Disaster Normals
CPASW 2023

Melanie Gall[1], Esther Boyle[2], Petar Jevtić[2]

[1]Center for Emergency Management and Homeland Security, School of Public Affairs, Arizona State University, Phoenix, Arizona, USA

[2]School of Mathematical and Statistical Sciences, Arizona State University, Tempe, AZ, USA

May 11, 2023

Introduction

- Projected increase in frequency and severity of natural hazards such as hurricanes, drought, and wildfires

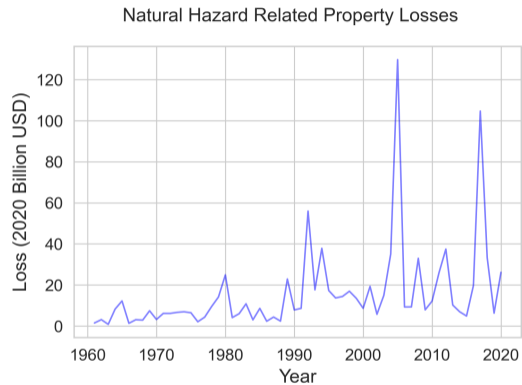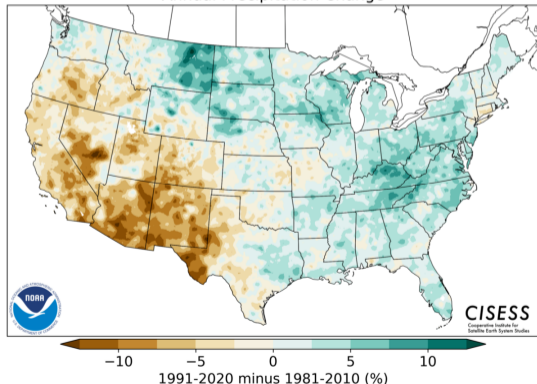- High variance, but increased losses from natural hazards in recent decades

Natural Hazard Related Property Losses

Figure: Property losses in 2020 USD resulting from natural hazards in the U.S.
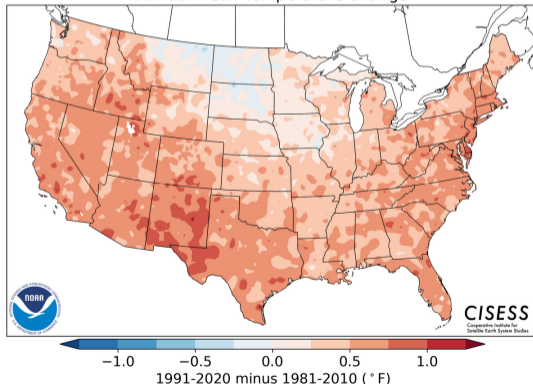Data from the SHELDUS database

Introduction: NCEI Climate Normals Product

Annual Precipitation Change

Annual Mean Temperature Change

1991-2020 minus 1981-2010 (%)

1991-2020 minus 1981-2010 (°F)

Motivation for Normals Products

Climate Normals:

- Empirical determination of a weather phenomenon as above or below normal or as extreme
- Comparison to reference normals can highlight changes in climate

Disaster Normals:

- How can we quantify extreme *loss* events?
- How can we detect long term changes in *loss* events?

SHELDUS Database

Spatial Hazard Events and Losses Database (SHELDUS)

- Available at: sheldus.org
- Developed by the Hazards and Vulnerability Research Institute at the University of South Carolina
- Maintained by ASU Center for Emergency Management and Homeland Security

SHELDUS Database

- County-level losses in the United States 1960 - 2021
- Property, crop, injury, and mortality losses
- Covers a variety of natural hazards:

Avalanche	Hail	Tornado
Coastal	Heat	Tsunami/Seiche
Drought	Hurricane/Tropical Storm	Volcano
Earthquake	Landslide	Wildfire
Flood	Lightning	Wind
Fog	Severe Thunderstorm	Winter Weather

SHELDUS Database Data Sources

- Storm Data and Unusual Weather Phenomena
- Global Significant Earthquake Database
- Global Historical Tsunami Database
- Significant Volcanic Eruptions Database
- Billion Dollar Weather and Climate Disasters

National Centers for Environmental Information
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Disaster Normals Products

Can be used to:

- Compare ongoing loss events to recent historical observations
- Make short term "forecasts"
- Illustrate impacts of the changing climate on ongoing loss events
- Foster improved disaster-related decisions

Development

- Adopts 30 year normal periods in line with Climate Normals product
- Is available for property, crop, injury, fatality, and total loss categories
- Considers raw loss values and losses per capita
- Includes 190 metrics for entire US and for each state

Product Type: US Normals

- Total Loss calculated using Value of Statistical Life adopted by FEMA National Risk Index ($11.6 M per fatality, $1.16 M per injury)
- Available as raw loss and per capita loss

Normal Product	US Normal (1991 - 2020)
Ann. Property Loss	$17.289 Billion
Ann.Crop Loss	$3.55 Billion
Ann. Fatalities	589
Ann. Injuries	4102
Ann. Total Losses	$32.43 Billion
Ann Property Loss PC	$62.66
Ann. Crop Loss PC	$13.68
Ann. Fatalities PC	0.0002%
Ann. Injuries PC	0.0017%
Ann. Total Losses PC	$123.75

Long term averages and standard deviations of:

- Total annual loss
- Daily average loss
- Daily max loss

Total Annual Loss State Level Normals

Quintiles

- $1042.19 M - $7369.72 M
- $476.14 M - $1042.19 M
- $281.23 M - $476.14 M
- $134.37 M - $281.23 M
- $20.67 M - $134.37 M

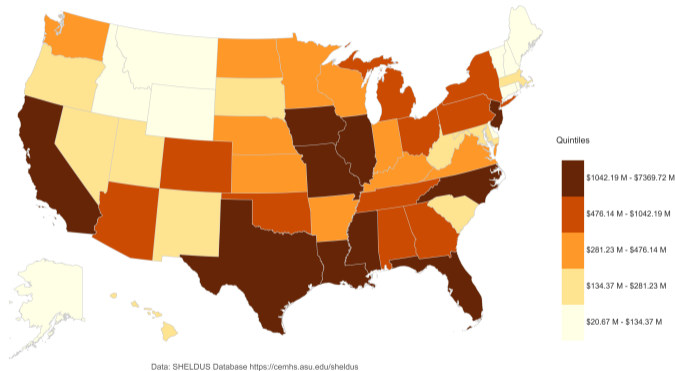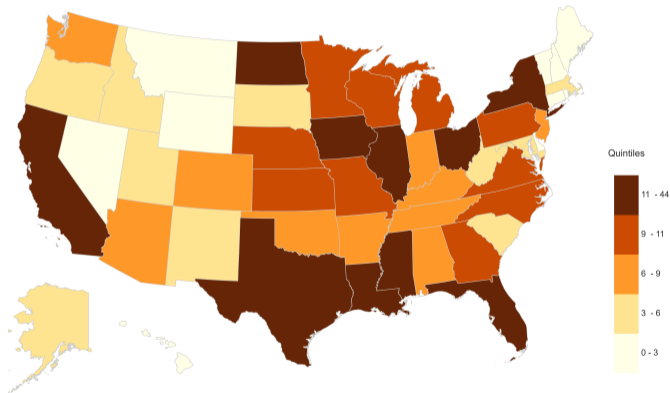Data: SHELDUS Database https://cemhs.asu.edu/sheldus

Figure: Includes Property Loss, Crop Loss, Injuries, and Fatalities. Presented in 2022 USD.

Product Type: Exceedance Values

Normal Product	Ex. Values
$ Losses	0
$ Losses	$1K
$ Losses	$100K
$ Losses	$1M
$ Losses	$100M
$ Losses	$1B
Inj./Fat.	0
Inj./Fat.	10
Inj./Fat.	20
Inj./Fat.	50

Days Property Loss Exceeds $1 M

Quintiles

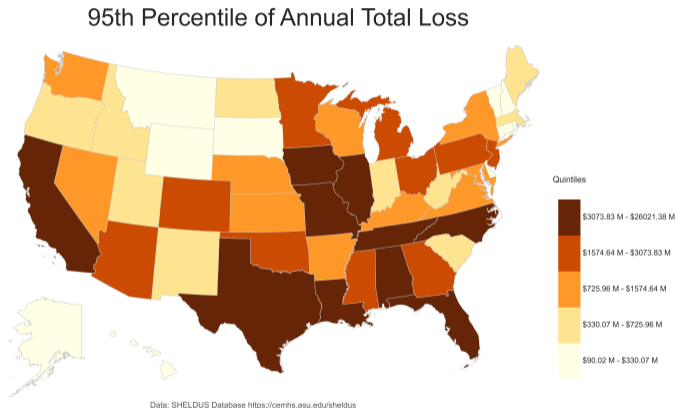11 - 44
9 - 11
6 - 9
3 - 6
0 - 3

Data: SHELDUS Database https://cemhs.asu.edu/sheldus

Percentiles are interpolated in line with WMO standards

Percentile Products Include:

- Long term quartiles
- Long term quintiles
- Long term 95th percentile

95th Percentile of Annual Total Loss

Quintiles

- $3073.83 M - $26021.38 M
- $1574.64 M - $3073.83 M
- $725.96 M - $1574.64 M
- $330.07 M - $725.96 M
- $90.02 M - $330.07 M

Data: SHELDUS Database https://cemhs.asu.edu/sheldus

Change in Annual Total Loss

Data: SHELDUS Database https://cemhs.asu.edu/sheldus

Quintiles

- $453.55 M - $5551.88 M
- $106.94 M - $453.55 M
- $0.18 M - $106.94 M
- $-91.91 M - $0.18 M
- $-384.88 M - $-91.91 M

- Historical reference normal and supplementary 15 year normal products in line with Climate Normals products
- Needs careful interpretation
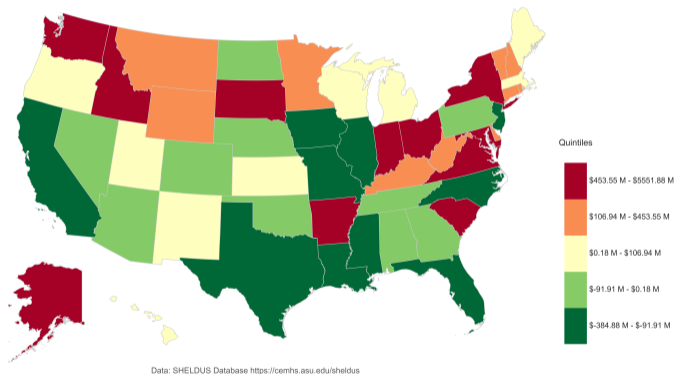
Future Disaster Normals Products

- County Level Normals
- Seasonal, Monthly, and Daily Normals
- Hazard Specific Normals
- Socioeconomic "Normalized" Normals