

Natural Hazards and Disasters

Lab 2: Measuring small changes, getting data, assessing risks and disasters

- 4+4 Forms
- Question Set 1
- Measuring small changes (questions 1 and 2)
- Getting data (question 3)
- Assessing risk and disasters (question 4)

This is important/a challenge:

- many commented on the class style, e.g.:
- very important for me.
- however, this fits better into the “private” I learned/I didn’t understand part

Challenges:

“Understanding the math portion”

“Wall-of-text power points ...”

“lots of small text on the slides, not many images or infographics”

“Not a lot of time on the slides to copy down information”

“There aren’t a lot of outlets ...”

Taking notes

I learned:

“In the last 200 years the flows have expanded to 100-1000 times larger”

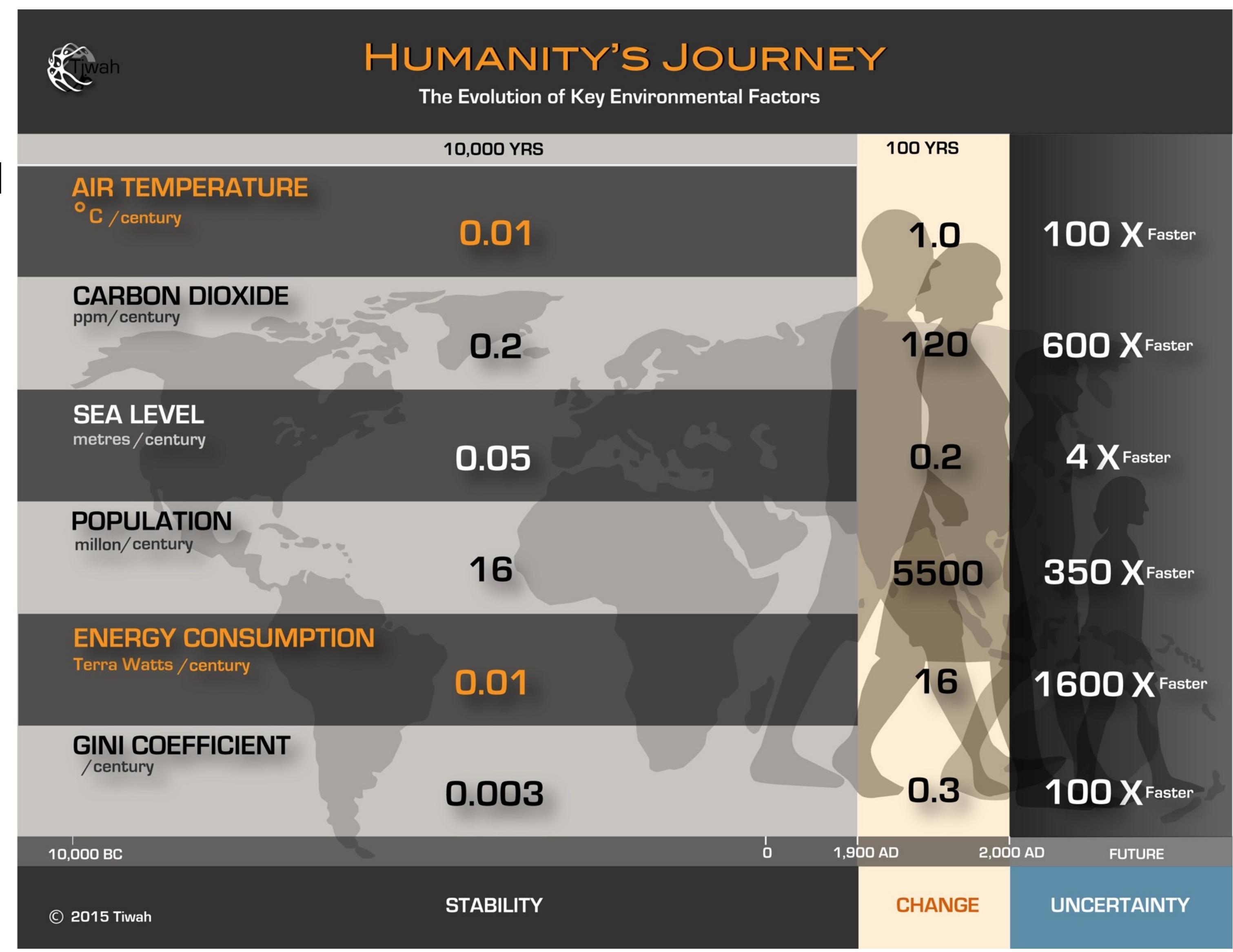
In the last 100 years, flows have increased a hundred to several thousand times faster than on averaged throughout the last 12,000

4+4 Forms

I learned:

“In the last 200 years the flows have expanded to 100-1000 times larger”

In the last 100 years, flows have increased a hundred to several thousand times faster than on averaged throughout the last 12,000



4+4 Forms

I learned:

“That the earth and all creatures have some form of economy”

I did not understand:

“What ways can individuals actually safeguard the ELSS?”

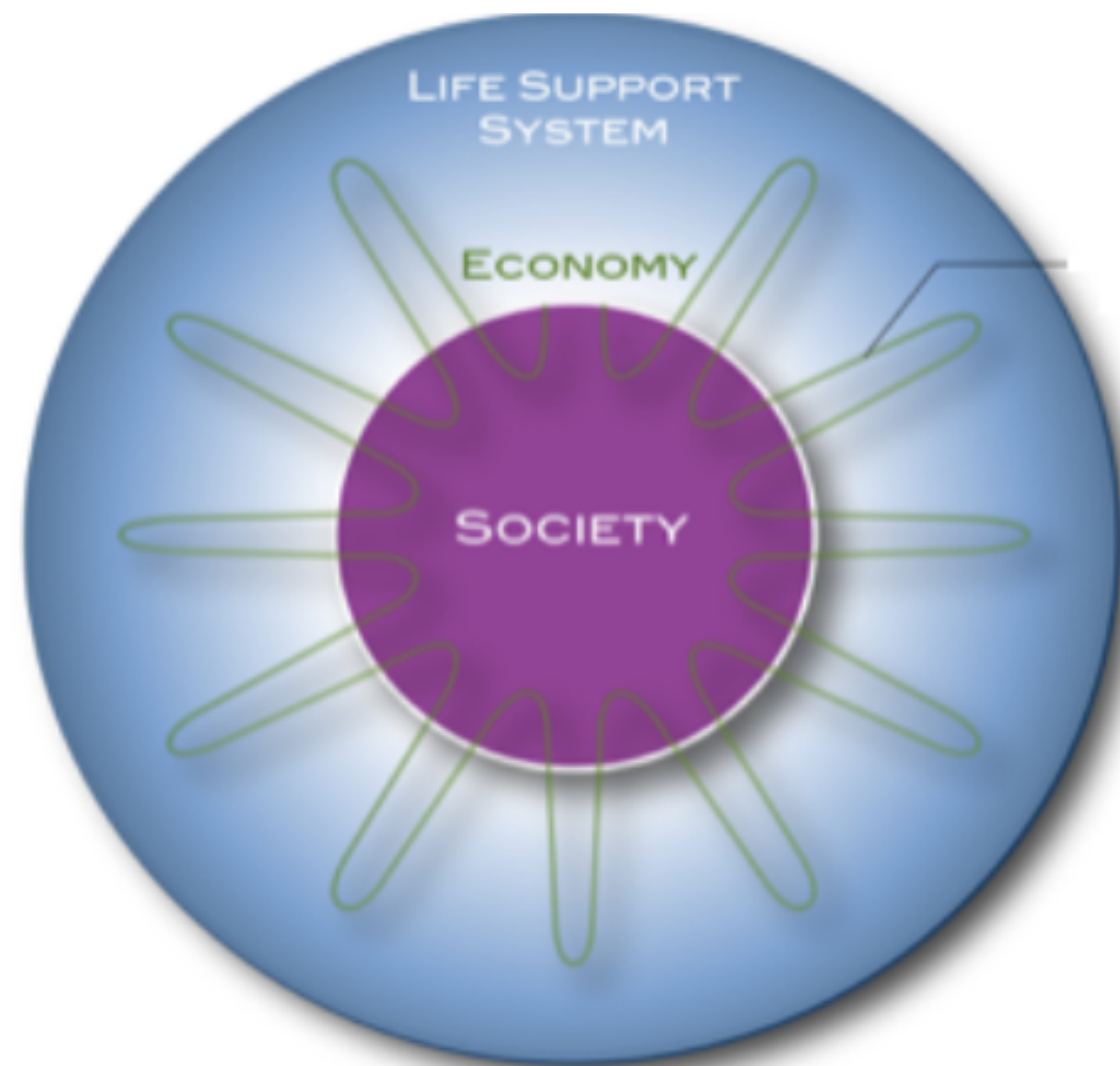
Did not understand:

“Need more explanation on the ELSS and how the economy affects both society and how society affects earth life support system.”

All human and non-human animal communities interact with the ELSS through flows.

For human communities, the flows are controlled by ethics, social norms, and, recently, economic rules.

We don't know yet how to safeguard the ELSS, maintain planetary health, ...



I did not understand:

“Sustainability needs to be connected to a value system. I think I just need to hear the meaning of the value system again, ...”

A (ethical) value system is a hierarchy of values that societal agents (individuals, communities, organizations, countries, ...) possess, which is demonstrated through the decisions made. Examples of such values are justice, freedom, human rights, education, peace, loyalty, integrity, ...

Discussions about what the sustainability of a community make only sense if the value system that governs decisions is shared by most of the community members and known to some extent.

In modern societies, value systems often differ very much between individuals, groups and organizations, leading to some level of social conflicts between groups with very different values systems.

I did not understand:

“How Earthquakes can be considered a natural hazard and not just a disaster.”

A hazard is a change of the system state that can lead to system degradation and/or a reduction of the system's capability to function.

A disaster is the loss of lives and property; often as the result of a hazardous event.

Depending on where An earthquake of a given magnitude can cause anything between very small to no loss of lives and very large loss of lives and property, depending on where it happened, how many people live there, and how the built environment is prepared for the hazard.

I did not understand:

“I still do not really understand the definition of vulnerability.”

Vulnerability is the inability of a system to withstand the effects of a hostile environment.

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Q1.1

How do we define a hazard and a disaster in the context of the class, and what is the connection between a hazard and a disaster? Give an example of a hazard and the resulting disaster and describe the connection.

“An example of a hazard is an earthquake. A resulting disaster of the earthquake could be a landslide, or fires/explosions from gas leaks. The disaster from the natural hazard could possibly destroy homes, and damage the infrastructure of a society. The connection between a hazard and a disaster is that disasters are human-made and they are just triggered by a natural phenomenon”

The “landslide, or fires/explosions” are not the resulting disaster, they are subsequent hazards that can make the disaster worse.

The disaster is not destroying houses, the hazard is doing this because the house were vulnerable, and this leads to the disaster.

The connection between a hazard and a disaster are processes that are triggered by the hazard - and these processes often depend on how humans have designed, built and maintained the built environment and developed the social communities and the services available to them.

Deterministic or Probabilistic - Robustness or Resilience: How to Respond to Climate Change?



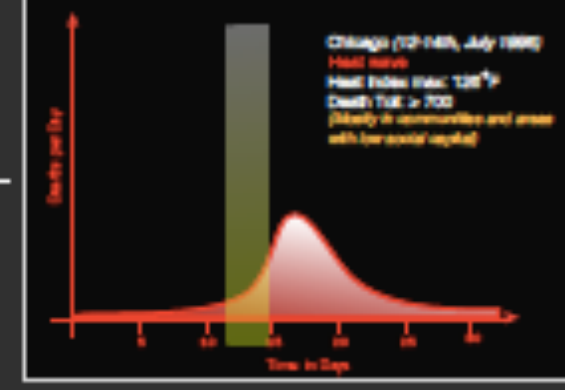
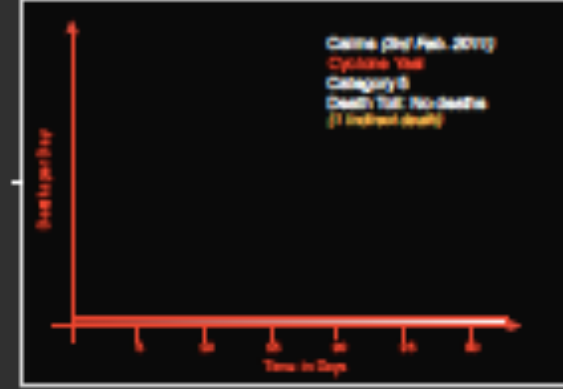
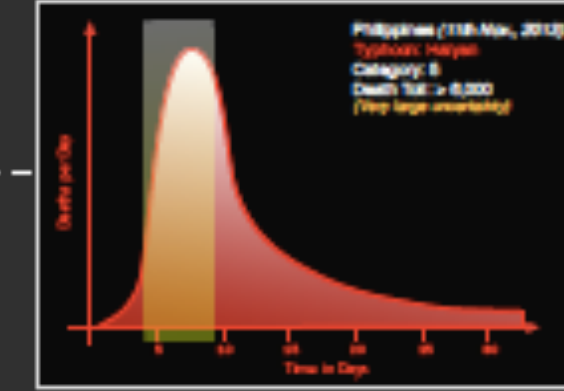
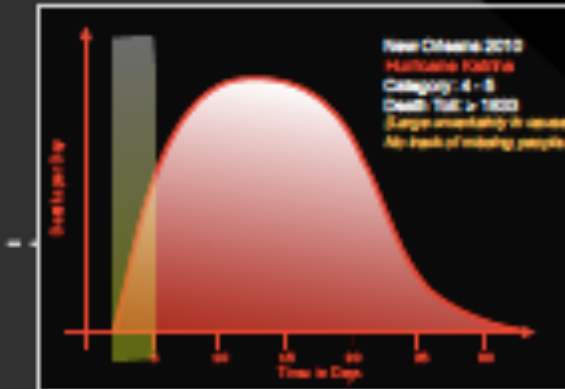
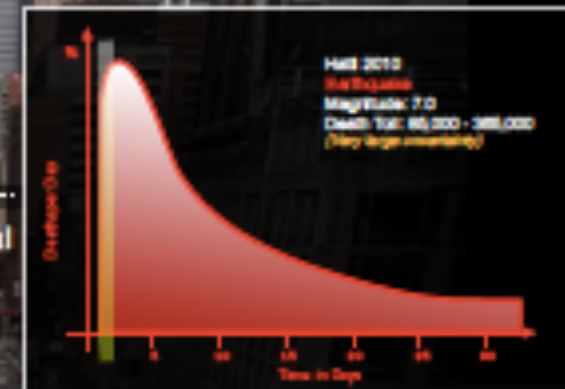
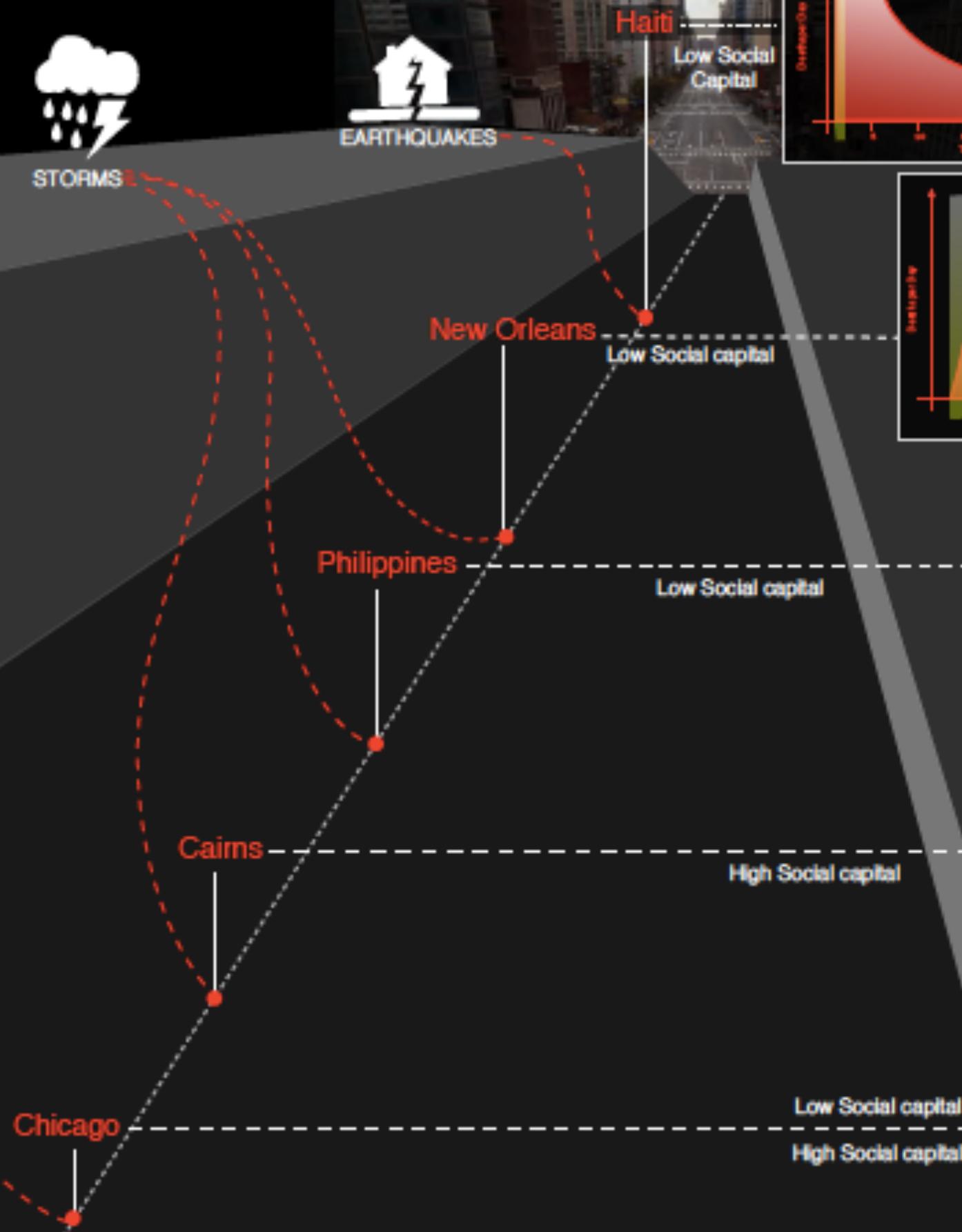
HEAT WAVES



STORMS



EARTHQUAKES



Natural hazards are not the disaster!

Deterministic predictions of climate change and sea level rise do not provide a basis for feasible planning of a built environment with thresholds that will not be exceeded by extreme events.

A paradigm shift to a probabilistic approach is needed, taking into account the risk associated with rare, extreme events.

For economic reasons, mitigation of impacts of climate change and sea level rise is limited, and rare surprising events will exceed thresholds.

Processes in place prior to a hazard and processes implemented during the event determine the extent of the disaster caused by hazards that exceed thresholds.

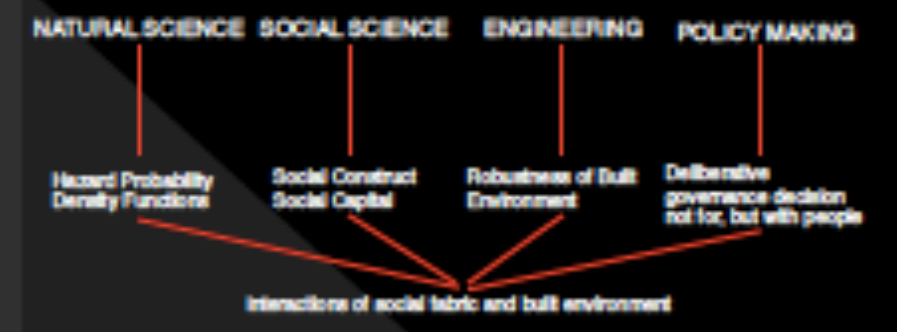
If an event exceeds thresholds of the built environment, the resilience of the social fabric determines the processes and extent of the disaster.

Resilience depends strongly on social capital. 'Social capital' refers to dense social networks with norms and social trust that allow community members to share interests, communicate valuable information, and identify opportunities to collaborate for the benefit of the entire community. Disaster risk reduction requires resilience and an increased social capital.

A best practice is needed that can utilize uncertainties and surprises to increase robustness, strengthen resilience, and reduce fragility of the social system during times when infrastructure fails.

A paradigm shift is needed to a new science-policy interface.

A Science - Engineering - Policy Paradigm



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Deterministic or Probabilistic - Robustness or Resilience: How to Respond to Climate Change?



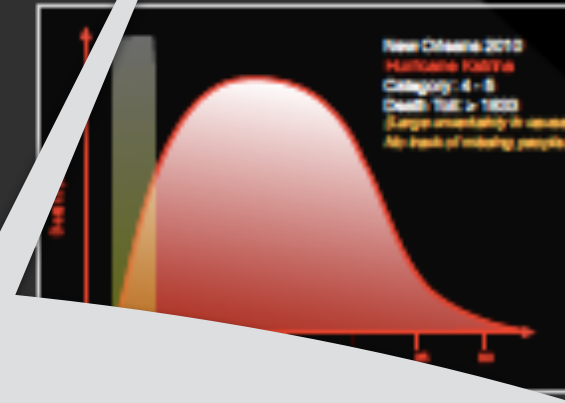
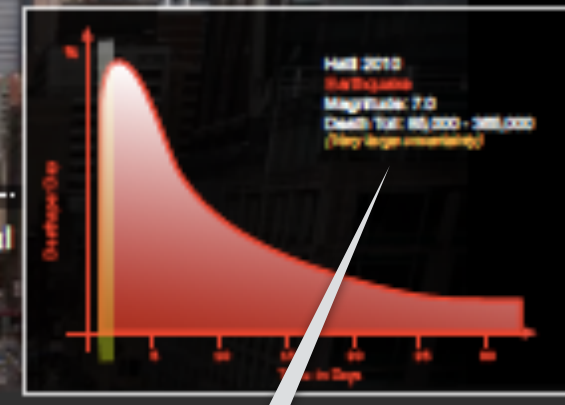
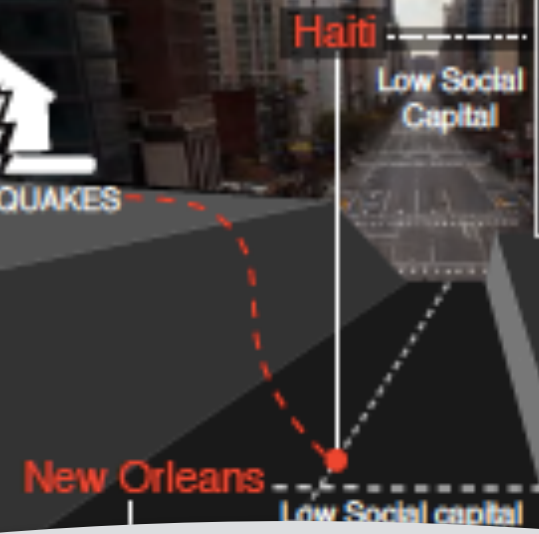
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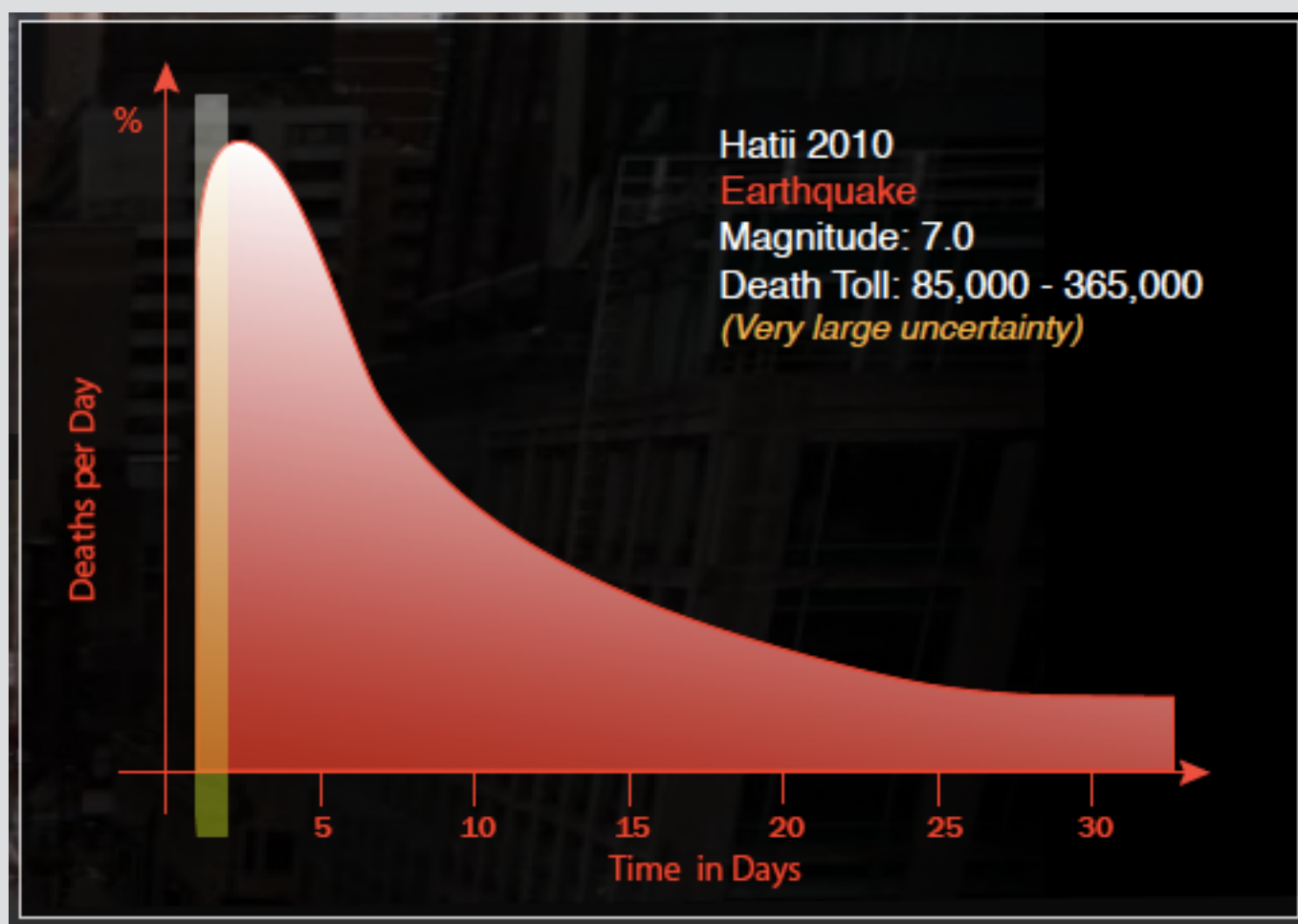
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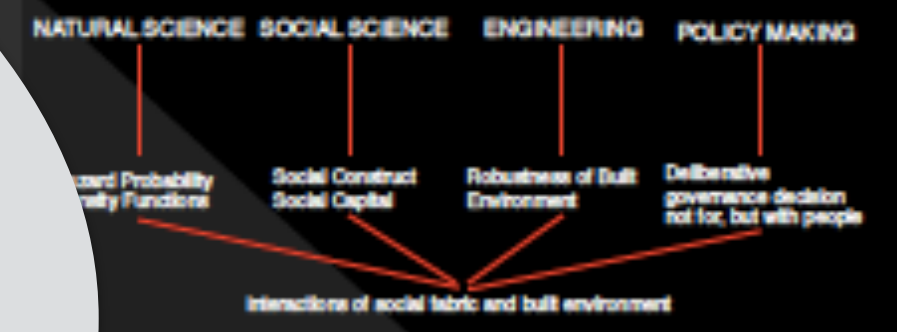
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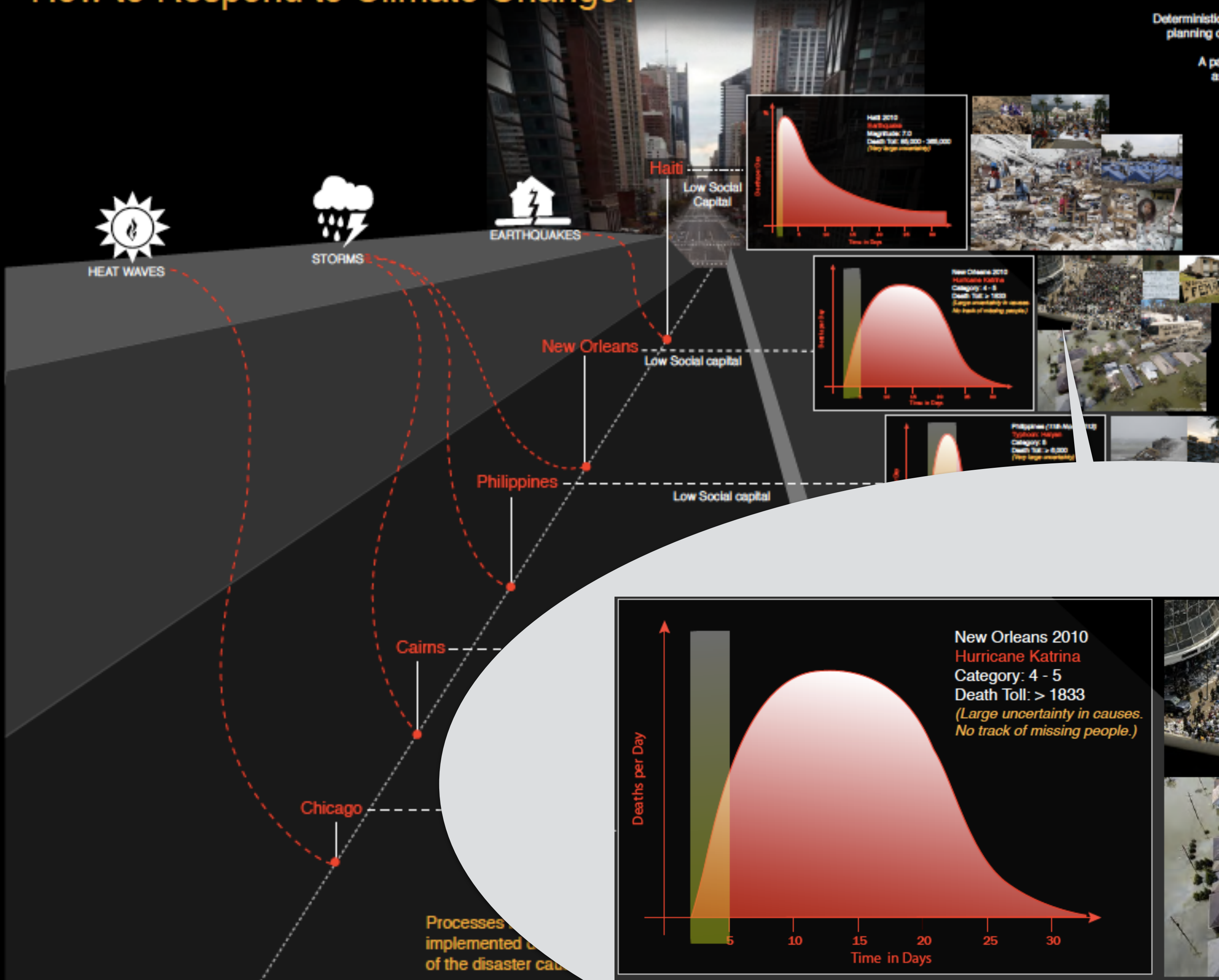
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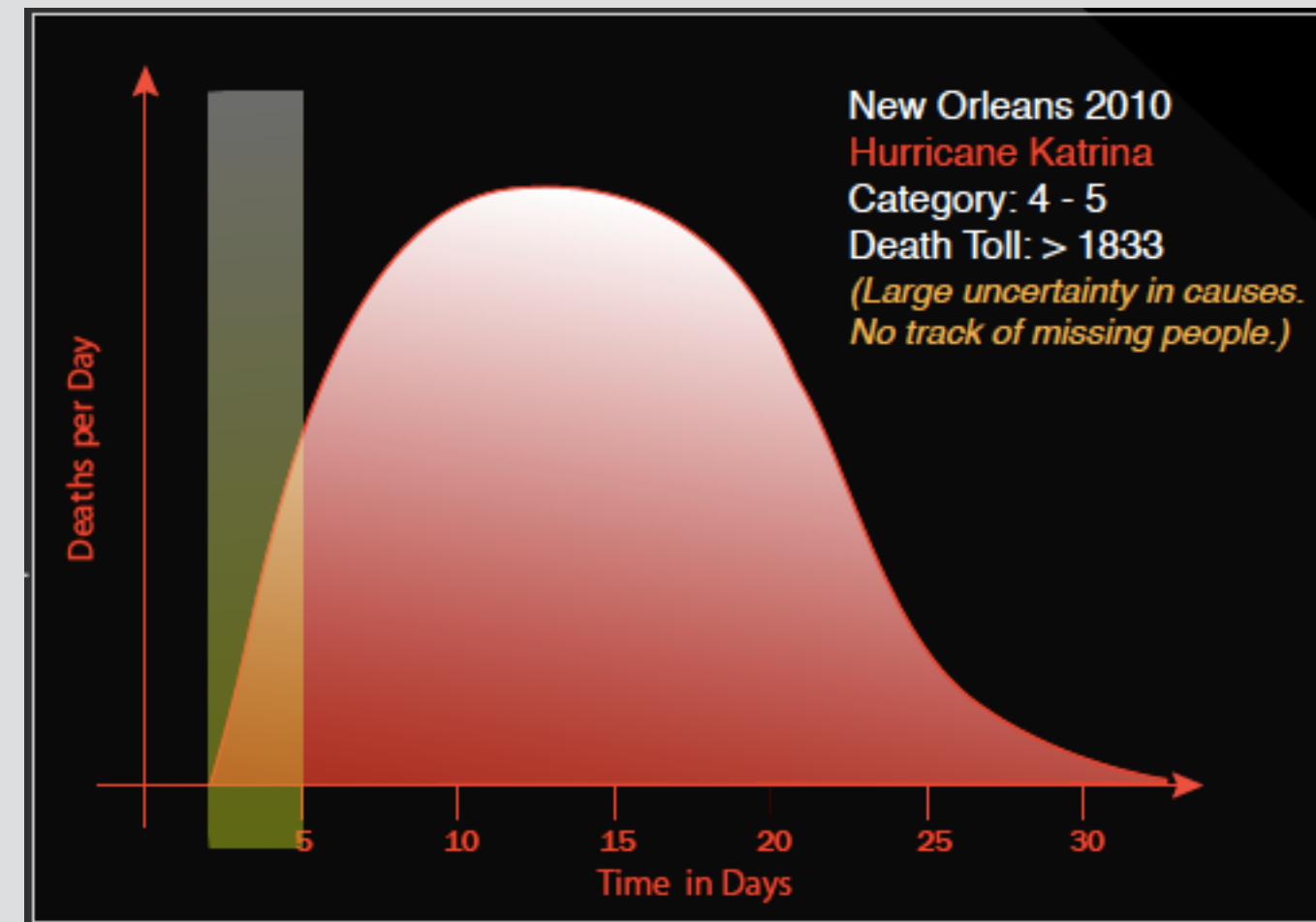
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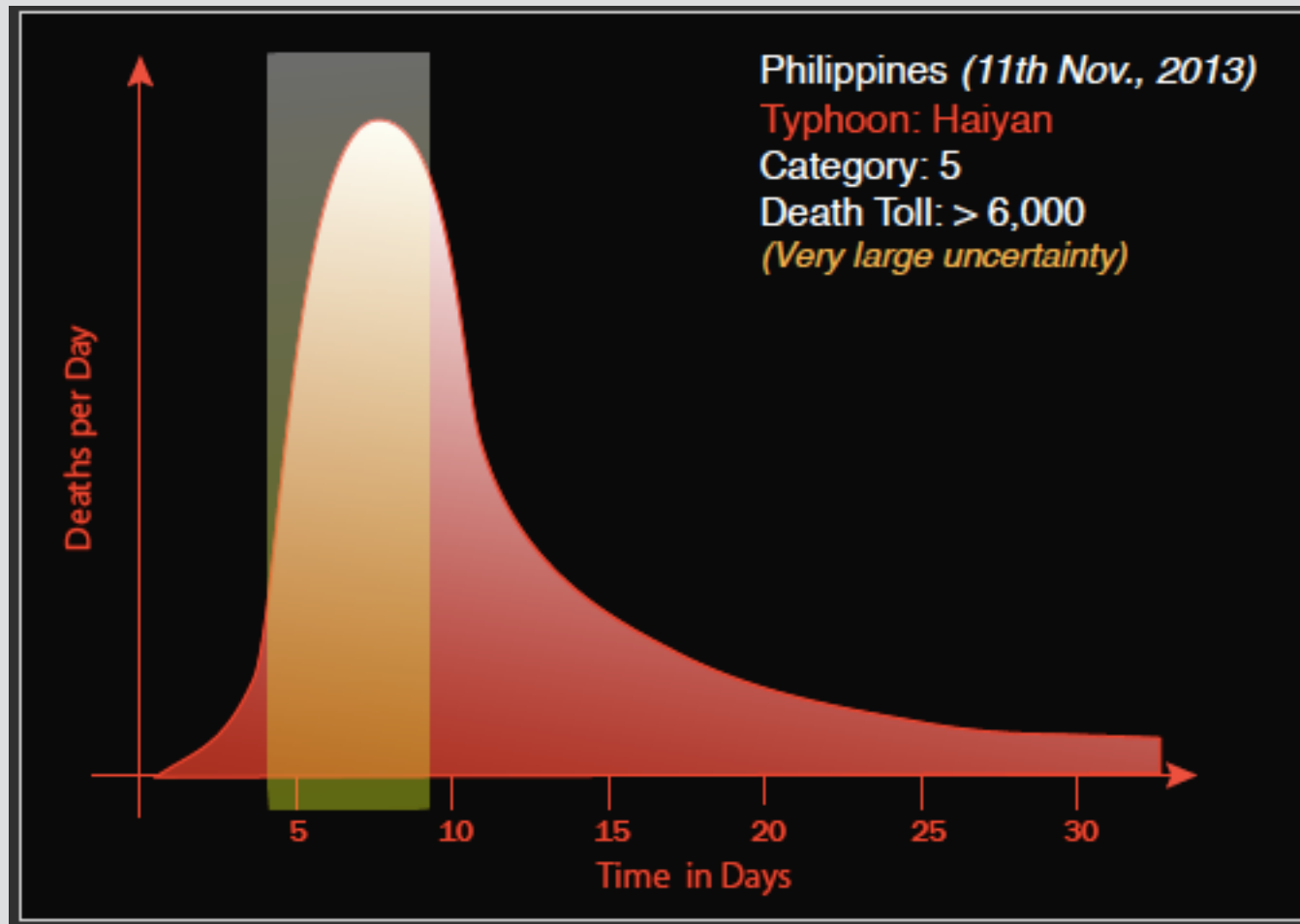
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Paradigm



Processes implemented during the event determine the extent of the disaster caused by hazards that exceed thresholds.



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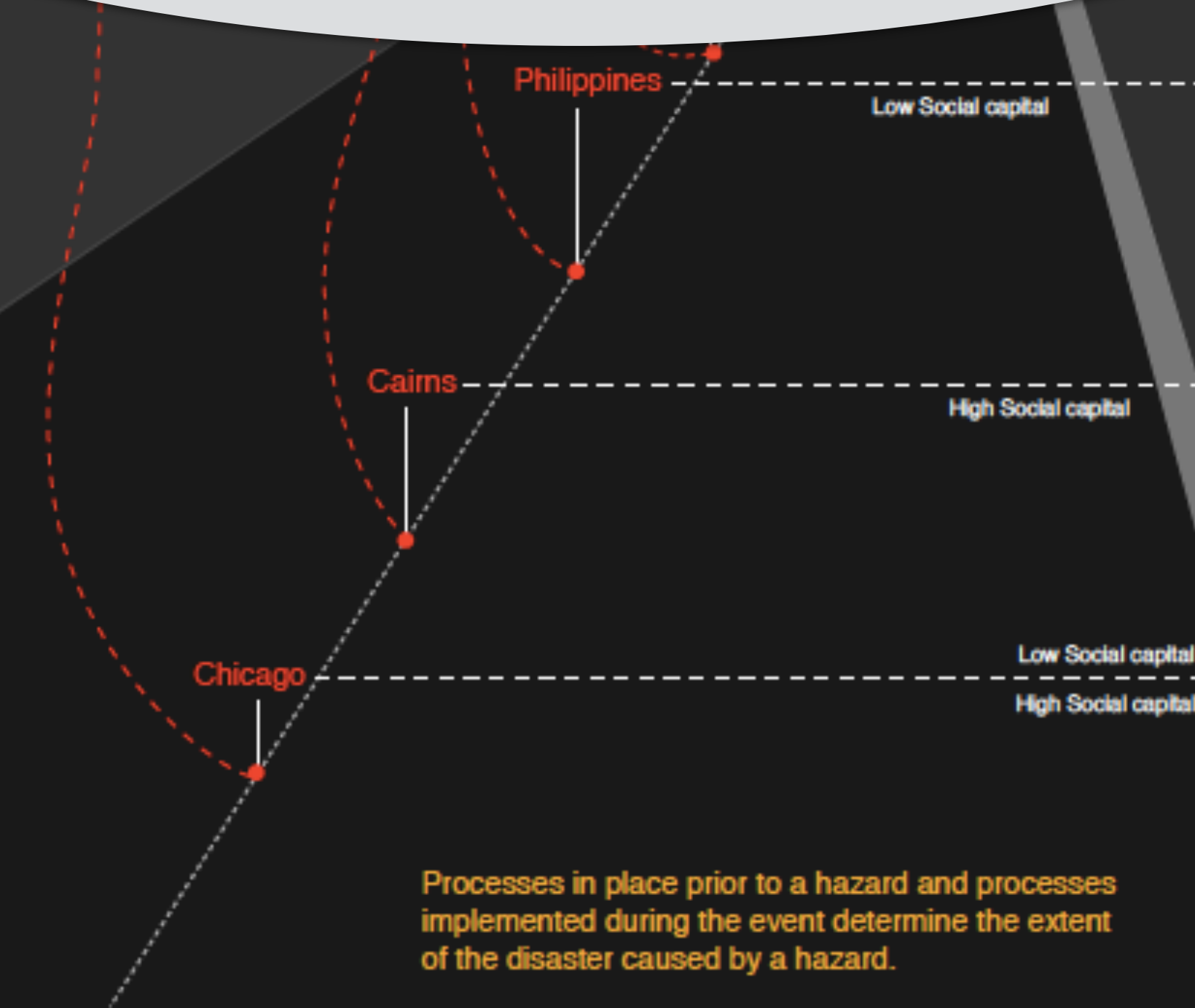
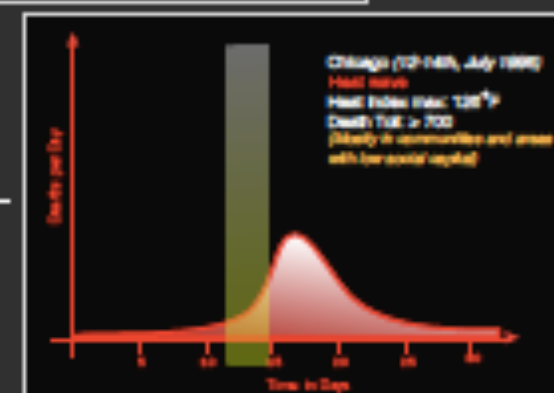
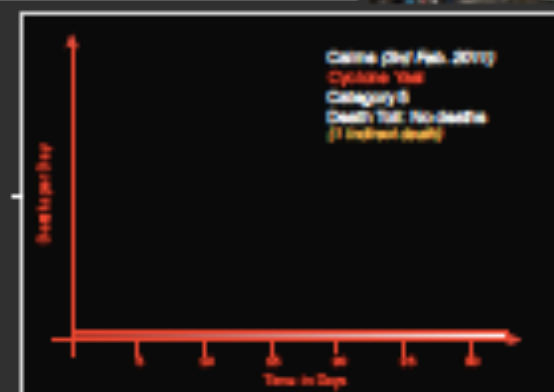
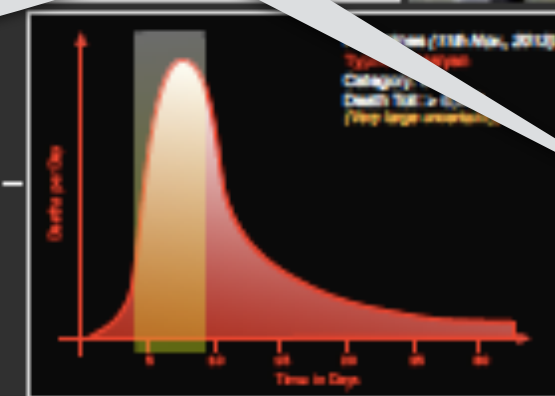
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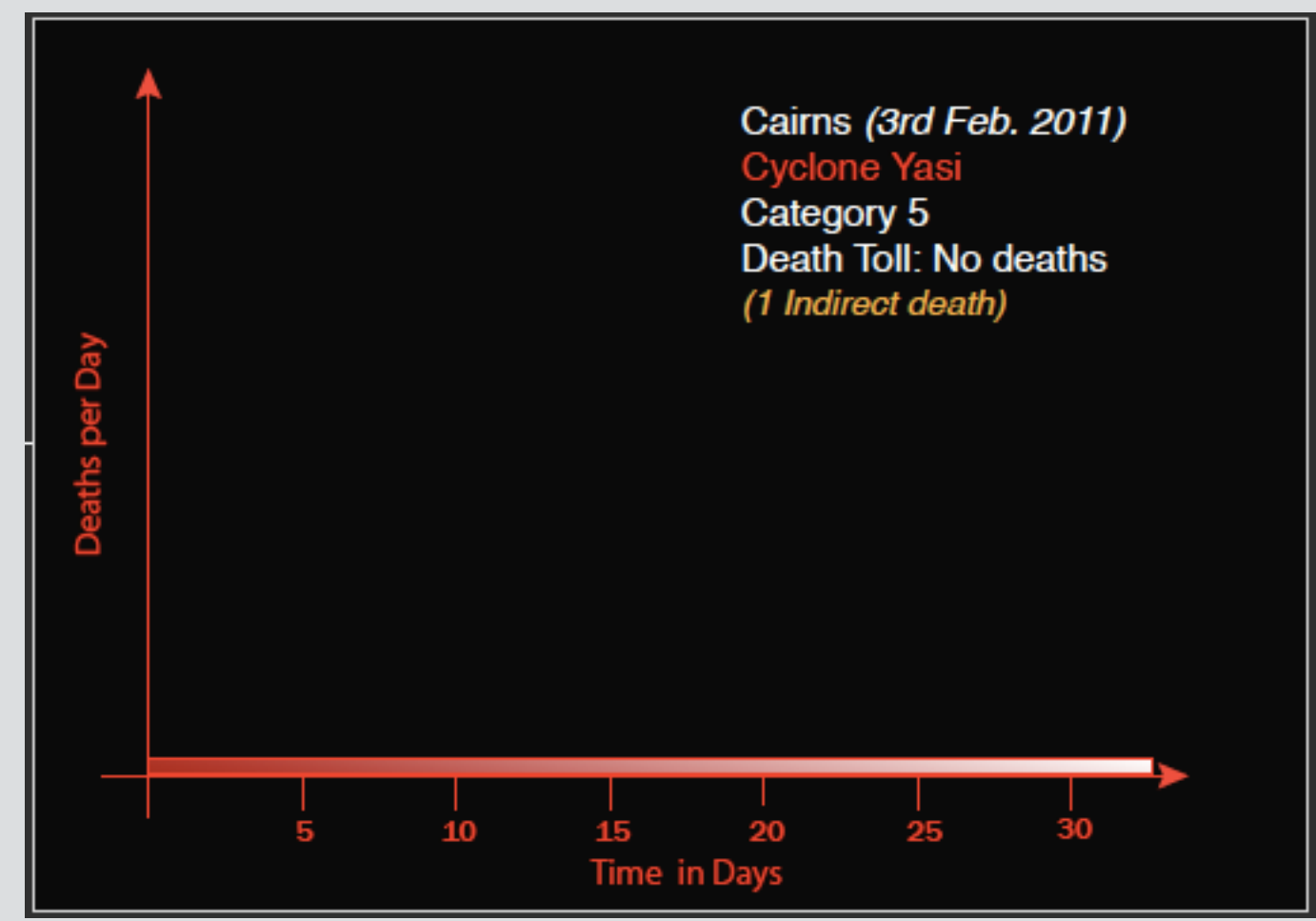
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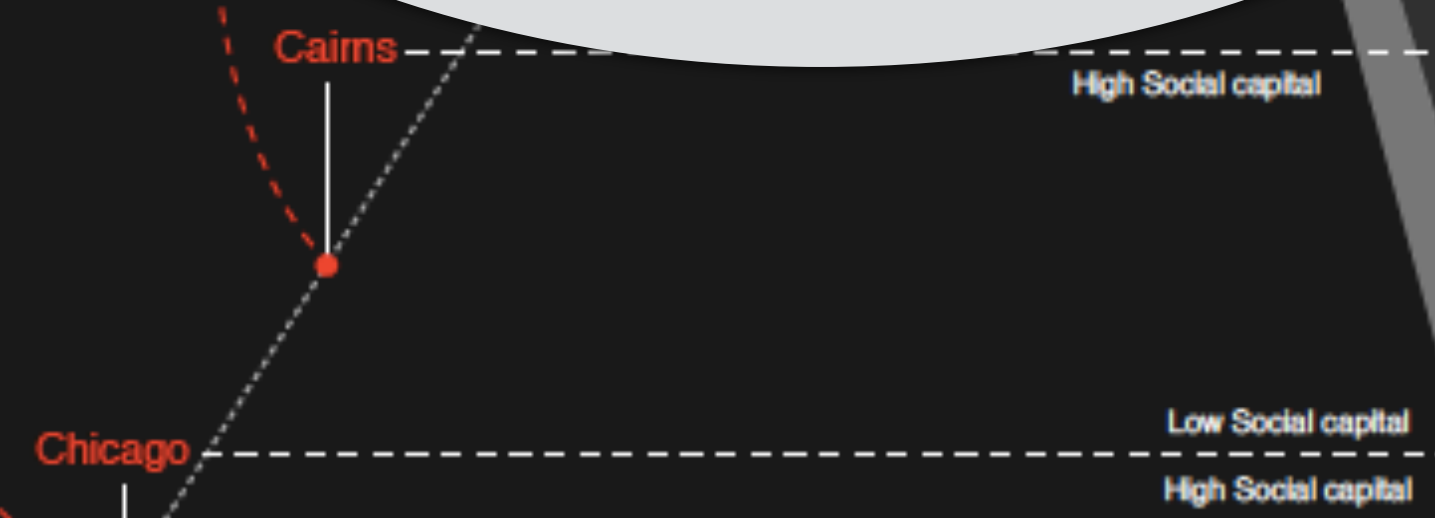
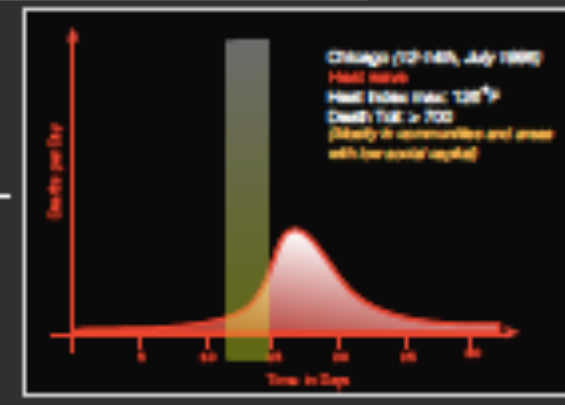
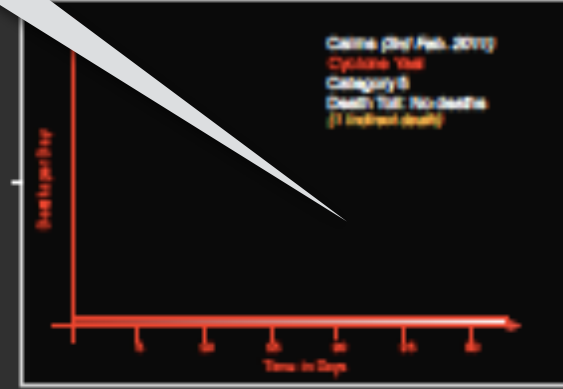
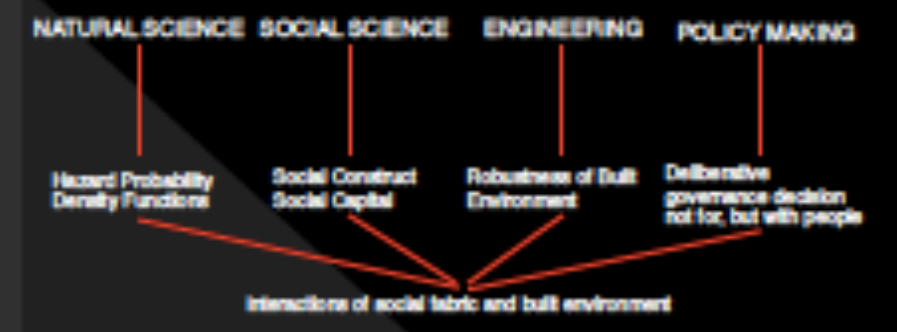
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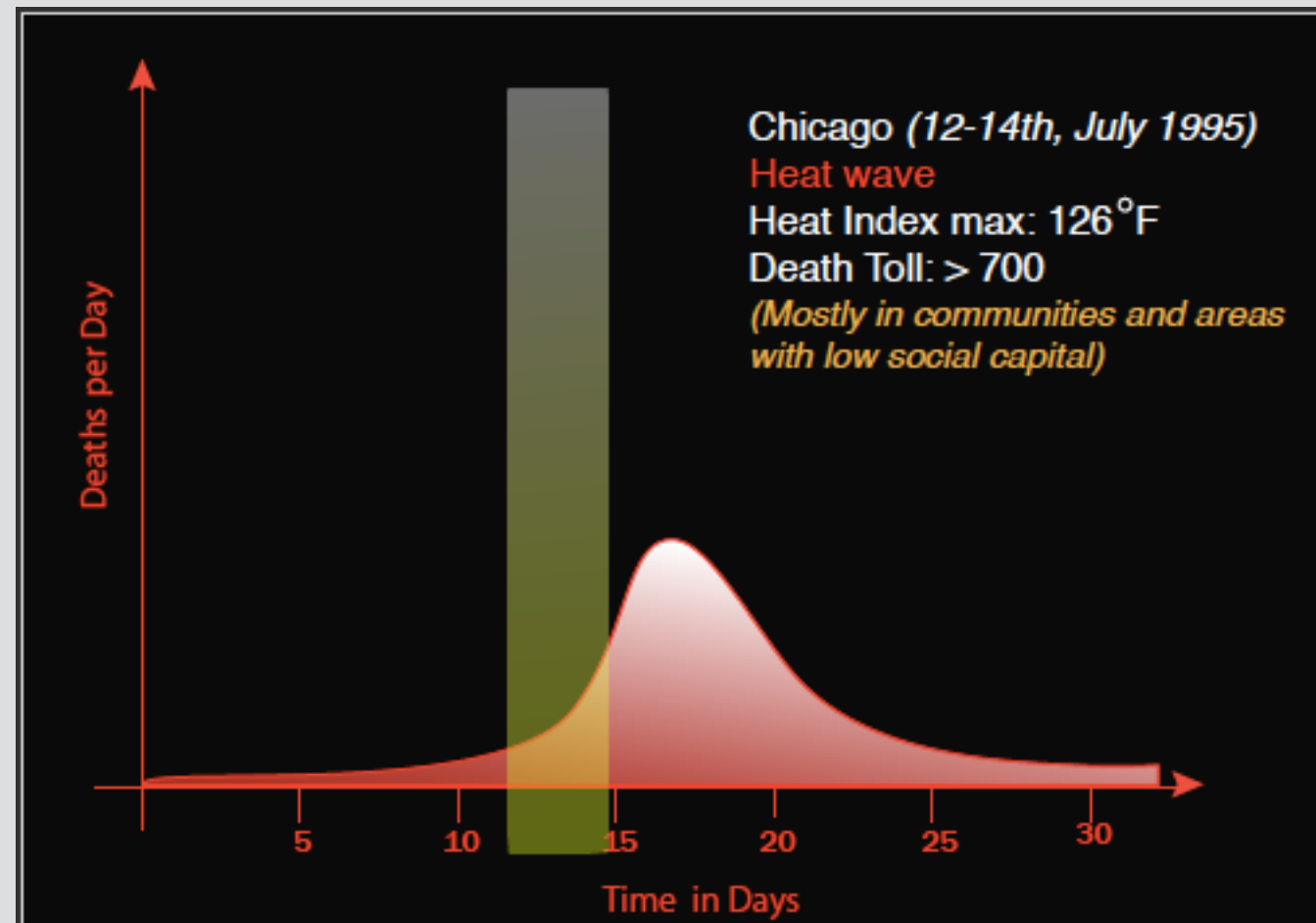
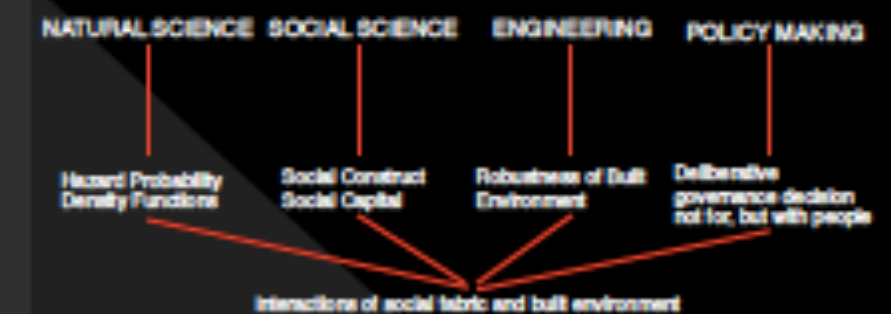
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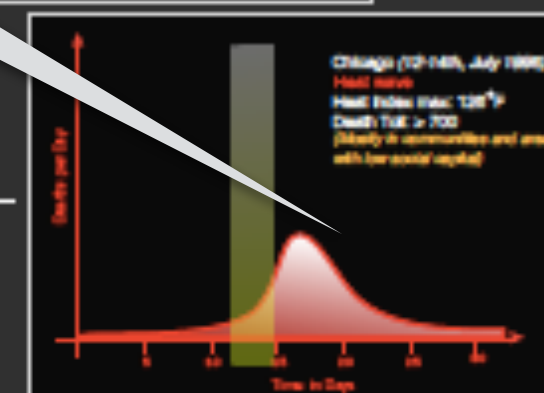


Chicago

Low Social capital

High Social capital

Processes in place prior to a hazard and processes implemented during the event determine the extent of the disaster caused by a hazard.



Q1.1

How do we define a hazard and a disaster in the context of the class, and what is the connection between a hazard and a disaster? Give an example of a hazard and the resulting disaster and describe the connection.

“For example, a natural hazard would be a malevolent category five hurricane spotted east of the Atlantic coast closing in. In this case, it is a POTENTIAL hazard to humans living on the coast. However, if the hurricane disappears and never even reaches the shore, not only is disaster evaded but there is no hazard to humans as well.”

A hazard remains a hazard, no matter whether it actually poses a threat to someone or causes a disaster. Thus, a hurricane category 5 is a severe hazard no matter whether it makes landfall or not. It has the potential to cause damage if something of value is exposed to it. That potential is what makes it a hazard.

Q1.2

In your own words, describe how the term risk is defined in different disciplines/fields, and what definition we are using in the class. Please, include references (others than what is on the class slides) for the definitions you provide.

“I believe that in different fields the term risk is very different such as in the accounting and financial field, Risk could be defined as the calculating assessment of how much a person can be depended on”

“There are several ways in which the word risk can be defined. There is a medical definition, legal definition, student definition, business definition and more. For example, the legal definition of risk is: “liability or loss or injury if it occurs” (Merriam-Webster, 2018). Most commonly, risk is defined as: “possibility of loss or injury” (Merriam-Webster, 2018).”

The first answer is not giving definitions in other fields and not providing citations of the sources. It is also very short and not comparing the definitions in other fields to the one we use in class.

The second answer is much better, giving an example and citing the source. However, more examples would have been helpful, and the comparison to the definition in class is missing.

Q1.3

Discuss the probability density function (PDF) of a hazard and identify the main uncertainties in knowing the PDF for natural hazards.

“The probability density function (PDF) is used to help evaluate the relevance of a risk. ... The main uncertainty in knowing the PDF for natural hazards, like an earthquake, is simply the fact that humans cannot predict with a strong certainty when exactly a natural hazard will occur. “

It is correct that the PDF is needed for risk assessments, but that does not describe what the PDF is. The uncertainties of the PDF are not related to the inability to predict the actual occurrence of a hazardous event. For most hazards, the uncertainty in the PDF is large for low-probability events because they do not happen very often and that makes it difficult to assess their probability based on past events.

Q1.4

Explain the concept of a 100-year or 500-year event and use the Poisson Distribution to compute the probability that we have one or more of a 500-year event in a given century. Note that how you answer this question will let me know whether I need to invest more time with you to explain the distribution.

A 100-year event is an event that is predicted to happen at least once in that 100 years but doesn't have to happen nor is it limited to only happening once, and the odds are in the favor that it does happen more than once, ...

A 100-year flood is the flood that over a very long time averaged happens on average once in a 100 year period. However, for a specific 100-year period, we can have anything from zero to many 100-year floods.

Poisson Distribution

Poisson Formula. In a Poisson experiment, in which the average number of successes within a given region is μ , the Poisson probability is:

$$P(x=k; \mu) = (e^{-\mu}) (\mu^k) / k!$$

where x is the actual number of successes that result from the experiment.

$$e \sim 2.71828$$

$$P(x=k; \mu) = \frac{\mu^k}{e^{\mu} * k!}$$

Probability of exactly one 100-year flood to occur in a specific century?

$$\mu = 1, k = 1, P=? \quad P = 1^1 / (e^1 * 1!) = 0.368$$

The factorial $k!$ is:

- $0! = 1$
- $1! = 1$
- $2! = 1 * 2 = 2$
- $3! = 1 * 2 * 3 = 6$
- $4! = 1 * 2 * 3 * 4 = 24$

Probability of no 100-year flood to occur in a specific century?

$$\mu = 1, k = 0, P=? \quad P = 1^0 / (e^1 * 0!) = 0.368$$

Probability of one or more 100-year flood to occur in a specific century?

$$\mu = 1, k \geq 1, P=? \quad P = 1 - P(k=0, \mu=1) = 1 - 0.368 = 0.632$$

Probability of one or more 500-year flood to occur in a specific century?

$$\mu = 0.2, k \geq 1, P=? \quad P = 1 - P(k=0, \mu=0.2) = 1 - 0.2^0 / e^{0.2 * 0!} = 1 - 0.819 = 0.181$$

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1 Describe the main components of the observing system that provides data to inform risk management.

Question Set 2

1 Describe the main components of the observing system that provides data to inform risk management.

Observation types:

(1) Sensor-based:

- In situ: observations of ambient conditions (e.g., thermometer)
- Remote sensing: Using a signal to sense something in the distance (e.g., radar)

(2) Sample-based:

- in situ
- in laboratory
- counting, assessing

Observation Mode:

- on the Earth surface (fixed and moving);
- satellite-borne
- dedicated air-borne, ship-borne
- opportunity (ships, airplanes, ...)
- balloons, robots, drones (within atmosphere, ocean, ...)
- citizen scientists
- Big Data

2 What are the two types of reference system needed to measure high-accuracy position in space and on Earth and how are they linked? How are they realized?

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3 What is a reasonable database for information on disasters and what are the most relevant variables that can be used to characterize a disaster?

Question Set 2

3 What is a reasonable database for information on disasters and what are the most relevant variables that can be used to characterize a disaster?

The screenshot shows the EM-DAT website homepage. At the top left is the EM-DAT logo and the text 'The International Disaster Database' and 'Centre for Research on the Epidemiology of Disasters - CRED'. To the right is a search bar and social media icons for Twitter and Facebook. Below the header is a navigation menu with 'Home', 'About', 'Database', 'Activities', 'FAQs', and 'Publications'. The main content area is divided into two columns. The left column, titled 'What's New', features a photo of a person in a dark, damaged building with the text 'Just published: Study on chemical attacks in the Syrian war' and 'Epidemiological findings of major chemical attacks in the Syrian war are consistent with civilian targeting...'. The right column, titled 'EM-DAT: Disasters Of The Week', lists disasters for 'Week 33-2018: August 13 - August 19' and 'Week 32-2018: August 06 - August 12'. The Week 33 list includes: Natural disasters: 2018-0302 Earthquake; Lombok Isl., Indonesia; 2018-0305 Typhoon 'Bebinca'; Vietnam; Technological disasters: 2018-0296 Collapse of a bridge of an highway, Genova, Italy; 2018-0297 Bus accident; near Quito, Ecuador; 2018-0300 Shipwreck with scholars; Bouhayra, Sudan; 2018-0303 Fire of houses; Bucavu, Congo (Dem P Rep); 2018-0304 Coal mine explosion; Sinjidi, Pakistan.

Welcome to the EM-DAT website

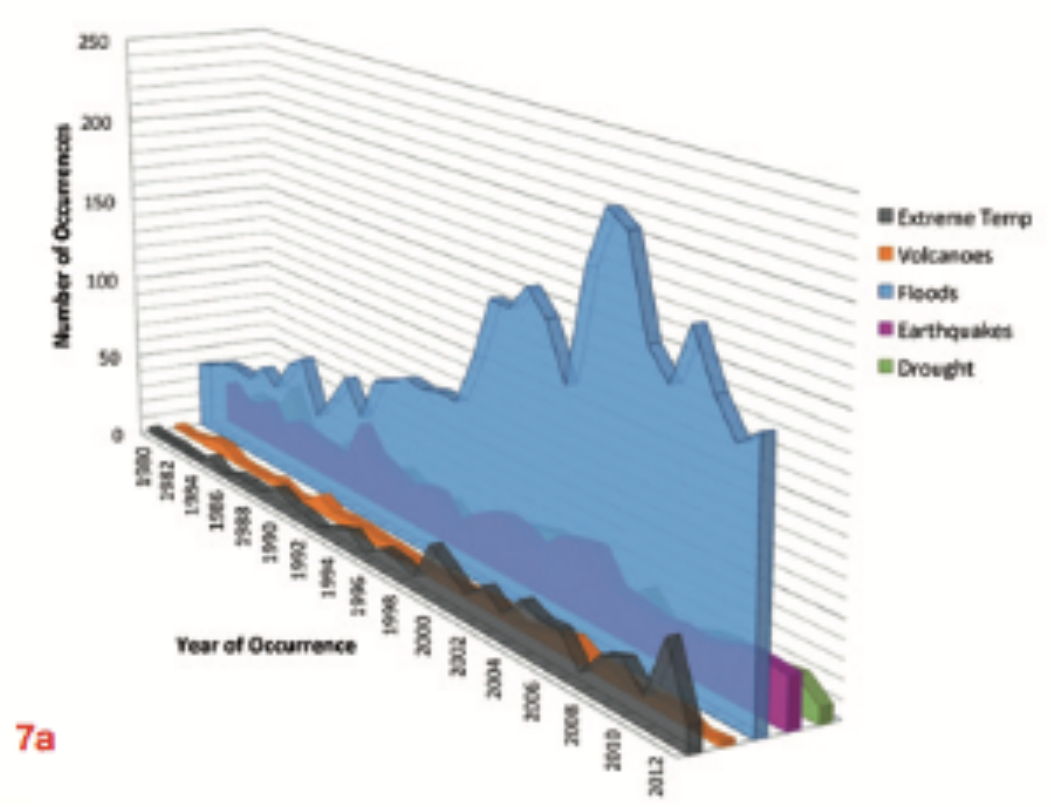
In 1988, the **Centre for Research on the Epidemiology of Disasters (CRED)** launched the Emergency Events Database (EM-DAT). EM-DAT was created with the initial support of the **World Health Organisation (WHO)** and the **Belgian Government**.

Options to consult the EM-DAT database

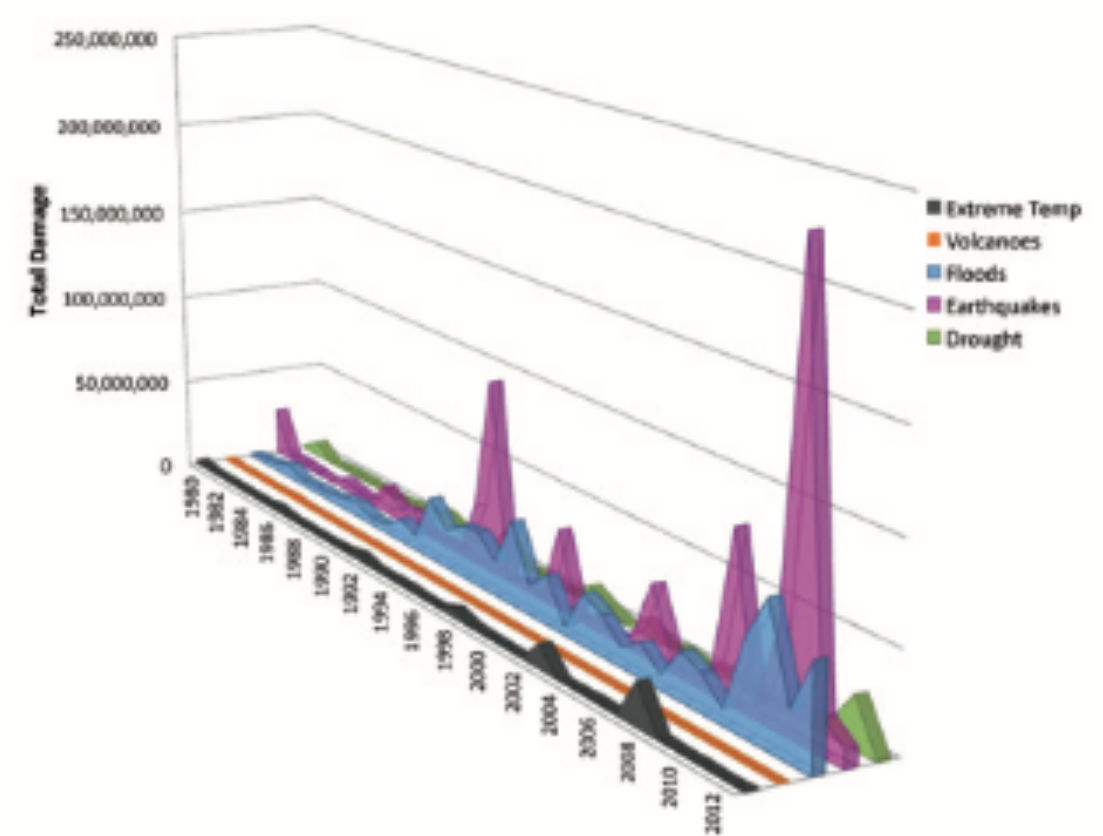
Any feedback from the EM-DAT users about

<https://www.emdat.be/index.php>

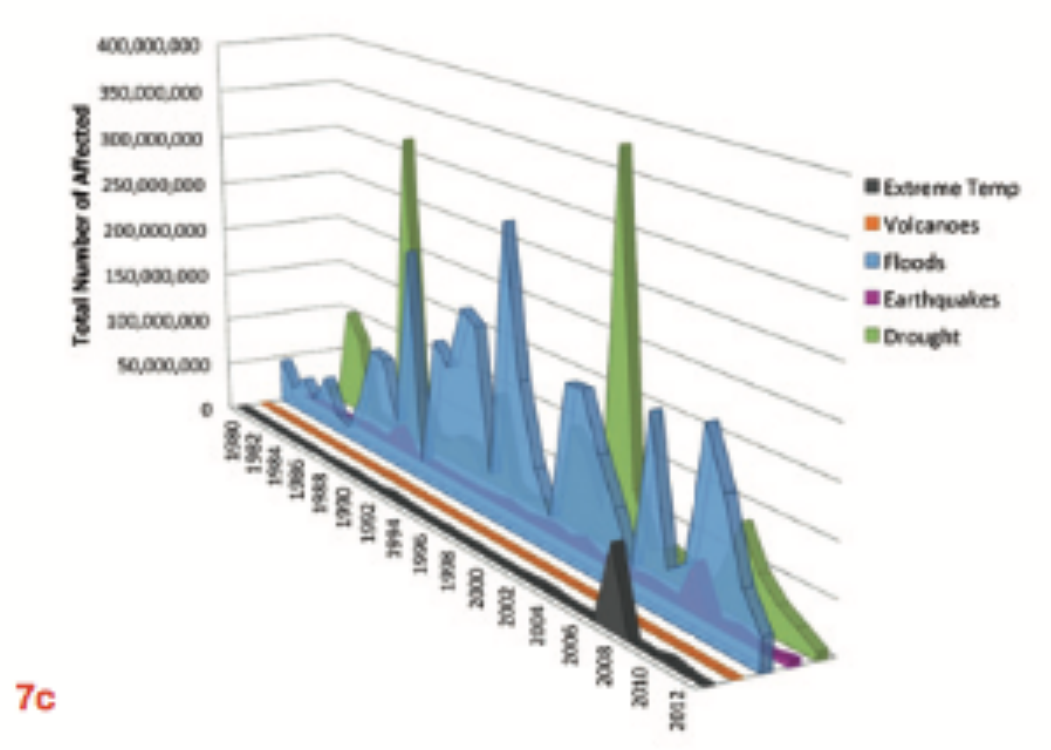
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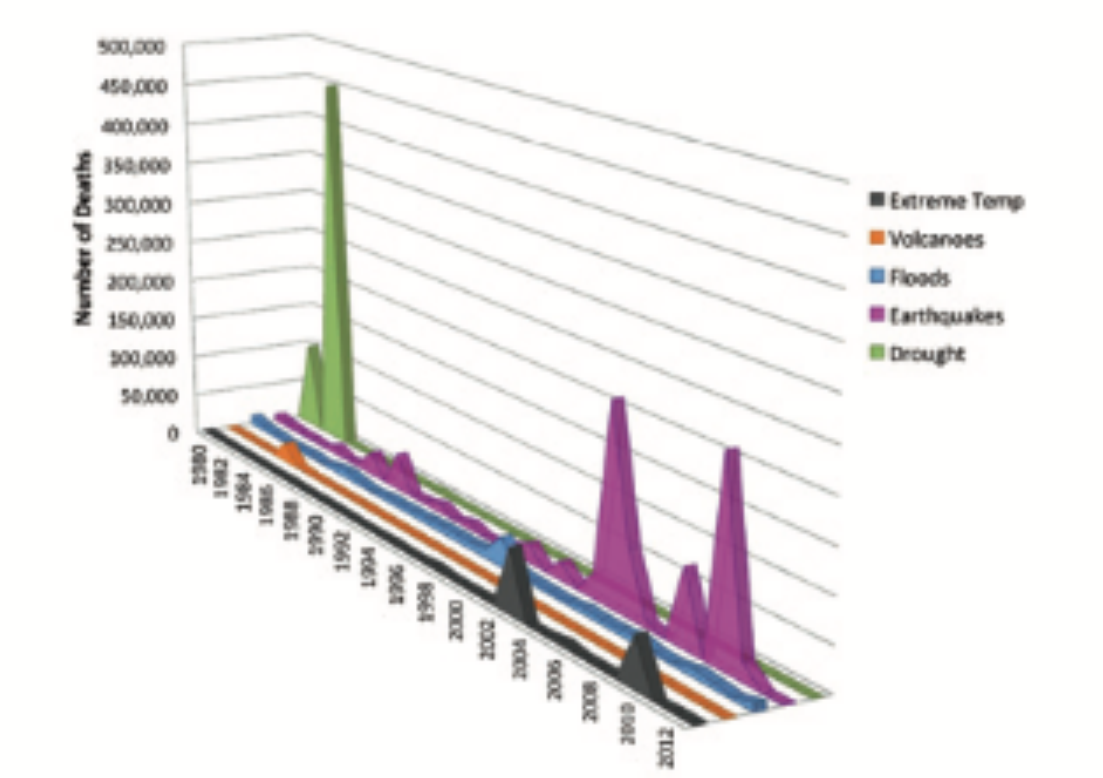
7a



7b

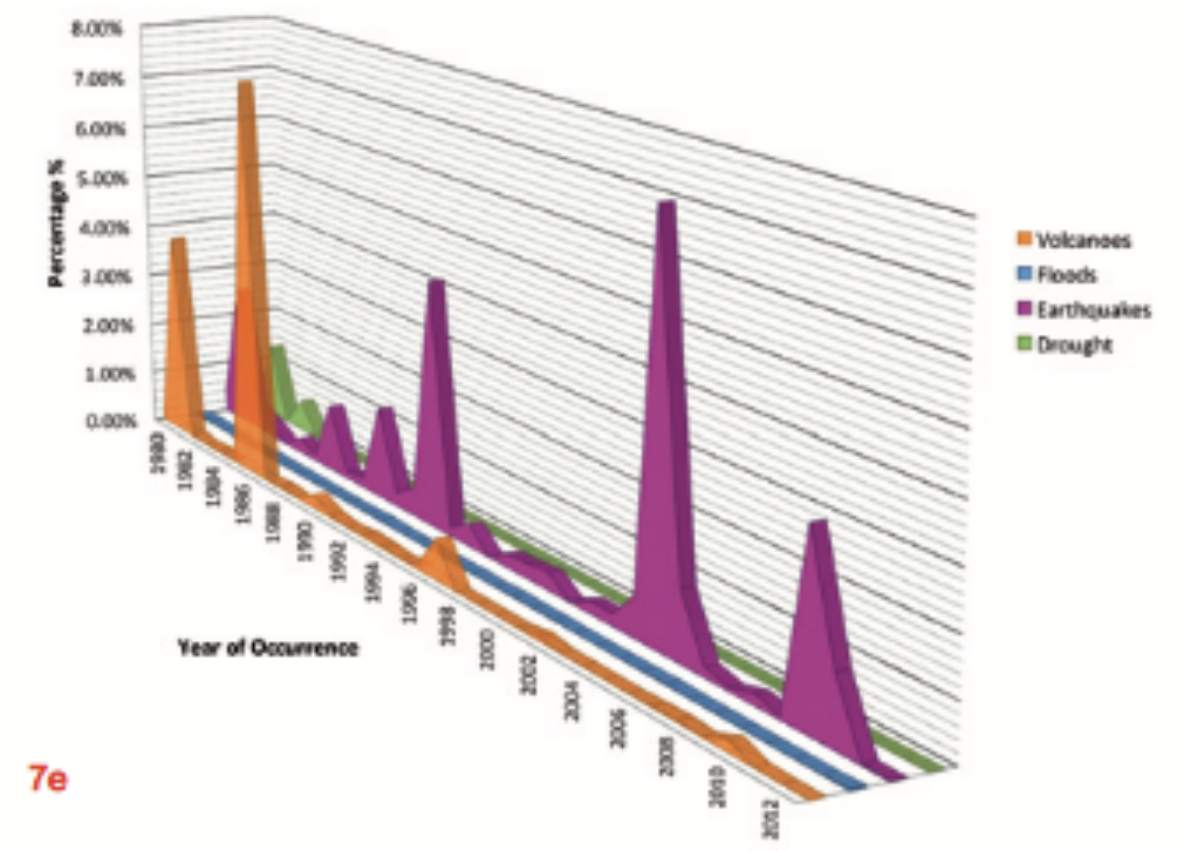


7c



7d

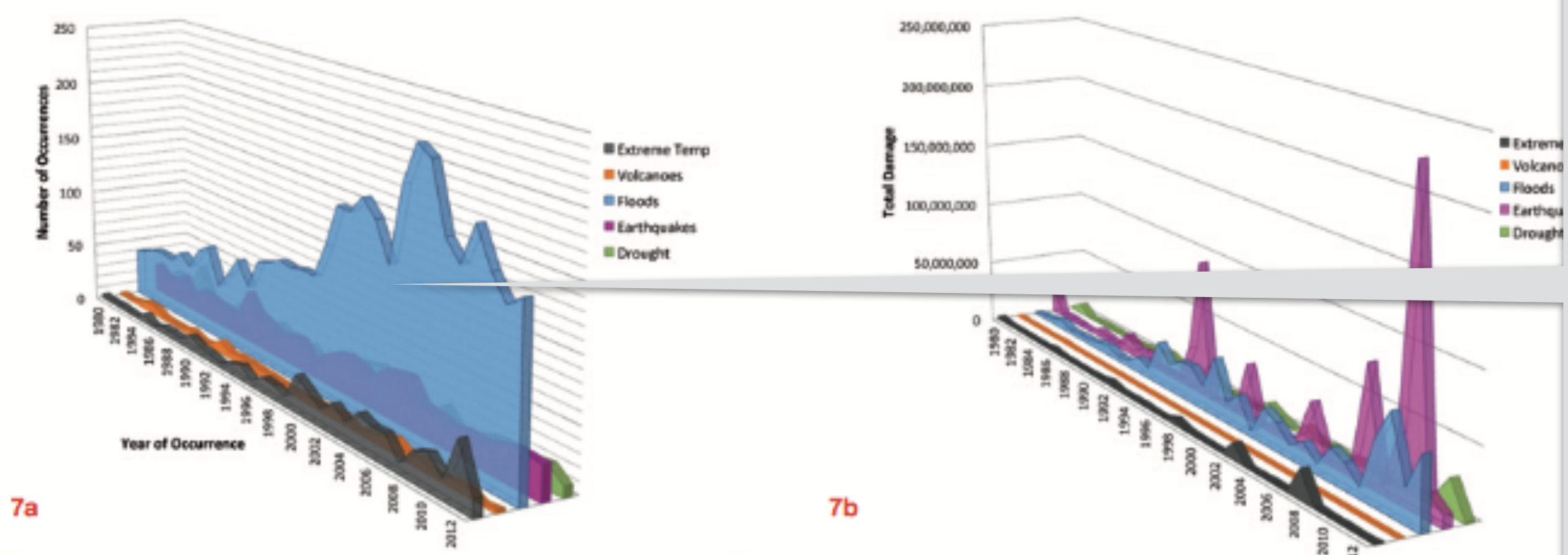
Figure 7. Natural Hazards for the time period between 1980 and 2013. Source is the International Disaster Database accessible through <http://www.emdat.be/advanced-search/>
 7a: Number of occurrences
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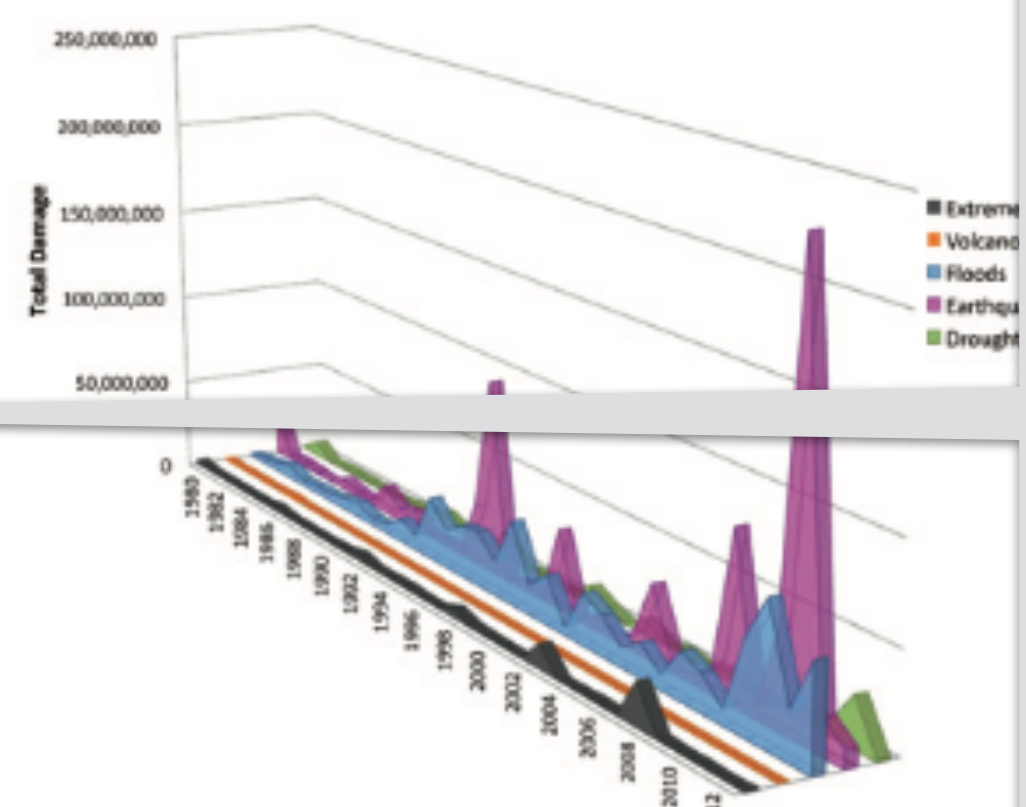
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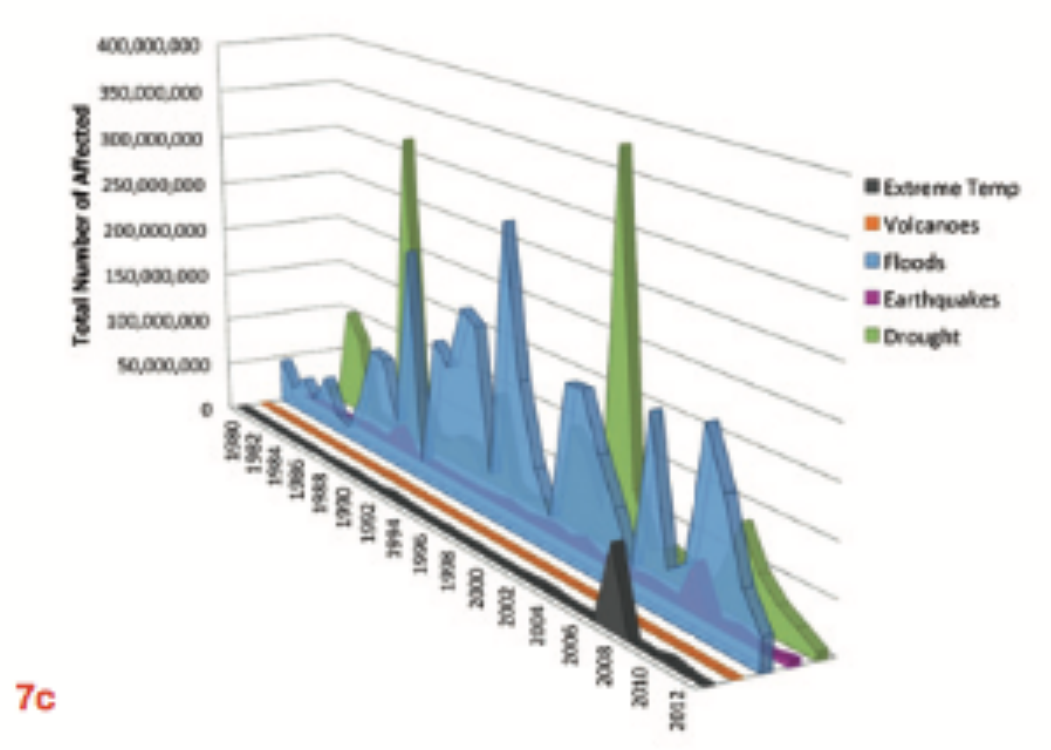
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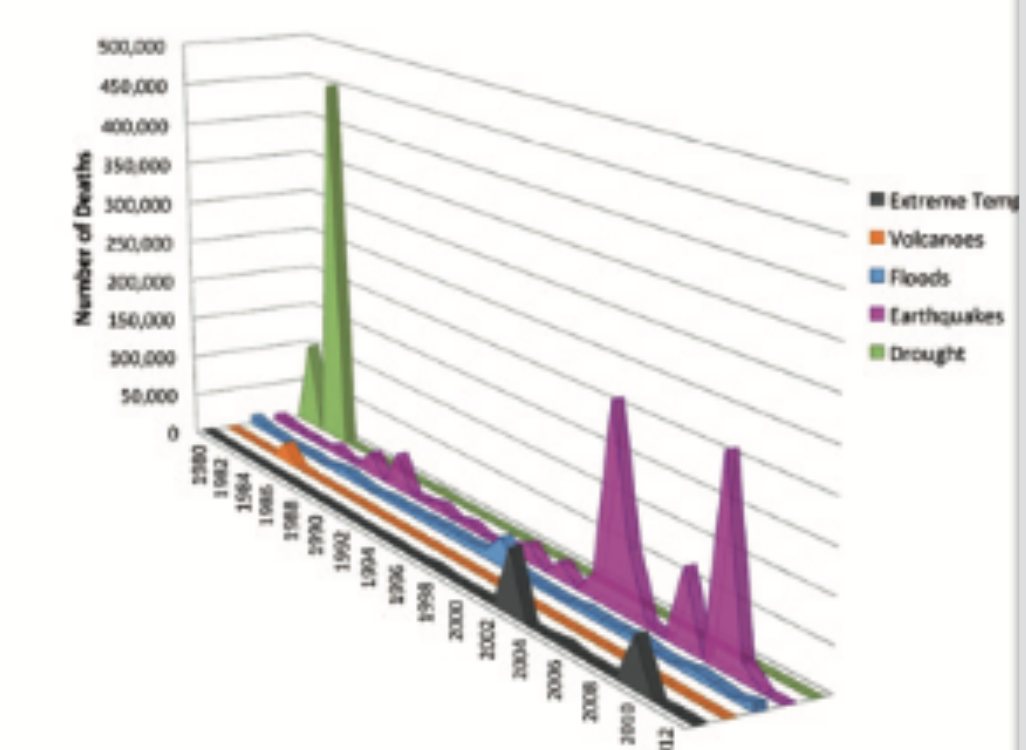
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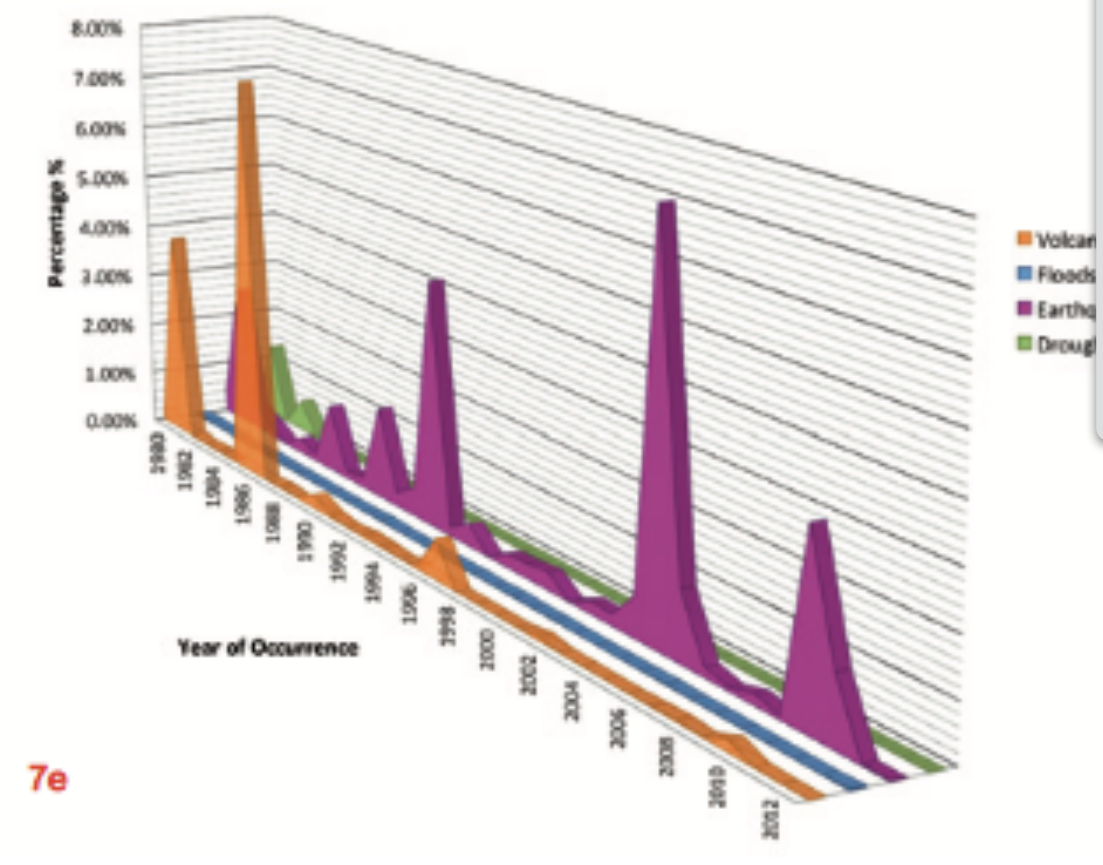
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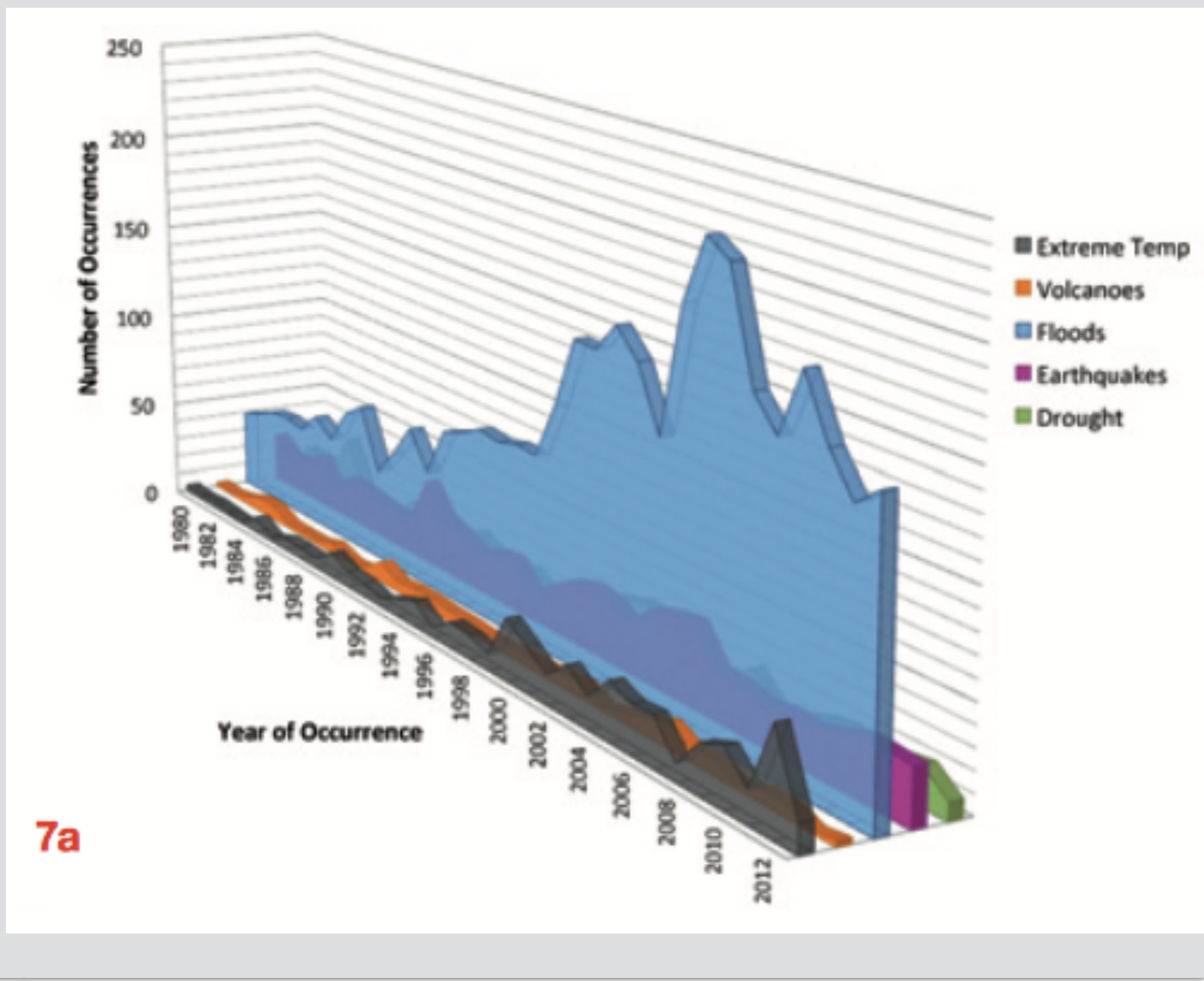
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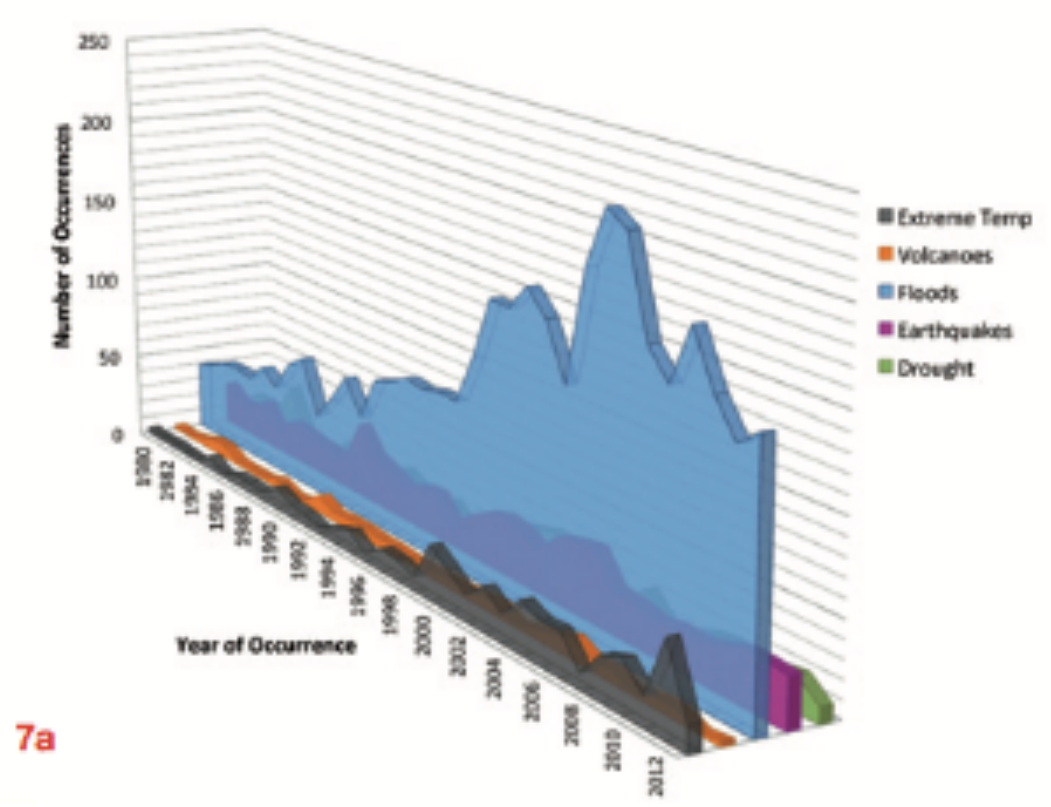


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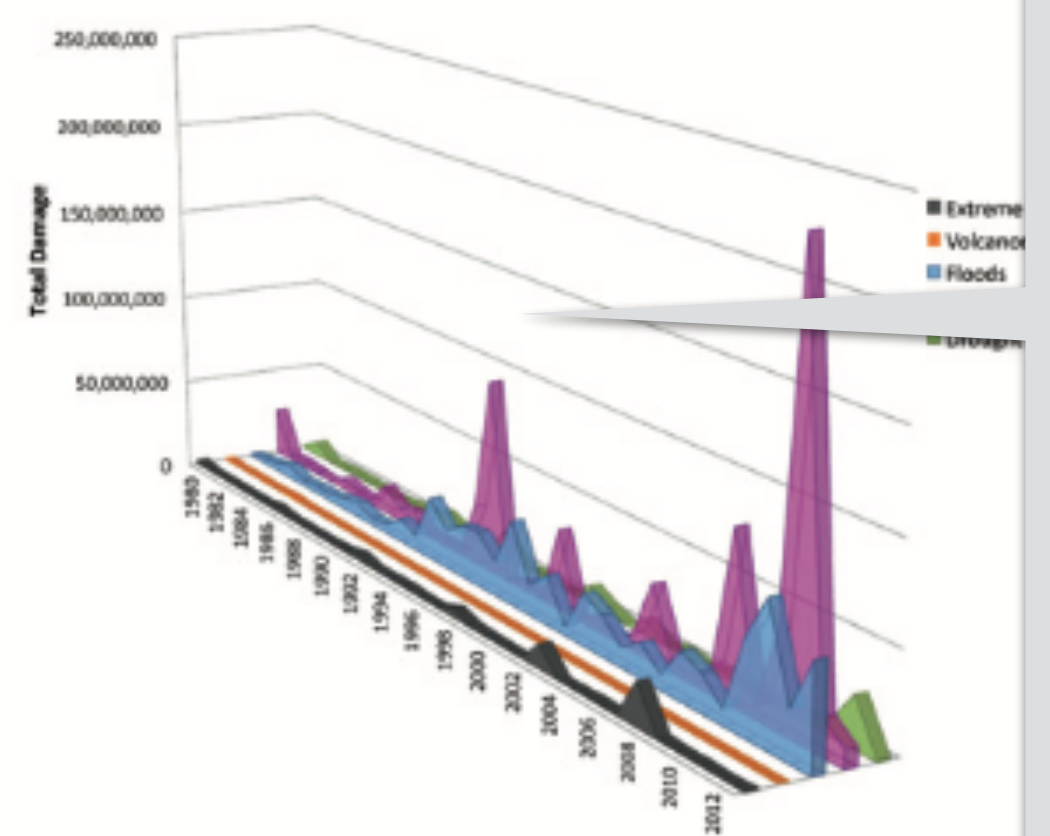


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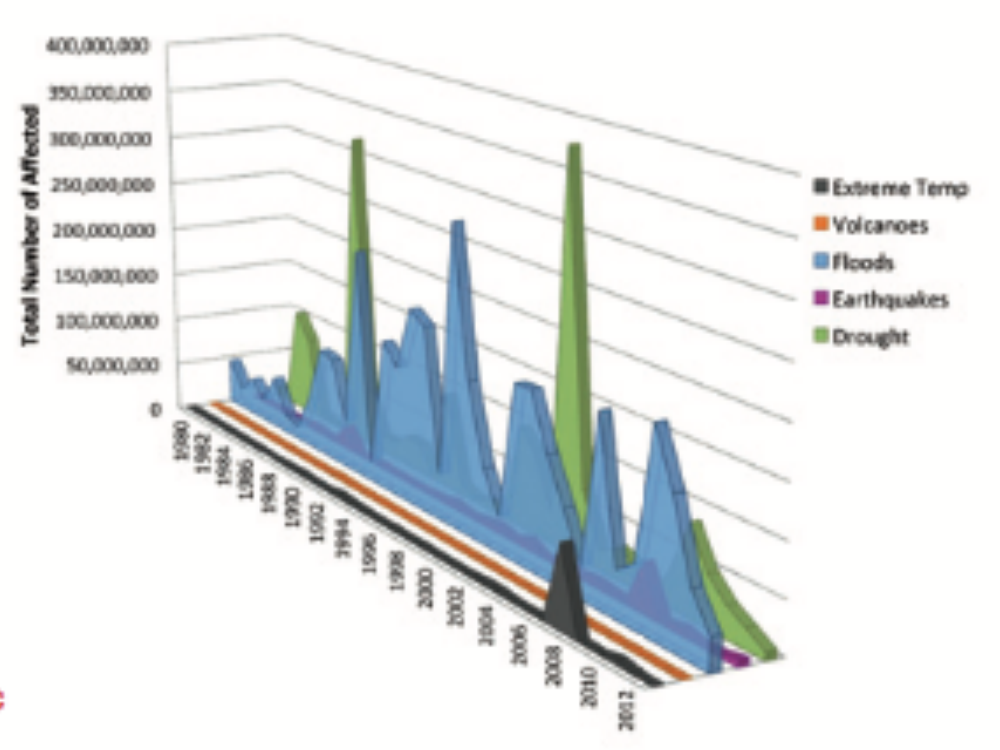
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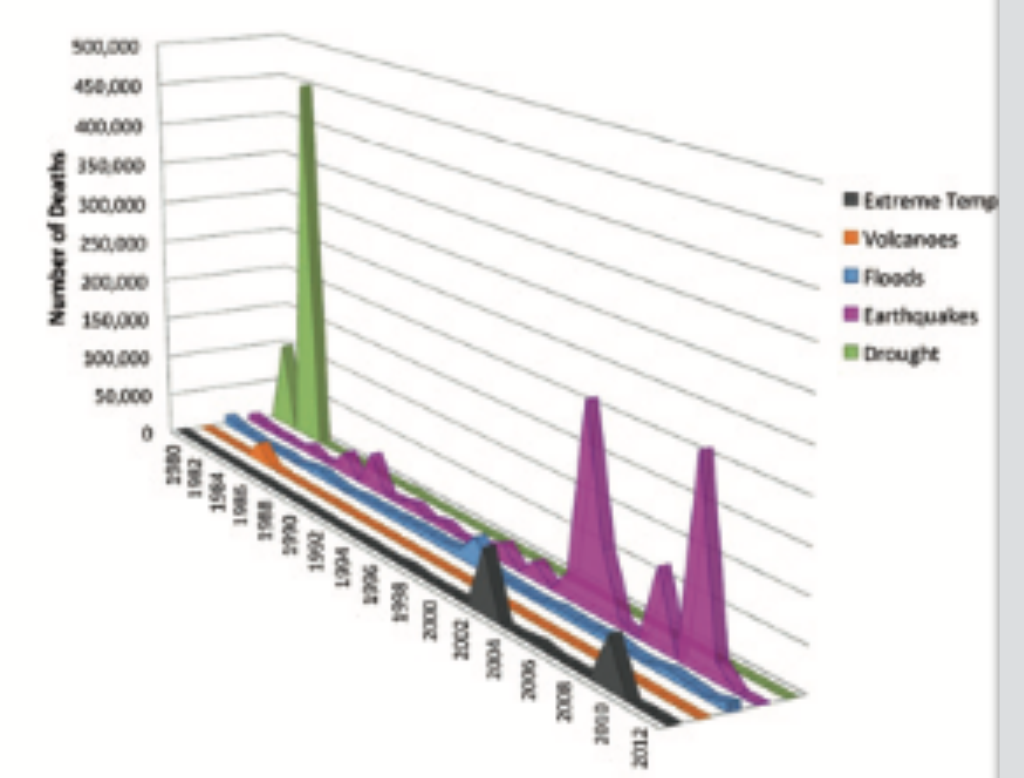
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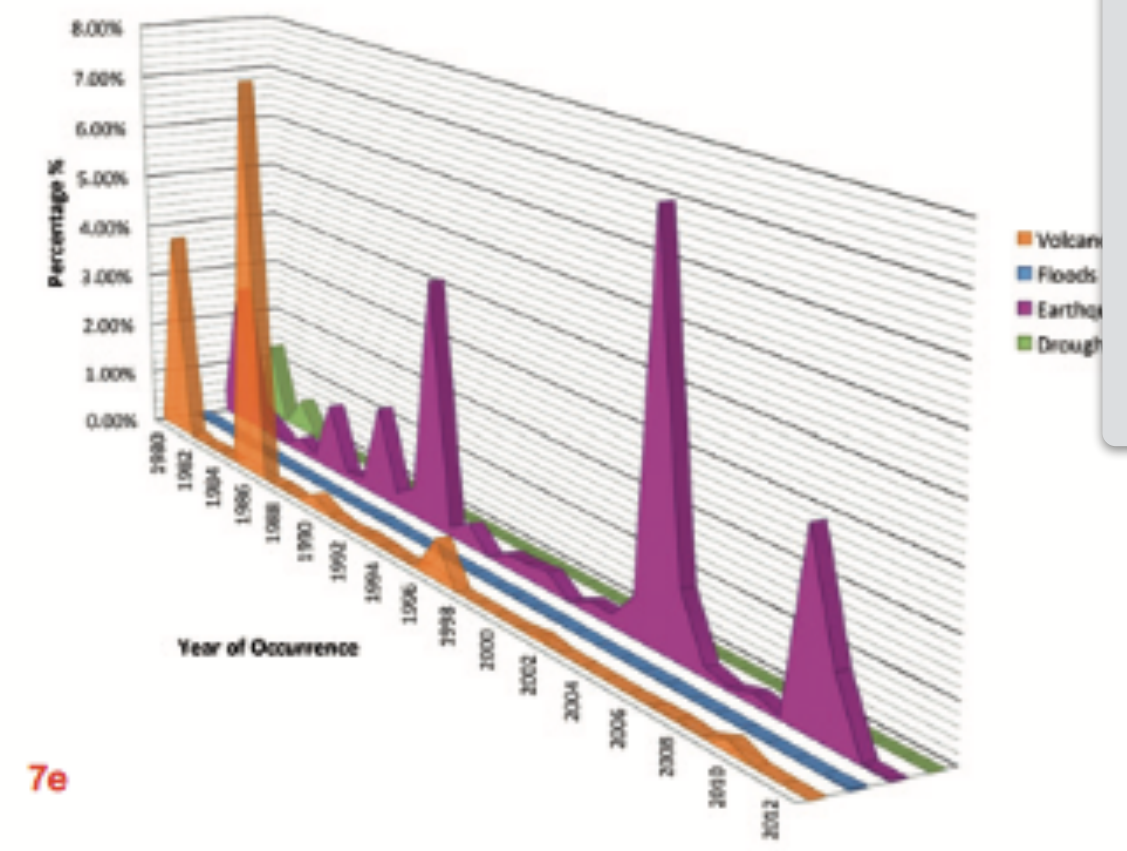
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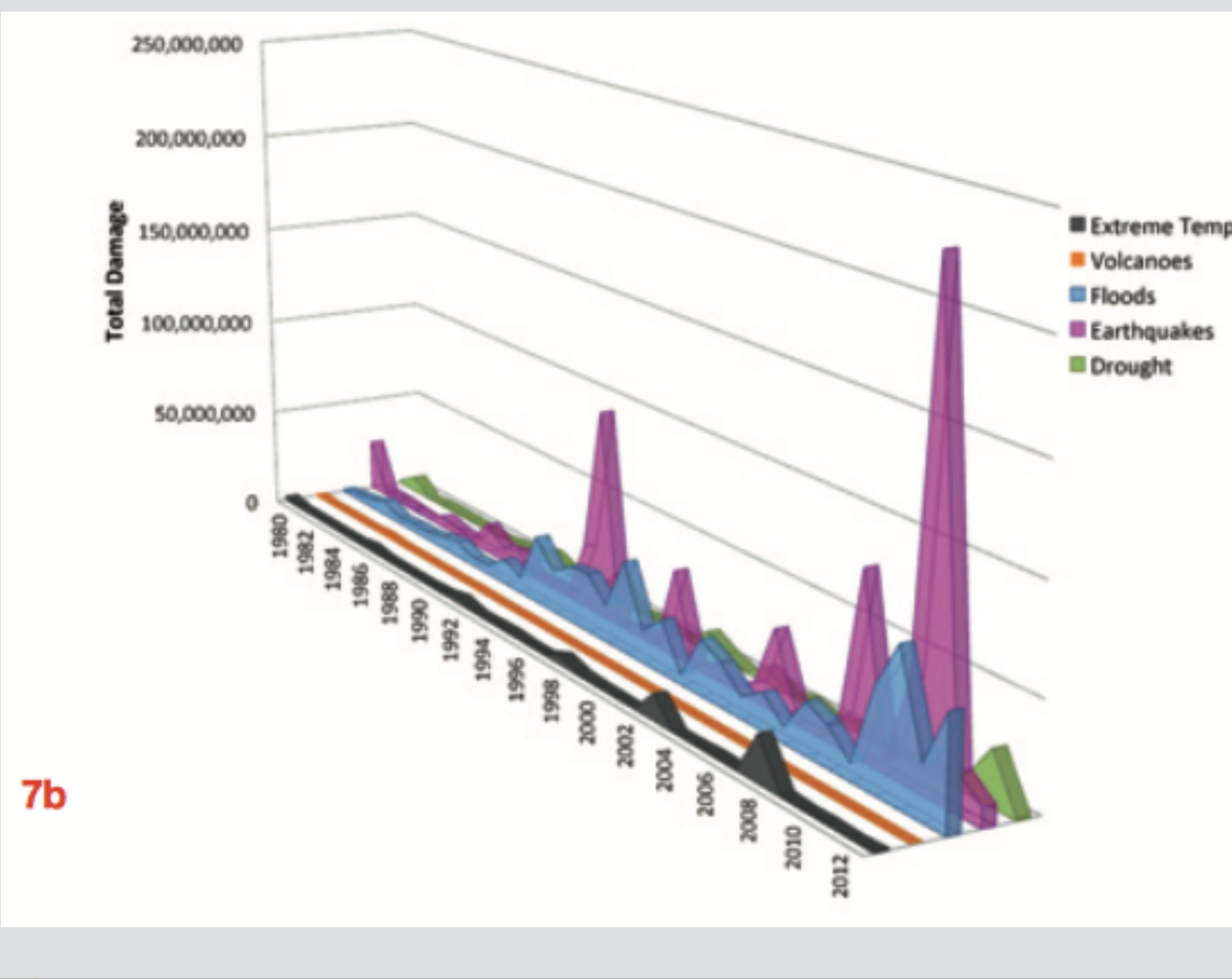
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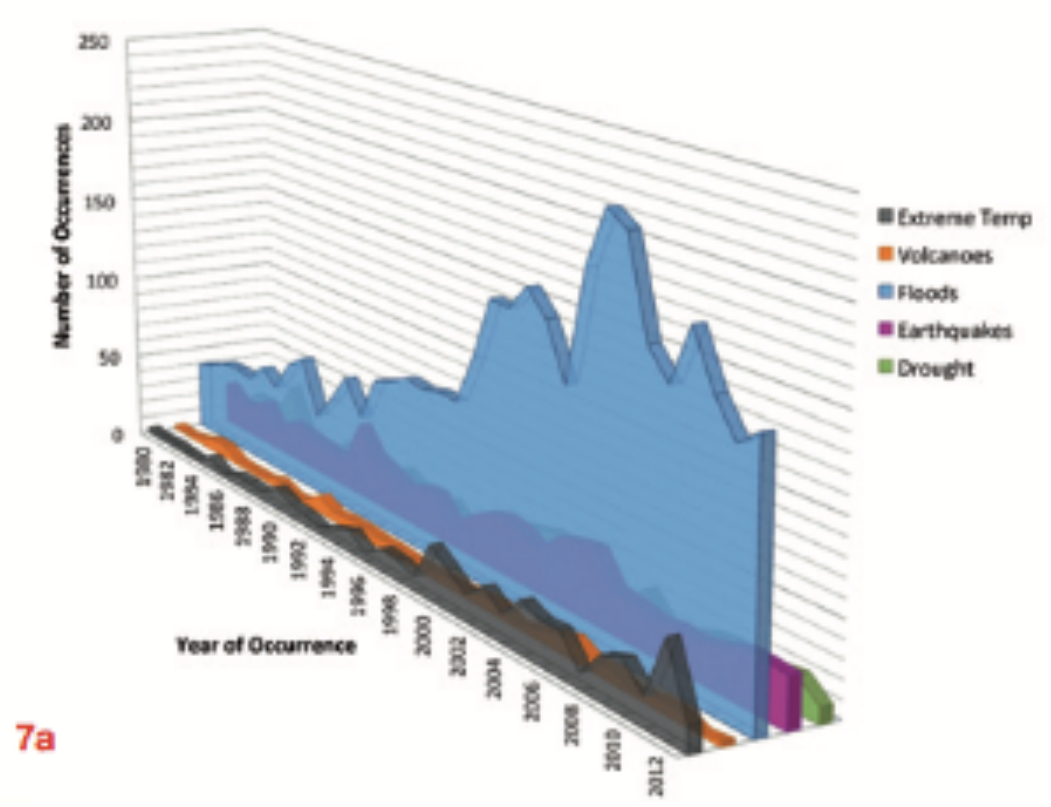


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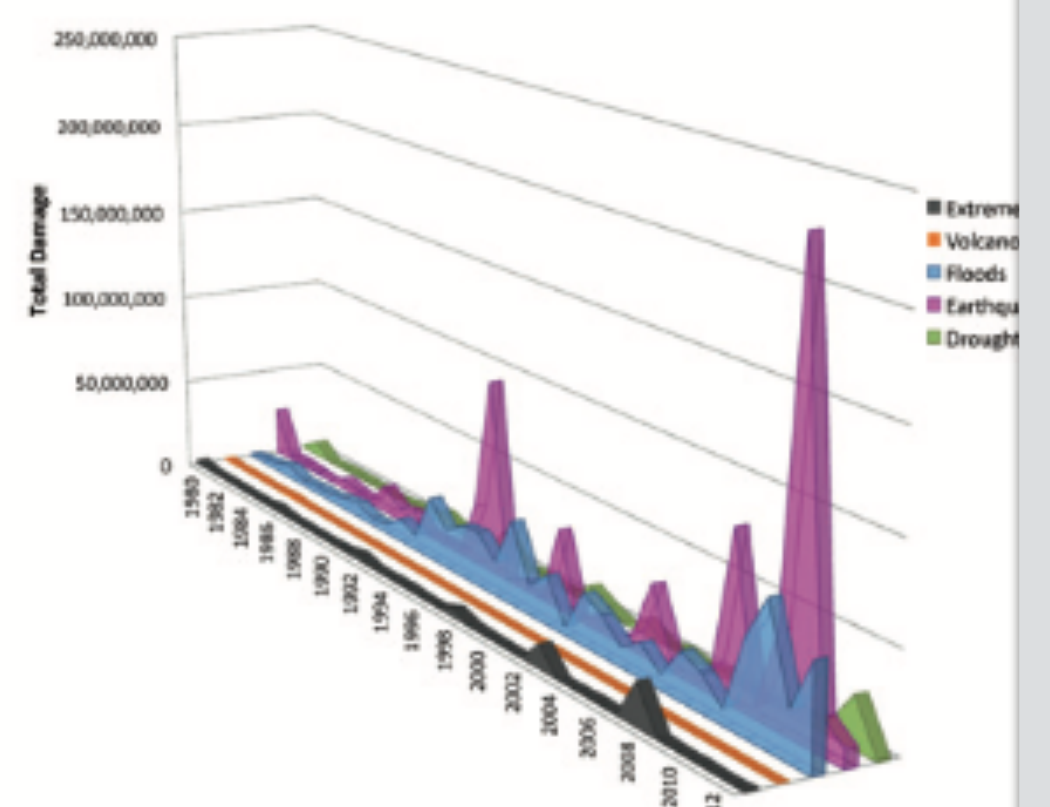
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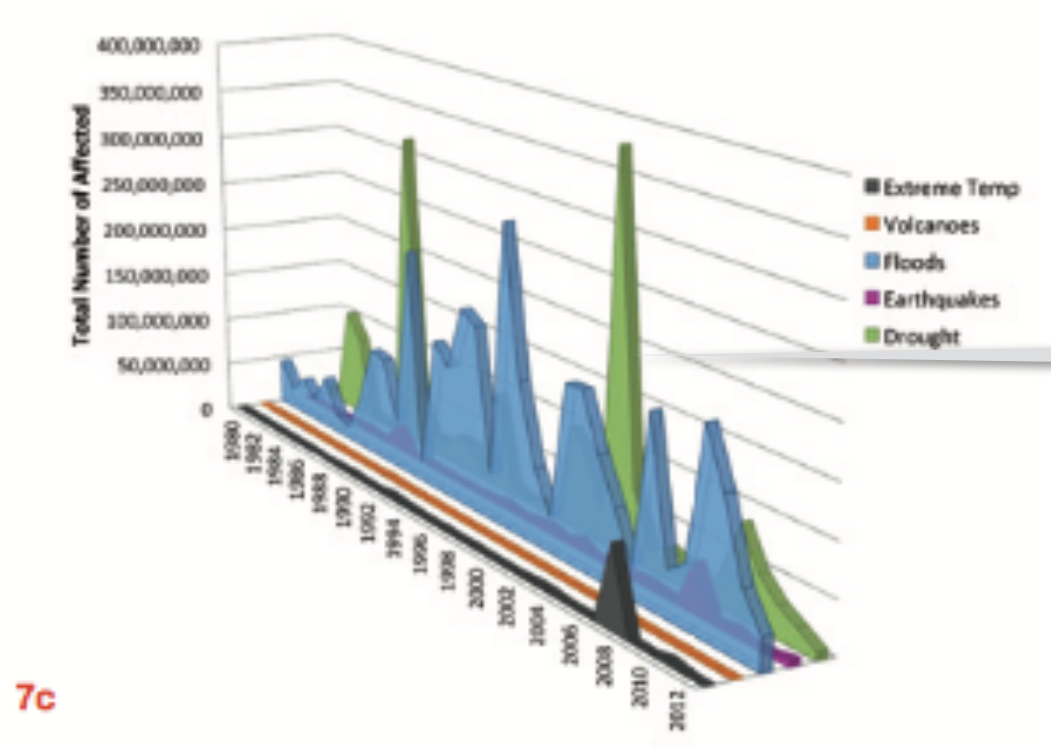
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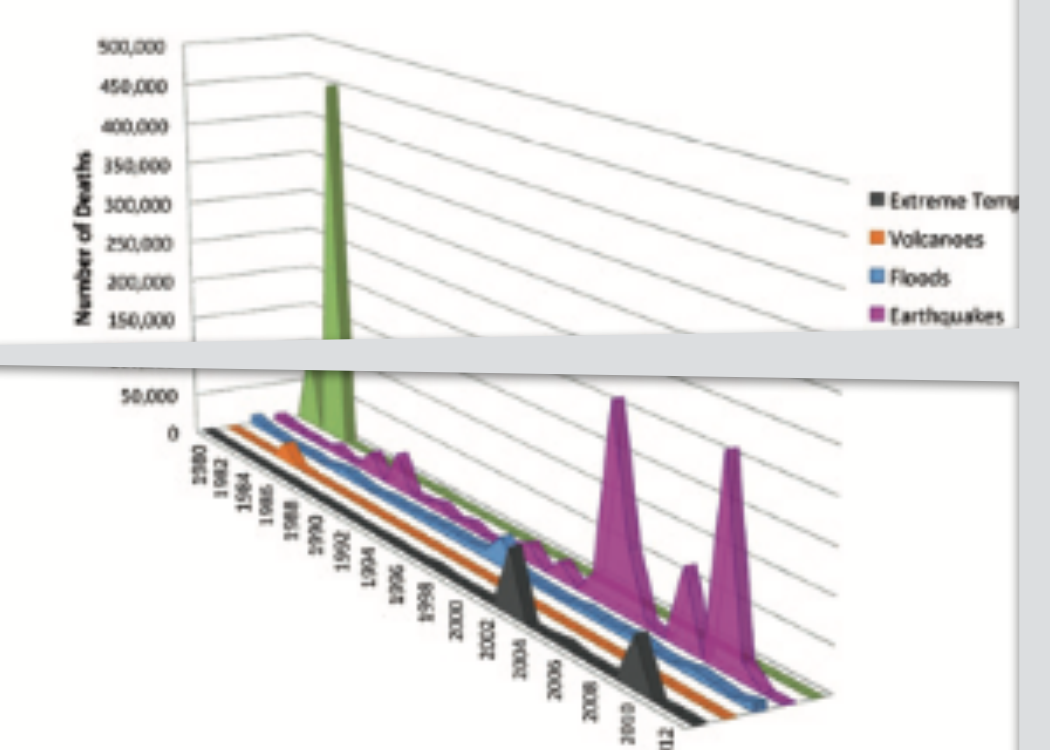
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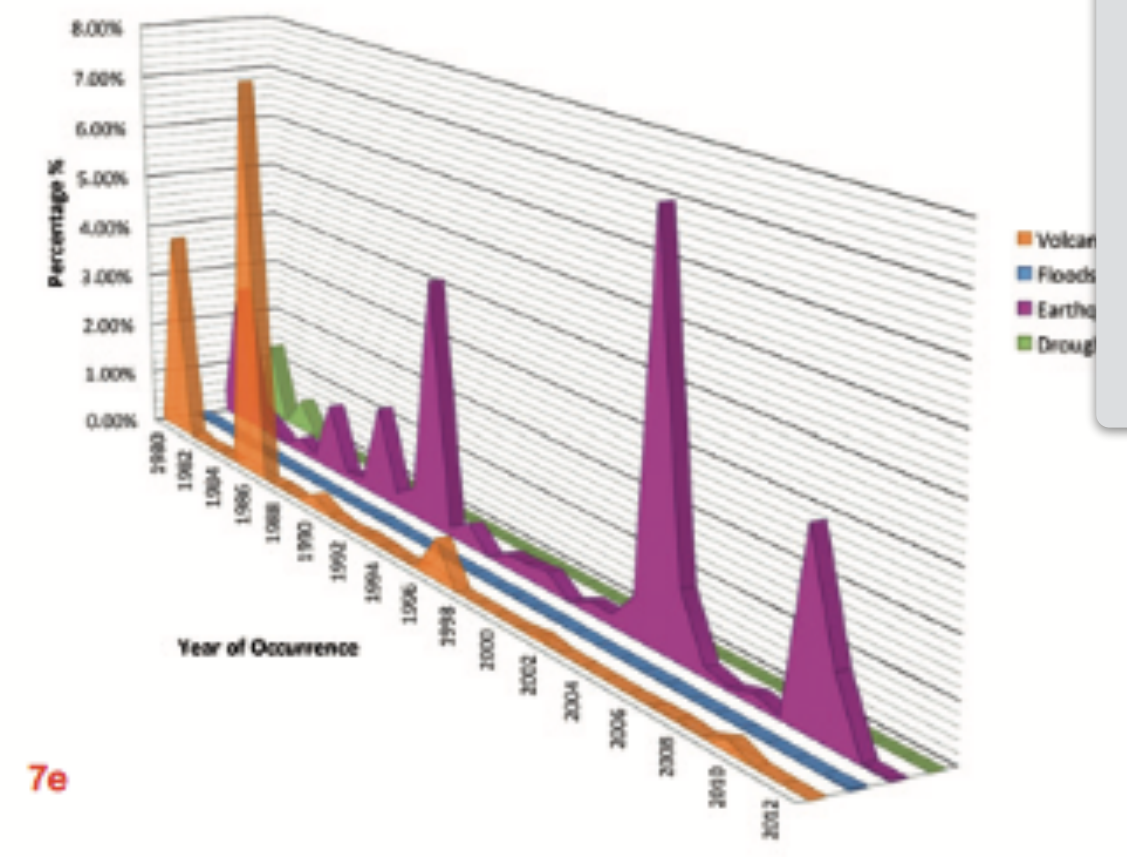
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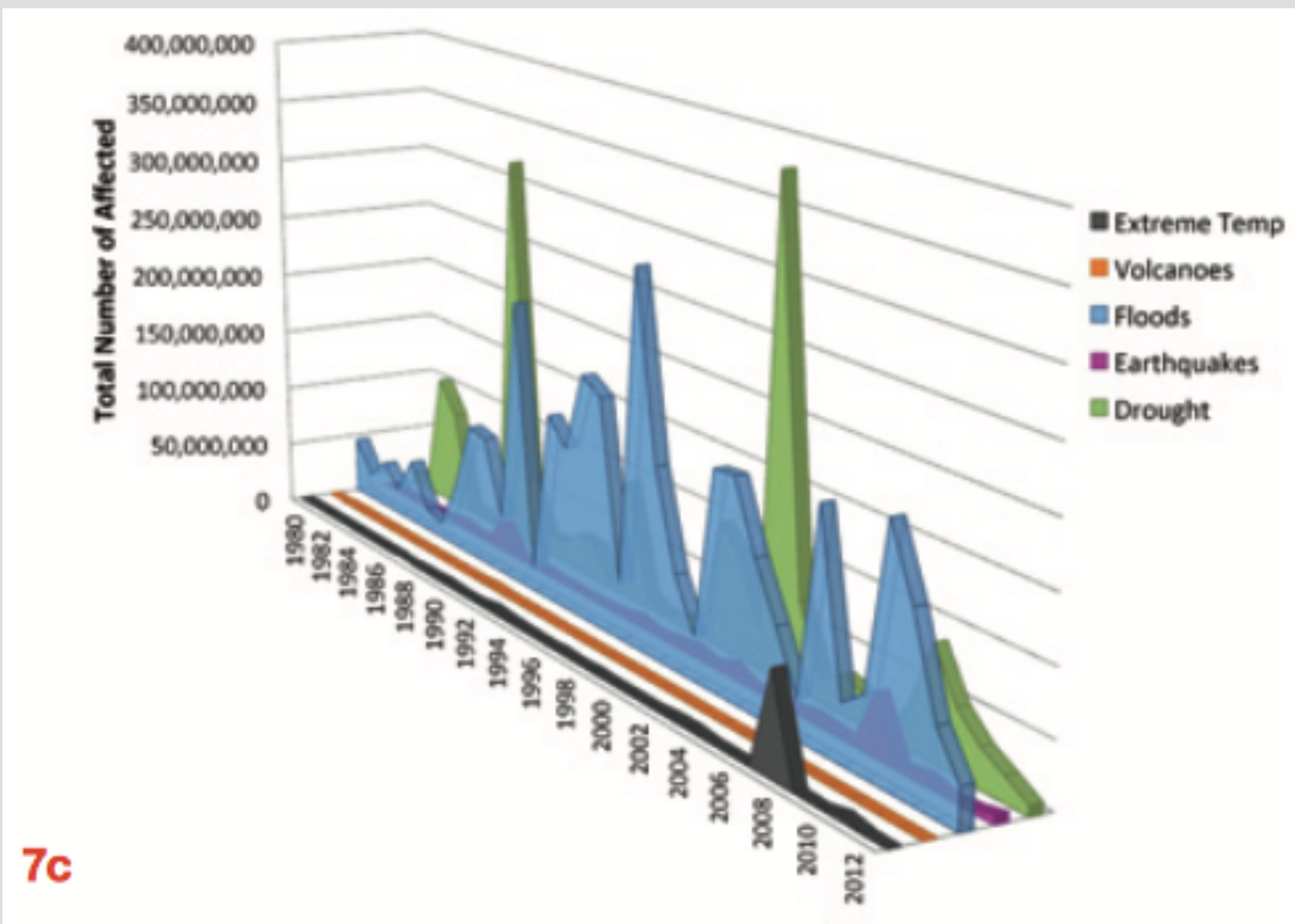
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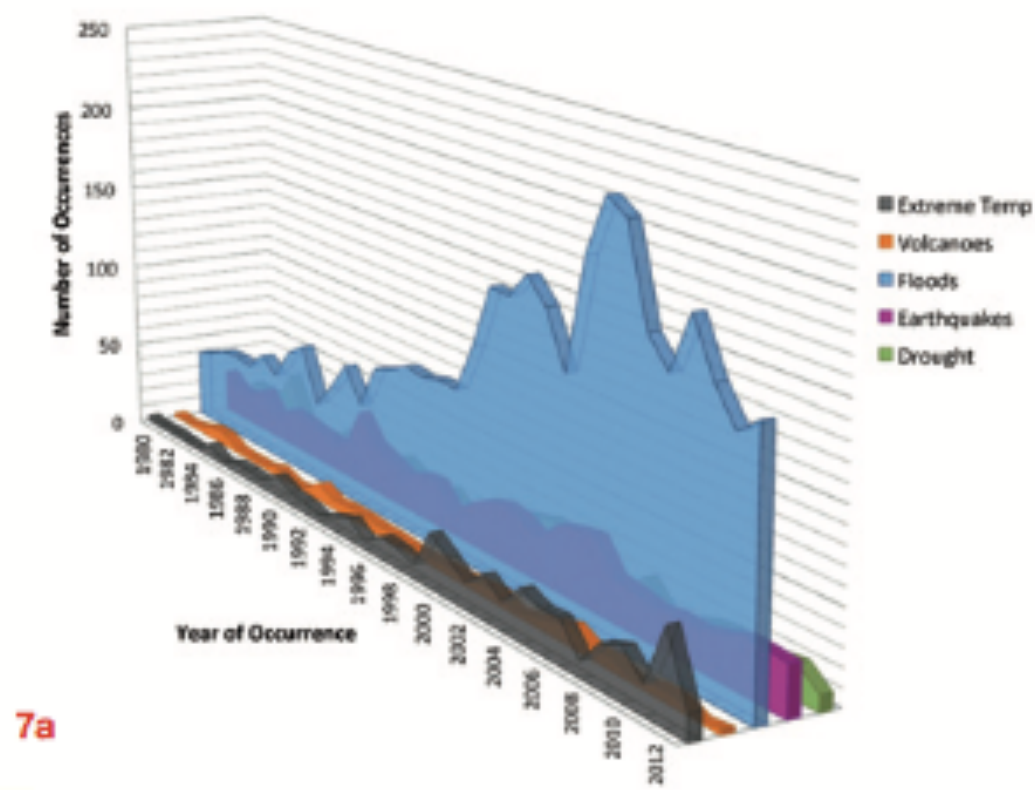


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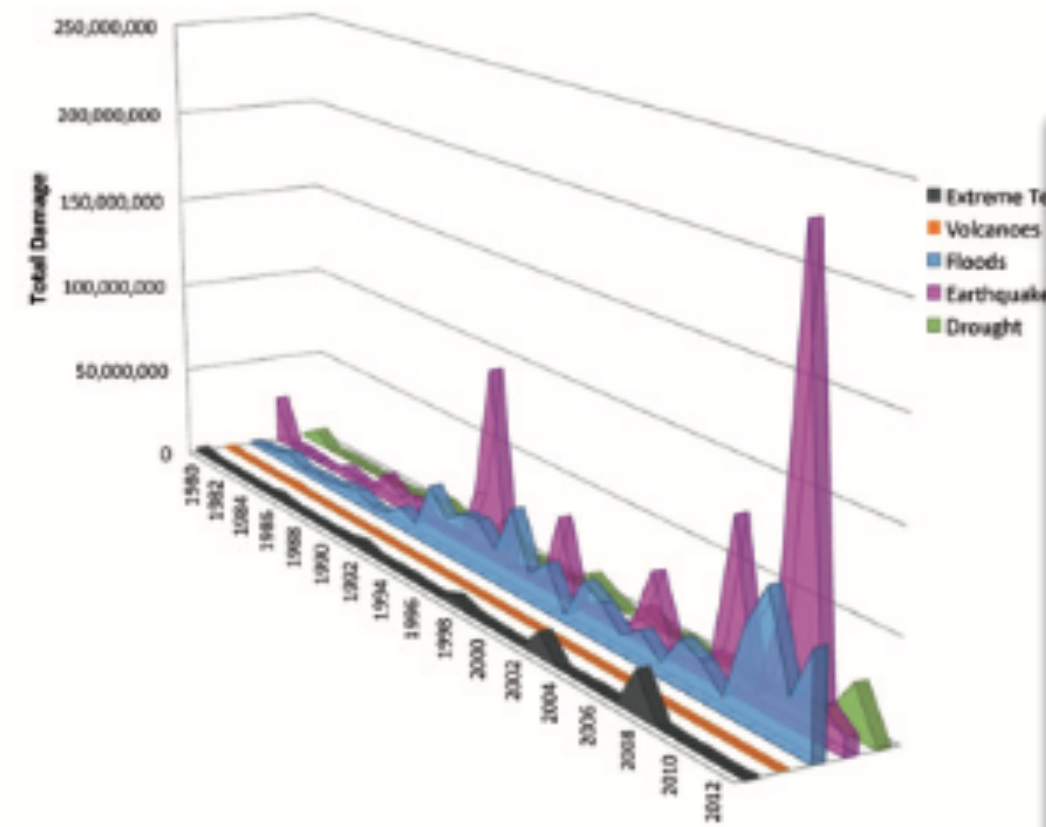


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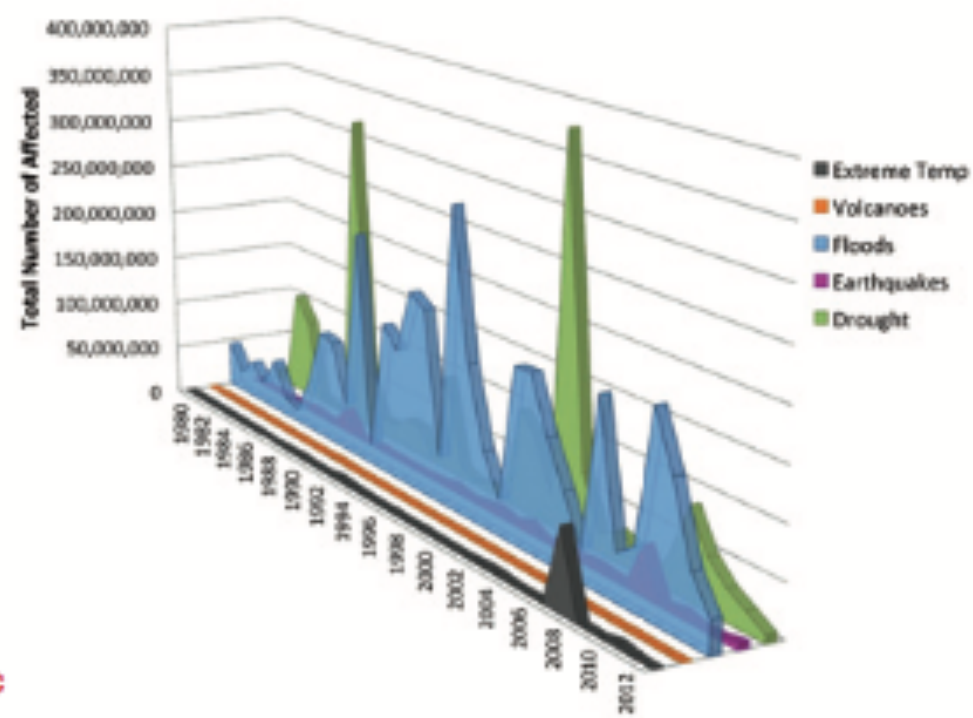
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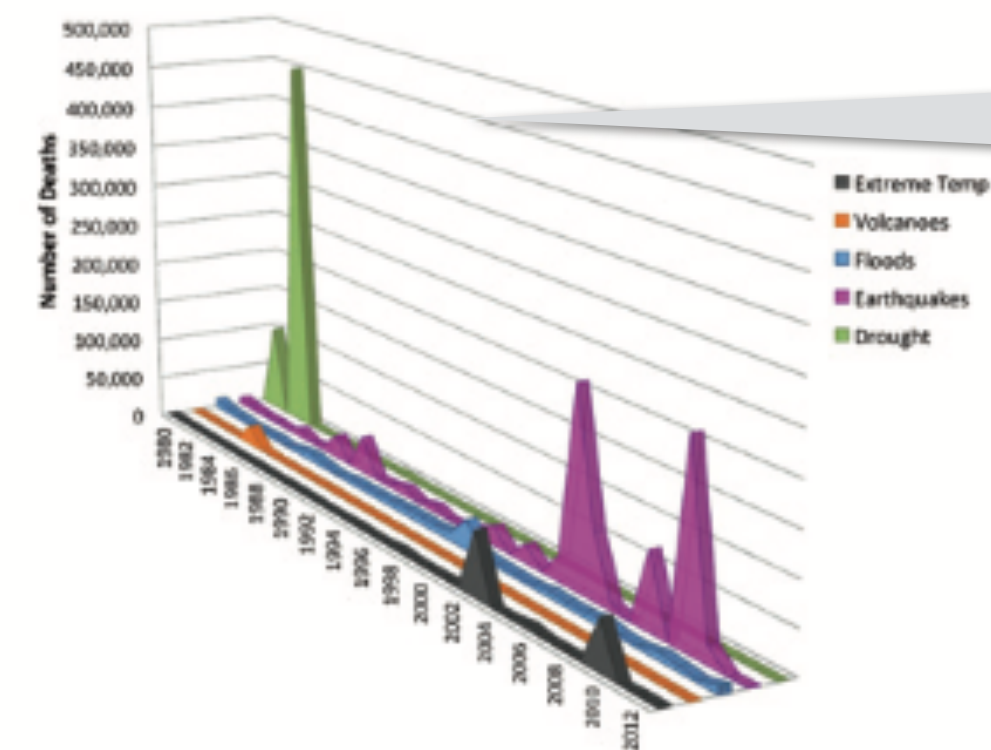
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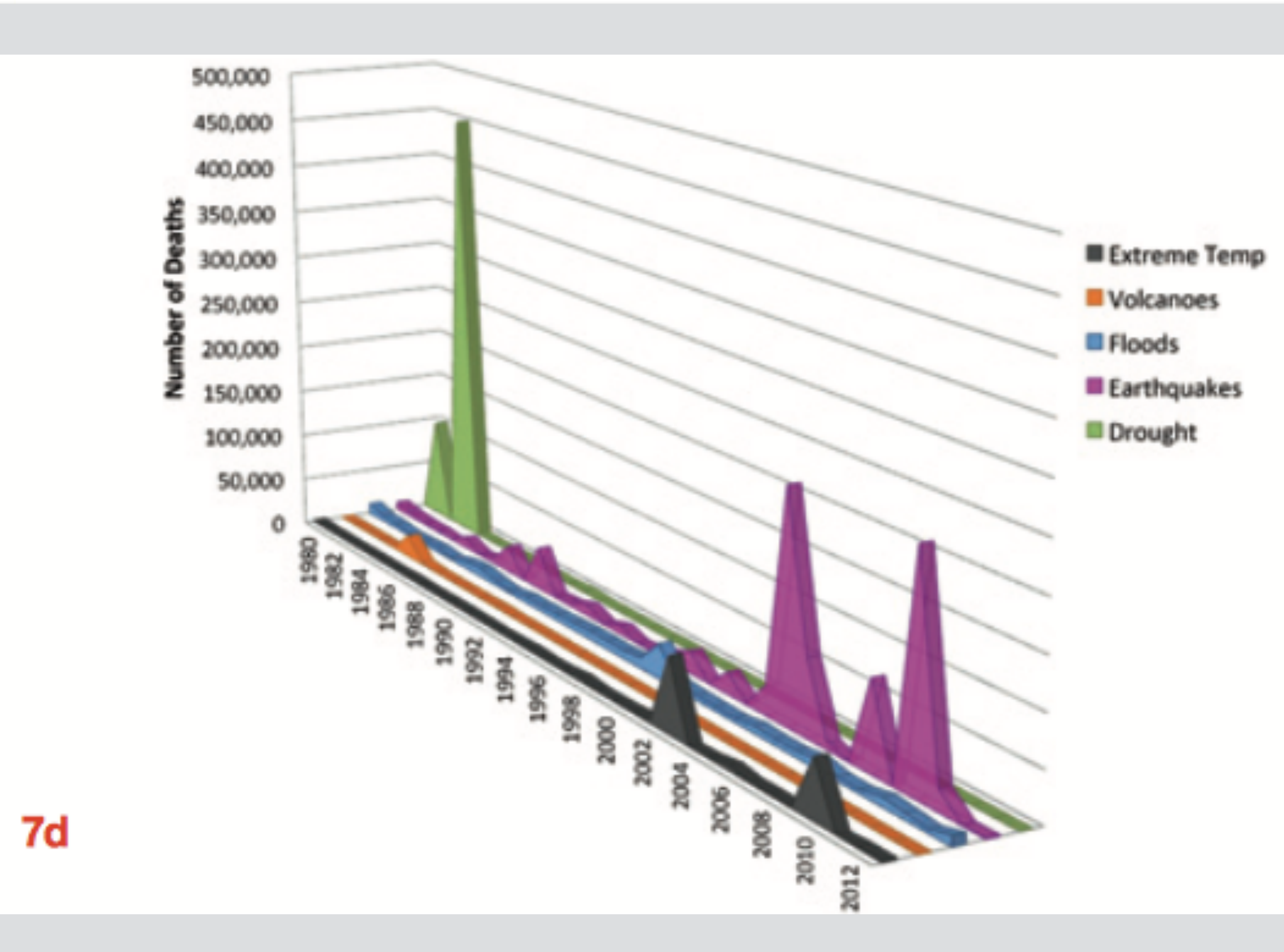
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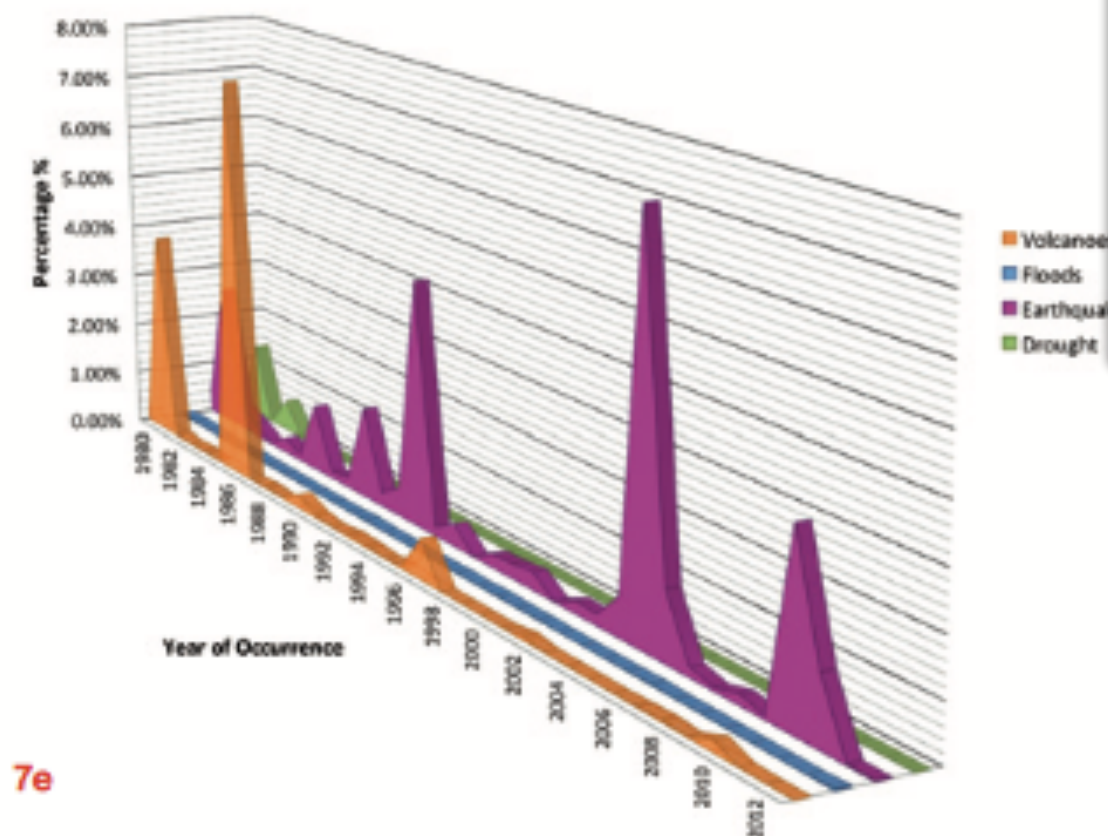
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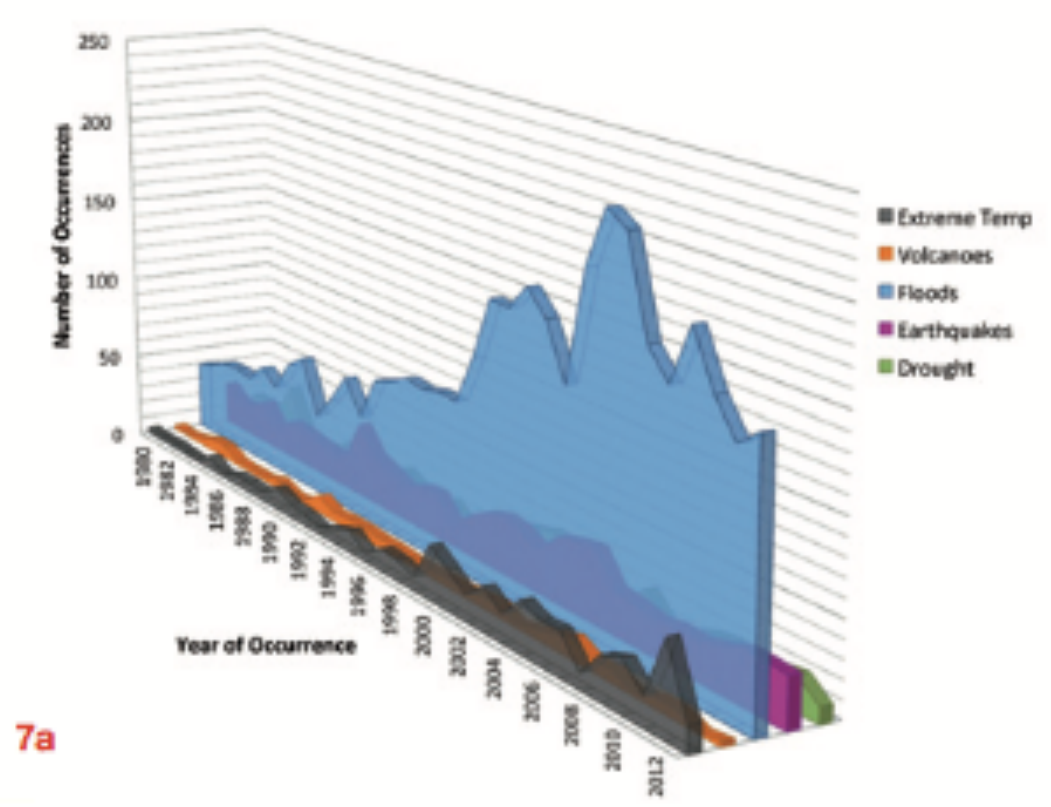


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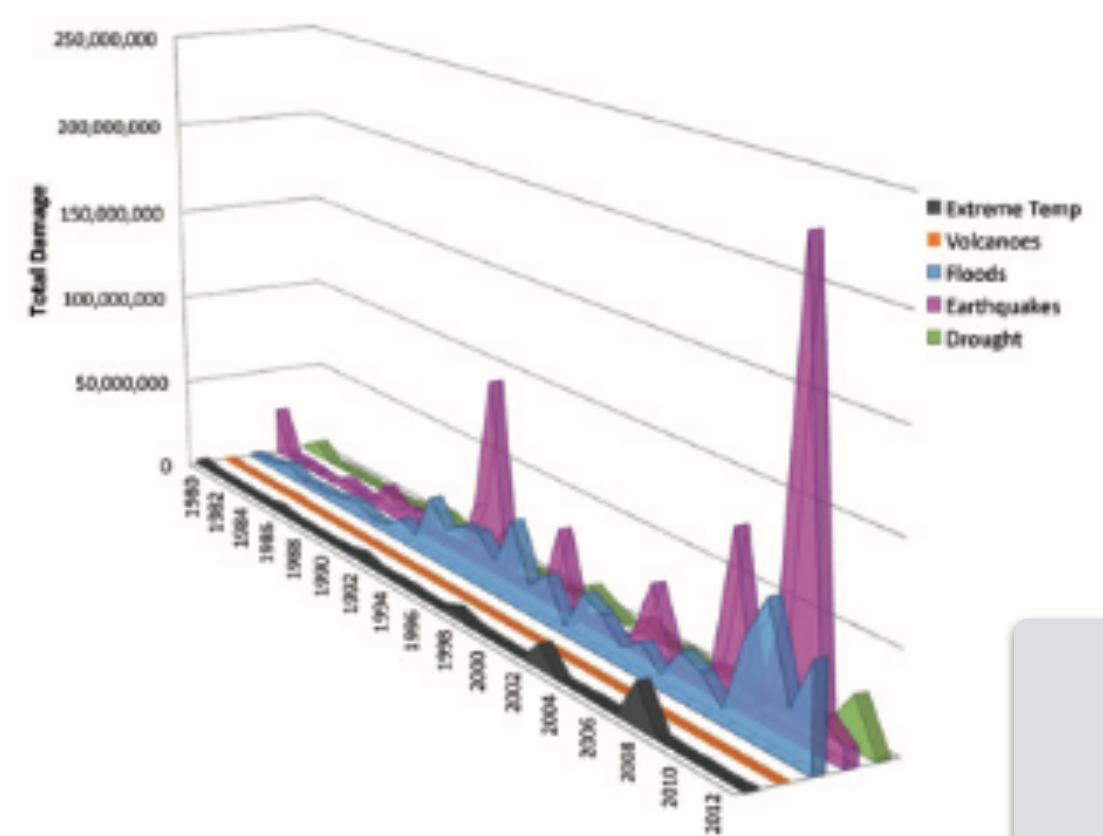
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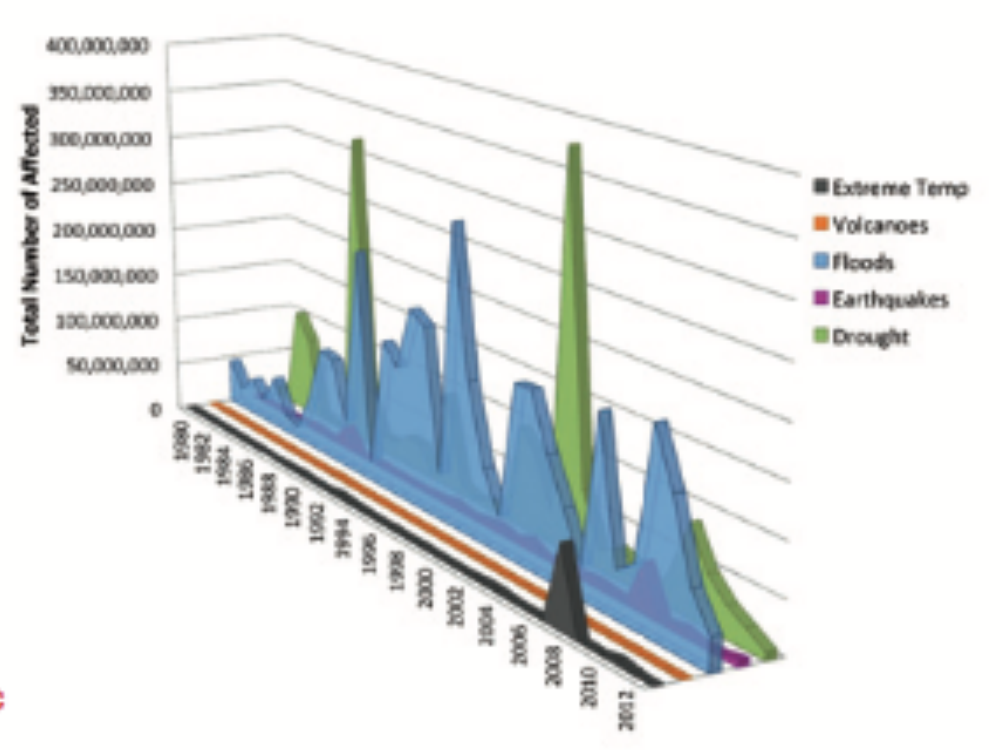
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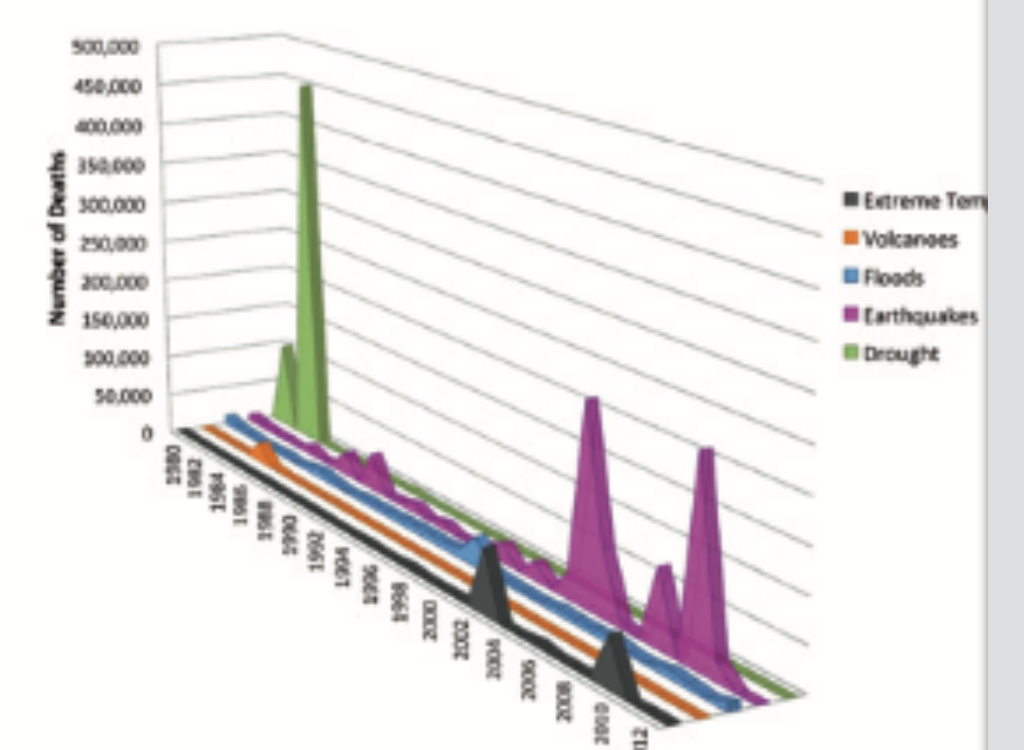
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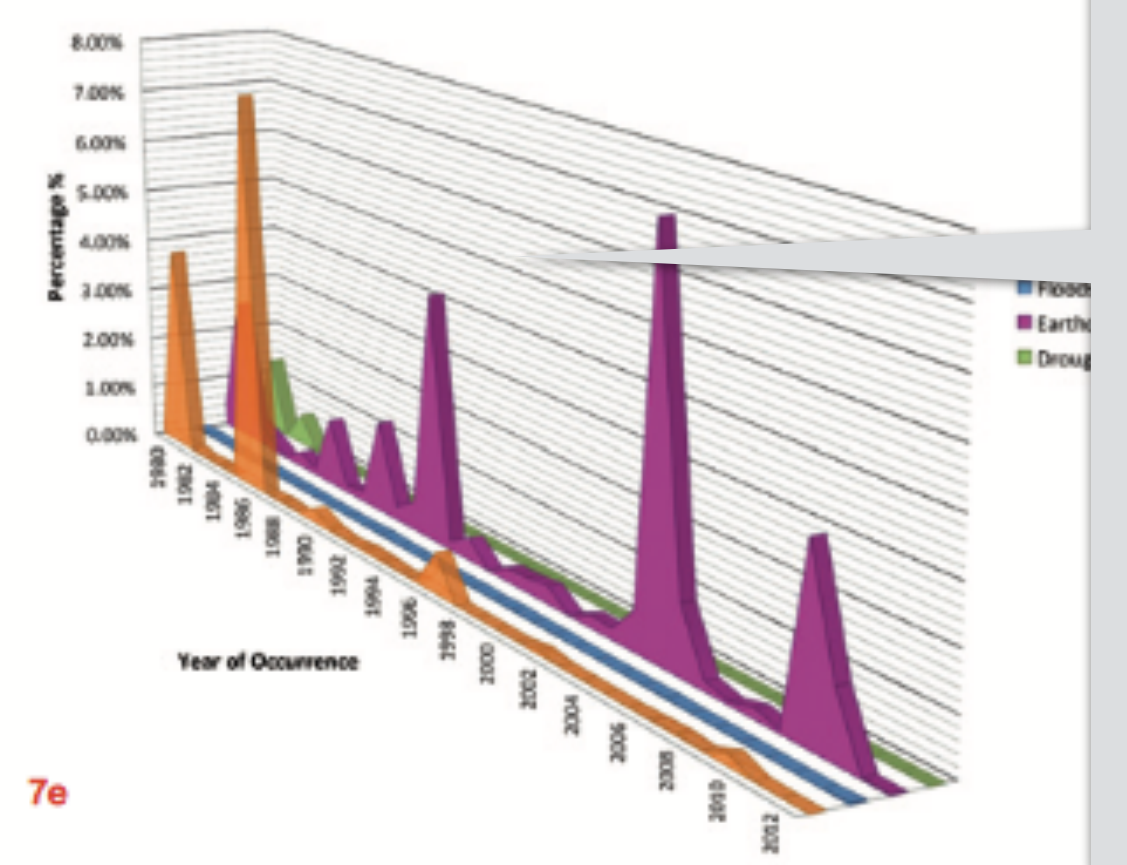
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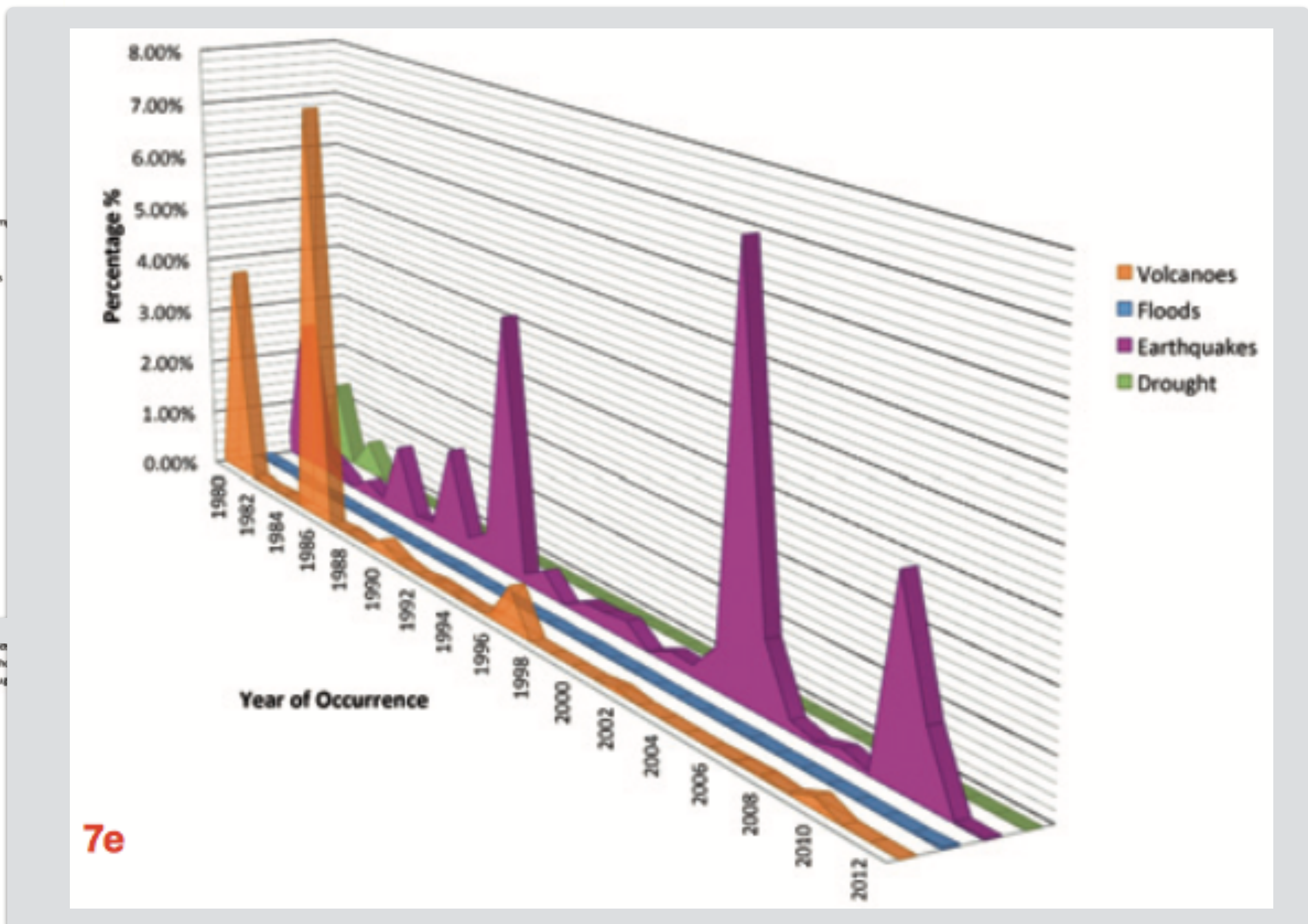
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Natural Hazards and Disasters

Lab 2: Measuring small changes, getting data, assessing risks and disasters

- 4+4 Forms
- Question Set 1
- Measuring small changes (questions 1 and 2)
- Getting data (question 3)
- Assessing risk and disasters (question 4)

4 How well known is the number of death caused by the 2017 Hurricane Maria in Puerto Rico? Explain the large uncertainty.

Mortality in Puerto Rico after Hurricane Maria

Nishant Kishore, M.P.H., Domingo Marqués, Ph.D., Ayesha Mahmud, Ph.D., Mathew V. Kiang, M.P.H., Irmay Rodriguez, B.A., Arlan Fuller, J.D., M.A., Peggy Ebner, B.A., Cecilia Sorensen, M.D., Fabio Racy, M.D., Jay Lemery, M.D., Leslie Maas, M.H.S., Jennifer Leaning, M.D., S.M.H., [et al.](#)

Article **Figures/Media**

Metrics

July 12, 2018

N Engl J Med 2018; 379:162-170

DOI: 10.1056/NEJMsa1803972

41 References **1** Citing Article

Abstract

BACKGROUND

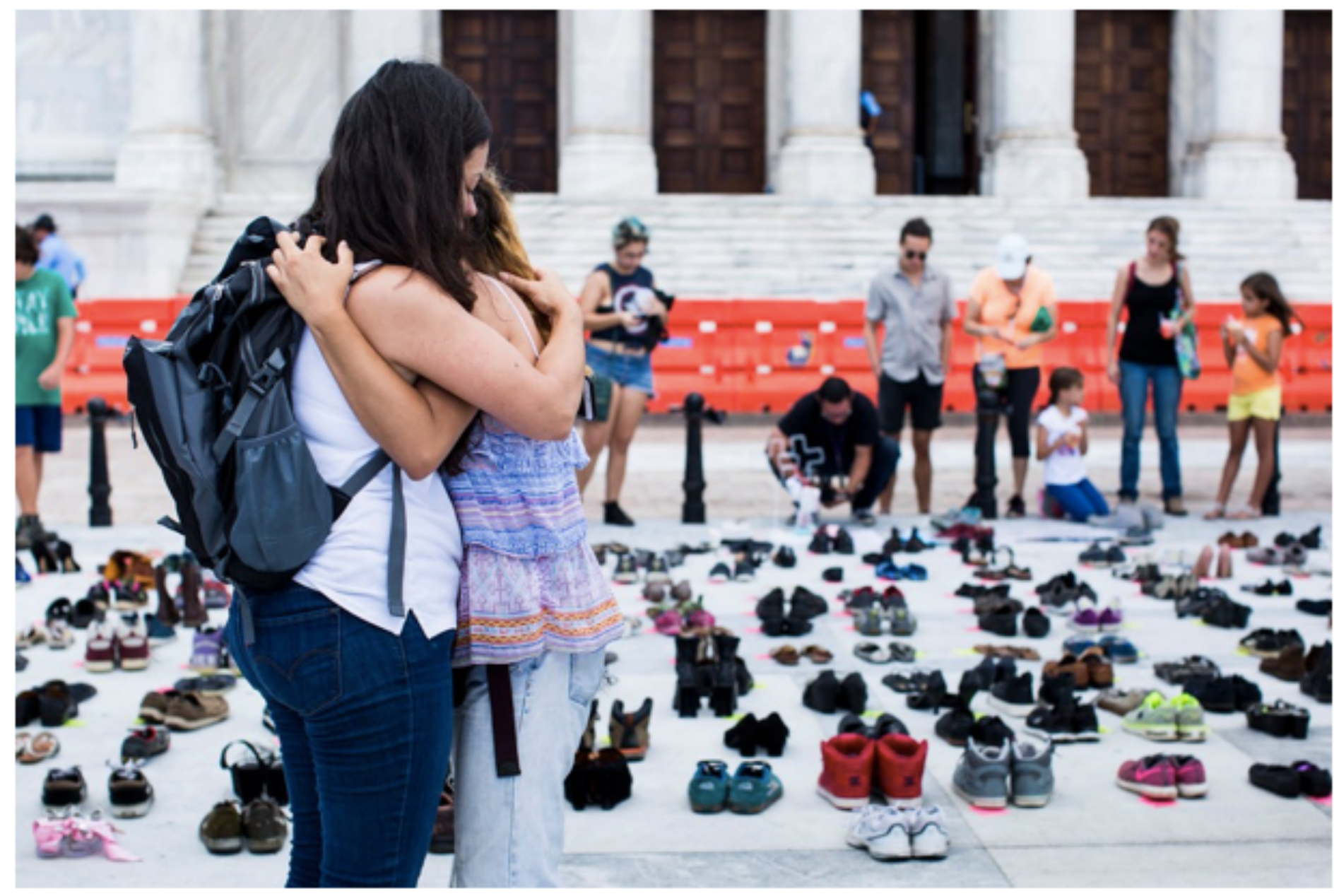
Quantifying the effect of natural disasters on society is critical for recovery of public health services and infrastructure. The death toll can be difficult to assess in the aftermath of a major disaster. In September 2017, Hurricane Maria caused massive infrastructural damage to Puerto Rico, but its effect on mortality remains contentious. The official death count is 64.

RESULTS

From the survey data, we estimated a mortality rate of 14.3 deaths (95% confidence interval [CI], 9.8 to 18.9) per 1000 persons from September 20 through December 31, 2017. This rate yielded a total of 4645 excess deaths during this period (95% CI, 793 to 8498), equivalent to a 62% increase in the mortality rate as compared with the same period in 2016. However, this number is likely to be an underestimate because of survivor bias. The mortality rate remained high through the end of December 2017, and one third of the deaths were attributed to delayed or interrupted health care. Hurricane-related migration was substantial.

- Official death count: 64
- May 31 2018: New result: 95%: 793 to 8498

Puerto Rican Government Acknowledges Hurricane Death Toll of 1,427



Hundreds of pairs of shoes in San Juan, P.R., paid tribute to the victims of Hurricane Maria. The storm's official death toll of 64 has not yet been changed. Erika P. Rodriguez for The New York Times

By Frances Robles

Aug. 9, 2018



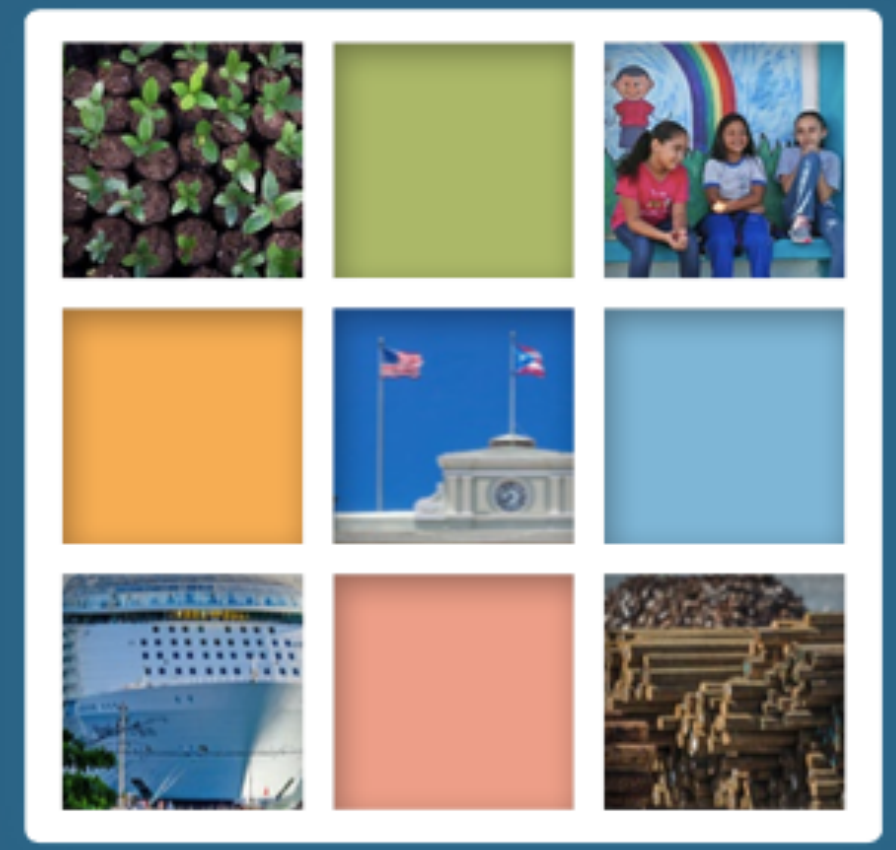
SAN JUAN, P.R. — The government of Puerto Rico quietly acknowledged in a [report posted online](#) that in all likelihood more than 1,400 people died

- Official death count: 64
- May 31, 2018: New result: 95%: 793 to 8,498
- July 9, 2018: 1,427

PRELIMINARY DRAFT FOR PUBLIC COMMENT, JULY 9, 2018

Transformation and Innovation in the Wake of Devastation

An Economic and Disaster Recovery Plan for Puerto Rico



<http://www.p3.pr.gov/assets/pr-draft-recovery-plan-for-comment-july-9-2018.pdf>

Question Set 2

QUARTZ

FINAL COUNT Puerto Rico's official study on Hurricane Maria deaths puts toll at 2,975

By Ana Campoy - August 28, 2018



A shifting number. Despite an official count of just 64 deaths, Puerto Ricans have long...

- Official death count: 64
- May 31, 2018: New result: 95%: 793 to 8,498
- July 9, 2018: 1,427
- August 28, 2018: 2,975

<https://qz.com/1372233/puerto-ricos-official-death-toll-from-hurricane-maria-is-now-2975/>

Nearly a Year After Hurricane Maria, Puerto Rico Revises Death Toll to 2,975



A funeral home in Vieques, P.R., last September. A new analysis found that nearly 3,000 more deaths than expected occurred in Puerto Rico in the months after Hurricane Maria.

<https://www.nytimes.com/2018/08/28/us/puerto-rico-hurricane-maria-deaths.html>

Milken Institute School of Public Health
THE GEORGE WASHINGTON UNIVERSITY

PROJECT REPORT
ASCERTAINMENT OF THE ESTIMATED EXCESS MORTALITY FROM HURRICANE MARÍA IN PUERTO RICO
IN COLLABORATION WITH THE UNIVERSITY OF PUERTO RICO GRADUATE SCHOOL OF PUBLIC HEALTH

<https://publichealth.gwu.edu/sites/default/files/downloads/projects/PRstudy/Acertainment%20of%20the%20Estimated%20Excess%20Mortality%20from%20Hurricane%20Maria%20in%20Puerto%20Rico.pdf>

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