Tornadoes: How unusual was 2011?

Jim Maher, CFA, FCAS, MAAA
Chief Risk Officer
Platinum Underwriters Reinsurance, Inc.

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PLATINUM
UNDERWRITERS REINSURANCE, INC.

2011 Tornado/Hail Losses (PCS)

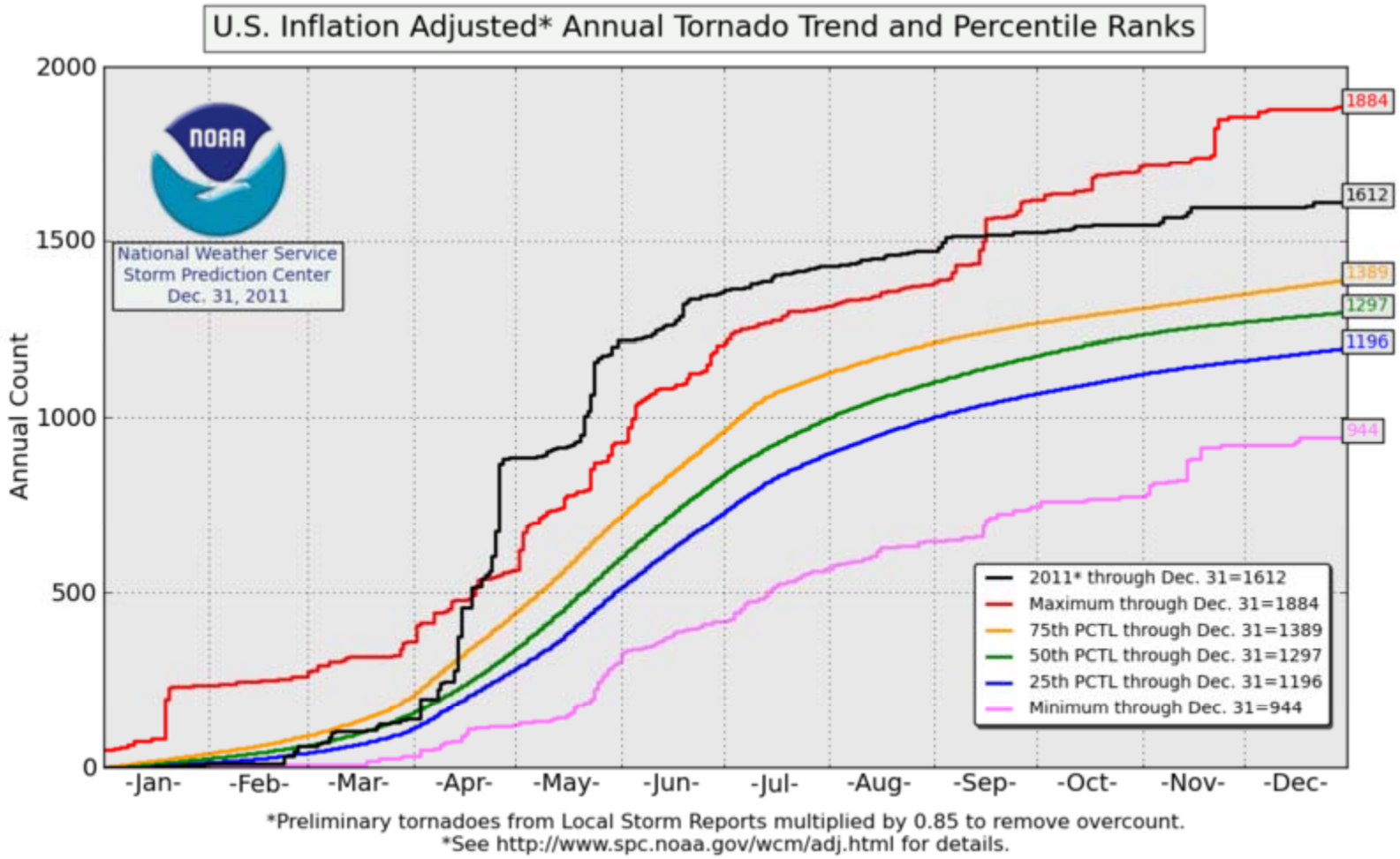
- Aggregate losses = $26 BN
  - Approx. 300 year Return Period in Cat Model X
  - Cat model X expected average annual loss = $10 BN

- 5 events > $1 BN (pre 2011 avg. is 1.3 events/yr)
  - CAT 46 (4/22-28) = $7.3 BN
  - CAT 48 (5/20-28) = $6.9 BN
  - Cat 42 (4/3-5) = $2.0 BN
  - CAT 43 (4/8-14) = $1.5 BN
  - CAT 44 (4/14-16) = $1.4 BN

Ways to assess tornado outbreak severity

- Insured loss
- Number of tornadoes
- Severity of tornadoes (Fujita scale)
- Number of fatalities
  - 553 fatalities in 2011 and 5,370 injuries

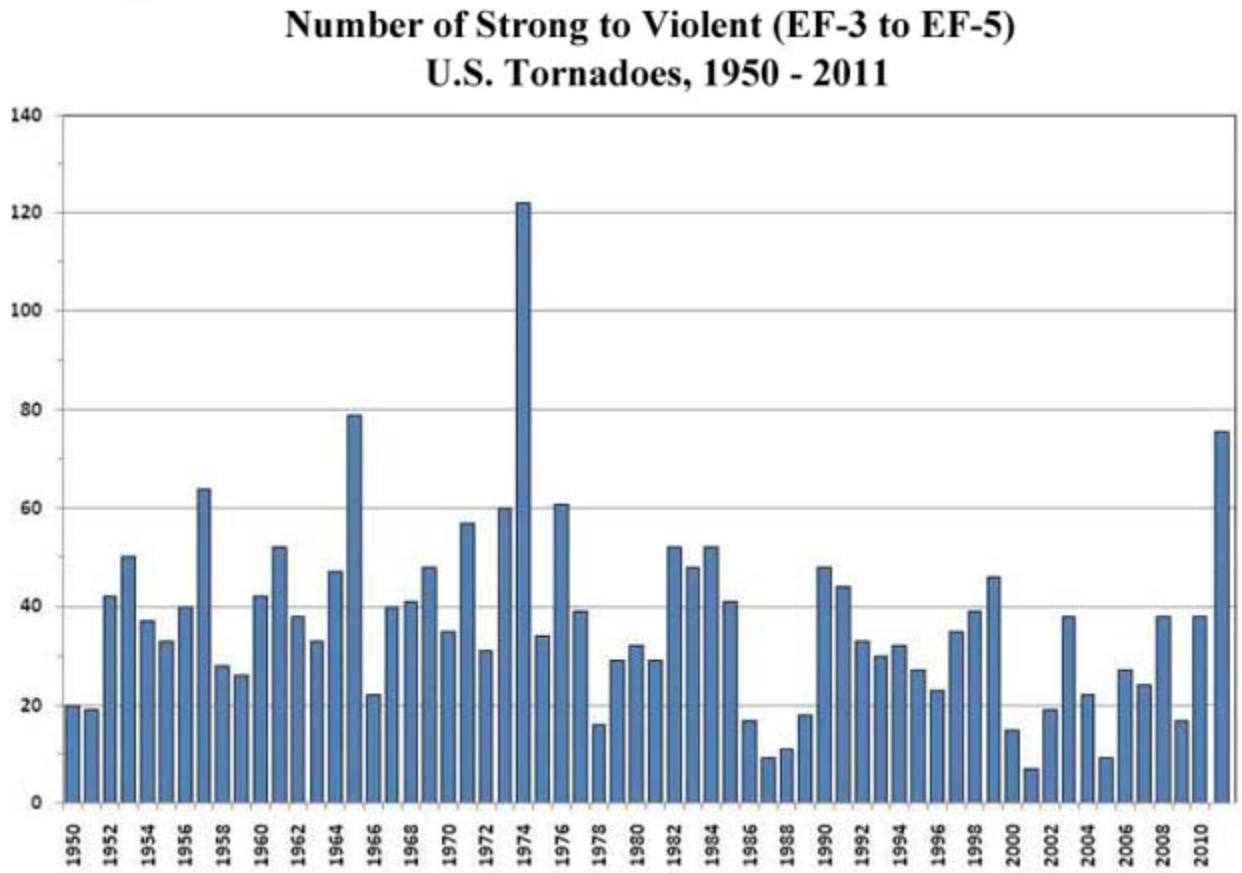
Number of tornadoes



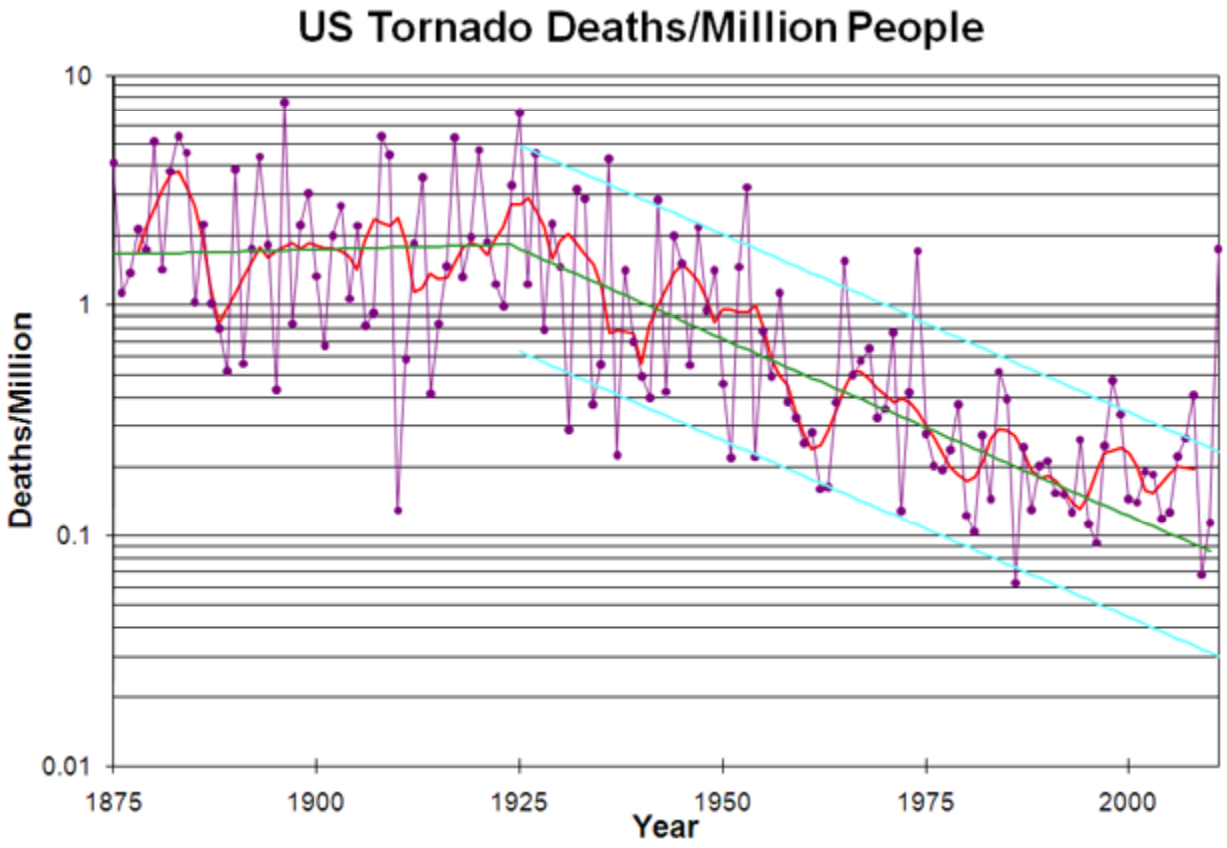
Enhanced Fujita Scale

Scale	Wind speed (Estimated)[3]		Example of damage	Relative frequency [citation needed]	Average Damage Path Width (meters) [citation needed]	Potential da
	mph	km/h				
EF0	65–85	105–137		38.9%	10–50	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
EF1	86–110	138–178		35.6%	30–150	Moderate damage. The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF2	111–135	179–218		19.4%	110–250	Significant damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; highrise windows broken and blown in; light-object missiles generated.
EF3	136–165	219–266		4.9%	200–500	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
EF4	166–200	267–322		1.1%	400–900	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
EF5	>200	>322		<0.1%	1100 ~	Incredible damage. Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 m (109 yd); trees debarked; steel reinforced concrete structures badly damaged.

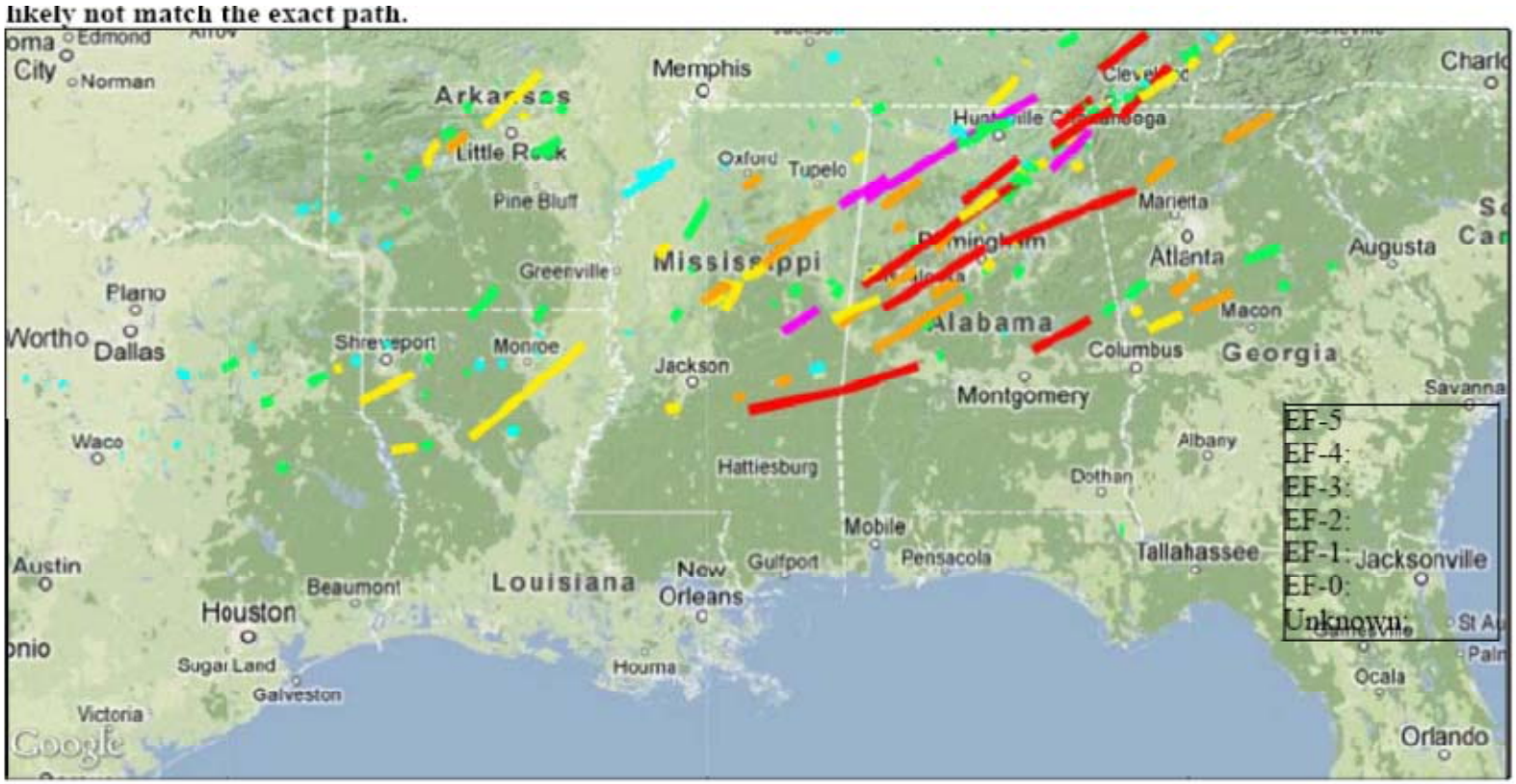
2011 ranks 3rd after 1974 and 1965 based on number of strong-to-violent tornadoes



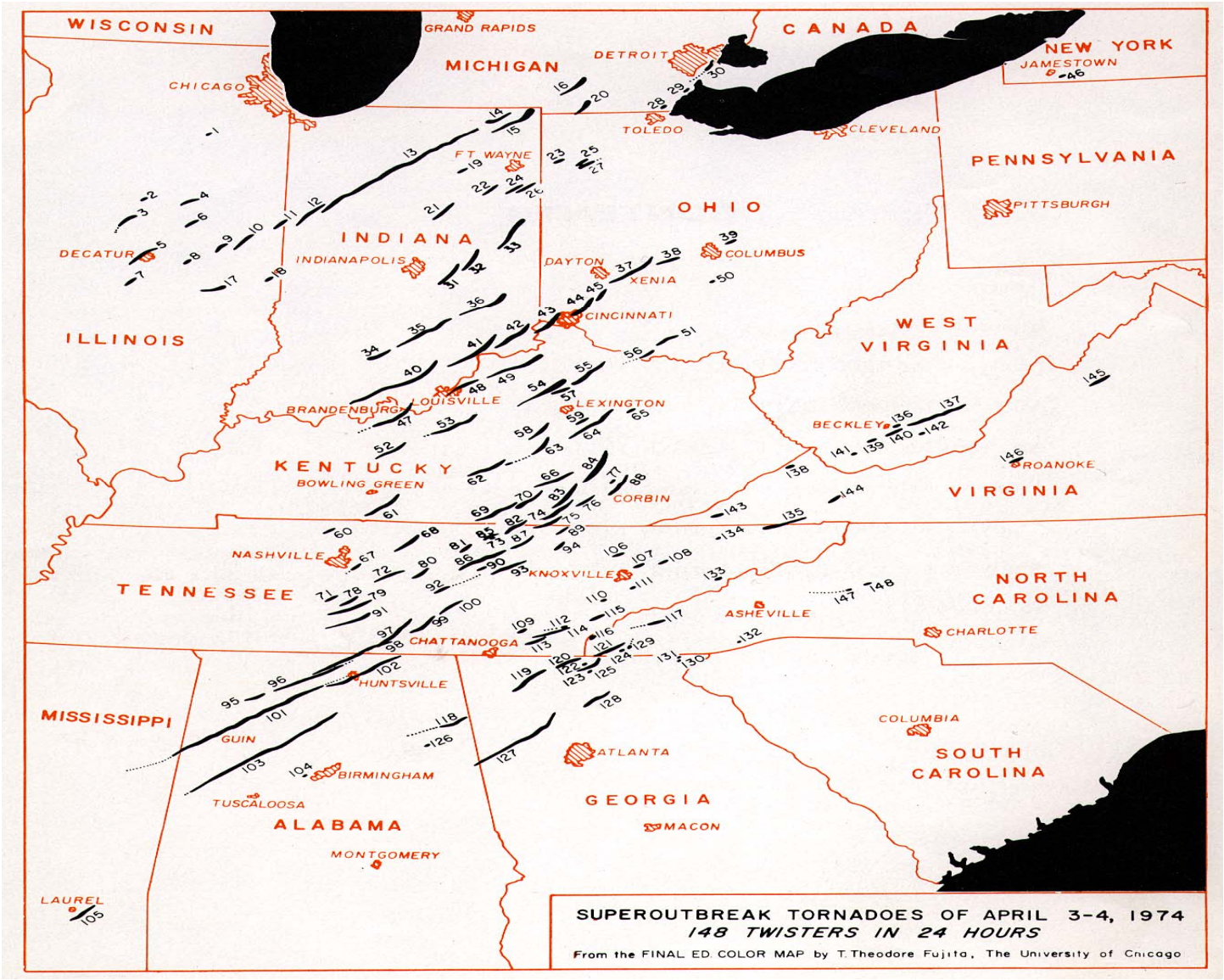
Tornado death rate declining but 2011 stands out



2011 Super Outbreak: 4/24-29 (pink=EF5, Red=EF4)



1974 Super Outbreak



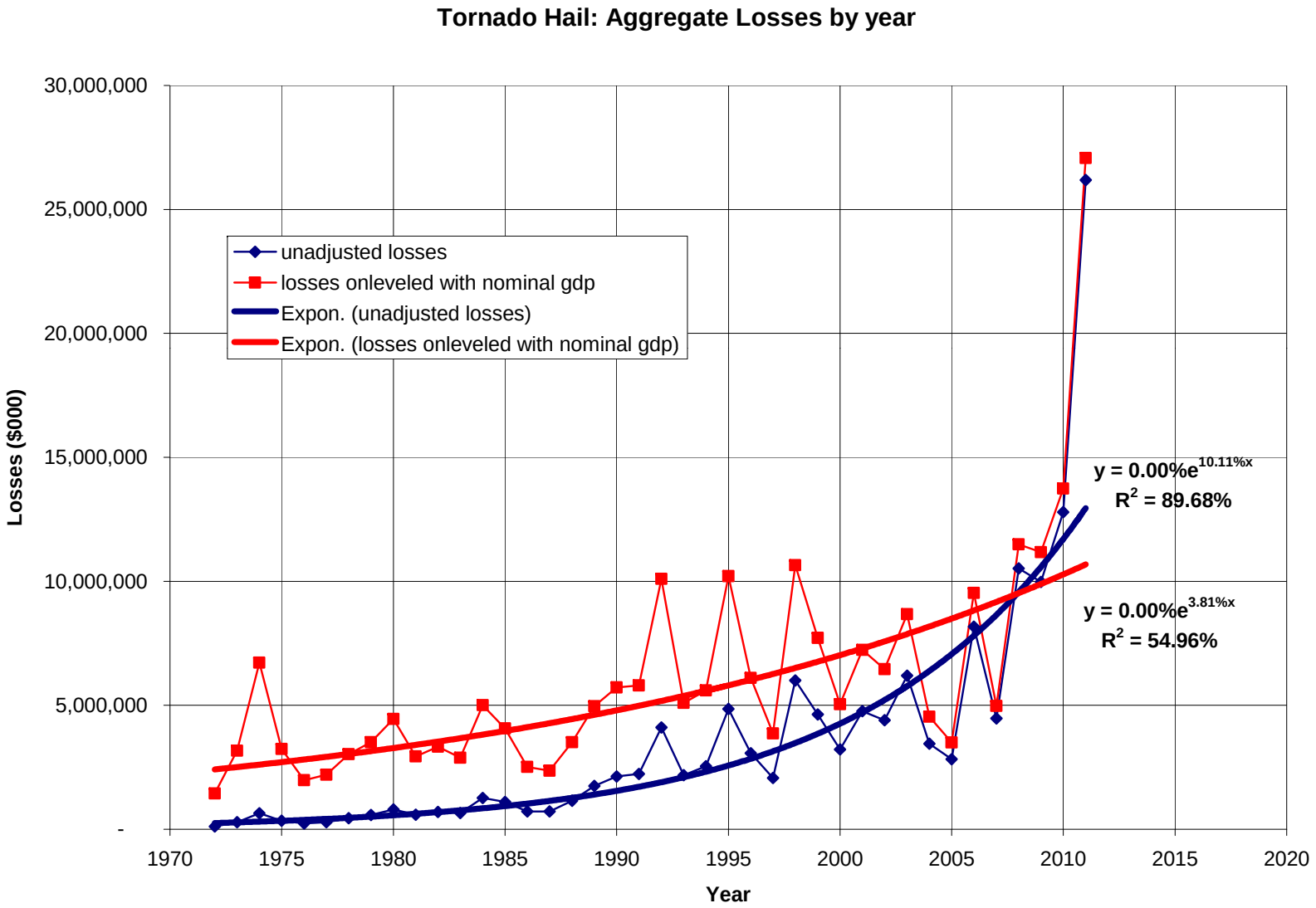
2011 Tornadoes-insured loss

- 2011 tornado/hail experience stands out from
  - Number of large events (5 events > $1 BN)
  - Total aggregate loss of $26 BN
- How do these losses compare to
  - Trended historical experience?
  - Cat model X output?
    - For individual events?
    - For the year as a whole?

US Tornado/Hail Historical Losses

- Period selected 1972-2011 (i.e. 40 years)
  - source ISO PCS database
  - Trend using nominal GDP growth
    - Includes inflation
    - And “real” growth in economy- proxy for property exposure growth
  - Extra 2% added to account for “social inflation”

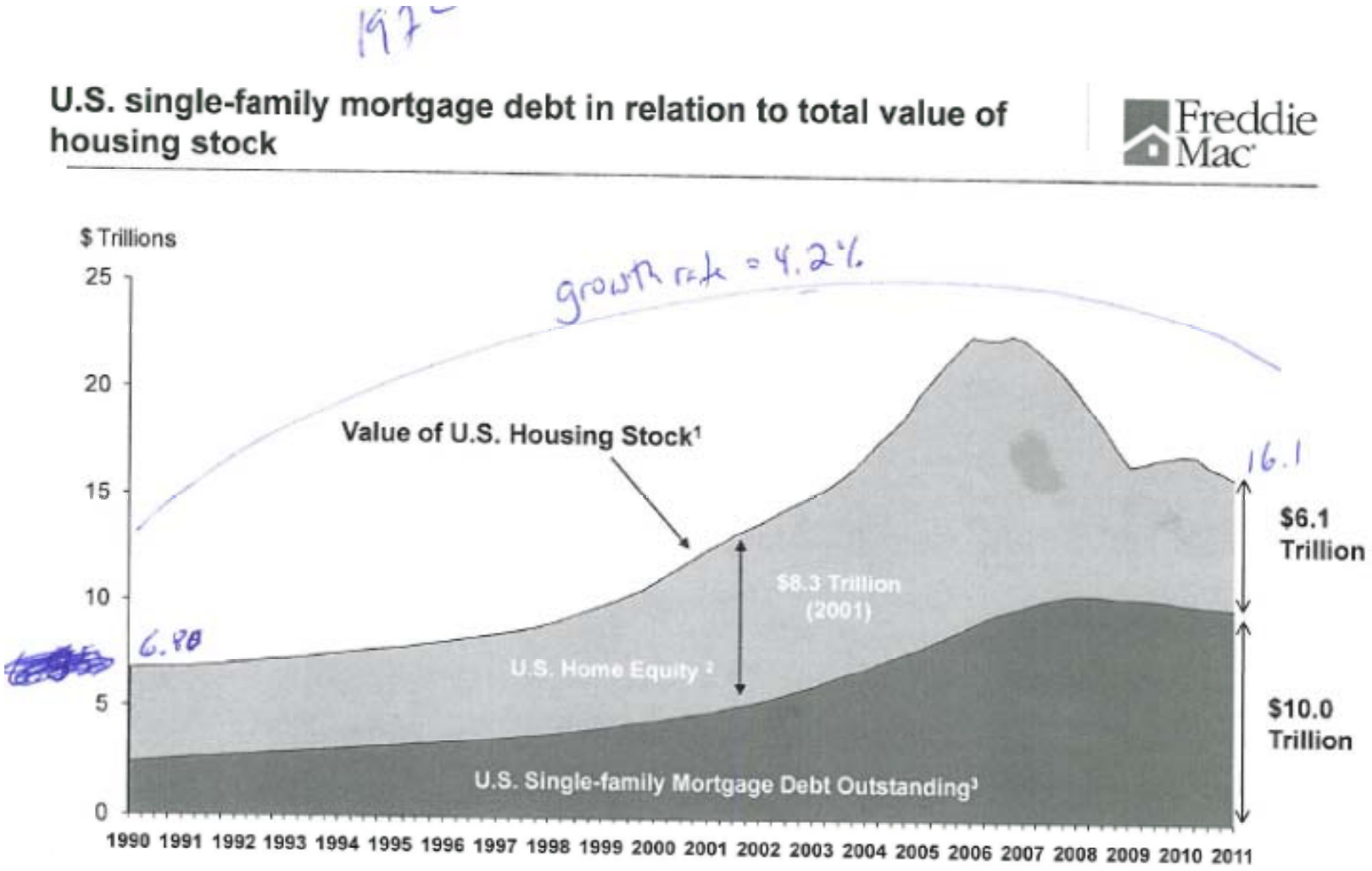
Tornado/Hail: 2011 looks extreme compared to previous years



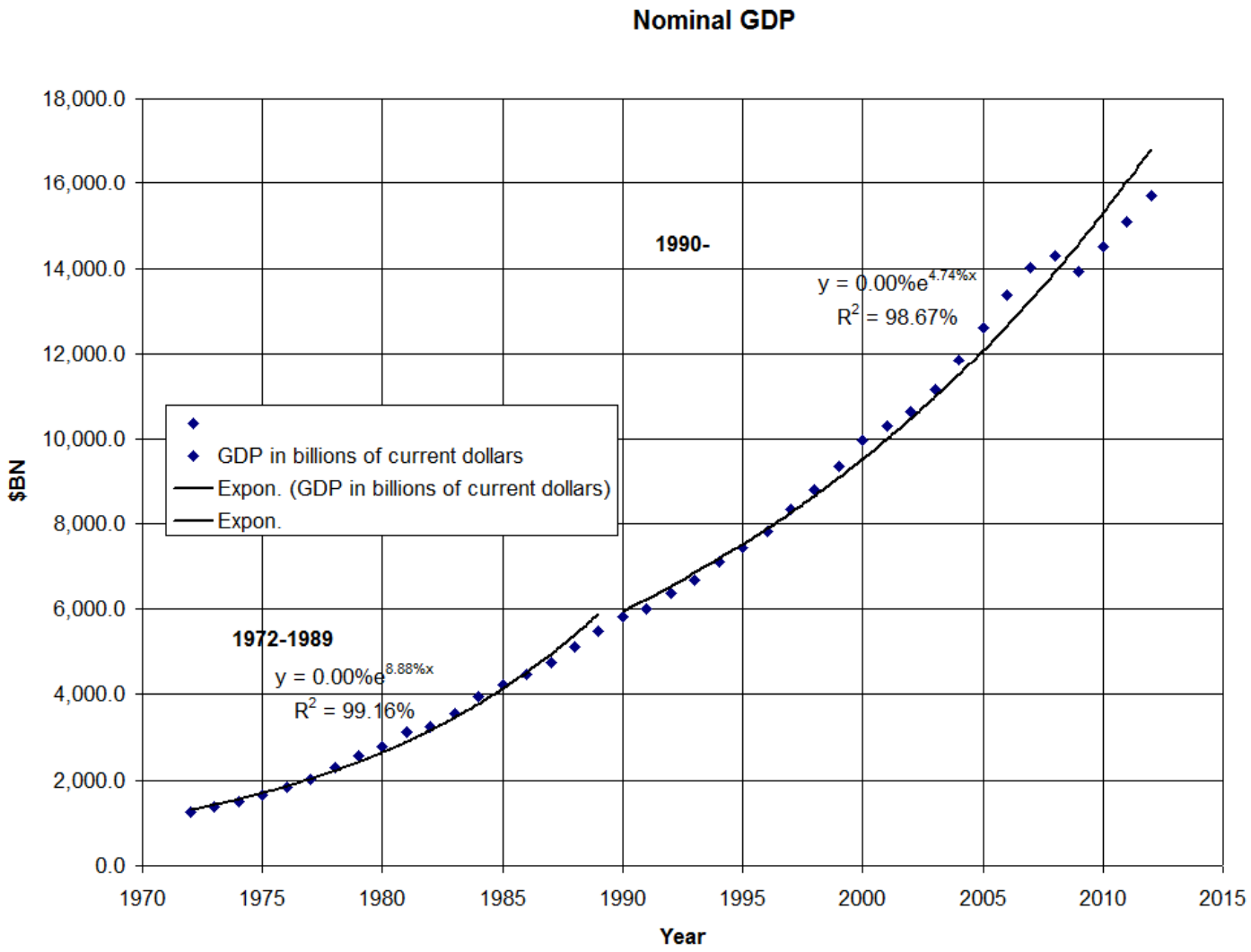
Tornado/Hail Losses: Annual Trend

- Initial trend based on nominal GDP
  - Allows for both inflation and real exposure growth
- But material residual trend of 3.81%
- Social inflation?
- Look at housing stock data

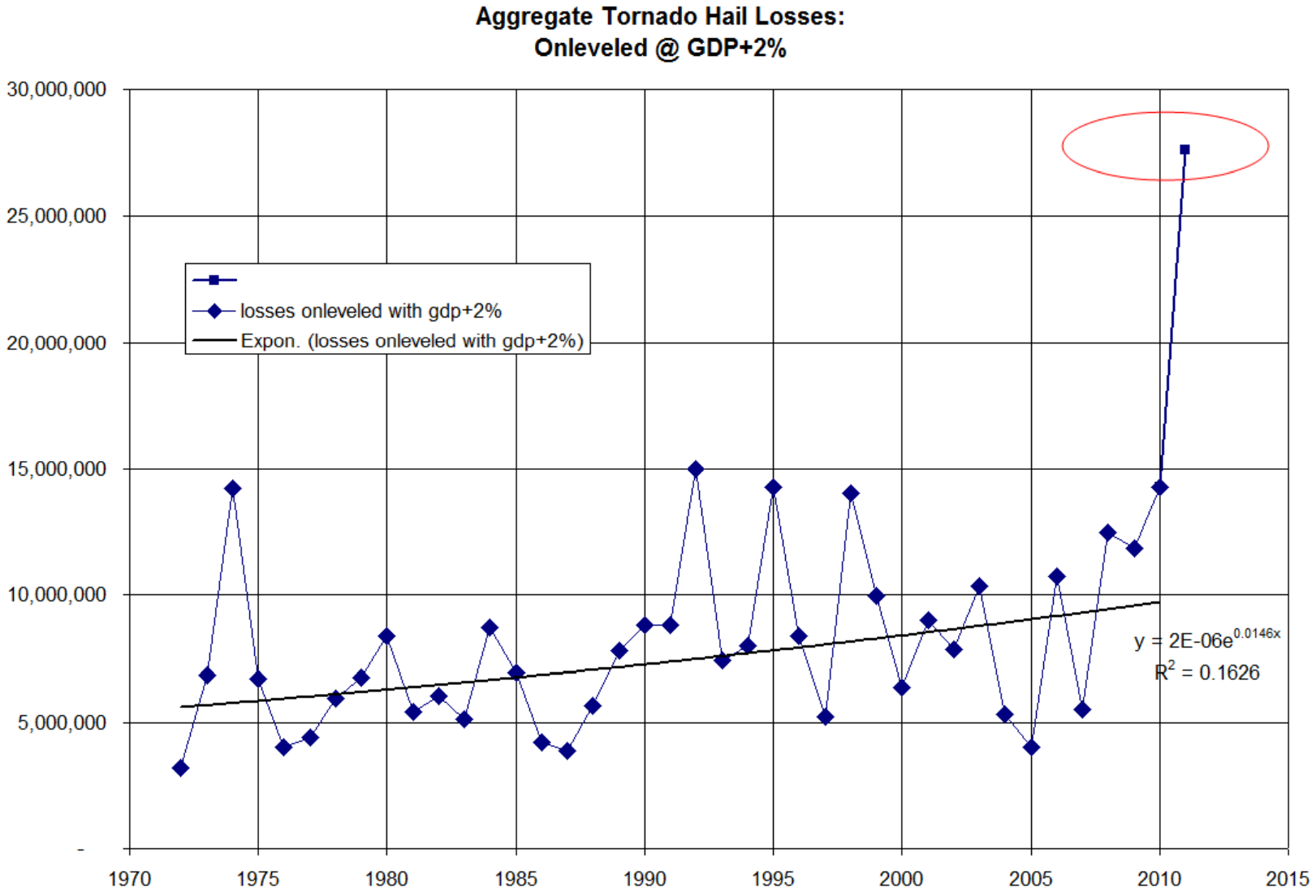
Annual Growth in value of Housing stock: 1990-2011 = 4.2%



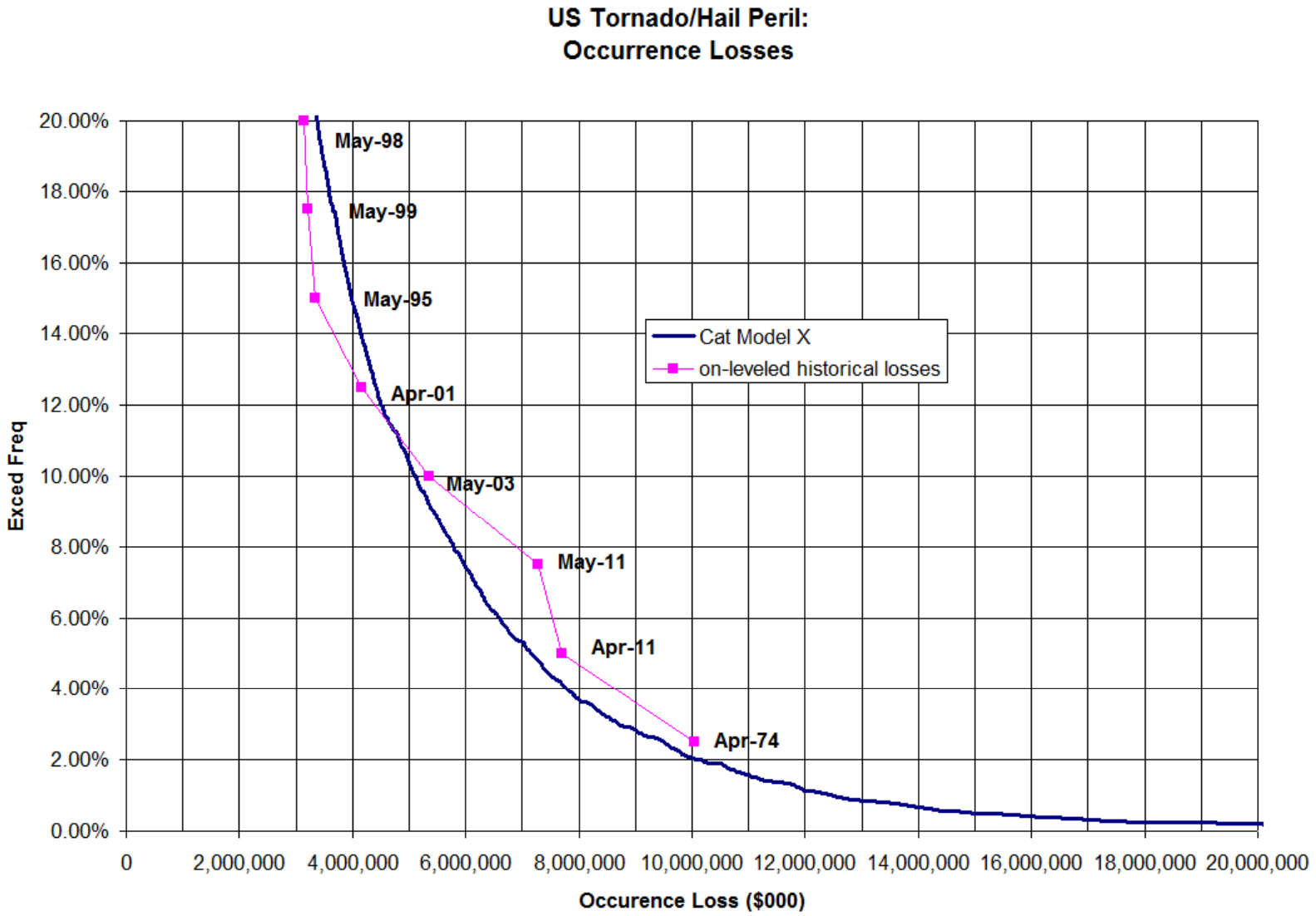
Nominal GDP Growth: 1990-2011= 4.86%



Trend at GDP +2% to eliminate residual trend (social inflation?)



Comparison to Cat Model X return period curve (Exced freq = 1/RP)



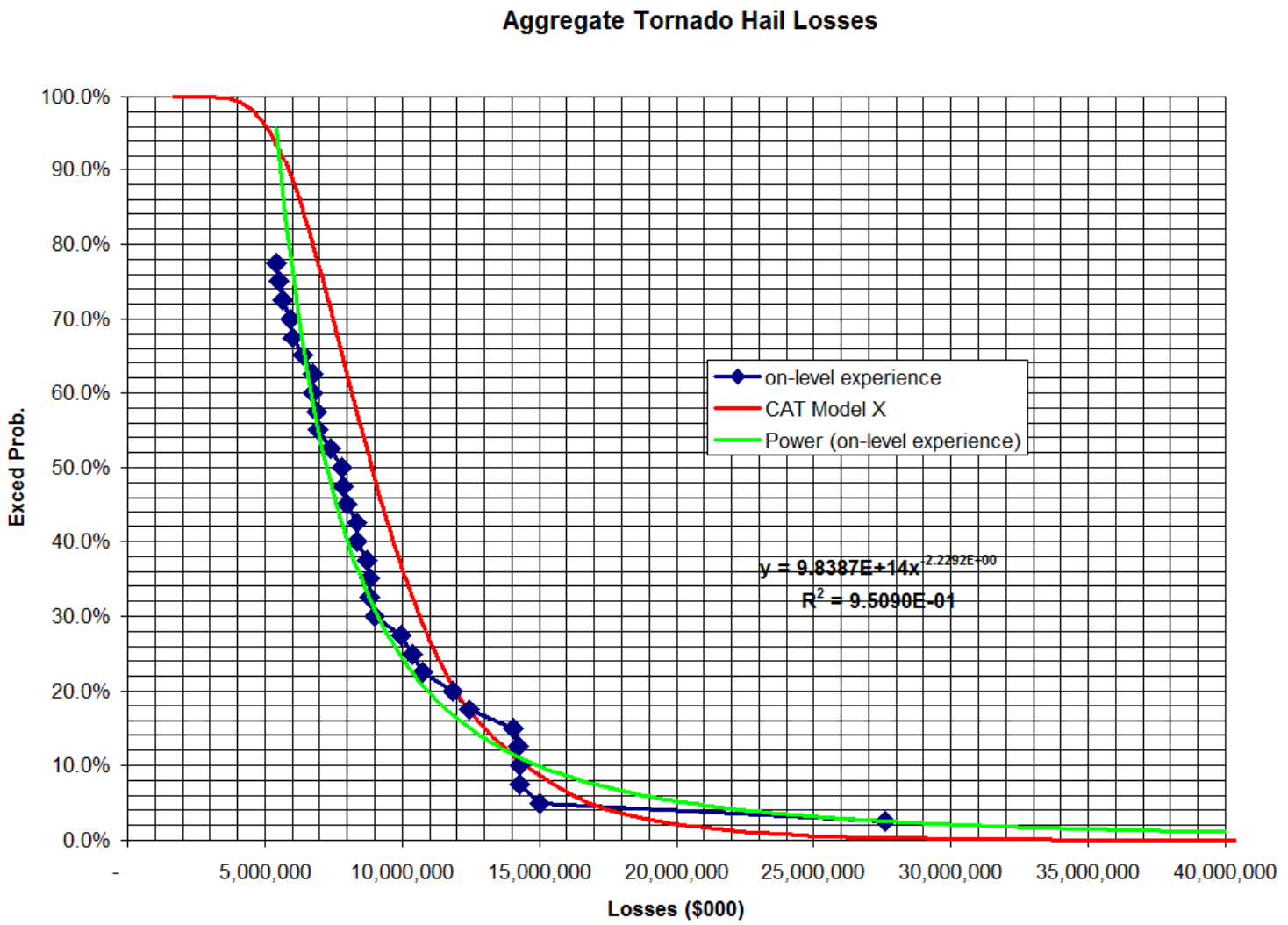
AIR return periods for Super Outbreak events (based on size of loss)

- 1974 Super Outbreak:
  - Cat Model X return period = 48 years
- 2011 Super Outbreak:
  - Cat Model X return period = 23 years
- May 2011 event:
  - Cat Model X return period = 20 years
- What are the odds of having two 20+ year events in the same year?

  - based upon a poisson distribution (doesn't allow for clustering) probability is 0.12%

  - not likely to be true probability- i.e. we must take event clustering into account

Tornado/Hail: 2011 Aggregate Losses are rather extreme



Return period for 2011 year as a whole?

- Cat Model X says it is a 300 year period year.
- Again perhaps not likely to be true
- Empirical return period: 40 years
- Power curve fit (green line) return period: 40 years