Regional fact sheet - Mountains

Common regional changes

The freezing level height in mountain areas is projected to rise and will alter snow and ice conditions (*high confidence*).

Warming has occurred in the Himalayas, the Swiss Alps, and the central Andes and has increased with altitude. Such elevation-dependent warming could lead to faster changes in the snowline, the glacier equilibrium-line altitude and the snow/rain transition height (*high confidence*).

With few exceptions, mountain glaciers have retreated since the second half of the 19th century (*very high confidence*). This retreat has occurred at increased rates since the 1990s, with human influence *very likely* being the main driver. This behaviour is unprecedented in at least the last 2,000 years (*medium confidence*). Furthermore, glaciers will continue to lose mass at least for several decades even if global temperature is stabilized (*very high confidence*).

The global warming-induced earlier onset of spring snowmelt and increased melting of glaciers have already contributed to seasonal changes in streamflow in low-elevation mountain catchments (*high confidence*).

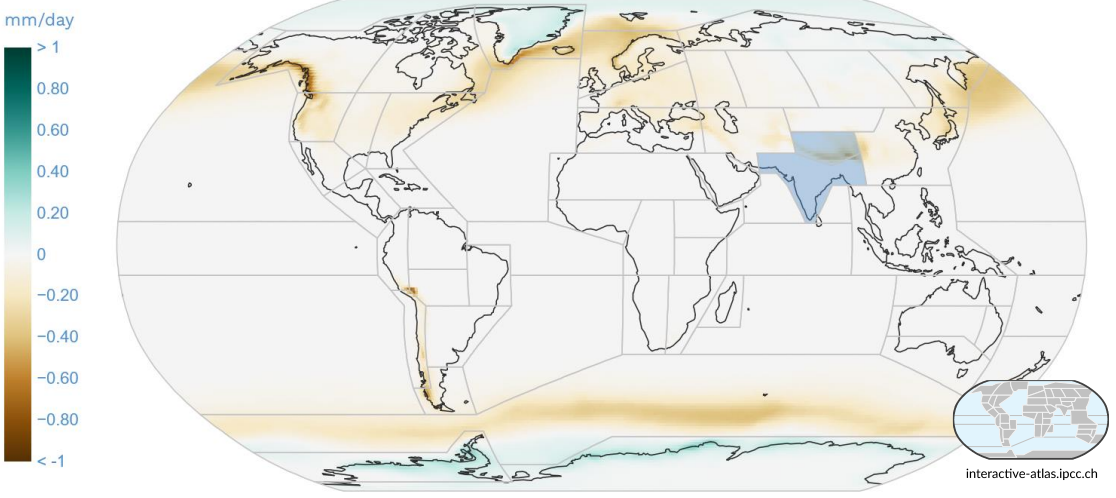
Mountain glaciers will continue to shrink and permafrost to thaw in all regions where they are present (*high confidence*). Mountain glaciers are projected to lose more mass in higher greenhouse gas emissions scenario over the 21st century (*medium confidence*).

It is *virtually certain* that snow cover will decline over most land regions during the 21st century, in terms of water equivalent, extent and annual duration.

Extreme precipitation is projected to increase in major mountainous regions (*medium to high confidence*, depending on location), with potential cascading consequences of floods, landslides and lake outbursts in all scenarios (*medium confidence*).

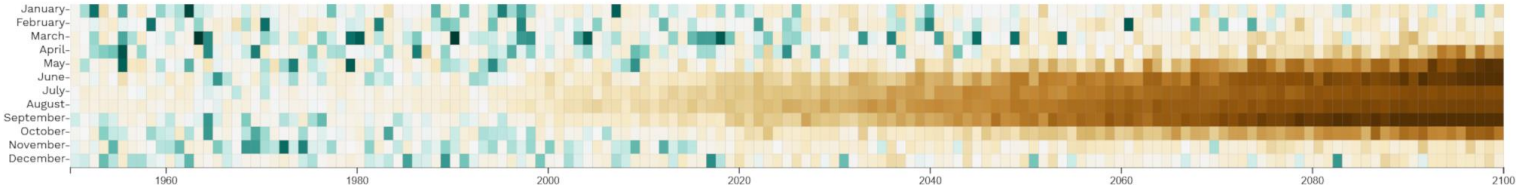
Projected runoff is typically decreased by contributions from small glaciers because of glacier mass loss, while runoff from larger glaciers will generally increase with increasing global warming levels until their mass becomes depleted (*high confidence*).

All the above-mentioned changes will pose challenges for water supply, energy production, ecosystems integrity, agricultural and forestry production, disaster preparedness, and ecotourism (*high confidence*) that will be assessed in the IPCC Working Group II report.

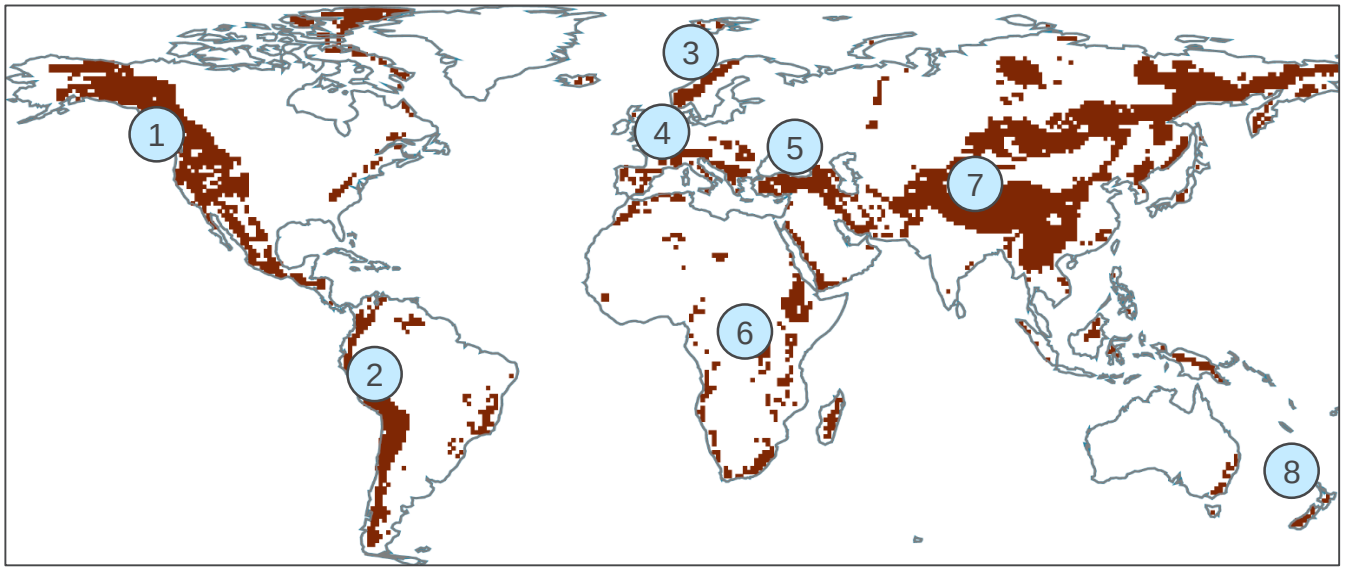


Projected annual snowfall change (mm/day) for 2°C global warming compared to 1850–1900 using the SSP5-8.5 scenario.

Results expanded in the Interactive Atlas (active links)



Projected changes in seasonal mountain snowfall (mm/day) in High Mountain Asia for GWL 2ºC using the very high emissions scenario (SSP5 8.5), relative to 1850–1900.



Typological mountain regions used in the report's Interactive Atlas. Labels correspond to the regions described below.

1 Rocky Mountains & Alaska

- Reduction in glaciers, seasonality of snow and ice formation, loss of shallow permafrost, and shifts in the rain/snow transition line are projected to alter the seasonal and geographic range of snow and ice conditions in the coming decades (*very high confidence*).
- Continued shrinkage of glaciers is projected to create further glacial lakes (*medium confidence*).

2 Andes

- Glacier volume loss and permafrost thawing will *likely* continue, causing important reductions in river flow and potentially high-magnitude glacial lake outburst floods.

3 Scandinavian Mountains

- Most periglacial debris-flow processes are projected to disappear by the end of 21st century, even for low-warming scenarios (*medium confidence*).

4 European Alps

- Elevation-enhanced long-term trends in maximum near-surface air temperature and diurnal temperature range were observed in the Swiss Alps.
- Snow cover will decrease below elevations of 1500–2000 m throughout the 21st century (*high confidence*). A reduction of glacier ice volume is projected with *high confidence*.

5 Caucasus & Pontic Mountains

- Mountain permafrost degradation at high altitudes has increased the instability of mountain slopes in the past decade (*medium confidence*).

6 East African Mountains

- African snow and glaciers have very significantly decreased in the last decades and this trend will continue over the 21st century (*high confidence*).

7 High Mountain Asia

- Snow cover has reduced since the early 21st century, and glaciers have thinned, retreated, and lost mass since the 1970s (*high confidence*), although the Karakoram glaciers have either slightly gained mass or are in an approximately balanced state (*medium confidence*).
- Snow-covered areas and snow volumes will decrease during the 21st century, snowline elevations will rise (*high confidence*) and glacier mass is *likely* to decline with greater mass loss in higher greenhouse gas emissions scenarios.
- Rising temperature and precipitation can increase the occurrence of glacial lake outburst floods and landslides over moraine-dammed lakes (*high confidence*).

8 Southern Alps

- Glacier ice volume in New Zealand has decreased in the last decades.

Links for further details:
Common changes: 12.4.10.4, TS.2.5, TS.4.3.1, TS.4.3.2.10, Box TS.6.
Rocky Mountains & Alaska: 12.4.6.4. **Andes:** 12.4.4.4. **Scandinavian Mountains. and European Alps**: 12.4.5.4 and 12.4.10.4. **Caucasus & Pontic Mountains**: TS.4.3.2.2. **East African Mountains**: 12.4.1.4.
High Mountain Asia: 12.4.2.4. **Southern Alps**: 12.4.3.4.