



- Landslides
- Features
- Impact
- Main points

A Resilient Future: Science and Technology for Disaster Risk Reduction

Hi. My name is Alessio Ferrari. I'm a Research Associate at the Laboratory of Soil Mechanics here at the EPFL. I'm a lecturer for the course of Slope Stability, and landslides are among my main research interests. In this video we will talk about landslide hazard. In particular we will discuss about what a landslide is. We will discuss the main features, briefly mention the impacts of landslides, and finally we will summarize the main points.

Notes

Summary



0m 04s

“The movement of a mass of rock, debris or earth down a slope.”

(Cruden, 1991)



Technology for Disaster Risk Reduction

Many definitions exist for the concept of a landslide. Here we will refer to the definition proposed by Cruden, which defines a landslide as, "the movement of a mass of rock, debris or earth down a slope." Mass movements occur mainly under gravitational forces, in some cases also under a dynamic input.

Notes

Summary



0m 32s



Each phenomenon is controlled by several factors, mainly:

- Geology
- Hydrogeology
- Topography
- Geotechnical properties
- Climate

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And the movement, of course, as a consequence of a failure, usually it's a shear failure, at the boundary between the mass which moves and the material which remains in place. This generic definition includes a large variety of phenomena. From the fall of a single rock block, with punctual, even if potentially dramatic consequences, to a complete failure of an entire hill with very serious, dramatic consequences. Each landslide phenomenon has its peculiar features, that are mainly controlled by factors like geology, hydrogeology, topography, the geotechnical properties of the above materials, and climate.

Notes

Summary



0m 54s



- Glossary
- Classification
 - Type
 - State of activity
 - Distribution
 - Style

(The International Geotechnical Societies' UNESCO Working Party for Landslide Inventory, 1993)

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Each landslide behaves very differently, both during the failure phase and the post-failure phase. This variety of phenomenon behaviors yields from one side to the need for a proper terminology to be used consistently by all the persons involved, especially considering the number of different actors involved in landslide management, from technicians and scientists, to politicians, stakeholders, that have to take decisions. From the other side, this variety of phenomena brings the need for a system of classification on landslides with the aims of identifying general types of movements, and synthesizing the main characteristics of the movements, both spatially and temporally. In this video, we will refer to the document produced by the International Geotechnical Societies' UNESCO Working Party for Landslide Inventory that was produced in 1993. In this document you will find a comprehensive glossary and a classification system for landslides, and you are all encouraged to refer to that document for a complete overview of the terms for a proper description of a landslide.

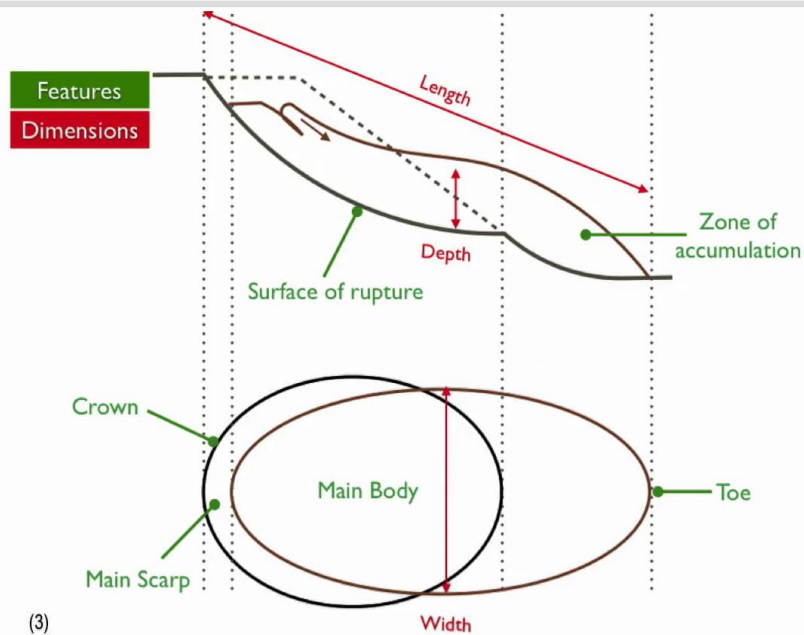
Notes

Summary



1m 40s

Glossary of landslides



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This is an example of the terms which define both the main features and the dimensions of a landslide. It refers to the particular case of a sliding mass which remains in contact with the underneath material. This is what we call a *rotational slide*. The main features that characterize this type of movement are: the *surface of rupture*, which is where the differential movements between the moving mass and the mass which remains in place concentrate; the *zone of accumulation*, that is the zone where the moving mass accumulates; the *main body*, which is representing the entire moving mass; the *toe*, which is the most elongated part of the main body; and the *main scarp*, which is the exposed part of the surface of rupture that we can see after the movement took place. The length, the depth, and the width characterize the dimensions of this landslide.

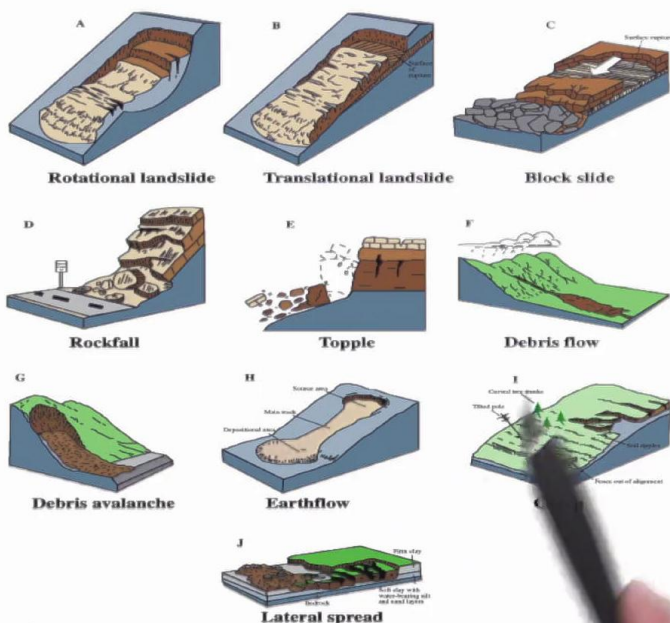
Notes

Summary



2m 52s

Landslide classification: Type



Landslides are usually classified on the basis of the material involved (rock, debris, earth, mud) and the type of movement (fall, topple, avalanche, slide, flow, spread)

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The rotational slide we have just seen is one of the possible landslide types that we can observe. This figure reports the many types, which are mainly distinguished considering the material involved: rock, debris, earth, mud, and the type of movement: fall, topple, avalanche, slide, flow, spread. Certain characteristics can be somehow anticipated by looking at the type of involved material and the geometry of the system. *Rotational landslides* will occur mainly when we have a system composed by a homogeneous material. *Translational slides* occur when we have some discontinuities in our systems. A *block slide* is a kind of a translational slide in which the material remains in the form of a block during the movement. *Rockfalls* will occur when the material is exposed to the air in the underneath part, and the movement will occur predominantly through the air. A *topple* is expected when the material is free to rotate during the movement. *Debris flow, avalanche, earthflow*, are movements that can travel for several hundred meters, even kilometers, and they can have very different velocities, depending on the type of material which is involved.

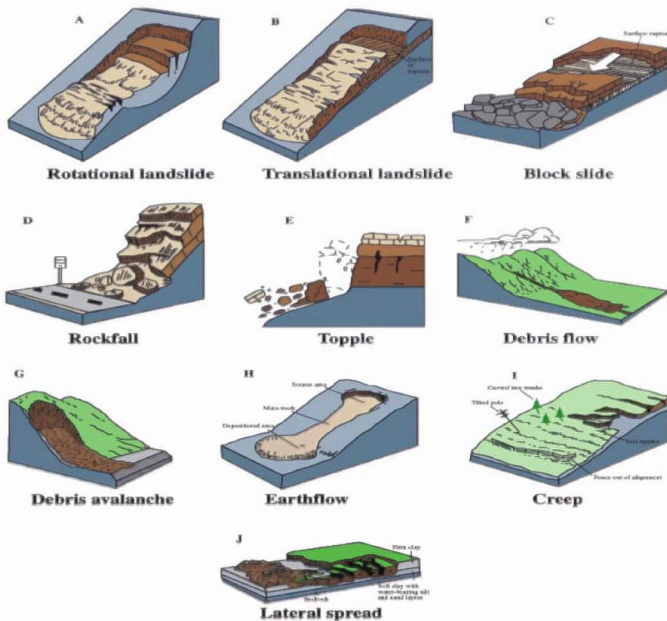
Notes

Summary



4m 03s

Landslide classification: Type



Landslides are usually classified on the basis of the material involved (rock, debris, earth, mud) and the type of movement (fall, topple, avalanche, slide, flow, spread)

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Creeps are movements that are occurring, essentially, under constant stress conditions, and the *lateral spreads* are lateral movements which occur mainly when we have a hard material sitting on a softer material.

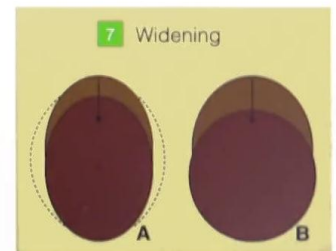
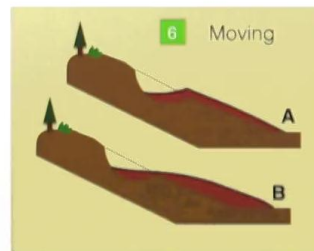
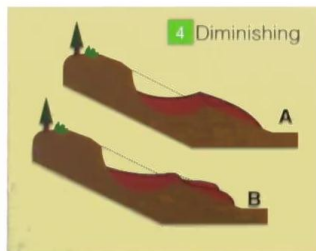
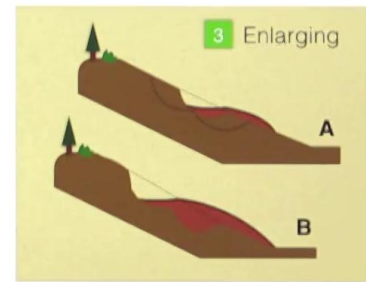
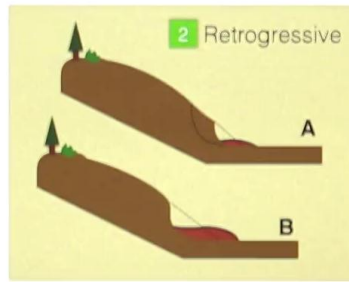
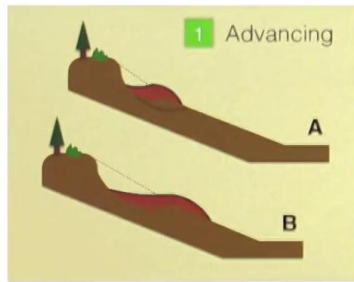
Notes

Summary



5m 47s

Landslide classification: Distribution



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As a part of the classification of a landslide, it is crucial that we define the state of activity. We will call *active* a landslide which is moving during the time in which we are analyzing the system. We say that the landslide is *suspended* if it was active, and now it is not moving, but the movement could start again in the near future. A *reactivated* landslide is a landslide that was suspended, and now has started to move again. *Inactive* landslides could be dormant, abandoned. They could be stabilized, if we have done something to prevent any further movement to occur, or it could be *relict*, if some time has passed that movements are not likely to occur anymore. *Distribution* is part of the classification system for a landslide. When we talk about distribution, we refer to the spatial evolution of the movements.

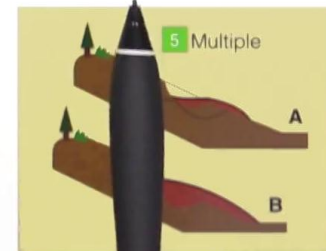
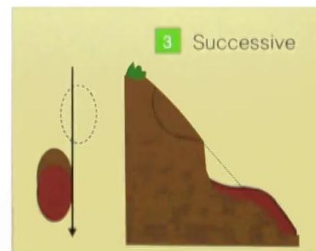
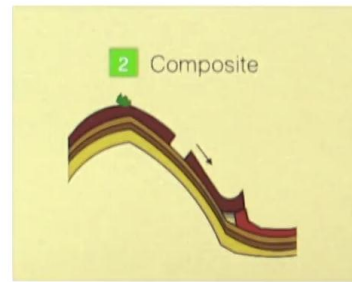
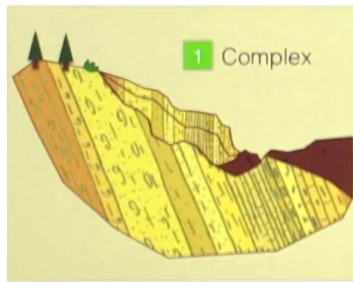
Notes

Summary



6m 07s

Landslide classification: Style



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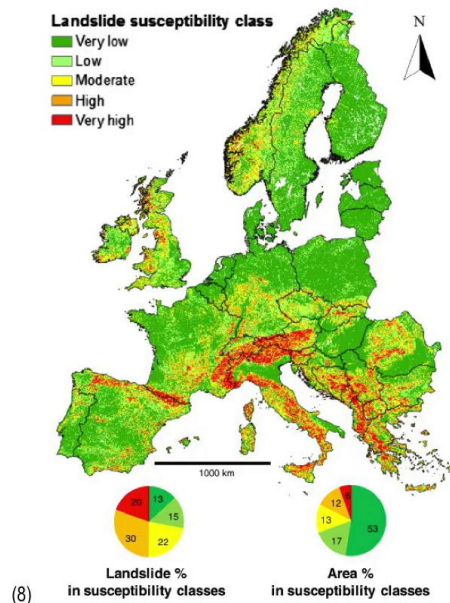
The *style* refers to the number of movements that are occurring in the system that we are analyzing. If we have just one type of movement, we will say that we have a *single* landslide. If this type of movement is occurring in the same slope but in different locations, without sharing the surface of rupture, we will say that the style of activity is *successive*. A *multiple* style of activity is the case in which the same type of movements is happening in different parts of the slope. A *complex* style is the case in which we have different types of movements which are happening in the same portion of the slope we're analyzing, while *composite* is the case where we have different types, but located in different portions of the slope.

Notes

Summary



Landslide impact



14% EU is formed of mountain relief (EEA,1999)

Where:

- Mountainous and hilly regions
- River banks
- Coastlines

Landslides may cause:

- Fatalities
- Damage to infrastructures
- Damage to property

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Let's briefly talk about landslide impact. It is quite obvious to think that mountain and hilly regions and coastlines where we find natural slopes, are the areas most exposed to landslides. But we don't have to neglect the risks related to man-made slopes, such as dams, cuts and fills, and tailing dams. Depending on the objects which are exposed to the landslides, landslides may cause fatalities, damages to infrastructures or to properties.

Notes

Summary



8m 13s

Main points



- Landslides are movements of rocks, debris, or earth

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Let's summarize the main points that we have discussed in this video. Landslides are defined as movements of rocks, debris, or earth, which are happening mostly under gravitational forces, but they could be also induced by earthquakes.

Notes

Summary



8m 48s

Main points



- Landslides are movements of rocks, debris, or earth
- Landslides are classified according to their type, state of activity, distribution and style
- Landslides are very complex phenomena which present large variety of features
- They can have a potentially destructive impact

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Landslides are classified according to their type, state of activity, distribution, and style. We have discussed about the need for a proper terminology to describe and characterize a given landslide. This is mainly due to the number of actors which are participating in the management of a problem of a landslide. Those are very complex phenomena, which present a large variety of features, and they can have really potential destructive impact.

Notes

Summary



9m 04s

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Notes

Summary

