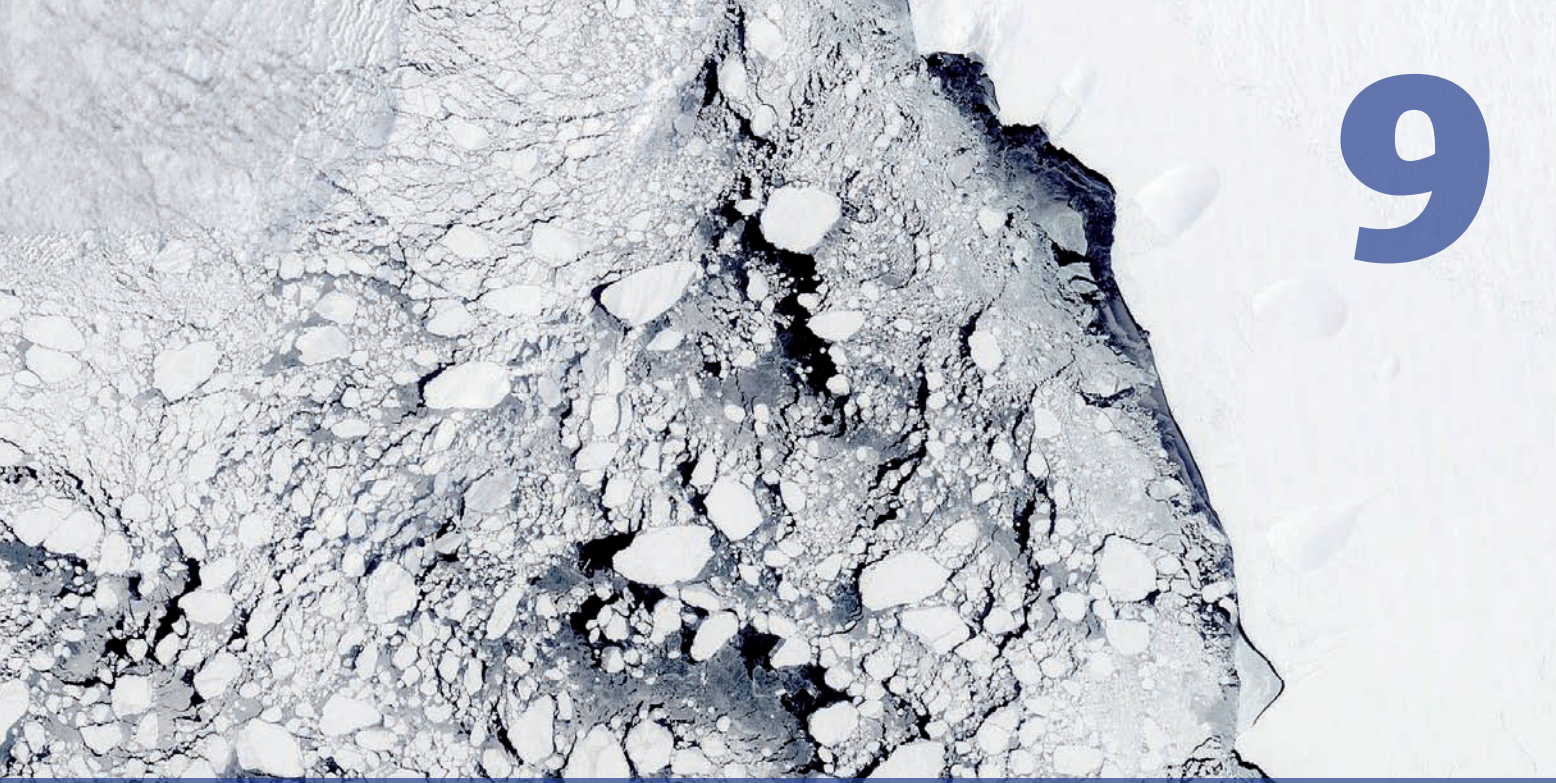

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Policy and Perspectives

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Policy and Perspectives

Photo: Christopher Uglow/UNEP/Still Pictures

Wrap up of key messages

The underlying theme in the preceding chapters is that changes are now observed in ice and snow and bigger changes are projected. The greenhouse gases from past and current emissions remain in the Earth's atmosphere for decades to centuries. Most of the extra heat on Earth caused by emissions of anthropogenic greenhouse gases is stored in the oceans. These two factors will lead to further changes in ice and snow no matter how quickly the world acts to reduce emissions. There is a danger of this time gap between policy implementation and real results leading to thinking that the situation is beyond control – but the projections for future change also make it clear that policies implemented now will have a real impact in slowing global warming in the decades and centuries to come.

Some of the impacts from changes in ice and snow are immediately visible, often showing up as increased frequencies of events that are within the range of natural variation. For example, winter roads might be open on average fewer days in the Arctic; feeding conditions might be poor for caribou and reindeer more frequently than in the past; amount and timing of runoff from snowmelt in the Andes, Alps or Himalayas might result in local water shortages in more years. Over time these short-term events lead to longer-term consequences including changes in biodiversity, ecosystems and regional economies.

In several chapters the theme of gradual and abrupt changes is discussed. Projections for future change are built on climate models, incorporating to the extent possible the complexity of interactions and feedbacks among atmosphere, oceans and land. The results are projections of incremental change – a bit warmer each decade, on average a bit more ice melting from the Greenland ice sheet each year. This type of change is somewhat predictable, as long as one takes into account the natural year-to-year variability in climate conditions. In discussing changes in ice and snow in the preceding chapters, authors reference the possibility of another type of change – abrupt, 'catastrophic' and unpredictable change that results in a jump in the line on the graph, a shift from one state to another. We know from ice cores in Greenland that abrupt climate change may happen naturally. These 'tipping points' can be related to the cryosphere itself. For example the break up of a section of an ice shelf in Antarctica may remove the plug at the end of glaciers draining the ice sheet, leading to a sudden increase in the rate of movement of land ice to the sea, directly translated into sea-level rise. Some of these abrupt changes are related to ecosystems, biodiversity

Sea-ice research in the Fram Strait between Greenland and Svalbard. *Photo: Sebastian Gerland, Norwegian Polar Institute*

and human well-being. When there is no more summer sea ice in the Arctic, some ice-adapted animal populations and species could be driven rapidly to extinction, from the ice algae and crustaceans that are key components of polar marine food webs to polar bears whose life cycles are built around the existence of year-round sea ice. There are potential cascading effects from these abrupt changes, including on the people whose livelihoods and cultures are tied to the affected resources.

The chapters in this book are built around components of the cryosphere, and the impacts are considered one by one. But in the real world, these impacts interact with one another, often in unexpected ways, in some cases resulting in greater impacts, in some cases partially compensating for one another. This is further complicated by negative and positive feedbacks altering the rates of change. This theme of complexity is introduced in the discussion of feedbacks and interactions in Chapter 3 and picked up in the subsequent chapters in discussions of impacts. The chapter on sea-level rise (Chapter 6C) discusses the complexity of interactions associated with assessing and responding to the impacts from sea-level rise.

Another message from the preceding chapters is the need for a concerted effort to improve research and long-term monitoring to address the gaps in our knowledge about what is happening with ice and snow. Some of the biggest questions, of most significance for the long-term future of human societies on Earth, are related to the fate of the ice sheets and the consequences to sea-level rise. But there are many other questions that need to be answered about how the changes in ice and snow affect climate and oceans, biodiversity, and human well-

being. It is clear from these chapters that there is optimism that the research and monitoring campaigns initiated through International Polar Year 2007–2008 will address these questions and reduce uncertainty about the outlook for ice and snow.

Policy responses and options

How will these changes in ice and snow affect human well-being? What policy issues will arise from these impacts? How are policymakers likely to frame these issues for public consideration and to evaluate the benefits and costs of the policy responses and options they identify? In order to answer these questions, we address a selection of key policy issues arising at the global, regional and local or community levels.

Global policy issues

From understanding to addressing climate change

Throughout the 1980s, a growing body of scientific documentation on the potential threat anthropogenic climate change could pose to ecosystems and human societies led the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to establish the Intergovernmental Panel on Climate Change (IPCC) in 1988. The IPCCs mandate is to assemble the best understanding and knowledge on climate change, its potential impacts and options for adaptation and mitigation (see box on the IPCC process).

The first IPCC assessment report in 1990 triggered the negotiation of the United Nations Framework Convention on Climate Change (UNFCCC). Thereafter, the momentum towards addressing climate change has further increased leading to the adoption of the Kyoto Protocol in 1997 which set targets to reduce greenhouse gases emissions and mitigate climate change.

Complementary to mitigation, adaptation measures are needed to respond to the impacts of past and on-going greenhouse gas emissions. Adaptation policy and measures, being region-specific, require increased resolution in scientific knowledge and call for regional climate impacts assessment. In 2000, the Arctic Council, the organization for governmental cooperation among the eight Arctic states, decided to conduct a full impact assessment for the Arctic region. Completed in 2004, the Arctic Climate Impact Assessment (ACIA) was submitted to the ministerial conference of the Arctic Council. The ACIA is the only regional impact assessment conducted for ice and snow covered areas.

Under the Norwegian Chairmanship (2006–2009), the Council is working on follow up on the ACIA's recom-

The Intergovernmental Panel on Climate Change

The mandate of the IPCC is to "assess the scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation." The IPCC does not carry out research, nor does it monitor climate-related data or other relevant parameters. Rather, it bases its assessment mainly on peer-reviewed scientific and technical literature that has already been published. The comprehensive assessment process involves the input of hundreds of scientists in compiling, analysing and synthesizing existing scientific publications to draw conclusions about the status of our scientific understanding of climate change.

One of the factors that have made IPCC successful is that it strives to be policy relevant but not policy prescriptive. IPCC reports benefit from a process founded on scientific integrity, objectivity, openness and transparency. Confidence in the results is enhanced through a rigorous review process and an adoption and approval process that is open to all member governments.

mendations by producing status reports on the impacts of vanishing sea ice, possible meltdown of the Greenland ice sheet, and on changes in permafrost. A study on adaptation challenges will also be carried out with the aim of enhancing the adaptive capacity of Arctic residents.

Options to mitigate climate change

One of the main conclusions of the fourth IPCC assessment report is that it is very likely (more than 90 per cent) that most of the global warming during the last 50 years is due to the observed increase in human-made greenhouse gas concentrations, and that continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century[1].

Today, the CO_2 level in the atmosphere has increased by 40 per cent over pre-industrial levels. Under a business-as-usual scenario for emissions from human activities, a doubling will occur in 50–80 years, depending on the rate of increase in emissions and how much nature will absorb, which would most probably lead to a global temperature increase of 3 °C.

A global temperature increase of more than 2–3 °C will constitute dangerous climate change with unacceptably high risk of:

- Significant negative impacts on global food production and water supply;
- Large-scale changes in ecosystems and biodiversity that will negatively affect ecosystem services;
- Melting of parts of the Greenland and Antarctic ice sheets with subsequent devastating sea-level rise;
- Irreversible abrupt climate changes, such as large-scale changes in ocean currents.

To avoid such temperature increases, greenhouse gases must be stabilized at a level below a doubling of pre-industrial levels. Achieving this means that no later than 15 to 25 years from now emissions will have to stop increasing and start decreasing significantly – to about 10–50 per cent of currents levels by 2050[2]. In the longer term, emissions must be cut by as much as 70–80 per cent in order to stabilize the Earth's climate system.

Recent comprehensive assessments and reports[2,3,4] indicate that such emission cuts can be achieved over the next few decades without significant welfare losses. The cost is estimated to be less than 2 per cent of the gross domestic product (GDP), well below the rate of growth in the economy. Many of the needed technologies exist, and the potential for improving them and developing new technologies is high. It is the sum of many small and medium contributions to reductions in emissions through the use of several different kinds of technologies for energy efficiency, renewable energy, and carbon capture and storage (CCS) that is likely to constitute the solution in the end.

At the political level, there is a wide variety of policies, measures and instruments that could be applied to stimulate the use of alternative existing technologies, improve them and develop new technologies. According to the IPCC[2], "A positive 'price of carbon' would create incentives for producers and consumers to significantly invest in lower carbon products, technologies and processes." A carbon price of US$20–50 per tonne of CO_2 equivalent could largely decarbonise power generation and make many mitigation options in the end-use sectors attractive[2–4]. A uniform carbon price must be globally accepted to ensure equal conditions for competition in a globalized economy. In addition, incentives related to direct governmental funding and regulations are required. For example, the development of new technologies will depend on large-scale governmental funding of research and development.

Regional policy issues

It is natural to turn first to the polar regions in thinking about regional policy issues. But the impacts of changes in ice and snow are not limited to the high latitudes. In mountainous areas where glaciers are prominent features of the landscape and the annual snow pack is an essential source of fresh water, changes in ice and snow will produce substantial impacts on human well-being. In this discussion of regional policy issues, we look at selected issues in three regions: the Arctic, the Antarctic, and the Himalayas.

Arctic: jurisdiction, oil, and minerals

In the Far North, the key policy issues centre on the prospects that retreating sea ice will open up the Northeast and Northwest Passages for commercial shipping and increase access to commercially significant deposits of oil and gas located in shallow waters of the Arctic littorals. If current forecasts regarding the navigability of Arctic waters (such as ice-free navigation along the Northern Sea Route for up to 120 days per year during this century) hold, incentives to ship a variety of goods – especially between Europe and the Far East – will grow rapidly in the coming decades. The combination of large recoverable reserves of oil and gas (25 per cent or more of the Earth's untapped reserves according to the US Geological Survey) and the relative security of the Arctic in geopolitical terms can be expected to make the extraction of hydrocarbons in this area irresistibly attractive.

These developments will give rise to two sets of policy issues that cannot be avoided even in the short run. The first set concerns jurisdiction. Already, Canada and Russia are taking steps to assert extended Exclusive Eco-

Arctic sea ice.
Photo: Andrea Taurisano, Norwegian Polar Institute

nomic Zones and enhanced control over continental shelves in the Arctic Basin. These jurisdictional issues will require resolution under the terms of Parts V (Exclusive Economic Zone) and VI (Outer Continental Shelf) of the UN Convention on the Law of the Sea (UNCLOS), even though the United States has never formally ratified UNCLOS. Article 234 on "ice-covered areas" may provide a point of departure for some initiatives relating to these matters. One option that may prove attractive is an agreement on jurisdiction in the Arctic Basin settling competing claims among the five littoral states, granting primacy in the region to these states, and making some provision for navigation in Arctic waters on the part of others.

The second set of issues concerns rules governing shipping and oil and gas development. The creation of regulatory regimes will be the first order of business. Some existing agreements, such as the International Convention for the Prevention of Pollution from Ships (MARPOL), already apply to the Arctic Basin. Designation of the Arctic as a Special Area under MARPOL was proposed by the Arctic Council's working group on the Protection of the Arctic Marine Environment several years ago, but the proposal did not receive the necessary consensus from the eight Arctic nations.

Other potential mechanisms include the development of a regional regime intended to articulate and codify standards for environmental protection in the Arctic under UNEP's Regional Seas Programme. The US and probably Russia are likely to oppose such a move. To the extent that oil and gas development occurs in areas under coastal state jurisdiction, national regimes governing such activities will apply. Even so, the fact that the Arctic Basin is a single system with its own biophysical dynamics will almost certainly stimulate efforts on the part of some coastal states to develop a regional regime to minimize adverse impacts of oil and gas development on Arctic ecosystems.

Antarctic: tourism expansion

Antarctic annual sea-ice extent is projected to decrease by 25 per cent by 2100 (Chapter 5), and this will bring easier access to the Antarctic continent by ship. This is likely to affect not only research, which is a main activity in a continent designated as a "natural reserve devoted to peace and science", but also commercial activities, such as tourism.

Tourism activities are expanding tremendously with the number of shipborne tourists increasing by 430 per cent in 14 years and land-based tourists by 757 per cent in 10 years (Figure 9.1). The majority of the seaborne voyages are to the Antarctic Peninsula region where the open sea condition in the summer season makes those voyages feasible and safer. Parallel to the growth in tourism is a substantial increase in tour-

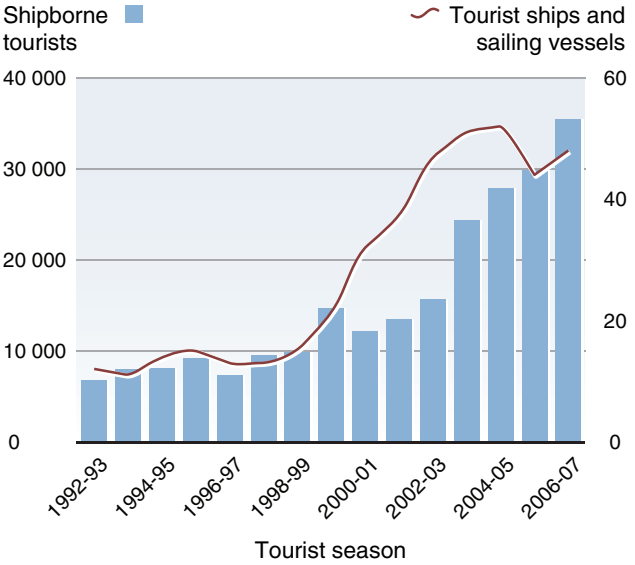


Figure 9.1: Growth of tourism in Antarctica.

Source: IAATO 2007[6]

ism vessels, some with large passenger capacities and without ice-strengthened hulls, such as the *Golden Princess* which has a capacity of 3700 persons, exceeding the estimated peak in personnel based in all Antarctic stations[5].

The projected retreat of sea ice is likely to lead to an expansion of tourism activities, as more sites will become accessible by sea and the season will lengthen. This, in turn, is likely to increase the risk tourism presents to the marine environment, as well as to terrestrial ecosystems, as over 80 per cent of the tourists land during their journeys. This will also present new challenges in maintaining the unique characteristics Antarctica presents for scientific monitoring and research on processes of global and regional importance. The growth in tourism has the potential to affect national research programmes through increased demand for services such as weather forecasting and search and rescue services.

In order to address these challenges, a comprehensive regime on tourism should be developed, complementary to the Madrid Protocol on Environmental Protection to the Antarctic Treaty, which provides a regulatory framework for human activities in Antarctica.

Himalayas Hindu Kush region: water supply and flood risk

Hundreds of millions of people are vulnerable to impacts from climate change in the mountain ranges and lowlands surrounding the Tibetan Plateau, far into Central Asia, Pakistan, India, Bangladesh and China. As discussed in Chapter 6B, projected changes in snowfall and in glacier melt are expected to lead to major impacts including increased flood risk and water shortages in many parts of this huge and densely-populated region.

River in Nepal.
Photo: Christian Lambrechts

These changes are exacerbated by unsustainable natural resource management practices which lead, for example, to substantial deforestation and overgrazing in most watersheds[7,8].

Addressing these issues will require strategies and policies related to land-use and water management, for example:

- Watershed management and protection: In most of the countries only 1-5 per cent of the watersheds are protected, leaving little in the way of natural buffers against flash flooding.
- Poverty alleviation and financial mechanisms to support development of more sustainable grazing and wood-cutting practices. In particular, improved household consumption patterns of firewood would increase the resilience of watersheds to greater seasonal fluxes of water flows.
- Development of alternative settlement opportunities for impoverished people who often settle in the available flatlands and low-lying urban areas exposed to floods.
- Assistance with transition to new economic bases for livestock-based villages in dry mountain areas where less snowfall and reduced snow seasons may lead to loss of traditional grazing lands.

Drying fish in a Greenland community.
Photo: Stine Rybråten/CICERO

Local policy issues in the Arctic

The impacts of changes in ice and snow are already major concerns in small communities scattered throughout the circumpolar North. Among the most significant of these are damage to infrastructure (such as buildings, municipal water and sewage system, roads, pipelines and airfields) arising from coastal storm surges and the deepening of the active layer of the permafrost; threats to safety (such as disintegration of sea ice used by hunters as a staging area) caused by unfamiliar weather conditions; health and nutritional concerns (related to availability of country food) associated with changes in the abundance and migratory patterns of subsistence resources, and a variety of social effects arising from the growth of commercial shipping and oil and gas development. The significance of these effects will vary from one community to another, and responses will differ – sometimes dramatically – from one part of the Arctic to another. What is clear is that most individual communities lack the capacity to cope effectively with these stresses, either because they do not have the resource base needed to reconstruct physical infrastructure or to relocate or because they do not have the authority to make binding decisions about key issues (such as the social impacts of commercial shipping). Actual responses are likely to reflect differences in the political and legal systems of the individual Arctic states. In the US, the State of Alaska will be a source of support for individual communities facing the impacts of changes in ice and snow. In Greenland, the government of Denmark is a likely source. Other affected communities, for example in the Russian North, may not receive sufficient support from outside of their regions.

While the impacts considered in the preceding paragraph are generally negative, changes in ice and snow may also have positive consequences at the local level. Oil and gas development can become a source of jobs; there is some prospect that changes in sea ice will permit the development of commercial fisheries in areas located farther north than existing fisheries, and conditions for agriculture may improve under a moderate warming. Jobs in the energy industry are often transient, and the sustainability of commercial fisheries in the Arctic may be low. So long as expectations are moderate and communities are careful to avoid undue dependence on these sectors, however, changes in ice and snow can become a source of benefits as well as threats to human well-being.

Perspectives on changing ice and snow

The essays below are from people living with and planning for the consequences of changing ice and snow in the Arctic, Pacific Islands and Nepal.

All things are connected...

A perspective from an indigenous world view

Patricia Cochran, Chair,
Inuit Circumpolar Council

In indigenous cultures, no one part of an ecosystem is considered more important than another part and all parts have synergistic roles to play. Indigenous communities say that "all things are connected" – the land to the air and water, the earth to the sky, the plants to the animals, the people to the spirit.

The Arctic may be seen as geographically isolated from the rest of the world, yet the Inuit hunter who falls through the thinning sea ice is connected to melting glaciers in the Andes and the Himalayas, and to the flooding of low-lying and small island states. What happens in foreign capitals and in temperate and tropical countries affects us dramatically here in the North. Many of the economic and environmental challenges facing Inuit result from activities well to the south of our homelands, and what is happening in the far North will affect what is happening in the South. If the Greenland ice sheet melts (as it seems to be doing now), not only do world water levels rise, but scientists speculate that dumping such massive quantities of cold water into the Atlantic may very well affect the Conveyer Belt. This circularly moving body of cold and warm waters regulates climate in much of the Northern Hemisphere. We are all connected on this planet and the Arctic plays an important role.

Living with snow and ice changes

An Indigenous Elder perspective

Caleb Pungowiyi,
Kotzebue, Alaska

"Since the late 1970s, communities along the coast of the northern Bering and Chukchi Seas have noticed substantial changes in the ocean and the animals that live there. We are seeing clear trends in many environmental factors and, we can expect major, perhaps irreversible, impacts if those trends continue.

The patterns of wind, temperature, ice and currents in the Bering and Chukchi Seas have changed. The winds are stronger and there are fewer calm days. In spring, the winds change the distribution of the sea ice and, combined with warm temperatures, speed up the melting of ice and snow and force many marine mammals to move away, often too far to be hunted. Near some villages, the wind may force the pack ice on the shore, making it impossible for hunters to move their boats from and back to the shore. High winds also make it difficult to travel in boats, reducing the number of days that hunters can go out. These reasons have reduced access to animals during the spring hunting period.

From mid-July to September, there is more wind from the south, making the season wetter. With less sea ice, fall storms are eroding much more of the coastline, threatening houses and even entire communities. Wave action has changed some sandy beaches into rocky ones as the sand washes away.

The formation of sea ice in fall has been late in many recent years. In such years, the ice is thinner than usual, which contributes to early break-up in spring. Another aspect of late freeze-up is the way in which sea ice forms. Under normal fall conditions, the cold water and the permafrost under the water help create ice crystals on the sea floor. When large enough, these crystals float to the surface, carrying sediments. The sediments contain nutrients that will be released in spring stimulating algae growth and the entire food chain.

Precipitation patterns have also changed, with a shift in snowfall from fall to late winter or early spring. The lack of snow makes it difficult for polar bears and ringed seals to make dens for giving birth, or in the case of male polar bears, to seek protection from the weather. The lack of ringed seal dens may affect the numbers and condition of polar bears, which prey on ringed seals and often seek out the dens. Hungry polar bears may be more likely to approach villages and encounter people.

Other marine mammals have been affected by the changes in sea ice, wind and temperature. The physical condition of walrus was generally poor in 1996-98 due to reduced sea ice which forced the walrus to swim farther between feeding areas in relatively shallow water and resting areas on the distant ice, compounded by a lower productivity of the sea bed. In the spring of 1999, however, the walrus recovered following a cold winter with good ice formation in the Bering Sea.

As we think about the future, we wonder what alternatives are available to Native villages in the Arctic. If marine mammal populations are no longer accessible to our communities, what can replace them? Today, there are stores with food and other resources that can be harvested. A gradual change might give us time to adjust, but a sudden shift might catch us unprepared and cause great hardship. We need to think about the overall effects on marine mammals and other resources. Some may adjust, but others will not. Our ancestors taught us that the Arctic environment is not constant, and that some years are harder than others. But they taught us that hard years are followed by times of greater abundance and celebration. As we have found with other aspects of our culture's ancestral wisdom, modern changes, not of our doing, make us wonder when the good years will return.

Vanishing beneath the waves

A Pacific island perspective

Taito Nakalevu,
Apia, Samoa

The sea has been part of Pacific islanders' life since the beginning of time. It has influenced the way they build, plan and carry out daily activities. It has also been an agent of chaos and change. Pacific islanders are now used to seeing islets vanish beneath the waves after cyclones or other extreme events. The greater worry at present for most Pacific nations is whether extreme events will increase in the future.

Pacific Island countries are some of the most vulnerable communities in the world and are already experiencing the effects of climate change. The Intergovernmental Panel on Climate Change, which represents the consensus of 2,000 scientists, talks about a rise in sea level up to a metre or possibly higher, depending on the melting of the Antarctic and Greenland ice sheets over the next 50 to 100 years. This is worrying particularly for low-lying atoll islands like Tuvalu, Kiribati and other Pacific islands. Many of the islands are not more than a few metres above water, so a sea-level increase of as little as half a metre would completely inundate some of those island States and threaten their populations.

The problem with sea-level rise is that it would exacerbate storm surge, erosion and other coastal hazards, threatening vital infrastructure, settlements, and facilities that support the livelihood of island communities. Prior to 1985, the Cook Islands had been considered to be outside the main cyclone belt and could expect a major twister every 20 years or so. But all that has changed. In 2005, in one month alone, five cyclones swept the Cook Island waters, three of which were classified at Category 5 intensity. In 2004, Niue had been hit by Cyclone Heta, with the ocean rising above the 30 metre cliffs, leaving two people dead and 20 per cent of the population homeless.

Early in the morning of April 16 this year, six families from the settlements of Tekavatoetoe on Funafuti in Tuvalu were evacuated from their homes after severe flooding from unusually high swells. Radio Tuvalu says the families were moved to the Tuvalu Red Cross with the assistance of the Disaster Management, the Police and the Red Cross. One of the woman rescued from her home told Radio Tuvalu that the first huge wave came around 4 o'clock on Monday morning. It swept most of their belongings out into the sea.

Many international environmental activists argue that Tuvaluans and others in a similar predicament should be treated like refugees and given immigration rights and other refugee benefits. This tiny nation was among the first on the globe to sound the alarm, trekking from forum to forum to try to get the world to listen. New Zealand did agree to take 75 Tuvaluans a year as part of its Pacific Access Category, an agreement made in 2001. But Tuvalu is not alone in the Pacific with its worries. Other states, such as Kiribati, are also confronted with rising sea level problems.

Some theorize that sea level rise and storm surges would simply "rearrange", but not obliterate, an atoll island like Tuvalu. Rearrangement would be bad enough for people in Pacific nations because any new land tenure issue would compound the already complex land tenure systems currently plaguing many Pacific nations. In fact, it could lead to a new security issue for the islands as some people may benefit while others lose out completely.

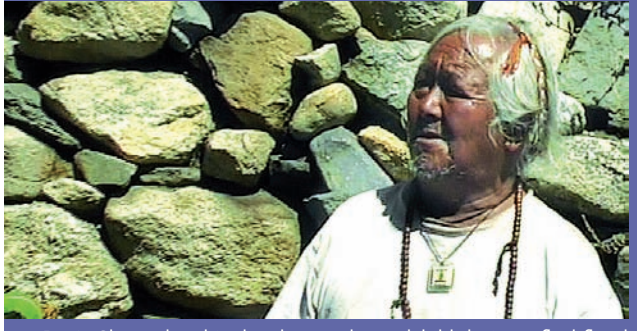
Himalayan meltdown

A Himalayan perspective

Kunda Dixit,
Kathmandu, Nepal

Ang Phurba lives in Khumjung near the base of Mt Everest in Nepal. The 65-year-old Sherpa has seen mountaineering expeditions come and go, but he has also seen other changes. In his own lifetime, the snowline on the northern flank of the 7000 m Thamserku is higher. "The ice used to come down to there in this season," he says pointing to eye-level, "now it's up there."

On nearby Ama Dablam, the signs of glacial retreat are dramatic. Seracs at the mouth of a short glacier on its west face are now 1000 m higher than the remnants of a terminal moraine. Right across the Nepal Himalaya, glaciers are receding dramatically. Moraine ponds in the Annapurnas, Everest and other mountains that climbing expeditions had taken pictures of in the 1950s have now become lakes up to 3 km long. In the Rolwaling Valley northeast of Kathmandu, the Tso Rolpa glacier has a lake that is about to burst its moraine dam. Nepal and Bhutan have more than 50 new glacial lakes that could unleash catastrophic outburst floods downstream.



Dorje Sherpa lost his daughter and grandchild during a flashflood triggered by a glacial lake on Ama Dablam that burst in 1993. He does not link the tragedy to global warming. He says: "The gods must have been angry, why else would it have happened?"
Photo: Naresh Newar

The lake-side town of Pokhara in central Nepal is one of the most spectacularly scenic places on earth. It is located at 600 m and less than 30 kilometres away rises the dramatic fishtail-shaped double peak of Machapuchre at 7000 m. The past two winters, the people of Pokhara have seen an apocalyptic sight: the black summit pyramid of Machapuchre completely devoid of snow.

Most Nepalis realise that something crazy is going on with the weather. Kathmandu saw its first snow in 63 years this spring. A localized hailstorm in central Nepal in April was so severe it pulverised a whole village. But most of us don't link all this to global climate variability. And even if we did, there is a feeling that it is beyond our control.

The Himalaya and the Tibetan Plateau are the water towers for Asia's biggest rivers. The source of the Yangtse, Mekong, and Irrawady are in eastern Tibet. The Brahmaputra, Ganges and Indus all begin within 30 km of each other near the tri-junction of the borders between Nepal, China and India.

What happens to the snows that feed these rivers due to global warming will determine the future of the billion people who live downstream. Think of that the next time you stop at a petrol station.

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