Use of Terrorism Catastrophe Risk Modeling to Manage Terrorism Exposure in the Insurance Industry

Terrorism Risk Analysis Symposium

University of Southern California

January 15, 2005

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AIR Worldwide Corporation

www.air-worldwide.com

BETTER TECHNOLOGY
BETTER DATA
BETTER DECISIONS

AIR

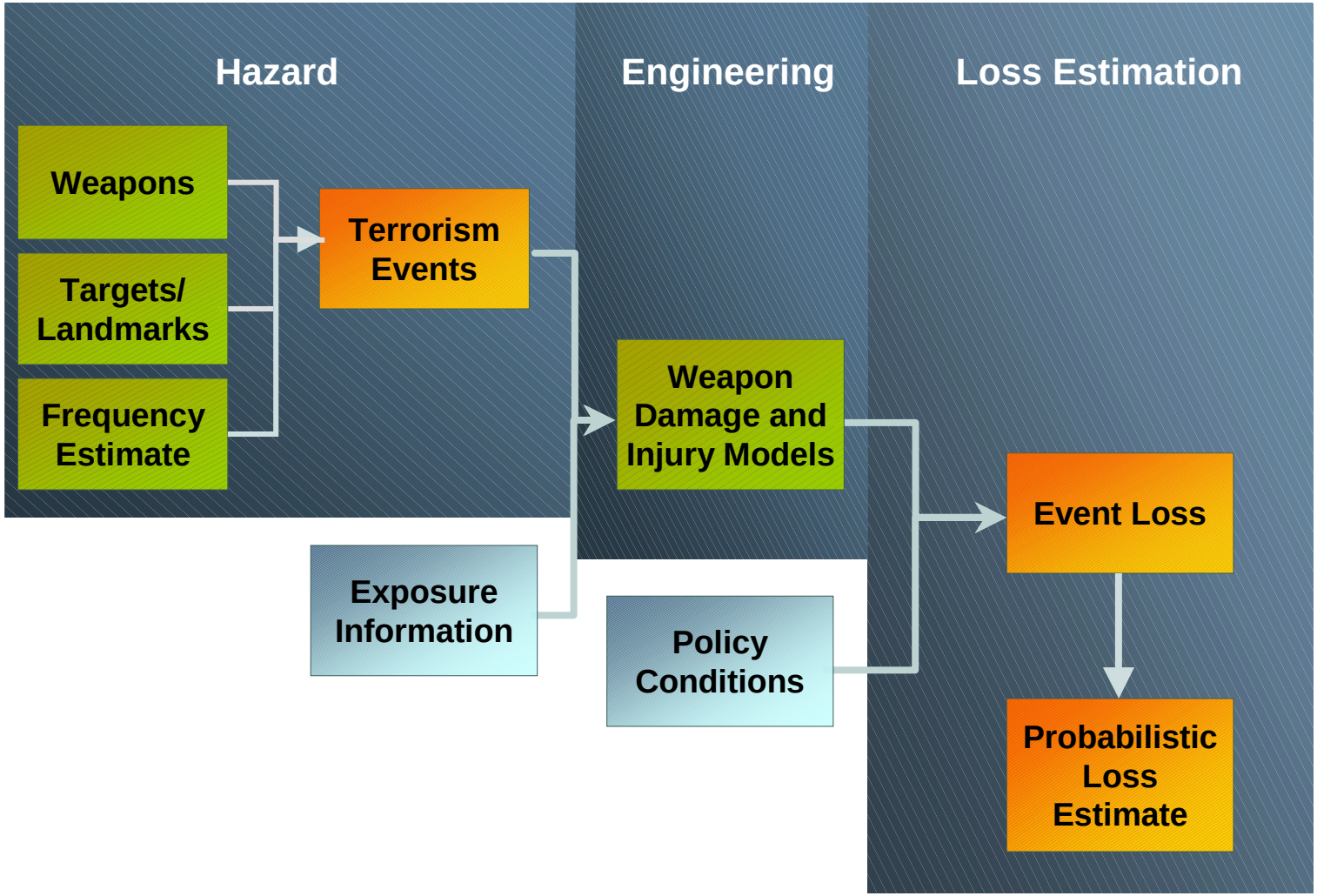
AIR Timeline

- Founded in 1987
- Pioneered “probabilistic” catastrophe modeling technology
- Accurate real time loss estimates for Hurricane Andrew (1992) solidified industry use of catastrophe modeling
- AIR Terrorism Loss Estimation Model released in September 2002

Purpose of AIR Terrorism Modeling

- Evaluate the risk quantitatively
- Obtain more complete picture of extreme event risk
- Respond to Terrorism Risk Insurance Act (TRIA) mandate to offer coverage
  - Identify loss costs by business lines and policy or property
    - Average cost per $100 value by ZIP or other area
  - ISO advisory loss cost filings based on credible modeling
    - Approved for use in all of the states
- Establish underwriting guidelines to offer profitable coverage while controlling risk
- Provide better understanding of reinsurance needs
- Demonstrate sound risk management practices to rating agencies
- Support homeland security risk management quantification

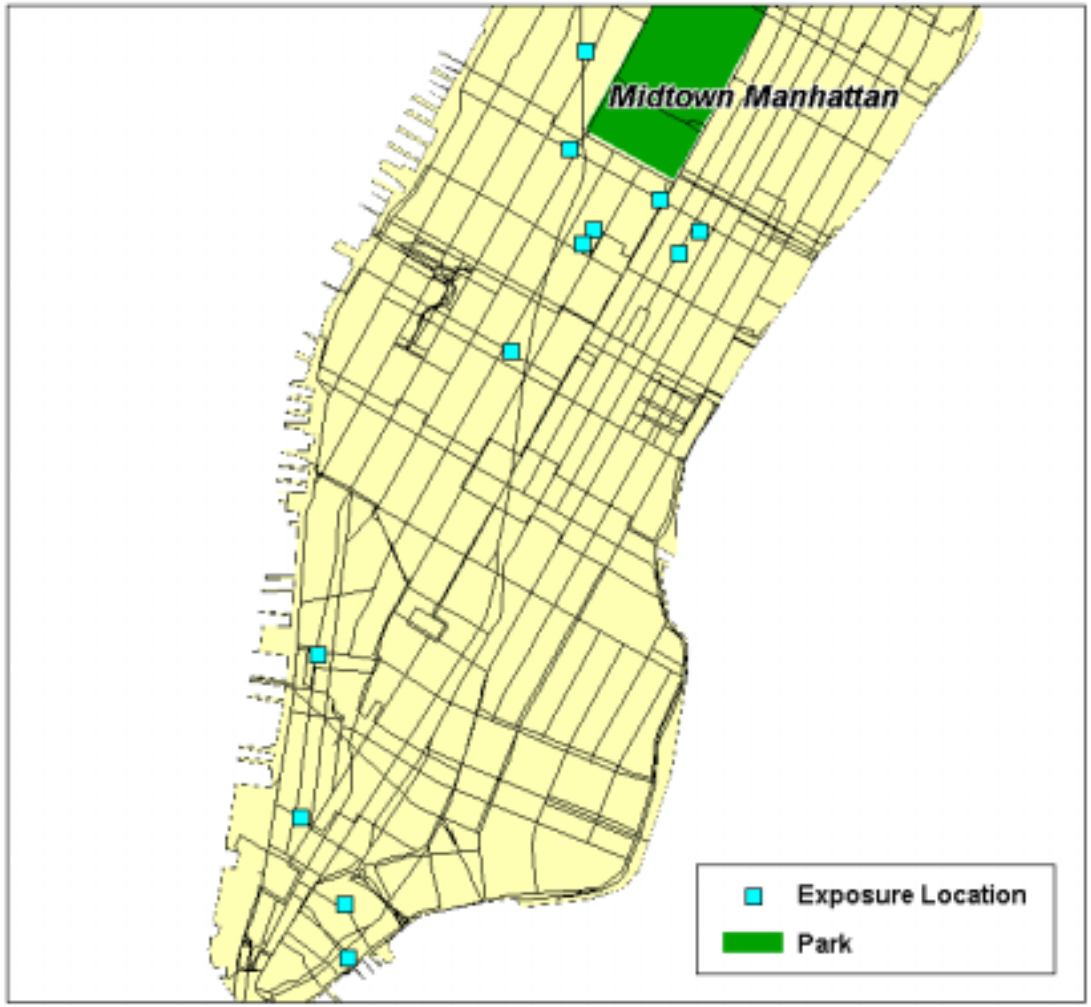
Terrorism Model Components



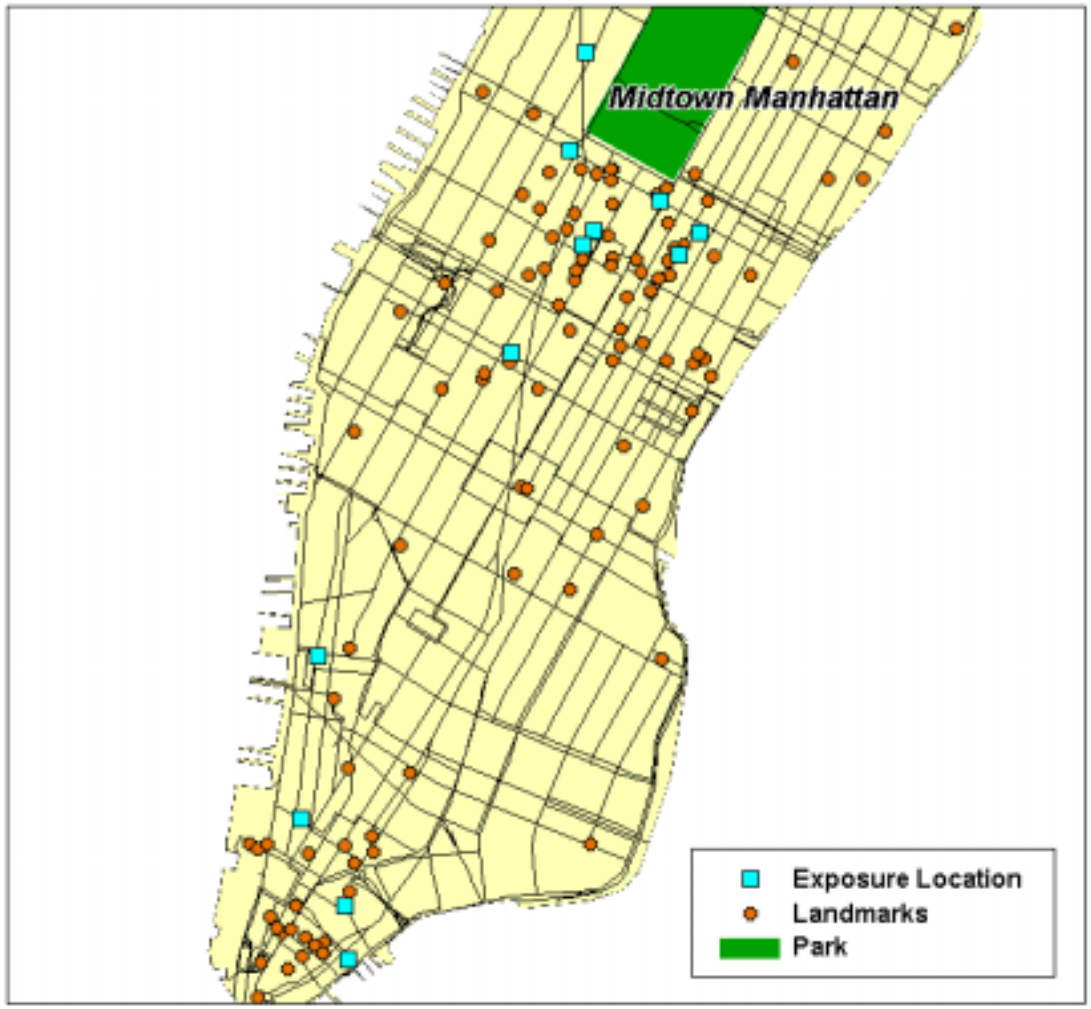
Loss Estimates Made for Specific Event Scenarios

- Scenario
  - Targets high-profile U.S. bank headquarters in Chicago
  - Van loaded with explosives
    - Oklahoma City - type
- Modeled losses
  - $1.9 billion property
  - $450 million workers' compensation

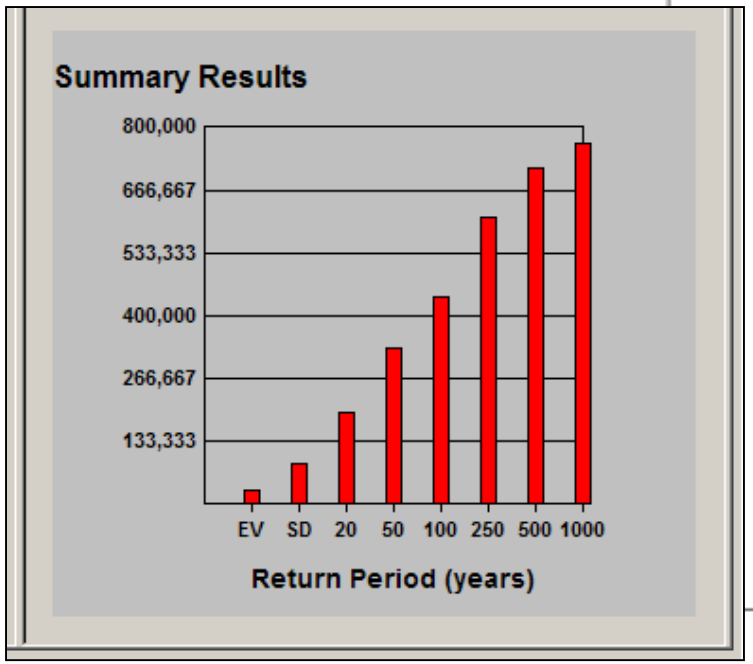
Sample Exposure Portfolio

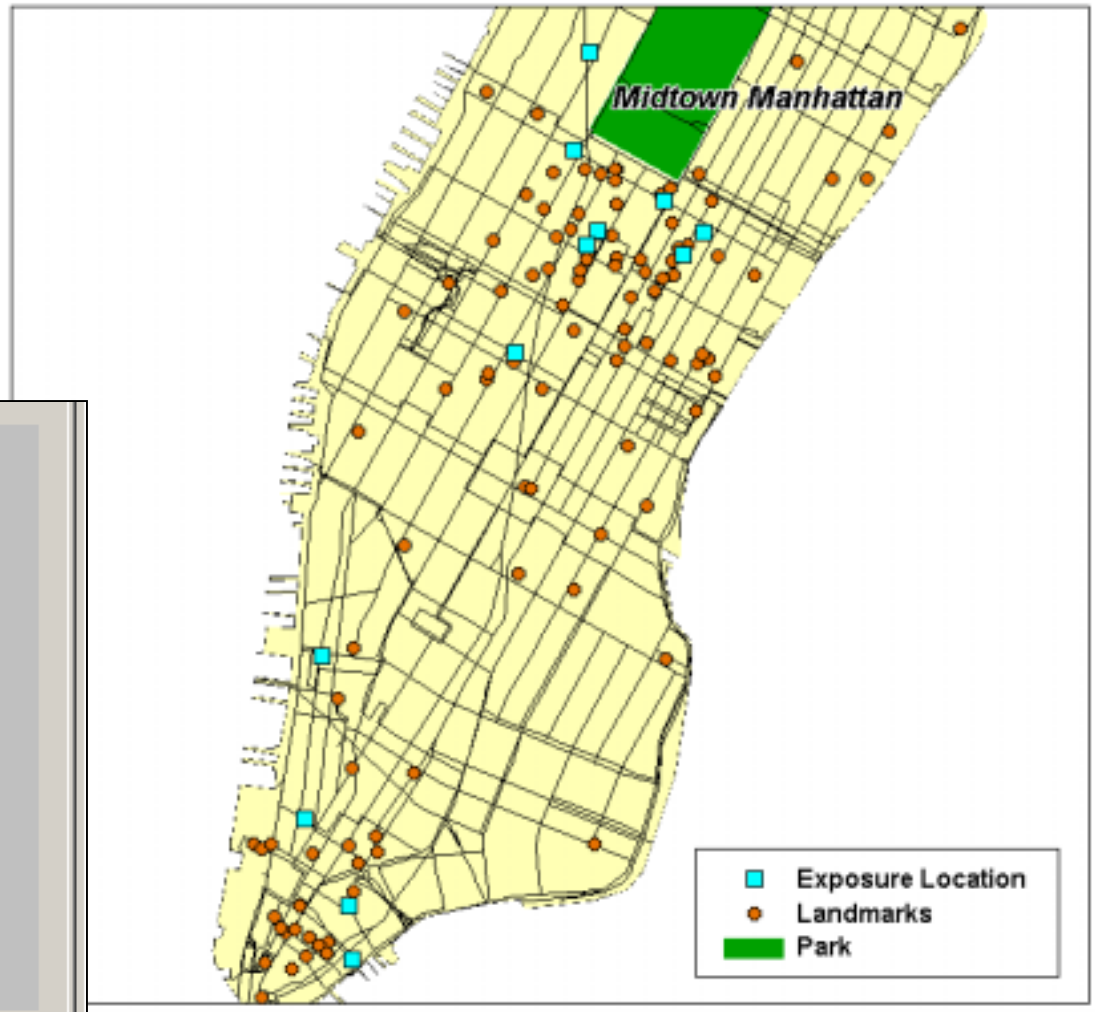


Analysis Conducted For Events At Each Landmark

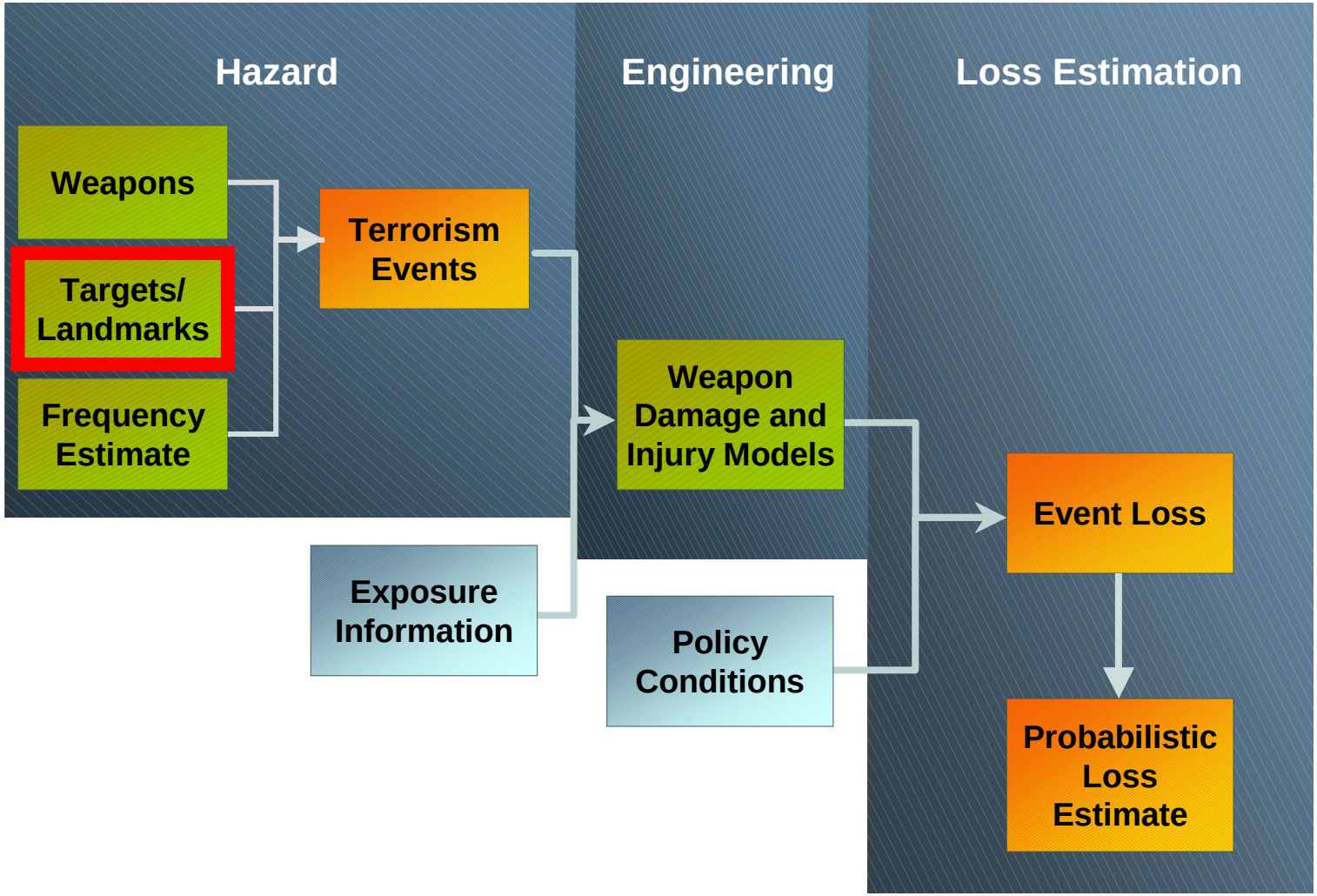


Probability of Loss Curve Results





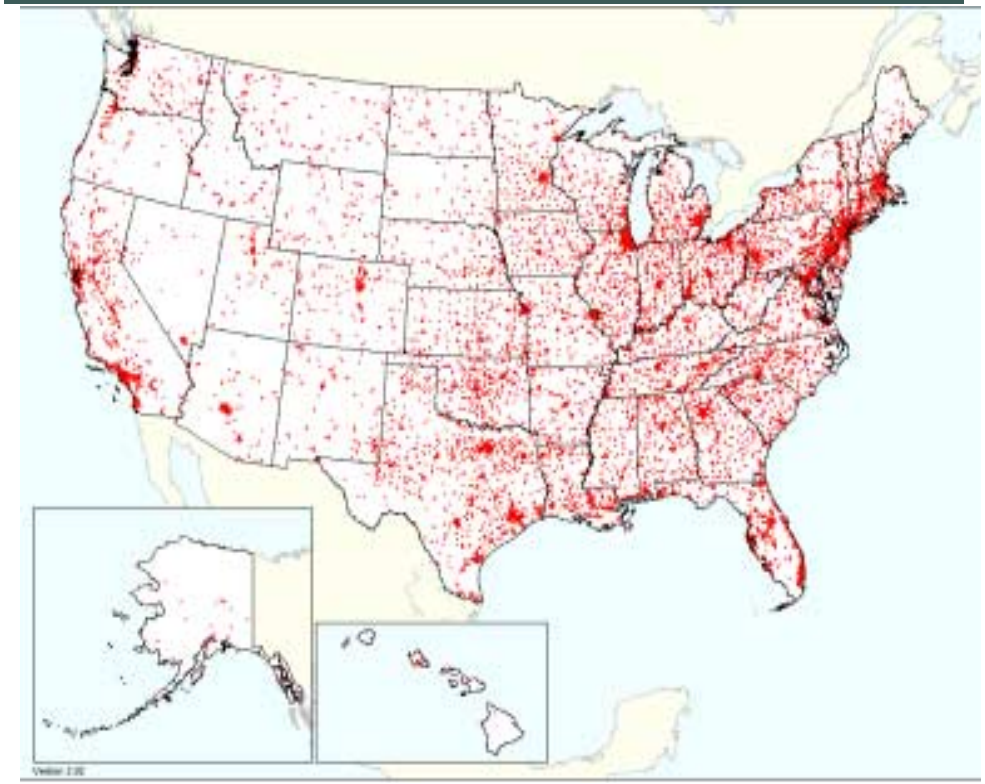
Terrorism Model Components



AIR Models Possible Future Attacks Where They Could Occur

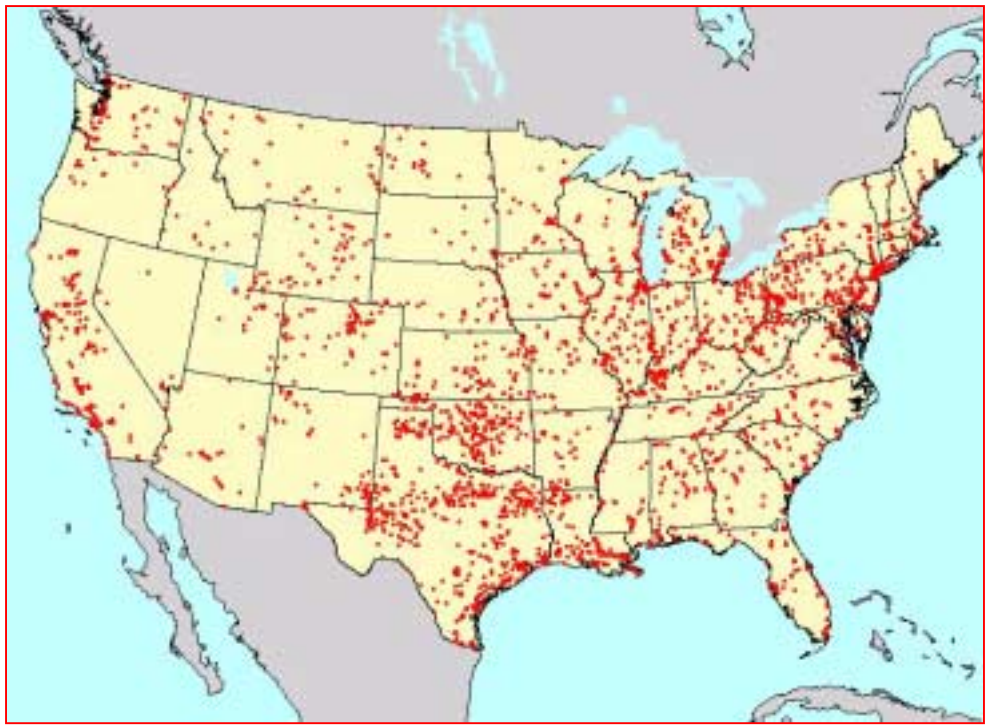
- Commercial facilities
  - Prominent buildings
  - Corporate headquarters
  - Transportation
    - Airports
    - Rail; Bus
    - Bridges; Ports
  - Chemical plants
  - Energy facilities
  - Retail centers and malls
  - Hotels and casinos
  - Amusement parks and sports venues
- Government facilities
  - Federal office buildings and courthouses
  - Embassies
  - State capitols
- Educational, medical, and religious institutions, etc.

Comprehensive Set of Possible Targets



Example: the Energy Sector

- Refineries
- Nuclear power plants
- Tank farms
- Natural gas production plants
- Natural gas compressor stations
- Fossil-based electric power plants



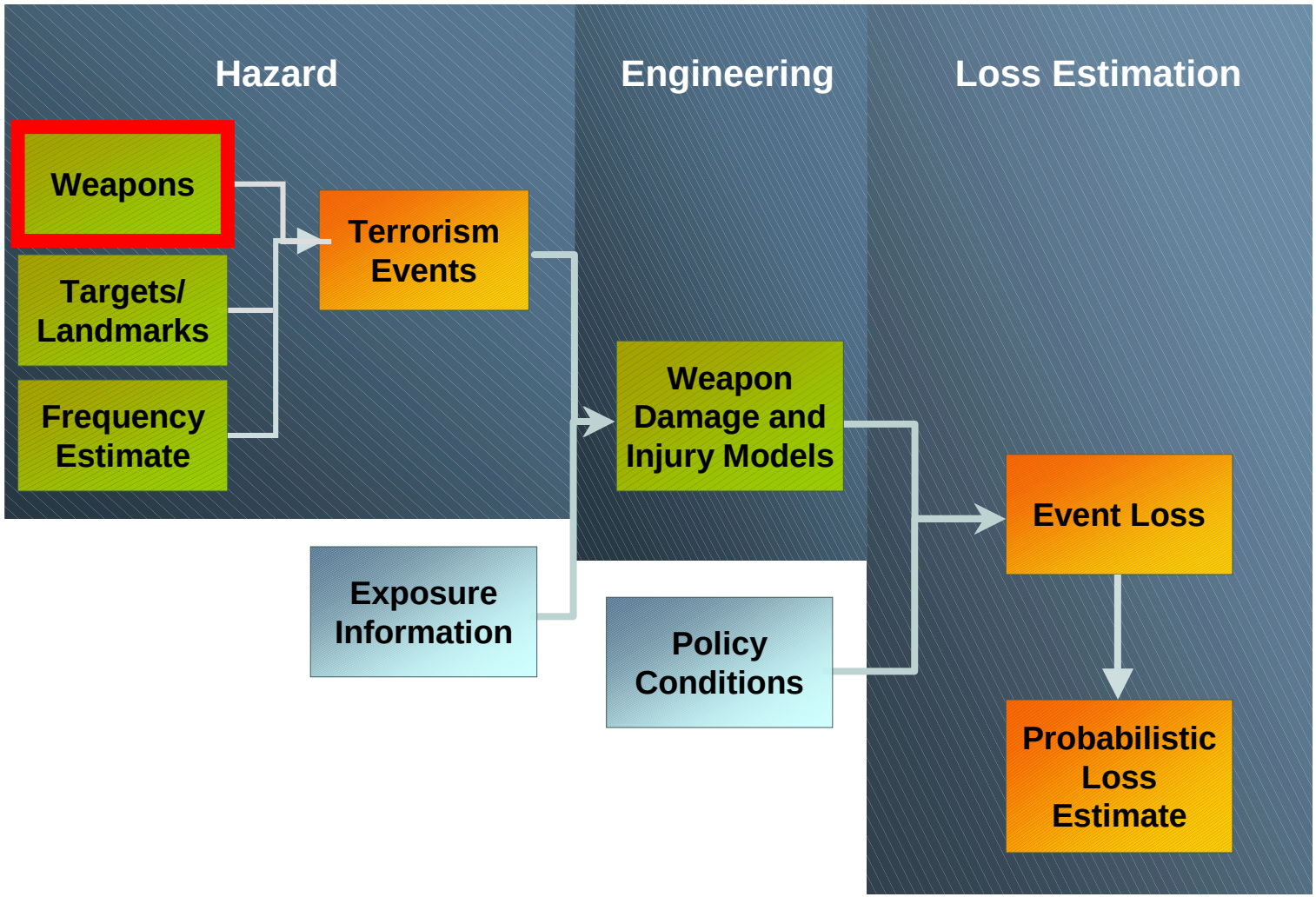
Consistent with Homeland Security Department –
Critical Infrastructures and Key Assets

- **Critical Infrastructures**
  - Agriculture and Food
  - Water
  - Public Health
  - Emergency Services
  - Defense Industrial Base
  - Telecommunications
  - Energy
  - Transportation
  - Banking and Finance
  - Chemicals and Hazardous Materials
  - Postal and Shipping

- **Key Assets**
  - National Monuments and Icons
  - Nuclear Power Plants
  - Dams
  - Government Facilities
  - Commercial Key Assets
    - Commercial Centers
    - Office Buildings
    - Sports Stadiums
    - Theme Parks
    - Other Commercial and Recreational Sites

The National Strategy for the Physical Protection of Critical Infrastructures and Key Assets February 2003

Terrorism Model Components



Types of Attacks Modeled by AIR

CONVENTIONAL

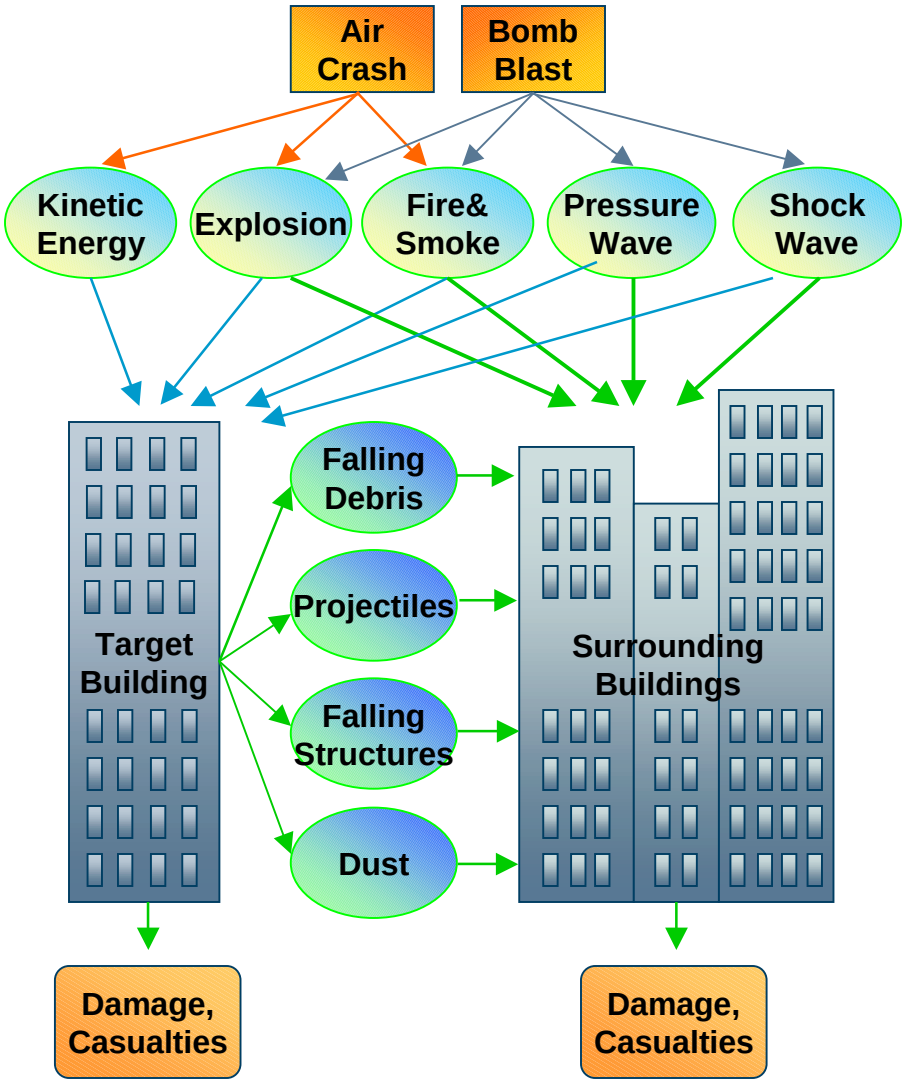
- Bombs
  - Portable
  - Car
  - Van
  - Delivery Truck
  - Large Truck
- Airplane crash
  - General aviation
  - Large commercial airliner

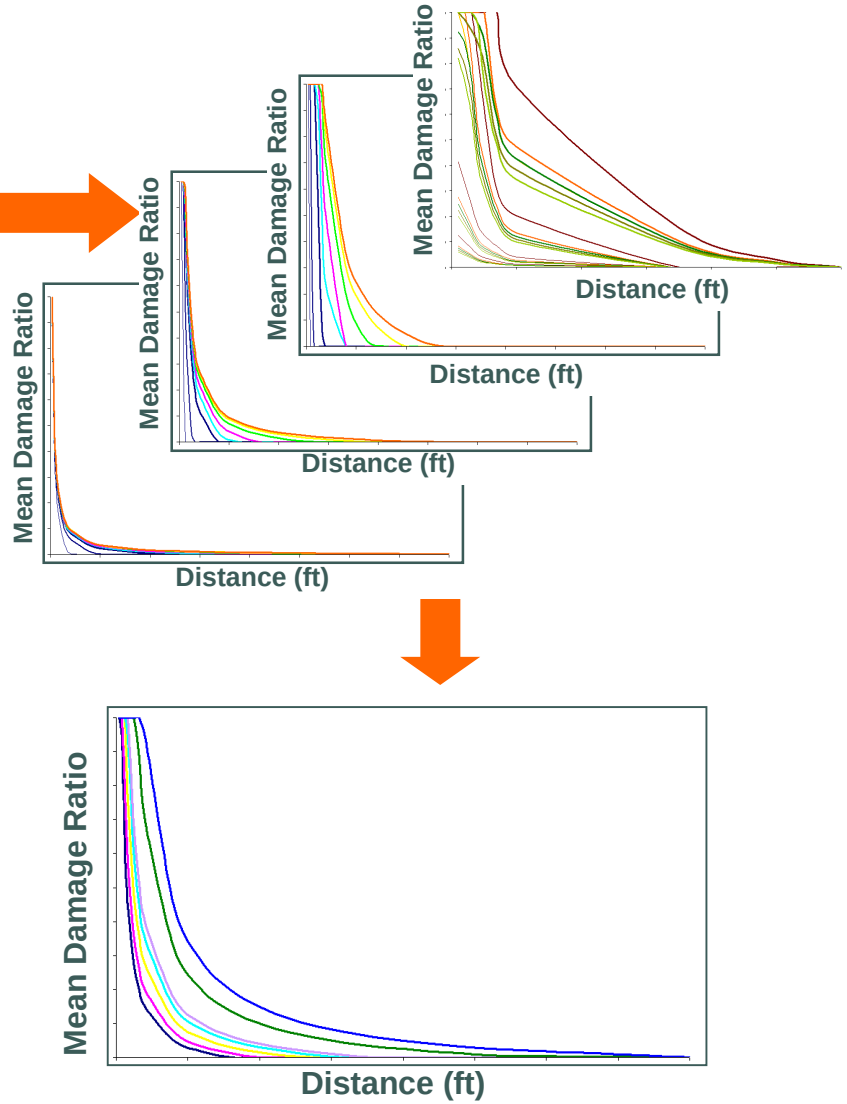
CBRN

- Chemical*
  - Sarin (GB)
  - VX Nerve
- Biological*
  - Anthrax
  - Small pox
- Radiological
  - Cesium 137
  - Cobalt 60
- Nuclear
  - Suitcase type
  - Medium
  - Large

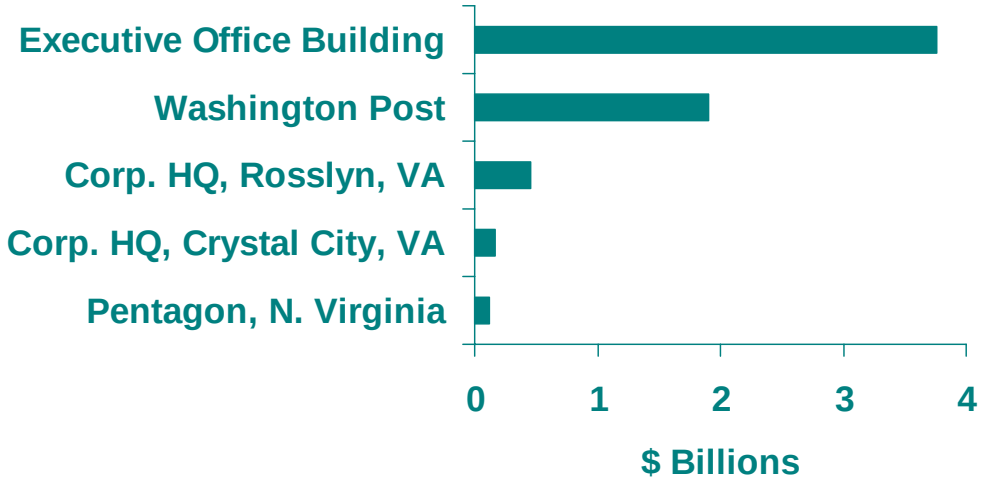
* Includes small, medium, and large

Conventional Damage Estimates Consider Multiple Effects on the Target and Surrounding Buildings



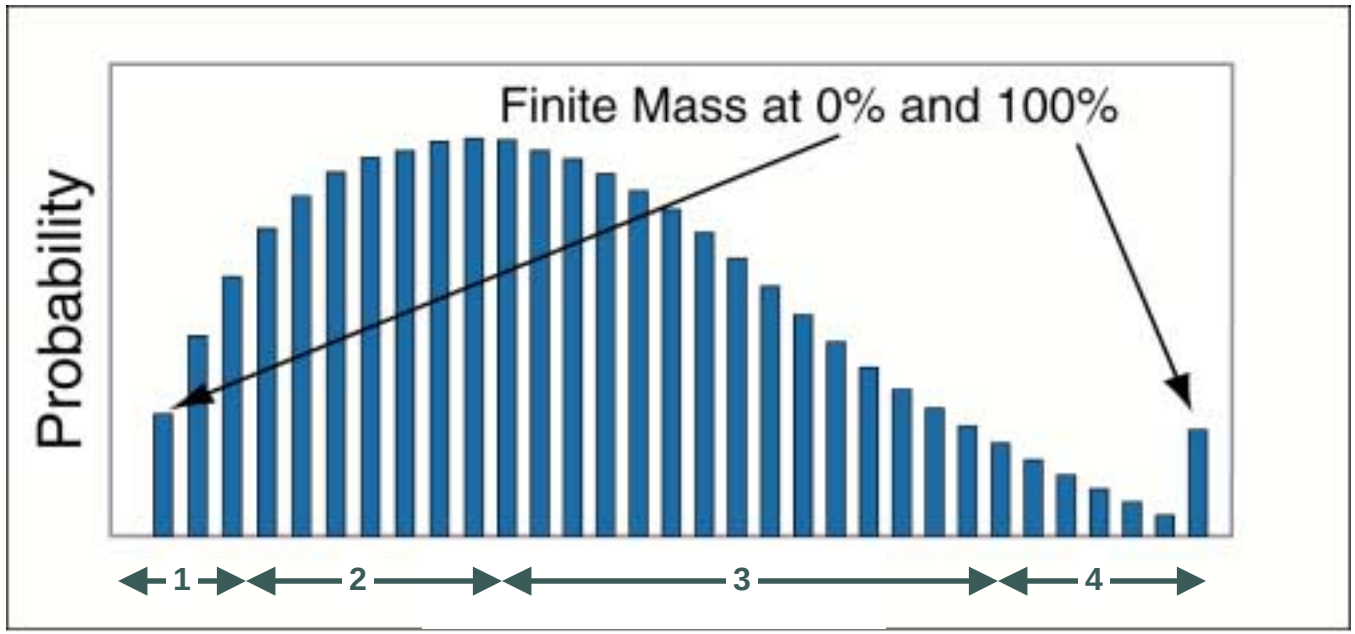


Exposure Density Strongly Influences Commercial Property Losses



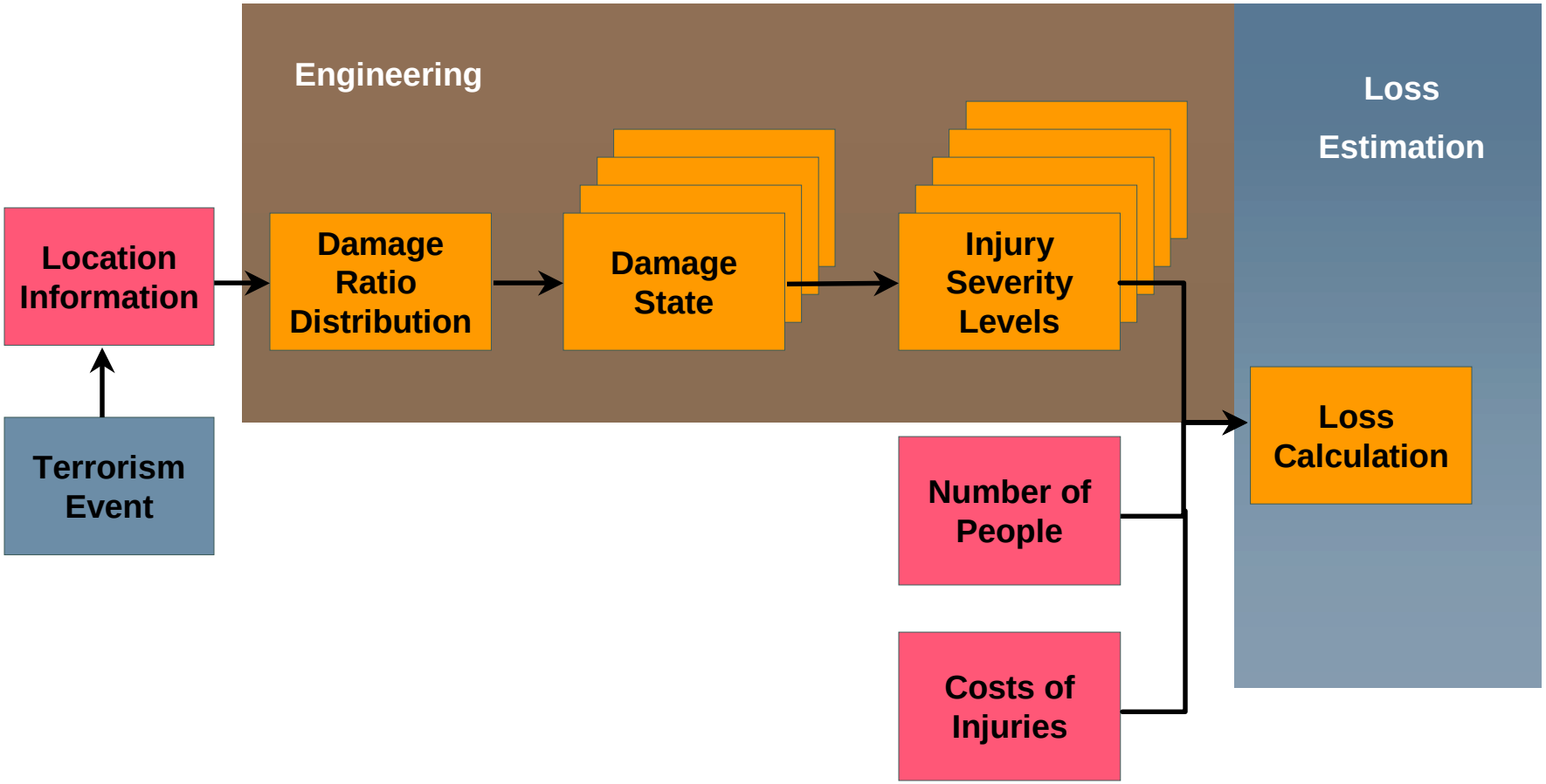
Scenario: Large Truck Bomb
Placed in Washington DC vs. Northern Virginia Area

Building Physical Damage Distribution Mapped to Damage States



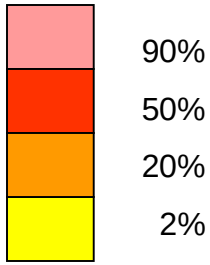
1 - Slight Damage
2 - Moderate Damage
3 - Extensive Damage
4 - Complete Damage
- **collapse**
- **no collapse**

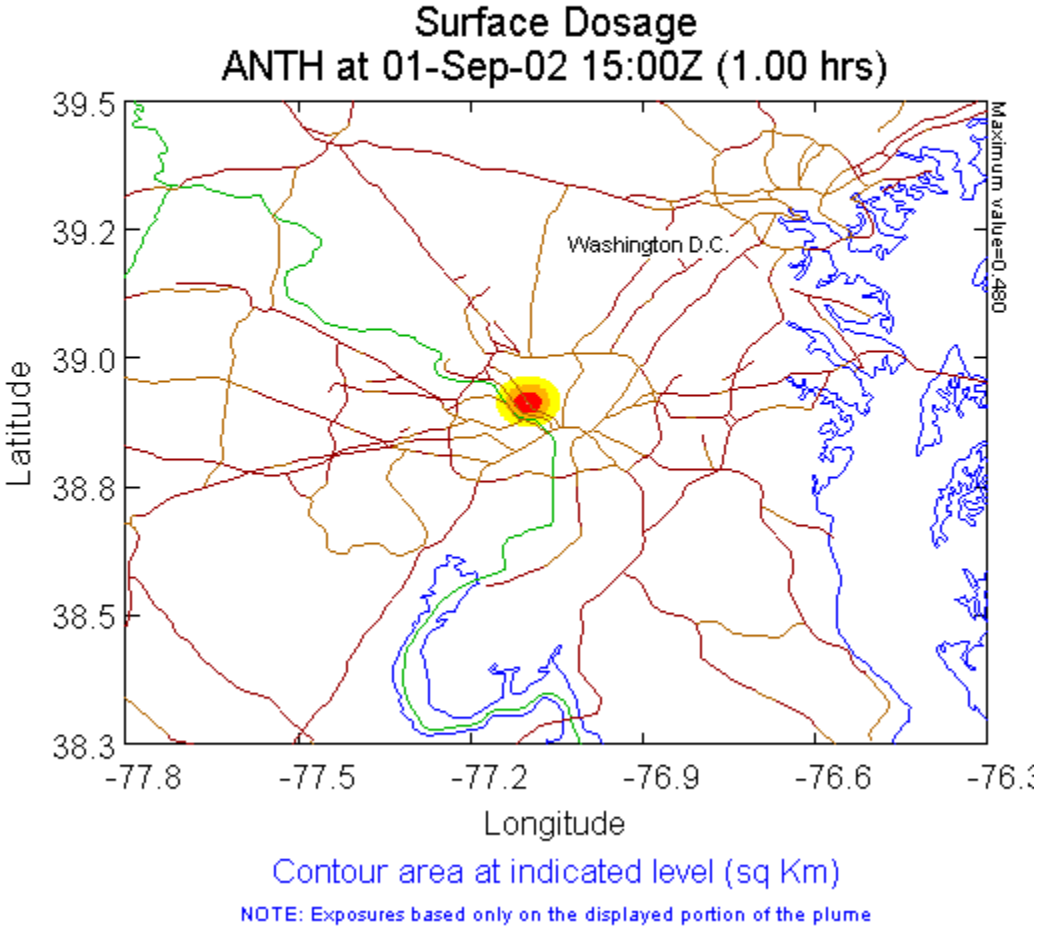
Components of AIR's Injuries and Fatalities Model -- Workers' Compensation, Life, Disability



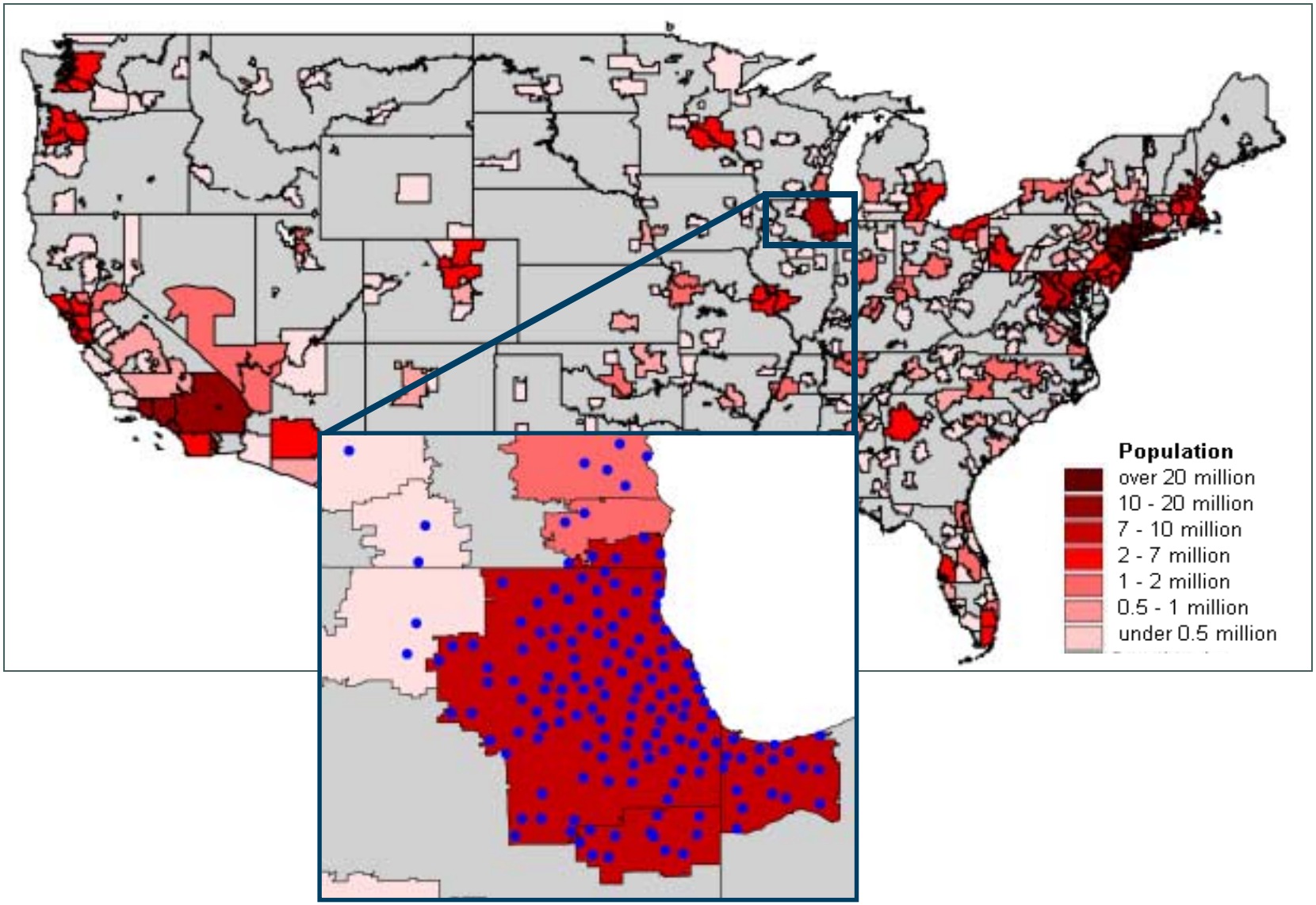
CBRN Events Modeled Using Department of Defense Standard Model

- Full spectrum of NBC weapons
- Accurately predicts the effects of hazardous material releases
  - Contamination
  - Injuries and fatalities
- Embedded climatology and historical weather data
- Terrain data and supporting wind-flow models calculate the local windfield

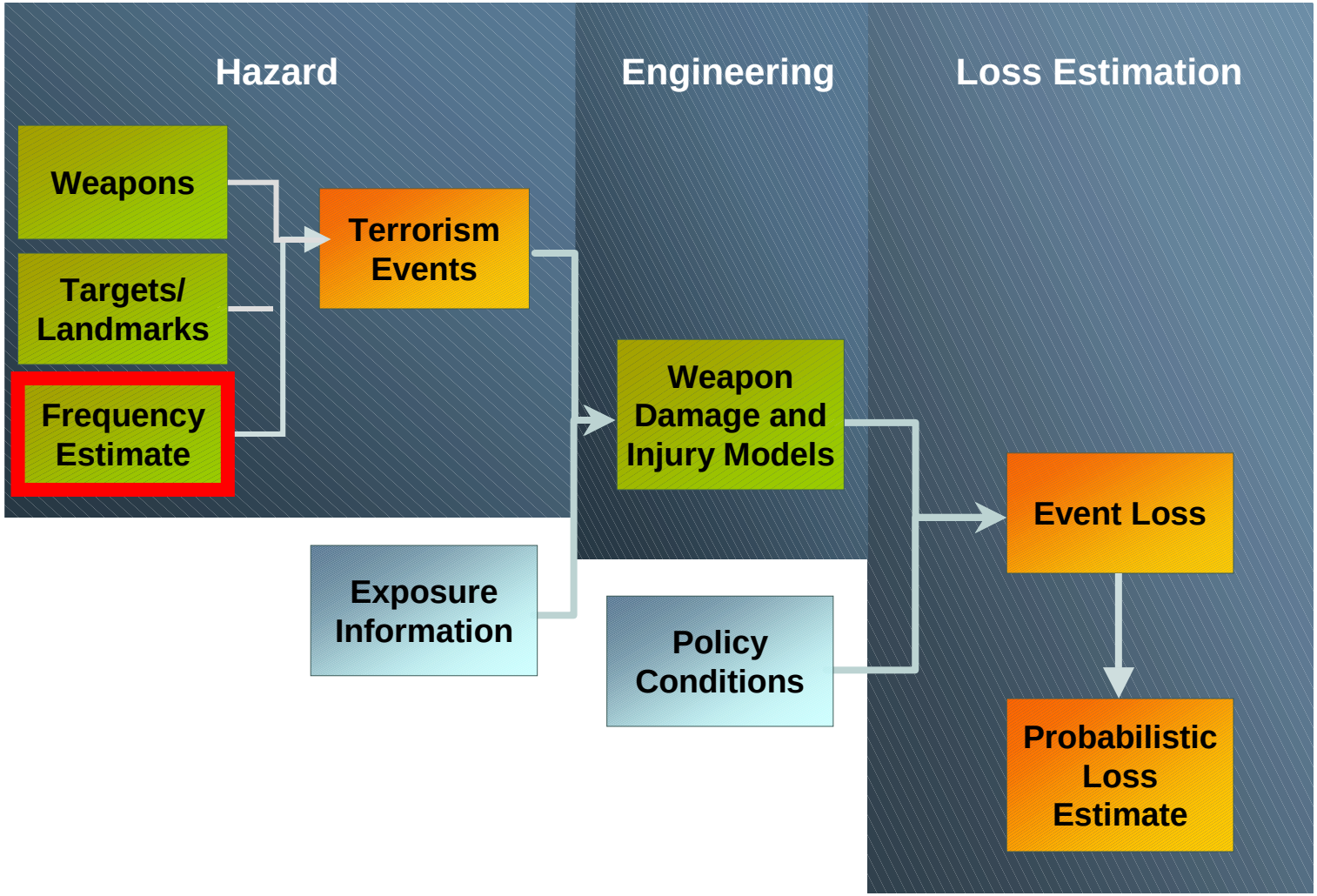




Distribution of Source Locations by CMSA/MSA



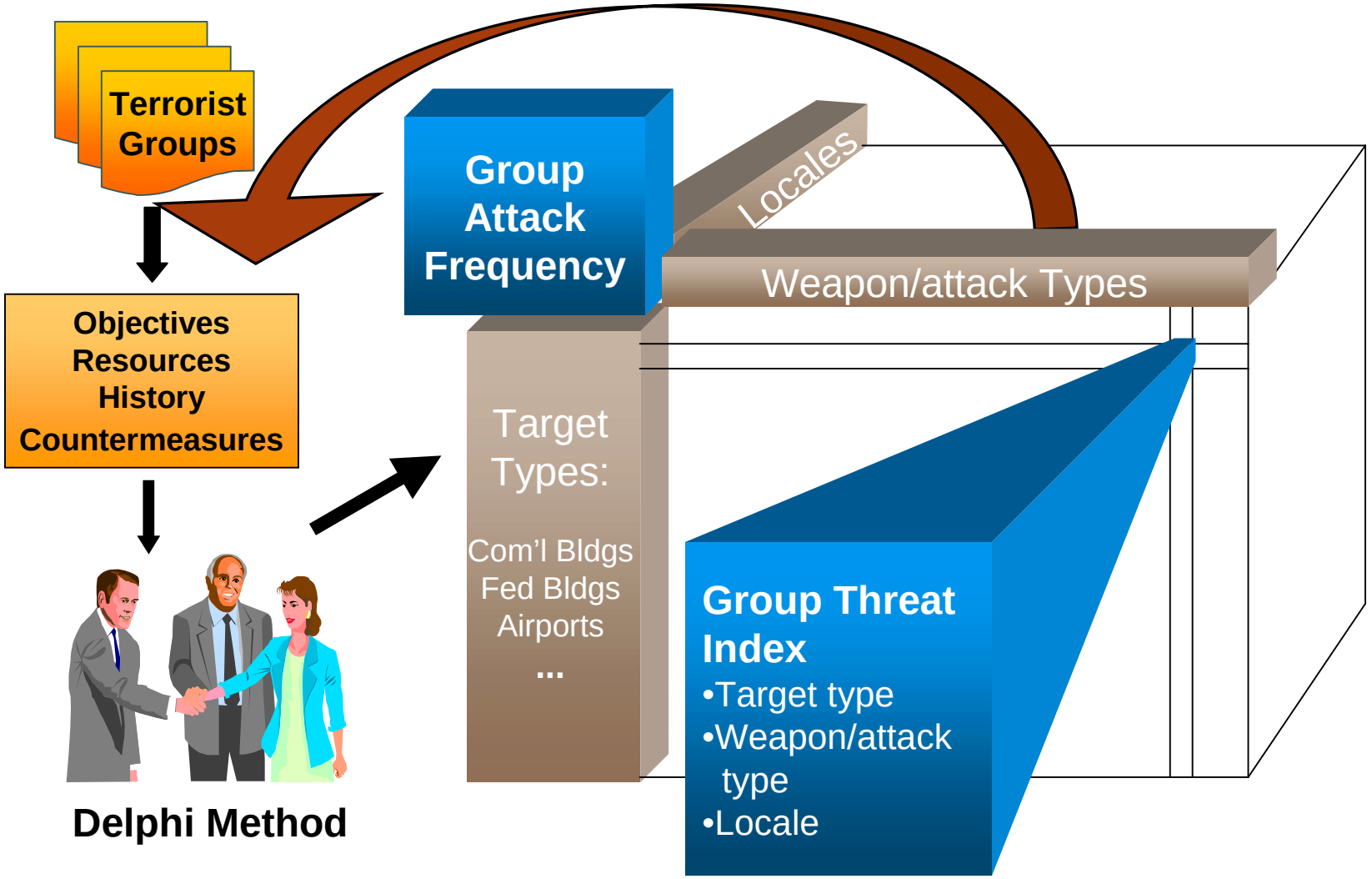
Terrorism Model Components



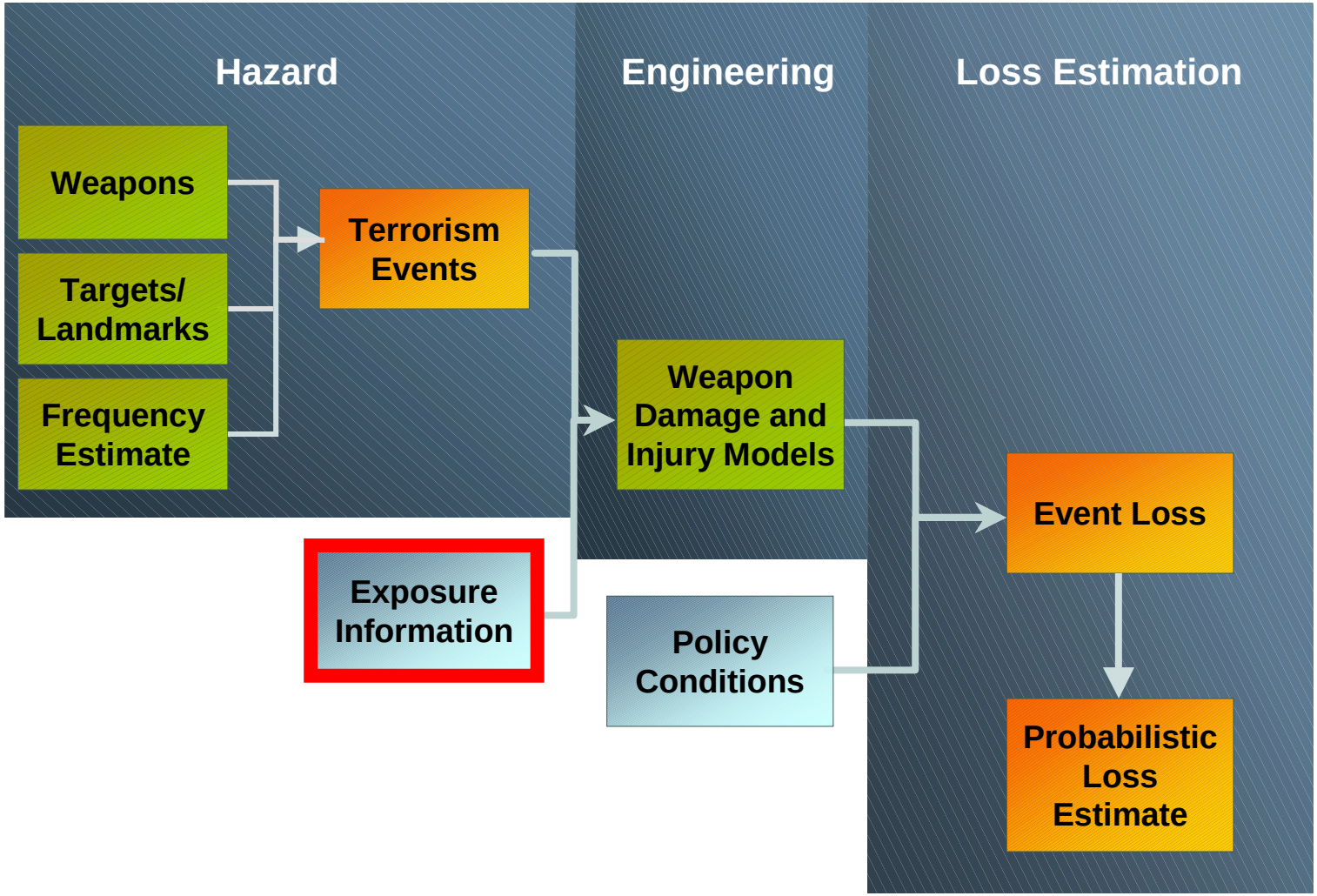
Frequency Estimates Based on Operational Assessment of Each Terrorist Group

- Objectives
  - Mass casualties?
  - Economic impact?
  - Symbolic?
  - Punish a group, industry, company, government?
- Capabilities and Resources
  - Weapon availability
  - CBRN efforts
  - Coordinated attacks
  - Manufacture vs. buy
  - Financial
  - Technical
  - Operational skills
- Deployment
  - Locales with presence
  - Financial vs. operational
  - Local target surveillance opportunity
  - Local support
- Historical attacks
  - Targets
  - Weapons
  - Locales
- Impact of Security
  - Federal
  - State
  - Local
  - Private

Frequency and Severity Update



Terrorism Model Components



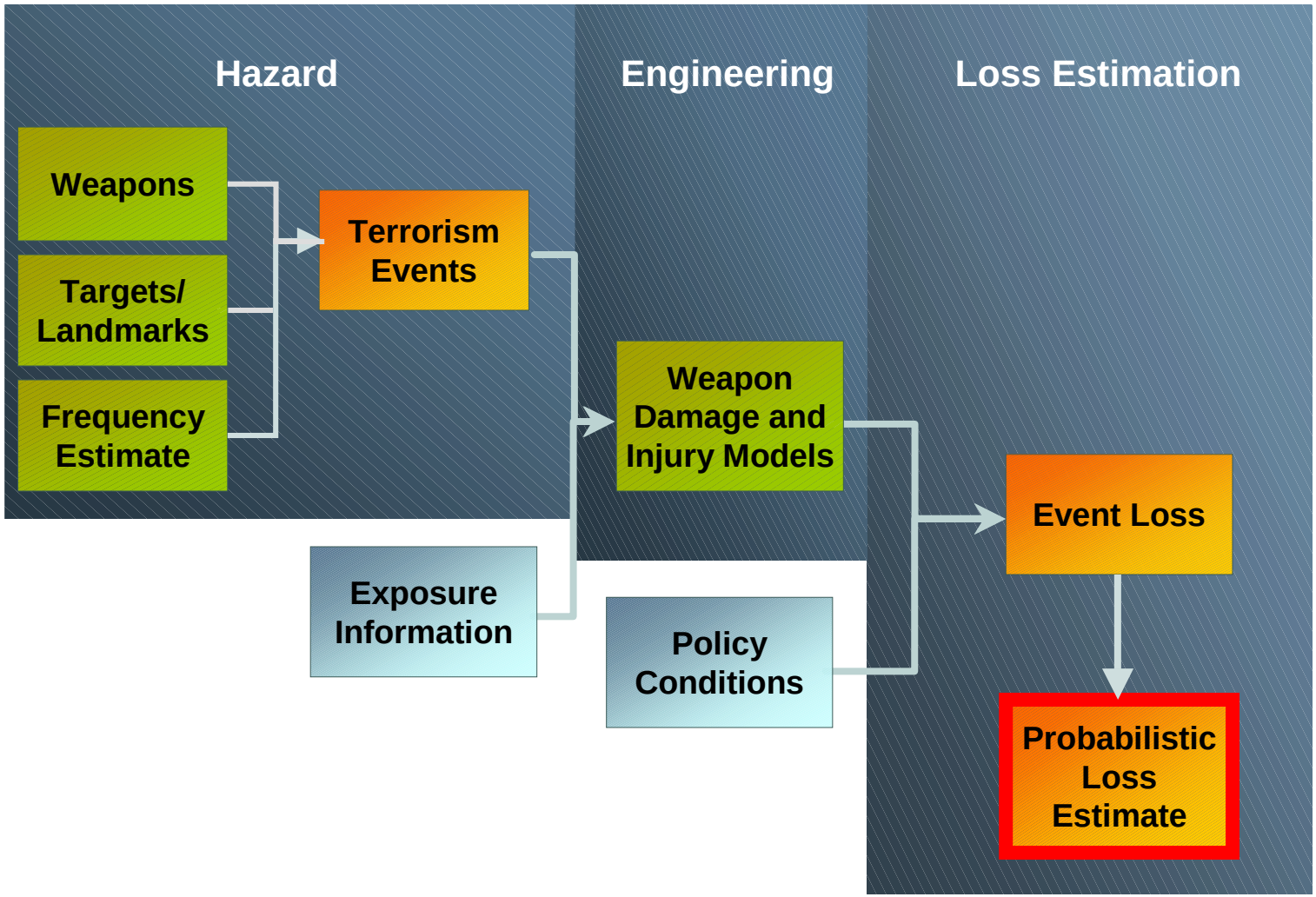
Complete National Exposure Database Used to Quantify Event Outcomes for the Industry

- Locations, values, construction, and occupancy database
- Commercial property, residential property, workers, automobiles
- Used throughout AIR's history for all catastrophe models

ISO Specific Property Information Database

- 2.5 million commercial properties
- 600 field inspectors
- Complete building data
  - Construction
  - Occupancy
  - Square feet
  - Number of stories
  - …
- 50 years legacy
- Up-to-date

Terrorism Model Components



Generation of Loss Probabilities

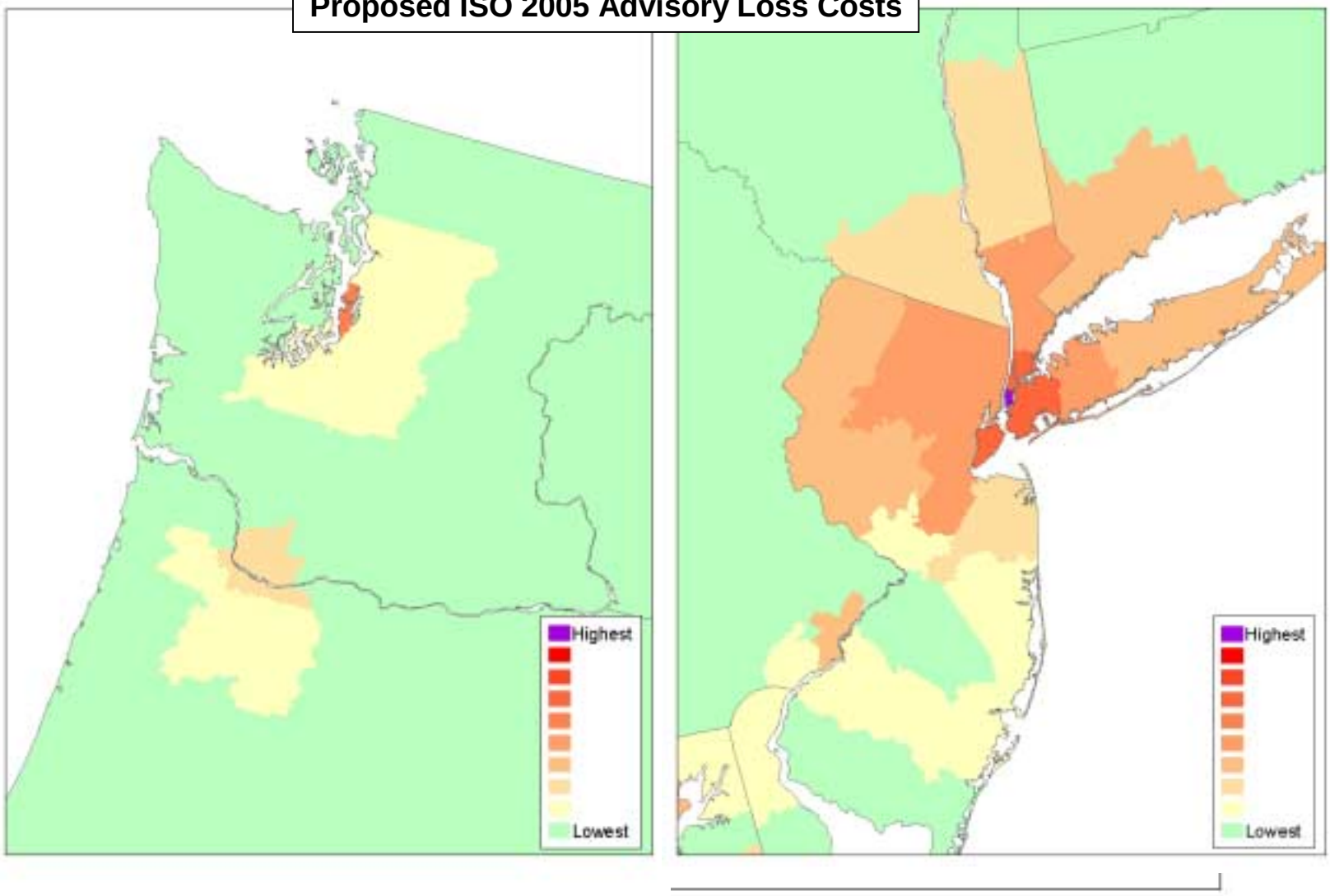
- Frequency estimation process results in expected frequency of each event (landmark attack vector element)
  - Frequently updated to reflect current threat
- Occurrence of each event is modeled as a Poisson process
- Catalog of 500,000 years of replications is generated
  - Catalog is delivered to customers within AIR software
- Results in calculation of probabilistic loss distribution
  - Distribution tail is of utmost importance in catastrophe risk management

ISO Used AIR Model to Develop New Filings

Proposed ISO 2005 Advisory Loss Costs

ISO Used AIR Model to Develop New Filings

Proposed ISO 2005 Advisory Loss Costs



Terrorism Risk Management – Insurer Decisions

- Underwriting
  - Measure and limit maximum loss exposure
- Transfer risk
  - Terrorism Risk Insurance Act of 2002 (TRIA)
  - Private reinsurance market
- Loss reserves

Terrorism Risk Measures Being Used

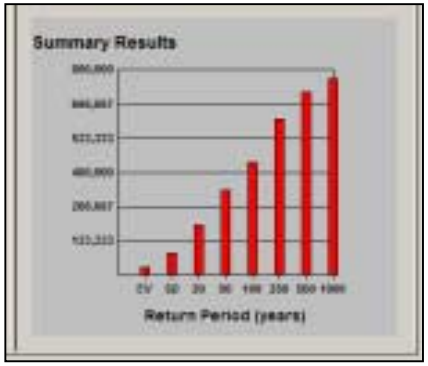
- Maximum Possible Loss (to the portfolio)
  - Single location
  - Ring concentration
  - Aggregate exposure
  - Deterministic loss scenario
- Maximum Landmark Risk
  - Landmark exposure – in the landmark
  - Landmark ring concentration
  - Landmark event loss scenario
- Probabilistic Loss Distribution
  - Portfolio
  - Policy

Multiple Tools for Measuring Terrorism Risk

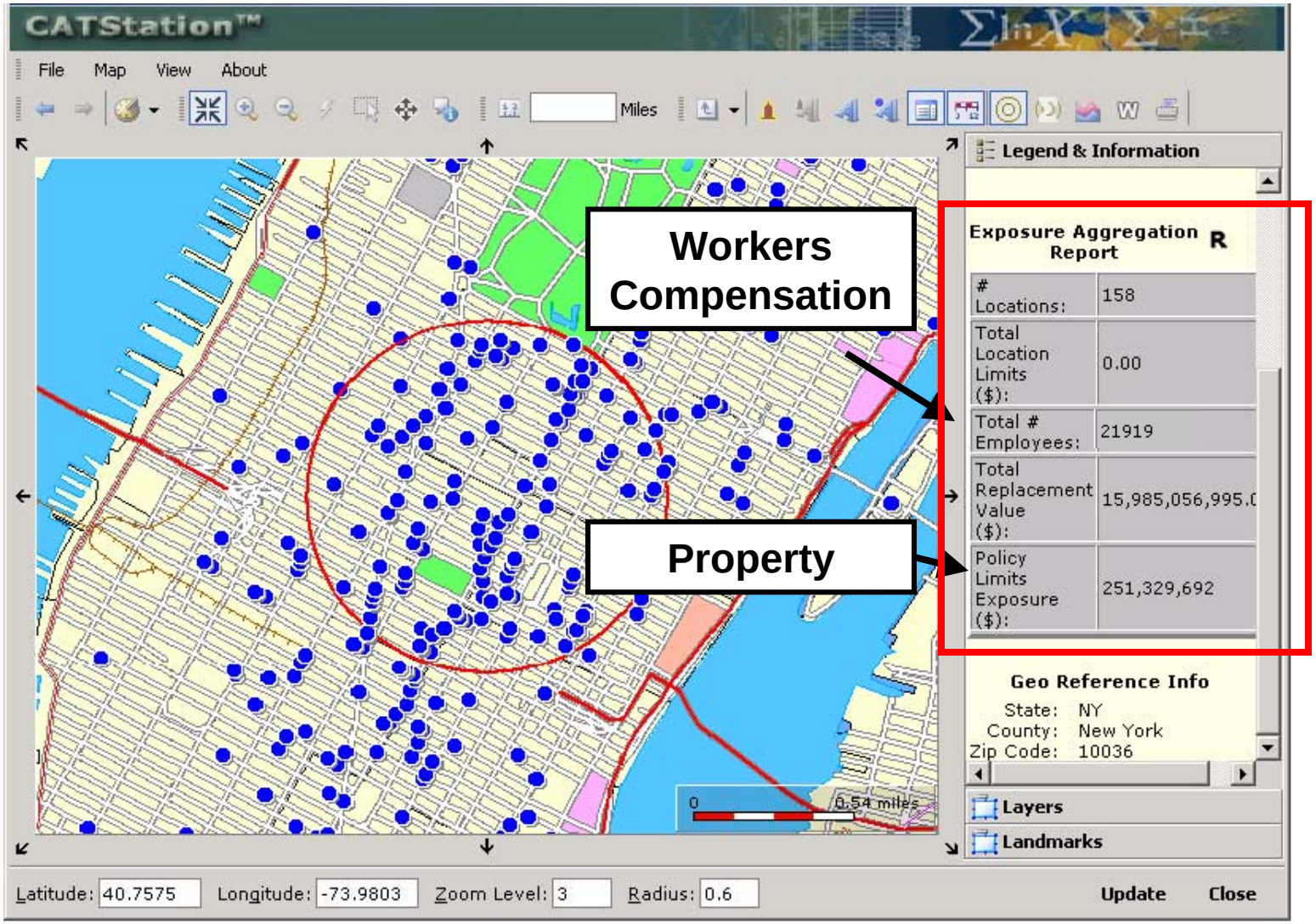
- Exposure concentration analysis
  - Single location
  - Ring
  - Insured location
  - Landmark

- Deterministic loss analysis
  - Insured location
  - Landmark

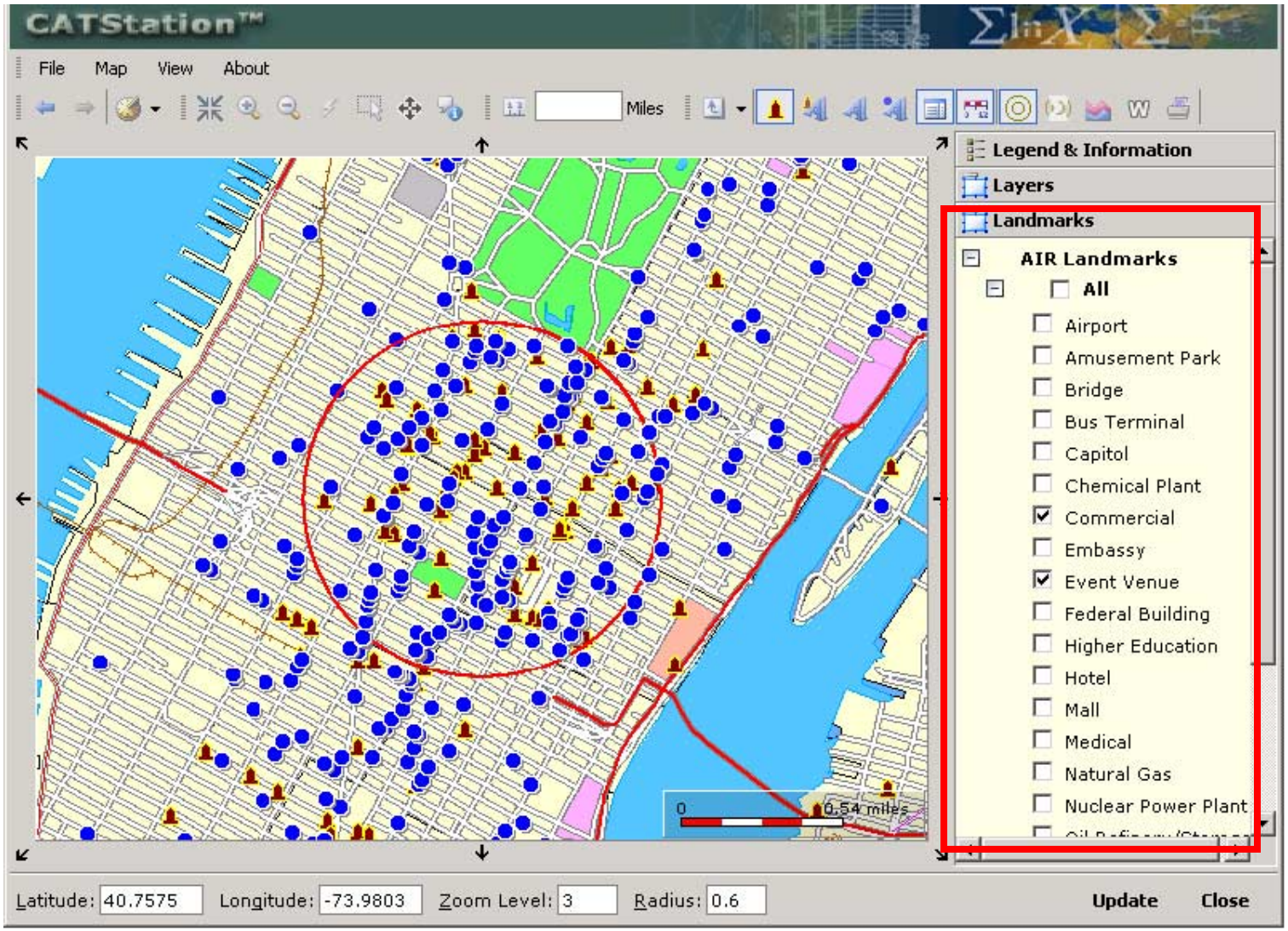
- Probabilistic loss analysis



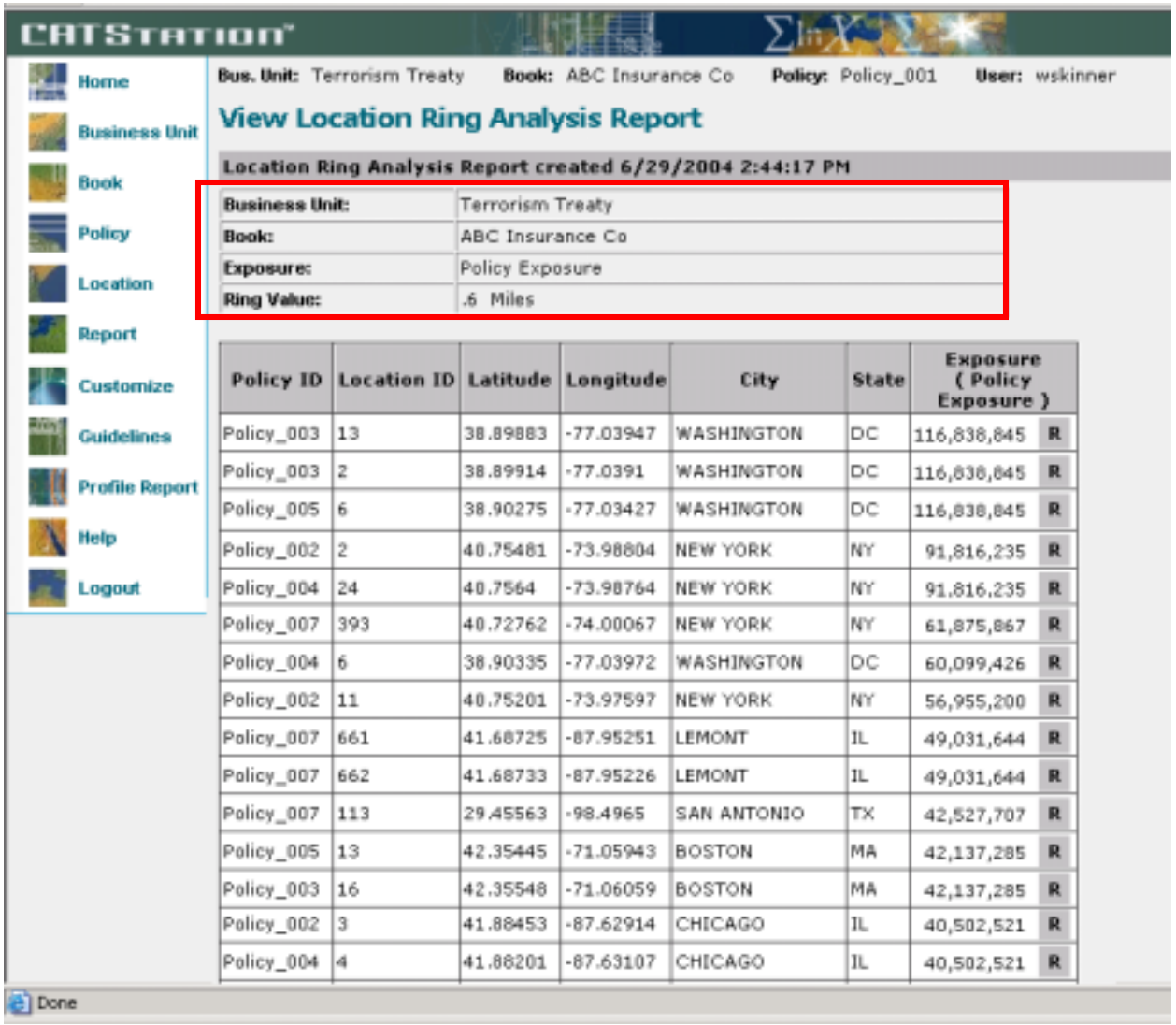
Include Concentrations Across Lines of Business



Identify Concentrations Around Targets



Largest Ring Concentration Report



Policy ID	Location ID	Latitude	Longitude	City	State	Exposure (Policy Exposure)
Policy_003	13	38.89883	-77.03947	WASHINGTON	DC	116,838,845 R
Policy_003	2	38.89914	-77.0391	WASHINGTON	DC	116,838,845 R
Policy_005	6	38.90275	-77.03427	WASHINGTON	DC	116,838,845 R
Policy_002	2	40.75481	-73.98804	NEW YORK	NY	91,816,235 R
Policy_004	24	40.7564	-73.98764	NEW YORK	NY	91,816,235 R
Policy_007	393	40.72762	-74.00067	NEW YORK	NY	61,875,867 R
Policy_004	6	38.90335	-77.03972	WASHINGTON	DC	60,099,426 R
Policy_002	11	40.75201	-73.97597	NEW YORK	NY	56,955,200 R
Policy_007	661	41.68725	-87.95251	LEMONT	IL	49,031,644 R
Policy_007	662	41.68733	-87.95226	LEMONT	IL	49,031,644 R
Policy_007	113	29.45563	-98.4965	SAN ANTONIO	TX	42,527,707 R
Policy_005	13	42.35445	-71.05943	BOSTON	MA	42,137,285 R
Policy_003	16	42.35548	-71.06059	BOSTON	MA	42,137,285 R
Policy_002	3	41.88453	-87.62914	CHICAGO	IL	40,502,521 R
Policy_004	4	41.88201	-87.63107	CHICAGO	IL	40,502,521 R

Look at Potential Losses (Deterministic)

CATStation

Home
Business Unit
Book
Policy
Location
Report
Customize
Guidelines
Profile Report
Help
Logout

Bus. Unit: Terrorism Treaty **Book:** ABC Insurance Co **Policy:** Policy_001 **User:** wskinner

View Location Ring Analysis Report

Location Ring Analysis Report created 6/29/2004 2:44:17 PM

Business Unit:	Terrorism Treaty
Book:	ABC Insurance Co
Exposure:	Policy Exposure
Ring Value:	.6 Miles

Policy ID	Location ID	Latitude	Longitude	City	State	Exposure (Policy Exposure)	
Policy_003	13	38.89883	-77.03947	WASHINGTON	DC	116,838,845	R
Policy_003	2	38.89914	-77.0391	WASHINGTON	DC	116,838,845	R
Policy_005	6	38.90275	-77.03427	WASHINGTON	DC	116,838,845	R
Policy_002	2	40.75481	-73.98804	NEW YORK	NY	91,816,235	R
Policy_004	24	40.7564	-73.98764	NEW YORK	NY	91,816,235	R
Policy_007	393	40.72762	-74.00067	NEW YORK	NY	61,875,867	R
Policy_004	6	38.90335	-77.03972	WASHINGTON	DC	60,099,426	R
Policy_002	11	40.75201	-73.97597	NEW YORK	NY	56,955,200	R
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Policy_007	113	29.45563	-98.4965	SAN ANTONIO	TX	42,527,707	R
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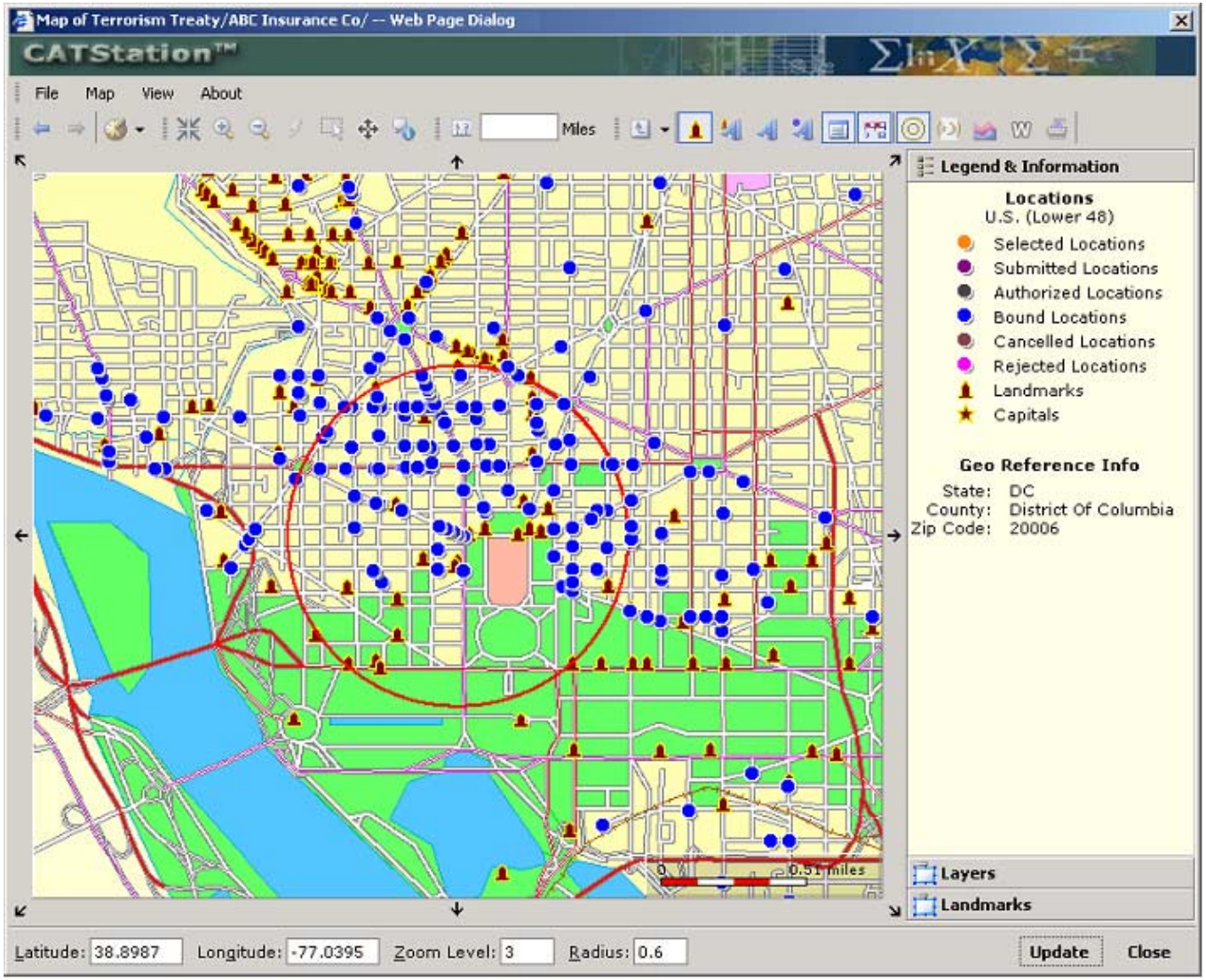
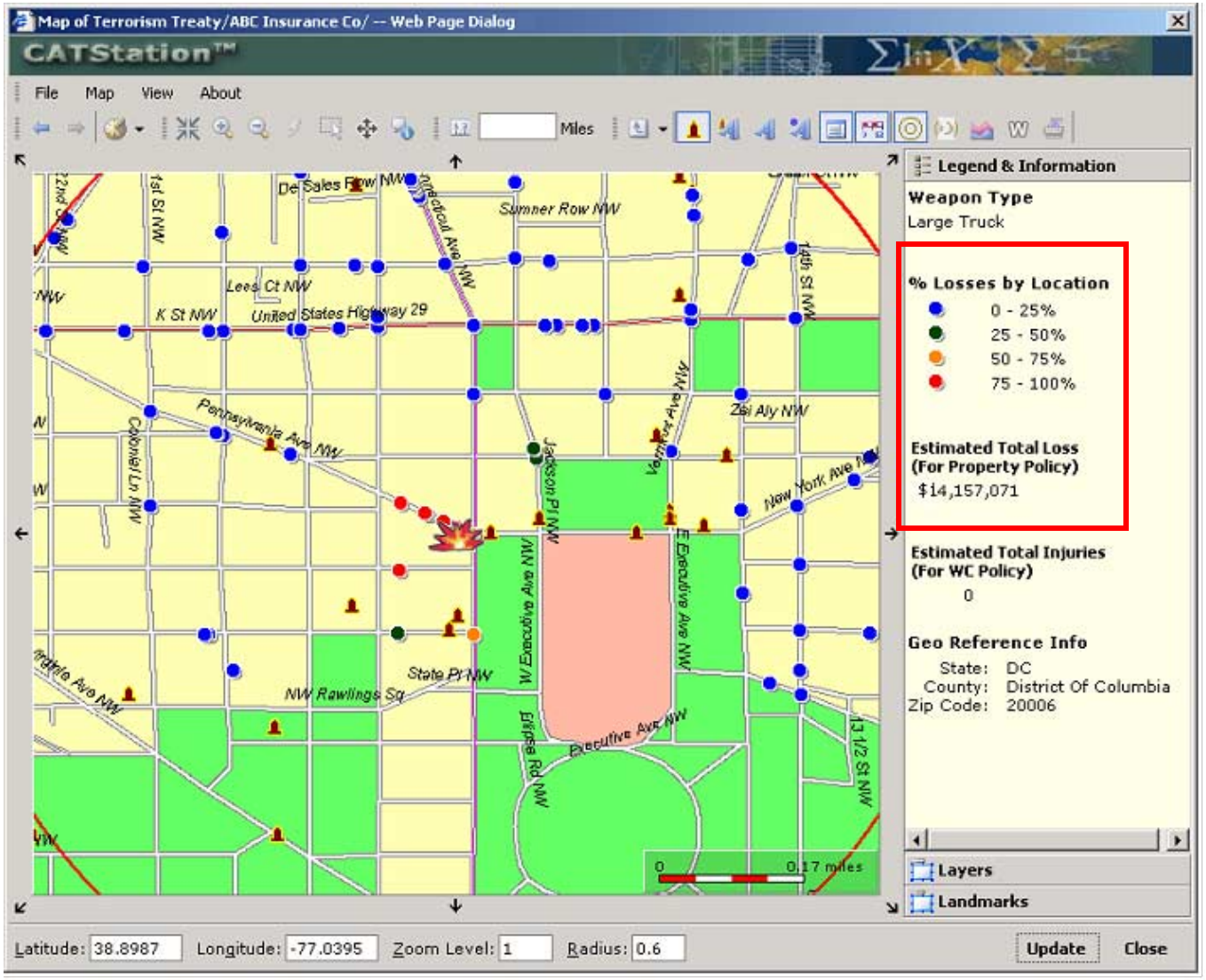
Policy_003	16	42.35548	-71.06059	BOSTON	MA	42,137,285	R
Policy_002	3	41.88453	-87.62914	CHICAGO	IL	40,502,521	R
Policy_004	4	41.88201	-87.63107	CHICAGO	IL	40,502,521	R

Done

Deterministic Loss Analysis at Largest Concentration



Deterministic Loss Analysis



Support for Rating Agency Reporting

A.M. Best Supplementary Rating Questionnaire

- Single location exposure
- Location ring exposure
- Deterministic modeled loss

Summary

- Terrorism Loss Estimation Model
  - Comprehensive landmark database
  - National exposure database
  - Conventional and CBRN weapons
  - Weapons effects modeling
  - Credible process for event likelihood estimation
- Risk measurement
  - Potential loss at insured locations and landmarks
    - Single location exposure
    - Ring accumulation
    - Deterministic (modeled) event loss
  - Probabilistic loss analysis
- Risk control
  - Underwriting
  - Risk transfer
  - Risk reserves/surplus/capital

Thank you

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