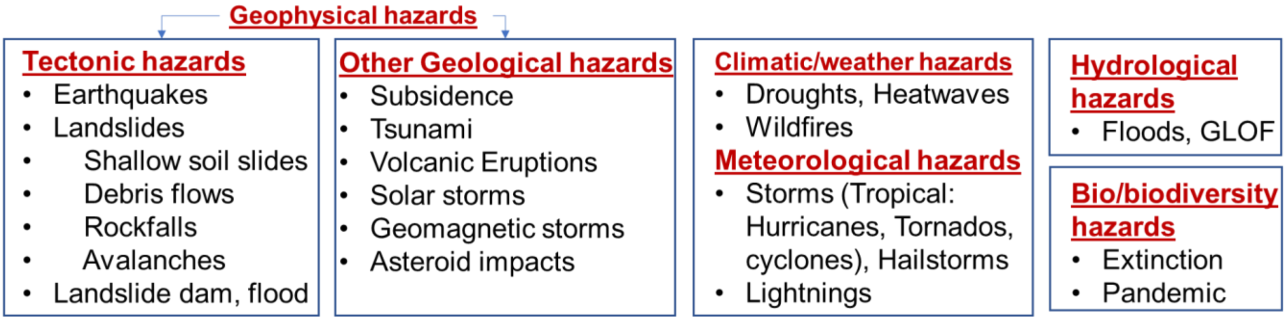
Introduction to various natural hazards: earthquakes, landslides, cyclones, floods, and tsunami.

Disasters and Natural Hazards:

- Disasters are serious disruptions to the functioning of a community that exceed its capacity to cope using its own resources. Disasters are caused by **natural, man-made, and technological hazards**.
- A **"natural hazard"** is a threat of a naturally occurring event/process that has a negative effect on humans. This negative effect is what we call a **"natural disaster".** In other words when the hazardous threat actually happens and harms humans, we call it a natural disaster.
- Natural Hazards (and the resulting disasters) are the result of naturally occurring geological processes that have operated throughout Earth's history.

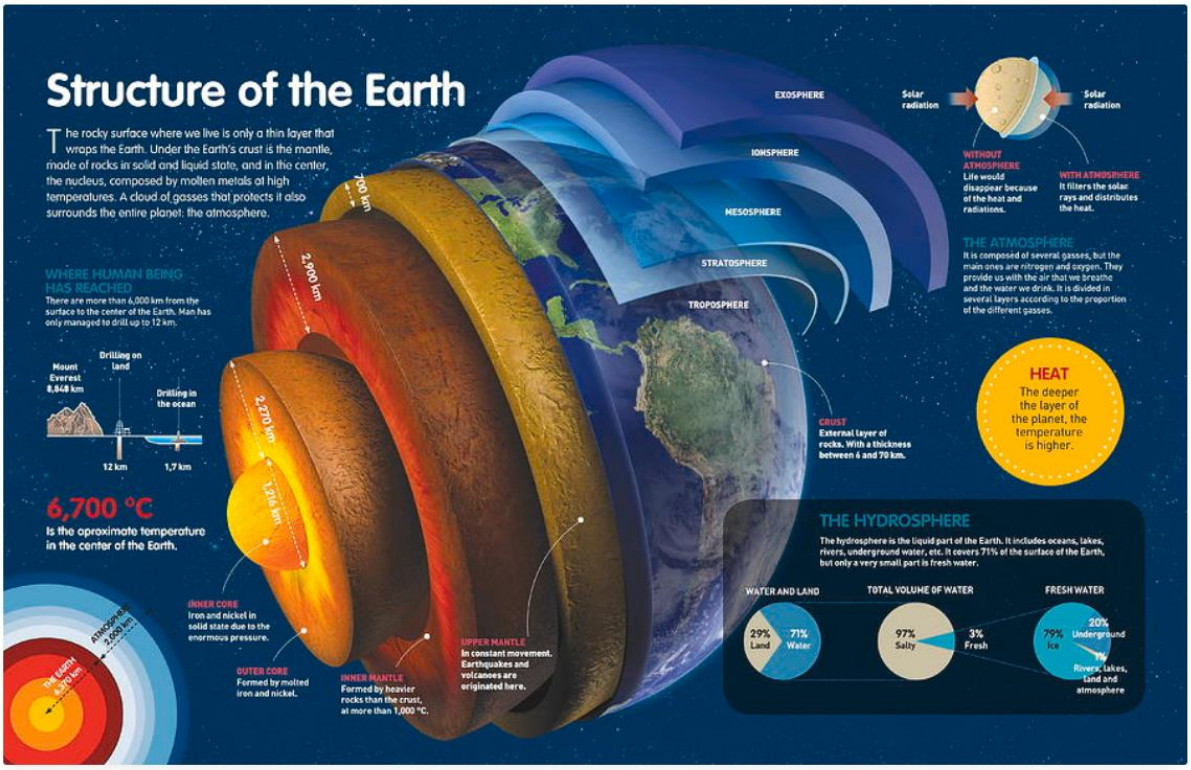


Geological processes" leading to natural hazards, short term & long-term prediction

The Earth

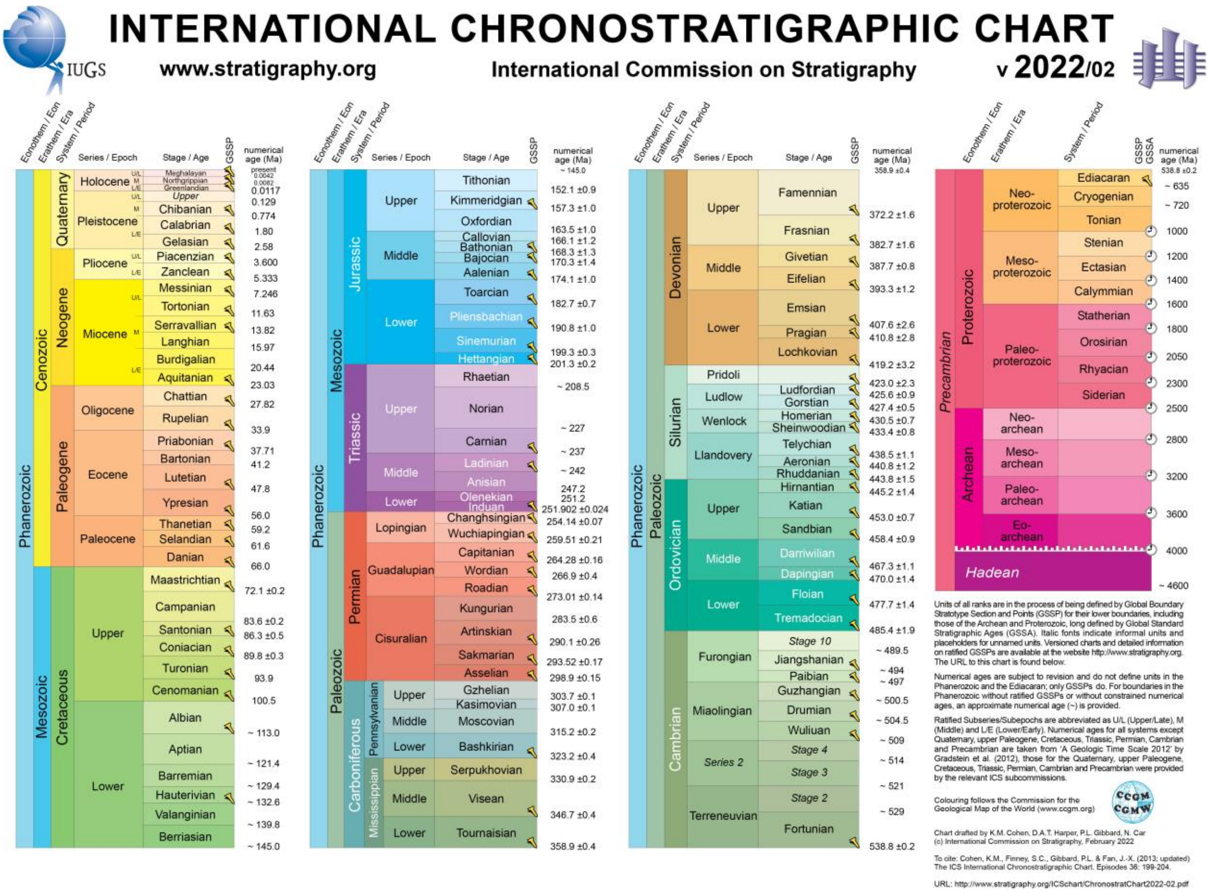
"*Everything is made up of matter*".

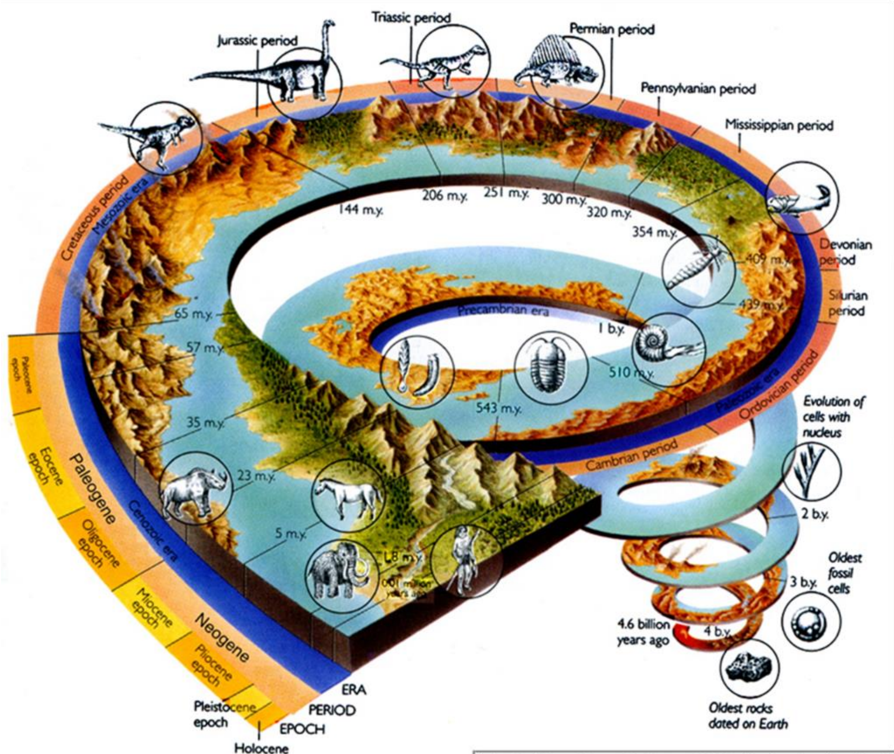
Matter is any substance that has mass and takes up space. Earth, and everything on it, is made of matter, and so are all the stars and planets in the universe



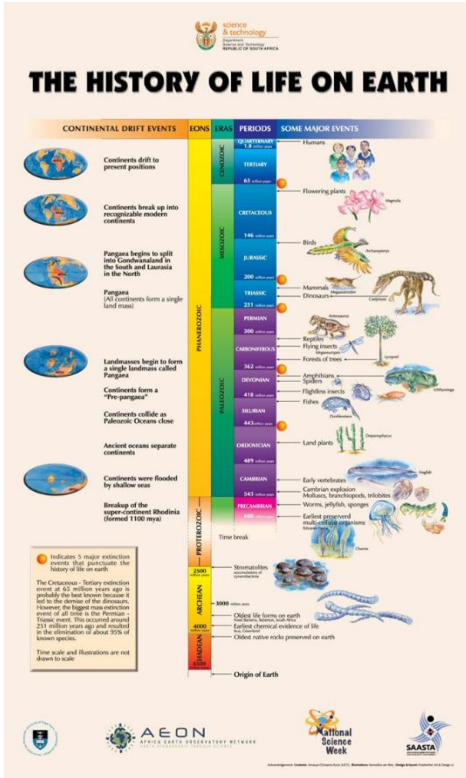
Structure of the Earth is a piece of digital artwork by Album which was uploaded on November 27th, 2019.

Geological Time Scale





Adapted from Press & Siever, 2000, Understanding Earth



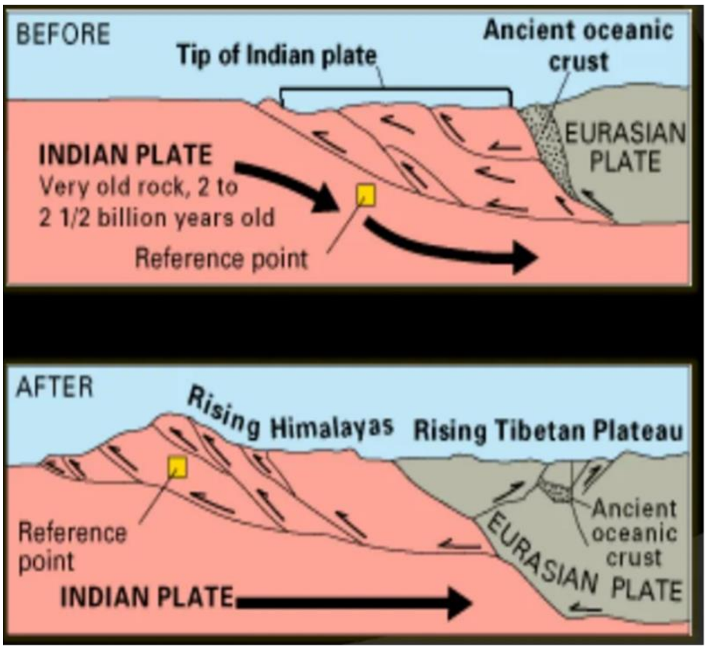
Mountain building / orogeny

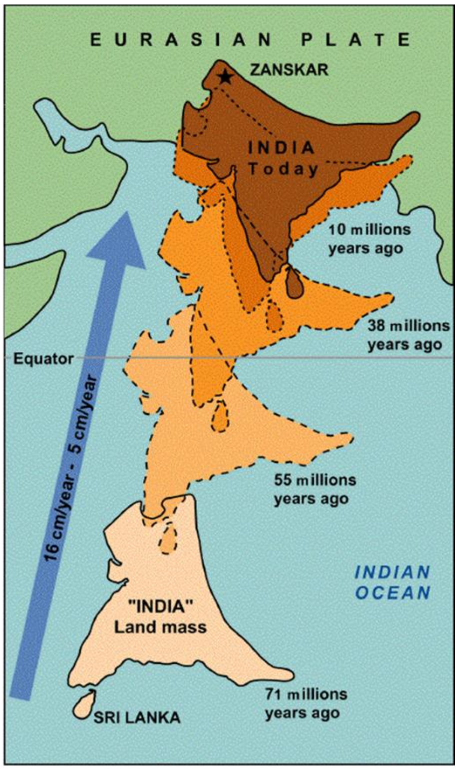
The Earth's Mountains

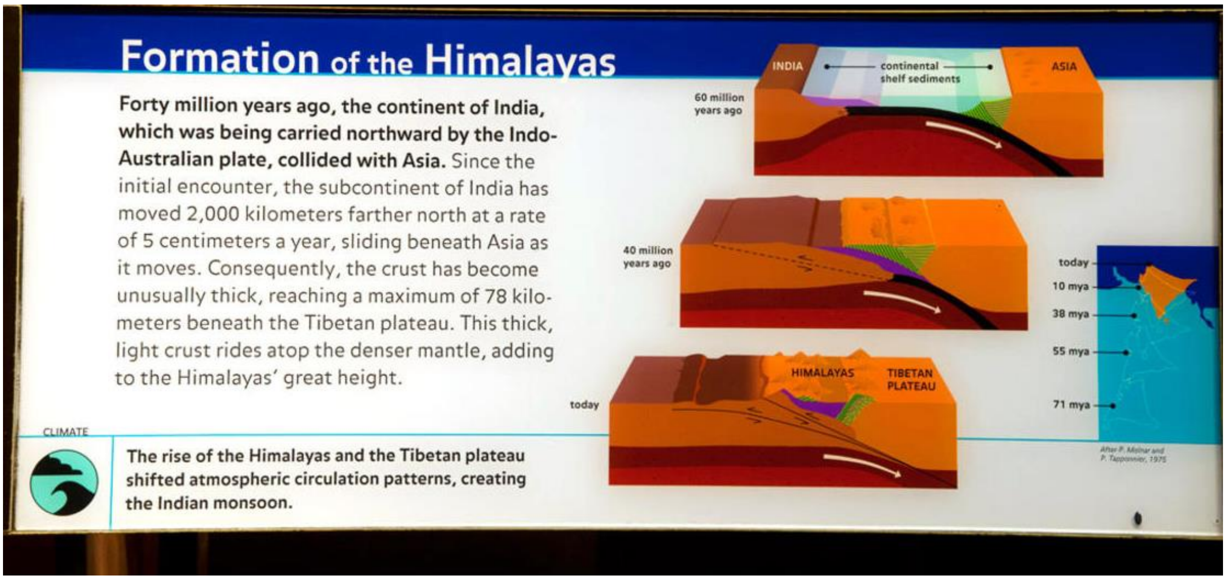
A mountain is any landmass on Earth's surface that rises abruptly to a great height in comparison to its surrounding landscape. By definition, a mountain rises 1,000 feet (305 meters) or more above its surroundings and has steep sides meeting in a summit that is much narrower in width than the mountain's base. Any highland that rises no higher than 1,000 feet (305 meters) above its surroundings, has a rounded top, and is less rugged in outline than a mountain is considered a hill. High hills at the base of mountains are known as foothills.

Orogenic Stage

In the orogenic stage of mountain building, the accumulated sediments become deformed by compressional forces from the collision of tectonic plates. This tectonic convergence can be of three types: arc- continent, ocean-continent or continent-continent. In an ocean- continent convergence, the collision of ocean and continental plates causes the accretion of marine sedimentary deposits to the edge of the continent. Arc-continent convergence occurs when an island arc collides with the edge of a continental plate. In this convergence, the ocean plate area between the arc and the continent is subducted into the asthenosphere and the volcanic rocks and sediments associated with the island arc become accreted to the margin of the continent over time. This type of collision may have been responsible for the creation of the Sierra Nevada mountains in California during the Mesozoic Era. The final type of convergence occurs when an ocean basin closes and two continental plates collide. Continent-continent convergence mountain building is responsible for the formation of the Himalayas, Ural, and Appalachian Mountain systems.







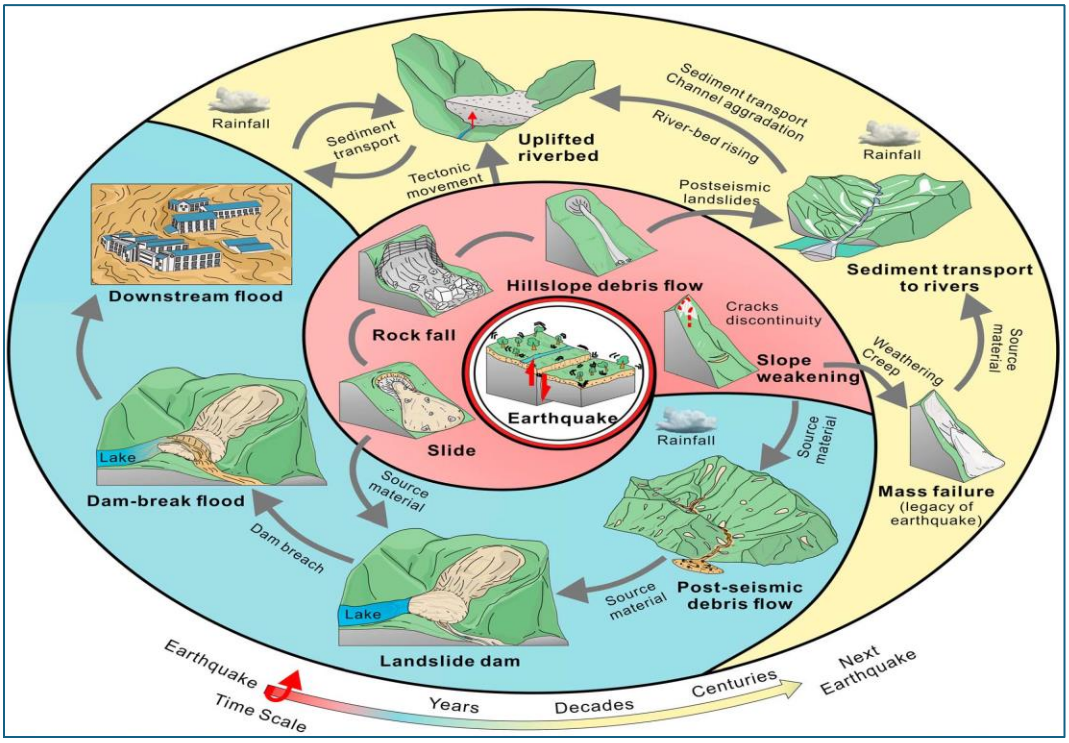
Activities in mountain ranges

d. Life History of Mountains

YOUNG	MATURE	OLD
➢High Elevation ➢Still growing	➢ Elevation is not very high, peak lowering ➢ Stopped growing	➢ Low elevation
➢ Rugged, irregular skyline ➢Good scenery ➢snowcapped	➢ Rounded tops covered with vegetation	➢ Monad rocks stand out
➢ Steep slope with base talus	➢ Uniform gentle slopes with covered talus	➢ Region rather flat with low rolling hills

YOUNG	MATURE	OLD
➢ Young rushing streams often torrential with deep ravines ➢Narrow valley	➢ Mature, slow flowing streams water gaps	➢ Move slowly ➢Have low banks
➢ Avalanches, earthquakes and landslides commonly occur	➢ Avalanche rare, earthquake unknown	

Let us consider an Earthquake as a precursor of natural hazards in mountainous regions.



Large earthquakes initiate chains of surface processes that last much longer than the brief moments of strong shaking. Most moderate- and large-magnitude earthquakes trigger landslides, ranging from small failures in the soil cover to massive, devastating rock avalanches. Some landslides dam rivers and impound lakes, which can collapse days to centuries later, and flood mountain valleys for hundreds of kilometers downstream. Landslide deposits on slopes can remobilize during heavy rainfall and evolve into debris flows. Cracks and fractures can form and widen on mountain crests and flanks, promoting increased frequency of landslides that lasts for decades. More gradual impacts involve the flushing of excess debris downstream by rivers, which can generate bank erosion and floodplain accretion as well as channel avulsions that affect

Triggering and controls on coseismic geo-hazards

- Mapping, spatial distribution patterns
- Initiation and failure mechanism analyses
- Evaluation of runout characteristics
- Controls on formation and failure of coseismic landslide dams

Triggering and controls on post-seismic debris flows

- Case studies and inventory
- Initiation and runout: mechanisms and modelling
- Observations and modelling of changing rainfall thresholds
- Structural and non structural risk management and mitigation

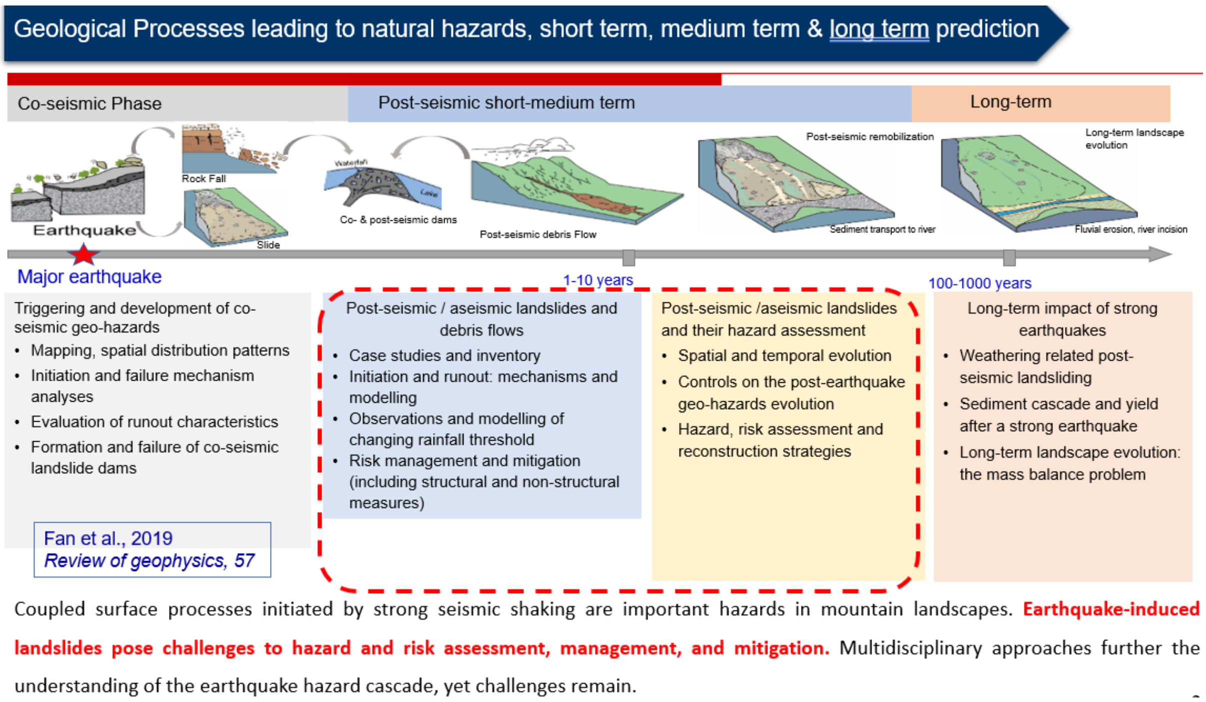
Post-seismic landslides and their hazard

- Distribution patterns and spatio-temporal evolution
- Controls on the post-earthquake geo-hazards evolution
- Susceptibility and hazard assessment
- Risk assessment and reconstruction strategies

Long-term impact of strong earthquakes

- Weathering-related post-seismic landsliding
- Sediment cascade and yield after a strong earthquake
- Long-term landscape evolution: the mass balance problem
- Tectonic control on landslide occurrence

flooding frequency, settlements, ecosystems, and infrastructure. Ultimately, earthquake sequences and their geomorphic consequences alter mountain landscapes over both human and geologic time scales.



Geological Processes leading to natural hazards, short term, medium term & long-term prediction

Tectonic hazards

- Earthquakes
- Landslides
  - Shallow soil slides
  - Debris flows
  - Rockfalls
  - Avalanches
- Landslide dam, flood
- Tsunami

Other Geological hazards

- Subsidence
- Tsunami
- Volcanic Eruptions
- Solar storms
- Geomagnetic storms
- Asteroid impacts