AGU AMA: Hi Reddit, I'm Dave Petley, author of The Landslide Blog and Vice-President (Research and Innovation) at the University of Sheffield in the United Kingdom. I'm here to talk about the science and management of natural hazards and disasters. AMA!

AmGeophysicalU-AMA [1] and r/Science AMAs[1]

[1]Affiliation not available

April 17, 2023

Abstract

Hi Reddit! I'm Dave Petley, Vice-President (Research and Innovation) at the University of Sheffield in the United Kingdom. I also run the Landslide Blog, which sits on the website of the America Geophysical Union, the World's largest earth science organisation. I have a strong interest in natural hazards and disasters. For 25 years I have been doing research into landslides, which collectively kill about 14,000 people per year worldwide on average. I'm interested in particular on how landslides occur and on the impacts that landslides have on society. I've worked all over the world, including in Europe, the US, Chile, Taiwan, China, Nepal, Pakistan and New Zealand. Landslides are often triggered by a larger event affecting a substantial area, such as a hurricane or an earthquake. As a result I have worked extensively on the anticipation of large disasters and on the management of their impact, as well as coping with the aftermath. For example, I have worked on the impact of typhoons in Taiwan and Hong Kong; on rainfall induced flood disasters in India and Nepal; and on the massive earthquakes in Taiwan in 1999, Pakistan in 2005, China in 2008 and Nepal in 2015. I was the co-author of one of the best-selling textbooks on the management of disasters. I will be back at 12 pm ET to answer you questions, ask me anything!

the WINNOWER

REDDIT

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AMGEOPHYSICALU-AMA R/SCIENCE

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Hi Dave and welcome to /r/science.

How is your work now influenced by climate change, especially in anticipating natural hazards?

If you were given £10,000,000, how would you put it to best use in order to save the most people from natural disasters over the next decade?

IceBean

And the £10 million question? I would invest it to make schools in developing countries able to withstand earthquake shaking. In both the 2005 Pakistan and 2008 China earthquakes many thousands of children were killed in schools. Often these are structures that can be strengthened quite easily. And a seismically-resistant school can then become the community centre after an earthquake, providing shelter for those who have lost their homes. There are a lot of wins by making schools safe.

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IceBean

I'll answer your questions one after the other. First climate change. In terms of landslides we anticipate three big impacts. First, in some areas the annual rainfall is falling in response to climate change. This is true for parts of the Himalayas for example, where the onsoon is becoming less intense. This might reduce the occurrence of landslides. But, second, rainfall intensities are increasing. Rainfall intensity is a big factor in triggering landslides, so we expect this to make the landslide problem much worse. And third, many high mountain rock slopes are basically stuck together with ice - permafrost. As this melts we see a big increase in rockfalls and, sometimes, large rockslides. It is this effect that is most obvious at the moment. There is little doubt that large rockslope failures in many high mountain areas are becoming more serious. As the climate continues to warm we will see this effect becoming worse, sadly.

In situations such as the current Oroville Dam warning, when massive water-filled lakes/reservoirs rapidly empty, I would imagine there is a sudden change to the structural integrity of the surrounding land. Is there any potential for higher elevation areas near the source, or further afield areas outside of the water damage zone along the flood path, to suffer secondary damage from consequential events such as landslips?

HerbziKal

Hello everyone. Welcome. Great question. Yes, when a lake empties quickly we often see the adjacent slopes fail. This is in part because we the adjacent slopes lose support, and in part because they are left with very high ground water levels. That water tries to drain, imposing a force that increases the instability. One of the mistakes in the terrible 1963 Vajont reservoir landslide disaster was that they tried to draw down the lake level very fast. However, this is only an effect when the water level falls a large distance, so it shouldn't be an issue in the case of the Oroville Dam.

Im moving to the mountainous area of Colorado. I understand avalanches do occur, often on or near roadways. Is there any equipment I should carry in my car? Also, are there any maneuvers in a vehicle that would help a person survive in such a situation?

MsMarhaS

Gosh, good question. I am not an avalanche specialist, but in general the best approach to any hazard is avoidance. Avalanche risk rises and falls with the depth of the snowpack, the air temperature, etc. Listen to warnings, know where is dangerous, and be mindful of those locations. I suspect avalanches are like landslides - they are very hard to outrun, so the best approach is to get out of the way (i.e. move across the path, not along the track, if you can. Others know more I'm sure.

My backyard includes a creek, about 2-3 feet wide, with an s-curve. At the curve, there is a very steep slope down to the creek, maybe 20 feet of slope. The slope is covered in natural forest, including a few trees, but on top it's just grass. Should I be worried about the stability of this slope? If so, what might help?

slowlyslipping

In general I would suggest two things. First, is there any evidence that other slopes on the creek have stability problems? Second, is there any sign that the slope itself has any problems - cracks, signs of creep, etc?

How good are current methods at identifying landslide hazards before they happen?

slowlyslipping

Ah, yes, a good question. I think the behaviour of any slope can be anticipated if enough detailed investigation is done. That is not to say we can predict exact behaviour - we cannot do that - but we can certainly envision a range of behaviours. However, to do so needs very detailed, and expensive, investigation, which is rarely possible. So we end up with rather more basic approaches. These serve us well - actually very few slopes on properly engineered transportation routes give us problems - but the nature of uncertainty in ground conditions means that there will always be surprises.

Thanks for taking the time to join us!

Directly following a landslide or other natural disaster, what is generally the sequence of events that follows when it comes to first-responders, triaging affected areas, etc?

What do you wish incoming emergency response teams did better when it comes to helping manage these disasters? (USAID, ICRC, WFP, etc.)

If there was one element in disaster management that you had complete authority over improving, what would it be?

Has any satellite imagery provided by the International Charter on Space and Major Disasters improved your ability to understand the situation on the ground and respond more effectively?

What data is typically hardest to capture during the beginning stages of emergency response but is most crucial?

Apologies in advance for all the questions but it's something I've been fascinated with for some time.

jike212

OK, again I'll answer your questions sequentially. The sequence of events first. What is frequently forgotten is the key role that survivors play in the immediate aftermath. In most disasters there is a huge focus on external teams offering assistance (this is really important of course), whist the survivors are portrayed as helpless victims. It is rarely like that. In fact after a disaster the vast majority of rescues are undertaken by local people using whatever they have to hand. So the first part of any disaster is local empowerment. The second is regional or national level assistance. The third is the international teams, but they typically arrive some time after. Of course the journalists arrive at the same time, so that is their focus. I think it is often really unfair on a lot of very brave people.

Thanks for taking the time to join us!

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jike212

I sometime wonder if we put too much emphasis on rescue teams. They make great stories, and of course if I was buried under a building I would want someone to rescue me. But at the same time there is a desperate need for doctors, especially surgeons, nurses, sanitation experts, water supply engineers, etc. In most disaster situations the opportunities to deploy people are limited by the availability of transportation. Is it better to fly in a rescue team or a team of surgeons and theatre nurses? Which saves more lives?

Hi Dave. Probably an ignorant question, but is there any work being completed on the social and/or financial impacts of undersea landslides (that have been caused by earthquakes, for example)? I've read some anecdotal evidence of marine life (and, subsequently, the fishing and managment of) being affected close to shore after serious earthquakes, but thought there might be some interesting work out there to read?

The thing that sparked this thought: although not a landslide, the upheaval of land after the recent Kaikoura earthquake (New Zealand) has undoubtedly affected access to crayfish etc, and presumably such earthquakes cause landslides under the sea that affect local fishing industries to some degree?

slipperysi

Undersea landslides have become a hot topic in recent years. The major concern has been possible damage to offshore assets such as oil rigs and pipelines, especially if there is a risk that the drilling may trigger a landslide itself. But in recent years there has been a lot more interest in the potential for such a landslide to trigger a localised tsunami, which has driven much more work on this problem (but probably still not enough). It is likely that large earthquakes have triggered submarine landslides. For example, there is some evidence that the highly variable height of the tsunami generated by the Tohuku Earthquake in Japan was the result of submarine landslides. David Tappin and others have written a very nice paper on this: http://www.sciencedirect.com/science/article/pii/S0025322714002898 We also know that the Kaikoura earthquake did generate submarine landslides - and impressively my friends at NIWA in New Zealand have even managed to start mapping and sampling them: http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11752867

Hi Dave, thanks for taking the time to speak with us about your work.

When it comes to saving lives, are there preventative measures that can be taken to minimize risk of a landslide occurring? Do they need to be done far in advance of the actual event occurring? If you determine ideal conditions for a landslide to occur, is it possible to 'defuse' it or maybe direct it somewhere you know is safe?

PapaNachos

In most cases the keys to reducing landslides are: 1. Drainage. If in doubt get the water out is not a

bad mantra, but it needs to be done in a controlled way. Suitable drainage can greatly help, and there are thousands of successful projects that have achieved this. But drains need maintenance. A fully functioning drain is a good way to stop landslides; a leaky drain is a good way to cause them as it concentrates the water. 2. Reducing slope angle. Often regrading the slope can be very effective. This is often carried about with drainage. There are lots of more complex approaches too. But these two are the core of many mitigation programmes. Landslides can be stopped, but it is harder. Typically the materials that form a landslide degrade (weaken) with both time and movement. So its easier and cheaper to stop the landslide before it starts. There has been some success in catching mobile flows, like debris flows, in dedicated basins, or of directing them down specific, strengthened channels. Not cheap but effective if the design is right. The Japanese are the masters of this through so-called sabo engineering. See: http://www.sabo-int.org/dott/images/hard1.jpg for example!

Hi Dave - I live in Guatemala near many, many volcanoes. We also have a decent amount of earthquakes in this region. When it comes to natural disasters, I've heard that the "next Pompeii" is among the most feared events for researchers. Do you agree that a large volcanic explosion/eruption is the most likely case for a large scale catastrophe in modern times?

brokencompass502

Volcanoes are really interesting events. We go for long periods with no large-scale loss of life from volcanic eruptions - far more people have been killed by landslides in the last ten years than by volcanoes - but then there is an event that kills thousands. And of course volcanoes also have the potential to change the climate for a year or two, or to ground aircraft, causing vast economic impacts. So we never know what might be around the corner. But my sense remains that the most likely next really big catastrophe is likely to be a very major earthquake in a large city in a developing country. Seismologists talk about the million fatality earthquake or the trillion dollar earthquake. Sadly, it is probably only a matter of time. Such an event can be anticipated but not predicted.

Does population growth and constant development contribute to more potentially hazardous landslides? If so, do you believe that disaster management strategies are keeping pace with the growing risks?

Indyanapolis

In fact the number of people being killed by disasters has not risen at the same rate as the population has increased globally, so at the individual level we have all become safer. So from that perspective yes. However, in some places that cannot be said - many large cities in Asia are extremely vulnerable, and are becoming more vulnerable, and these problems will increase as they grow and as the climate continues to change and the seas continue to rise.

And yes population growth and poorly planned development certainly increase landslide risks. The picture in some parts of the world is not pretty. Last year I went to Darjeeling in India, and saw many examples of poorly planned development on old landslides that are now being reactivated.

Thank you for doing this AMA!

What poorly understood aspect of natural disasters in general or landslides in particular do you wish members of the public understood better? What aspect do you wish policy-makers understood better?

In addition, one dynamic of reporting on natural disasters seems to be a placing of blame, whether it is on politicians or agencies for not responding fast enough or in the right ways, or in a few instances on

scientists themselves for incorrectly predicting aspects of the event. Do you have a sense about whether in the aftermath of such an event, there is a collective emotional need to place blame somewhere, rather than accepting that there are disaster situations that we will never have good control over?

neurobeegirl

I wish that the public would get that the answer is not prediction. In fact there are lots of reasons why prediction is not a good idea. The best approach is anticipation and preparedness, and we know plenty enough now to be able to do this properly.

Hi Dave, are there any books you would recommend for someone with an interest in a career in Disaster Risk Management? Thanks!

Arm-Triangle

I think the best one is Keith Smith's Environmental Hazards book, now in its 6th edition: https://www.routledge.com/Environmental-Hazards-Assessing-Risk-and-Reducing-Disaster-6th-Edition/Smith/p/book/9780415681063. I am biased though as I co-wrote the 5th edition!

Is there anything that people can do on a personal scale to reduce the impact of landslides, or is that something that can only be addressed on a larger (city, state, nation) scale?

kerovon

Interesting one. Yes, on the most macro scale we can move to a low carbon economy and stop burning so much fossil fuel. Global warming will make the landslide problem worse, in some places at least, and we can all contribute to that. On a more local scale, in Hong Kong the authorities run huge advertising campaigns in the rainy season to make people observant. They want people to maintain slopes properly if they are a land owner, to report a slope that might be dangerous if they are a member of the public, and to move to safe places if it rains heavily. Losses from landslide have reduced dramatically in Hong Kong in the last 40 years, so it seems to work.

What would be the best way to prevent landslides on a massive scale? Thanks for the AMA

Paulcashcarter

To be honest the best thing I can think of is to stop building so many poorly engineered roads in mountain areas. These roads are causing havoc on an unbelievable scale, and its so unnecessary. Its fine to build roads, but do it properly!

Hi Dave,

Due to the fact that some areas are at a much greater risk of landslide induced tsunamis, are there effective pre-disaster methods that can be put in place to mitigate damage? Additionally, are there early warning systems in place for tsunamis induced by landslide?

NationalsFan1

I don't know of any landslide-induced tsunami warning systems, sadly. The best ways to reduce losses are effective tsunami evacuation routes and regular drills. At least then you can get out of the way if

there is a warning. In Japan there are tsunami protection structures, some of which worked well in Tohuku. Others were less effective of course. I suspect its much harder to make these effective for landslide-induced tsunamis as they are so unpredictable.

How do you enjoy traversing Sheffield's many hills?

thepewis

Sheffield is brilliant thanks. I moved from East Anglia, which is almost completely flat - to Sheffield with its many hills. I love it. Its a great city and a fab university. And I do like being able to go into the Peak District National Park.

I cannot wait for the summer.