Mass Movement and Landslide

M.Sc. Remote Sensing and GIS
IVth Semester

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Mass Movement

- Definition – The movement of material downhill under the influence of gravity
- Loose weathered material on the surface of the Earth is known as **Regolith**
- When you have regolith on a slope (even a gentle slope) the possibility exists for Mass Movement
- Movement can be very fast (Km/hr) or very slow (mm/year) – but can dramatically change the Earth's surface over time
- Mass Movement can also be **triggered** by natural or man-made factors – anything that makes regolith **unstable**

Triggers of Mass Movement

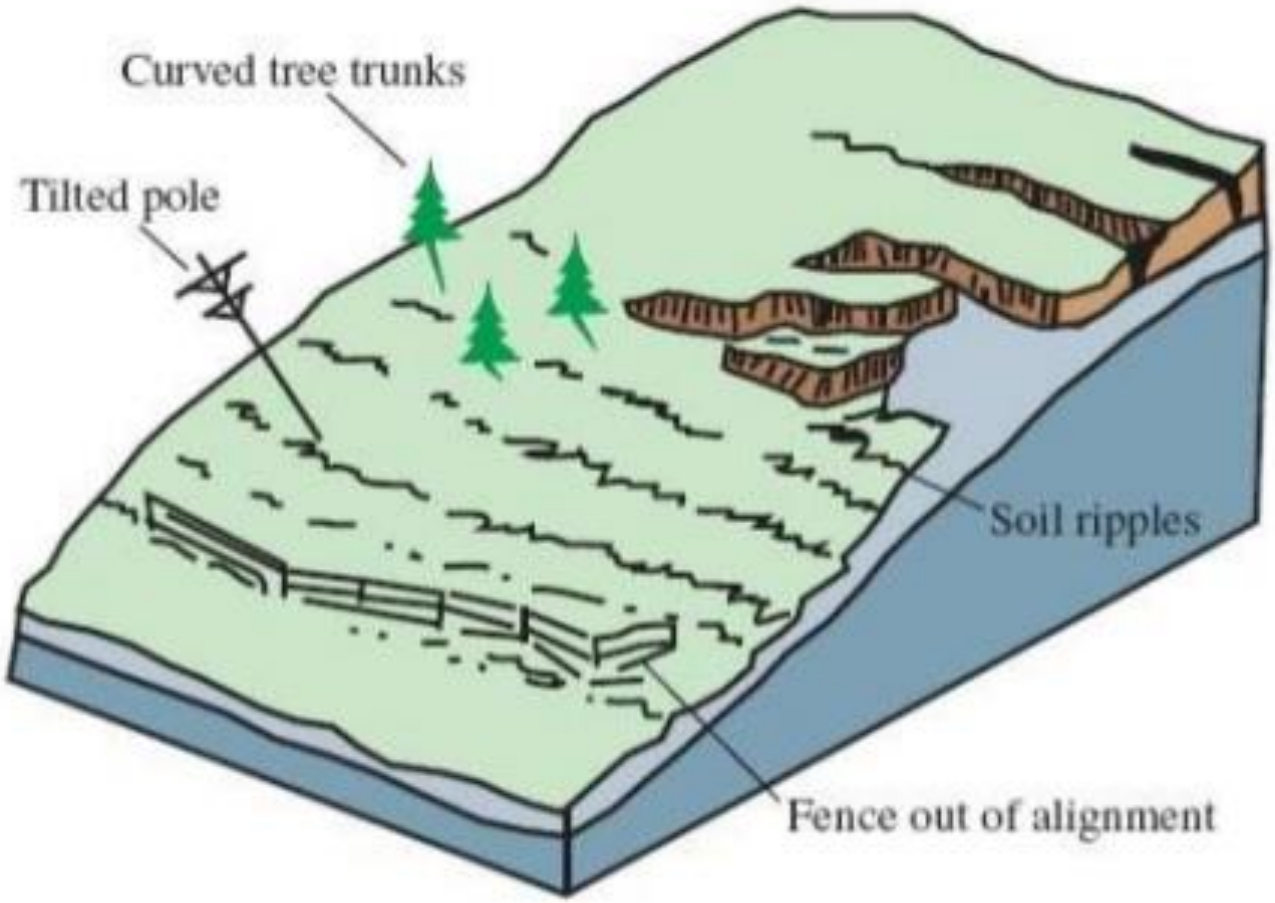
Factors affecting mass movement

- **Effect of Gravity** – the bigger they are, the harder (and faster) they fall
- **Slope** – the steeper the slope, the faster the mass movement
- **Water** – helps to lubricate the regolith, more water = more sliding potential
- **Vegetation** – roots help keep the regolith together, lack of vegetation means more potential for movement
- **Human activities** – anything that disturbs the regolith (e.g. road building, farming on steep slopes)
- **Type of regolith** – loose snow is more likely to move quickly than Glacial Ice

Slow Mass Movement

- **Soil Creep** – this is the slowest type of MM. It is probably the most common type of MM in Ireland and despite it's slowness it can have significant impacts over time
- Main Processes Involved – Freeze Thaw, wetting and drying
- These processes cause the soil to expand (freezing, wetting) and shrink (thawing, drying) – eventually the soil moves downhill
- As little as 1mm of movement per year movement
- Soil Creep is a relatively dry type of movement – the soil "rolls" rather than "flows" downhill

Soil Creep - effects



Soil Creep - effects

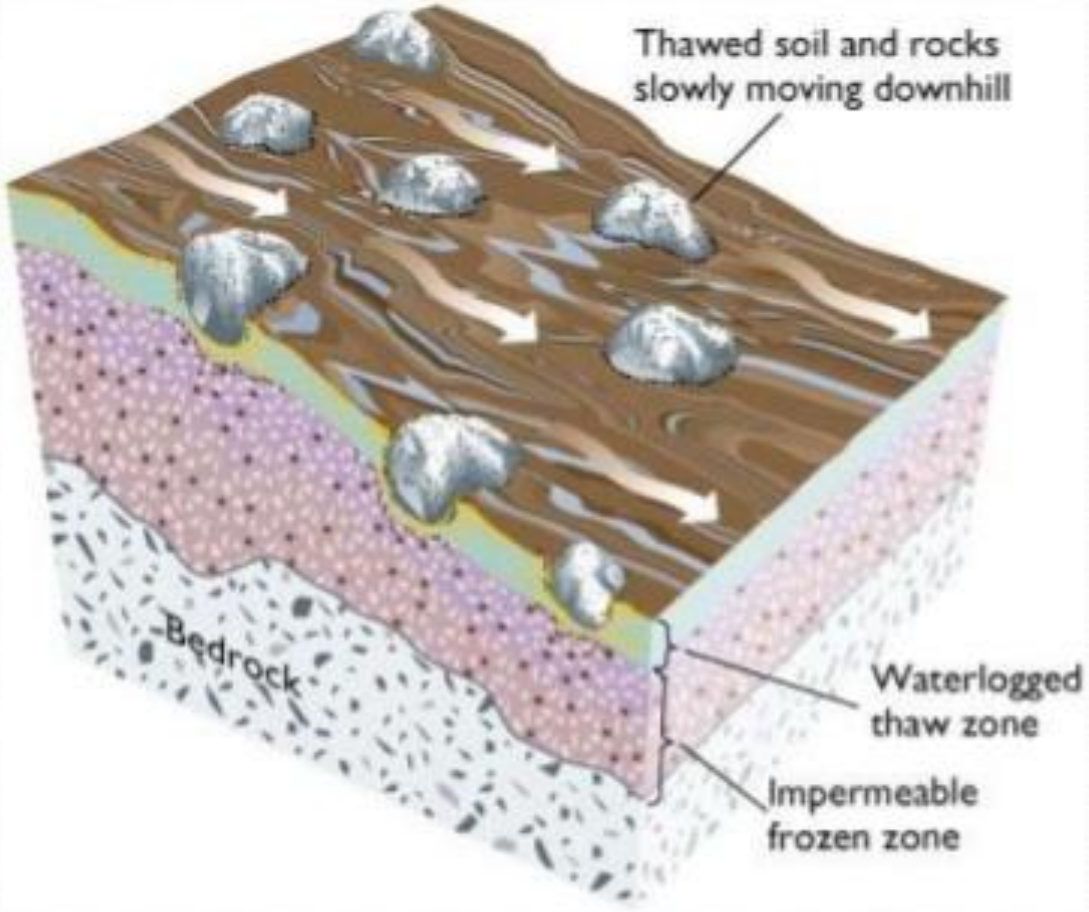
Aspen growth in Utah shows progressive soil creep downslope.

Trees and Poles bend, ripples appear on hillsides

Solifluction

- A type of "Waterlogged Soil Creep" that mainly occurs where **Permafrost** is present
- Upper layers of the soil melt in summer, however the lower layers remain frozen
- This results in the upper layers "sliding" over the lower layers
- Regolith in this case has the consistency of treacle or honey
- Leaves behind curved bulges called "lobes"

Solifluction



Solifluction lobes

Fast and Wet Mass Movements

- When the regolith is very wet the mass movement can flow downhill quite rapidly – however when the movement stops the regolith can become dry and hard like concrete, which makes removal very difficult

Digger trapped in a Lahar

Mudflows

- The main process at work here is **heavy rain** and **flooding**
- Because of the mixture of water, mud and loose rock they are very dangerous – think of a tsunami with rocks embedded in it – the greater mass leads to greater damage
- Can travel a long distance depending on the gradient - gradients over 25 degrees are needed

Lahar

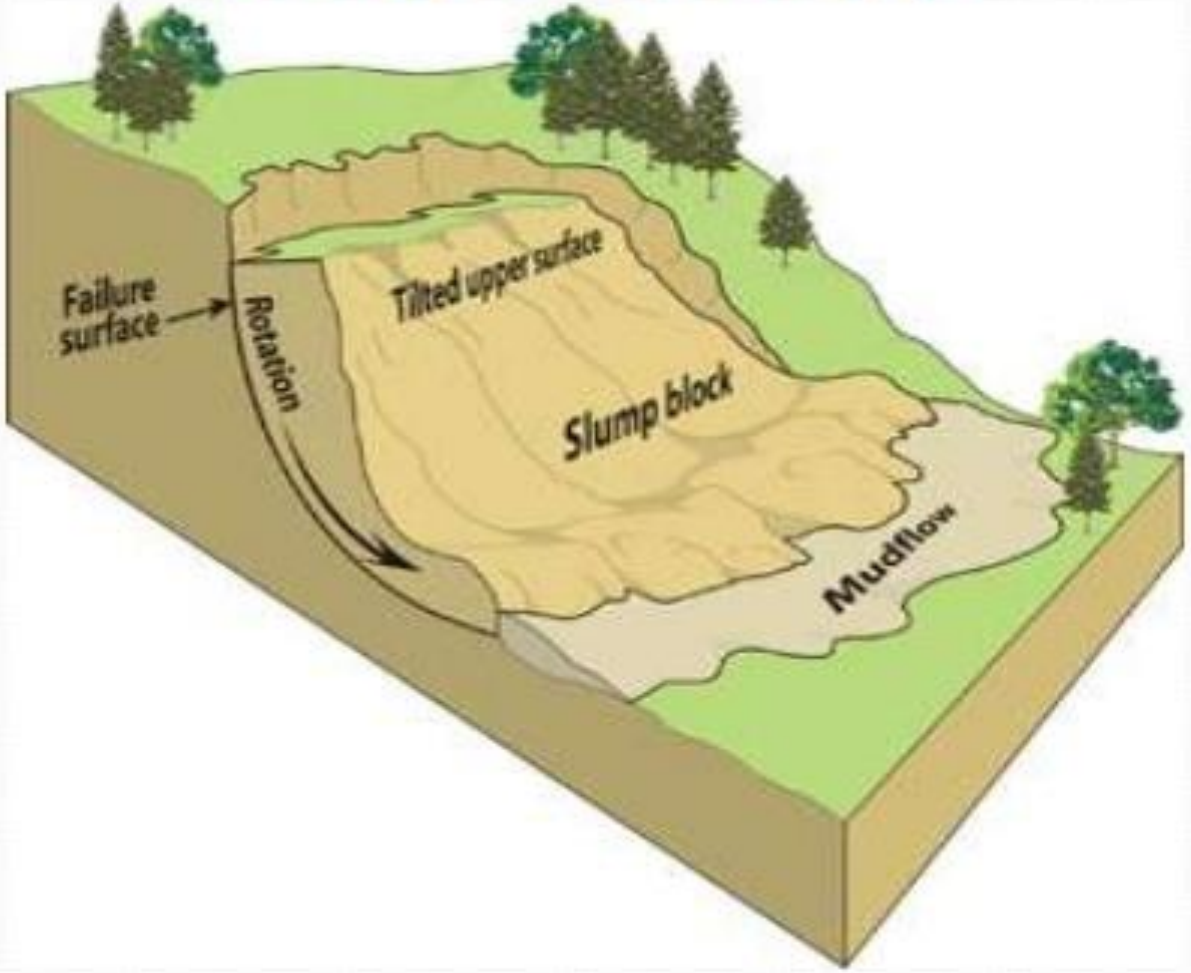
- These occur when volcanic ash, not mud, mixes with water and flows downstream
- On tall volcanoes the snow can melt and mix with the ash to form a thick substance with the consistency of wet concrete – when this substance flows downhill a Lahar is formed
- Can cause massive damage and are very difficult to remove – think of Pompeii in Italy

Lahar Deposits, Guatemala

Landslides or Slumps

- These are very fast forms of mass movement (at least compared to soil creep)
- Need a "trigger" to take place – can be a storm, earthquake, shockwave from explosion etc
- Human activity (e.g. road building) can increase the likelihood of a landslide – DART between Dalkey often disrupted (see P189)
- A **Rotational Slump** is a landslide where regolith slips along a curved surface and falls back on itself

Rotational Slip



Avalanches

- A sudden rapid movement of a mass of **snow** down a slope
- Often confused with landslides – landslides have little or no snow
- Major issue in Alpine regions – a single skier can act as a "trigger" and cause unstable snow to fall
- Because snow in high areas is frozen, it acts like dry particles of material – like dry sand