

# Are Natural Hazards and Disaster Losses in the U.S. Increasing?

More than 35 major Presidential disaster declarations, including those for Hurricanes Katrina and Rita, already have been declared across the United States in 2005. This is a harbinger of another costly year for natural disasters.

While losses from the 2004 hurricane season are still being tallied, estimates suggest that each Florida hurricane last year was responsible for more than \$5 billion in damages (<http://www.ncdc.gov/oa/reports/billionz.html>). This year (2005) may prove to be the costliest ever. To see whether the years 2004–2005 are unique or are the continuation of an increasing trend in disaster losses over time, spatial and temporal trends in natural hazards losses for the United States (1960–2003) were examined and compared with the geographic patterns of Presidential disaster declarations.

Results suggest that losses are increasing, that weather-related events produce more dollar damages than any other hazards, and that the geographic pattern of Presidential disaster declarations does not always match the overall spatial pattern of losses caused by natural disasters.

## *Loss Estimation: Science or Art?*

Despite the United States' long record of experiences with natural hazards, it is still not known for certain how much disasters cost this nation. Estimates hover between \$6–\$10 billion annually [Mileti, 1999]. At present, the nation does not have a system-

atic inventory of all hazard events and their associated losses (property, crops, or human casualties) in one centralized location, despite repeated calls for such an accounting system [National Research Council, 1999; Cutter, 2001].

The reason for this is unclear, other than possibly that natural hazards do not have the political salience as other social issues or that there is no obvious agency with a mandate to do this. Long-term archival of loss data is possible for some mission agencies (the U.S. National Climatic Data Center (NCDC) comes to mind), but these storm records do not represent all natural hazards. Another concern is how losses are defined and measured. With concerted effort, such a national loss inventory can be created, but it will require the political will to do so. Perhaps the nation's experience with the Katrina disaster will renew efforts to compile such a systematic spatial accounting.

The U.S. Federal Emergency Management Agency (FEMA) keeps records of Presidential disaster declarations (PDD) and the expenditures (e.g., payouts to individuals, businesses, and local governments). However, the PDDs are not a systematic inventory, as they normally represent extremely large and infrequent events. Smaller, more localized, less costly, and more frequent events such as tornadoes normally do not result in a PDD, yet contribute significantly to the overall loss matrix for the nation.

## *Hazard Events and Loss Data*

To examine the evolution of losses from natural hazards in the United States, the

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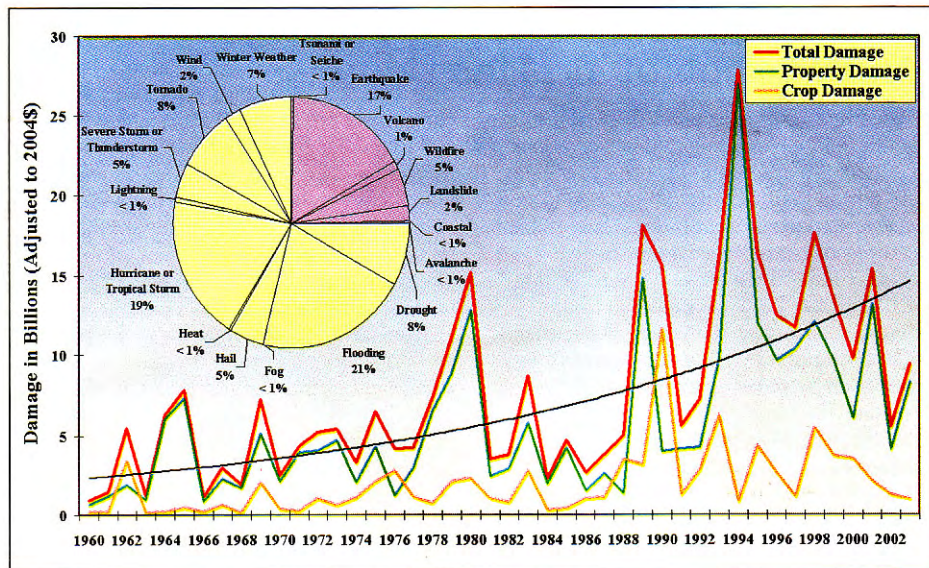


Fig. 1. Natural hazards losses from 1960–2003 based on the Spatial Hazard Events and Losses Database for the United States (SHELDUS).

Spatial Hazard Events and Losses Database for the United States (SHELDUS) was created (<http://sheldus.org>) by the lead author and colleagues at the Hazards Research Lab at the University of South Carolina. The database, presently covering 1960–2003 (updates are made every six months), was collated from a variety of governmental sources including the U.S. Geological Survey (USGS) and the NCDC.

Events were selected for the database if they caused more than \$50,000 in property and/or crop losses. The events then were classified into 18 different hazard categories, and were geo-referenced by county. SHELDUS, which downscales hazards loss data to the county level, provides an important contribution to understanding the temporal and spatial changes in natural hazards losses for the nation. The database now serves as the baseline for county-level event and loss data, and it is used in the compilation of hazard vulnerability assessments under the

U.S. federal Disaster Mitigation Act of 2000 (PL 106-390).

### Losses are Increasing

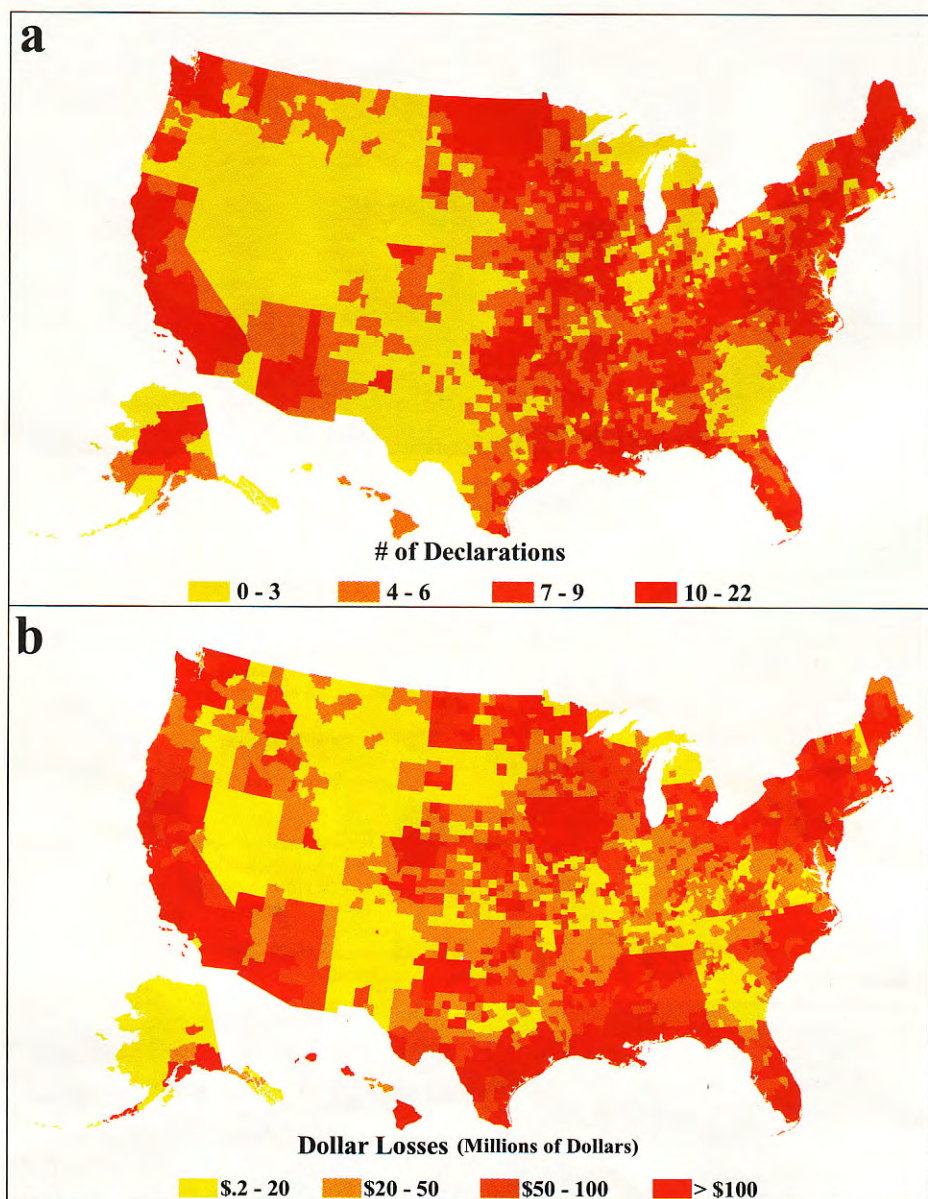
On average, natural hazards result in direct annual losses (crop and property) exceeding \$7.6 billion (adjusted to 2004 dollars). This is a conservative estimate and does not include insured loss payments to individuals and businesses, disaster payments to individuals, businesses, or local governments, or indirect losses such as lost wages, business downtime, or environmental damage.

Losses from natural hazards have been increasing exponentially since 1960 (Figure 1). The decadal annual mean loss also has been steadily increasing, peaking at \$14.4 billion (adjusted to 2004 dollars) in the 1990s. With only four years of data for the



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*Fig. 2. (a) The number of Presidential disaster declarations (PDD), 1965–2003, and (b) total property and crop losses, 1960–2003 (adjusted to \$2004), from SHEL DUS, both mapped by quartiles.*

present decade (the inclusion of data from 2004 and the first half of 2005 is in process), it appears that the nation is on track to surpass the 1990s average annual loss. The 1990s were not only the most costly decade for natural hazards, but also were the most deadly, with more than 5200 fatalities attrib-

uted to natural hazard events.

Certain peak periods of losses in the past can be explained by singular large events, (such as Hurricane Andrew or the Northridge earthquake) but these singular events alone do not completely explain the exponential rise in natural hazards losses.

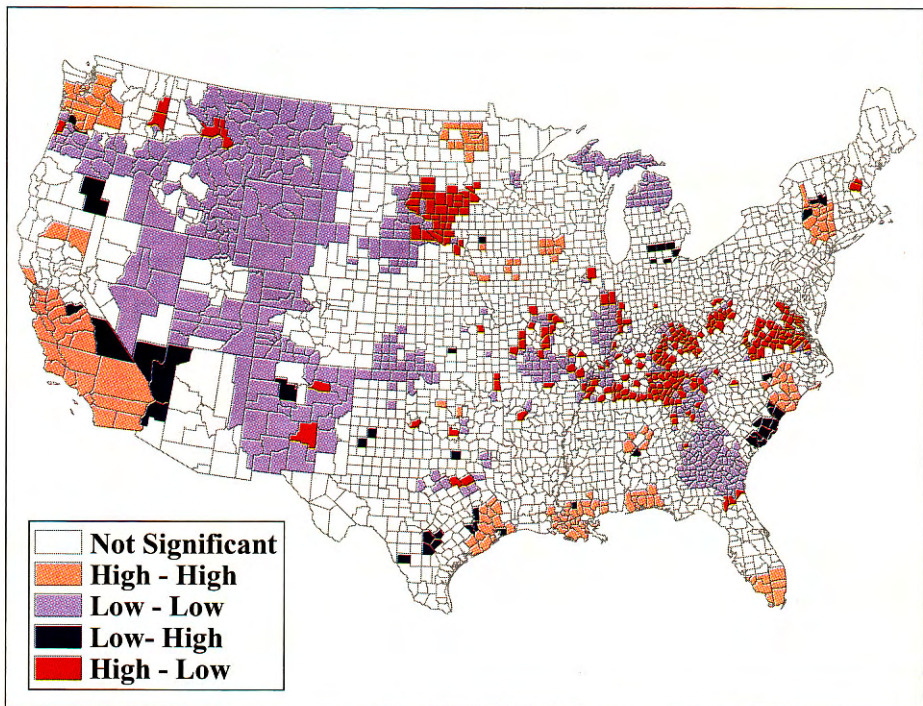


Fig. 3. Spatial correlation (based on Moran's  $I$  statistic) between Presidential disaster declarations and total property and crop losses from the SHELDUS database, 1965–2003. Counties shaded in dark blue registered large dollar losses over the past four decades yet did not have comparable numbers of Presidential disaster declarations. Counties shaded in red highlight larger numbers of disaster declarations and lower dollar losses. Pink and light blue areas illustrate the spatial consistency between large dollar losses and numbers of disaster declarations (pink) and fewer dollar losses and lower numbers of disaster declarations (light blue).



SHELDUS data indicate that weather-related events produce more dollar damages than other general hazard types (Figure 1). Weather-related disaster events generally occur with greater frequency than geophysical events, which partially explains the higher loss figure. Some reduction (rather than increases) in losses from these more frequent weather events might be expected, given significant advancements in detection, warning systems, and mitigation (such as flood-proofing, hurricane shutters, and tornado safe rooms).

However, the cause of the increasing disaster losses is clear: More people and property are placed in harm's way. While hazard events wax and wane, and knowledge about them improves, the frequency of these events has remained relatively constant [Board on Natural Disasters, 1999; van der Vink et al., 1998]. But human factors—population growth and migration to more hazard-prone locations such as coasts—are the more likely contributor to increased losses.

### Geography of Natural Hazard Losses

The cumulative impact of natural hazard losses affects some places more than others (Figure 2). When the property and crop losses from SHELDUS are mapped (Figure 2b), they are concentrated in a number of places: California, along the U.S. Gulf Coast and Florida, along the southeastern U.S. coast, in the Hudson River valley, in Iowa and the northern Great Plains, and in the Pacific Northwest.

Los Angeles County, California, leads the nation in cumulative natural hazards losses (more than \$32.7 billion in adjusted 2004

dollars), but it also has a significant record of Presidential disaster declarations (20 have been declared since 1965). Rounding out the top five counties in total losses are Alameda, California (\$3.8 billion), Grand Forks, North Dakota (\$3.7 billion), San Benito, California (\$2.0 billion), and Monterey, California (\$2.0 billion).

When the loss data are standardized to account for disparities in county size, Los Angeles remained in the top five, with \$7.97 million in losses per square mile. San Francisco County had the highest loss per square mile in the nation (\$26.8 million), followed by Los Alamos, New Mexico (\$16.5 million). The former is due to the 1989 Loma Prieta earthquake, while the latter is due to a single large wildfire event (Cerro Grande in 2000). Rounding out the top five by area were two very small independent cities in Virginia: Norton (\$8.86 million per square mile) and Bristol (\$8.59 million per square mile).

Presidential disaster declarations are concentrated along the U.S. west coast, Gulf Coast and Florida, eastern Great Plains, Appalachia, and the Northeast (Figure 2a). When PDDs are compared with the county SHELDUS losses, there is very little statistical (Pearson's correlation coefficient  $R = 0.35$ , significant at the 0.01 level, two-tailed) or spatial correlation between the two.

This suggests one of two possible explanations. The first possibility is that event loss data represent higher-frequency, lower-impact (in terms of losses) events as well as the singular, high-impact, but infrequent disaster. This would result in geographic variations between the two distributions, i.e., PDDs illustrate the "disasters" while property and crop losses illustrate more chronic, yet less devastating events.

A second explanation focuses on the political nature of the disaster declaration process [Platt, 1999; Garrett and Sobel, 2003]. In this explanation, the receipt of a disaster declaration is less reflective of the true "need" based on estimated losses, but more reflective of the effectiveness of the state (and county) in securing the disaster designation.

Data show there are many areas of the country that have relatively large numbers of disaster declarations (shaded in red) yet relatively modest levels of losses (Figure 3). These areas include tidewater Virginia, portions of Appalachia, and most of South Dakota.

Also shown are those regions of the country (dark blue) that are less effective at garnering disaster declarations—areas with higher loss levels yet fewer declarations—such as coastal South Carolina, south central Texas, and southeastern Michigan.

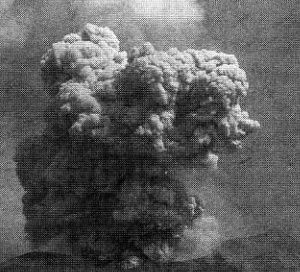
### Where Do We Go From Here?

Over the past four decades, the losses from natural disasters have escalated, as have the number of disaster declarations. Is the nation becoming more vulnerable to natural disasters, or is the Presidential disaster declaration simply a newer mechanism to provide pork barrel dollars to local communities?


While there are clearly instances when Presidential disaster declarations are required to assist local communities in times of need, perhaps it is time to begin

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thinking about the difference between ordinary and extraordinary events. When is a natural hazard event truly deserving of a disaster declaration? More to the point, shouldn't the nation strive to prevent disasters in the first place, or at least increase our resilience in the face of future disasters?

Repeated calls by the U.S. National Research Council and others indicate that it is time to develop a standardized accounting of hazard events and losses for the nation. A national center for hazard and disaster informatics would be a first step in this direction as suggested elsewhere [Cutter, 2001].

As part of its mandate, the center would produce an annual "state of disaster" report charting the nation's progress toward reducing losses from natural hazards. The vulnerability of the nation to natural hazards can be reduced, but it will require a moral and financial commitment from federal, state, and local governments. The establishment of a systematic accounting of losses is the first step in developing public policies designed to monitor, assess, and reduce the nation's vulnerability to natural hazards. Given the devastation along the Gulf Coast, the need now is greater than ever.

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