



A landscape photograph showing a wide river in the foreground, partially covered with large, white ice floes. The river flows from the left towards the right. In the middle ground, there is a flat, dry plain with sparse, brownish vegetation. In the background, a range of reddish-brown mountains stretches across the horizon under a clear, bright blue sky.

Mountains and Climate Change

A Global Concern

Mountains and Climate Change: A Global Concern

Mountains are among the regions most affected by climate change, and some of the clearest evidence, such as the shrinkage of glaciers, comes from mountain areas. As the present publication shows, the implications of climate change in mountains will reach far beyond mountain areas: Climate change in mountains is a global concern.

Mountains: a key concern on the global climate change agenda

Mountains provide freshwater to half of the world's population. Climate change will affect the availability of water. In many cases, this will mean less water when it is most needed (Chapters 2 and 3 in the present publication). Regions with the most mountain land are also the regions where mountain water for surrounding lowlands is most important – including the countries across the Eurasian continent from the Middle East to China, the Andean countries, the Nile Basin, and western North America (Map page 69). Also, many countries with less mountain land critically depend on mountain waters for specific regions or uses. Climate change in mountains will thus have important implications for irrigation, urbanization and industrialization, and hydropower generation. This will mean using water more efficiently, increasing storage capacities, and establishing, or re-visiting, institutional arrangements for sharing water equitably within and between nations.

Mountain areas are typically exposed to multiple hazards. Climate change is likely to increase this exposure, as extreme events such as storms, landslides, avalanches, and rockfalls are likely to become more common and more intense in mountain areas (Chapter 4), threatening both livelihoods and infrastructure. Hazards cannot be prevented, but mountain regions can be supported in managing the risks emanating from these hazards. This support begins with preparedness and ends with recovery; key ideas include effective early warning systems, land use zoning, and strategies for intervention.

Half of the global biodiversity hotspots are in mountain regions. They are an important global heritage that is being threatened by climate change and human action (Chapter 5). Impressive achievements have been made in safeguarding this heritage; protected areas have been the fastest growing land use category in recent decades, especially in mountains. While mountain biodiversity is thus increasingly seen as a global common good by many, local communities who directly depend on its services must be included in stewardship of this valuable resource. Mountain communities should see more tangible benefits from conservation efforts than has been the case in the past. Payment for Environmental Services is a way to achieve this aim.

Mountains are home to about 10% of the global population. The large majority of mountain people live in developing countries. One third of them are food-insecure, a high proportion in global comparison (Chapters 6 and 7). Mountains are often limited-choice environments due to harsh living conditions and a marginal position in terms of economic integration and political decision-making. External support is needed in order to reduce poverty levels. As temperatures rise, however, climate change might hold prospects for mountain agriculture – for crops previously not grown or limited to lower altitudes – provided that water, land, labour and capital through credit schemes or remittances from migrants are available to exploit such opportunities, and that access to markets is assured.

The importance of moving beyond climate change

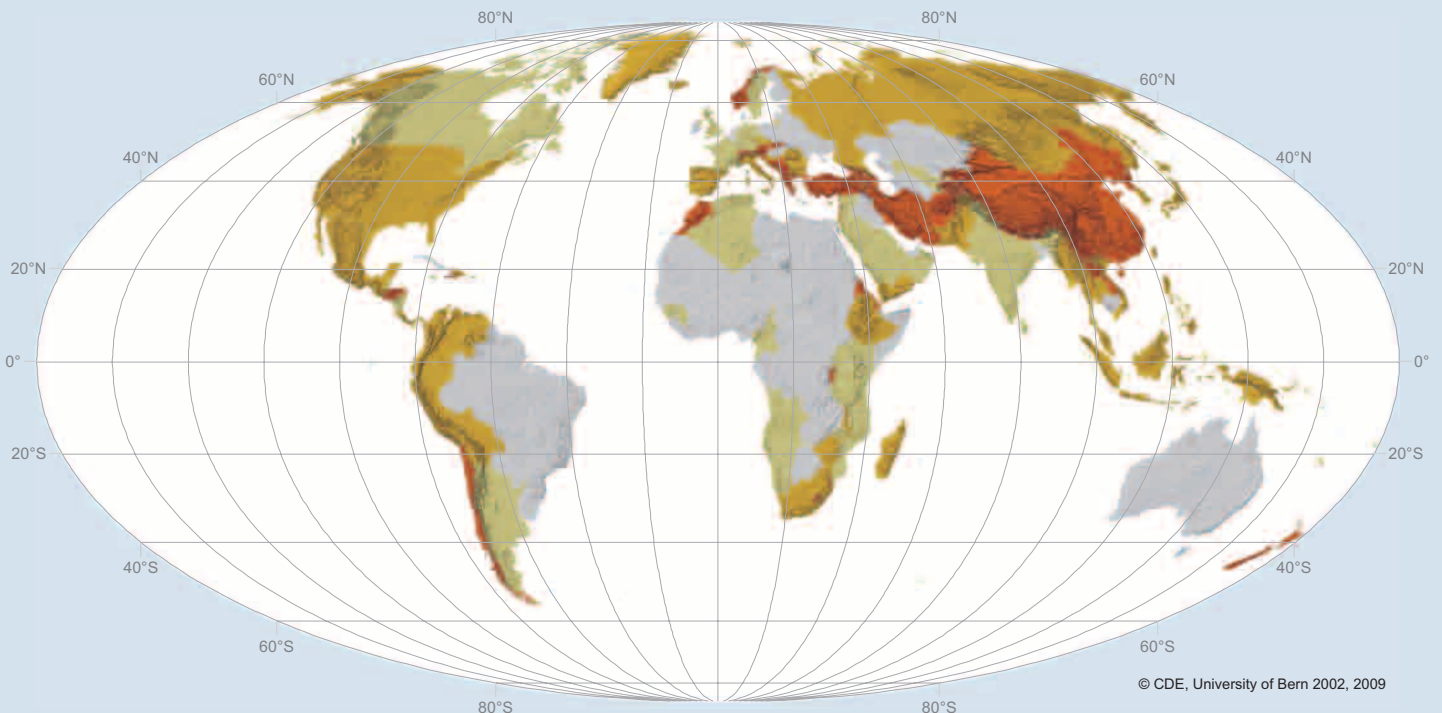
Much recent and current debate on adaptive capacity and vulnerability has been driven by the climate change agenda, but understanding the multidimensional nature of drivers of change, responses and feedback mechanisms is essential. This also applies to mountain regions, which are exposed to a wide range of mainly external drivers of change, including political, economic, and socio-cultural forces. Climate change action must therefore be embedded into a more general framework as provided, for example, by the concept of sustainable development. Any such framework will have to take note of the great diversity of mountain development contexts relating to environment, people, economies and cultures (Map below). Specific and tailored strategies will therefore be needed when it comes to climate change action. Human factors such as governance need to be considered in order to avoid simplistic projections about the impacts of climate change.

Managing climate change in mountains: a huge externality

Many mountain countries, especially those with a high percentage of mountain territory, are developing countries with lower levels of industrialization, and many are smaller nations (Map below). For these countries, adaptation is the main answer; they are far less the cause of the problem than they are the victims when it comes to climate change. For them, this change is a huge externality that will mean substantial additional costs in future. As adaptive measures are designed and implemented, the involvement of mountain populations is a must, as they have important knowledge and will be among those most directly affected by climate change and remedial action. As the case studies collected in the present publication show, the involvement of local people is increasingly becoming a reality.

Adaptation will have to be supported by mitigating measures that address the root causes of climate change: the emission of greenhouse gases and other substances that cause global warming. The involvement of economic and population centres

Map of the countries of the world and their mountain areas.



Percentage of mountainous area per country

0 – 10 %	25 – 50 %
10 – 25 %	50 – 100 %

Map scale: approx. 1:200,000,000

Map Source

Terrain data: resampled from GTOPO30, produced by US Geological Survey (UGS)

Administrative: ESRI Data and Maps

Map projection: Mollweide

Map authors: Sebastian Eugster, Hans Hurni, Albrecht Ehrensperger, Thomas Kohler and Kristina Imbach 2002 (CDE, University of Bern)

Map compilation 2009: Ulla Gaemperli Krauer (CDE, University of Bern)

outside mountain regions in industrialized, emerging and developing economies will be critical for achieving a tangible reduction of these emissions, as a major share of the greenhouse gases are released in these areas. Some of the largest emissions of greenhouse gases come from countries with a significant proportion of mountain areas, such as China, the US, and Russia (Map page 69).

The way forward

At the global level: Chapter 13 of Agenda 21, with its focus on mountain areas, as well as the UN Framework Convention on Climate Change and its Clean Development Mechanism (CDM), provide frameworks for concrete action to tackle the drivers of climate change and to mitigate its impact. It is hoped that the UN Climate Change Conference in Copenhagen in 2009 will be a starting point for strengthening these mechanisms. As many mountain countries are smaller developing nations, they have not benefited much from the CDM programme and the carbon market, due to institutional constraints and the complexity of accessing funds. This requires urgent re-examination. Mountains and money do not easily come together. Technological, financial, and institutional support for development in mountain countries thus need be strengthened. Mechanisms for coordinating and extending such support include the Global Environment Facility (GEF), the National Adaptation Programmes for Action (NAPA), and the Global Climate Change Alliance of the EU, to mention but a few mechanisms already in place.

At the national and regional levels: Many countries have established national focal points and regional bodies for managing climate change and have carried out impact assessments to determine how climate change is likely to affect them. However, progress on mainstreaming climate change adaptation has been limited, especially in relation to key development concepts such as poverty reduction policies, land use planning and zoning, and national development strategies. There is a growing number of Payment for Environmental Services (PES) programmes with proven track records in industrialized and developing countries. PES relating to watershed management, water regulation for hydropower and irrigation, biodiversity conservation, and hazard prevention are a means for ensuring that mountain communities can benefit from the implementation of measures to maintain environmental services that are important for lowland areas and their large population centres. Many of the efforts made to date in climate change adaptation are generic. Proven practices that could be upscaled are as yet lacking. Documentation and lessons learnt will thus be crucial for establishing a body of sound experience tailored to the specific needs of mountain regions.

The importance of research: The research community has a responsibility to sensitize policy-makers and the public about climate change in mountains and its implications in wider highland-lowland interactive development contexts. Research should also focus on designing integrated mitigation and adaptation measures. Given the paucity of reliable and long-term data on mountain climates and resources, especially in countries of the South and East, there is a need to establish long-term observatories and monitoring mechanisms that will allow more accurate projections of climate change, more precise assessment of impacts, and documentation of existing adaptation strategies in and beyond mountain regions. For the research and education communities, capacity development and transdisciplinary approaches will be important components of all these activities.

Now is the time for action in addressing climate change issues in mountains. This could help transform currently perceived problems into opportunities for a better future in mountain regions and in the many lowland areas that depend on their services.

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“By three methods we may learn wisdom:
first, by reflection, which is noblest;
second, by imitation, which is easiest;
and third, by experience, which is the most bitter.”

Confucius