So Much for Global Warming

A new study of the history of U.S. hurricanes in the 20th century fails to demonstrate any effects of global warming on the number and intensity of catastrophic storms.

By Douglas J. Collins

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There has been much debate in recent years over the existence, causes and effects of global warming. Although some analysts have claimed that global warming is generating stronger, more destructive hurricanes, an objective review of the historical record does not support the contention that U.S. hurricane damages have been increasing.

If actual insured hurricane damages are adjusted (i.e., normalized) to reflect current property values and the increase in the number of people living near the coast, insured damages in the 1990s do not appear unusually high, compared to insured losses in other decades of the 20th century. (See *Exhibit 1*.) Nor is there evidence of an upward trend in the frequency of hurricane landfall or in insured damages, based on an analysis of the last century. Although Atlantic hurricane frequency did increase during the second half of the 1990s, the number of such storms striking the U.S. in that decade was actually the second lowest in the century.

Insured hurricane damages during the 1990s accounted for almost 75% of the total insured losses for the century. On a normalized basis, however, the 1990s represented only 12% of the total losses. Hurricane Andrew in 1992 distorts the actual historical figures because it was a major event that occurred relatively recently. Its weight is also exaggerated by the relative lack of major storms in the 1970s and 1980s.

These conclusions derive from a recent study that adjusted historical U.S. hurricane losses from the conditions at the time of each event to those existing today. This analysis produced normalized hurricane losses by event, state and county, reflecting estimated changes in price levels, housing density by county, wealth per capita and wind insurance coverage.

The Value of Hurricane Modeling. Contemporary computer models have become valuable tools for property insurers and other managers of property catastrophe risk. Hurricane simulation models generate estimates of potential catastrophe damages of rare storms, expected average costs from all likely hurricanes and current dollar costs of historical hurricanes for any portfolio of properties.

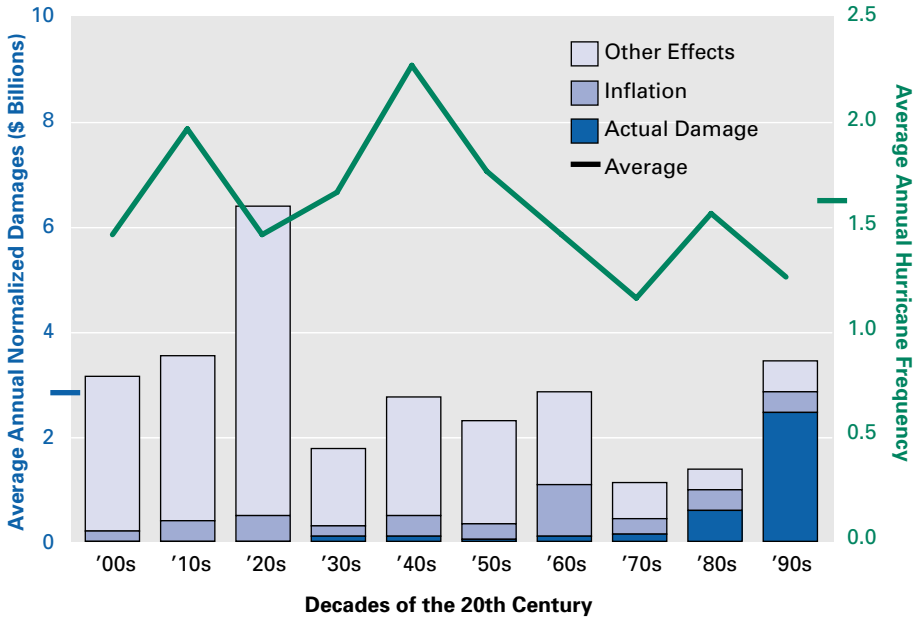
These models provide the analytical capability to assist in decision-making relating to pricing, underwriting, and risk and capital management. Outside users of hurricane models generally depend on the modeler to demonstrate the validity and reasonableness of model results.

This particular study was not undertaken to contribute to the debate on global warming. Rather, it sought to create a data set that would allow model users to compare the overall results of any hurricane model to the historical record. For example, comparisons of expected losses or 25-year return period losses (i.e., the largest losses occurring in a 25-year period) by state or for the entire U.S. can yield insights into the differences between model assumptions and the historical record for the 20th century.

Following are some key findings of the study.

Inflation Was Not the Most Important Factor. *Exhibit 1* also shows the relative importance of the components of normalized damages by decade. Actual damages at the time of each event are insignificant for hurricanes prior to the 1960s relative to normalized damages for those events. Based on the study, actual average annual insured hurricane damages were less than $40 million in the 1950s and no more than $10 million in any of the five previous decades.

Exhibit 1
Insured Losses From Hurricanes Are Not Increasing



Even more surprising, *Exhibit 1* indicates that the relative importance of the inflation adjustment in the normalization process is small, compared to the other adjustments. In total, changes in housing density, wealth and wind insurance coverage far outweigh inflation in their contribution to the level of normalized damages for events occurring prior to the 1950s. The long-term increase in housing density near the coast emerged as the most important factor.

According to figures published by the U.S. Census Bureau, the migration to southeastern coastal areas will continue. Population growth in Florida, the state with substantially higher hurricane risk than any other, is expected to exceed national growth for at least another 25 years, a continuation of a trend that began more than 50 years ago. From 1950 to 2000, while housing units throughout the U.S. grew at an average annual rate of about 2%, housing units in Florida increased 4.2% per year.

Those Florida coastal counties most susceptible to hurricanes had an even faster average growth rate, 4.5%, over this period. Fortunately, from a hurricane risk standpoint, growth rates in the 1980s and 1990s in those coastal counties dropped below Florida's total growth rate but remain well above national rates. This migration has a significant economic cost.

Florida Was the Hardest Hit. The study produced a database of normalized insured damages by event, state and county. *Exhibit 2* (see page 4) displays average damages and return period distributions by state and for the continental U.S. in total, based on normalized losses from 1900 to 1999. Also shown are the top ten U.S. states according to average normalized losses. Florida, with almost 50% of the expected annual losses, and Texas, with more than 21%, dominate the results. Based on normalized data for the 20th century, Florida experienced average annual insured hurricane damages of $1.4 billion.

This average annual loss demonstrates the high cost of Florida's hurricane risk. Historically, the cost of insuring coastal properties has been subsidized, in part, from property insurance rating plans that were designed primarily for fire risk. These plans did not properly reflect differences between coastal and inland hurricane risk. The period of relatively low hurricane damages in Florida prior to Hurricane Andrew also contributed to inadequate property insurance rates.

Political pressures subsequent to Hurricane Andrew have made the attainment of adequate rates difficult. Federal subsidies also exist, through such programs as flood insurance and disaster assistance. The coastal migration might

Exhibit 2
Florida and Texas Suffered the Most Hurricane Damage

State	Return Period (Years) 100	25	10	Average Annual	% of Total
Florida	49,700	8,000	3,100	1,423	49.5
Texas	16,400	4,600	1,000	615	21.4
Louisiana	10,400	1,100	340	196	6.8
North Carolina	1,900	1,400	270	109	3.8
Mississippi	2,500	800	160	77	2.7
Massachusetts	2,900	460	1	64	2.2
South Carolina	4,100	240	40	62	2.1
Alabama	2,400	390	31	61	2.1
New York	3,100	210	36	61	2.1
Connecticut	4,100	150	–	51	1.8
All	**51,800**	**16,500**	**9,400**	**2,873**	**100**

Note: Normalized Insured Damages in $ Millions. States With Lesser Damages Are Not Listed.

not have been as rapid if coastal residents had been required to pay their fair share of costs.

In 2000, the Florida Windstorm Underwriting Association (FWUA) implemented a controversial 106% rate level increase for hurricane insurance premiums in coastal areas. Along with the rate level increase, which will be phased in over several years, the FWUA revised its classification/rating plan to better reflect hurricane risk and mitigation devices. These changes will have the dual effect of almost eliminating the subsidy of coastal property insurance and increasing the economic incentive to build or modify properties to better withstand hurricane damage. Given the large cost of hurricanes in the state, the economic incentives to reduce those costs are the highest in the country.

Downgrading Hurricane Andrew. Contrary to popular opinion, Hurricane Andrew did *not* produce the highest damages, when normalized damages are used as the measure. Another Florida storm, the September 1926 Miami hurricane, ranks as the most severe event of the last century. It would have produced insured damages of $50 billion in today's environment. Andrew would actually run a distant second, with $25 billion in normalized insured damages.

Category 4 Storms Were the Worst. Meteorologists usually measure hurricane strength using the Saffir–Simpson scale. For example, minimal hurricanes (winds of 75 to 95 miles per hour) are designated as Category 1 storms, while the strongest hurricanes (winds greater than 155 miles per hour) are Category 5. Thus, the Saffir–Simpson system provides another useful hurricane model comparison.

In the 20th century, 164 hurricanes made landfall in the continental U.S. On a normalized basis, these hurricanes averaged $1.75 billion in damages per storm, or $2.87 billion per year. The resulting size of loss distribution by Saffir–Simpson category shows the impact of storm severity on insurance losses. (See *Exhibit 3.*)

While only 15 of these storms were Category 4 hurricanes (about 9% of the total), those events produced 55% of the normalized losses. Interestingly, Category 5 hurricanes did not produce a similarly skewed impact because the only two such events (Hurricane No. 2 in 1935, affecting principally the Florida Keys, and Hurricane Camille in 1969, affecting principally Mississippi) did not hit densely populated areas. One would expect hurricane models to indicate a much larger portion of losses deriving from Category 5 storms.

A Quest for Better Data. Data on the losses sustained from past hurricanes are available from two primary sources:

- The National Weather Service (NWS) has compiled data on the *economic* impact (i.e., not just insured damages) of each U.S. hurricane since 1900.
- Property Claim Services, Inc. (PCS), a subsidiary of Insurance Services Office (ISO), prepares estimates of the direct insured losses by state for each natural catastrophe, including hurricanes. Its historical data date from 1949.

These sources, however, have their limitations:

- The unavailability of insured loss estimates prior to the first PCS estimates in 1949 requires the approximation of insured losses from the NWS economic damage figures.
- There are serious inaccuracies in the historical PCS insured loss estimates. For example, in 1986, the All-Industry Research and Advisory Council conducted a survey of insured losses from seven hurricanes occurring in 1983 and 1985. After Hurricane Andrew, a Florida Department of Insurance study compiled actual losses from insurers. Both studies indicated levels of industry losses that differed markedly from the PCS estimates.

Although the best available sources were used in constructing the study database, actual insured damages for many older storms remain uncertain. For major historical events, property insurers may have access to actual incurred loss information that could be used to improve the PCS estimates prior to the early 1990s. Given the widespread use of the PCS estimates, a historical study to achieve such improvement would benefit many in the industry.

The Normalization Process. After selecting an estimate of the industry's actual aggregate insured losses, the losses were allocated by county and adjusted to the current level. This adjustment reflects changes in price levels, property values by county and the insurance system.

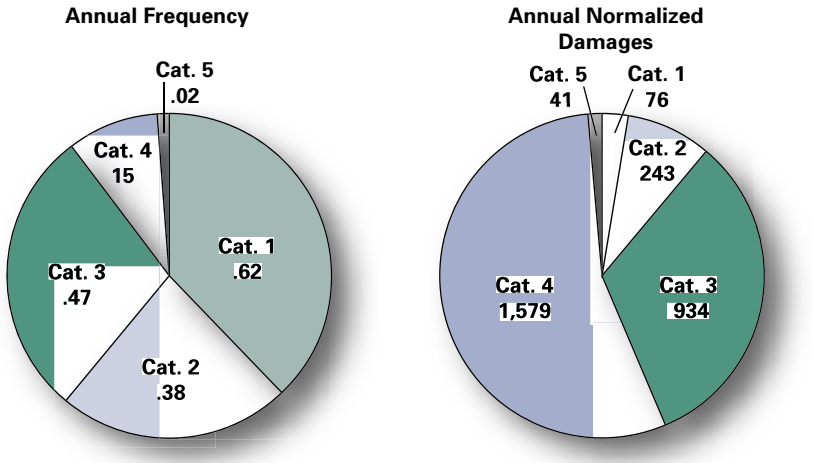
Monetary inflation was measured by reference to the GNP implicit price deflator. The study determined the national growth in the value of property using data on fixed reproducible tangible wealth published by the Department of Commerce. The total number of housing units (both residences and vacation homes), available from the Census, was used to calculate the variation by county.

The adjustment for changes in the insurance system was derived from an analysis of PCS insured loss estimates and NWS economic loss estimates. The resulting index reflects the greater prevalence of wind coverage today, increases in standard coverage provisions (e.g., the contents limit and the move to replacement cost coverage). This, however, was offset somewhat by decreases in coverage due to mandatory increases in wind deductibles since Hurricane Andrew.

The Hardest-Hit Counties in Florida. Hurricane King provides a representative example of how the various normalization components combine to increase the level of insured losses from a hurricane. Hurricane King battered southeast Florida in October 1950, producing approximately $10.4 million of insured damages according to the PCS. The study indicates that the bulk of these damages occurred in Miami–Dade county (about $7.3 million) and Broward county ($1.8 million).

From 1950 to 2000, inflation raised prices nationally at an average annual rate of 3.7%, as measured by the implicit price deflator. Housing units in Miami–Dade grew at an average rate of 3.3% over the same period. In Broward county, however, housing units increased at an average rate of 6.5%. The other normalization components, wealth per capita and insurance utilization, rose nationally at average rates of 1.3% and 1.9%, respectively. Thus, the 3.7% annual impact of inflation on the normalization of 1950 Hurricane King damages is small compared to the total contributions of the other three components (6.6% annual impact in Miami–Dade and 9.9% in Broward). On a normalized basis, Hurricane King would produce $2.8 billion of insured damages today, with Miami–Dade and Broward contributing $1.2 billion and $1.3 billion, respectively.

Exhibit 3
Category 4 Hurricanes Caused the Greatest Losses



Note: Storm Sizes Are in Saffir–Simpson Categories 1–5. Damages Are in $ Millions.

Predicting Future Damages. Hurricane experts generally agree that we entered a period of more frequent hurricanes in the Atlantic basin in 1995. How long this era of hurricane-favorable conditions will last is less certain. Estimates range from ten to 40 years. Many factors influence Atlantic hurricane frequency, including the El Niño–Southern Oscillation, Africa's Western Sahel rainfall and sea surface temperatures. The science of hurricane prediction cannot yet make accurate long-term forecasts. Nor has the impact of global changes in climate on hurricane frequency been resolved.

A period of more frequent hurricanes means more hurricane landfalls. But will this lead to more insured damages on a normalized basis during the coming decades? The answer will depend primarily on the landfall locations of the strongest storms and our ability to mitigate future damages by better construction and risk management.