Section 5

The Tropical Cyclone Hazard

In this section .....

Tropical Cyclones: Glossary of Key Terms

Anemometer: A instrument used to measure and record wind speed.

Atmospheric (or air) pressure: The pressure at a certain point exerted by the weight of the 'column' of air above that point.

Coriolis effect (or force): The deflection of winds (and any other freely moving objects) produced by the rotation of the earth on its axis.

Eye: The calm area of extreme low pressure at the centre of a tropical cyclone.

Eye wall: A band of heavy cloud associated with moist air which spirals around the centre of a tropical cyclone.

Hectopascals: Units of measurement for atmospheric pressure.

High pressure system (high, anticyclone): A region, often thousands of kilometres in diameter, in which the atmospheric pressure is high compared with that of adjacent areas and which appears on the weather map as a series of concentric widely spaced isobars.

Isobars: Lines on a weather map joining places of equal atmospheric pressure.

Low pressure system (low, depression, cyclone): An area of low atmospheric pressure with winds moving in a spiral around the centre of the area.

Pressure gradient: The change of atmospheric pressure from one area to another. On a weather map this is indicated by the distance between isobars.

Rain depression: A low pressure system over the land (or cooler water) which is the remnant of a tropical cyclone. Associated with heavy rainfall in inland areas.

Storm surge: The 'piling up' of sea water caused by extremely low pressure conditions and strong onshore winds (thus often associated with tropical cyclones). The rapid rise in tide level resulting from a storm surge can cause serious damage to coastal areas.

Tropical cyclone (typhoon, hurricane): An intense low pressure system in which air moves in a large, tightening spiral around the centre.

Wind: The invisible movement of air from one place to another.

Pressure, Wind and Cyclones

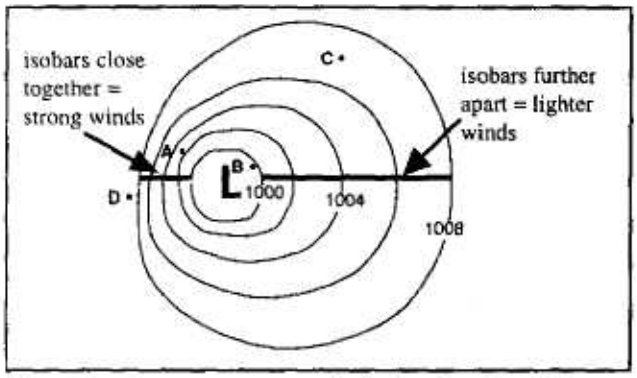


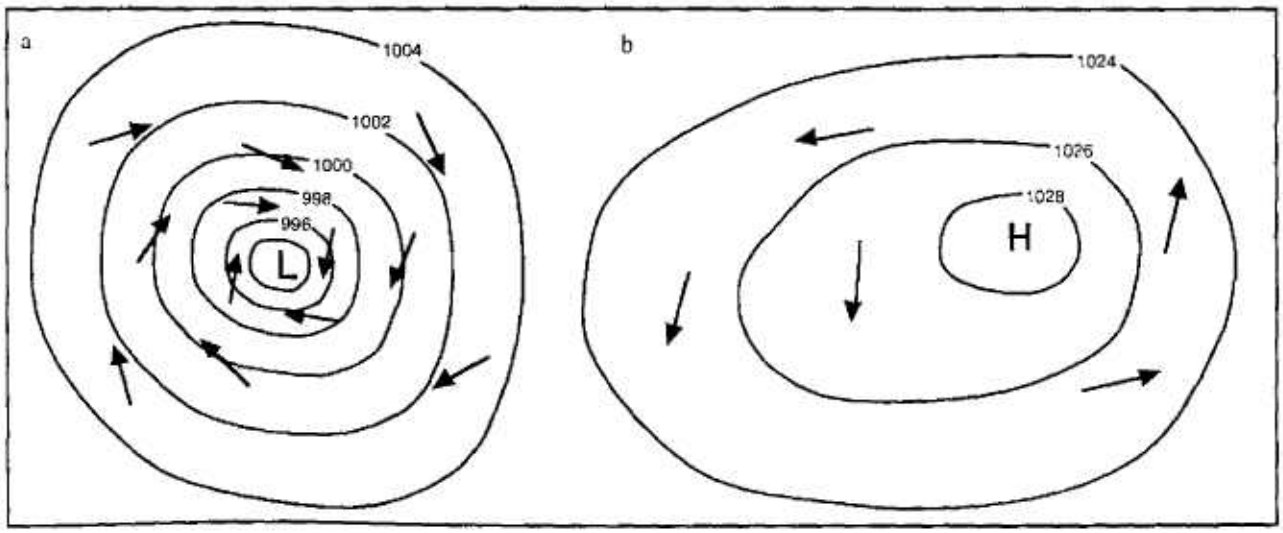
Figure 1: Low pressure system in the Southern Hemisphere showing the effect of pressure gradients on wind speed

Figure 2: An anemometer

Figure 3: Pattern of wind circulation in (a) a low pressure system and (b) a high pressure system in the Southern Hemisphere

HAZARD DATA

- **Wind** is the invisible movement of air from one place to another.
- **Atmospheric (or air) pressure** is the pressure at a point on the earth's surface caused by the weight of the column of air above that point.
- Atmospheric pressure varies from place to place.
- Regions of high pressure are known as **high pressure systems ('highs')** or **anticylones**, regions of low pressure are known as **low pressure systems ('lows')**, **depressions** or **cyclones** (Figure 1).
- Air, in the form of wind, moves from areas of high pressure to areas of low pressure.
- The speed of the wind depends on the difference in air pressure between two points. The greater the difference in pressure the greater the wind speed.
- On a weather map, **isobars** are lines which connect places of equal air pressure. Air pressure is measued in **hectopascals**, with isobars normally drawn at intervals of two hectopascals.
- If isobars are close together this means the pressure difference between two points will be great and therefore the winds will be strong. If they are a long way apart winds will be lighter (Figure 1).
- Wind speed is measured in **kilometres per hour** or in **knots**. The instrument used to measure wind speed is an **anemometer** (Figure 2).
- Winds do not move in a straight line, but instead are deflected because of the rotation of the earth. This is known as the **Coriolis Effect**.
- This deflection - to the left in the Southern Hemisphere and to the right in the Northern Hemisphere - causes winds to circulate around highs and lows.
- In the Southern Hemisphere ciculation is clockwise into the centre of a low and anti-clockwise out from the centre of a high (Figure 3). The opposite occurs in the Northern Hemisphere.
- A **tropical cyclone** is a very severe low pressure system (i.e. where pressure gradients are very steep). In parts of Asia it is called a **typhoon** and in North America a **hurricane.**



contd.....

Pressure, Wind and Cyclones (contd)

Activities

1 Using the information in Figure 1 and in 'Hazard Data' on the previous page, complete the following questions by circling the correct answer from the alternatives provided:

a Which of the locations in Figure 1 has the highest air pressure?
A B C D

b Which of the locations in Figure 1 has the lowest air pressure?
A B C D

c Which of the locations in Figure 1 has an air pressure reading of 1003 hectopascals?
A B C D

d Which of the locations in Figure 1 is probably experiencing the highest wind speed?
A B C D

e Which of the locations in Figure 1 is probably experiencing the lowest wind speed?
A B C D

f The wind direction at location C would be:
(i) northerly
(ii) south-westerly
(iii) westerly
(iv) easterly

(Figure 3 may help you with this answer)

g The wind direction at location A would be:
(i) northerly
(ii) south-westerly
(iii) north-westerly
(iv) easterly

2 Study Figure 2. Explain, with the help of some research if necessary, how the anemometer works.

3 Study Figure 3.
a Suggest two other names for the low pressure system in Figure 3a.
b How can you tell that the pressure systems shown are in the Southern Hemisphere?
c Why do you think low pressure systems are sometimes called 'zones of convergence'?
d Describe what the wind conditions are probably like in the centre of the high.

4 Try the following experiment to test the Coriolis Effect.
- Have a friend rotate a cicular piece of card, anchored by a drawing pin in the middle.
- As the card is rotating try to draw a straight line with a pencil from the edge to the centre.
- Stop the spinning card and study the lines you have produced.
- Did you find your lines were curved rather than straight? If so, they can be be likened to the deflection of winds as they move towards the centre of a low.

5 Find the following key words from this topic hidden in the puzzle on the left:

H	E	C	T	O	P	A	S	C	A	L	S
I	N	C	W	G	R	A	S	T	O	N	K
G	O	O	H	A	E	W	A	E	S	D	R
H	L	R	U	L	S	E	I	S	N	E	E
T	C	I	R	E	S	A	R	I	R	P	T
N	Y	O	R	S	U	T	W	W	N	R	E
E	C	L	I	R	R	H	E	K	O	E	M
I	I	I	C	A	E	E	Z	C	O	S	O
D	T	S	A	B	M	R	E	O	H	S	M
A	N	C	N	O	L	M	E	L	P	I	E
R	A	N	E	S	A	A	R	C	Y	O	N
G	E	Y	E	I	C	P	B	I	T	N	A

DEPRESSION
CORIOLIS
WIND
KNOTS
CLOCKWISE
ANEMOMETER
ISOBARS
TYPHOON
HURRICANE
GALE
BREEZE
CALM
EYE
ANTICYCLONE
WEATHER MAP
HIGH
LOW
AIR
PRESSURE
GRADIENT
HECTOPASCALS

The remaining letters make up the name of an Australian city which has a high tropical cyclone risk.

_ _ _ _ _ _ _

Tropical Cyclones Explained

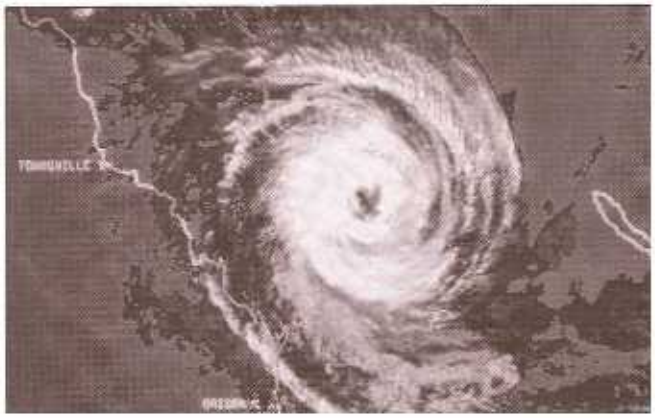


Figure 1: A tropical cyclone viewed from space

Activities

1 a Make a sketch of Figure 1. On your sketch, label: *the eye of the cyclone, the eye wall, the area of strongest winds and heaviest rainfall, the direction of wind circulation.*

b Does Figure 1 show a tropical cyclone in the Southern or Northern Hemisphere? How can you tell?

2 Explain why the eye of a cyclone is an area of (i) calm conditions and (ii) clear skies.

3 Why do tropical cyclones tend to develop over warm ocean waters between 5° and 10° from the equator?

4 Heavy rain is always associated with tropical cyclones. Why is this the case?

5 Study Figure 2. Explain how air is removed faster than it is flowing in. Why is this so important in tropical cyclone formation?

6 Why do tropical cyclones weaken when they move over land or cooler water?

7 What is a 'rain depression'? Who might benefit from the weakening of tropical cyclones as they move over land in Australia?

HAZARD DATA

- **Tropical cyclones** (or **hurricanes / typhoons**) are intense low pressure systems in the tropics. Air spirals at speeds exceeding 120km/h around the centre of these lows, like a giant whirlwind.
- In the Southern Hemisphere wind circulates in a clockwise direction.
- Winds circulate around the **eye** or centre of a tropical cyclone. This is therefore an area characterised by calm conditions and often clear skies. The diameter of the eye can range from 10km to over 100km.
- The eye is surrounded by a dense ring of cloud about 15km high called the **eye wall** (Figure 1). This marks the belt of strongest winds and heaviest rainfall.
- The vast amount of energy released from a tropical cyclone is obtained from heat and moisture. Tropical cyclones therefore tend to develop over warm ocean waters between 5° and 10° from the equator.
- The average 'life cycle' of a tropical cyclone lasts about seven days but can extend up to three weeks. It consists of a number of stages:
  - i Intense summer heat beating on the warm ocean causes a core of moist warm air to rise.
  - ii This rising air spirals outwards at upper levels, producing conditions in which air is removed faster than it is flowing in (Figure ? .
  - iii This causes a lowering of air pressure on the surface of the sea. As a result, the winds get stronger and the low pressure intensifies until a powerful tropical cyclone has developed.
  - iv The rapid uplift of moist air produces huge banks of cumulonimbus clouds around the eye, bringing the intense rain associated with tropical cyclones.
  - v The cyclone follows a track which is generally poleward, but may be marked by major changes in speed and direction.
  - vi As a tropical cyclone reaches cooler water or land the loss of sustaining heat energy causes it to drop most of its moisture as it weakens to a **rain depression.**

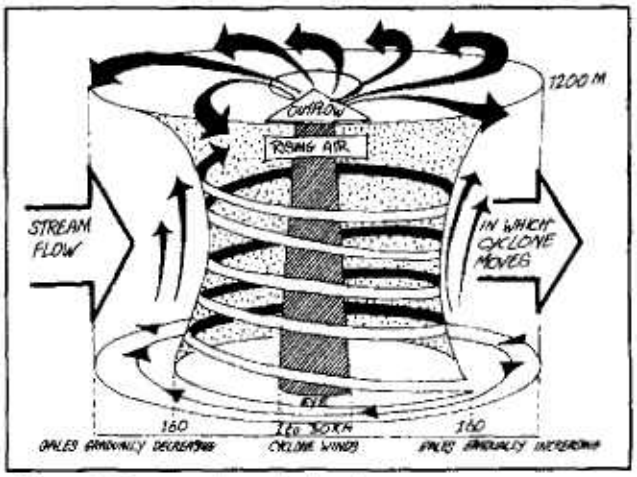


Figure 2: Structure of a tropical cyclone

contd.....

Tropical Cyclones Explained (contd)

8 Study the weather map, Figure 3.
- a Suggest at least two reasons why the low pressure system south of Perth would *not* be considered a tropical cyclone.
- b Describe the air pressure, wind speed and wind direction at each of the following places: *Perth, Adelaide, Sydney, Townsville, Hobart.*
- c What is the air pressure at Port Hedland? Can you suggest a possible wind speed and direction for Port Hedland? Explain how you worked this out.
- d How are the following characteristics of tropical cyclone Damien shown on the map:
  - extremely strong winds close to the centre of the cyclone
  - extremely low air pressure in the centre of the cyclone
  - widespread rain associated with the cyclone.
- e From evidence on the map, say why the people of Alice Springs might welcome cyclone activity on the coast.
- f Imagine that tropical cyclone Damien is moving in a south-easterly direction at a speed of 30km/h. Explain what is likely to happen to the cyclone in the next 24 hours.

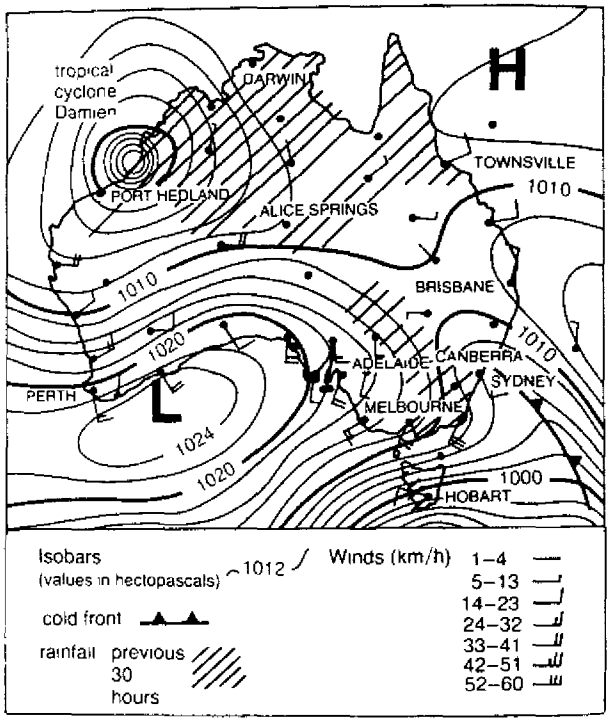
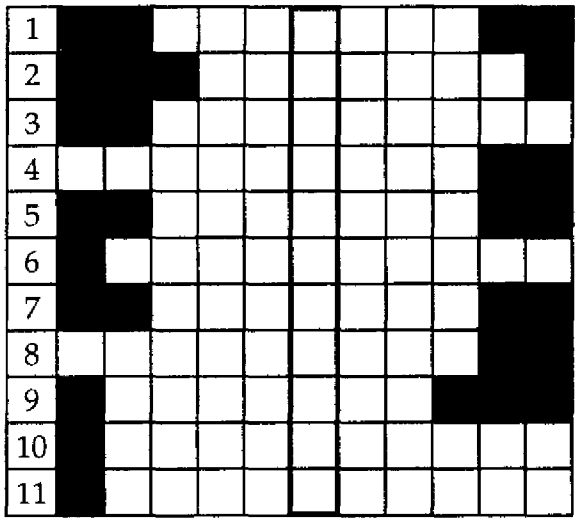


Figure 3: Weather map, 3 February 1987

9 Complete the puzzle below using the clues provided. If solved correctly the centre column forms the name of a Western Australian city which often experiences cyclone activity.



Clues

1 Cyclones, hurricanes and typhoons all occur in the _ _ _ _ _ _ _
2 In a tropical cyclone, these lines on a weather map will be very close together _ _ _ _ _ _ _.
3 A tropical cyclone is known as a _ _ _ _ _ _ _ _ _ in North America.
4 Tropical cyclones often change their speed and _ _ _ _ _ _ _ _ as they track polewards.
5 A tropical cyclone is known as a _ _ _ _ _ _ _ _ in parts of Asia.
6 When a tropical cyclone moves over the land, it weakens into a rain _ _ _ _ _ _ _ _ _ _
7 As the movements of tropical cyclones are often very erratic, this makes the time and place where they will cross the coast difficult to _ _ _ _ _ _ _.
8 Winds _ _ _ _ _ _ _ _ around the centre or eye of a tropical cyclone.
9 The belt of strongest winds and heaviest rainfall surrounding the eye is called the _ _ _ _ _ _ _.
10 Tropical cyclones are common along the north coast of _ _ _ _ _ _ _ _ _ _.
11 The area surrounding the eye is characterised by very heavy _ _ _ _ _ _ _ _ _ _ (2 words).

Cyclone Approaching!

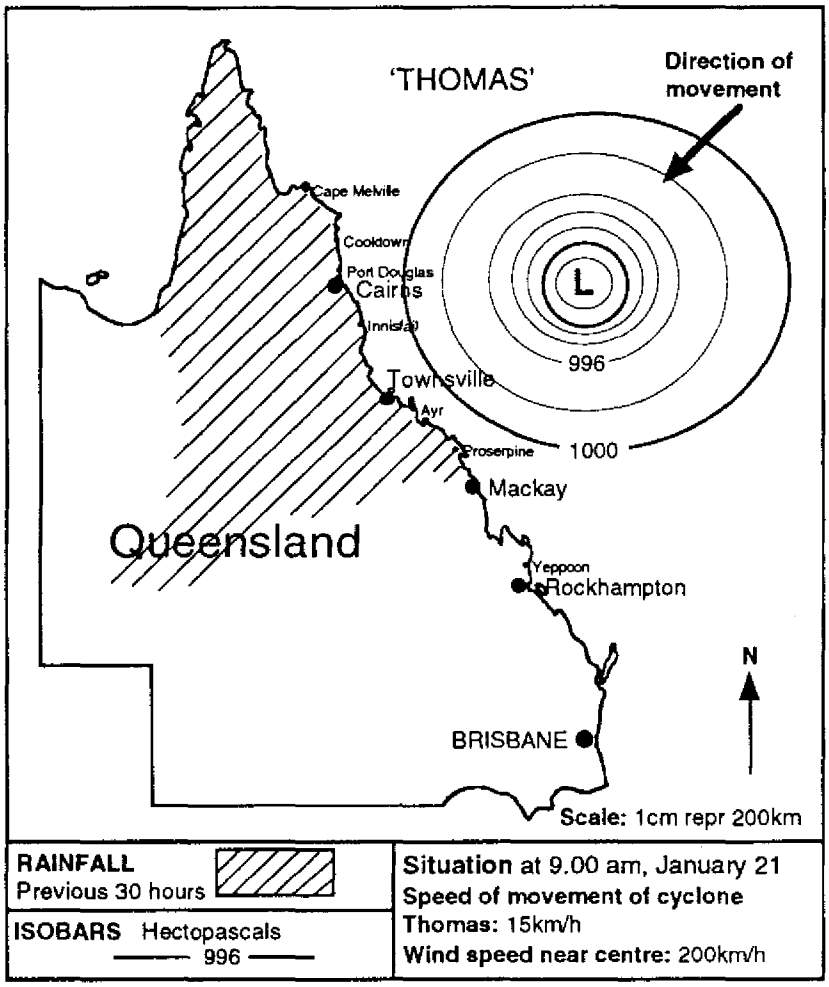


Figure 1: Cyclone Thomas approaching the Queensland coast

Activities

1 Answer the following using information in Figure 1, as well as your own ideas.
   a For Cairns, Townsville and Mackay describe the likely weather conditions at 9.00am, January 21. (include estimated temperature, wind speed and direction, cloud cover, rainfall and air pressure).
   b Choosing one of these centres, describe how conditions are likely to change in the next 24 hours. Using information in Figure 2 on the next page to help you, describe the types of damage which people living in this centre might expect as cyclone Thomas approaches.
   c Townsville is expecting high tide at 6.20pm on January 21 and at 5.45am on January 22. How might damage be increased if either of these tide times coincides with cyclone Thomas crossing the Queensland coast?
   d A flood-alert has been issued for Brisbane, saying that *their is a strong possibility of localised river flooding in the next 48 hours.* How do you account for the likelihood of flooding in Brisbane?

2 With the help of Figures 1, 2 and 3, complete the 'Cyclone Warning' on the next page for cyclone Thomas by filling in the blank spaces.

contd.....

Cyclone Approaching! (contd)

Category	Strongest Gust (km/h)	Typical Effects
1	less than 125	Negligible house damage. Damage to some crops, trees and caravans. Craft may drag moorings
2	125-170	Minor house damage Significant damage to signs, trees and caravans. Heavy damage to some crops Risk of power failure. Small craft may break moorings
3	170-225	Some roof and structural damage. Some caravans destroyed. Power failures likely.
4	225-280	Significant roofing loss and structural damage. Many caravans destroyed and blown away. Dangerous airborne debris. Widespread power failures.
5	More than 280	Extremely dangerous with widespread destruction.

Figure 2: Cyclone severity categories

Cyclone Warnings

- Cyclone warnings are issued as soon as gales or stronger winds are expected to affect coastal or island communities within 24 hours
- Cyclone warnings are issued every three hours. When a cyclone is under radar surveillance close to the coast and poses a severe threat, hourly advices are issued.
- The strength of maximum wind gusts over particular areas are indicated in the following terms:
  - gales with gusts to 125km/h
  - destructive winds with gusts above 125km/h
  - very destructive winds with gusts over 170km/h
- The warning may mention above normal tides. They are described as follows:
  - abnormally high tides could cause minor flooding .... .
  - exceptionally high tides could cause serious flooding .. ...
  - dangerously high tides could cause inundation of low lying coastal land .....

Figure 3

CYCLONE WARNING: Top priority - for immediate broadcast

Issued by: ..... **Time of issue:** .....

Name of cyclone: ..... **Category (see Figure 2)** .....

Position of cyclone at a specified time: .....

Direction and speed of movement: .....

Strength of maximum wind gusts over particular areas (see Figure 3): .....

.....

Prediction of dangerous tides / storm surges (see Figure 3): .....

.....

Likely area of flood rain: .....

.....

Details of severe cyclone Thomas

Central pressure: ..... **Location of centre:** .....

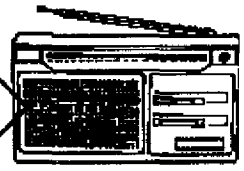
Recent movement: .....

Extent of destructive winds (ie distance out from centre): .....

Maximum wind gusts: .....

Residents between ..... **and** ..... **are advised to take precautions and listen for further advices.**

The next advice will be issued at .....



Rewa: Diary of a Tropical Cyclone

Tropical Cyclone Rewa: December 30, 1993 - January 22, 1994

December 30, 1993	The Weather Bureau reports that it is keeping a close watch on tropical cyclone Rewa, about 1,200km of the Queensland coast. The category two cyclone is south-west of the Solomon Islands and moving west-southwest at about 30km/h.
December 31, 1993	A warning is issued to shipping, with cyclone Rewa centred about 800km north-east of Cairns. Rewa is producing wind gusts between 125 and 170km/h.
January 1, 1994	Rewa, is upgraded to a category three tropical cyclone- now rated as 'severe'. The cyclone has intensified in the last 24 hours
January 2-12, 1994	Cyclone Rewa moves parallel to the Queensland coast, but eventually declines in intensity and wind speed, and appears to 'breakdown' near New Caledonia
January 13, 1994	Cyclone Rewa appears to 're-form' off the Far North Queensland coast. It is given its old name back by the Papua New Guinea cyclone centre It has a central pressure of 985 hectopascals.
January 17, 1994	Cyclone Rewa lying 680km north-east of Gladstone and moving closer to the Queensland coast.
January 18, 1994	Fears of a major storm surge associated with cyclone Rewa ease as the cyclone's movement slows It is now 280 km east of Mackay.
January 19, 1994	Ports are closed, ships are told to head to sea to weather the storm, flights to resort islands are cancelled and a major army exercise is called off as Rewa - now a category three cyclone - gets closer to the coast. A cyclone warning is current for the coast between Mackay and Gladstone.
January 20, 1994	The cyclone weakens slightly to a category two as it moves closer to the coast, but still batters the shore with heavy seas, gale-force winds and torrential rain. A child dies in flash-floods in Brisbane and a fishing trawler with two crew members is stranded at sea until a rescue is successfully completed using an army helicopter
January 21, 1994	Three people die in car crashes directly linked to Rewa's treacherous conditions. Three men are washed overboard from a small boat and are found clinging to a beacon 15 hours later. Flash-flooding submerges cars and damages about 100 houses. The cyclone changes direction and heads out to sea.
January 22, 1994	The Bureau of Meteorology says that cyclone Rewa is no longer a threat. It is now 300 km east of Fraser Island, off south-east Queensland and has been downgraded to a category one.

Figure 1

Activities

1 Using information in Figure 1 , answer the following:
   a Why could Rewa be considered as two tropical cyclones rather than one?
   b Cyclone Rewa changed its behaviour in a number of ways betweenDecember 30, 1993 and January 22, 1994. Outline at least three characteristics of the cyclone that changed in this time?
   c Why do you think the Bureau of Meteorology uses cyclone severity categories (eg category one, two, three etc)?
   d Cyclone Rewa never crossed the Queensland coast, and yet it still caused significant damage. Why was this the case?
   e Why do you think ships were advised to weather the storm by heading out to sea, rather than sheltering in a port?
   f In one incident, coal shipments at the port of Hay Point were disrupted by the cyclone. Suggest at least three other economic costs which may have resulted fromthe activities of cyclone Rewa along the Queensland coast.
   g Cyclone Rewa eventually died out as it headed south-east away from Queensland. Explain why.

Case Study: Cyclone Tracy, Darwin, 1974

Cyclone Tracy, December 1974 - Diary of a disaster

December 20: A low pressure system identified in the Arafura Sea.

December 21: Satellite photographs show the low moving slowly south-westwards.
9.30pm - A cyclone warning is issued and the name 'Tracy' is given.

December 22: 3 30pm - Radar in Darwin clearly identifies the eye about 200 kilometres north of the city. Rapid development and intensification of the cyclone is evident.

December 23: 7 30am - Eye diameter has shrunk to 12km (a strong indicator of intensification) The centre is just off the northern tip of Melville Island (see Figure 2) and is still moving south-west.
9.00am to 3 00pm - Strong winds and heavy rain are reported from Bathust and Melville Islands.
Midnight - Tracy changes direction and heads south. Winds strengthen at the automatic weather station at Cape Fourcroy.

December 24: 6.00 to 9.00am - Average wind speeds reach 120km/h at Cape Fourcroy as Tracy rounds the south-west corner of Bathurst Island
Noon· Tracy again changes course and heads south-west towards Darwin.
12.30pm - Cyclone warning issued to Darwin residents advising that Tracy should cross the coast early on Christmas Day

December 25: Midnight to 1am - Wind gusts stronger than 100km/h commence in Darwin
1.00 to 3 00am - Numerous reports of severe damage in and around Darwin. Both radio stations fail.
3.00am - Maximum recorded wind gust of 217km/h recorded before anemometer recording system fails. Torrential rain falling.
4.00am - Cyclone's eye directly overhead and calm is felt for about 30 minutes
4.30am - Extreme winds resume but this time from the opposite direction.
6 00am - Tracy's centre located near Howard Springs, with winds abating in Darwin
Midday - After crossing Adelaide River, Tracy quickly degenerates into a rain depression.

Figure 1: Cyclone Tracy, December 1974 - Diary of a disaster
adapted from 'Hazards, Disasters and Surviv. ', Natural Disasters Organisation, 1992

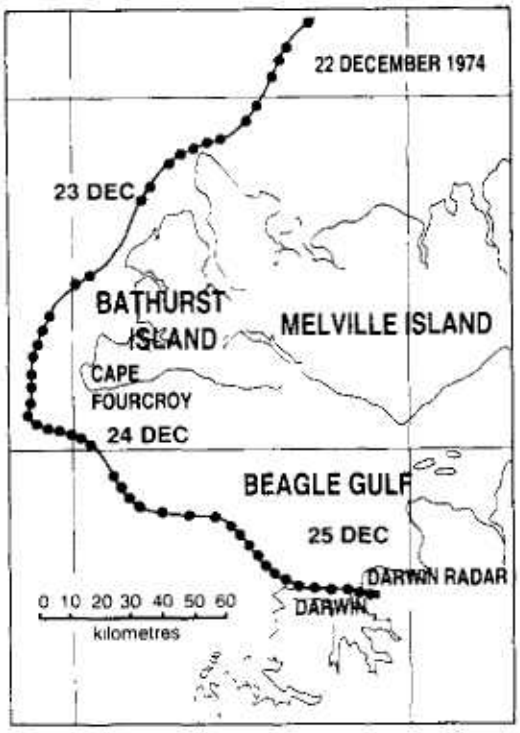


Figure 2: Track of cyclone Tracy showing approximate hourly positions of the eye

Figure 3: Aerial view of Darwin's northern suburbs, Christmas morning 1974

contd .

Case Study: Cyclone Tracy , Darwin, 1974 (contd)

Activities

1 Study the information in Figures 1 and 2 and answer the following:
   a Why did Darwin seem safe from the full impact of cyclone Tracy until noon on December 23?
   b How might the following have influenced people's preparations for the arrival of the cyclone:
      - the date on which it occurred;
      - the time of day at which it arrived;
      - the fact that other cyclones had appeared to be heading towards Darwin in the past, but had changed direction to miss the city?
   c Why do you think the failure of both radio stations at the beginning of the most intense cyclone activity was seen as a major setback?
   d Many people in Darwin thought the cyclone was over when the eye arrived. What problems might have resulted from this?
   e Explain why the winds picked up from the opposite direction after the eye had passed. How might this have caused additional problems?
   f Locate Adelaide River on a map in your atlas. Why do you think Tracy had degenerated into a rain depression by the time it reached here.

2 Look at the information in Figure 4.
   a Why do you think more than three-quarters of Darwin's residents were evacuated after the cyclone? Suggest some of the problems which may have been involved in such a large scale evacuation.

Figure 6: Damage to elevated house following Cyclone Tracy, Darwin, 1974

Death and Damage, Cyclone Tracy

- Tracy claimed 49 lives in Darwin.
- A further 16 lives were lost at sea on several small vessels which were in the path of the cyclone.
- 650 people were treated for injuries.
- 35,000 people (out of a population of 43,000) were evacuated from Darwin in the days following the cyclone. 23,000 of these were by air, in the largest airlift operation ever attempted in Australia.
- Relief teams, coordinated by the Natural Disasters Organisation, cleaned up wreckage and debris, disinfected buildings and collected and recorded personal possessions.
- About 90 per cent of Darwin's 12,000 homes were damaged or destroyed.
- Insured property losses exceeded $700 million and total estimated costs were more than $3.5 billion.

adapted from 'Hazards, Disasters and Survival', Natural Disasters Organisation, 1992.

Figure 4

Figure 5: Street scene, Darwin, Christmas morning 1974.

   b Why do you think all buildings were disinfected after the cyclone?

3 Study Figure 5. Why do you think corrugated iron can be particularly dangerous during a tropical cyclone?

4 Study Figure 6. Why do you think most of the damage caused by Cyclone Tracy was to elevated rather than 'low-set' houses?

Storm Surges

Storm Surges: What are they? How do they happen?

A storm surge is a raised dome of sea water typically 60km to 80km across and 2 metres to 5 metres above normal sea level. As a tropical cyclone reaches the coast, the huge winds whip up the sea and push the dome of water over low-lying coastal areas. The waves and sea water can move inland quite quickly, damaging buildings and cutting off escape routes. There is a high risk of drowning.

A storm surge is NOT the same as a tsunami - a huge wave caused by an earthquake which comes crashing into shore. A storm surge comes in like a rapidly rising tide, except it may be extremely dangerous and destructive.

Every tropical cyclone produces a storm surge but not all storm surges are dangerous. The height of the storm surge depends on:

- *The intensity of the cyclone* - the stronger the winds the higher the surge.
- *The speed of the cyclone* - the faster the cyclone crosses the coast the higher the surge.
- *The angle at which the cyclone crosses the coast* - crossing at right angles will increase the height.
- *The shape of the sea floor* - the more gentle the slope the greater the surge.
- *Local features such as bays, headlands and islands* - can funnel the surge and amplify its height.

The extent of flooding will depend on the tide at the time the cyclone and storm surge reach the coast. If this occurs at high tide, the flooding will be at its worst.

Figure 1

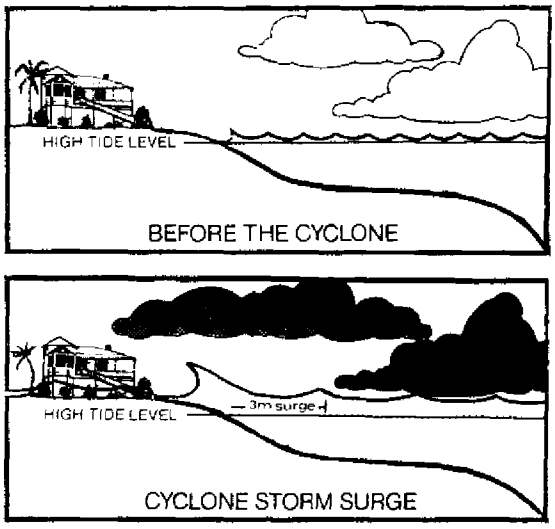


Figure 2: Storm surge formation

answers in back of book

Activities

Fill in the blanks in the following sentences using information in Figures 1 and 2. Check your answers by finding them in the puzzle on the right.

1 Every _ _ _ _ _ _ _ _ cyclone produces a storm surge.
2 During a storm surge, _ _ _ water flows over _ _ _ - lying land, where it may cause damage to _ _ _ _ _ _ _ _ _
3 Three examples of local features which may amplify the height of a storm surge are _ _ _ _, _ _ _ _ _ _ _ _ and _ _ _ _ _ _ _
4 The _ _ _ _ _ _ _ _ and _ _ _ _ _ of a tropical cyclone will influence the height of a storm surge.
5 _ _ _ _ _ _ _ _ is a common cause of death during a storm surge. .
6 A storm surge raises the level of sea water two to five metres above _ _ _ _ _ _ level.
7 The _ _ _ _ _ at which a cyclone crosses the coast and the _ _ _ _ _ of the sea floor will both influence the size of a storm surge.
8 A storm surge is a raised _ _ _ _ of sea water which is like a rapidly rising _ _ _ _
9 A storm surge is not the same as a tidal _ _ _ _
10 The huge _ _ _ _ _ associated with a tropical cyclone, push sea water over low-lying _ _ _ _ _ _ _ areas.
11 The more gentle the _ _ _ _ _ of the sea floor, the greater the storm surge.

T	R	O	P	I	C	A	L	D	I	T
B	I	E	A	C	O	A	S	T	A	L
U	S	D	D	S	M	S	P	E	E	D
I	W	T	E	R	A	S	L	O	P	E
L	E	A	O	D	O	M	E	O	A	B
D	L	N	V	L	O	W	I	N	H	B
I	G	I	V	E	W	I	N	D	S	A
N	N	I	N	T	E	N	S	I	T	Y
G	A	I	S	L	A	N	D	S	N	S
S	H	E	A	D	L	A	N	D	S	G

Emergency Management: Tropical Cyclones

HAZARD DATA

- Emergency management can be defined as a process which is used in potentially hazardous situations to minimise uncertainties and maximise public safety.
- This process may cover everything from a minor, localised incident to a major disaster.
- Emergency management is put into operation before or during a hazardous situation to:
  - minimise community vulnerability to hazards
  - maximise people's safety
  - minimise damage and loss of property
  - help with rehabilitation and recovery.

Figure 1: Loading cyclone relief stores for Vanautu, 1985

Activities

1 Using a major flood as an example of an emergency, write each of the following actions in the appropriate place in the right-hand column of Figure 2:
- relocation of valuables and equipment
- construction of cyclone shelters
- studying cyclone history and behaviour
- stockpiling of sandbags to protect against coastal flooding
- drawing up of maps showing high risk areas
- cyclone-proofing of buildings
- providing medicine and food for victims
- investigating how the cyclone behaved and comparing it to past events
- restoring utilities and community services
- search, rescue and evacuation operations
- issuing warnings during the cyclone
- rehearsal of counter-disaster plans
- installing instruments to monitor wind speed
- building of storm surge barriers on the coast
- preparation of emergency/evacuation kit
- installation of warning system
- repairing cyclone-damaged buildings
- supporting cyclone victims.

2 Using Figure 2 to help you, say which stage of emergency management is shown in Figure 1.

Figure 2: Emergency management

Stages in emergency management	What it involves	Examples of actions
HAZARD ANALYSIS	• Identifying the hazard • Providing warning of a developing threat • Working out community vulnerability	
PREVENTION/MITIGATION	• Preventing the threat eventuating • Minimising the impact of the event	
RESPONSE PREPARATION	• Alerting people to the threat • Raising awareness of preparation needs • Allocating responsibilities • Stockpiling essential food and equipment	
THE EMERGENCY EVENT	A major flood	
RESPONSE	• Combatting the cause and effect of the hazard • Assisting people affected • Minimising effect of repeated events	
RECOVERY	• Cleaning up and repairing damage • On-going medical treatment • Counselling of victims • Financial, legal and other support • Revision of hazard analysis • Evaluation of prevention and mitigation	

Cyclone Survival and Property Protection

CYCLONE ACTION!

BEFORE THE CYCLONE SEASON

- Have a portable radio and torch with fresh, spare batteries.
- Check your house is in good condition, particularly the roof.
- Trim tree branches clear of your house.
- Clear property of loose items likely to cause damage in high winds
- Know your community disaster plan.
- In case of storm tide warning, identify your nearest safe high area
- Create an **emergency kit** of tinned food, water containers, emergency lighting, first aid kit, medicines, tape and plastic bags.

UPON A CYCLONE WARNING

- Listen to your radio and TV for further information.
- Board or tape windows, store loose articles inside.
- Lock up pets, fill water containers, fuel car and place under cover.
- Check your emergency kit and put spare clothing and shoes in plastic bags.

ON WARNING OF A LOCAL EVACUATION

- Switch off electricity, gas, etc and lock your house upon leaving
- Don't forget your emergency kit.
- Follow instructions from emergency personnel

WHEN THE CYCLONE STRIKES

- Stay inside and shelter in the strongest part of the house (eg bathroom or cellar).
- Protect yourself with mattress, blankets Anchor yourself to a strong fixture (such as water pipes) or get under a strong table.
- Beware the calm **eye**. Remain indoors until advised the cyclone has passed.

AFTER THE CYCLONE

- Don't go outside until advised officially or you are positive the cyclone has passed
- Listen to your radio for further information and advice.
- If you had to evacuate, don't go home until advised Use route recommended.

Above all: Don't ignore warnings!

Figure 1: Cyclone Action!
adapted from Emergency Management Australia, Canberra

Activities

1 Study Figure 1 above and answer the following:
   a Explain why you would take the following actions upon hearing a cyclone warning:
      - tape up windows
      - fill your car up with fuel
      - fill water containers
   b What problems might arise if you were to rely only on radio and television for cyclone information?
   c What does 'beware the calm eye' mean?

2 Construct a poster, suitable for display in a cyclone-prone area, on one of the sections of Figure 1 Your poster should (i) be designed to capture the viewers attention by using illustrations, and (ii) contain accurate supporting written information

Community Responses to a Tropical Cyclone

The Scenario

An intense tropical cyclone has passed through the middle of your city at 6.00am on January 26. The Bureau of Meteorology issued warnings of serious damage for three days prior to the cyclone's arrival and accurately predicted the path of the cyclone over the 12 hours before it crossed the coast. During this time warnings were broadcast to residents of your city each hour.

Torrential rain fell for 24 hours prior to the cyclone's arrival and for about 4 more hours after it had passed. Maximum wind gusts of more than 200km/h were reported, with the passage of the eye lasting about 20 minutes. A storm surge of about 3 metres flooded many low-lying areas along the coast, and several people have been reported as missing in the heavy seas.

It is now midday - six hours after the cyclone has passed. The scene is one of major devastation. About half of the houses in your city have been demolished by the winds, while almost all of the shacks along the beachfront have been swept away by the storm surge.

Twenty people are already confirmed dead, with a further 200 still missing. Emergency service personnel have begun arriving from the south, but communications have been hampered by the loss of broadcast radio and television at the height of the storm.

Figure 1

The Characters

The Kelly family - The four of us live in a weatherboard house on the beach. The house is on stilts, with a corrugated iron roof and a large windows at the front. We have just moved in, and haven't really had time to think about preparing for the cyclone season.

Nursing staff at the local hospital - We've done some specialist training, along with the ambulance team, on the types of injuries to expect after a tropical cyclone. However, I doubt that the hospital could cope if a major cyclone hit.

Local shopkeeper - All of the shops in our centre have been built to withstand major cyclone damage. We are also well stocked to feed and cloth victims of the cyclone - provided looters don't get to our shops first!

The Marston family - We're about 25 km inland from town on a large property. I'm not quite sure how the cyclone will affect my family, our home and our 1000 head of cattle.

Social workers - We can provide post-trauma stress counselling for cyclone victims. This is an essential part of the recovery process.

Emergency service personnel - We've worked hard to prepare for a major disaster. There are many jobs we can do in supporting victims, cleaning up and rebuilding. However, if evacuation is required we're going to need outside help.

The local council - Out town hall is likely to be a focal point in the event of a major catastrophe. We've made sure that this and other public buildings can resist damage and remain safe for people after a cyclone. Our building inspector has also enforced stricter cyclone- proof features in all new homes over the last two years.

The Capuano family - Our place is in the middle of town and is about a year old. It was built after the new rules came in on cyclone-proofing of houses. We've also tried to take a range of other precautions prior to the cyclone season

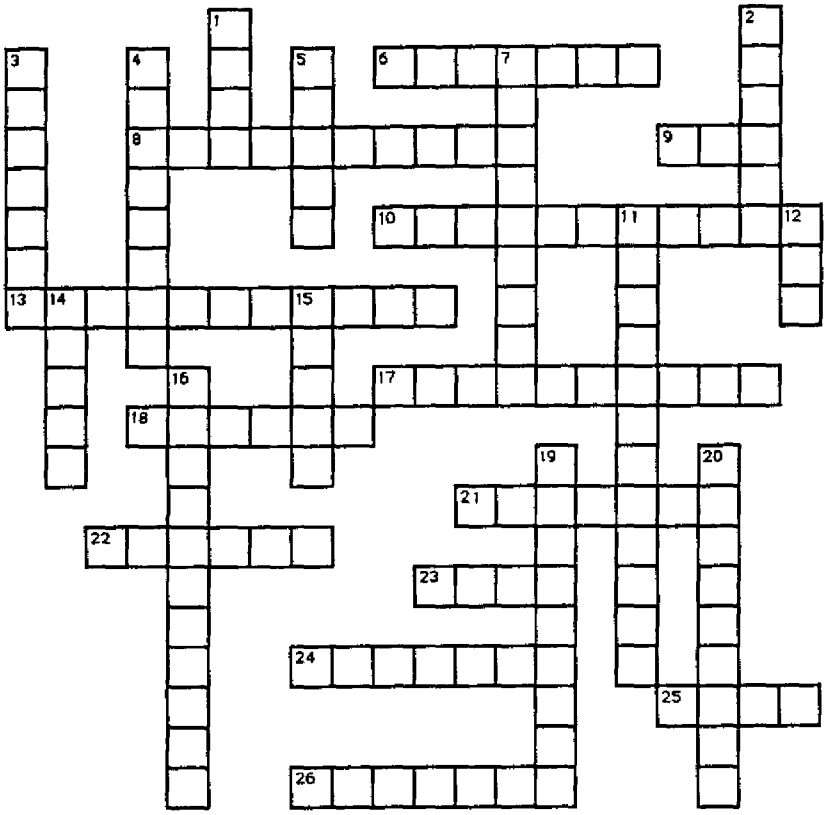
Figure 2

Activities

Study Figures 1 and 2.

1 Divide into groups representing the various people shown in Figure 2.
2 In your groups, discuss how you prepared for the cyclone, the impact it had on you and how you responded after the cyclone.
3 Staying in your groups, prepare for a meeting of the community to discuss your experiences before, during and after the cyclone. The aim of the meeting is to come up with a range of actions which could improve the community's response to future cyclones.
4 The group representing the council should prepare an agenda for the meeting, which allows all groups a chance to have their say. They should also appoint a 'mayor' to chair the meeting.
5 Each class member comes to the meeting at the town hall wearing their name tags for identification (This may involve allocating different roles to people within each group)
6 The meeting is conducted and a list of recommendations is drawn up for display and public comment.

Crossword: tropical cyclones



Across

6 Tropical cyclones are called .... in Asia.
8 Instrument used for measuring wind speed.
9 Tropical cyclones are areas of intense . ..... pressure.
10 Another name for a high pressure system.
13 Huge ocean waves whipped up by tropical cyclones.
17 Australian state where tropical cyclones are common
18 Tropical cyclones over the Bay of .... drive storm surges onto the coast of Bangladesh.
21 State of the USA where hurricanes are common.
22 This natural hazard may often result from a tropical cyclone.
23 Sheets of roofing . .. . can be lethal during a tropical cyclone
24 Port .... in Western Australia narrowly avoided damage from cyclone Orson in 1989.
25 Pacific Island country which experiences regular and disastrous tropical cyclones
26 Tropical cyclones only occur in the .....

Down

1 A very strong wind.
2 City hit by cyclone Tracy in 1974.
3 Lines on a weather map joining places of equal air pressure.
4 The .. .. Scale uses everyday observations to measure and describe wind conditions.
5 Units used to measure wind speed.
7 A tropical cyclone in the USA is called a ....
11 Large, anvil-shaped clouds associated with the formation of tropical cyclones.
12 An area of calm conditions at the centre of a tropical cyclone.
14 Cyclone .... was the most damaging in Australia's history.
15 System used for tracking tropical cyclones.
16 The Bureau of .... issues cyclone warnings.
19 Powerful, funnel-shaped storms which form over land (not to be confused with tropical cyclones).
20 Using .... photographs, meteorologists are able to tell the location and size of tropical cyclones.