Misinformation and media literacy on the topic of earthquakes

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Teaching material developed by the Swiss Seismological Service at ETH Zurich in collaboration with the University of Lausanne and the Earthquake Prevention Learning Centre (CPPS) in Sion.

Access
Published

Further information
Further information on this teaching unit and other modules can be found on the website of the Swiss Seismological Service (SED) at ETH Zurich at www.seismo.ethz.ch.

Overview

Duration	– 2 x 45 min. (double lesson)
Prior knowledge	– Plate tectonics – Origin of earthquakes – Earthquake hazard and risk – Induced seismicity (optional)
Learning objectives	– Students are familiar with the most common myths about earthquakes. – Students understand why misinformation is believed and spread. – Students can critically reflect on their own behaviour on social media. – Students can identify misinformation and explain it is not true. – Students can assess information independently and use various tools to evaluate its trustworthiness.
Required material	– Laptop – Internet
Further information	– Earthquake myths: www.seismo.ethz.ch/knowledge/earthquake-prophets/ – Communication Guide for Earthquake Misinformation: Dallo I., Corradini M., Fallou L. & Marti M. (2022). How to fight misinformation about earthquakes? - A Communication Guide. https://doi.org/10.3929/ethz-b-000530319. – Youth and media - the information portal for the promotion of media literacy: www.jugendundmedien.ch/ – Project CheckNews: www.iqesonline.net/bildung-digital/checknews/lernumgebungen/einfuehrung-fuer-lehrpersonen/

Structure and content of the module

Glossary

The terms misinformation, disinformation, fake news and conspiracy theories have different meanings, even though they are often used interchangeably.

Misinformation	Information that is disseminated but is false or misleading according to current scientific knowledge at the time of transmission. However, it is shared without the intention to deceive. Example: People assume that earthquakes can be predicted.
Disinformation	False information shared intentionally to deceive or manipulate. Example: A self-proclaimed expert claims to be able to predict the exact location and time of the next devastating earthquake.
Fake news	A sub-category of disinformation in which false or misleading claims are intentionally spread to influence public opinion. Example: A blog post states that a certain project caused a damaging earthquake.
Conspiracy theory	These theories attempt to explain events in the world through conspiracies. They offer simple answers that contradict the established scientific consensus. Conspiracy theories often divide the world into 'good' and 'evil'. While they may appear logically consistent within themselves, they frequently contradict available data or the laws of nature. Such theories tend to spread especially during uncertain times, or after catastrophes and disasters. Example: HAARP (High Frequency Active Auroral Research Program) is a real US research programme that uses radio waves to study the upper atmosphere. Conspiracy theorists claim that HAARP causes natural disasters such as earthquakes and can even control people's minds.

Misinformation

Misinformation has always existed – in the form of rumours, conspiracy theories or gossip. It can be found in all cultures and throughout human history: from the pharaohs to its targeted use in the Second World War. They are still used today to promote political or other interests.

Introductory question: Which conspiracy theories do you know in general or specifically about earthquakes?

How is misinformation spread?

New communication channels such as social networks (e.g. TikTok, Instagram) and messenger apps (e.g. WhatsApp, Telegram) have taken the spread of misinformation to a new level: Users can now share misinformation with a wide audience in a matter of seconds. Especially in times of crisis, such as after the earthquake on the Turkish-Syrian border in March 2023, various pieces of misinformation circulated on social media. Fear and uncertainty in such times of crisis make people more susceptible to believing such information or not questioning it and sharing it.

Misinformation and conspiracy theories about earthquakes

On Monday, 6 February 2023 at 04:17 (local time), a magnitude 7.8 earthquake struck near the city of Gaziantep in south-central Türkiye, around 50 km north of the Syrian border. The main quake was followed by thousands of aftershocks, some of which were very strong. The earthquake claimed more than 59,000 lives and injured over 125,000 people. Various misinformation and conspiracy theories circulated after the earthquake, such as the following reports:[1]

- The USA or NATO[2] were responsible for the earthquake and had carried out a "punitive action" against Türkiye because of its stance on the Russia sanctions.
- Pictures of an alleged tsunami on the southern coast of Türkiye circulated on social media. In reality, they were from a storm in the South African city of Durban in 2017.
- The Chinese embassy in France posted a video on X purporting to show the Çanakkale Bridge (a large suspension bridge) in Türkiye. The post claimed that the bridge was built by China and therefore withstood the earthquake. In fact, the bridge was built by South Korean companies and is very far away from the epicentre.
- Self-proclaimed experts spread earthquake predictions of possible stronger quakes on social media.

Various false reports[3] were also circulated after the severe earthquake in Morocco on 8 September 2023 at 23:11 (local time):

- A video shows a collapsing building and people screaming as they flee to safety. However, the recording was made in Casablanca in 2020 (Figure 1).
- The information that Cristiano Ronaldo made his 4-star hotel in Marrakesh available to the survivors of the earthquake was also wrong.

Figure 1 Post on X about the alleged house collapse in the earthquake in Morocco in 2023.

[1] https://www.tagesschau.de/faktenfinder/tuerkei-erdbeben-desinfomation-101.html (06-03-2025)
[2] North Atlantic Treaty Organization (North Atlantic Treaty Organisation)
[3] https://www.tagesschau.de/faktenfinder/marokko-erdbeben-falsche-videos-100.html (06-03-2025)

Why do people spread misinformation?

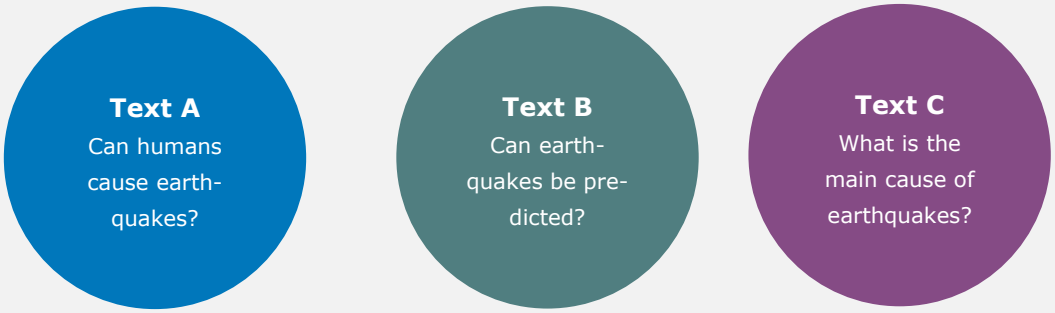
There are various reasons why people intentionally or unintentionally spread misinformation:
- Shortly after an event, there is often no reliable information available, and people find it difficult to deal with **uncertain situations**. Misinformation often fills information gaps when facts are missing.
- People tend to believe and spread information that supports **previous beliefs and ways of thinking**.
- False information often arouses **strong emotions** such as fear, anger or surprise. Such emotionalising content is shared more frequently.
- They are not always able to **distinguish between true and false information**.
- They **trust the source**. The information appears on their favourite channel/medium and/or is shared by people they trust.
- They pursue **self-interest** or **malicious intent**.

Specific to earthquakes:

- Other natural hazards, such as tsunamis or storms, can often be **predicted** for several hours, which is why this is also expected for earthquakes.
- After **longer earthquake sequences**, people tend to assume that general **earthquake activity** has **increased**.
- Some members of the public are generally **critical of technologies** that interfere with nature (e.g. geothermal energy) and are therefore more willing to protest.
- People tend to **see meaning** in **random patterns** – such as the appearance of oarfish from the deep sea before earthquakes[4] or the accumulation of earthquakes at full moon. However, these are random correlations, not causal relationships.

Task 1A: The most widespread misinformation about earthquakes

A. Form groups of three to read the following texts and then tell each other what you have learnt from the texts.



B. Then answer the enquiry received by the Swiss Seismological Service at ETH Zurich. Take on the role of the seismological service and formulate an answer using the knowledge you have just acquired.

[4] Study that investigated the occurrence of deep-sea fish and earthquakes: https://pubs.geoscienceworld.org/ssa/bssa/article/109/4/1556/571628/Is-Japanese-Folklore-Concerning-Deep-Sea-Fish (06-03-2025)

Text A

Can humans cause earthquakes?

Human activities such as oil extraction, groundwater extraction, wastewater disposal or underground gas storage, as well as geothermal and mining activities can trigger earthquakes. While most of these so-called induced earthquakes go unnoticed, earthquakes can occasionally be felt or even cause damage. The exact location, strength and timing of such induced earthquakes cannot be controlled.

Examples of man-made earthquakes:
- Magnitude 5.8 earthquake in Oklahoma (USA) in 2016, triggered by the deep injection of waste fluids from oil and gas production.
- Magnitude 5.5 earthquake in Pohang (South Korea) in 2017, triggered by a deep geothermal energy project .

A more recent example is a series of induced earthquakes with magnitudes of up to 3.5 near Strasbourg (France) in 2019/2020, triggered by geothermal activities.

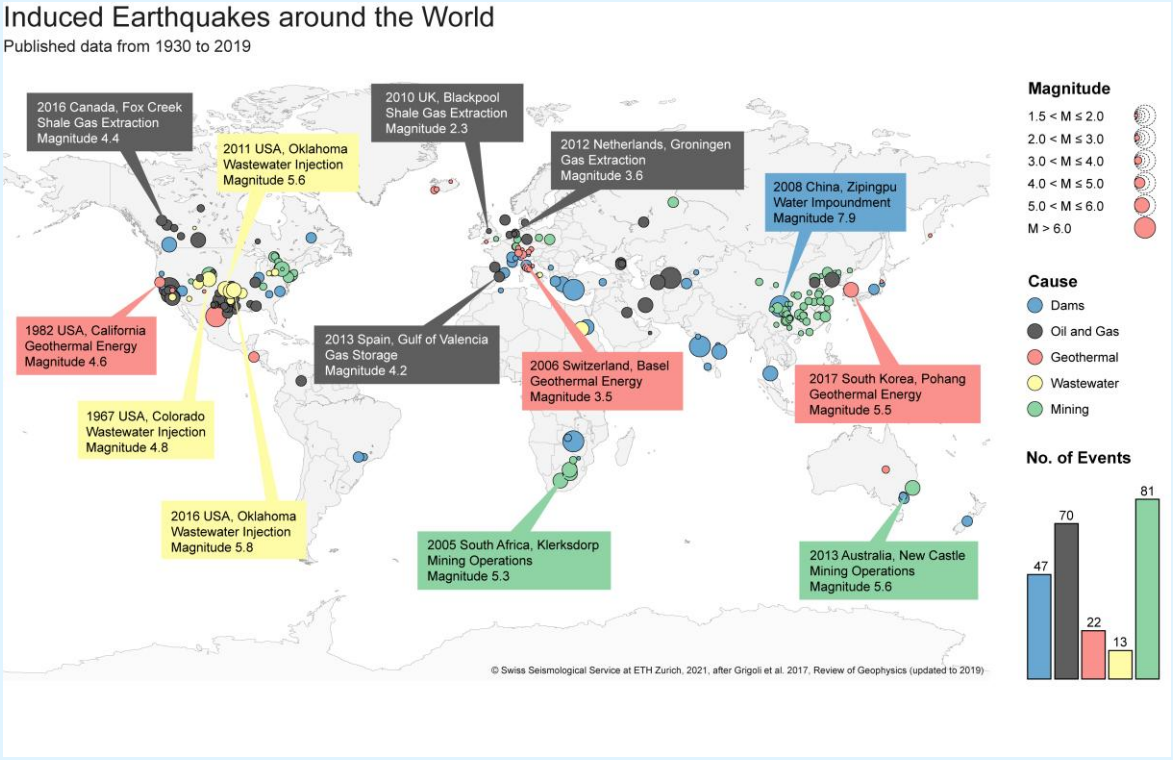


Figure 2 Map of induced earthquakes worldwide from 1930-2019.

Other human activities such as traffic, construction work, blasting or concerts do not cause earthquakes, but they do cause tremors that can be recorded by seismic stations.

Are there more and more earthquakes worldwide?

Earthquakes have been measured with seismic instruments since around 1900. Information about earlier earthquakes comes from chronicles, books and illustrations, which mainly refer to significant earthquakes in inhabited regions. Since the beginning of instrumental earthquake monitoring, natural earthquake activity has remained largely constant on a global average. However, the number of earthquakes can fluctuate in certain regions and time periods, as earthquakes sometimes occur more frequently in space and time. In addition, denser seismic networks make it possible to record a larger number of smaller earthquakes that could not be registered with earlier, less dense measuring networks. In contrast, the number of induced earthquakes (e.g. caused by geothermal energy) has increased in recent years and could continue to rise.

Text B

Can earthquakes be predicted?

According to the current state of research, it is not possible to predict the exact strength (magnitude), location and time of earthquakes. However, researchers can calculate probabilities of where, how often and how strongly the earth could shake at certain locations (→ earthquake hazard). For decades, researchers have been searching for reliable signs that herald an impending earthquake, such as altered electromagnetic signals, earthquake lights, supermoons, rising radon concentrations, seismic gaps or foreshocks. So far, however, none of these harbingers has proven to be sufficiently reliable. However, people repeatedly claim that they can predict the next big earthquake. Especially after a major earthquake, when many people are looking for information, these self-proclaimed experts actively communicate and predict further earthquakes.

Can animals predict earthquakes?

Many years ago, people in Japan believed that a giant catfish (Namazu) lived deep underground and triggered earthquakes as soon as it moved – this myth persisted for a long time. There were also reports of unusual behaviour by catfish in Japan before the Edo earthquake in 1855. Catfish live on the muddy bottom of bodies of water. Researchers therefore suspect that the fish can sense tiny changes in the electrical currents that can occur underground before an earthquake. This could explain the unusual activity of the catfish. So far, however, there is no reliable scientific evidence of a connection between the behaviour of catfish and earthquakes.

Before the Haicheng earthquake in China in 1975, snakes were observed leaving their burrows and freezing on the earth's surface despite the winter cold. Based on further observations and numerous foreshocks, the city was successfully evacuated before the strong earthquake. Despite this success, no warning was issued for another earthquake in Tangshan a year later. In 2005, the snakes on a snake farm in southern China also behaved conspicuously. Four days later, a severe earthquake occurred around 100 kilometres away.

A Chinese research team then launched a project and installed cameras in snake farms. They used them to observe the animals' behaviour and gather information about a possible impending earthquake. However, it is not possible to reliably predict whether, when and where exactly an earthquake will occur based on the behaviour of snakes (and other animals).

Can smaller earthquakes prevent stronger earthquakes?

It is a widespread misconception that a large earthquake can no longer occur after many small earthquakes. Although small earthquakes can relieve pressure from small faults or fault zones, the pressure on larger fault systems is only very slightly reduced.

Numerous documented cases also show that smaller earthquakes can be harbingers of a larger event. Many smaller earthquakes even increase the probability that further small and, in rarer cases, larger earthquakes will follow. An example is the series of earthquakes in L'Aquila in Italy in 2009, where a series of smaller earthquakes was followed by a magnitude 6.3 earthquake that caused severe damage and claimed many lives. But most large earthquakes occur without warning. And small earthquakes do not necessarily herald a large earthquake.

Text C

What is the main cause of earthquakes?

Earthquakes are mainly caused by the collision of tectonic plates. This creates stress in the underground. An earthquake occurs when this stress is suddenly released.

Do weather or climate change influence earthquakes?

There is no such thing as "earthquake weather" in the sense that more or larger earthquakes occur due to specific climatic or meteorological conditions. However, external influences can alter the stress in the subsurface. In particular, water plays a crucial role: heavy rainfall or meltwater from glaciers can affect existing stress and, under certain conditions, trigger small, near-surface earthquakes.

The rise in temperature due to climate change is accelerating the melting of glaciers in certain regions. This alters the load on the underlying rock, which can trigger earthquakes. Climate change also affects the atmosphere and, consequently, the intensity of tropical storms. In some cases, the resulting changes in atmospheric pressure can activate slow slips of tectonic plates. These, in turn, have the potential to trigger earthquakes or earthquake swarms.

Climate change increases the risk of so-called multiple crises, in which several disasters occur simultaneously. Earthquakes can happen anywhere and at any time – regardless of whether a region is already affected by flooding or drought. This poses major challenges for the regions concerned. In many parts of the world, landslides represent a serious natural hazard, especially in connection with extreme weather events. If slopes become unstable due to heavy rainfall, for example, earthquakes can intensify or even trigger landslides. However, all of these climate-related influences do not lead to a fundamental increase in the occurrence of strong earthquakes.

Do earthquakes occur more frequently at certain times?

Some meteorological phenomena occur more frequently at certain times of the year in specific regions – for example, glacier melt in spring in Alaska or heavy rainfall during the Indian monsoon season. This can lead to seasonal fluctuations in earthquake activity, but such variations usually only affect small, near-surface earthquakes.

On the other hand, there is no scientific evidence that earthquakes occur more frequently at certain times of the day. The impression that earthquakes are felt more often at night is likely because people are more sensitive to ground movement during quiet periods. In Mexico City, 19 September is feared because three strong earthquakes have already occurred on this date (in 1985, 2017, and 2022). Although such temporal clusters do occur, they are coincidental.

The influence of tides on earthquake activity remains a subject of debate. Some earthquakes in the middle of oceans (at "oceanic ridges") appear to be linked tidal forces: falling water pressure at low tide can expand the magma chambers located there and increase stress in the surrounding rock, which may trigger an earthquake under certain conditions.

External factors can both increase and decrease stress on existing faults and, under specific conditions, trigger earthquakes earlier than might otherwise have occurred. However, the decisive factor in earthquake generation remains tectonics, as the relevant processes occur in deep layers of the earth, that are largely unaffected by climatic influences.

Task 1B: Enquiries from the public

The Swiss Seismological Service at ETH Zurich regularly receives enquiries from the public. This sometimes involves incorrect information that they must correct.

1. Now take on the role of the Seismological Service and answer the enquiry below together. Formulate an answer using your prior knowledge of earthquakes and the knowledge you have just acquired from the three texts.

From: P. Williams | Subject: Restless cats

My cats have been unusually restless and hectic since Sunday! I have read that there are more earthquakes in Switzerland due to climate change (melting glaciers). Should I now be worried that there will soon be a major earthquake in central Switzerland?

From: Swiss Seismological Service
To: P. Williams
Subject: Restless cats

Media literacy

Introductory questions

1. How important do you think mass media such as newspapers (including online news portals), radio and television are for disseminating information?

2. What tasks and functions do the media fulfil?

The mass media

The media – also known as the "fourth power" – are caught between the state and society and fulfil several functions at once. They act as **mediators of information**, diverse perspectives, and points of view. By **setting the agenda**, they decide what to report on and influence the (political) discourse through their choice of topics. In addition, the media are there to highlight grievances in politics, society, and the economy, thereby fulfilling a **monitoring and critical role**. The media thus play an important part in supporting the **free and balanced formation of opinion**, and thereby the functioning of democratic societies. The Swiss Federal Constitution states that radio and television should contribute to education, cultural development, the free formation of opinion, and entertainment (Art. 93, para. 2 of the Federal Constitution of the Swiss Confederation).

The media landscape is undergoing significant change as a result of **digital transformation**. Increasing competition and cost pressures, as well as changes in audience usage patterns, are affecting media diversity, the range of content on offer, and distribution channels. People can now decide for themselves when, what, and where to consume content. In addition to traditional media (such as newspapers, radio, and television), social media have become an important platform for shaping both private and public opinion.

While artificial intelligence (AI) offers **new opportunities**, AI-driven misinformation is seen as one of the greatest risks in the coming years (World Economic Forum Global Risks Perception Survey 2023–2024). The media industry can play a key role here through its informative and watchdog functions. At the same time, media organisations must find ways to make efficient use of the advantages of AI (e.g. for content generation) without compromising the credibility and authenticity of their content.

Task 2: Analyse the media reports on earthquakes in Switzerland

1. Form pairs.
2. Decide who will read Report 1 and who will read Report 2. Both media reports are about the earthquake risk in Switzerland.

1 **Earthquake risk in Switzerland comprehensively determined for the first time**

2 **New earthquake risk model: Zurich and Bern more at risk than expected**

3. Analyse the text you have been assigned. Pay attention to the following:

Content: What is the core message of the report? Which topics are in focus? Is there any misinformation in the text? Are there any quotes – if so, from whom?

Tonality: factual and neutral, humorous, ironic, dramatic, objective, subjective, sarcastic, formal, etc.?

Other: Is the text written in an understandable way and is it easy to read? Does the article appeal to you – why or why not?

Images and graphics used: Which images are used in the article? Does the image selection match the text? What is the source of the images?

4. Then discuss together the similarities and differences between the two media reports.

Report 1

Earthquake risk in Switzerland comprehensively quantified for the first time

The Swiss Seismological Service (SED) at ETH Zurich has developed a new earthquake risk model for Switzerland on behalf of the Federal Council. The model is intended to help better assess the potential impact of earthquakes and to plan specific risk reduction measures.

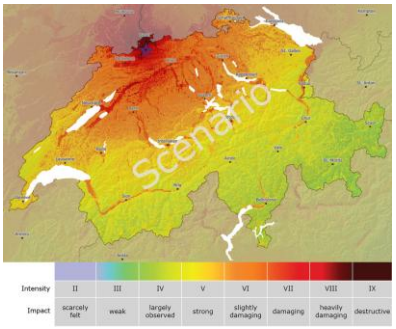
Until now, research into earthquake hazard has mainly focused on prediction: where will earthquakes occur in the future, and how strong will they be? The new model differs significantly from the previously used hazard model. While earthquake hazard is based on seismic recordings, geophysical models, and data on geology and tectonics, the earthquake risk model goes one step further: in addition to the hazard, it combines data on the local subsoil, the vulnerability of buildings, and the people and assets affected. In this way, the potential impact of earthquakes on buildings – and the associated financial and human losses – can be estimated reliably for the first time, the SED announced in a statement.

Benefits for the authorities

Such an earthquake risk model helps the authorities at local, cantonal and national levels to plan preventive measures and respond more quickly and efficiently in the event of an emergency. Among other things, it provides the basis for planning evacuation strategies and organising disaster drills. This knowledge is particularly important in a densely populated city like Zurich, where there are many old buildings.

Historical memory of 1356

Although Switzerland has a moderate earthquake hazard compared to other European countries, it is not immune to strong earthquakes. The most severe documented earthquake occurred in Basel in 1356. A similar event today would have serious consequences due to the high population density and modern infrastructure. Based on its modelling, the SED estimates that a strong earthquake could claim around 3,000 lives and injure tens of thousands of people. It could also cause damage totalling around 45 billion Swiss francs.



The varying intensities of shaking from a hypothetical magnitude 6.6 earthquake near Basel.

Visualising risks

The new risk model clearly visualises the danger posed by earthquakes in Switzerland. Although earthquakes occur less frequently than other natural hazards, they can cause massive damage – as the new model confirms.

The four factors for calculating the earthquake risk.

Report 2

New earthquake risk model: Zurich and Bern more at risk than expected

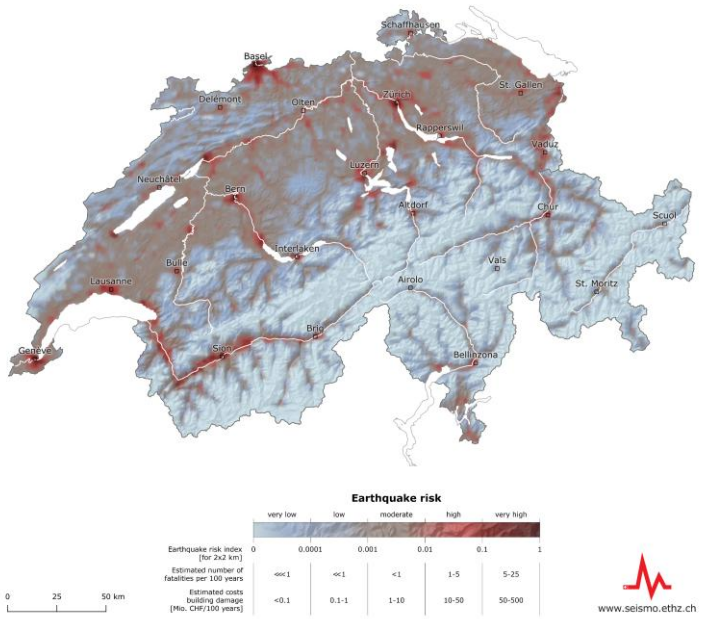
A new study has found that the earthquake risk in Swiss cities like Zurich and Bern is higher than previously thought. A team of experts developed a new model on behalf of the federal government – and it includes more factors than ever before.

What is special about this new model? "Analysing the buildings plays a key role," says Stefan Wiemer, Director of the Swiss Seismological Service (SED) at ETH Zurich. "It's about where the buildings are, how many there are, and how vulnerable they are. We have sorted them into what we call vulnerability classes to see out how they would react in an earthquake."

By combining this building data with information about the earthquake hazard, the local ground conditions, and how many people and assets could be affected, reseachers created a detailed risk model. "The risk can vary greatly from one building to the next – sometimes by a factor of 10,000!" Wiemer points out.

A closer look at the map

The new map reveals some surprising results: Basel isn't the only city at high risk. Geneva, Lucerne, Bern and Zurich also show up in a bright red. Many people might not expect Zurich to be so badly affected. But Wiemer explains: "Zurich has lots of expensive buildings and a high population. Plus, it's also built on soft lakebed sediments." All of these factors increase the risk in case of an earthquake.



The redder the colour, the greater the risk: the Central Plateau and cities are particularly affected. (Image: Swiss Seismological Service at ETH Zurich)

Damage in billions

According to the new risk model, earthquake could cause damage between CHF 11 to 44 billion over a period of 100 years. The human toll could also be severe: up to 1,600 people might lose their lives in a major earthquake, and 40,000 to 175,000 people end up homeless. "If an earthquake like the one in Basel in 1356 happened today, it'd be a disaster: Up to 20,000 injured, 3,000 dead and around 200,000 people withouth shelter," warns Wiemer. Such an earthquake with a magnitude of around 6.6 could happen again at any time. But the earthquake expert reassures: "A catastrophic magnitude 7.8 earthquake like the one in Türkiye isn't something we expect here." That's because Switzerland's tectonic setting makes it extremely unlikely that such big earthquakes with magnitudes larger than 7 will occur.

It's not a question of if – but when

The new model gives a clearer picture of earthquake risk in Switzerland. It could also revive the debate around national earthquake insurance, which has been on the table for years. "It's important to act before the ground starts shaking," says Wiemer. Because one thing's for sure: the next big quake is coming – we just don't know when.

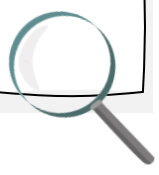
Analyse the media reports: Note down here what you noticed. 1

Content: What is the key message of the report? Which topics are in focus? Is there any misinformation in the text? Are there any quotes – if so, from whom?

Tonality: factual and neutral, humorous, ironic, dramatic, objective, subjective, sarcastic, formal, etc.?

Images and graphics: What images are used in the report? Does the image selection match the text? What is the source of the images?

Other: Is the text written in an understandable way and is it easy to read? Does the article appeal to you – why or why not?



Analyse the media reports: Make a note here of what you noticed. 2

Content: What is the core message of the report? Which topics are in focus? Is there any misinformation in the text? Are there any quotes – if so, from whom?

Tonality: factual and neutral, humorous, ironic, dramatic, objective, subjective, sarcastic, formal, etc.?

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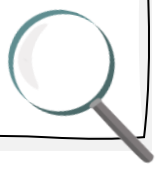


Task 3: Recognising misinformation – how does it work?

Digital media act as a catalyst for the spread of misinformation, disinformation and fake news. This is where freedom of expression reaches its legal limits. In addition, AI-generated images and videos are getting better and better, making it more difficult to verify information.

There are various techniques you can use to check whether a text, image or video is correct or not. One reliable technique is reverse image search.

1. Select one of the three images/videos below[5], which were distributed in connection with the severe earthquake in Türkiye on 6 February 2023. Use Google reverse image search to find out whether the event shown is accurately described or not:

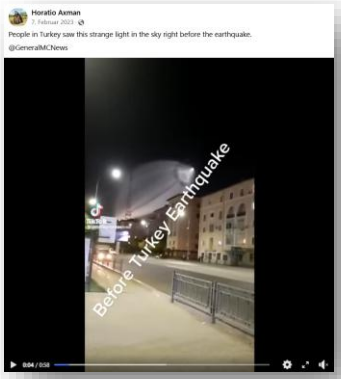
Start image search from Google

(Link: https://support.google.com/websearch/answer/1325808?hl=en&co=GENIE.Platform%3DDesktop)

1: "Numerous towns and villages lie in ruins after the earthquake."

2: "Explosion of a nuclear power plant after the earthquake."

3: "Light in the sky shortly before the earthquake."



2. What other strategies help you to check the authenticity of a picture or video?

[5] Sources: Adobe Stock; X, screenshot; X; screenshot and blackening: CORRECTIV.factcheck

Task 4: News literacy test

How good are you at news literacy? **Take the online test:**
Duration: approx. 20 minutes.

Go to the news test

Test developed by the News Literacy Project (Link: https://newslit.org/about/)

For further reading

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Reporters Without Borders (2024b). Press freedom ranking - suppression of unwelcome reporting on the rise worldwide [Website] https://www.reporter-ohne-grenzen.de/rangliste/rangliste-2023

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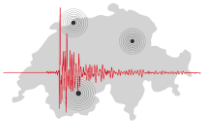
Further teaching material

Would you like to learn more about earthquakes? You can find out more here:



Earthquakes: Basics and the most important concepts
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Earthquake hazard and risk in Switzerland
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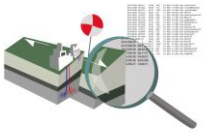

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Further information on the topic of earthquakes can be found on the website of the Swiss Seismological Service at ETH Zurich at www.seismo.ethz.ch.

We are happy to receive questions and suggestions on the learning modules or other related topics.

E-mail us: seismo_at_school@sed.ethz.ch