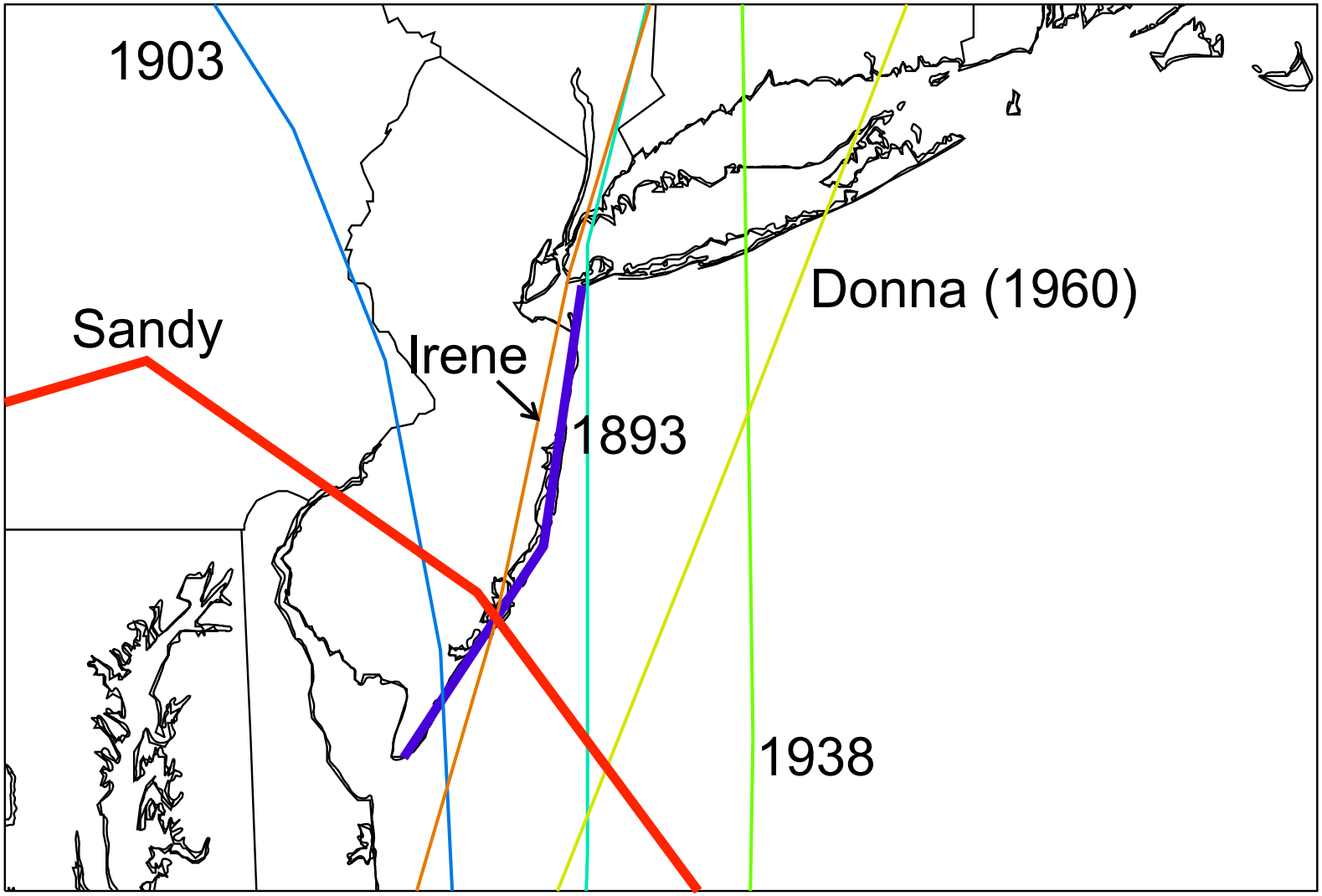
Catastrophe modeling and extreme event risk

Adam Sobel

Social Enterprise Leadership Forum
Near-Term Impacts of Climate Change on Investors
May 2, 2017

Disaster losses are “fat-tailed” – dominated by a few big, rare, even “unprecedented” events



Hall and Sobel, *Geophys. Res. Lett.* 2013

The rareness makes it hard to estimate the risk in a meaningful way from historical data

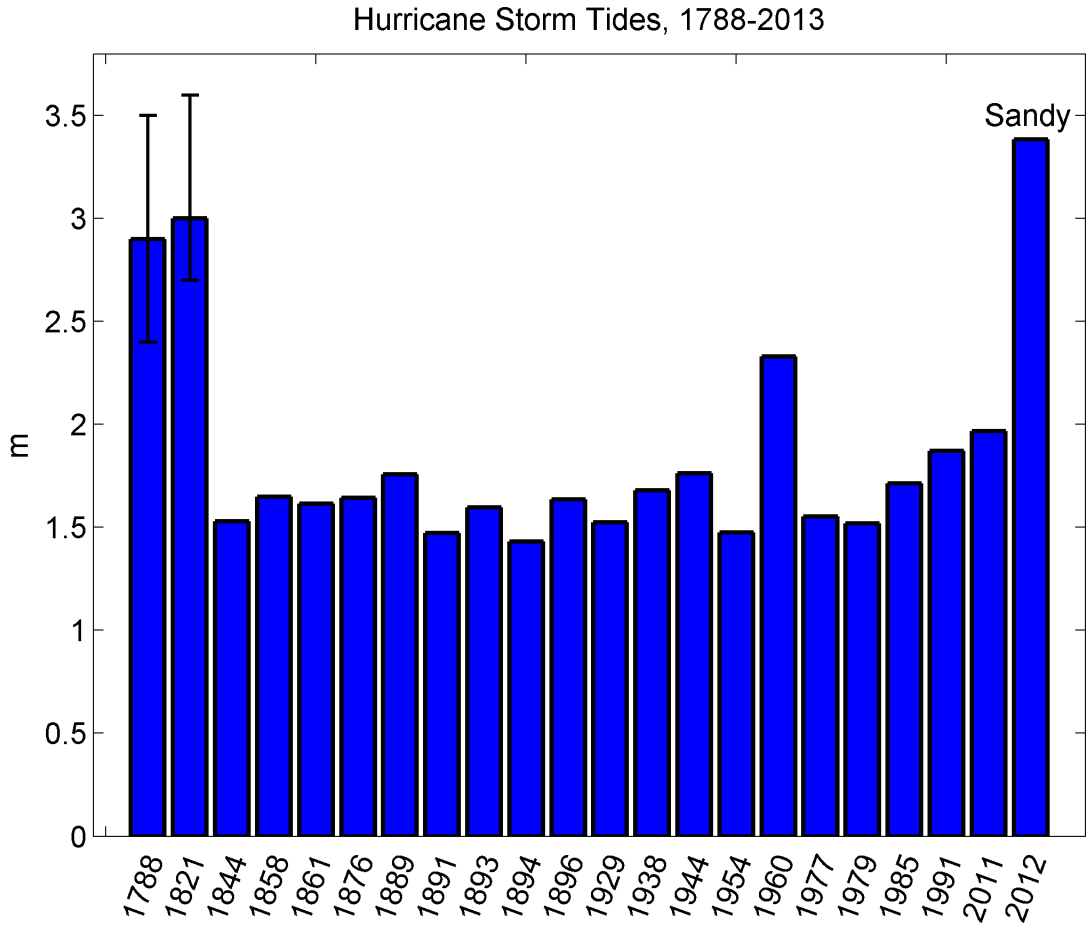
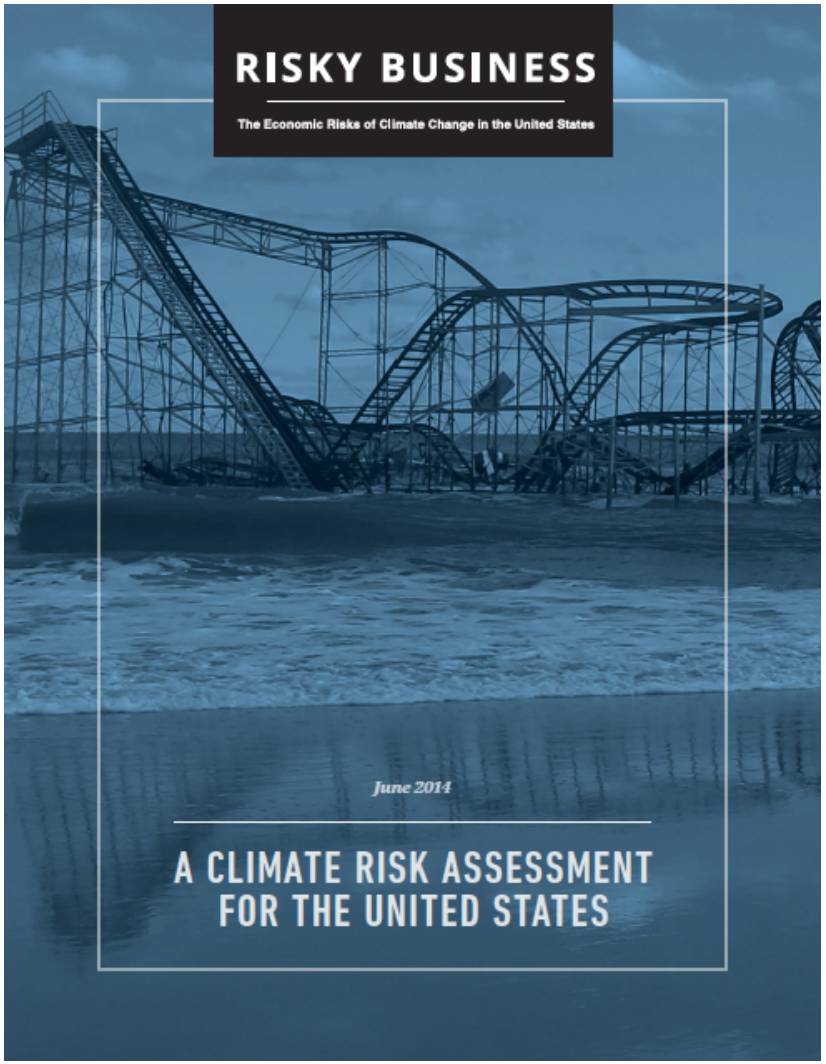
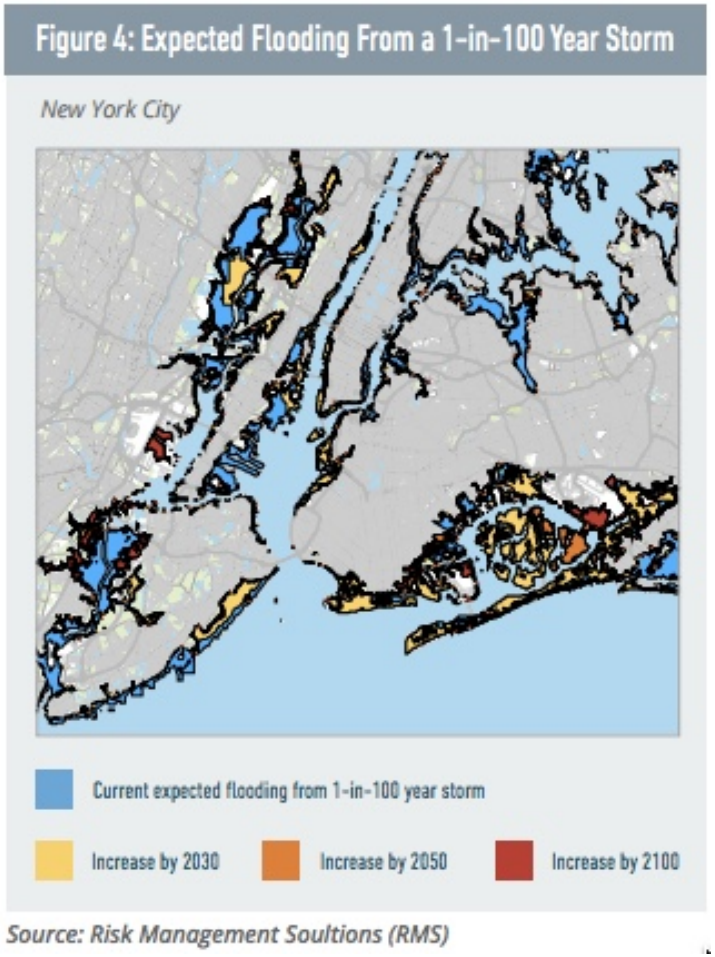


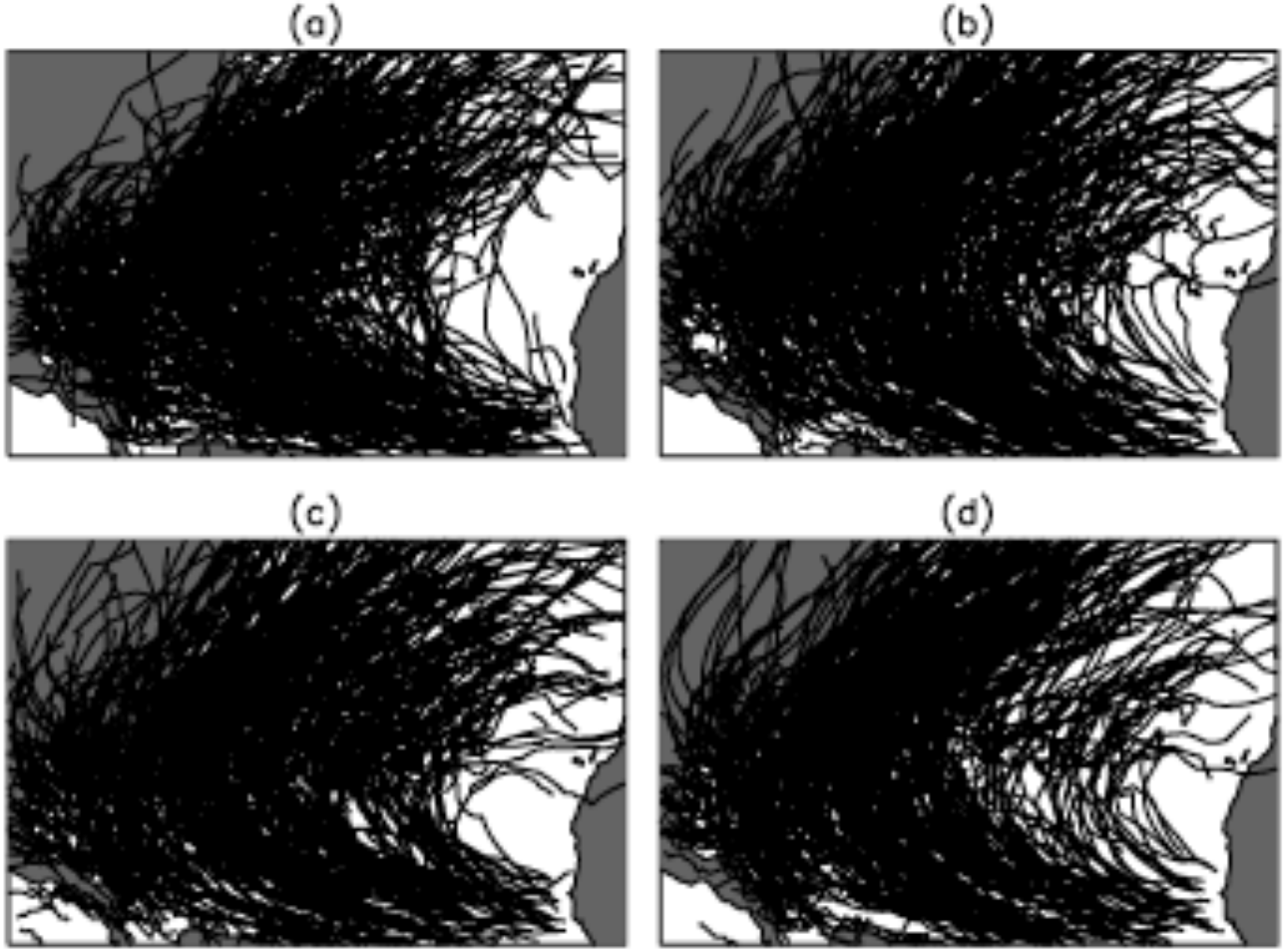
Figure courtesy of Stefan Talke and Philip Orton

“If you can’t measure it, you can’t manage it” – M. Bloomberg (orig. Peter Drucker) – can we measure disaster risk?





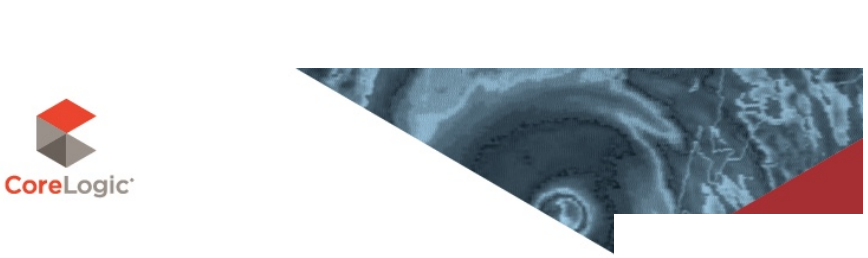
“Catastrophe models” generate synthetic event sets, allowing more robust risk assessment. Methods largely statistical, for practical reasons.

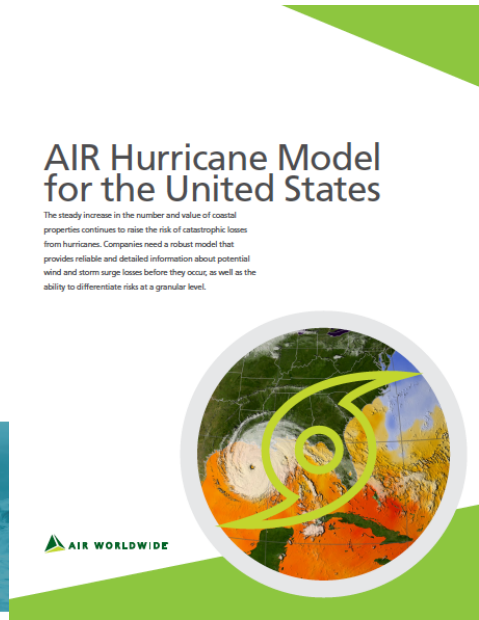


Hall and Jewson (2007)

Catastrophe models are widely used in insurance, but:

- They are not open source
- They are based on historical data, and can't handle climate change
- They are built to handle problems where the insurance industry has significant investments, and not others

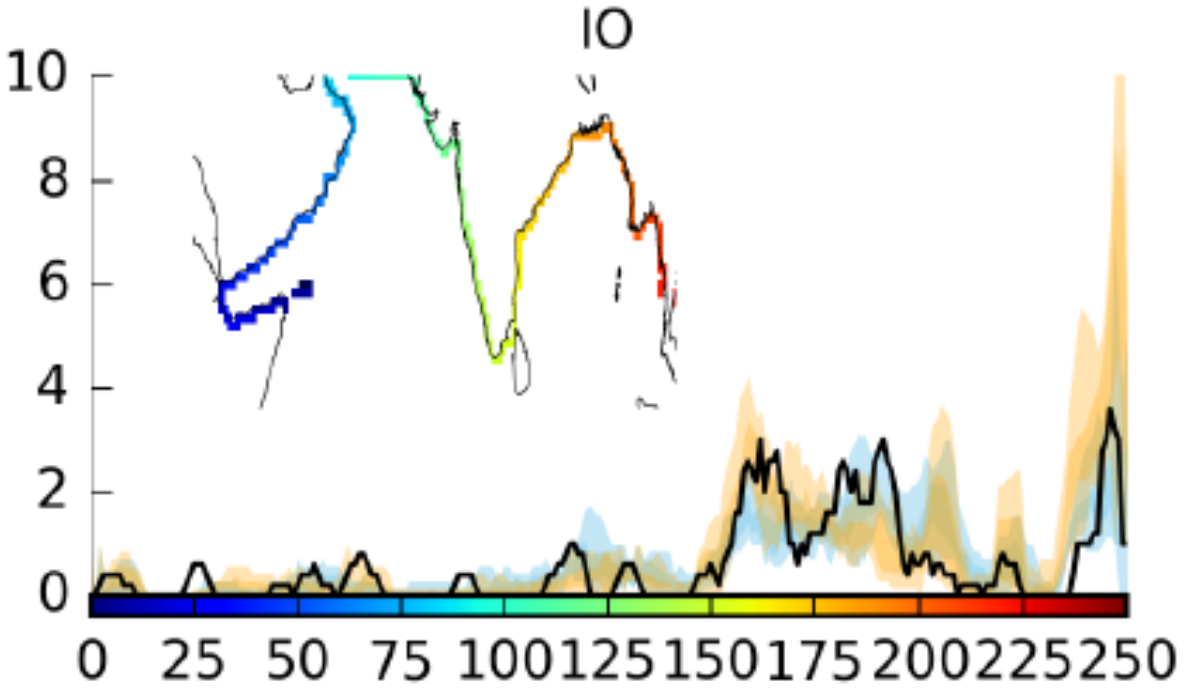




Catastrophe models are widely used in insurance, but:

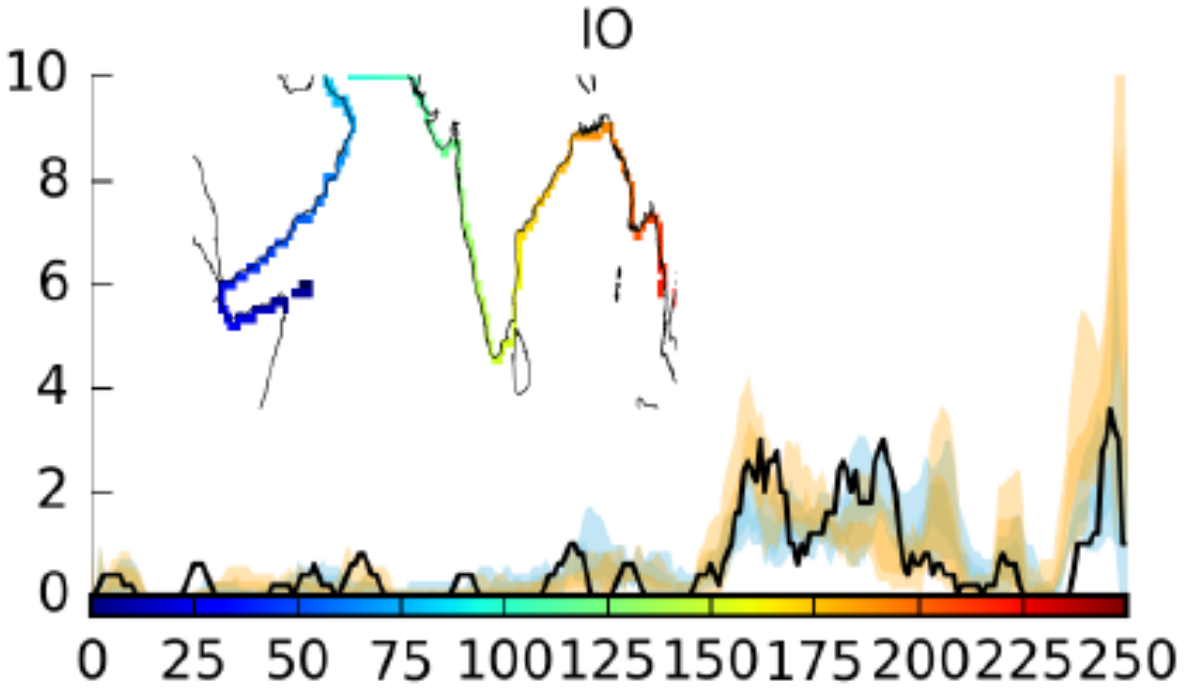
- They are not open source
- They are based on historical data, and can't handle climate change
- They are built to handle problems where the insurance industry has significant investments, and not others
- **We (and a few other academic groups) are developing open source catastrophe models, using peer-reviewed science, and accounting for climate.**

Example: an open-source tropical cyclone hazard model, using a mix of physics and statistics



Observed (black) and simulated landfall counts at 50 km resolution. Color codes location along the coast. Chia-Ying Lee et al., work not yet published.

Example: an open-source tropical cyclone hazard model, using a mix of physics and statistics



Observed (black) and simulated landfall counts at 50 km resolution. Color codes location along the coast. Chia-Ying Lee et al., work not yet published.

Our model has more physics than industry models, less than Emanuel (2006, & thereafter)

This is an area with much potential for industry-academic interaction. We can learn much from each other, and are starting to do so more.

Proposal for a Tropical Cyclone Hazard Model Intercomparison

Scientific Steering Committee:

Adam Sobel, Suzana Camargo (Columbia University), Kerry Emanuel (MIT), Mark Guishard (Risk Prediction Initiative), Dail Rowe (WeatherPredict), Peter Sousounis (AIR Worldwide), Paul Wilson (RMS)

Introduction

We propose an intercomparison of models used to assess the probability of tropical cyclone (TC) occurrence and impacts. We refer to these models as "TC hazard models". Such models may be statistical, dynamical, or a hybrid, and may come from the private sector, academia, or government. The project will survey the field of available models and determine the spread in current estimates of TC hazard. The project aims to advance academic-industry collaboration and the state of the science generally.

Models used to assess the risk of financial losses from TCs also include components to assess the vulnerability of physical assets and financial losses. The vulnerability and financial components will not be included in the proposed intercomparison.

Proposed Project Specifications

We propose that the outputs from each participating model include the following, subject to change based on a broader discussion by a group of likely participants:

What is the role of climate change?

- It changes the risks, over time. On short time horizons, natural variability is generally more important.
- A large impact – sometime in the next couple decades, perhaps sooner than later – will be felt in coastal real estate, due to sea level rise
- SLR is probably more important than the climate change influence on the storms themselves

Saffir-Simpson Scale

Saffir-Simpson Category	Maximum sustained wind speed			Minimum surface pressure	Storm surge	
	mi/h	m/s	kt	mb	ft	m
1	74-95	33-42	64-82	greater than 980	3-5	1.0-1.7
2	96-110	43-49	83-95	979-965	6-8	1.8-2.6
3	111-130	50-58	96-113	964-945	9-12	2.7-3.8
4	131-155	59-69	114-135	944-920	13-18	3.9-5.6
5	156+	70+	136+	less than 920	19+	5.7+

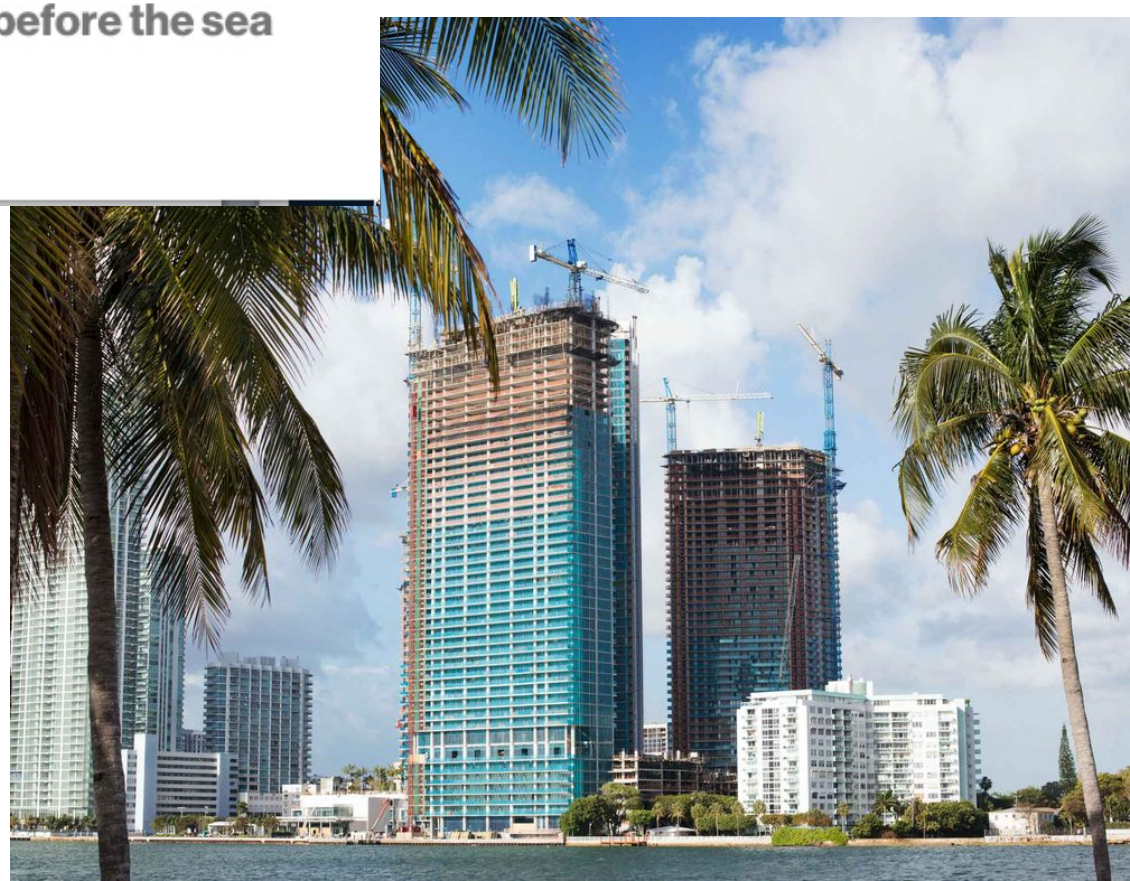
Understanding of the risk could be enough to do the damage to the market.

The Nightmare Scenario for Florida's Coastal Homeowners

Demand and financing could collapse before the sea consumes a single house.

by **Christopher Flavelle**

April 19, 2017, 5:00 PM EDT



- Major disasters are too rare to evaluate risk just from historical data.
- Catastrophe models address this, but there is much they don't do yet.
- There is great potential for more academic-industry collaboration on weather & climate risk assessment.

extremeweather.columbia.edu
adamsobel.org
www.facebook.com/adam.sobel
@profadamsobel
www.columbia.edu/~ahs129/home.html