

# Disaster Loss Normalization: Methods, Applications, Limitations

**Roger A. Pielke, Jr.**  
**University of Colorado**

## **The Study of Economic Loss from Natural Disasters**

London School of Economics  
and Munich Re  
London, UK  
30 November 2010



THE LONDON SCHOOL  
OF ECONOMICS AND  
POLITICAL SCIENCE ■



**Münchener Rück**  
**Munich Re Group**

# Outline – Five Questions

- What is “normalization”?
- What is “bias” in normalization?
- Why is it so difficult to identify signals of climate change in a normalization?
- What should we expect from normalization studies?
- What about future research and applications?

# Defining “normalization”

A normalization of disaster losses seeks to answer a deceptively simple question:

*What would a historical record of disaster losses look like if all disasters in the time series occurred under the societal conditions of a common base year?*

In other words, a normalization seeks to remove the integrated signal(s) of societal change from a time series of disaster losses.

# How might one evaluate a normalization?

Consider two normalizations of US hurricane losses . . .  
First, Nordhaus (2010)

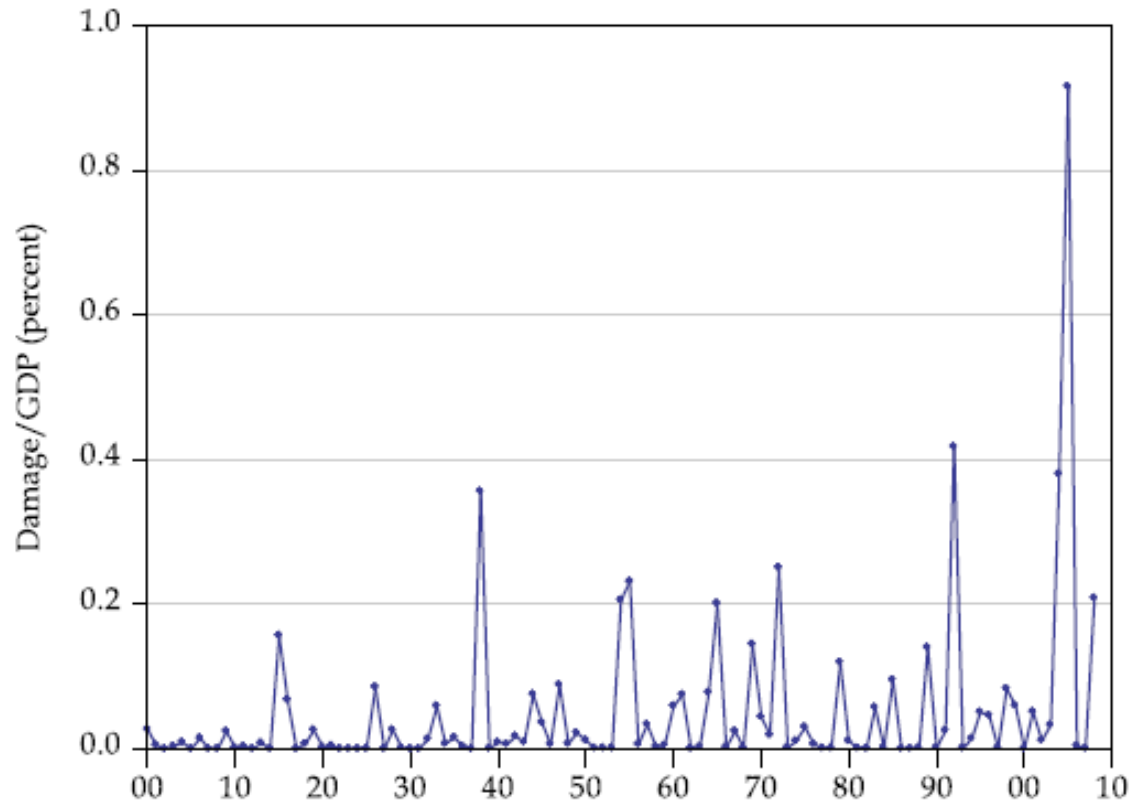


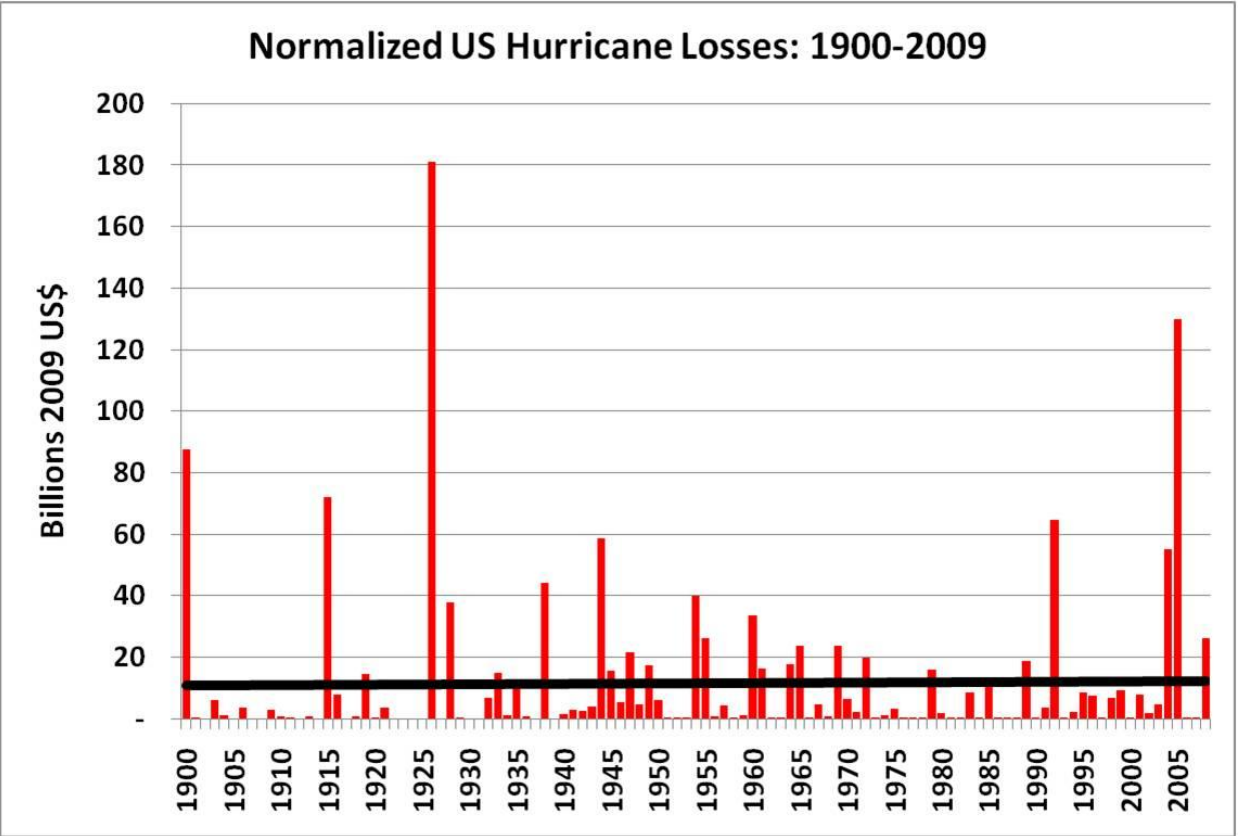
Figure 2. Normalized costs of hurricanes, 1900–2008

This figure shows the ratio of damages to GDP for all hurricanes for the given year.

*Source:* See text for discussion of damages. GDP from US Bureau of Economic Analysis.

# How might one evaluate a normalization?

Consider two normalizations of US hurricane losses . . .  
Second, Pielke et al. (2008)



# What would it mean to say that one normalization is "better" than another?

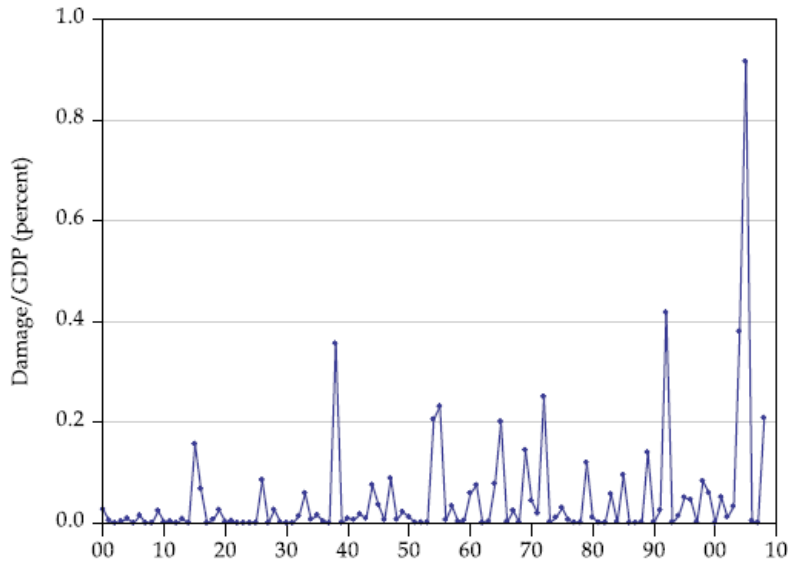
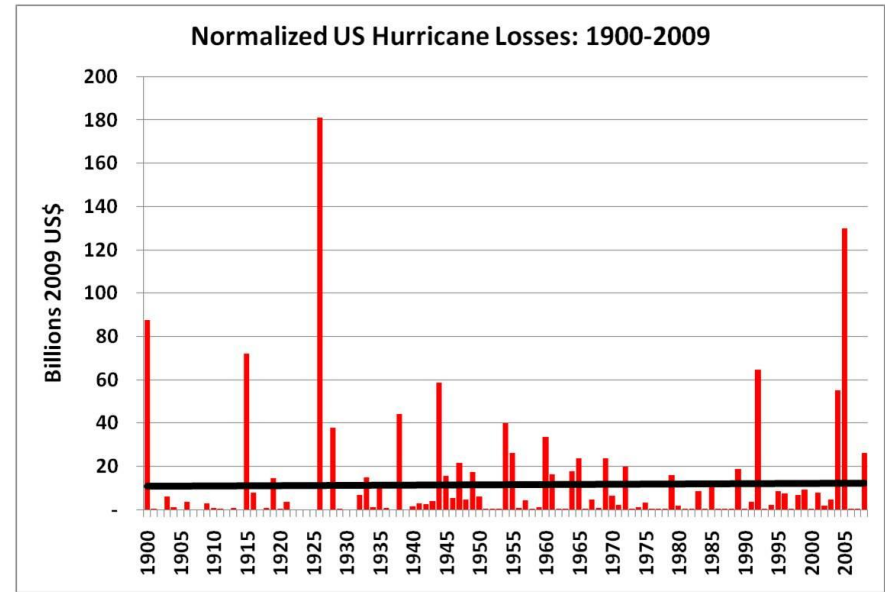
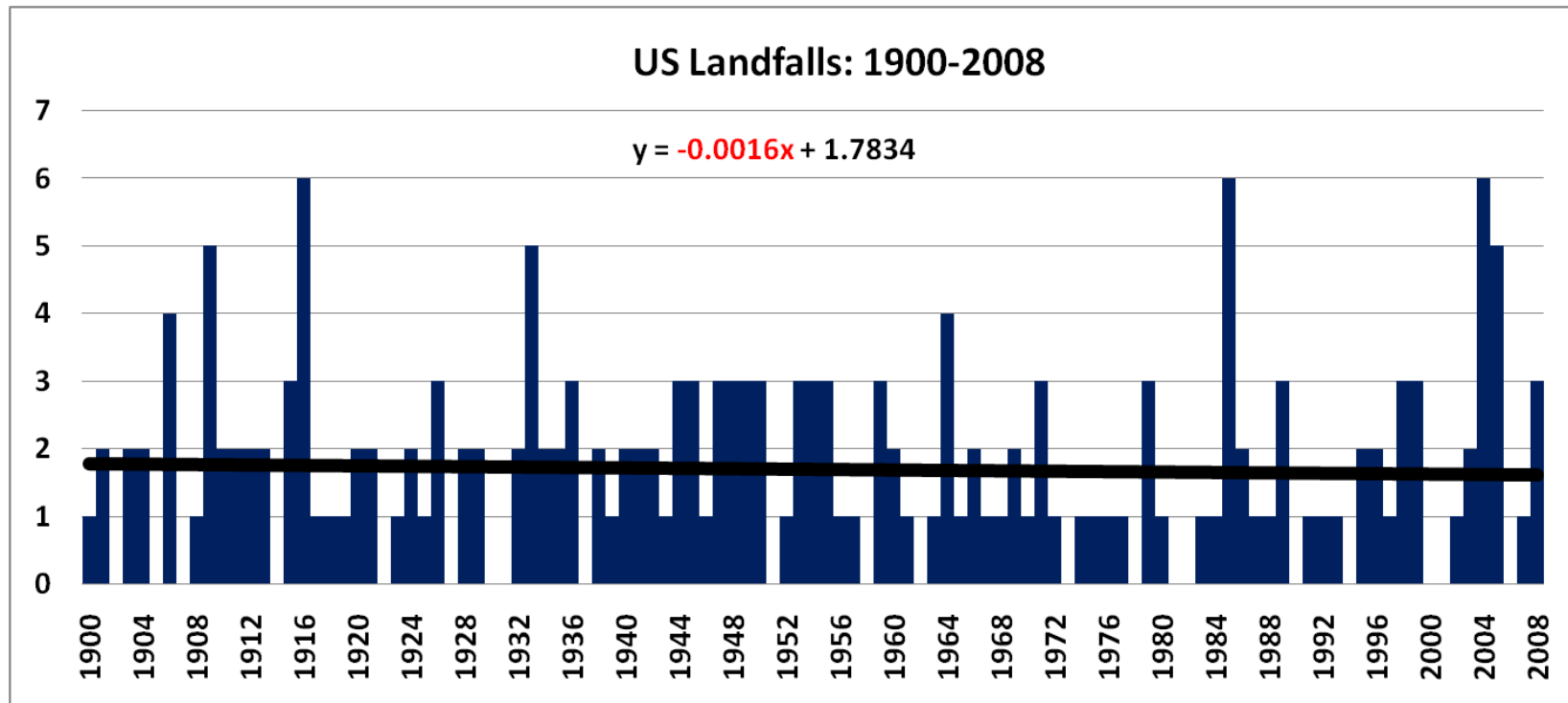


Figure 2. Normalized costs of hurricanes, 1900–2008  
This figure shows the ratio of damages to GDP for all hurricanes for the given year.  
Source: See text for discussion of damages. GDP from US Bureau of Economic Analysis.



The answer lies in recalling what a normalization seeks to do: specifically, to remove the integrated signal(s) of societal change, leaving behind a time series that reflects the signal of geophysical phenomena.

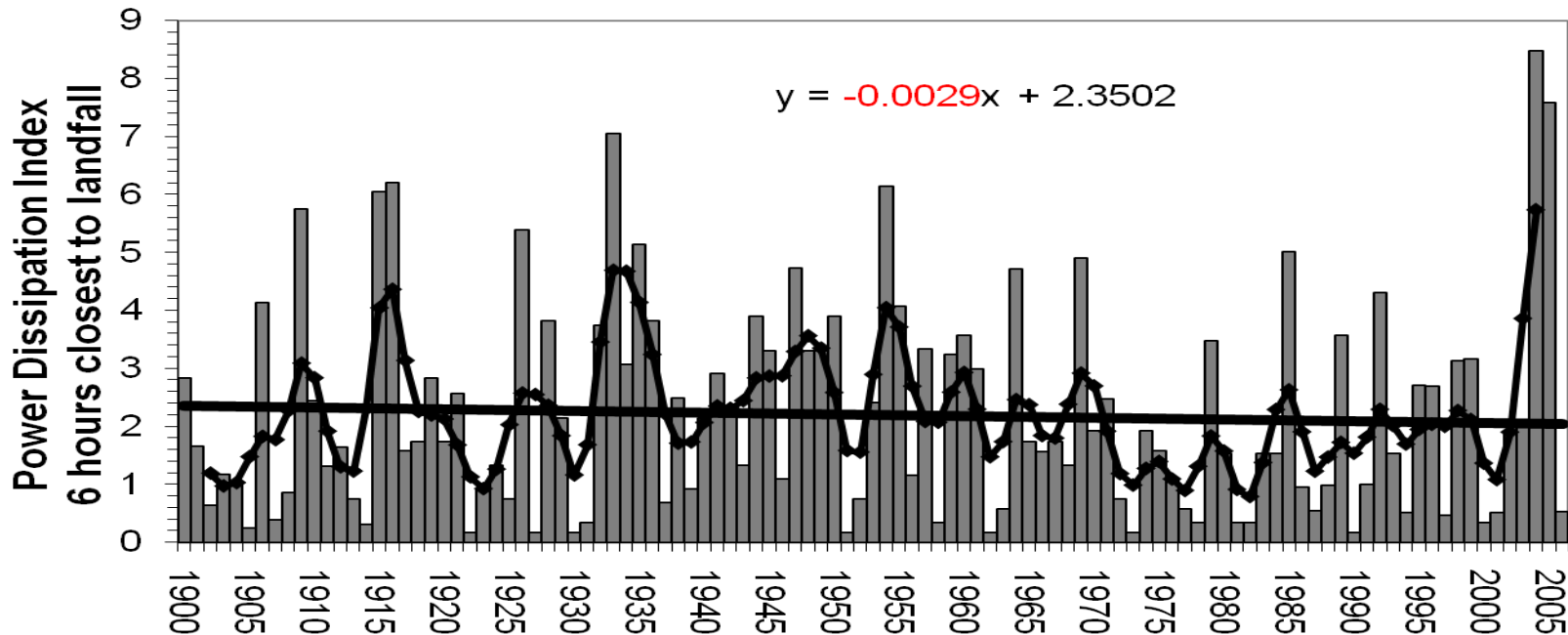
# For NATL tropical cyclones, data on hurricane landfalls can be used to evaluate a normalization of losses



From 1900 to 2008 there was no upwards trend in the number of US hurricane landfalls (but instead a very, very slight decrease)

# For NATL tropical cyclones, data on hurricane landfalls can be used to evaluate a normalization of losses

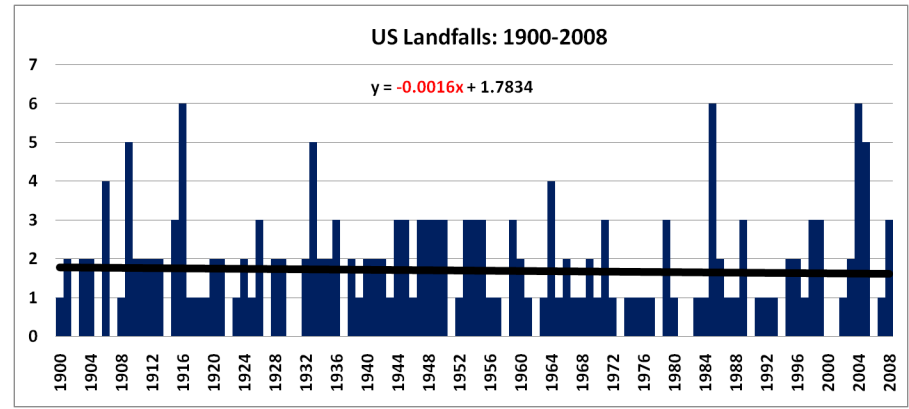
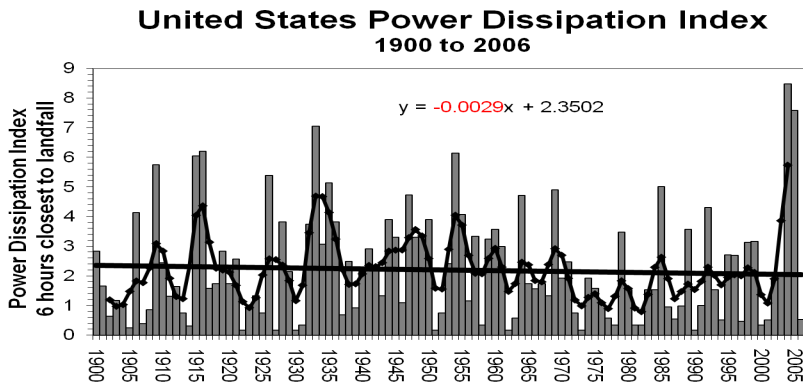
## United States Power Dissipation Index 1900 to 2006



From 1900 to 2008 there was no upwards trend in the intensity of US hurricane landfalls (but instead a very, very slight decrease)



# For NATL hurricanes data on hurricane landfalls can be used to evaluate a normalization of losses



With no upwards trends in hurricane landfall frequency or intensity, there is simply no reason to expect to see an upwards trend in normalized losses

# What would it mean to say that one normalization is "better" than another?

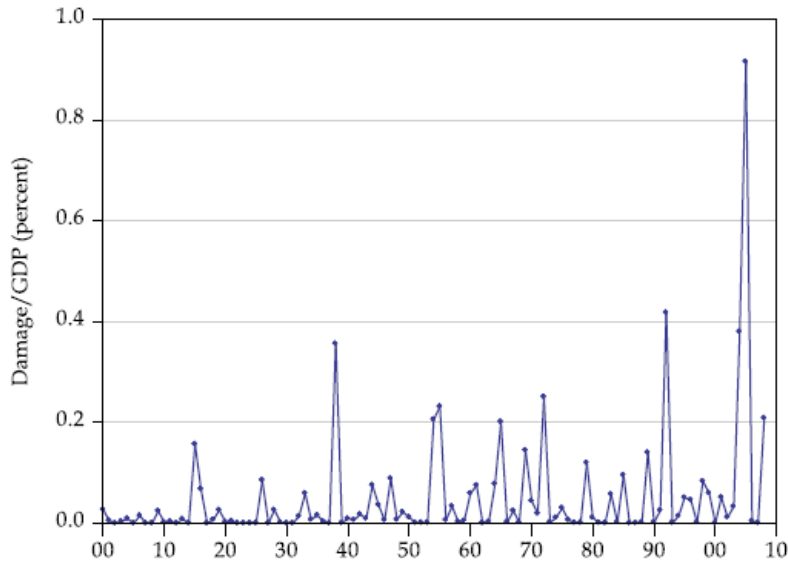
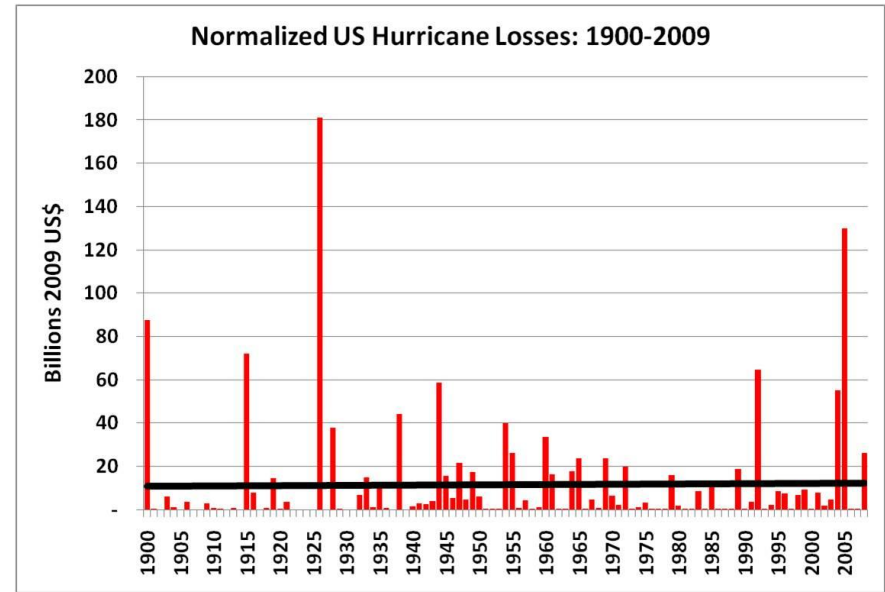


Figure 2. Normalized costs of hurricanes, 1900–2008  
This figure shows the ratio of damages to GDP for all hurricanes for the given year.  
Source: See text for discussion of damages. GDP from US Bureau of Economic Analysis.



The evidence suggests that Nordhaus (2010) is biased in the sense that, after normalization, a trend is evident that is at odds with the trends observed in the most directly relevant geophysical data.

# What would it mean to say that one normalization is "better" than another?

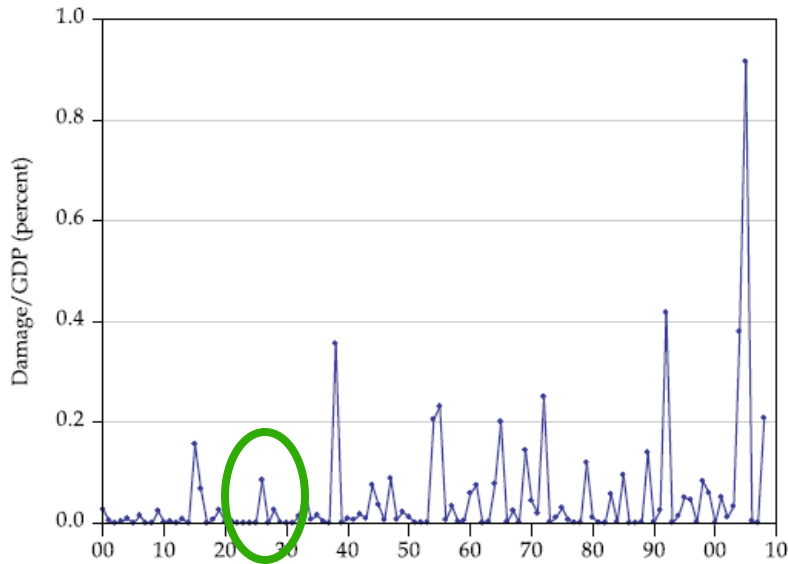
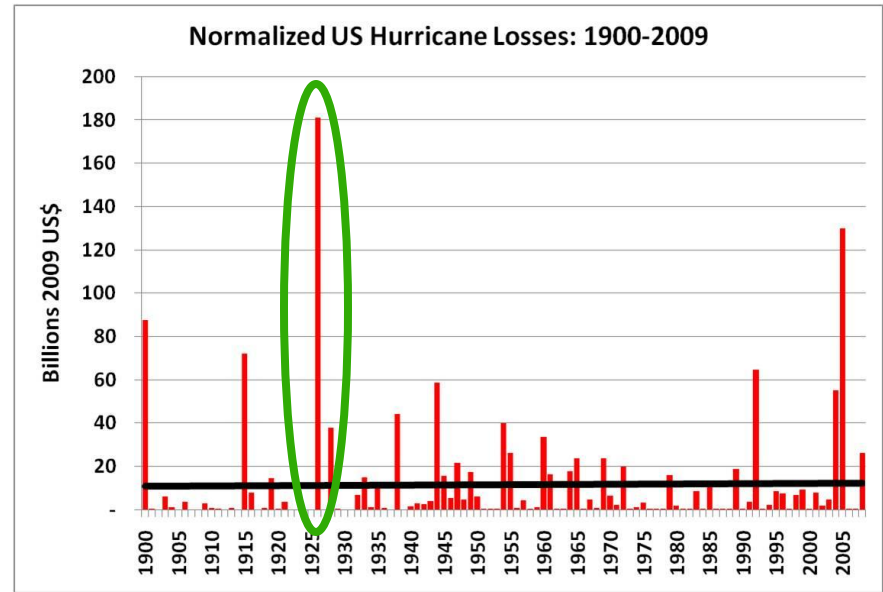


Figure 2. Normalized costs of hurricanes, 1900–2008  
This figure shows the ratio of damages to GDP for all hurricanes for the given year.  
Source: See text for discussion of damages. GDP from US Bureau of Economic Analysis.



## Consider 1926!

Is it plausible that the Great Miami Hurricane of 1926 (Cat 4 over downtown Miami) would result in 1/5 the damages of Andrew (1992)?

# Why is it difficult to see a climate signal in a loss record?

## Idealized Comparison of the Effects on Damages of Climate and Societal Changes Over 50 Years



- climate change (10% increase in intensity, raised to the 6th power)
- societal change (doubling of losses every 10 years)

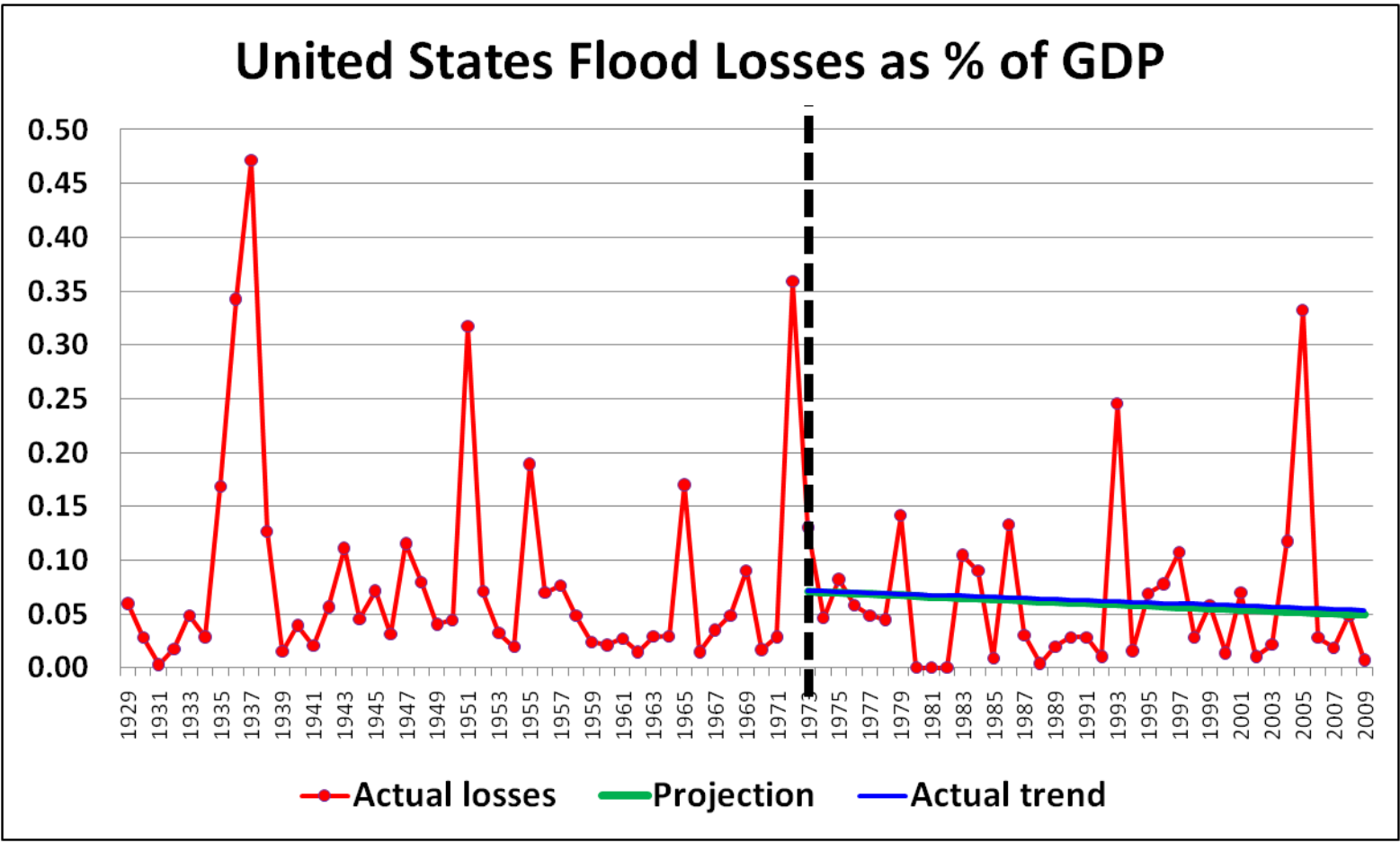
# What normalization can and can't do

- An unbiased normalization can be used to identify strong climate signals (e.g., ENSO)
- A normalization can be used to identify long-term trends in geophysical phenomena that influence losses (detection)
- Detection requires a longer time period for normalized losses than for the geophysical phenomena itself (see Crompton et al.)
- A normalization cannot be used for purposes of attribution of causal factors driving geophysical trends

# Frontiers in normalization research

- Robust findings related to climate change – the Hohenkammer consensus remains current!
- Other applications, e.g., evaluation of catastrophe models, identification of signal of policy interventions (US NFIP)
- Other phenomena and regions, e.g., “developing” world losses
- More rigorous evaluation of bias and methodologies in particular contexts, US hurricanes well studied in this regard, in other cases, not so much ...

# Search for signals of policy implementation



# Outline – Five Questions

- What is “normalization”?
- What is “bias” in normalization?
- Why is it so difficult to identify signals of climate change?
- What should we expect from normalization studies?
- What about future research and applications?



# Thank you!

---

- [pielke@colorado.edu](mailto:pielke@colorado.edu)
- Papers etc. can be downloaded from:  
<http://sciencepolicy.colorado.edu>