THE NATURAL DISASTER VULNERABILITY OF AMERICA'S URBAN BLACK POPULATIONS

A report prepared for the National Black Caucus of States Institute

by

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Surely *Natur*e is blind to race or social class. Why then do these factors appear so important in determining the most tragic social outcomes of natural disasters?

NATURAL EXTREMES AND HUMAN CONSEQUENCES: A GLOBAL PERSPECTIVE

Natural hazards such as severe storms, earthquakes, floods and droughts occur in well-documented patterns in space and time throughout the globe. Scientists have studied these patterns for decades and their origins are now largely understood. Earthquakes, for instance, occur along well-defined bands that mark the boundaries where shifting "plates' of the Earth's outer shell collide[1]. Seismologists understand why these bands occur where they do, their locations are accurately mapped and their recurrence intervals are fairly well known[2]. It is very clear that some parts of the Earth are at great risk of experiencing destructive earthquakes while others are at negligible risk. Nobody should be surprised if a large earthquake occurred in northern Turkey, but we should be astonished if one occurred in Ireland. Similarly, aided by modern satellite observations, meteorologists and climate scientists have developed a very refined understanding of the nature of weather systems and can describe with considerable confidence the regions and time frames in which extreme events such as hurricanes are likely to occur.

Human settlement patterns are driven by many factors. Historically, people have settled where adequate food production and other life support systems are available but many other factors -- social, political, religious and economic – also drive settlement patterns. As a result, wittingly or unwittingly, millions of people now reside in places where natural hazard exposure is quite high and thousands of lives are lost annually in natural disasters. Coastal regions, and especially coastal cities, are particularly favored and as urban centers swell, more and more people are becoming exposed to natural hazards.

People and *Nature* intersect to create what we call natural disasters[3] and their impact on some groups of people are more direct and more severe than on others. Natural extremes do not seek out poor communities, but the poorest are the most severely impacted and, because their coping mechanisms are weaker than those of richer communities, the long-term consequences are often much greater[4]. Poverty causes people to be vulnerable to disaster impacts. Inadequate recovery further contributes to continued vulnerability. Disasters vulnerability is therefore both an outcome of poverty and a contributor to poverty. This situation is often referred to as a poverty trap, a situation in which the poverty condition itself is responsible for further poverty.

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[1] Textbooks used at grade school level now contain descriptions of plate tectonics, the theory that provides the explanation for the observed pattern of earthquakes.

[2] There is a known power law scaling relationship between the repeat intervals of earthquakes and their magnitude know as the frequency-magnitude relationship.

[3] In general a natural event that is classified as a disaster is one that overwhelms the capacity of the effected population to cope without external intervention.

[4] There are somewhat perverse effects as well. Because the wealthy tend to be insured they often remain and rebuild in hazardous areas, middle class people will relocate and poorer people will actually in-migrate to these areas because rents are cheap (see V. Kerry Smith and co-authors, "Adjusting to natural disasters" in Journal of Risk Uncertainty, 33, p.37-54, 2006 that is based on a study of Hurricane Andrew in Florida)

The impacts of disasters are widely variable in terms of loss of life and economic consequences. Economic growth requires transportation infrastructure like roads, rail, bridges and ports. It requires healthy people so hospitals and clinics are important, and it requires educated people so schools matter a great deal. A natural disaster can instantly wipe out decades of capital stocks of these critical infrastructures that were acquired gradually through slow development gains. Poor people (and poor countries) have low savings rates and are often deeply indebted so their ability to recover critical capital losses relies on outside assistance. Although assistance is often pledged in large enough amounts to ensure recovery relief amounts that actually arrive are typically much less than the pledges. Countries with large debt burdens cannot borrow to finance rebuilding. Furthermore, poor areas typically rely on a small number of industries. In many instances these industries are themselves likely to be deeply impacted by disasters, but even if they are not, they cannot accelerate their output to provide tax revenue for rebuilding. The bottom line is that the base conditions of poor areas tend to make them more susceptible to the impacts of disasters and have a more difficult time rebuilding than areas with stronger economies. Prosperity appears to bring disaster resilience.

Other factors are involved. Disaster losses are greatest in countries where educational attainment is low, corruption is endemic, financial systems are weak, and governments are large and bureaucratic[5]

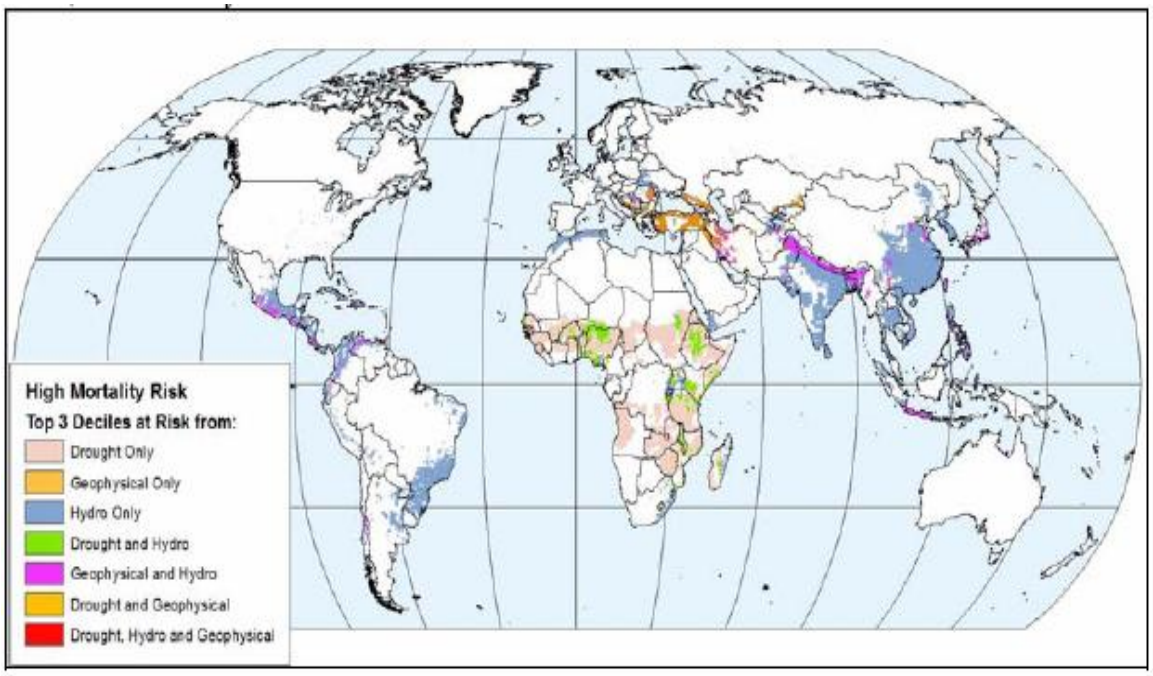
Just how grave the risk is that natural hazards pose to human populations has been brought into focus by two recent studies, one by the UNDP[6] and the other by the World Bank.[7] Each independently produced major global assessments of disaster risk. They show that disasters in poor countries demonstrably take more lives in both absolute and relative terms -- more people are killed in total and more people are killed as a proportion of population.

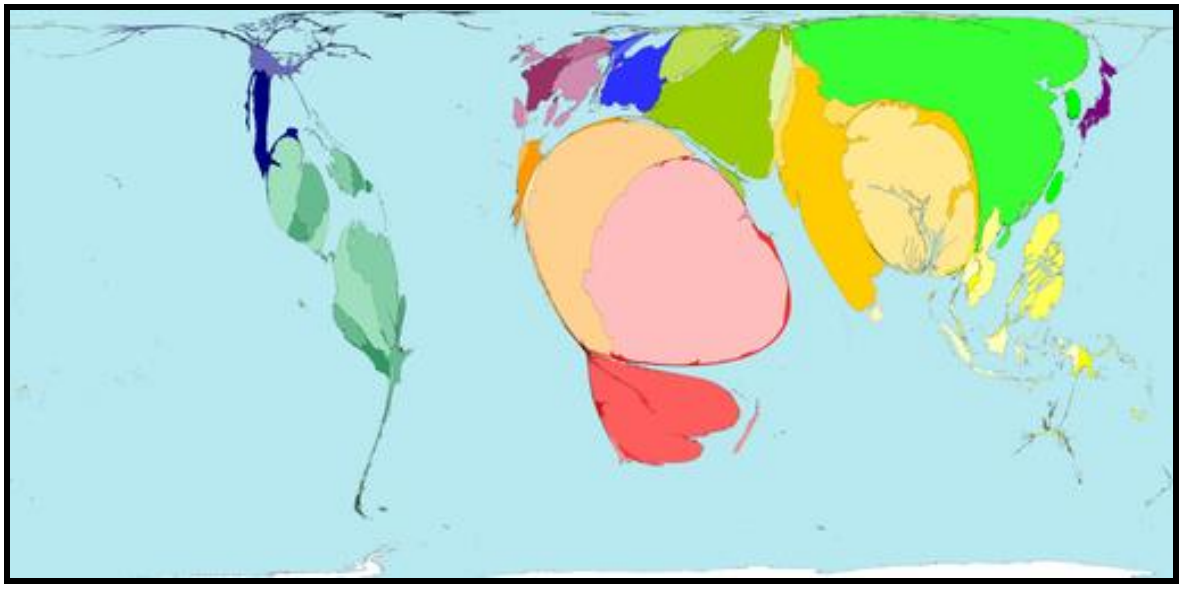
The risk of dying in a disaster is much higher in poor areas. For instance, citizens of New Zealand and of Morocco have roughly equal levels of exposure to flooding events, yet the mortality risk for Moroccans is two orders of magnitude higher than that of New Zealanders. Alternatively, the flood mortality risk for people in Botswana and in Germany is roughly the same although German's exposure level is three orders of magnitude greater. Simply put, these studies show that the poorest are the most vulnerable among us.

[5] A recent study by Hideki Toya and Mark Skidmore "Economic development and the impacts of natural disasters" in Economics Letters, 94, 2006; analyses these factors globally in a simple regression approach that points to these factors.

[6] Disaster risk reduction: A challenge for development; UNDP, 2004

[7] Dilley et al, 2005; World Bank Disaster Hot Spot report





These two maps illustrate the way in which poor people are more prone to mortality risk than populations living in more developed countries.
The upper figure shows the world map in its correct geographic proportions and depicts the regions where people are at greatest mortality risk from various types of natural extremes and combinations of extremes. The information is from the World bank's Disaster Hot Spot report.
The lower map uses essentially the same data but emphasizes the impact on certain areas by the devise of distorting the shape of countries in proportion to the total number of disaster victims. Note how Africa becomes massively inflated in this presentation (worldmapper.org).

Financial loss data can be deceptive. Typically, insured property losses are quickly assessed but the poor are seldom insured so their property loss goes unrecorded. Country scale economic losses in poor countries can seen small in absolute terms, partly because so much of the economy in such countries is informal, but in comparison to the size of the poor country economy it can be very significant. Rebuilding without insurance benefits can be very difficult so disasters tend to be absolute set backs that may take generations to recover from, only to be faced by the next disaster.

Both nationally and internationally, the effect of natural disasters is greatest on the poor. Where people live reinforces their risk. These are the places where wealthier people have learnt not to live—steep hillsides that easily give way to landslides after soaking rains such as the barrios around Caracas, flood-prone riverbanks, and swamps.[8] Add to this the fact that the poor cannot afford to construct strong housing, are less likely to receive warning of impending extreme events and have minimum capacity to escape, and the recipe for catastrophe is complete. Most disaster victims worldwide live and die in these settings.

HURRICANE KATRINA – A POOR WORLD CATASTROPHE IN A RICH COUNTRY.

The events of August 29th 2005 in New Orleans and the Gulf Coast, and in the days and weeks that followed shone a harsh light on some uncomfortable social realities that echoed the fate of poor people worldwide. The unsettling truth is that we have amongst us in the United States people who are as vulnerable to *Nature's* extremes as anyone in the world today.

Much has been written about Hurricane Katrina, and much of it seeks to assign blame for the desperately inadequate response and its consequences on people's lives. There is little purpose in reiterating or extending that discussion. What we consider to be very important is to dispel the notion that Katrina was an extraordinary meteorological event and hence is unlikely to recur. Hurricane Katrina built to a category five event as it crossed the Gulf of Mexico. As it approached the coastline near New Orleans it had abated somewhat to a category four and quickly dropped to category three upon making landfall. In the context of historic of hurricanes over the last 150 years or so Katrina was neither unusual in magnitude nor in its track. What *was* unusual was less the devastation that accompanied the hurricane than the resulting death toll and the profile of those who died.

Typically, hurricanes that make landfall in Florida and the Gulf Coast cause very large property losses but almost insignificant loss of life. Ample warning is generally available, people evacuate inland as it is well understood that hurricanes reduce their intensity over land, they wait it out and return to assess the damage to their properties. Few people if any die when considered in proportion to the number of people in the impacted region. Some forms of mortality risk, like those associated with violent crime, may actually decline as cities empty of people. Hurricanes in wealthy countries like the

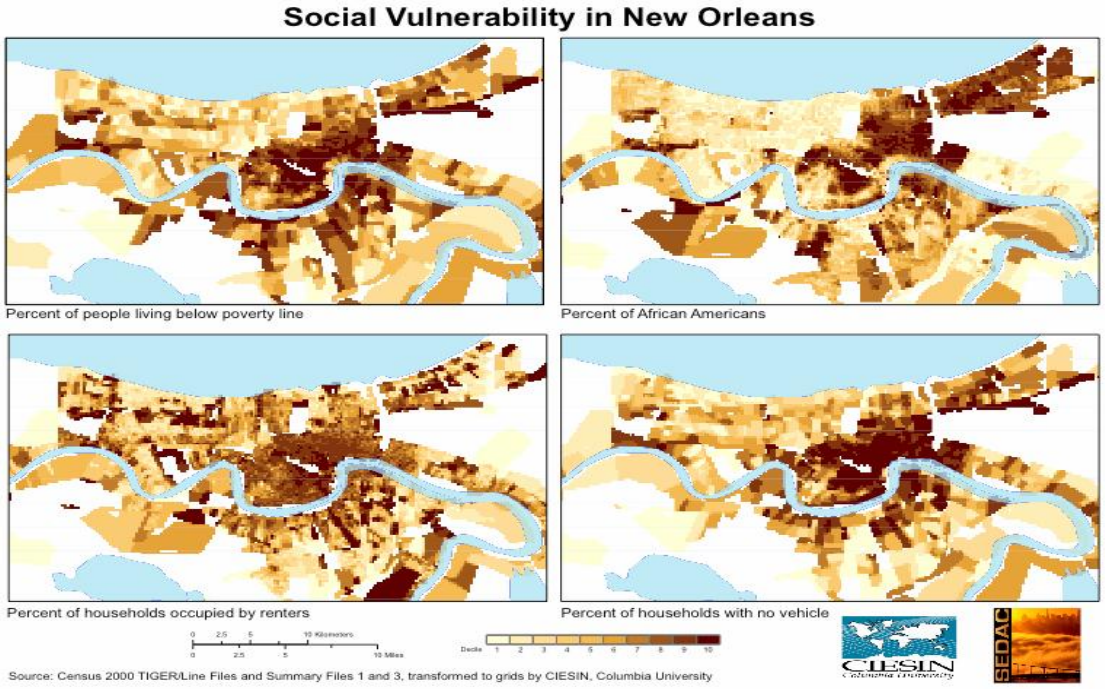
[8] In *Planet of Slums* M. Davis paints a stark picture of the rapid growth of slums in developing countries and details the vulnerabilities their residents face to all forms of daily crises including natural disasters.

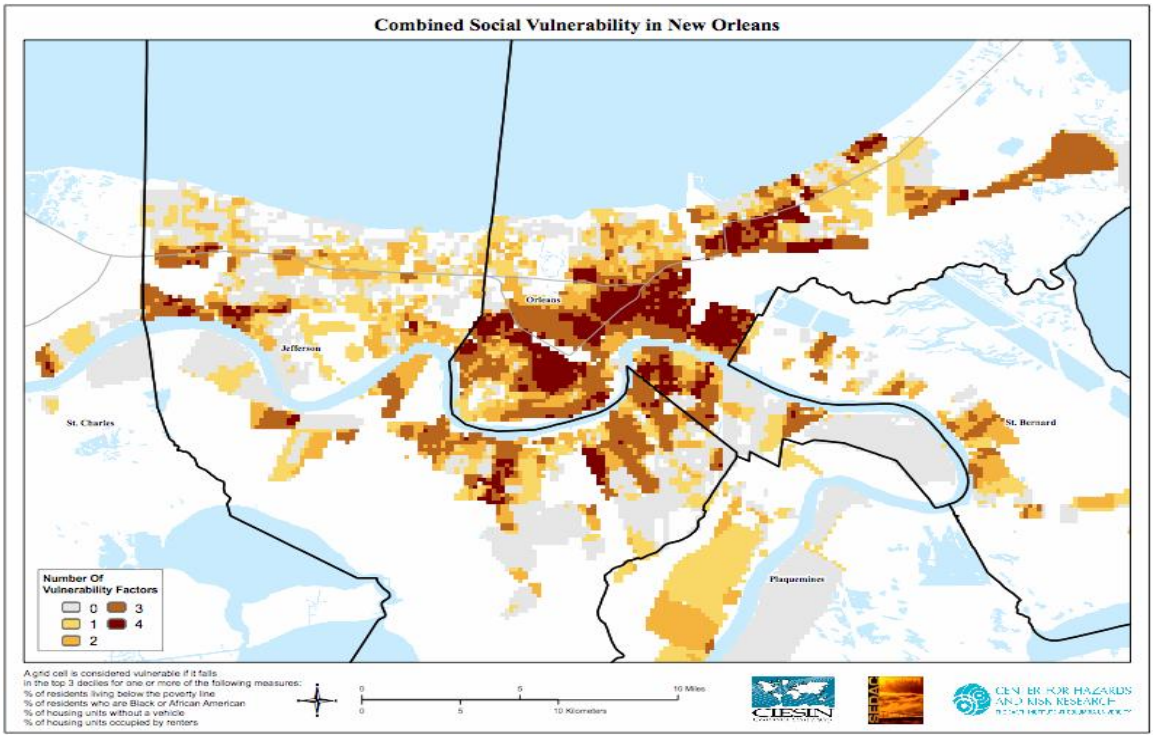
US tend to be huge inconveniences but not a significant threat to lives and livelihoods. They are seldom more than a temporary set back to the economy because most property is insured allowing people to rebuild relatively quickly. In fact, there may be perverse benefits to the building and building supply industries.

Why was Katrina so different? The chief differentiating characteristic of Katrina is that it impacted an area that included one of the largest concentrations of poverty in the US. New Orleans today is a "majority minority" city with the former white residents largely absent from the inner city. Most measures of well being such as household income, automobile ownership, home ownership, educational attainment, and health status describe a population that is near the bottom of the social ladder in the US. Moreover, these disadvantaged people are concentrated in relatively dense communities whose names, such as the Lower Ninth Ward, are now very familiar to everyone. Katrina affected many other areas because of its immense size, but the areas of concentrated poverty accounted for the greatest numbers of fatalities. There remains a common misunderstanding that the areas where fatalities were concentrated were those that lay at greatest depth below sea level and that of Lake Pontchartrain. The relatively wealthy sections of Lakeview and Gentilly lie at about the same depth and some parts are at greater depth. The Lower Ninth does not lie at a lower elevation but was created when the former Ninth Ward was divided by the Industrial Canal that breached after the storm passed. Living in close proximity to a levee put people at far greater risk than living below sea level. Living below the poverty line sealed their fate.

Just how many people died, and the causes and circumstances of their death may never be known. We have attempted to estimate the total number of deceased victims in a novel way by creating an open access Web tool that allows people to provide the names of people they consider to be victims and describe something of their lives. To these personal entries on the site http://www.katrinalist.columbia.edu/ we will add the official records from relevant state authorities in the affected regions. The reason to take this two-pronged approach is that official records likely underestimate the true totals. There is first an issue of definition in that people die from a variety of causes that may not appear to be directly related to the hurricane. Thus a person who died in traffic accident attempting to escape, or someone who dies of a prior condition that was fatally aggravated by the trauma of the hurricane may not have causes of death as they appear on death certificates that would be clearly related to the hurricane. One person is known to have committed suicide in the Superdome – was that person a hurricane victim? Perhaps more contentious is to ask if those shot by police for looting should also be considered hurricane victims.

There is also a question of time frame. How long after the hurricane can deaths be attributed to the disaster? The katrinalist web site now includes many names of elderly people who had been displaced several times and lost continuity of health care. They died weeks to months after the disaster from conditions they were dealing with quite adequately before. A recent study published in the initial issue of the journal Disaster





Proxies for social vulnerability are created from four individual measures shown in the upper panels (percentage living below the official poverty level, percentage of black residents, percentage of people renting, and percentage without motor vehicles). They are summed in the figure below to create a combined measure of social vulnerability. The great majority of deceased victims from Hurricane Katrina victims were found in areas mapped here as having the greatest social vulnerability.

Medicine and Public Health Preparedness[9] shows that average mortality from all causes increased 47% in the first six months of 2006 compared to averages for the same period in previous years. The analysis does not examine causes or circumstances of the deaths, nor does it attempt to determine if social class is a factor in mortality but it does suggest that the aftermath of Katrina is long and deep and in doing so supports the informal accounting made in katrinalist. Ample anecdotal evidence from newspaper reporting suggests that the poorer segments of the population remain deeply impacted, are recovering less rapidly, and at heightened mortality and morbidity risk almost two years following the event.

Currently we believe that Hurricane Katrina left in its wake more than 3000 deceased victims and that the wake has yet to subside. Overwhelmingly those who were victims were poor, elderly, isolated, distrustful of government, and without means of escape. This casualty figure would make it the worst natural disaster since the so-called Galveston Flood that occurred in 1900 well before FEMA existed, before adequate hurricane warnings were available and before it was easily possible to escape inland by motor vehicle. That the victims of Katrina number the same as those in Galveston more than 100 years ago is a national tragedy and a national scandal.

ATTITUDES AMONG AFRICAN-AMERICANS TOWARDS DISASTER THREATS, HOUSEHOLD EMERGENCY PREPAREDNESS, AND CONFIDENCE IN GOVERNMENT

The National Center for Disaster Preparedness (NCDP) at Columbia University has conducted an annual survey of US attitudes towards preparedness and government since 2002. Conducted in collaboration with the Marist College Institute for Public Opinion (MIPO), each annual survey is a random-dial telephone survey of approximately 1,300 adults stratified according to U.S. Census 2000 data.

Among the questions asked each year include confidence in government; willingness and ability to evacuate; personal and family preparedness; community preparedness; and perceptions of risks and threats. Although such data do not measure social vulnerability directly, they do reflect certain elements of it. In particular, a population unprepared for disasters – whether the disasters are accompanied by warnings (such as hurricanes or floods) or arrive without warning (such as terror attacks or earthquakes) -- may be at greater risk for poor outcomes than would a prepared population. Social adjustments and mitigating activities such as hardening critical infrastructure and protective elements (e.g., levees and wetlands), and assuring community-level preparedness and response structures, will contribute towards greater population survival and enhanced economic recovery. Such success, though, is often contingent upon a population's preparedness and upon its physical and socioeconomic status.

[9] Stephens, K.U., D. Grew, K, Chin, P. Kadek, P. Grenough, F. Burkle Jr., S. Robinson, and E. Franklin, Excess Mortality in the aftermath of Hurricane Katrina: A preliminary study. *Disaster Medicine and Public Health Preparedness*, vol. 1 nu. 1, pages 15-20, 2007.

The NCDP finds that as a group, African-Americans differ in their views from the general US population in a number of ways. Although they are no more likely to report being prepared for a disaster or catastrophic emergency than the general population, African-Americans are more likely to view themselves at risk from man-made disasters such as terrorist attacks, industrial or nuclear power plant accidents, or a nuclear bomb than is the average US citizen. 54% of African-Americans said they would likely experience a major disaster in the next five years, compared to 47% of the US population; furthermore, 40% of black respondents said they would characterize the threat level in the US as "high" or "severe" in comparison to 30% of the US population.

Despite such an elevated perception of risk, though, only 24% of African-Americans surveyed said they had been prepared for at least 6 months, a proportion similar to that of the US population. On the other hand, blacks did report a great "intention to prepare," 34% compared to 23%, than did the general population, and they further indicated that they would be more likely to prepare if offered a tax credit or financial incentive to do so (37% of African-Americans versus 38% of general US population).

African-Americans exhibit a complex relationship to governmental structures and authority. Although they are the least likely to trust President Bush to provide accurate and reliable information in the event of a major disaster (35% of African-Americans trust Bush compared to 49% of the US population), they are more likely to believe that local first responders will be able to arrive and assist them within the first few hours of a catastrophic disaster (83% compared to 65% of the US population), far more likely than the average citizen to believe the government can adequately protect our borders from terrorist threats (49% compared to 37%), and are more confident than the average citizen that health care systems are prepared for a pandemic flu (51% versus 44%).

Taken together, these preparedness data paint a picture of an American sub-group quite sensitive to the possibility of an external threat, and who place a fair amount of confidence in governmental and health care systems to protect them. Earlier multi-variate regression analyses of 2006 national data illustrated, though, that the more people felt confident in such community systems, the less prepared they were themselves. Such reliance upon public systems, particularly in areas where such systems have not proven to be particularly robust (such as the Gulf Coast, post-Katrina), poses its own hazard. If such a dependence is combined with inadequate or insufficient resources to mobilize or shelter in the event of a major emergency, then poor outcomes (whether health-related, social, or economic) could result from both the disaster event itself as well as the extant response system or structure.

SIX CITIES, SIX POPULATIONS AT RISK

To illustrate the vulnerability of populations to natural hazards we assembled a comparable set of indicators for six cities in the US that have hazard expose and high concentrations of poor black communities. In addition to New Orleans already mentioned we made comparable maps for Houston, Los Angeles, Washington DC,

Miami and New York City. Each of the four-panel social vulnerability maps were created using data from the 2000 US Census. The household or population proportions in each census tract were obtained by dividing the absolute counts of a particular characteristic by the total households or population in that tract. The proportional calculations are then sorted into quintiles (0-20%; 20.1-40%; 40.1-60%; 60.1-80%; and 80.1-100%) and colored accordingly. White signifies tracts with no data (parks, wetlands and other unpopulated areas). The census tracts were then gridded for display purposes.

Each of these characteristics represents a proxy for vulnerability to natural hazards, subject to certain assumptions. As proxies, these characteristics are only partial measures of community response capacity and resiliency; a more detailed analysis is needed to develop the ***structural*** relationships between these factors and disaster preparedness. Nevertheless, qualitative statements can be made.

For example, the percent of households without a vehicle correlates with the ability to follow evacuation orders, or the reliance on mass transit and community facilities during a disaster. Households occupied by renters indicates a proclivity to be less vested in the property and to have fewer options available for rebuilding and post-disaster housing. Poverty level correlates with many vulnerability factors, including awareness of proper procedures, access to early warning, ability to store emergency supplies, access to post-disaster health care, and access to resources for preparedness and recovery. Each of the panels can also be interpreted in terms of the community relationships that might underlie disaster resiliency.

As with the other proxies, these will vary according to context and from place to place. Being without a private vehicle presents much greater difficulties for people in Los Angeles than for people in New York City, for instance. However, the chief natural hazard for Los Angeles residents is earthquake risk and vehicle ownership does not mitigate that risk. Renting versus home ownership differs across cities as a measure of vulnerability. Even quite wealthy people rent apartments in New York so it is not a good indicator of vulnerability unless calibrated against other factors. The most telling factor with regard to disaster vulnerability and is especially true in the case of New Orleans is the percentage of people without vehicles as this removes an evacuation option. For hurricanes, there is a single, very simple survival strategy – evacuate! Any factor that mitigates the opportunity to evacuate increases mortality risk.

The “Combined Social Vulnerability” maps demonstrate how these simple, preliminary calculations can be used to combine these proxies into a single social vulnerability index. Each category is divided into 10 equal-area deciles. The top three deciles (30% of the area) are taken to indicate a disaster vulnerability factor. At each pixel, the presence or absence of each vulnerability factor is counted, and the results summed to give a numerical value between 0 and 4. A value of 4 indicates that all four vulnerability factors (top 30% of each category) are present at that pixel, 3 indicates 3 of 4, and so on. These are then plotted on the same grid. The resulting map gives a sense of the presence of potential vulnerability factors at a particular grid location. This “screening” provides a clear depiction of where further investigation might be warranted.

To obtain a sense of risk, these combined social vulnerability factors should be compared against maps of hazard occurrences and exposure. Each of these maps shows four panels, based on analysis of historical data: hazard occurrence and severity; mortality, absolute economic loss; and economic loss as a percentage of area gross product (wealth). The mortality and loss maps are calibrated against recent demographic and economic data, using scale factors derived from past occurrences. These are useful as indicators of the potential geographic exposure of people and their economic assets to natural hazards.

Since natural hazards occur on a much larger scale than individual census tracts, the grids used for depicting hazard occurrence and exposure are coarser. For cyclones (hurricanes), each pixel represents the number of times the wind velocity at a particular location has been exceeded, relative to a global average. Thus in some areas such as the northeast, the tracks of individual severe storms can be detected in the occurrence patterns. In areas where storms are more frequent, such as southern Florida, the maps indicate a more cumulative occurrence pattern. For Los Angeles, the earthquake hazard is shown as the likelihood that a certain level of ground motion is exceeded. Because earthquakes are common in southern California, these patterns tend to follow fault zones rather than depict individual events.

In the following we show for each of the six cities the physical hazard information in four panel presentation and the social vulnerability determined by summing the four factors mentioned above. The individual vulnerability components as shown for New Orleans on page 6 are available also though not shown here. Each page is the data for an individual city.

Washington, D.C. and surrounding regions (page 14)

The coastal and riverfront areas of the Washington metropolitan region are the most exposed to wind and storm surge. The potential mortality is highest along the I-95 corridor, where the cities with greatest population density are located. What is surprising is the difference between the absolute economic loss and the relative economic loss. Absolute economic loss tends to track with mortality, but relative loss appears to be concentrated in the coastal zones of eastern Maryland and around Chesapeake Bay and its inlets. This is probably a function of the economic strength of these regions relative to the cities, and suggests that there is a special need to deal with some of the city hinterland and rural development issues in the region.

New York City Metropolitan Region (Page15)

Even though the New York metropolitan area ranks lower than Gulf Coast and southeastern cities for hurricane occurrence, its concentration of population and its physical assets create a high, broadly regional level of hurricane risk. In cases like this, social vulnerability factors are the determining factor in the geographic distribution of natural hazard risk. Thus areas of concern include east Brooklyn and southern Queens, especially around Jamaica Bay and Kennedy Airport, the South Bronx, and Harlem.

While household renting and vehicle ownership are signs of a densely populated area with multifamily housing and a reliance on public transit, these represent vulnerability issues especially with regard to mass evacuations. Areas of concentrated African-American populations, especially in northeast Manhattan, Brooklyn and Queens are also correlated with regions subject to storm surge (not shown). The high proportion of renters in multifamily dwellings suggests that rebuilding will be subject to larger scale agreements between developers and their insurers, and less on the objectives of individuals and families.

Miami and South Florida (page 16)

The greatest potential for mortality and economic loss is concentrated in Miami and surrounding counties. The combined social vulnerabilities are greatest in areas with high concentrations of African-Americans. The proportions of rental housing and vehicle ownership are especially troubling. For the former, the history of low-quality construction suggests that the rental market may not be the most effective agent for building robust protection into housing. For the latter, Miami is faced with evacuation scenarios that require mass transit or other arrangements. It would be useful to know how the regional transportation systems would accommodate an evacuation order.

Houston and the Gulf Coast of Texas (page 17)

The recent experiences in Houston suggest that evacuation scenarios, even for those with vehicles, are inadequate predictors of actual behavior. The Galveston-Houston region is especially exposed to high mortality and economic loss. In Houston, the percent of households occupied by renters is broadly distributed through the region, with some concentrations outside the center city, perhaps a function of sprawl. On the other hand, the poverty and vehicle proxies are more or less concentrated in areas with high African-American populations, which indicates disproportionate vulnerabilities. The locations of these communities closer to the coast, and thus closer to the hazard, is also a factor.

Los Angeles earthquakes (page 18)

The Los Angeles metropolitan region has been extensively studied by seismologists and civil engineers, and has an active and responsive public sector emergency management operation. It is well understood, for example, that the soils within the flat-lying parts of Los Angeles, what is known as the Los Angeles Basin, are particularly prone to amplifying the effects of earthquakes. Good construction practices in these areas are essential in order to provide adequate protection. Since earthquakes strike without warning, earthquake disaster scenarios emphasize emergency response functions and post-disaster recovery, rather than pre-disaster evacuation. Thus the delivery of emergency services, the reliance on robust and redundant infrastructure, and the performance during the earthquake of critical facilities such as hospitals and fire stations are of paramount importance. What is needed is a census of these facilities and an evaluation of their performance characteristics as they relate to social vulnerability

indicators, and whether there are differences that would generate disproportionate vulnerabilities compared to the rest of the population.

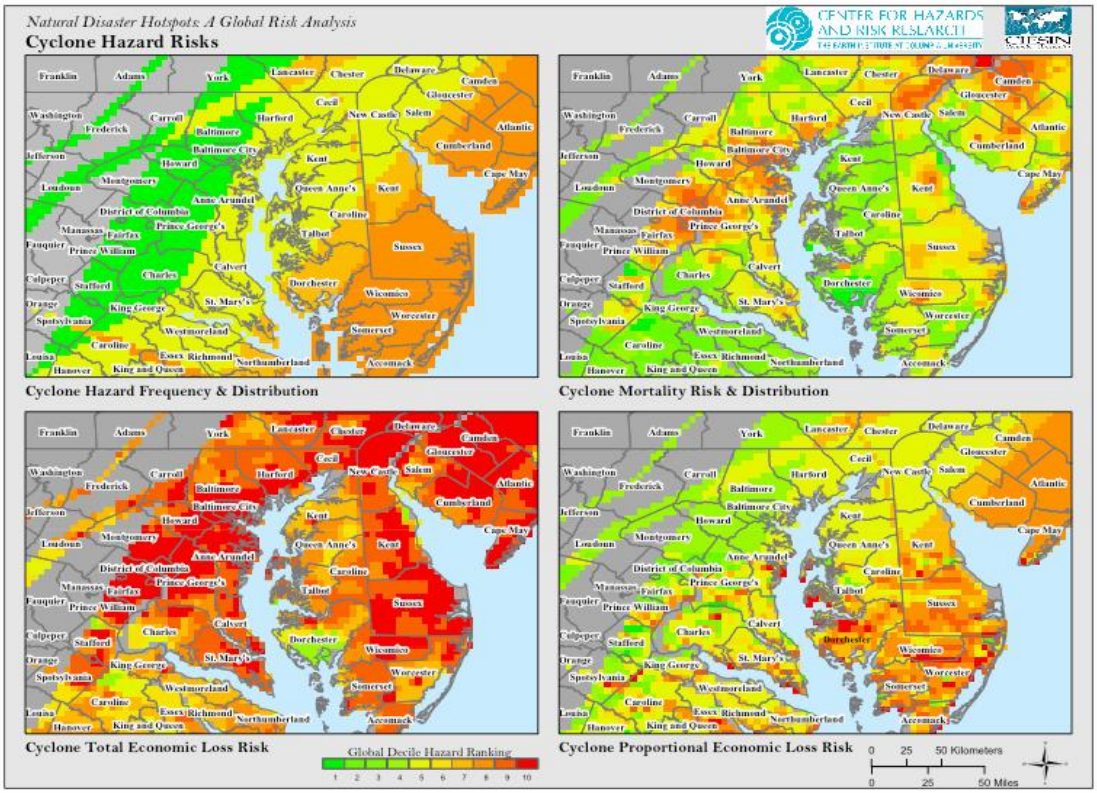
CONCLUSIONS AND RECOMMENDATIONS: FOCUS ON PEOPLE.

Throughout the country, but particularly in the coastal mega-cities we studied, large population of African-Americans, those who typically make up the majority living in the poorest circumstances face mortality risks in natural disasters that are considerably greater than those faced by more prosperous segments of the community. This reflects the global reality in which mortality risks are as much as two orders of magnitude greater for those toward the bottom of the development ladder. Some of our own communities are as vulnerable as those in the least developed parts of the world. The vulnerability of these communities are acquired over a very long period of time. We merely become aware of them when disasters occur. The lesson from Hurricane Katrina is that social class was a primary determinant in establishing the outcome of that catastrophe. The lesson is universal – the poorest suffer the most.

Assessments of disaster losses by insurance companies, as well as federal and state agencies tend to focus on property loss, in part because insured property losses can be fairly quickly assessed. These are given in terms of economic losses. But natural disasters are primarily human tragedies of massive scope. The officially calculated death toll is probably no more than half the true toll as deaths continue to occur months and years after the disaster event itself and often impact the elderly in a disproportionate way. The wakes left by natural disasters are long and persistent and continue to rock the lives of the poorest for years. Having less ability to cope and recover the poor become even more distant from the wealthier segments of society that can easily rebuild. Making a smaller contribution to the economy the lives lost among poor communities often go virtually unnoticed.

It is imperative that we focus our attention on the lives and vulnerability of those who will inevitably be most impacted by natural extremes in the future. Certainly we must strengthen our physical infrastructure to provide the most protection we can, but we must also understand the landscape of human vulnerability and strengthen the resilience of those most likely to be impacted. Our analysis presented a fairly crude assessment of vulnerability proxies but brought to light the special risks faced by some communities. We need to rigorously evaluate and map the contours of human vulnerability and, from it, establish best practices for protecting the lives of those least able to protect themselves.

A hurricane like Katrina will happen again, a large magnitude earthquake will certainly occur in Southern California. We cannot prevent acts of *Nature*, but the question of who and how many die is largely in our hands.


Natural Disaster Hotspots: A Global Risk Analysis
Cyclone Hazard Risks
CENTER FOR HAZARDS AND RISK RESEARCH
Cyclone Hazard Frequency & Distribution
Cyclone Mortality Risk & Distribution
Cyclone Total Economic Loss Risk
Global Decile Hazard Ranking
Cyclone Proportional Economic Loss Risk
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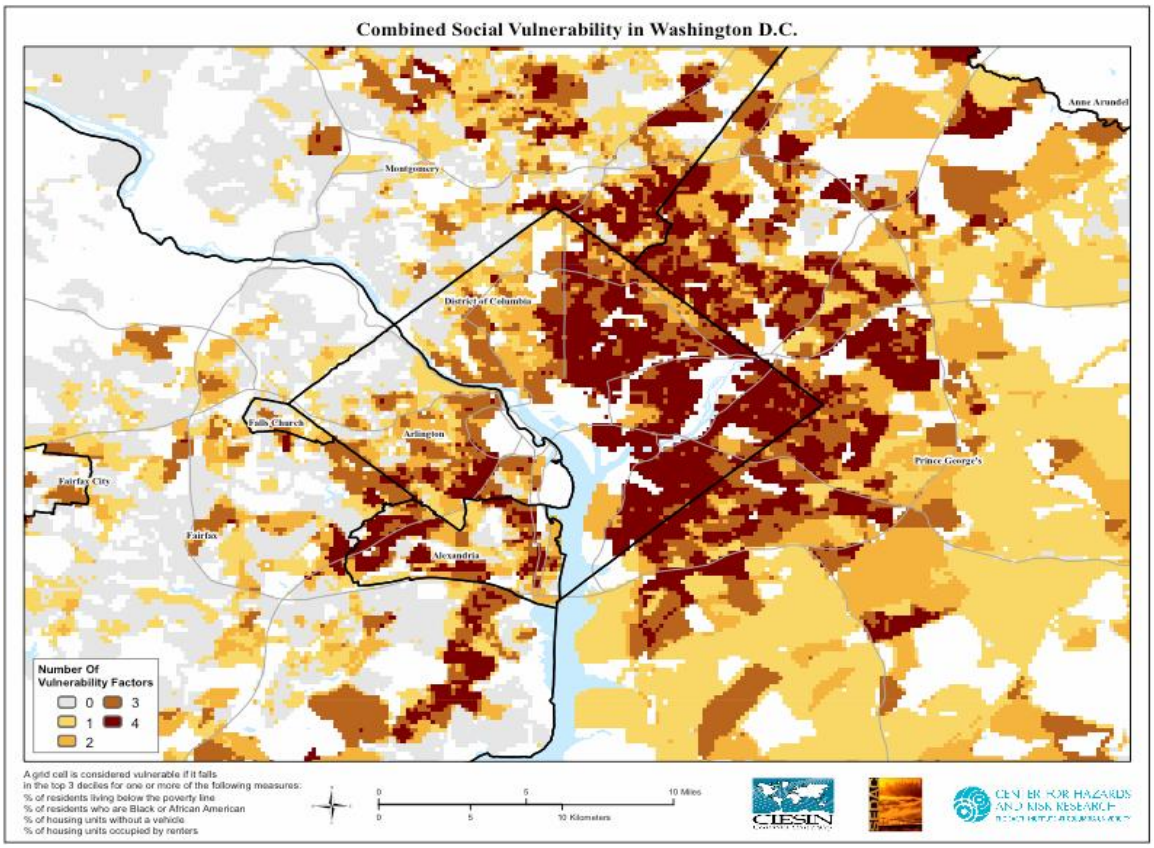
Combined Social Vulnerability in Washington D.C.
Anne Arundel
Montgomery
District of Columbia
Falls Church
Arlington
Fairfax City
Fairfax
Alexandria
Prince George's
Number Of Vulnerability Factors
0
1
2
3
4
A grid cell is considered vulnerable if it falls in the top 3 deciles for one or more of the following measures:
% of residents living below the poverty line
% of residents who are Black or African American
% of housing units without a vehicle
% of housing units occupied by renters
0 5 10 Miles
0 5 10 Kilometers
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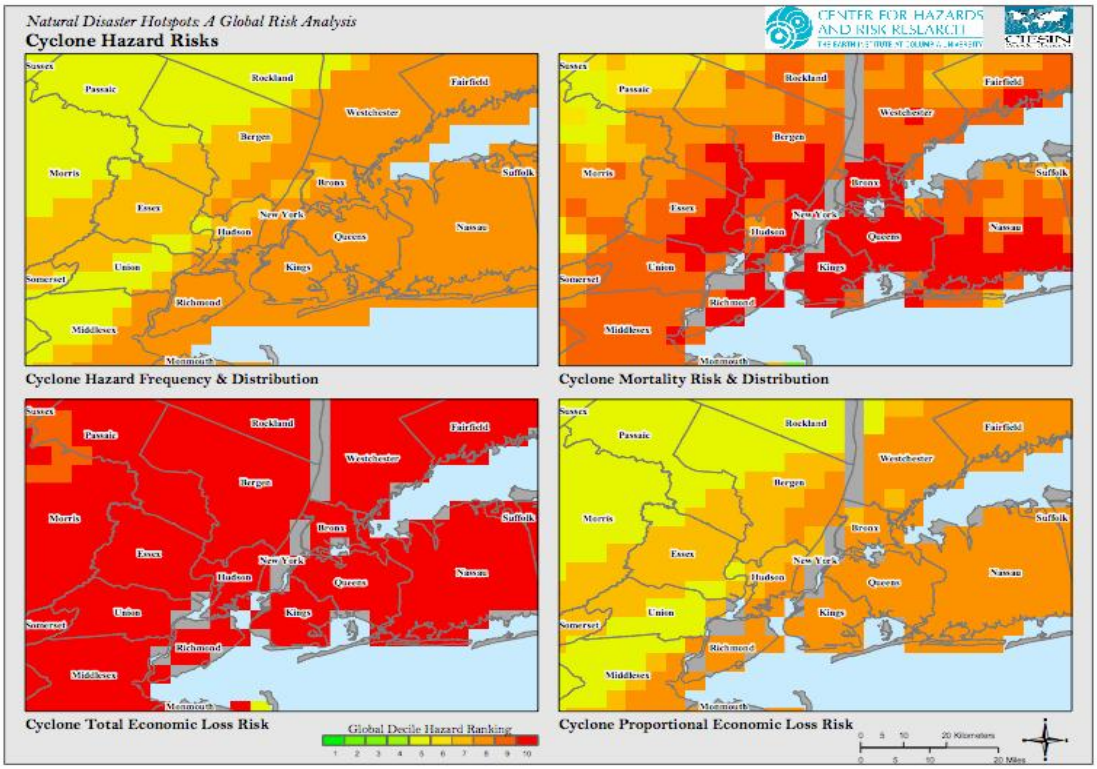
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Cyclone Mortality Risk & Distribution
Cyclone Total Economic Loss Risk
Global Decile Hazard Ranking
Cyclone Proportional Economic Loss Risk
Sussex
Passaic
Rockland
Fairfield
Westchester
Bergen
Morris
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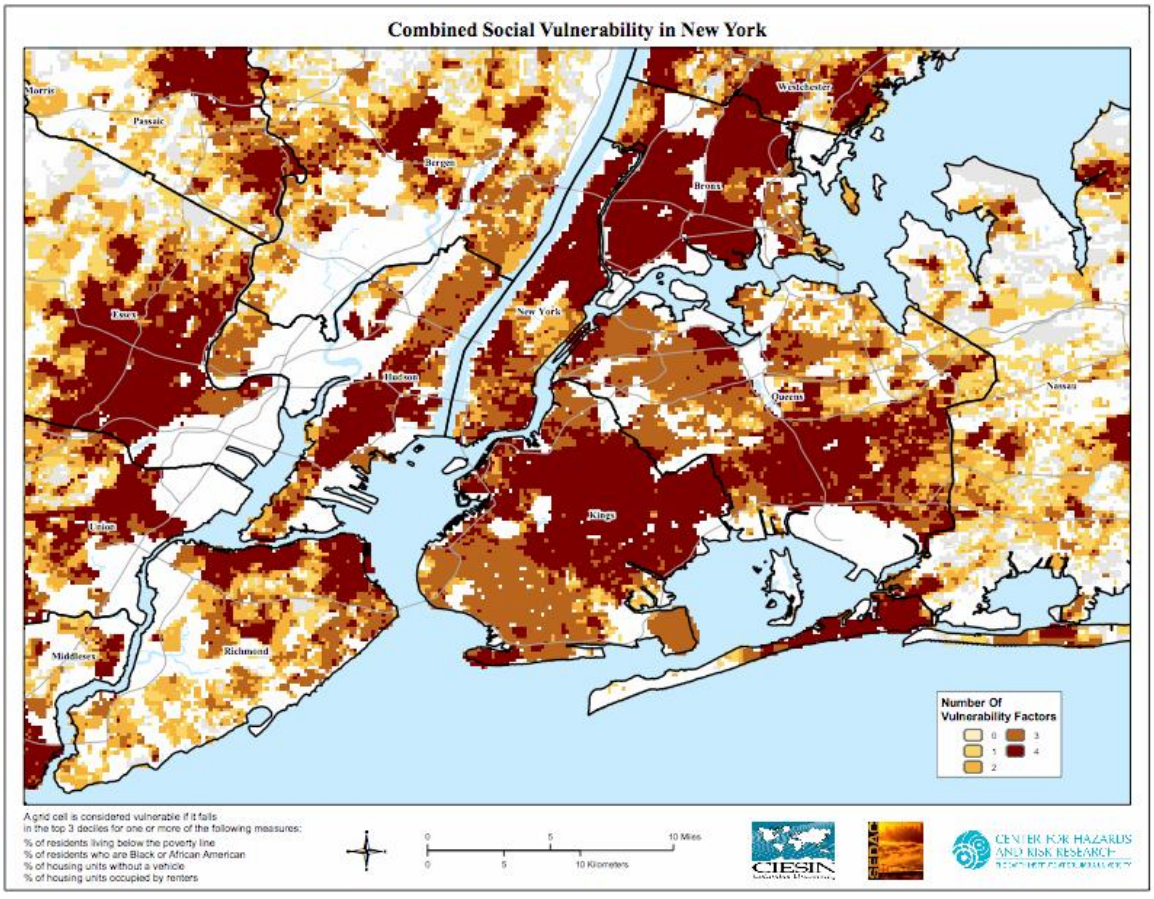
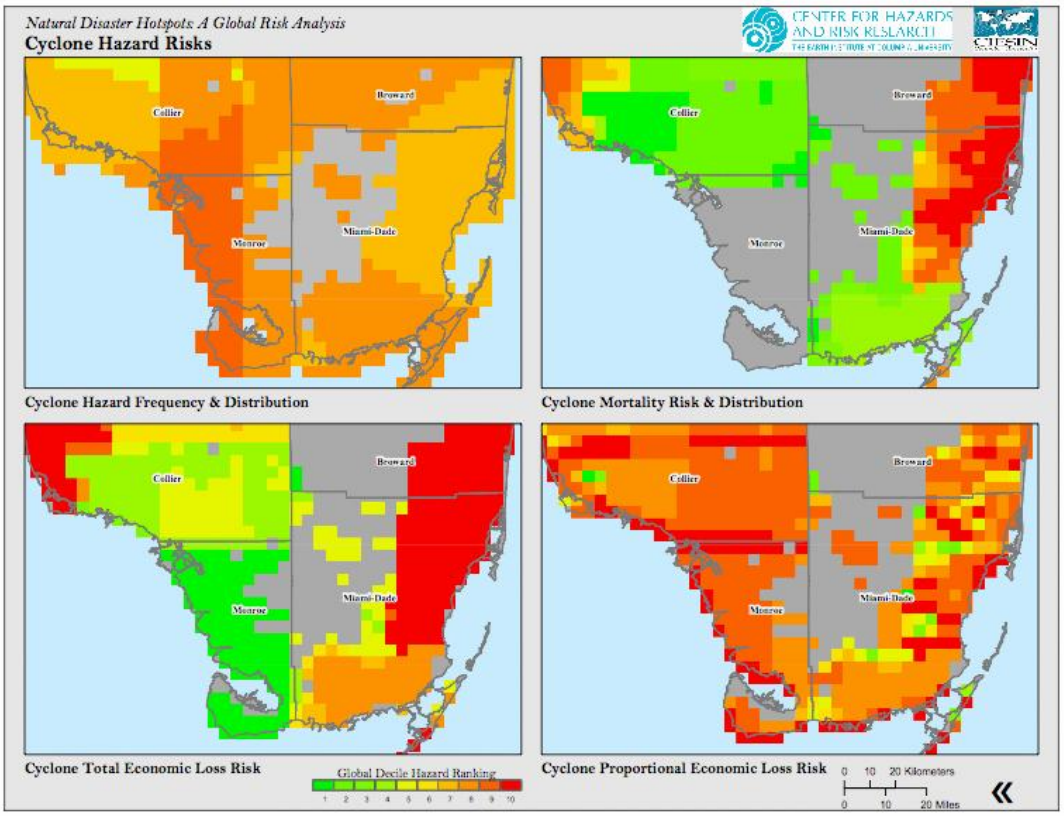
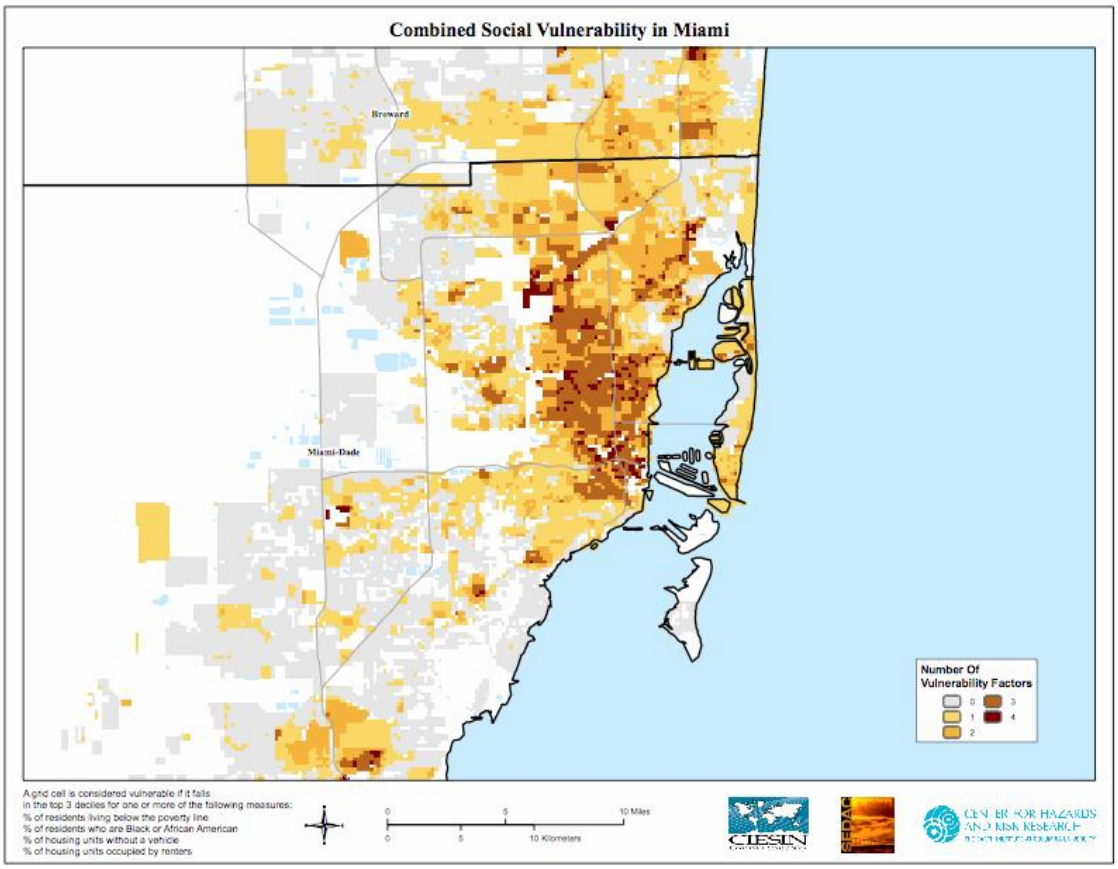
Somerset
Richmond
Middlesex
Monmouth


Combined Social Vulnerability in New York
Morris
Passaic
Bergen
Westchester
Bronx
Essex
New York
Hudson
Queens
Nassau
Union
Kings
Middlesex
Richmond
Number Of Vulnerability Factors
0
1
2
3
4
A grid cell is considered vulnerable if it falls in the top 3 deciles for one or more of the following measures:
% of residents living below the poverty line
% of residents who are Black or African American
% of housing units without a vehicle
% of housing units occupied by renters
0 5 10 Miles
0 5 10 Kilometers
CIESIN
CENTER FOR HAZARDS AND RISK RESEARCH


Natural Disaster Hotspots: A Global Risk Analysis
Cyclone Hazard Risks
CENTER FOR HAZARDS AND RISK RESEARCH
Collier
Broward
Monroe
Miami-Dade
Cyclone Hazard Frequency & Distribution
Cyclone Mortality Risk & Distribution
Cyclone Total Economic Loss Risk
Global Decile Hazard Ranking
1 2 3 4 5 6 7 8 9 10
Cyclone Proportional Economic Loss Risk
0 10 20 Kilometers
0 10 20 Miles


Combined Social Vulnerability in Miami
Broward
Miami-Dade
Number Of Vulnerability Factors
0
1
2
3
4
A grid cell is considered vulnerable if it falls in the top 3 deciles for one or more of the following measures:
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% of residents who are Black or African American
% of housing units without a vehicle
% of housing units occupied by renters
0 5 10 Miles
0 5 10 Kilometers
CIESIN
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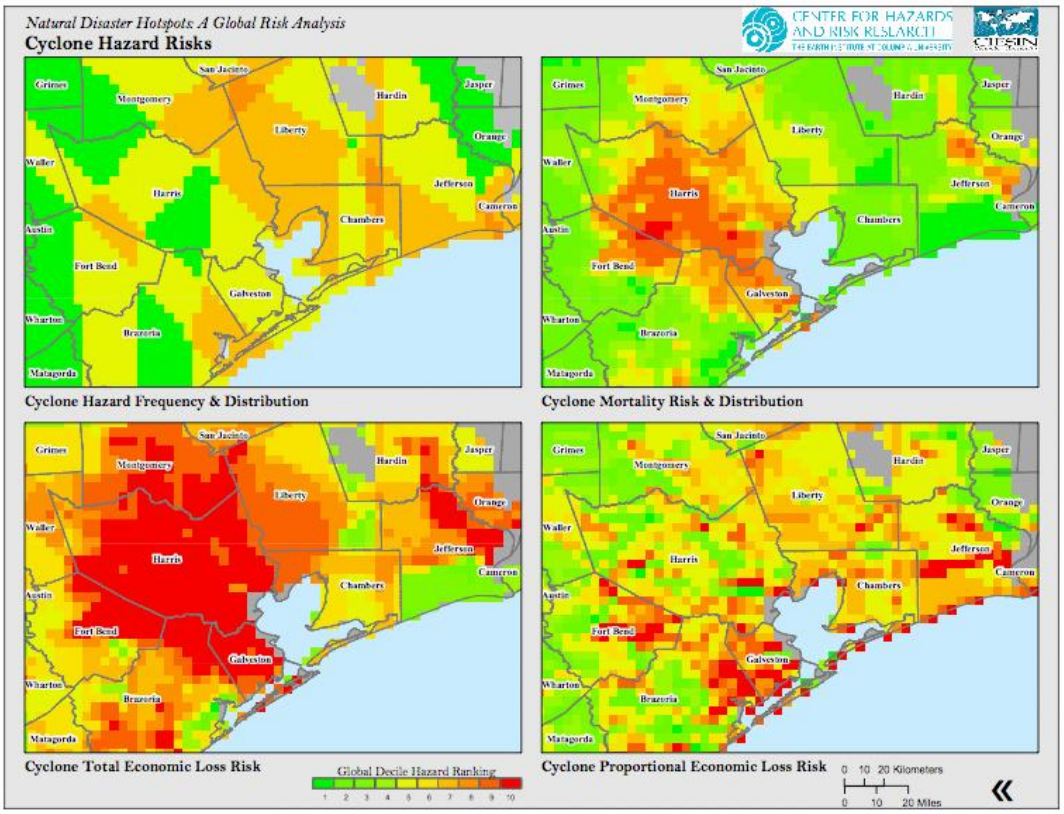
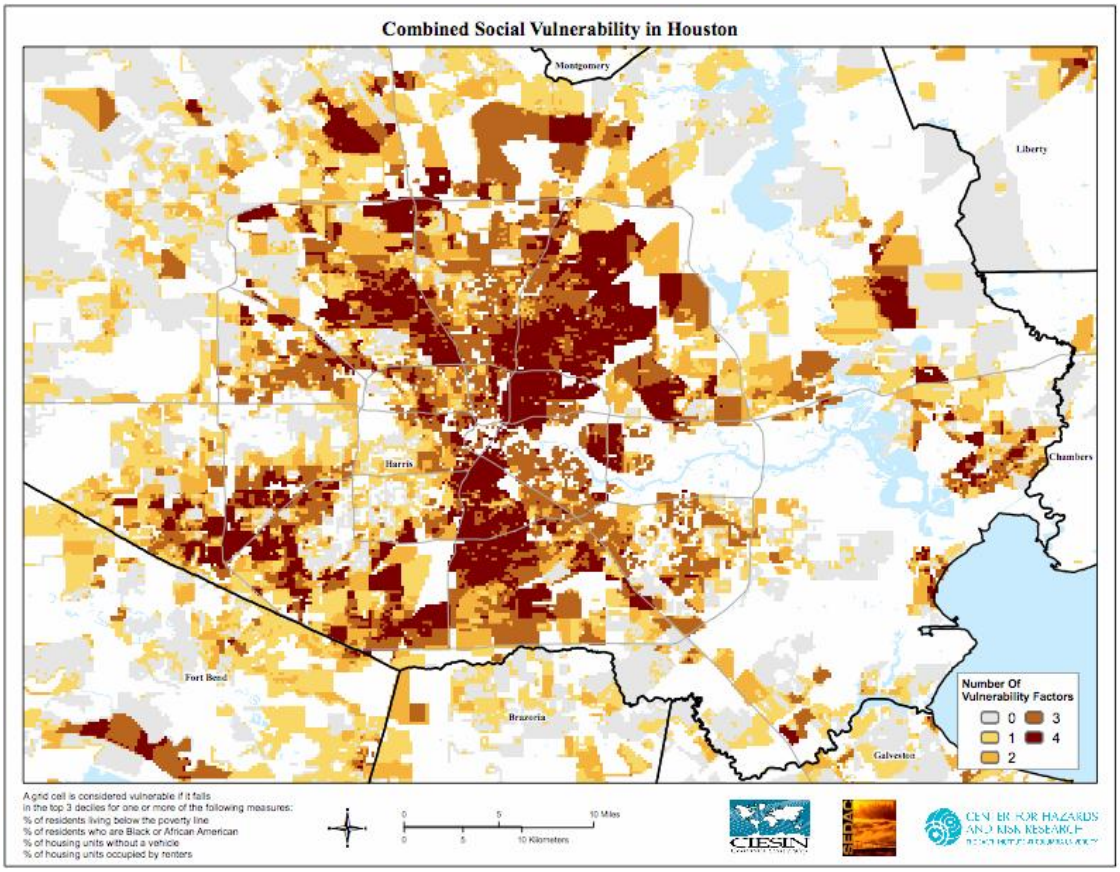

Natural Disaster Hotspots: A Global Risk Analysis
Cyclone Hazard Risks
CENTER FOR HAZARDS AND RISK RESEARCH
Cyclone Hazard Frequency & Distribution
Cyclone Mortality Risk & Distribution
Cyclone Total Economic Loss Risk
Cyclone Proportional Economic Loss Risk
Global Decile Hazard Ranking
0 10 20 Kilometers
0 10 20 Miles
San Jacinto
Grimes
Montgomery
Hardin
Jasper
Liberty
Orange
Waller
Harris
Jefferson
Cameron
Chambers
Austin
Fort Bend
Galveston
Wharton
Brazoria
Matagorda


Combined Social Vulnerability in Houston
Montgomery
Liberty
Harris
Chambers
Fort Bend
Brazoria
Galveston
Number Of Vulnerability Factors
0
1
2
3
4
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% of residents who are Black or African American
% of housing units without a vehicle
% of housing units occupied by renters
0 5 10 Miles
0 5 10 Kilometers
CIESIN
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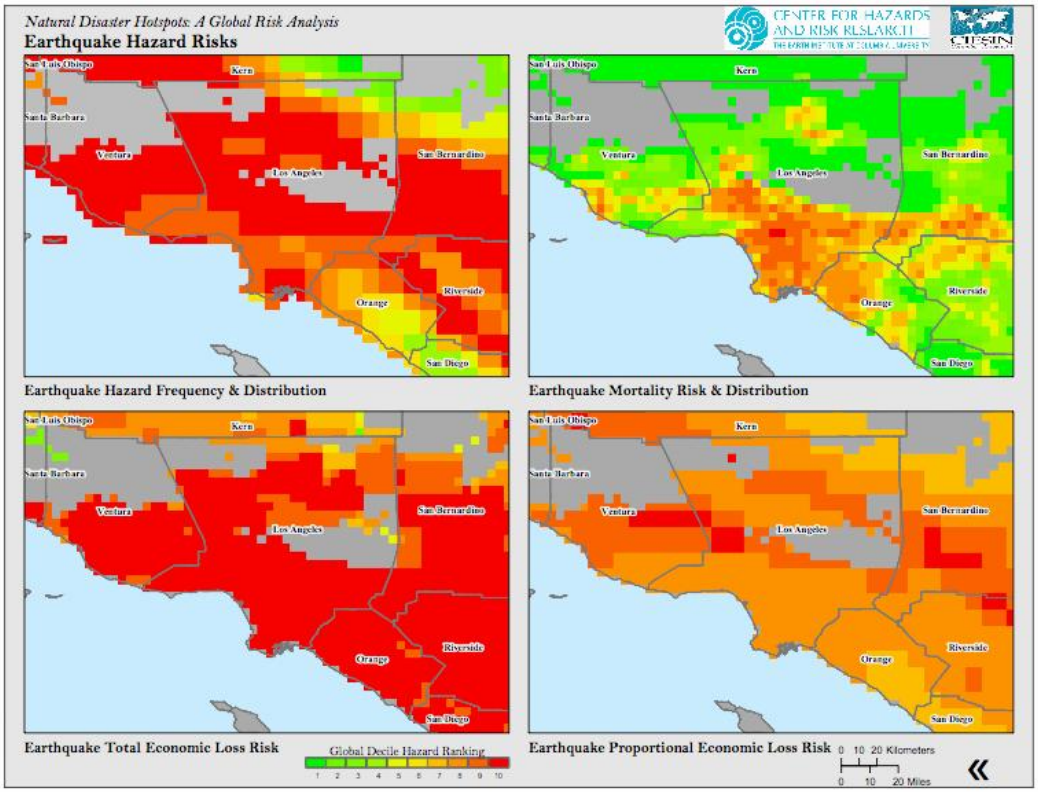
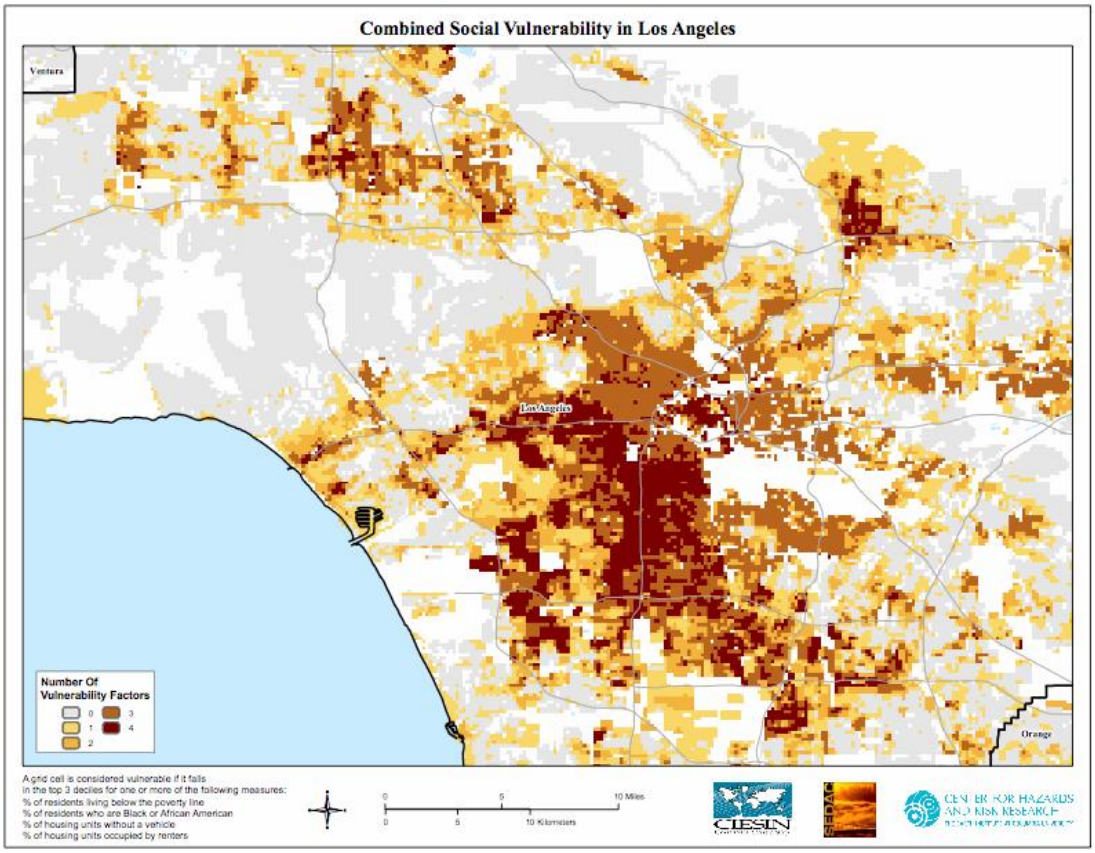
CENTER FOR HAZARDS AND RISK RESEARCH


Natural Disaster Hotspots: A Global Risk Analysis
Earthquake Hazard Risks
CENTER FOR HAZARDS AND RISK RESEARCH
Earthquake Hazard Frequency & Distribution
Earthquake Mortality Risk & Distribution
Earthquake Total Economic Loss Risk
Global Decile Hazard Ranking
Earthquake Proportional Economic Loss Risk
0 10 20 Kilometers
0 10 20 Miles
San Luis Obispo
Kern
Santa Barbara
Ventura
Los Angeles
San Bernardino
Riverside
Orange
San Diego


Combined Social Vulnerability in Los Angeles
Ventura
Los Angeles
Orange
Number Of Vulnerability Factors
0
1
2
3
4
A grid cell is considered vulnerable if it falls in the top 3 deciles for one or more of the following measures:
% of residents living below the poverty line
% of residents who are Black or African American
% of housing units without a vehicle
% of housing units occupied by renters
0 5 10 Miles
0 5 10 Kilometers
CENTER FOR HAZARDS AND RISK RESEARCH

DISASTER FACT SHEET

- Natural disasters are increasing in their frequency and economic and social impact. Earthquakes, floods, drought, and other natural hazards continue to cause tens of thousands of deaths, hundreds of thousands of injuries, and billions of dollars in economic losses each year around the world. While a disaster may occur anywhere, it is most likely to cause more loss of life and economic value in poor, disadvantaged communities. In other words, Hurricane Katrina and its impact on New Orleans was exceptional, but not unique. We can expect more, and more severe disasters, to occur in our lifetimes.

- We can anticipate where many of the most severe disasters will occur by using historical data along with meteorological and geophysical information. What we cannot do as precisely is to predict when a disaster may occur, or how severe it is likely to be. The science behind these estimations has become much better in recent years. More and more of this information is becoming available in graphic form, accessible to many on-scientist users.

- Natural hazard risks are highly concentrated, so special attention needs to be given to planning ahead for disaster and to reducing long-term vulnerability in communities at highest risk. The major events considered to form the bulk of natural disasters include earthquakes, volcanoes, landslides, floods, drought, and hurricanes or cyclones.

- Our ability to predict the groups of people likely to be most affected in a given disaster is also improving. Some of this is obvious – people on affected coasts or geological fault lines are standing in harm's way. More important risks are social in nature and harder to predict with precision. For example, poverty often relates to poorer housing construction, more people living under one roof, living on low-lying land, and not having a vehicle for evacuation. Each of these can make the impact of flooding worse. But social networks can help people to overcome these limitations. A disproportionate number of the people who died in flooding from Katrina in the first days were elderly whites. Although blacks were poorer, they were helped by extended family and community bonds, which resulted in more elderly blacks being saved from drowning.

- More affluent communities generally invest more in engineering to limit the impact of disasters by, for example, constructing damns, culverts, flood barriers, and earthquake-resistant buildings. Better organized communities also tend to mobilize more resources and use them more effectively when a disaster strikes. Examples include erecting emergency sand-bag walls to limit the impact of flooding, or bus convoys to evacuate people in harm's way. Better educated people tend to understand and heed warnings.

- Preparedness for disasters is not reserved for the rich. Some poor communities are more organized and better prepared than their rich neighbors. Identification of risk factors creates an opportunity to change from relief and reconstruction following disasters to prevention and preparedness to reduce recovery time following disasters.

- Social vulnerability is influenced by history. If environmental contaminants were dumped in the soil, or if dirty industries surround a community, they face extra hazards that may multiply the effects of a disaster. If a poor community has been isolated politically or cut in two by an interstate highway, it will likely be harder to organize and evacuate in the event of a disaster. Planning to mitigate a disaster may have to overcome apathy and mistrust, another reason that it must be started long before disaster strikes.

- But resources alone cannot protect people unless government coordinates these resources well. This has to start with local government, which directs assistance, regional or state government, which provides coordination, and national government which must lead planning for disaster response long before a disaster occurs. All three levels have a role, and all three levels have to coordinate well over time if potential disasters are to be identified and mitigated, people are to be protected, and communities are to recover well.

- Investing in disaster preparedness and mitigation makes good economic sense. They can greatly reduce the financial losses that may occur in a disaster, and may greatly increase the effectiveness of funds that become available for rebuilding after a disaster.

- Failure to help communities prepare for and rebuild after a disaster can result in slow recovery at best, with thousands of people's lives placed on hold, or the disintegration of communities altogether. In this sense, natural disasters are much like social conflict, where some communities rebuild after riots while others never fully recover even decades later. The accumulated losses to the economy and people's lives from poor recovery can far exceed the more easily identified losses that occur during the disaster.

- Disaster planning starts with the identification of major risks to a local area, assessment of the population's vulnerabilities and resources, and the organizations (both governmental and non-governmental) that should take part in disaster planning.

- Most communities in the U.S. now have some kind of disaster plan in place. But how good is the plan? Do key potential participants KNOW what is in the pan and agree with its priorities? Is the chain of command known and understood? Has the public been informed about the plan? Have local leaders taken part in practice exercises? Are major local vulnerabilities identified, and are they being addressed?

- Disaster mitigation begins years before a disaster occurs. It takes at least 3 years to plan, organize, and do the engineering work to reduce the impact of most potential disasters.

- FEMA is the lead national agency to coordinate these activities. The agency has lost many of its best staff and is smaller than it was 10 years ago. Thus, we cannot depend on FEMA to lead as we once could. Local elected officials should lead locally, with whatever help FEMA can provide, and demand that FEMA along with other key national agencies be strengthened. Our constituents will not accept if we only blame FEMA for what it is not doing. We have much to do, and cannot afford to wait for federal agencies to act.

- Even with a rebuilt FEMA, there will be a continuing need for research into the physical and environmental hazards that a community faces, the vulnerabilities and strengths that a community can draw upon to mitigate the impact of a disaster, the adequacy and appropriateness of disaster planning, and the conditions for improved recovery after a disaster.

SOME DEFINITIONS

Disaster A serious disruption of the functioning of a community or a society causing widespread human, material, economic, or environmental losses that exceeds the ability of the affected community or society to cope using its own resources.

Disaster risk management The systematic process of using administrative decisions, organization, operational skills, and capacities to implement policies, strategies, and coping capacities of the society and communities to lessen the impacts of hazards.

Disaster risk reduction The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards.

Hazard A potentially damaging physical event, phenomenon, or human activity that may cause loss of life or injury, property damage, social and economic disruption, or environmental degradation.

Mitigation Structural and nonstructural measures undertaken to limit the adverse impact of natural hazards, environmental degradation, and technological hazards.

Preparedness Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations.

Prevention Activities to provide avoidance of the adverse impact of hazards and means to minimize related environmental disasters.

Recovery Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk.

Relief/response The provision of assistance or intervention during or immediately after a disaster to meet the needs of those affected. It is generally immediate and short term.

Resilience/ resilient The capacity of a system, community, or society potentially exposed to hazards to adapt, by resisting or changing to reach and maintain an acceptable level of structure and functioning.

Risk The probability of harmful consequences, or expected losses (deaths, injuries, property and livelihood loss, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions.

Risk assessment/ analysis A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods, and the environment on which they depend.

Structural/nonstructural measures Structural measures refer to any physical construction to reduce or avoid possible impacts of hazards, which include engineering measures and construction of hazard-resistant and protective structures and infrastructure.

Vulnerability The conditions determined by physical, social, attitudinal, economic, and environmental factors or processes that increase the susceptibility of a community to the impact of hazards.