DROUGHT IN THE MURRAY DARLING BASIN

Drought is a familiar phenomenon in the Murray Darling basin and is one of the most hazardous and most complex threats to humankind and the natural ecosystems they rely on. Extended periods of droughts can lead to degradation of soils and desertification, as well as famine and impoverishment (Vicente-Serrano, 2006). In the agricultural sector, drought is the main cause of crop loss in the USA (Tadesse et al., 2005).

The study focuses on the Murray Darling Basin in Australia. The basin is one of the biggest river systems in the world. This area was chosen because of the intense effects of drought over the period of the Millennium Droughts, which saw extensive and frequent periods of drought, alternated with periods of higher than average precipitation from 2001-2009.

In the period 1997 to 2006, the average annual precipitation was lower than 16% of the long-term average. Even run-off dropped by 39% over the same period (Potter et al., 2010). Based on data from the Bureau of Meteorology (2014) the 7-year period of October 2001-September 2008 had the lowest recorded precipitation in the MDB since 1900.

The periods of drought are shown in the table below.

Table 1: Drought periods in the MDB adapted from Helman (2009)

Drought years	Popular name	Extent of drought
1790-1793	Settlement Drought	Probably SE Australia
1797-1805		Probably whole basin
1809-1814	Great Drought	Probably whole basin
1824-1830	Sturt's Drought	Most severe in northern basin
1836-1845		SE Australia
1849-1853	Black Thursday Drought	SE Australia
1861-1866	Goyder's Line Drought	Australia wide, 1864 to 1866 severe in western basin and South Australia
1881-1882		Mostly inland, wet on coast
1895-1903	Federation Drought	Eastern Australia, devastating stock losses

1911-1915	First War Drought	Mostly inland spreading to southern Australia
1927-1929		Mostly inland spreading to southern Australia
1935-1945	Second War Drought	Especially severe in SE, devastating stock losses
1952		Northern Australia to northern MDB
1964-1965		MDB to Central Australia, devastating crop and stock losses
1982-1983	Dust Cloud Drought	Eastern Australia, with extensive loss of agriculture production
1990-1995		Eastern and northern Australia
1997-2009	Big Dry	Eastern Australia contracting to SE, dams low, water allocation restrictions

The "Millennium Drought" period between 2001-2009 was the worst drought on record for southeast Australia (Van Dijk et al., 2013), although its start and end dates are disputed as different drought assessments use different criteria to determine this. Van Dijk et al. (2013) define the period 2001-2009 as the longest uninterrupted series of years with below average precipitation in southeast Australia since 1900. The end of the drought is less disputed, as in early 2010 a strong La Niña occurred which brought extreme precipitation and large scale flooding.

According to Wittwer & Griffith (2011) from 2003 – 2004 to 2005 – 2006 there seem to be a partial recovery to near average precipitation in the MDB. 2002 and 2005 have below average precipitation, as seen in the anomaly chart in Figure 1. The Millennium Drought period is not shown that distinctively in the annual anomaly chart 1900 – 2013, while there are clear distinct lower than average periods in the '20s, '30s, '40s, and '60s.

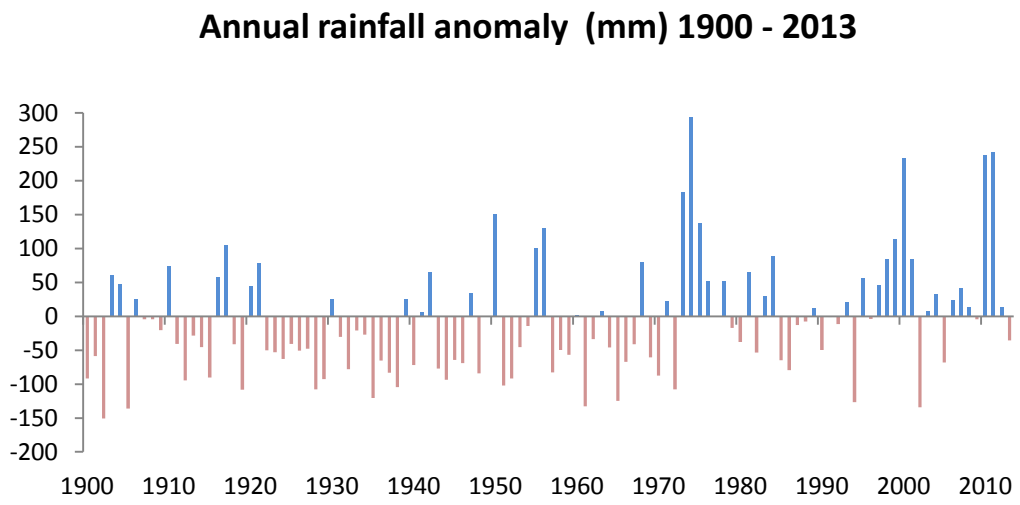

Figure 1: Annual precipitation anomalies 1900-2013 in the MDB (Source: Bureau of Meteorology, 2014)

The monthly average anomaly rainfall from 2001 – 2011 shows more seasonal patterns, shown in figure 2. Precipitation occurs mostly in the wet season: November to March. The dry season is from April to October. 2010 and 2011 have relatively high precipitation values, also noticeable in figure 6 in the anomaly chart.

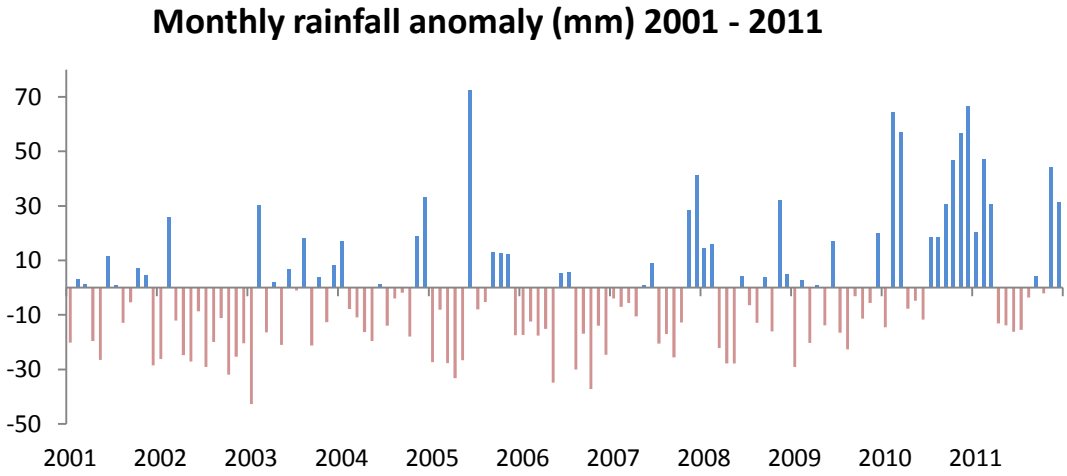

Figure 2: monthly precipitation anomaly 2001-2011 in the mdb based on data from the 1900s (source: bureau of meteorology,2014)

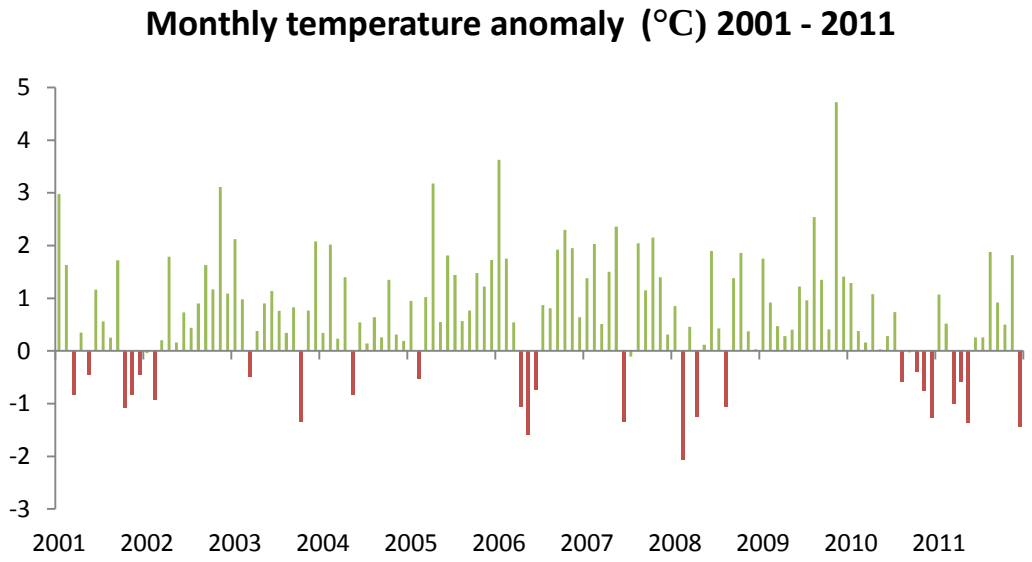

Figure 3: monthly temperature anomaly 2001-2011 in the mdb based on data from the 1900s (source: bureau of meteorology,2014)

The dry seasons are clearly shown in the anomaly chart. 2002 and 2006 shows a relatively drier season than the average of more than a century. Compared to figure 3, there is not much correspondence between the temperature and the precipitation. Throughout 2001 – 2011 there is a prevalence of higher than average temperatures. There are periods with lower than average temperatures. Late 2001 and early 2002 are one of those periods.

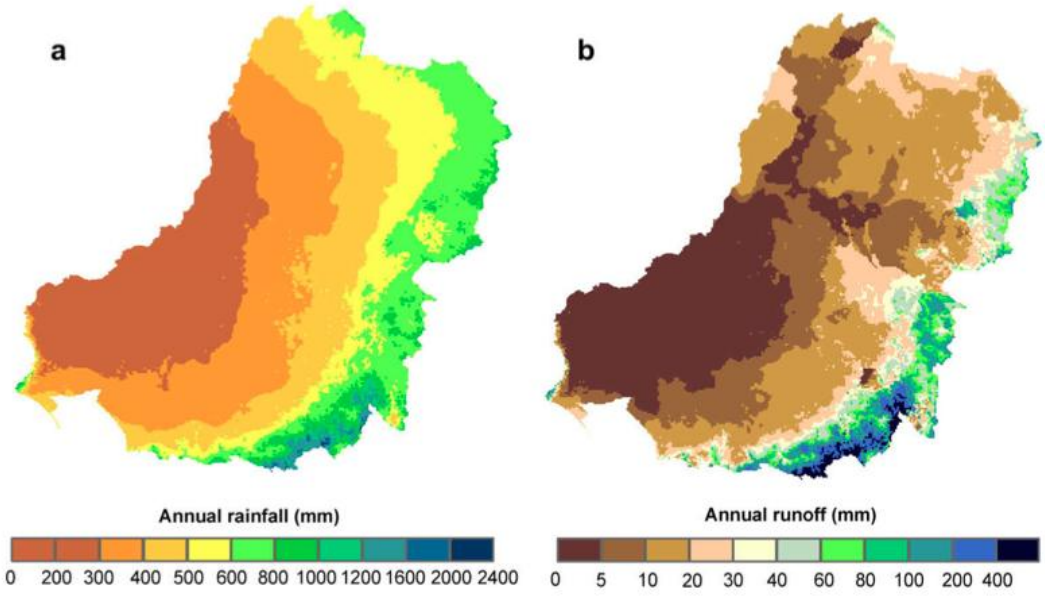

Figure 4: the distribution of annual (a) precipitation and (b) runoff in the mDB (Potter et al., 2010)

Precipitation in the MDB is not distributed evenly. As seen in figure 4, there is a west to east distribution of precipitation. Highest precipitation is in the southeast and lowest in the west of the study area. Runoff shows the same pattern as the precipitation distribution. However, there is more variation in the pattern due to the distribution of the rivers.