

# **SEVERE THUNDERSTORMS**

## **FACTS, WARNINGS, PROTECTION**

### **THE IMPACT OF SEVERE STORMS**

Severe storms are localised events, usually affecting smaller areas than tropical cyclones and floods, so their devastating impact is often under-estimated. These storms, which are more common than any other natural hazard, can occur anywhere in Australia. Each year, on average, severe storms are responsible for more damage (as measured by insurance costs) than tropical cyclones, earthquakes, floods or bushfires. Unfortunately, storms also kill people: between 5 and 10 deaths are caused by lightning strikes each year. More deaths occur when strong winds cause tree limbs to fall, debris to become projectiles and small boats in open water to capsize. Although many people believe that tornadoes do not occur in Australia, they have caused at least 41 deaths here.

### **SEVERE STORMS: DEFINITIONS, CAUSES AND OCCURRENCE**

A SEVERE THUNDERSTORM is defined by the Bureau of Meteorology as one which produces; hail, diameter of 2 cm or more (\$2 coin size); or wind gusts of 90 km/h or greater; or flash floods; or tornadoes, or any combination of these.

Many people believe that tornados do not occur in Australia; this is not true, they do and have caused numerous deaths. Most thunderstorms do not reach the level of intensity needed to produce these dangerous phenomena, but they all produce lightning which can cause death, injury and damage.

### **LIGHTNING AND THUNDER**

Lightning is the discharge produced when voltage differences between ground and atmospheric electrical charge are large enough (several hundred million volts) to overcome the insulating effect of the air. Strokes can occur within the cloud, between clouds, or between clouds and the ground. Thunder is the sound produced by the explosive expansion of air heated by the lightning stroke to temperatures as high as 30,000°C.

### **HAIL**

Hailstones can form in a thunderstorm with a strong updraught when frozen raindrops, suspended in the updraught, grow rapidly by sweeping up small cloud droplets which freeze on contact. Hailstones larger than cricket balls have been recorded in Australia.

### **WIND GUSTS**

In a mature thunderstorm, the falling rain and hail drag the surrounding air downwards. In addition, evaporation from the raindrops cools the nearby air,

accelerating the downward rush. This strong downdraught spreads out upon reaching the ground, producing a cool, gusty wind that can cause damage.

### **FLASH FLOODS**

The updraught of a mature thunderstorm produces raindrops by the condensation of moist air that cools as it rises. When the raindrops become too large to be supported they fall, but the intense updraught of a severe storm can suspend huge amounts of rain before releasing a deluge. Such rain can reach intensities of more than 200 mm/h, provided the environment is humid enough to feed the storm with enough moisture. Flash floods often result when the storm moves slowly, so that a small area receives most of the rain, but the drainage and run-off characteristics on the ground can also determine the area of greatest impact.

### **TORNADOES**

These are the rarest but most violent of thunderstorm phenomena. A rapidly swirling mass of air (called the vortex) which can range in width from a few metres to hundreds of metres, descends in the well-known funnel shape from the base of a storm cloud. A tornado usually whirls clockwise (viewed from above) and contains very damaging winds that may reach more than 450 km/h.

### **WHAT ARE LAND GALES?**

Land Gales are simply gale force (62 kph) or stronger winds which occur over the land. They usually last longer and affect much larger areas than thunderstorms. Gales blow when large differences in atmospheric pressure are concentrated over a small distance. This can happen between a “deep” low pressure system and a strong high, or near an intense cold front.

In the southern half of Australia extreme winds generally occur in winter and spring and are usually due to land gales. In the tropical north the strongest winds usually hit in summer and autumn, and are often due to tropical cyclones.

### **WHAT CAUSES SEVERE THUNDERSTORMS**

Thunderstorms require 3 main ingredients; a source of moist air, an unstable atmosphere and a trigger mechanism. Moist air is important because when it condenses to form cloud, heat energy is released making the rising air more buoyant and fuelling further cloud growth. An unstable atmosphere is necessary so that developing cloud is able to rise freely to great heights in the atmosphere. And trigger mechanisms are important as they serve as a focus for storm development. Typical triggers are cold fronts, heat troughs and regions of low pressure. Hills and mountains may also enhance storm development.

The severity of any subsequent thunderstorms will depend largely on the buoyancy of the rising air within the storm and the structure of the wind within the atmosphere. Wind direction and speed is rarely constant, and generally tends to increase in speed and turn anti-clockwise (in the southern hemisphere) with

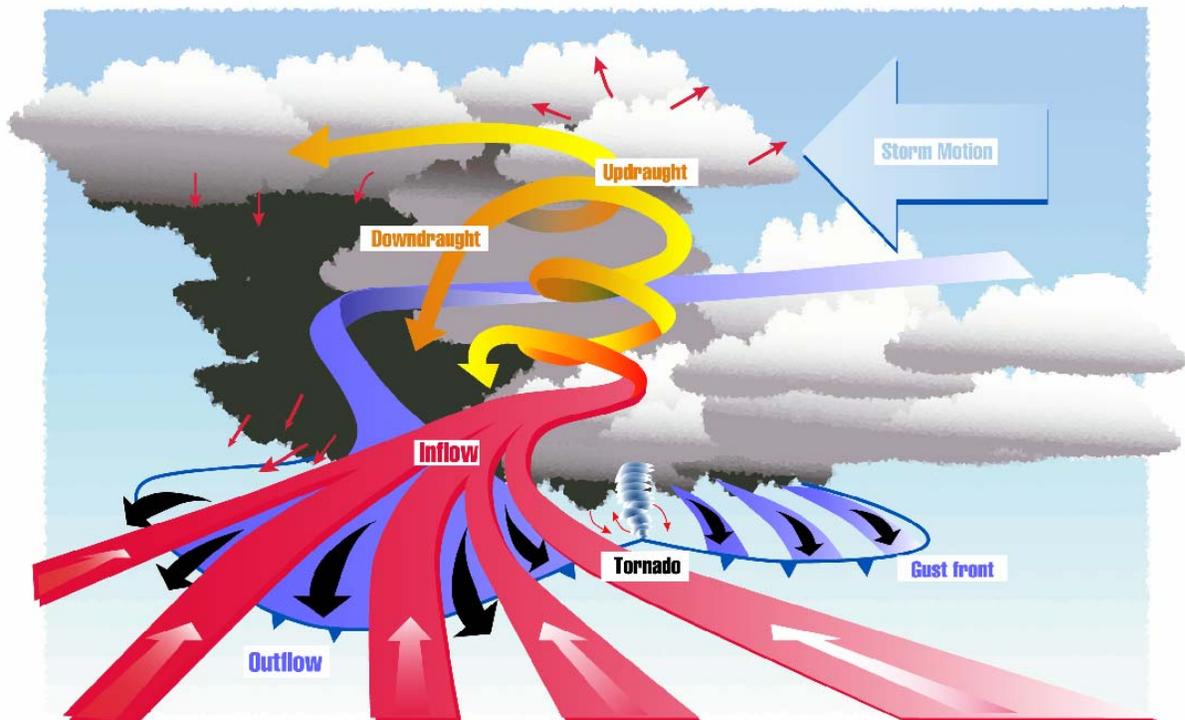
increasing altitude. The change in wind direction and speed as you move upwards through the atmosphere is known as "wind shear".

Non-severe thunderstorms generally occur within environments possessing only low to moderate instability and minimal wind shear.

If the atmosphere is very unstable with light winds and little shear, storms develop a "pulse-like" character, rising strongly upwards then collapsing over the period of half to one hour.

Severe thunderstorms in these conditions may produce large hail and strong bursts of wind but rarely produce widespread damage. An increase in wind shear produces storms with additional opportunities for regeneration. This allows several storm "cells" at different stages of their lifecycle to be found within the one storm system, increasing their overall lifetime and the area they may affect. These "multicellular" thunderstorms may produce severe hail and wind, with the added possibility of flash flooding and weak tornadoes.

Certain instability and wind profiles can lead to the development of long-lived thunderstorms with strong rotation within their cores. These storms are known as "Supercells" and are responsible for the majority of damage caused by severe thunderstorms. Supercell thunderstorms may produce very large hail, extraordinarily strong wind gusts, powerful tornadoes and heavy rainfall



## **WHERE AND WHEN DO SEVERE THUNDERSTORMS STRIKE?**

Severe thunderstorms can occur at any time of the year, although they are very rare during the dry winter months in the north. Most strike between September and March when the supply of solar energy is greatest, but severe winter storms linked to cold fronts are common in the south-west of Western Australia and south-east South Australia.

The geographical spread of severe thunderstorms in Australia is difficult to determine because of our low population density and lack of observations over most of the continent. While records of storm impact show that the most damaging storms have occurred in the populous south-east quarter of the continent, analysis of wind, hail and tornado data suggests that severe thunderstorms are a significant threat throughout the country. The most damaging individual storms have hit south-eastern Queensland and the central NSW coast.

## **PROTECTION FROM SEVERE STORMS**

### **AT THE START OF THE STORM SEASON**

- Trim trees and remove overhanging branches so that they are well clear of your home and clear guttering and downpipes of leaves
- Check and secure tiles or roofing sheets
- Protect skylights with strong wire mesh, and fit windows and glass doors with shutters or external metal insect screens
- Clear your yard of loose materials and rubbish that may blow about, and be dangerous.
- Prepare an emergency kit of:
  - portable radio, torch, spare batteries;
  - first aid kit and manual, and strong plastic bags; and
  - plastic sheeting, timber strips, hammer and nails (for temporary repairs).
- List your emergency phone numbers.
- Check your home insurance is current and adequate.
- If you live in a caravan, ask your State or Territory Emergency Service for a 'Protecting Caravans' pamphlet.
- If you own a boat, check that it is securely moored, or protected on land.

### **WHEN A SEVERE STORM THREATENS**

- Listen to your local radio station for storm warnings.
- Shelter and secure pets and animals.
- Put garden furniture, toys, etc. inside. Fill empty garbage bins with water to hold them down.

- Park vehicles under solid shelter or cover with firmly tied tarpaulins/blankets.
- Secure all external doors and windows and draw curtains.
- Put valuables, medications and spare warm clothing in plastic bags with your emergency kit and keep it handy.
- Disconnect all electrical items, external TV/radio aerials and computer modems.

### **WHEN THE STORM STRIKES**

- Stay inside and shelter well clear of windows, doors and skylights.
- If the building starts to break up, shelter in the strongest part (cellar, internal room, hallway, or built-in wardrobe) under a mattress, doona, or a strong table or bench (see photo 22).
- Listen to your portable radio for severe thunderstorm warning updates.
- If outdoors, seek solid enclosed shelter (not a tree).
- If driving, stop, clear of trees, powerlines and streams.
- Don't use a fixed telephone during a thunderstorm due to lightning danger

### **If caught outdoors**

- Seek shelter in a 'hard-top' (metal-bodied) vehicle or solid building but avoid small open structures or fabric tents.
- Never shelter under small groups of (or single) trees.
- If far from shelter, crouch (alone, feet together), preferably in a hollow. Remove metal objects from head/body. Don't lie down flat but avoid being the highest object in the vicinity.
- If your hair stands on end or you hear 'buzzing' from nearby rocks, fences, etc, move immediately. At night, a blue glow may show if an object is about to be struck (St Elmo's fire).
- Don't fly kites or model aeroplanes with control wires.
- Don't handle fishing rods, umbrellas or golf clubs etc.
- Stay away from metal poles, fences, clothes lines etc.
- Don't ride horses, bicycles or travel in open vehicles.
- If driving, slow down or park away from trees, power lines etc. Stay inside metal-bodied (hard top) vehicles or caravans but don't touch any metal sections.
- If swimming, surfing etc, leave the water immediately.
- If boating, go ashore to shelter as soon as possible.
- Be sure the mast and stays of a sailing boat are adequately 'grounded' to the water.

### **If you are indoors**

- Before the storm arrives, disconnect external aerial and power leads to radios and television sets. Disconnect computer modems and power leads.

- Draw all curtains and keep clear of windows, electrical appliances, pipes and other metal fixtures
- Avoid touching brick or concrete, or standing bare-footed on concrete or tiled floors.
- Avoid the use of fixed telephones. In emergencies, make calls brief.

### **AFTER THE STORM PASSES**

- Beware of fallen powerlines, damaged buildings and trees and flooded watercourses.
- Listen to your portable radio for Severe Thunderstorm Warning updates.
- Check for damaged windows, walls, or roof. Temporarily cover with plastic sheeting and nailed on wooden strips.
- For emergency assistance, see below.
- If you don't need help, check, and if necessary, help your neighbours.
- Don't go sight-seeing.

### **EMERGENCY ASSISTANCE**

- For emergency assistance with serious damage, or advice on temporary accommodation, food and clothing, call the State or Territory Emergency Service.
- In case of power failure, fallen powerlines, electrical problems - call your local power supplier.
- In case of gas or water supply interruption or emergencies - call the relevant local supplier.
- To arrange permanent repairs to your home, call your insurance company for a claim form.

### **THE WARNING SERVICE**

The Bureau of Meteorology is responsible for providing warnings for dangerous weather, so that the community can take appropriate actions to minimise the risks of injury and property damage. Severe Thunderstorm Warning services are provided from the Bureau's Regional Forecasting Centres in State and Territory capital cities.

The warnings advise of the expected dangerous phenomena, and include advice of what precautionary action should be taken to minimise the risk.

Forecasters use numerical and meteorological observations to help in the prediction of severe thunderstorms. The observations are obtained through observers, storm spotters, radar and satellites. As storms develop and evolve, the weather watch radar plays an important role in the continuous monitoring of severe thunderstorms.

### **LIMITATIONS OF SEVERE THUNDERSTORM WARNINGS**

With lifetimes usually less than an hour and dimensions as little as 10km, severe thunderstorms are especially difficult to predict. Warnings are generally issued when there is strong evidence of impending or actual severe thunderstorm activity. This means the average lead-time for warnings is quite short (about 20 minutes). Where there is radar coverage, effective monitoring of storms can be maintained, however many parts of the country are not covered by radar; observing networks and storm spotters work to detect severe storms, but there are large gaps, meaning some severe thunderstorms can develop undetected.

## **WHERE CAN I GET INFORMATION?**

Warnings for Severe Thunderstorms and other Severe Weather issued by the Bureau of Meteorology are accessible through the following communications systems:

World Wide Web	<a href="http://www.bom.gov.au">http://www.bom.gov.au</a>
Telephone Services	<a href="http://www.bom.gov.au/other/tws/twsdir.shtml">http://www.bom.gov.au/other/tws/twsdir.shtml</a>
Weather by Fax	<a href="http://www.bom.gov.au/other/wbf/wbf.shtml">http://www.bom.gov.au/other/wbf/wbf.shtml</a>

Also, current weather radar displays, satellite pictures of the weather, weather charts and weather observations are available through the above Fax and World Wide Web services.

Monthly significant weather summaries (since 1996) are also available on the Bureau of Meteorology Web Site.

Emergency Management Australia publishes a number of other natural hazard brochures, available through your State or Territory Emergency Service. Also visit the EMA Web site at [www.ema.gov.au](http://www.ema.gov.au).

This pamphlet was jointly produced by Emergency Management Australia and the Bureau of Meteorology.

© Commonwealth of Australia 2004.

This is a text version of the pamphlet – to obtain a printed version of the pamphlet, please contact EMA: [ema@ema.gov.au](mailto:ema@ema.gov.au)