B-READI Building Reliable Effective and Aware DIsaster emergency and prevention managing skills

Disasters “almost” natural and/or Impacts on society and human infrastructure

Dott. Geologo Gabriele Ponzoni
OGER-FEG

B-READI PILOT

University of L'Aquila - from 26 to 30 June 2023

What are we talking about..? .. of events that destabilize portions of the territory from their daily routine for variable periods of time (from a few hours to years)..

High energy events: (therefore large portions of the territory and very destabilizing)

Low energy events: (therefore limited portions of territory)

Another element to consider regarding these events is the variable connected to time: that is, how persistent they are and how long their effects remain on the territory ... but we will talk about this element later

HIGH ENERGY EVENTS …
WITH IMPACTS ALSO ON THE ECONOMIC ACTIVITIES OF THE AREA

EARTHQUAKE/TSUNAMI MESSINA 1908

Messina: This city also had a particular strategic-military importance, as a landing place along the routes that connected the basins of the Tyrrhenian Sea and the central Mediterranean with the Suez Canal. Reggio Calabria has less attention, an element that weighed in the reconstruction phase of the city, which began only about ten years after the event. Overall, the earthquake was responsible for damage estimated at 600 million lire, i.e. a much higher figure than the total amount of interest on the public debt for the period 1907-1912.

EMILIA ROMAGNA EARTHQUAKE 2012

the companies involved are a few thousand for a total value of the estimated damage of 2.7 billion euros. The two sectors most affected are the biomedical and the textile clothing. the estimate conducted starting from assessments of the affected companies, production downtime and the economic size of the area leads to an assessment of the added value lost due to the earthquake at 3.1 billion euros

EVENT TYPE = ENERGY INVOLVED

Landslides/Avalanches
Earthquakes/Tsunami/Eruptions
Meteorological: Snow/Heat/Rain/Wind (storms)
Coastal or river floods (minor than lakes or lagoons)
Meteorites (e.g. Russia 2013)

EVENT SEQUENCE

Single Events / Multiple Events
Cascading or interacting events (example Pinatubo 1991 eruptions/rains/landslides)
Events in time sequence or concurrently

WHEN THE EVENT HAPPENS

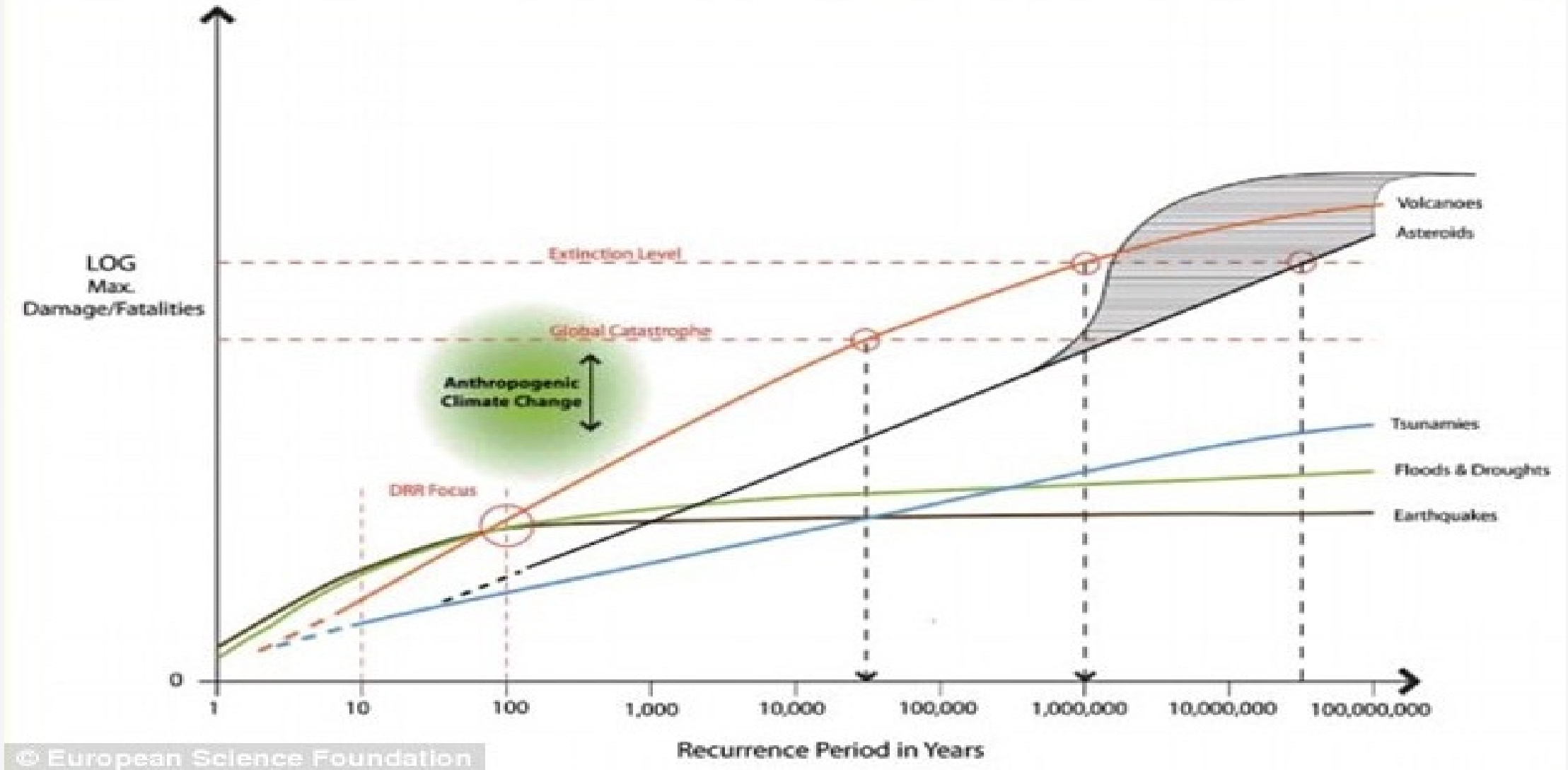
Identical events but on different periods (impacting on the period of the year)

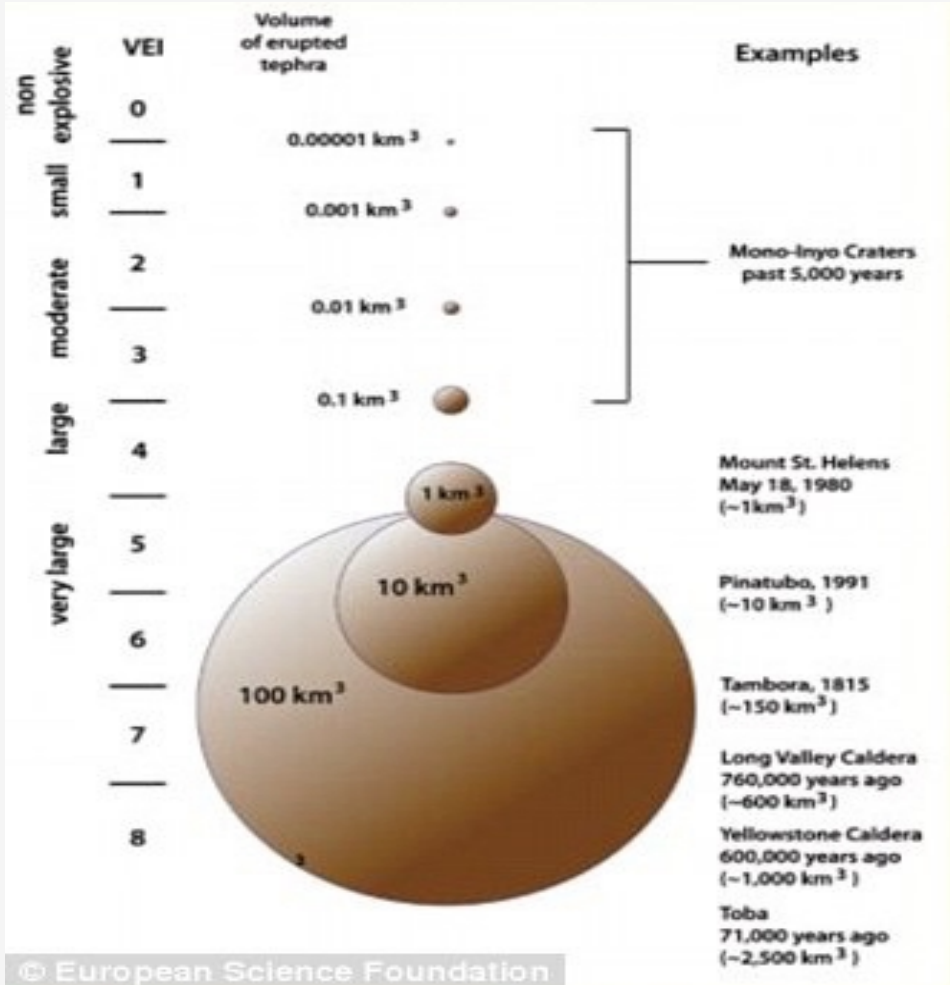
Or

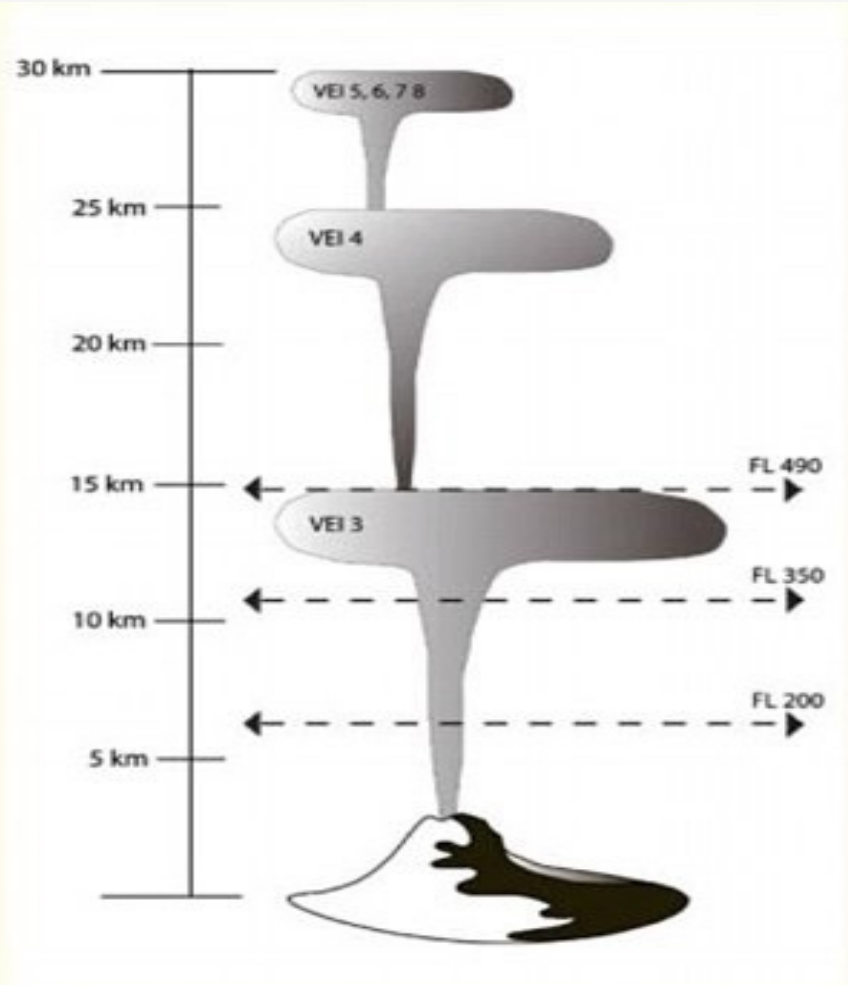
Different events but on the same period of time

In short …..

It is necessary to connect the event investigated in a very precise temporal context and not random or probabilistic ...


LOG
Max.
Damage/Fatalities
Extinction Level
Global Catastrophe
Anthropogenic
Climate Change
DRR Focus
Volcanoes
Asteroids
Tsunamies
Floods & Droughts
Earthquakes
0
1
10
100
1,000
10,000
100,000
1,000,000
10,000,000
100,000,000
Recurrence Period in Years
© European Science Foundation


VEI
Volume of erupted tephra
Examples
non explosive
small
moderate
large
very large
0
1
2
3
4
5
6
7
8
0.00001 km³
0.001 km³
0.01 km³
0.1 km³
1 km³
10 km³
100 km³
Mono-Inyo Craters past 5,000 years
Mount St. Helens May 18, 1980 (~1km³)
Pinatubo, 1991 (~10 km³)
Tambora, 1815 (~150 km³)
Long Valley Caldera 760,000 years ago (~600 km³)
Yellowstone Caldera 600,000 years ago (~1,000 km³)
Toba 71,000 years ago (~2,500 km³)
© European Science Foundation


30 km
25 km
20 km
15 km
10 km
5 km
VEI 5, 6, 7 8
VEI 4
VEI 3
FL 490
FL 350
FL 200

So the first elements to consider are related to the portion of territory involved (area extension) and energy released by the event itself ... And as we have seen before the TIME Factor. All this because it allows us to better approach a quantification of the event given by:

$$R = P * V * E$$

Where
P ---> dangerousness
V ---> vulnerability
E ---> exposed value

This formula has now been seen countless times but due to its nature of approach is extremely simplistic and not inclined to be indicative and predictive ... a couple of examples and concepts:

the analysis of the reliability of the human factor (human reliability analysis), a problem that occurred both in the Twin Towers NY, or in the telephone operators of the aid points...

common-cause-failure analysis, a phenomenon that occurred in Fukushima, JP; … this is a typical factor to be considered in the management of nuclear facilities…

Let's go back to our equation:

R1 = P * V * E

Where ...
P ---> dangerousness
V ---> vulnerability
E ---> exposed value

And let's try to consider other useful elements as possibilities...

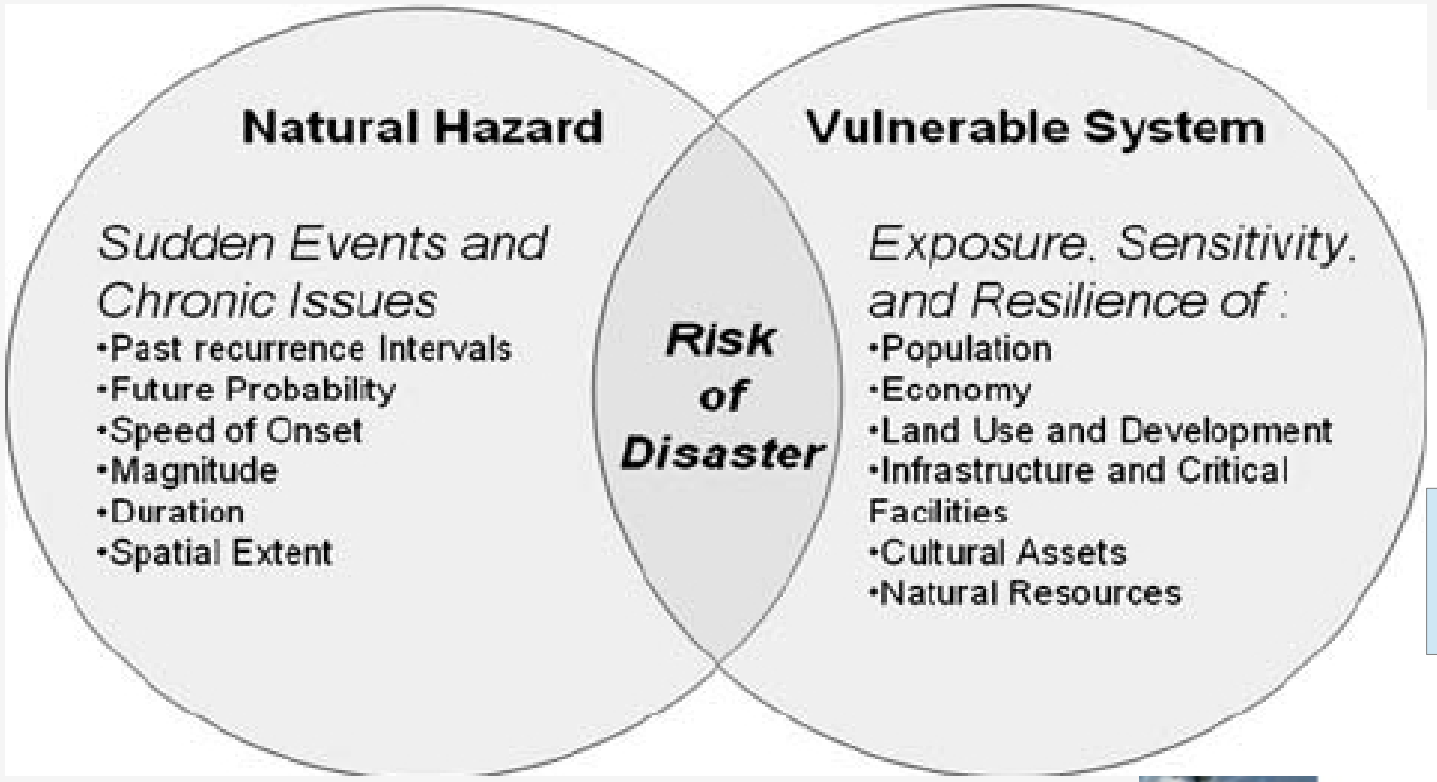
Rmodified = (R1 / Pr) * (Vr * Pr1) * Ver * E

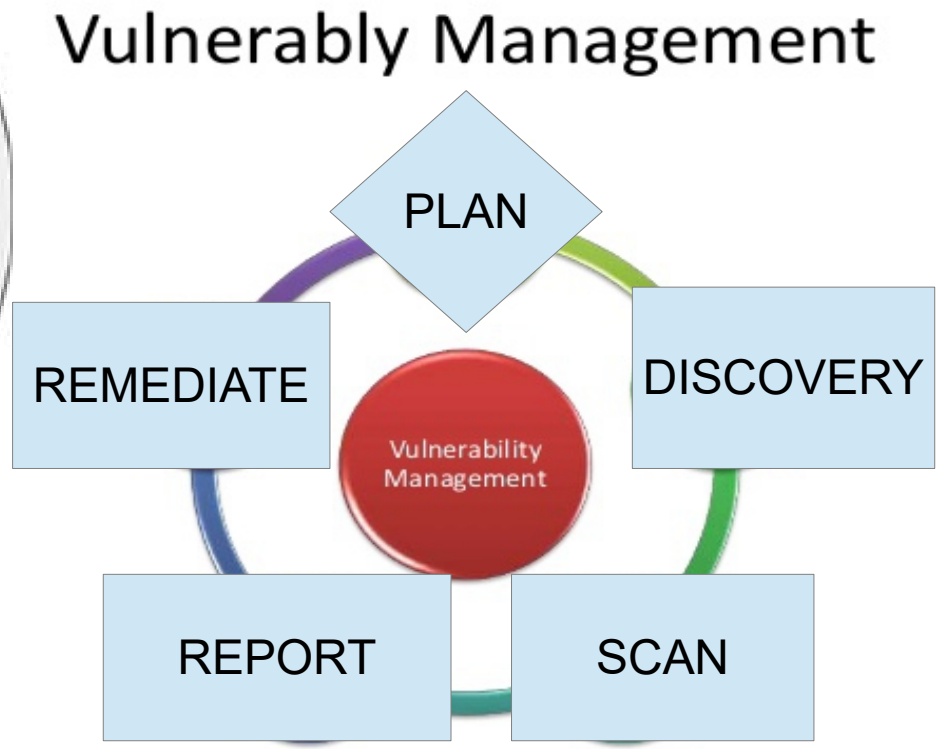
Pr -→ perception of the risk by the potential victims, [0.1 for no perception, at 1 max perception: the reason is due to the consideration that one has towards the perception of a risk and more prudential behaviors are implemented]

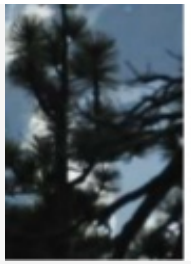
Pr1 → risk propensity and depends a lot on individuals, subjective element; a classic example is the propensity cards for investors; value from 1 to 10, where 10 is attributable to people brought to risk, example American submarine commander who alone sinks an entire Japanese convoy 1942, and the following year disappears in the sea of Japan against a single ship.

Vr → Evaluation of the risk influenced by natural variables (ranging from 0.1 to 10, where 10 is given by the presence of other adverse natural elements such as heavy snowfalls that overlap with seismic events and more)

Ver → assessment of risk exposure: it can be voluntary or not, ranging from 1 to 100, where 100 is when there is a delegation to others, (examples twin towers and evacuation and concept of resilience)







Rev1/8/2010 © 2010 Maze & Associates 2

Black swan theory

From Wikipedia, the free encyclopedia.
The black swan theory, or black swan theory of events, is a metaphor that expresses the concept that an event with a strong impact is a surprise to the observer. Once it has happened, the event is rationalized in retrospect.
The theory was developed by Nassim Nicholas Taleb 2007 to explain:

The disproportionate role of high-impact, rare, and hard-to-predict events compared to normal expectations in history, science, finance, and technology.
The impossibility of assessing the probability of periodic rare events using scientific methods (due to their nature of very low probability events).
The psychological biases that blind people individually and collectively to the uncertainty and unawareness of the importance of the role of high-impact rare events in the course of history.

The "black swan theory" refers only to unexpected events of large magnitude and their consequent dominant role in history. Such events, considered unique, collectively play an important and vast role, contrary to the normal flow of normal events.

There are two types of rare events:
a) the described black swans, those that are part of the public debate and that we are likely to hear about on television, and
b) the black swans that no one talks about, because they escape models and which we he is ashamed to speak in public, since they appear implausible.

The fact that in the first case the frequency of black swans is overestimated and in the second severely underestimated is entirely compatible with human nature

***heuristic traps* (the importance of personal perception to danger)**

- **availability** .. use of the information that comes to mind first
- **anchoring**... letting yourself be conditioned by previously adopted information or solutions, limiting yourself to small adjustments
- **narcissus effect** ... fall in love with your own solution. In comparison your own idea is better regardless
- **discordance** ... elimination of information apparently discordant with one's idea
- **details** ... concentration on details versus a global view (this is a sign of withdrawing the mind from reality)

The perceptual hallucination of evident data: the question of how to lower bomber losses (WWII)

In the end it was decided to armor the bombers, but since obviously every kilo of armor means one kilo of bombs less, the whole fuselage cannot be protected.

Not only that, armor is a double-edged sword: it protects, but it worsens performance and makes the bomber more vulnerable. You have to choose where to place the protections: employees are appointed who, when the allied bombers land in the base from which they left, note the position of the shots received. After a few months of rigorous and methodical work, we finally have a precise map of the areas most damaged by the bombers. Then to Wald, this brilliant mathematician and statistician, comes the bomber damage data and the proposed fuselage reinforcements. What to others seems obvious, his trained mind and expert in statistics turns on a red light: ***stop everyone!***

Wald's intuition

What seems obvious, ... reinforcing the most affected parts, would be a very serious mistake. In fact, Wald rightly points out, damage is noted on bombers that have landed at the base; all those that have been shot down have fallen somewhere and cannot be observed.

Therefore, it is not the most damaged areas that need to be reinforced, but the exact opposite. Because the bombers hit in the healthy areas have been lost, and therefore it is necessary to reinforce not the most damaged areas, but those that appear unscathed

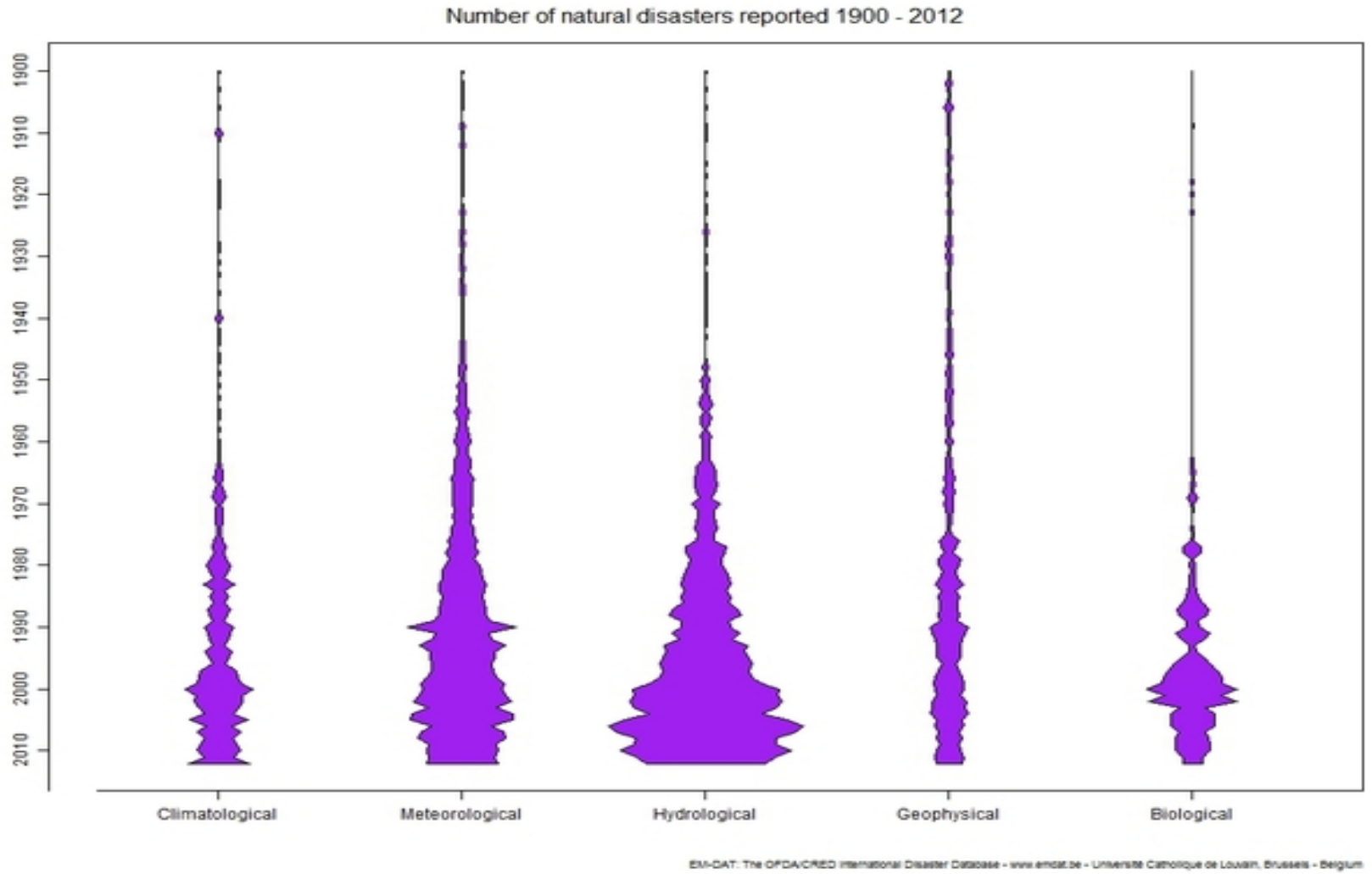
THE EURISTIC TRAPS

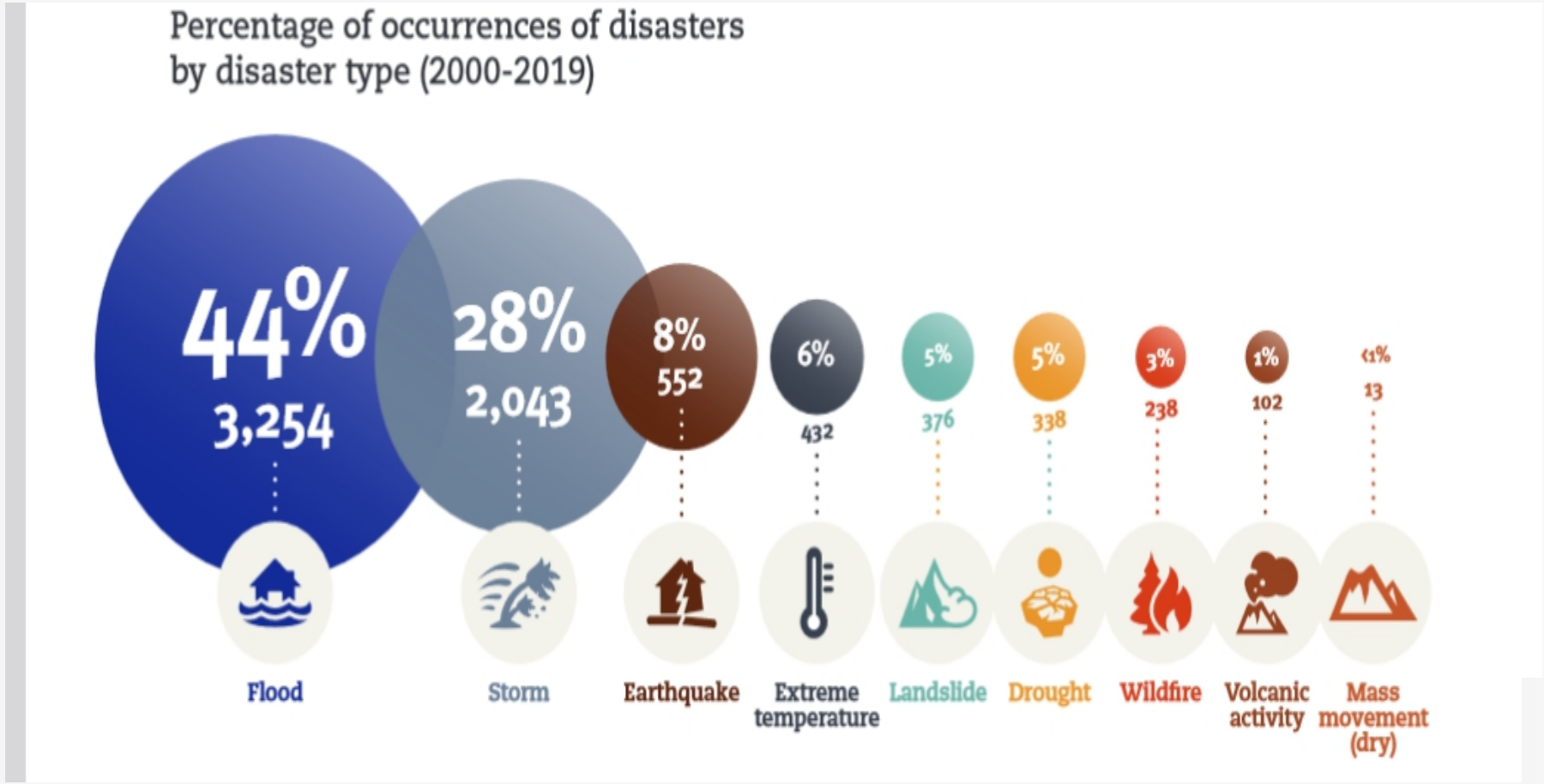
In common practice, the decision-making process uses the heuristic method. That is, decisions on uncertain events are entrusted to "logical" shortcuts based on a few simple rules or on previous experiences that avoid the analytical effort of the entire mass of information available, allowing you to quickly choose between conflicting/competing options. It is a preconscious (therefore unaware) decision-making method governed by the sometimes erroneous perceptions, attitudes and desires with which knowledge and information are selected and filtered before arriving in the conscious field. The decision is usually a function of two criteria: the solution that has already worked in the past and the one with which we are more familiar.

In general, the more complex and ambiguous the situation, the more we tend to decide in an intuitive, unreasoned and wholly subjective way, mediated by the "protocols of action" established and transmitted by our cultural model, often therefore based on clichés which become a source of risk and an obstacle to the correct resolution of the problem. Heuristic oversimplification, in complex decision-making contexts, can therefore lead to serious errors of judgment. However, the heuristic method is preferred to the analytical one, as the latter, based on knowledge, is slower and more boring, requires greater cognitive effort and can sometimes provide ambiguous answers which, without experience, cannot be selected.

EURISTIC TRAPS - THOUGHT STRATAGEMS TO SOLVE PROBLEMS -
THEY ARE HINDERED BY BIASES (mind tunnels or prejudices or propensities)

SOLUTION: **HAVE SEVERAL PEOPLE FACE THE SAME PROBLEM (AND ROTATE THEM EACH OTHER TO AVOID HABITS)**


Number of natural disasters reported 1900 - 2012
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Climatological
Meteorological
Hydrological
Geophysical
Biological
EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Université Catholique de Louvain, Brussels - Belgium

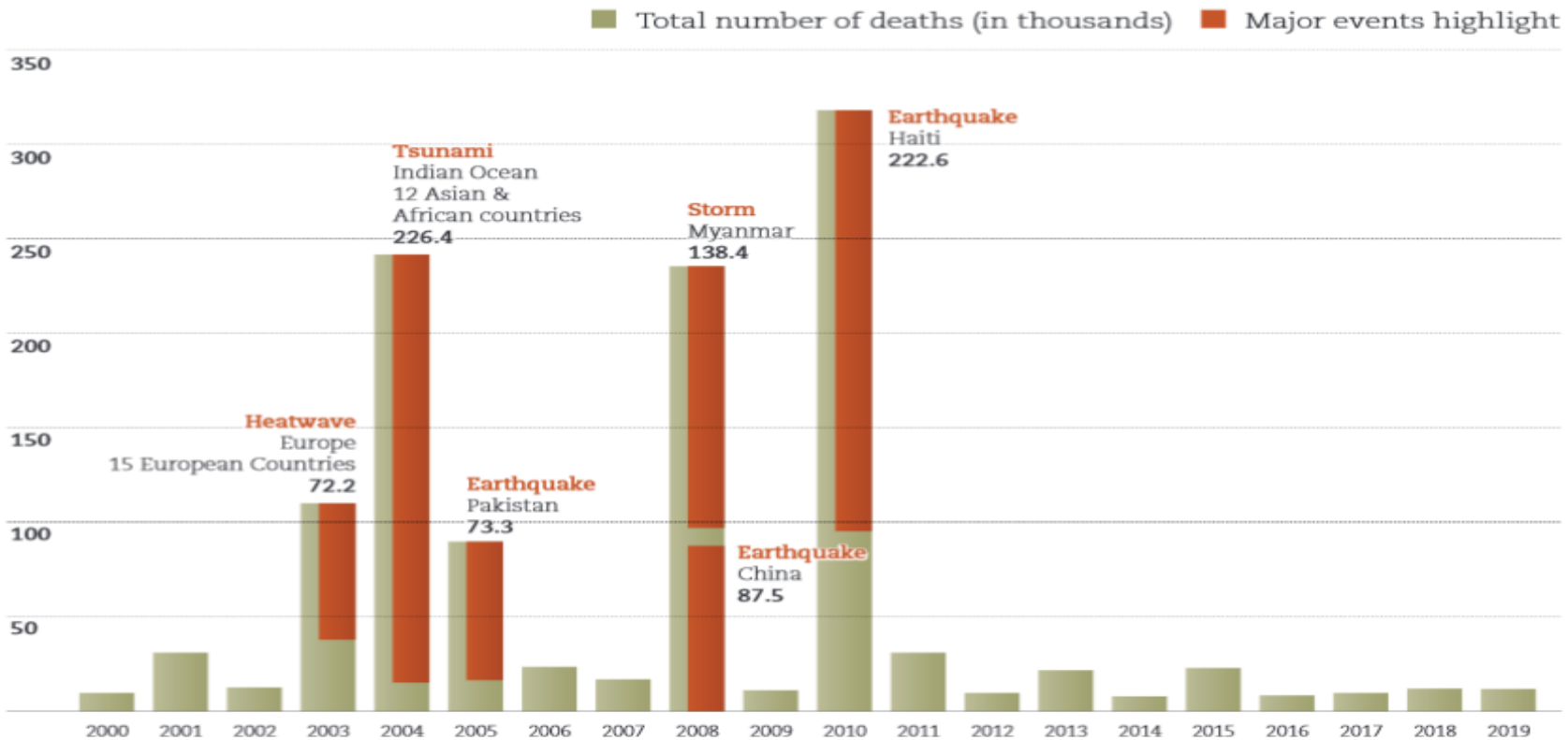


UNDRR
UN Office for Disaster Risk Reduction

UNDRR
The UN Office for Disaster Risk Reduction

Source: 74124_humancostofdisasters20002019reportu

Total number of deaths per year with major events highlighted (in thousands) (2000-2019)



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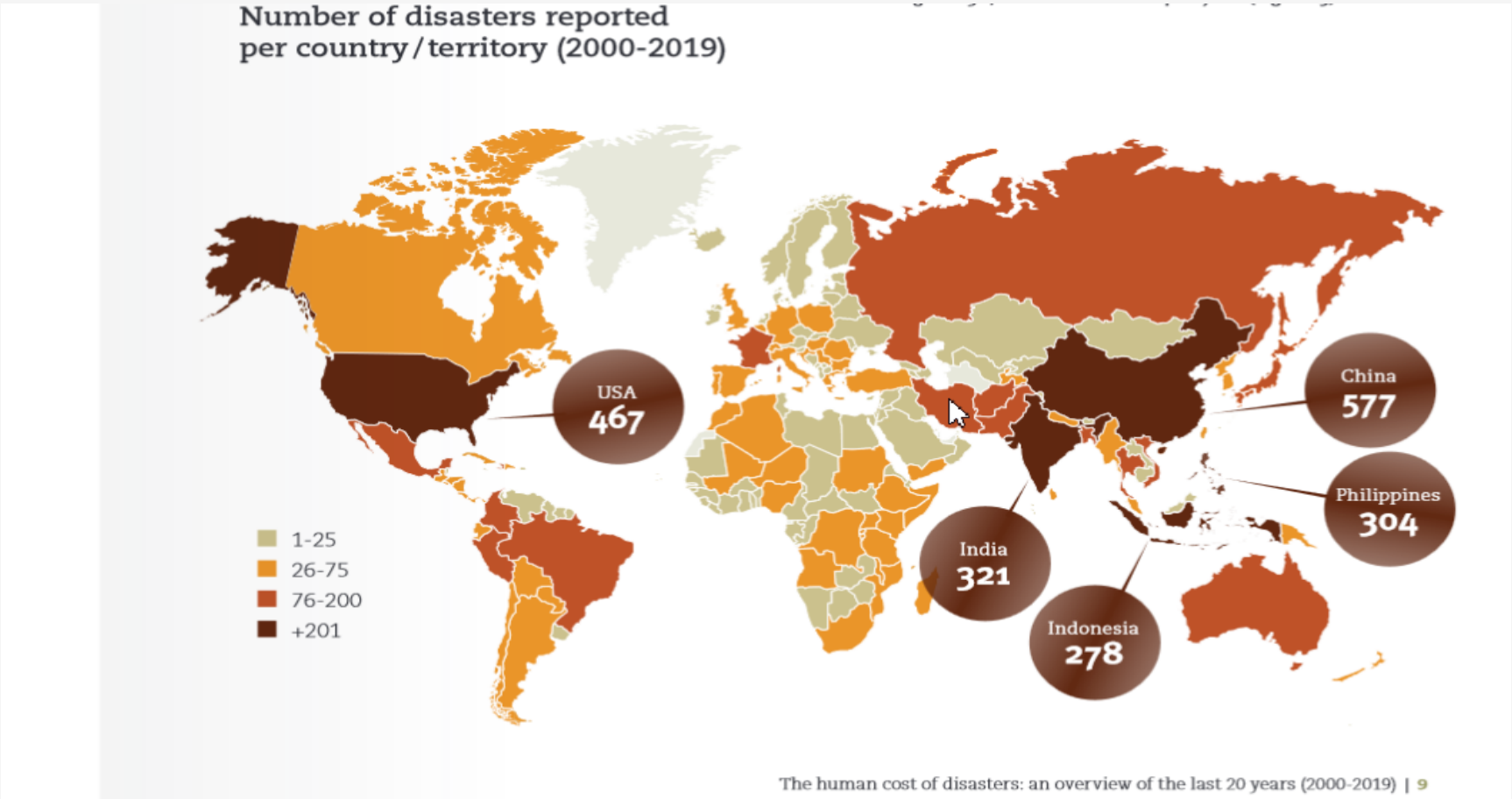

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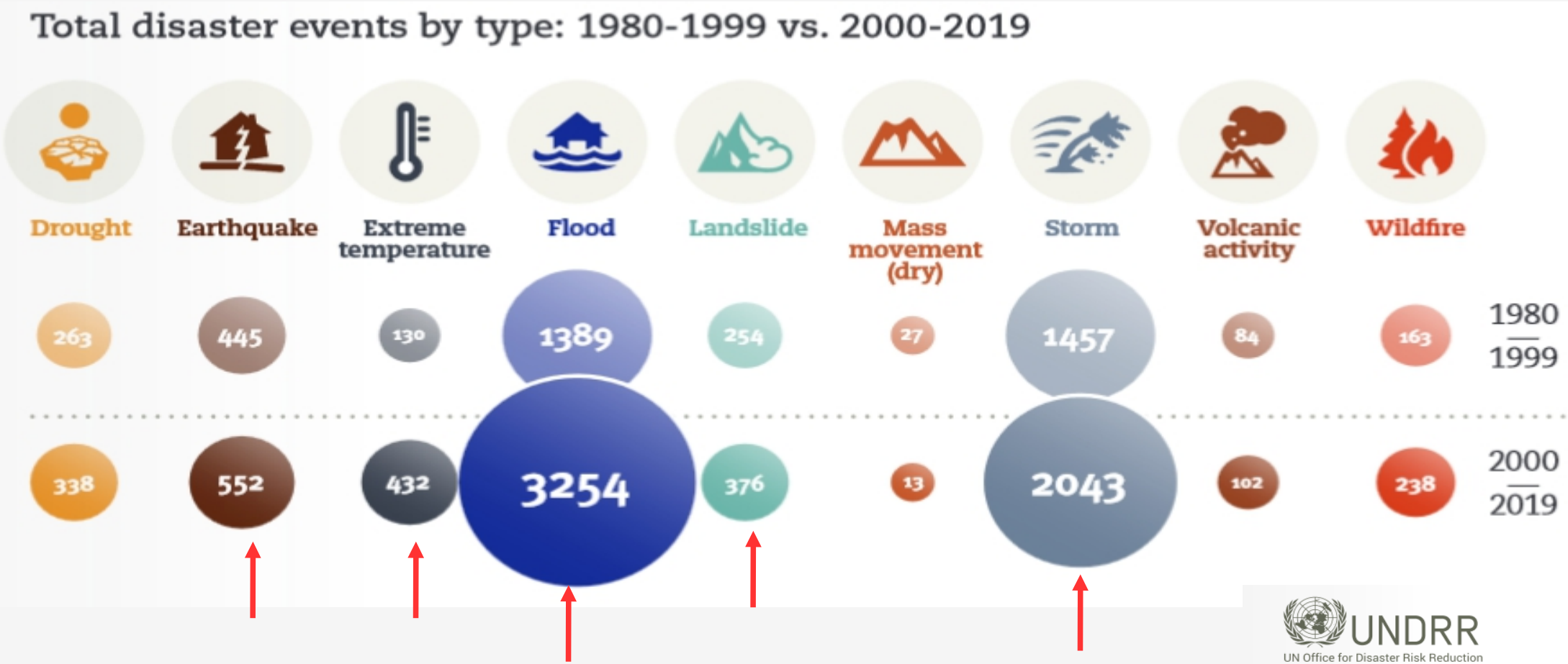

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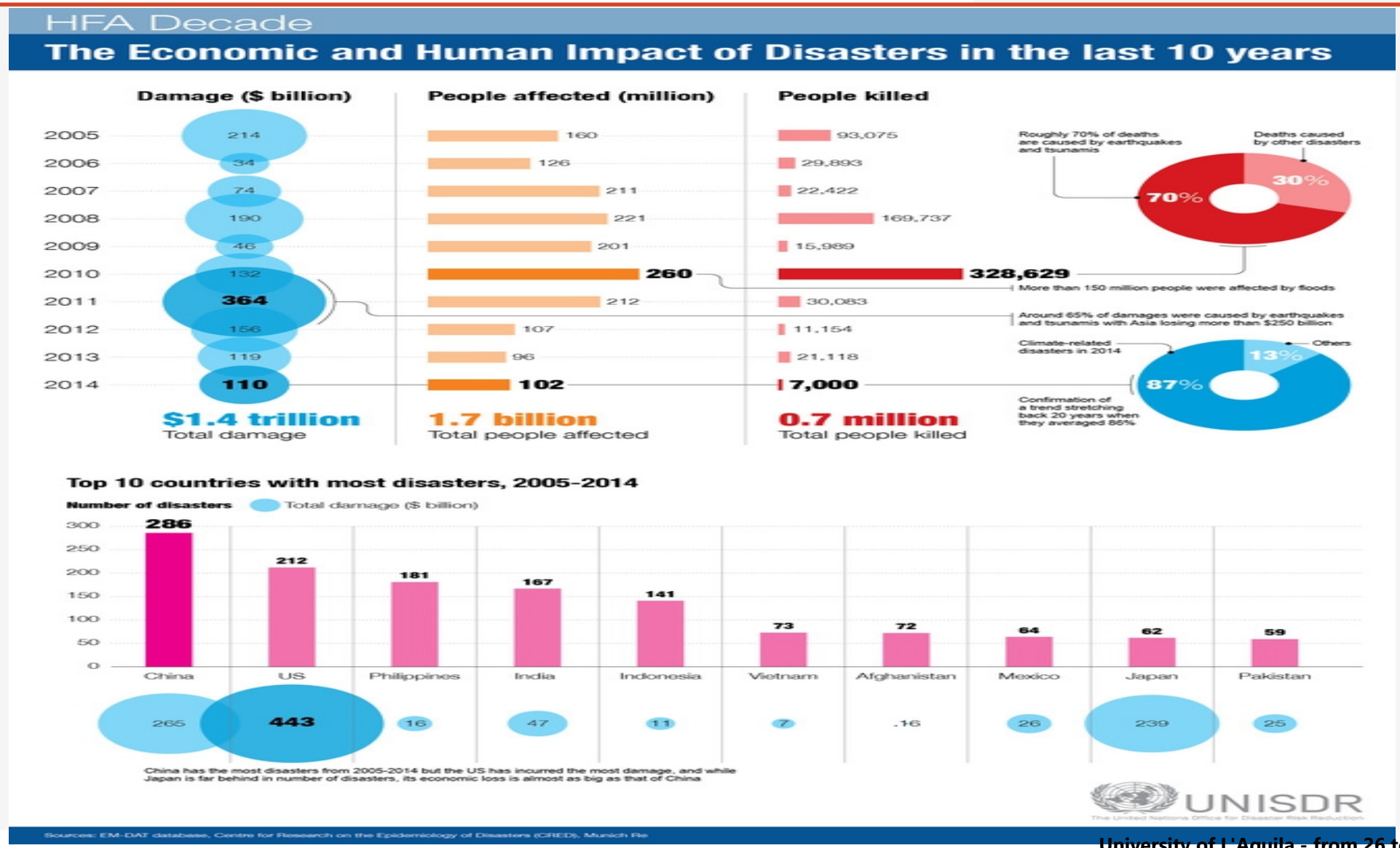
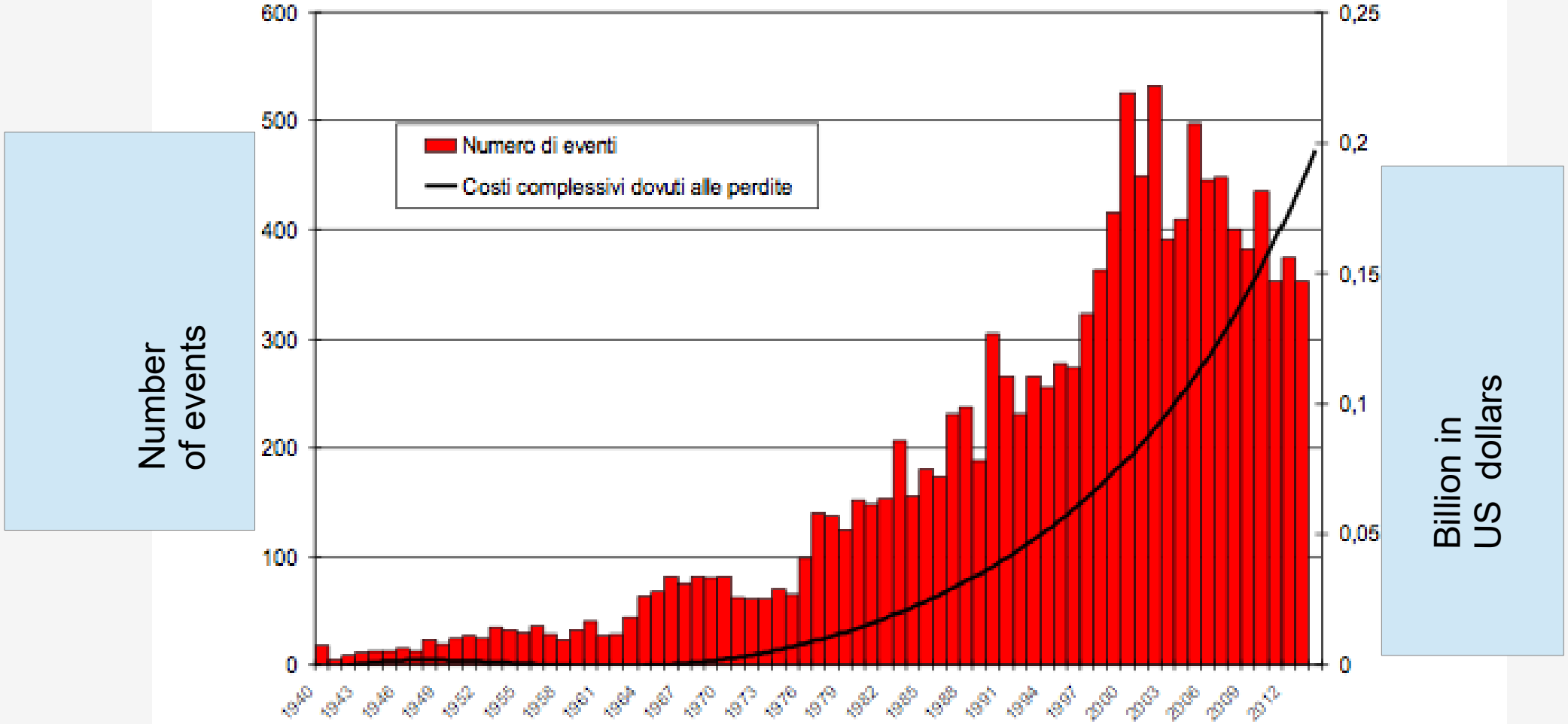
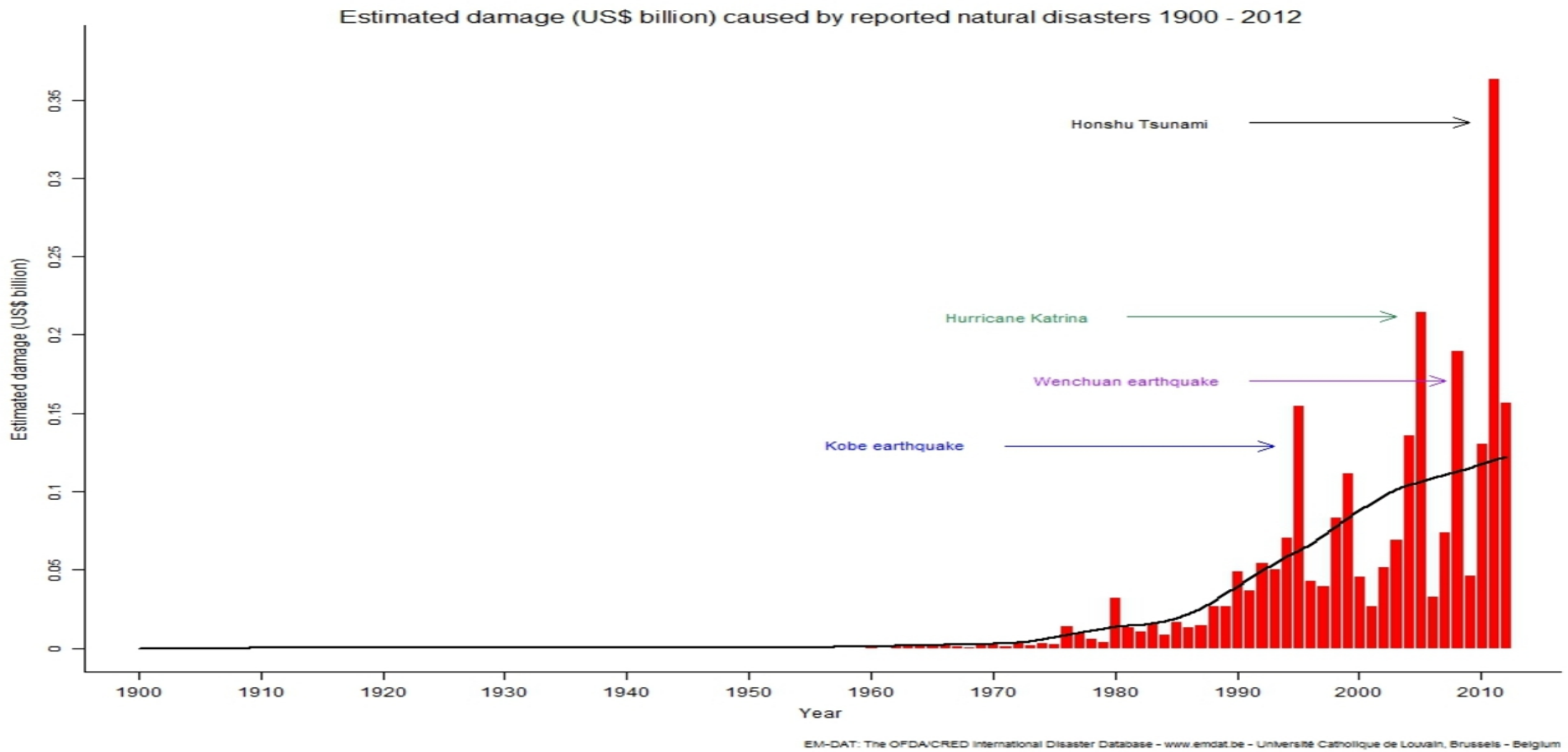
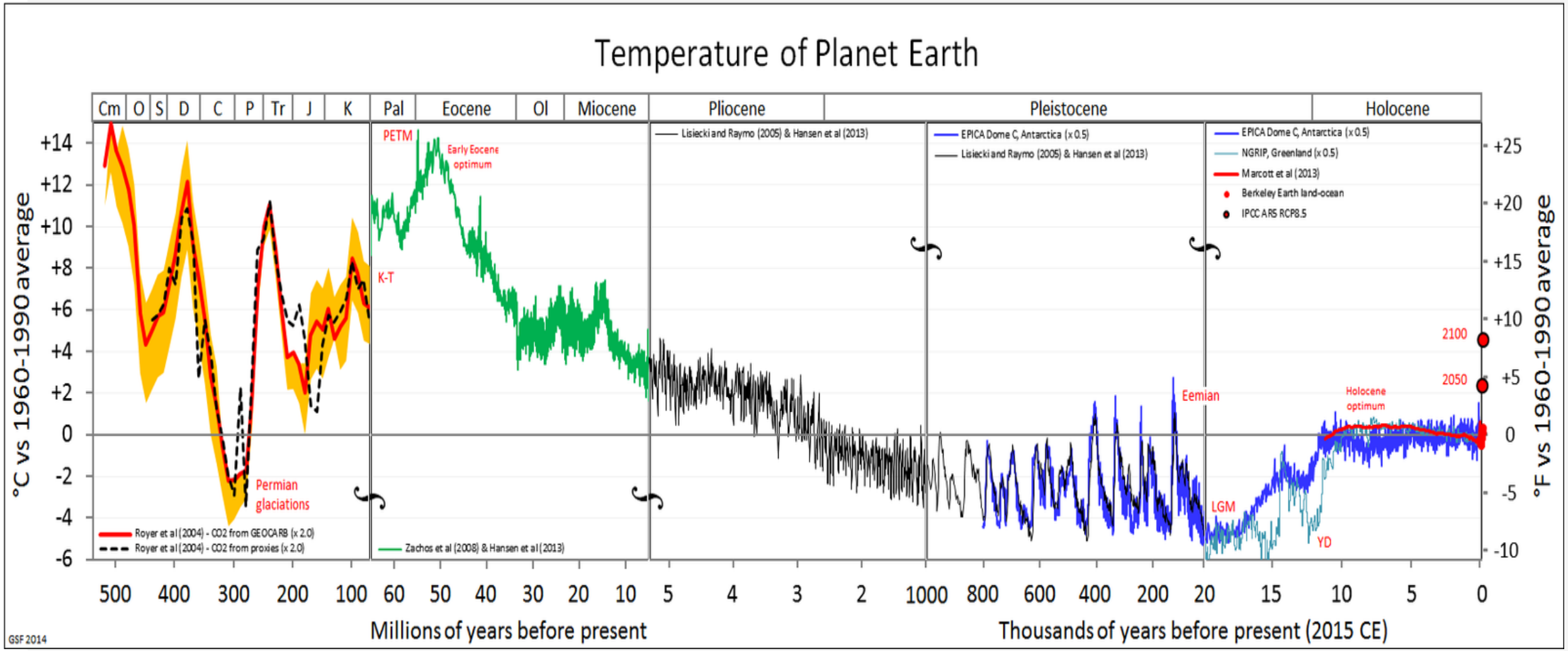

HFA Decade
The Economic and Human Impact of Disasters in the last 10 years
Damage ($ billion)
People affected (million)
People killed
2005 214 160 93,075
2006 34 126 29,893
2007 74 211 22,422
2008 190 221 169,737
2009 46 201 15,989
2010 132 260 328,629
2011 364 212 30,083
2012 156 107 11,154
2013 119 96 21,118
2014 110 102 7,000
$1.4 trillion
Total damage
1.7 billion
Total people affected
0.7 million
Total people killed
Roughly 70% of deaths are caused by earthquakes and tsunamis
Deaths caused by other disasters
70%
30%
More than 150 million people were affected by floods
Around 65% of damages were caused by earthquakes and tsunamis with Asia losing more than $250 billion
Climate-related disasters in 2014
Others
13%
87%
Confirmation of a trend stretching back 20 years when they averaged 86%
Top 10 countries with most disasters, 2005-2014
Number of disasters
Total damage ($ billion)
China 286 265
US 212 443
Philippines 181 16
India 167 47
Indonesia 141 11
Vietnam 73 7
Afghanistan 72 .16
Mexico 64 26
Japan 62 239
Pakistan 59 25
China has the most disasters from 2005-2014 but the US has incurred the most damage, and while Japan is far behind in number of disasters, its economic loss is almost as big as that of China
UNISDR
Sources: EM-DAT database, Centre for Research on the Epidemiology of Disasters (CRED), Munich Re

number of natural disasters:

1940-2013 EM-DAT: The OFDA/CRED




Estimated damage (US$ billion) caused by reported natural disasters 1900 - 2012
Estimated damage (US$ billion)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Honshu Tsunami
Hurricane Katrina
Wenchuan earthquake
Kobe earthquake
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Year
EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Université Catholique de Louvain, Brussels - Belgium


Temperature of Planet Earth
Cm
O
S
D
C
P
Tr
J
K
Pal
Eocene
Ol
Miocene
Pliocene
Pleistocene
Holocene
PETM
Early Eocene optimum
K-T
Permian glaciations
Lisiecki and Raymo (2005) & Hansen et al (2013)
EPICA Dome C, Antarctica (x 0.5)
NGRIP, Greenland (x 0.5)
Marcott et al (2013)
Berkeley Earth land-ocean
IPCC AR5 RCP8.5
Royer et al (2004) - CO2 from GEOCARB (x 2.0)
Royer et al (2004) - CO2 from proxies (x 2.0)
Zachos et al (2008) & Hansen et al (2013)
Eemian
LGM
YD
Holocene optimum
2100
2050
°C vs 1960-1990 average
°F vs 1960-1990 average
Millions of years before present
Thousands of years before present (2015 CE)
GSF 2014

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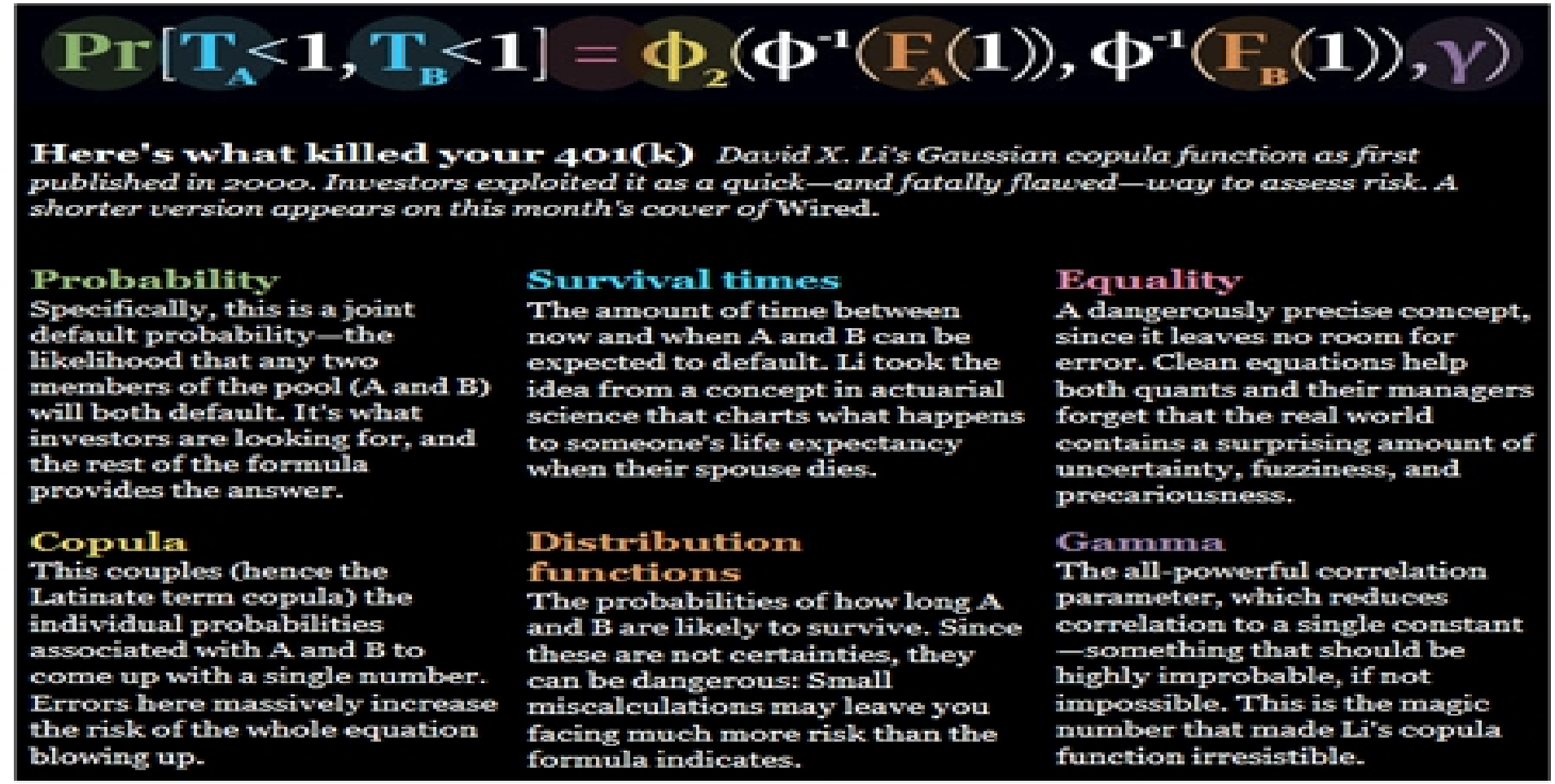
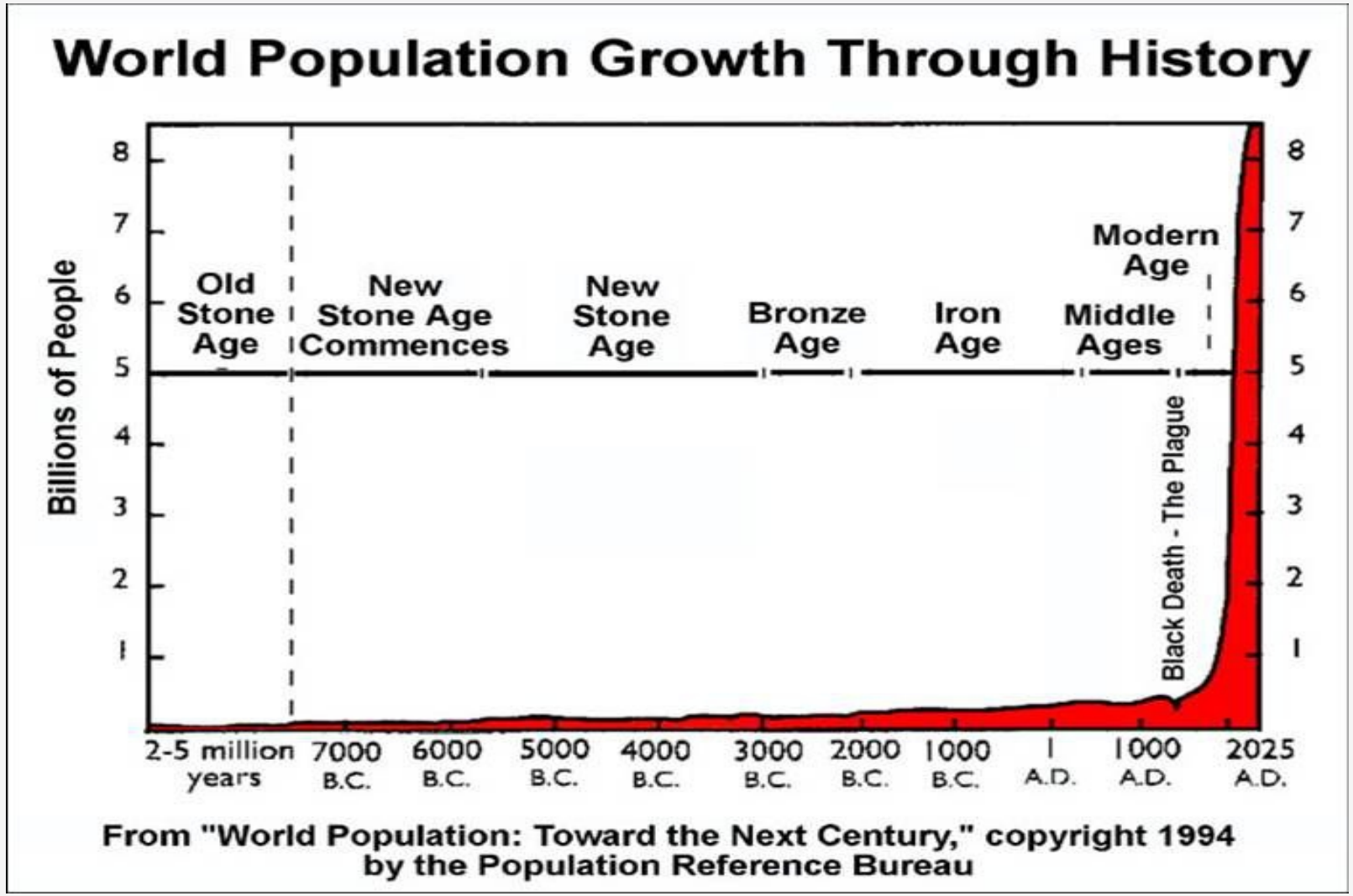
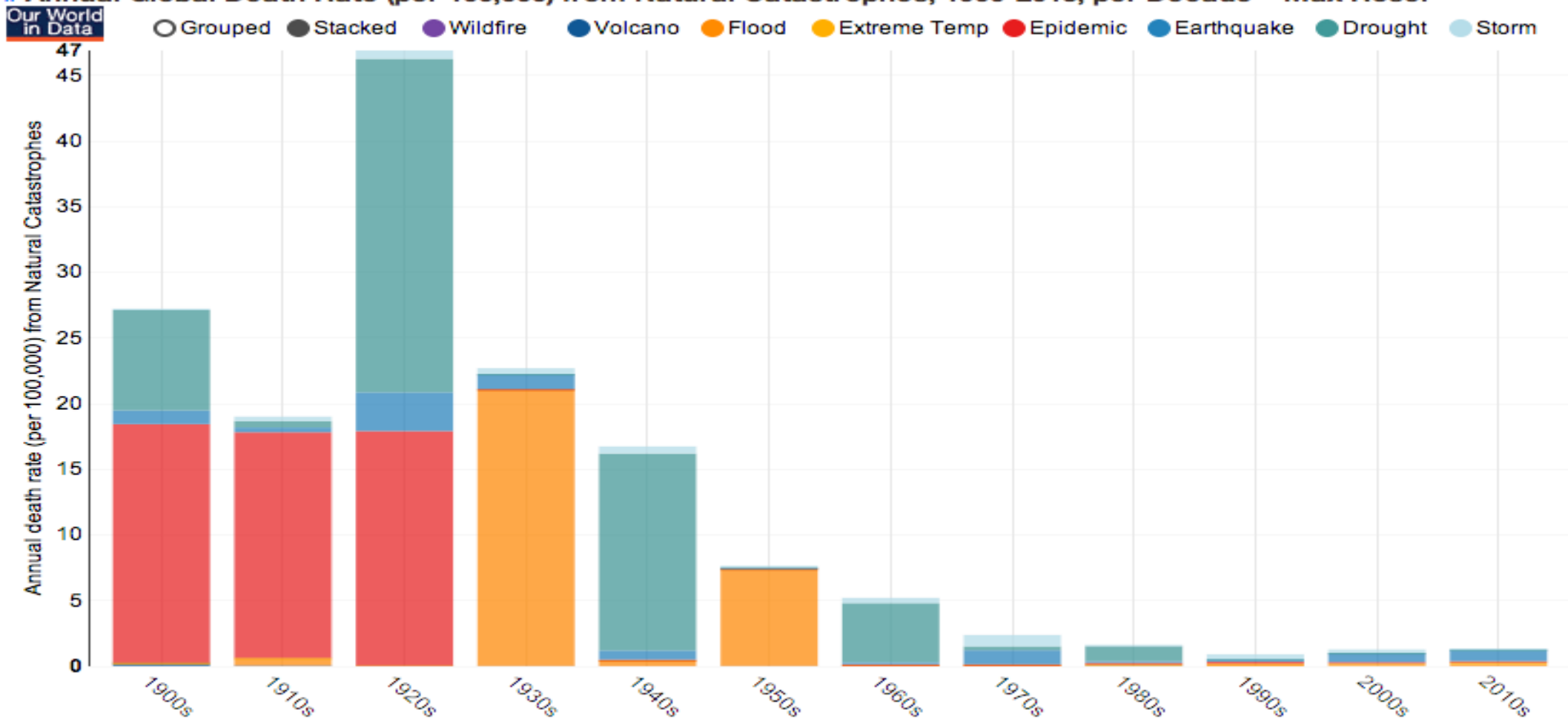


equation used for financial models and cause of the financial stock market crash of 2007/2008


World Population Growth Through History
Billions of People
8
7
6
5
4
3
2
1
Old Stone Age
New Stone Age Commences
New Stone Age
Bronze Age
Iron Age
Modern Age
Middle Ages
Black Death - The Plague
2-5 million years
7000 B.C.
6000 B.C.
5000 B.C.
4000 B.C.
3000 B.C.
2000 B.C.
1000 B.C.
1 A.D.
1000 A.D.
2025 A.D.
From "World Population: Toward the Next Century," copyright 1994 by the Population Reference Bureau

Annual Global Death Rate (per 100,000) from Natural Catastrophes, 1900-2013, per Decade – Max Roser[1]



Thanks for your attention and Good Continuation
Gabriele Ponzoni