2008 Sichuan Earthquake Investigation



My Research Question



Was the 2008 Sichuan Earthquake natural, man-made, or somewhere in between?

Background Information



- Magnitude of 7.9
- May 12th, 2008
- Sichuan Province of China
- Near the city of Chengdu
 - Population of 6.9 million in 2008
- 87,150 dead or missing
- 4.8 million people left homeless





Reservoir-Triggered Seismicity (RTS)

- Reservoirs have historically been known to trigger earthquakes
 - 1967 Koyna Dam Earthquake (M 6.4)
- How RTS could happen after a reservoir is filled with water:
 - Pressure exerted on the underlying ground increases and can cause stress on the tectonic plates
 - When water from the reservoir is forced into the ground it can cause more instability and slipping of the plates below



- 320 million tons of water
- Built less than a mile from the Longmenshan fault





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Against the earthquake being human-induced

Too large of an earthquake

- Reservoir-triggered earthquakes usually have magnitudes of less than 5
- The strongest case of RTS was at the Koyna reservoir with a magnitude of 6.4 making the Sichuan earthquake 200 times stronger in energy

The dam was only a minor stress

- Stress of the reservoir was probably minor compared to the natural stress buildup since the last earthquake
- MIT researcher claims the weight of the reservoir alone wouldn't be enough to cause an earthquake



- Scientists claimed frequency and size of small earthquakes was unchanged by impoundment
- The Sichuan Province is a very active tectonic area, historically moderate/strong earthquakes





- Didn't follow the same usual pattern of foreshock-mainshock-aftershock
- RTS usually have epicenters less than 5 km deep
- Sichuan was caused by thrust faulting which isn't typical of RTS
- Very few reservoirs trigger earthquakes, only 101 have which is about 1% of total reservoirs worldwide

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In favor of the earthquake being human-induced

The earthquake doesn't need to follow patterns of other RTS

- Knowledge on RTS of larger magnitude is poor because there are such few cases of it
- The foreshock-mainshock-aftershock pattern isn't necessary for seismic activity to qualify as RTS
- Maximum magnitude of RTS is dependent on the scale of nearby faults and regional tectonic background conditions

An increase in seismic activity

- Some studies found that the dam caused a significant increase in seismic activity pre-earthquake
 - Data from 2004 and 2005 showed 730 minor earthquakes with a magnitude of less than 3
 - Two other studies found an increase in shallow and low-magnitude seismicity in the local area after impoundment

Potentially hastened a natural earthquake

- Multiple researchers found that the stress of the water's weight potentially hastened an earthquake by tens to hundreds of years
- The water in the dam was equal to 25 times the natural stress of tectonic movement
- No major ruptures on the Longmenshan Fault
 Zone in 1000-2000 years but the recurrence time
 for this type of earthquake is 3000-5000 years

My own findings Mapping seismic data

Local Earthquakes 1998-2022



Karun Dam Earthquakes 1998-2022



Oklahoma Earthquakes 1998-2022



Conclusion Man-made or not?



- With so much disagreement among scientists/researchers as well as good evidence on each side, there is no clear right answer
- My best guess:
 - The reservoir likely contributed to the earthquake being triggered but didn't play a big role in causing it

Limitations/challenges to my project

The earthquake catalog I extracted data from for my maps only recorded earthquakes above M 2.5 Finding a good example of RTS that I could map to use as a comparison to the Sichuan earthquake

Finding evidence against the earthquake being human-induced in regular news articles

THANKS!

Any questions?