



Modeling and Managing Catastrophe Risk

Symposium on Managing the Risk of Catastrophe Failure in Complex Systems, Cambridge University

Hemant Shah

<http://www.risk.jbs.cam.ac.uk/news/events/risksummits/downloads/pdfs/2009/shahh.pdf>
(retrieved 12 October 2015)

President and CEO, Risk Management Solutions

December 10, 2009

Bringing Science to the Art of Underwriting™



Risk Management Solutions

Risk Management Solutions is the world's leading developer of models to quantify risk from catastrophic events

RMS is an independent and objective provider of products and services that enable clients to manage these risks

Clients include insurance companies, corporations, investors, and agencies of government



THE ROUGH GUIDE TO

CAT Models

Kate Baillie and Tim Salmon

ZAGAT SURVEY®

2000/2001

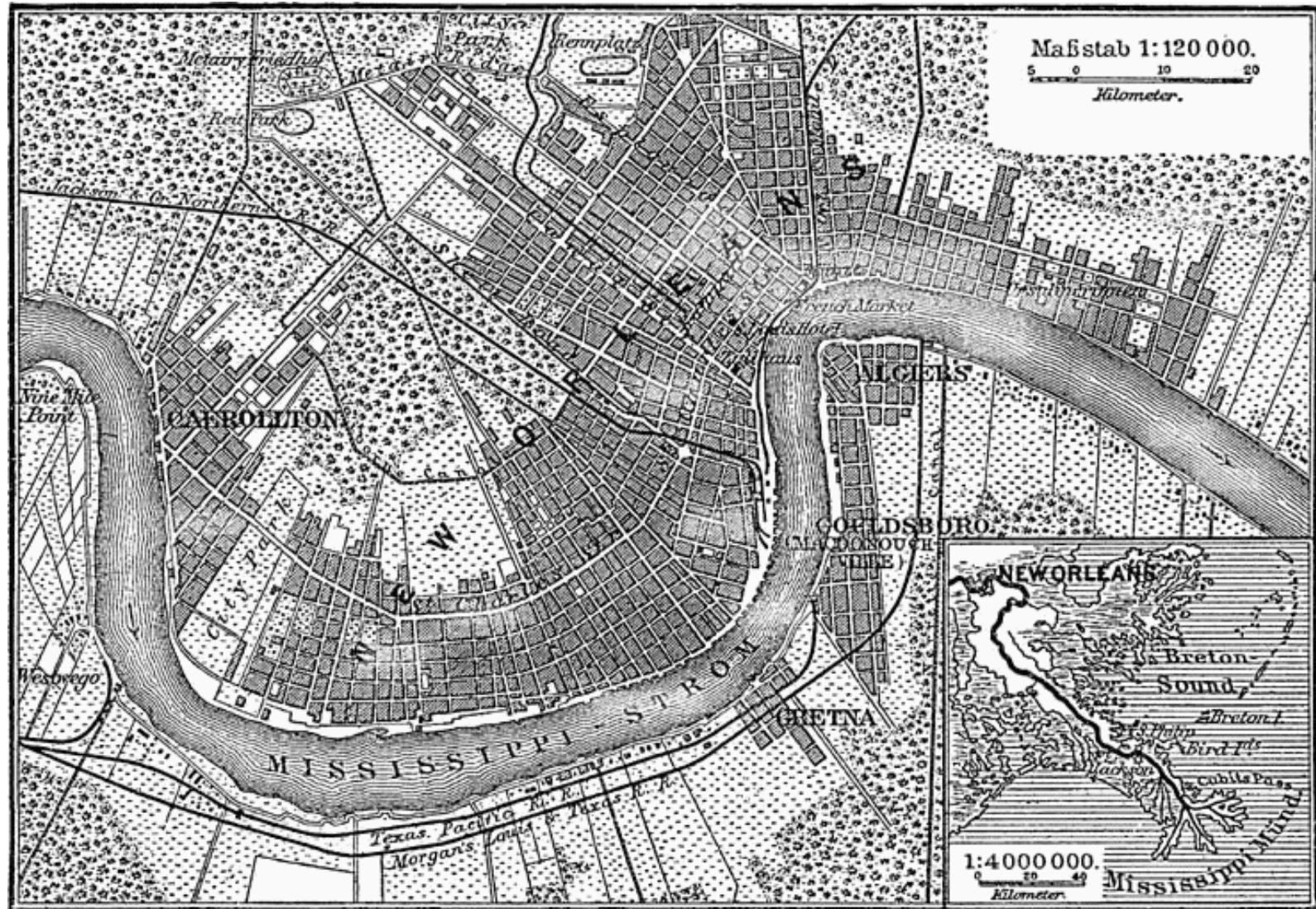
**CAT
Models**

Including

Earthquake, Hurricane, Tornado/Hail
and Flood

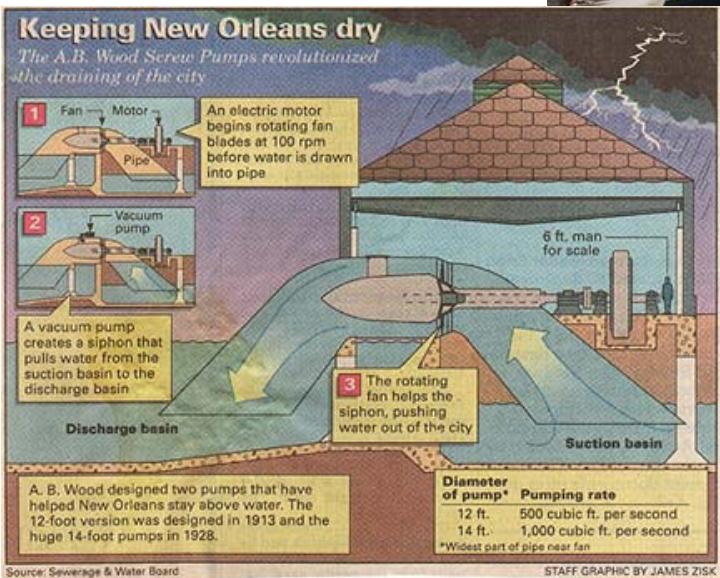
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New Orleans Before the Pumps



The Expansion into the Floodplain

- Pumps initially deployed from 1913-1928



1915 “New Orleans” Hurricane

- Cat 4 Hurricane, 20 miles east of New Orleans (Grand Isle)
 - *“Whole country between Poydras and Buras inundated. Levees gone, property loss appalling. Life toll probably heavy. Conditions estimated worse than ever before. Relief needed. No Communications...”*
- Storm struck before the construction of the Industrial Canal
- On the Mississippi River below New Orleans storm surge overtopped the levees below New Orleans and rose to 15-20 feet above sea level.
 - Swells rolled up the river in New Orleans 10-12 feet above high water.
- Water was carried into Lake Pontchartrain and overflowed the existing levees to flood western part of the city
 - From the Old Basin canal (parallel to Orleans Avenue) to Broadway and from Claiborne Avenue to Lake Pontchartrain
 - Flooding 1-8 feet
- After the passage of the storm the surge receded rapidly but the flood waters stayed in place for 3-4 days in New Orleans and had to be removed by the drainage system

(from 1915 *Monthly Weather Review*).

The Expansion into the Floodplain

- Second generation of pumps elevated to be able to function after a flood



Bayou St. Jean at Lake Pontchartrain

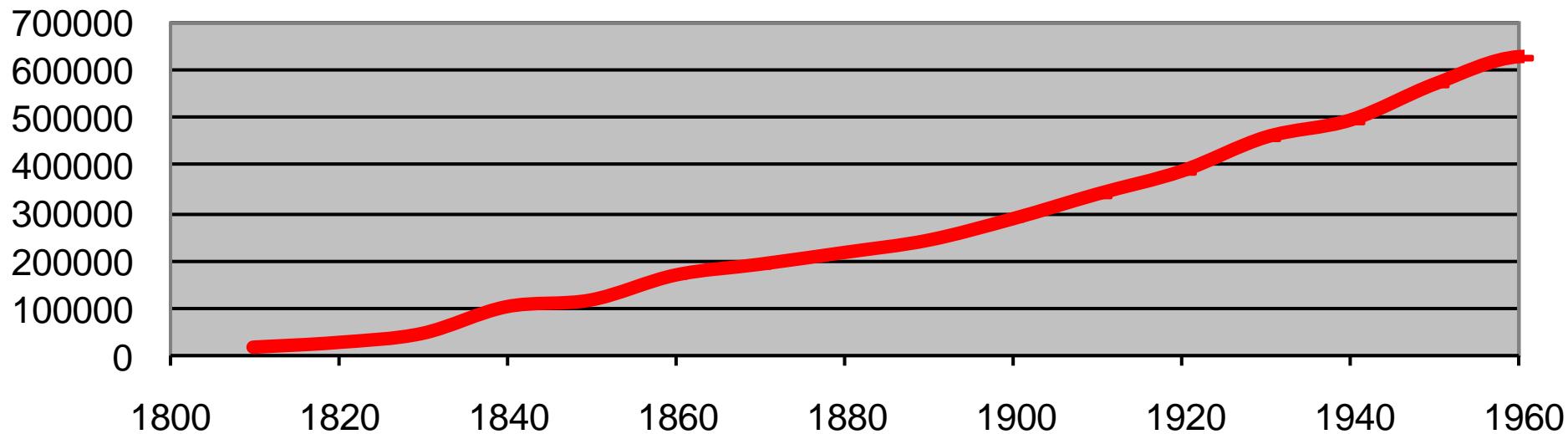
1947 Hurricane

- Cat 3 directly over the City
- Surge overtopped Lake Pontchartrain levees
- 17th St Canal wall failed
- Up to 6 feet of water in parts of Jefferson parish
- Standing water for weeks
 - Removed through cutting and blasting holes in the levees

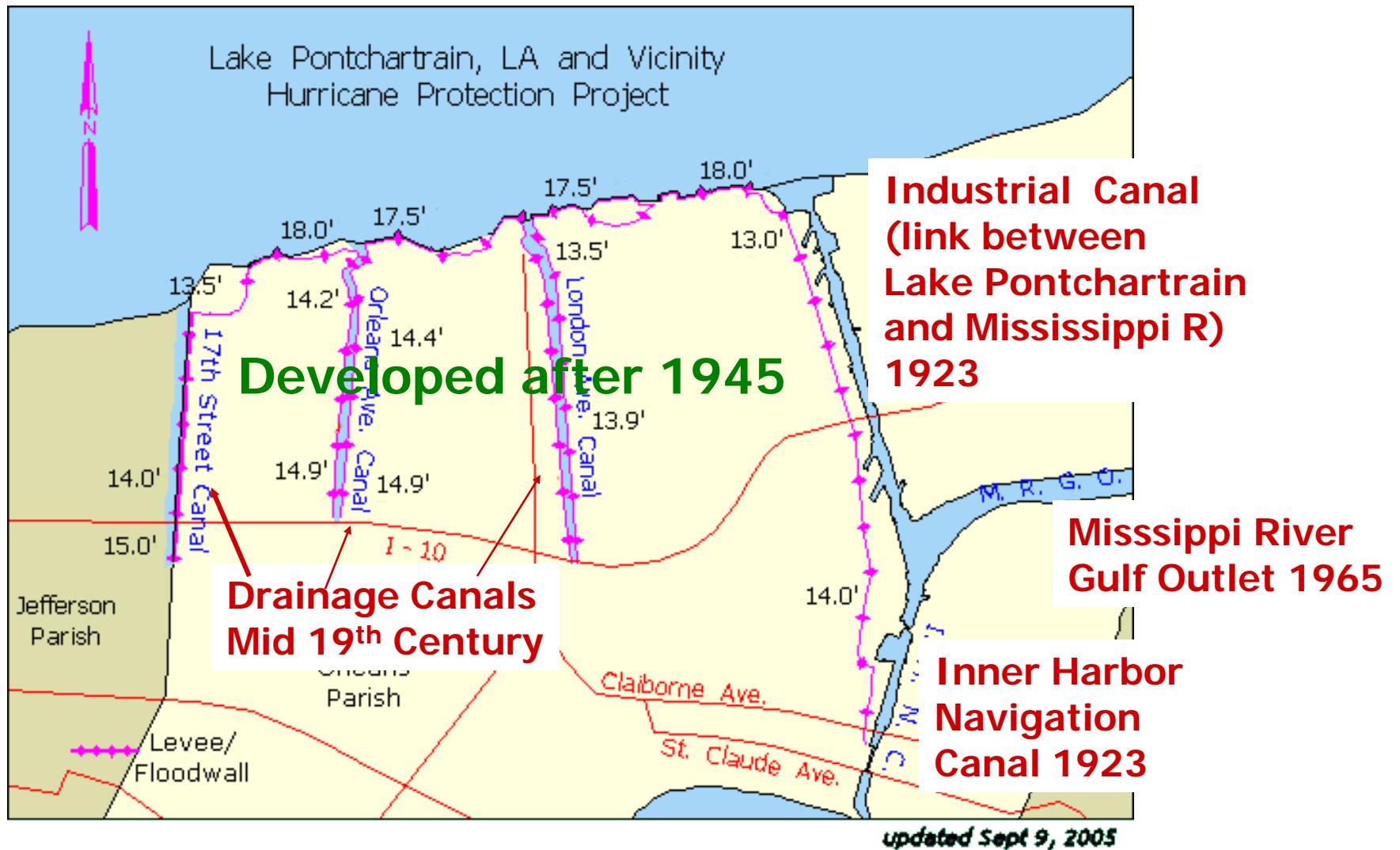


Growth of New Orleans

Population of New Orleans



New Orleans Canals



1965 Hurricane Betsy

- Cat 3 Hurricane
- 12 foot storm surge



1965 Hurricane Betsy - Presidential Response

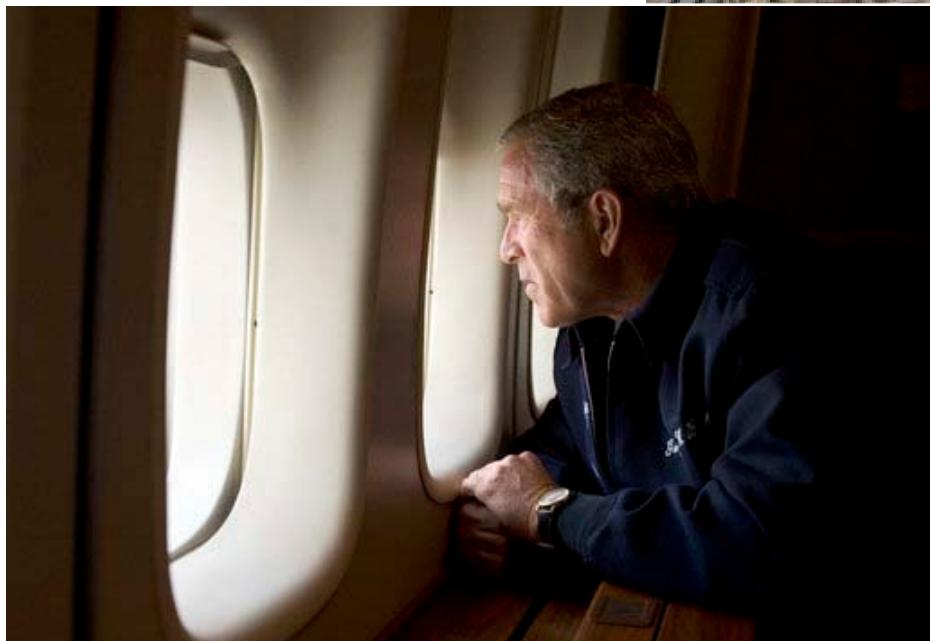
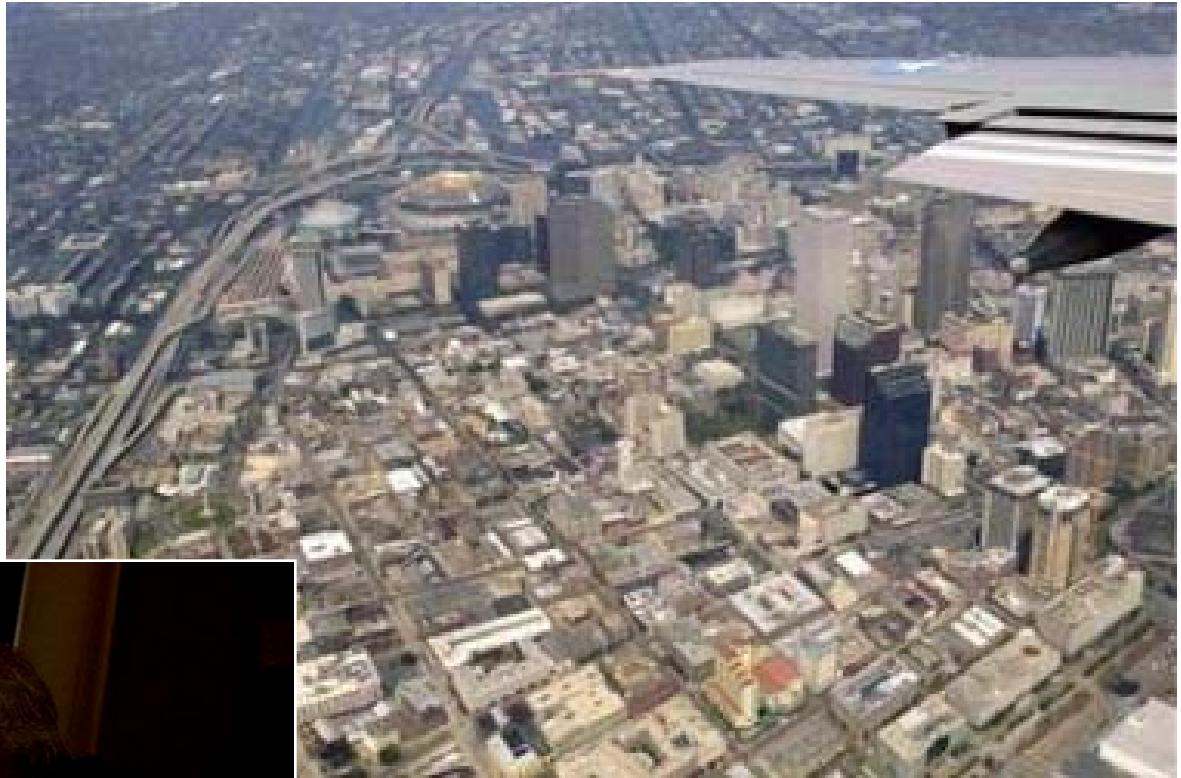
LBJ and the Response to Hurricane Betsy

by Kent B. Germany

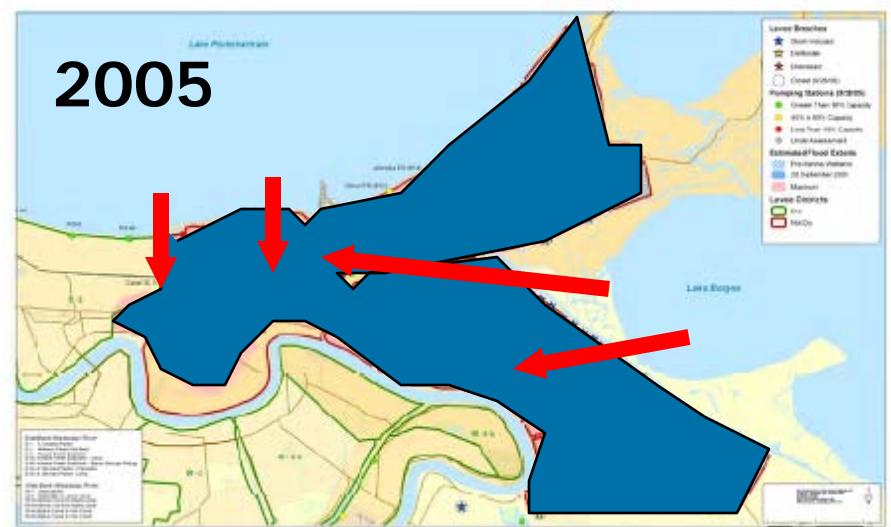
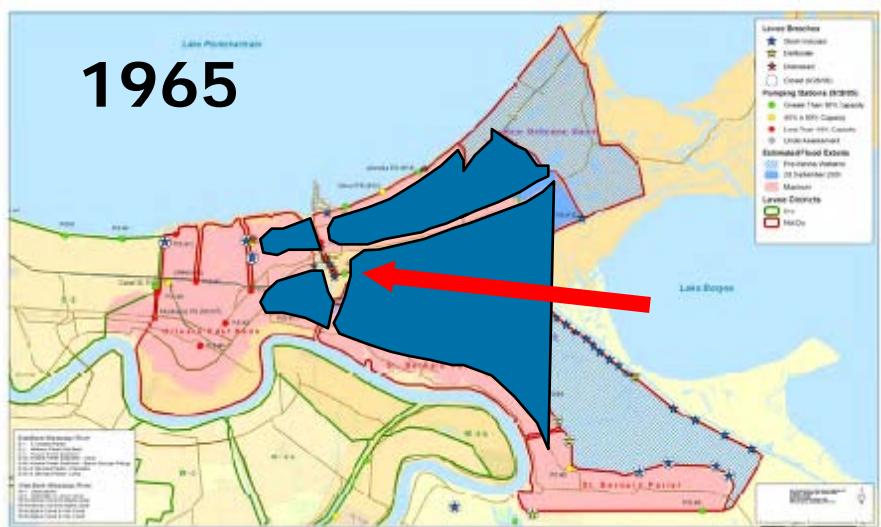
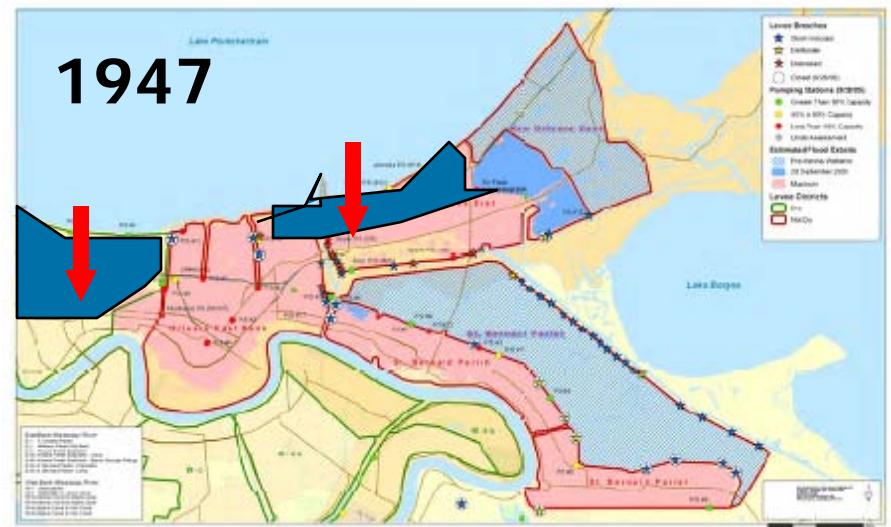
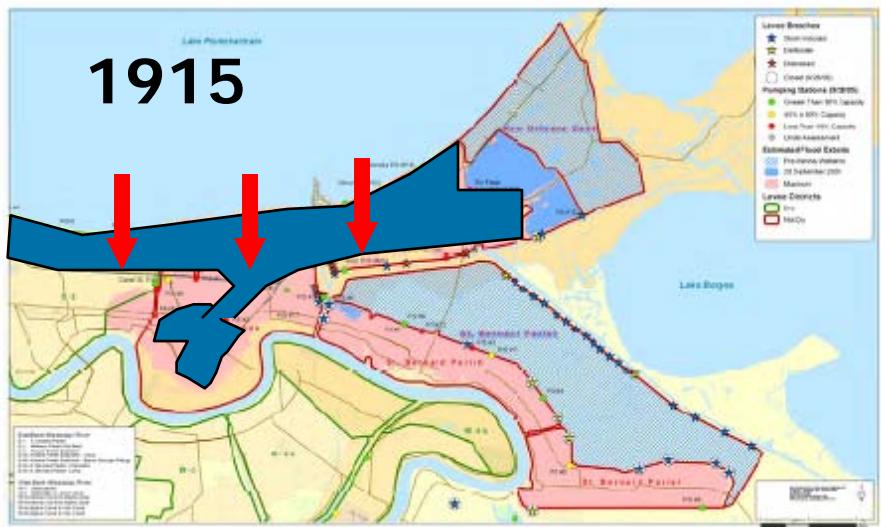


Johnson surveys the flooding in Louisiana from Air Force One, September 10, 1965
Courtesy of LBJ Library.

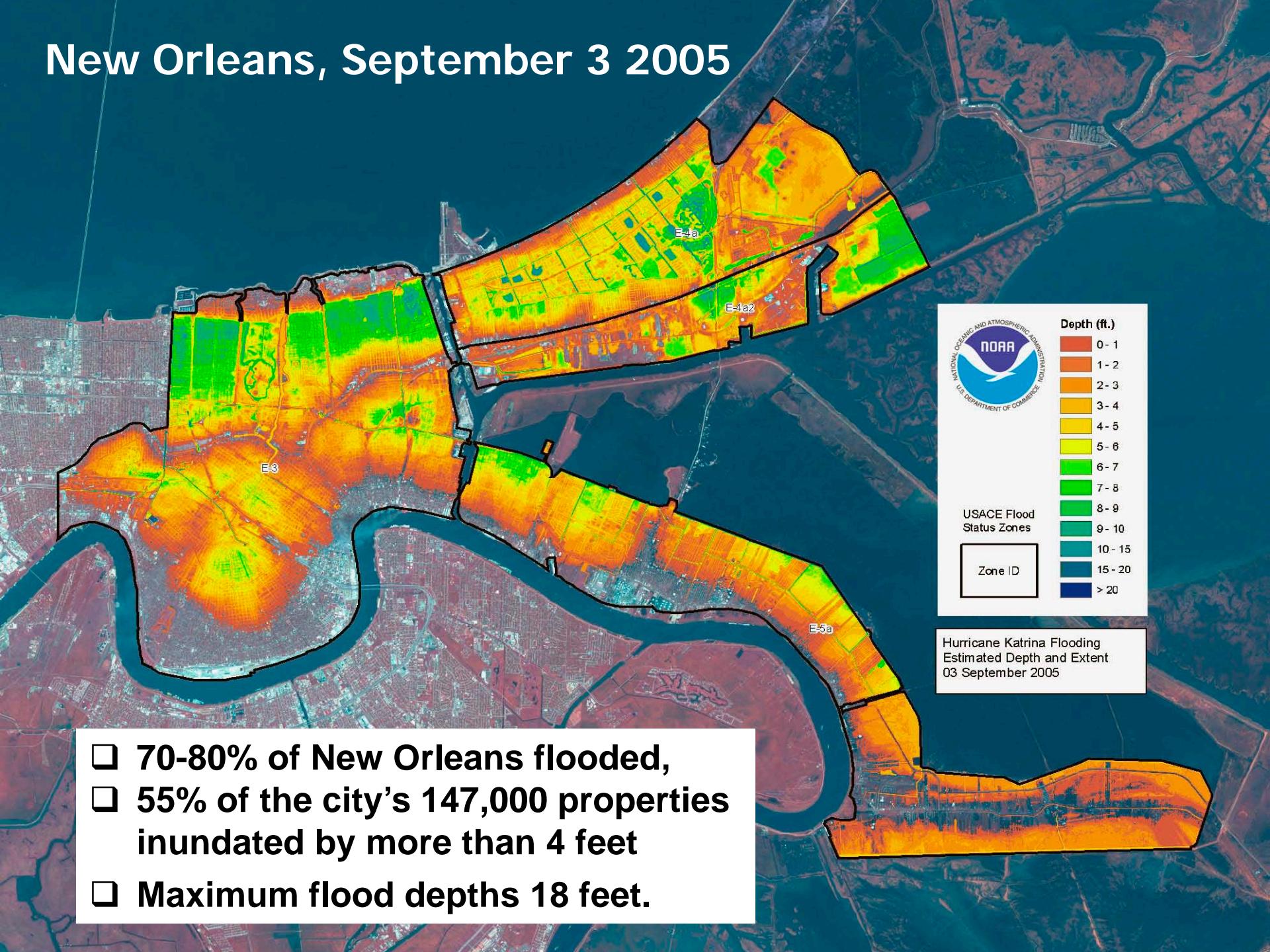
2005 Hurricane Katrina - Presidential Response



100 Years of Storm Surge Flooding



New Orleans, September 3 2005



One Disaster Sets The Terms For The Next



Mayor Pomfh's Vision...

"I want to give positive assurance that our friends will find Miami this winter the same enjoyable, hospitable, comfortable vacation city it has always been.

I predict that Miami will make a world record come-back...we are ready to resume our place as the playground of the world"

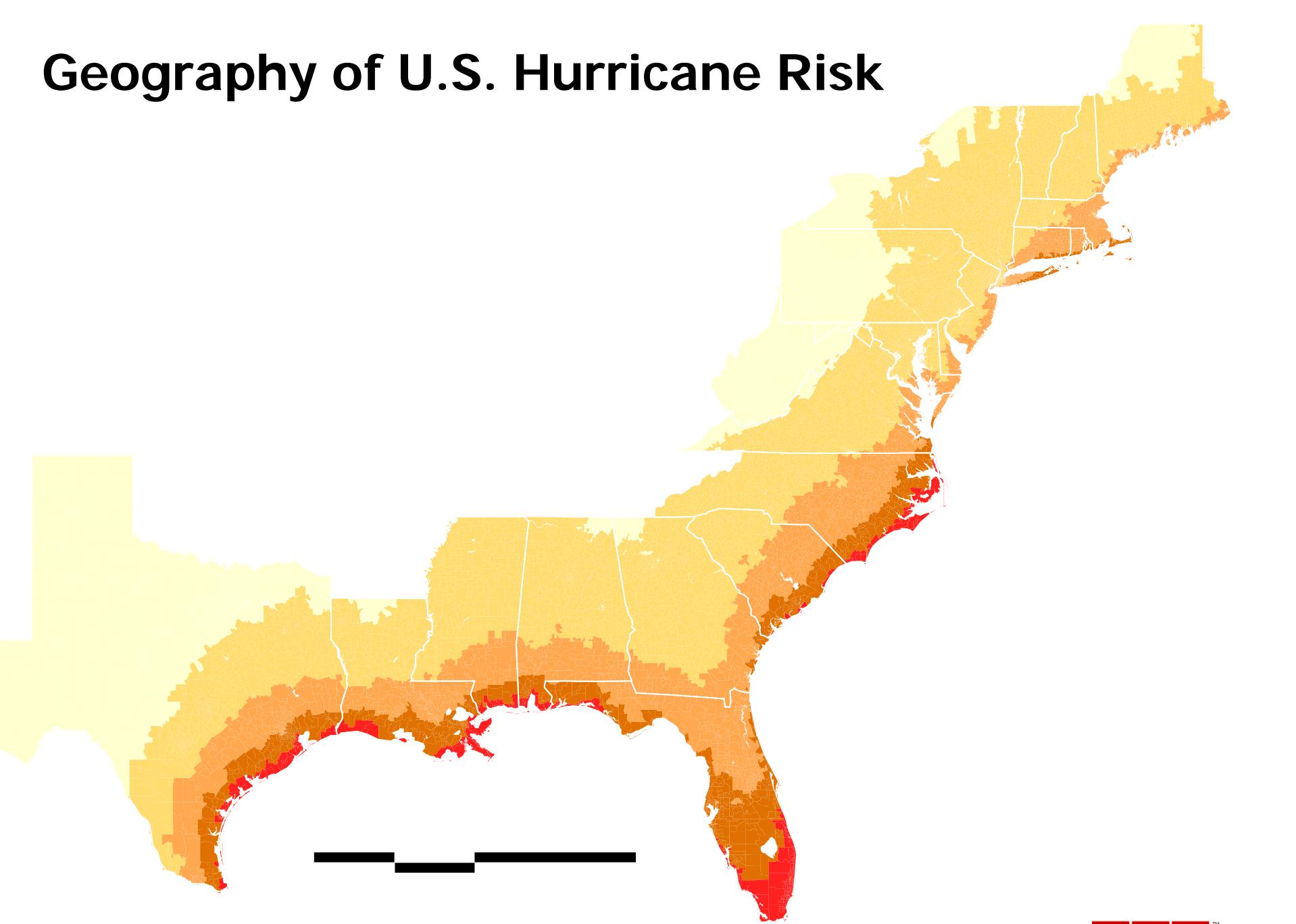
-Miami Mayor E.C. Pomfh

...speaking six days after the September 18, 1926 storm struck south Florida

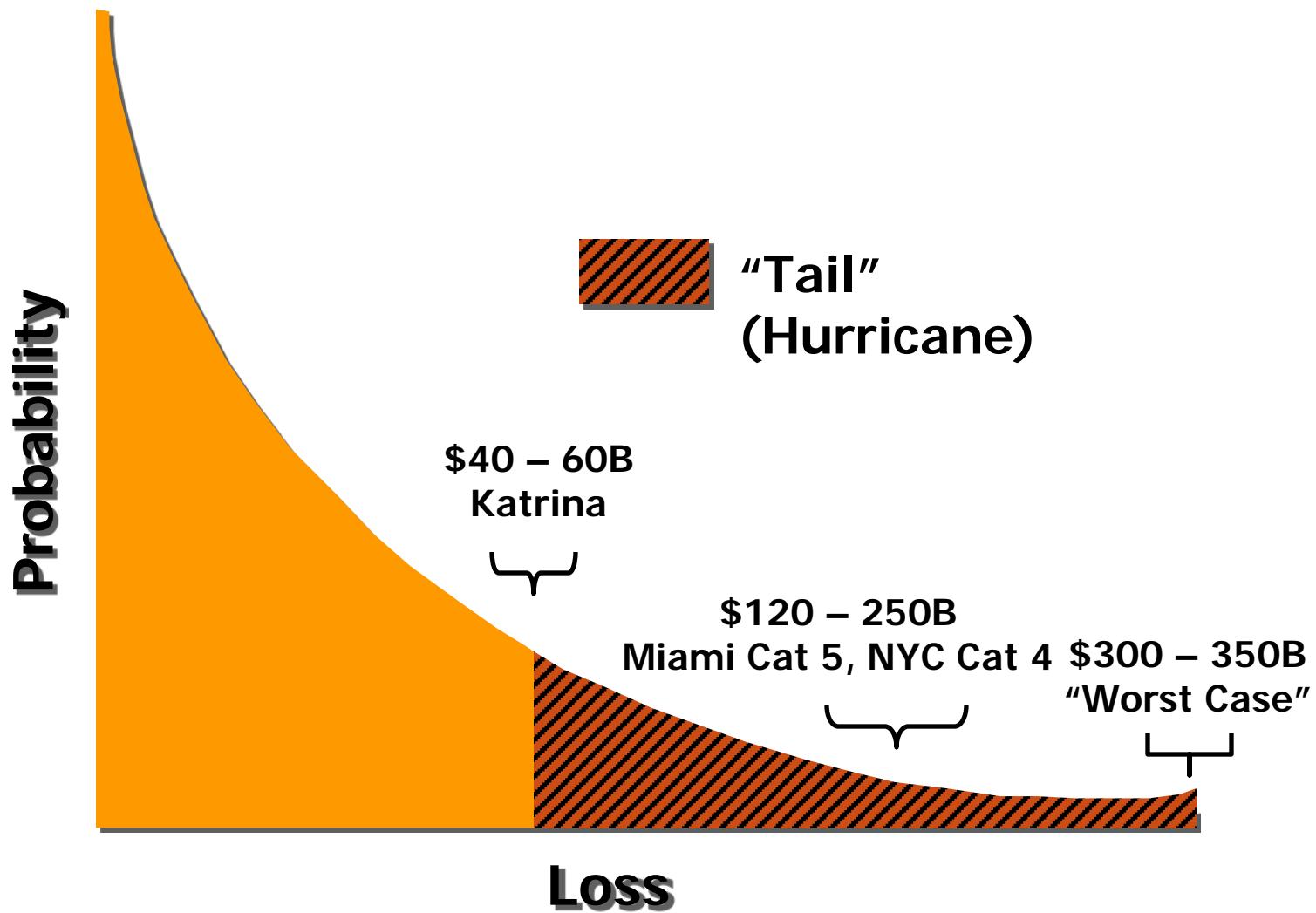
Mayor Pomfh's Vision...Realized

- 1990 Population of Dade and Broward alone exceed that of *all* 109 coastal counties (TX – VA) in 1930
 - Of 67 coastal counties in LA ->FL, pop. density is 2.5X national average
- During the Florida construction boom from 1970 – 1990:
 - 70% of buildings in Broward and Palm Beach counties built in this period
 - 75% increase in the population density in SE Florida
 - Commercial values almost tripled in value
- The trend continues; from 1990 to 2000:
 - The population of Broward County increased by 29%,
 - and Collier County by 65%
- 1,540 building permits issued in coastal counties every day

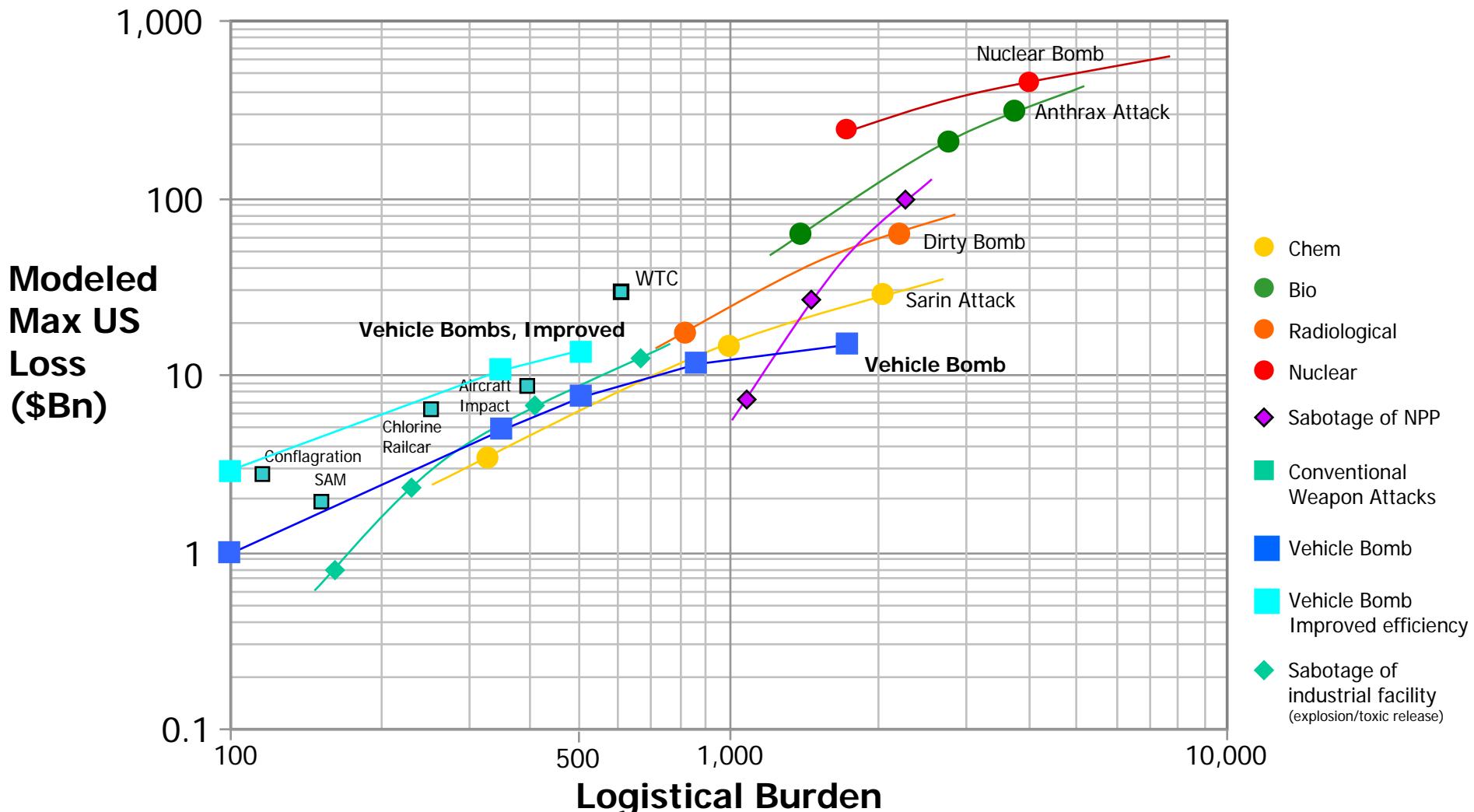
Geography of U.S. Hurricane Risk



Putting Katrina in Perspective: US Hurricane

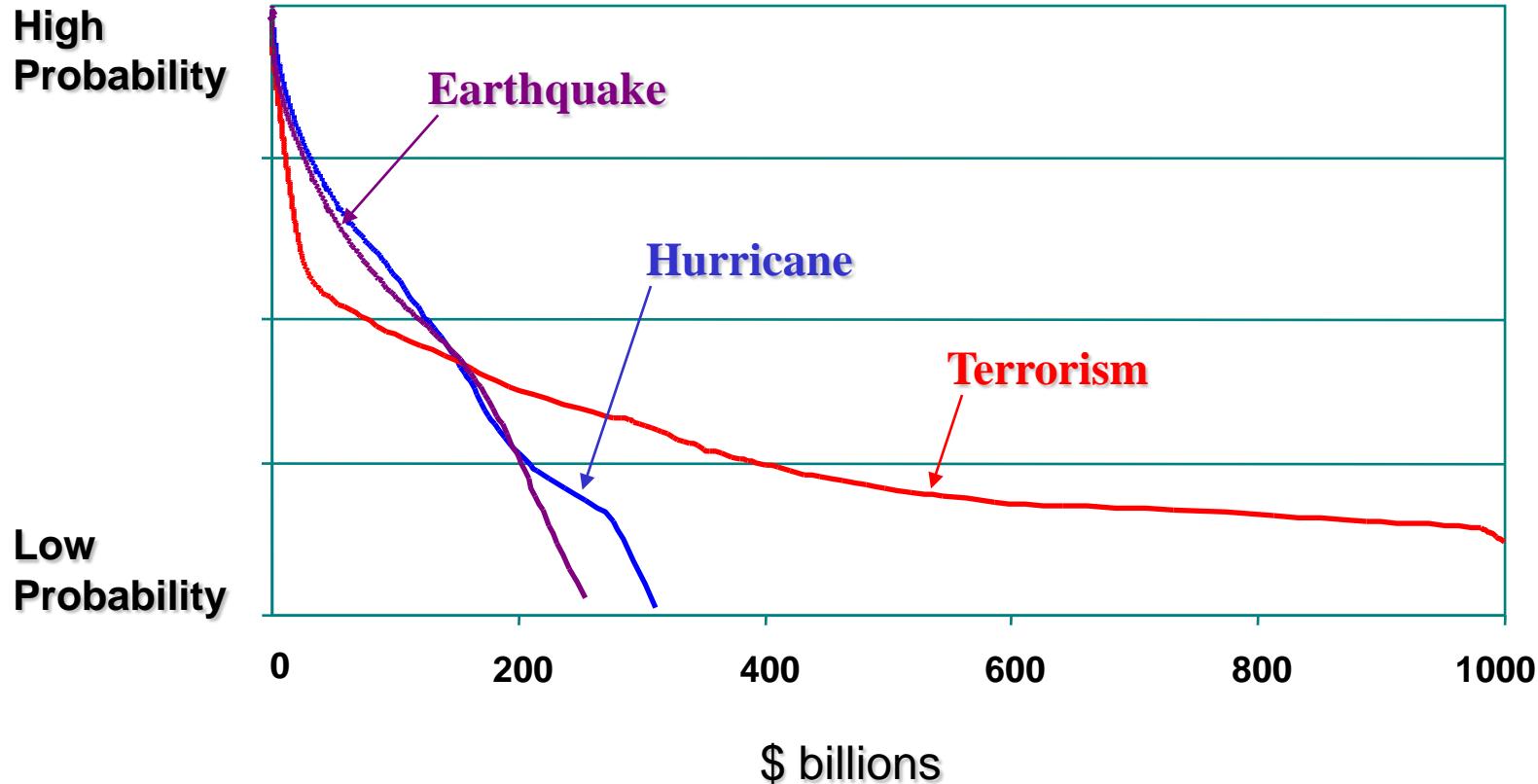


Quantifying Terrorism Risk

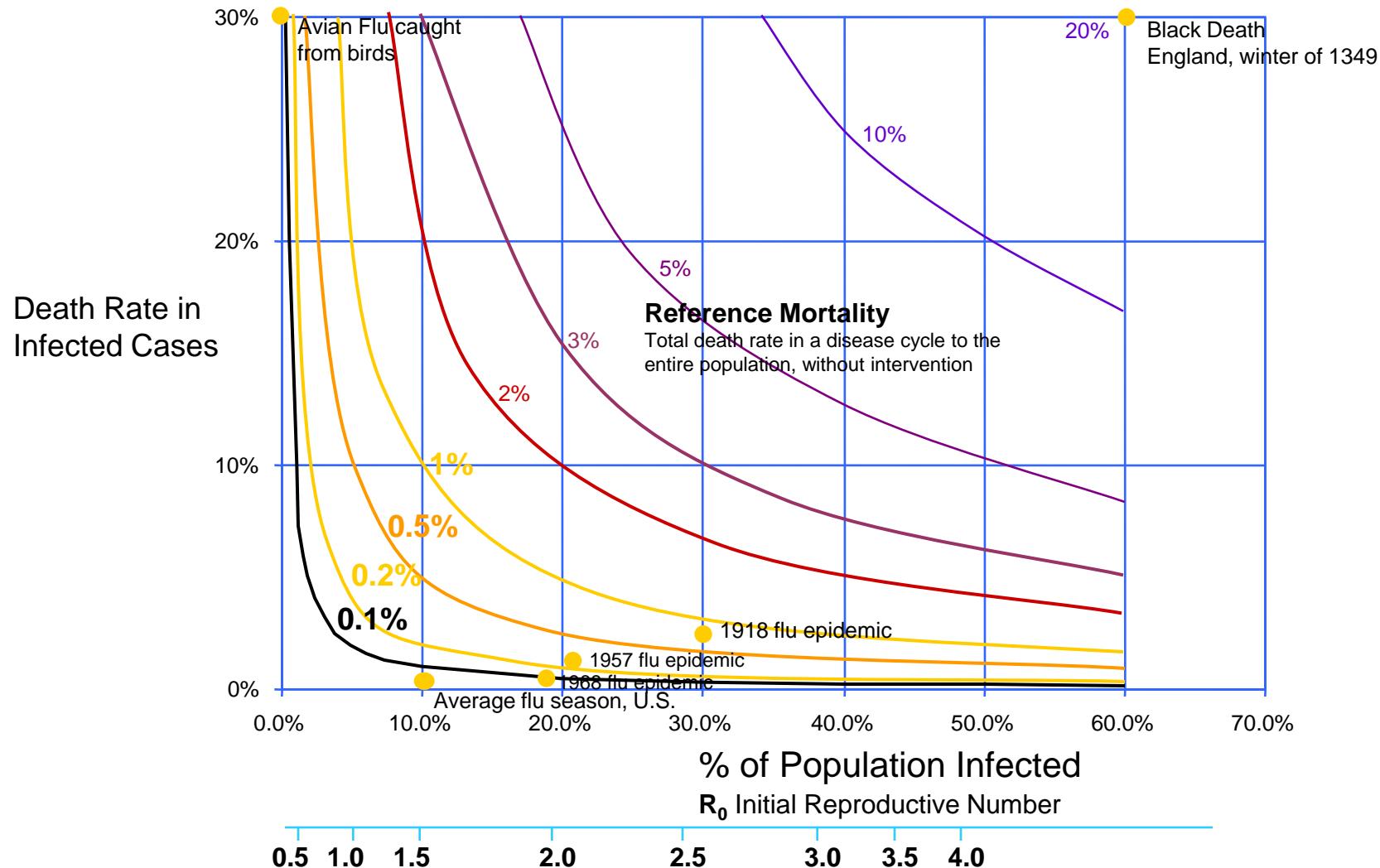


Risk Across Perils

US Insurance Industry Losses

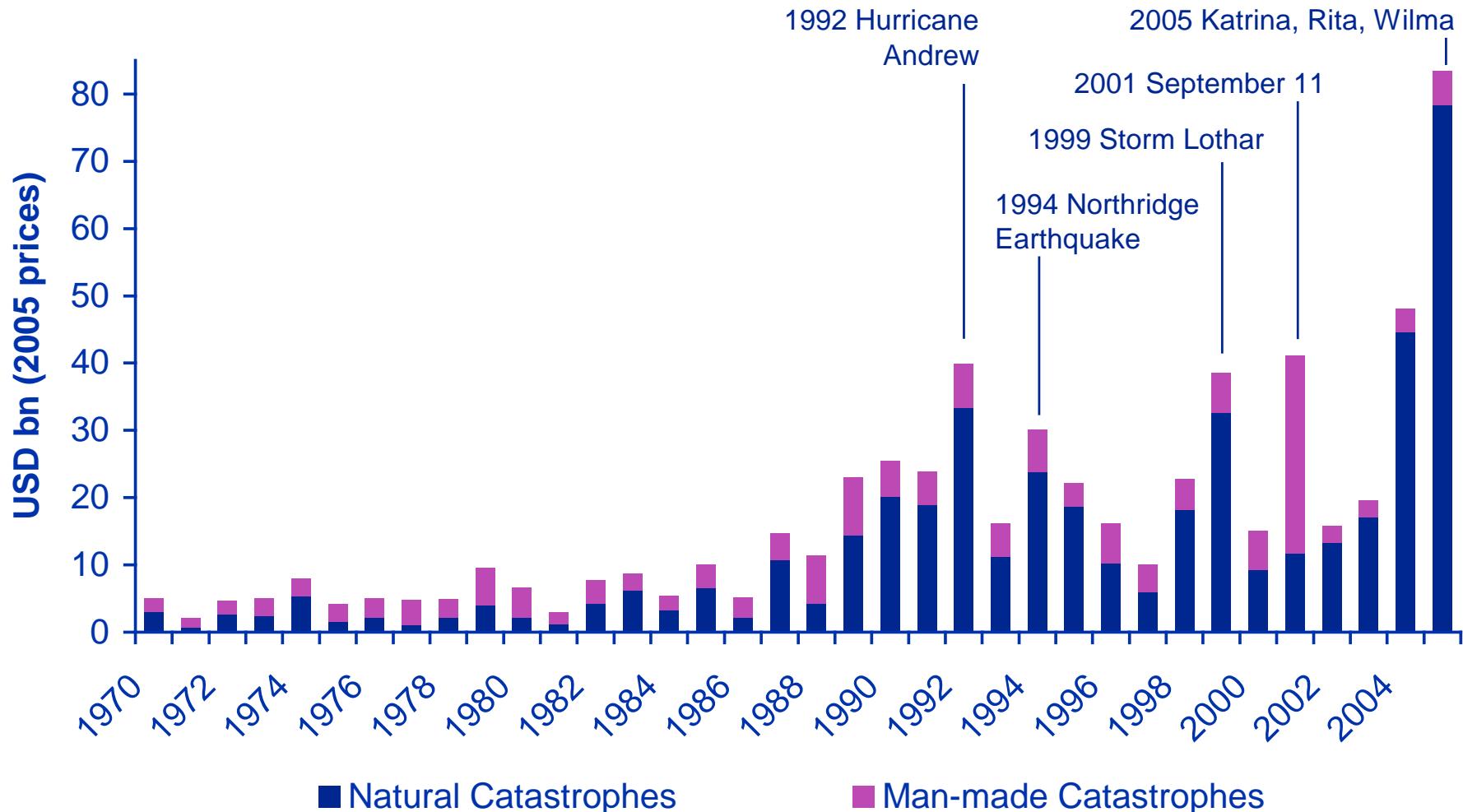


Losses could be \$50 – 400 Billion in a Catastrophic Pandemic



Re/insurers at Significant Risk

Global Insured Losses

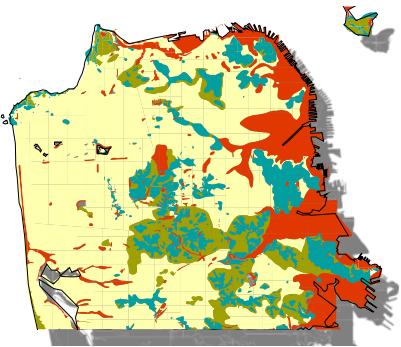


What is a Catastrophe Model?

Built environment



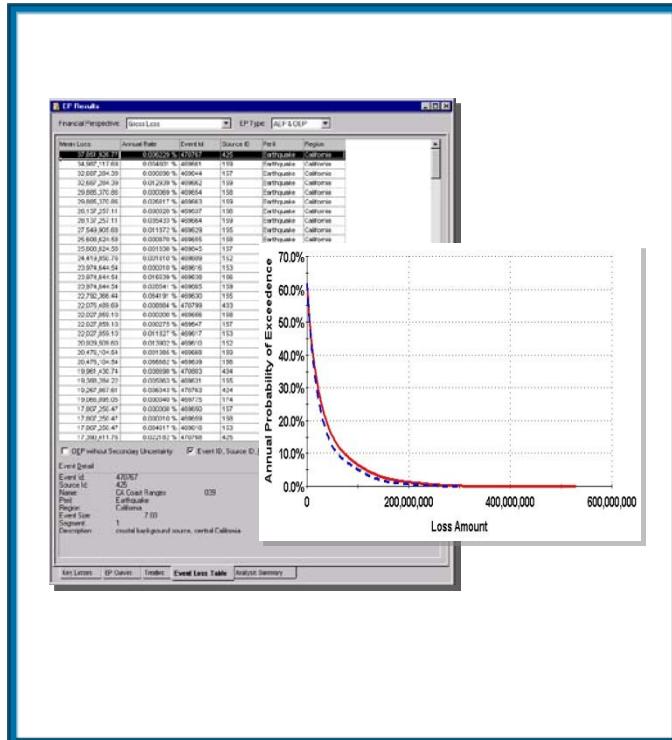
Geospatial hazards



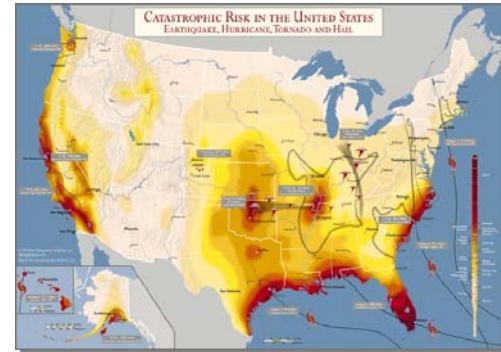
Event models



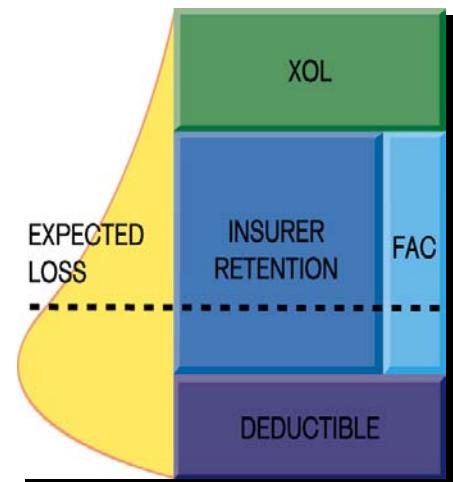
Stochastic Simulation



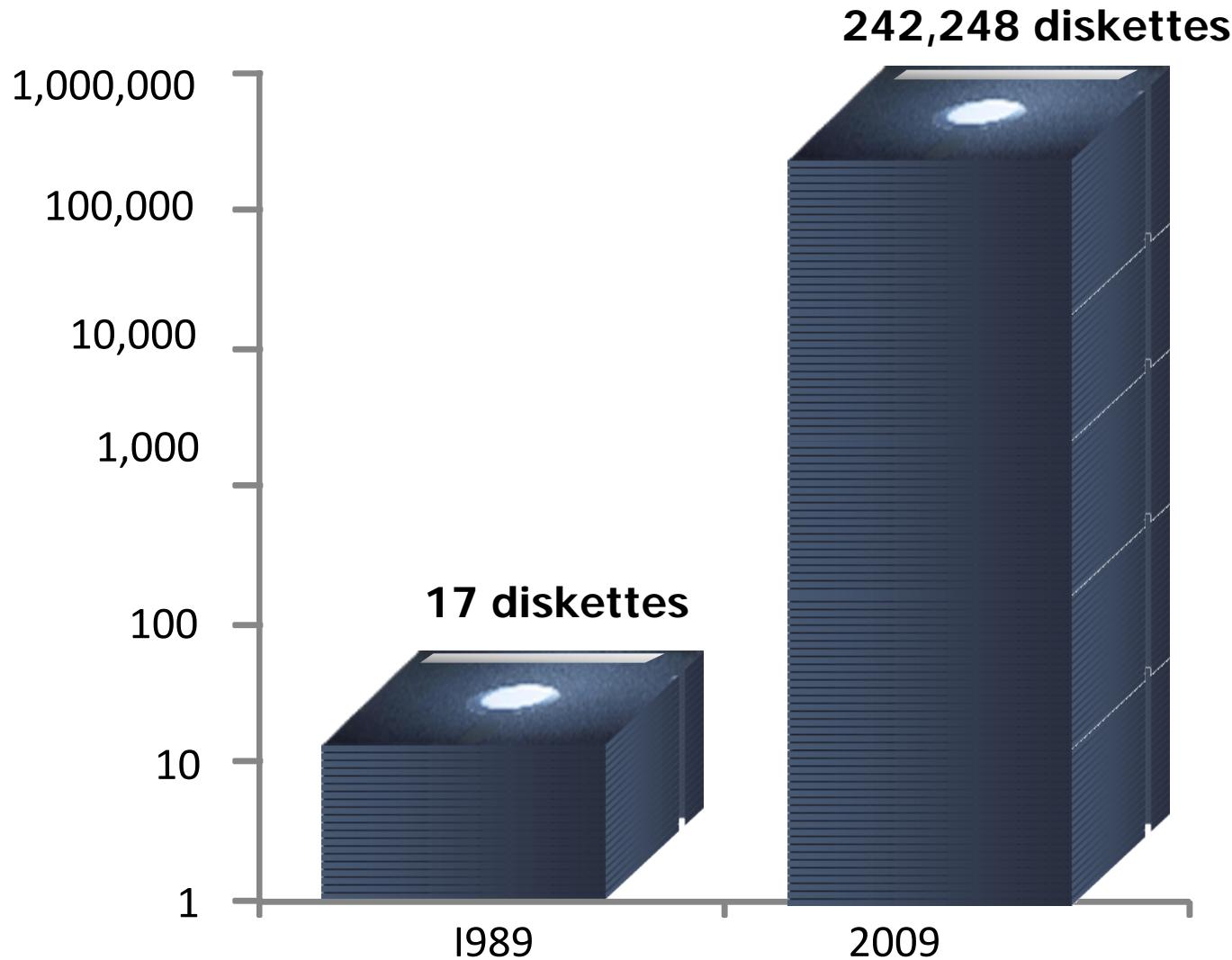
Geography of Risk



Policy or Portfolio Risk



Growing Sophistication of Models



Evolution of a Significant Value Proposition

1999 Tower Group	"The representation of risk in technologically enabled quantitative models is at the center of the changing world of how insurance risks are managed. These models offer significant benefits for the companies that use them..."
2003 Deloitte Survey	"The most important factor in improving underwriting is better information on risks...[executives] also believe that they need more granular risk assessments than traditional class-based pricing affords..."
2007 Global Re Survey	83% of the respondents agreed that "modeling is a core competency leading to competitive advantage rather than just a means to maintain a sound credit rating or regulatory compliance." Respondents further elaborated: "...the players who have used cat models to drive their decision making process usually produce the largest returns for their shareholders"

Integral Element of Risk Management Practice

1. Corporate governance

Clear risk appetite and aligned policies

2. Underwriting

Improve
granularity,
Technical Price

3. Capital management

Rating agencies and
Economic Capital

4. Risk control

More healthy
skepticism

5. Risk analytics

Probabilistic Modeling and
Scenario “Stress Testing”

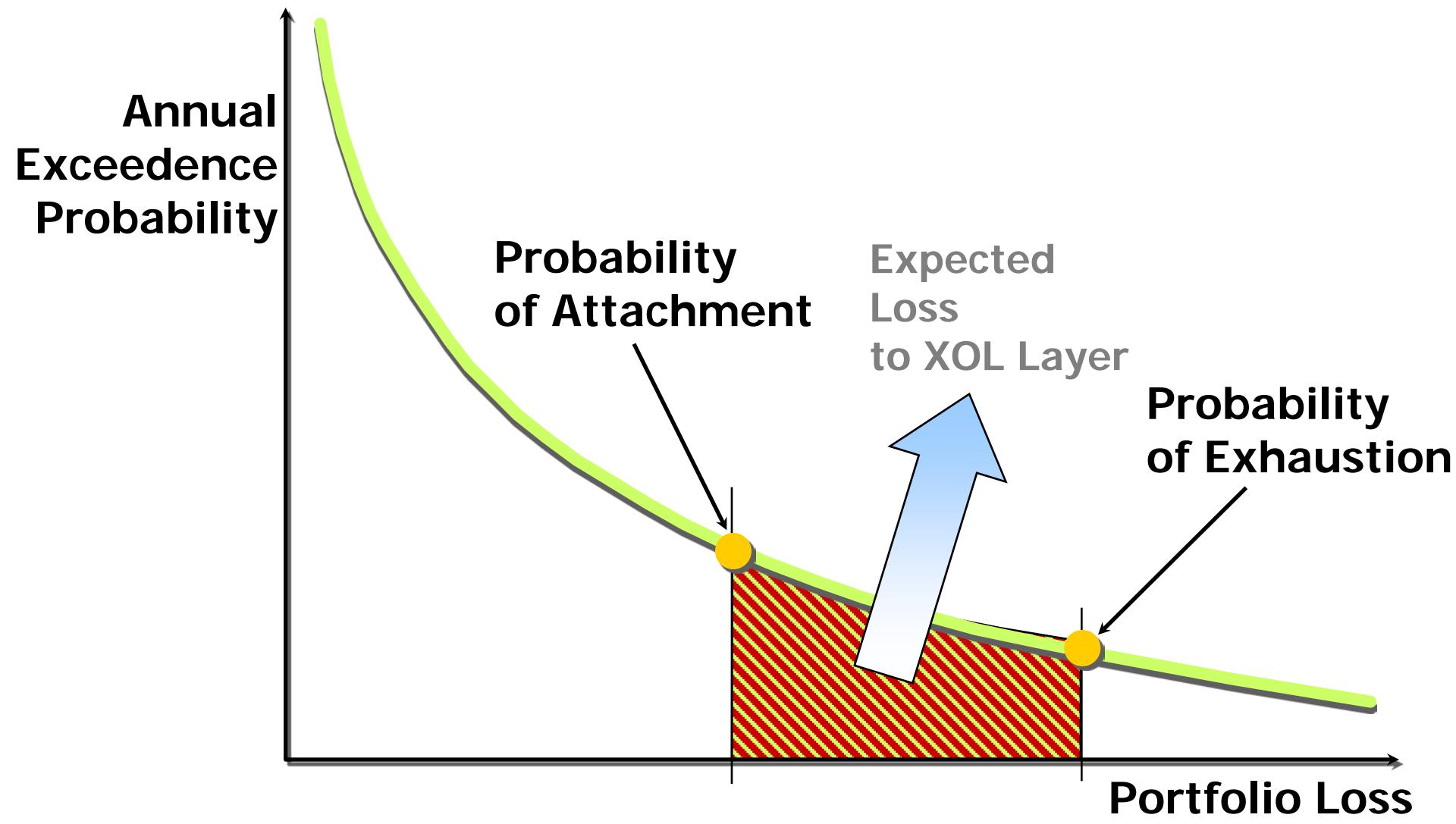
6. Data and technology

Incentives and
accountability for data

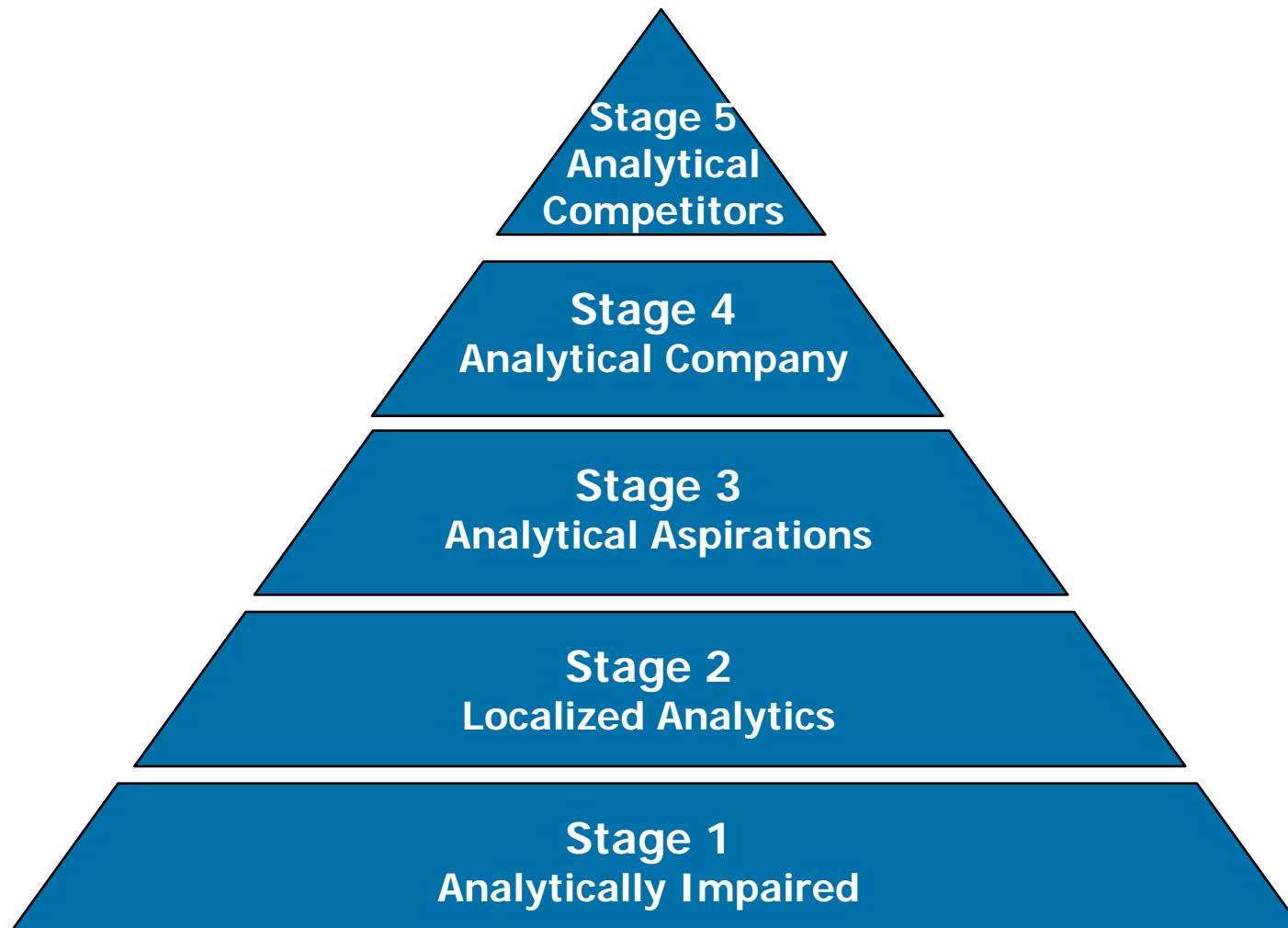
7. Stakeholders management

Better communication

Illustrative Application of Model Output



Five Stages of Analytical Competition*

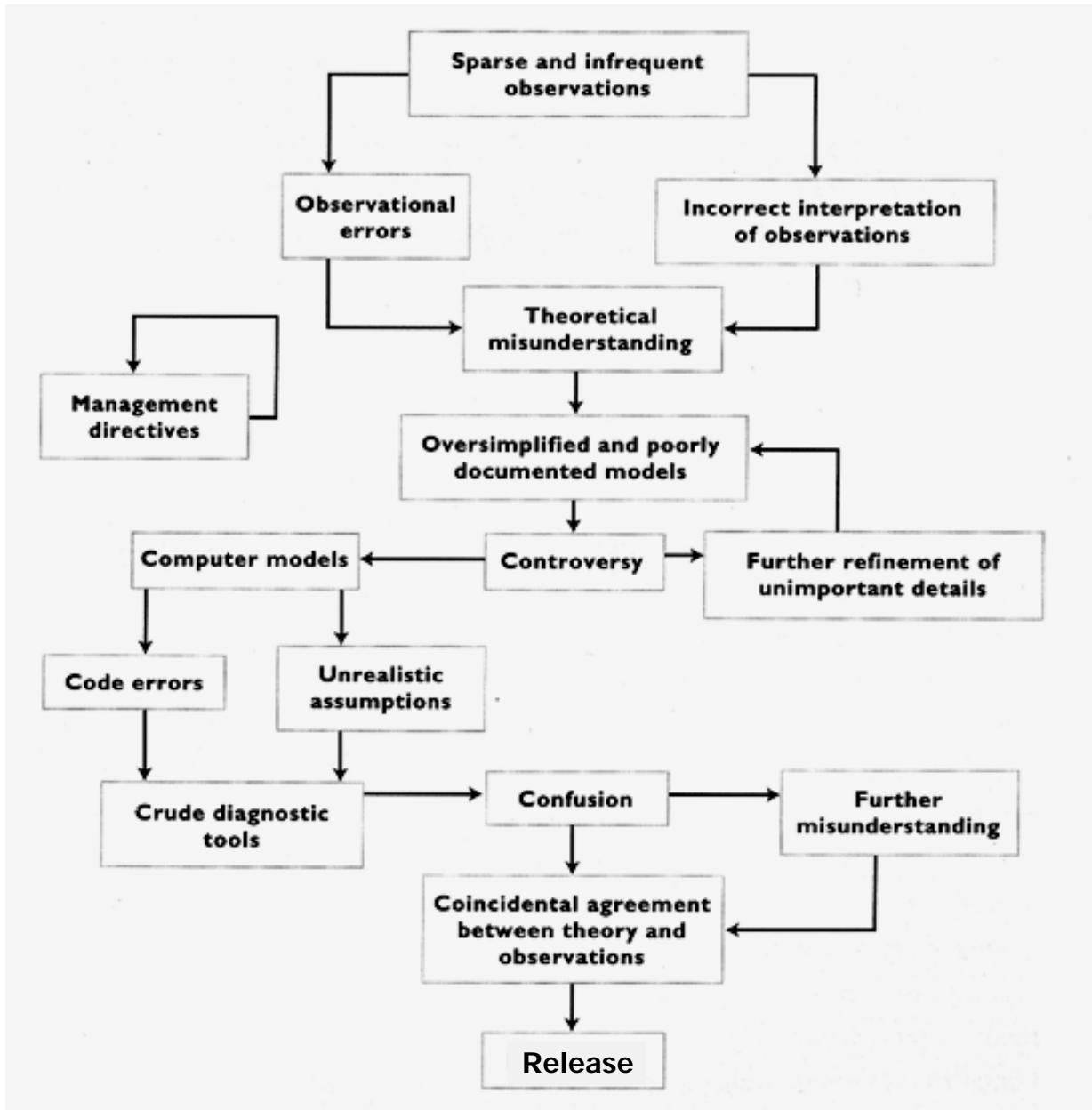


* Thomas Davenport, Competing on Analytics

Growing Demand for Catastrophe Models

- Catastrophe risk is increasing with time, driven by growth in exposures, a changing climate, and an expanding take-up of insurance in developing regions of the world
- Ongoing adoption of decision analytics and penetration of model-based risk management practices across the re/insurance enterprise
- Extension of re/insurance risk into the capital markets through insurance-linked securitization
- Expansion of the addressable market through provision of new classes of risk models
 - Catastrophe and climate change
 - Human casualty and “Excess Mortality”
 - Catastrophic Liability Losses (mass litigation)
 - Life, health and pension exposures

Building Better Models



A Core Design Principle

"There are some models, especially some science and engineering models, that are large and complex because they need to be.

But many more are large and complex because their authors gave too little thought to why and how they were being built and how they would be used"

- *Uncertainty : A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis*, 1992

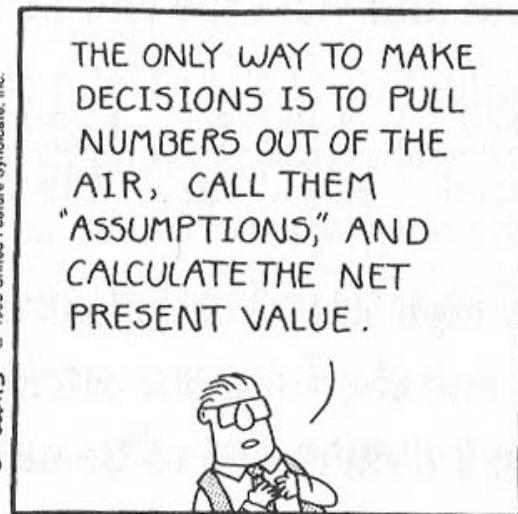
"It is a mark of educated people, and a proof of their culture,

that in addressing any problem they seek only so much precision as its nature demands or its solution requires"

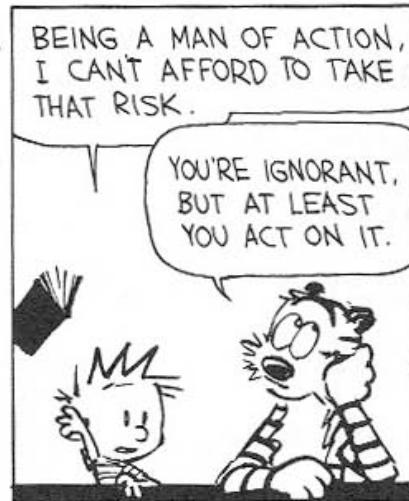
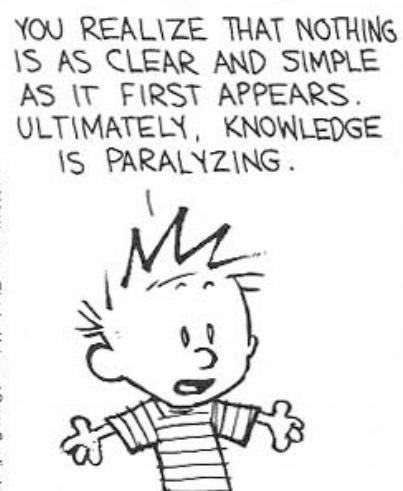
- Aristotle, *Nichomachean Ethics*

Interpretation and Use of Models

Too Hot



Too Cold



Managing Data Quality

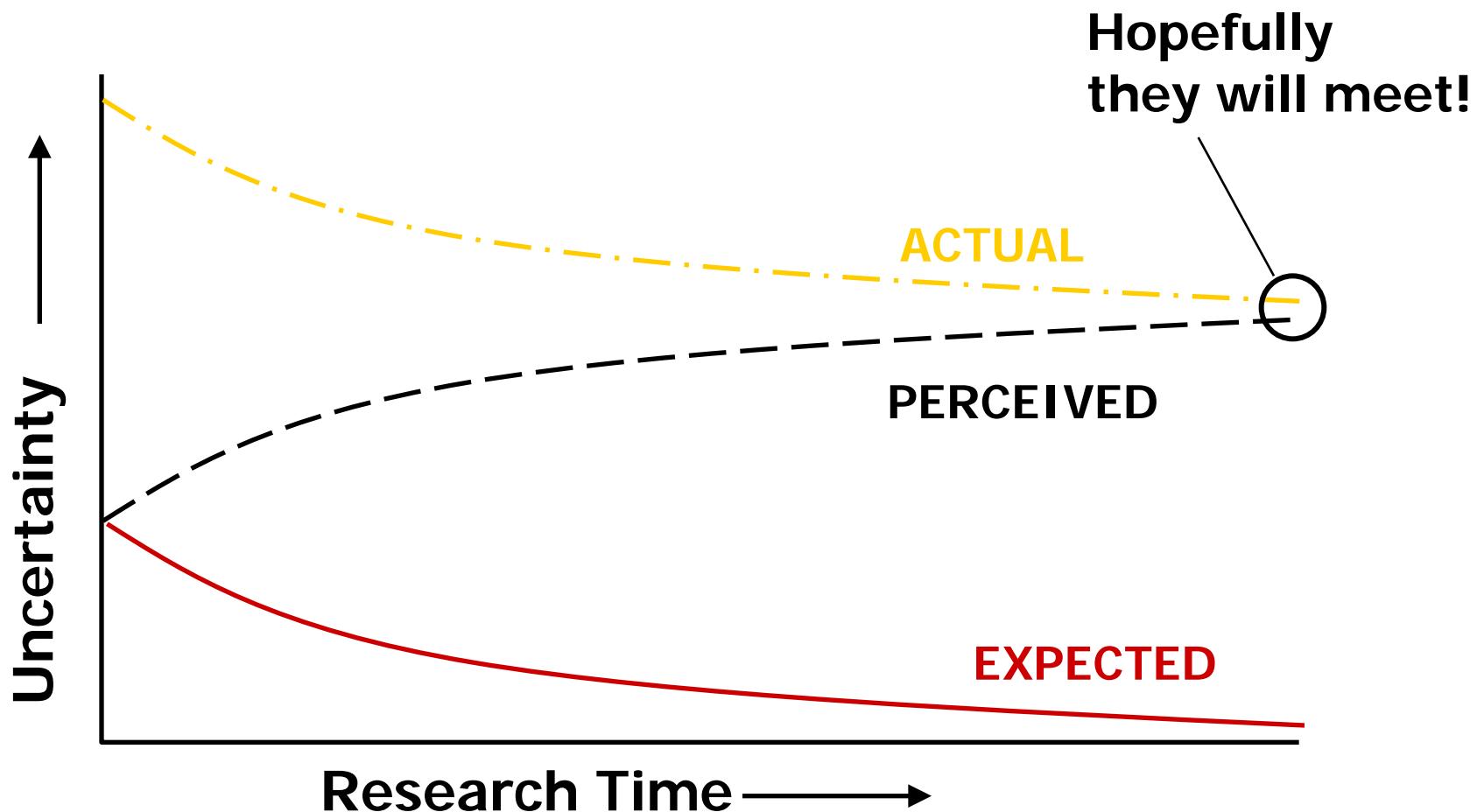
"The Government are very keen on amassing statistics.

They collect them, add them, raise them to the nth power, take the cube root and prepare wonderful diagrams...."

"...but you must never forget that every one of these figures comes in the first instance from the village watchman,
who just puts down what he damn pleases."

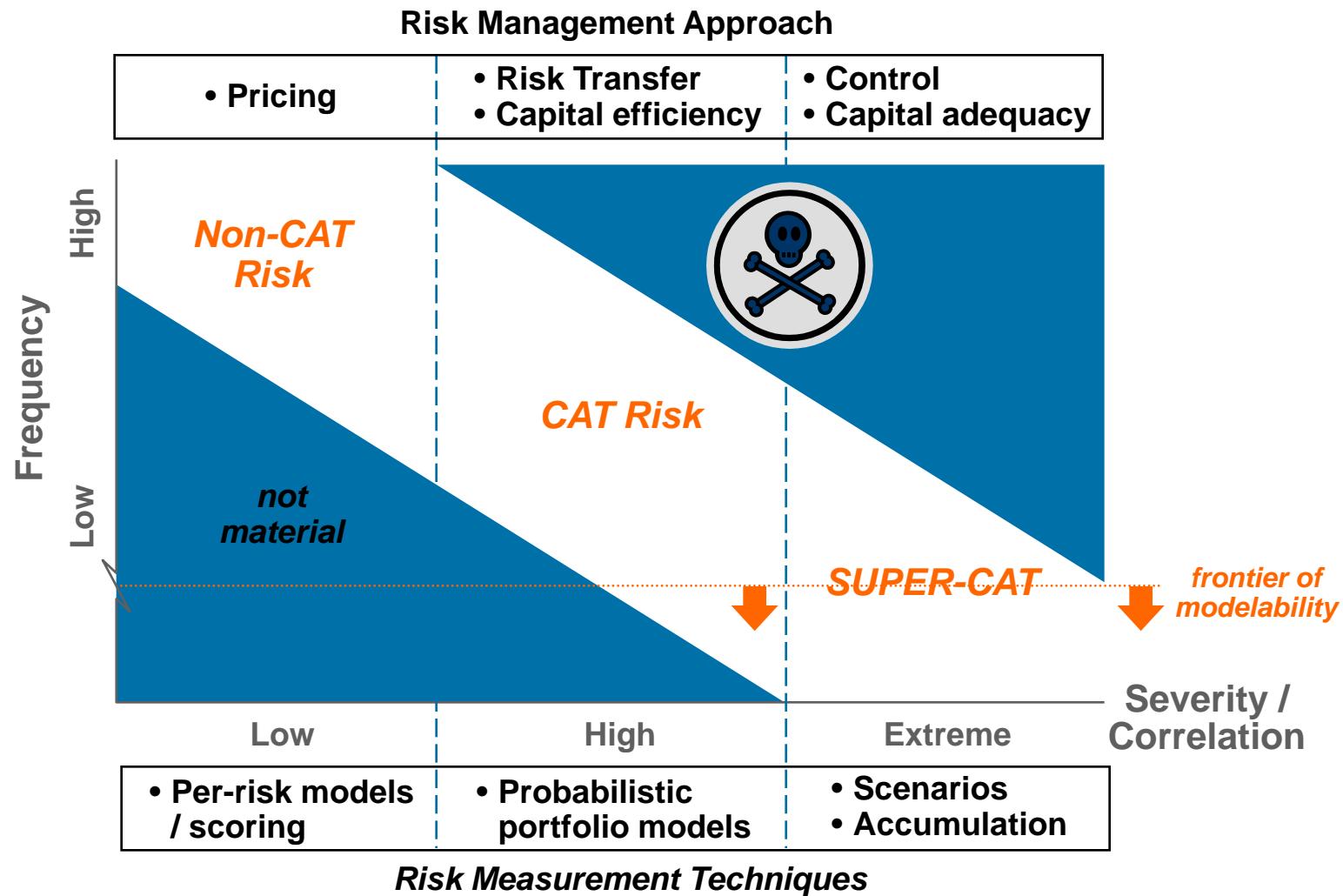
— Sir Josiah Stamp, Inland Revenue Department of England, 1896 - 1919

The More You Research, the More You Understand the True Uncertainty

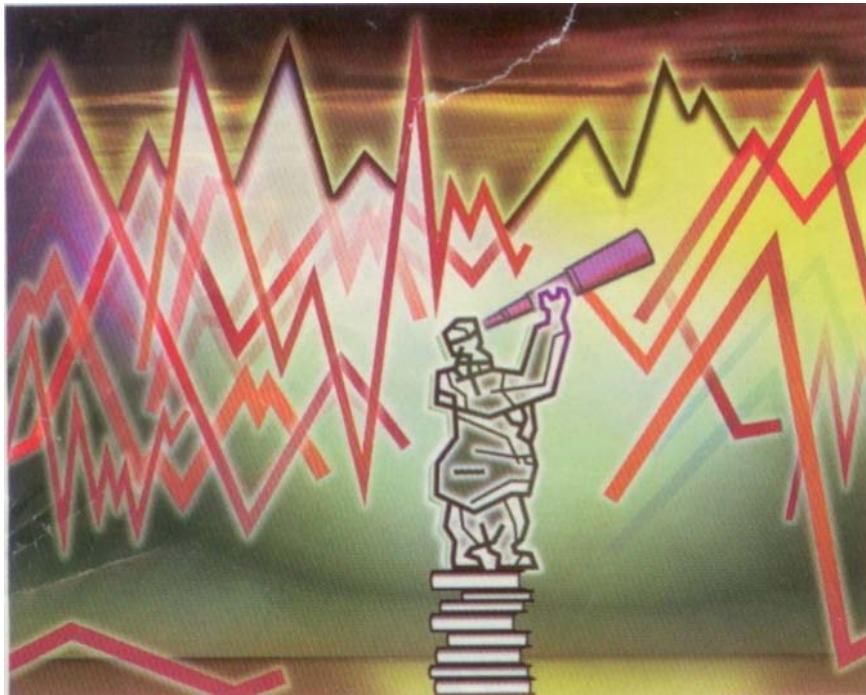


From: Reiter, L. and Allen, C. (2000). Geological issues in siting U.S. nuclear facilities. 31st International Geological Congress (Rio de Janeiro, 6-15 August 2000), Abstracts volume.

Decision Making Under “Deep” Uncertainty



"A New Fashion in Modeling"*



"The forecaster is like an entrepreneur. He uses quantitative methods, but also studies history, and relies on intuition and judgment. He is not a scientist."

- Roman Frydman,
Imperfect Knowledge
Economics, 2007

*The Economist, 2007

