

ACTUARIAL SOCIETY 2015 CONVENTION

Hail and Quake in South Africa : What should you be worried about?

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Given the OEP Table on the screen which of the following statements is the most accurate?

- We expect a loss of R50bn every 200 years
- 2. The probability of a loss exceeding R50bn in one year is 0.5%
- We have observed two losses above R10bn in last 100 years so the above curve must be wrong
- On average we would expect a loss to exceed R50bn once every 200 years

Occurrence Exceedance Probability (OEP)				
Return Period (years)	Loss (ZAR m)			
2	2			
5	15			
10	50			
20	120			
25	300			
50	2,500			
100	10,000			
200	50,000			
250	60,000			
500	75,000			
1000	80,000			







Does the OEP table below suggest a correlation (clash) between Cape Town EQ and Gauteng EQ?

- 1. Yes
- 2. No

Occurrence Exceedance Probability (OEP)					
Return Period (years)	Gauteng Loss (R'm)	Cape Town Loss (R'm)	South Africa Loss (R'm)		
50	1,000	1,000	5,000		
100	5,000	5,000	25,000		
200	25,000	25,000	33,000		
250	30,000	30,000	35,000		
500	35,000	35,000	40,000		
1000	40,000	40,000	45,000		

What regions and EQ drive loss?



EQECAT - Average Annual Loss by Cresta and Magnitude

Cresta									
7000	5.00	5.25	5.50	5.75	6.00	6.25	6.50	6.75	Grand Total
zone							7,289,435		7,289,435
1	221,462,596	286,237,759	486, 696, 474	638,170,915	3,855,240		82,824,190	1,035,691,229	370, 242, 356
2	192,446	397,411	3, 499, 552	11,586,584	1,222,402	35,489,924	9,298,390		6,577,693
3	19,671,059	3,452,079	47, 326, 142				16,003,449	69,374,495	67,414,320
4	239,447	278,006	48, 203, 064	282,616,143	1,253,070		8,385,738	5,562,856	4,125,069
5	390,716,242	710,217,142	1,095,053,247	1,631,269,807					645,364,945
6	684,268,530	962,182,894	1,433,253,339	2,350,970,112					984,629,369
7	288,856,339	617,622,873	1,120,624,390	1,704,518,836					584,319,101
8	307,112,349	40,634,303	677, 126, 021	676,672,357	1,428,930,782	1,679,981,396			715,759,075
9	83,801,754		94, 302, 121						87,301,876
10	43,794,234	77,094,849	158, 880, 642	122,206,927	551,387,847	398,458,128			236,062,513
11	17,487,733	7,849,566	57,727,481	30,531,626	1,056,850,836	163,529,141			79,313,316
12	1,354,790	3,123,536	36, 588, 277	2,539,044	38,945,089	101,373,367			35,252,286
13		87,651,636	182, 246, 577						181,041,546
14	215,896	110,546	45, 140, 757		11,115,599		89,632,946		38,036,844
15	12,372,096								12,372,096
16	610,185	7,984,018	47, 256, 900		7,604,016		6, 794, 742		40,749,253
Grand Total	180,233,469	397,374,107	372, 860, 316	358,375,545	377,516,908	159,954,680	47,277,374	70,825,435	290, 300, 293

What zones and size earthquakes drive the tail? EQECAT Model :1 in 200-Year



Mo	agnitude	Cresta 5	Cresta 6	Cresta 7	Cresta 8	Cresta 9	Cresta 10	Cresta 11
	5	89,791,320	819,545,280	46,512,514	362,467,072	-	8,474,680	7,814,756
	5.25	181,793,074	985,461,777	61,715,008	-	-	-	-
	5.5	240,027,456	1,066,847,552	217,173,650	393,834,336	-	17,947,746	25,609,913
	5.75	132,037,680	1,061,886,656	134,523,020	-	-	38,521,716	228,145
	6	-	-	-	1,132,252,928	-	4,332,511	152,766,864
	6.25	-	-	-	35,953,576	-	94,983,200	45,253,724
	6.5	-	-	-	-	-	-	-
	6.75	-	-	-	-	46,112,784	-	-



How many earthquakes do you think have occurred in the last 200 years which would cause an insured loss of more than R1bn (in current values) in South Africa?

- 1. 1
- 2. 2
- 3. 3 or more
- 4. None

Scenario – Most destructive earthquake in recent times

29th September 1969, Tulbagh-Ceres, M6.3

Lander (1970) :

Economic Loss of \$24m which converts to R18m (at current ROE would be R343m!)

Indexation since 1969

House Price Index : Average 10.6% p.a. (Retail price 9.2% p.a.)

So > R1bn in current values

But building count has also increased (population 2.4x since 1969)

So Total Indexed Loss > R2bn

EQECAT (Core Logic) Estimate :

Economic Loss ~ R75m Built Environment Loss ~ R50m Indexed Built Environment ~ R5.5bn









Modified Mercali Intensity scale

Not felt	Not felt except by a very few under especially favorable conditions.
II. Weak	Felt only by a few persons at rest, especially on upper floors of buildings.
III. Weak	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV. Light	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V. Moderate	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI. Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII. Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII. Severe	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX. Violent	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X. Extreme	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI. Extreme	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII. Extreme	Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.

Analysing the scenario intensity map

Loss Scenario ~ R3.6bn





MMI	Property	Engineering	Motor	Total
III - IV	29.3bn	0.6bn	1.5bn	31.4bn
IV - V	1,971.5bn	76.5bn	102.5bn	2,150.6bn
V - VI	355.0bn	6.4bn	11.5bn	372.8bn
VI - VII	19.2bn	0.2bn	0.3bn	19.7bn
VII - VII	7.8bn	7.0bn	0.1bn	14.8bn
VIII - IX	5.9bn	1.2bn	0.1bn	7.2bn
Total accumulation MMI V and above	387.8bn	14.7bn	12.0bn	414.5bn

Analysing the scenario intensity map Loss Scenario ~ R11.8bn



ACTUARIAL SOCIETY OF SOUTH AFRICA

SA Council for Geosciences Intensity Footprint

ММІ	Property	Engineering	Motor	Total
III - IV	308.5bn	17.0bn	17.4bn	342.8bn
III - IV	451.5bn	23.1bn	24.4bn	499.0bn
IV - V	238.4bn	6.1bn	9.4bn	253.9bn
V - VI	1,767.4bn	72.0bn	95.1bn	1,934.5bn
VI - VII	506.5bn	10.3bn	16.6bn	533.5bn
VII - VII	12.0bn	7.9bn	0.1bn	20.1bn
_VIII - IX	9.5bn	0.3bn	0.2bn	10.0bn
Total accumulation MMI V and above	2,295.4bn	90.6bn	112.1bn	2,498.1bn

Scenarios What else has occurred since then?



<u>8 December 1976</u>: Welkom, M5.54, estimated market loss of ~ **R200m**

22 February 2006: Mozambique magnitude 7.0 - was felt and caused damage in Durban, ca. 1000 km from epicentre, estimated market loss of ~ **R50m**

<u>5 August 2014</u>: M 5.4 seismic event in Orkney (just south of Klerksdorp), caused one death and significant damage to infrastructure, estimated market loss of ~ **R300m**

Date E	Epicentre	M_L	Depth	Market Last (Current Values)	
29-Sep-69 🗈	Near Tulbagh	6.3		>R2bn	
08-Dec-76 \	Welkom	5.2		~ R200m	
26-Sep-90 \	Welkom	4.2			Top 25
09-Mar-05 S	Stilfontein, North West	5.3			
28-May-13	Near Mbabane	4			
22-Jun-13 T	Thabazimbi, Limpopo	3.9	9 km		
07-Jul-13 F	Barberton, Mpumalanga	4.7	5 km		
11-Nov-13 l	University of Johannesburg, Gauteng	4			
02-Dec-13 ^	~25 km south of Bela-Bela, Limpopo	4.8	5 km		2 2.0
15-Jun-14 🛚 🖻	Near Orkney, North West	4.9 MW	5 km		
05-Aug-14	Near Orkney, North West	5.5	5 km	~ R300m	٢٠, [*] ٩, [*] 6, [*] 8, [*] 8
22-Aug-14	Near Orange Farm, Gauteng	3.8	10 km		

Scenarios

And what about before 1969?



Checking Model Components against independent research







Which of the following natural hazards concerns you most?

- 1. Drought
- 2. Earthquake
- 3. Flood/Rain/Wind
- 4. Hail





Hail events in South Africa



Hail events Understanding the claims distribution



Most catastrophe models estimate loss as a % of insured values

So double the insured value = double the loss

That does not happen in practice, especially for perils such as Hail, Wind and Flood



Use of Satellite Drone Imagery



Pre-event imagery captures pre-event land-use and cargo inventory

Post-event imagery from +1 day partially obscured by smoke

Post-event +4 day image is smoke free and clearly shows impact area

Bright white areas of the image are due to the sun reflecting off residue water from firefighting efforts and fallen glass/debris.



Hail Scenarios

Nov. 28 2013 hailstorm : Total Loss of ~ R2bn (Bloomberg Report)

Centurion Car Park Scenario

Number of cars	4,500		
Average Sum Insured	170,000	Total SI	765,000,000
Average Claim	30,000	Total Claim Amount	135,000,000

N1 Traffic Jam

Highway Length45kmAverage Car LengthLength Affected20kmSpace Between Cars	21,33	cles Damaged	Total Vehic	8	Number of lanes
Highway Length45kmAverage Car LengthLength Affected20kmSpace Between Cars	21,33	cles Damaged	Total Vehic	8	Number of lanes
Highway Length 45km Average Car Length	3	ween Cars	Space Betv	20km	ength Affected
	4.5	Car Length	Average C	45km	Highway Length

FSB (based on Motor	Insured Values only)	GC Model	(Combined)	
		Return Period	Loss (ZAR)	
Market Factor	0.46%	2	40,000,000	
1.200	4 100 000 000	5	160,000,000	
-,100,000,000		10	380,000,000	
		20	1,050,000,000	









Which of the following other perils/risks concerns you most?

- 1. Cyber attack
- 2. Dam Burst
- 3. Power Blackout
- 4. Terrorism
- 5. Explosion
- 6. Pandemic



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