Assessing the Temporal and Spatial Variability of Four Damaging Weather Events and Their Impacts

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How does one Define a Damaging Weather Event?

- It generally occurs infrequently, but is associated with economic losses.
- Amount of loss may or may not be linked to the intensity of the event.
- Although loss may be related to the simultaneous occurrence of several weather factors (e.g., snow, wind, temperature) during the event, the primary loss can be attributed to a primary cause (e.g., snow).

Research Questions Associated with the Four Studies:

- Has the occurrence of certain U.S. damaging weather events changed during the 20th Century? What can be said about these changes:
  - Are temporal changes linear (and significant)?
  - Has the event intensity changed?
  - Are changes uniform across the U.S.?
  - How are the economic losses, associated with these events, changing (temporal/spatial issues)?

Review of Weather Events in 20th Century

- Since 1995 four NOAA-OGP sponsored projects have examined specific U.S. weather events and the *economic losses* related to them.
  - Hail Days
  - Thunderstorm Days
  - Freezing Rain Days
  - Snowstorms

Key Databases Evaluated for These Studies include:

- First-order station (FOS) hourly/daily data back to 1900 (viewed as backbone to studies).
- Long-term cooperative weather stations (U.S. Coop network) with periods of "good" records beginning in 1900.
- *Storm Data* publications (since mid 1950s).
- Crop-hail and property/casualty insurance records (1949-2000).

Approach to Studies:

- Evaluate annual changes at station, region, and national scales (i.e., determine trends and discuss variability).
- Assess decadal characteristics between 1900 and 2000.
- Compare variability characteristics of events to insured losses at the regional and national levels (estimate losses in earlier record where possible).
- Attribute results to potential causes where possible.

Results: Hail-Days and Losses

- National hail trend formed a bell-shaped distribution during the 20th Century, with hail occurrences peaking in mid-century. National hail losses increased dramatically beginning in 1970 (due to increased liability).
- Regional hail trends existed:
  - Increasing trends—High Plains; central/southern Rockies, and SE Coast
  - No trend—northern Midwest, along East Coast
  - Decreasing trends—Far West, Midwest, and Deep South

Results: Thunderstorm-Days and Losses

- Results similar to those for hail...National frequency of thunderstorm-days peaked in the middle of the 20th Century and have decreased since.
- Important regional trend differences exist.
- Greatest increases in thunderstorm-related damages are in areas where population has increased significantly.

Results: Freezing Rain-Days and Losses

- Since 1949, the national frequency of freezing rain days has increased only slightly.
- The trend in national losses related to freezing rain exhibits a U-shaped distribution with highs in the early 1950s and from 1993-2000.
- The Southeast U.S. experiences the highest insured loss per freezing rain-day.

Results: Snowstorms and Losses

- Northeast U.S. experiences most intense and most frequent damaging snowstorms.
- Annual average number of U.S. snowstorm "catastrophes" has remained near 3 since 1949—no trend.
- National insured losses related to snowstorms have steadily increased.

General Conclusions:

- National frequency of these damaging weather events *have not* increased during the 20th Century.
- National losses associated with these events *have* increased during the 20th Century, especially since 1980.
- Are increases in losses explained by societal changes and/or more intense events (which is often difficult to measure)?

General Conclusions cont.

- When examined at the *regional-scale*, increased insurance losses are noted in regions near coasts (Northeast, Southeast, and South) and in the Southwest where populations (and level of wealth) have increased rapidly over the past 30 year (i.e., altering the target!).
- It appears that even if the weather event climatology does *not* change in the future, losses associated with these events will continue to increase due to increased societal vulnerability to these weather events.
- Most extremes produce economic *winners* as well as *losers*!

Looking Down the Road:

- Long-term "quality" weather event *impact* data is generally not available.
- Lack of systematic data collection and dissemination by sectors outside insurance. Most available impact data are "estimates."
- Opportunities for interdisciplinary research exist and need to be explored.
- Is there a need for an "Impact Data Collection Agency" in U.S.?
- Changes in weather station observing practices (FOS and Coop networks) may "cloud" future analyses.

Subtopic 1: Have we observed impacts based on changes people have observed?

- Difficult question to answer!
- We have observed and performed economic analyses of impacts for some sectors (e.g., impact of warm winter of 2001/02).
- People (in general) observe changes in extremes (e.g., Chicago truck driver during a winter with many snowstorms), but we haven't measured the impacts on various sectors (e.g. transportation).

Subtopic 2: Can we link what we observe to impacts (socioeconomic and environmental)?

- We believe that in terms of economic impacts the answer is "yes" for many sectors (e.g., insurance, agribusiness, energy, etc.).
- However, it appears to be more difficult to develop direct relationships when considering environmental impacts (issues more complex?).
- In both cases, the role of non-weather factors is often difficult to separate from that of the extreme weather event.