Are damaging floods becoming more frequent? Is there a recognizable trend? ESIG researcher Mary Downton and CU researcher Roger Pielke, Jr. have completed a reanalysis of the National Weather Service (NWS) flood loss database for the twentieth century. They did so in order to address these and similar questions, and to provide an understanding of the changing character of damaging floods in the United States.

According to NWS estimates, damage from floods caused approximately $50 billion damage in the United States during the 1990s alone. Although flood damage can fluctuate greatly from year to year, the trend appears to have increased during the past century. Some researchers speculate that the trend is indicative of a changing climate; others blame population growth and development; still others place the blame on federal policies. Some observers suggest that focusing on the trend distracts attention away from the larger success of the nation’s flood policies.

Unfortunately, the records of historical flood damage are inadequate for policy evaluation, scientific analysis, and disaster mitigation planning. For example, there are no uniform guidelines for estimating flood losses, nor is there a central hub for collecting, evaluating, and reporting flood damage. The NWS is the only organization that has maintained long-term and fairly comprehensive estimates of flood damage throughout the United States. Only from newspaper archives in cities and towns across the nation might a more complete historical record of local flood damage be constructed.

To understand the implications of increasing flood damage, decision makers need to recognize the influences of climate, population growth, land use, and policy on trends in flood damage, since an increase in damage due to changing climate may require different policy responses than damage increases due to implementation of flood policies.

Objectives of the Reanalysis

The ESIG/CU reanalysis objectives were to: (1) assemble a national database of historical flood damage from 1926 to 2000, making it as complete and consistent as possible; (2) describe what the estimates mean; (3) evaluate the accuracy and consistency of the estimates; (4) develop guidelines for use of the data; and (5) make it widely available to users. The review team evaluated NWS flood damage data sets by examining archived information, interviewing people who collected the data, identifying sources of error and inconsistency, and performing error analyses. Corrections were made only when changes could be clearly justified based on published sources or information in NWS files. Three data sets resulted from the study:

- Estimated flood damage, by river basin and drainage basin, for the US (1933–1975, by calendar year).

An interactive website was created from the data, allowing the user to enter a year or series of years, choose whether the damage data appears as total current dollar values, inflation-adjusted 1995 dollar values, or per-capita 1995 dollar values. The website also allows further refinement by searching a national data set, a states data set, or a drainage basin data.
set. Every operating system is accommodated (Windows, Macintosh, Solaris, and Linux operating systems) by the website. The data appears in printable text for ease of use.

**Limitations of the Data**

These data are rough estimates of direct physical damage to property, crops, and public infrastructure. The estimates are obtained from diverse sources soon after a flood and are not compared with records of actual costs. This study assessed the accuracy of the data by comparing damage estimates from NWS and other sources. Individual damage estimates for small floods frequently disagreed by more than a factor of two. However, estimates became proportionally more accurate at higher levels of aggregation. In floods with damage over $500 million (in 1995 dollars), estimates from different sources varied by 40% or less.

Every effort has been made to construct the best possible data set. At the national level, annual damage totals are reasonably accurate because they are sums of damage estimates from many flood events. At the state level, however, annual damage estimates are more problematic. Since flood damage does not occur every year, both frequency and magnitude of damage must be considered. Lack of a damage estimate does not necessarily imply zero flood damage, because reporting in small flood events is unreliable.

If appropriately used, the reanalyzed NWS damage estimates can provide reliable information about historical flood damage in the United States. But users should be aware of the deficiencies in the damage data sets and the importance of social context. The following procedures are recommended when using the reanalyzed NWS flood damage estimates:

1. When comparing national flood damage over time, reasonable consistency in annual damage estimates can be assumed during the years 1934–1979 and 1983–2000. Adjustment for changes in population or economic development is advised.

2. To determine the frequency of damaging floods in a state or a region, establish a threshold below which estimates are simply classified as “low” or “minimal” and report only on the frequency of floods that exceed the threshold.

3. To reduce the impact of estimation errors at the state level (especially in regions where damage estimates tend to be low), aggregate estimates over space or time. To compare damage between years, one can aggregate state damage estimates over regions that encompass many states.

4. When comparing flood damage in different geographical regions, consider the effect of differences in population, wealth, geographic area, or incidence of extreme weather events during the period of study.

5. When comparing individual floods in a state, use of broad categories such as low, medium, high, and major damage levels is advised. To compare floods of a similar magnitude, look for qualitative descriptions of the nature and impacts of damage.

6. Check for incompatibilities before combining damage estimates from different sources. For example, various agencies define “flood” and “flood damage” somewhat differently.

Economic damage results from an interaction between floodwaters and human activities in the flooded area, so one must consider social factors, including policy decisions and community responses.

Davenport, Iowa, 6 May 2001: Sgt. Ron Wubben from the Iowa National Guard’s 224th Engineer Battalion instructs guardsmen as they begin patrolling the levy in anticipation of the Mississippi River cresting for the second time. Photo by Anita Westervelt, FEMA News.

Using the data in an earlier study, Downton and Pielke compared presidential flood-related disaster declarations from 1965 to 1997 to measures of precipitation and flood damage. They examined how seven presidents made use of their discretionary authority in the disaster declaration process. A short version of this study was featured in *The Natural Hazards Observer*, and the complete results were presented in “Discretion without accountability: Politics, flood damage, and climate,” *Natural Hazards Review* (November 2001). For more information about this project, or other related projects under way at ESIG, please contact Mary Downton (downton@ucar.edu).

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