BLSA

Weather Handout

This handout will supplement what you have already received.

We will go through the questions in the back of the handout, answers are also enclosed.

TERMS YOU MAY FIND IMPORTANT

THE BIOPHYSICAL ENVIRONMENT: The interaction of the atmosphere, hydrosphere, lithosphere and biosphere.

THE HYDROSPHER: The layer of water that cover the earth from a maximum depth of more then 11km in the oceans to shallower and less extensive bodies of water in lakes and river.

THE ATMOSPHERE: An envelope of air composed mainly of nitrogen and oxygen, which stretches from the earth's surface to about 100km above our planet.

THE BIOSPHERE: The system of living things and non-living environment with which they interact.

THE LITHOSPHERE: The sphere of rocks or upper layer of the mantle, which lies above the hot, semi molten and deformed rock of the deeper earth's mantle.

CLIMATE: The average state of the atmosphere

WEATHER: The day to day description and measurement of the weather elements (temperature, moisture, cloud and wind)

ISOBARS: Lines drawn on a weather map to show places of equal barometric pressure.

ISOHYETS: Lines drawn on a map to show places of equal average annual rainfall (millimeters)

ISOTHERMS: Lines drawn on a map to show places of equal average temperature.

DIURNAL RANGE: The daily range of temperature or other weather elements.

THE TROPOSPHERE: The lowest layer nearest the surface i.e. where all our weather patterns develop (12,000m above the surface)

THE STRATOSPHERE: The layer from about 12,000 meters to about 50kms above the surface – this is where the sky is always clear, there is no water vapour and no changes in the weather.

THE GREENHOUSE EFFECT: This is a natural warming process of the earth where the earth's atmosphere has always retained heat from the sun by a process similar to that which takes place in a greenhouse. This works by the glass trapping the incoming short wave solar energy and preventing it from re-entering back into space as it has changed to long wave radiation. The temperature rises as more heat enters the greenhouse than escapes. In the case of the atmosphere it is not glass but a blanket of carbon dioxide, water vapour and other greenhouse gases such as methane, which refract and reflect the heat energy and so prevent its outflow. When the sun's energy reaches the earth, some of it is reflected back to space and the rest is absorbed. The absorbed energy warms the earth's surface, which then emits heat energy back toward space as longwave radiation. This outgoing longwave radiation is partially trapped by greenhouse gases such as carbon dioxide, methane and water vapour, which then radiate the energy in all directions, warming the earth's surface and atmosphere.

THE WATER CYCLE: The movement of water from the sea to clouds: to rain or snow: to rivers or underground and back to the sea.

EVAPOTRANSPIRATION: Evaporation from all terrestrial bodies.

EVAPORATION: Liquid water changes to invisible water vapour.

CONDENSATION: Water vapour changes (condenses) to droplets of water creating condensation forms like clouds, fog and dew.

PRECIPITATION: Water falling from the clouds as rain, hail, snow or sleet.

INFILTRATION: Some water falling on the earth's surface soaks into the ground, and joins the underground aquifers.

RUNOFF: The water, which does not soak into the ground or is used by plants, animals and people, runs off the surface into streams, river and lakes.

CONDENSATION LEVEL: The level in the atmosphere at which condensation takes place.

DEW POINT: The temperature at which condensation takes place.

CONDENSATION PROCESS: For condensation to occur, the temperature in the atmosphere or on the land surface must be reduced. As the temperature decreases, the relative humidity in the air increases. If the relative humidity reaches 100%, condensation occurs as the air becomes saturated with moisture.

TEMPERATURE INVERSION: This is a feature occurring in the early morning after a clear night, when terrestrial radiation is lost to space and the air near the ground has become cooler than the air above.

CONVECTIONAL RAINFALL: When moist air passes over land surfaces that have been strongly heated, the air is forced to rise and the condensation process begins.

FRONTAL RAINFALL: Rainfall that is associated with the passage of a front over a location.

OROGRAPHIC RAINFALL: When moist air is forced to rise up over a mountain range in its path.

CONVERGENCE RAINFALL: When two large air masses come together or converge, the air is forced to rise and the condensation process commences.

MERIDIAN ALTITUDE: The angle the sun makes with the earth's surface at midday.

ALBEDO: The reflectivity of a surface.

OCEAN CURRENTS: Are large continuous movements of seawater which circulate in the oceans and are caused by the rotation of the earth.

ASPECT: The way in which a slope faces towards or away from the sun and only has a noticeable affect in mid-high latitudes.

INSOLATION: The sun's energy transmitted in the form of short wave radiation.

CONDUCTION: A form of energy that can be transferred by passing of heat by contact.

CONVECTION: The transfer of heat by air currents or movements.

ADVECTION: The horizontal movement or transfer of heat by convection.

RADIATION: Heat in wave form sent out by the sun or earth.

LATENT HEAT: Heat transfer which occurs during evaporation, condensation, freezing and melting.

SHORT WAVE RADIATION: Incoming radiation from the sun.

LONG WAVE RADIATION: Outgoing radiation from the earth's surface – sometimes referred to as terrestrial radiation.

NET RADIATION: This is the difference between the incoming and outgoing energy.

THE RADIATION BALANCE: This is a comparison of the energy gained and lost (inputs and outputs of energy).

THE THERMAL EQUATOR: A belt of heat about ten degrees either side of the equator.

SYMBOPTIC CHART: A weather map.

FRONTS: The boundary zones between two air masses.

AIR MASS: A thick and extensive portion of the troposphere having uniform temperature and humidity characteristics derived from its source region.

EFFECTIVE RAINFALL: The average number of months where the average precipitation is greater than evapo-transpiration.

EL NINO: A name given to the occasional development of a warm ocean current along the coast of Peru as a temporary replacement of the cold Humboldt current which normally operates. El Nino is an extension of the Equatorial current and leads to an increase in surface – water temperature of ten degrees and a decrease in plankton, which thrive in the colder current. As a result of this reduction in their food supply the fish population is seriously depleted. It recurs every seven to fourteen years and results from a weakening of the S E Trades in the Pacific.

GREENHOUSE EFFECT: Natural event maintaining a temperature that supports life on earth - trapping of heat.

ENHANCED GREENHOUSE: Increased gas (greenhouse) carbon dioxide, methane, and nitrous oxide, CFC.

HUMIDITY: Humidity refers to the amount of water vapour present within the atmosphere. The actual amount of water vapour per unit volume is called absolute humidity. Relative humidity is the amount of water vapour in a given volume of air.

RAINFALL: Evaporation and transpiration from a land or plant source. Water changes from a liquid to a gas through heating of the water surface. Heat is trapped within the vapour (latent heat). Vapour rises in the air. Temperature decreases, condensation begins to occur, relative humidity starts to increase (if the relative humidity reaches 100% condensation occurs as the air becomes saturated with moisture). Condensation takes place in the atmosphere at a level called condensation level. The temp at which condensation occurs is called the dew point. Water droplets become to heavy to be suspended in the cloud – they then fall out of the cloud as rain.

DEW FORMATION: Dew is formed in calm and settled conditions generally associated with anti-cyclonic weather. During the night, the temperature falls and the air is unable to hold as much water vapour. The cooling which causes dew is the result of radiation during the night. The air-cools from the ground upwards, and if dew point is reached, condensation will occur.

FOG: Fog occurs when a whole layer of air is cooled below its dew point and moisture is condensed around tiny particles of dust. Depending on the temperature, it may be in the form of droplets of water, or ice crystals, both of which are heavier than air, but they are kept suspended by the slightest movements of the

atmosphere. Fogs are usually the result of air cooling by contact with a cold surface.

SUMMARY POINTS:

HIGH PRESSURE CELLS:

- Highest pressure in the centre
- Anti-clockwise direction
- Isobars are elongated in an east west direction
- Isobars are widely spaced
- Associated with clear sky

LOW PRESSURE CELLS:

- Lowest pressure in the centre
- Moves in an clockwise direction
- Associated with rising and cooling air and therefore rain
- Possibility of cloud cover
- Isobars closer together therefore giving stronger winds.
- More common in southern Australia in winter.
- In tropical regions they develop into tropical cyclones under hot moist conditions.

COLD FRONT:

- Boundary zone between two air masses
- Air masses of different temperature and moisture characteristics do not mix
- Cold air move more vigorously and force their way beneath warm air causing the warm air to rise.
- Rising and cooling air gives rise to cloud and the possibility of rain
- Cold front occurs you experience – temp decrease, pressure decrease, winds increase, winds change direction, cloud increases, chance of rain increases
- Occurs more often in winter – rainfall to mid latitudes.
- They bring the cool change in summer.

AIR MASSES:

An air mass is a thick and extensive portion of the troposphere having uniform temperature and humidity, characteristics derived from its source region

WEATHER MAPS (SYNOPTIC CHARTS)

High-pressure systems in southern and eastern Australia bring warm to hot northerly, westerly or northwesterly winds from the inland areas.

- Low-pressure systems in southern and eastern Australia bring cool and moist southerly winds from the southern ocean and Tasman Sea.
- Low-pressure cells with rising and cooling air are responsible for much of the rain.
- As cold fronts pass over southern and eastern Australia they bring the following conditions; a fall in temp, a fall in air pressure, an increase in cloud cover, possibility of rain, change in wind direction from the north to the south, increase in wind strength.
- In summer the position of the high pressure cells are frequently over the Great Australian Bight. Low pressure cells over the centre of Australia – due to the strong heating of the earth surface and intense low-pressure cells off the northwest and northeast coasts may develop into tropical cyclones.
- In winter southern Australia cold fronts pass over more frequently. High pressure over the centre of Australia. Rainfall is common over the southern part of Australia.

WIND DIRECTION:

- Air moves anti-clockwise outwards around a high (anticyclone)
- Air moves clockwise inwards around a low (cyclone)
- Winds are approximately parallel to the isobars
- Winds are named by the direction which they below.

TERMS:

- **Fine:** No rain or other precipitation
- **Fog:** Suspension of fine water droplets reducing visibility
- **Mist:** Similar to fog but greater visibility
- **Smog:** Smoke induced fog
- **Drizzle:** Uniform precipitation in fine droplets
- **Rain:** Steady and falls from status clouds
- **Showers:** Often short lived and heavy rain periods

ATMOSPHERIC VARIATIONS AND GLOBAL WARMING

- 1996 and 1997 were the warmest years on average around the world since 1860. Scientists believe temp will increase two-degree in the next 100 years – will cause a sea level rise of approx. 50cms.
- Some climatologists believe the rate of warming within the atmosphere is greater know than in those periods of warming after earlier ice ages. Some believe temp changes are within the range of natural temperature swings.
- All agree that warming is due to an increase in the enhanced greenhouse effect resulting from an increase in the emissions of greenhouse gases.
- United Nations intergovernmental panel on climatic change in 1994 noted that the rate of global warming had increased between 10 and 30 % over the previous two years. At the same time carbon dioxide emissions had also increased during that period after an interval of stability in the growth of emissions.
- Reasonable agreement that there has been heating of the atmosphere by about .5 - .7 degrees.

SIGNIFICANCE OF GLOBAL WARMING FOR THE WORLD:

- Northern Europe to warm up
- Tropics to increase at the expense of the polar regions
- Coral reefs to die – unable to cope with sudden sea level rise
- Forests sensitive to high temp. will disappear
- Food production will decrease in areas – unpredictable weather
- Small islands will be swamped
- Low lying delta regions will be flooded more often
- Shortage of water as warmer weather dries out rivers and streams
- Heat stress mortality and vector borne disease will increase
- Extreme storms and unpredictable events will cause flooding and damage
- El Nino and Enso will be more frequent

SIGNIFICANCE TO AUSTRALIA:

- 20% more summer rainfall in northern and eastern areas.
- 10 – 20% less winter rainfall in southern and southwestern areas.
- Rainfall may increase in central and western Australia
- Cyclone belt will move south
- Monsoon will become more intense
- Loss of land and amenities in coastal locations due to sea level rise
- Temperature increase of 2-3 degrees in coastal eastern Australia
- Inland Australia temp increase of 4-5 degrees
- Brisbane – warmer, wetter and less windy
- Sydney – like Brisbane
- Melbourne – drier, warmer and windier.
- Adelaide and Perth could be drier, warmer and less windy
- Darwin – warmer, wetter and less windy
- 40% more vegetation on some desert areas in northern Australia
- Wheat growing areas – higher rainfall will shift the planting into poorer more marginal soil
- Inland Queensland – cropping to replace grazing in areas of increased rainfall

THE VARIABILITY AND EFFECTIVENESS OF RAINFALL

- Rainfall generally decreases inland and therefore the effectiveness of this rainfall for various forms of land-use changes from cropping and intensive livestock activities closer to the coast to no cropping and extensive livestock activities in the drier inland.
- The principal control on the distribution and intensity of land use is the availability of soil moisture.
- Effective rainfall means the average number of months where the average precipitation s greater than evapotranspiration.
- The main cereal producing regions are in areas with 5-9 months of effective moisture. Higher rainfall zones land use is more intensive, with fat lamb and cattle production on well-watered pastures being the norm.
- Intensive cropping is possible where there is 9 months of effective rainfall. This area is very limited in extent and much of the land is too mountainous for cultivation.

- Environmental factors that influence the effectiveness of rainfall and viability of land use are; soil productivity – fertilizers, trace elements deficiencies and salinity. Topography – steep land, Drainage – low lying, water logged soils.

DROUGHT:

- The definition of drought varies depending upon the activities carried out in a particular location.
- Drought is commonly defined as a long period without rainfall, in a climate regime where evapotranspiration exceeds precipitation and water levels in the soil are lowered.
- The physical causes of drought have their origins in the natural fluctuations of the global climate system.
- 1994/95 drought conditions: A persistent belt of high pressure lodged itself over a very wide area of Australia. Normally their would be a procession of high and low pressure systems, with cold fronts bringing the possibility of rainfall, however the high pressure system blocked their passage for months on end. The failure of expected rains left wide areas without sufficient water supplies.

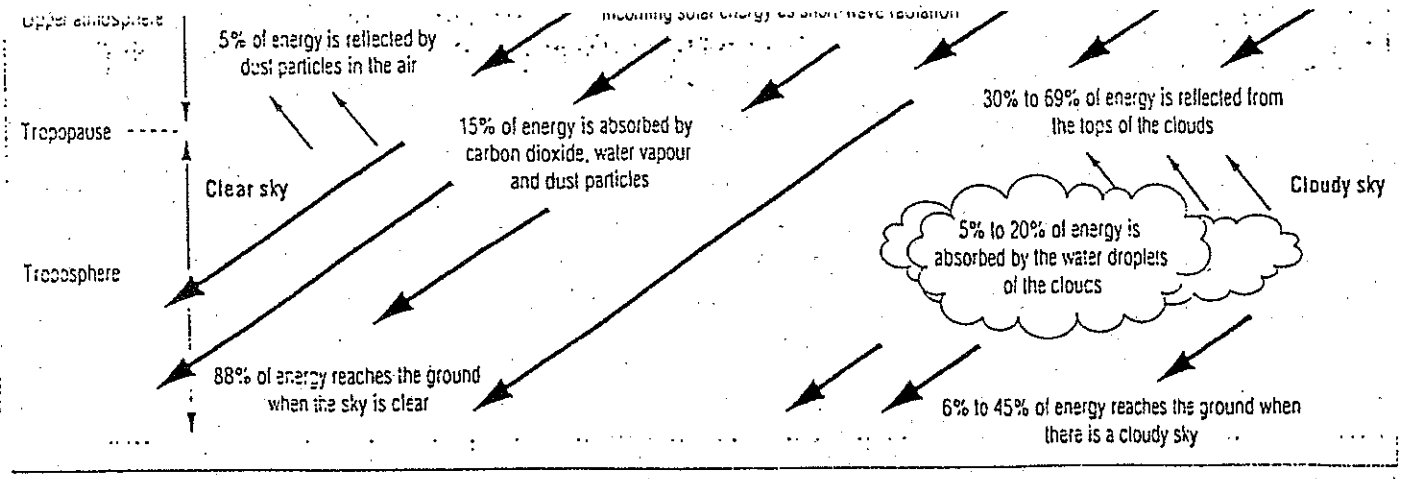


Figure 1.2.4
The absorption and scattering of insolation.

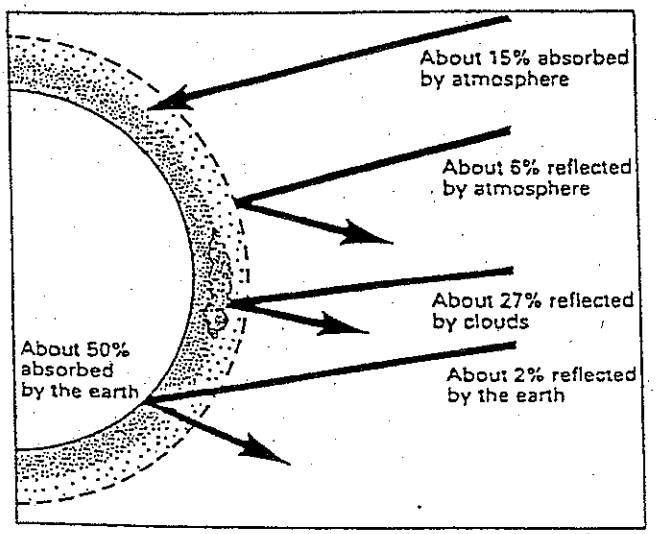


Figure 11.2 Solar radiation budget

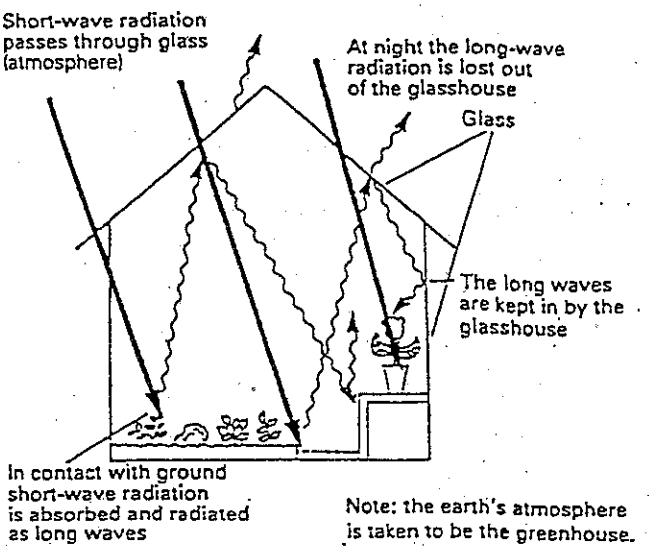
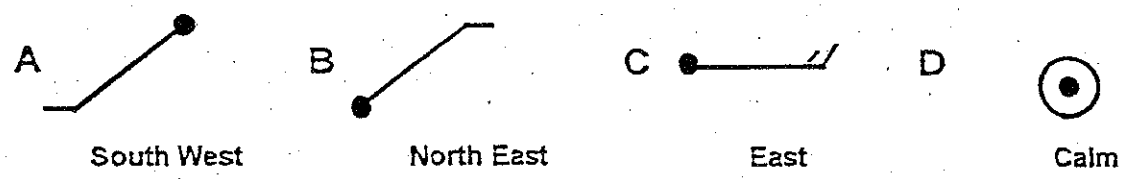
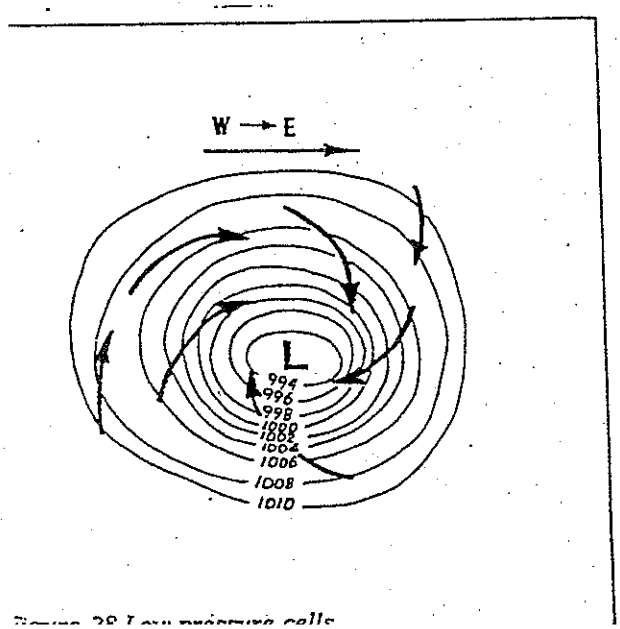


Figure 11.3 The greenhouse effect

Figure 32 Wind direction arrows *(below)*





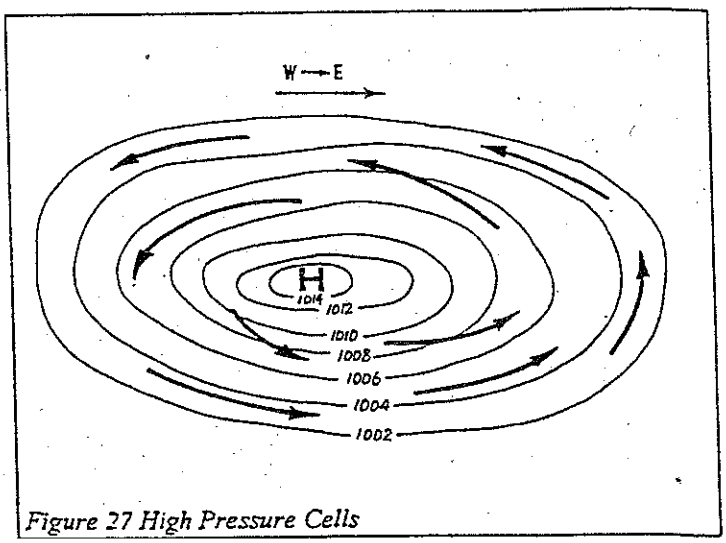


Figure 27 High Pressure Cells

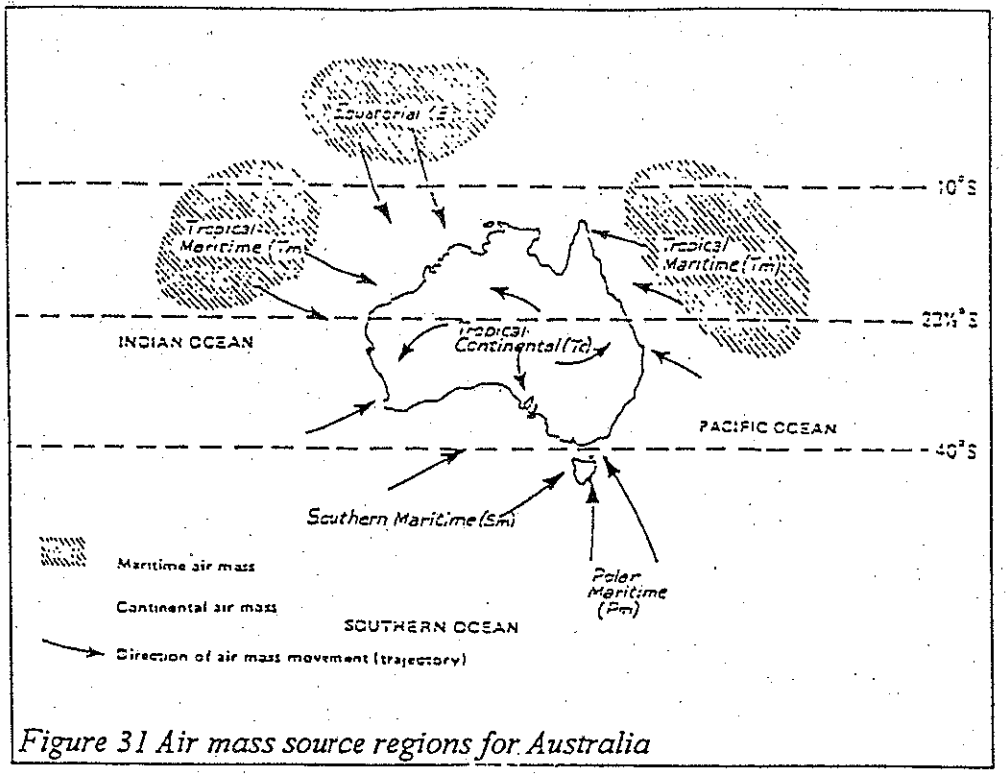


Figure 31 Air mass source regions for Australia

Figure 30 Air masses affecting Australia

Name and symbol		Characteristics	Typical features and Occurrence
Tropical	T	hot	• originating in or near the tropics
Polar	P	cold	• originating from or near the poles
maritime	m	moist	• originating over an ocean
continental	c	dry	• developed over land
Equatorial	E	very warm and moist	• influences Northern Australia in summer
Tropical maritime	Tm	warm and moist	• influences coasts near the Pacific and Indian Oceans. Tm air may bring summer thunderstorms in SA, and Victoria and rainfall along the NSW and Queensland coast
Tropical Continental	Tc	Hot and dry	• influences southern Australia in summer with hot, dry, dusty
Southern maritime	Sm	Cool and moist	• common in southern Australia all
Polar maritime	Pm		• Only occasionally influences southern and eastern Australia. • Brings our coldest winter weather. eg. snow falls in alps.

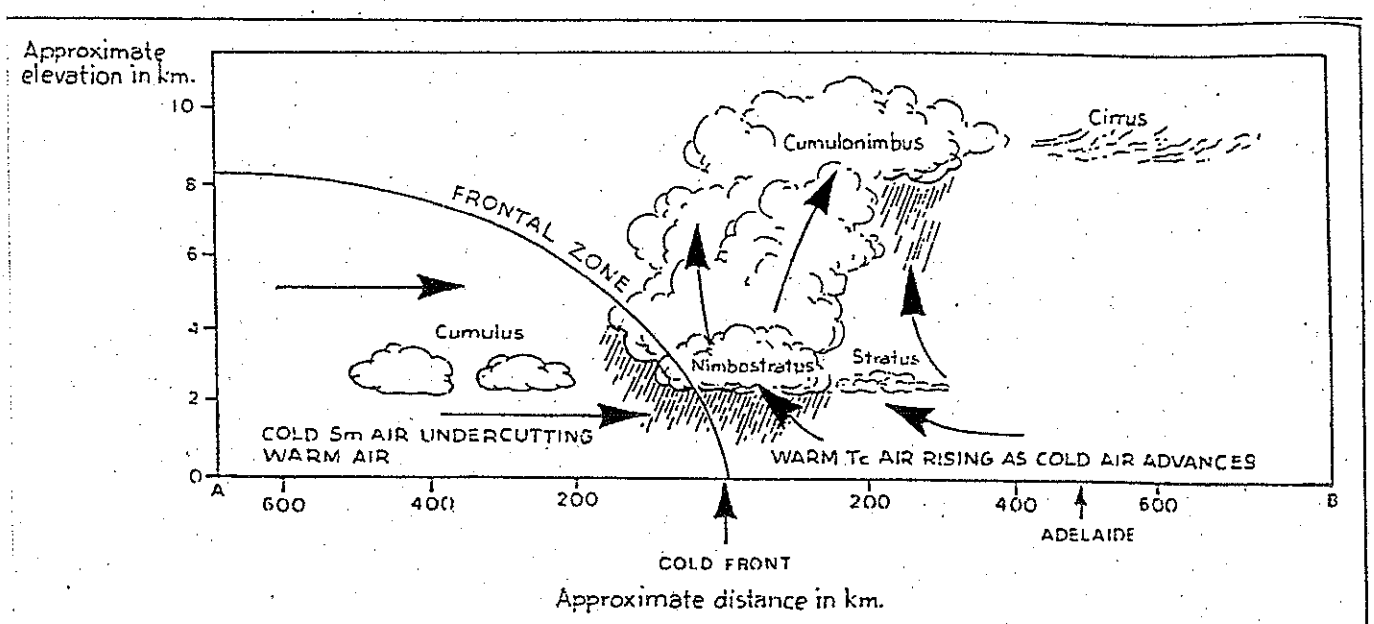
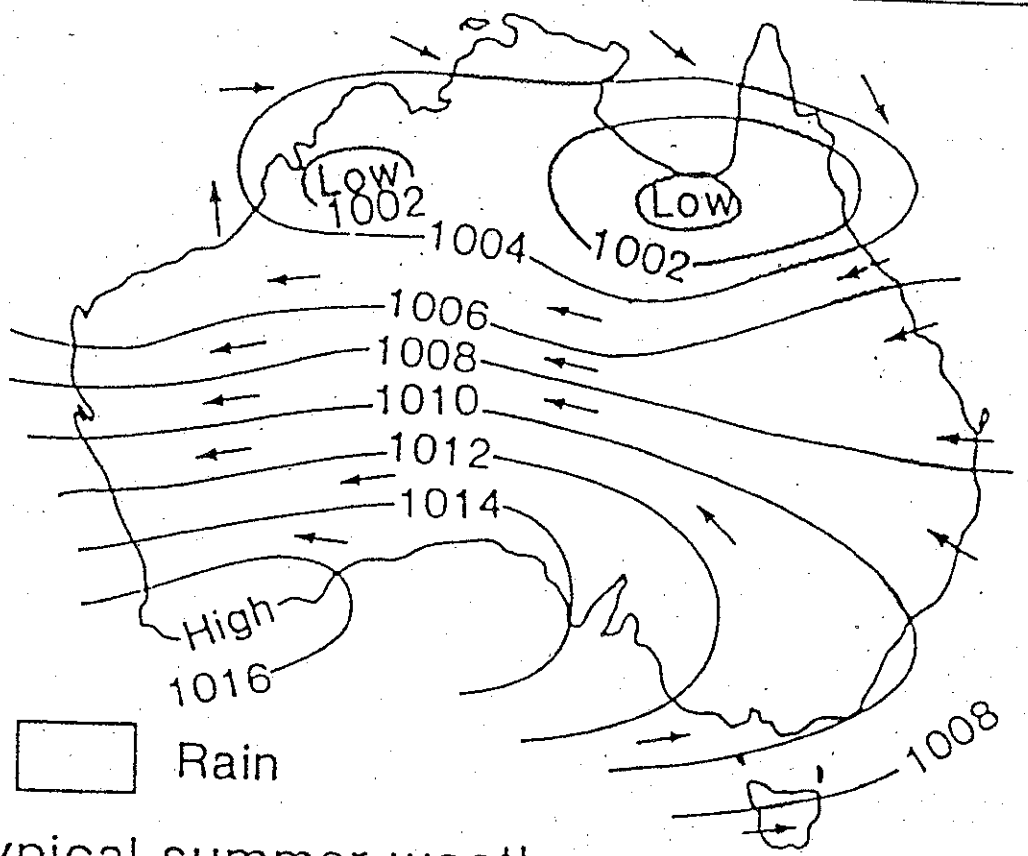


Figure 29 The passage of a cold front over Australia

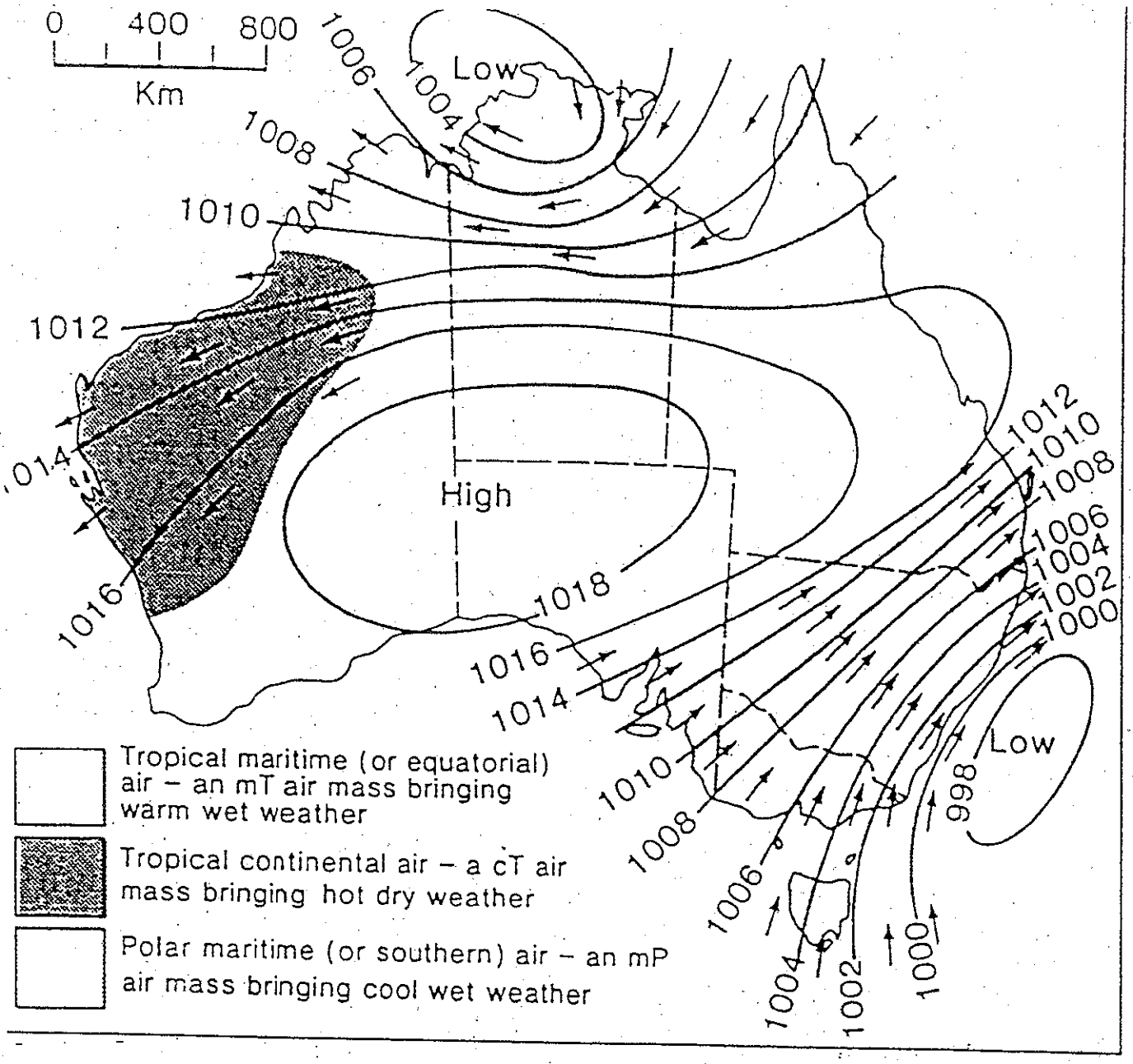


Typical summer weather map

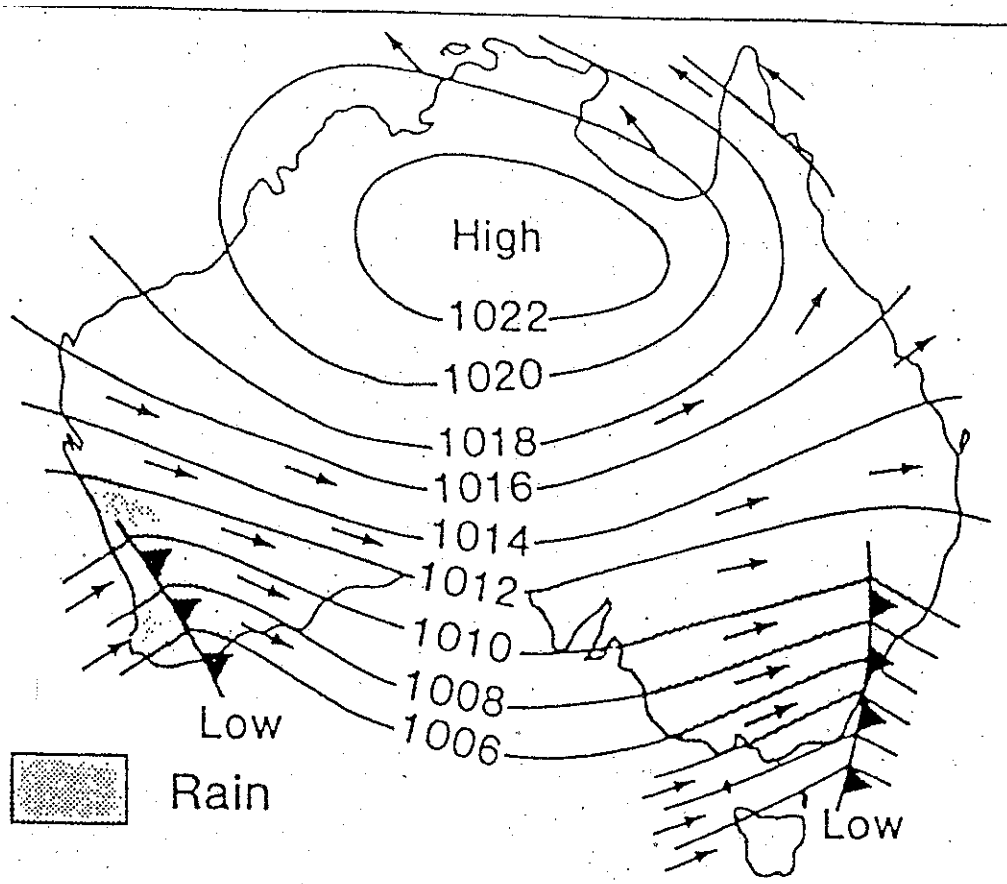
1 Equatorial low pressure systems and north-west monsoon winds (E air masses) bring rain to northern Australia

2 Maritime easterly air streams bring rain to east coast and adjacent highlands

3 Interior and south-west areas, with cT air masses, are hot and very dry



ig. 2.35 An Australian weather map showing three major air nass systems. Warm moist air in an mT air mass is sweeping cross northern Australia. Cool to cold moist air in an mP air mass s moving over south-eastern Australia. The centre and west are ominated by the warm dry air of a cT air mass.



Typical winter weather map

1 Westerly (mP air masses), low pressure systems, and their fronts bring precipitation to southern parts of Australia

2 Easterly winds (mP and mT air masses) may bring some rain to the north-east coast

3 The high pressure systems result in fine dry weather with dry off-shore winds (cT air masses) in northern Australia