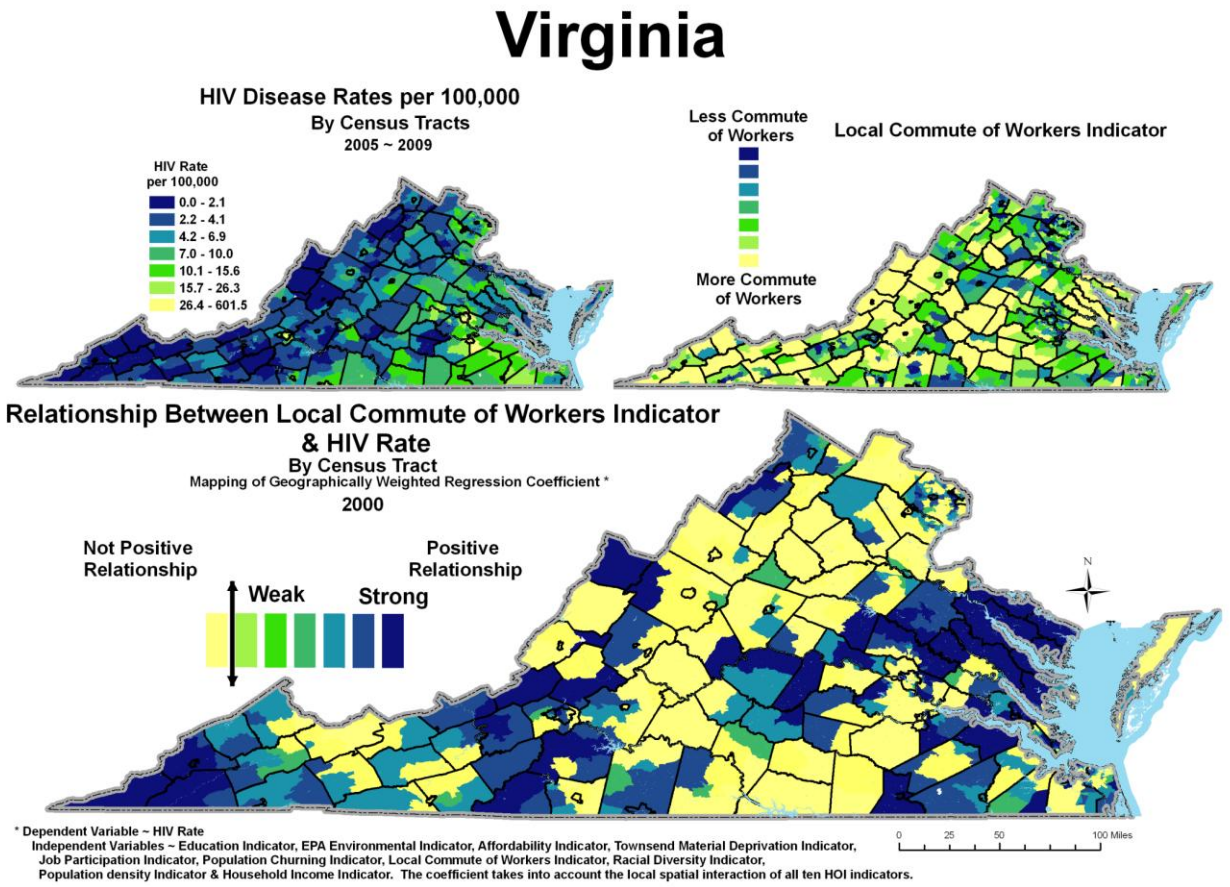

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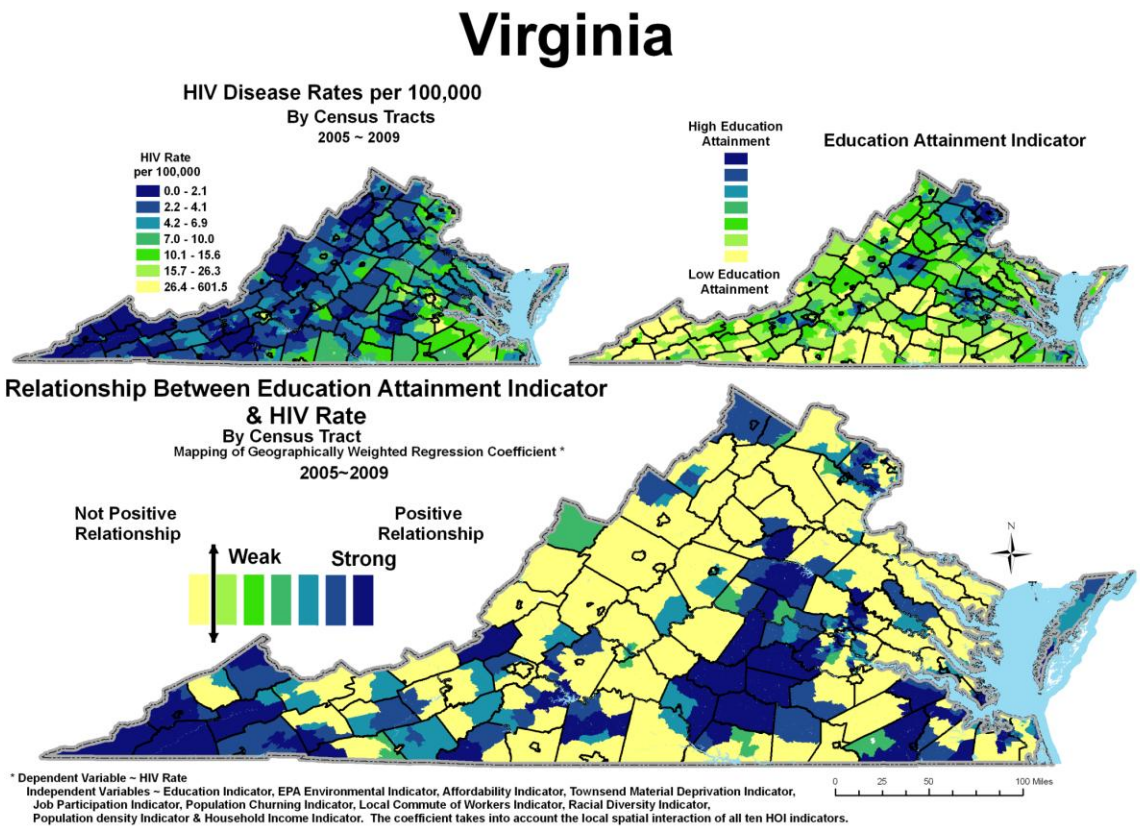

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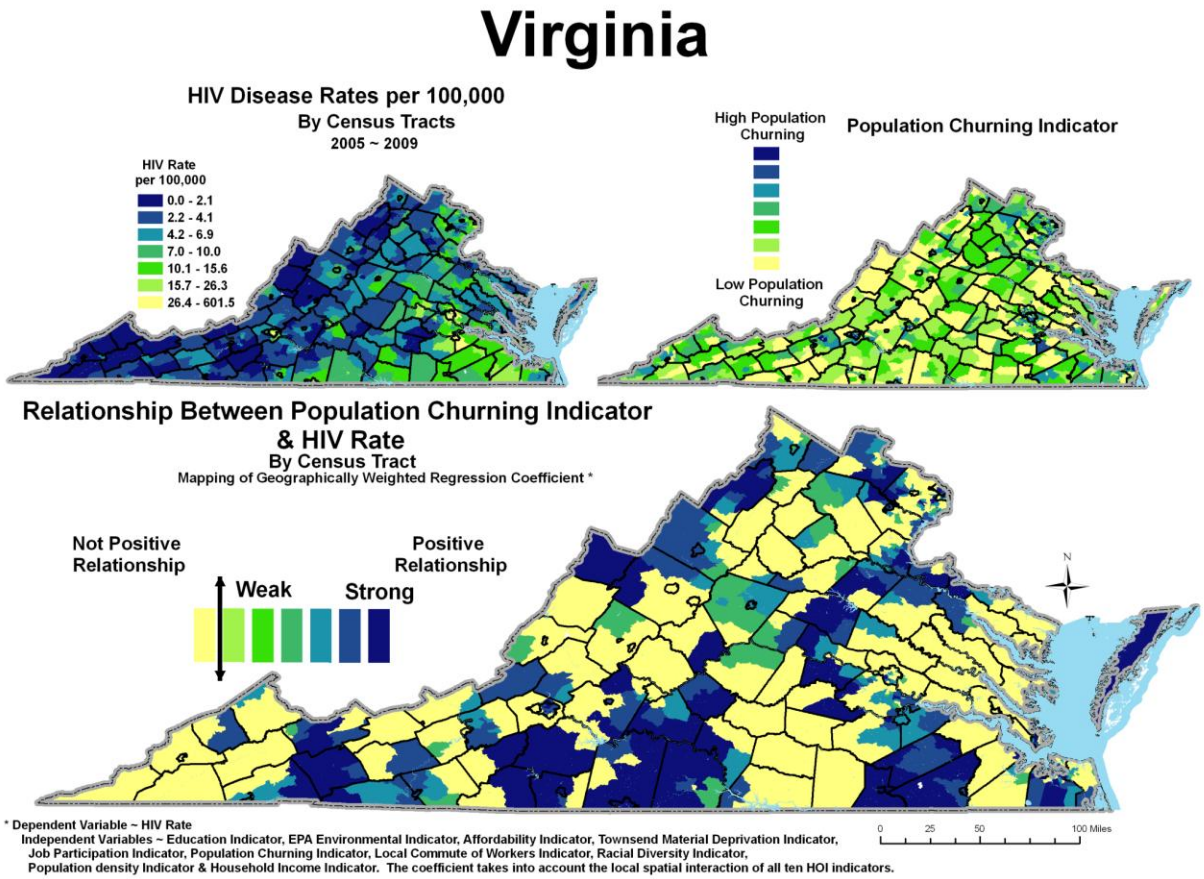

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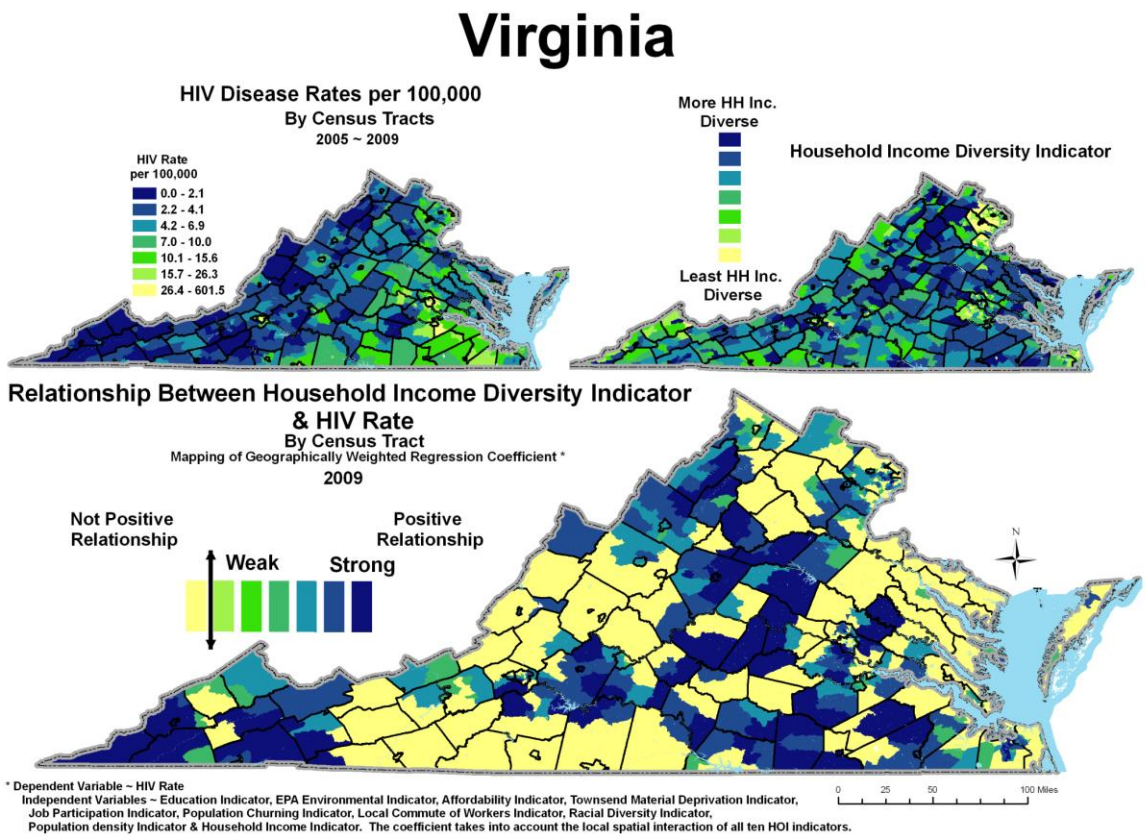

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