Cat Modeling for the Insurance Industry: Accounting for Climate Change

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The Gathering Storm: Digital and Climate Disruptors
October 27 - 28 2016
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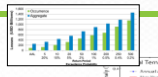
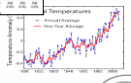
AIR WORLDWIDE

Presentation Outline





1. Insurance Industry Perspective

2. Climate Change and Weather Systems

3. What AIR is Doing

Insurance Industry Perspective

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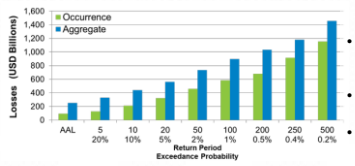
EP Curves From Cat Models Indicate Loss Probabilities

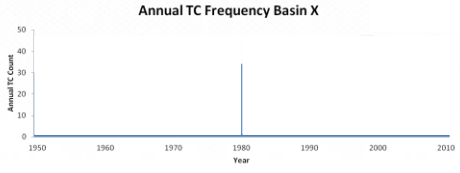


- cat models contain hundreds of thousands of scenarios
- probabilities of extreme events based on existing climate conditions
- AAL indicates typical annual loss
- insurance industry sets rates based on their portfolio-specific information

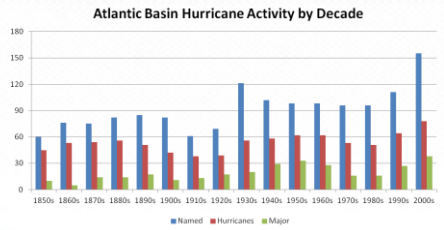
The Insurance Industry is Focused on the Short Term

- upcoming year may not be a standard year
- insurance companies want to get some advantage
- near-term outlook is typically unreliable
- landfalls uncorrelated to basin activity
- climate *conditioned* views are helpful

Most Cat Models Based on Long-Term Historical Data



Is Climate Change Affecting Atlantic Hurricanes?



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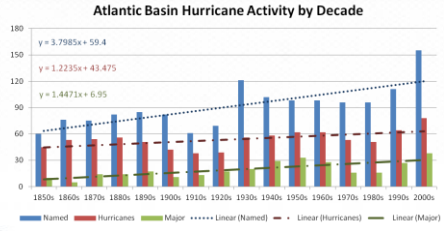

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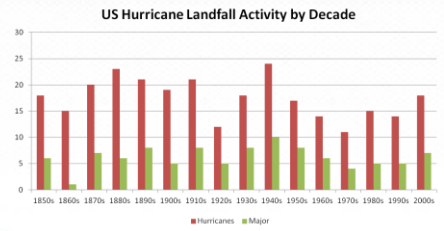

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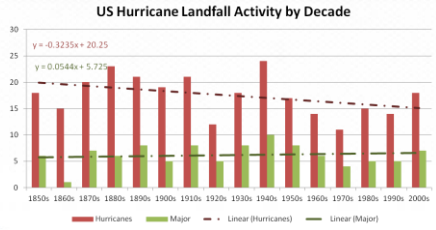

Climate Change and Extremes

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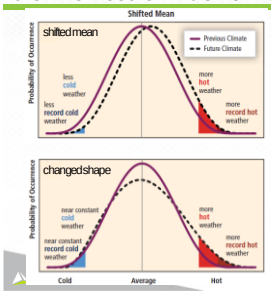
Is Climate Change Affecting Our Weather Now?

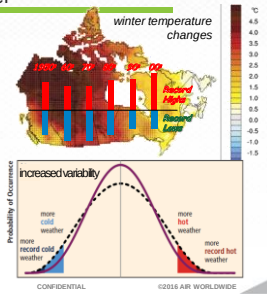
The Analogy with Baseball and Steroids

The weather on steroids

An analogy…
Climate warming is changing the weather like steroids change a baseball player.

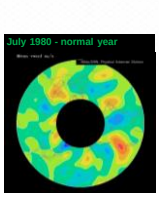
Changes in the Mean and Variability will Increase the Likelihood of Extreme Weather

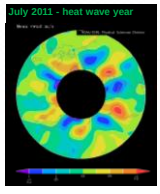




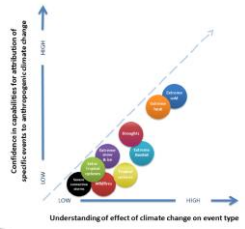
Other Theories Support More Weather Extremes

Arctic ice melt has likely reduced the pole to equator temperature difference, which can change the wavenumber and can cause stationary waves to occur more easily





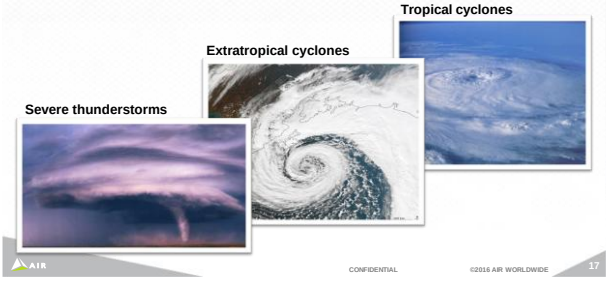
The Science of Climate Change Attribution



overall confidence in event attribution is strongest for extreme event types that are:

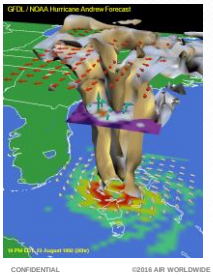
- adequately simulated in climate models
- have a long-term historical record of observations
- are linked to human-caused climate change through an understood and robustly simulated physical mechanism

Heat Waves and Heavy Rains are Relatively Easy to Understand, But What About…

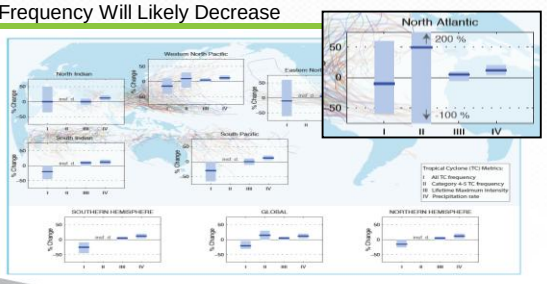


Tropical Cyclones (TCs) Need Several Ingredients to Form

1. SST > 26.5 C
2. Mid-level moisture
3. Low to mid-level shear
4. Coriolis Force
5. Thermodynamic instability
6. Pre-existing disturbance

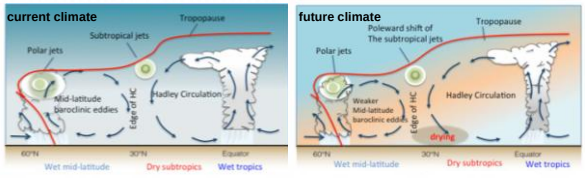


TC Frequency Will Likely Decrease



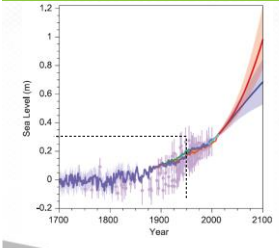
A Weaker Hadley Circulation is the Explanation

Weaker circulation, narrower ascent, broader descent, and drier tropical troposphere will likely reduce TC frequency



From Fu (PNAS 2015)

Another Component of Hurricane Risk is Storm Surge

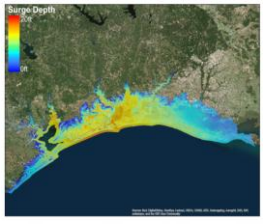


- Sea level has increased globally ~20 cm in the last century
- Projections are that increases will be 2-5X greater by 2100
- Regional changes could be very different from global averages
- Impacts on tsunamis and other coastal storms could be very significant

What AIR is Doing

Frequent Model Updates Incorporate Climate Change

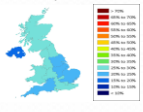
- AIR updates its catastrophe models every 5-6 years
- Signature of climate change is continuously folded in
- Water-based perils use latest DTMs

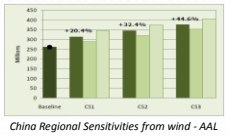


AIR Has Looked at Climate Change Impacts by Developing Climate Change Conditioned Catalogs

UK Regional Sensitivities from wind - AAL

Source: http://www.abi.org.uk



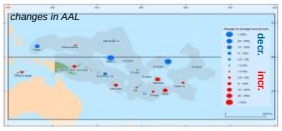


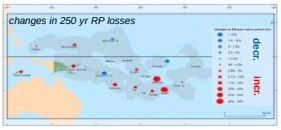
China Regional Sensitivities from wind - AAL

UK Regional Sensitivities from flood - AAL

(Based on 2008 GBP values)

In 2013, AIR Looked at Climate Change Impacts in the South Pacific





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Australian Government

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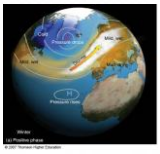
GFDRR

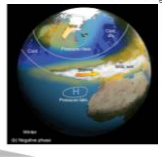
With financial support from the European Union

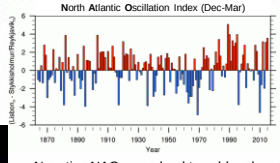
In the framework of the ACP-EU Natural Disaster Risk Reduction Program managed by the GFDRR

What We Are Doing Now – Developing NAO Conditioned Catalogs for European ETC Model

- Positive NAO years lead to warm snow free New England Winters in the U.S. and stormy activity for northern Europe





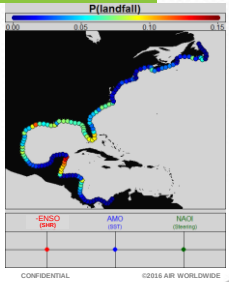


- Negative NAO years lead to cold and snowy New England Winters in the U.S. and stormy activity for southern Europe
- This technique can be applied to climate change GCM output

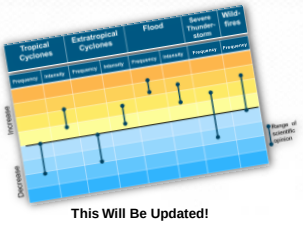
What We Are Doing Now – Developing Climate Conditioned Catalogs for U.S. Hurricane Model

- Negative ENSO years lead to high probability of landfalls
- Positive AMO years lead to high probability of landfalls
- Negative NAO years lead to high probability of landfalls

ENSO - El Nino-Southern Oscillation
AMO - Atlantic Multi-decadal Oscillation
NAO - North Atlantic Oscillation



What We Are Doing Now – Publications

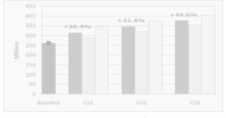


This Will Be Updated!

AIR Will Update ABI Study Using Latest Climate Change Scenarios

Source: http://www.abi.org.uk

UK Regional Sensitivities from wind - AAL



China Regional Sensitivities from wind - AAL

UK Regional Sensitivities from flood - AAL

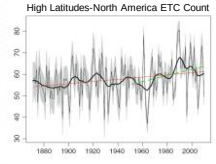
So Will This!

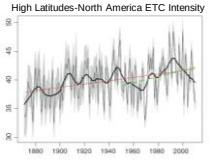
(Based on 2008 GBP values)

What We Are Planning To Do – Continue to Analyze

- Do we see a signal or signals – in the mean – in the variability?
- How can we include signals when they are just appearing?
- How do we reconcile different signals in different regions and from different analyses?

From Wang et al 2013





What We Are Planning To Do – Scenarios

What would a stronger Sandy look like with a ½ meter of sea level rise?

What would a stronger Vera look like with a ½ meter of sea level rise?

Summary

- Climate change happening slowly
- Insurance Industry focuses on next year
- Catastrophe models are updated frequently and somewhat account for climate change
- Climate change conditioned catalogs and scenarios are standard cat modeling approaches to addressing longer term impacts from climate change