Normalized Hurricane Damage in the United States: 1900-2005

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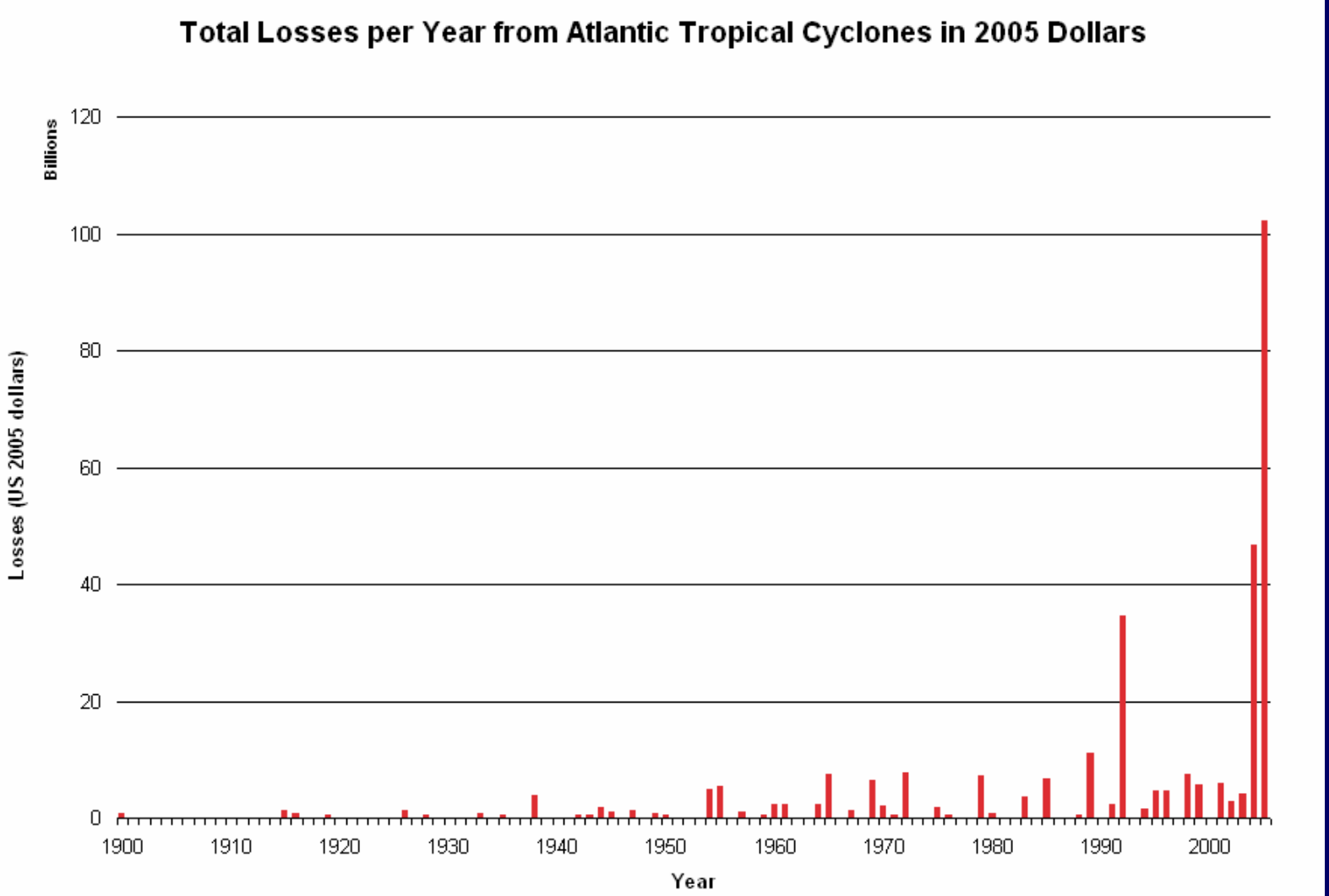
Outline

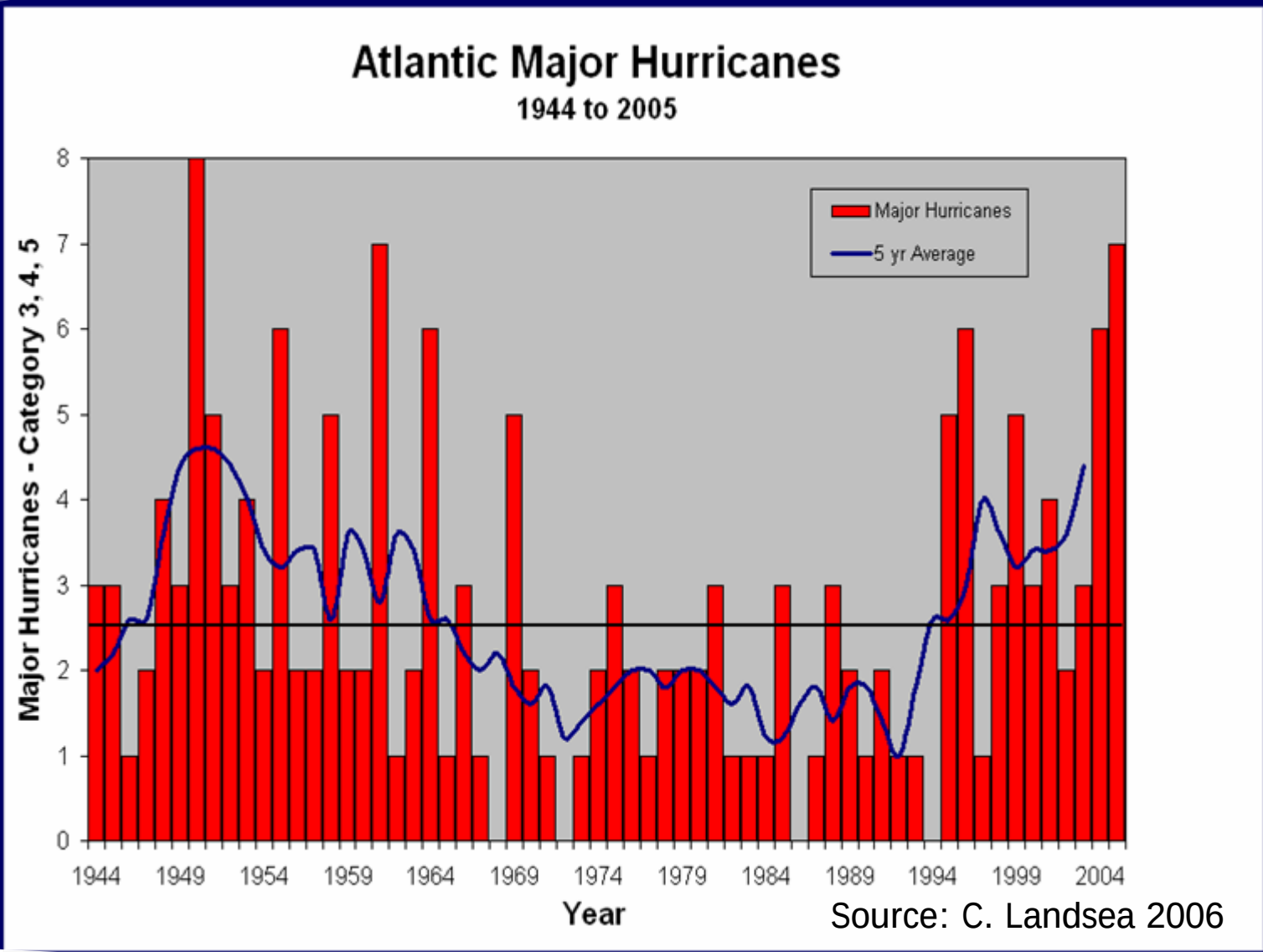
OUTLINE

- Introduction – Background
- Methods
- Results
- A few words on data and additional questions
- Conclusions

Rapidly increasing losses



Can't be due to storm behavior alone



Source: C. Landsea 2006

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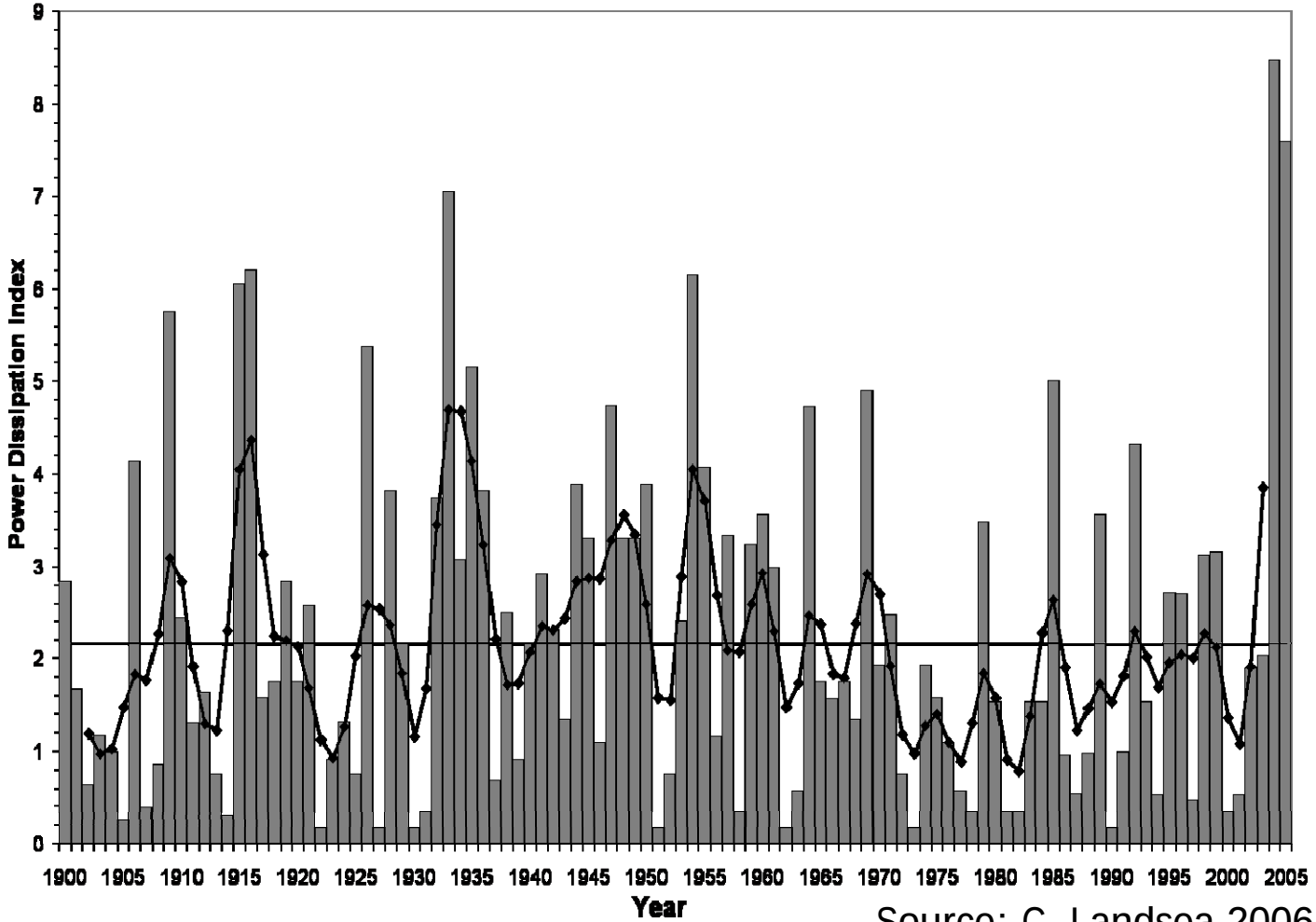
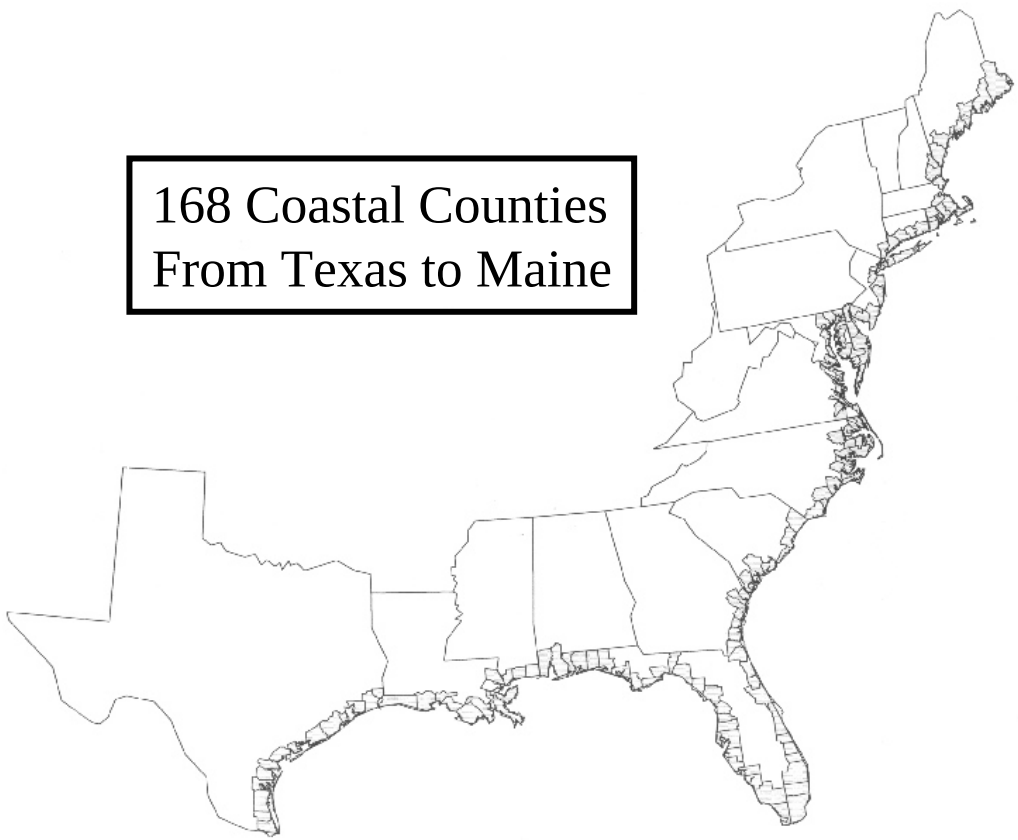
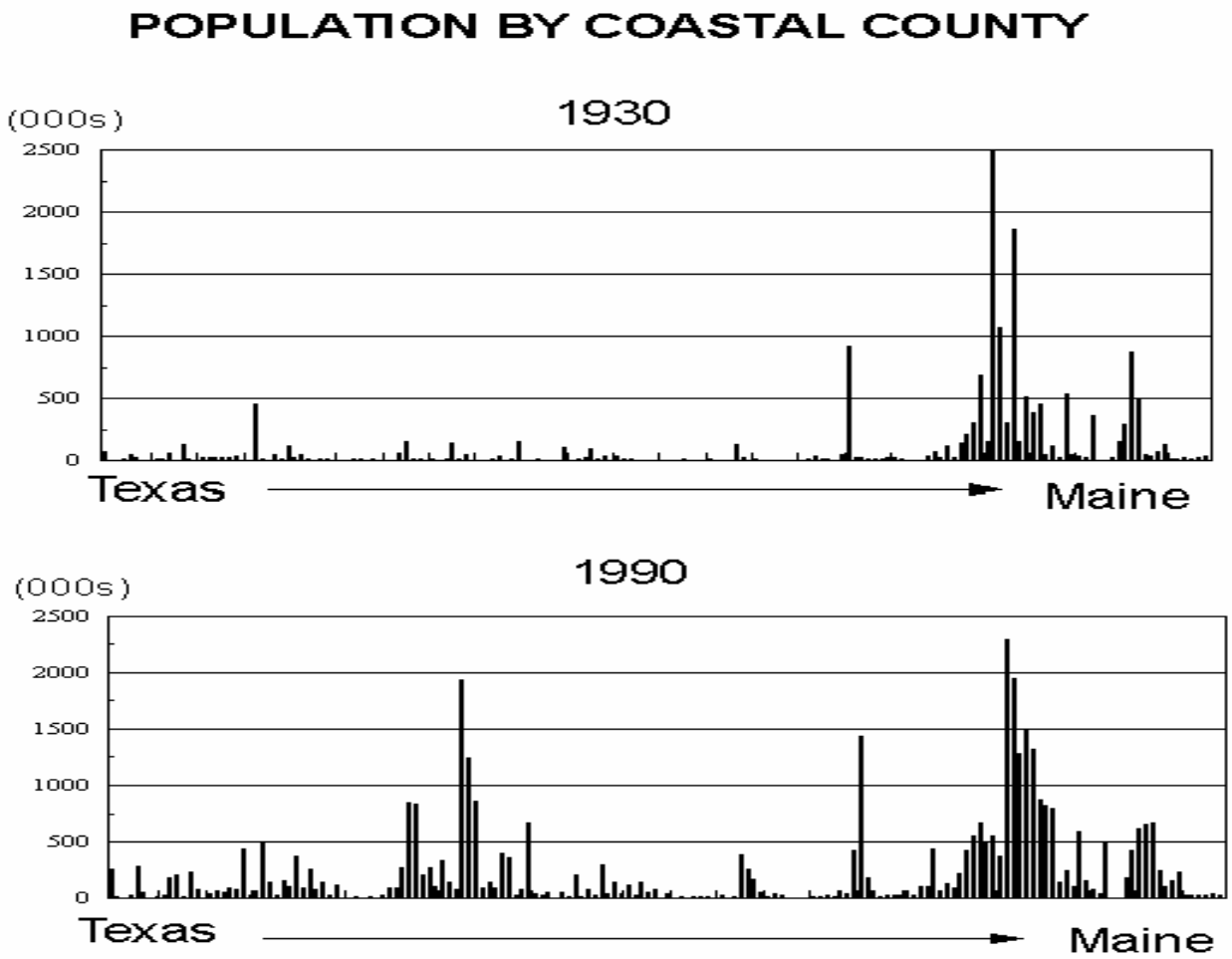


Source: C. Landsea 2006

Accounting for societal change



Two snapshots in time



How things used to look

Miami Beach
1926

Source:
Wendler Collection

How they have changed

Miami Beach
~2000

Background

- Update of Pielke, Jr., R. A., and C. W. Landsea, 1998: Normalized Hurricane Damages in the United States: 1925-95. *Weather and Forecasting*, 13:621-631.
- New adjustment data
- Added 1996-2005
- Added 1900-1924
- To come
  - Additional uncertainty analysis
  - Relationship with climate indicies
    - PDI
    - ACE
    - ENSO
    - MDO

Normalized Hurricane Damages in the United States: 1925–95

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ABSTRACT

Hurricanes are the costliest natural disasters in the United States. Understanding how both hurricane frequencies and intensities vary from year to year as well as how this is manifested in changes in damages that occur is a topic of great interest to meteorologists, public and private decision makers, and the general public alike. Previous research into long-term trends in hurricane-caused damage along the U.S. coast has suggested that damage has been quickly increasing within the last two decades, even after considering inflation. However, to best capture the year-to-year variability in tropical cyclone damage, consideration must also be given toward two additional factors: coastal population changes and changes in wealth. Both population and wealth have increased dramatically over the last several decades and act to enhance the recent hurricane damages preferentially over those occurring previously. More appropriate trends in the United States hurricane damages can be calculated when a normalization of the damages are done to take into account inflation and changes in coastal population and wealth.

With this normalization, the trend of increasing damage amounts in recent decades disappears. Instead, substantial multidecadal variations in normalized damages are observed: the 1970s and 1980s actually incurred less damages than in the preceding few decades. Only during the early 1990s does damage approach the high level of impact seen back in the 1940s through the 1960s, showing that what has been observed recently is not unprecedented. Over the long term, the average annual impact of damages in the continental United States is about $4.8 billion (1995 $), substantially more than previous estimates. Of these damages, over 83% are accounted for by the intense hurricanes (Saffir–Simpson categories 3, 4, and 5), yet these make up only 21% of the U.S.-landfalling tropical cyclones.

1. Introduction: Why trends matter

In recent years, decision makers in government, insurance, and other sectors have demonstrated increasing concern about the actual and potential impacts of weather and climate on society. To a significant degree, concern has been motivated by expectations that human-induced climate change will result in increasingly greater weather-related impacts to society. Concern has also been motivated by actual increases in weather-related impacts documented in recent years. Understanding these impacts in terms of trends, causes, and projections has significance for a range of policy decisions related to disaster mitigation and the international negotiations on climate change.

This paper focuses on trends in hurricane impacts in the United States because of the relatively well-documented information available on trends in hurricane climatology, economic impacts, and societal factors underlying those impacts.[1] Recent increases in the impacts of hurricanes in the United States have focused attention on them. In addition, the increased damages related to hurricanes have been attributed to climate change by the U.S. Senate, many in the insurance industry, and *Newsweek* magazine, among many others (U.S. Senate Bipartisan Task Force on Funding Disaster Relief 1995, hereafter BTFFDR; Dlugolecki 1996; cover of *Newsweek*, 21 January 1996). Recent research indicates that this attribution has been made incorrectly, leading to a conclusion that the factors responsible for documented trends in hurricane impacts are widely misunderstood (Landsea et al. 1996; Pielke 1997). The purpose of this paper is to examine trends in hurricane impacts in the United States in order to provide researchers and policy

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[1] The term "hurricane" is used throughout the paper as a generic term to include subtropical storms, tropical storms, and hurricanes (Landsea 1993).

Methods

Normalized 2005 Damages = $f(L_y * I_y * W_y * P_{y,c})$

- L_y = storm's loss in year *y,* in current dollars (i.e., not adjusted for inflation)
- I_y= ratio of the 2005 implicit price deflator for GNP to that of year *y*;
- W_y= ratio of the inflation-adjusted 2005 fixed reproducible tangible wealth to that of year *y*;
- $P_{y,c}$ = ratio of the change in the population of the coastal county(ies) most affected by the storm from year *y* to 2005.

Data Sources

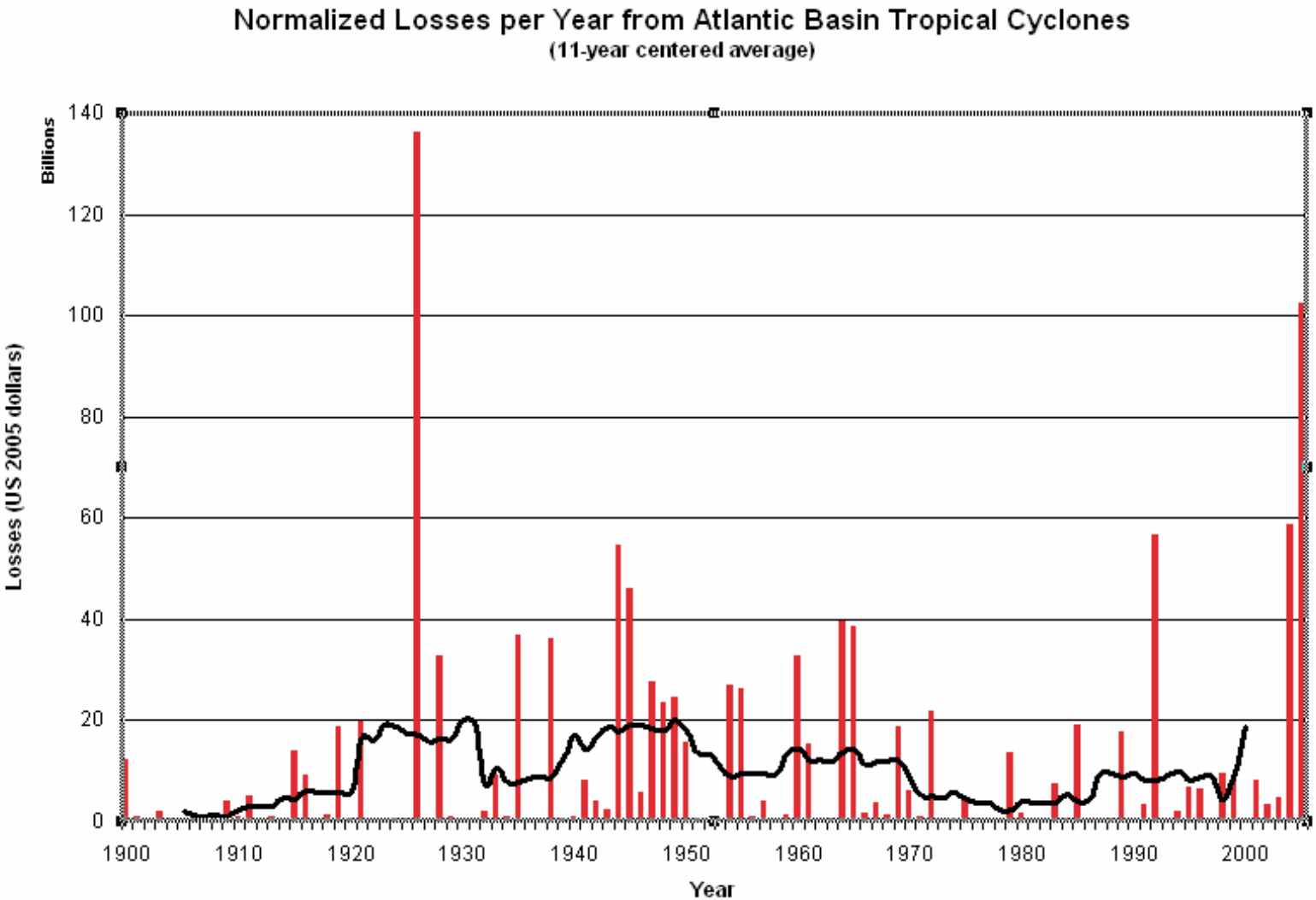
Normalized 2005 Damages = $f(L_y * I_y * W_y * P_{y,c})$

- L_y – U.S. National Hurricane Center, NOAA
- I_y = 2005 Economic Report of the President;
- W_y = Bureau of Economic Analysis, Dept. of Commerce
- $P_{y,c}$ – U.S. 2000 Census

Meaningful data?

- Normalized data contains climate information
  - ENSO (e.g., Katz 2002)
- Consistent with catastrophe model results
  - Pielke et al. 2000
- Includes primarily wind damage, not floods
- Possibility of large underestimates pre-1950
  - NHC collection procedures
  - Federal hurricane relief
  - Comprehensiveness of loss estimates
- Multiple datasets?

Preliminary Data



Preliminary Data – Most Damaging Storms

1.	1926	Great Miami	$129,700,000,000
2.	2005	Katrina	$80,000,000,000
3.	1900	Galveston	$53,100,000,000
4.	1992	Andrew	$50,800,000,000
5.	1915	Storm 2	$50,200,000,000
6.	1938	New England	$35,000,000,000
7.	1944	Storm 9	$34,300,000,000
8.	1928	Lake Okeechobee	$29,600,000,000
9.	1960	Donna	$23,900,000,000
10.	1903	Storm 3	$20,700,000,000

Preliminary Data – Most Damaging Years

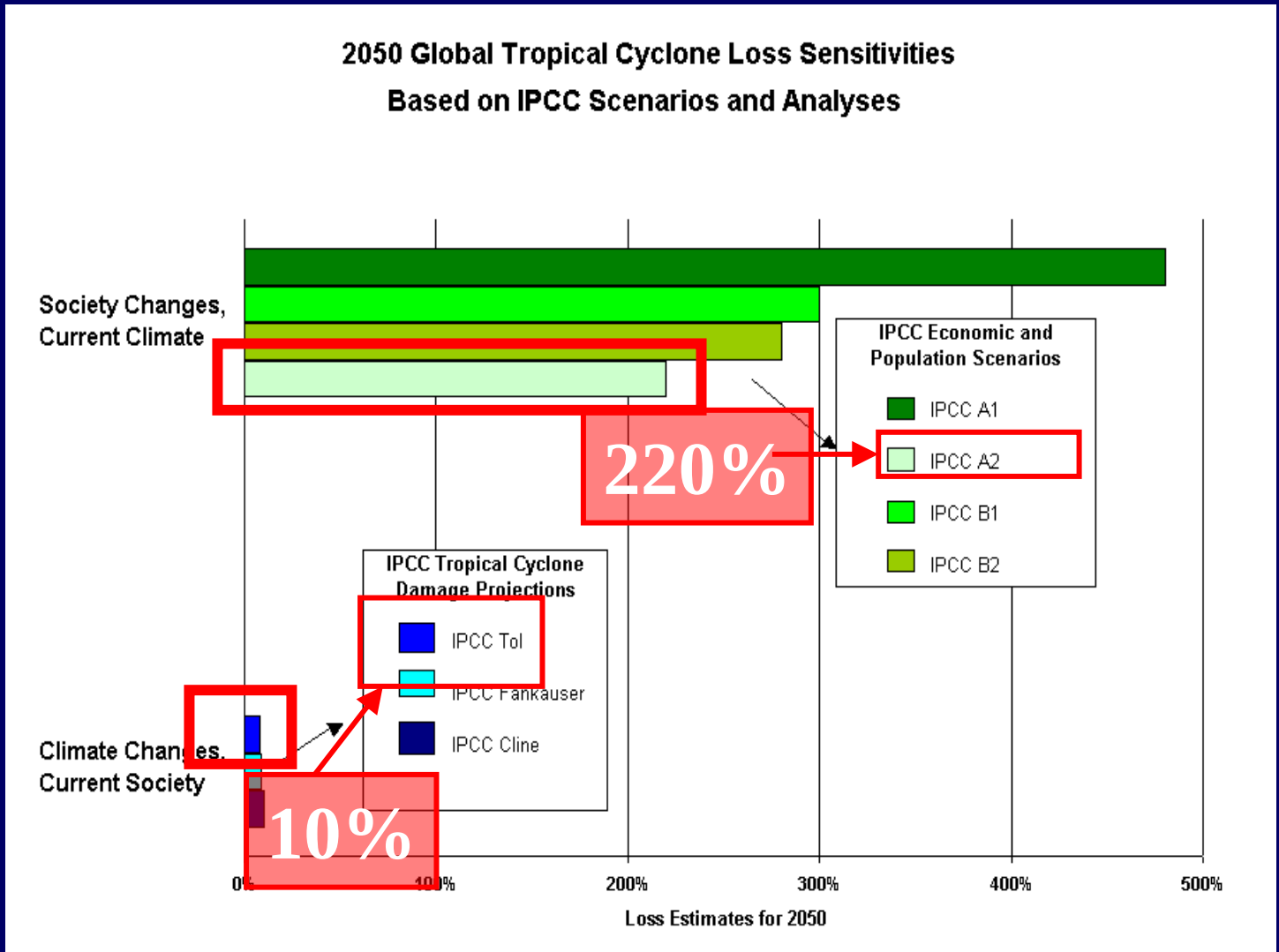
1.	1926	$141,400,000,000
2.	2005	$100,000,000,000
3.	1900	$53,100,000,000
4.	1992	$52,500,000,000
5.	1915	$52,200,000,000
6.	1944	$45,900,000,000
7.	2004	$45,100,000,000
8.	1938	$35,000,000,000
9.	1954	$32,700,000,000
10.	1928	$29,600,000,000

Preliminary Data – Most Damaging 10-Year Period

1935-2005, End date shown

1.	1935	$193,300,000,000
2.	2005	$175,700,000,000
3.	1947	$125,500,000,000
4.	1950	$114,400,000,000
5.	1951	$112,600,000,000
6.	1952	$110,600,000,000
7.	1949	$107,700,000,000
8.	1953	$107,400,000,000
9.	1946	$106,000,000,000
10.	1955	$103,000,000,000

Hurricanes damage in context



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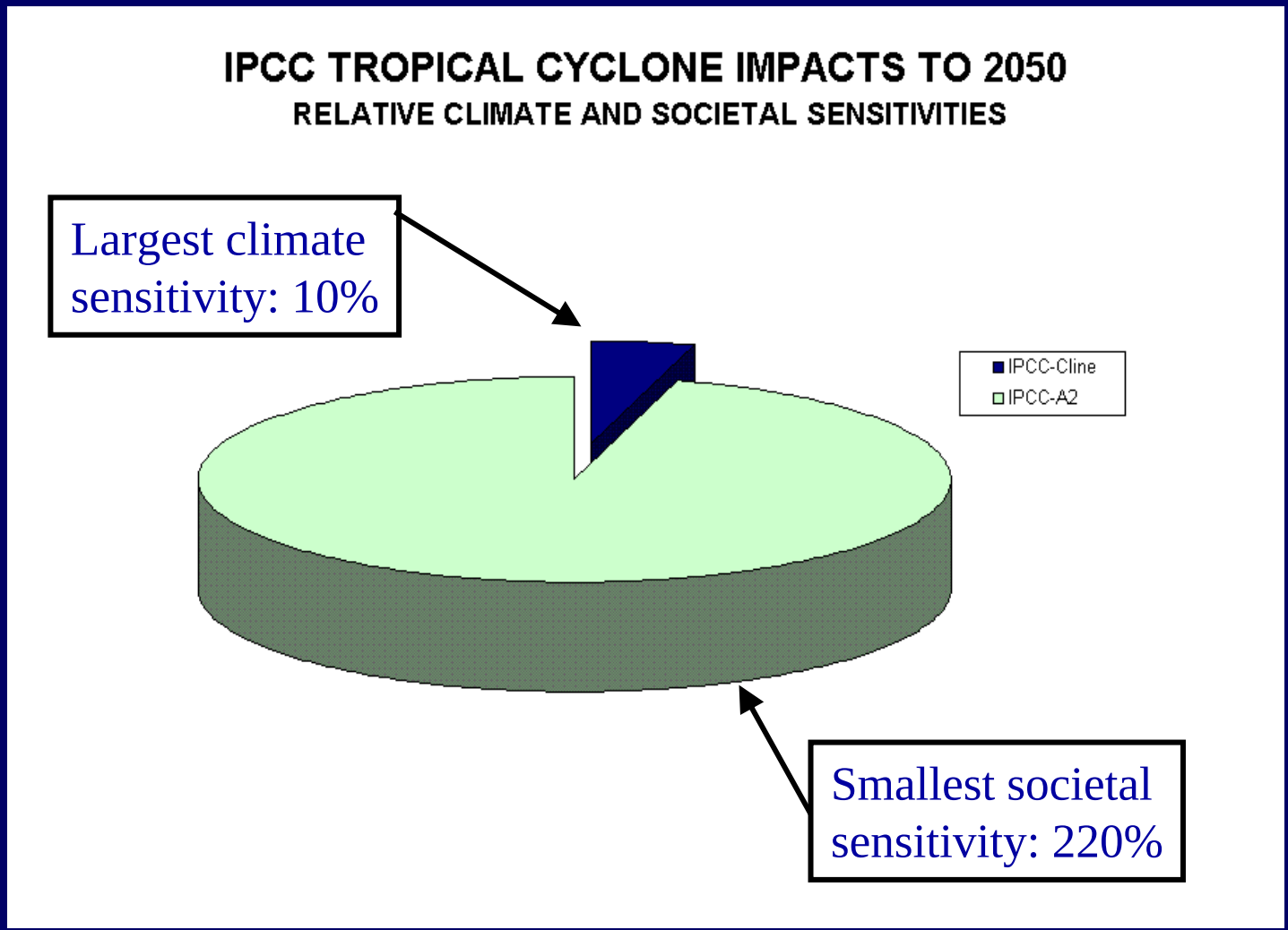

Looking Ahead

What will future damages look like?

- Trend: doubling in real terms every 7-12 years
- If this trend continues by ~2020
  - 1926 Great Miami = ~$500 billion
  - 1992 Andrew = ~200 billion
  - 2005 Katrina = ~320 billion
- Damages will continue to rise
- We may continue to underestimate loss potentials
- Societal change and climate change

How to provide feedback!

- pielke@colorado.edu
- http://sciencepolicy.colorado.edu/prometheus

Thanks!