Communicating Climate Change
Module 1
An initiative of the National Agriculture and Climate Change Action Plan
August 2008

Weather drivers in Victoria

Key facts

Major weather drivers in Victoria are:

- El Niño - Southern Oscillation
- frontal systems
- cut-off lows
- blocking highs
- Southern Annular Mode
- cloudbands

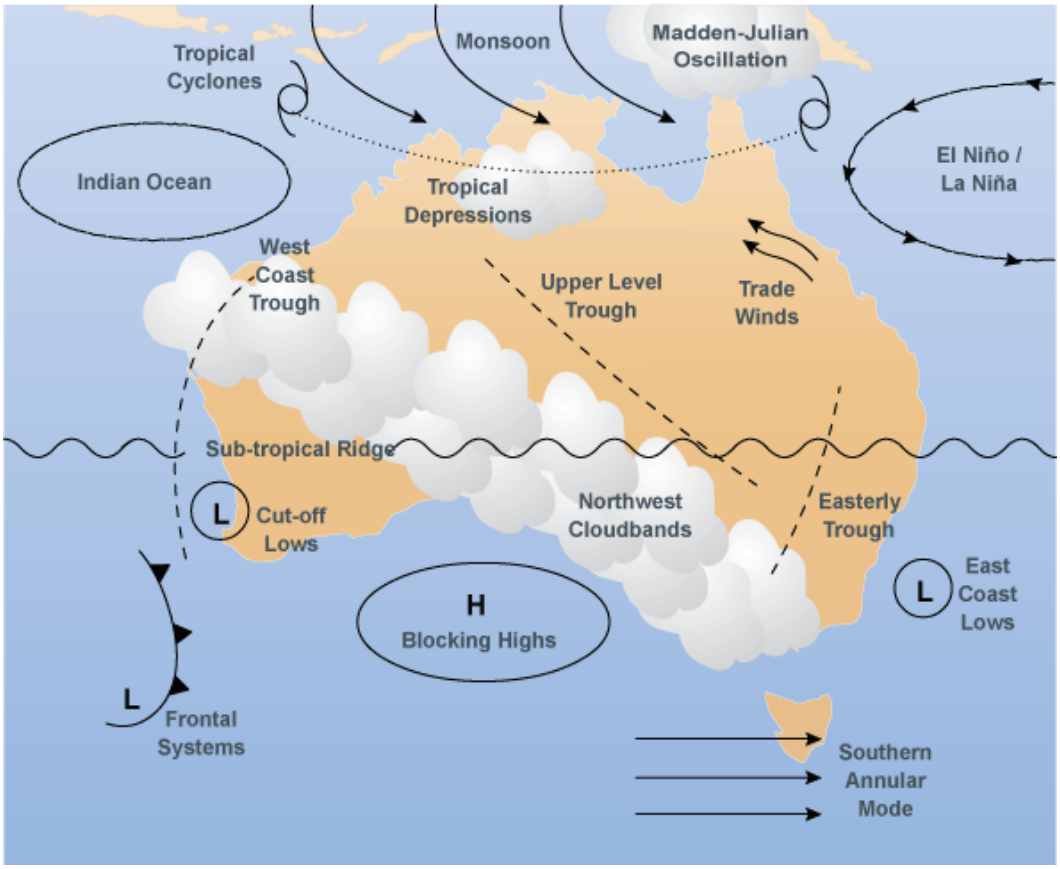


Figure 1: The major weather and climate drivers across Australia

A cooperative venture between

MANAGING CLIMATE VARIABILITY R&D PROGRAM
mla MEAT & LIVESTOCK AUSTRALIA
BCG shared solutions
Australian Government
Department of Agriculture, Fisheries and Forestry
Bureau of Meteorology

Introduction

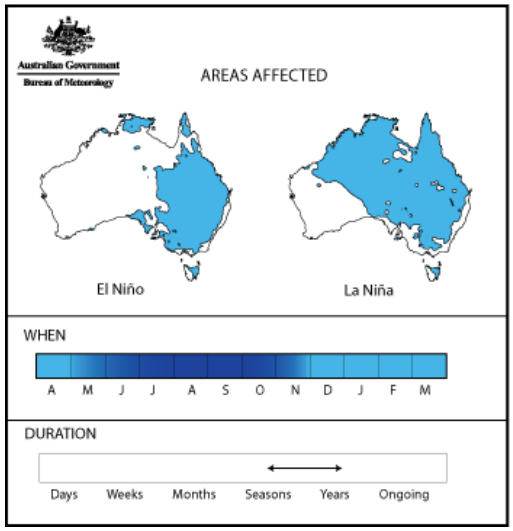
The driving force behind our weather is the general circulation of the atmosphere, caused by unequal heating of the Earth's surface. Energy from the sun causes evaporation from the tropical oceans and uneven heating of land and sea surfaces near the equator.

An extensive area of high pressure, known as the **sub-tropical ridge**, is a major feature of the general circulation of our atmosphere. It is a major influence on the climate of southern Australia. Its position varies with the seasons, allowing cold fronts to pass over Victoria in the winter, but pushing them to the south in summer.

The climate of Australia varies across many different regions and timescales. Here we introduce the major elements that affect the weather and climate of Victoria.

El Niño - Southern Oscillation

Sea surface temperatures in the Pacific Ocean can affect rainfall across the eastern half of Australia, including Victoria.



The El Niño-Southern Oscillation (ENSO) is a major influence on our climate. ENSO is the oscillation between El Niño and La Niña conditions, which describe the variations in sea surface temperatures in the central and eastern tropical Pacific Ocean.

El Niño is associated with extensive warming of the sea surface in the central and eastern tropical Pacific, and is often associated with below average winter/spring rainfall over much of eastern Australia.

La Niña is associated with extensive cooling of the sea surface in the central and eastern tropical Pacific, and is often associated with above average winter/spring rainfall over much of eastern Australia.

The El Niño event of 2002–03 seriously affected rainfall over Victoria. Rainfall was well below average across the state (Figure 2), with many areas experiencing severe water shortages and high bushfire risk.

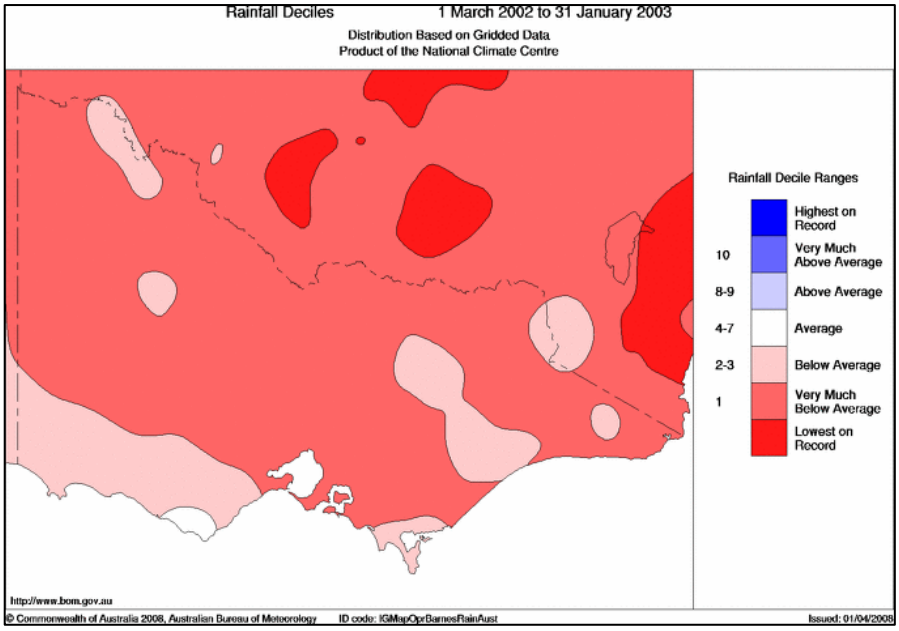


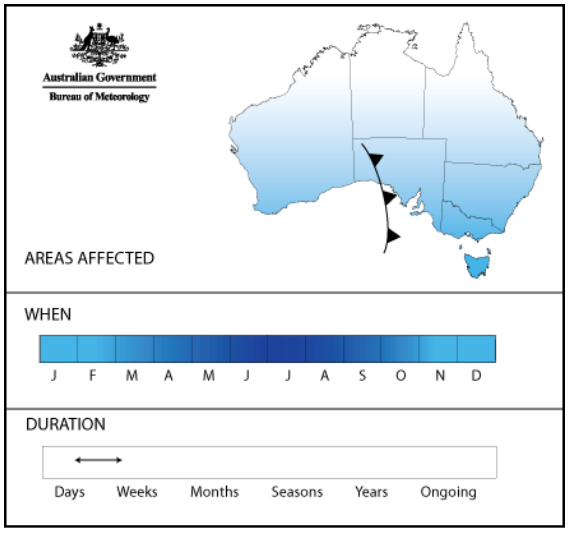
Figure 2: Below average rainfall in Victoria due to 2002–03 El Niño event

Frontal systems

Frontal systems, such as cold fronts, generally move from west to east across the Southern Ocean and vary in their intensity and speed.

More **intense systems are generally associated with heavier rainfall**. If frontal systems are slower moving, rainfall may occur for extended periods and may be heavy at times.

A cold front moved across Victoria on 17 July 2007 (Figure 3). Heavy rainfall was recorded in parts of Victoria (Figure 4) and there were reports of extensive storm damage. Many areas reported snowfalls, with road closures in Ballan, Daylesford, Trentham, Woodend and Mount Macedon due to snow and ice.



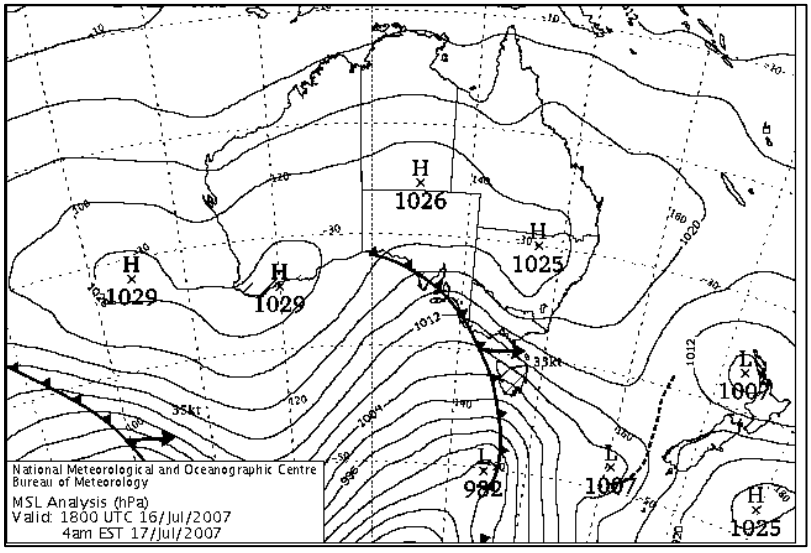


Figure 3: Cold front moving across Victoria, 17 July 2007

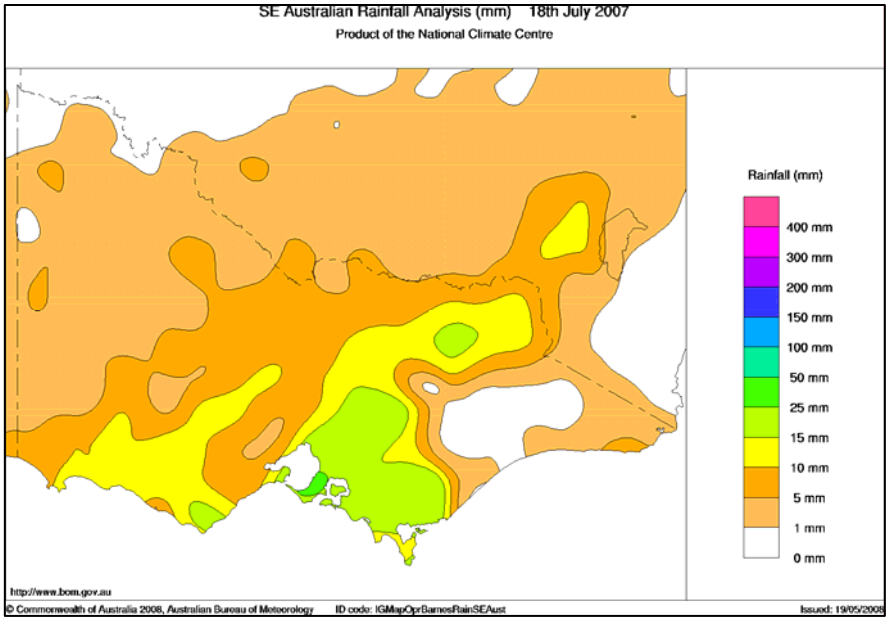
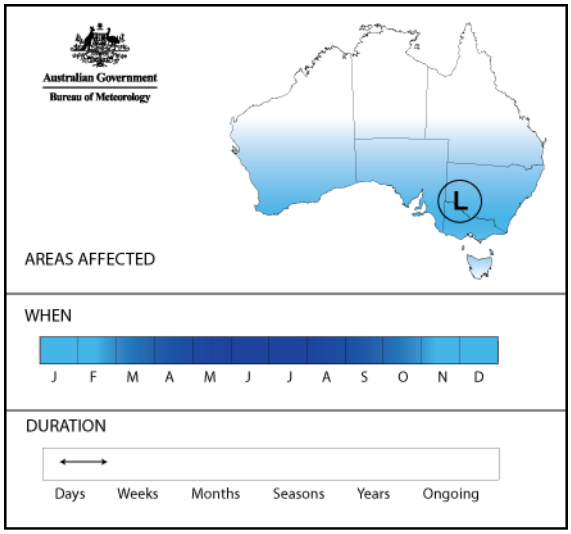


Figure 4: Rainfall in Victoria, 18 July 2007

Cut-off lows

Cut-off lows are low-pressure systems that break away from the main belt of low pressure that lies across the Southern Ocean. They are associated with **sustained rainfall** and can produce **strong, gusty winds** and **high seas**.



If a cut-off low is slow-moving or near-stationary, rainfall may occur for extended periods and may be heavy at times.

The cut-off low in Figure 5 produced widespread and substantial rain across south-eastern Australia from 23 to 25 October 2000. Three-day rainfall totals in the 15–100 mm range covered most of Victoria (except Gippsland) (Figure 6). The Murray River around Albury-Wodonga experienced moderate flooding after the Hume Dam spilled. This was the most recent occurrence.

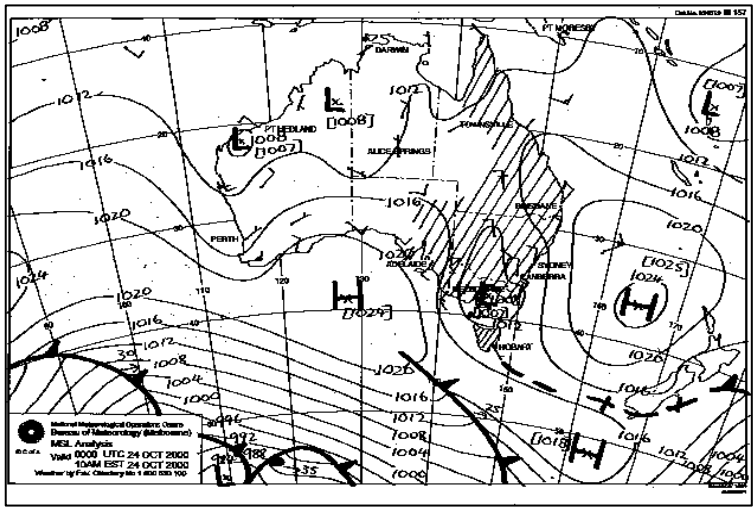


Figure 5: Cut-off low, 24 October 2000

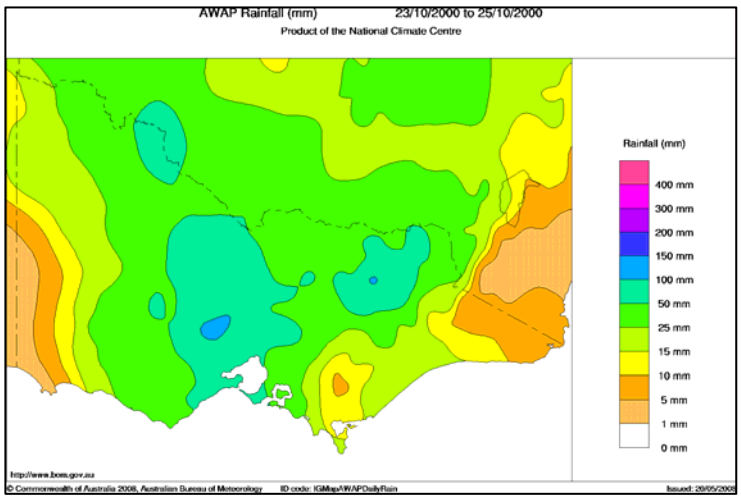
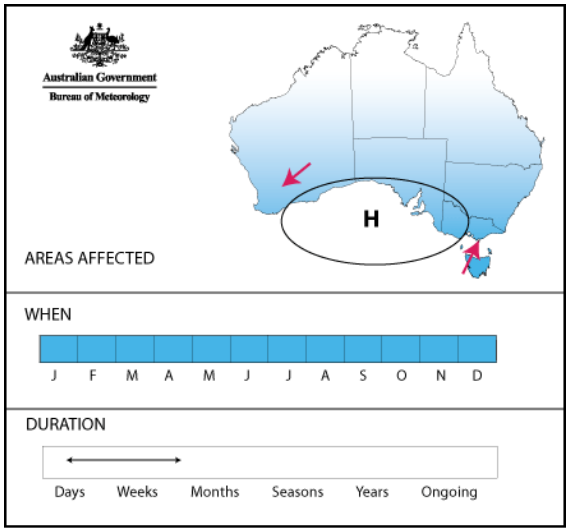


Figure 6: Rainfall in Victoria, 23–25 October 2000

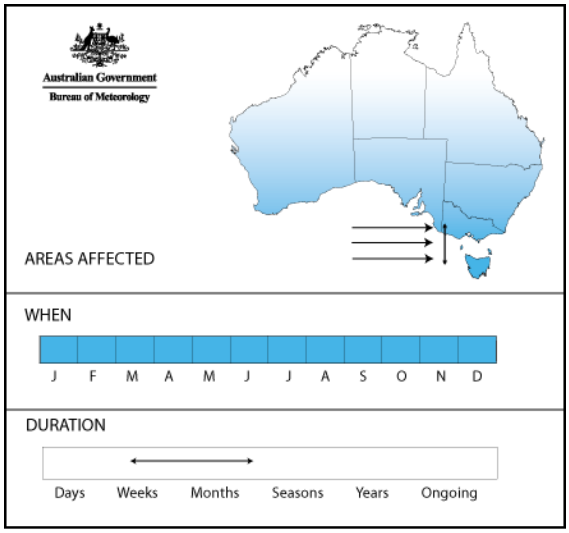
Blocking highs



Blocking highs are strong high-pressure systems that form further south than usual, and remain near-stationary for an extended period of time. They block the west-to-east progression of weather systems across southern Australia, and are usually formed in the Great Australian Bight or Tasman Sea.

A blocking high's impact on the weather varies depending on its location and the systems around it. Generally, a blocking high in the Bight produces a cold spell and wet conditions in Victoria, while a blocking high in the Tasman produces a hot spell and dry conditions. Blocking highs can also contribute to fog and frost occurrence.

Southern Annular Mode

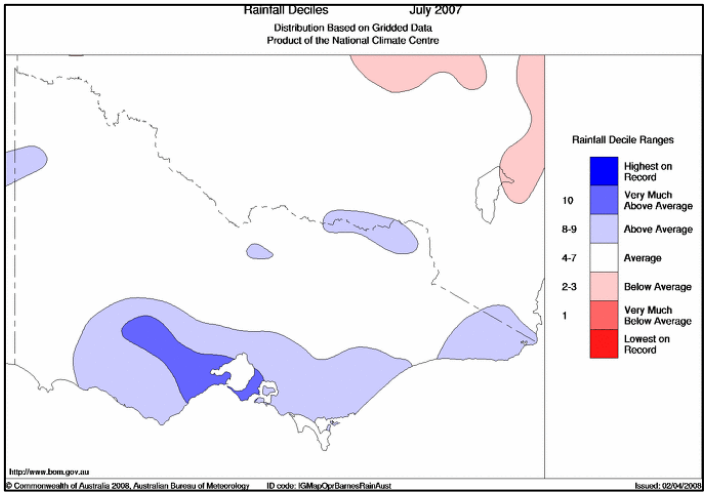


The Southern Annular Mode (SAM) can affect rainfall in southern Australia. It describes a north–south movement in the belt of strong westerly winds across the south of the continent. This region of strong westerly winds is associated with cold fronts and storm activity, and heavily influences weather in southern Australia. The mode can be positive or negative.

During a **positive** SAM event, the belt of strong westerly winds contracts toward the South Pole. This causes weaker-than-normal westerly winds and higher pressure over southern Australia. In spring and summer, a positive SAM event can result in increased rainfall over parts of south-eastern Australia, particularly southern New South Wales, by strengthening the moist easterly flow from the Tasman Sea. During autumn and winter, a positive SAM event results in fewer storm systems and less rainfall across the southern coastal regions of Australia.

The **negative** phase of the SAM is associated with a northward shift in the belt of strong westerly winds. In autumn and winter, this can cause more storms and increase rainfall for southern Australia.

A SAM event can be identified by observing the pattern of westerly wind flow and pressure to the south of Australia, which is monitored by the Antarctic Oscillation Index as produced by the US National Weather Service.



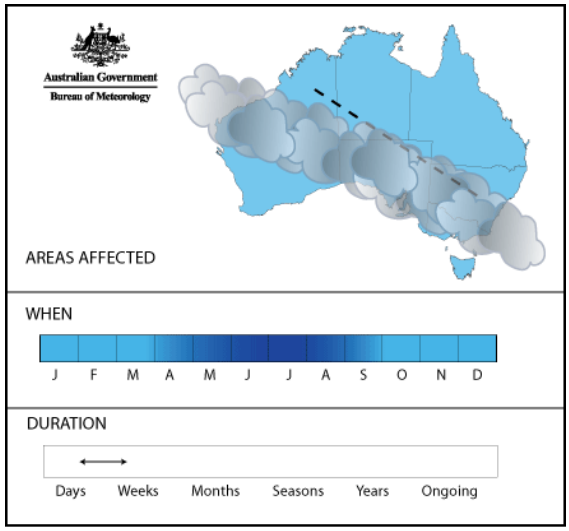
During July 2007, the SAM was in a negative phase. The belt of westerly winds was expanded towards the equator, resulting in slightly stronger westerly winds over southern Australia. These winds brought more cold fronts and increased rainfall to Victoria (Figure 7).

Figure 7: Increased rainfall in Victoria during a negative SAM phase in July 2007

Cloudbands

Sea surface temperatures in the Indian Ocean strongly affect rainfall patterns over much of Australia. In general, warmer-than-average SSTs in the Indian Ocean near Australia result in increased rainfall, while cooler-than-average SSTs result in reduced rainfall. This phenomenon contributes to the formation of cloudbands.

A cloudband is an extensive layer of cloud that can stretch across Australia, often from north-west to south-east. Cloudbands can form when a trough of low pressure occurs in the upper atmosphere, or when warm, moist tropical air originating over the Indian Ocean moves towards the pole (generally south-eastward), and is forced to rise over colder air in southern Australia. Cloudbands bring widespread, often heavy rainfall to Victoria. However, since 1997, there has been a marked reduction in the number of northwest cloudbands bringing rainfall to Victoria.



Further Information

The Bureau of Meteorology – weather drivers:
http://www.bom.gov.au/watl/about-weather-and-climate/australian-climate-influences.html

US National Weather Service – Antarctic Oscillation Index (SAM):
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/aao/aao.shtml