IndonesiaRe

Indonesia Leading Reinsurer

Life Insurance Catastrophe Reserve

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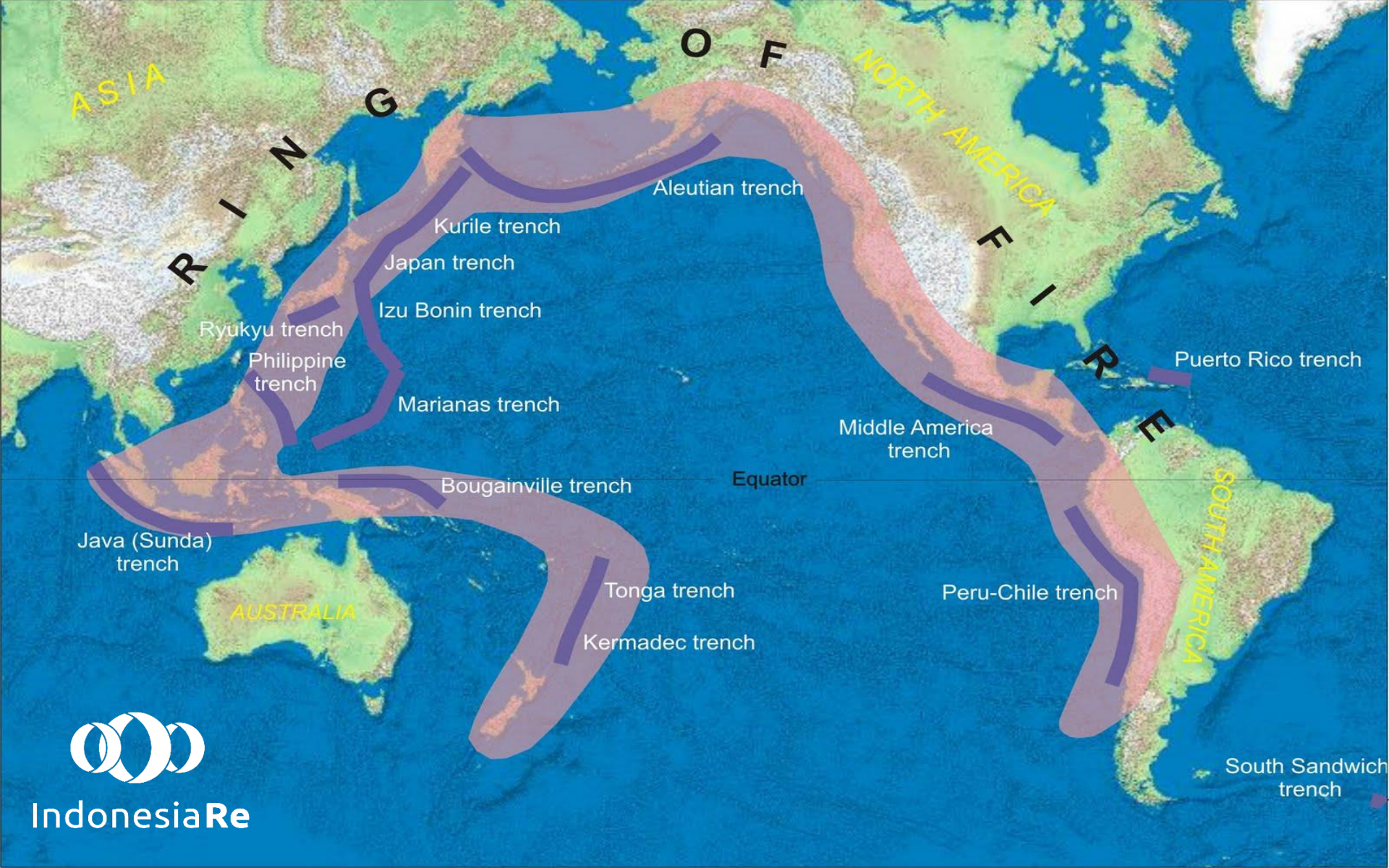
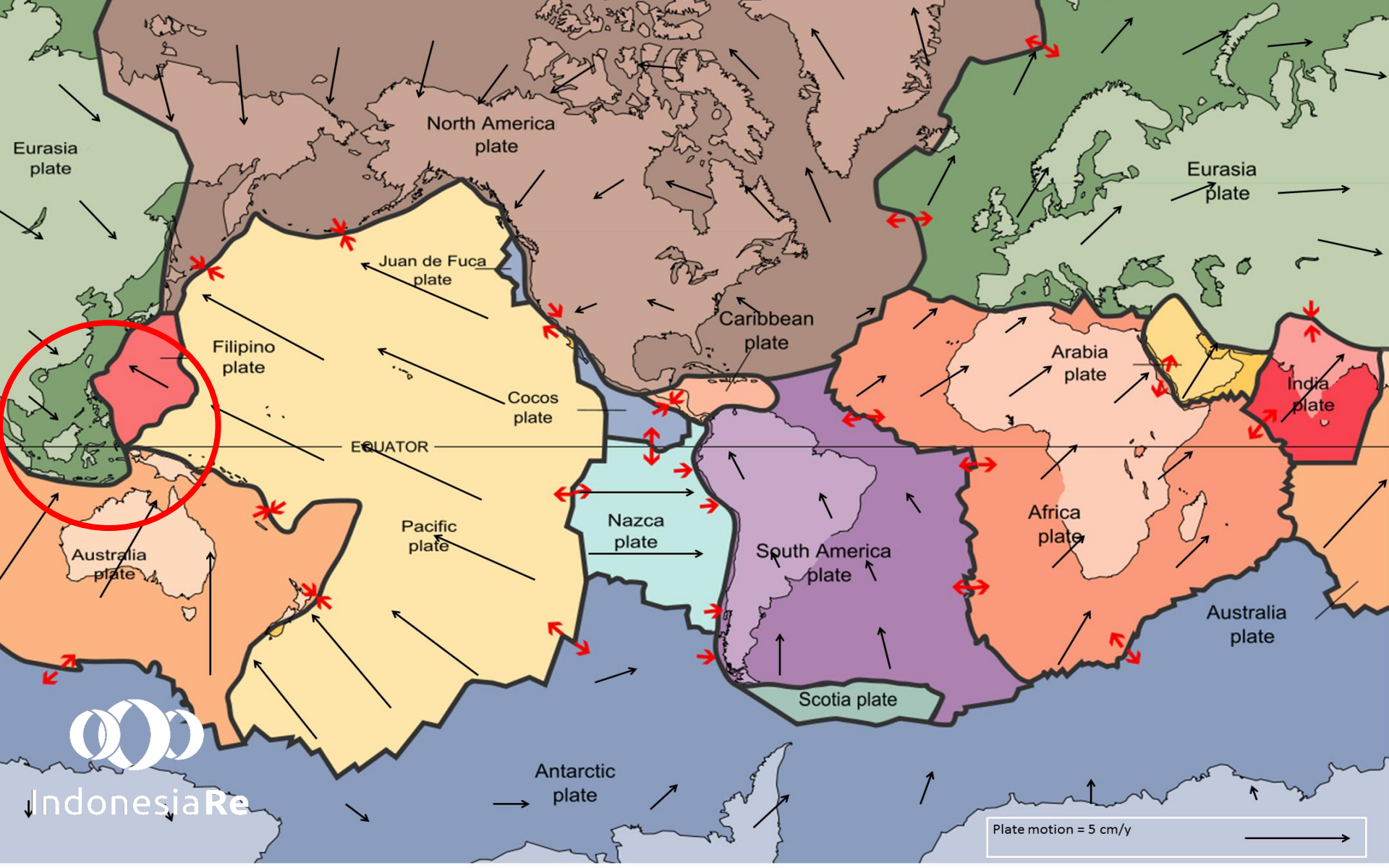
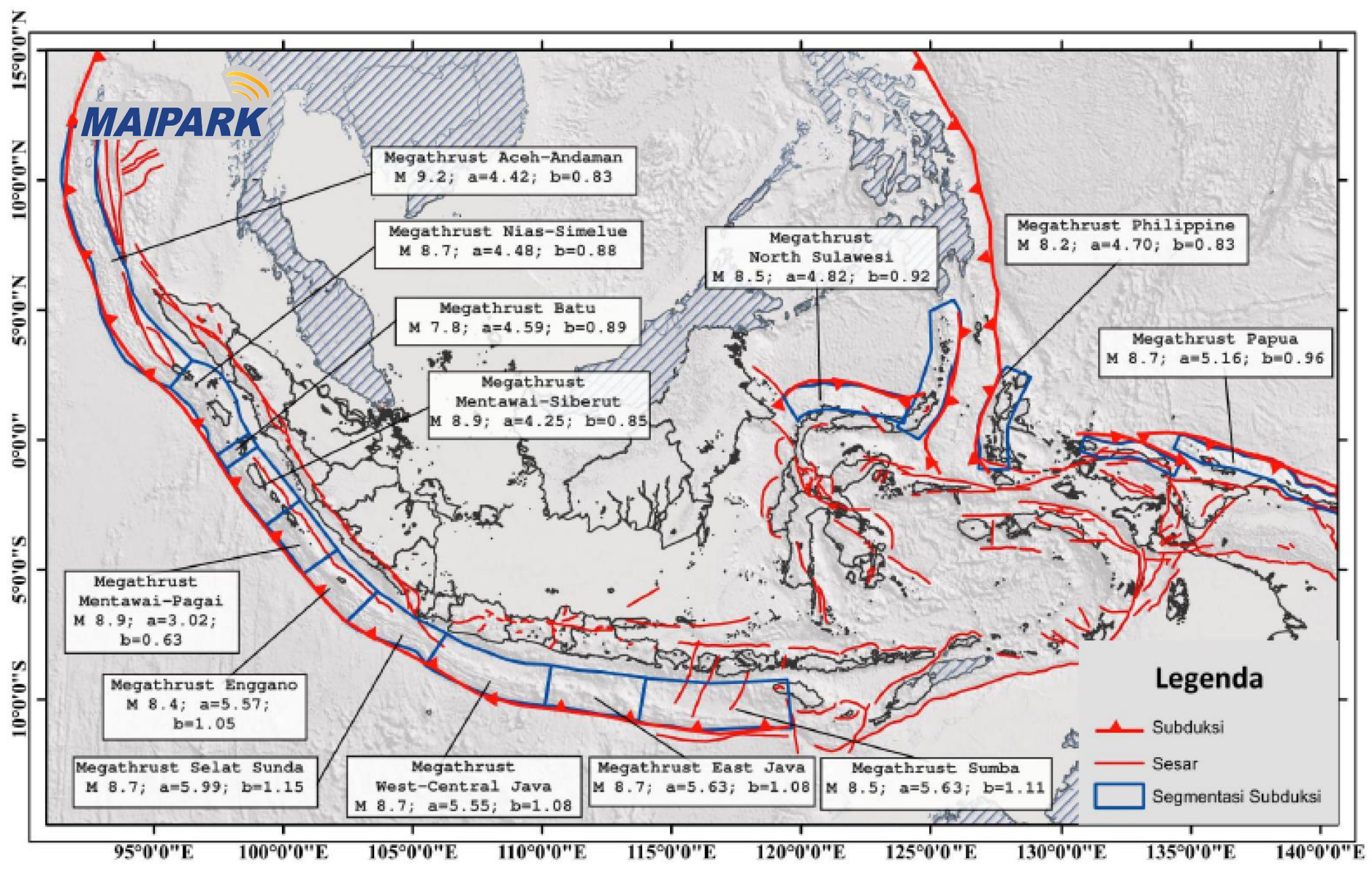
IndonesiaRe
Catastrophe. (n)
A single event causing great and often sudden damage or suffering.
Area Limit ▪
How far (distance) the effect of the single event
Time Limit ▪
How long (duration) the effect of the single event


RING OF FIRE
ASIA
NORTH AMERICA
SOUTH AMERICA
AUSTRALIA
Aleutian trench
Kurile trench
Japan trench
Izu Bonin trench
Ryukyu trench
Philippine trench
Marianas trench
Bougainville trench
Java (Sunda) trench
Tonga trench
Kermadec trench
Middle America trench
Puerto Rico trench
Peru-Chile trench
South Sandwich trench
Equator
IndonesiaRe


Eurasia plate
North America plate
Eurasia plate
Juan de Fuca plate
Caribbean plate
Filipino plate
Arabia plate
India plate
Cocos plate
EQUATOR
Pacific plate
Nazca plate
South America plate
Africa plate
Australia plate
Australia plate
Scotia plate
Antarctic plate
Plate motion = 5 cm/y


MAIPARK
Megathrust Aceh-Andaman
M 9.2; a=4.42; b=0.83
Megathrust Nias-Simelue
M 8.7; a=4.48; b=0.88
Megathrust Batu
M 7.8; a=4.59; b=0.89
Megathrust
Mentawai-Siberut
M 8.9; a=4.25; b=0.85
Megathrust
North Sulawesi
M 8.5; a=4.82; b=0.92
Megathrust Philippine
M 8.2; a=4.70; b=0.83
Megathrust Papua
M 8.7; a=5.16; b=0.96
Megathrust
Mentawai-Pagai
M 8.9; a=3.02;
b=0.63
Megathrust Enggano
M 8.4; a=5.57;
b=1.05
Megathrust Selat Sunda
M 8.7; a=5.99; b=1.15
Megathrust
West-Central Java
M 8.7; a=5.55; b=1.08
Megathrust East Java
M 8.7; a=5.63; b=1.08
Megathrust Sumba
M 8.5; a=5.63; b=1.11
Legenda
Subduksi
Sesar
Segmentasi Subduksi
15°0'0"N
10°0'0"N
5°0'0"N
0°0'0"
5°0'0"S
10°0'0"S
95°0'0"E
100°0'0"E
105°0'0"E
110°0'0"E
115°0'0"E
120°0'0"E
125°0'0"E
130°0'0"E
135°0'0"E
140°0'0"E

Natural Disaster

Landslide

Flood

Landslide caused by flood

Volcanic Eruption

Earthquake

Tsunami

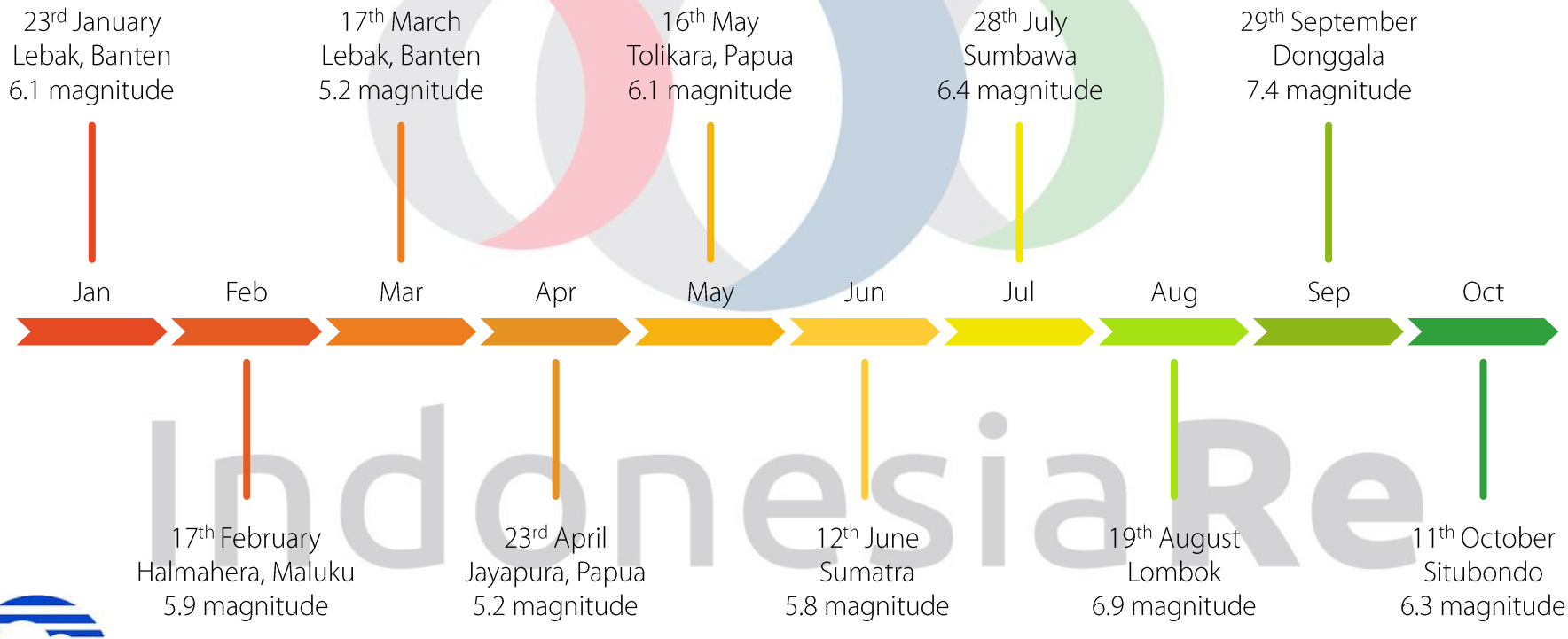
Natural Disaster
Earthquake in Lombok

The victims of the mag. 7 **earthquake** that struck Nusa Tenggara and Bali continue to increase. As of 15 August 2018, the earthquake has caused **460** fatalities. The breakdown:
North Lombok 396 fatalities
West Lombok 39 fatalities
City of Mataram 9 fatalities
East Lombok 12 fatalities
Central Lombok 2 fatalities
City of Denpasar 2 fatalities

BADAN NASIONAL PENANGGULANGAN BENCANA

Natural Disaster

Earthquake in Indonesia in 2018



Natural Disaster

Tsunami in Aceh (2004)

Around **170,000** people were killed (130,000 confirmed dead, 37,000 missing) in Indonesia, most of them in Aceh province. For a while it was thought around 230,000 people were killed there but in April 2005, the government reduced the number of missing from 95,000 to 37,000. The tsunami left more than 500,000 people homeless and caused an estimated $4.5 billion in losses and damage.

Natural Disaster

Earthquake and Tsunami in Central Sulawesi

The National Disaster Mitigation Agency (BNPB) reported the death toll from earthquake and tsunami in Central Sulawesi reached **1,407** people as of October 3rd, at 1 pm

The 7.4-magnitude earthquake rocked Palu and Donggala on Friday, September 28, at 17:2 local time. The devastating quake triggered the tsunami in the region

Natural Disaster

Flood and Landslide in West Sumatra

Torrential rains triggered flash floods and landslides on the Indonesian island of Sumatra, killing at least **27** people, including a dozen children at a school, officials said Saturday.

Man-Made Disaster
Transportation Accident

Disobeying traffic rule

Poor vehicle condition

Increasing number of vehicles

Lack of driving skills

Inadequate transport infrastructure

Transportation Accident

Latest Bus Accident in Sukabumi

Twenty-one people died and **nine** others were severely injured on Saturday afternoon, when the driver of the **bus** they were traveling in **lost control** of the vehicle in Sukabumi, West Java, causing the bus to plunge into 30-meter-deep ravine.

TheJakartaPost

Transportation Accident

Some Aviation Accident in Indonesia

Silk Air 185 (1997)
Palembang – 104 fatalities

Garuda Indonesia 152 (1997)
North Sumatera – 234 fatalities

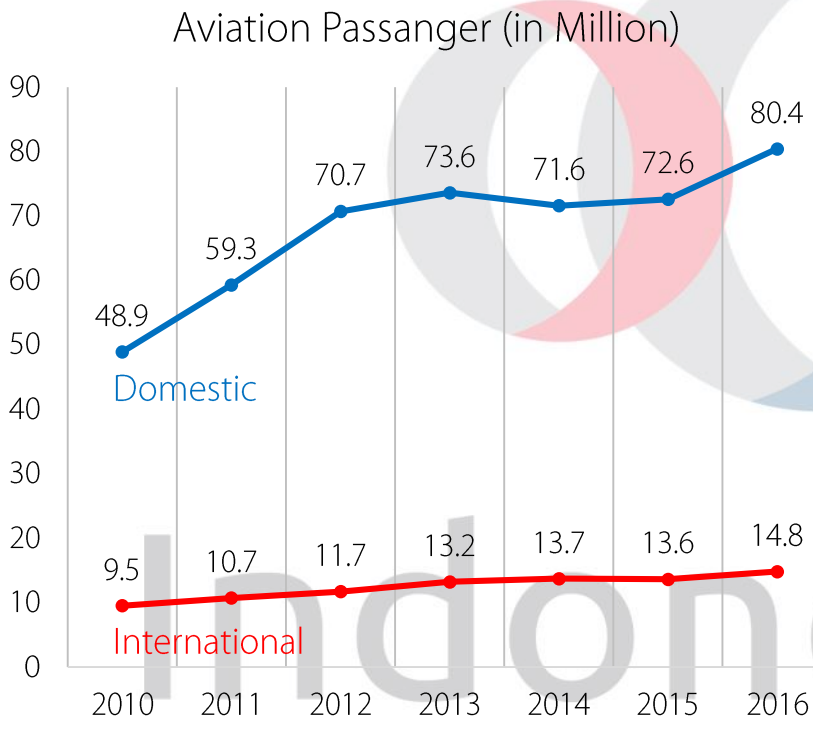
Mandala Airlines (2005)
Medan – 101 fatalities

Adam Air Kl-574 (2007)
102 fatalities

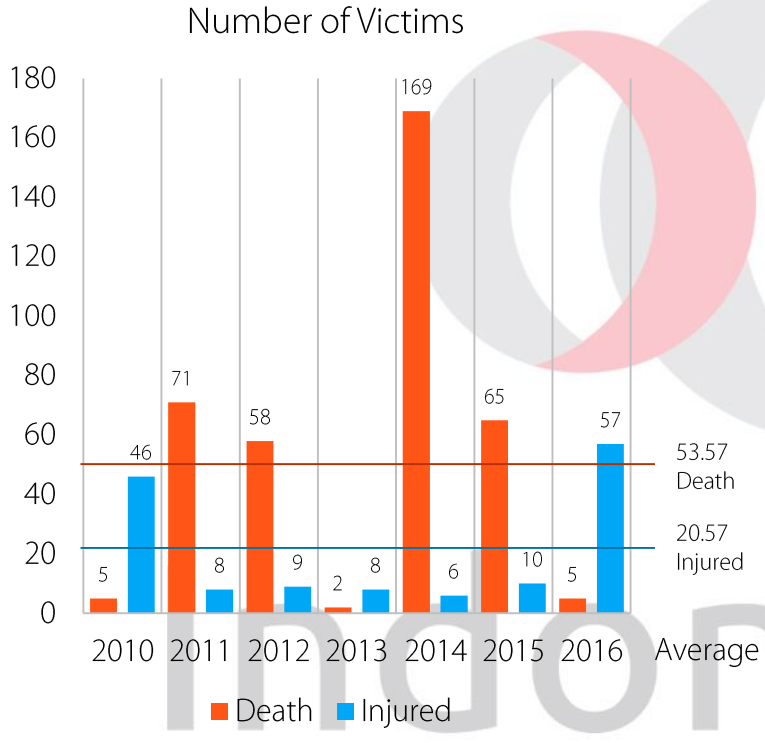
AirAsia 8501 (2014)
Karimata Strait – 162 fatalities

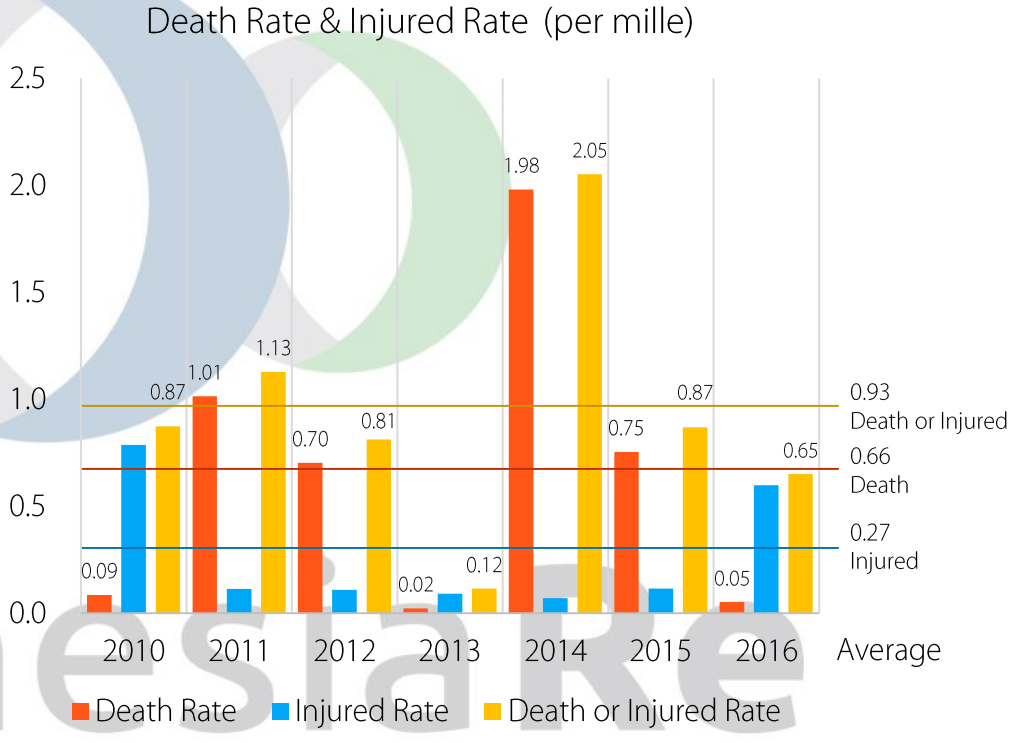
Hercules C-130 (2015)
Medan – 141 Fatalities

Aviation Statistics in Indonesia

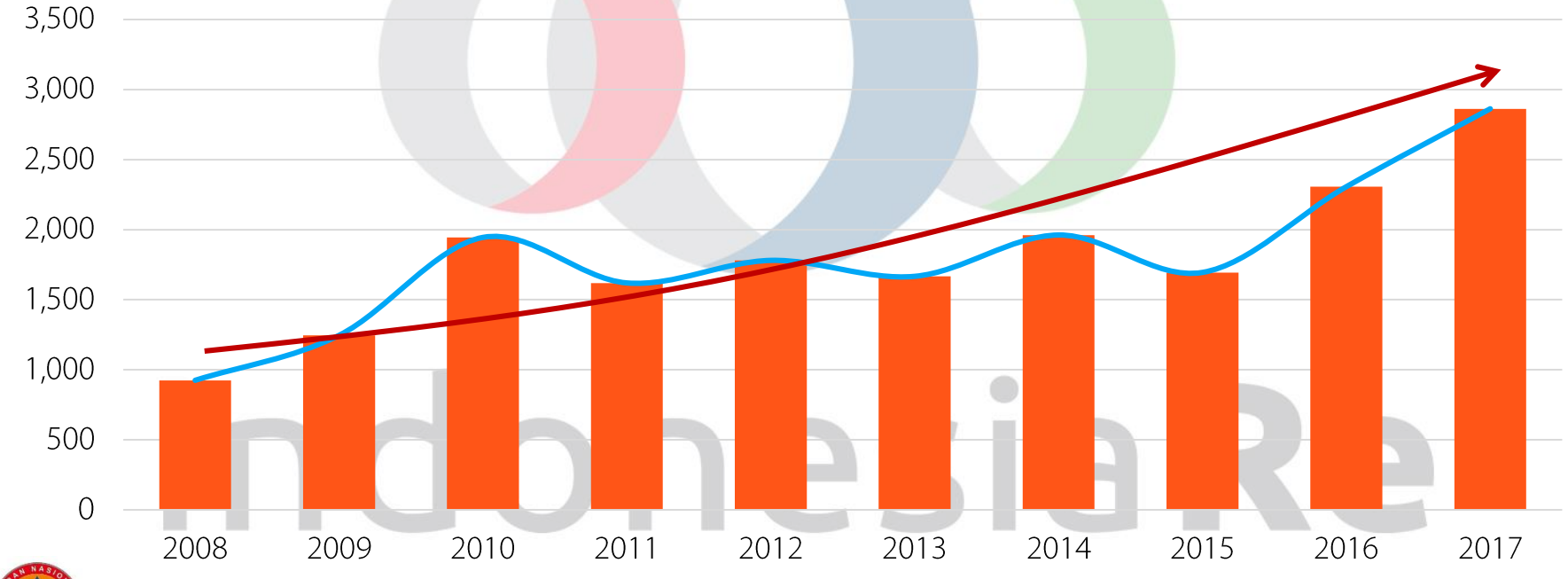


Aviation Accident in Indonesia



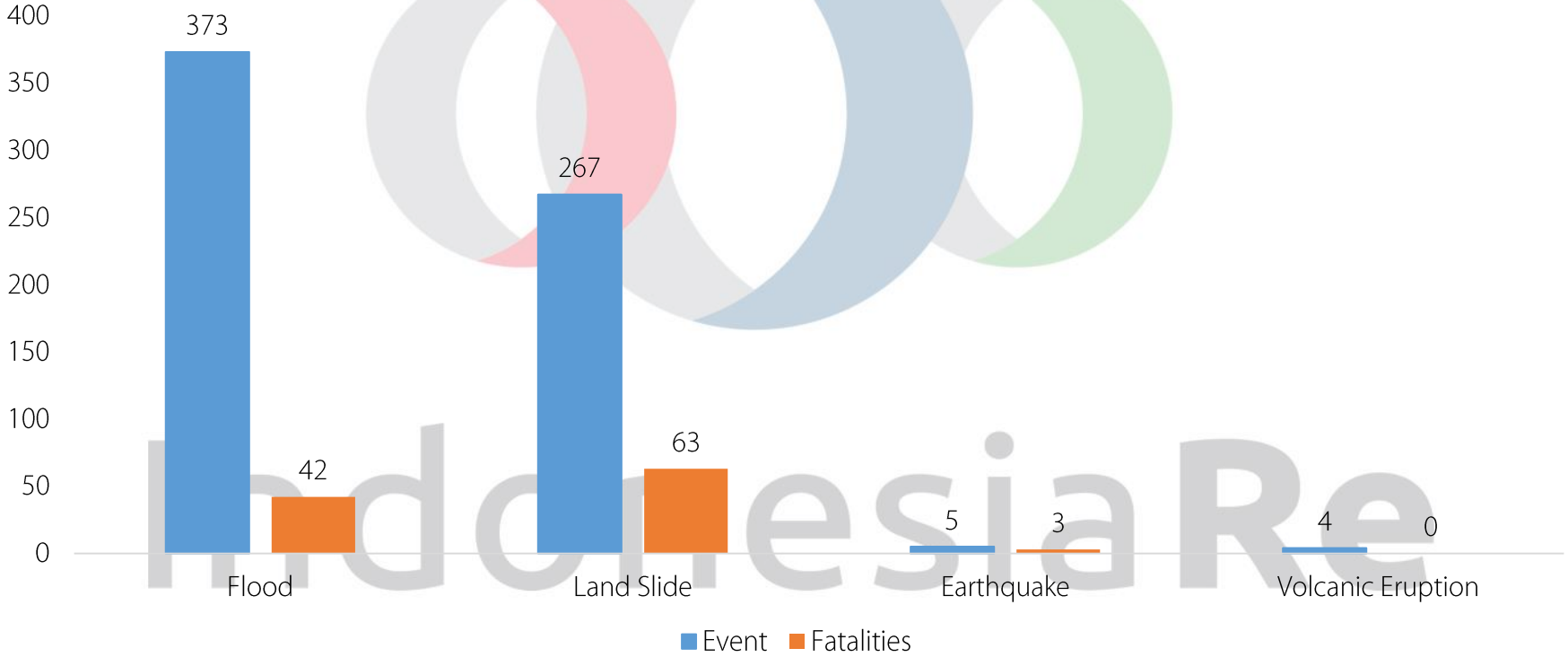


Natural Disaster
Frequency in Decade



Catastrophe Event in Indonesia

Event until Q2 2018




Transportation Accident


Natural Disaster


IndonesiaRe
SRCC


EXCLUDED
Epidemic


Nuclear Hazard


Tsunami in Chile (2010)
520 Fatalities
Insured Loss : USD 8,000 Mio


Tornado in US (2012)
IndonesiaRe
350 Fatalities
Insured Loss : USD 2,500 Mio


Tsunami in Japan (2011)
16,000 Fatalities
Insured Loss : USD 40 Bio


Flood in Australia (2011)
22 Fatalities
Insured Loss : AUD 1,900 Mio

Catastrophe Mapping Construction

Illustration of Catastrophe Mapping

30%

Population density
of Indonesia

40%

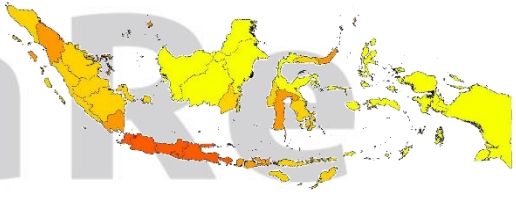
Number of Event
for each Catastrophe

30%

Number of Fatalities
for each Catastrophe

Vulnerability Level of
Each Area

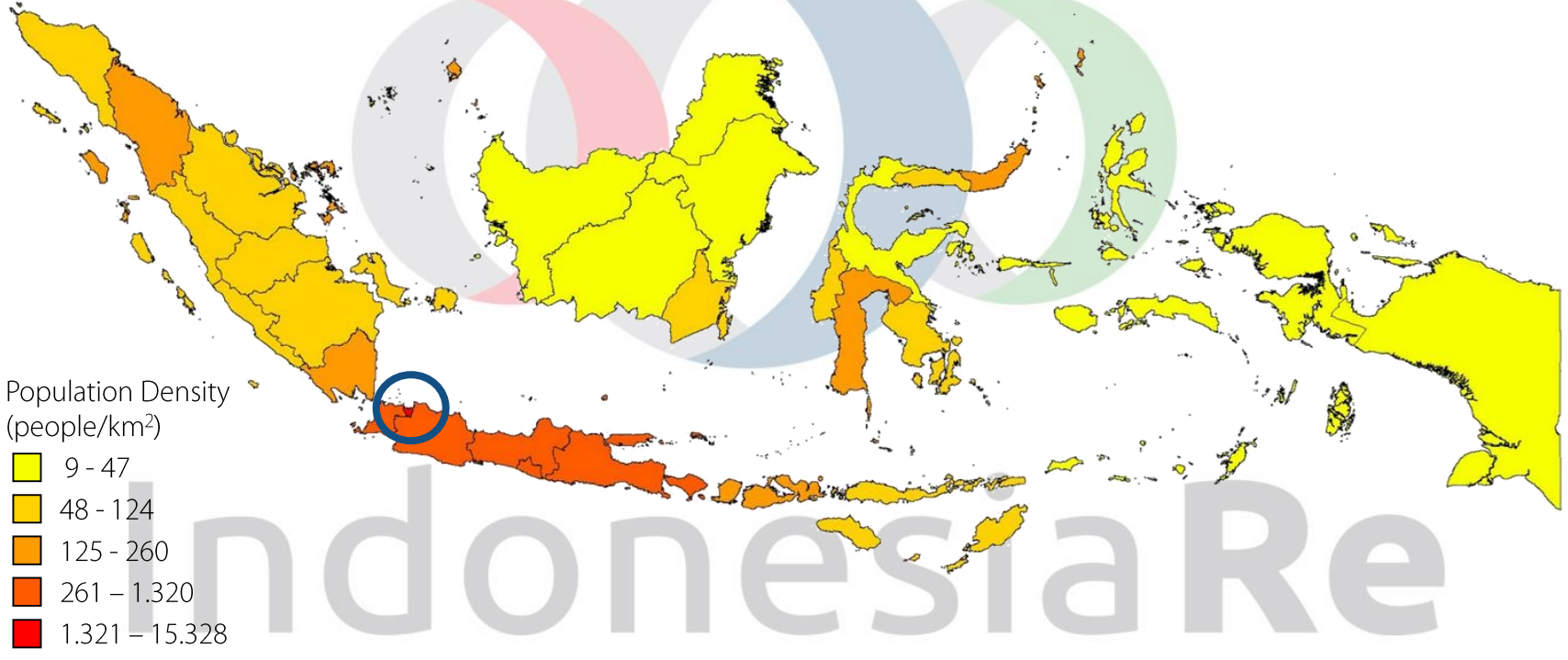
ArcGIS
ESRI



Vulnerability Maps

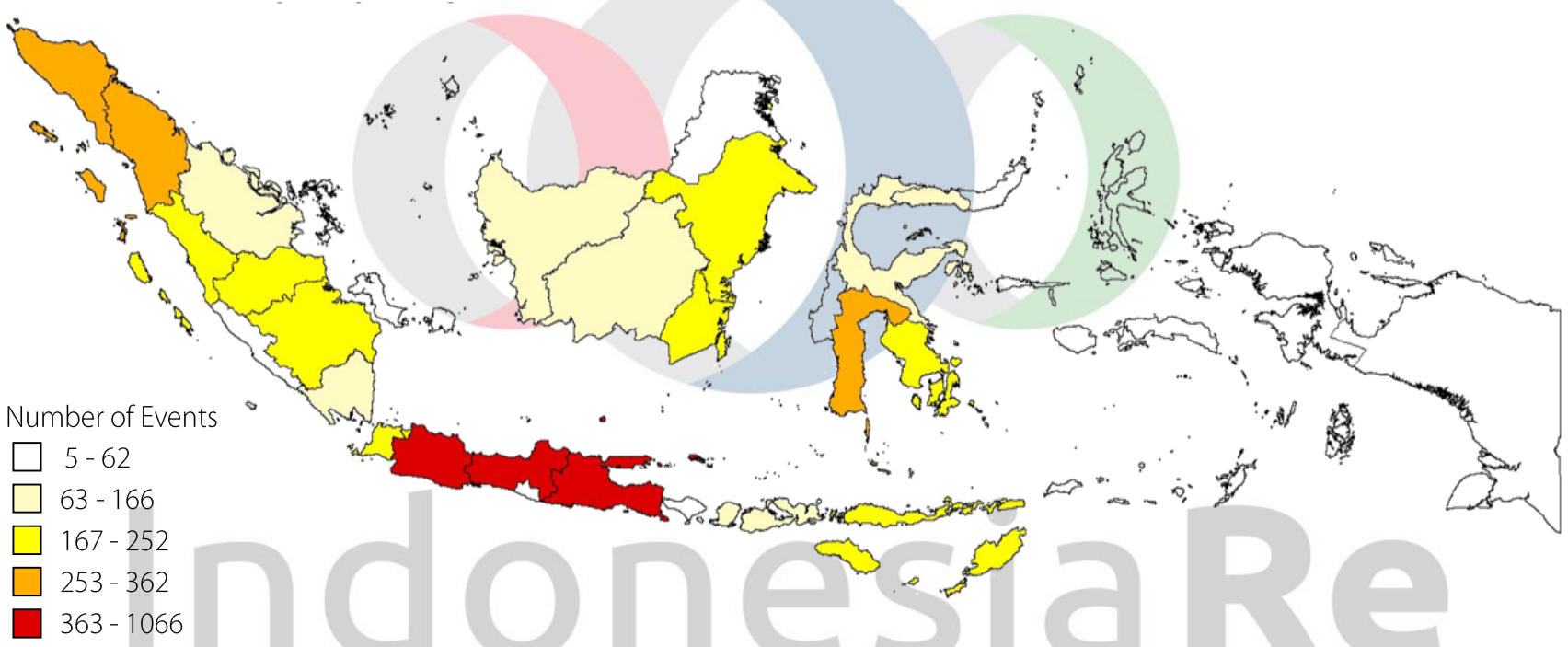
Population Density

Density Level in Each Area



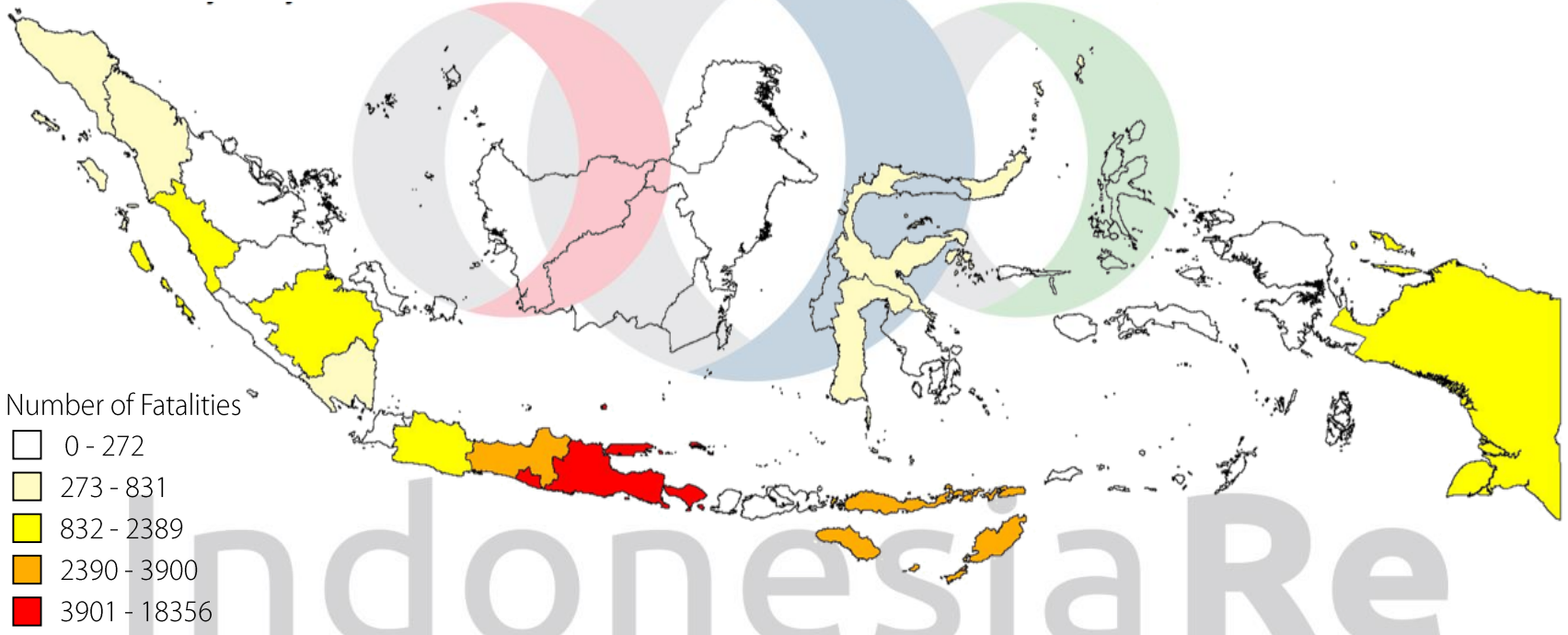
Catastrophe Events

Number of Events (Last 100 Years)



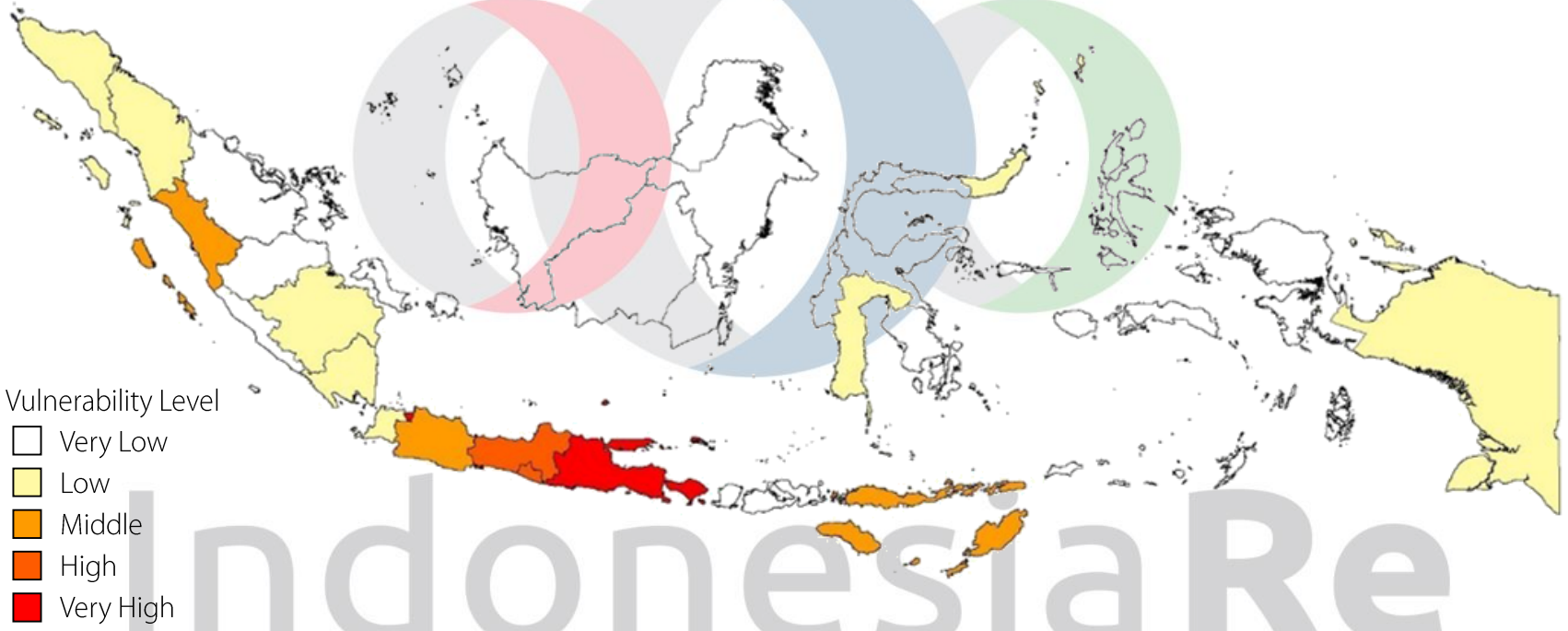
Catastrophe Events

Number of Fatalities (Last 100 Years)



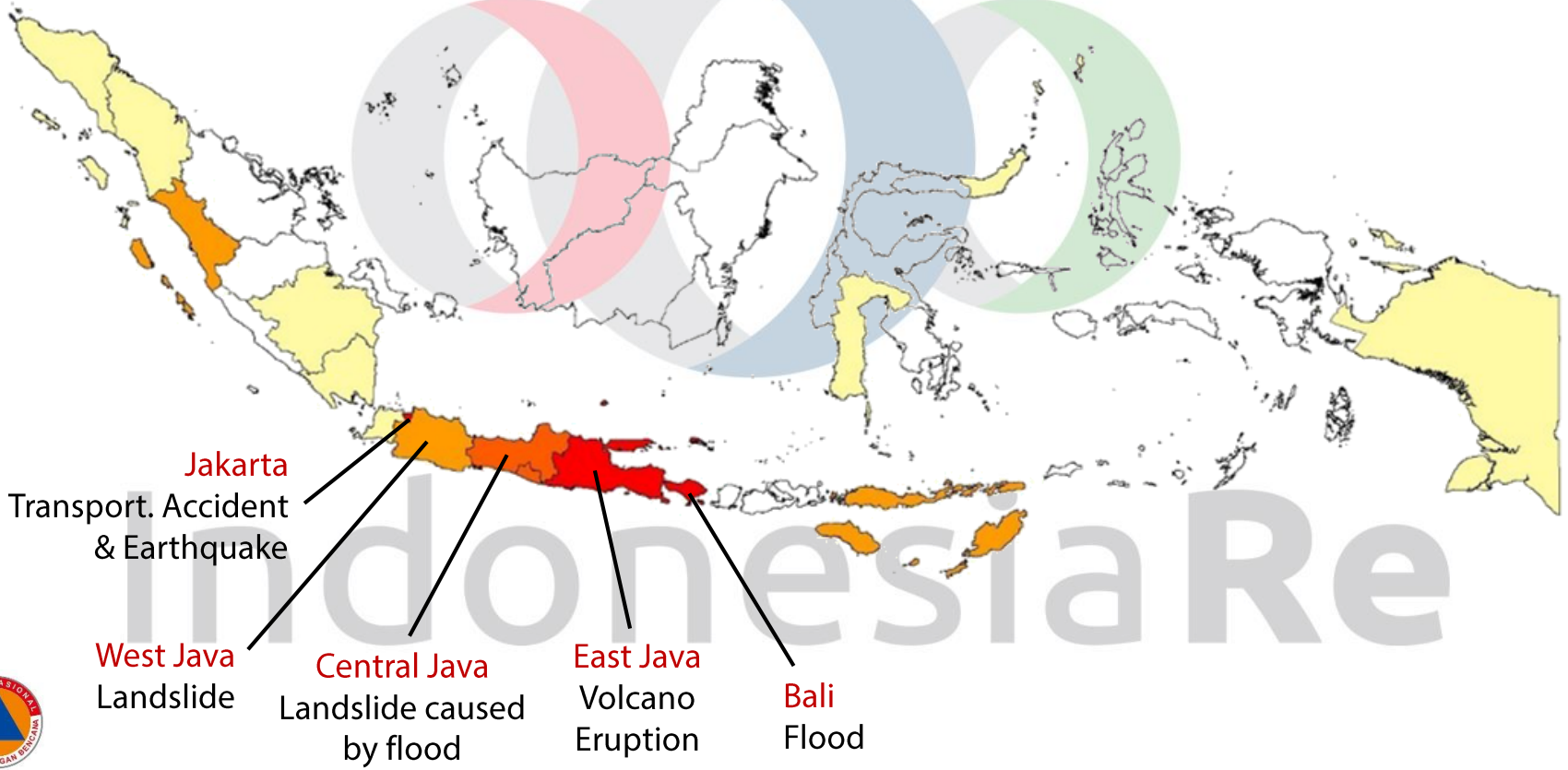
Catastrophe Events

Vulnerability Level (Last 100 Years)



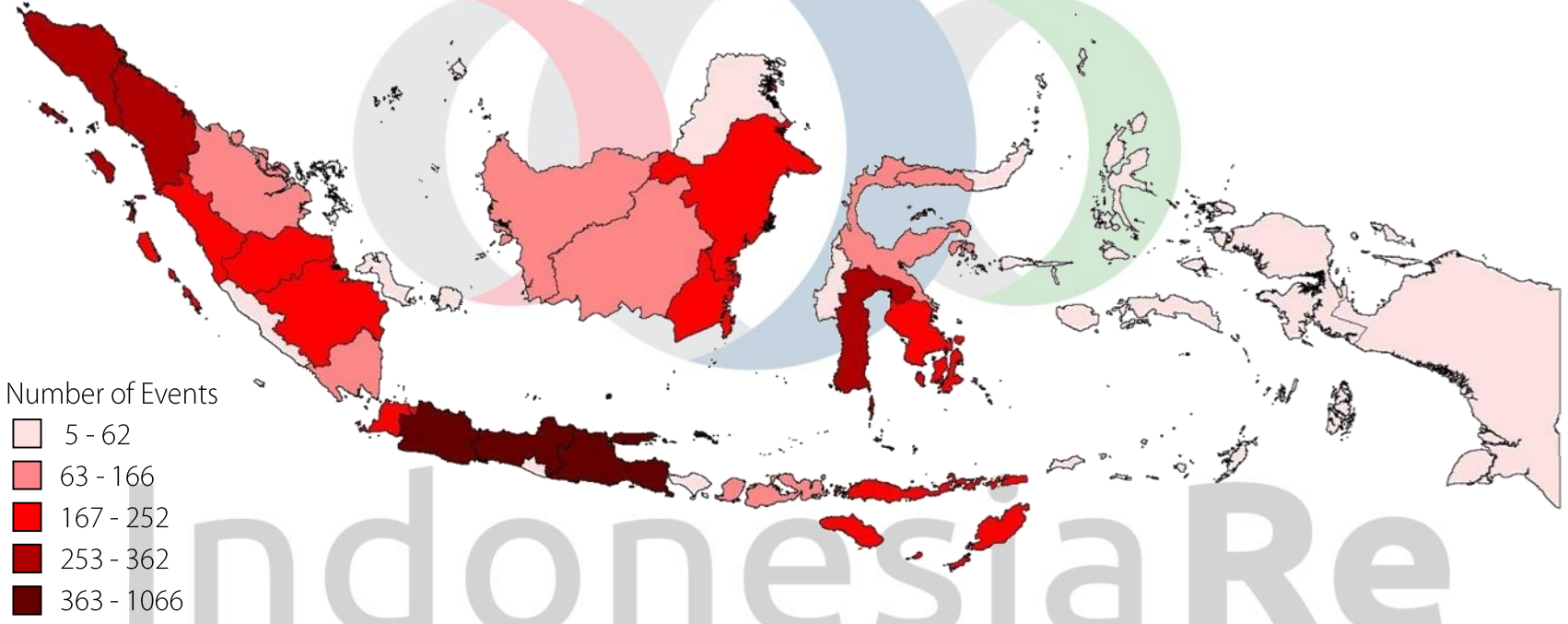
Vulnerability Level

Highest Vulnerability Level of Each Event (Last 100 Years)



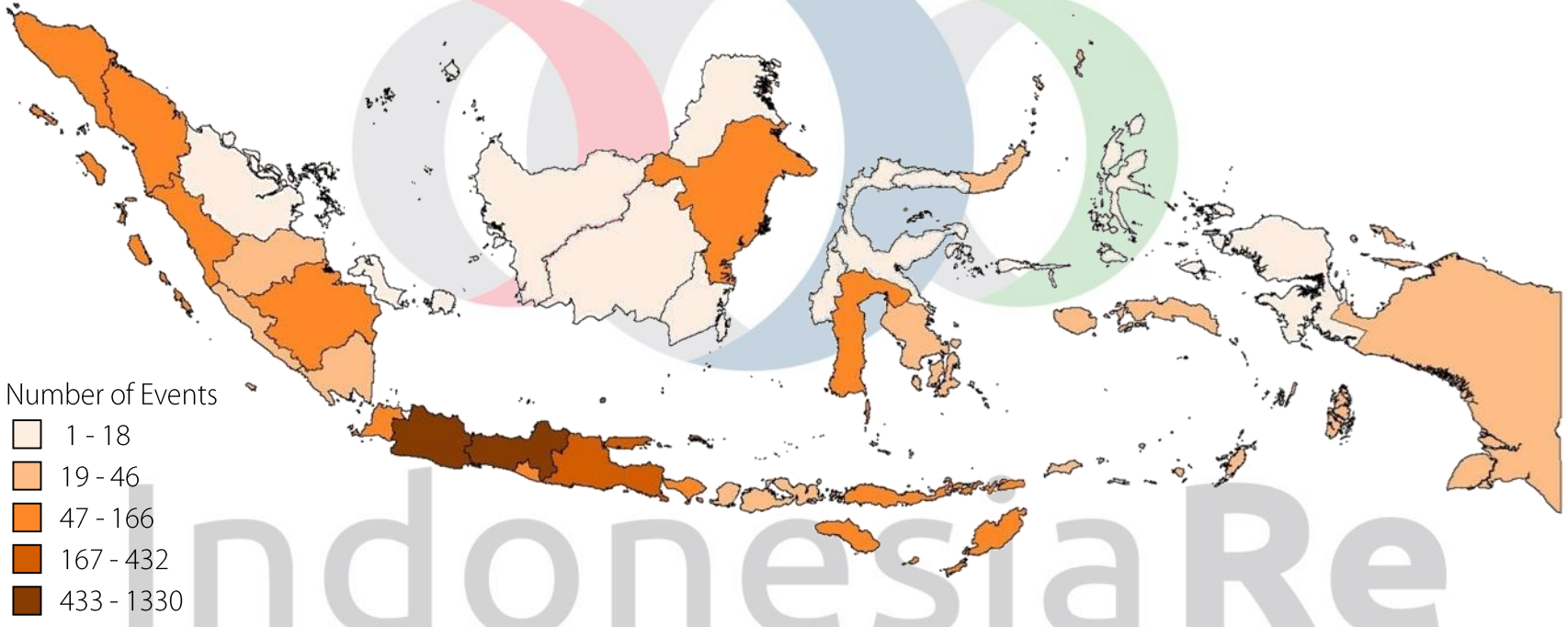
Catastrophe Events (Flood)

Number of Events (Last 100 Years)



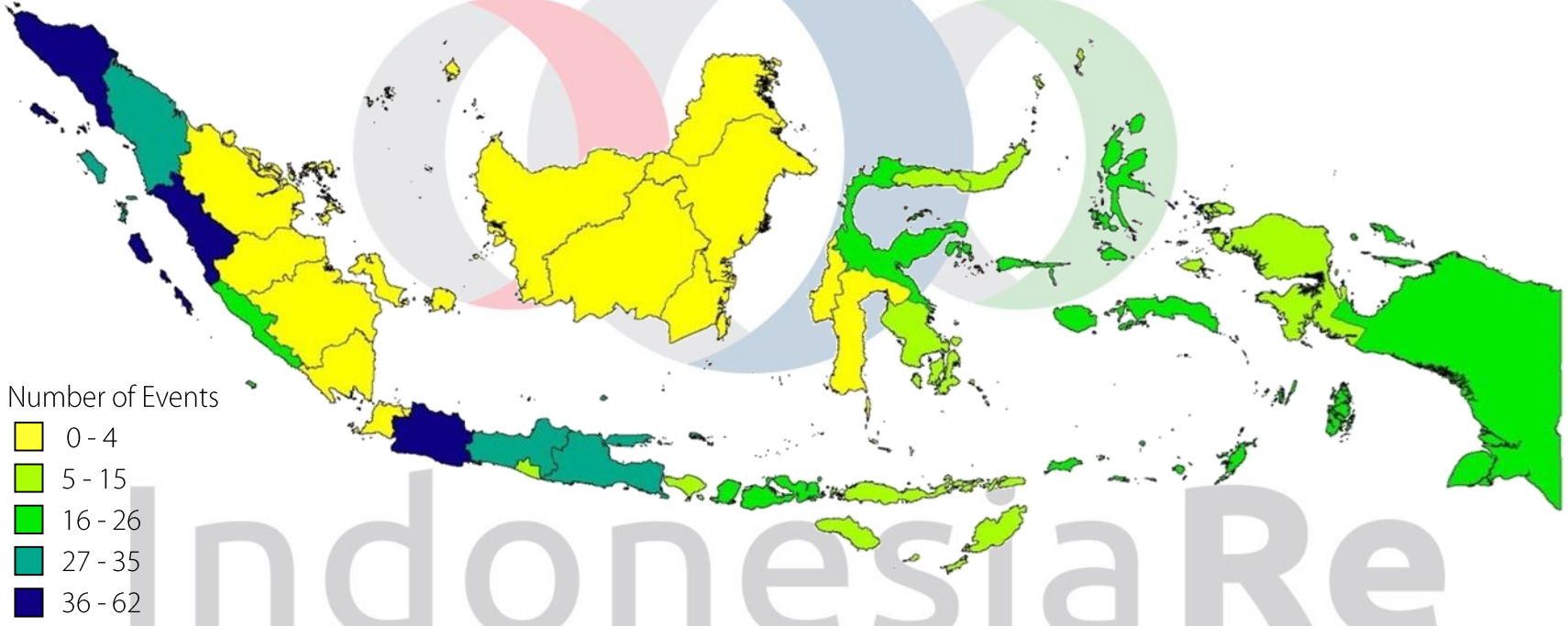
Catastrophe Events (Landslide)

Number of Events (Last 100 Years)



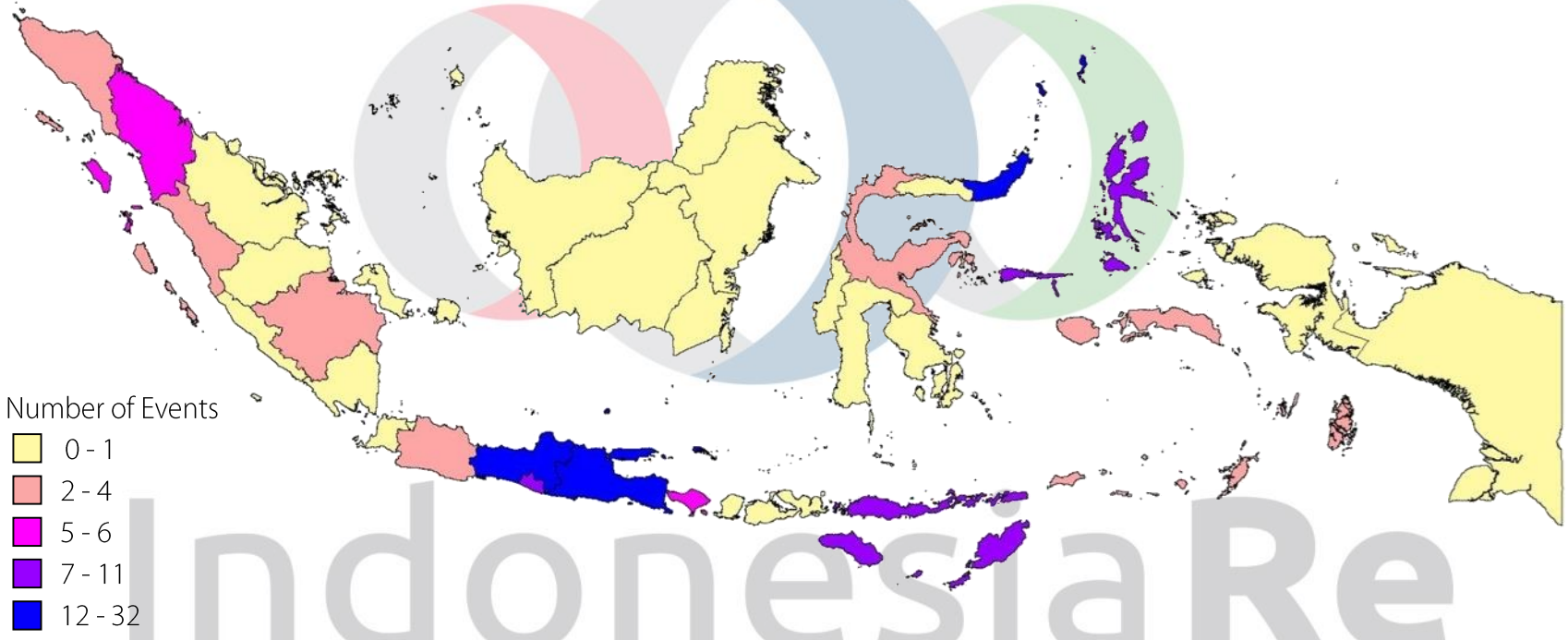
Catastrophe Events (Earthquake)

Number of Events (Last 100 Years)



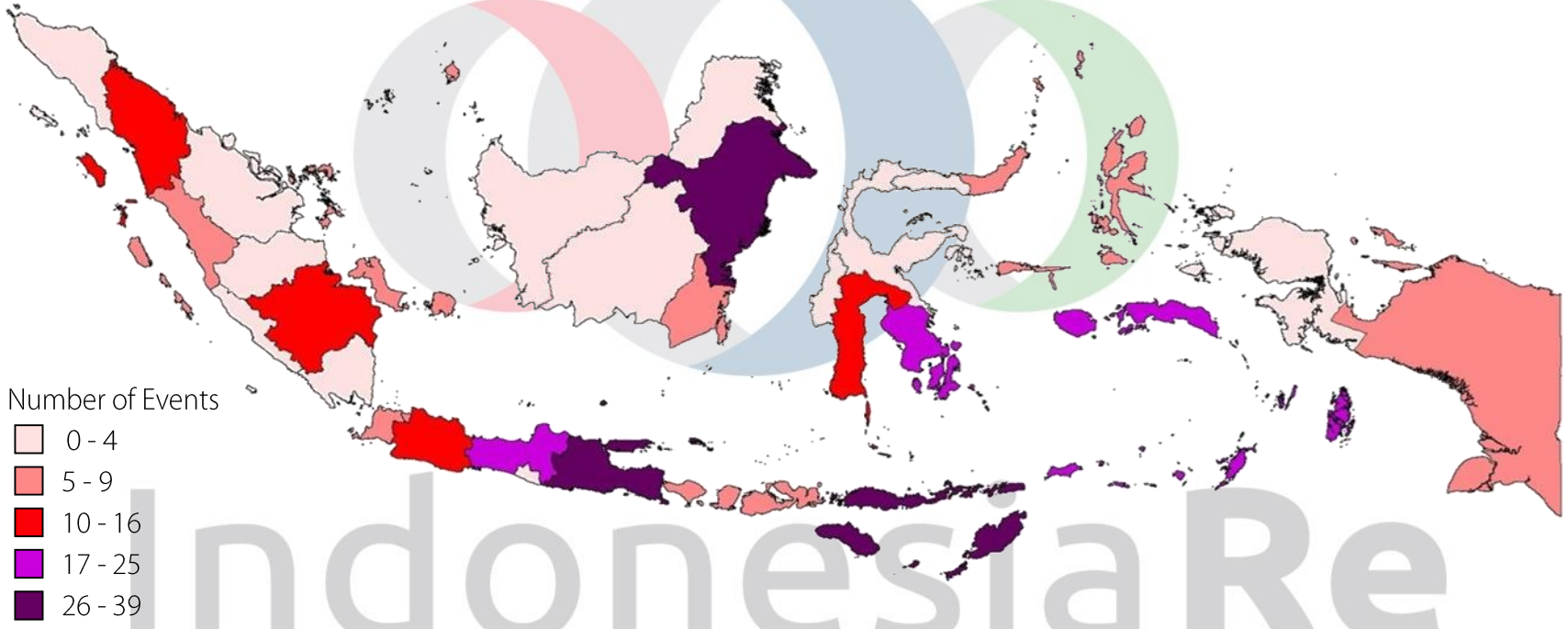
Catastrophe Events (Volcanic Eruption)

Number of Events (Last 100 Years)



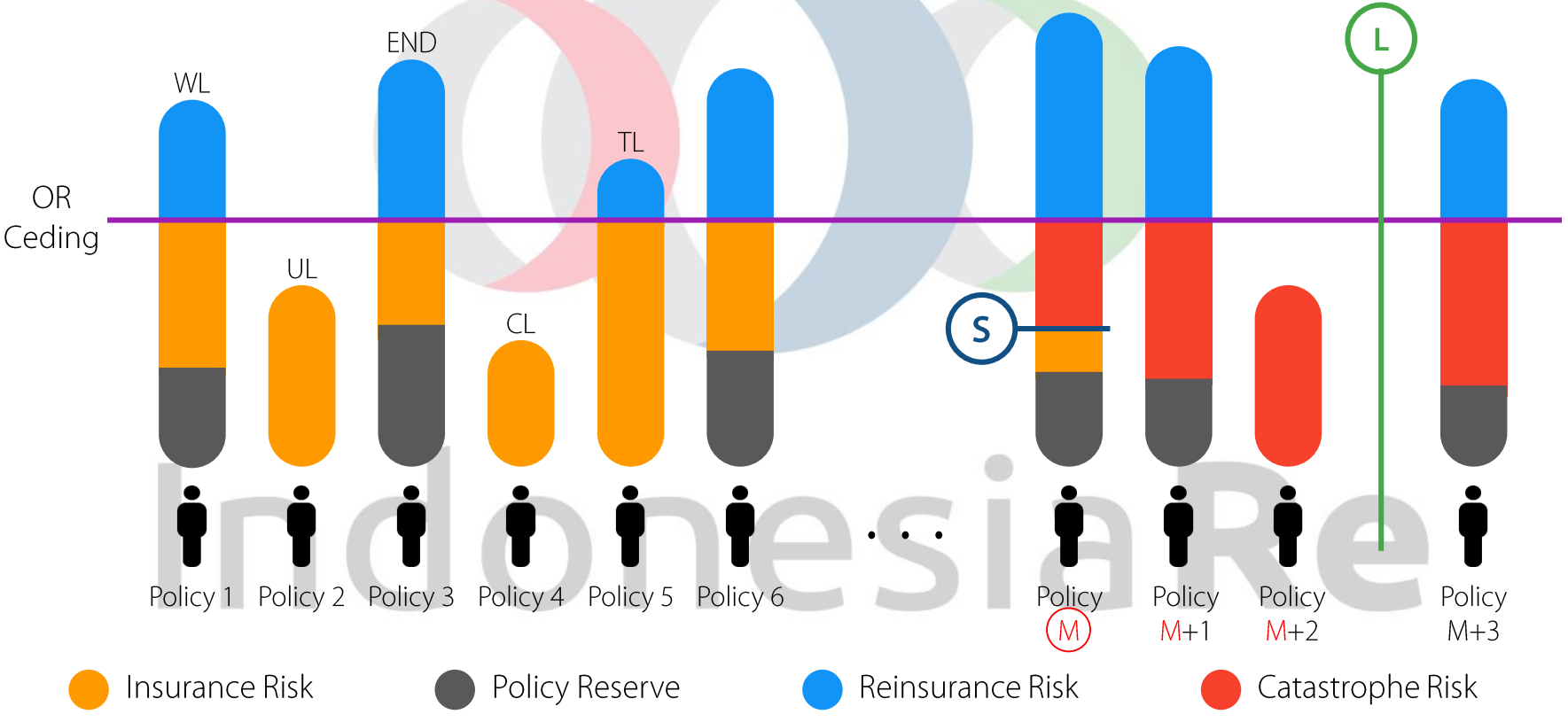
Catastrophe Events (Transp. Accident)

Number of Events

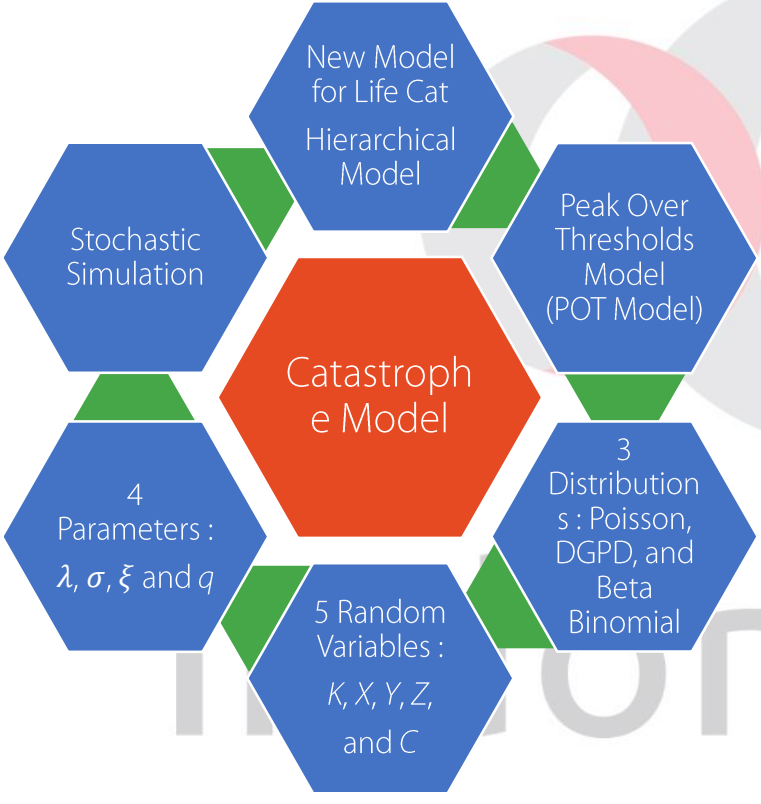


Catastrophe Risk

Portfolio in Life Insurance Company



Catastrophe Model



M — Minimum person insured dies from a single event

S — Insurance company's deductible

L — Maximum amount payable in single catastrophe event

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

Catastrophe Model

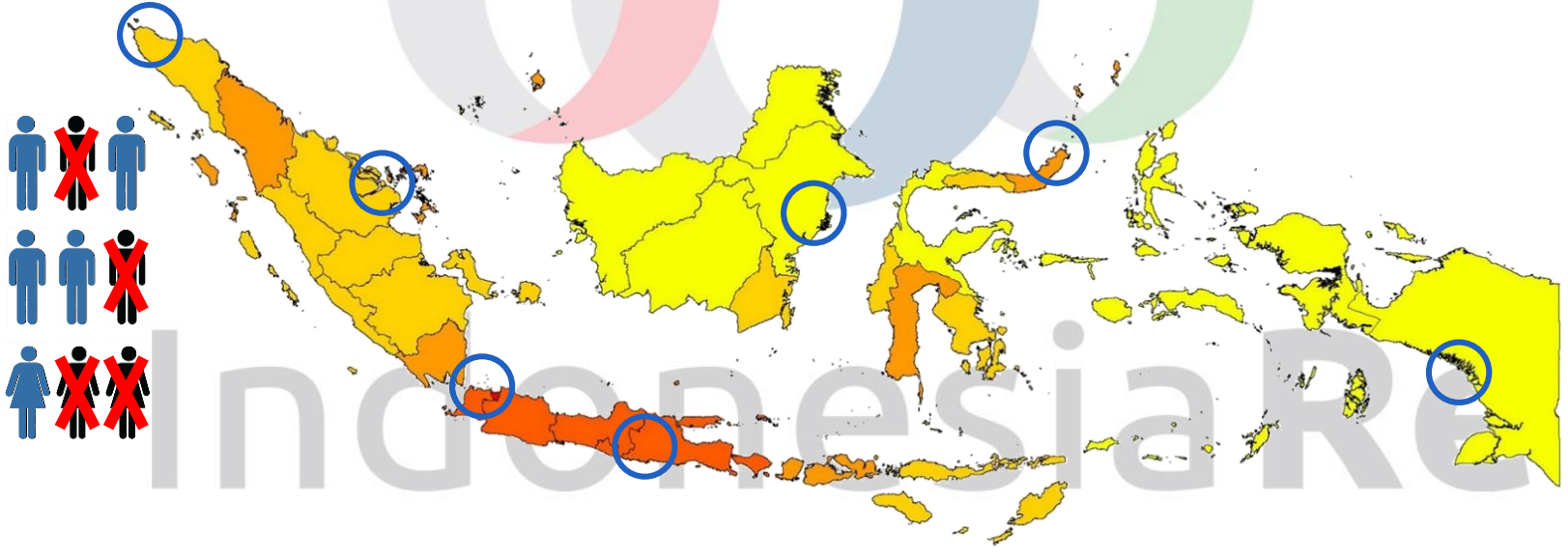
Hierarchical Model

1. The number of catastrophe events → K : Number of event catastrophe in 1 year
2. The number of death for each events → X_k : Number of Death from the kth Catastrophe
3. The number of insured death for each events → Y_k : Number of Insured Death from the kth Catastrophe
4. The amount of claim for each event → Z_k : The Amount of Claim from the kth Catastrophe
5. Total Annual Claim → $C = \sum_{k=1}^{K} Z_k$

Catastrophe Model

Illustration of the Model

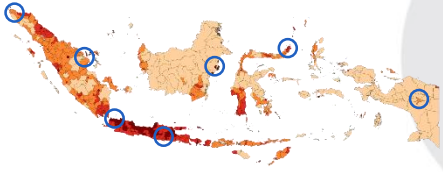
The number of catastrophe events → The number of death for each events → The number of insured death for each events → The amount of claim for each event → Catastrophe Reserve



Catastrophe Model

The Models

The number of catastrophe events

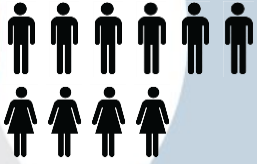


$K \sim \text{Poisson}(\lambda_M)$

λ_M is estimated by

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

The number of death for each events

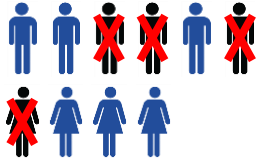


$X_k \sim \text{DGPD}(M, \sigma_M, \xi_M)$

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 Density

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

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

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

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

Catastrophe Reserve

Total annual claim

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

Simulate C for certain number of simulation

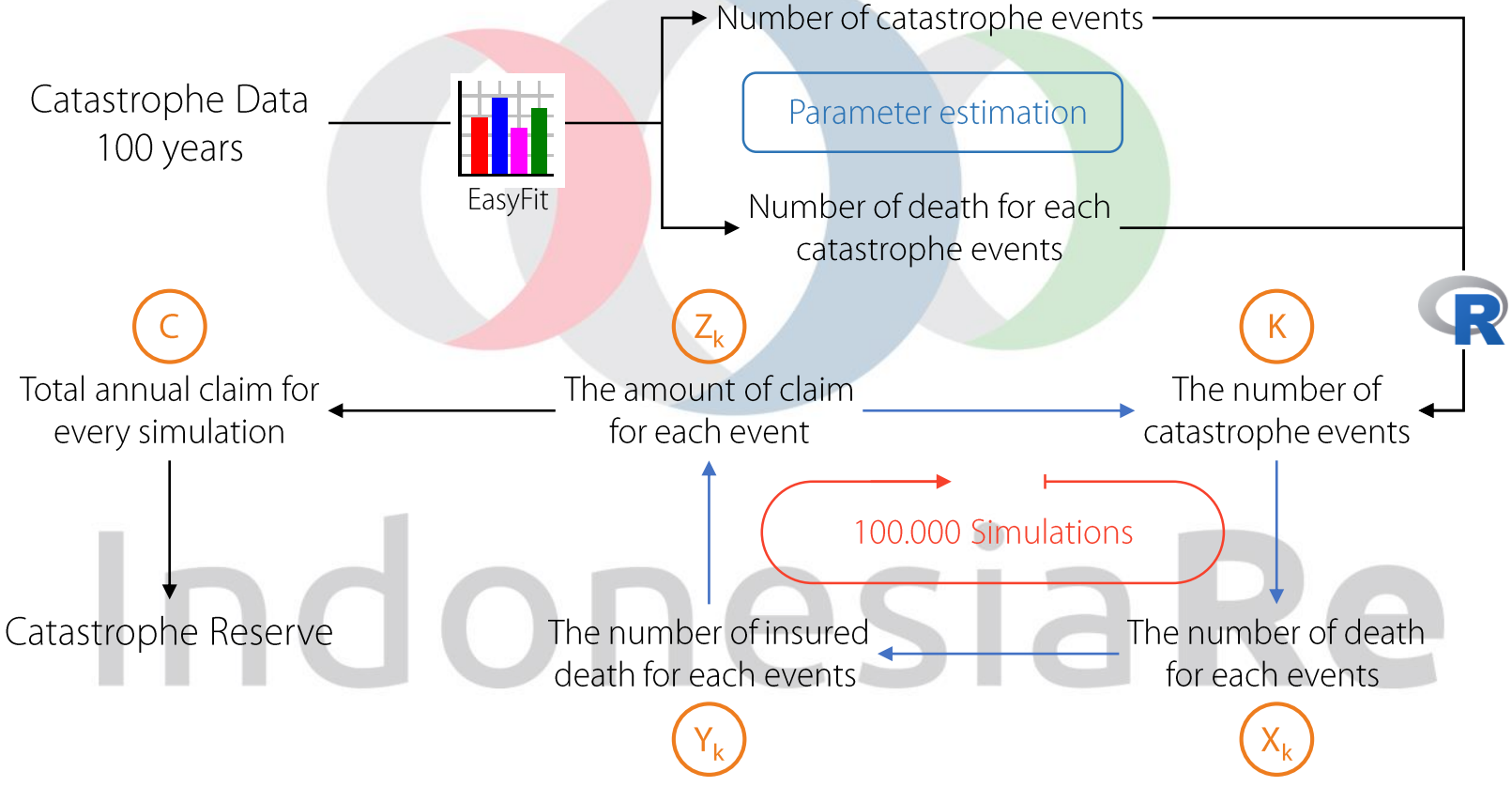
$\text{Reserve} = \text{TVaR}_p(C)$

$\text{VaR}_p(x) = \pi_p \rightarrow \Pr(x > \pi_p) = 1 - p$

$\text{TVaR}_p(x) = E(x \mid x > \pi_p)$

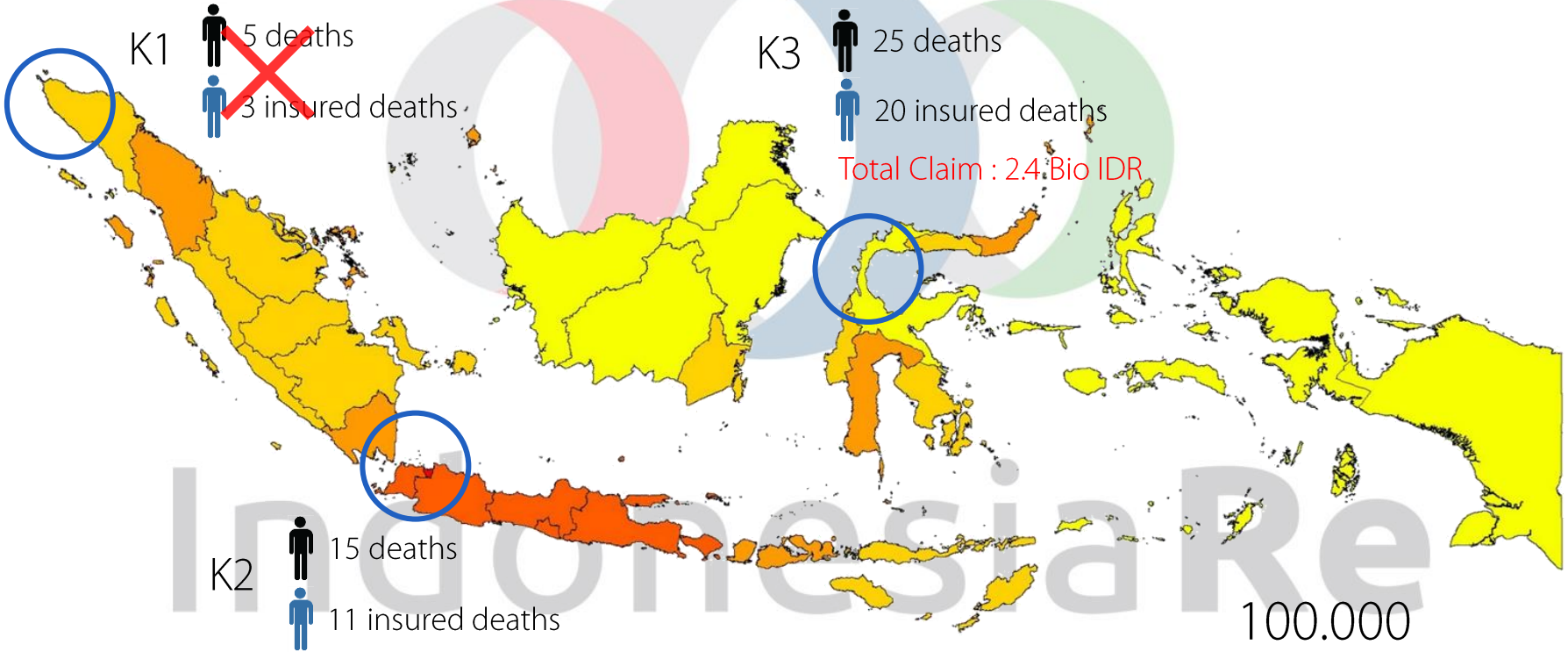
Catastrophe Model

Simulation Procedure



Catastrophe Model

Simulation of Event



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	1,100	2,400

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 99.999

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 100.000

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

Case Study

Company : ABC Life

ABC life intends to make a decision whether they should retain any catastrophe risk they have or transfer the catastrophe risk to the reinsurer.

- How much policies do they have? — 8 million policies
- How much exposure do they cover (in total)? — IDR 560 trillion
- What is the definition of catastrophe risk they expect (number of fatalities in each event)? — Minimum 10 person in each event
- Since they have a plan to transfer the cat risk to the reinsurer, how big is their deductible regarding the catastrophe event? — IDR 500.000.000,- per individu
- From the reinsurer side, do they have limitation of maximum amount payable in single catastrophe event? — IDR 30.000.000.000,-

Life Catastrophe Reserve

Company : ABC Life

10 death — Minimum person insured dies from a single event

5 bio — Insurance company's retention

30 bio — Maximum amount payable by the reinsurer

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

$= 0.03$

Average Insurance Risk $= \frac{\text{Total exposure}}{\text{Total policies}}$

$= 70$ mio

Scenario A
Retaining any cat. risk they have

M = 10 — Minimum person insured dies from a single event

S = L — Insurance company's retention

L = ∞ — Maximum amount payable in single catastrophe event

Scenario B
Transferring the cat. risk to the reinsurer

M = 10 — Minimum person insured dies from a single event

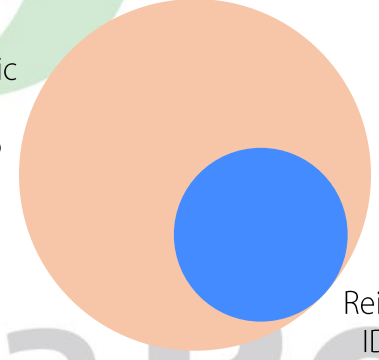
S = 5 bio — Insurance company's retention

L = 30 bio — Maximum amount payable in single catastrophe event

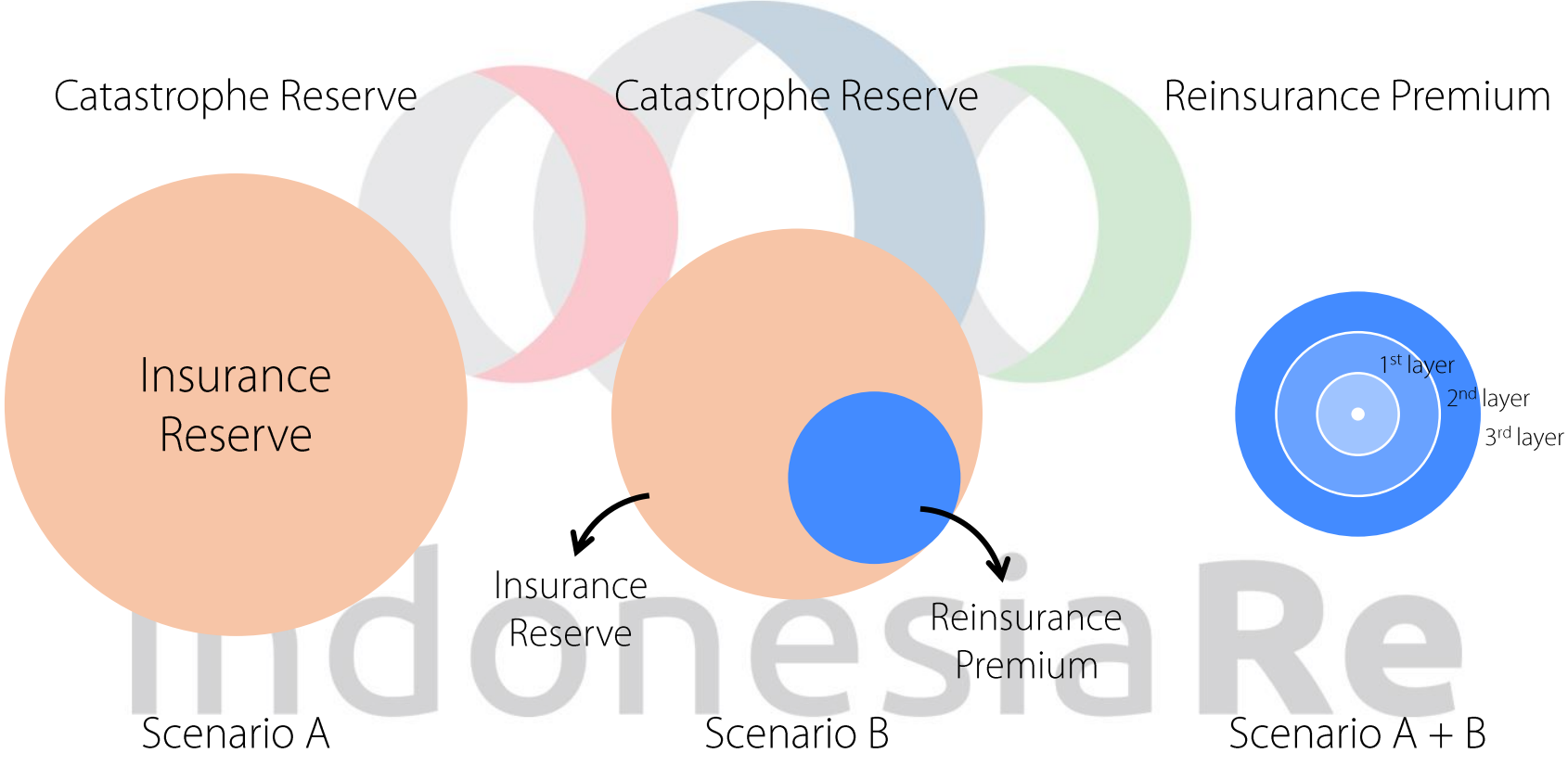
Life Catastrophe Reserve

Scenario A
Retaining any cat. risk they have

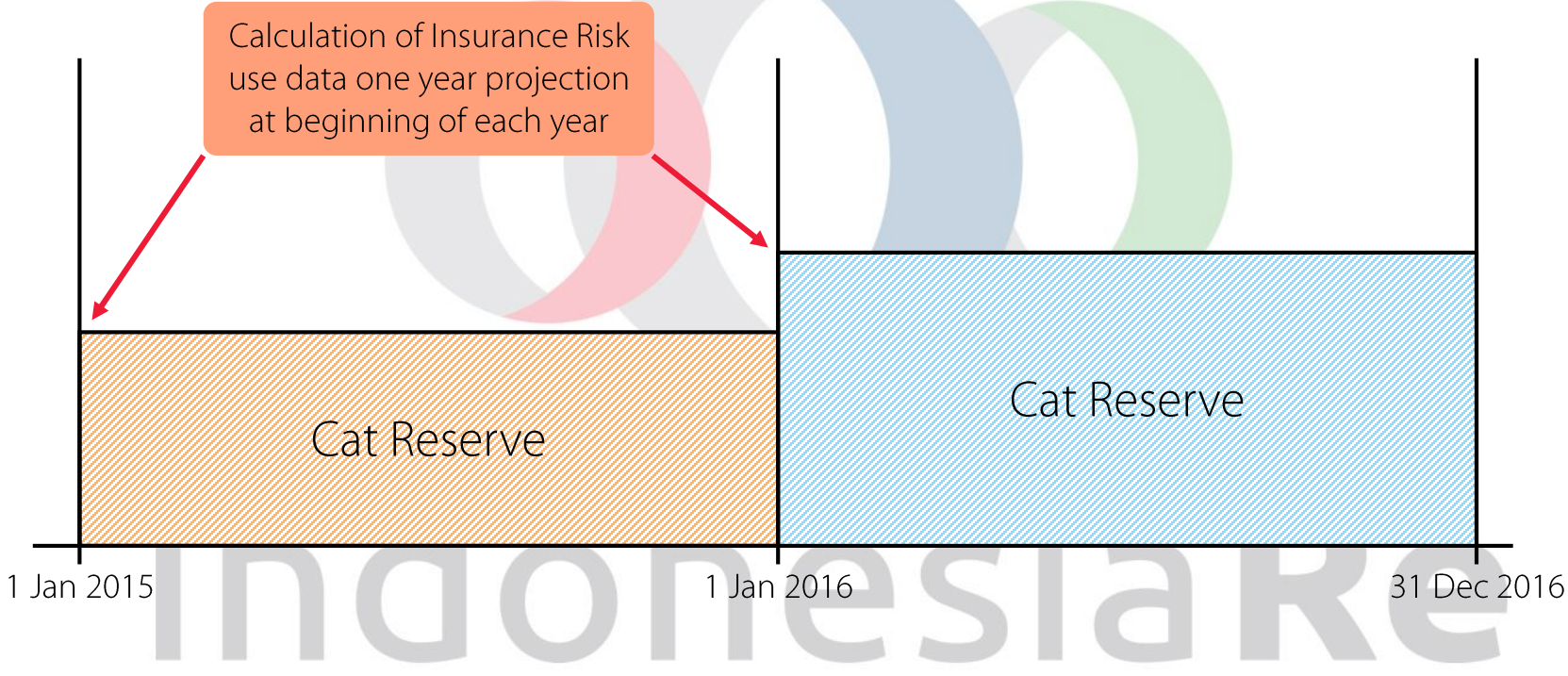
Scenario B
Transferring the cat. risk to the reinsurer



Life Catastrophe Reserve



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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