National Overview

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2 National Overview

2.1 Introduction

This chapter of the *Australian Water Resources Assessment 2012* (the 2012 Assessment) presents an assessment of climatic conditions and water flows, stores and use in the Australian landscape during 2011–12. It provides an overview at the national scale and discusses the variations in water availability and use between the reporting regions (see Figure 2.1).

The assessment presents an overview of rainfall and landscape water balance terms for the year including evapotranspiration, landscape water yield, and change in soil moisture. It also considers changes in surface water storage, use, and supply in the regions.

The important drivers of climatic conditions in Australia are also examined and their impact on rainfall over the year is evaluated. Information on notable rainfall and flood events experienced during 2011–12 is presented.

Long-term average annual rainfall across Australia varies from less than 300 mm per year in central Australia to over 4,000 mm per year in parts of far northern Queensland. Of this rainfall, about 85–95% evaporates directly from the land surface or from the upper soil layer or is transpired by plants into the atmosphere. These two processes are collectively referred to as evapotranspiration. The remaining water (5–10%) finds its way into streams and other surface water features like storages and wetlands, or drains below the soil root zone into groundwater aquifers that may subsequently discharge to surface water features.

The proportion of rainfall used by vegetation depends on soil type and depth, vegetation type and condition and the stage of the growth cycle of the vegetation. Annual crops and pasture use less water than perennial vegetation, such as trees, primarily due to their shallower root systems and the reduced interception of water by leaves and branches.

The processes mentioned above are represented conceptually in the landscape water balance model used in this report (see Introduction for a description of the AWRA-L model) to provide estimates of the dominant water balance components.

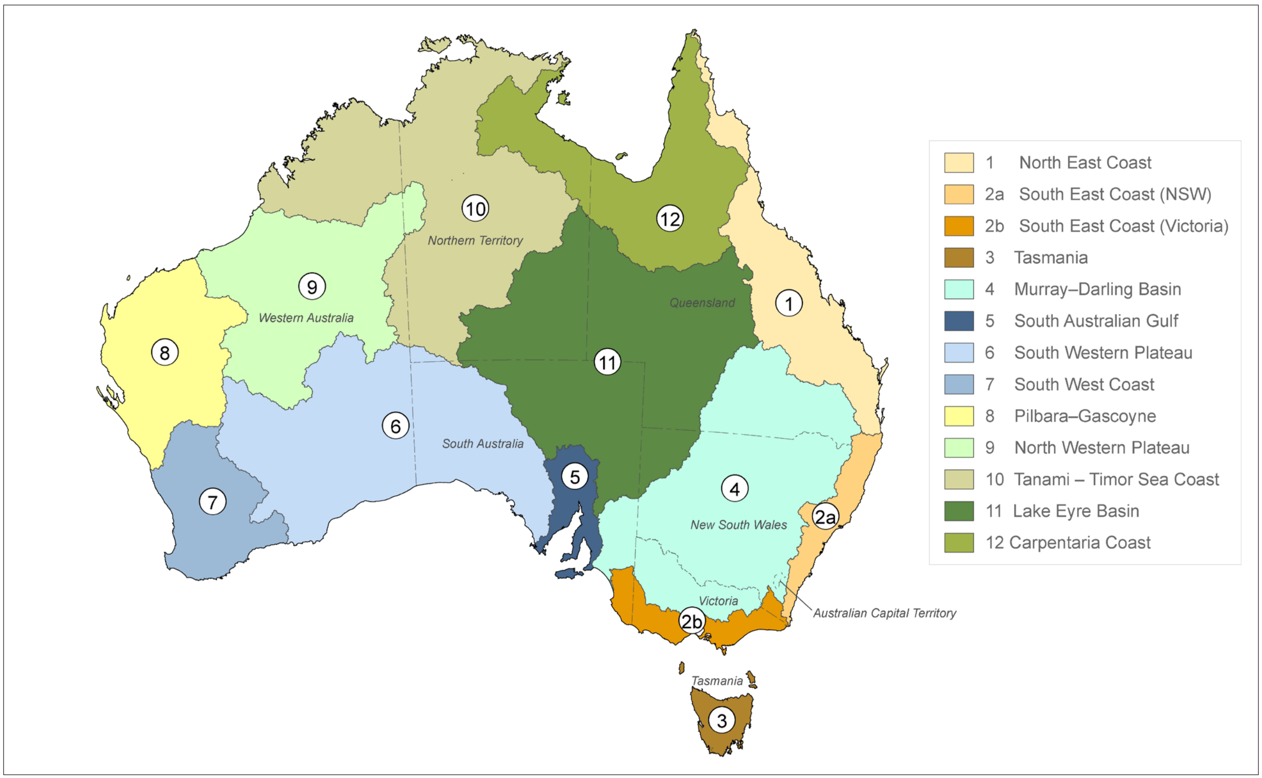


Figure 2.1 2012 Assessment reporting regions

2.2 National key findings

Climate drivers

The Australian climatic condition during 2011–12 was characterised by a moderately strong La Niña event.

The year started with neutral conditions in the Pacific. This followed the very strong La Niña event of 2010–11, which decayed to neutral conditions by the beginning of the 2011–12. During July–September 2011, average to below average rainfall was recorded over much of the country.

A La Niña developed again in spring 2011 with markedly above average rainfall across most of the country. The La Niña event was declared over in late March 2012 and, after Australia's third wettest March on record, below average rainfall was seen over large areas of the country for the remainder of the 2011–12 period.

For more information on the drivers of Australian climatic conditions in 2011–12, see section 2.9.

Landscape water flows

The year 2011–12 began with wet soil moisture conditions throughout most of the country, except for southwest Australia. Total annual rainfall for 2011–12 was 33% above the long-term average for 1911–2012, most of which fell between November 2011 and March 2012. This increased the soil moisture substantially, particularly across the southeast of the country. With elevated water availability in most regions, evapotranspiration was 30% above the long-term average and landscape water yield was 57% above the long-term average.

The Pilbara–Gascoyne and South West Coast regions had low soil moisture conditions at the start of the year. The above average rainfall for these regions during 2011–12 substantially elevated the soil moisture conditions for Pilbara–Gascoyne region; however, in the South West Coast region soil moisture conditions increased only marginally. In this region, soils were dry and remained well below long-term average levels as evapotranspiration processes reduced much of the absorbed rainwater. As a result, landscape water yield remained below average in this region.

Surface water

The relatively high landscape water yield of 2011–12 contributed to above average streamflow in large parts of the country. Many surface water storages received substantial inflows, causing the total water in major storages to increase from 75% at the end of 2010–11 to 83% at the end of June 2012. Increases were particularly significant in the Murray–Darling Basin and Tasmania, as well as in the storages supplying drinking water to Sydney in the South East Coast (NSW) region.

Despite the below average landscape water yield in the South West Coast, the total accessible volume of water held in surface water storages increased as a result of greater inputs of desalinated water and above average coastal rainfall in the first half of 2011–12 in this region.

Groundwater

Rising trends in groundwater levels were present in most of the selected aquifers within the North East Coast, South East Coast (Victoria) and Murray–Darling Basin regions. This reflects the high rates of recharge to groundwater due to the average to above average rainfall, streamflow and soil moisture in 2010–11 and 2011–12.

Trends in groundwater levels in the South Australian Gulf region were more variable, reflecting the local groundwater extraction and rainfall.

Urban and agricultural water use

Urban water consumption in 2011–12 remained consistent with that of the previous year for all State and Territory capitals considered in this assessment. Total urban water use in 2011–12 was 1,530 GL, a rise of just 1% from 1,513 GL in 2010–11.

Irrigation water use increased since 2010–11, but did not reached the 2005–06 levels.

Major rainfall and flooding

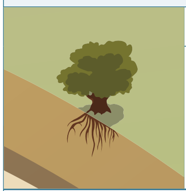
Widespread flooding occurred as the wet La Niña-influenced summer period (November 2011–April 2012) brought high rainfall particularly to the South East Coast (NSW) and Murray–Darling Basin regions. Major rainfall events in November 2011, January and March 2012 caused widespread flooding in parts of the South East Coast (NSW), Murray–Darling Basin, North East Coast and Lake Eyre Basin regions.

A localised rainfall event in June 2012 caused extensive flooding in eastern parts of the South East Coast (Victoria) region.

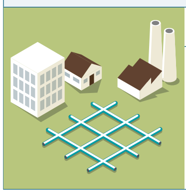
Table 2.1 gives an overview of the key components of the information in this chapter.

Table 2.1 Key information on national water flows, stores and use indicators for 2011–12

Landscape water flows			
	Region average	Difference from 1911–2012 long-term annual mean	Decile ranking with respect to the 1911–2012 record
Rainfall	567 mm	+33%	10th—very much above average
Evapo-transpiration	483 mm	+30%	10th—very much above average
Landscape water yield	83 mm	+57%	10th—very much above average

Mean annual soil moisture (decile ranking with respect to the 1911–2012 record averaged over Australia)		
	2011–12	2010–11
	10th—very much above average	10th—very much above average

Surface water storage (comprising about 94% of the region's total capacity of all major storages)							
	Total accessible capacity	30 June 2012		30 June 2011		Change	
		accessible volume	% of total capacity	accessible volume	% of total capacity	accessible volume	% of total capacity
	79,700 GL	66,300 GL	83%	60,100 GL	75%	+6,200 GL	+8%

Urban water use (for all State and Territory capitals, excluding Hobart due to data unavailability)			
	Total use in 2011–12	Total use in 2010–11	Change
	1,530 GL	1,513 GL	17 GL (+1%)

2.3 Landscape water flows

Table 2.2 gives an overview of the regions' average annual totals of the three water balance components (rainfall, evapotranspiration and landscape water yield) for 2011–12 and their percentile rankings with respect to the 1911–2012 record. The values on the left side of the table show how the regions relate to each other in absolute terms for the year 2011–12. Values to the right show how 2011–12 compares to the reference period 1911–2012.

For most regions the annual rainfall was approximately equal to the annual evapotranspiration and landscape water yield combined; however, in two regions (the South Western Plateau and Pilbara–Gascoyne) the total evapotranspiration exceeded the rainfall. In these two regions, soil moisture levels at the beginning of the year were above average due to high rainfall during the preceding months.

The regional totals for 2011–12 are all ranked above median, except for the landscape water yield in the South West Coast region. With relatively low soil moisture levels at the start of the year in this region, the above average rainfall in the first half of the year was largely absorbed by the soil. For the rest of 2011–12, landscape water yield in this region was generally low.

The Murray–Darling Basin region had the highest ranked rainfall and landscape water yield of all regions in 2011–12. This was the third highest estimate of landscape water yield on record for this region and contributed to a substantial increase in total water volume in the storages across the region (see section 2.5).

Rainfall in Tasmania was the highest of all regions though this was close to average for the region, itself. Annual rainfall in Tasmania is normally higher than for the other regions.

Similarly, the landscape water flows in the South Western Plateau region were lower than those for the other regions. The flows were, however, relatively high in 2011–12 with respect to the long-term record.

Table 2.2 Average rainfall, evapotranspiration and landscape water yield as well as its percentile ranking in 2011–12 by region, with highest (blue) and lowest (red) values shown

Region	Region average in 2011–12 (mm)			Percentile ranking with respect to the 1911–2012 record		
	Rainfall	Evapo-transpiration	Landscape water yield	Rainfall	Evapo-transpiration	Landscape water yield
North East Coast	1,041	814	223	84	87	83
South East Coast (NSW)	1,265	**919**	352	87	89	92
South East Coast (Victoria)	842	648	180	88	**64**	**97**
Tasmania	**1,396**	769	**632**	**62**	72	54
Murray–Darling Basin	651	559	65	**95**	93	**97**
South Australian Gulf	331	306	9	74	70	53
South Western Plateau	**256**	**268**	**6**	89	94	92
South West Coast	499	455	28	77	86	**32**
Pilbara–Gascoyne	338	341	19	82	89	91
North Western Plateau	319	291	26	91	92	90
Tanami – Timor Sea Coast	754	646	142	90	94	87
Lake Eyre Basin	337	327	25	88	93	93
Carpentaria Coast	992	775	237	89	**95**	87

2.3.1 Rainfall

Average Australian rainfall for 2011–12 is estimated to be 567 mm, which is 33% above the estimated national long-term average of 426 mm (calculated from July 1911–June 2012). Large areas of the country received very much above average rainfall although these areas are not the areas with the highest rainfall totals (Figure 2.2).

Close to 50% of the Murray–Darling Basin region received very much above average rainfall in 2011–12. In contrast, the Wimmera and Mallee areas in the southwest of this region received relatively low rainfall.

Towards the south of the continent, the Limestone Coast areas in South Australia, the South East Coast (Victoria), particularly the Barwon coastal area in southwestern Victoria, also received below average rainfall. Most of Tasmania, the Nullabor Plain in the southwest and the west coast of Western Australia experienced average rainfall.

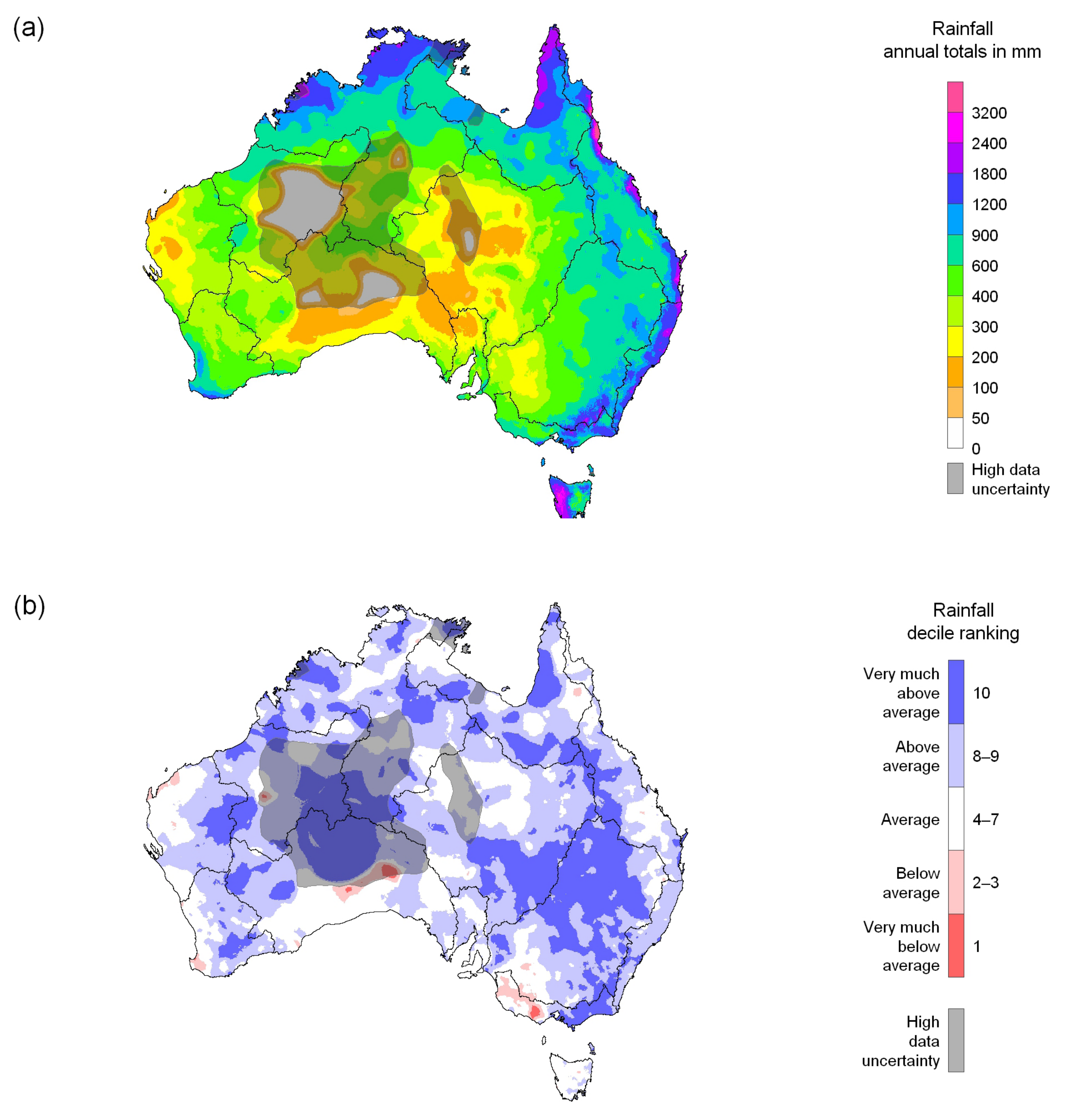


Figure 2.2 (a) Annual total rainfall in 2011–12, and (b) its decile range with respect to the 1911–2012 record

Figure 2.3 shows the monthly rainfall totals for 2011–12 and Figure 2.4 shows the monthly rainfall decile ranking of 2011–12 with respect to the 1911–2012 record. The first three months of the 2011–12 year showed a varying pattern of both above average and below average rainfall. From October 2011 onwards very much above average rainfall prevailed over large parts of the country as a La Niña event was established in the Pacific Ocean (see Section 2.9 for a description of the major drivers of Australian climate). This period of widespread above average rainfall continued until March 2012 when a relatively dry period ensued, predominantly across the southern half of Australia. In June 2012 most of the country returned to average rainfall conditions with the exception of some areas in the northeast and southwest which received above average rainfall.

The South West Coast, South Australian Gulf, South East Coast (Victoria) and Tasmania regions mostly received average rainfall during July–September 2011. Following this period, the South West Coast region had above average rainfall, with the fifth highest monthly rainfall total on record for October. Above average sea surface temperatures were evident in the Indian Ocean during spring 2011, which generated many thunderstorms over the whole of Western Australia. From November 2011–April 2012 the southern regions, except Tasmania, all experienced above average rainfall. From October–December 2011 the South West Coast region had the highest rainfall on record. During May–June 2012 average rainfalls occurred in these regions, with only the South East Coast (Victoria) experiencing above average rainfall, including the sixth wettest June on record.

The regions with summer dominant rainfall (that is, Tanami – Timor Sea Coast, Carpentaria Coast, North East Coast and South East Coast [NSW]) also received above average rainfall over the November 2011–April 2012 period. March 2012 recorded the third highest March rainfall on record for the Carpentaria Coast region, fourth highest for the North East Coast region, and seventh highest for the Tanami – Timor Sea Coast region.

The arid regions (that is, the Pilbara–Gascoyne, North Western Plateau, South Western Plateau, and Lake Eyre Basin) and extensive parts of the Murray–Darling Basin region experienced above average to very much above average rainfall in the summer period (November 2011–April 2012). The Murray–Darling Basin region had its third highest rainfall total on record for the period November 2011–April 2012. All these regions had one or more of these months ranking in the top five monthly rainfall events. For the Murray–Darling Basin region, the months of November and December 2011, and January, February and March 2012, were all in the top ten monthly rainfalls. Rainfall during July–October 2011 was average for the eastern regions and above average for the western regions. During May–June 2012, rainfall was also average for the eastern regions, but generally below average for the more western regions. For example, rainfall in May 2012 was the sixth lowest May rainfall on record for the Pilbara–Gascoyne region.

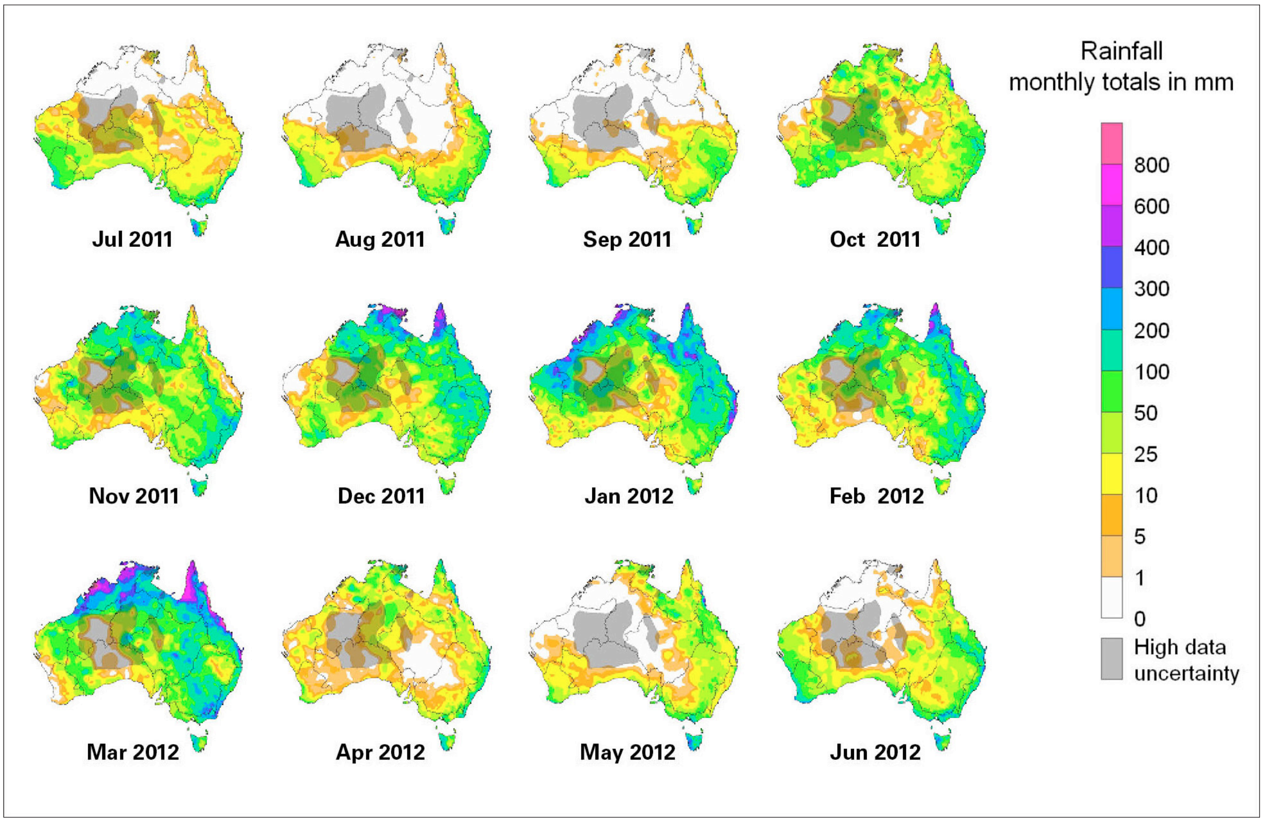


Figure 2.3 Monthly rainfall totals for 2011–12

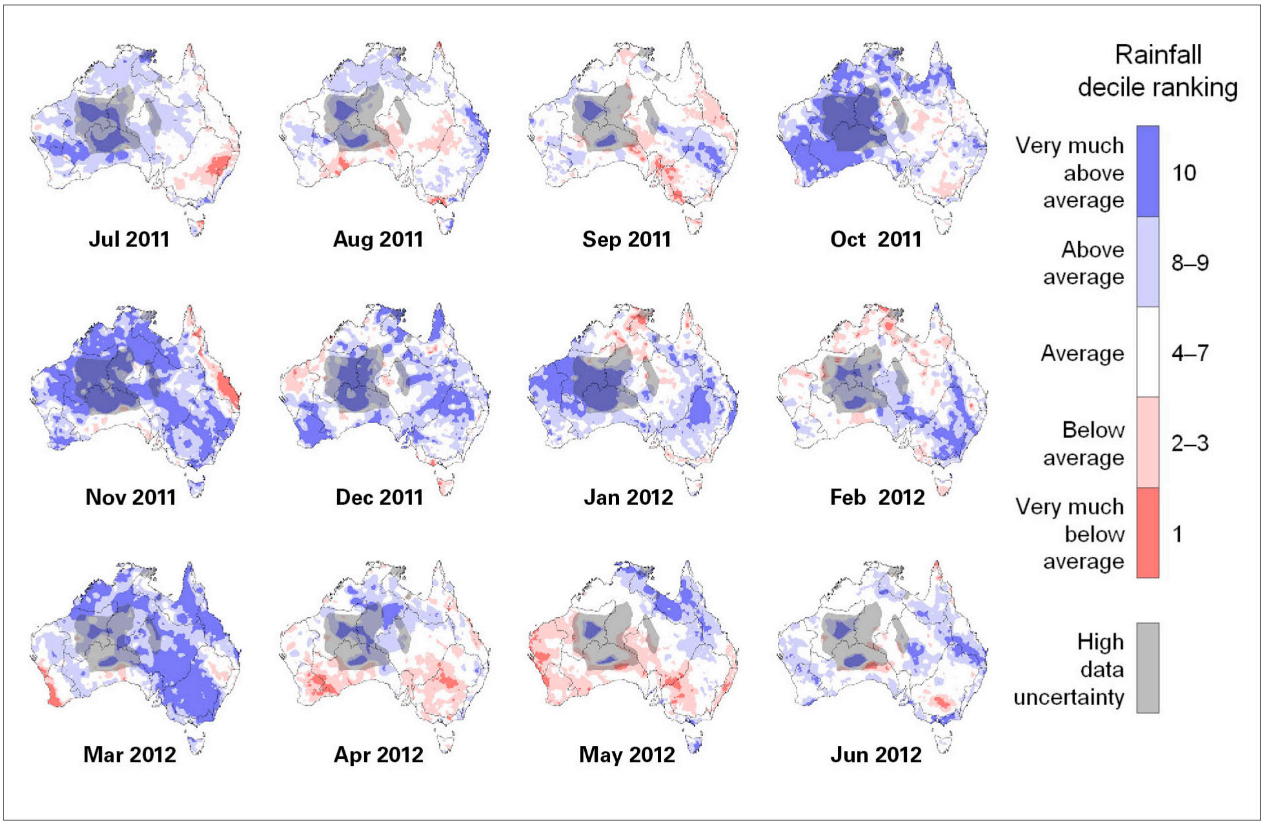


Figure 2.4 Monthly rainfall deciles for 2011–12 with respect to the 1911–2012 record

2.3.2 Evapotranspiration

Average Australian evapotranspiration for 2011–12 is estimated to be 486 mm, which is 32% above the estimated national long-term average of 368 mm (calculated from July 1911–June 2012). Large areas of the country experienced very much above average evapotranspiration, particularly in the inland areas of the continent where water availability is normally limited and evapotranspiration is generally lower than in the coastal areas (Figure 2.5).

Exceptions to this pattern were in several areas along the west and south coast and along the north east coast. As with rainfall (section 2.3.1), low evapotranspiration occurred in the western part of the South East Coast (Victoria) region and in the southwestern tip of the South West Coast region. Evapotranspiration was close to average in Tasmania.

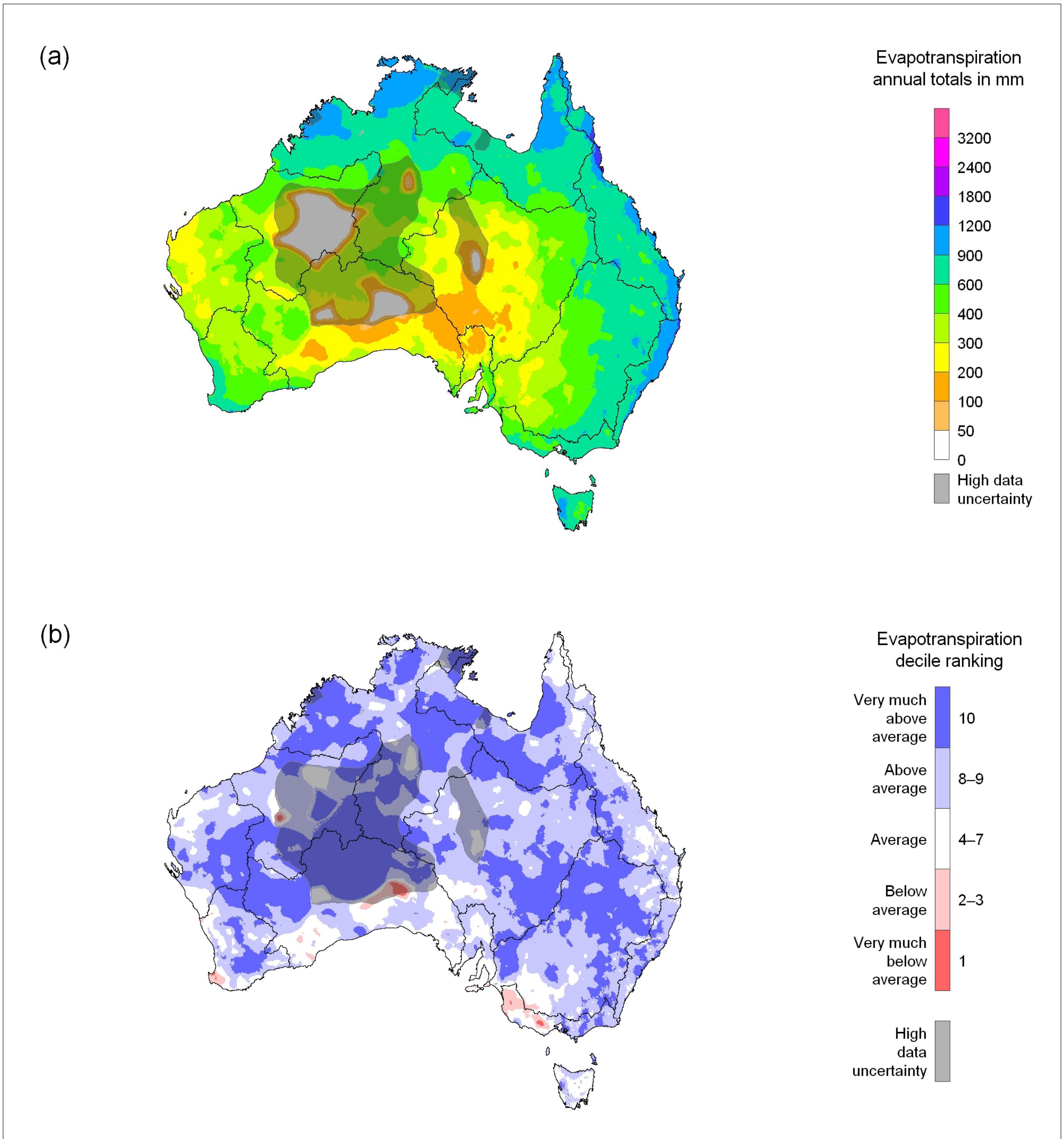


Figure 2.5 (a) Modelled annual total evapotranspiration in 2011–12, and (b) and its decile range with respect to the 1911–2012 record

Figure 2.6 shows modelled monthly evapotranspiration for 2011–12 which is highest during the months of November 2011 through to March 2012. This is strongly related to the temperature and the above average rainfall during this period as identified in subsection 2.3.1. For some months, even the arid areas in the centre of the country experienced evapotranspiration rates of more than 25 mm per month (effectively reaching 1 mm per day).

Figure 2.7 shows the modelled monthly evapotranspiration decile ranking of 2011–12 with respect to the 1911–2012 record. Throughout 2011–12, evapotranspiration was very much above average in different parts of the country for several months. November, December 2011 and March 2012 stand out as months with extensive areas experiencing very much above average evapotranspiration. The North Western Plateau, South Western Plateau and Tanami – Timor Sea Coast regions experienced their highest November evapotranspiration on record. In addition, the South West Coast and Pilbara–Gascoyne regions experienced their second highest November evapotranspiration on record. The South West Coast region also experienced their highest evapotranspiration on record for December while the Murray–Darling Basin region experienced their third highest evapotranspiration on record for December.

Evapotranspiration was also particularly high for the Murray–Darling Basin, South Australian Gulf and Lake Eyre Basin regions during March 2012.

Despite the general pattern of above average evapotranspiration throughout 2011–12, some regions had prolonged periods of below average evapotranspiration. Most affected was the South West Coast region, where evapotranspiration was consistently below average for the last four months of 2011–12. This is in contrast to the first half of the year, which had the highest evapotranspiration on record for this region. In May 2012, many of the southern and western regions recorded below average evapotranspiration. This is directly associated with the shortage of rainfall for this month and the previous month (see Figure 2.4).

An interesting feature of the northern regions is that evapotranspiration is normally highest during the months of January and February. The average to below average evapotranspiration in these regions during January and February 2012 reflects the rainfall pattern (see Figure 2.4).

In the northern regions, the evapotranspiration is normally highest during the months of January and February. Interestingly, in January and February 2012 the evapotranspiration was average to below average, similar to the rainfall pattern (see Figure 2.4).

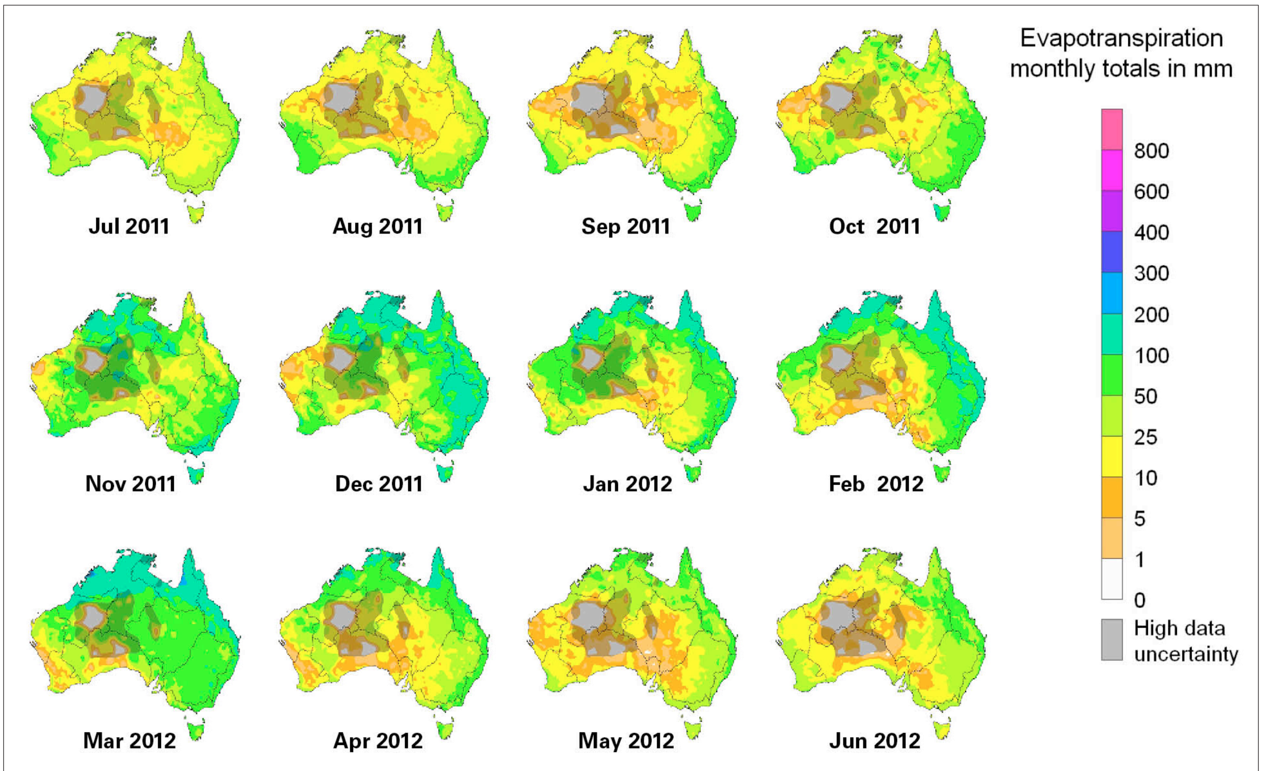


Figure 2.6 Modelled monthly evapotranspiration totals for 2011–12

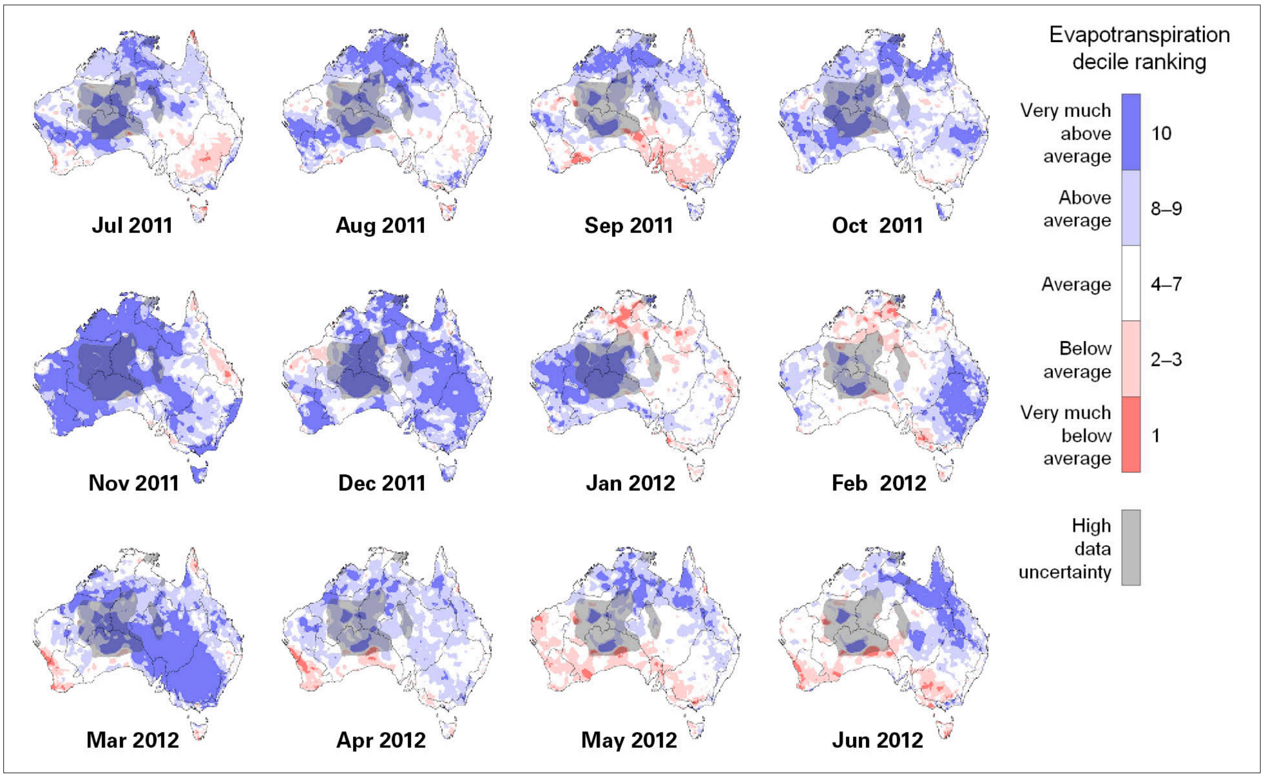


Figure 2.7 Modelled monthly evapotranspiration deciles for 2011–12 with respect to the 1911–2012 record

2.3.3 Landscape water yield

Average Australian landscape water yield for 2011–12 is estimated to be 87 mm, which is 56% above the estimated national long-term average of 56 mm (calculated from July 1911– June 2012). Large areas of the country had very much above average landscape water yield, although mostly this was in areas where total landscape water yield itself was low (Figure 2.8).

Landscape water yield was very much above average across most of the Murray–Darling Basin region. In contrast, landscape water yield was relatively low for the South West Coast region.

Decile rankings along the north coast of the country were average to above average with only some areas within the highest decile ranking. Landscape water yield was generally average throughout Tasmania.

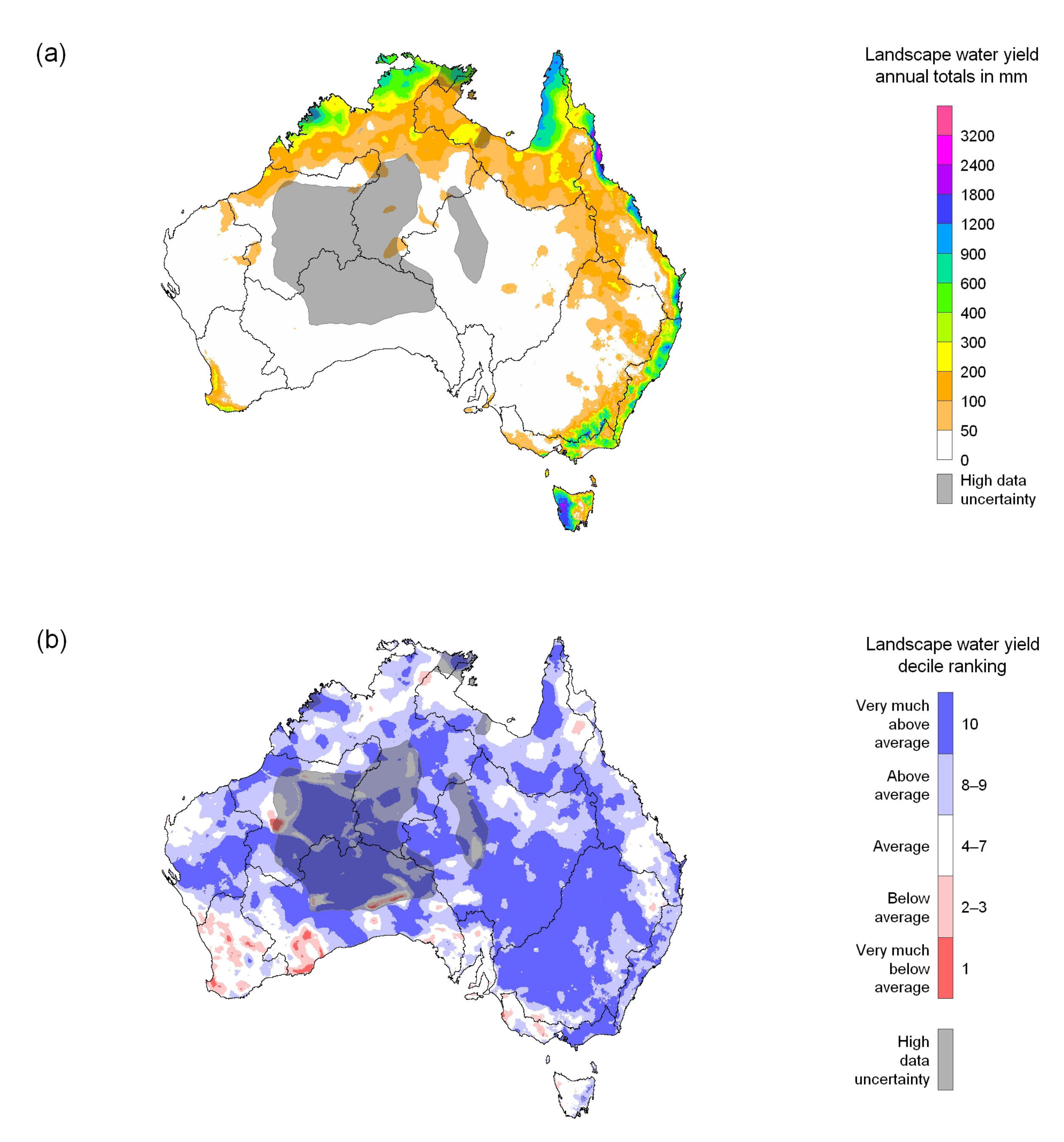


Figure 2.8 (a) Modelled annual total landscape water yield in 2011–12, and (b) its decile range with respect to the 1911–2012 record

Monthly modelled landscape water yield, shown in Figure 2.9, indicates that for large parts of the centre of the country total landscape water yield remained below 1 mm per month throughout most of 2011–12 including large portions of the South West Coast, Pilbara–Gascoyne, North Western Plateau, South Western Plateau, South Australian Gulf, Lake Eyre Basin regions and even some areas of the Murray–Darling Basin region. Notable landscape water yield occurs consistently throughout the year only in the South East Coast (Victoria), South East Coast (NSW), and Tasmania regions. Conversely, particularly low landscape water yield occurs during the dry season in the northern regions.

Figure 2.10 shows the modelled monthly landscape water yield decile rankings. During 2011–12, very much above average landscape water yields were experienced during each month in many regions. Very much above average landscape water yields were experienced in November 2011 and March 2012 for more than 50% of the country. Very much above average landscape water yield also occurred throughout most of the year in the arid regions in the centre and west of the country; however, as can be seen from Figure 2.9, the landscape water yield for these areas did not exceed 5 mm. The frequently above average landscape water yield during most months in these regions distinguishes the year from previous years.

In contrast, landscape water yields were below average in the southwest of the country. From July–September 2011 and from March–May 2012, the South West Coast region in particular had below average landscape water yield, with the latter period having the eighth lowest landscape water yields on record (1911–2012).

The southeast of the country was most affected by widespread rainfall. In March, landscape water yield was the highest on record for both the Murray–Darling Basin region as well as the South East Coast (Victoria) region. The month had also the third highest on record landscape water yield for the North East Coast region. November 2011– March 2012 as a whole had the second highest landscape on record water yield for the Murray–Darling Basin region, fourth highest on record for the South East Coast (NSW) region and sixth highest on record for the South East Coast (Victoria) region.

In January 2012, two tropical cyclones affected the Pilbara–Gascoyne region and provided it with almost half its average annual rainfall. As a result, landscape water yields were the highest on record for the month. The North Western Plateau region also experienced the fifth highest landscape water yield on record.

The only region without any top-ten months of highest landscape water yield for 2011–12 was Tasmania.

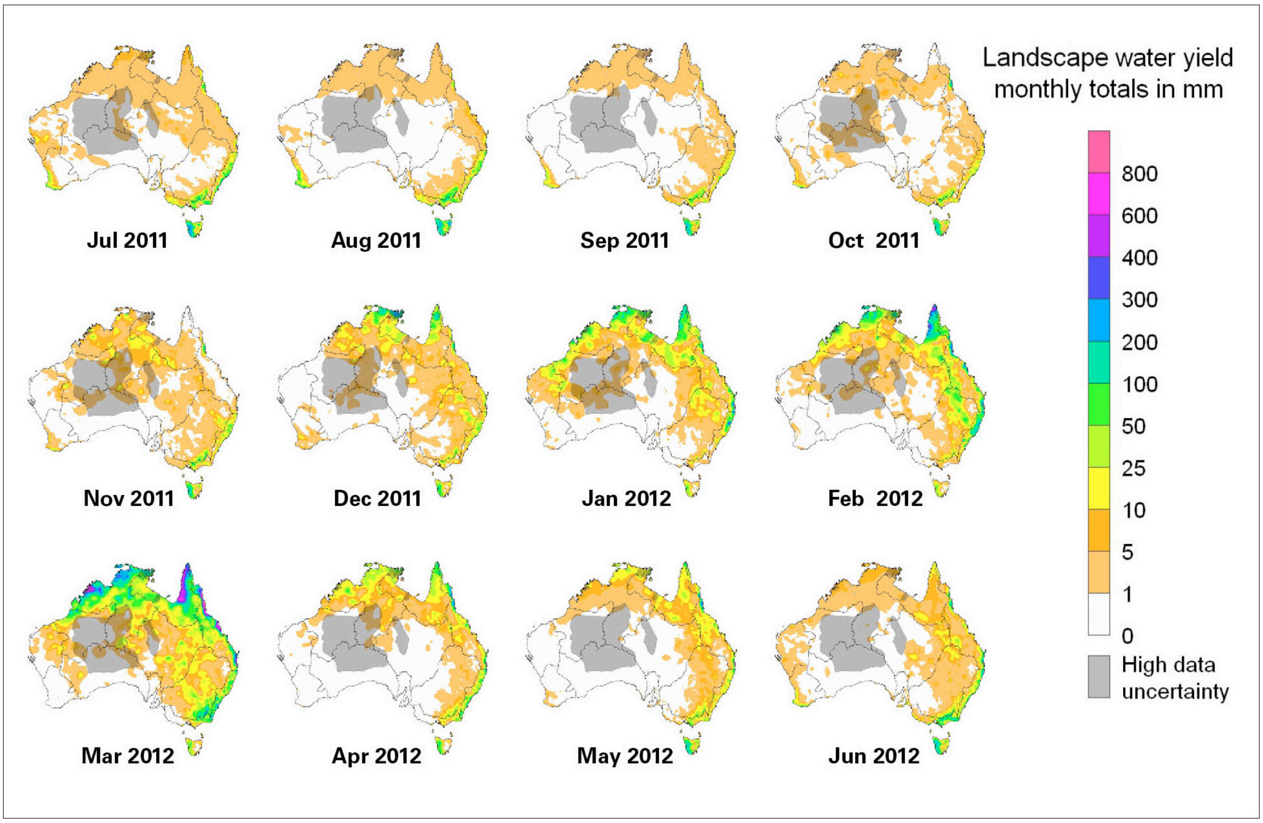


Figure 2.9 Modelled monthly landscape water yield totals for 2011–12

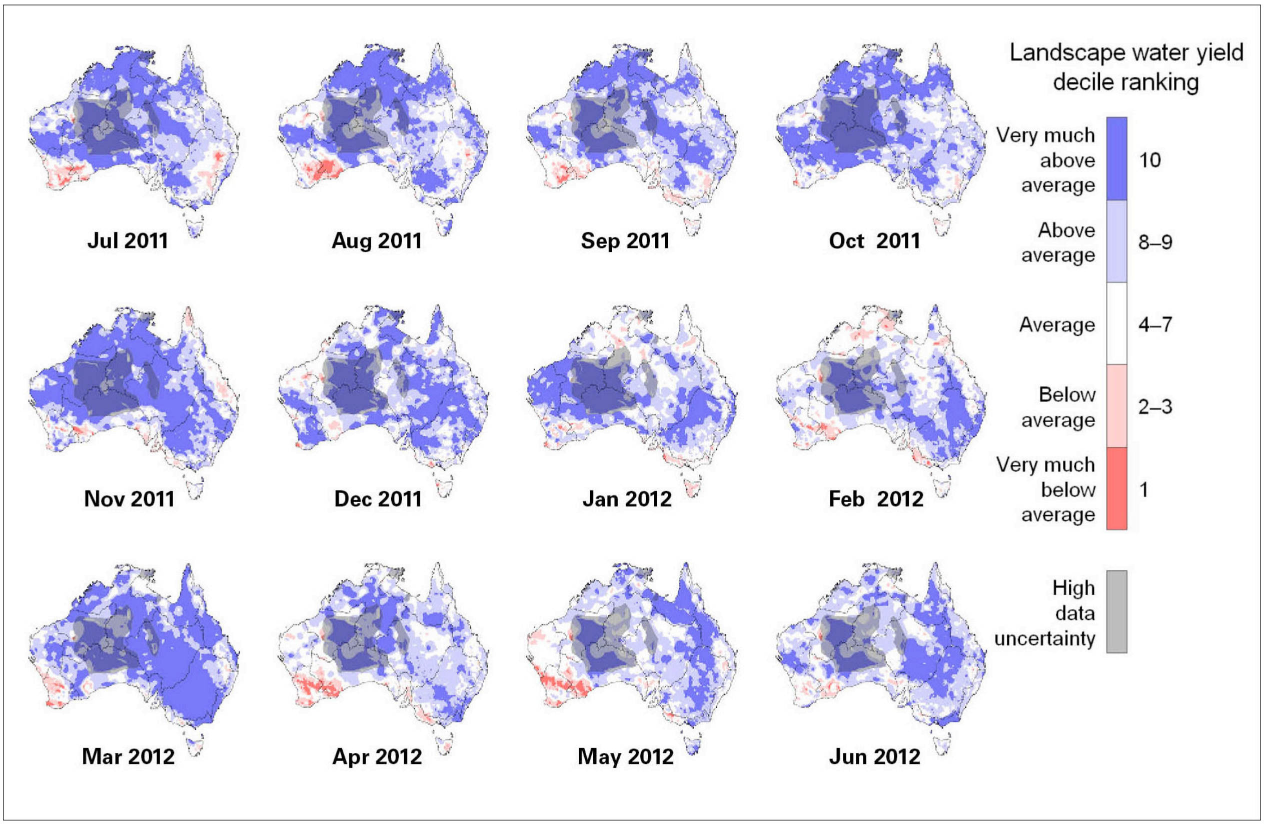


Figure 2.10 Modelled monthly landscape water yield deciles for 2011–12 with respect to the 1911–2012 record

2.4 Soil moisture

The AWRA-L landscape water balance model derives soil moisture volumes at daily time steps. The model conceptualisation of soil water storage and transfer processes is relatively simple. Since the modelled outputs are not verified against local soil moisture measurements, they are presented in relative terms only.

Figure 2.11 shows the decile ranking of the 2011–12 modelled annual average soil moisture with respect to the 1911–2012 period.

In 2011–12, soil moisture volumes were very much above average in most regions of the country, with the exception being the South West Coast region. Very low soil moisture volumes were experienced in this region at the start of the year. Even the relatively high rainfall during the year (Figure 2.2) could not lift the overall soil moisture to average levels.

The large areas of very much above average soil moisture volumes cover many important agricultural areas. For the regions in the highly cultivated southeast of the country, soil moisture was high.

The soil moisture deciles of Figure 2.11 correspond mostly to the landscape water yield deciles of Figure 2.8. This is because of the way the flow processes correlate with each other in the model. Both rainfall infiltration excess (that is, rainfall that is not infiltrating into the soil) and groundwater discharge are dependent on soil moisture levels. The model is designed so that with higher soil moisture levels both infiltration excess and deep percolation into the groundwater system becomes higher. Both processes generate higher landscape water yield.

As there is a temporal variability in soil moisture volumes, an additional monthly analysis is presented separately for each region (see the regional chapters).

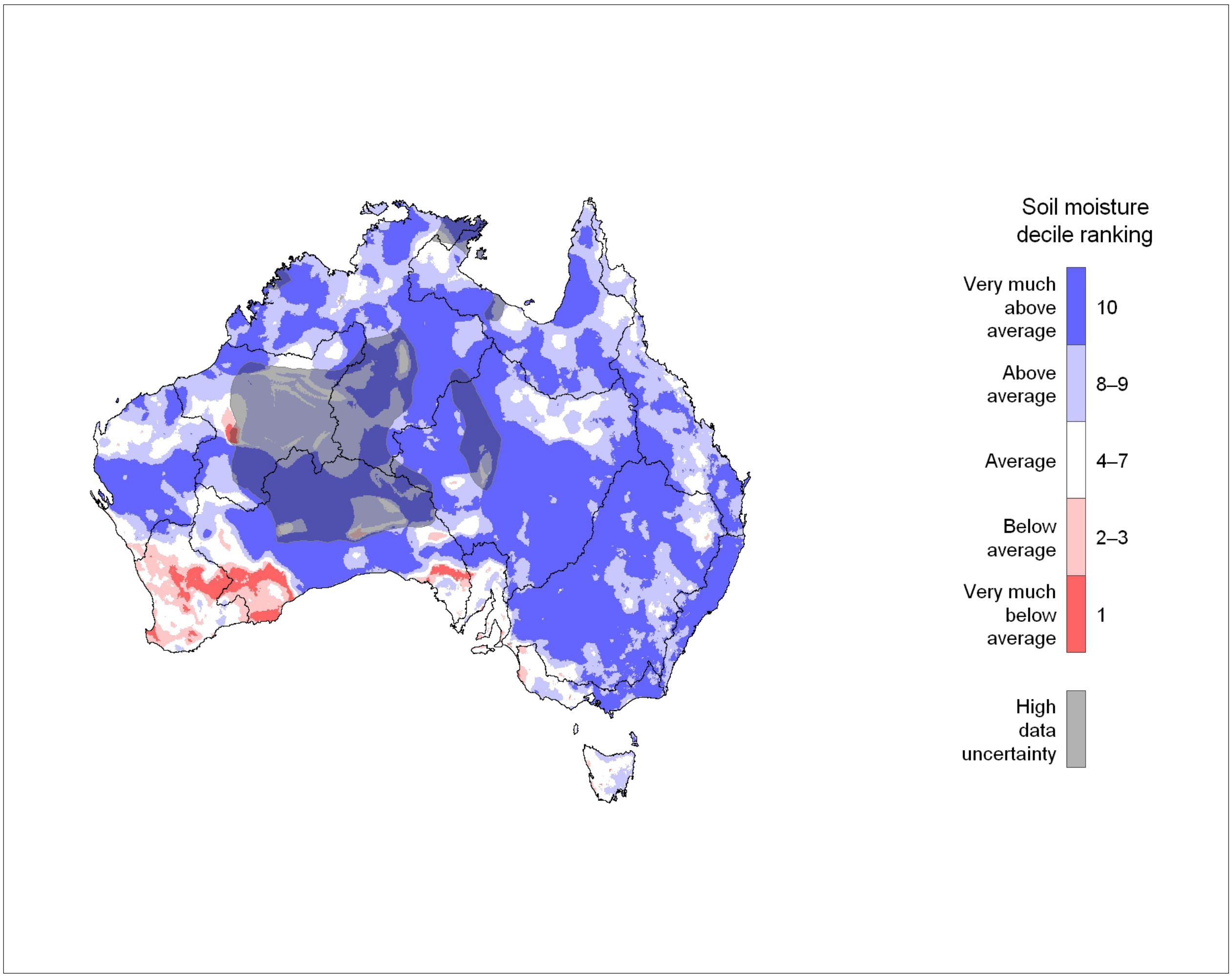


Figure 2.11 Decile rankings of modelled annual average soil moisture for 2011–12 with respect to the 1911–2012 record

2.5 Surface water storage

The total volume of water stored in major public water storages in Australia at the end of 2011–12 was at 83% of their total accessible capacity. This represents an 8% increase on the previous year (Table 2.3). The increase is largely due to storage volume increases in the Tasmania and Murray–Darling Basin regions.

Surface water storage in the South Australian Gulf, Carpentaria Coast, Pilbara–Gascoyne and Tanami – Timor Sea Coast regions decreased over this period. The changes in the Tanami – Timor Sea Coast region (mainly Lake Argyle) and the Carpentaria Coast region (Lake Julius) are negligible in comparison to their total storage volumes, especially as the storage volumes were close to full capacity.

After substantial increases in storage volumes in most regions during 2010–11, storage volumes continued to rise during 2011–12. Storage volumes in the eastern regions, which had not reached full capacity the previous year, increased substantially. The highest relative increase in storage volume occurred in the South East Coast (NSW) region, where the Warragamba storage reached full capacity and spilled on several occasions during the year. The Warragamba storage accounts for more than 50% of the total storage capacity in the region.

While landscape water yield for the year was average and locally below average in the South West Coast region, the volume of water in surface storage in this region increased from 22% of accessible volume to 32% of accessible volume. This was as a result of a number of significant coastal rainfall events (in July, August and September 2011) and the steady provision of other sources of water (such as groundwater and desalinated water).

Water restrictions in metropolitan areas also contributed to the observed increase in surface water storage in the South West Coast region.

Table 2.3 Change in surface water storage over 2011–12 by region

Region	Accessible volume in storage (GL)			% of total accessible capacity		
	30 June 2011	30 June 2012	Difference	30 June 2011	30 June 2012	Difference
North East Coast	9,135	9,301	+166	96	**98**	+2
South East Coast (NSW)	3,049	3,658	+609	79	95	**+16**
South East Coast (Victoria)	1,078	1,346	+268	57	71	+14
Tasmania	13,576	15,672	+2,096	61	71	+10
Murray–Darling Basin	22,006	25,230	+3,224	73	84	+11
South Australian Gulf	135	96	–39	69	49	–20
South Western Plateau[1]	—	—	—	—	—	—
South West Coast	210	309	+99	**22**	**32**	+10
Pilbara–Gascoyne	62	36	–26	98	57	**–41**
North Western Plateau[2]	—	—	—	—	—	—
Tanami – Timor Sea Coast	10,710	10,549	–161	**100**	**98**	–2
Lake Eyre Basin[3]	—	—	—	—	—	—
Carpentaria Coast	93	92	–1	94	93	–1
Total Australia	**60,054**	**66,289**	**+6,235**	**75**	**83**	**+8**

[1–2] No major public storages exist in the South Western Plateau, North Western Plateau, and Lake Eyre Basin regions.

2.6 Groundwater levels

A complete national overview of groundwater availability cannot be presented in this report due to the limited amount of quality-controlled data available in a suitable form at this time.

Nationally-significant groundwater systems in Western Australia, the Northern Territory and Tasmania have not been assessed. They are expected to be reported on in future assessments. No analysis has been attempted for aquifers of the Great Artesian Basin (GAB) in this report; however, the CSIRO has recently led a GAB Water Resource Assessment (Smerdon et al. 2012). Interested readers are referred to the reports of this study.

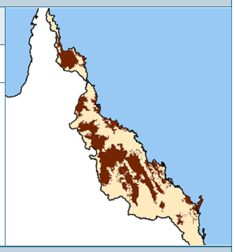
The status of groundwater levels was evaluated in a number of aquifers in four regions where data were available. The data is presented as linear trends for the period of 2007–08 to 2011–12. The trends in groundwater levels within large aquifers are categorised as decreasing, increasing, stable or variable for each 20 km x 20 km grid (for the Murray–Darling Basin and South East Coast [Victoria] regions), and for 5 km x 5 km grid (for intermediate to local flow systems within smaller aquifers in the North East Coast and South Australian Gulf regions).

The available results are summarised in Table 2.4. The maps on the right present the location and spatial distribution of the aquifers identified for trend analysis in the four regions. Colours used to represent aquifers in the maps correspond to colours in the first column of the table; note that some aquifers overlie others and are shown with hatching. More details on aquifer extent and location are given in the groundwater status section of the regional chapters.

Table 2.4 Groundwater level trends for the 2007–08 to 2011–12 period

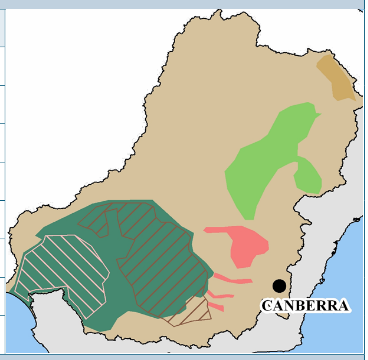
North East Coast

Region aquifers	Trend
Alluvial and Tertiary basalts	rising ↗



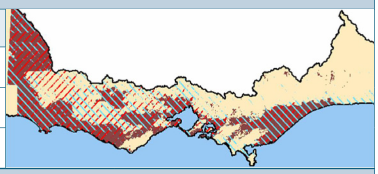
Murray–Darling Basin

Region aquifers	Trend
Condamine alluvial	rising ↗
Condamine basalts	rising ↗
Narrabri and Gunnedah	stable or rising →↗
Cowra and Lachlan	rising ↗
Shepparton	no prevalent trend
Calivil	declining ↘
Murray Group	stable →
Renmark	no prevalent trend



South East Coast (Victoria)

Region aquifers	Trend
Quarternary and upper Tertiary	rising ↗
Upper middle and lower middle Tertiary	stable or rising →↗
Lower Tertiary	no prevalent trend



South Australian Gulf

Region aquifers	Trend
Adelaide Plains watertable	rising ↗
Tertiary aquifer (T1)	declining ↘
Tertiary aquifer (T2)	rising ↗
McLaren Vale watertable	stable →
Port Willunga	stable or declining →↘
Maslin Sands	no prevalent trend

2.7 Urban water use

Average water consumption per property for the nation along with a number of major cities is presented in Figure 2.12.

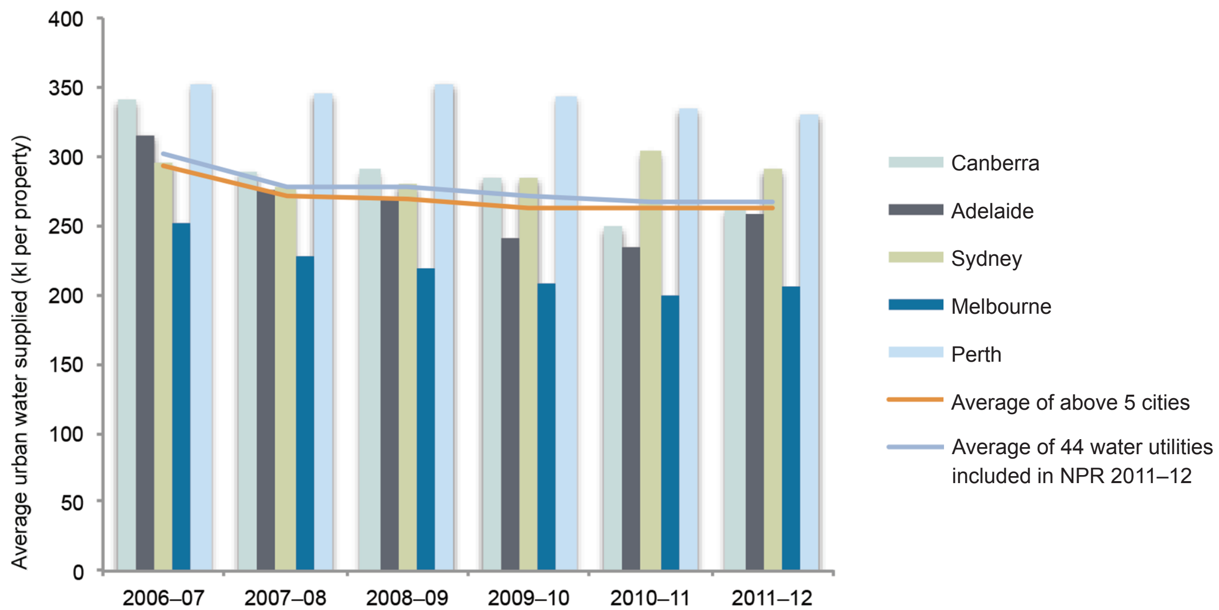
Water conservation and demand management have seen a reduction in the nation's urban water consumption over the past six years. Significantly above average rainfalls in many parts of Australia over the past two years has seen increased water storage levels and an easing of water restrictions across much of the country. The exception is southwest Western Australia, including Perth, which continued to experience low rainfall.

Capital city urban water consumption continued to fall with the exception of the southeast where above average rainfalls and increased water storage volumes has seen a shift in consumer behaviour and a rise in urban water consumption.

While continuing its downward trend, Perth remains the highest urban user of water on a per property basis.

Total urban water supplied to the capital cities increased by 1.4% from 2010–11 to 2011–12, with increases in the total amount supplied observed in Melbourne, Perth, Adelaide and Canberra.

In 2011–12 residential water use accounted nationally for 63% of the total volume supplied to urban areas. Commercial, municipal and industrial uses comprised 25% and the remaining 12% was attributed to uses categorised as 'other' (National Water Commission, 2013).



Source: National Performance Report 2011–12

Figure 2.12 Total urban water supplied per property from 2006–07 to 2011–12 (Brisbane, Darwin and Hobart have been excluded from the individual and capital city analysis due to data unavailability)

Figure 2.13 presents the volume of water sourced from major supply sources for each capital city. With the exception of Perth, surface water continues to be the major source of supply. With ongoing drought in southwest Western Australia, groundwater usage and desalination are increasing to meet the cities' needs.

On a per property basis, residential recycled water use continued on its flat trend in 2011–12. At 22 kL per connected property, it remains consistent with 2009–10 and 2010–11 figures of 22 and 21 kL per connected property.

2.8 Agricultural water use

Average agricultural water use in Australia between 2005–06 and 2010–11 was 8,232 GL (Australian Bureau of Statistics 2011a), 90% of which (7,400 GL) was used for irrigation of crops and pasture. Annual water use for irrigation over the 2010–11 period was 6,645 GL. The highest use of water for irrigation occurred in New South Wales (2,745 GL), which also showed the greatest reduction in irrigation water use between 2005–06 and 2007–08 at the peak of the drought. Victoria and Queensland showed notable decreases in total irrigation water use during the same period. The Northern Territory used the lowest irrigation volume (22 GL in 2010–11) of any Australian State or Territory (data of the State's irrigation water use for 2011–12 was not available at the time of preparing the report). Figure 2.14 compares water use for irrigation between the Murray–Darling Basin region and the rest of Australia. In 2005–06, irrigation water use in the Murray–Darling Basin was more than double that of the rest of the country, but by 2007–08 water use in this basin was approximately equal to the rest of Australia. Water allocation and use has increased gradually since. Although the proportion of water use in the basin compared to the rest of Australia during the last two years was the same as that in 2005–06, the total water use had not increased as such.

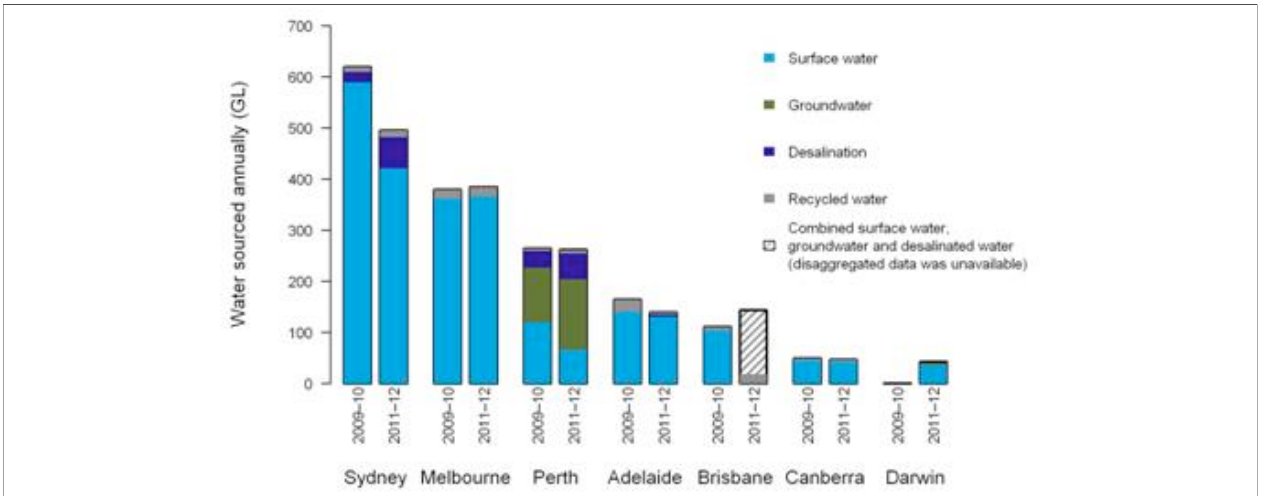


Figure 2.13 Sources of water supplied in capital cities, 2011–12 (National Water Commission 2011a, 2013)

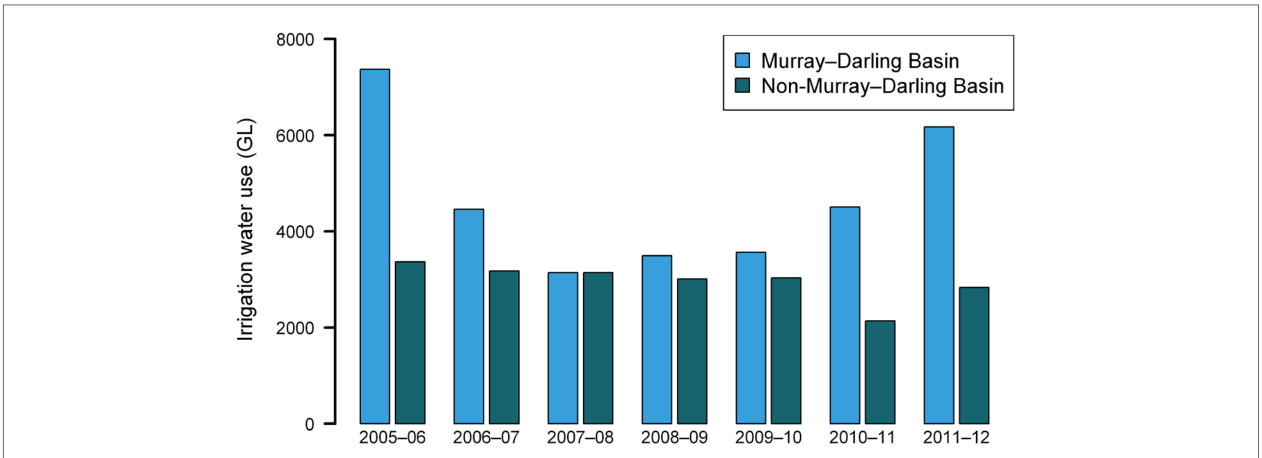


Figure 2.14 Irrigation water use between 2005–06 and 2011–2012

2.9 Drivers of climatic conditions

There are a number of broad-scale influences on the climate of Australia. The climate observed in Australia during 2011–12 can be largely explained by variations in two of the main drivers: conditions in the tropical Pacific Ocean and the eastern Indian Ocean. Tropical Pacific climate indicators include the Southern Oscillation Index (SOI), trade winds, cloudiness and sea temperatures. Of these two drivers, the La Niña conditions that established in the Tropical Pacific by October 2011 dominated Australian rainfall patterns. See Box 2.1 for more on the influence of Pacific Ocean temperatures on rainfall in Australia.

In the first half of 2011 a positive SOI and the corresponding strong La Niña conditions brought very much above average rainfall to most of Australia. These conditions receded in later months and much of the country recorded average to below average rainfall for the months July–September (Figure 2.15).

A La Niña developed again in spring 2011, causing above average rainfall across large parts of the country. To the northwest of Australia, the Indian Ocean Diopole (IOD) index was positive from August–November 2011, peaking at 0.9 °C in late August 2011 (Figure 2.16). This may have moderated the above average rainfall, especially in southeastern Australia; however, spring generally had above average rainfall over large parts of Australia, with large parts of Western Australia receiving very much above average rainfall. Averaged over Australia as a whole, spring 2011 was in Australia's top-ten wettest springs on record. See Box 2.2 for more on the influence of Indian Ocean temperatures on rainfall in Australia.

The positive SOI declined at the start of autumn to be in the neutral range by the end of autumn. During March 2012, much of northern and eastern Australia recorded average to very much above average rainfall (Australia's third wettest March on record). Conditions then turned drier as the La Niña waned. Averaged as a whole, autumn was still wetter than average across Australia, largely due to the very wet March.

More information on the drivers of climatic conditions in Australia can be found on the Bureau's website at: www.bom.gov.au/lam/climate/levelthree/analclim/analclim.html and at: www.bom.gov.au/water/newEvents/presentations/ncwbriefings/index.shtml

Storm over the approach to Canberra Airport | Nathan Campbell

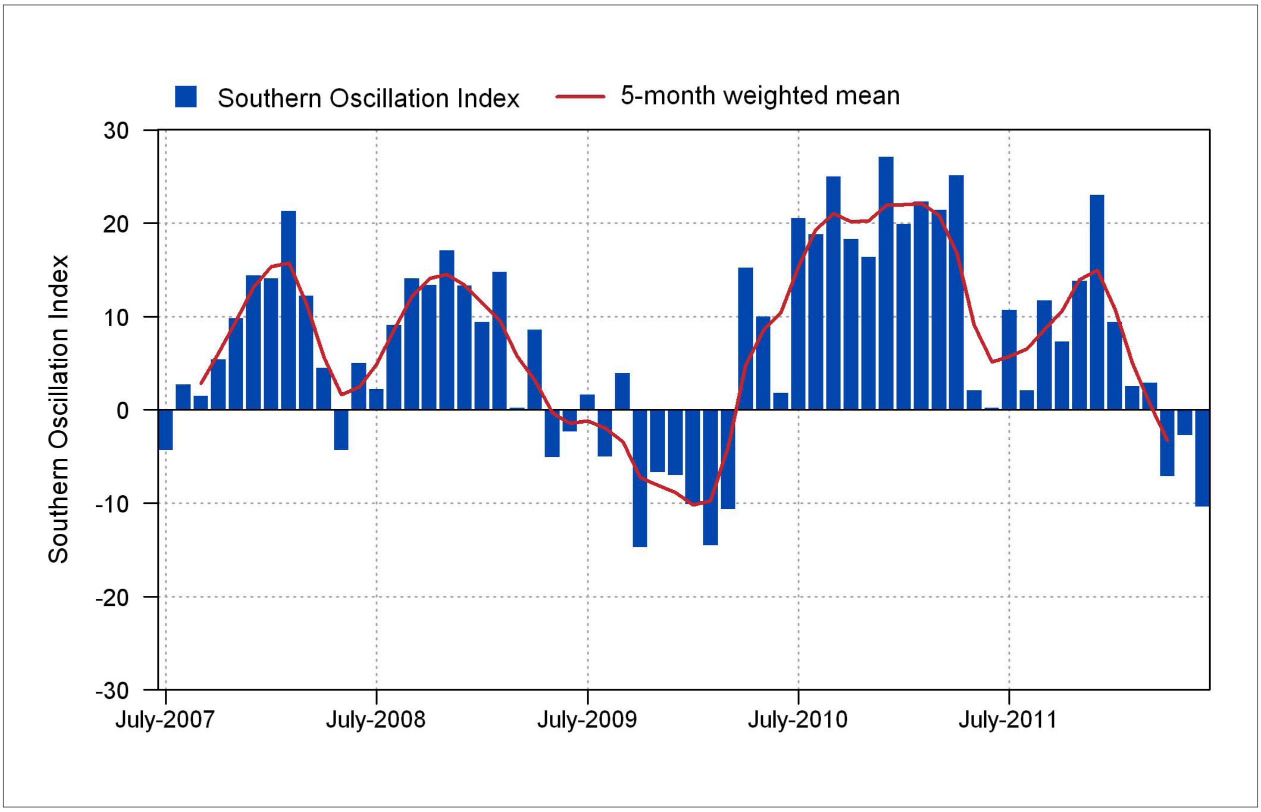


Figure 2.15 Southern Oscillation Index monthly time-series from July 2007–June 2012 (data available at: www.bom.gov.au/climate/enso/indices.shtml)

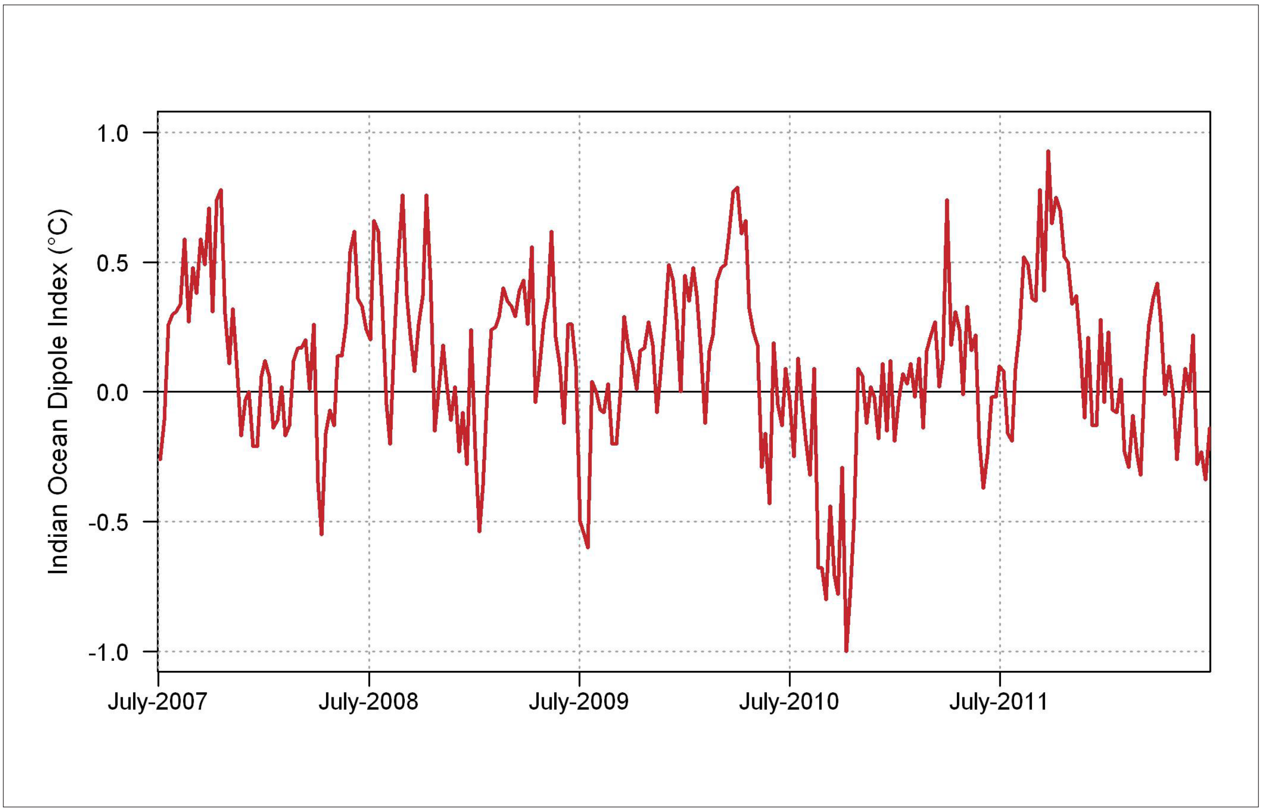


Figure 2.16 Indian Ocean Dipole index time-series from July 2007–June 2012 (data available at: www.bom.gov.au/climate/enso/indices.shtml)

Box 2.1 The Southern Oscillation and El Niño / La Niña

Much of the variability in Australia's climate is connected with the atmospheric phenomenon called the Southern Oscillation, a major see-saw of air pressure and rainfall patterns between the Australian/Indonesian region and the eastern tropical Pacific. The Southern Oscillation Index (SOI) is calculated from the monthly mean air pressure difference between Tahiti and Darwin and provides a simple measure of the strength and phase of the Southern Oscillation and Walker Circulation.

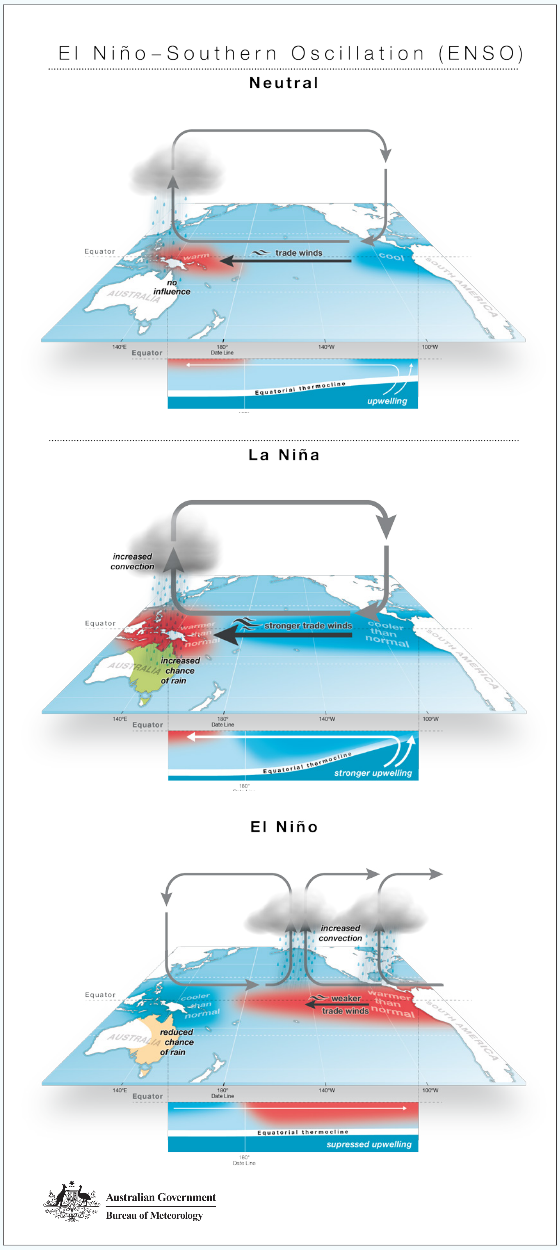
The typical Walker Circulation patterns shown in the first panel of the schematic has an SOI close to zero (that is, the Southern Oscillation is close to the long-term average, or neutral, state). Positive values of the SOI are associated with stronger than average Pacific trade winds blowing from east to west and warmer sea temperatures to the north of Australia. Together these give a high probability that eastern and northern Australia will be wetter than normal.

During El Niño episodes, the Walker Circulation weakens, seas around Australia cool, and slackened trade winds feed less moisture into the Australian/southeast Asian region (bottom panel of schematic). Air pressure is higher over Australia and lower over the central Pacific in line with this shift in the Walker Circulation, and the SOI becomes persistently negative (for example, below −7). Under these conditions, there is a high probability that eastern and northern Australia will be drier than normal. In addition to its effect on rainfall, the El Niño phenomenon also has a strong influence on temperatures over Australia. During winter/spring, El Niño events tend to be associated with warmer than normal daytime temperatures. Conversely, reduced cloudiness means that the air tends to cool very rapidly at night, often leading to widespread and severe frosts.

When the Pacific trade winds and Walker Circulation are stronger than average, the eastern Pacific Ocean is cooler than normal and the SOI is usually persistently positive. This enhancement of the Walker Circulation, also called La Niña, often brings widespread rain and flooding to Australia.

The effect of La Niña on Australian rainfall patterns is generally more widespread than that of El Niño. During La Niña phases, temperatures tend to be below normal, particularly over the northern and eastern parts of Australia. The cooling is strongest during the October–March period.

For more information, see: www.bom.gov.au/watl/about-weather-and-climate/australian-climate-influences.shtml?bookmark=enso



The three phases of the Southern Oscillation and Walker Circulation patterns

Box 2.2 The Indian Ocean Dipole

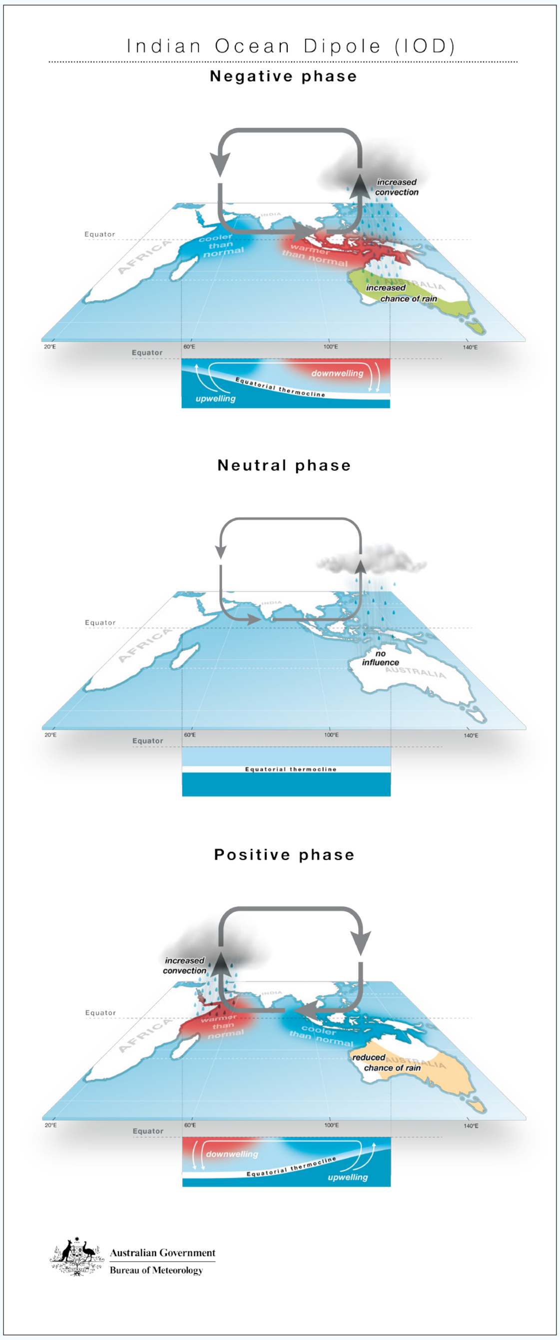
The Indian Ocean Dipole (IOD) is a coupled oceanic and atmospheric phenomenon in the equatorial Indian Ocean that affects the climatic conditions in Australia and other countries that surround the Indian Ocean basin.

The IOD is commonly measured by an index that is the difference in sea surface temperature (SST) between the western and eastern equatorial Indian Ocean. The images below show the east and west poles of the IOD and the phases the index can be in.

A negative IOD period is characterised by warmer than normal water in the tropical eastern Indian Ocean and cooler than normal water in the tropical western Indian Ocean. A negative IOD SST pattern can be associated with an increase in rainfall over parts of southern Australia.

A positive IOD phase is characterised by cooler than normal water in the tropical eastern Indian Ocean and warmer than normal water in the tropical western Indian Ocean. A positive IOD SST pattern can be associated with a decrease in rainfall over parts of central and southern Australia.

For more information see:
www.bom.gov.au/climate/IOD/about_IOD.shtml



The three phases of the Indian Ocean Dipole (IOD)

2.10 Notable rainfall periods

The wet La Niña-influenced summer period (November 2011–April 2012) brought high rainfall, particularly to the South East Coast (NSW) and Murray–Darling Basin regions.

A slow-moving trough brought heavy rainfall in the north of the Murray–Darling Basin region and throughout South East Coast (NSW) region in late November 2011 (Figure 2.17). Rainfall totals were highest on record for a few areas in the northeast of the Murray–Darling Basin region. These heavy rainfalls caused major flooding to occur in some rivers which continued into December.

A major summer rainfall event occurred in late January 2012 which mainly impacted rivers in the north of the South East Coast (NSW) and Murray–Darling Basin regions and the south of the North East Coast region (Figure 2.18). Heavy rainfall continued into February, particularly in the northeast of the Murray–Darling Basin region. A near-stationary trough produced daily rainfall totals up to 200 mm in some areas.

Figure 2.19 shows a major rainfall event, caused by a slow moving low pressure trough, which happened in early March 2012. The Murray–Darling Basin recorded its wettest seven-day period for any month. The Murrumbidgee River basin received seven-day rainfall totals that were double the previous highest on record (> 200 mm). It resulted not only in high river levels and local flooding in rivers across large areas of the region, but large areas of the Tanami – Timor Sea Coast, Lake Eyre Basin and the south of South East Coast (NSW) regions were also affected.

In the north, three tropical cyclones (*Grant*, *Heidi* and *Iggy*) passed through the north and western parts of the Australian continent in December 2011 through to February 2012. Tropical cyclone *Grant* crossed the northern part of the Northern Territory in late December 2011, producing heavy rainfall near the town of Katherine. The highest rainfall total was 385 mm, measured at Edith Falls Ridge on 27 December 2011. Tropical cyclone *Heidi* made landfall on the Pilbara coast near Port Hedland in mid-January 2012. Tropical cyclone *Iggy* briefly affected the coast of Western Australia in the Pilbara and Kimberley areas in late January and early February 2012.

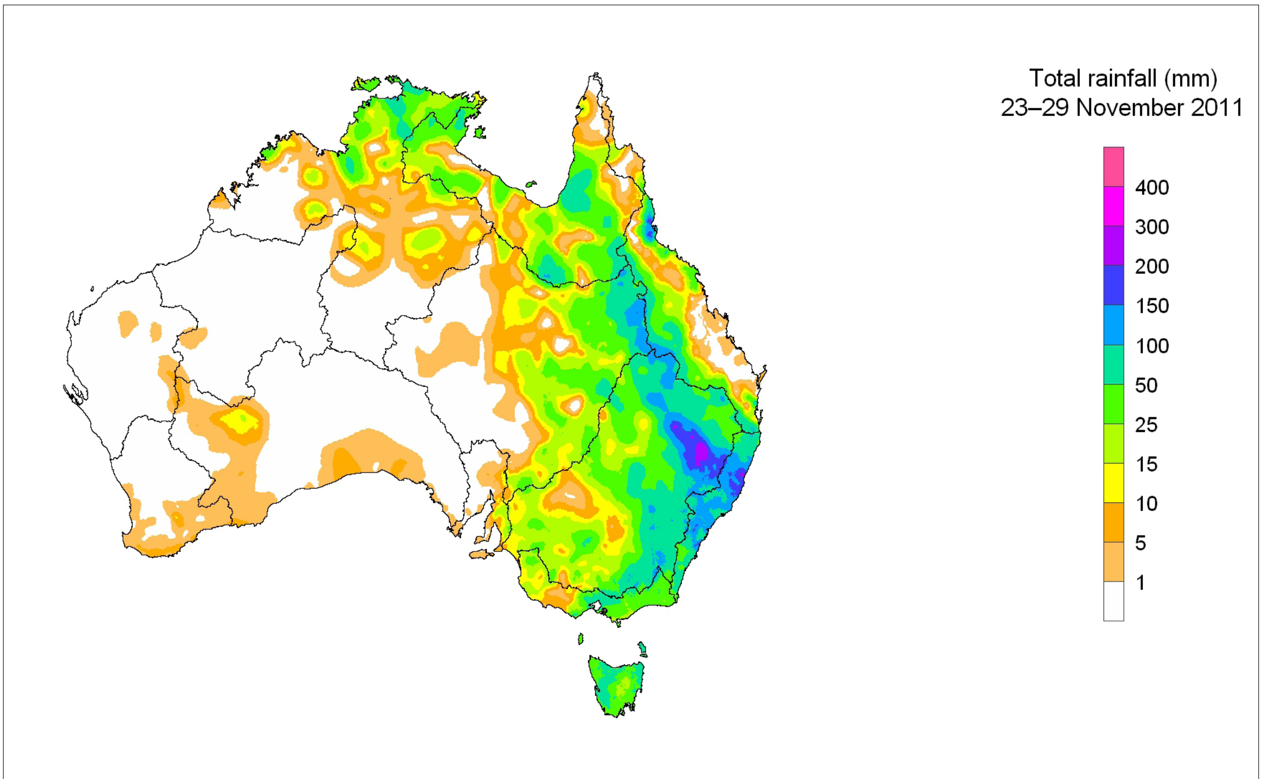


Figure 2.17 Rainfall that contributed to flooding in the Murray–Darling Basin and South East Coast (NSW) regions in late November and early December 2011

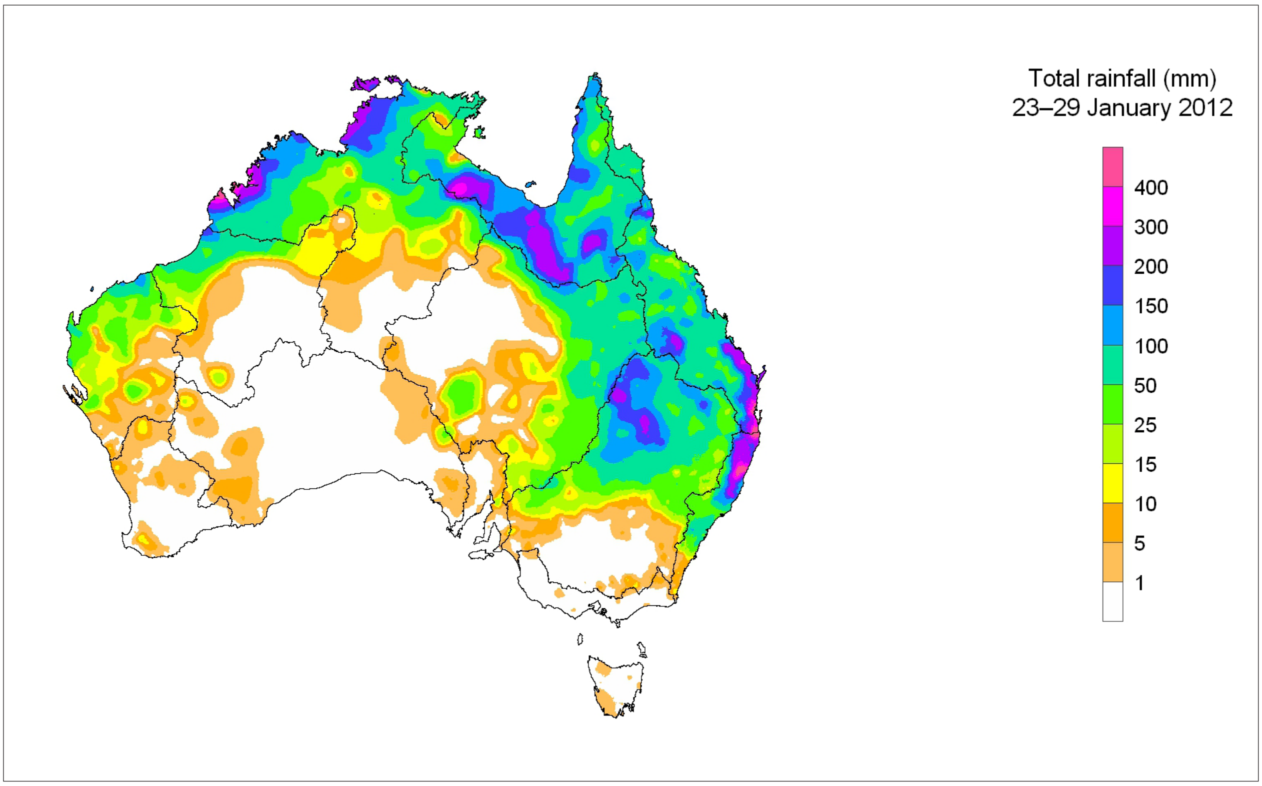


Figure 2.18 Rainfall that contributed to flooding in South East Coast (NSW), Murray–Darling Basin and North East Coast regions in late January 2012

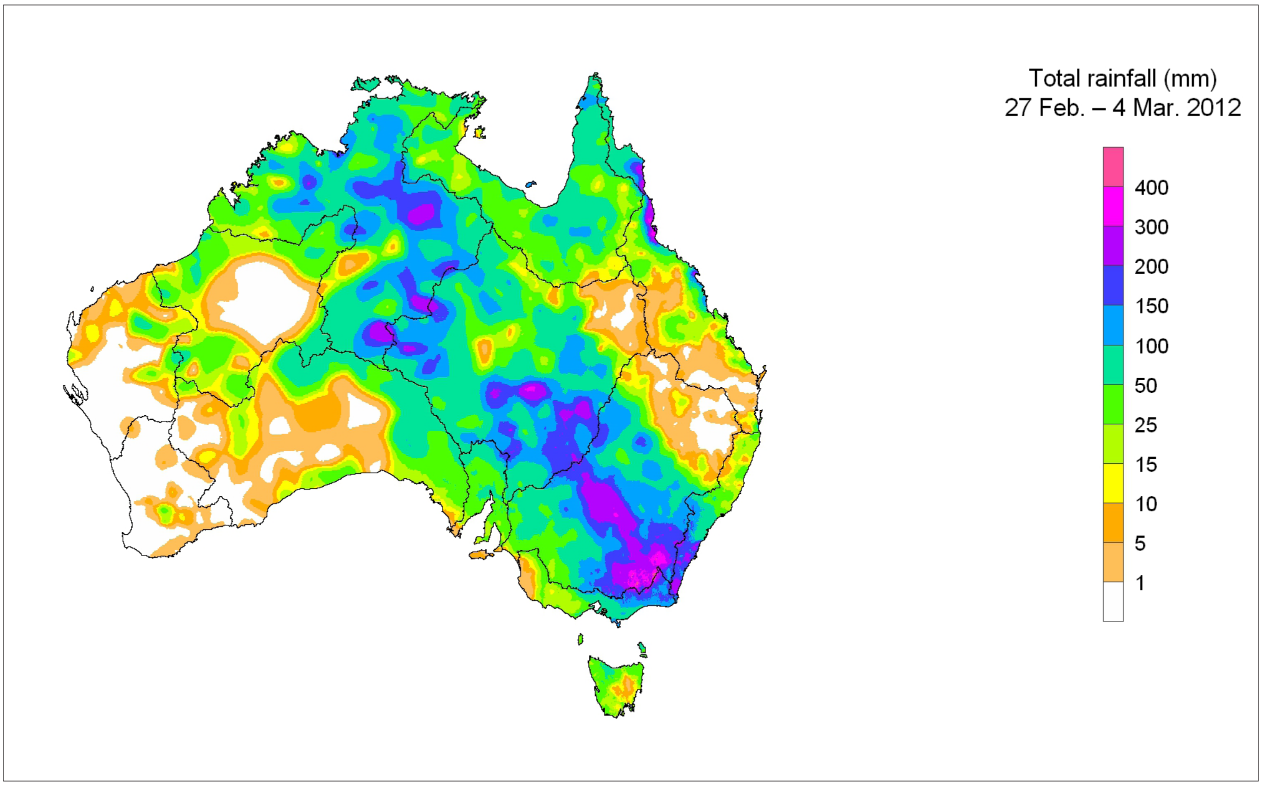


Figure 2.19 Rainfall that contributed to flooding in Tanami – Timor Sea Coast, Lake Eyre Basin, Murray–Darling Basin and South East Coast (NSW) regions in early March 2012

2.11 Major flood events

Major floods are events that cause large infrastructural disturbance and extensive inundation of rural or urban areas. Following on from a very wet preceding year, Australia experienced more widespread major flood events during 2011–12 than typically occurs. This was predominantly in rivers in the eastern part of the country (Figure 2.20).

Heavy rainfall in August generated floods in the northeast part of the Tasmania region. The resulting highly saturated soils caused many landslides.

In the northeast part of the Murray–Darling Basin region, floods were recorded in the Gwydir and Namoi river basins in November 2011.

In these two basins, the floodwaters moved downstream during December 2011 and, with additional high rainfall at the end of January 2012, many rivers in the Darling River basin experienced flooding through to April 2012.

The coastal rivers of the North East Coast region flooded during March. During this month in the Murray–Darling Basin region, a large rainfall event caused widespread flooding, particularly in the Lachlan and Murrumbidgee rivers.

The South East Coast (Victoria) region experienced major floods in June 2012 that were the result of a rare local rainfall event. Most of the east of the region received rainfall of over 100 mm on 5 June, resulting in a rapid rise in river levels and flash flooding.

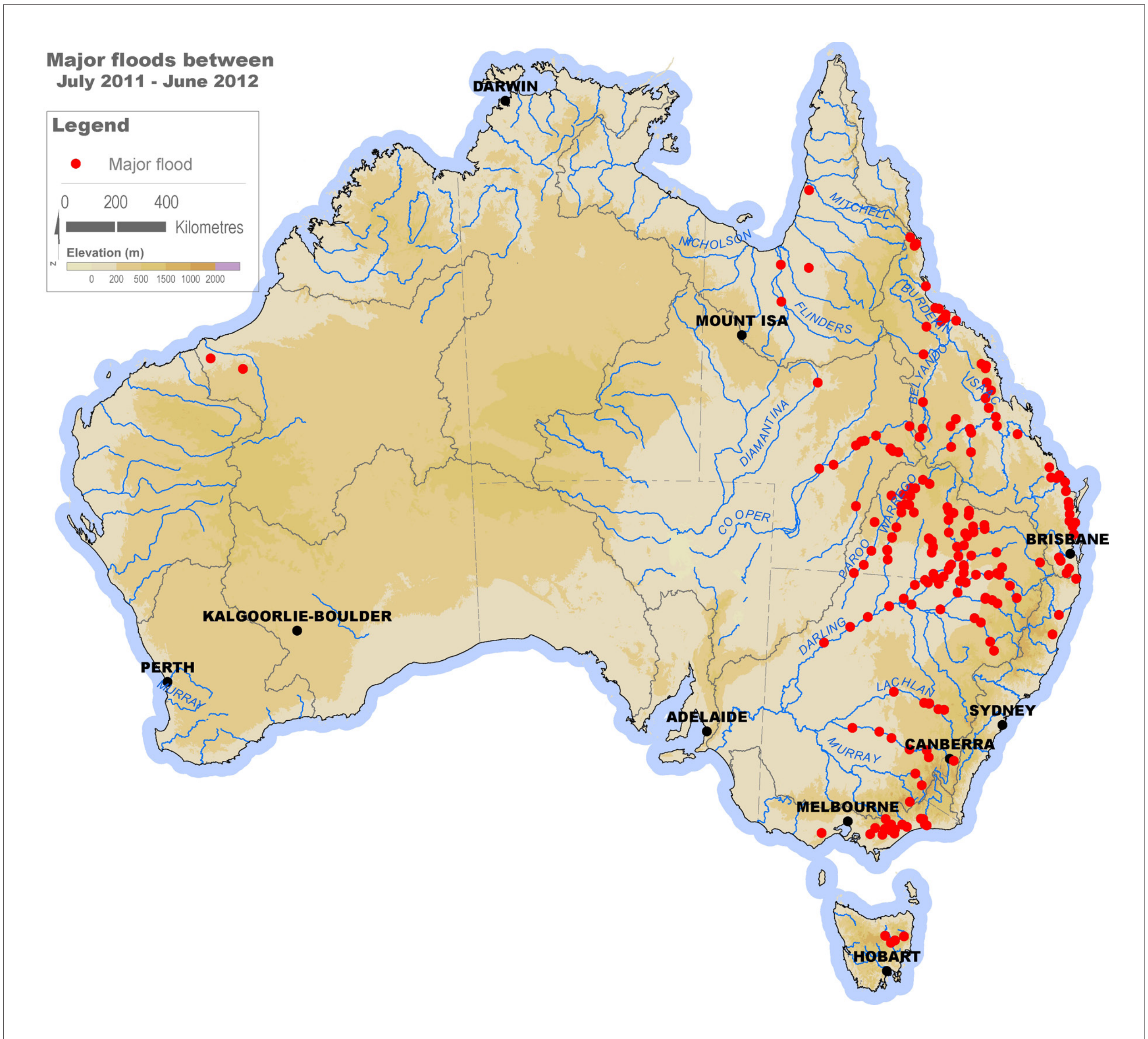


Figure 2.20 Major floods in 2011–12, as monitored by the Bureau's Flood Forecasting and Warning Service

2.12 Regional water resources assessments

Chapters 3–15 detail assessments of water availability and use at regional scales. Within each reporting region, patterns, variability and trends in water availability and use are considered.

Topics addressed include the impacts of the climatic condition on water resources over 2011–12 and between 1980 and 2012.

The report focuses on presentation of annual to decadal trends in water resources and over monthly and seasonal periods.

Particular consideration is given to describing the hydrological state of rivers within each region during 2011–12 and over recent years. Groundwater resources are also described where data were available. Water availability and use in selected cities and irrigation areas is also presented. Information is conveyed in general descriptions of each region and the results of analysis are presented in graphs, tables and diagrams.

Modelled landscape water balance data provide a spatially explicit regional perspective, and data from selected monitoring sites give more detail at particular locations.