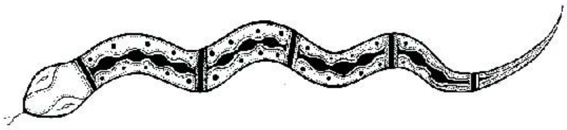
Climate and weather patterns of the Australian Alps

The sun keeps us warm and gives us light. The wind cools or warms the land and brings rain. Together they dictate the life cycle of plants and animals. Our people travelled across the country in response to the seasonal availability of food, the weather and family traditions.

Rod Mason, Indigenous Education and Liaison Officer, Snowy Mountains Region, DEC NSW
Illustration: Jim Williams



Climate is long-term weather

Climate is the condition of the atmosphere near the earth's surface. In other words, it is the long-term weather of a particular place, the weather that is most likely for that area over a period of 30 years or more. This includes the region's general pattern of weather conditions such as temperature, humidity, precipitation, winds and weather extremes like cyclones, droughts or rainy periods.

Humidity

Humidity is the amount of water-vapour in the air at a particular temperature.

Relative humidity is a ratio of the air's water vapour content to its capacity. Relative humidity changes with temperature, pressure and water vapour content.

The higher the temperature, the more water the air can hold. If the relative humidity is 100 percent, then the air is holding as much water as it can at that temperature.

When the humidity is high, there is enough water in the air to make rain or snow. If the humidity was 100 percent and the temperature goes down, the air pushes together and forces out water as rain or snow.

Precipitation

All precipitation (rain and snow) comes from water vapour in the air. If the air is warm, the frozen droplets melt and fall to the earth as rain. If the air is cold, the water vapour crystallizes around a speck of ice or dust and falls to the earth as snow.

The prime conditions for heavy snowfall in the Australian Alps are persistent, strong westerlies through the winter, which produce considerable precipitation and are usually accompanied by relatively low temperatures.

Baw Baw National Park (Tourism Victoria)

Altitude and temperature

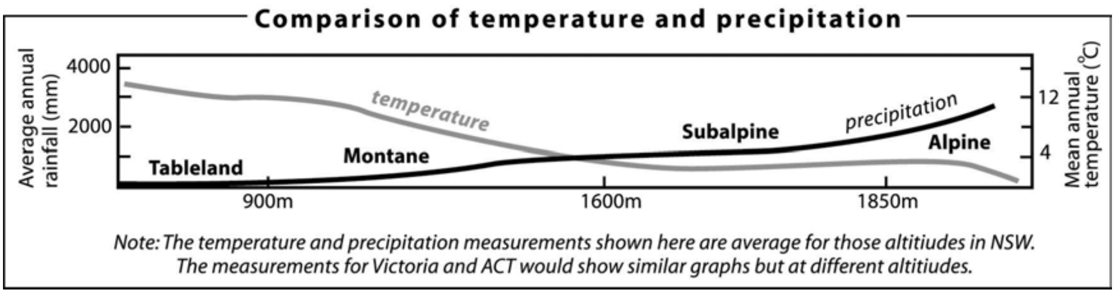
Mountain climates are usually cool to cold. For every 1,000 metre rise in altitude there is a 6.5°C drop in ambient air temperature in the troposphere. This is called the environmental lapse rate. It occurs because the atmosphere is not warmed directly by the sun, but by heat radiated from the earth's surface and distributed by conduction and convection.

Temperature falls as altitude increases because there is:

- a decrease in water vapour, carbon dioxide and dust which absorb and retain heat (reducing conduction);
- a decrease in the land area available to radiate heat; and
- a decrease in density and pressure of air which reduces its ability to retain heat.

Biomes

Climate, plants and animals are interwoven to create the fabric of a biome. Equatorial biomes are hot and humid (tropical) and lower latitudes are cool and temperate. The climate of a biome will determine what plants will grow there, and what animals will inhabit it. Mountain climates have the same seasons and wet and dry periods as the biome they are in.



Temperature and precipitation

Weather patterns in the Australian Alps

The Australian Alps experiences a mid-latitude mountain climate, with no dry season and a mild summer. Precipitation falls more often in winter and spring but does occur all year round. Cold temperatures in winter mean that precipitation then falls as snow which covers the higher altitudes for many months at a time. The Australian Alps experiences rain, hail, sleet, snow, frost, strong winds, low temperatures and frequent blizzards especially during winter and spring. During summer the occasional dry, sunny day can see daytime temperatures rising above 30°C but the nights are cool.

Persistent snow cover over the winter months makes the Australian Alps an important region for people skiing and snowboarding. A number of resorts have developed throughout the Alps including; Thredbo, Perisher, Mt Buller and Falls Creek. These places experience the coldest temperatures in Australia but also some of the greatest visitor numbers.

Mild mountain climates of mid-latitude biomes, such as the Australian Alps, give rise to an important water storage function. Precipitation occurs all year round but is greatest in winter and spring.

Transpiration, which is a major form of water loss in other areas, remains low all year in the Alps because of low daytime temperatures.

The ability to hold water and regulate its discharge to rivers flowing out of the alpine environment, and general seepage downslope makes the Australian Alps an important water storage for the eastern coastal catchments and the Murray-Darling Basin. During winter, much water is held as snow and ice and held back from streams until it thaws in warmer weather. Stream flows are also boosted during early summer, ensuring water availability for most of the year.

Temperature and rainfall data for the Australian Alps (from http://nationalparks.nsw.gov.au)

Mean annual temperature	3 – 12 °C
Minimum average monthly temperature	- 7- 0.4 °C
Maximum average monthly temperature	15.9 – 29.5 °C
Mean annual rainfall	606 – 2344 mm
Minimum average monthly rainfall	44 – 126 mm
Maximum average monthly rainfall	63 – 295 mm

Other weather conditions that are present

Ultraviolet radiation is also more noticeable at higher elevations due to the thinner atmosphere. More of these harmful rays from the sun can penetrate throughout the year, increasing in summer and causing sunburn on unsuspecting visitors. It also means that many animals need the protection of vegetation to escape the sun's rays.

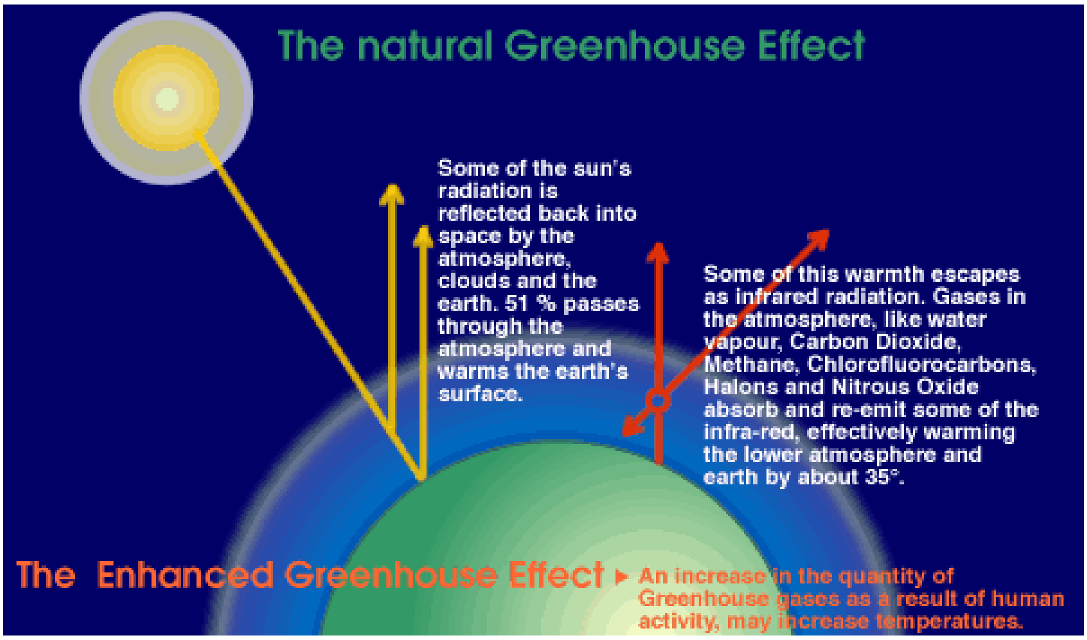
When the wind blows it can feel colder close to the body than the ambient air temperature indicates as the wind takes away trapped heat. This is known as the wind chill factor. Survival in these conditions can mean wearing clothing that traps heat next to the skin to keep in warmth and to remain dry.

Rainfall is also higher in mountain areas than the surrounding area. This is due to orographic rainfall. The dominant wind patterns force air to go up and over the mountain. As the air rises it cools and the moisture within the air condenses and falls as precipitation. The side of the mountain that the air has been forced up receives more precipitation, leaving the opposite mountainside drier. This is called the rainshadow area and is on the leeward side of the mountain.

The weather in the past

Over many millions of years, the climate of Australia has changed many times. Six million years ago rainforest covered much of Australia, including the Alps. Three million years ago colder conditions with increased rainfall dominated. Vast cold, treeless plains replaced the rainforest vegetation and the alpine plants and animals started to colonise the area. In the last two million years the area was covered by ice several times. In the glacial periods, the species of plants and animals that could withstand the cold, spread out over the land. As these periods ended, these species retreated back to the only area where it was still cold – the Australian Alps. These plants and animals had special characteristics, which species today still demonstrate, to cope with the wide temperature variations. The last Ice Age concluded only 10,000 years ago.

Climate in the future



The natural greenhouse effect and the enhanced greenhouse effect (© Bureau of Meteorology)

Increases in temperatures around the world due to the greenhouse effect will have significant impacts on the Australian Alps. The global average temperature has increased by approximately 0.6 °C in the past 100 years and is predicted to continue to rise. An average global warming of 0.7 to 2.5 °C is predicted by 2050 and 1.4 to 5.8 °C by 2100.

Warmer temperatures that lengthen summer or result in autumn and winter not being as cold as in the past means less snow will fall. Predictions for the Australian Alps are presented below.

The 'best-case' scenario for snow is the least increase in temperature and the greatest increase in winter precipitation. Even a modest warming of 0.6°C by 2050 will result in a reduction of 15 to 20 days of snow cover in the Australian Alps.

With less snow and the soil becoming warmer the higher elevations will become more suitable for trees and other lower altitude plants to grow. The altitude at which trees can grow will be higher, the treeline will advance upwards and the alpine habitats will become smaller, thereby reducing the endemic alpine plants and animals to even smaller areas of land.

Our true alpine habitats may eventually disappear as the climate continues to get warmer.

Changes in:	Low impact 2020	High impact 2020	Low impact 2050	High impact 2020
Temperature	+0.2°C	+1.0°C	+0.6°C	+2.9°C
Precipitation	+0.9%	-8.3%	+2.3%	-23%
Snow cover (days)			-15 to 20	-100

Climate Change scenarios for Australian Alps (Source: Hennessy et al 2003)

Climate change and the flora and fauna of the Alps

Changes in the diversity and abundance of plants and animals may be particularly severe in the Australian Alps because of the minimal area of true alpine habitat and, therefore, the limited availability of high altitude refuge.

Mountain Pygmy Possum

It is predicted that there will be both good and bad impacts on the flora with increases in the occurrence and distribution of several dominant plant communities at higher elevations including Tall Alpine Herbfield, Heathland and Tussock Grassland. However, there will be decreases in more sensitive communities, particularly Short Alpine Herbfield and the wetter communities (fens, bogs and peatlands) that are particularly important for water storage.

The numbers of different species of birds at specified altitudes may increase with increased warming and it is predicted that global warming will have significant impacts on the distribution and numbers of the alpine endemic Mountain Pygmy Possum and the Broad-toothed Rat. However, much research is required to know about other animals including invertebrates in the Australian Alps.

Managing climate change

There are a number of issues that land managers in the Australian Alps will need to consider in the face of climate change. Climate change will mean changes in the natural values through changes to habitat and consequently diversity and abundance of plants and animals. At the highest elevations there will be possible extinction of species including the Mountain Pygmy Possum and the Broad-toothed Rat.

A reduction in snow fall and cover might have big impacts on the recreational activities currently enjoyed by many Australians. A reduction of snow cover could initially lead to increased pressures on the already highly used ski resorts and pressure to push further into the fragile alpine zone.

Predictions are that climate change will contribute to an increase in the distribution and diversity of weeds in the subalpine and alpine areas of the Australian Alps. Managers will have to make informed decisions about the appropriate levels of allowable disturbance and potential weed invasion when considering future developments.

Glacial lake (Auswalk Pty Ltd)

Management agencies for the national parks of the Australian Alps acknowledge the challenges of managing for climate change and have committed to supporting research and monitoring to assist in the on-ground management of those species and communities considered to be at risk from climate change. Furthermore, agencies are committed to undertaking operations and developments to reduce greenhouse gases and ameliorate climate change.

Alps warming (Illustration: Andrew Hore)

Ozone depletion

Ozone depletion occurs when the destruction of stratospheric ozone exceeds the production of stratospheric ozone. Although natural phenomena can cause temporary ozone loss, chlorine and bromine released from man-made synthetic compounds are now accepted as the main cause of this depletion.

Ozone depletion allows more ultraviolet radiation through to the earth. Ultraviolet radiation can damage humans, plants and animals. It can interfere with photosynthesis in plants and cause eye problems and skin cancer in humans and animals. This is particularly relevant to the Australian Alps.

The Applied Ecology Research Group at the University of Canberra, in conjunction with the AIAS and NSW National Parks and Wildlife Service, has established a UV-B monitoring installation to measure ultraviolet-B radiation over the Australian Alps. One monitoring station is at Berridale, at an altitude of 870 metres, and another at Perisher Valley at 1880 metres.

Given the same degree of solar radiation, UV-B radiation increases exponentially with altitude so the impact of UV-B on alpine organisms is of concern, particularly as ozone depletion has resulted in increased levels of ultraviolet radiation reaching the surface. In order to understand longer-term trends at different elevations, the permanent stations have been placed at altitudes differing by over 900 metres. This will allow for an examination of seasonal trends in ultraviolet radiation.

The implications of ozone depletion on the fauna of the Australian Alps

S. Broomhall, Applied Ecology Research Group, University of Canberra, PO Box 1 Belconnen ACT 2616

The expected increases in ultraviolet-B radiation due to **anthropogenic** ozone depletion appear likely to have particular impact on the Australian Alps, as it is situated at high elevations, middle to high latitudes, and in the Southern Hemisphere. A number of studies have affirmed that ozone-related changes in UV-B will probably be most pronounced at such locations. While complete clarification of the effects of UV-B on many different organisms remains elusive, existing research indicates that in many cases, UV-B can have deleterious consequences. For example, UV-B radiation has been directly linked to skin cancer, corneal tumours, and immunosuppression. This is of specific significance in alpine regions where levels of UV-B radiation are expected to be high, particularly given the albedo of snow in the UV-B wavelengths. Many plant species have also been shown to be negatively impacted by UV-B, although some of these impacts may take a number of years to manifest. Furthermore, complex interactions between trophic levels and differential UV-B sensitivities may lead to substantial changes in species composition. As there appears to be a paucity of long-term data on the effects of increases in UV-B radiation, it seems that the most acceptable solution is to initiate rigorous sampling and monitoring studies, and simultaneously assess and test the effects of UV-B in conjunction with other stresses, such as low temperatures. Finally, research has determined that existing levels of UV-B in the south-eastern alpine region of Australia are likely to be a significant causative factor in the decline of populations of a high altitude frog species. This finding, in conjunction with previous research, leads to concern over the potential vulnerability of other species in the Australian Alps to pervasive increases in UV-B radiation.

Source: Australian Institute of Alpine Studies, Newsletter No. 1, February 1998

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Glossary

Anthropogenic

The description of something that is created by humans and is a subject of scientific study.

Biomes

A major regional or global biotic community, such as a grassland or desert, characterized chiefly by the dominant forms of plant life and the prevailing climate.

Climate

Describes typical weather conditions over a period of time.

Conduction

The transfer of heat between bodies that are in contact.

Convection

The transfer of heat by currents of air or fluid.

Endemic

A species that is unique to that place or region and found nowhere else.

Glacial periods

Any period of time in which glaciers covered a large part of the earth's surface.

Greenhouse effect

Greenhouse gases; carbon dioxide, methane and water vapour, play an important role in keeping the temperature of the earth's surface at the right level because they absorb and trap heat from the sun. Without them the earth would be very cold. Over the past 200 years there has been an increase in the amount of greenhouse gases in our atmosphere, especially carbon dioxide from the burning of fossil fuels (coal, oil and natural gas). As the amount of greenhouse gases increases, the atmosphere is trapping more heat and the earth is slowly getting warmer. This is called the greenhouse effect. This warming of the atmosphere is slowly changing weather patterns.

Mid-latitude

Latitude is the measurement, in degrees, of a place's distance north or south of the equator. A region's latitude has a great impact on its climate and weather patterns. Mid-latitudes are those occurring midway between the equator and the poles and tend to experience cool and temperate conditions.

Orographic rainfall

The dominant wind patterns force air to go up and over the mountain. As the air rises, it cools and the moisture within the air condenses and falls as precipitation.

Precipitation

When cloud particles become too heavy to remain suspended in the air, they fall to the earth as precipitation. Precipitation occurs in a variety of forms; hail, rain, freezing rain, sleet or snow.

Transpiration

The evaporation of water from plants.

Treeline

The upper altitude where trees can grow. Above the treeline is too cold for trees to grow and is known as the alpine zone. In the Australian Alps the treeline generally coincides with the mean mid-summer temperature of about 10℃.

Troposphere

The lowest layer of the atmosphere extending from the surface up to an elevation of about 15 kilometres.

Ultra-violet radiation

The wavelengths of solar radiation in the spectrum, from 200-400 nm. The increased incidence of cutaneous malignancy from sun exposure and increased ultra-violet radiation (UVR) caused by thinning of the stratospheric ozone is now a major health concern. Ozone is one of the natural sunscreens in the upper atmosphere and used to be a more effective filter against solar ultra-violet radiation. UV exposure causes sunburn, skin aging, photodermatoses and skin cancer. Ulta-violet light is divided into three bands; A, B & C. UVA and UVB are both responsible for photo ageing.

Weather

Describes the daily changes experienced by the elements of the atmosphere such as the minimum and maximum temperatures, wind direction and strength, precipitation type and amount and humidity.

Plant and animal species

Mountain Pygmy Possum	*Burramys parvus*	Broad-toothed Rat	***Mastacomys fuscus***

http://www.australianalps.deh.gov.au/