



# **ESRI Gulf Coast Updates Methodology: 2006/2011**

*An ESRI® White Paper • August 2006*

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# ESRI Gulf Coast Updates

## Methodology: 2006/2011

### Introduction

ESRI's 2006 updates include estimates of the demographic and economic effects of Hurricanes Katrina, Rita, and Wilma along the Gulf Coast. To estimate the impact of these 2005 hurricanes, ESRI investigated new sources of information gathered from disaster response agencies, news reports, and fieldwork. Some of this information is conflicting; all of it is subject to change. The 2006 estimates reflect information current as of January–February 2006.

Gauging the effects of the 2005 hurricanes has been complicated by the lack of information from ESRI's usual data sources. Estimates for 2005 commonly reflected a midyear date of July 1 before the storms. Databases that are updated continually have not been revised to incorporate the loss of population and businesses in the impacted areas because the situation is "too fluid." Aerial imagery can be misleading. For example, homes that were wholly destroyed along the Gulf Coast may show only a foundation or scattered debris. Homes that were flooded by the levee breaches in New Orleans are still standing, apparently untouched. Only the waterlines reveal the underlying damage to the homes. Measuring the demographic and economic consequences has proved to be a singular challenge. The data sources, assumptions, and methods used to estimate the change along the Gulf Coast are provided here.

### 2006 Step 1: The Loss

Hurricanes Katrina, Rita, and Wilma were record-breaking Category 5 hurricanes that struck the Gulf Coast in August, September, and October 2005, respectively. Katrina and Rita were the strongest hurricanes ever recorded in the Gulf of Mexico and among the top five Atlantic hurricanes. Wilma holds the number one position as the most intense Atlantic hurricane on record. Although these hurricanes were Category 3 or 4 when they made landfall, the storm surges extended from seven feet in Galveston, Texas, to above twenty feet along the Louisiana coast. Damage estimates range from \$9.4 billion for Hurricane Wilma to more than \$100 billion for Katrina, the costliest hurricane in history.

Given the magnitude of these storms and damage estimates approximated in billions of dollars, the question was how to estimate the effects of the storms on residents and businesses by block group in the impacted areas. News accounts of the storms provided the first estimates of the population displaced by the storms. Beginning with Katrina, the first storm of the 2005 hurricane "trifecta," the media reported more than one million evacuees from Louisiana, Alabama, and Mississippi. News accounts of the residents rescued after the storm and subsequent flooding in New Orleans varied from 58,000 to 62,000.<sup>1</sup> Whether these residents could not evacuate ahead of the storm or would not leave is unknown. Anecdotal evidence supports both causes. From approximately 185,000 households in New Orleans prior to Katrina, more than 27 percent had no

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<sup>1</sup> News accounts estimated 33,000 people rescued by the Coast Guard and 25,000 rescued by the National Guard. The Department of Homeland Security estimated the rescued population at 62,000.

vehicle and more than 25 percent had an income below the poverty level.<sup>2</sup> At least one in four households did not have the means to evacuate voluntarily. Many older residents, who remembered Hurricane Camille in 1969, assumed that they could ride out this storm. However, Katrina certainly had an effect on evacuation in advance of Hurricane Rita. The gridlock on Texas highways from Houston residents who evacuated was epic. Rescues after Rita were estimated between 350 and 1,000 people. No rescues were reported after Hurricane Wilma struck south Florida in October. There are no estimates of the number of residents who left ahead of these storms.

The estimate of more than one million people being displaced by Hurricane Katrina was provided by emergency relief workers and reported widely. To find more information about the damage and the population impacted by these storms, ESRI investigated the data available from the Federal Emergency Management Agency (FEMA) and the American Red Cross. Response to disasters requires information about the extent of damage to homes and the residents who may need temporary shelter and meals. To supply and staff emergency shelters, the Red Cross estimated housing unit (HU) damage from fieldwork and FEMA data. Structural damage was classified as

- Destroyed: Housing unit is gone, shifted on foundation, and so forth.
- Major damage: Housing is uninhabitable (e.g., roof missing).
- Minor damage: Housing unit is habitable but repairs are required.
- Affected: Property requires cleanup, not repairs.
- Inaccessible: The area(s) cannot be accessed to assess damage.<sup>3</sup>

The Red Cross report included housing units by type (single family, apartment, or mobile home) and damage assessment. Comparing its estimates to ESRI's 2005 housing unit estimates by county revealed some inconsistency. Following are housing units reported for selected counties:

County	Red Cross Damaged HUs	Percent Damaged	2005 ESRI HUs
Mobile County, Alabama	1,100	0.6	174,700
Cameron Parish, Louisiana	1,000	18.2	5,500
Orleans Parish, Louisiana	226,600	<b>106.2</b>	213,300
St. Bernard Parish, Louisiana	27,100	99.3	27,300
Hancock County, Mississippi	16,300	68.8	23,700
Harrison County, Mississippi	78,700	91.6	85,900
Galveston County, Texas	1,600	1.3	126,800
Monroe County, Florida	15,400	28.2	54,600

Clearly, there are some discrepancies in the data—compared to ESRI's 2005 housing units. For example, in Orleans Parish, the estimate of damaged or destroyed housing units exceeds the total housing inventory. Some inconsistency is to be expected between independent data sources; there are no perfect databases. Even the decennial census

<sup>2</sup> The percentage of households with no vehicle available or households with incomes below the poverty threshold are Census 2000 estimates for the city of New Orleans. The estimate of 185,000 households in New Orleans represents ESRI's July 1, 2005, update.

<sup>3</sup> American Red Cross, "Damage Assessment Collection Excerpts," November 2005.

counts are subject to error, or there would be no need for Count Question Resolution. However, when reviewing new or untested data sources, some consistency in the various estimates is an important clue as to the validity of the data. Greater geographic detail is necessary here, too. Damage at the block group level cannot be estimated with county data.

For a more precise picture of the damage to housing and displaced population, ESRI turned to FEMA data, which included maps of the impacted areas, damage polygons, and summary counts of applications for FEMA assistance. ESRI began the process with damage polygons that FEMA had compiled from surveys and aerial photographs of damaged areas after the storms. Because each polygon was attributed with a damage code, the first step was to assign the polygons to census blocks in order to link the damage assessment to demographic data. Shapefiles were appended using ESRI® ArcGIS® 9.1 and "united" with census blocks to assign damage codes to blocks. When a block was linked to multiple damage codes, manual review was used to assign a unique damage code to the block. Summary tables of blocks with damage codes were generated using ArcGIS 9.1 and exported as SAS databases for further analysis, using SAS® Bridge. The block tables were merged with revised Census 2000 block data, aggregated by damage code and block group, and applied to ESRI's 2005 block group updates to estimate population, households, and housing units by damage code.

FEMA damage codes are, naturally, different from the Red Cross damage categories. Damage assessments from FEMA include the following:

- Catastrophic: Most solid and all light or mobile structures were destroyed.
- Extensive: Some solid structures were destroyed; most sustained exterior and interior damage (e.g., roofs missing, interior walls exposed); most mobile homes and light structures were destroyed.
- Flooded.
- Moderate: Solid structures sustained exterior damage (e.g., missing roofs or roof segments); mobile homes were destroyed, damaged, or moved.
- Limited damage: Solid structures sustained superficial damage (e.g., loss of tiles or roof shingles); some mobile homes were damaged or displaced.
- Saturated.
- Possible or probable flooding.

To associate the condition of the housing with population displacement, more information was needed. Catastrophic or extensive damage is obvious—homes are destroyed or uninhabitable. However, damage due to flooding or possible flooding is not as apparent. Similarly, moderate or limited damage does not necessarily imply that homes are uninhabitable or that the residents have left. To learn more, ESRI relied on fieldwork. Neighborhoods in Orleans, St. Bernard, and Plaquemines parishes in Louisiana and

Hancock County in Mississippi were surveyed in February 2006 to address the following questions:

- Are the damage codes realistic?
- Are people living in neighborhoods with moderate or limited damage or in areas labeled saturated or possible flooding?
- How is recovery progressing?

Almost six months after Hurricane Katrina, the extent of the damage was stunning. Neighborhoods that sustained catastrophic damage showed piles of rubble in lieu of homes or bare foundations with steps leading nowhere. Extensively damaged homes were missing roofs and walls or had obviously shifted on their foundations. Flooded neighborhoods in New Orleans appeared to be untouched by the devastation, except for the waterlines and the spray-painted notes. Below the surface, however, was evidence that these homes had been under water for weeks. Interiors were completely damaged, and mold was pervasive. Flooded homes were still standing, but they could not be inhabited without extensive work.

Homes that were classified with moderate damage frequently displayed the characteristic blue tarps on the roofs, but they were livable. Like the lesser damage assessments (limited damage, possible or probable flooding, saturated), blocks that were classified with moderate damage showed signs of life. Some residents were clearly at home in these areas, although most homes were not occupied. Whether residents had ever evacuated was unknown. The goal, however, was to derive a current population estimate.

Because some neighborhoods were partially occupied, the next step was to get more exact estimates of the population that had relocated away from the impacted areas versus the population that chose to stay. This was accomplished by reviewing FEMA's applications for assistance. Summary counts of applications for assistance have been updated periodically since October 2005:

- October 2005: 2.39 million
- January 2006: 2.49 million
- February 2006: 2.54 million
- April 2006: 1.71 million

Compared to the reports of one million evacuees, the numbers appeared higher than expected. The initial count of 2.39 million also represented approximately 70 percent of all residents in the impacted Gulf Coast counties and parishes (excluding Florida). The explanation for the perceived discrepancies was found in a FEMA report. At the end of December 2005, FEMA was paying rental assistance to 685,635 households. "FEMA officials generally estimate three people per household as a rule of thumb."<sup>4</sup> Of course, an applicant for assistance is not necessarily an evacuee. Approximately 50,000 FEMA applicants were residing in Orleans Parish in February 2006. Fortunately, another source of data was available to estimate outmigration directly.

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<sup>4</sup> "2 Million Displaced by Storms," *Washington Post*, page A3, January 13, 2006.



The U.S. Postal Service (USPS) provided summary counts from their National Change of Address (NCOA) file. Specific to Gulf Coast areas impacted by Hurricanes Katrina and Rita, the counts showed both origin and destination ZIP Codes. The first file reflected households that had filed change of address forms by October 2005. The second file included change of address forms filed through December 2005. USPS plans two more quarterly updates of the households in specific Gulf Coast ZIP Codes whose residents filed change of address forms.

Comparing the outmigration, or displacement of the population, estimated from all of these data sources for the same counties finally yielded consistent estimates.

#### ■ Summary, by population

- Reported estimate of evacuees: more than 1 million
- FEMA polygons/2005 ESRI data: 1.1 million

#### ■ Summary, by households

- FEMA applicants for assistance: 846,000 households
- FEMA recipients of assistance: 685,000 households
- USPS outmigration: 405,000 households
- FEMA polygons/2005 ESRI data: 407,000 households

#### ■ Summary, by housing units

- Red Cross estimate of damaged/destroyed housing: 611,000 units
- FEMA polygons/2005 ESRI data on damaged/destroyed housing: 656,000 units

The only numbers that remain inconsistent are figures for the total FEMA applicant/recipient households. However, a household that applied for or received assistance from FEMA did not necessarily leave the area. Outmigration from the impacted counties was estimated using the FEMA damage polygons, ESRI 2005 block group updates, and USPS tabulation of households that filed change of address forms.

## 2006 Step 2: Relocation

Outmigration is only half the picture. To complete the population and household totals in 2006, the next step was to estimate the destination of evacuees, whether they returned to their homes or relocated elsewhere. The estimated destination of evacuees was based on the USPS tabulation of destinations from the change of address forms filed through December 2005. Immigration was calculated by county first, then apportioned to block groups. Return migration to impacted areas was assumed to occur first in areas with limited storm damage. Although fieldwork confirmed the existence of FEMA trailers in a small number of the more damaged neighborhoods, there were very few trailers in areas that were flooded or damaged extensively compared to the less damaged areas.

The net effects of movement in impacted areas are the 2006 population and household totals. The data represents the period of January–February 2006. Given the continued change in return migration and FEMA numbers through February 2006, no attempt was made to forecast change for another four months—to July 1, 2006.

**2006 Step 3:  
Characteristics of  
the Population**

The characteristics of movers were developed from their points of origin, first by block, then by block group. Among the areas that experienced a net loss of population and households, their characteristics were calculated by applying ESRI's standard techniques for updating age, race, Hispanic origin, income, and so forth, to smaller population/household bases.<sup>5</sup> The challenge was to estimate the change in characteristics among destination areas. Many evacuees tried to settle as close to their homes as possible, which created a major influx of evacuees in nearby towns. Under these circumstances, evacuees could create significant changes in the profiles of destination communities.

To estimate the effect, a sample group of evacuees was built that included the characteristics of the population in 2005 from the areas that experienced a loss of population. The attributes of the evacuees were added to the communities that served as destinations. However, some exceptions to this approach had to be developed, especially for labor force characteristics. Evacuees who were employed prior to the storms were not necessarily able to locate similar positions. When they left their homes, residents left their source of employment, too. Beginning in October 2005, the Current Population Survey (CPS) added questions related to the population displaced by the hurricanes to its monthly questionnaire. The goal was to estimate the number of evacuees as well as their displacement and employment status. Because the CPS is a household survey, these posthurricane estimates do not represent the total evacuee population. People living in makeshift or temporary residences—such as hotels, cruise ships, churches, or shelters—are, by definition, excluded from the sample.

As of May 2006, the CPS identified more than 1.1 million people who evacuated from their homes in the Gulf Coast due to the storms. An estimated 40 percent still had not returned home. Overall, 62 percent are participating in the civilian labor force, but the rate of unemployment is close to 15 percent. The difference in unemployment between evacuees that returned versus those still displaced is substantial—6.5 percent compared to approximately 25 percent.

ESRI's civilian labor force updates include the changes in the population bases as well as their employment status. However, the 2006 updates of employment status reflect the consequences of the storms only to the extent that the changes were covered by the Local Area Unemployment Statistics (LAUS) program from the Bureau of Labor Statistics (BLS). Where the BLS included modifications to its state and county models as a result of the hurricanes, ESRI incorporated the adjustments. LAUS population adjustments were made at the state level with the help of the U.S. Post Office NCOA data. LAUS small area models also included information from unemployment insurance claims.

Due to insufficient input data to produce reliable estimates, LAUS has not published civilian labor force estimates for seven Louisiana parishes since September 2005. These parishes are Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. John the Baptist, and St. Tammany. Because these seven parishes define the New Orleans-Metairie-Kenner, Louisiana, Metropolitan Statistical Area—an area for which LAUS has continued to publish estimates—ESRI was able to derive updated employment status estimates for the component parishes from the posthurricane trends in the metropolitan area.

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<sup>5</sup> The methods used to calculate the characteristics of population and households are addressed in ESRI's 2006/2011 Demographic Update Methodology.

Although employment status directly affects income for most households, the impact of the storms on household income was not incorporated in any of the data sources used to update income. Since the income updates in 2006 actually reflect income received in 2005, the overall effect may be an overestimate of annual income for selected households. The financial impact of the storms is likely to affect net worth more than annual income because most households derive most of their net worth from the value of their homes.

ESRI tracked the change in home value through December 2005 using the House Price Index from the Office of Federal Housing Enterprise Oversight and complemented this information with local sources on home sales after the storms. Homes that were damaged beyond the point of being inhabitable are not included in the 2006 update because home value is updated only for owner-occupied housing units. After adjusting for the hurricane damage, median home value increased in some areas. A disproportionate destruction of homes with a lower value in areas of Orleans Parish, in particular, drove the increases in median home value. In some hurricane-affected areas, particularly in New Orleans, the number of homes sold has actually increased relative to comparable periods prior to the hurricanes. The demand for some of these homes resulted from bargain hunters seeking an opportunity.

Finally, ESRI had to adjust the net worth to income relationship for homeowners in impacted areas to account for changes in the posthurricane value of residential housing stock. The primary step in constructing net worth estimates is to establish the relationship to household income by age of householder and by tenure. Tenure has served as an important differentiator in net worth, especially with the growth in homeownership and home value since 2000. A household's real estate portfolio has been an important, and growing, component of net worth. Consequently, when the hurricanes destroyed or flooded thousands of residential dwellings, the impact on household balance sheets was significant.

## 2011 Forecasts

There are no precedents to the effects of Hurricanes Katrina, Rita, and Wilma on the Gulf Coast. Hurricane Andrew held the record for the costliest hurricane damage prior to 2005, and subsequent recovery in Homestead, Florida, took approximately five years. The challenges that face the communities along the Gulf Coast simply cannot be measured with the usual yardsticks. The degree of damage, and subsequent recovery efforts, vary widely from one area to another.

For example, six months after the storms, most of the streets in New Orleans were cleared; however, street signs and traffic signals were intermittent, at best, and piles of rubbish remained along many thoroughfares. Repair work on the levees was in progress, but flooded homes were vacant and untouched. Block after block of vacant neighborhoods show the watermarks but no sign of recovery. Along the Mississippi coast, the recovery was more conspicuous. Although some lots remained untouched after the storm, bulldozers were clearing the debris, and many lots had already been cleared.

Therefore, it was assumed that most communities would recover by 2011. The exceptions are Orleans Parish and St. Bernard Parish in Louisiana. The extent of destruction in these parishes will certainly take longer to repair, and the recovery that was evident six months after Hurricane Katrina provided an insufficient base to forecast change over the next five years. Therefore, ESRI did not calculate 2011 forecasts for either parish. The estimates

that were developed for 2006 are carried over to 2011. This does not mean that recovery is not expected—only that it will take longer to effect and to measure.

Efforts to repair and rebuild the impacted areas along the Gulf Coast do not guarantee the return of the residents who evacuated due to the storms. The extent of return migration is another variable factor in the 2011 forecasts, since it is still changing. It is likely that many former residents do not yet know whether they will return. Given the continuous change in return migration to date, the probability of return migration through 2011 was set at 50–50. There is not enough information yet to change the probability of return.