4.1 Nature's way — our climate

It always seems to rain when we don't want it to, but rarely when it suits us. Still, there are times of the year when we expect rain more often. Nature has its way in setting **climate** patterns. We know that the climate varies throughout the year, and that our climate is different from climates in other parts of Australia and the world.

There are three main climatic zones: the polar regions (North and South poles), the tropics (the regions around the Equator) and the temperate regions, which lie between these two extremes. Within these zones are a number of subclassifications, as shown in figure 1.

Why does climate vary?

The main natural factors that affect climate are **latitude**, **altitude** and the physical shape of the land; proximity to the ocean; proximity to ocean currents; and the existence and movement of air masses.

FIGURE 1 World climatic zones

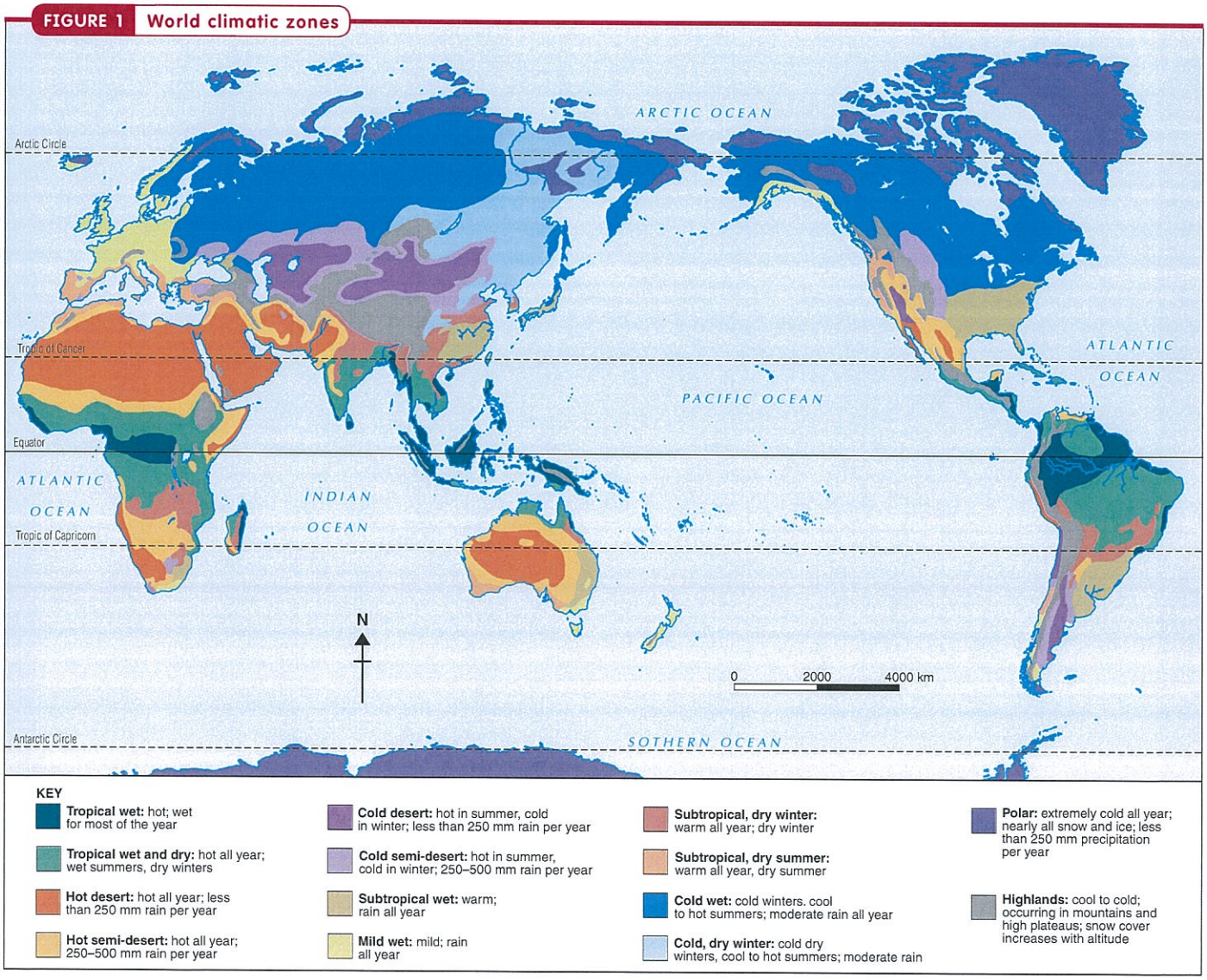


FIGURE 2

Altitude and physical shape of land

The combination of altitude and the shape of the land of an area gives rise to different climatic conditions. For example, one side of a mountain range can experience high levels of rainfall as warm moist air cools and is forced to drop its water as it moves over the mountain range. This is called orographic rainfall. Also temperatures vary with altitude. For example, Mount Kilimanjaro, Africa's highest mountain, is located only 3 degrees south of the Equator, and yet it always has snow on its summit. This is because air becomes cooler as it rises. Temperatures decrease by between 1 and 2 degrees for every 300 metres in altitude.

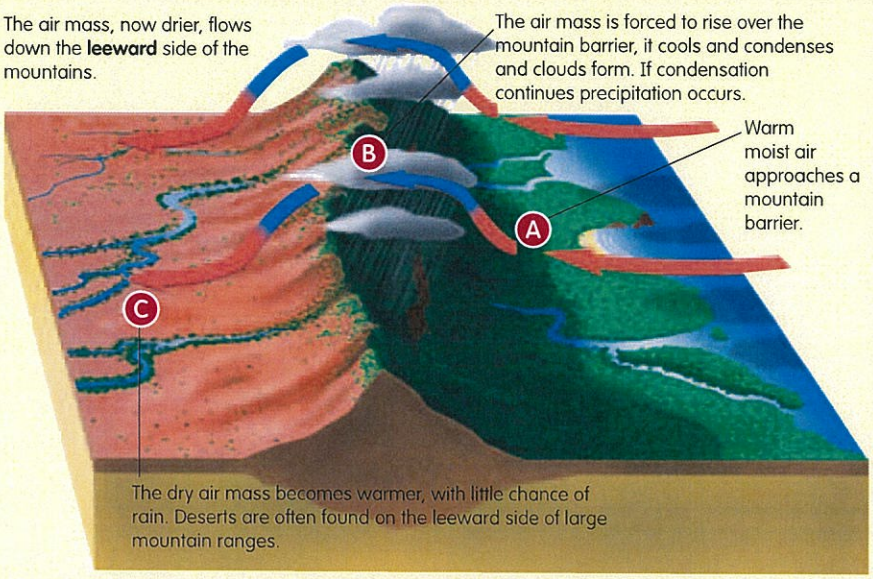
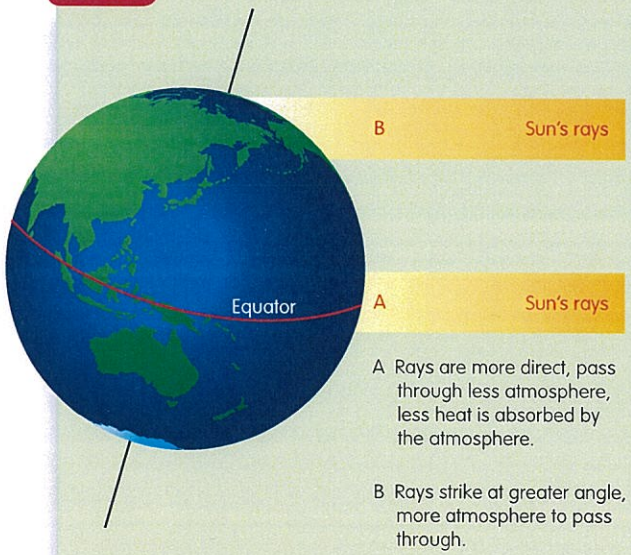


FIGURE 3



A Rays are more direct, pass through less atmosphere, less heat is absorbed by the atmosphere.

B Rays strike at greater angle, more atmosphere to pass through.

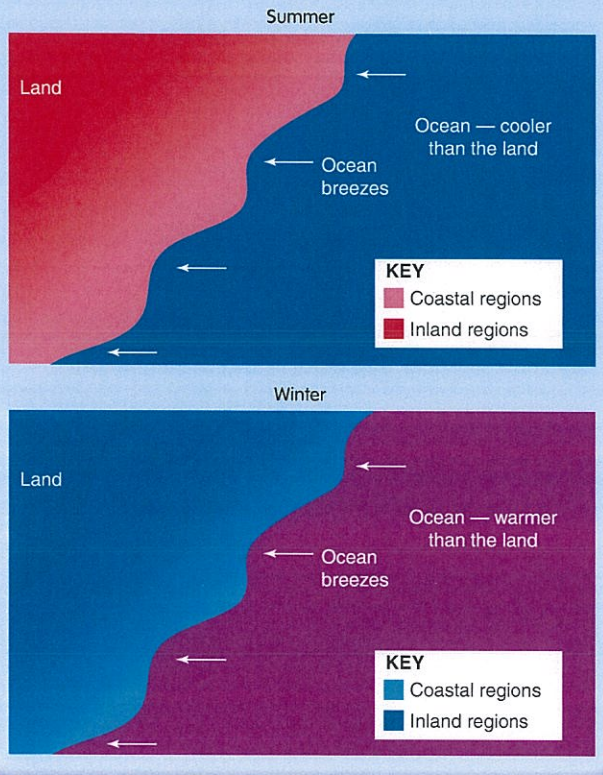
Latitude

Latitude has an important influence on climate. General differences in world temperatures are determined by the angle at which the sun's rays hit the Earth's surface. The geographic region between the Tropic of Capricorn (23.5 degrees south of the Equator) and the Tropic of Cancer (23.5 degrees north of the Equator) is known as the tropical zone or the tropics. Higher temperatures are experienced in this region because the sun is often almost directly overhead. In some parts of the tropics there are only two seasons — the wet and the dry. The temperate zones are found between 23.5 and 66.5 degrees north and south of the equator. The climate in these regions is more differentiated, with four seasons (summer, autumn, winter and spring). The Arctic and Antarctic zones are found between 66.5 degrees north of the equator and the North Pole and between 66.5 degrees south of the equator and the South Pole respectively. In the polar regions the sun barely sets at all during the summer months and barely rises during the winter.

FIGURE 4

Proximity to the coast

How close a place is to the coast can influence its climate. This is because land heats up and cools down faster than a body of water does. So an ocean will be cooler than the land in summer and warmer than it in winter. Coastal regions are thus cooled by the ocean breeze in summer and warmed by it in winter. They are said to have a **maritime climate**. Areas well inland, influenced mainly by the heating and cooling of the land, have more extreme seasonal temperature variations. They are said to have a **continental climate**.

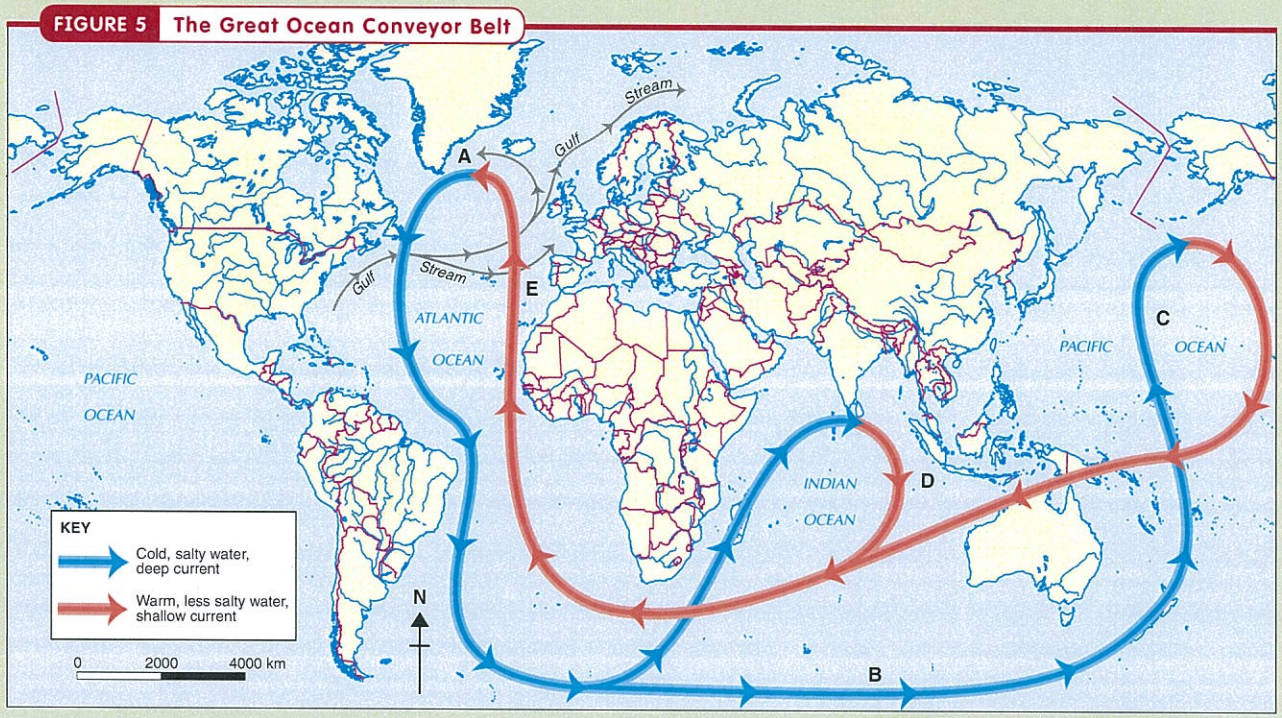


Proximity to ocean currents

The waters in the ocean are always moving. The direction in which currents move is influenced by a number of factors: the Earth's rotation, the shape of the ocean floor, salinity levels, heat and wind. Surface currents are largely driven by winds; deep-water currents are powered by **thermohaline circulation**. Deep-water currents begin when cold, saltier water — denser than warmer, less salty water — sinks, displacing water below as it does so.

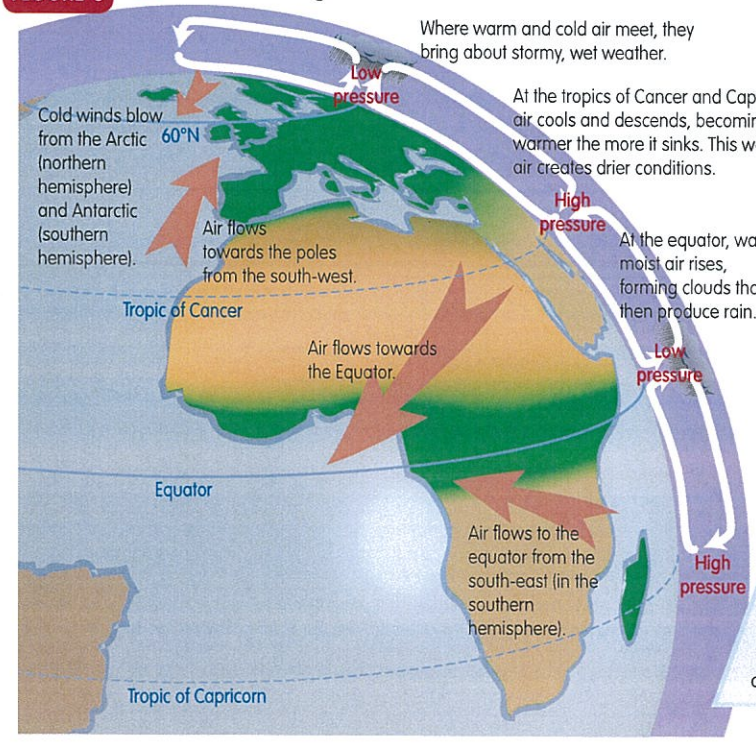
The deep-water current illustrated below, known as the Conveyor Belt, carries more than 16 times the water volume of all the world's rivers. If this current were to change (e.g. by oceans becoming less salty as a result of the melting polar ice), climate could be dramatically altered. For example, the North Atlantic would become very much colder if no longer warmed by the Conveyor Belt and **Gulf Stream** currents.

FIGURE 5 The Great Ocean Conveyor Belt



A The Great Ocean Conveyor Belt begins in the North Atlantic Ocean. As the Gulf Stream delivers warm water, colder, denser, saltier water sinks and is pushed southwards.
B The deep current flows down through the Atlantic and eastwards along the coastline of Antarctica, passing south of Australia and into the Pacific.
C The current circulates the Pacific, rising towards the surface as the water becomes warmer and less salty.
D The warm, shallow current flows through the Indian Ocean, and around the tip of Africa back into the Atlantic.
E The current merges with the Gulf Stream as it flows into the North Atlantic, warming the European seaboard before cooling again, becoming denser and saltier, and sinking towards its starting point. The journey has taken 1000 years!

FIGURE 6 Air circulation patterns



Existence and movement of air masses

Air masses move as a result of differences in air temperature. Warm air rises and becomes lighter, creating areas of low pressure. When colder, denser air moves in to replace this rising warm air, wind is created.

Facts about the Gulf Stream

An ocean current can be thought of as a river that flows through the world's oceans rather than on land. The Gulf Stream, a large, warm ocean current that originates in the Gulf of Mexico before crossing the North Atlantic:

- is between 80 and 150 kilometres wide
- is between 800 and 1200 metres deep
- flows faster than the Amazon River (the fastest part is near the surface, and the speed decreases with depth)
- is powerful enough to be readily seen from space
- may have caused the 'little ice age' experienced in Europe between 1300 and 1800 when the world's ocean currents, including the Gulf Stream, slowed down.

Summing up

The features and systems described in this spread help sustain a natural balance in the Earth's climatic system. They occur in a fairly predictable and regular way over time.

So the farmer who owns the cows scratching a living in a dry dusty paddock (below), and who may be looking for an explanation for, say, an apparently sudden and sustained increase in droughts and other extreme weather patterns, may need to look beyond these naturally occurring conditions. In the following pages we will examine some aspects of climate change brought about by human activities.

FIGURE 7

altitude height above sea level
climate the predicted weather at a particular place, based on the average weather conditions over an extended period of time
continental climate the climate of a place that lies well inland on a landmass, where it is not affected by the cooling influence of the sea in summer and its warming influence in winter; temperatures are usually more extreme than those closer to the sea
Gulf Stream a warm current of water (part of the ocean current cycle known as the Great Ocean Conveyor Belt) that runs up the east coast of America, bringing warm water to the northern Atlantic
latitude imaginary lines drawn on the Earth's surface which indicate distance north or south of the Equator
leeward the side sheltered from the wind
maritime climate the climate of a coastal region warmed by the sea in winter and cooled by it in summer; temperatures are generally less extreme than those of inland regions
thermohaline circulation flow patterns in ocean currents, such as the Gulf Stream, which are driven by differences in temperature and salinity

Activities

Student worksheet 4.1

REMEMBER

1 In short paragraphs, and using your own words, describe briefly how the following factors naturally influence the world's climate:
- latitude
- altitude and physical shape of land
- proximity to the coast
- proximity to ocean currents
- existence and movement of air masses.

THINK

2 (a) Use figure 1, the map of world climatic zones, on page 104 to decide which two climatic zones are most extensive (in terms of area) in (i) southern Africa, (ii) Australia and (iii) South America.
(b) Use an atlas and the map to identify two countries that have predominantly:
- a tropical wet climate
- a hot desert climate
- a highlands climate.

3 Study figure 3 on page 105. Use it to explain why it is warmer at the Equator than at the Poles.

4 Look at figure 2 on page 105. Decide which place (A, B or C) is more likely to have (a) a wetter climate or (b) a warmer climate. Explain your answers.

COMMUNICATE

5 Explain why frosts may be common in places with a continental climate, while coastal locations at the same latitude have no frosts at all.

6 (a) Explain in your own words the natural systems maintaining the Great Ocean Conveyor Belt.
(b) Why might the North Atlantic region become very much colder if the natural flow of ocean currents such as the Conveyor Belt and the Gulf Stream was changed?

7 In what way do the air circulation patterns in the Earth's atmosphere influence rainfall patterns?

8 Which of the factors outlined on these pages do you think is most variable, and therefore most likely to cause changes in climate that are not part of a regular and predictable pattern? Justify your answer.

INVESTIGATE

9 Find out where Mount Kilimanjaro is located and what type of climate it has. Use the information in this spread to explain your findings.