



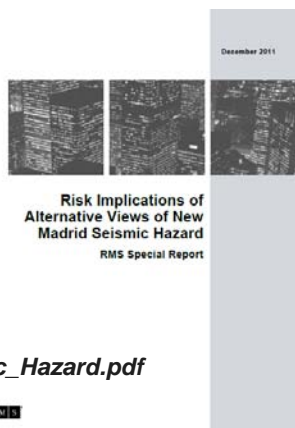
April 13, 2012  
2012 National Earthquake Conference

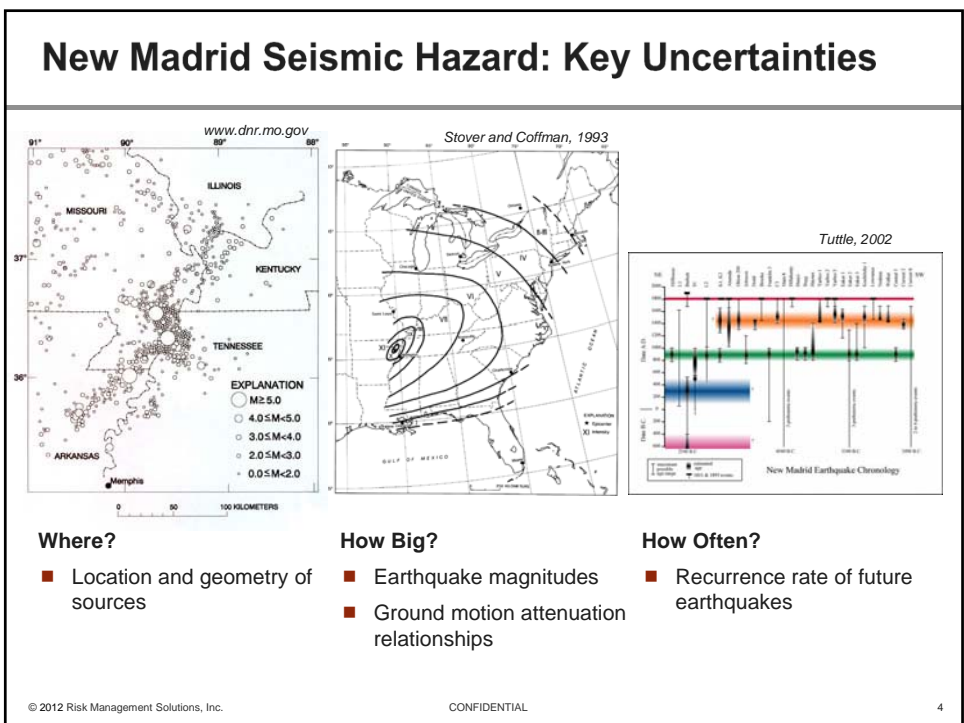
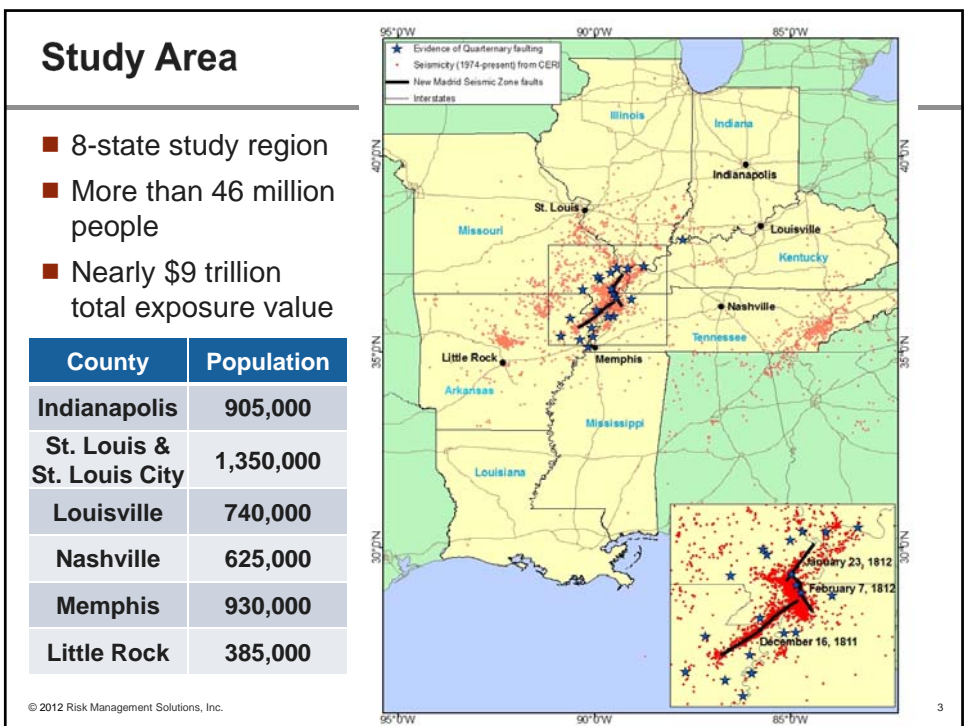
## Risk Implications of Alternative Views of New Madrid Seismic Hazard

Dr. Patricia Grossi

### RMS New Madrid Study Overview

- Objective: To examine how scientific assumptions regarding the level and uncertainty of the seismic hazard posed by the New Madrid Seismic Zone (NMSZ) impact estimated losses.
- Presented preliminary findings at the Seismological Society of America meeting in April 2011.
- Partnered with USGS collaborators (with Mary Lou Zoback): *Oliver Boyd, Chuck Mueller, Leo Ramirez Guzman, and Rob Williams*
- RMS research report published in December 2011, available at  
[www.rms.com/Publications/New\\_Madrid\\_Seismic\\_Hazard.pdf](http://www.rms.com/Publications/New_Madrid_Seismic_Hazard.pdf)



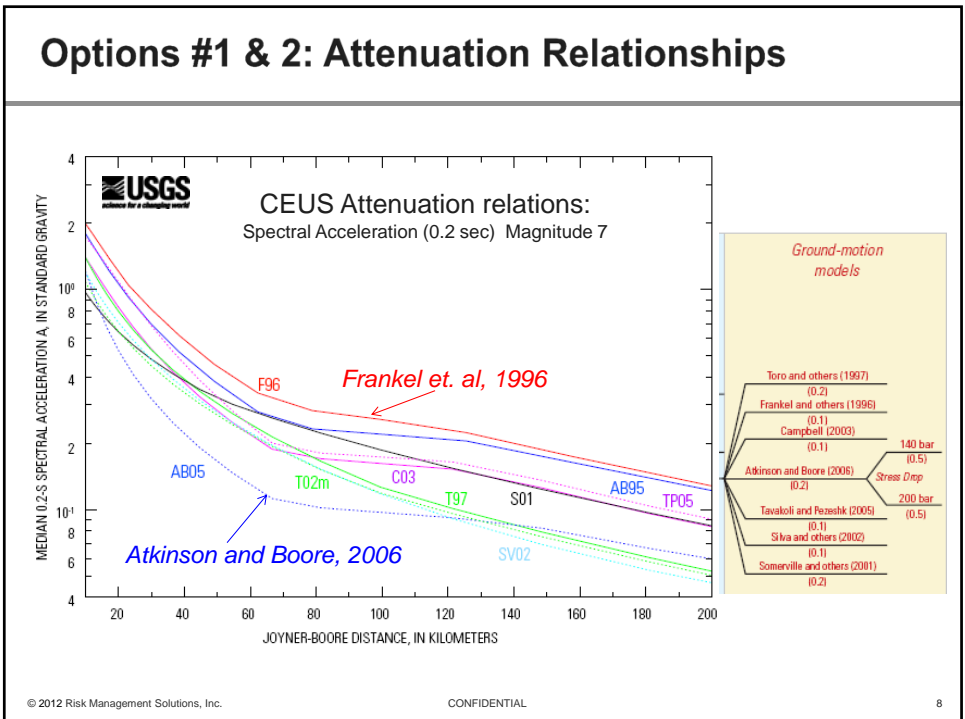
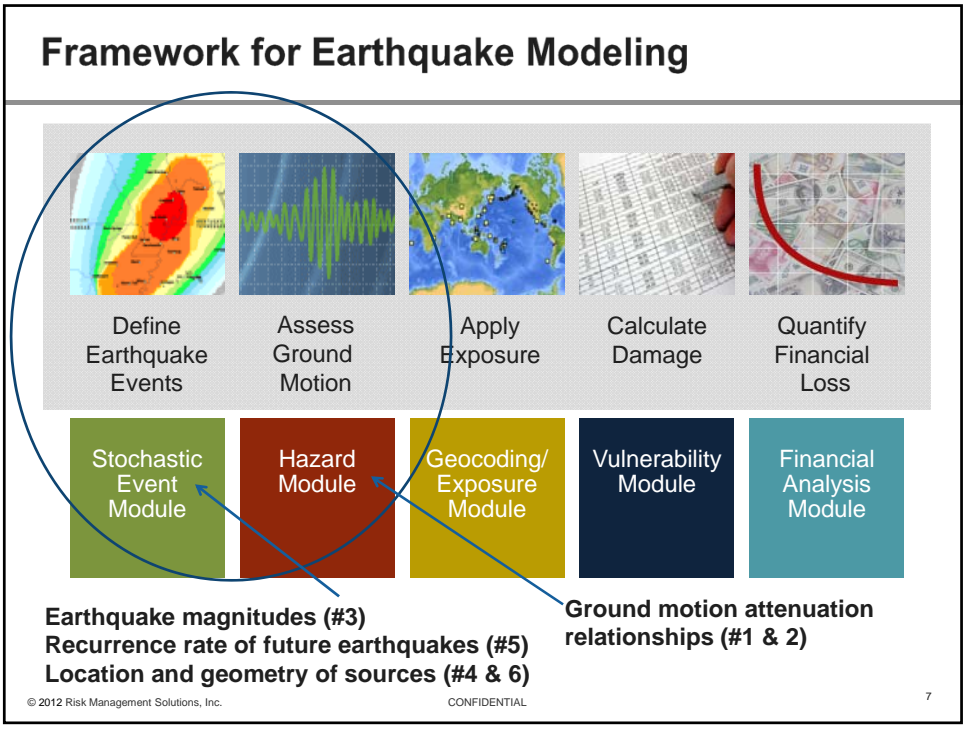


## New Madrid Seismic Hazard Options

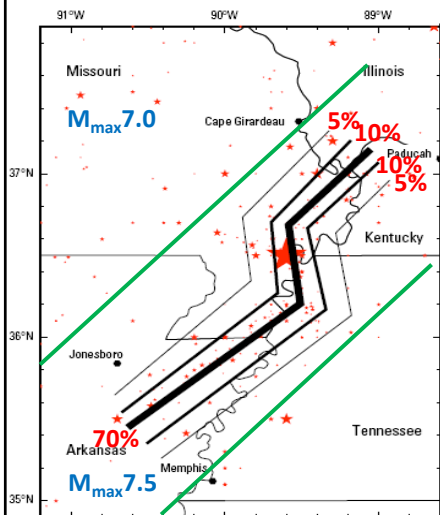
- Ground motion attenuation relationships
- Earthquake magnitudes
- Recurrence rate of future earthquakes
- Location and geometry of sources

## New Madrid Seismic Hazard Options

- Ground motion attenuation relationships (#1 & 2)
- Earthquake magnitudes (#3)
- Recurrence rate of future earthquakes (#5)
- Location and geometry of sources (#4 & 6)
  
- One parameter varied at a time and compared to baseline hazard (2008 USGS National Seismic Hazard Maps).
- In all but option #6, parameter variations follow branches of the USGS logic tree, simply changing the weight to test the assumption.
- A modified version of the RMS U.S. Earthquake Model was created to evaluate each option.



## 2008 USGS National Seismic Hazard Maps



### New Madrid Source Zone

	$M_w$ 7.1	$M_w$ 7.3	$M_w$ 7.5	$M_w$ 7.7	$M_w$ 7.8	$M_w$ 8.0
South NM-1		.15	.20	.50		.15
North NM-2	.15	.20	.50		.15	
Central NM-3		.15	.20	.50		.15



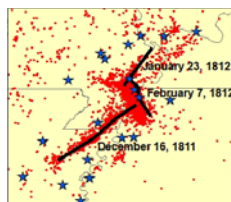
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9

## Option #3: Reduced Earthquake Magnitudes

Event	Rupture Segment	Johnston (1996)	Hough et al (2002) Hough and Martin (2002)	Bakun and Hooper (2004)	Hough and Page (2011)	Cramer and Boyd (2011)	Magnitude assumed for Hazard Option 3
December 16, 1811	Southern segment	8.1	7.2 – 7.3	7.2 – 7.6	6.8	~ 7.6	7.3
January 23, 1812	Northern segment	7.8	7.0	7.2 – 7.5	6.6	7.2 – 7.6	7.1
February 7, 1812	Central segment	8.0	7.4 – 7.5	7.4 – 7.8	7.0	> 7.6	7.3



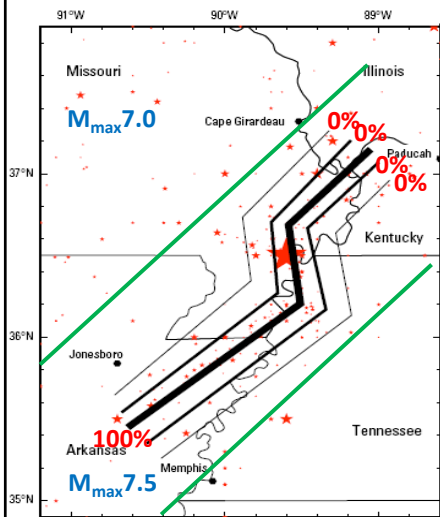
	$M_w$ 7.1	$M_w$ 7.3	$M_w$ 7.5	$M_w$ 7.7	$M_w$ 7.8	$M_w$ 8.0
South NM-1		.15 <b>1.0</b>	.20	.50		.15
North NM-2	.15 <b>1.0</b>	.20	.50		.15	
Central NM-3		.15 <b>1.0</b>	.20	.50		.15

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10

### Options #4 & 5: Source Location and Recurrence



- Option 4: Single source for NMSZ
  - 100% weight on “central” pseudo-fault
- Option 5: Reduced recurrence rate for future earthquakes
  - 90% weight on 1,000 years, 10% weight on 500 years (i.e., flipped USGS weighting)

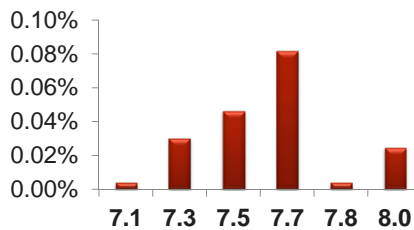
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### Option #6: NMSZ as Distributed Source Region



- Zone uses the same magnitude distribution as NMSZ
- Redistributed NMSZ recurrence rate uniformly throughout

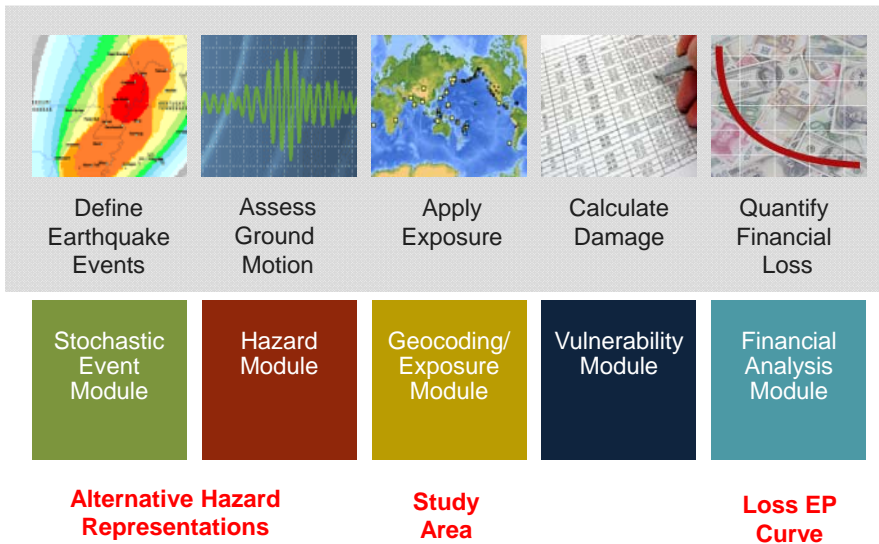


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12

## Framework for Earthquake Modeling



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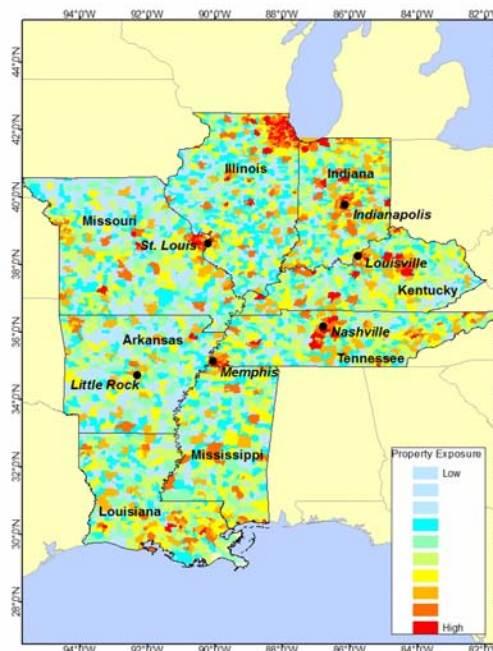
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13

## Study Area

- 8-state study region
- More than 46 million people
- Nearly \$9 trillion total exposure value

County	Population
Indianapolis	905,000
<b>St. Louis &amp; St. Louis City</b>	<b>1,350,000</b>
Louisville	740,000
Nashville	625,000
<b>Memphis</b>	<b>930,000</b>
Little Rock	385,000

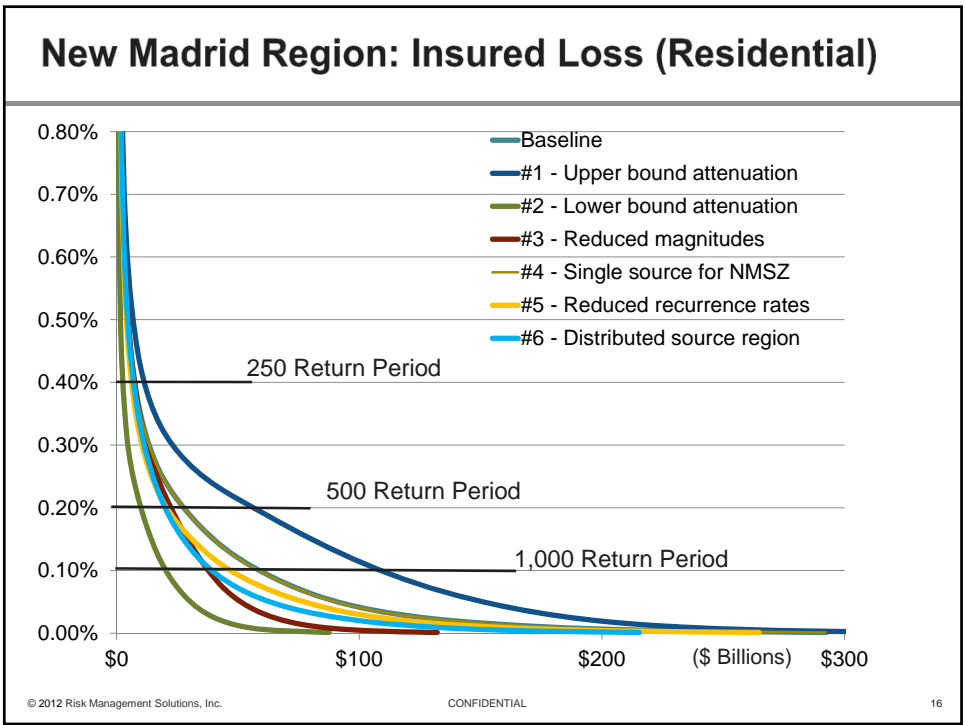
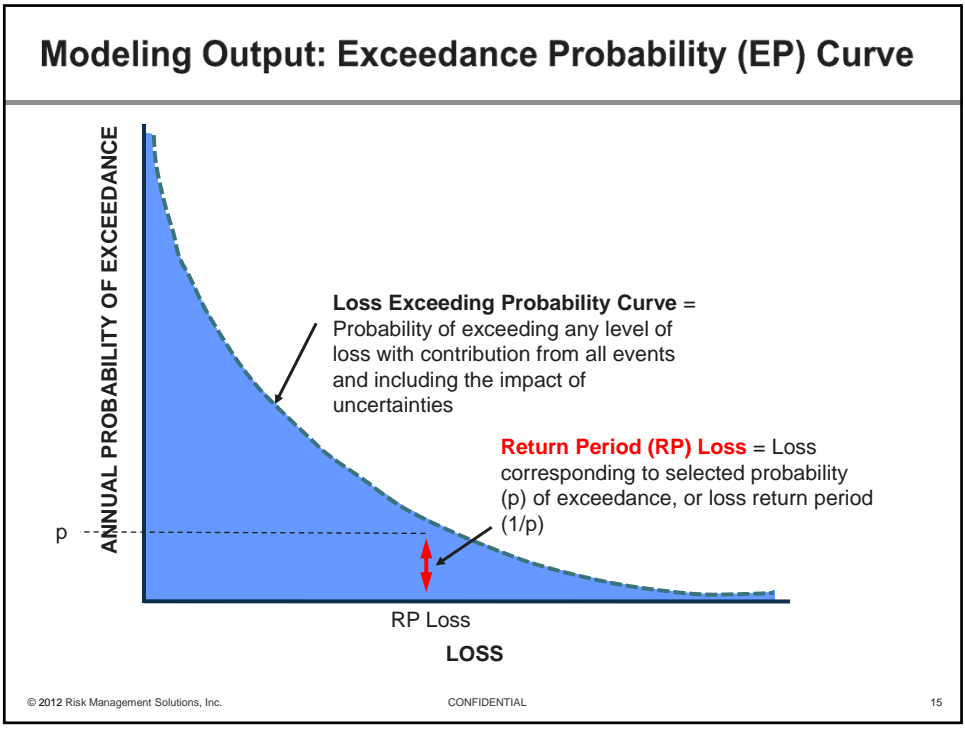


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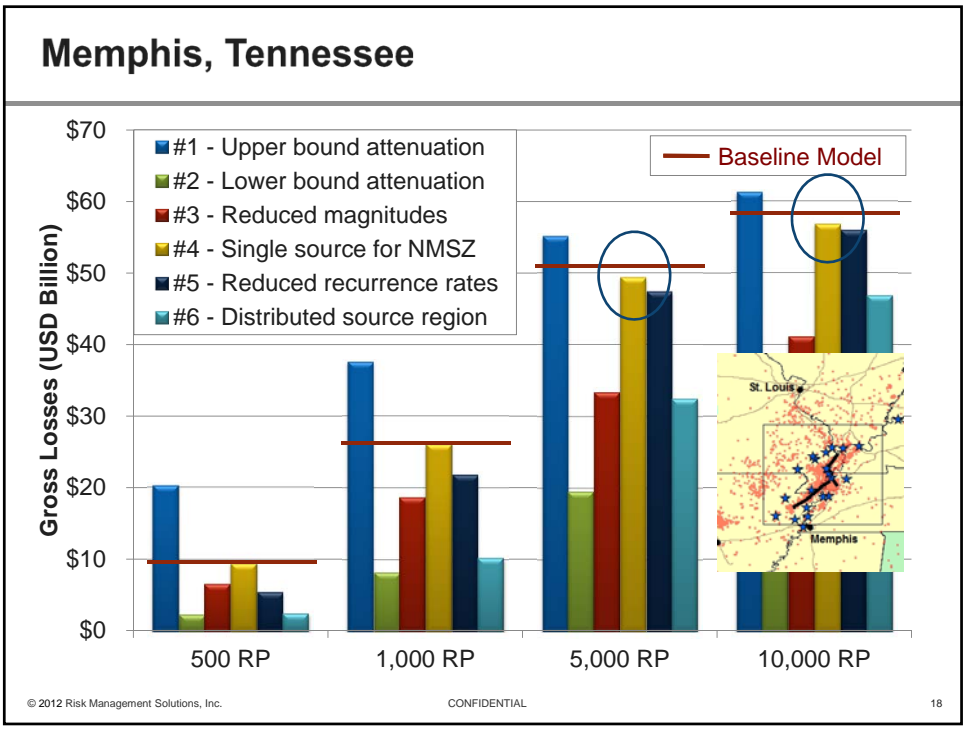
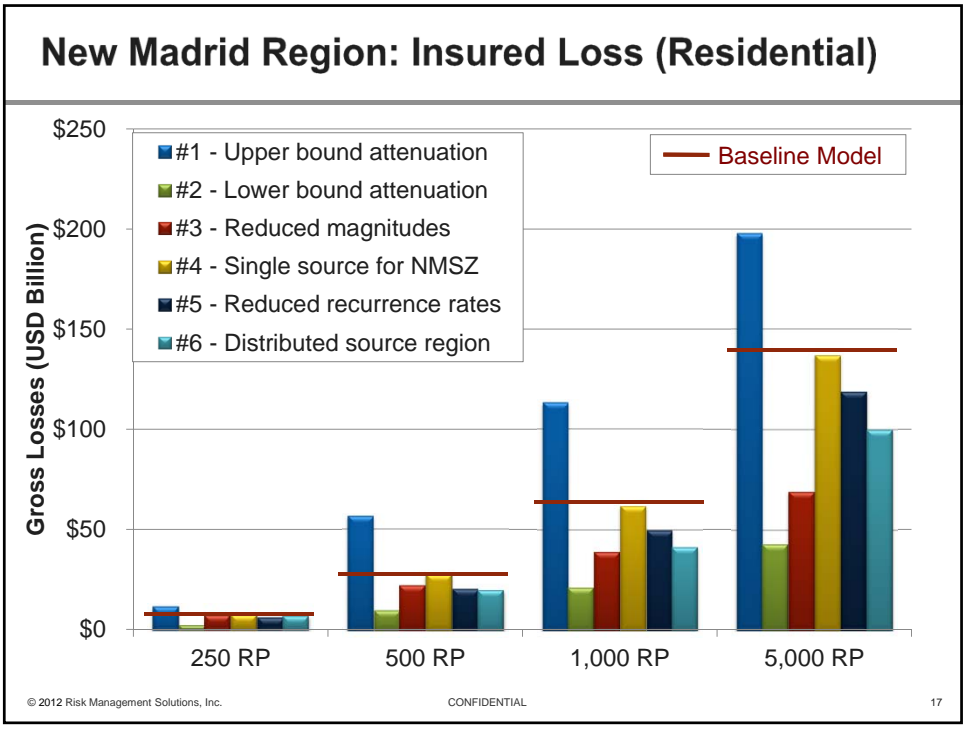
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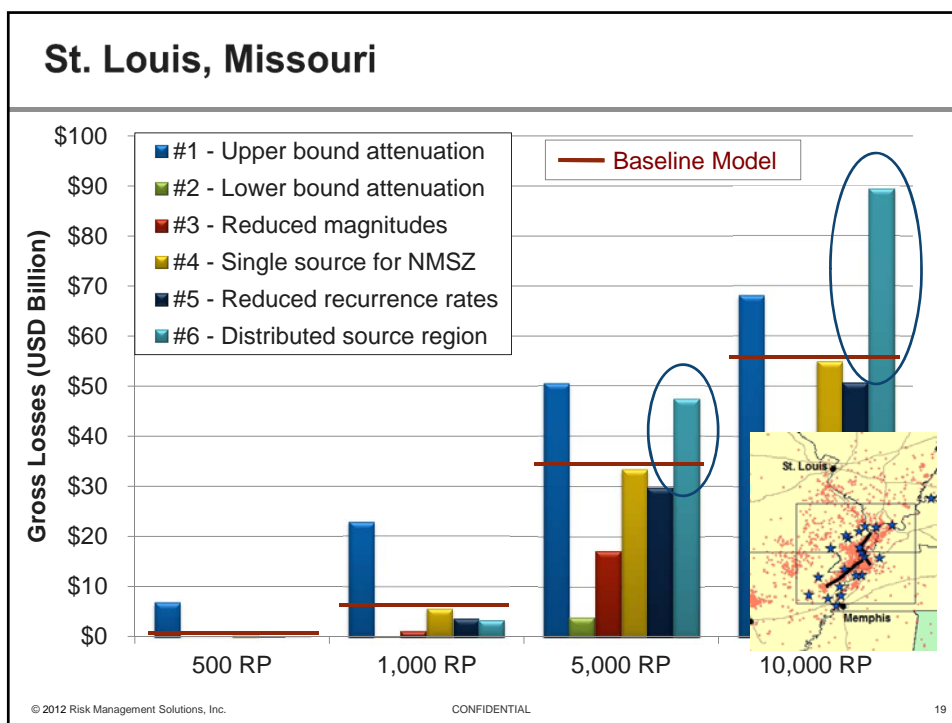
14











## Conclusions

- Regional impact varies with alternative hazard representations; however, estimated losses remain significant
- Biggest source of uncertainty in losses comes from ground motion attenuation relationships
- Reducing magnitudes on the NMSZ would reduce risk across the New Madrid region
- Lengthening the recurrence of 1811-1812 type events will primarily impact losses at very low probabilities of exceedance (5,000 year return period or beyond)
- Expanding the NMSZ will result in higher risk for all cities except Memphis

## Final Thoughts

- The 200th anniversary of the 1811–1812 New Madrid earthquake sequence is a reminder of the susceptibility of the region to earthquake hazards and the need for preparation for a possible future event.
- The results presented here highlight areas for future research – already under consideration for the 2014 Seismic Hazard Maps in the Central and Eastern U.S.

**Thank you...**