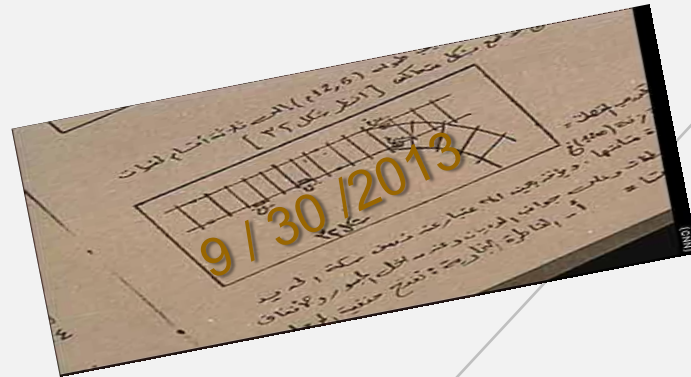



# COMPARATIVE RISK ASSESSMENT OF TERRORISM AND NATURAL HAZARDS

Dr. Gordon Woo

CAS In Focus:  
Elephants in the room  
Chicago

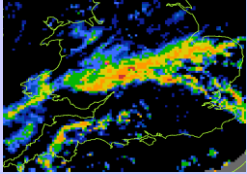




# TERRORISM MODELING: FREQUENCY

# Building blocks of a flood model

Stochastic



Define events

Hazard



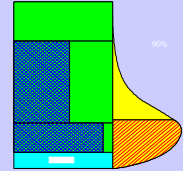
Assess flood footprint

Vulnerability



Calculate damage

Financial



Quantify Loss

Exposure & geocoding



**Thames flood  
level markers  
at Trinity  
Hospital,  
Greenwich,  
London**

**Next flood  
marker might  
be around  
1983?**

# Thames Barrier flood protection



Completed in October 1982, the Thames Barrier has been closed on average about four times per year to protect London from flooding.

# What if the Thames Barrier failed?

Special effects were used to predict how London could look if the Thames barrier was overwhelmed by a surge of water.



**Keith Weston**

**Police International  
Counter Terrorism Unit**

# UK government funding for river flood protection

The UK government announced in November 2012 £120m of funding for river flood defences.

It is estimated that the money, will improve flood protection for up to 60,000 homes.



Funding for flood protection underlies a deal **[FloodRe]** with the UK insurance industry to cap the amount which most flood-risk householders would be charged for a home insurance policy.

# Western alliance denial to terrorists of plot resources

- Safe havens for training and weapon development
- Secure communications and meeting places
- Finance for operational funding
- Materiel for destructive attack modes

**Annual US expenditure on security and intelligence  
~ \$ 100 billion >> annual expected economic loss**



# Prevailing deterministic view of history

Historical hazard experience is regarded as binary – a disaster either happened or it did not.

But what if the environmental circumstances had been somewhat different?

What was the chance of a disaster?



# Counterfactual disasters: resampling history

Disasters are complex functions of variables defining the state of the world at a given time. Changes in the input Environmental values perturb the output disaster consequences.

Each historical scenario corresponds to a specific realization of the input Environmental values. Perturbations to these values leads to alternative disaster scenarios.

$$D = f(E_1, E_2, E_3 \dots E_n)$$

# Aviation risk: accidents are rare, but near-misses are numerous

On Saturday, July 6, 2013, an Asiana Airlines Boeing 777 crash-landed at San Francisco International Airport, killing at least two passengers and injuring dozens more, many of them seriously.

This accident was the first multiple-fatality crash involving a major airline in North America since November 2001.



**Atlantic  
tropical  
storms:**

**Only a small  
proportion  
make landfall.**



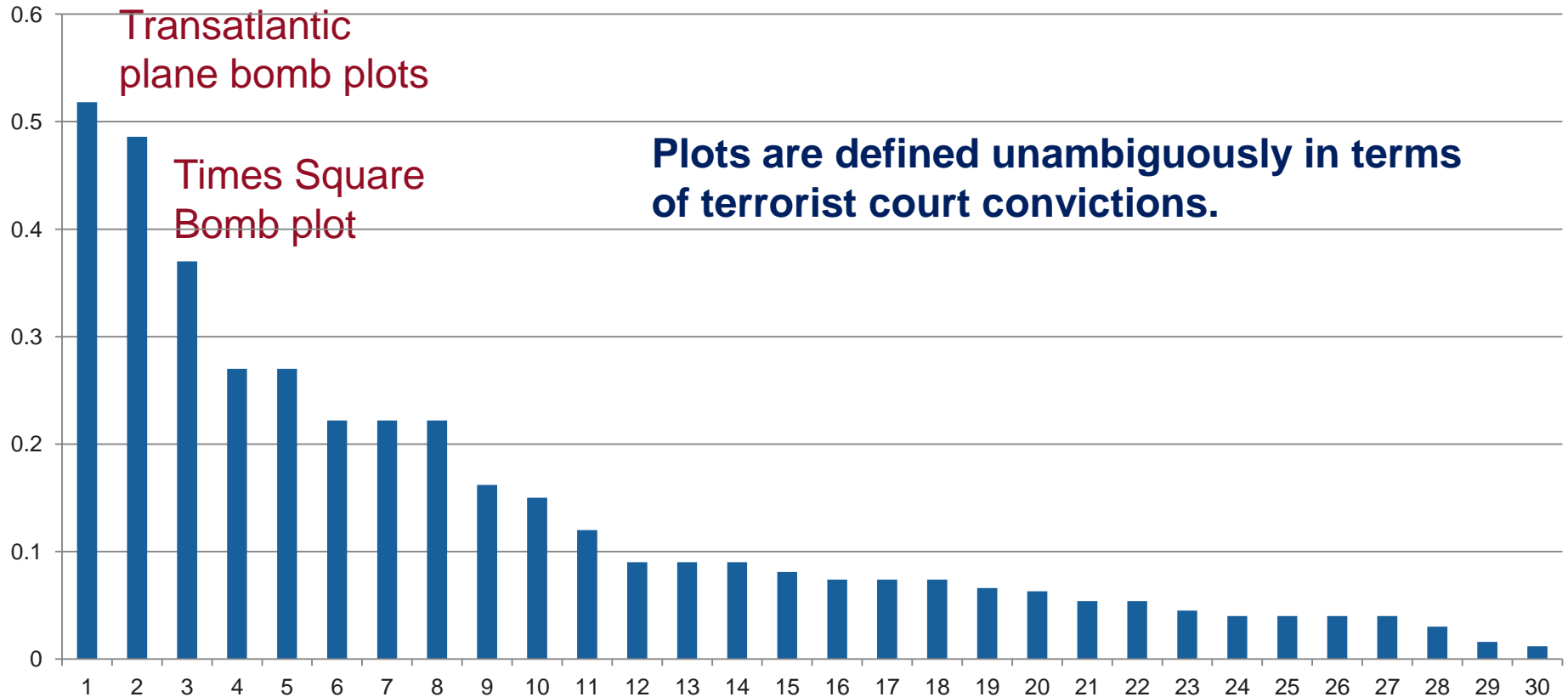
# The likelihood of plot interdiction



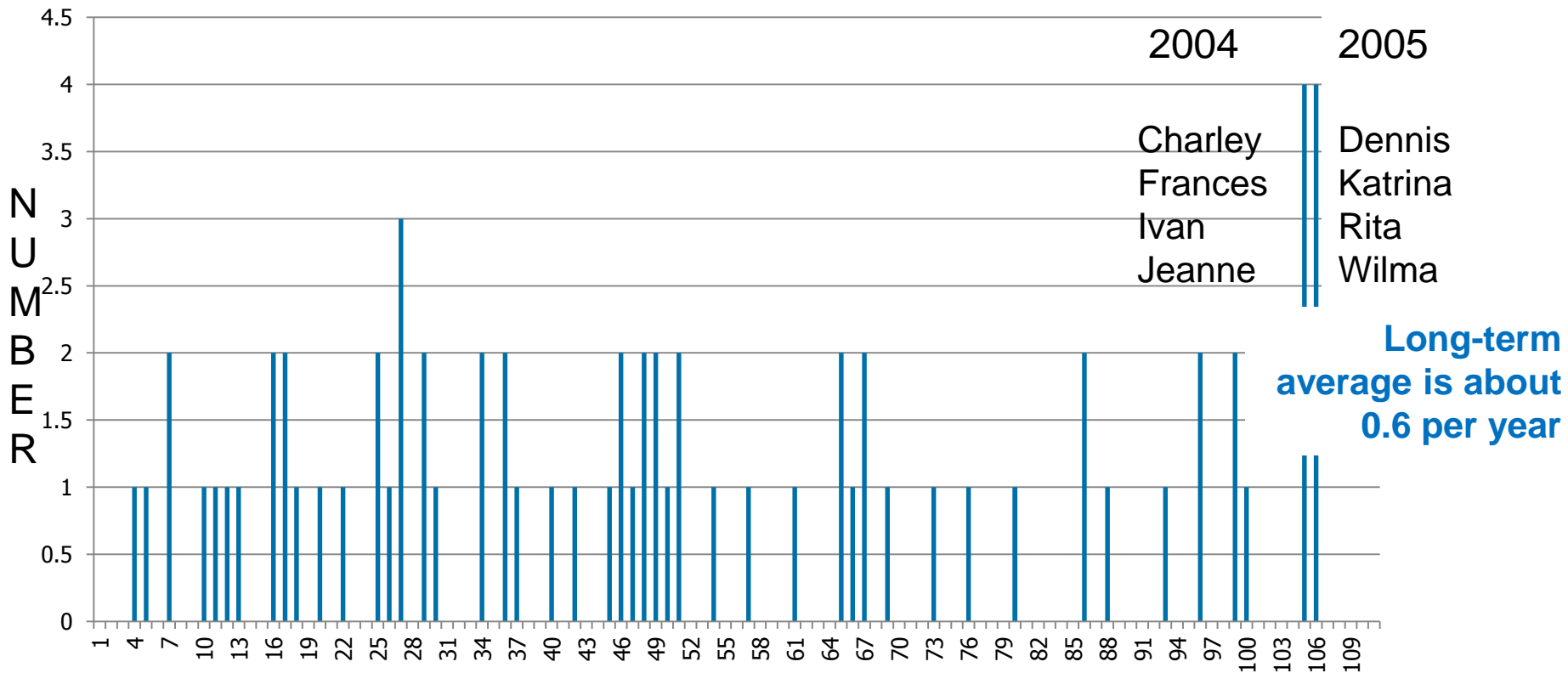
*‘Fighting terrorism is like being a goalkeeper. You can make a hundred brilliant saves but the only shot that people remember is the one that gets past you.’*

Prof. Paul Wilkinson  
Chairman, Centre for the Study of  
Terrorism and Political Violence, St. Andrews

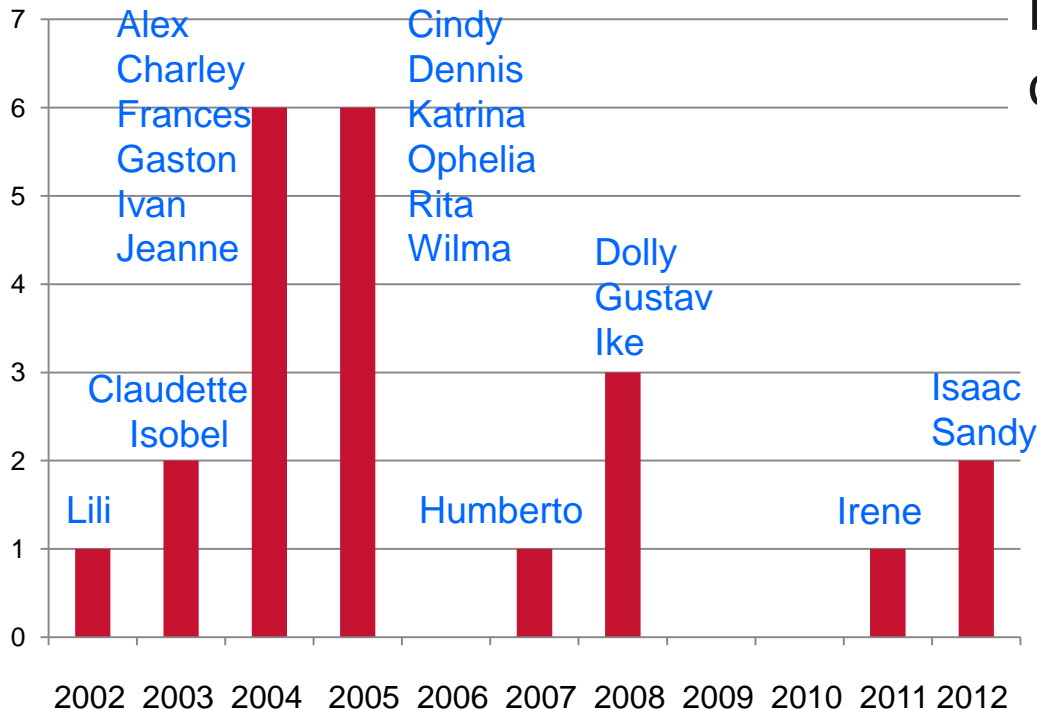
# Post-9/11 US plot success probabilities



# Annual frequency of Florida land-falling hurricanes since 1900



# US landfalling hurricane counts 2001-2012



Least spread error  
over 11 years is: **20**

which is **three** times  
the spread error of  
the terrorism  
frequency.



# TERRORISM MODELING: TARGETING

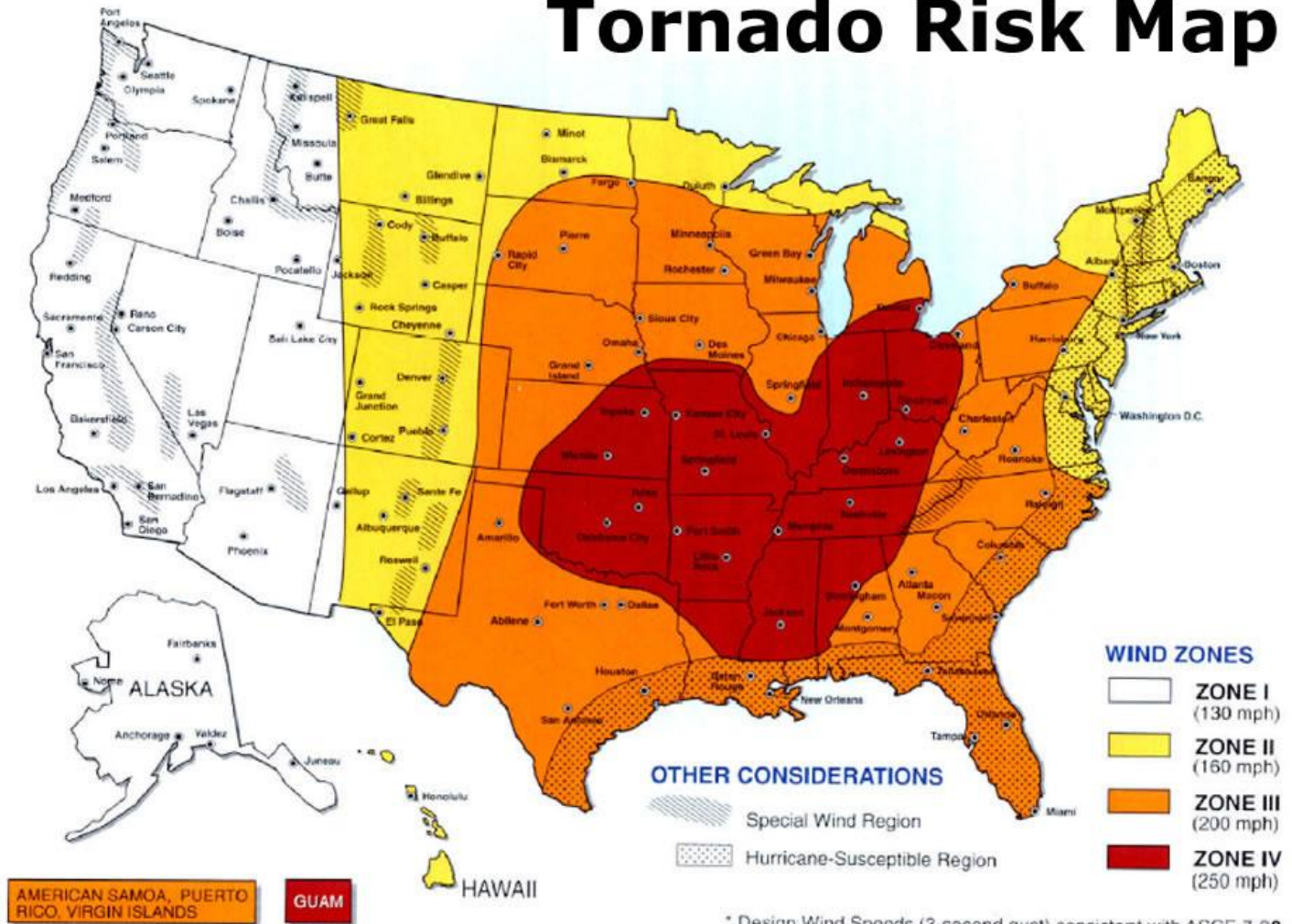


*'Al Qaeda wins over the Umma  
when we choose a target  
that it favors.'*

Dr. Ayman Al Zawahiri  
Knights Under the  
Prophet's Banner  
(December 2001)

# Tornado Risk Map

A large proportion of the USA is significantly exposed to tornado risk, which is spatially dispersed across many states.



\* Design Wind Speeds (3-second gust) consistent with ASCE 7-98



**The insured loss from the Moore, Oklahoma, EF 5 tornado of May 20, 2013 is likely to exceed the previous record of \$2.8 billion.**

# Insurability of US tornado risk

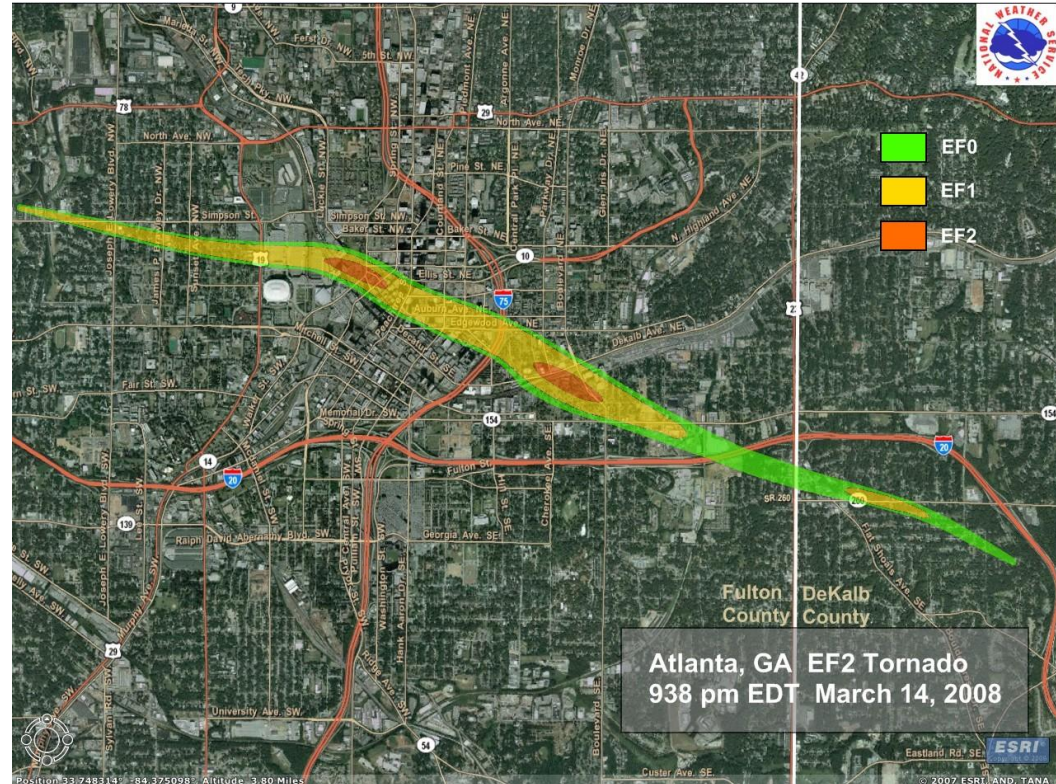
- Tornado risk is geographically highly diversifiable.
- Although not in the prime tornado hazard zone, properties in Atlanta do need tornado insurance.
- On March 14, 2008, for the first time since records began in 1800, an EF2 tornado struck downtown Atlanta.



# Indiscriminate nature of a tornado strike

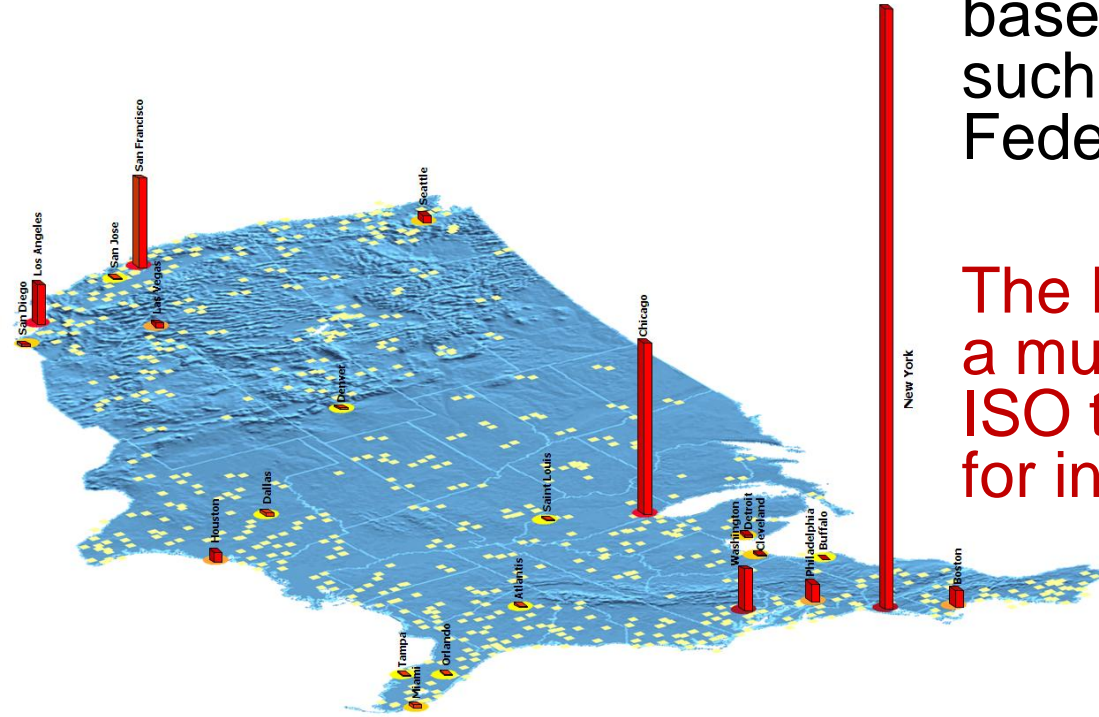
When a tornado approaches a city, all the buildings in its path are endangered.

The path through the city may be narrow, but is random, so the tornado hazard is uniform and does **not** target specific individual buildings.



The 2002 RMS model challenged the 'population-based' assessments of risk, such as those used to distribute Federal funds.

The RMS model contrasted with a much flatter gradient of the ISO terrorism rating by zip code for insurance.

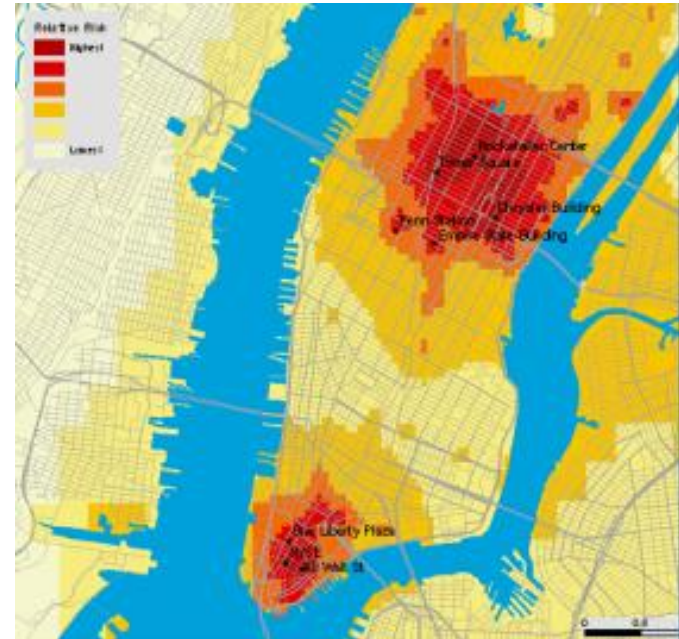


The heartland theory suggested that terrorists might concentrate their attacks in small towns, so that no American could feel safe.

# Concentrating force at crucial points

*'It's been said that when you find a terrorist, he'll have a map of New York City in his back pocket.'*

*Mayor Bloomberg  
(following Times Square bomb plot  
of May 1, 2010)*



Dzhokhar Tsarnaev told the FBI that he and his brother had intended to drive to New York and detonate additional explosives in Times Square.

# Precise terrorist targeting of high-value properties

- With the centers of the principal US cities being the prime focus of terrorism, there is a heavy concentration of exposure at risk that is only weakly diversifiable across the country.
- Commercial insurers cannot build a significant book of business without including a high proportion of exposures in these areas.
- This leads to substantial adverse selection: the strongest demand for terrorism insurance comes from the principal cities.



# Target substitution



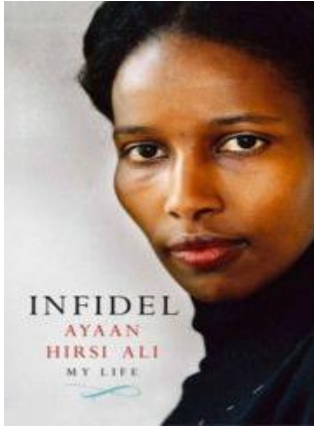
If two targets are equally attractive, terrorists will tend to attack that which has worse security.

*'Terrorists are also becoming more operationally adept and more technically sophisticated in order to defeat counter-terrorism measures.'*

*For example, as we have increased security around government and military facilities, terrorists are seeking out softer targets that provide opportunities for mass casualties.'*

*George Tenet, Director CIA, February 7, 2001*

# Target substitution in Amsterdam



Ayaan Hirsi Ali,  
ex-Muslim,  
was under  
police protection.



On November 2, 2004, Bouyeri, a Moroccan-Dutchman, assassinated Theo van Gogh, the maker of the film 'submission', who was a soft target.

# Target substitution in New York

On October 17, 2012, Quazi Nafis, a 21-year-old Bangladeshi, attempted to set off a 1,000 bomb outside the Federal Reserve Bank, after originally intending to strike Wall Street.



Liberty Street, NY



Wall Street, NY