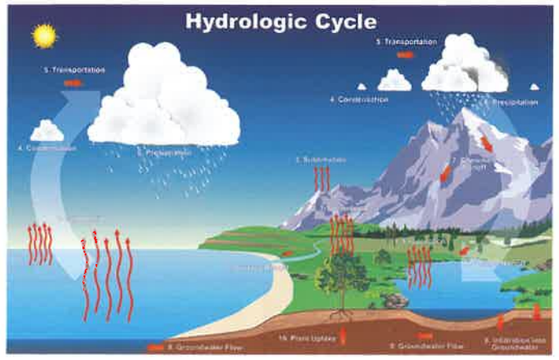
INVESTIGATION 1

CAUSATION: Why did the east coast of Australia flood in January 2011?

Floods occur when water temporarily overflows from its normal channel onto land that is normally dry. The basic cause of this is rain.

- Water evaporates — for eastern Australia the main source of evaporation is sea water from the Pacific Ocean
- This water vapour rises, then cools and condenses into clouds
- The clouds pass over land, driven by winds
- As the water vapour cools it forms back into water droplets which join together as rain, and fall as precipitation
- Rain is then absorbed by the earth, or flows across the surface towards the lowest point, usually the sea
- The cycle starts again as the surface water and the water that has reached the sea starts to evaporate again.

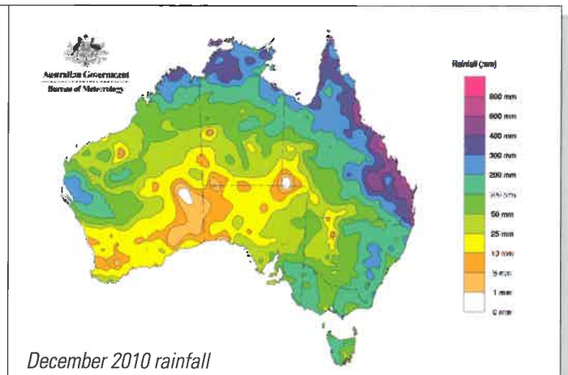
If the rain is particularly heavy it causes floods.



http://water.me.vccs.edu/courses/env110/lesson1.htm

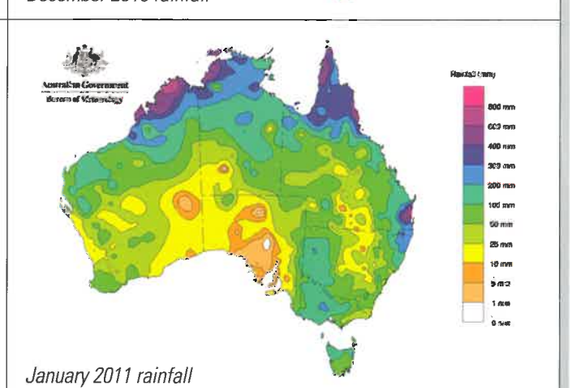
Here are maps showing the average rainfall for December in Australia, and the actual rainfall for December 2010 and January 2011.

Average rainfall for December



December 2010 rainfall

Average rainfall for January



January 2011 rainfall

www.bom.gov.au/jsp/ncc/climate_averages/rainfall/

http://www.bom.gov.au/cgi-bin/silo/rain_maps.cgi

1.1 Describe the patterns of rainfall in Australia in both December 2010 and January 2011.

1.2 How might the rainfall figures for December 2010 influence what happened in January 2011? In answering, think about the nature of the surface of the land and rain falling on it

Rain is likely to be particularly heavy during a La Niña period — the name given to a periodical natural phenomenon involving equatorial currents, trade winds and water temperature.

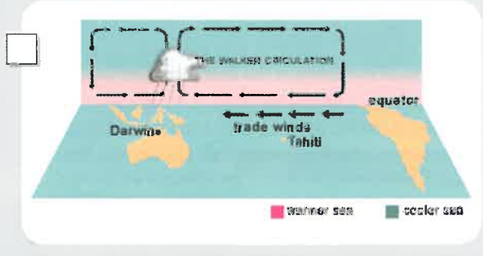
This phenomenon is called the Walker Circulation, and refers to the east-west circulation of the atmosphere in a vertical plane above the equator in the Pacific Ocean.

1.3 Look at the descriptions and diagrams that follow of the three variations of the Walker Circulation — **Normal**, **El Niño** or **La Niña** pattern. The descriptions and the diagrams do not match. Study the descriptions and the diagrams and write the number of the description next to the appropriate diagram

1 Under **normal conditions** the Humboldt Current brings relatively cold water northward along the west coast of South America. Deep cold water upwelling along the Peruvian coast joins the Humboldt Current. The trade winds then push this cold water westward along the equator where it gradually warms. As the water heats it evaporates and forms clouds, most of which are then pushed east by the winds, until they drop their rain.

2 In some years the pattern changes into what is called **'El Niño'** — so called because it usually starts around Christmas time, and is nicknamed the 'Christ child' in Spanish. In these years the currents along the South American coast are not as cold, and the trade winds are weaker, so the water warms more quickly and further east than normal. This means the evaporation occurs sooner, and more of the rain-bearing cloud travels east rather than west. In these conditions Australia gets less rain.

3 In other years the opposite, **'La Niña'** occurs. The trade winds are stronger, the water is further west as it warms and evaporates, meaning that the rain-bearing clouds are closer to Australia. If the water further west is warmer than usual then the evaporation is intense, and large amounts of water form in the clouds. These clouds are then pushed south over eastern Australia by winds, meet the Great Dividing Range along the east coast, and dump their rain storms on Australia.



1.4 Australia has been affected by El Niño and La Niña patterns over the past century. El Niño years tend to be drier, even leading to droughts. La Niña years are wetter, and can cause floods. We can identify their intensity, as well as when they occurred. Below is a list of the El Niño and La Niña years from 1900. Create a graph to show these, locating them within the appropriate decades, and at the appropriate strength.

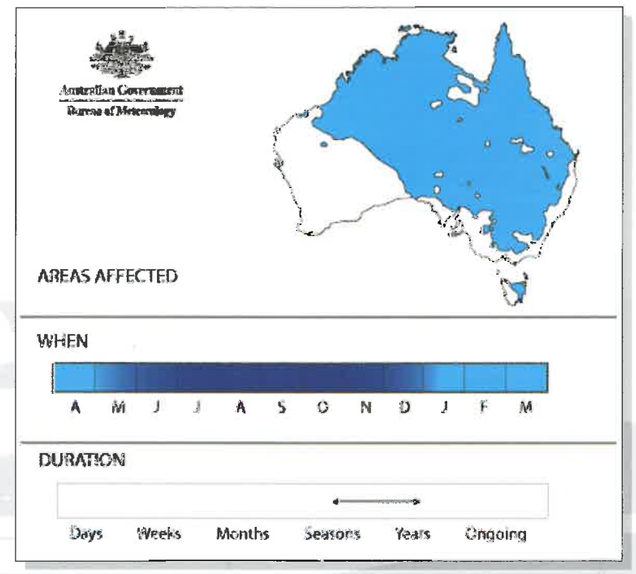
	Weak	Weak-Moderate	Moderate	Moderate-Strong	Strong
La Niña years	1924-25 1942-43	1906-07 1928-30 2007-08 2008-09	1903-04 1938-39 1954-57 1964-65 1970-72 1988-89 1998-2001	1909-11 1949-51 1973-76	1916-18 2010-11
El Niño years	1902-03 1913-14 1951-52 1957-58 1963-64 1969-70 2002-03 2006-07	1919-20 1946-47 2009-10	1925-26 1972-73 1977-78	1905-06 1911-12 1965-66 1997-98 1991-92 1993-94	1914-15 1940-41 1941-42 1982-83 1994-95 1997-98

www.bom.gov.au/climate/enso/enlist/index.shtml (El Niño) and www.bom.gov.au/climate/enso/lnlist/ (La Niña)

1.5 Meteorologists know when an El Niño or La Niña pattern is forming. What would you expect people who are in charge of water policies to do when they know that an El Niño or La Niña pattern is about to occur?

1.6 Here is a map showing where, when and for how long La Niña affects Australia. Compare this to the weather maps on page 4. How does this map illustrate or help explain the impact of La Niña in December 2010 and January 2011?

1.7 Would you expect above-average rain to fall in eastern Australia in any other months? Explain your reasons.



www.bom.gov.au/wait/about-weather-and-climate/australian-climate-influences.shtml?bookmark=lanina