14. Lake Eyre Basin

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14.1 Introduction

This chapter examines water resources in the Lake Eyre Basin region in 2009–10 and over recent decades. Seasonal variability and trends in modelled water flows, stores and levels are considered at the regional level.

Details for selected rivers, wetlands, groundwater, urban areas and agriculture are not addressed. At the time of writing, suitable quality controlled and assured information was not identified in the Australian Water Resources Information System (Bureau of Meteorology 2011a).

The chapter begins with an overview of key data and information on water flows in the region in recent times followed by a description of the region.

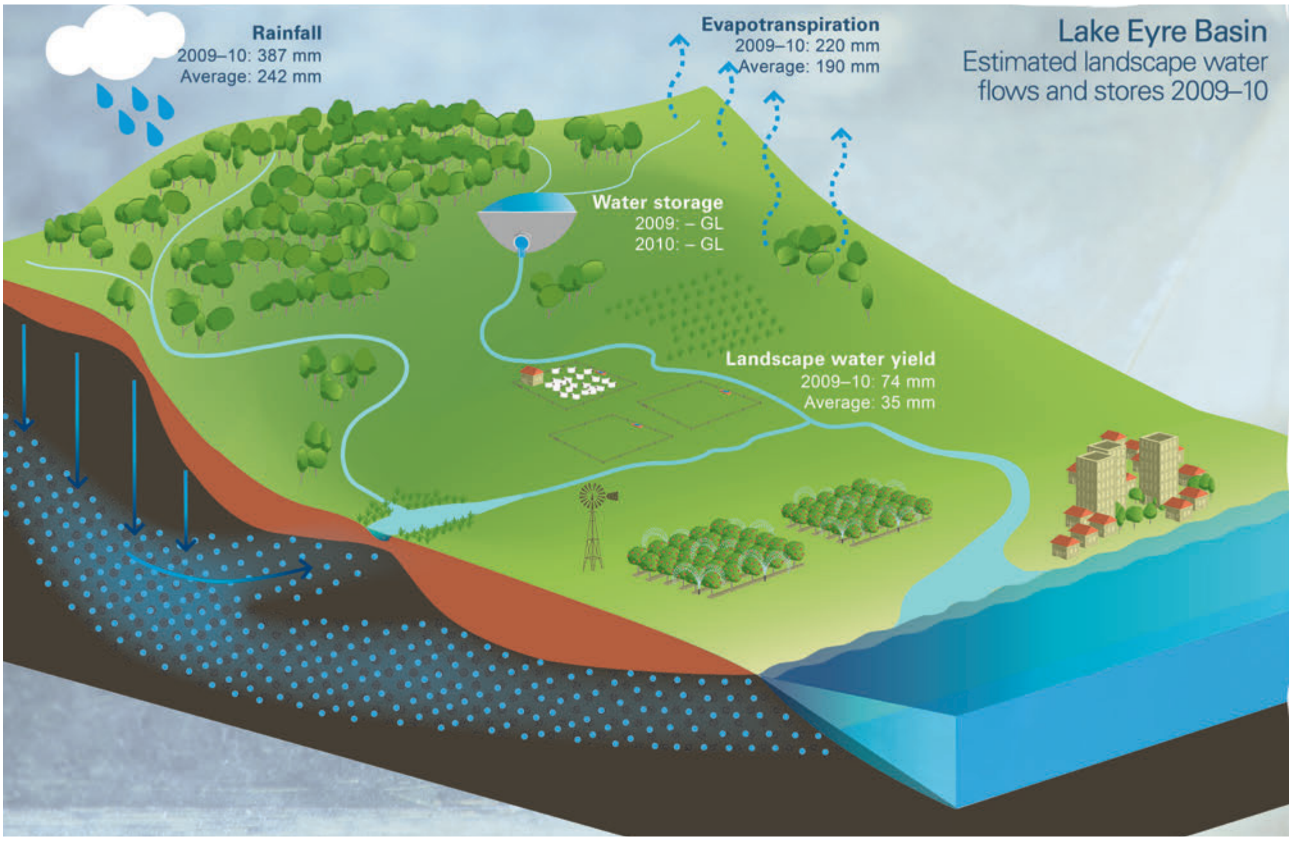


Figure 14-1. Overview of annual landscape water flow totals (mm) in 2009–10 compared to the long-term average (July 1911 to June 2010) for the Lake Eyre Basin region

14.2 Key data and information

Figure 14-1 presents the 2009–10 annual landscape water flows in the Lake Eyre Basin region (no information is available for major storages in the region). The region experienced very much higher than average rainfall in 2009–10 (see Table 14-1) and this high level of water availability also resulted in very much above average levels of evapotranspiration and landscape water yield[1].

Table 14-1 gives an overview of the key findings extracted from the detailed assessments performed in this chapter.

1. See Section 1.4.3 of Chapter 1–Introduction for the definition of this term.

Table 14-1. Key information on water flows in the Lake Eyre Basin region[2]

Landscape water balance	During 2009–10			During the past 30 years	
	Region average	Difference from long-term mean	Rank (out of 99)*	Highest value (year)	Lowest value (year)
Rainfall	387 mm	+60%	92	421 mm (1999–2000)	168 mm (2002–03)
Evapotranspiration	220 mm	+16%	81	242 mm (2000–01)	160 mm (1982–83)
Landscape water yield	74 mm	+111%	96	74 mm (2009–10)	22 mm (2005–06)

* A rank of 1 indicates the lowest annual result on record, 99 the highest on record

2. See Section 1.4.3 of Chapter 1–Introduction for the definition of these terms.

14.3 Description of region

The Lake Eyre Basin region covers approximately 1.2 million km^2 of arid and semi-arid central Australia. It represents 17 per cent of the continent and stretches, north to south, from just below Mount Isa in Queensland to Marree in South Australia. From west to east, it extends from Alice Springs in the Northern Territory to Longreach and Blackall in central Queensland. Lake Eyre is the world's largest internally draining system and fifth largest terminal lake in the world.

The region's climate is arid throughout. Rainfall is much below potential evaporation and the region is driest in the northeast of the Lake Eyre Basin, but it receives some monsoonal rain from the upper reaches of the Diamantina and Georgina rivers.

Landforms are typical of desert conditions. The region mainly consists of plains, inland dunes, sandplains, floodplains, and low relief hills and plateaus. Seasonal or persistent aridity has resulted in low vegetation cover and intermittent river systems.

The region is divided into several major drainage catchments, including Cooper's Creek, Georgina–Diamantina, desert rivers, western rivers and Lake Frome basins. The major rivers in the region are the Georgina, Diamantina, Thomson and Barcoo rivers and Cooper Creek, which flow from central and western Queensland into South Australia; as well as the Finke, Todd and Hugh rivers in central Australia. These waterways all drain into Lake Eyre. The rivers and creeks are characterised by high variability and unpredictability in their flow with high transmission losses and very low gradients. All creeks and rivers of the basin are ephemeral with short periods of flow following rain and long periods with no flow.

The region includes only two Ramsar wetland sites (Coongie Lakes and Lake Pinaroo), which are an important habitat for rare bird species. These lakes only fill under unusually high rainfall intensities northeast of the lakes and, when full, they can hold water for several years.

The region is sparsely populated, with about 57,000 people. Approximately 26,000 live in Alice Springs. The major towns (with a population greater than 1,000) are Alice Springs, Birdsville, Longreach and Winton. Alice Springs and most other towns in central Australia rely almost completely on groundwater aquifers as a source of water. A large portion of the Alice Springs municipal area is situated on a floodplain of the Todd River.

There are no reported major water storages in the region and irrigated agriculture is only practised very locally in the northeast.

Most of the land use within the Lake Eyre Basin is pasture and nature conservation (Figure 14-2). There are numerous dry lakes which form a substantial part of the region. Only a small patch in the far south includes some dryland agriculture.

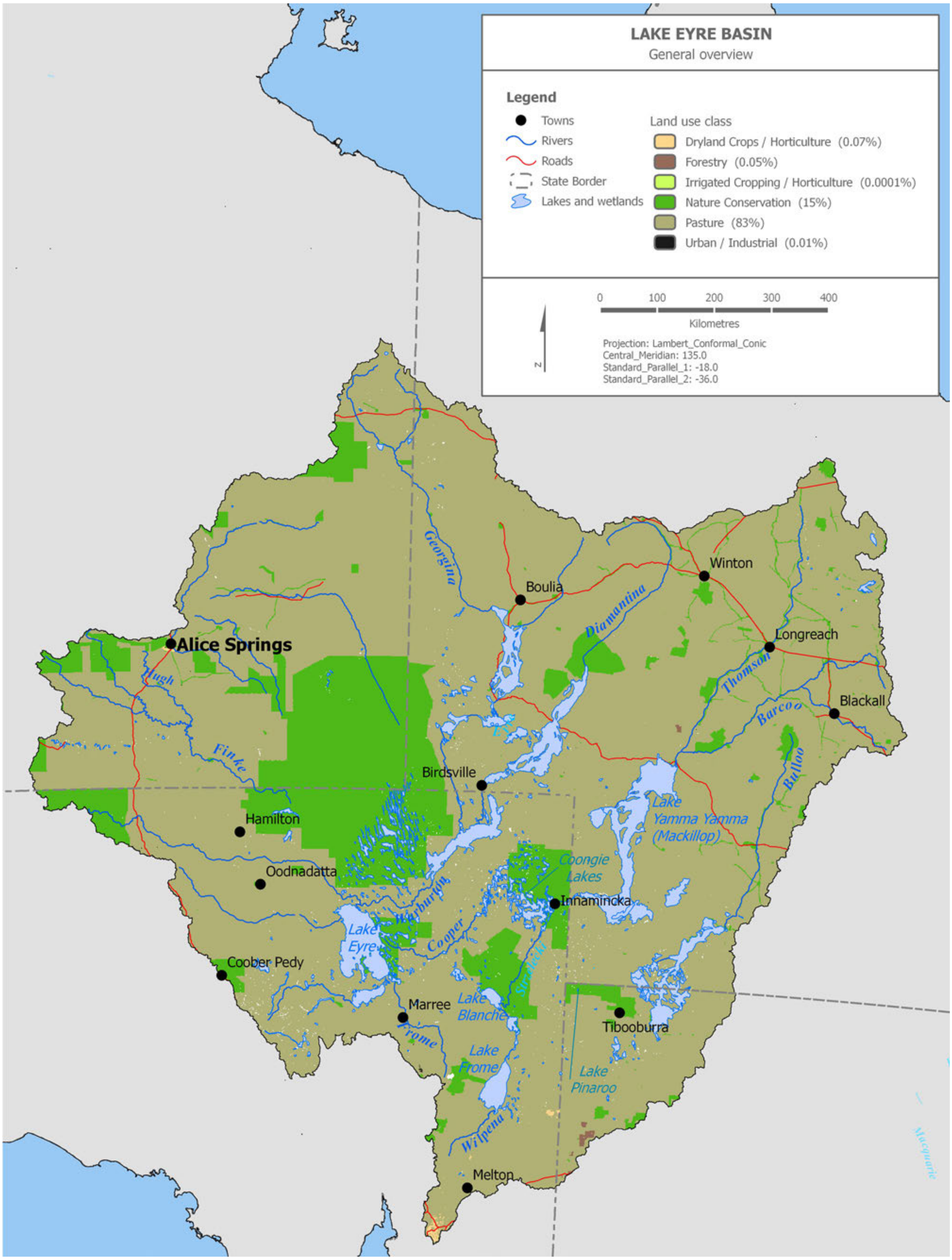


Figure 14-2. Key landscape and hydrological features of the Lake Eyre Basin region (land use classes based on Bureau of Rural Sciences 2006)

14.3 Description of region (continued)

The hydrogeology of the region is dominated by the sediments of the Great Artesian Basin (GAB) with porous sandstone aquifers of the Triassic, Jurassic and Cretaceous. This groundwater basin underlies the Lake Eyre Basin from the northeast, (Figure 14-3), and extends through to the central and southwest margins of the Lake Eyre Basin.

It is one of Australia's most significant groundwater basins. There is notable extraction of groundwater for stock and domestic purposes. The areas identified as Palaeozoic fractured rock (low permeability) in the northwest of this region typically offer restricted low volume groundwater resources. In contrast, the areas identified as fractured and karstic and Palaeozoic fractured rock (consolidated and partly porous) offer a usable groundwater resource in some parts. These units provide 95 per cent of the town water supply for Alice Springs.

The major watertable aquifers present in the region are given in Figure 14-3 (extracted from the Bureau of Meteorology's Interim Groundwater Geodatabase). Groundwater systems that provide more potential for extraction are labelled as:

- fractured and karstic rocks (regional) and (local)
- Mesozoic (porous media – consolidated)
- Mesozoic sediment aquifer (porous media – consolidated).

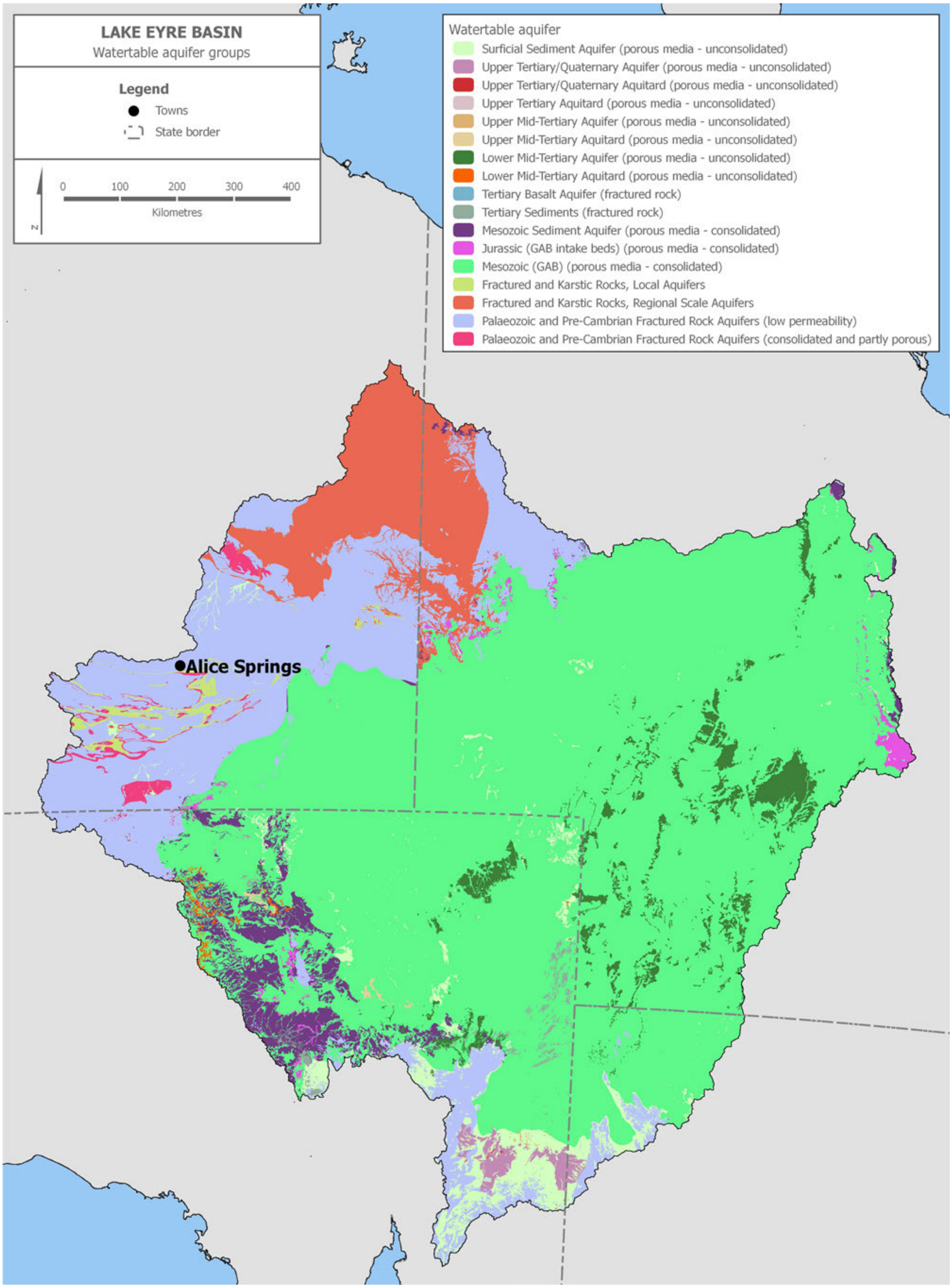


Figure 14-3. Watertable aquifer groups in the Lake Eyre Basin region (Bureau of Meteorology 2011e)

14.4 Recent patterns in landscape water flows

The landscape water flows analyses presented in this section were derived from water balance models and are estimates of the real world situation. Some areas of the region have been excluded from the landscape water balance modelling results (classified as 'No data') due to the unreliability of rainfall data or absence of model parameter data for areas such as salt lakes, salt pans and inland water. The models used and the associated output uncertainties are discussed in Chapters 1 and 2, with more details presented in the Technical supplement.

Figure 14-4 shows that the Lake Eyre Basin region experienced a generally drier than average start to 2009–10 (July to October). The relatively dry start to the year was followed by a wetter than usual summer (November to April), especially in February 2010.

This period of high rainfall was due in large part to a significant rain event in the middle of February and to a monsoonal low event of late February/early March 2010 that generated widespread heavy, and in some places record-breaking, rainfall across much of central and eastern Australia (Bureau of Meteorology 2011d). Total rainfall for February 2010 represented the second highest February total in the long-term record (July 1911 to June 2010).

The extremely high rainfall during the summer of 2009–10 led to very much higher than normal evapotranspiration rates from January through to April 2010. As rainfall returned to more normal monthly levels towards the end of the year, evapotranspiration losses were also within the typical range.

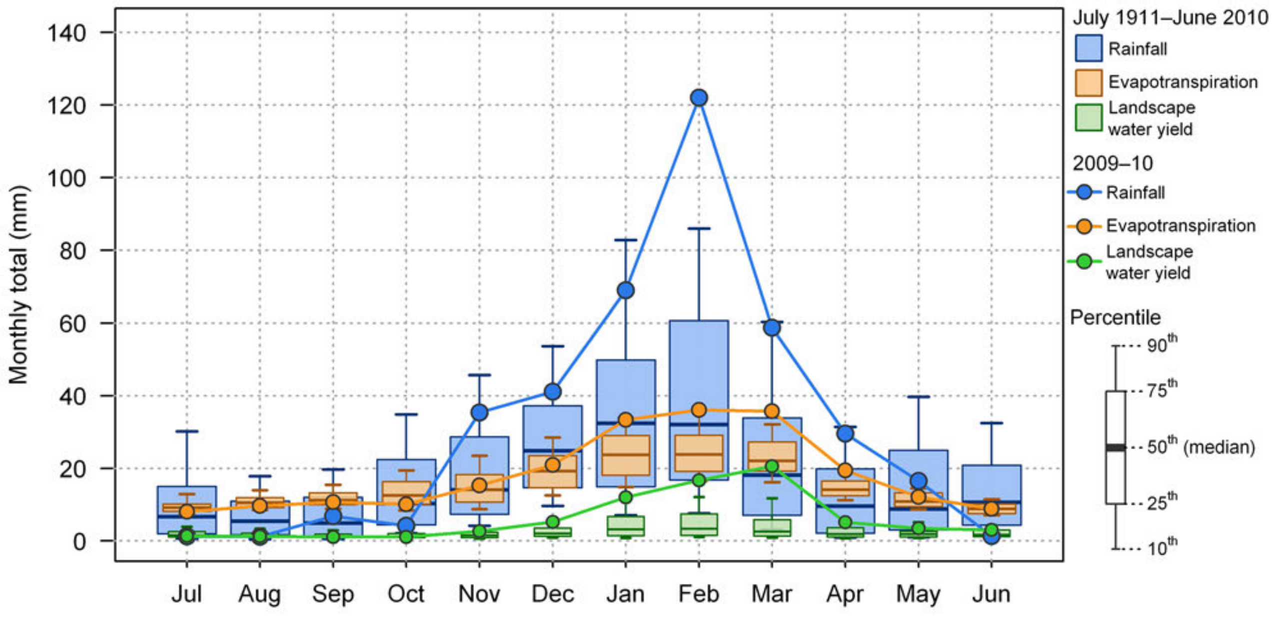


Figure 14-4. Monthly landscape water flows for the Lake Eyre Basin region in 2009–10 compared with the long-term record (July 1911 to June 2010)

14.4 Recent patterns in landscape water flows (continued)

Despite the higher than normal estimated evaporative losses through the wet summer of 2009–10, monthly modelled landscape water yield from November 2009 through to June 2010 was very much higher than normal for the region. The months from February to April 2010 experienced total landscape water yields in the highest decile range for their respective months in the long-term record (July 1911 to June 2010).

14.4.1 Rainfall

Rainfall for the Lake Eyre Basin region for 2009–10 was estimated to be 387 mm, which is 60 per cent above the region's long-term (July 1911 to June 2010) average of 242 mm. Figure 14-5 (a)[3] shows that during 2009–10 the highest rainfall was experienced across the north and northeast of the region. Total rainfall for the year shows a general decreasing gradient running from the northeast to the southwest. Rainfall deciles for 2009–10, shown in Figure 14-5 (b), indicate rainfall was above average across the majority of the region, with very much above average rainfall occurring across much of the east, centre and west.

Figure 14-6 (a) shows annual rainfall for the region over the past 30 years (July 1980 to June 2010). Over the 30-year period, rainfall ranged from 168 mm (2002–03) to 421 mm (1999–2000). The annual average for the period was 257 mm. The data show that the rainfall experienced in 2009–10 represents the second highest annual total of the past 30 years and follows a period of relatively low annual rainfall since 2001–02.

An indication of patterns, trends and variability in the seasonal rainfall over the 30-year period summer (November–April) and winter (May–October) are presented using moving averages in Figure 14-6 (b). The seasonal distribution of rainfall for the region is characterised by higher summer than winter rainfall. The summer rainfall averages exhibit a higher level of variability over the 30-year period, particularly for the relatively wet years of 1999–2000 and 2009–10, which are not reflected in the winter period rainfall averages.

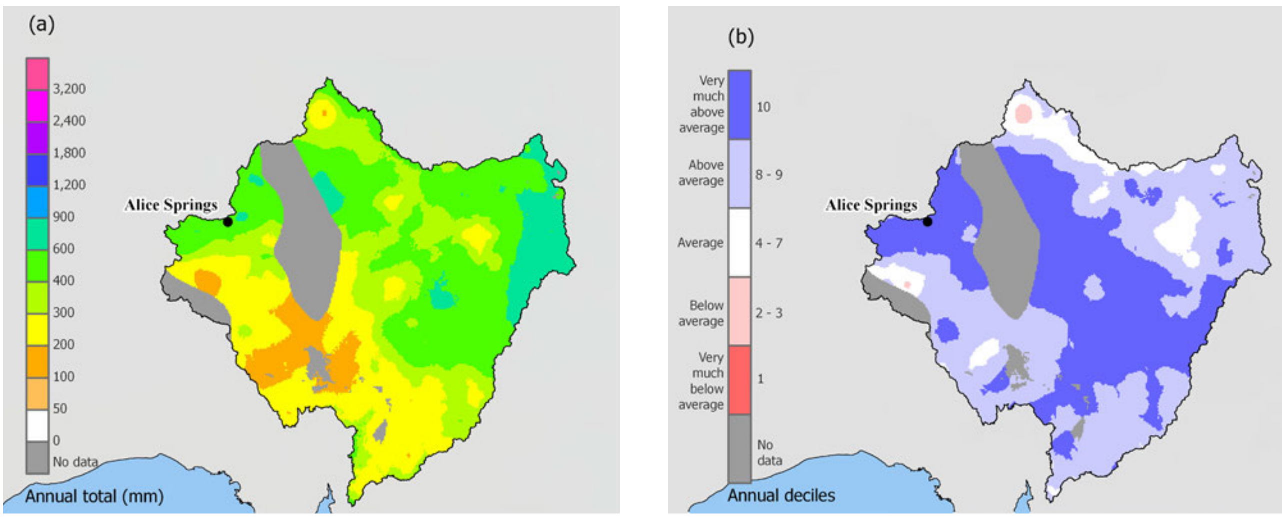
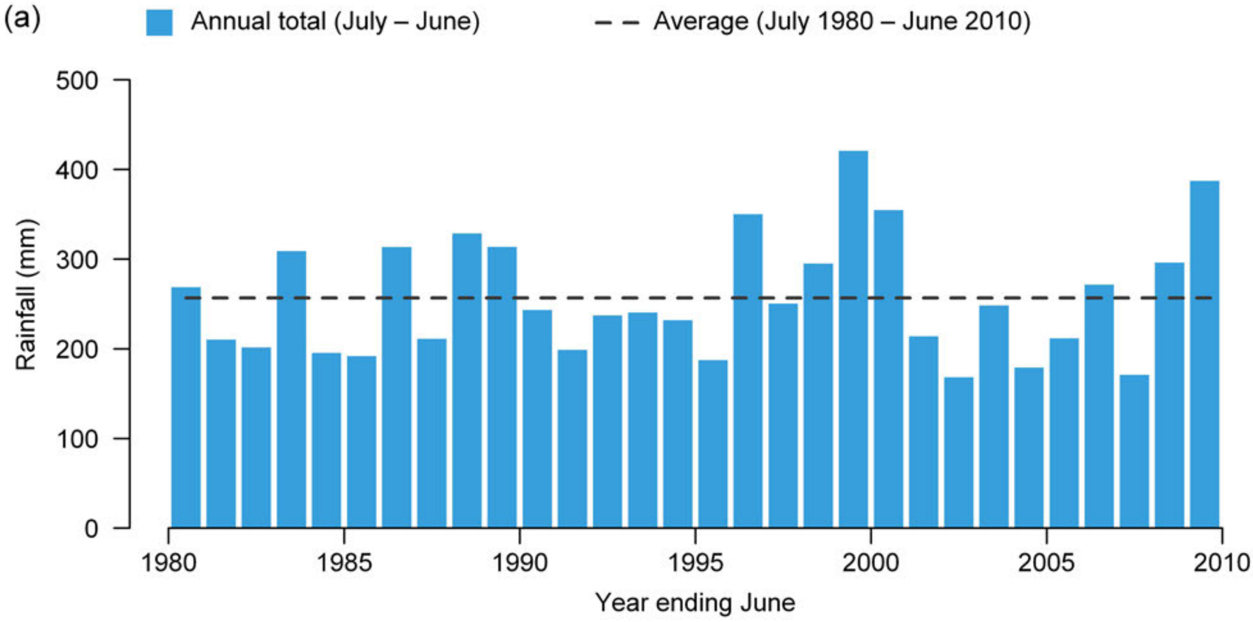


Figure 14-5. Maps of annual rainfall totals in 2009–10 (a) and their decile rankings over the 1911–2010 period (b) for the Lake Eyre Basin region

3. Areas where rainfall interpolation was assessed to be greater than 20 per cent unreliable for any period of the long-term record were excluded from the landscape water balance modelling (classified as 'No data'). More details are presented in the Technical supplement.



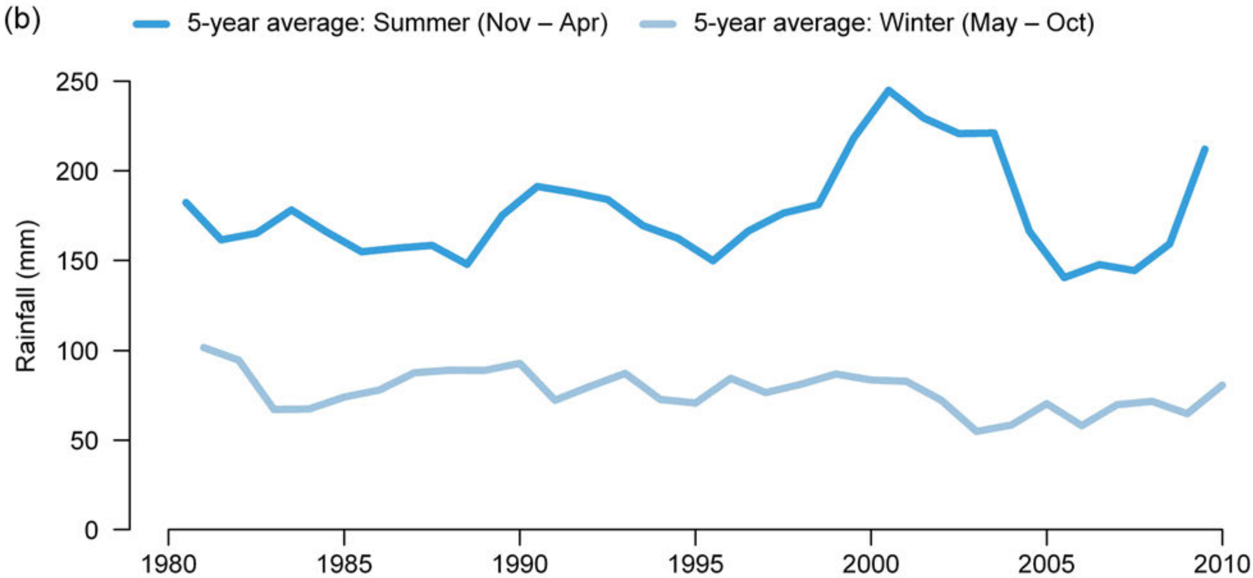


Figure 14-6. Time-series of annual rainfall (a) and five-year (backward looking) moving average of November–April (summer) and May–October (winter) totals (b) for the Lake Eyre Basin region

14.4.1 Rainfall (continued)

Figure 14-7 provides a spatial representation of summer (November–April) and winter (May–October) rainfall trends throughout the region between November 1980 and October 2010. The linear regression slope calculated for each 5 x 5 km grid cell depicts the change in seasonal rainfall over the 30 years.

The summer period rainfall shows generally positive trends across the region, with strongest increases in the north and northeast. Slight negative trends are observed across the south and southwest of the region. The analysis of the winter period rainfall indicates reductions in rainfall across much of the north and east of the region. Slight increasing trends are identified across the centre and west of the region.

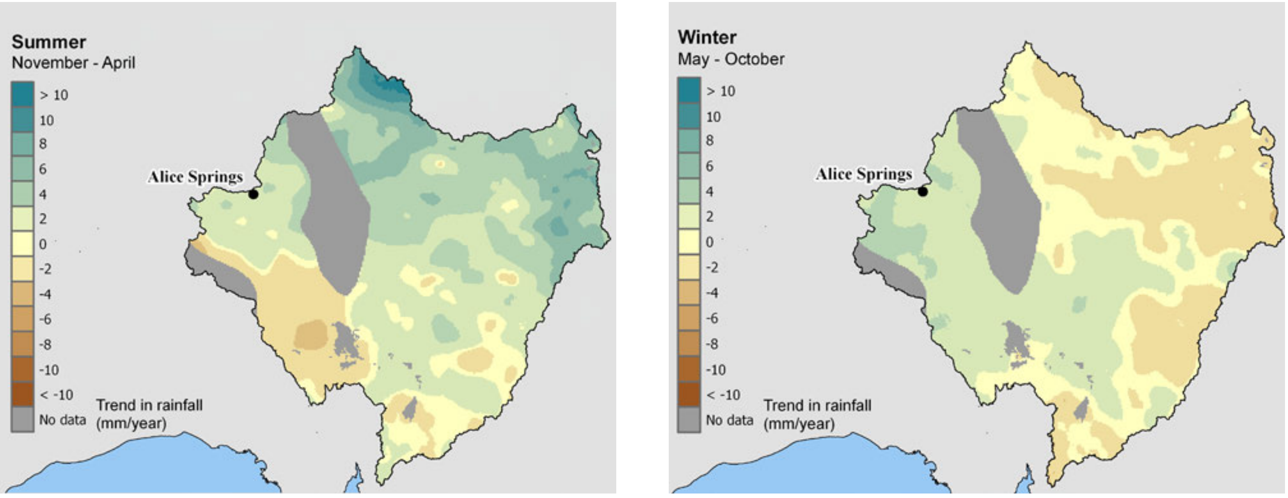


Figure 14-7. Linear trends in summer (November–April) and winter (May–October) rainfall over 30 years (November 1980 to October 2010) for the Lake Eyre Basin region. The statistical significance of these trends is often very low

14.4.2 Evapotranspiration

Evapotranspiration for the Lake Eyre Basin region for 2009–10 was estimated to be 220 mm, which is 16 per cent above the region's long-term (July 1911 to June 2010) average of 190 mm. Figure 14-8 (a) shows that evapotranspiration for 2009–10 has a similar regional distribution to annual rainfall (Figure 14-5 [a]). The highest values were estimated in the wetter north and northeast areas with a generally decreasing gradient from north to south. Evapotranspiration deciles for 2009–10, shown in Figure 14-8 (b), indicate above average levels were experienced across almost the entire region. Very much above average values are estimated across much of the southern half of the region.

Figure 14-9 (a) shows annual evapotranspiration for the past 30 years (July 1980 to June 2010). Over the 30-year period, annual evapotranspiration ranged from 160 mm (1982–83) to 242 mm (2000–01). The annual average for the period was 197 mm. The data show evapotranspiration for the past two years was above the 30-year average following a period of relatively low annual evapotranspiration.

An indication of patterns, trends and variability in the seasonal evapotranspiration over the 30-year period summer (November–April) and winter (May–October) are presented using moving averages in Figure 14-9 (b). Winter period evapotranspiration averages remain relatively consistent over the 30 years, whereas the summer period averages show higher levels of variability, particularly over the second half of the period.

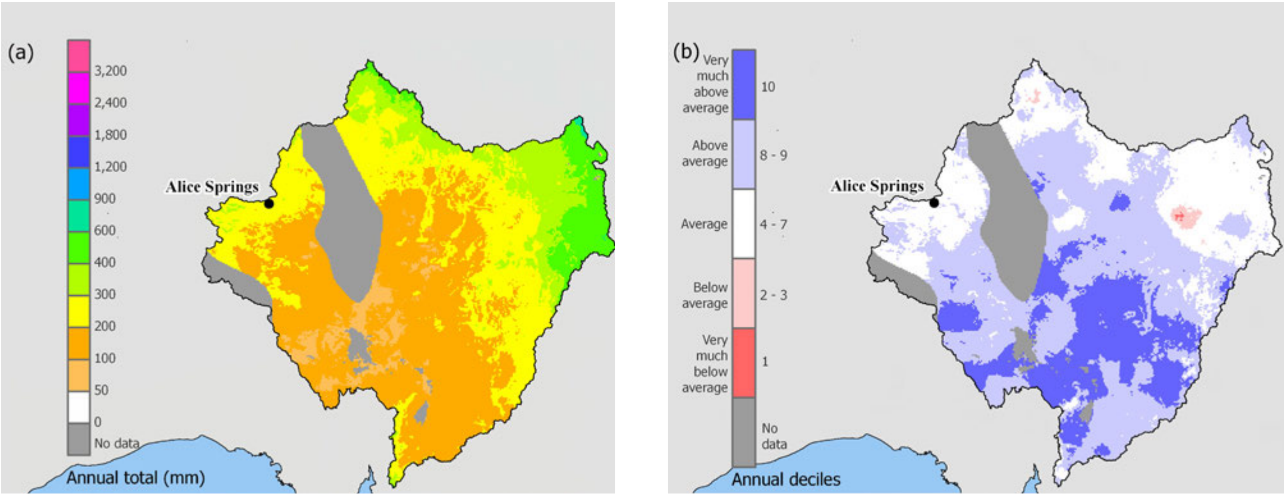
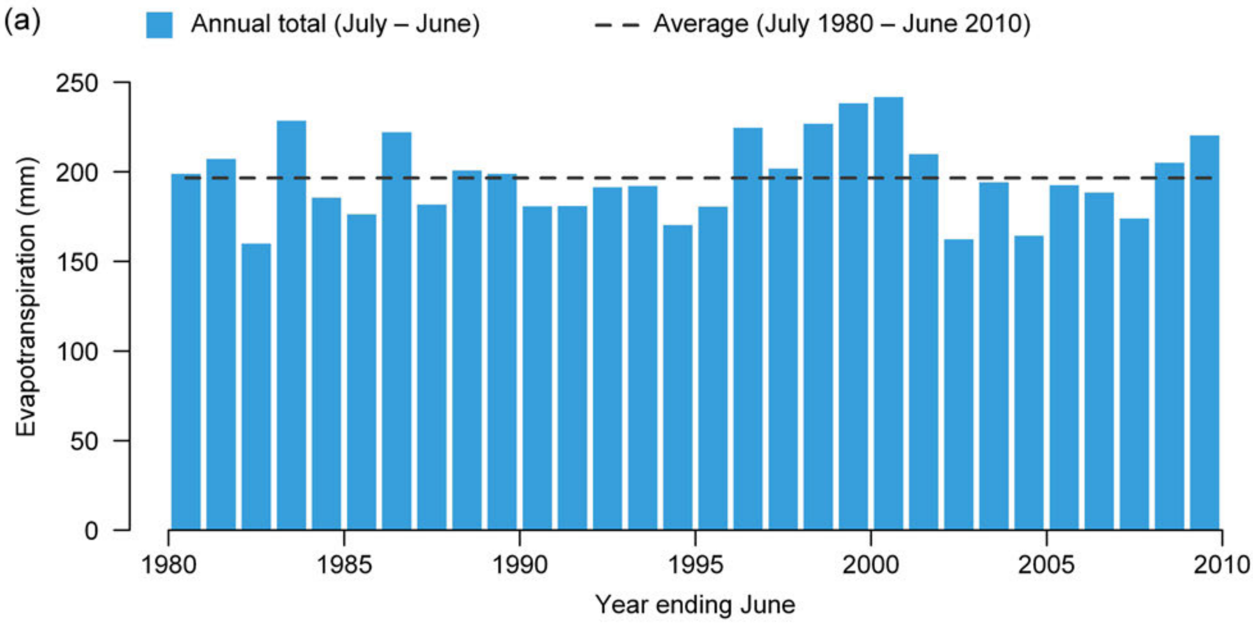


Figure 14-8. Maps of modelled annual evapotranspiration totals in 2009–10 (a) and their decile rankings over the 1911–2010 period (b) for the Lake Eyre Basin region



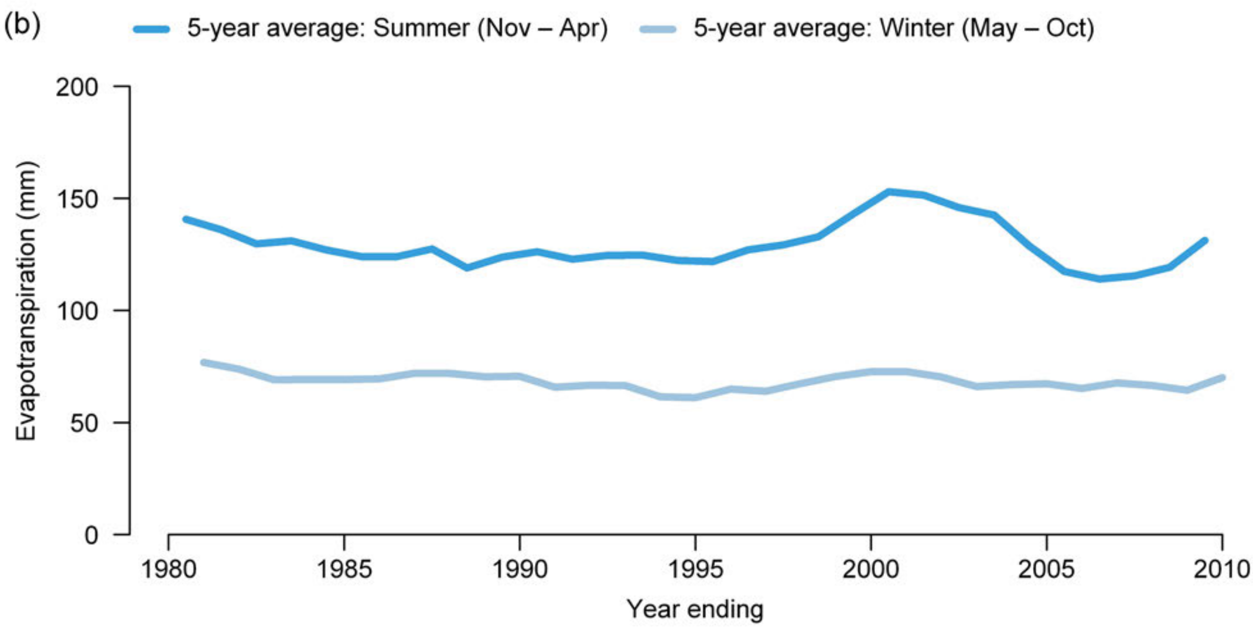


Figure 14-9. Time-series of modelled annual evapotranspiration (a) and five-year (backward looking) moving averages for summer (November–April) and winter (May–October) evapotranspiration (b) for the Lake Eyre Basin region

14.4.2 Evapotranspiration (continued)

Figure 14-10 provides a spatial representation of summer (November–April) and winter (May–October) evapotranspiration trends throughout the region between November 1980 and October 2010. The linear regression slope calculated for each 5 x 5 km grid cell depicts the change in seasonal evapotranspiration over the 30 years.

The summer period analysis indicates very slight increases in evapotranspiration across much of the north of the region with no clearly defined trends across the southern areas. The winter period analysis indicated no trend in evapotranspiration across the region over the 30-year period.

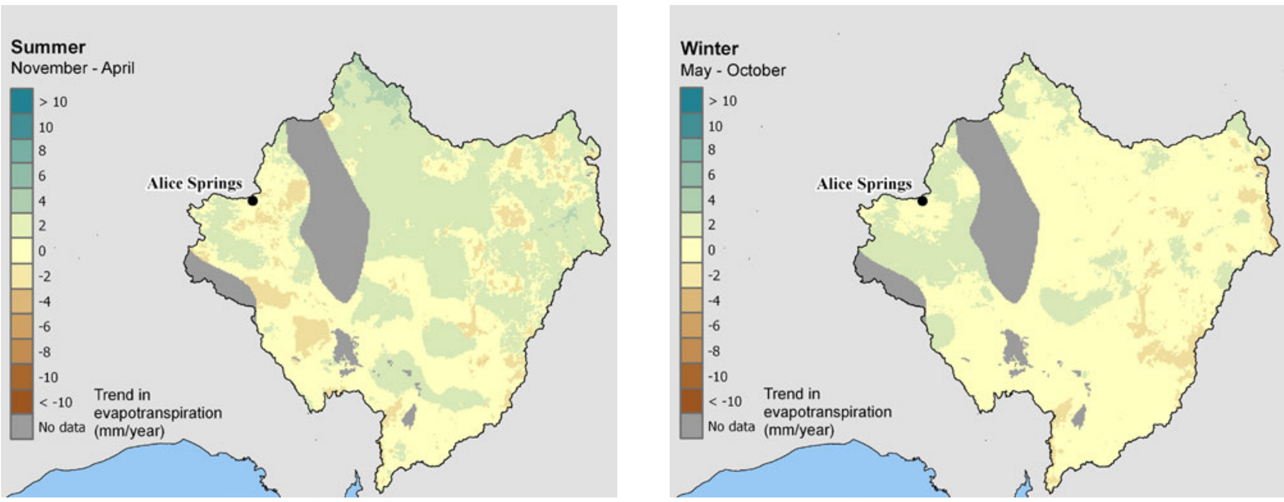


Figure 14-10. Linear trends in modelled summer (November–April) and winter (May–October) evapotranspiration over 30 years (November 1980 to October 2010) for the Lake Eyre Basin region. The statistical significance of these trends is often very low

14.4.3 Landscape water yield

Landscape water yield for the Lake Eyre Basin region for 2009–10 was estimated to be 74 mm, which is 111 per cent above the region's long-term average (July 1911 to June 2010) of 35 mm. Landscape water yield for 2009–10, shown in Figure 14-11 (a), indicates that highest totals were experienced across the centre and northeast of the region. Lower levels are shown across the south of the region. Landscape water yield deciles for 2009–10, shown in Figure 14-11 (b), indicate much of the region experienced average or above average levels of landscape water yield. Very much above average values are observed across a large area in the centre of the region.

Figure 14-12 (a) shows annual landscape water yield for the past 30 years (July 1980 to June 2010). Over the 30-year period, annual landscape water yield ranged from 22 mm (2005–06) to 74 mm (2009–10). The annual average for the period was 40 mm. The graph shows that total landscape water yield for 2009–10 was very much higher than the 30-year average with similarly high totals experienced in 1999–2000 and 2000–01.

An indication of patterns, trends and variability in the seasonal landscape water yield over the 30-year period summer (November–April) and winter (May–October) are presented using moving averages in Figure 14-12 (b). Landscape water yield is consistently higher during the summer period than for the winter. The summer period average exhibits higher levels of variability over the 30-year period. The winter period shows a slight decreasing trend over time.

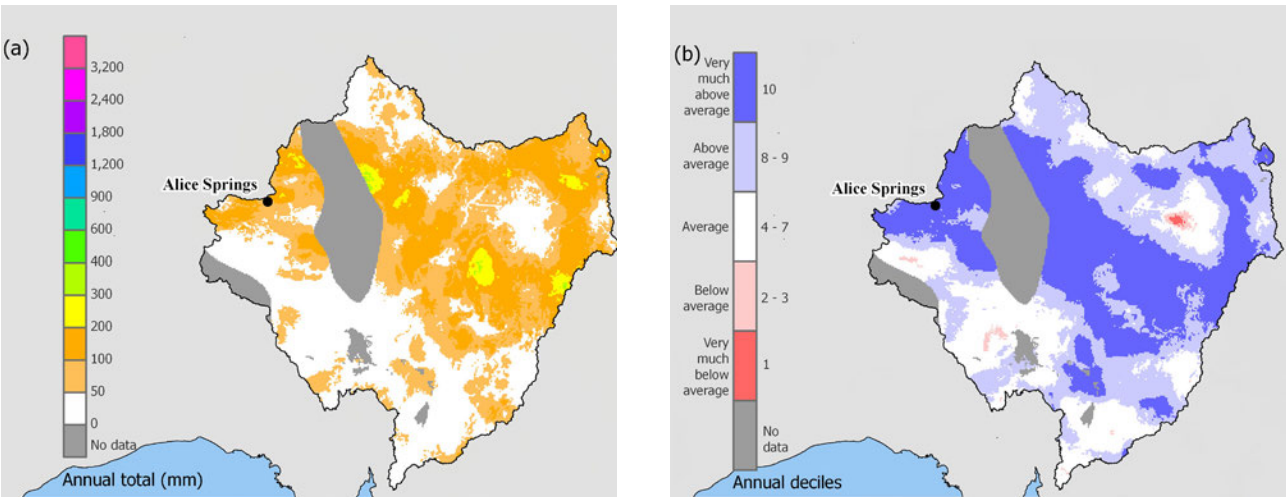
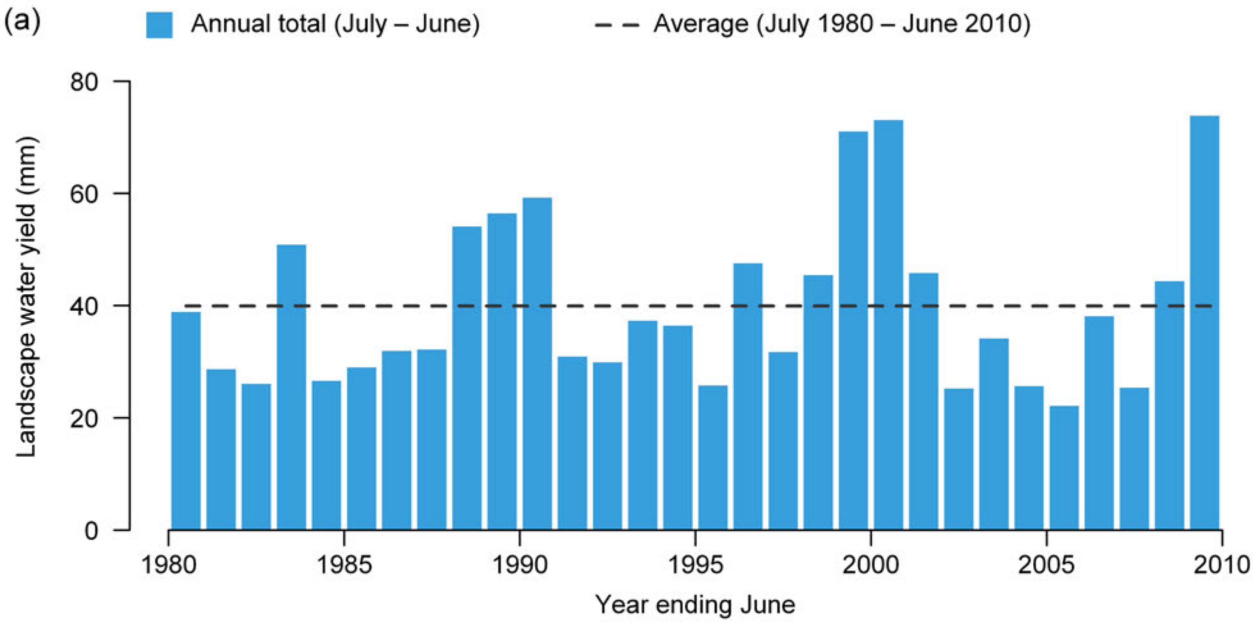


Figure 14-11. Maps of modelled annual landscape water yield totals in 2009–10 (a) and their decile rankings over the 1911–2010 period (b) for the Lake Eyre Basin region



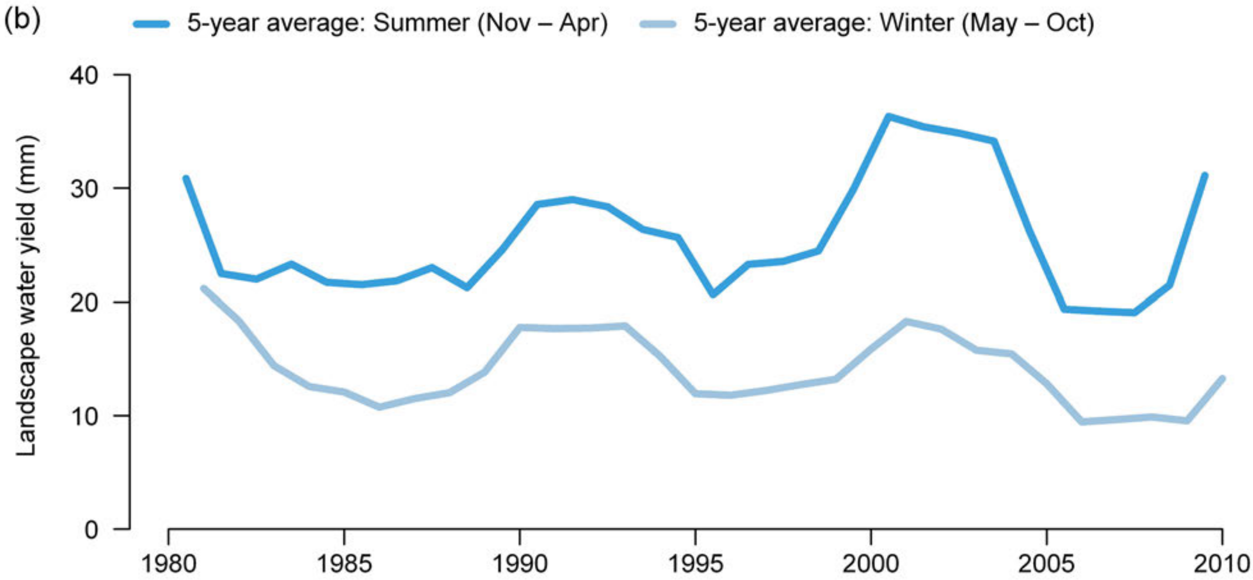


Figure 14-12. Time-series of modelled annual landscape water yield (a) and five-year (backward looking) moving averages for summer (November–April) and winter (May–October) landscape water yield (b) for the Lake Eyre Basin region

Figure 14-13 provides a spatial representation of summer (November–April) and winter (May–October) landscape water yield trends throughout the region between November 1980 and October 2010. The linear regression slope calculated for each 5 x 5 km grid cell depicts the change in seasonal landscape water yield over the 30 years.

The analysis for the summer period shows increases in landscape water yield across the north of the region with decreases apparent across the far south. The winter period shows no clear trends in the region.

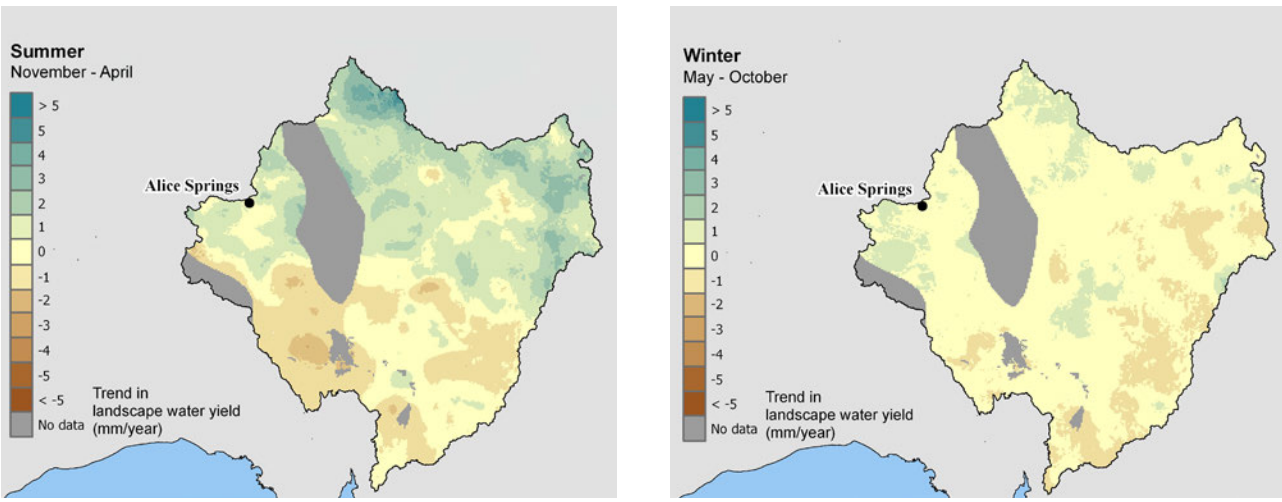


Figure 14-13. Linear trends in modelled summer (November–April) and winter (May–October) landscape water yield over 30 years (November 1980 to October 2010) for the Lake Eyre Basin region. The statistical significance of these trends is often very low