LIT03.1
Erosion shapes the Himalayas

The Himalayas separate the green lowlands in the south from the arid Tibetan Plateau in the north.

Erosion plays an important role in shaping the contrasting landscapes of the northern and southern slopes of the Himalayas, driven by climatic differences and other geographical factors. The Himalayas, the world's tallest mountain range, span a region with very different climates on each side, resulting in varied processes shaping the landscape.

The southern slope of the Himalayas, which faces the Indian subcontinent, is exposed to the Indian monsoon. It receives heavy rainfall, especially during the monsoon season, with annual precipitation exceeding 5,000 mm in some areas. The humid and wet climate makes the southern slope prone to intense water-driven erosion processes, particularly:

- **Fluvial erosion**: Rivers fed by monsoonal rains carve deep valleys and gorges.
- **Landslides**: Frequent and heavy rains also trigger landslides, especially on the steep and rugged terrain of the southern slope.
- **Glacial erosion**: In higher altitudes, glaciers contribute to erosion through glacial scouring.

The combined effects of rainfall, river activity, and landslides create dramatic features on the southern slope, such as steep, forested valleys, and deep gorges.

The northern slope of the Himalayas, facing the Tibetan Plateau, experiences an arid, cold desert climate. The region lies in the rain shadow of the Himalayas and receives minimal precipitation, in some areas less than 100 mm. Here erosion is dominated by:

- **Glacial erosion**: large parts of the landscape have been formed by glaciers, as the moraines and glacial lakes show. However, with the retreat of the glaciers, their role as erosive power decreases.
- **Wind erosion**: In the dry, barren northern slope, wind erosion plays a significant role. Winds carry fine particles across the plateau, sculpting rock formations and creating vast expanses of sand dunes and gravel plains.

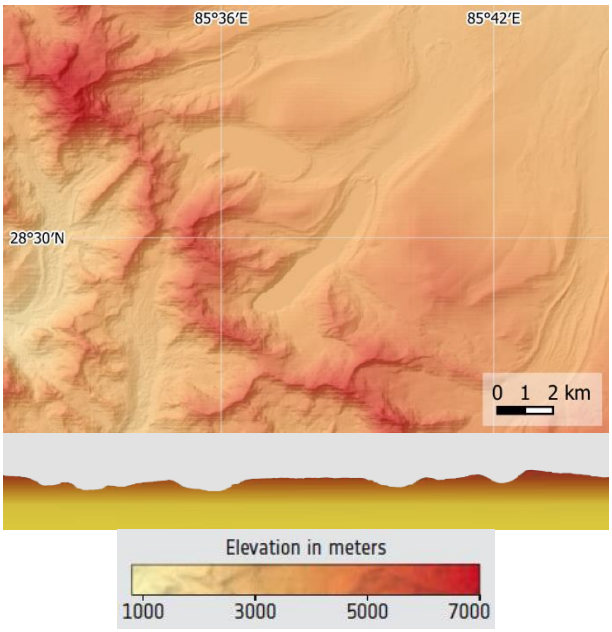
As a result, the northern slope features more gradual, expansive valleys with less dramatic relief compared to the southern side.

Satellites are used for monitoring erosion and landscape formation in the Himalayas. They provide valuable data on a large scale, offering insights into changes over time. Some key uses of satellite technology in this context include: topographic mapping, monitoring the vegetation cover, glacial monitoring, and detecting landslides e.g. for disaster relief support.

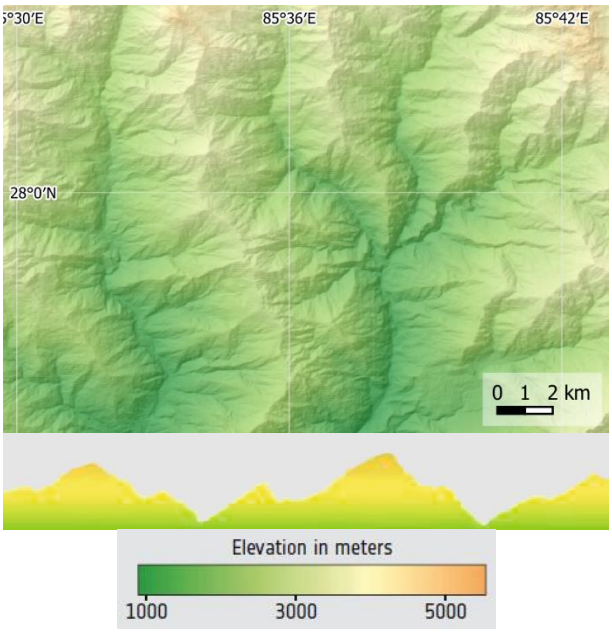
Exercises

- Look at the satellite image and try to identify important land cover classes (e.g. bare land in the north, tree cover and agricultural land in the south, and ice/snow).
- Looking at the satellite image maps, what can you say about the relief of the terrain? Where is it rugged, where smooth? Which indicators support your findings? During which time of the year is the relief best visible in satellite images? Think about shadows and the sun position! Compare with the elevation maps and profiles shown below.
- Try to identify the regions shown in the elevation maps below in the satellite image

Additional Material



Typical smooth, U-shaped valleys at the northern slope of the Himalayas, formed by glaciers are accompanied by moraines and glacial lakes.



Typical V-shaped, rugged valleys formed by the rivers along the southern slopes of the Himalayas

Links and Sources

- https://www.esa.int/ESA_Multimedia/Images/2018/06/Mount_Makalu_Himalayas - ESA image of one of the fifth highest mountains in the world, showing (retreating) ice and snow at the "roof of the world".
- https://www.esa.int/ESA_Multimedia/Images/2024/02/Earth_from_Space_A_veil_of_haze_and_smoke - Sentinel-3 image of the Himalayas, a high-reaching barrier for atmospheric currents.
- https://www.esa.int/ESA_Multimedia/Images/2016/12/Proba-V_images_Mount_Everest - large area satellite image (Proba-V) showing the Himalayas separating the arid north from the lush vegetation in the south.
- https://earthobservatory.nasa.gov/images/147980/himalayas-near-and-far - Astronaut photo of the Himalayas viewed over Mt. Everest towards east.