IndonesiaRe

Indonesia Leading Reinsurer

Life Insurance Catastrophe Model

Nico Demus – Head of Actuarial & Life Portfolio Management Division

Agenda

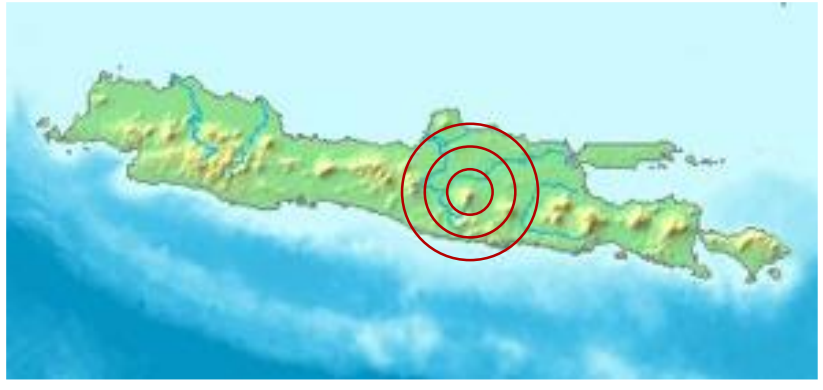
- Catastrophe Definition
- Catastrophe Events in Indonesia
- Catastrophe Mapping
- Catastrophe Model
- Catastrophe Reserve

Catastrophe Definition

Catastrophe → **Single** Event → Great / Sudden

Dimension

Area Limit



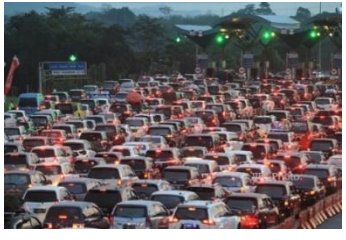
Time Limit

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
26	27	28	29	30	31	1
2	3	~~4~~	~~5~~	~~6~~	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22

Catastrophe Event in Indonesia
Man Made

Factors

Inadequate transport infrastructure



Increasing number of vehicles

Lack of driving skills

Poor vehicle condition

Disobeying traffic rule

Catastrophe Event in Indonesia

Natural Disaster

Tsunami

Volcano Erruption

Landslide

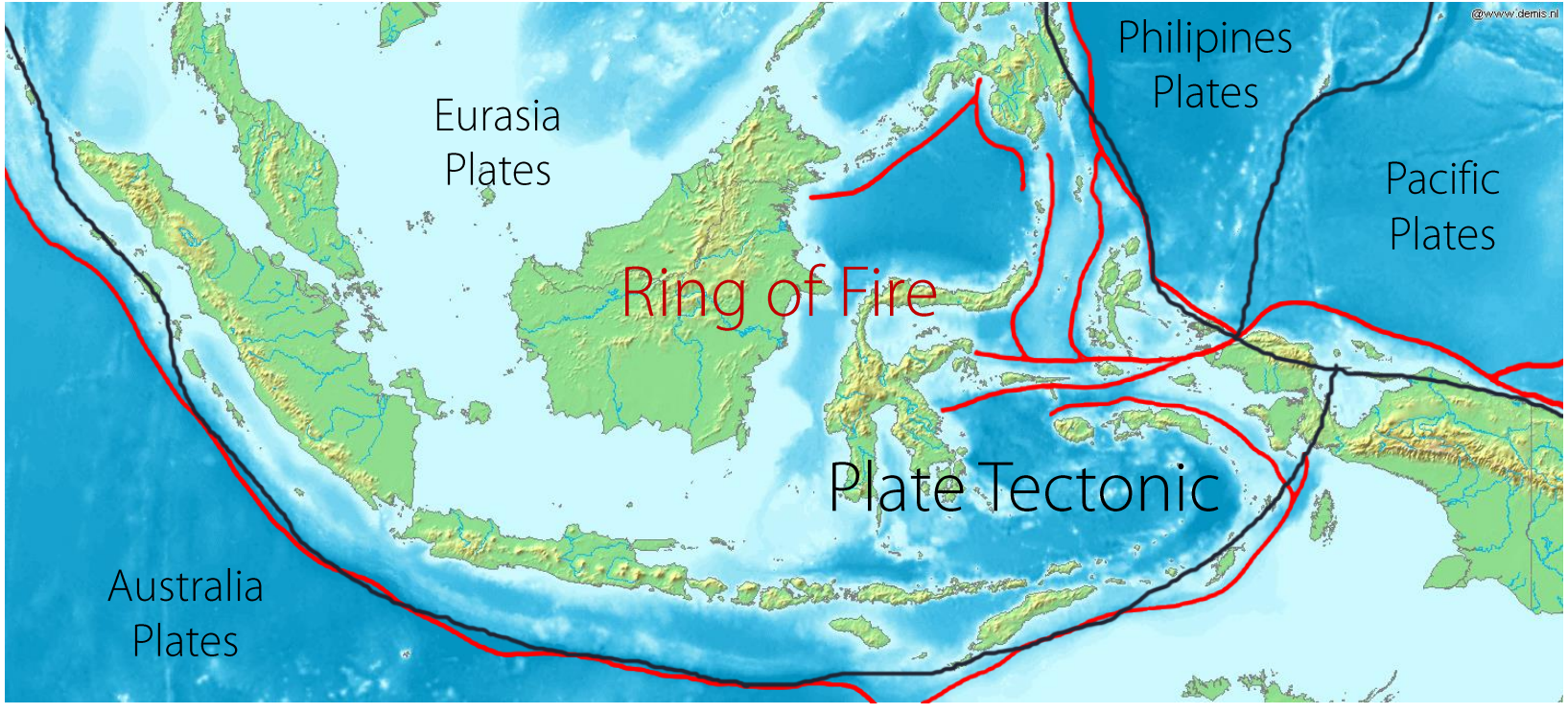
Earthquake

Tornado

Flood

Catastrophe Event in Indonesia

Natural Disaster



Catastrophe Coverage

Life Catastrophes Event are characterized by a sudden and concentrated increase in mortality and as such present a major risk for life insurers

Transportation Accident

Natural Disasters

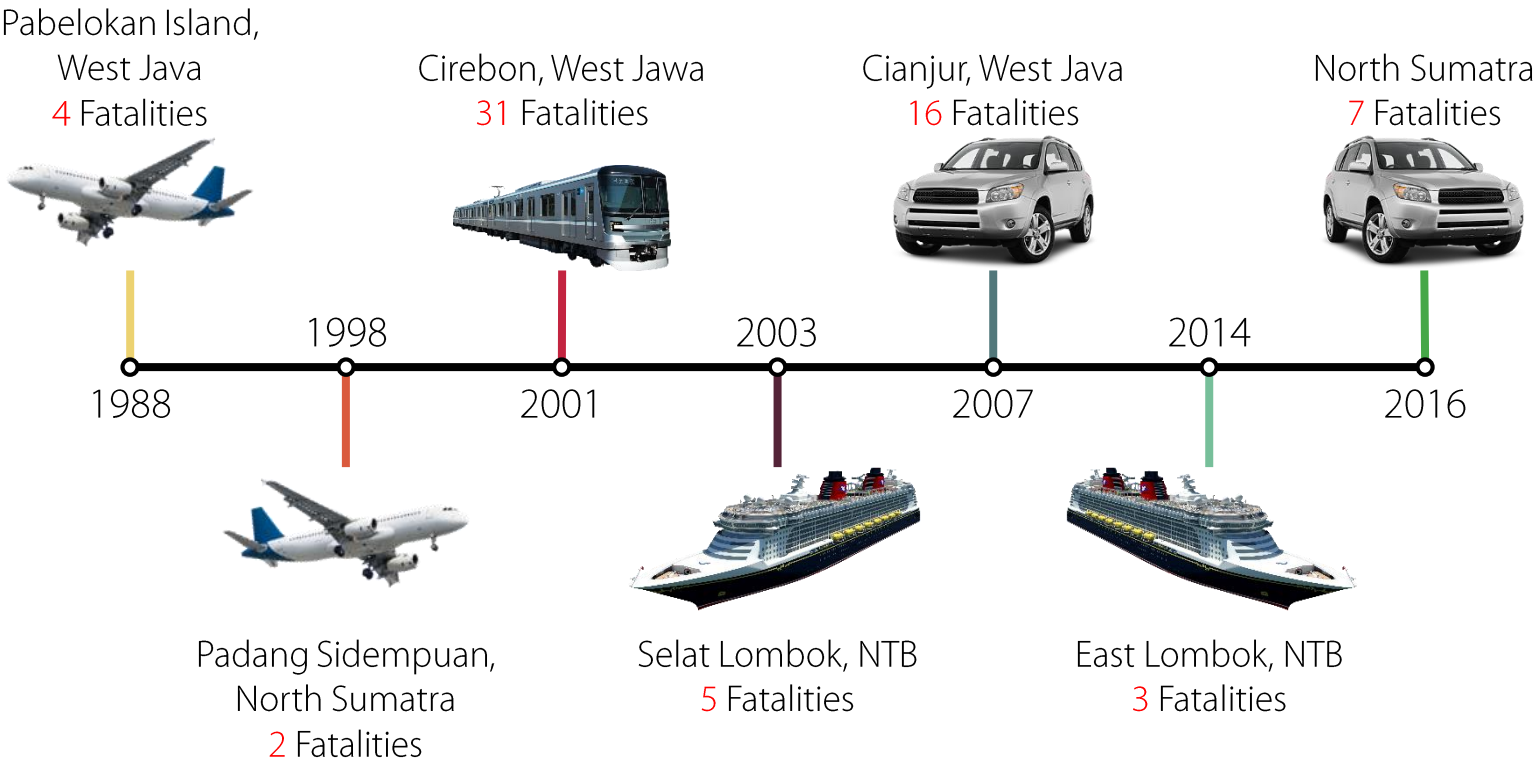
Terrorism

Epidemics

Nuclear Hazard

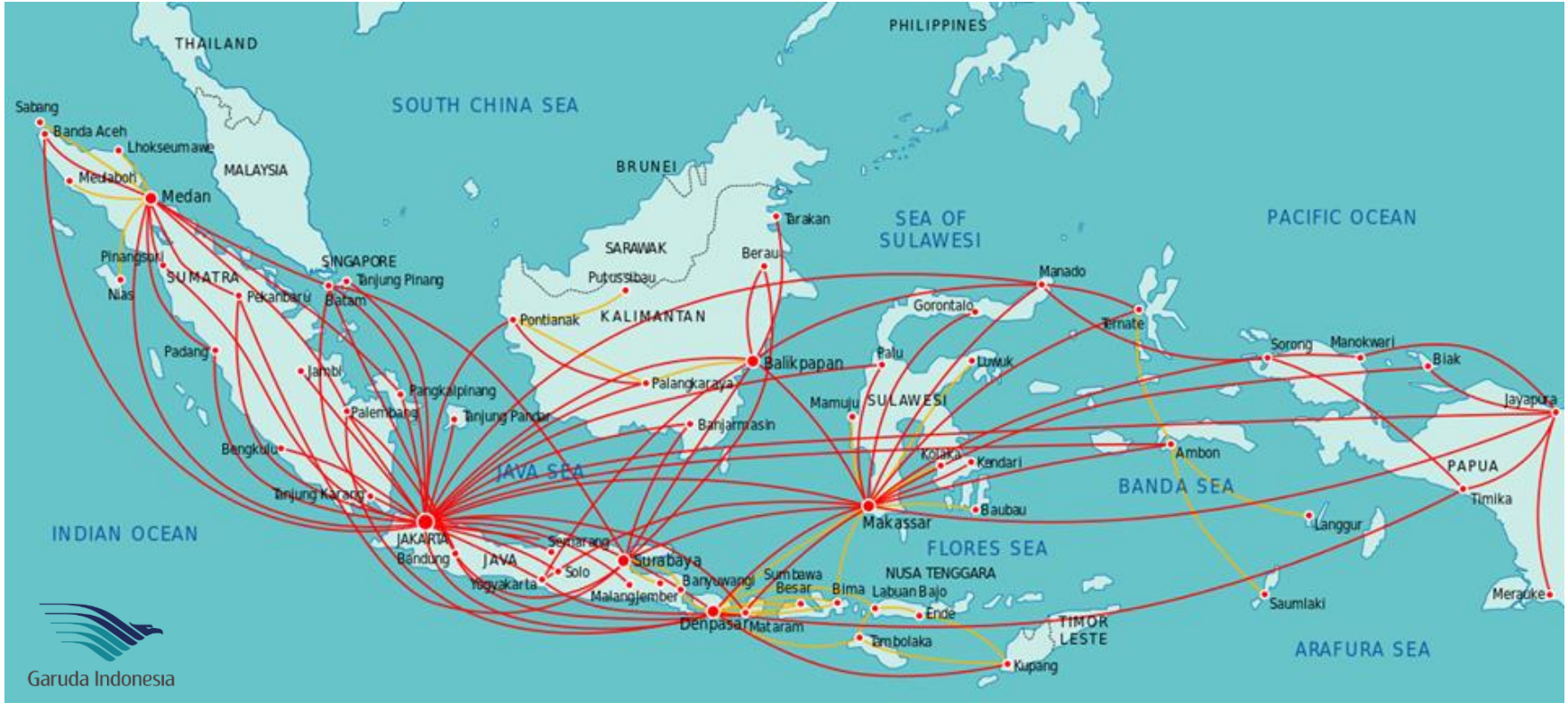
Catastrophe Events in Indonesia

Transportation Accidents



Aviation Accident in Indonesia

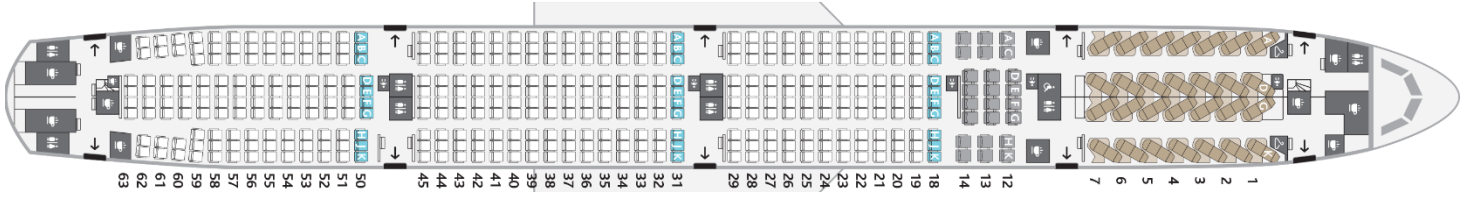
Aviation Route in Indonesia



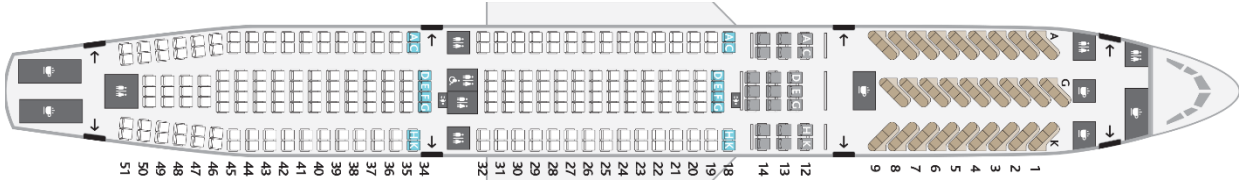
Aviation Accident in Indonesia

Flight Capacity

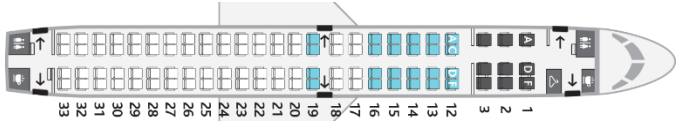
Boeing
777-300ER (77W)



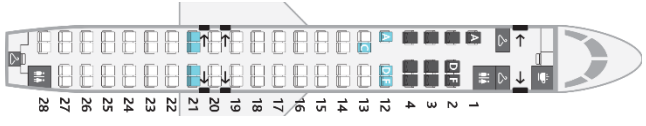
Airbus
A330-300 (333)



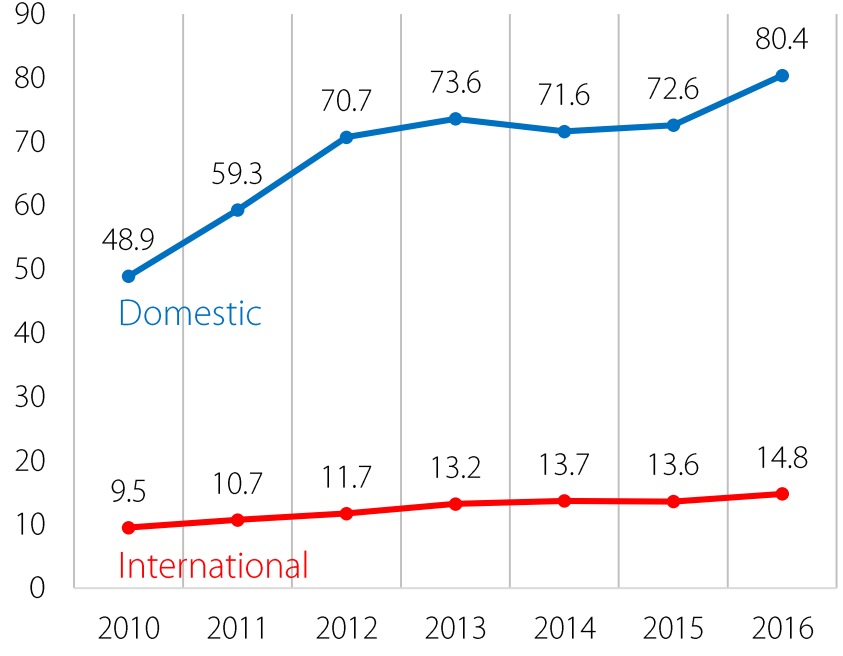
Embraer
E190 (E90)

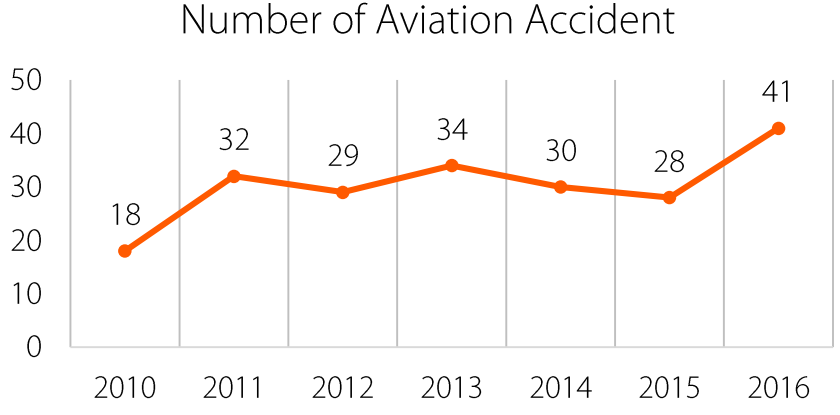


Bombardier
CRJ705/900

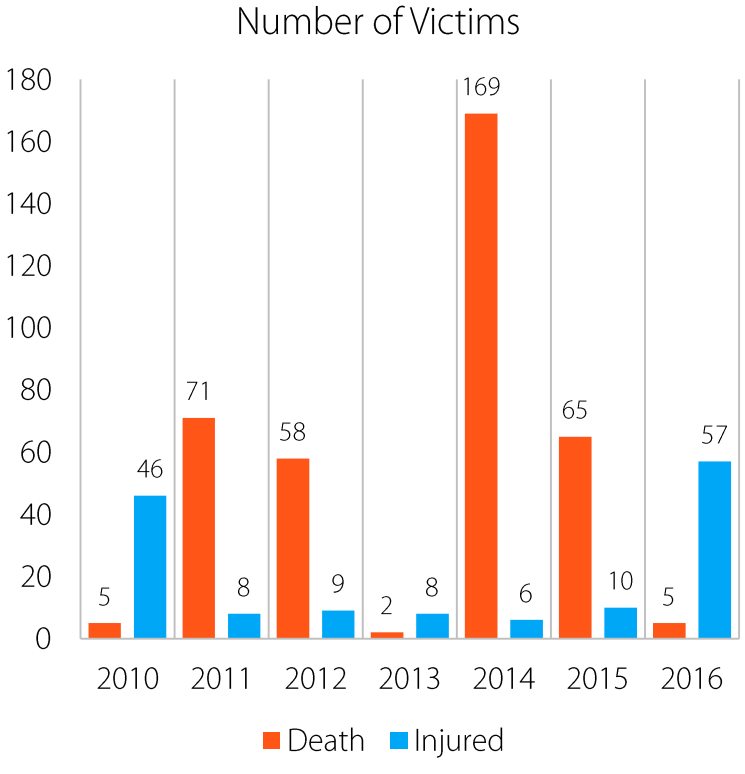


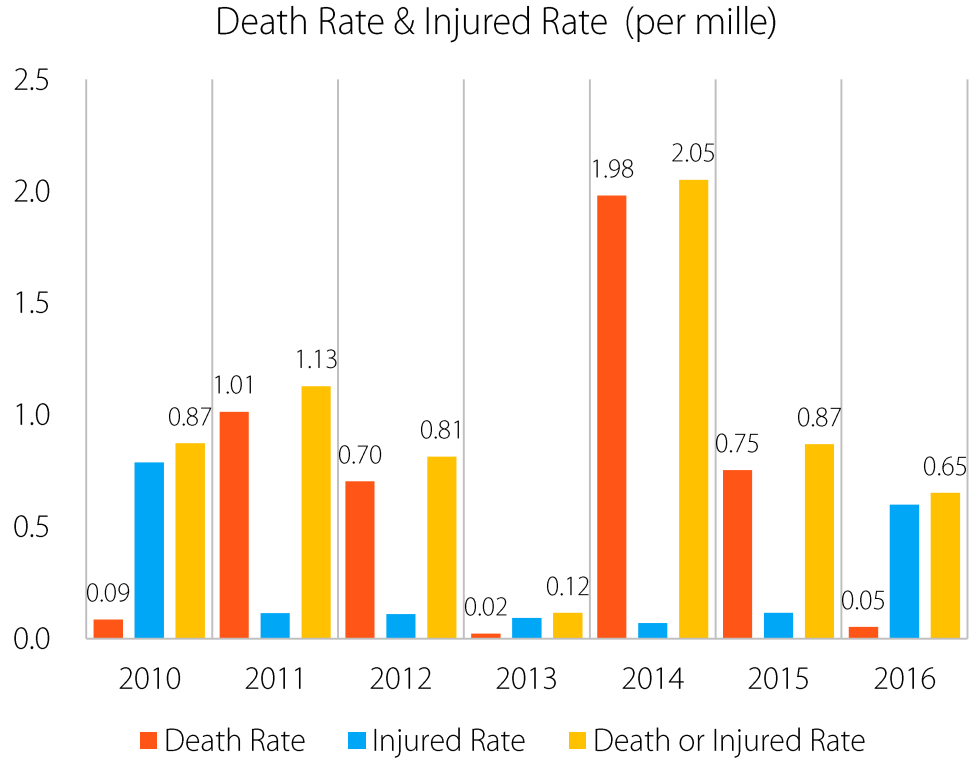
Aviation Statistics in Indonesia





Aviation Accident in Indonesia





Some Aviation Accident

mandala

5 September 2005
149 Fatalities
Medan, North Sumatra

ADAMAIR

1 January 2007
102 Fatalities
Makassar Strait, Sulawesi

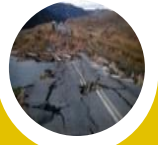
AirAsia

28 December 2014
162 Fatalities
Karimata Strait

Catastrophe Events in Indonesia

Natural Disasters

Yogyakarta
213 Fatalities
1943
Earthquake

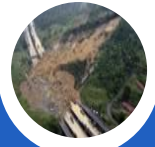


Volcano Eruption
1966
Sulawesi Utara
34 Fatalities

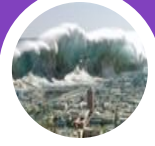
Aceh
24 Fatalities
1978
Flood

Volcano Eruption
1 April 1997
Sulawesi Utara
2 Fatalities

Jawa Barat
11 Fatalities
20 July 1988
Landslide



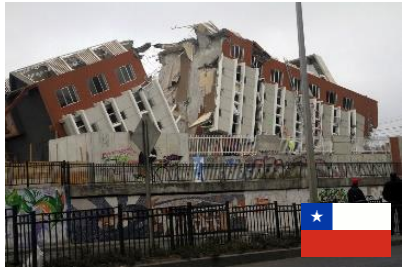
Tsunami
26 Desember 2004
Aceh
166.541 Fatalities



DKI Jakarta
48 Fatalities
1 February 2007
Flood

Earthquake
7 December 2016
Aceh
96 Fatalities

Catastrophe Events in Insurance
Natural Disasters



Tsunami in Chile

2 February 2010

520 Fatalities

USD 8,000 Mio
Insured loss

Flood in Australia

10-14 January 2011

22 Fatalities

AUD 1,900 Mio
Insured loss

Tsunami in Japan

11 March 2011

16,000 Fatalities

USD 40 Bio
Insured loss

Tornado in US

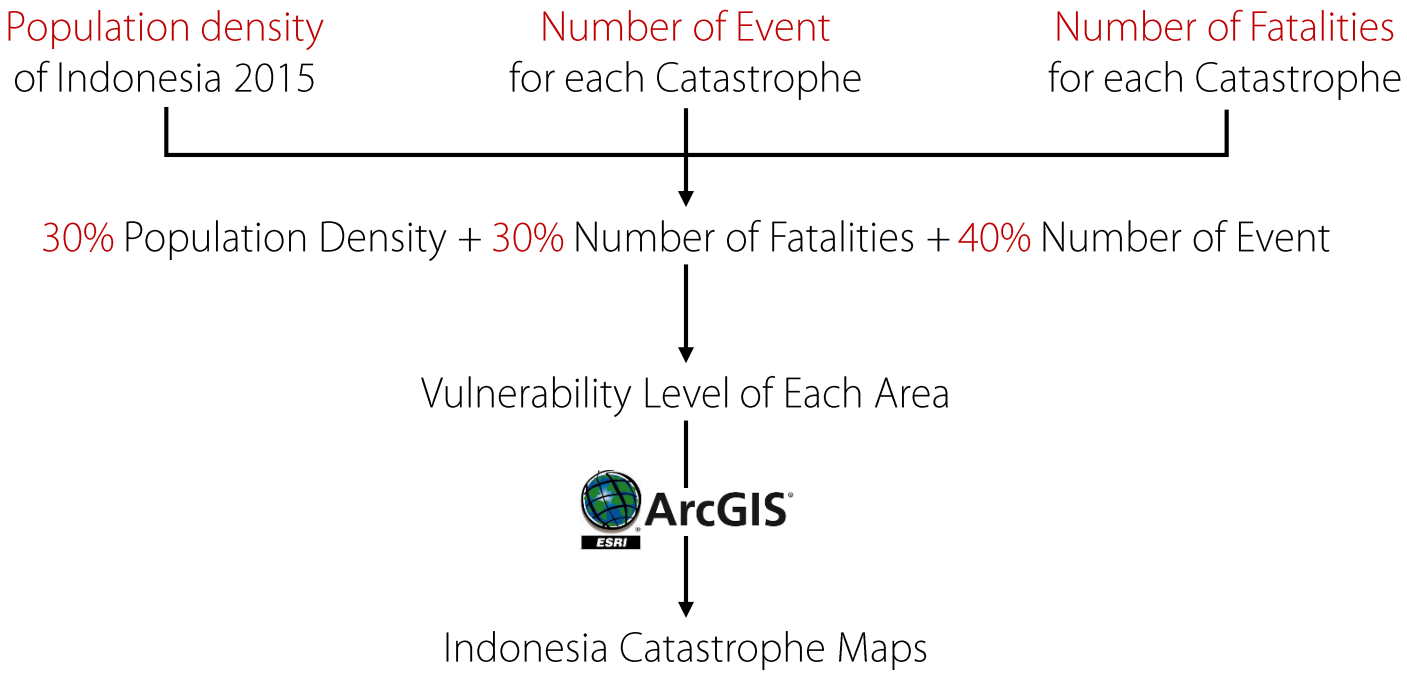
28-29 April 2012

350 Fatalities

USD 2,500 Mio
Insured loss

Catastrophe Mapping Construction

Illustration of Catastrophe Mapping



BNPB

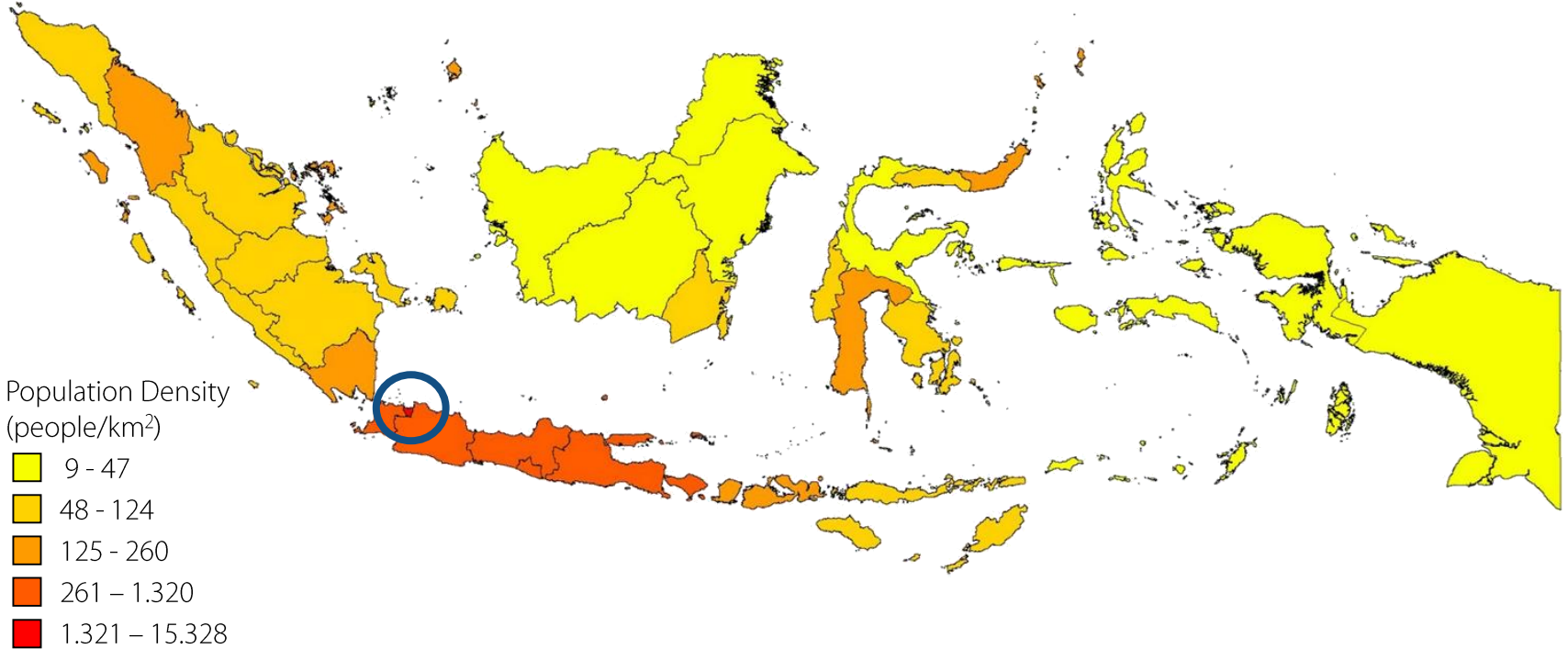
Observation period:
1917-2016 (100 Years)

Types of Catastrophe:

1. Floods
2. Landslides
3. Landslides caused by floods
4. Earthquake
5. Volcano
6. Transportation Accident

Population Density

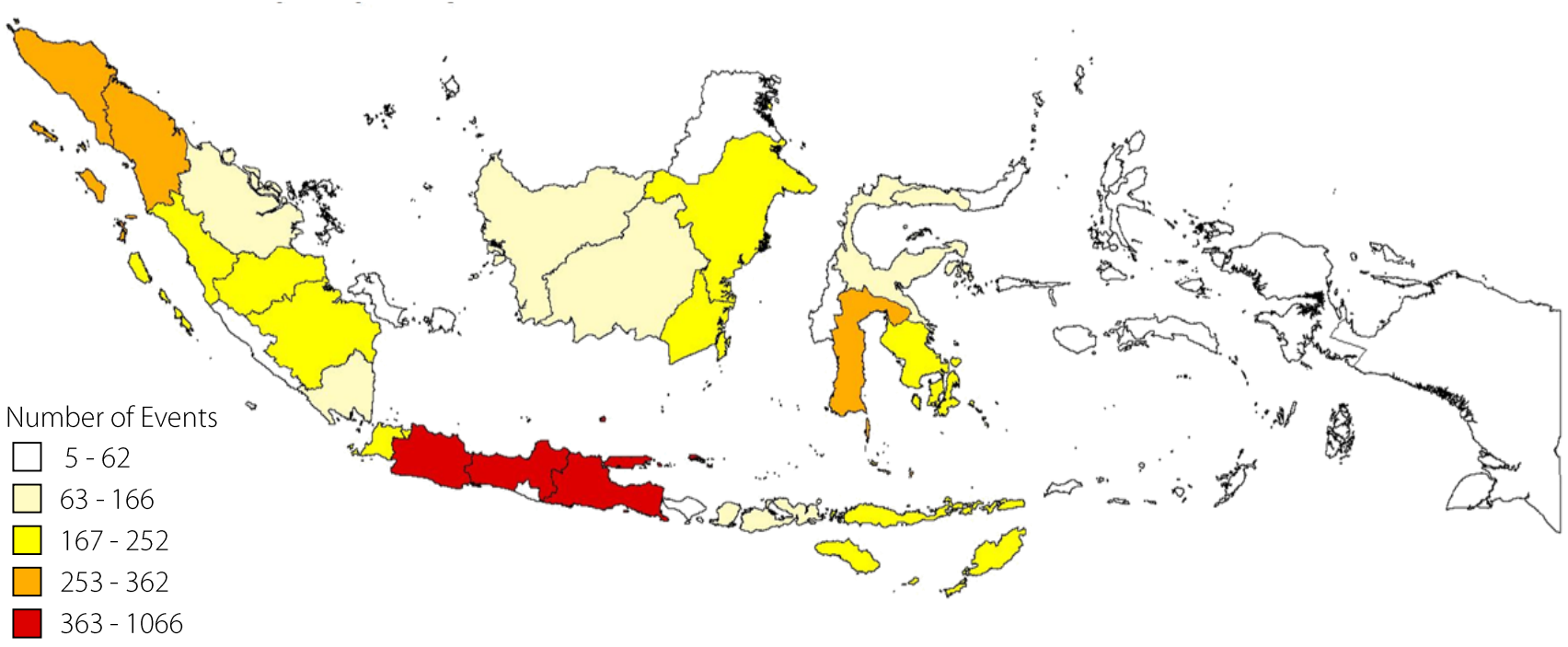
Density Level in Each Area



BADAN PUSAT STATISTIK

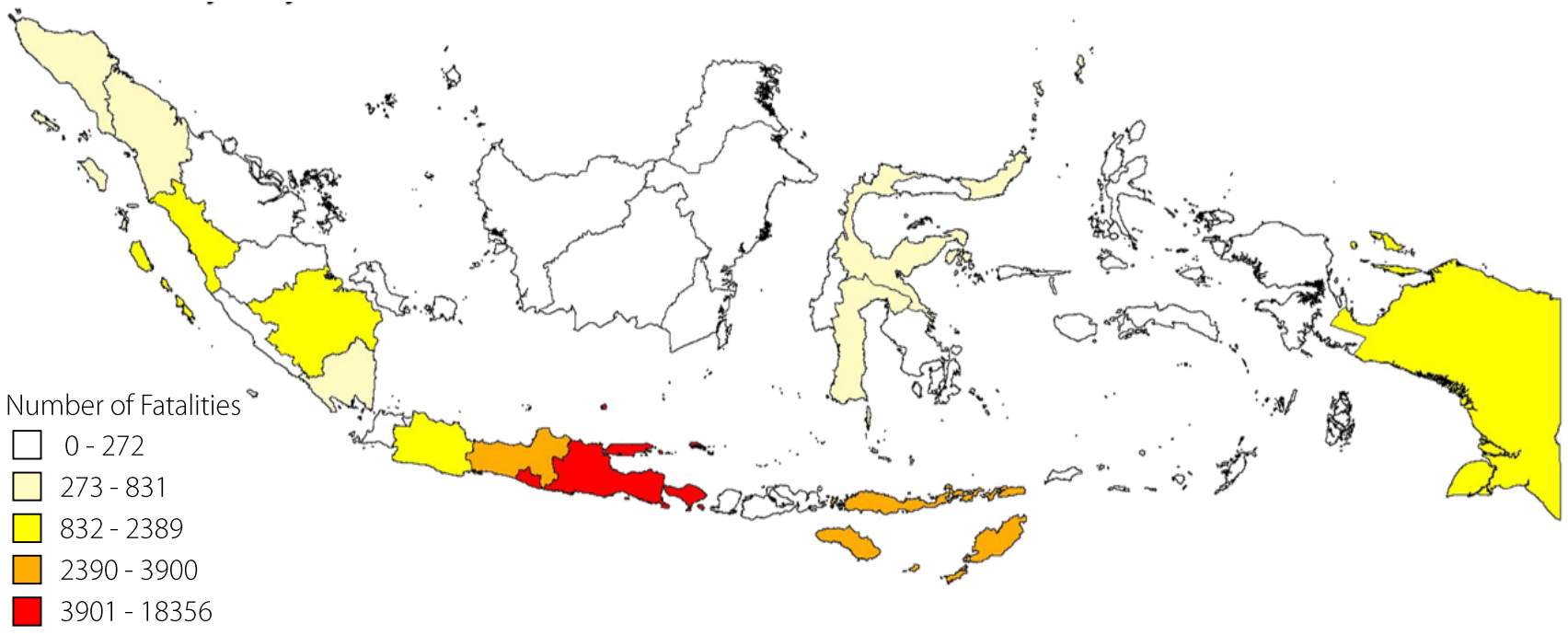
Catastrophe Events

Number of Events (Last 100 Years)



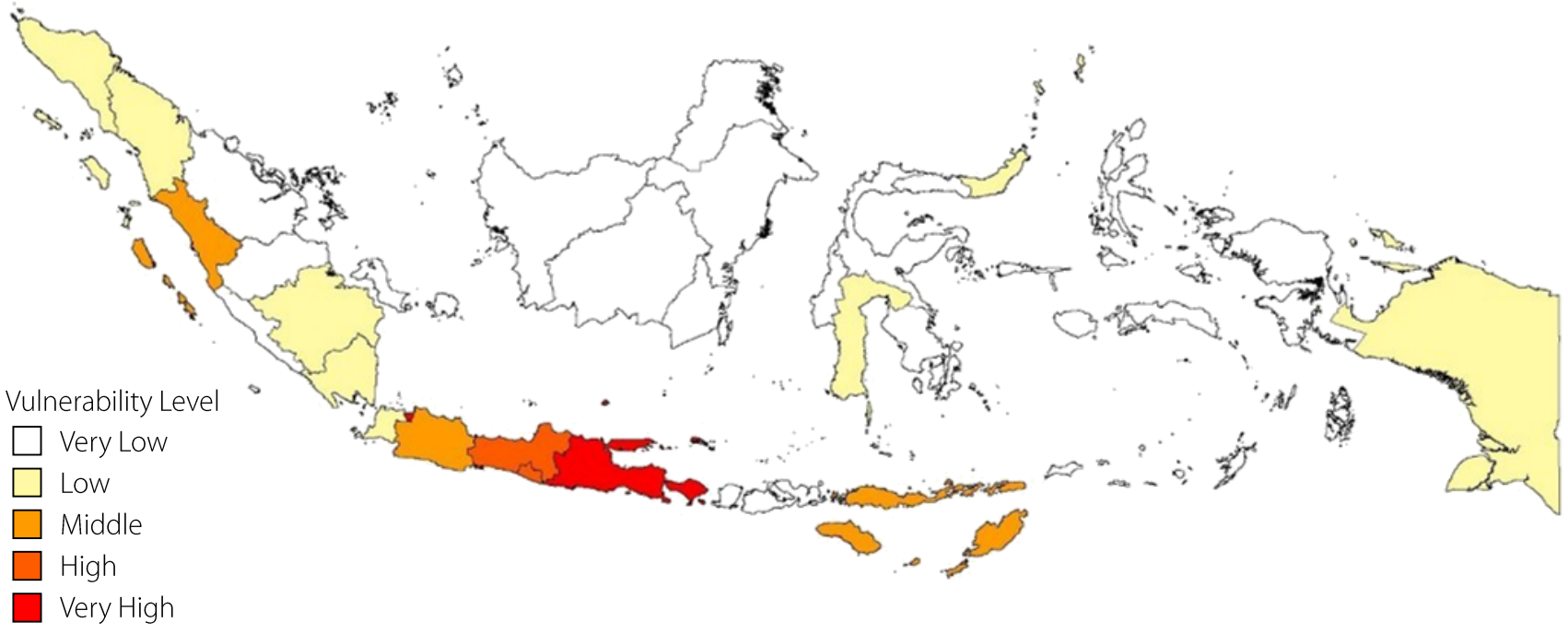
Catastrophe Events

Number of Fatalities (Last 100 Years)



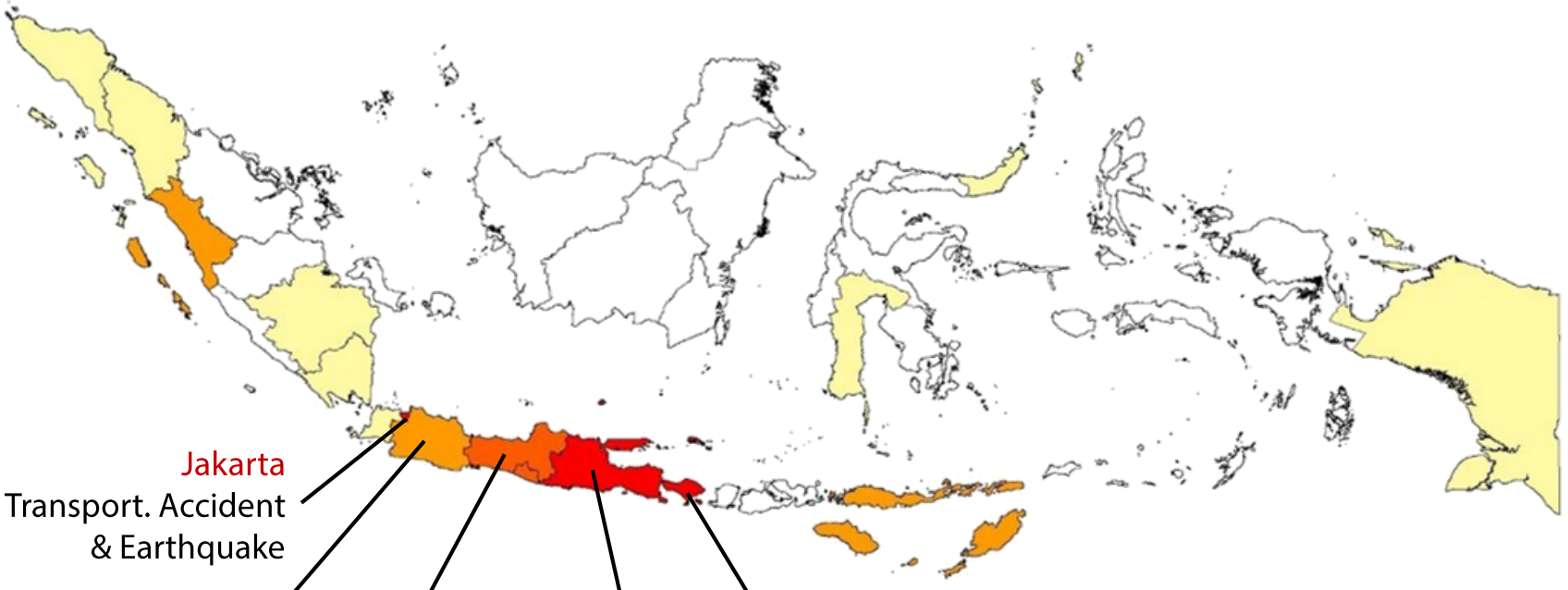
Catastrophe Events

Vulnerability Level (Last 100 Years)

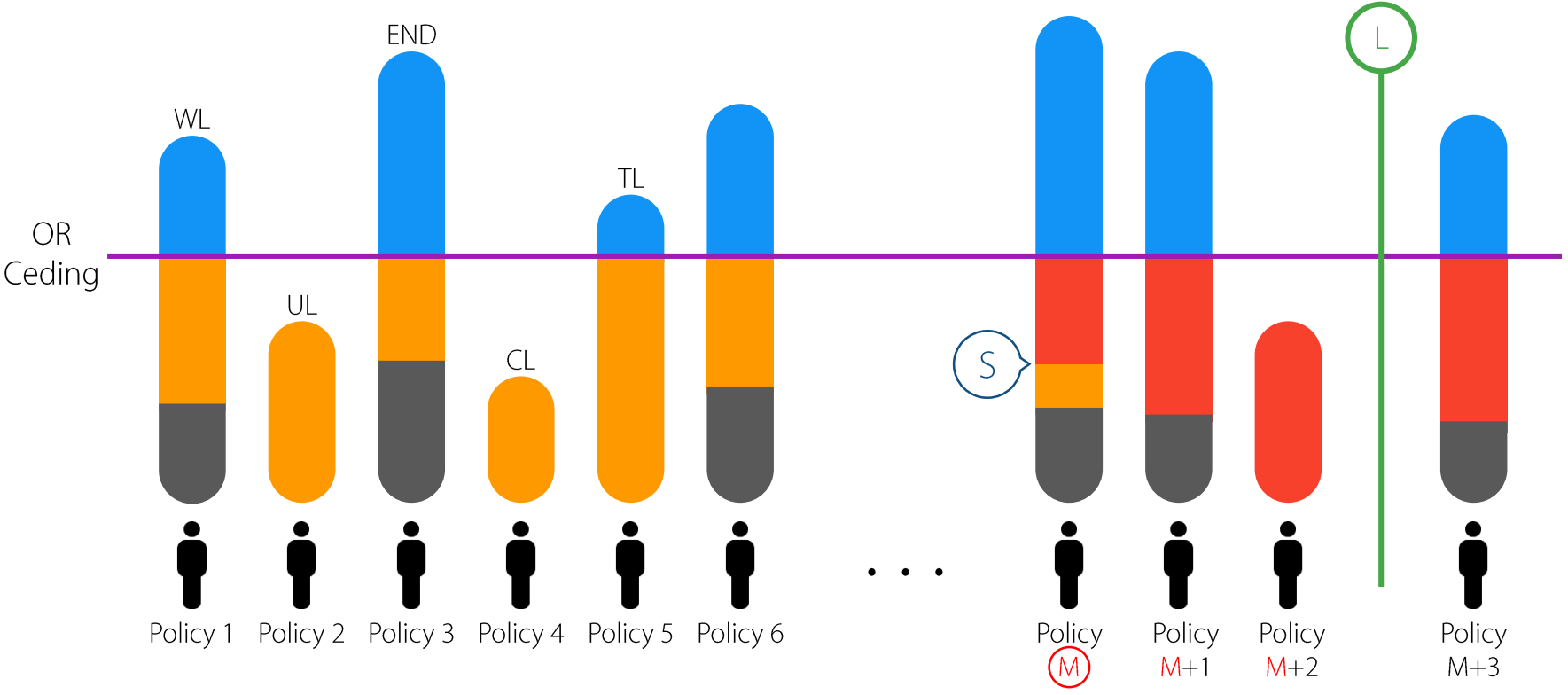


Vulnerability Level

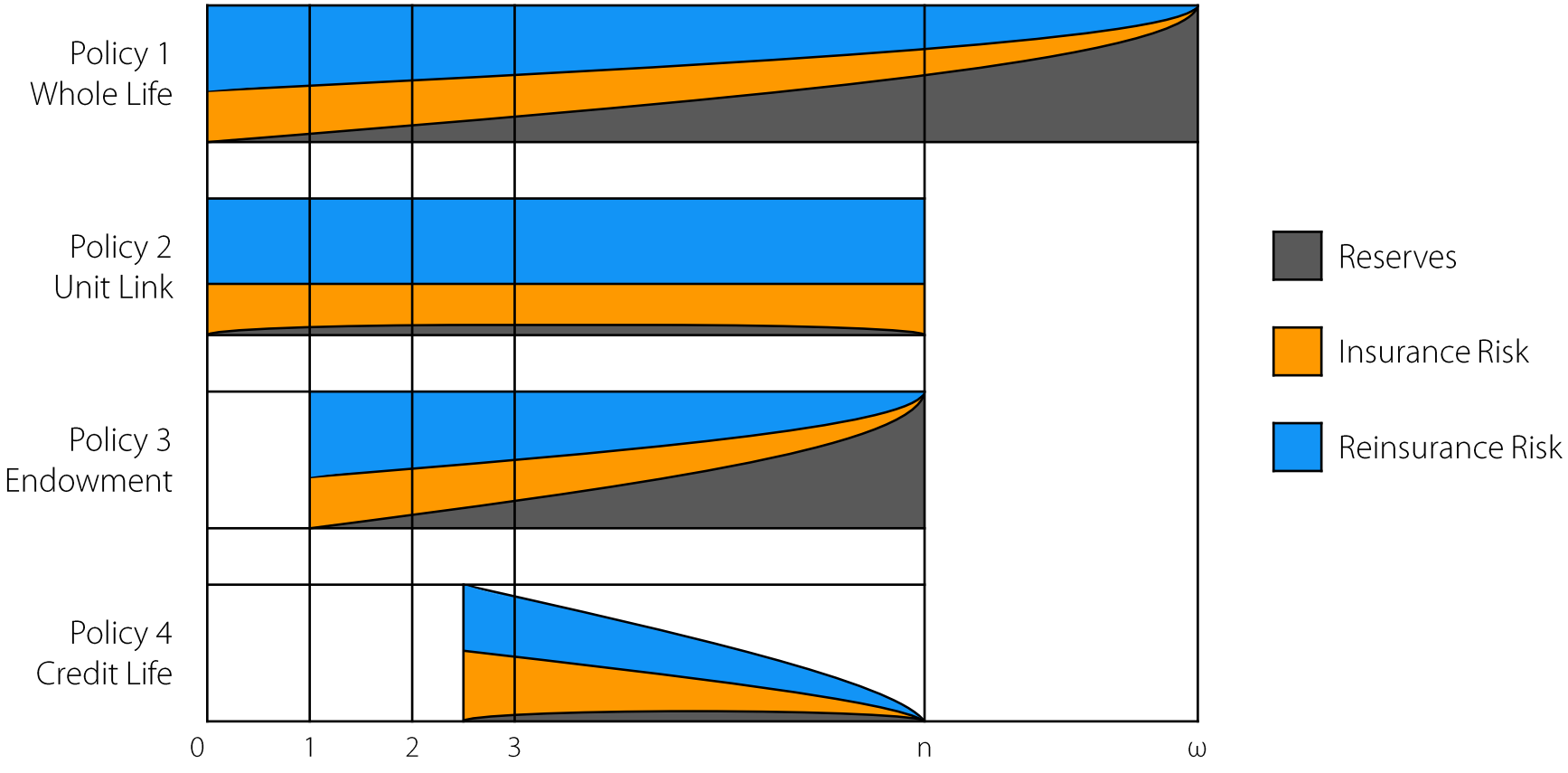
Highest Vulnerability Level of Each Event (Last 100 Years)



Catastrophe Risk



Life Insurance Risk



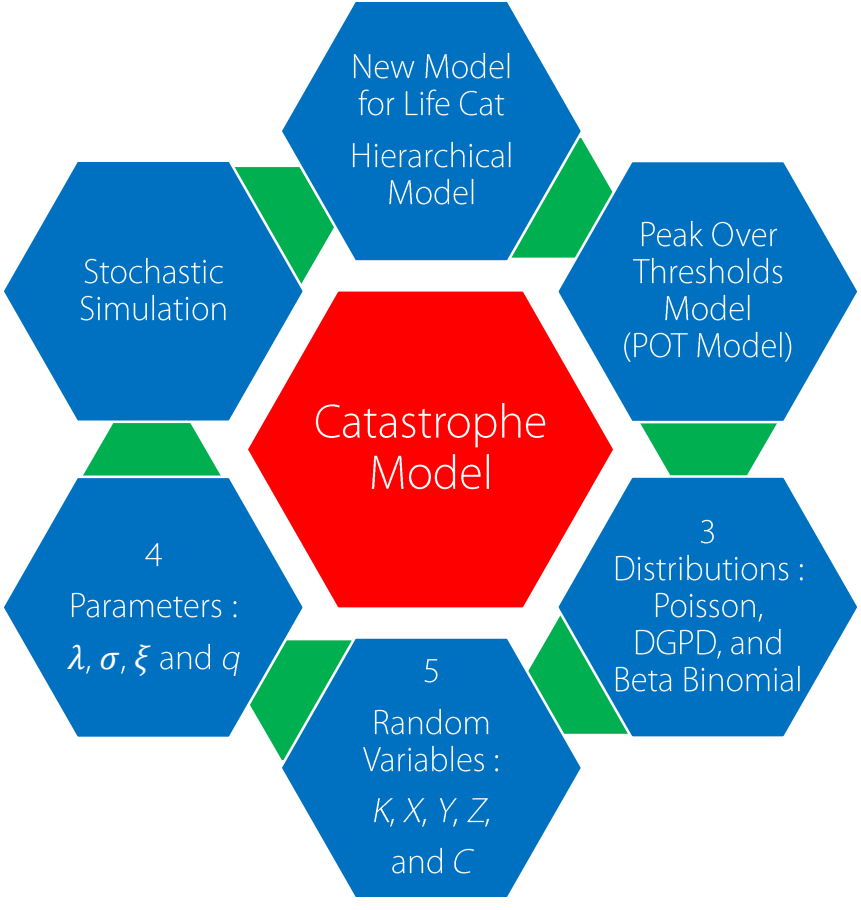
Catastrophe Model

Minimum person insured dies from a single event

Insurance company's deductible

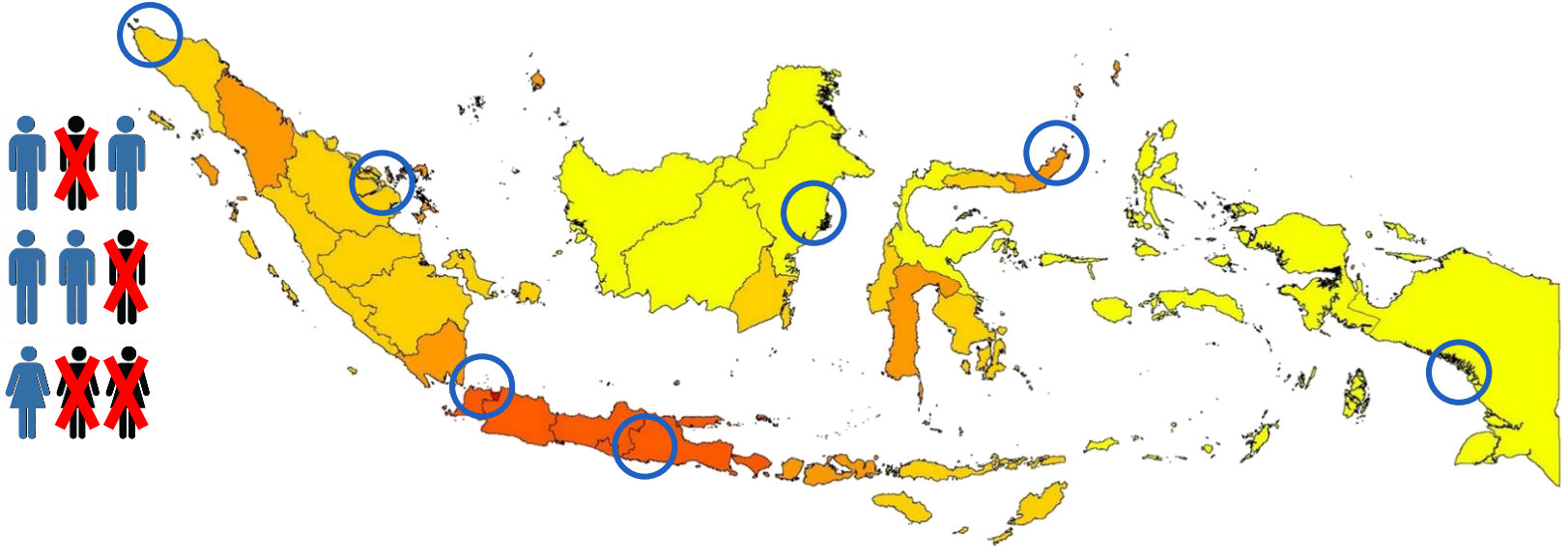
Maximum amount payable in single catastrophe event

Catastrophe Model



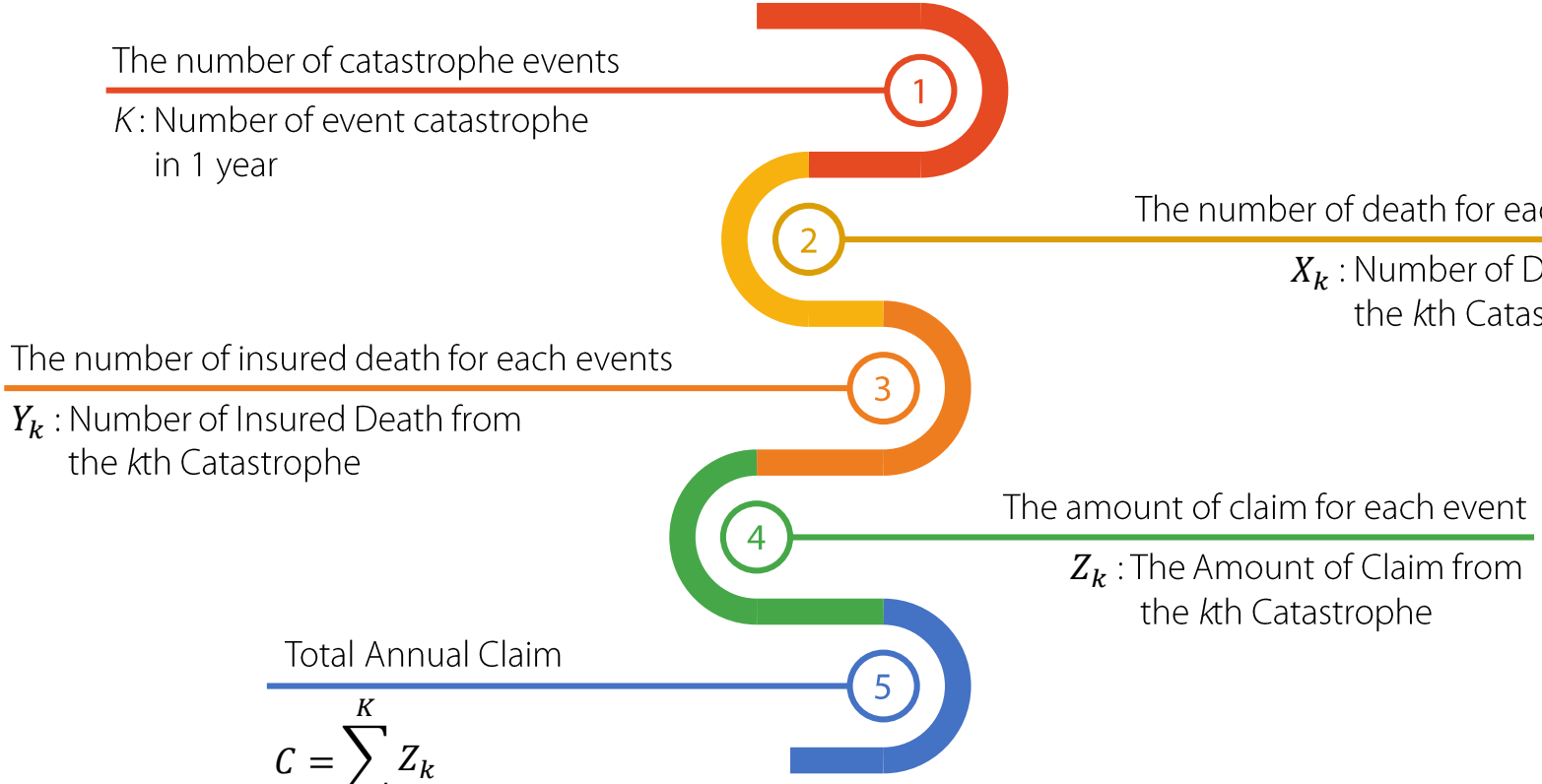
Catastrophe Model
Illustration of the Model

The number of catastrophe events → The number of death for each events → The number of insured death for each events → The amount of claim for each event → Catastrophe Reserve



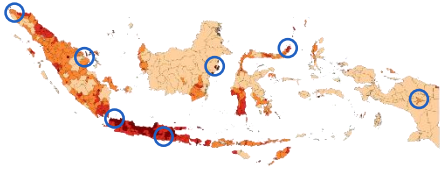
Catastrophe Model

The Models



Catastrophe Model
The Models

The number of catastrophe events

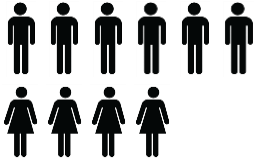


$K \sim \text{Poisson}(\lambda_M)$

λ_M is estimated by

$\hat{\lambda}_M = \text{mean}(K_M)$

The number of death for each events

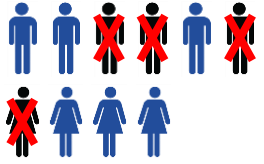


$X_k \sim \text{DGPD}(M, \sigma_M, \xi_M)$

DGPD : Discrete Generalized Pareto Distribution

σ_M, ξ_M is estimated by Maximum Likelihood Method

The number of insured death for each events



$Y \sim \text{BetaBinom}(X_k, q, d(X_k))$

q = Market Penetration

$= \frac{\text{Number of sold policies}}{\text{Size of total population}}$

$d(X_k) = \log(X_k)\theta$

θ is estimated by experience

$$Y_k = \begin{cases} Y \; ; Y \geq M \\ 0 \; ; Y < M \end{cases}$$

Catastrophe Model
The Models

The amount of claim for each event

Assume that sum insured for each person is identical

$Z = Y_k$ x Insurance Risk

$$Z_k = \begin{cases} 0 & ; Z < S \\ Z - S_i & ; S \le S + L \\ L & ; S + L \ge Z \end{cases}$$

Catastrophe Reserve

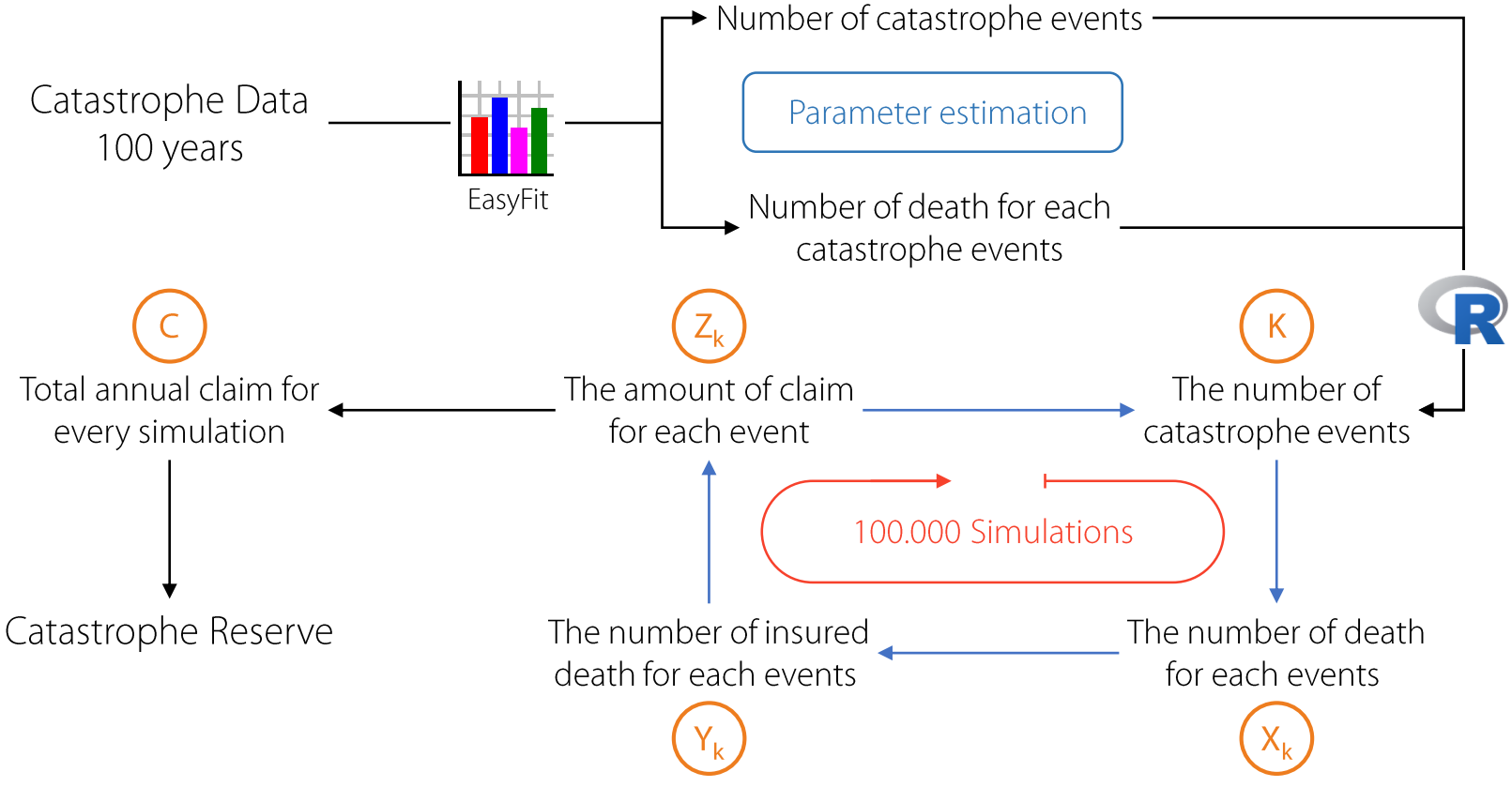
Total annual claim

$$C = \sum_{k=1}^{K} Z_k$$

Simulate C for certain number of simulation

Reserve = $E[C] + Z_\alpha \cdot STD(C)$

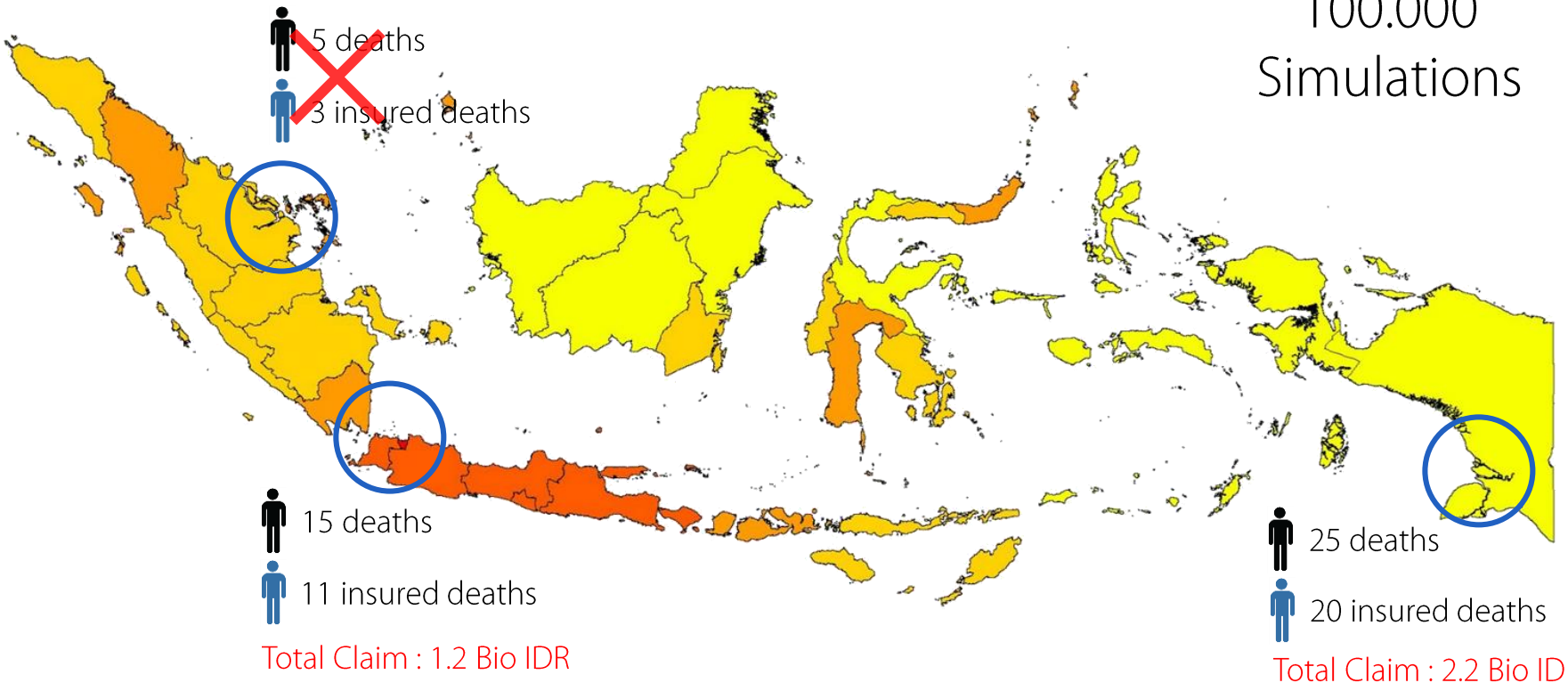
Catastrophe Model
Simulation Procedure



Catastrophe Model

Simulation of Event

100.000
Simulations



Catastrophe Model

Simulation of Event

Simulation 1

Variable	K1	K2	K3
Xk	5	15	25
Y	3	11	20
Yk	0	11	20
Z	0	1,200	2,200

Simulation 2

Variable	K1	K2	K3	⋯	K10
Xk	51	17	95		96
Y	43	8	75		17
Yk	43	0	75		17
Z	3,053	0	4,275		1,003

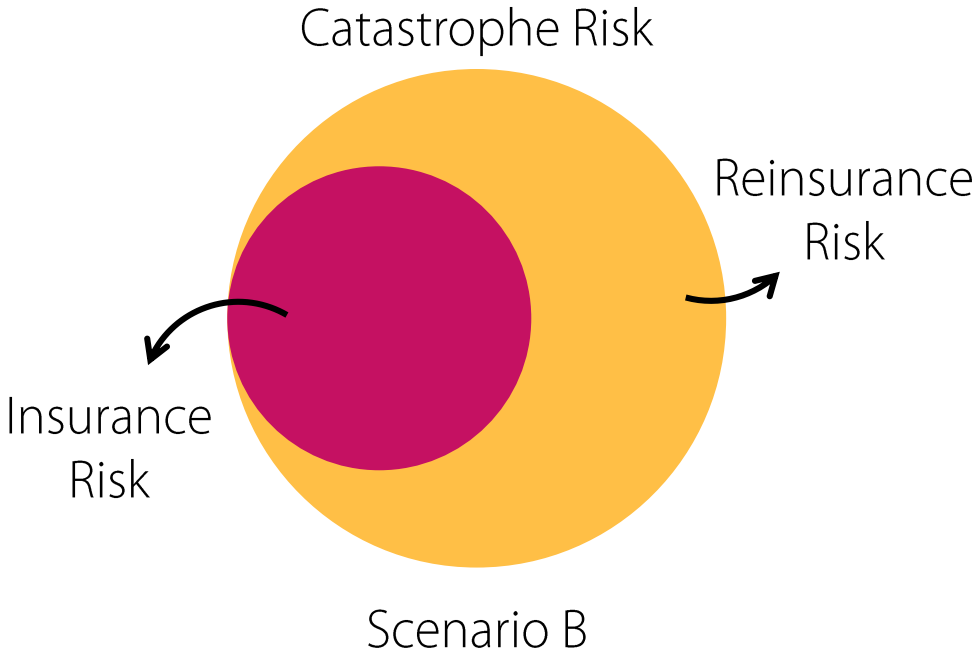
Simulation 3

Variable	K1	K2	K3	K4
Xk	35	14	90	93
Y	0	13	23	19
Yk	0	13	23	19
Z	0	897	1,380	1,273

Simulation 4

Variable	K1	K2	K3	⋯	K50
Xk	29	24	97		8
Y	16	1	26		2
Yk	16	0	26		0
Z	848	0	1,274		0

Catastrophe Risk



Catastrophe Reserve
Scenario A

IndonesiaRe

Asumption

- $M = 10$ — Minimum person insured dies from a single event
- $S = L$ — Insurance company's retention
- $L = \infty$ — Maximum amount payable in single catastrophe event
- $\theta = 0.1 \quad \alpha = 25\% \quad Z_\alpha = 0.67$
- $\lambda_M, \sigma_M, \xi_M$ — Estimated from data within 100 years observation
- 2016
  Average Insurance Risk = 70mio IDR
  Market Penetration (q) = 0.03

Catastrophe Reserve
Scenario B

Asumption

- $M = 10$ — Minimum person insured dies from a single event
- $S = 500$ mio IDR — Insurance company's retention
- $L = 30$ bio IDR — Maximum amount payable by the reinsurer
- $\theta = 0.1 \quad \alpha = 25\% \quad Z_\alpha = 0.67$
- $\lambda_M, \sigma_M, \xi_M$ — Estimated from data within 100 years observation
- 2016
  Average Insurance Risk = 70mio IDR
  Market Penetration (q) = 0.03

Catastrophe Reserve

Scenario A

Variable	Assumption / Result
S	L
L	∞
Mean	101,242,531
Std. Deviation	1,945,903,592
Cat Reserve	1,404,997,938

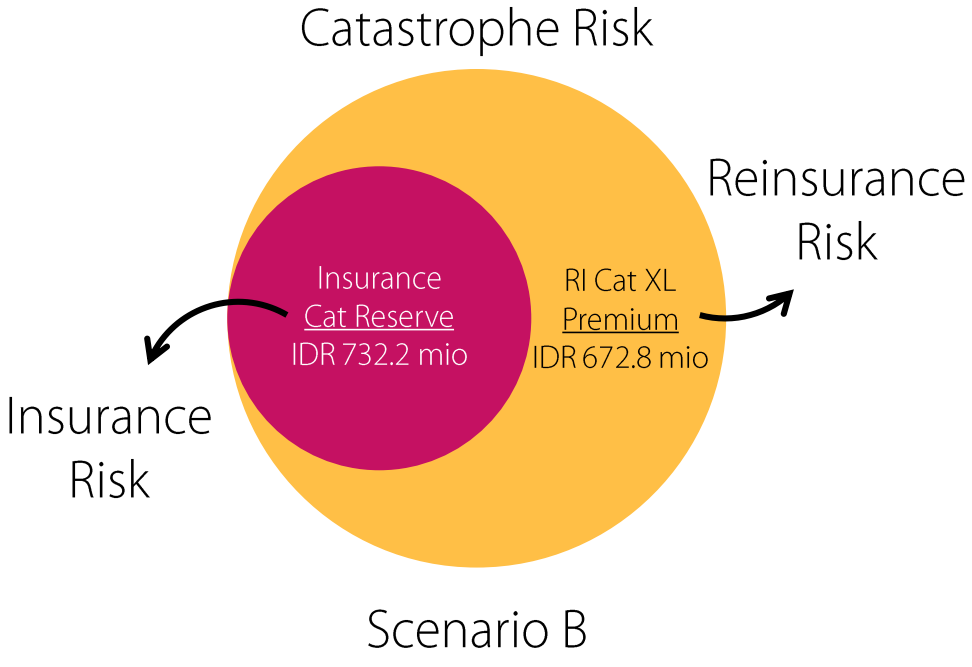
Scenario B

Variable	Assumption / Result
S	500,000,000
L	30,000,000,000
Mean	69,494,554
Std. Deviation	900,507,464
Cat Reserve	672,834,555

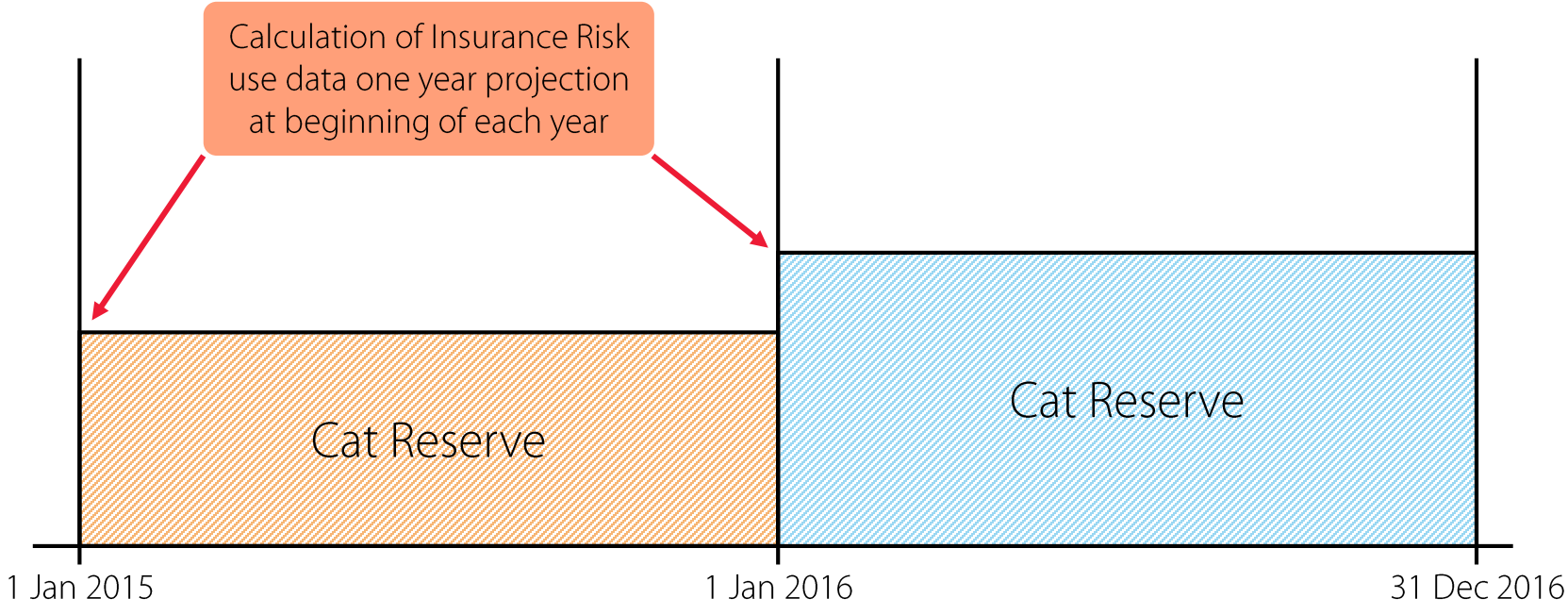
Implementation of SEOJK 27

1. Catastrophe Reserve : IDR 1.40 bio
2. Reinsurance Catastrophe Coverage with Premium : IDR 672.8 mio
3. Reinsurance Catastrophe Coverage with Premium : IDR 672.8 mio and Catastrophe Reserve : IDR 732.2 mio

Catastrophe Reserve
Implementation of SEOJK 27



Life Catastrophe Reserve



References

Ekheden, E. and Hössjer, O. (2014). Pricing Catastrophe Risk in Life (Re)insurance. Scandinavian Actuarial Journal. 2014:4, 352-367.

Badan Nasional Penanggulangan Bencana, https://www.bnpb.go.id/.

Badan Pusat Statistik, https://www.bps.go.id/.

Data dan Informasi Bencana Indonesia, Badan Nasional Penanggulangan Bencana, http://dibi.bnpb.go.id/.

Komite Nasional Keselamatan Transportasi, Kementerian Perhubungan Republik Indonesia, http://www.dephub.go.id/.

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