

Climate Change 2022

Mountains as pivoting points for climate impacts, adaptation and vulnerability

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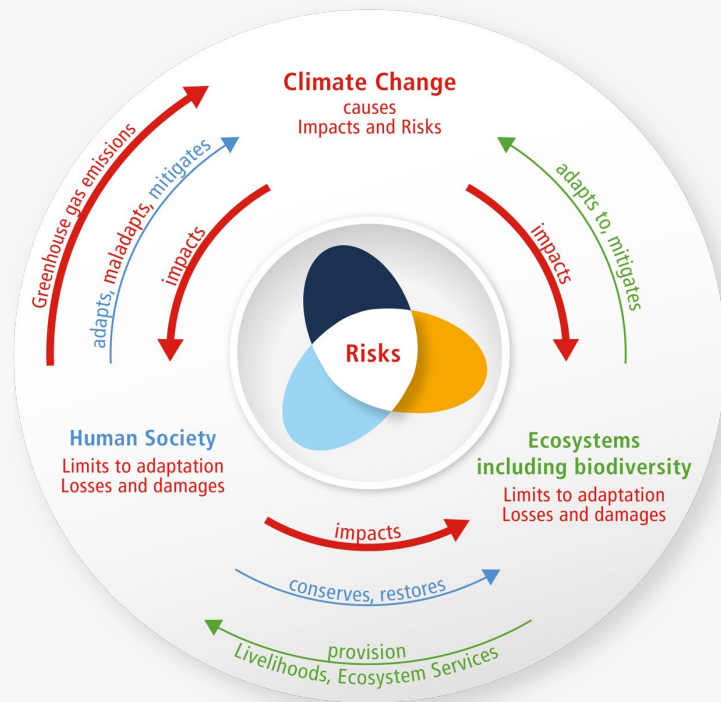


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New understanding of interconnections



The risk propeller shows that risk emerges from the overlap of:

- Climate hazard(s)
 - Vulnerability
 - Exposure
- ...of human systems, ecosystems and their biodiversity



Delineation of mountain regions, population densities

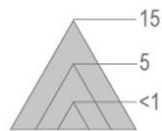
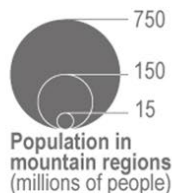
(a) Delineations of mountain regions and population densities in 2015

IPCC WGII Continental Regions

- Asia
- Africa
- Small Islands
- Australasia
- North America
- Central and South America
- Europe

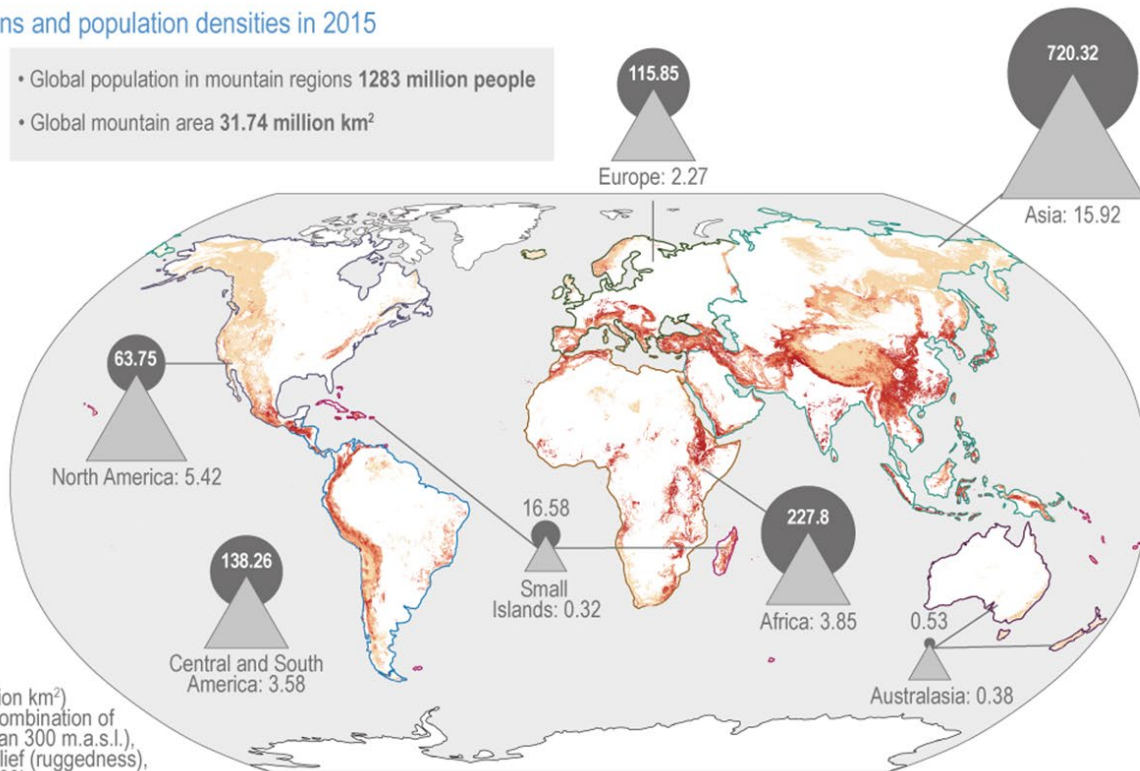
Population density in mountain regions (people/km²)

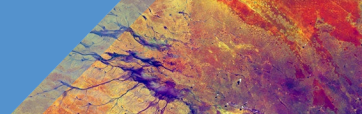
□ Non-mountainous/ out of scope regions. The assessment excludes Svalbard, Greenland and Antarctica



Mountain area (million km²) characterised as a combination of elevation (greater than 300 m.a.s.l.), slope and relative relief (ruggedness), based on Kapos (2000)

- Global population in mountain regions 1283 million people
- Global mountain area 31.74 million km²

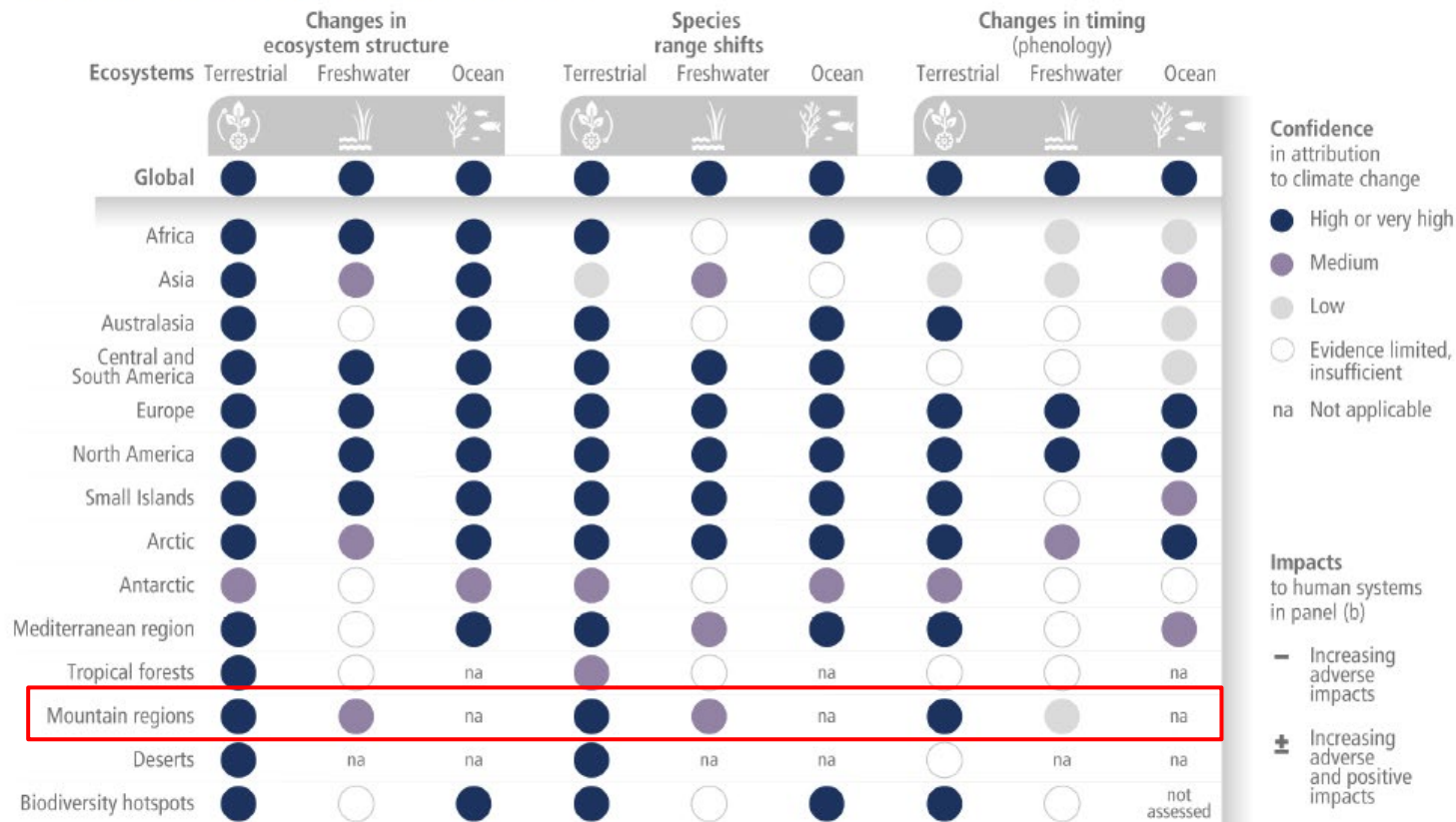




**Figure
SPM.2**
(IPCC, 2022)

Impacts of climate change are observed in many ecosystems and human systems worldwide

(a) Observed impacts of climate change on ecosystems



(b) Observed impacts of climate change on human systems

Figure SPM.2
(IPCC, 2022)

Human systems	Impacts on water scarcity and food production				Impacts on health and wellbeing				Impacts on cities, settlements and infrastructure			
	Water scarcity	Agriculture/crop production	Animal and livestock health and productivity	Fisheries yields and aquaculture production	Infectious diseases	Heat, malnutrition and other	Mental health	Displacement	Inland flooding and associated damages	Flood/storm induced damages in coastal areas	Damages to infrastructure	Damages to key economic sectors
Global	+	-	○	-	-	-	-	-	-	-	-	-
Africa	-	-	-	-	-	-	-	-	-	-	-	-
Asia	+	+	-	-	-	-	-	-	-	-	-	-
Australasia	+	-	+	-	-	-	-	not assessed	-	-	-	-
Central and South America	+	-	+	-	-	-	not assessed	-	-	-	-	-
Europe	+	+	-	+	-	-	-	-	-	-	-	-
North America	+	+	-	+	-	-	-	-	-	-	-	-
Small Islands	-	-	-	-	-	-	-	-	-	-	-	-
Arctic	+	+	-	-	-	-	-	-	-	-	-	+
Cities by the sea	○	○	○	-	○	-	not assessed	-	○	-	-	-
Mediterranean region	-	-	-	-	-	-	not assessed	-	+	-	○	-
Mountain regions	+	+	-	○	-	-	-	-	-	na	-	-

(b) Observed impacts of climate change on human systems

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Mediterranean region	-	-	-	-	-	-	not assessed	-	+	-	○	-
Mountain regions	+	+	-	○	-	-	-	-	-	na	-	-

(b) Observed impacts of climate change on human systems

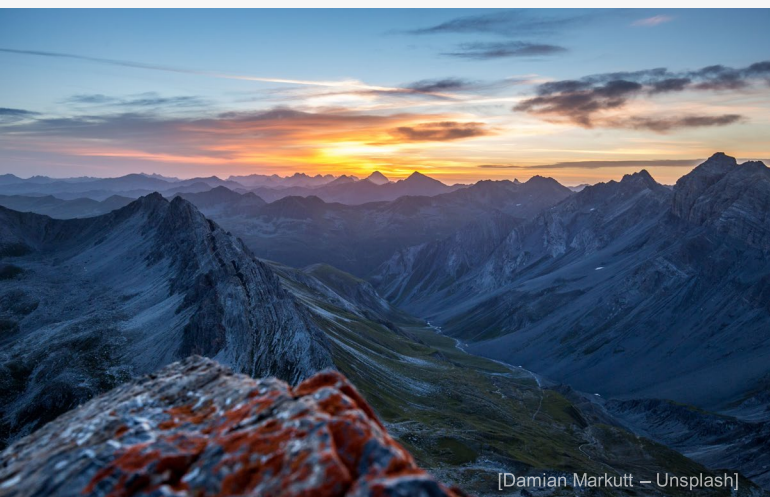
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[Damian Markutt – Unsplash]



[Prateek Katyt – Unsplash]



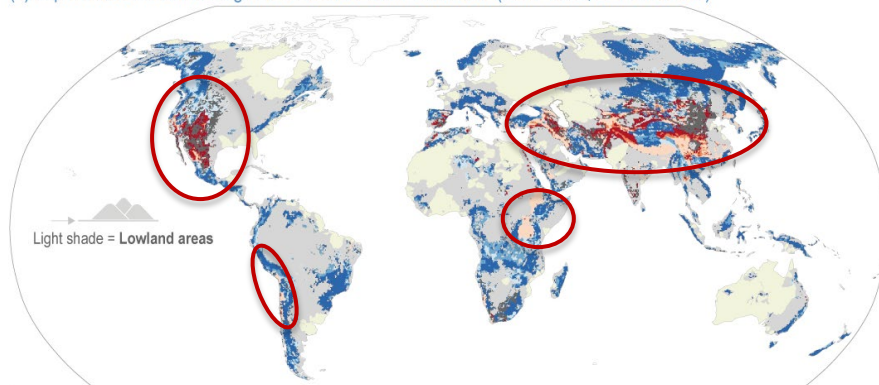
[Xavier von Ertlach – Unsplash]

Observed climate change and impacts in mountain regions

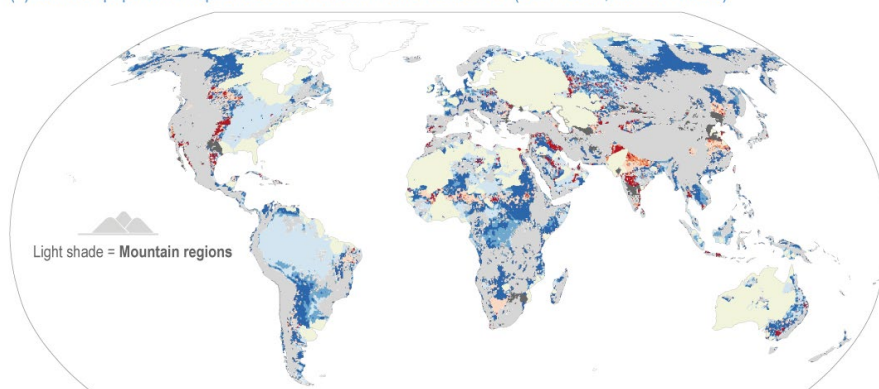
- Climate change impacts, and their attribution to human influence, have increased - observable and serious consequences for people and ecosystems in many mountain regions.
- Two-thirds of irrigated agriculture is dependent on water from mountain sources. Variable timing of glacier- and snow-melt increasingly affecting people and economies, and exacerbating conflicts over water resources in seasonally dry regions.
- Observed seasonal changes negatively affecting tourism (e.g. winter); while exposure to climate-related hazards such as flash floods and landslides are contributing to an increase in disasters affecting a growing number of people in mountain regions and further downstream.

Importance of mountain water resources for lowland areas and populations

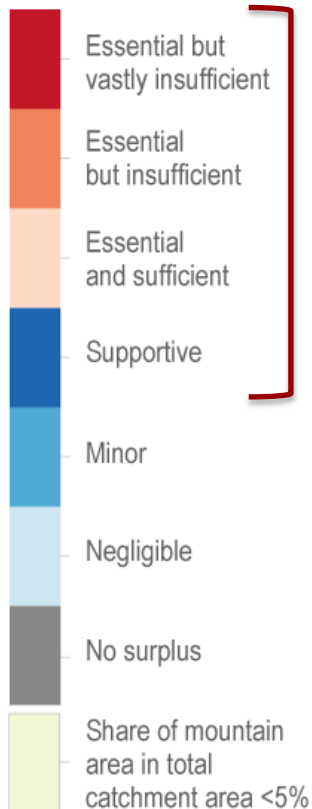
(a) Importance of mountain regions for lowland water resources (2041–2050, SSP2-RCP6.0)



(b) Lowland population dependence on mountain water resources (2041–2050, SSP2-RCP6.0)

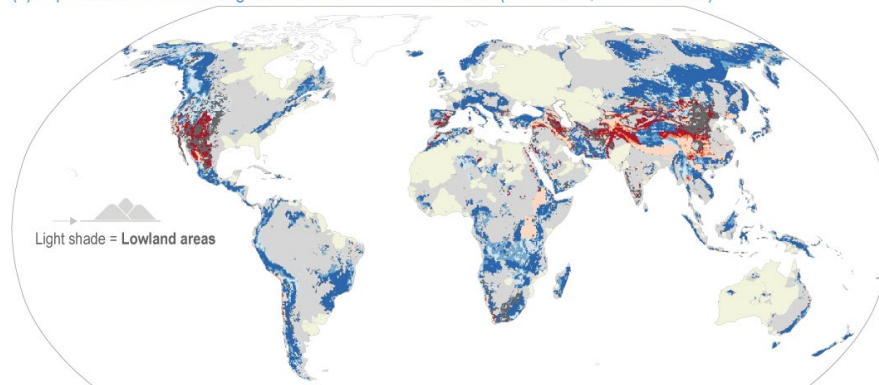


Extent of importance and dependence

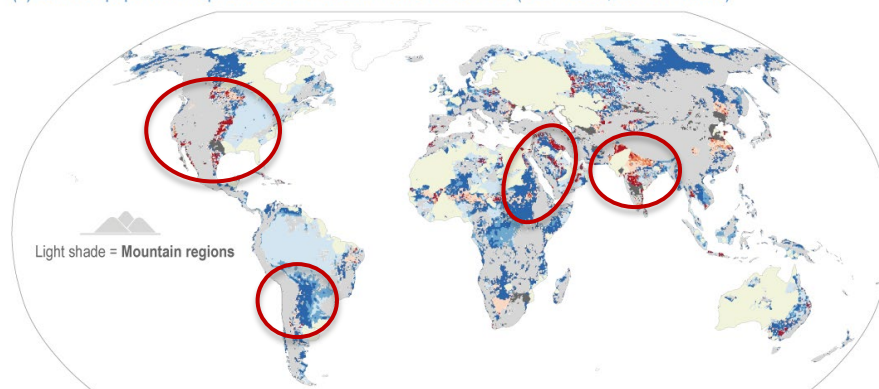


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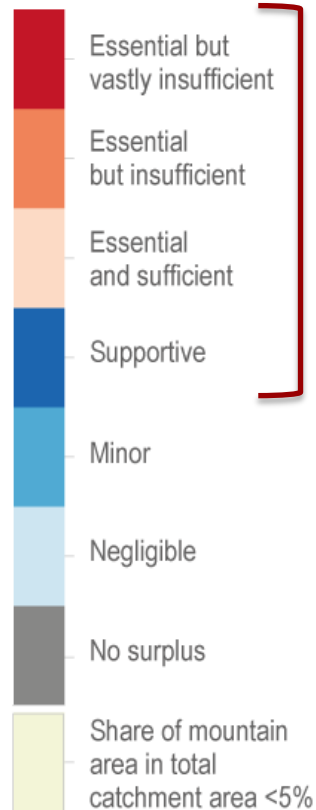
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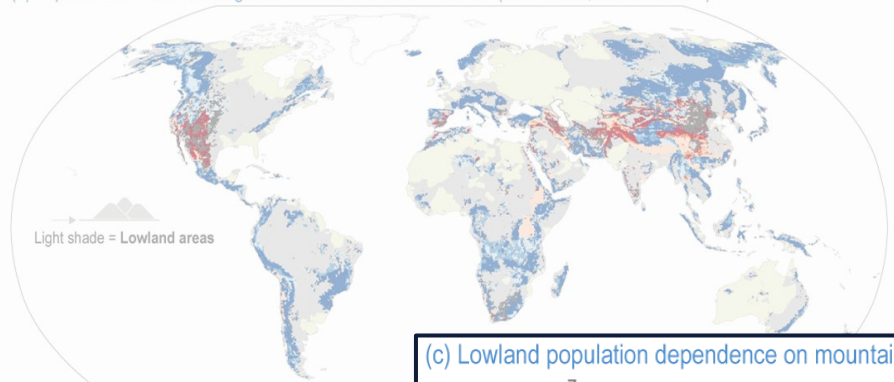


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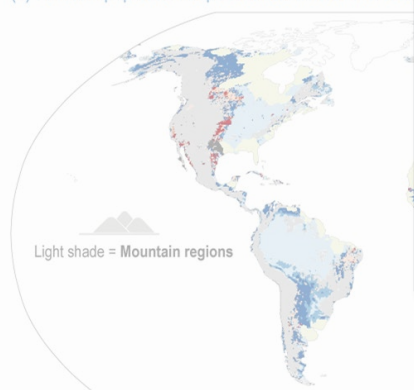


Importance of mountain water resources for lowland areas and populations

(a) Importance of mountain regions for lowland water resources (2041–2050, SSP2-RCP6.0)



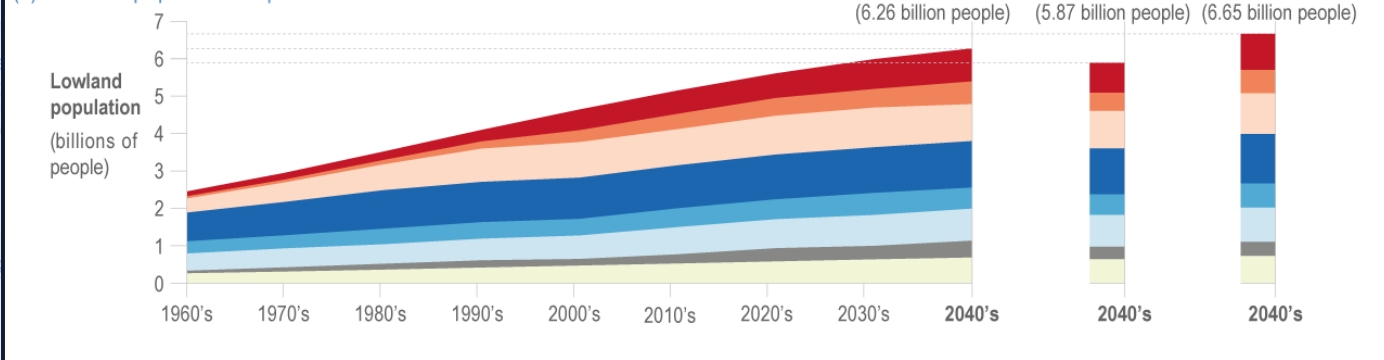
(b) Lowland population dependence on mountain water resources



Mountains are an essential source of freshwater for large, and growing populations

The number of people largely or fully dependent on water from mountains has increased worldwide from ~0.6 billion in the 1960s to ~2 billion in the past decade.

(c) Lowland population dependence on mountain water resources over time





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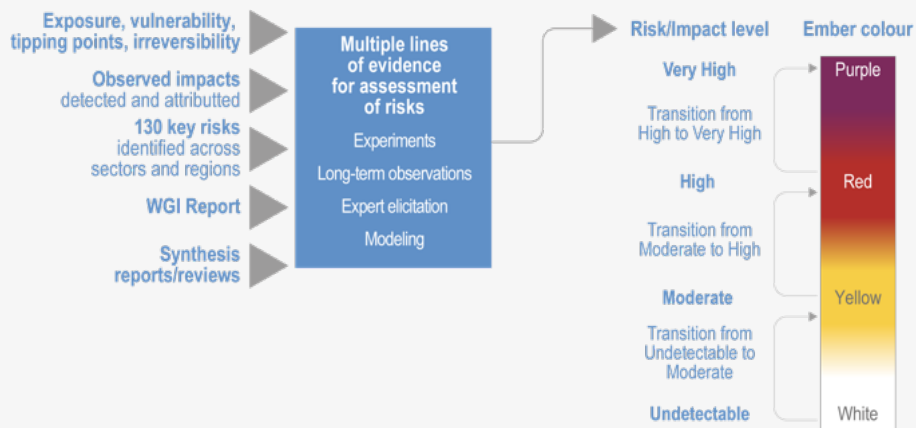
Increasing temperatures will continue to induce changes in mountain regions throughout the 21st century, with expected negative consequences for mountain cryosphere, biodiversity, ecosystem services and human well being (CCP5.3.1)

Projected impacts at 1.5°C and beyond

- Many low elevation and small glaciers will lose most of their total mass at 1.5°C.
- Endemic mountain species will be at increasingly risk of extinction by exceeding 1.5°C (even temporarily).
- Regions relying on glacier- and snow-melt for irrigation will face erratic water supply and increased food insecurity (already irreversible).
- Damages and losses from water related hazards such as floods and landslides are projected to increase between 1.5°C and 3°C. Globally projected increase in direct flood damages are 2.5-3.9 times higher at 3°C compared to 1.5°C.



Key risks assessments and key risks in mountains



- Loss of lives, harm to people, and damages to infrastructures from landslides and floods.
- Adverse impacts to livelihoods and risks to economic sectors for mountain communities and in the lowlands from changes in water supply and its managements.
- Changes to mountain ecosystems and risks of mountain top species extinction due to warming and range constraints including shifts in treelines.
- Intangible losses and harm to people and loss of cultural values from decline of ice, snow cover and warming as well as increase in disasters.

Loss of lives, harm to people, and damages to infrastructures from landslides and floods

People and infrastructure in mountain regions at risks of landslides and/or floods
for 1.3–1.7°C, 2.0–2.5°C and 4°C Global Warming Levels

(a) Risks in AR6 WGI reference regions

Global warming per subregion



Risk



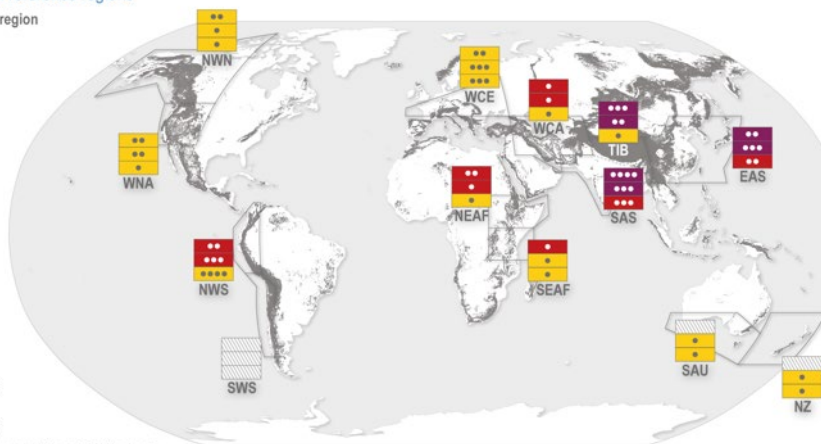
Confidence



Mountain regions

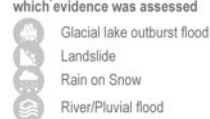
AR6 WGI reference regions

Dotted border between TIB and SAS is due to discrepancies between studies referring to the Southern Himalaya as part of SAS, and the new AR6 WGI reference region delineations which include most of the Southern Himalaya in TIB.



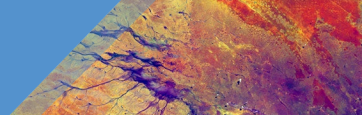
(b) Risk and driving hazards in mountain regions

Principal hazards for which evidence was assessed



Risk



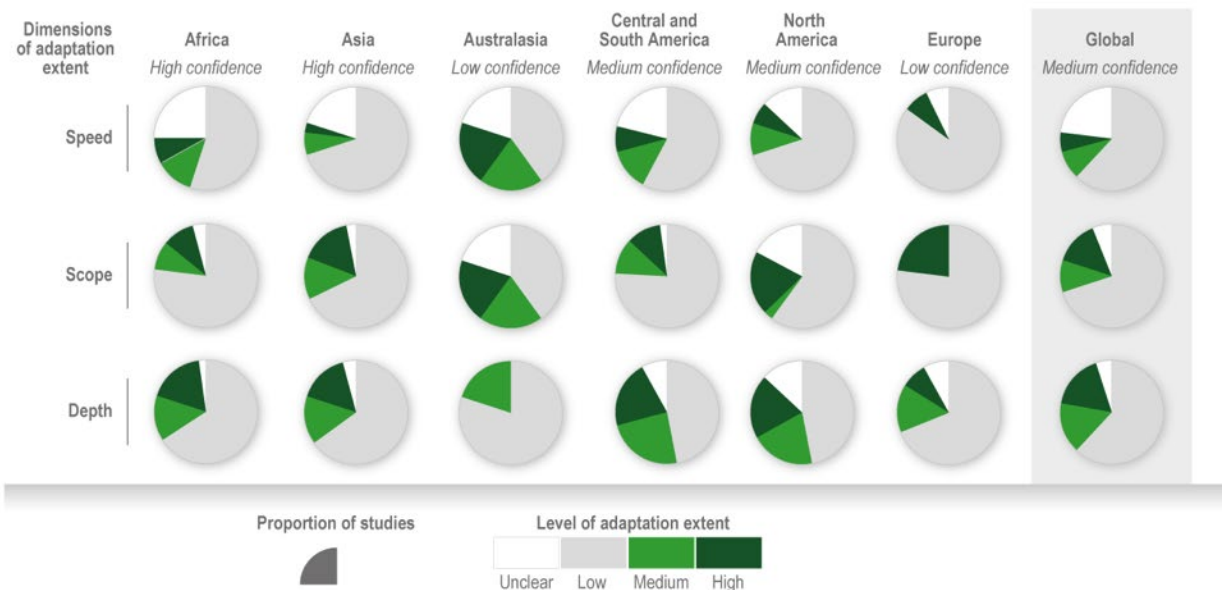


Examples of severe consequences in mountains by mid to end century

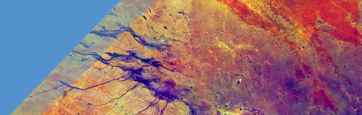
- **Twofold average** increase in the number of people exposed to inland flooding between **2°C and 4°C** with highest increases in South Asia, Southeast Asia and North-western South America.
- **By mid century 50 to 100%** of the lowland population is projected to become water stressed in areas dependent on essential but largely insufficient share of freshwater (e.g. Northwestern South America, Central Asia).
- Underlying conditions contributing to the severity of consequences: current level of vulnerabilities continuing into the future (e.g. Northwestern South America and South Asia); people and infrastructure in new hazard prone locations; high dependency on water supplies from snow melt and glaciers (e.g. Northwestern South America, Central Asia, South Asia); limited financial resources and low adaptive capacity.

The extent of implemented and planned adaptation in mountains is insufficient to address future (key) risks in mountains and in particular at higher warming (beyond 1.5°C)

Extent of adaptation observed in mountain regions

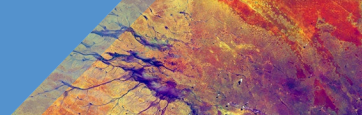


Extent of planned and implemented adaptation actions observed in mountain regions shown in terms of three dimensions: i) speed (timeframe within which adaptations are being implemented), ii) scope (the scale of changes observed from the adaptation action), and iii) its depth (i.e., degree to which a change reflects something new)



With warming above 1.5°C the needs for adaptation to address the key risks becomes increasingly urgent. We are not on track to achieve a climate resilient, sustainable world

- Effective measures to reduce risks are those that are robust under uncertain futures (i.e. allow for adaptive planning), incorporate people's concern and values and address multiple risks.
 - Examples: Ecosystem-based adaptation / awareness raising combined with early warning systems; multi-purpose water reservoirs.
- Regional cooperation and transboundary governance enable long-term actions where risks go beyond boundaries and jurisdictions.
- Ability of adaptation to reduce risks declines with increasing warming.
- The scope and options to achieve a climate resilient and sustainable development will become more limited by 2°C and might not be possible in some regions and sub-regions (including mountains) if warming exceeds 2°C.



THANK YOU

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