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Meltdown

Climate Change and the Greening of the Alps



Left: The Mont Blanc massif photographed by Walter Mittelholzer in 1919. The Swiss pilot and entrepreneur was the first man to fly over the snows of Kilimanjaro.

Right: The Mont Blanc massif photographed by researchers from Dundee University in 2019.

With another summer of record temperatures and heat waves across Europe the signs of a warming planet are all too evident. The effects of climate change have significant consequences for plants and animals, their habitats and their ultimate survival. This article takes a look at the changing climate in the European Alps where it is having a pronounced and visible impact on both the physical environment and the living world.

Last year was exceptional in many ways in terms of climate. It followed a trend in which 16 of the past 17 years have been the warmest on record. The winter before saw little snowfall in the Alps and very mild conditions too. A hot, dry summer followed across Europe and the Alps experienced rapidly deteriorating conditions. These conditions have been widely reported with major Alpine events including the tragic news of a serac collapse on the Marmolada glacier in the Dolomites that killed 10 mountaineers in its worst recorded incident. Rock collapse, widening crevasses and generally



A large moraine abandoned by the retreating Glacier du Râteau.

poor glacier conditions have also led to the closure of some normal routes up major Alpine peaks including the Matterhorn, Mont Blanc and Jungfrau.

Impacts of Climate Change

At the scale of the European Alps, over the course of the 20th century, temperatures have risen by 2°C which is double the increase recorded in the northern hemisphere. This rate of warming, observed since the industrial revolution, has accelerated in the past 40 years (see fig 1 overleaf). Data recorded by MeteoSwiss in 2022 reported a record-high freezing point of 5,184 metres – an altitude higher than Mont Blanc – compared with the normal summer level of 3,000m to 3,500m. This temperature change impacts all living things and represents an upward movement of about 100m. As a consequence, in order for species to be able to stay in the same temperature conditions they will need to move 100m upslope. This forms a major challenge for biodiversity as species try to keep pace with such rapid changes.

Snow Cover

The rate of warming is amplified in the mountain environment as many different habitats occur over a small area. Snow beds are reduced in size and length of time, ice melts from scree and rocky ridges earlier and meadows are exposed for longer periods. These habitats are all experiencing reduced snow and ice cover, which presents several problems. Snow and ice reflect the sun's rays keeping the ground cold but when they melt they are replaced by rock and vegetation. These both absorb the sun's heat increasing ground temperature, which contributes to more melting. These effects have been

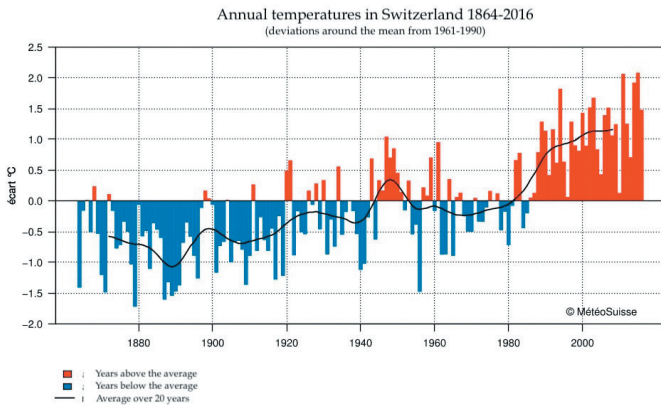


Fig 1. Annual temperatures in Switzerland based on the 1961-1990 average.

recorded on the Mont Blanc massif, which has lost one month of snow cover, at mid elevation, in the past 40 years. This trend is predicted to continue and an equivalent reduction is likely by 2050.

Drought

Europe had its hottest summer and hottest August on record in 2022. Associated with these heat waves is drought due to a lack of rain, warmer soils and enhanced evaporation due to the high temperatures. Yet as southern and central Europe baked, Scandinavia soaked this summer. According to scientists global rainfall patterns have changed little over the past century, however, regional and seasonal changes have been observed and we are witness to this in Europe. A noticeable consequence I observed last summer was with Switzerland's drinking water fountains. These are normally a constant flow of fresh spring water but many were turned off to conserve water supplies. Thanks to the risk of wildfires, no fires were permitted which included during the Swiss day celebrations when fireworks displays are traditionally seen across the evening sky on 1 August.

Glacial Volume

Global heating is supercharging extreme weather at an astonishing speed. High temperatures have a dramatic effect on glacial ice volume causing retreat to occur at an alarming rate. Since 1850 glaciers in the Alps have lost between 30% and 40% of their surface area and half of their volume. The speed of loss has accelerated and since the turn of the millennium the Alps have lost about 17% of their ice volume. Iconic glaciers such as the Mer de Glace in the Mont Blanc massif and the Aletsch glacier in the Swiss Valais have experienced huge reductions in ice volume. The Mer de Glace experienced a seven metre loss of thickness this summer alone and the Aletsch glacier, the largest in the Alps, is contracting by five metres or more each year.



Pioneer plants colonising rock debris following the retreat of a glacier.

In 1919, the Swiss pilot and photographer Walter Mittelholzer flew over Mont Blanc in a biplane to photograph the Alpine landscape. Exactly 100 years later, researchers from the University of Dundee in Scotland recreated his photographs to show the impact that the changing climate has had on the mountain's glaciers (see p146).

Permafrost

Permafrost is the permanently frozen ground and consists of soil, rocks and sediments usually bound by ice. Permafrost generally occurs in the Alps from around 2,300m altitude. Investigations into the link between permafrost thawing and rock collapses were started around the time a large part of the Bonatti pillar on Les Drus collapsed in 2005 but have been the subject of speculation about since the 1970s. Long-term monitoring has revealed progressive warming and degradation of permafrost, which has a profound influence on the evolution of the mountain landscape and the stability of the mountains. The potential for natural hazards such as rock falls, landslides and debris flows, will become more frequent and will impact not just mountaineers but settlements, infrastructure and all living things in the Alps.

Impacts on the Natural World

Such rapid changes in the physical environment have significant effects on all living things. The effects of climate change on alpine flora and fauna are noticeable and are already contributing to changes in species distribution and abundance. They have to keep pace with the evolution in order to survive but the gradual greening of the Alps illustrates the changing distribution of species.



Glacier crowfoot a high alpine specialist.

Growing Season

Alpine plants are specialists at survival. They are at home in the harsh alpine environment with its extreme climate and short growing season. As snow cover melts earlier the growing season lengthens and this will begin to favour the less well adapted and more competitive species usually confined to lower elevations. Gradually the high-altitude, alpine specialists will become restricted to newly exposed areas uninhabitable to the invading plants. The rise in spring temperatures, combined with earlier melting of the snow cover allows the majority of species to develop earlier in the season and to produce more biomass over the course of the growing season. This is generally a positive effect but some species are sensitive to frost, especially in early season, so this can increase the risk of damage to species such as bilberry.

Vertical Migration

Over the past decades, with the warming climate, a rise in elevation of both plant and animal species has been observed. Plants are rising vertically at a rate of about 30m per decade with animals rising about 100m per decade. Forest trees have migrated around 30m over the 20th century. This vertical migration increases the competition for space and resources and combined studies across the Alps indicate an increase in plant species found on summits over the past few decades.

Phenology

This is the timing of events in nature. It is when plants come into flower, when eggs are laid and when you see the first swallow of summer. It also focuses on



ibex.

how plants and animals respond to the climate. In order to survive changes in climate species can either migrate to preferable conditions or they can adapt to the new environmental conditions. Examples of this are: the arrival of migrating birds advancing by about 15 days over the past 30 years; common toad eggs being laid about a month earlier than 25 years ago; and plants flowering between two and five days earlier per decade.

Grazing Animals

The changing in the times of spring is also having a great effect on grazing animals such as ibex and chamois. They are becoming desynchronised with peak vegetation production in the spring with dire consequences for their young. Their mating season is in the autumn and young are born in the springtime. During relatively warm winters peak plant production is out of synch with weaning their young. As a result higher mortality of young ibex and chamois has been observed due to a lack of suitable food.

Summary

It is without doubt that the Alps are entering a period of unprecedented change. Climate change continues to alter the alpine ecosystem and there will be winners and losers. While alpine species will lose significant areas of habitat, colonising plants and forest trees will expand their territories. As individuals, we have our role to play in mitigating climate change. The decisions we make regarding how we travel, what we eat and what we buy all have an important impact.