WILDFIRE: LESSONS LEARNED FROM THE 2017-2018 EVENTS

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NAIC – Austin, Texas – December 6, 2019

Wildfire: Lessons Learned

Presentation to the

NAIC's Catastrophe Risk Subgroup

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Extreme Events and Property Lines Committee

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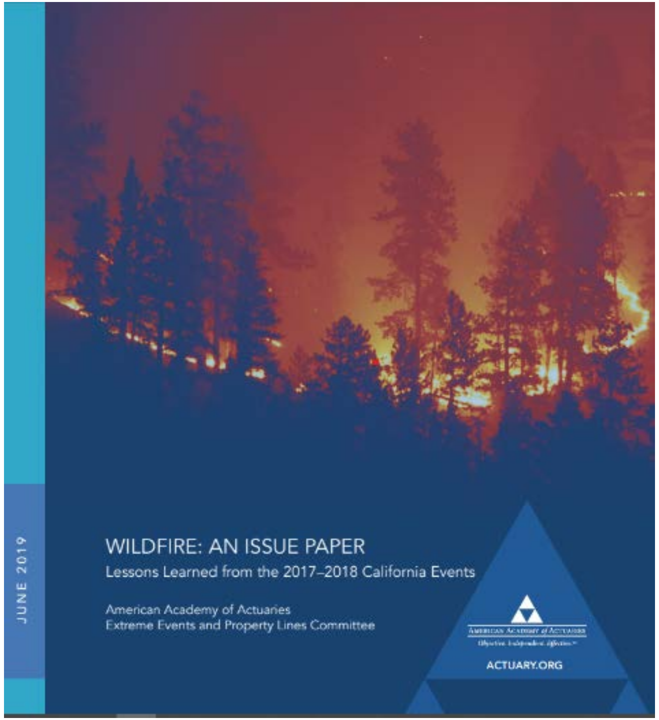
Wildfire: Lessons Learned



WILDFIRE: AN ISSUE PAPER
Lessons Learned from the 2017-2018 California Events

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https://www.actuary.org/sites/default/files/2019-06/Wildfire.IssuePaper_0.pdf

Most Destructive Wildfires in California

- 8 of the 20 most destructive California wildfires in history occurred in 2017 or 2018
- 11 of the 20 most destructive California wildfires occurred in the last decade
- Top causes of these fires are powerline, electrical, and other human-related activity

Top 20 Most Destructive California Wildfires

	FIRE NAME *(CAUSE)*	DATE	COUNTY	ACRES	*STRUCTURES*	DEATHS
1	**CAMP FIRE** *(Powerlines)*	November 2018	Butte County	153,336	**18,804**	85
2	**TUBBS** *(Electrical)*	October 2017	Napa & Sonoma	36,807	**5,636**	22
3	**TUNNEL - Oakland Hills** *(Rekindle)*	October 1991	Alameda	1,600	**2,900**	25
4	**CEDAR** *(Human Related)*	October 2003	San Diego	273,246	**2,820**	15
5	**VALLEY** *(Electrical)*	September 2015	Lake, Napa & Sonoma	76,067	**1,955**	4
6	**WITCH** *(Powerlines)*	October 2007	San Diego	197,990	**1,650**	2
7	**WOOLSEY** (Under Investigation)	November 2018	Ventura	96,949	**1,643**	3
8	**CARR** *(Human Related)*	July 2018	Shasta County, Trinity County	229,651	**1,614**	8
9	**NUNS** *(Powerline)*	October 2017	Sonoma	54,382	**1,355**	3
10	**THOMAS** *(Powerline)*	December 2017	Ventura & Santa Barbara	281,893	**1,063**	2
11	**OLD** *(Human Related)*	October 2003	San Bernardino	91,281	**1,003**	6
12	**JONES** *(Undetermined)*	October 1999	Shasta	26,200	**954**	1
13	**BUTTE** *(Powerlines)*	September 2015	Amador & Calaveras	70,868	**921**	2
14	**ATLAS** *(Powerline)*	October 2017	Napa & Solano	51,624	**783**	6
15	**PAINT** *(Arson)*	June 1990	Santa Barbara	4,900	**641**	1
16	**FOUNTAIN** *(Arson)*	August 1992	Shasta	63,960	**636**	0
17	**SAYRE** *(Misc.)*	November 2008	Los Angeles	11,262	**604**	0
18	**CITY OF BERKELEY** *(Powerlines)*	September 1923	Alameda	130	**584**	0
19	**HARRIS** *(Undetermined)*	October 2007	San Diego	90,440	**548**	8
20	**REDWOOD VALLEY** *(Powerline)*	October 2017	Mendocino	36,523	**546**	9

**"Structures" include homes, outbuildings (barns, garages, sheds, etc) and commercial properties destroyed.

***This list does not include fire jurisdiction. These are the Top 20 regardless of whether they were state, federal, or local responsibility.

8/08/2019

Source: Cal Fire, 2018

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2017-2018 California Insured Losses: $25.4 Billion

	Number of Claims	# Claims resulting in Total Loss	Direct Incurred Loss (Millions)
Oct 2017 Wildfires	35,466	6,222	$10,401
Dec 2017 Wildfires	19,309	943	$1,883
Jan 2018 Mudslide	2,958	163	$736
Jul 2018 Wildfires	10,343	998	$934
Nov 2018 Wildfires	46,305	13,154	$11,430
Grand Total	**114,381**	**21,480**	**$25,384**

Source: California Department of Insurance, 2018

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Top 10 States at High to Extreme Wildfire Risk

Rank	State	Estimated Number of Properties at Risk
1	California	2,019,800
2	Texas	717,800
3	Colorado	371,100
4	Arizona	237,900
5	Idaho	175,000
6	Washington	160,500
7	Oklahoma	153,400
8	Oregon	151,400
9	Montana	137,800
10	Utah	136,000

Source: Verisk, 2019

Source: Getty Images

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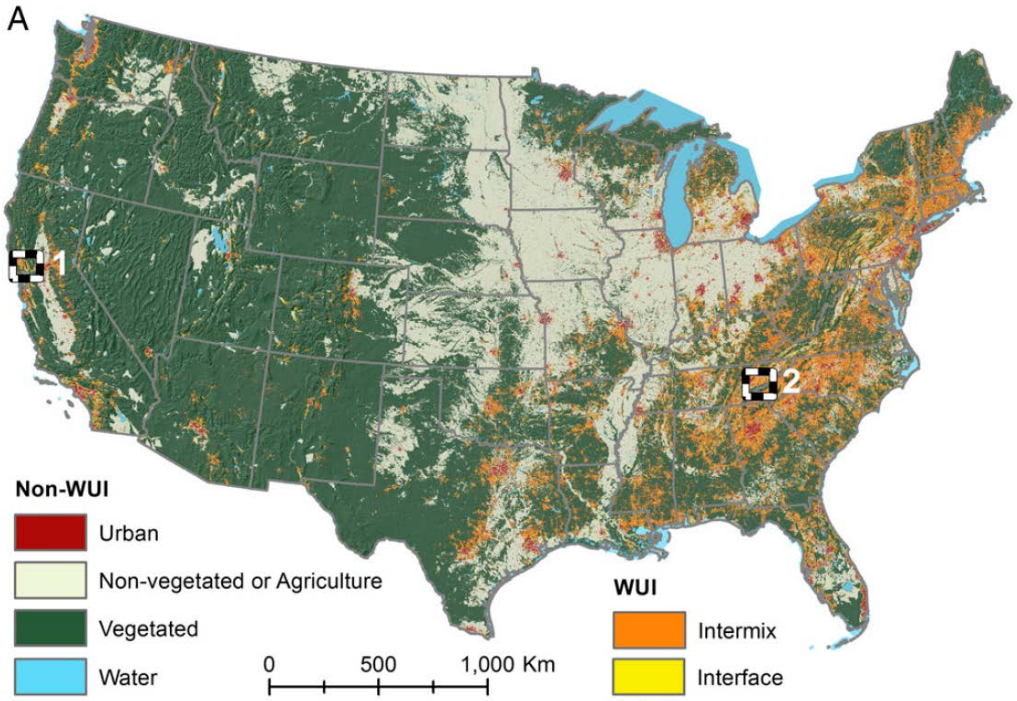
Wildland Urban Interface

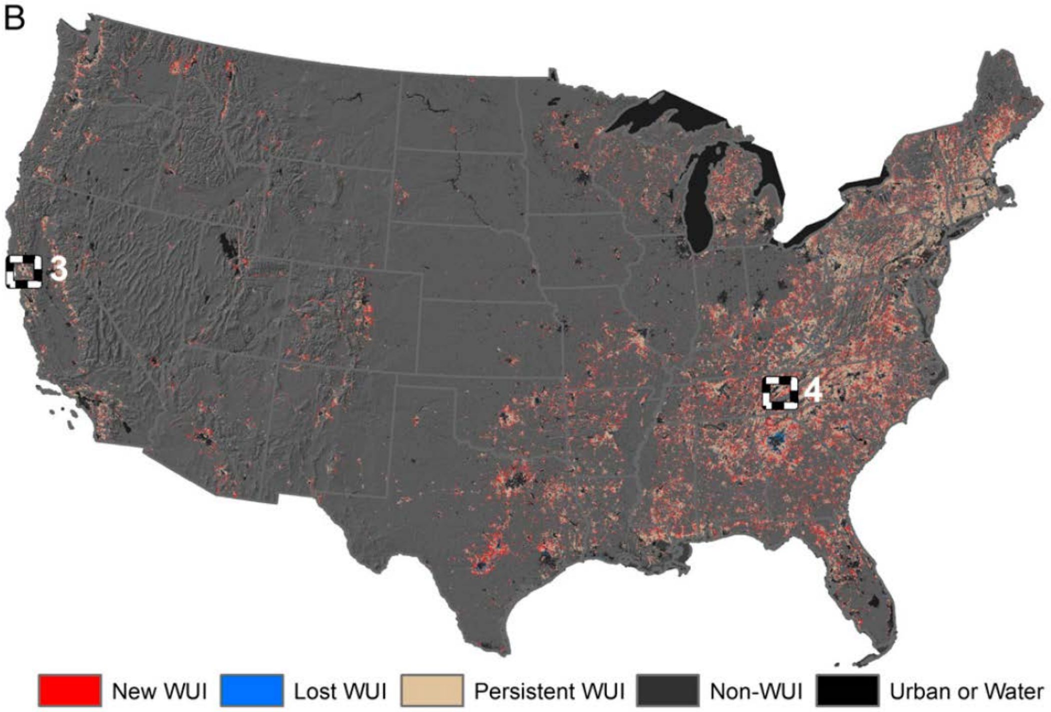


Wildland urban Interface (WUI): an area where human development is adjacent to or mixed in with undeveloped wildland

WUI covered 9.5% of the conterminous US in 2010

Source: Radeloff et al., Proceedings of the National Academy of Sciences 2018

Growth of the WUI from 1990 to 2010

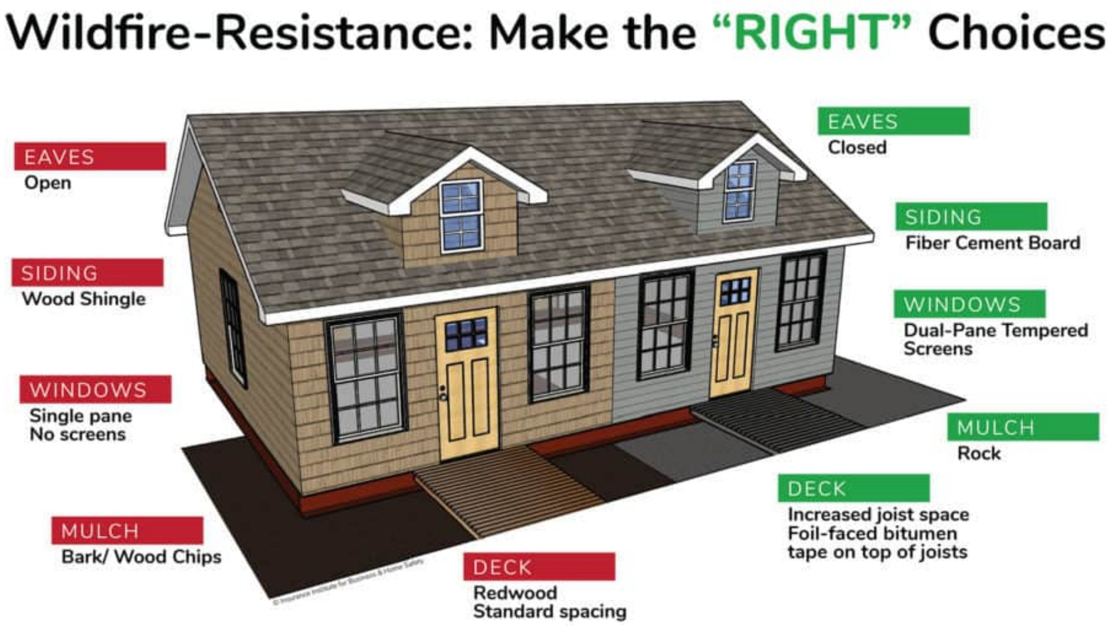


From 1990-2010:
- Population in WUI increased 35% (73M to 98M)
- Number of houses in WUI increased 41% (31M to 43M)

Growth of the WUI causes 2 problems:
- More ignitions caused by humans
- Wildfires that occur will be closer to people and homes

Source: Radeloff et al., Proceedings of the National Academy of Sciences 2018

Mitigation and Resiliency in our Communities



Source: IBHS

1. Establish defensible space around homes
2. Spread awareness and prepare for wildfire risk
3. Provide retrofit incentives and resources
4. Extend wildfire building code requirements
5. Update building code requirements according to new research

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Wildfire Catastrophe Modeling

Current State of Wildfire Modeling

- Wildfire modeling is complex due to the localized nature of wildfire exposure and losses
- Commercial stochastic models have been available in the marketplace for several years
- Recently released updates show that climate and weather are major influences affecting area burned in the US
- Use of wildfire modeling by insurers and regulators is limited

Image Source: Getty Images

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Wildfire Catastrophe Modeling

Challenges

- Compounding high winds with other fuel factors
- Effectiveness of early detection and fire suppression efforts
- Uncertainty around human-related ignition
- Lack of comprehensive exposure data
- Incorporating the impacts of risk-mitigation efforts
- Post event factors: additional living expense, demand surge, building code changes, potential for subrogation, regulatory rulings

Image Source: Getty Images

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Experience Rating vs. Exposure Modeling

- Many insurers are still relying on historical loss experience to price for wildfire risk
- In California, catastrophe loading is to be based on multi-year long-term average of catastrophe claims. For homeowners multiple peril fire, the number of years over which to average must be at least 20 years.

Source: Getty Images

Experience Rating vs. Exposure Modeling

- Consider:
  - Experience rating assumes the past is indicative of the future
  - Wildfire risk is changing due to WUI growth and climate change
  - Using long-term average may cause rate instability when significant events occur as in 2017 and 2018
- There is a need for wildfire catastrophe modeling

Regulatory and Legislative Actions 2017-2018

- Coverage to be provided for a combination of perils, e.g. mudslides, if wildfire is proximate cause (SB 917, approved 9/21/18)
- Promotion of wildfire mitigation and prevention (SB 901, approved 9/21/18)
- Insurers required to offer renewal of policy for at least next 2 renewal periods or 24 months, extend ALE from 24 to 36 months (SB 894, approved 9/21/18)
- Ceasing of moratoriums on writing policies in wildfire-impacted areas
- Extend amount of time the insured has to rebuild home from 2 to 3 years, and receive full replacement costs

Recommendations

- Wildfire Risk
- Mitigation
- Modeling

Source: Getty Images

Recommendations: Wildfire Risk

Wildfire risk landscape is evolving. Exposure to potential wildfire loss is increasing as a result of the changing wildland urban interface and climate risk.

- Promote awareness of the wildland urban interface among consumers
- Make available to the public a resource or tool that can provide a risk "score" for new home buyers

Recommendations: Mitigation

As wildfire risk exposure continues to grow, there is an increasing importance placed on recognizing and implementing ways to prevent and mitigate the risk.

- Enforce latest building codes
- Continue research on how to establish fire-resistant communities
- Perform regular inspections of homes in wildfire-prone areas
- Incorporate wildfire mitigation credits into rating plans

Recommendations: Modeling

Wildfire catastrophe modeling can reflect the current exposure and consider the full range of possible events.

- Study detailed claims from recent events to improve understanding of wildfire losses
- Increase stakeholders' confidence in wildfire modeling by increasing the transparency of model assumptions
- Establish generally accepted modeling standards for wildfire model review

Considerations for the Cat Risk Subgroup

- Wildfire loss frequency and severity are being re-evaluated by the insurance industry in light of recent experience
- There is need for more development and broader acceptance of wildfire modeling
- Better catastrophe modeling can lead to more accurate pricing, which in turn can broaden availability of insurance and improve solvency

Considerations for the Cat Risk Subgroup

- Legislative actions after the 2017-2018 events expanded policy coverage, which adds to the uncertainty of pricing for wildfire and increases the cost to insurers
- The legislative actions contribute to “post loss amplification,” which is not yet built into insurer rates

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Wildfire: Lessons Learned

Discussion

Wildfire: Lessons Learned

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Actuaries Climate Index and Actuaries Climate Risk Index

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Actuaries Climate Index (ACI)

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- www.ActuariesClimateIndex.org

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ACI—Background

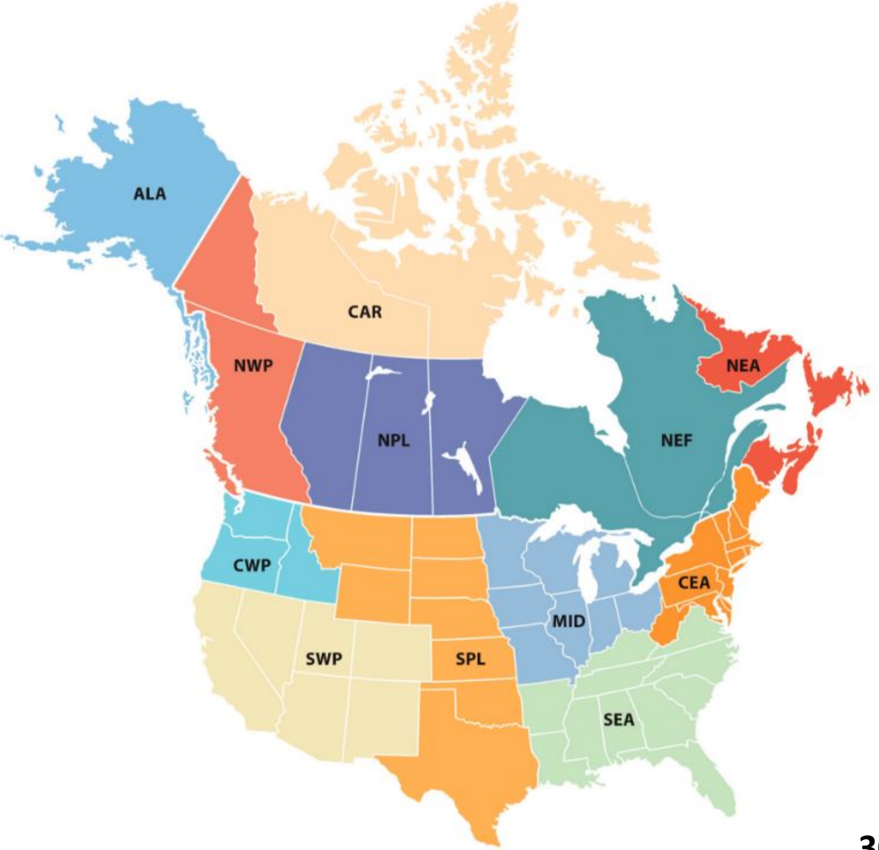
- An educational tool providing information about weather trends in the United States and Canada
- Retrospective analysis of data as opposed to a forecast of future trends
- Updated quarterly using publicly available data from the National Oceanic and Atmospheric Administration and the Permanent Service for Mean Sea Level
- Covers rainfall, temperature, dry spells, wind speed, and sea level

ACI—Background (cont'd)

- Breaks North America into 12 regions, and analyzes each region separately
- Breaks time into monthly units
- Spans the period from 1961 to the present (with a reporting lag of 6 to 12 months)
- Uses 1961–90 as a reference period

ACI Components—Climate Regions

Region Name	Region
Central Arctic	CAR
Northeast Atlantic	NEA
Northeast Forest	NEF
Northern Plains	NPL
Northwest Pacific	NWP
Alaska	ALA
Central East Atlantic	CEA
Central West Pacific	CWP
Midwest	MID
Southeast Atlantic	SEA
Southern Plains	SPL
Southwest Pacific	SWP



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ACI—Components

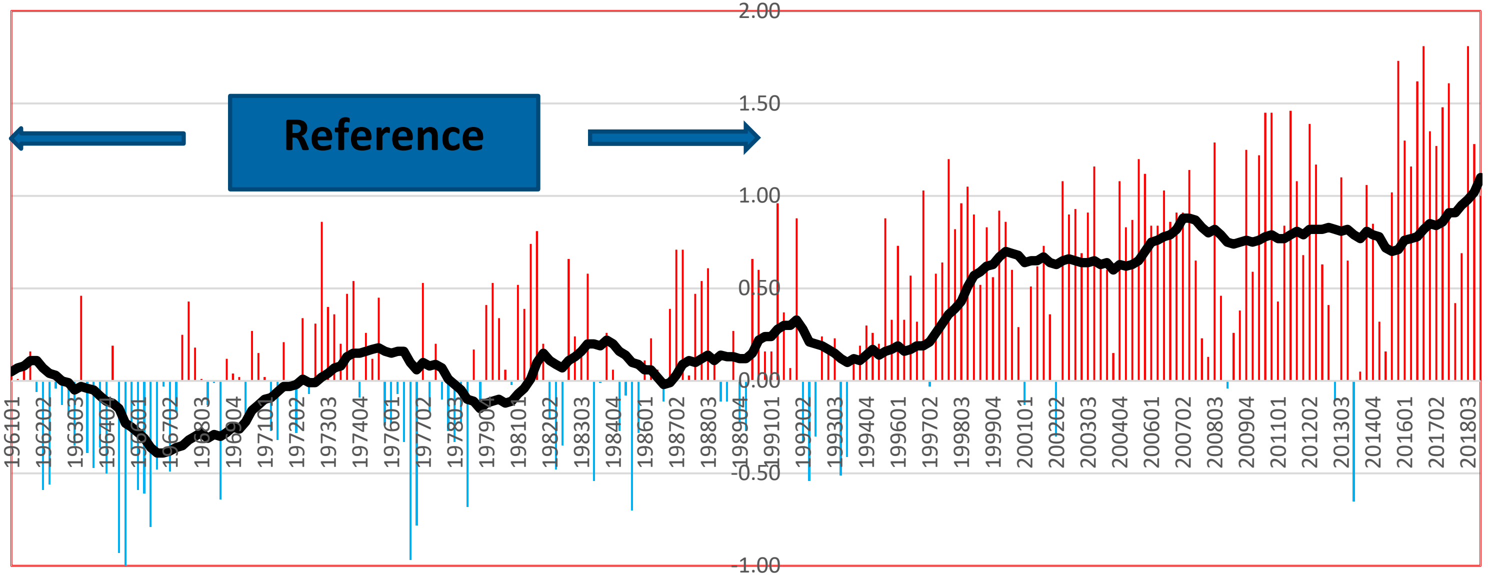
- Covers rainfall, temperature, dry spells, wind speed, and sea level
  - Frequency of temperatures above the 90th percentile (T90)
  - Frequency of temperatures below the 10th percentile (T10)
  - Maximum rainfall per month in five consecutive days (P)
  - Annual maximum consecutive dry days (D)
  - Frequency of wind power above the 90th percentile (W)
  - Sea level changes (S).

ACI—Recent Index Findings

- Latest press release: August 29, 2019.
- “The increase in average winter values is one factor driving the ACI’s five-year moving average to new highs. The moving average increased by 0.08, from 1.02 to 1.10…”
- Based on data through the winter of 2019.
- “Since last quarter, the ACI moving average increased by the largest amount in the post– reference period, making this five-year period the greatest outlier so far in terms of frequent extreme weather and sea level change.”

ACTUARIES CLIMATE INDEX

U.S. and Canada Combined - Seasonal and Five-Year Average Values



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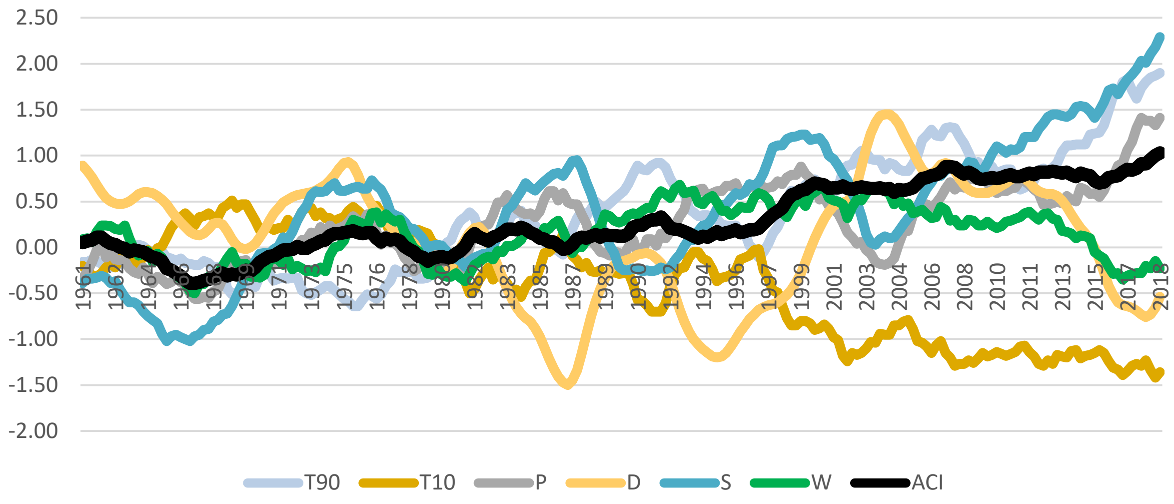
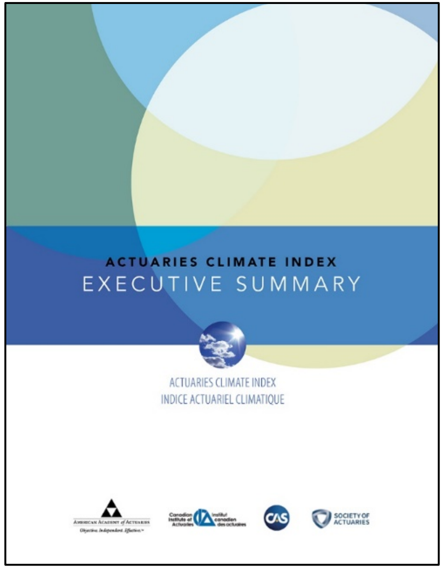
Overall ACI and Components

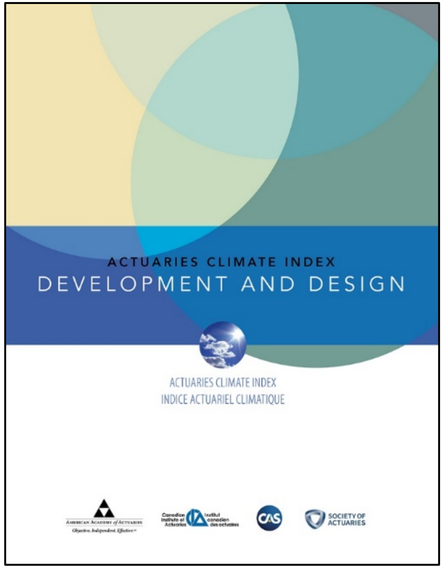
Seasonal Five Year Moving Averages of Components
Canada and the United States

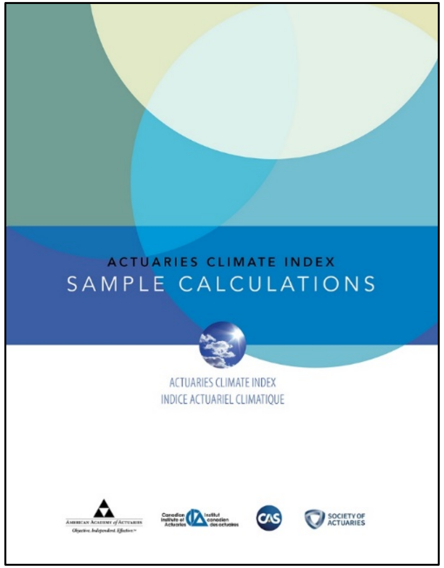
Reference Period Standard Deviations



Three Foundational Documents on the ACI Website







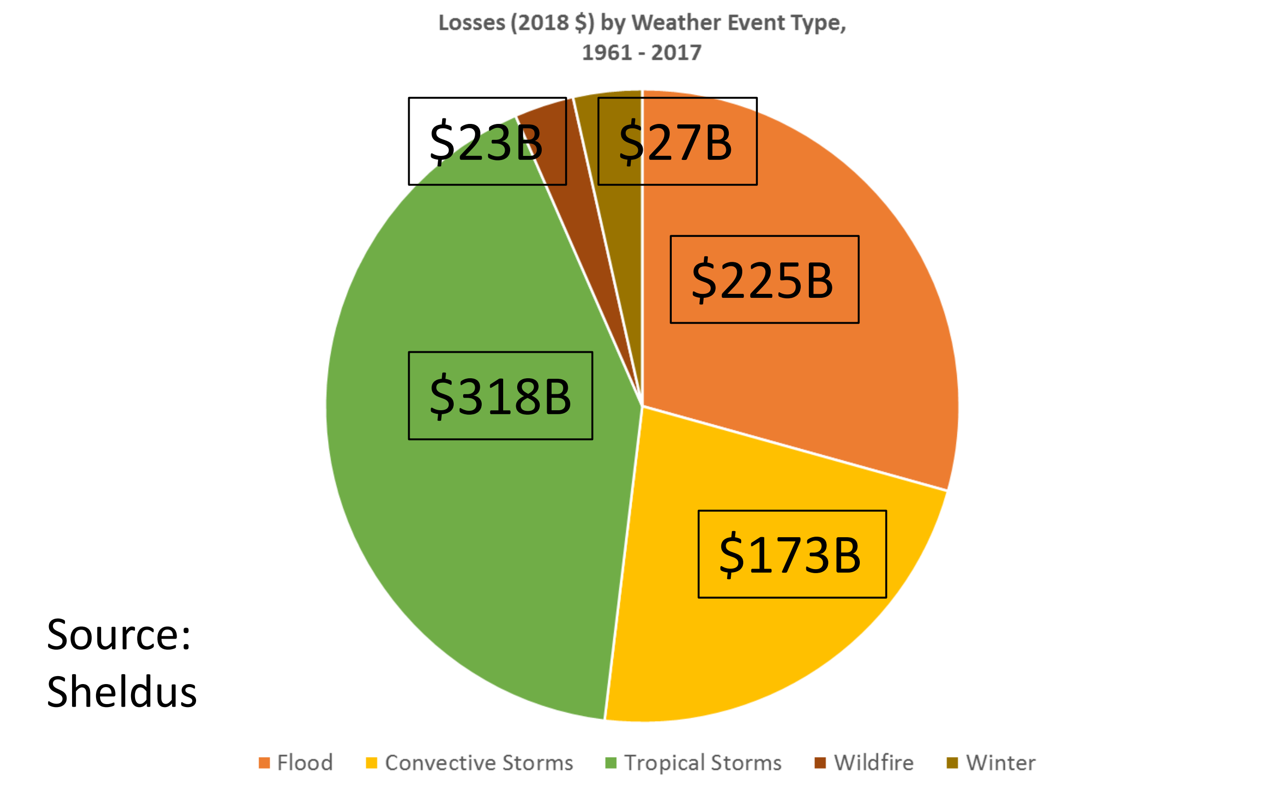
actuariesclimateindex.org

Actuaries Climate Risk Index (ACRI)

ACRI—Status Update

- Research update describing version 1.0 of ACRI under review by the sponsoring actuarial associations
- Estimates relationships between the ACI's weather metrics and weather-related losses; derives ACRI from those estimates
- ACRI 1.0 will focus only on the United States due to data limitations for Canada
- ACRI 1.0 Research Update expected publication 4Q 2019 – 1Q 2020

Losses by Weather Categories, 1961 - 2017



Source:
Sheldus

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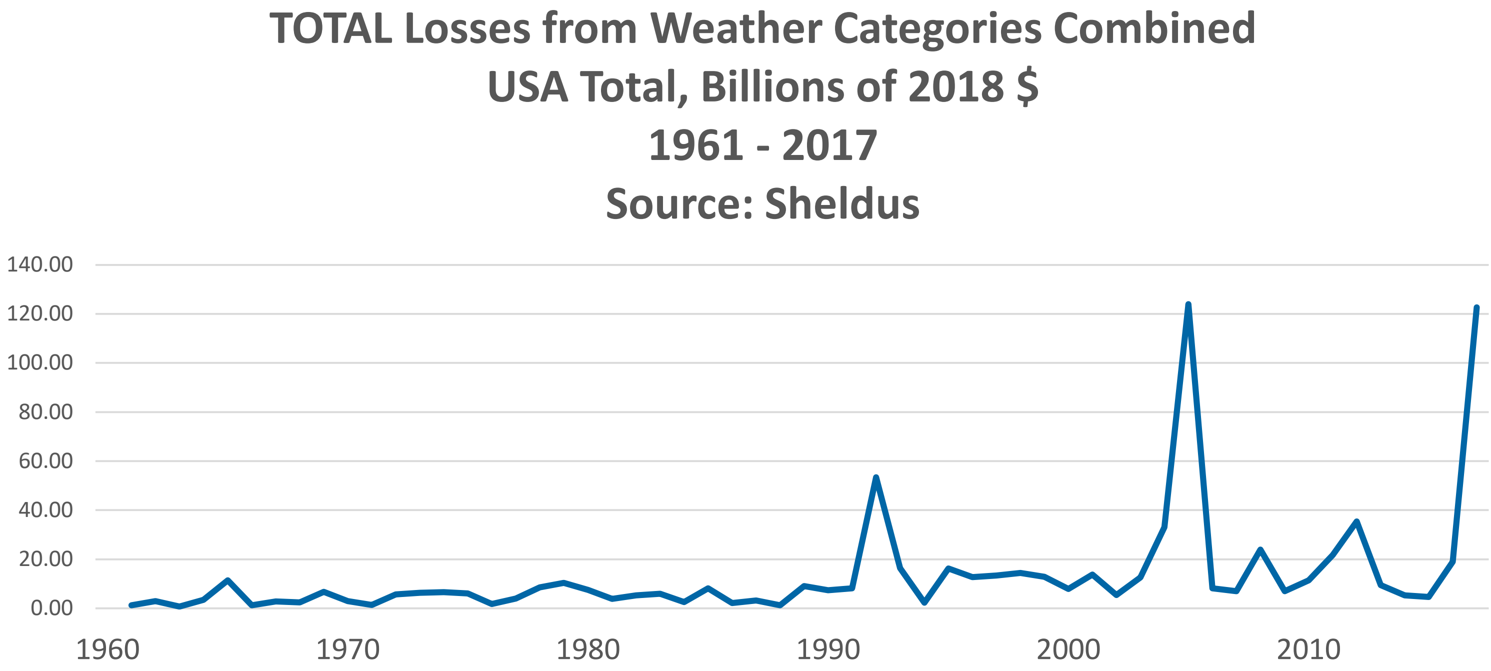
Weather-related Losses Combined, 1961 - 2017



Statistical Approach to ACRI

1) Combine losses from all weather categories
2) Fit exponential model of Losses to Set of ACI weather metrics using OLSQ:
3) $Losses(\$) = A * T90^{a} * T10^{b} * Precip^{c} * Wind^{d} * Exposure^{e}$
4) Use a pooled, cross-section for Region-Months
5) Correct for Heteroskedasticity by adjusting covariance matrix (MacKinnon and White)
6) ACRI for a region-month equals (predicted losses) – (average, exposure-adjusted predicted losses during reference period)

ACRI Losses with Confidence Intervals

ACRI Losses by Region, with Confidence Intervals
(in billions)

	1991-2016	Intrinsic, Lower Limit	Extrinsic, Lower Limit	Intrinsic, Upper Limit	Extrinsic, Upper Limit
USA	$23.78	$15.72	$2.42	$35.98	$45.15
SEA	$22.42	$14.82	$10.90	$33.91	$33.94

- ACRI Best Estimate: ~$1 billion per year in the USA, mostly from the South East Atlantic region
- ACRI (USA) 90% confidence Interval, intrinsic uncertainty: ~$0.5 billion - ~$1.5 billion per year
- Intrinsic 90% confidence interval: uses 90% confidence interval for predicted losses to produce ACRI estimates, capturing uncertainty of parameter estimates
- ACRI (USA) 90% confidence interval, extrinsic uncertainty: ~$0.0 billion - ~2.0 billion
- Extrinsic 90% confidence interval: based on standard errors of 30 estimates of ACRI with synthetic data sets, drawn from pool of actual observations with replacement, capturing uncertainty due to sampling

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ACRI: Conclusion

- While others find likely large losses due to changes in weather by end of 21st century, but little loss yet when controlling for changes in exposure, we find small increases in loss likely already occurred, 1991 – 2016 (~5% of total weather-related losses)
- We also find substantial uncertainty in these estimates.
- Challenges inspiring us to version 2.0

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