

Catastrophe Models: Evaluating Risk in a Changing Climate

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*The Innovation and Technology Leader in
Weather, Climate, and Catastrophe Risk Modeling*

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KCC: Innovation Leader in Weather, Climate, and Catastrophe Risk Modeling



Multidisciplinary team of PhD scientists and engineers
spanning the fields of:

Atmospheric Science
Geophysics/Seismology
Hydrology
Wind engineering

Structural engineering
Earthquake engineering
Statistics/data science



KCC delivers scientifically advanced,
high-resolution, and accurate models for:

Tropical cyclones
Extratropical cyclones
Earthquakes
Severe convective storms

Winter storms
Wildfires
Floods



KCC models and software applications are used by the
world's leading financial institutions

Top 10 P&C insurers
Regional and super-regional insurance companies
Reinsurers, banks, and ILS investors

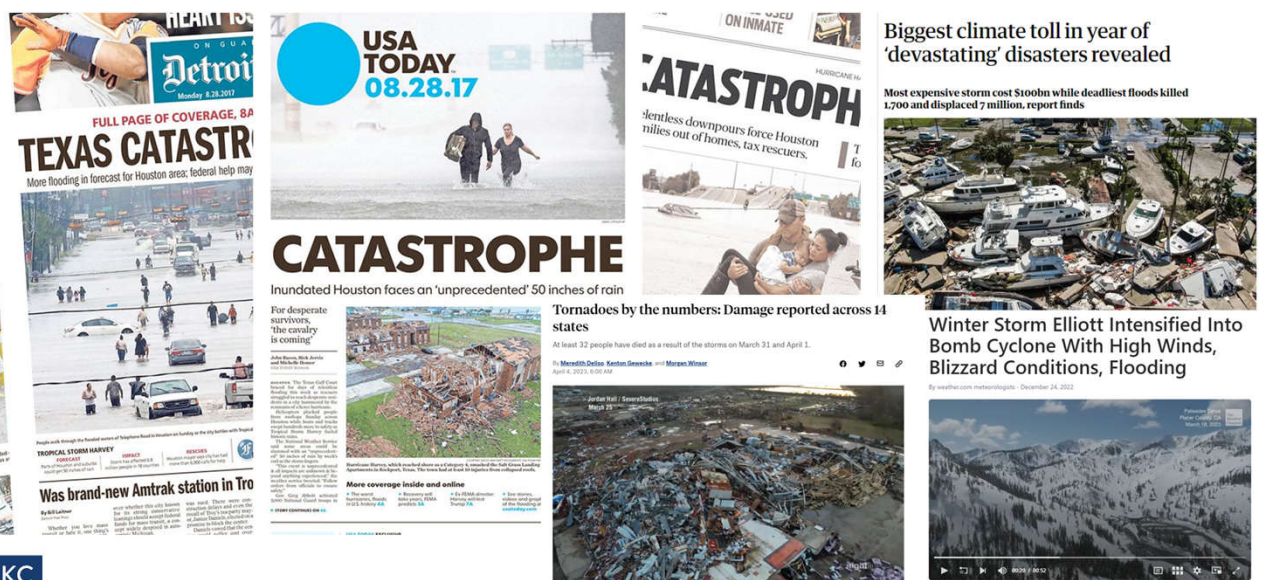


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Natural Catastrophes Are Increasingly Front-Page News and Causing \$Multi-billion Losses



TEXAS CATASTROPHIC
More flooding in forecast for Houston area; federal help may

CATASTROPHE
Inundated Houston faces an 'unprecedented' 50 inches of rain

Biggest climate toll in year of 'devastating' disasters revealed
Most expensive storm cost \$100bn while deadliest floods killed 1,700 and displaced 7 million, report finds

Tornadoes by the numbers: Damage reported across 14 states
At least 32 people have died as a result of the storms on March 31 and April 1.

Winter Storm Elliott Intensified Into Bomb Cyclone With High Winds, Blizzard Conditions, Flooding

Was brand-new Amtrak station in Tro

More coverage inside and online

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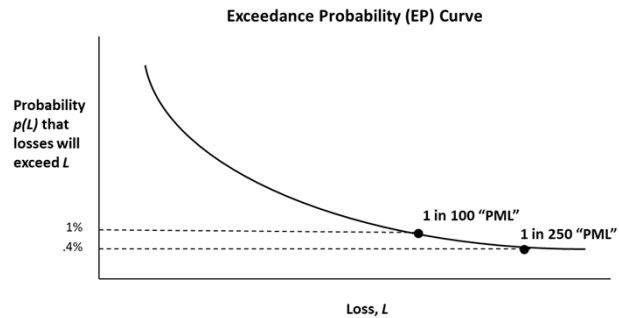
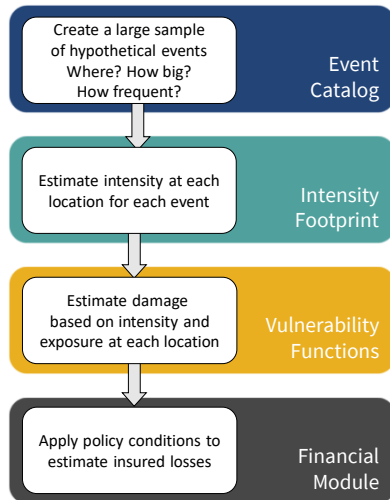
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What Insurance Companies Need to Know

- How likely are we to have a solvency impairing event?
- How much reinsurance do we need to buy?
- How much do we need to charge to cover our expected losses?
- Which properties are more or less vulnerable than others?
- How much business can we write in different geographical areas?

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Catastrophe Modeling is the Global Standard Technology for Answering These Questions



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Frequency (aka Secondary) Perils Have Taken Center Stage When it Comes to Insurance Claims and Losses

Severe Convective Storms (SCS)



Wildfires



Winter Storms

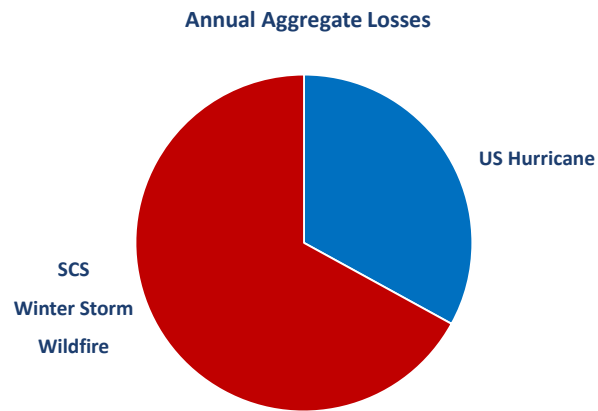


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AAL from SCS, Winter Storm, and Wildfire Significantly Exceed Hurricane



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Severe Weather was a Major Reason for Company Downgrades in 2024

63% of property insurer senior executives cite the frequency and severity of weather events as their number one concern

A.M. Best

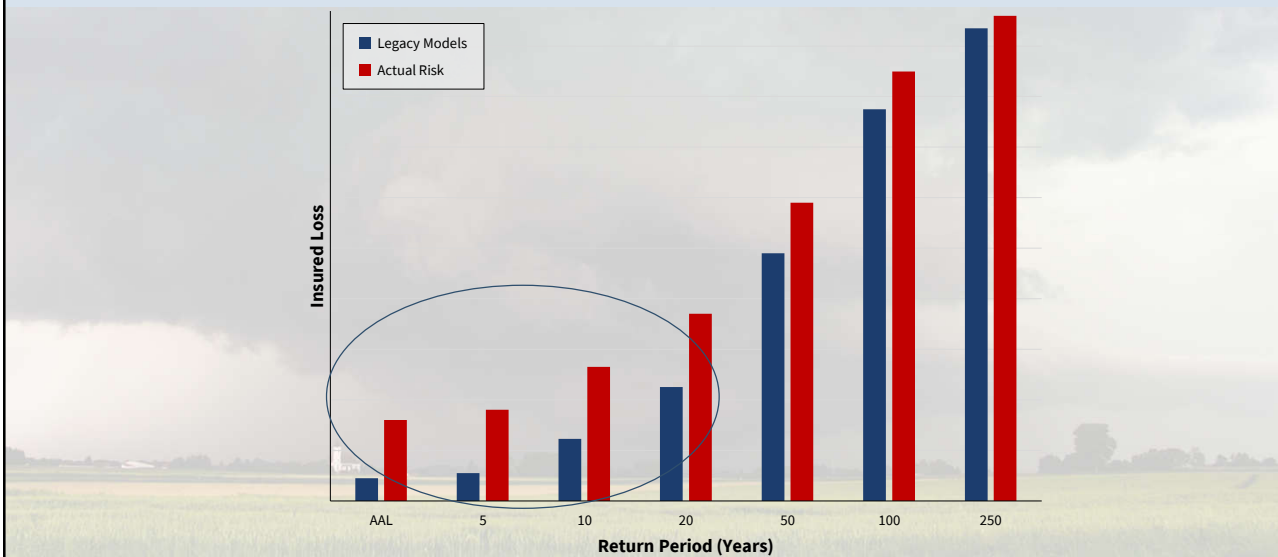


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Frequency Perils Dominate the Lower Return Periods—Where First Generation Models Miss

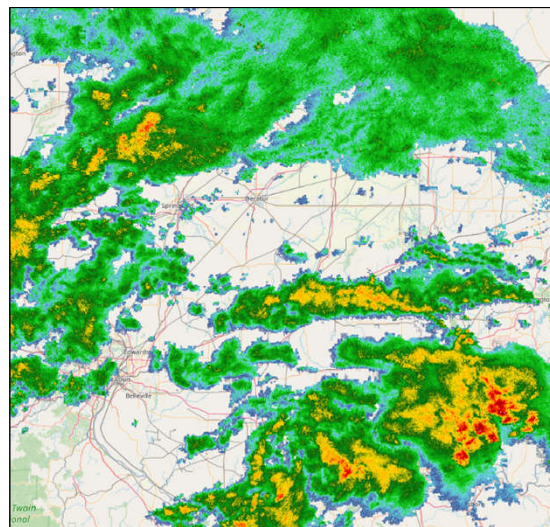
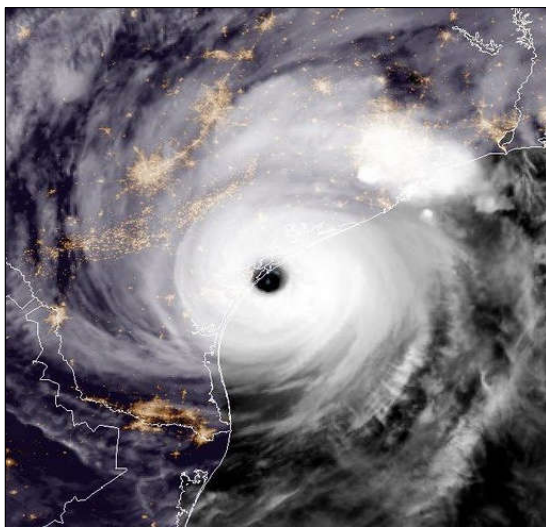


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Why Severe Convective Storms Are More Challenging to Model than Hurricanes



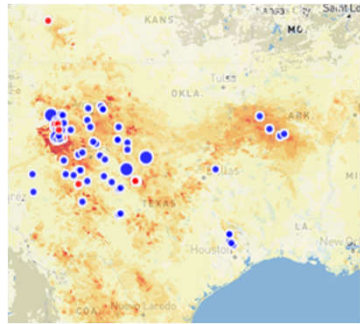
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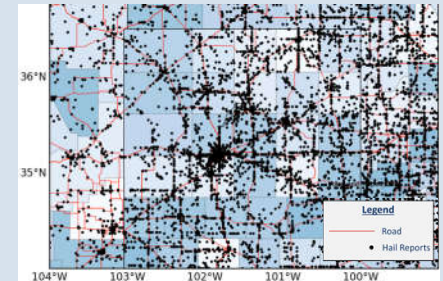
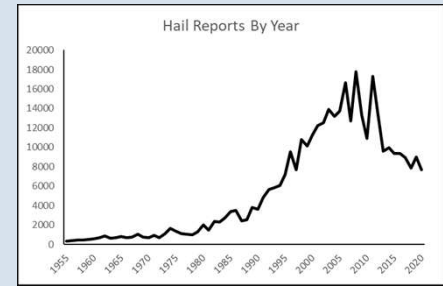
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Why Modeling Individual Tornadoes, Localized Hail, and Wind Gusts Does Not Lead to Credible Loss Estimates

- Significant temporal and spatial reporting biases in the SPC tornado, hail, and straight-line wind data
- Tornado touchdowns, hailstones, and isolated winds >70 mph do not capture all the damage and claims from a severe thunderstorm event
- **Most importantly, isolated tornadoes, wind gusts, and hail do not capture all of the damage caused by these events**



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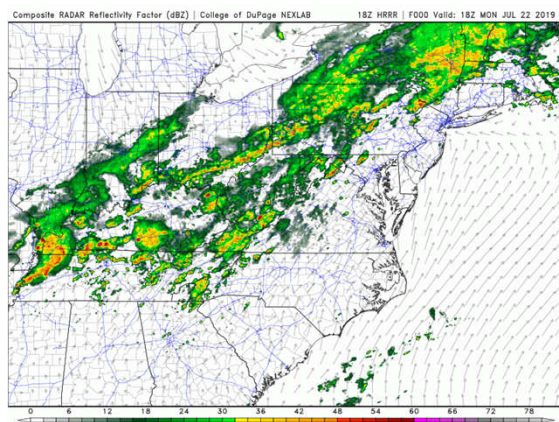


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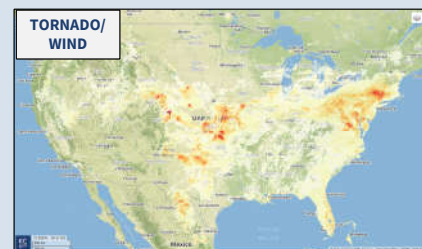
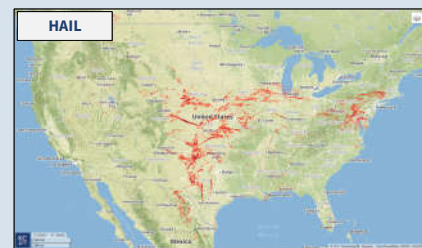
How KCC Scientists Built an Accurate SCS Model: Start with Advanced and Innovative Scientific Techniques

- KCC scientists developed a **physics-based** modeling methodology (NWP), that captures all impacts of severe weather across the entire affected area



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High resolution footprints capture all claims

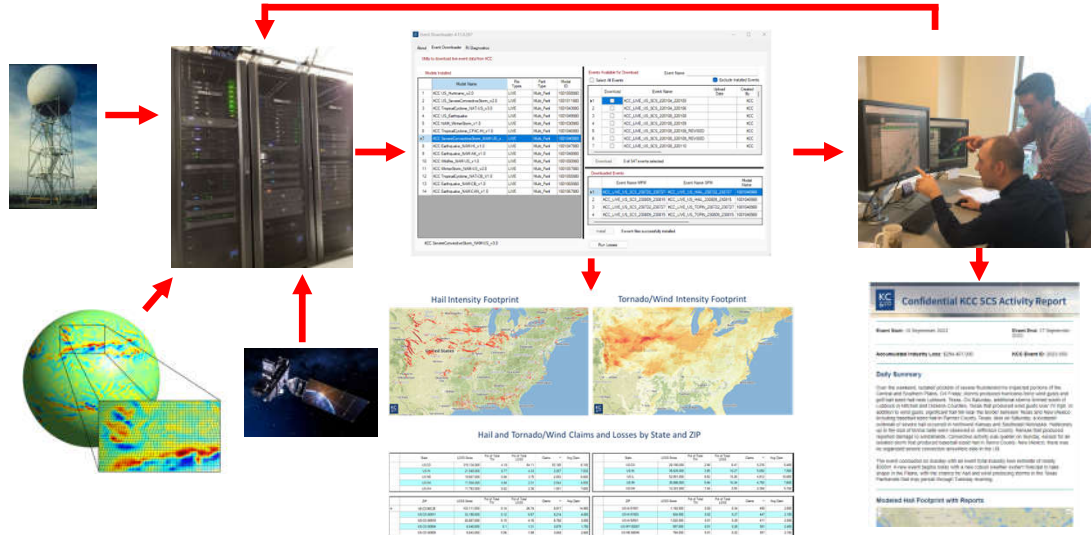


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Advanced Science Combined with Continuous Model Testing: KCC LiveEvents

KCC automatically downloads and archives ~30 GB of data per day to support SCS LiveEvents



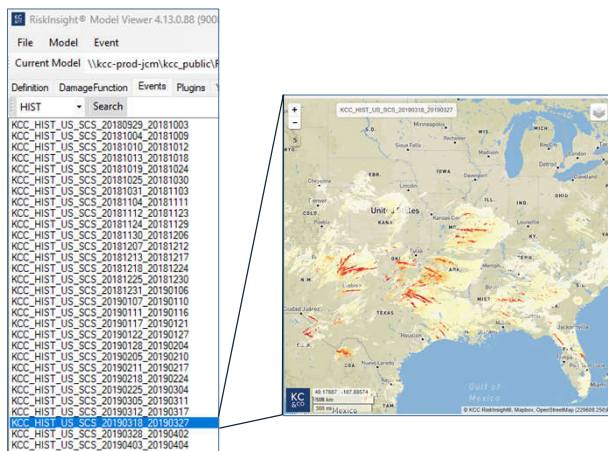
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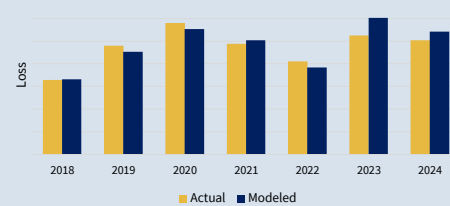
KCC SCS Model: Proven Accuracy With \$10s Billions of High-Resolution Insurer Claims Data

14-year Historical Catalog: 400+ Events
Stochastic Catalog: 50,000+ Events

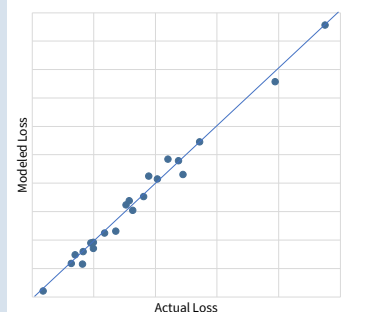


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How Actual and Modeled Losses Compare



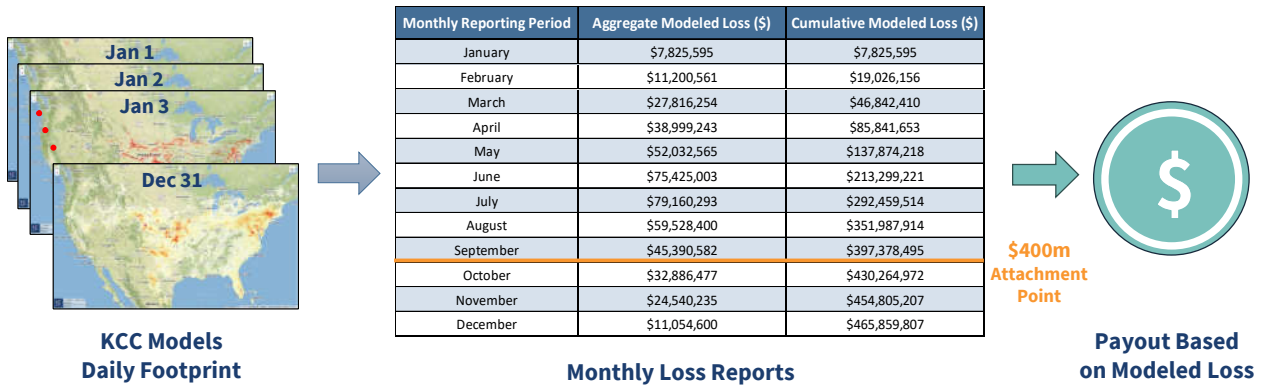
Modeled vs Actual Event Loss



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Accurate Models Can Expand Reinsurance Capacity: Modeled Loss Transactions

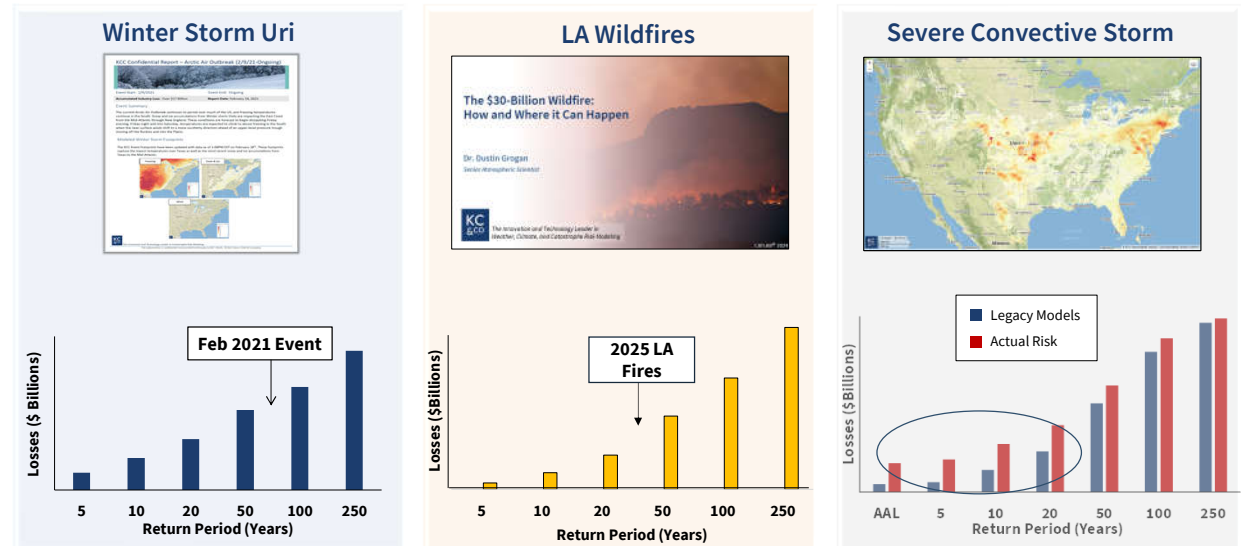


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KCC Physics-Based Models – No Model Miss, Validated by Recent Events



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Climate Change Impacts on Weather and Extreme Events – the AR6 Scientific Consensus

	Frequency	Severity	Confidence
Hurricanes	No change	Increase	High
Coastal Flooding	Increase	Increase	High
Wildfires*	Increase	Increase	High
Inland Flooding*	Increase	Increase	Medium
Winter Storms	Uncertain	Increase	Medium
Severe Convective Storms	Uncertain	Uncertain	Low

*Impacts of climate change on these hazards is highly region-dependent



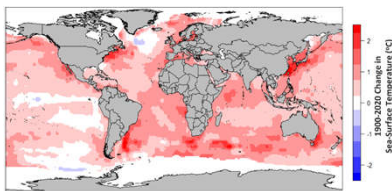
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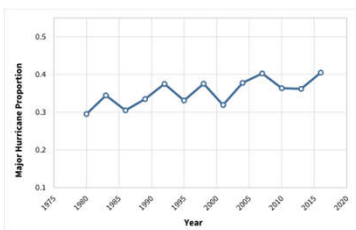
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How Does Warming Influence Hurricanes?

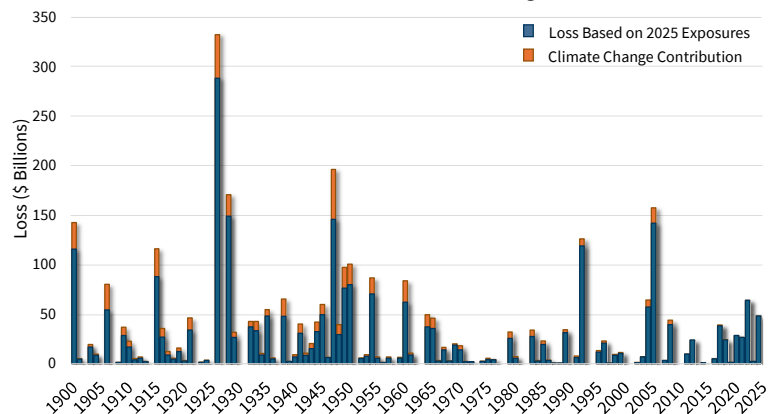
Sea-Surface temperatures have warmed since 1900



An increase in major hurricanes has been observed



Annual Hurricane Losses with Climate Change Contributions



Climate change has caused about an 12% increase in annual expected losses from hurricanes

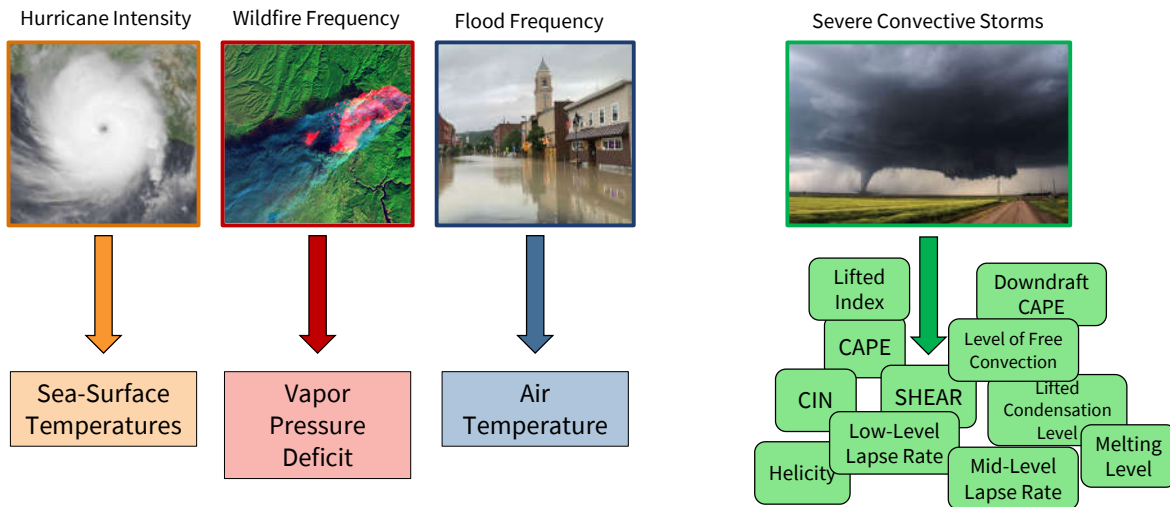


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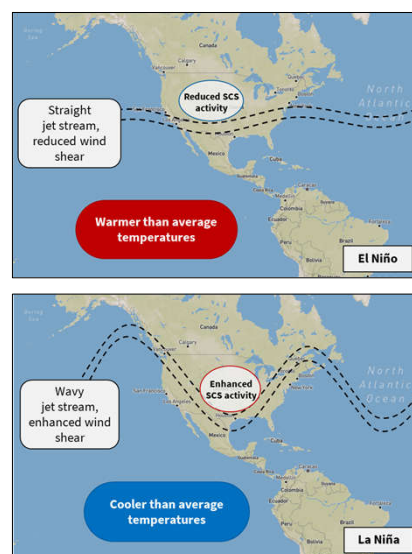
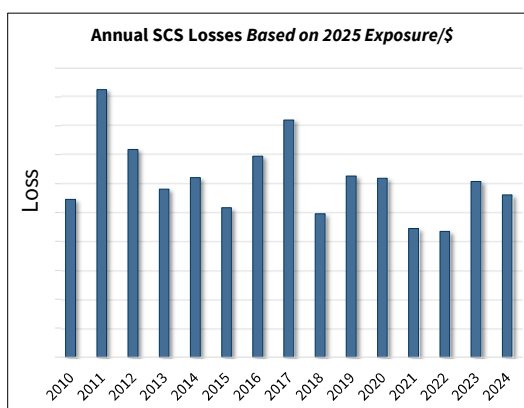
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Why is it so Challenging to Quantify Climate Change Impacts on SCS?



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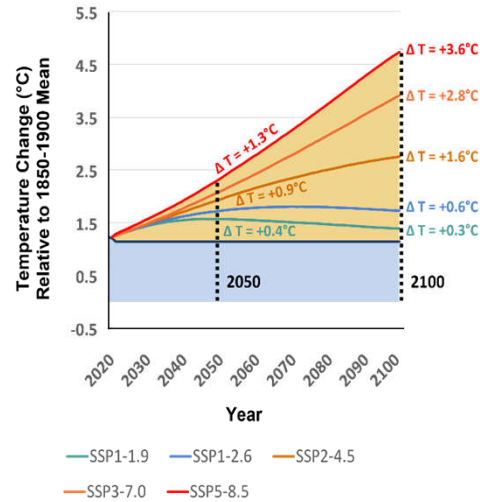
Are Increases in SCS Insured Losses in Recent Years Due to Climate Change?



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Future Scenario Uncertainty Captured Using Shared Socioeconomic Pathways (SSPs)

Scenario	Radiative Forcing (Wm ⁻²)	SSP Assumptions
SSP1-1.9	1.9	Global shift toward environmentally sustainable economic growth. Significantly and rapidly reduced per capita energy consumption, reaching net zero emissions by 2050.
SSP1-2.6	2.6	Global shift to sustainability and emissions cut significantly to net zero by 2050, but at a slower rate than SSP1-1.9 leading to a larger radiative forcing.
SSP2-4.5	4.5	Largely business-as-usual with regard to technological advancements and economic growth, with slow progress toward sustainability goals.
SSP3-7.0	7.0	Increased global competition and a shift towards national security and resource stockpiling, leading to a significant increase in emissions from modern level
SSP5-8.5	8.5	Rapid global economic growth supported by heavy investment in fossil fuel energy



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KCC Provides Climate Change-Conditioned Reference Models and Future Catalogs

KCC Climate Conditioned Future Catalogs			
	2030 (SSP2)	2040 (SSP2)	2050 (SSP1, SSP2, SSP5)
Hurricanes	✓	✓	✓ ✓ ✓
Coastal Flooding	✓	✓	✓ ✓ ✓
Wildfires	✓	✓	✓ ✓ ✓
Inland Flooding	✓	✓	✓ ✓ ✓
SCS	Physics-based model incorporates atmospheric changes as they occur		
Winter Storm	Physics-based model incorporates atmospheric changes as they occur		
European Windstorm	Physics-based model incorporates atmospheric changes as they occur		



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