5

PHYSICAL GEOGRAPHY AND CLIMATE OF AUSTRALIA

This chapter is concerned with the physical geography of Australia and Australia's climate. Detailed climatic data for each capital city are included at the end of the chapter.

Geography of Australia

Position and area

Position

Australia comprises a land area of 7,682,300 square kilometres. The land lies between latitudes 10°41′S. (Cape York) and 43°39′S. (South Cape, Tasmania) and between longitudes 113°09′E. (Steep Point) and 153°39′E. (Cape Byron). The most southerly point on the mainland is South Point (Wilson's Promontory) 39°08′S. The latitudinal distance between Cape York and South Point is about 3,180 kilometres, while the latitudinal distance between Cape York and South East Cape, Tasmania, is 3,680 kilometres. The longitudinal distance between Steep Point and Cape Byron is about 4,000 kilometres.

Area of Australia compared with other countries

The area of Australia is almost as great as that of the United States of America (excluding Alaska), about 50 per cent greater than Europe (excluding USSR) and 32 times greater than the United Kingdom. The following table shows the area of Australia in relation to areas of other continents and selected countries.

AREAS OF CONTINENTS AND SELECTED COUNTRIES
('000 square kilometres)

Country	*Area*	*Country*	*Area*
Continental divisions—		Canada	9,976
Europe *(a)*	4,936	China	9,590
Asia *(a)*	27,532	Germany, Federal Republic of	248
USSR (Europe and Asia)	22,402	India	3,288
Africa	30,319	Indonesia	1,919
North and Central America and West Indies	24,247	Japan	372
South America	17,834	Papua New Guinea	462
Oceania	8,504	New Zealand	269
		United Kingdom	244
Country—		United States of America *(b)*	9,363
Australia	7,682		
Brazil	8,512	**Total, land mass excluding Arctic and Antarctic continents**	**135,771**

(a) Excludes USSR, shown below. *(b)* Includes Hawaii and Alaska.

Rivers and lakes

The rivers of Australia may be divided into two major classes, those of the coastal margins with moderate rates of fall and those of the central plains with very slight fall. Of the rivers of the east coast, the longest in Queensland are the Burdekin and the Fitzroy, while the Hunter is the largest coastal river of New South Wales. The longest river system in Australia is the Murray–Darling which drains part of Queensland, the major part of New South Wales and a large part of Victoria, finally flowing into the arm of the sea known as Lake Alexandrina, on the eastern side of the South Australian coast. The length of the Murray is about 2,520 kilometres and the Darling and Upper Darling together are also just over 2,500 kilometres long. The rivers of the north-west coast of Australia, e.g. the Murchison, Gascoyne, Ashburton, Fortescue, De Grey, Fitzroy, Drysdale and Ord, are of considerable size. So also are those rivers in the Northern Territory, e.g. the Victoria and Daly, and those on the Queensland side of the Gulf of Carpentaria, such as the Gregory, Leichhardt, Cloncurry, Gilbert and Mitchell. The rivers of Tasmania have short and rapid courses, as might be expected from the configuration of the country.

There are many types of lake in Australia, the largest being drainage sumps from the internal rivers. In dry seasons these lakes finally become beds of salt and dry mud. The largest are Lake Eyre 9,500 square kilometres, Lake Torrens 5,900 square kilometres and Lake Gairdner 4,300 square kilometres.

Other lake types are glacial, most common in Tasmania; volcanic crater lakes predominantly in Victoria and Queensland; fault angle lakes, of which Lake George near Canberra is a good example and coastal lakes formed by marine damming of valleys.

Area, coastline, tropical and temperate zones, and standard times

The areas of the States and Territories and the length of the coastline were determined in 1973, by the then Division of National Mapping, Department of National Resources, by manually digitising these features from the 1:250,000 map series of Australia. This means that only features of measurable size at this scale were considered. About 60,000 points were digitised at an approximate spacing of 0.5 kilometre. These points were joined by chords as the basis for calculation of areas and coastline lengths by computer.

The approximate high water mark coastline was digitised and included all bays, ports and estuaries which are open to the sea. In these cases, the shoreline was assumed to be where the seaward boundary of the title of ownership would be. In mangroves, the shoreline was assumed to be on the landward side. Rivers were considered in a similar manner but the decisions were rather more subjective, the line being across the river where it appeared to take its true form.

AREA, COASTLINE, TROPICAL AND TEMPERATE ZONES, AND STANDARD TIMES AUSTRALIA

	Estimated area			*Percentage of total area*		*Standard times*	
State or Territory	*Total*	*Percentage of total area*	*Length of coastline*	*Tropical zone*	*Temperate zone*	*Meridian selected*	*Ahead of GMT(a)*
	km²		km				hours
New South Wales	801,600	10.43	1,900	..	100	150°E	*(b)*10.0
Victoria	227,600	2.96	1,800	..	100	150°E	*(b)*10.0
Queensland	1,727,200	22.48	7,400	54	46	150°E	10.0
South Australia	984,000	12.81	3,700	..	100	142°30'E	*(b)*9.5
Western Australia	2,525,500	32.87	12,500	37	63	120°E	8.0
Tasmania	67,800	0.88	3,200	..	100	150°E	*(b)*10.0
Northern Territory	1,346,200	17.52	6,200	81	19	142°30'E	9.5
Australian Capital Territory	2,400	0.03	35	..	100	150°E	*(b)*10.0
Australia	**7,682,300**	**100.00**	**36,735**	**39**	**61**	..	..

(a) Greenwich Mean Time. *(b)* For States with 'daylight saving' an hour should be added for this period.

Climate of Australia

The climate of Australia is predominantly continental but the insular nature of the land mass is significant in producing some modification of the continental pattern.

The island continent of Australia is relatively dry, with 80 per cent of the area having a median rainfall of less than 600 millimetres per year and 50 per cent less than 300 millimetres. Extreme minimum temperatures are not as low as those recorded in other continents because of the absence of extensive mountain masses and because of the expanse of the surrounding oceans. However, extreme maxima are comparatively high, reaching 50°C over the inland, mainly due to the great east–west extent of the continent in the vicinity of the Tropic of Capricorn.

Climatic discomfort, particularly heat discomfort, is significant over most of Australia. During summer, prolonged high temperatures and humidity around the northern coasts and high temperatures over the inland cause physical discomfort. In winter, low temperatures and strong cold winds over the interior and southern areas can be severe for relatively short periods.

Climatic controls

The generally low relief of Australia causes little obstruction to the atmospheric systems which control the climate. A notable exception is the eastern uplands which modify the atmospheric flow.

In the winter half of the year (May–October) anticyclones, or high pressure systems, pass from west to east across the continent and often remain almost stationary over the interior for several days. These anticyclones may extend to 4,000 kilometres along their west–east axes. Northern Australia is then influenced by mild, dry south-east trade winds, and southern Australia experiences cool, moist westerly winds. The westerlies and the frontal systems associated with extensive depressions travelling over the Southern Ocean have a controlling influence on the climate of southern Australia during the winter season, causing rainy periods. Cold outbreaks, particularly in south-east Australia, occur when cold air of Southern Ocean origin is directed northwards by intense depressions having diameters up to 2,000 kilometres. Cold fronts associated with the southern depressions, or with secondary depressions over the Tasman Sea, may produce large day-to-day changes in temperature in southern areas, particularly in south-east coastal regions.

In the summer half of the year (November–April) the anticyclones travel from west to east on a more southerly track across the southern fringes of Australia directing easterly winds generally over the continent. Fine, warmer weather predominates in southern Australia with the passage of each anticyclone. Heat waves occur when there is an interruption to the eastward progression of the anticyclone (blocking) and winds back northerly and later north-westerly. Northern Australia comes under the influence of summer disturbances associated with the southward intrusion of warm moist monsoonal air from north of the inter-tropical convergence zone, resulting in a hot rainy season.

Tropical cyclones develop over the seas around northern Australia in summer between November and April. Their frequency of occurrence and the tracks they follow vary greatly from season to season. On average, about three cyclones per season directly affect the Queensland coast, and about three affect the north and north-west coasts. Tropical cyclones approaching the coast usually produce very heavy rain and high winds in coastal areas. Some cyclones move inland, losing intensity but still producing widespread heavy rainfall. Individual cyclonic systems may control the weather over northern Australia for periods extending up to three weeks.

Rainfall

Annual

The annual 10, 50 and 90 percentile* rainfall maps are shown on Figures 1, 2 and 3 respectively. The area of lowest rainfall is in the vicinity of Lake Eyre in South Australia, where the median (50 percentile) rainfall is only about 100 millimetres. Another very low rainfall area is in Western Australia in the Giles–Warburton Range region, which has a median annual rainfall of about 150 millimetres. A vast region, extending from the west coast near Shark Bay across the interior of Western Australia and South Australia to south-west Queensland and north-west New South Wales, has a median annual rainfall of less than 200 millimetres. This region is not normally exposed to moist air masses for extended periods and rainfall is irregular, averaging only one or two days per month. However, in favourable synoptic situations, which occur infrequently over extensive parts of the region, up to 400 millimetres of rain may fall within a few days and cause widespread flooding.

The region with the highest median annual rainfall is the east coast of Queensland between Cairns and Cardwell, where Tully has a median of 4,048 millimetres (63 years to 1987 inclusive). The mountainous region of western Tasmania also has a high annual rainfall, with Lake Margaret having a median of 3,565 millimetres (76 years to 1987 inclusive). In the mountainous areas of north-east Victoria and some parts of the east coastal slopes there are small pockets with median annual rainfall greater than 2,500 millimetres, but the map scale is too small for these to be shown.

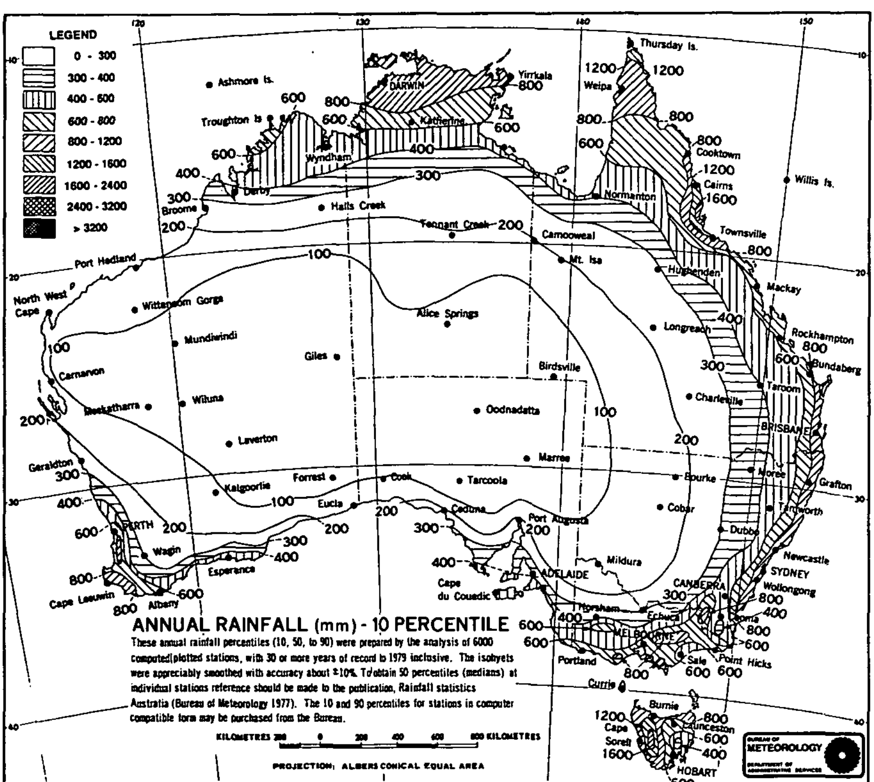


FIGURE 1

*The amounts that are not exceeded by 10, 50 and 90 per cent of all recordings are the 10, 50 and 90 percentiles or the first, fifth and ninth deciles respectively. The 50 percentile is usually called the median.

The Snowy Mountains area in New South Wales also has a particularly high rainfall. The highest median annual rainfall isohyet drawn for this region is 3,200 millimetres, and it is likely that small areas have a median annual rainfall approaching 4,000 millimetres on the western slopes above 2,000 metres elevation.

The following table shows the area distribution of median annual rainfall.

AREA DISTRIBUTION OF MEDIAN ANNUAL RAINFALL: AUSTRALIA
(per cent)

Median annual rainfall	*NSW (a)*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*Aust.*
Under 200 mm	8.0	..	10.2	74.2	43.5	..	15.5	29.6
200 to 300 mm	20.3	6.3	13.0	13.5	29.6	..	35.6	22.9
300 to 400 mm	19.0	19.2	12.3	6.8	10.5	..	9.0	11.2
400 to 500 mm	12.4	11.8	13.5	3.2	4.3	..	6.6	7.6
500 to 600 mm	11.3	14.1	11.6	1.8	3.1	12.2	5.8	6.6
600 to 800 mm	15.1	24.5	20.5	0.5	4.6	18.2	11.6	10.7
800 to 1,200 mm	11.3	17.7	12.6	..	3.7	25.0	9.6	7.7
Above 1,200 mm	2.6	6.4	6.3	..	0.7	44.6	6.3	3.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

(a) Includes Australian Capital Territory.

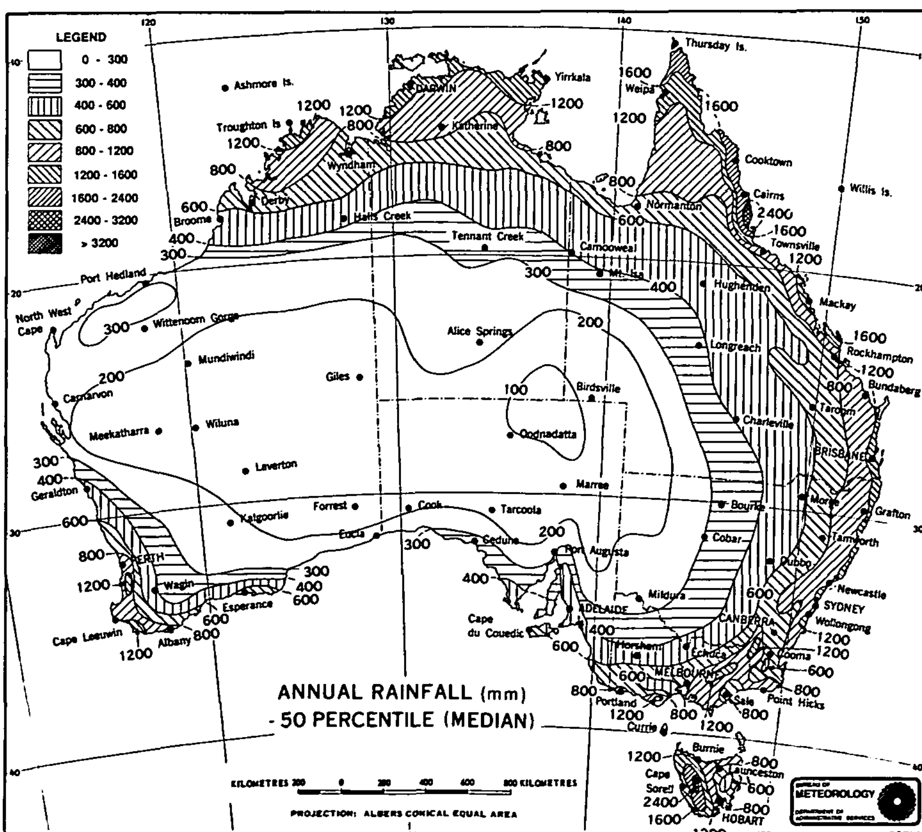


FIGURE 2

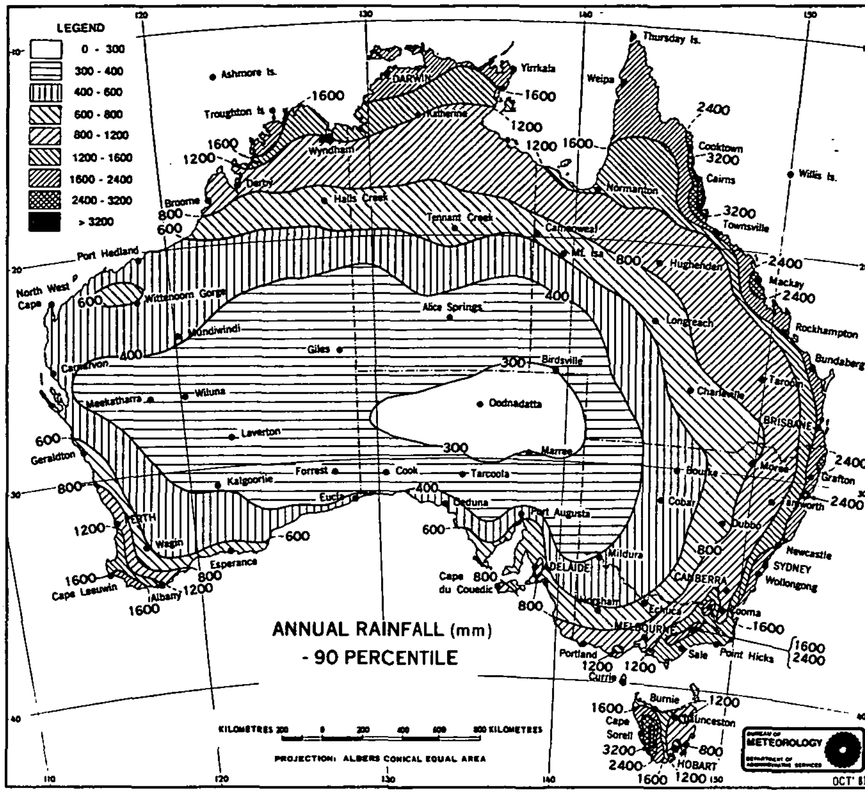


FIGURE 3

Seasonal

As outlined above, the rainfall pattern of Australia is strongly seasonal in character with a winter rainfall regime in the south and a summer regime in the north.

The dominance of rainfall over other climatic elements in determining the growth of specific plants in Australia has led to the development of a climatic classification based on two main parameters. The parameters are median annual rainfall and seasonal rainfall incidence. Figure 4 is a reduced version of the seasonal rainfall zones arising from this classification (*see* Bureau of Meteorology publication *Climatic Atlas of Australia, 1988*).

Evaporation and the concept of rainfall effectiveness are taken into account to some extent in this classification by assigning higher median annual rainfall limits to the summer zones than the corresponding uniform and winter zones. The main features of the seasonal rainfall are:

- marked wet summer and dry winter of northern Australia;
- wet summer and relatively dry winter of south-eastern Queensland and north-eastern New South Wales;
- uniform rainfall in south-eastern Australia—much of New South Wales, parts of eastern Victoria and southern Tasmania;
- marked wet winter and dry summer of south-west Western Australia and, to a lesser extent, much of the remainder of southern Australia directly influenced by westerly circulation;
- arid area comprising about half the continent extending from the north-west coast of Western Australia across the interior and reaching the south coast at the head of the Great Australian Bight.

The seasonal rainfall classification (*Climatic Atlas of Australia, 1988*) can be further reduced to provide a simplified distribution of seven climatic zones as shown in Figure 5.

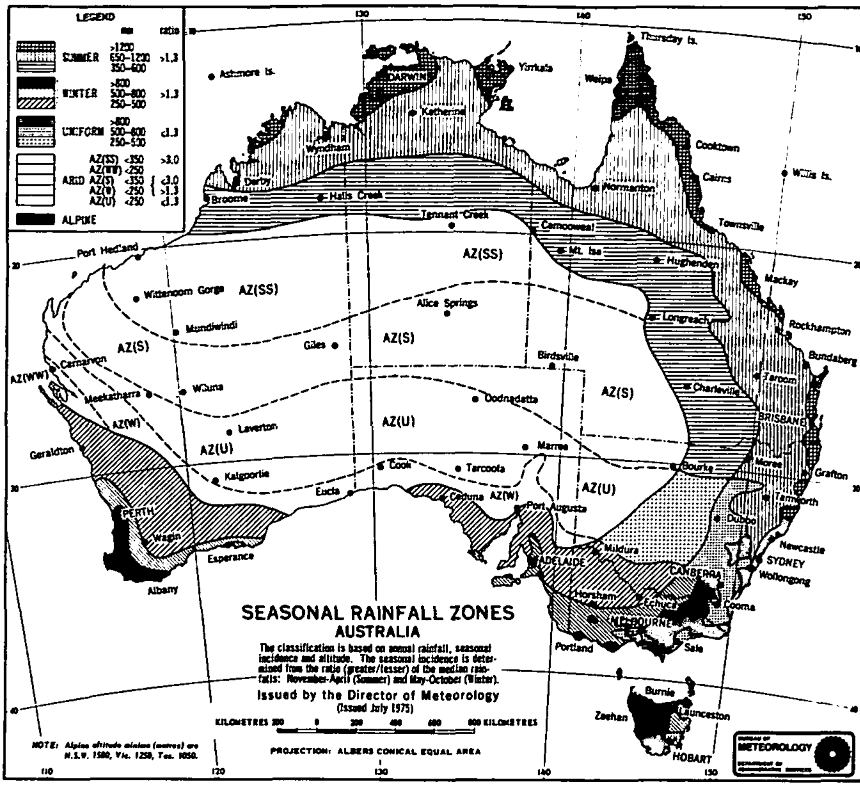


FIGURE 4

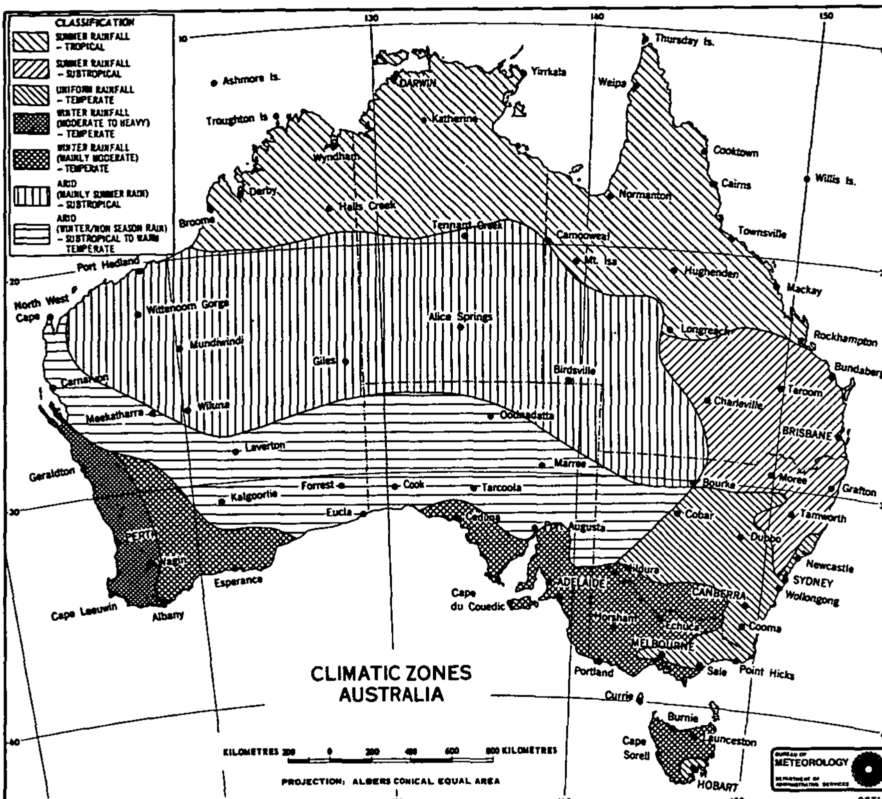
Variability

The adequate presentation of rainfall variability over an extensive geographical area is difficult. Probably the best measures are found in tables compiled for a number of individual stations in some of the Climatic Survey districts. These tables show the percentage chances of receiving specified amounts of rainfall in monthly, seasonal or annual time spans. Statistical indices of rainfall variation based on several techniques have been used to compile maps showing main features of the variability of annual rainfall over Australia.

One index for assessing the variability of annual rainfall is given by the ratio of the 90–10 percentile range to the 50 percentile (median value):

$$\text{i.e. Variability Index} = \left\{ \frac{90\text{–}10}{50} \right\} \text{ percentiles.}$$

Variability based on this relationship (Gaffney 1975 and Lee and Gaffney 1986) is shown in Figure 6. The region of high to extreme variability shown in Figure 6 lies mostly in the arid zones with summer rainfall incidence, AZ (S) defined on Figure 4. In the winter rainfall zones, the variability is generally low to moderate as exemplified by the south-west of Western Australia. In the tropics, random cyclone visitations cause extreme variations in rainfall from year to year: at Onslow (Western Australia), annual totals varied from 15 millimetres in 1912 to 1,085 millimetres in 1961 and, in the four consecutive years 1921 to 1924, the annual totals were 566, 69, 682 and 55 millimetres respectively. At Whim Creek (Western Australia), where 747 millimetres have been recorded in a single day, only 4 millimetres were received in the whole of 1924. Great variability can also occur in the heavy rainfall areas: at Tully (Queensland), the annual rainfalls have varied from 7,898 millimetres in 1950 to 2,486 millimetres in 1961.



CLASSIFICATION	SEASONAL CHARACTERISTICS SUMMER	SEASONAL CHARACTERISTICS WINTER
Summer Rainfall - Tropical	Heavy periodic rains (heavier in coastal & highland areas) Hot generally Humid in coastal areas	Generally rainless Mild to warm Dry
Summer Rainfall - Subtropical	Heavy periodic rains (heavier in coastal & highland areas) Mainly hot Humid in highlands & coastal areas	Some significant rain Mild
Uniform Rainfall - Temperate	Mainly reliable rain Warm to hot	Mainly reliable rain Cool to cold
Winter Rainfall (moderate to heavy) - Temperate	Irregular rain, mostly light Warm to hot	Reliable rain (moderate to heavy) Cool to mild
Winter Rainfall (mainly moderate) - Temperate	Mostly light irregular rain Warm to hot	Reliable rain (mainly moderate) Cool to cold
Arid (mainly summer rain) - Subtropical	Variably rain Hot to extreme Very dry	Mainly irregular light rain Mild to warm Dry
Arid (winter or non-seasonal rain) - Warm Temperate to Subtropical	Very irregular rain Hot to extreme Very dry	Variable rain, mainly light Cool to mild Dry

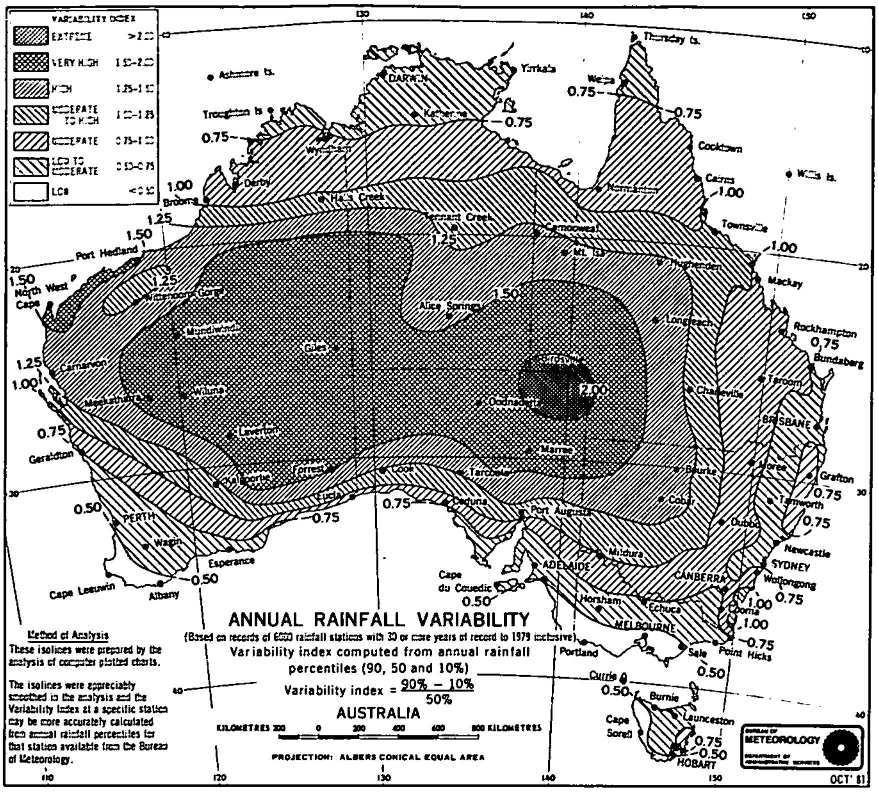
[Reference:- Climatic Atlas of Australia, Map set 5, Bureau of Meteorology 1975]

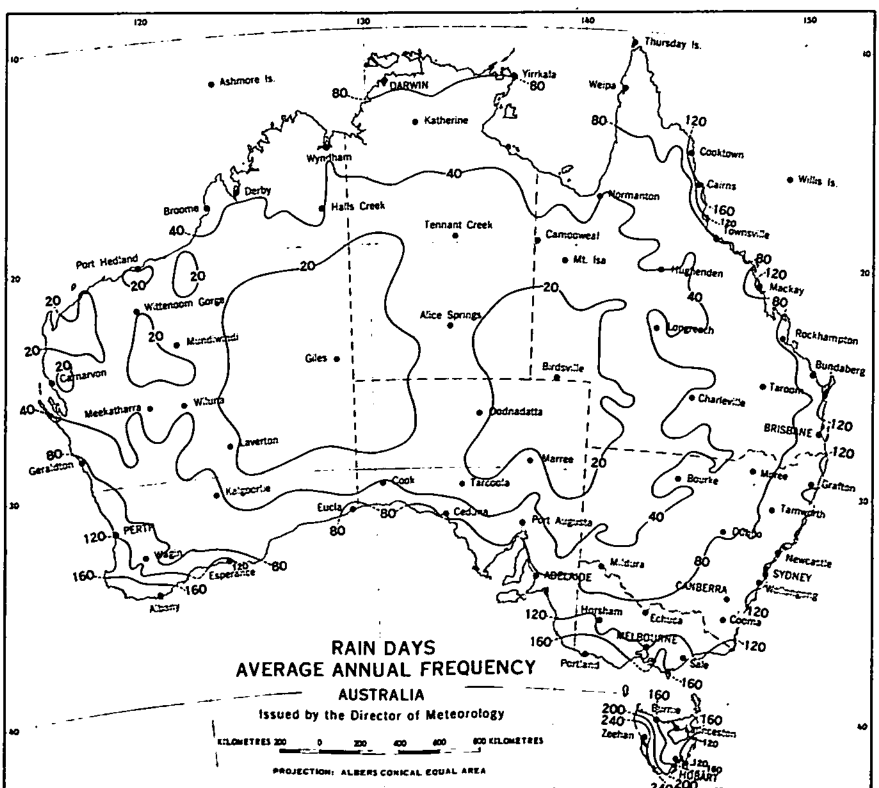
FIGURE 5

Rainday frequency

The average number of days per year with rainfall of 0.2 millimetres or more is shown in Figure 7.

The frequency of raindays exceeds 150 per year in Tasmania (with a maximum of over 200 in western Tasmania), southern Victoria, parts of the north Queensland coast and in the extreme south-west of Western Australia. Over most of the continent the frequency is less than 50 raindays per year. The area of low rainfall with high variability, extending from the north-west coast of Western Australia through the interior of the continent, has less than 25 raindays per year. In the high rainfall areas of northern Australia the number of raindays is about 80 per year, but heavier falls occur in this region than in southern regions.





FIGURES 6 AND 7

Intensity

The highest rainfall intensities for some localities are shown in the table below.

HIGHEST RAINFALL INTENSITIES IN SPECIFIED PERIODS
(millimetres)
(*Source:* **Pluviograph records in Bureau of Meteorology archives)**

Station	*Period of record*	*Years of complete records*	*Period in hours* 1	3	6	12	24
			mm	mm	mm	mm	mm
Adelaide	1897–1979	79	69	133	141	141	141
Alice Springs	1951–1986	36	75	87	108	133	150
Brisbane	1911–1987	77	88	142	182	266	327
Broome	1948–1983	36	112	157	185	313	353
Canberra	1938–1982	37	40	57	67	76	120
Carnarvon	1956–1982	27	44	63	83	95	108
Charleville	1953–1987	35	42	66	75	111	142
Cloncurry	1953–1981	23	59	118	164	173	204
Darwin (Airport)	1953–1987	35	89	138	214	260	291
Esperance	1963–1979	15	23	45	62	68	79
Hobart	1911–1985	75	28	56	87	117	168
Meekatharra	1953–1982	30	33	67	81	99	112
Melbourne	1873–1986	100	76	83	86	97	130
Mildura	1953–1986	34	49	60	65	66	91
Perth	1946–1983	37	31	37	48	64	80
Sydney	1913–1987	71	118	194	200	244	340
Townsville	1953–1987	34	88	158	235	296	319

These figures represent intensities over only small areas around the recording points because turbulence and exposure characteristics of the measuring gauge may vary over a distance of a few metres. The highest 24-hour (9 a.m. to 9 a.m.) falls are listed below. Most of the very high 24-hour falls (above 700 millimetres) have occured in the coastal strip of Queensland, where a tropical cyclone moving close to mountainous terrain provides ideal conditions for spectacular falls.

HIGHEST DAILY RAINFALLS
(All years to date)

State	*Station*	*Date*	*Amount*
			mm
New South Wales	Dorrigo (Myrtle Street)	21.2.1954	809
	Lowanna (Yalamurra)	22.4.1974	662
Victoria	Tanybryn	22.3.1983	375
	Nowa Nowa (Wairawa)	11.3.1906	275
Queensland*	Beerwah (Crohamhurst)	3.2.1893	907
	Finch Hatton PO	18.2.1958	878
South Australia	Stansbury	18.2.1946	222
	WirrabaraForest Reserve	4.6.1978	222
Western Australia	Roebourne (Whim Creek)	3.4.1898	747
	Broome (Kilto)	4.12.1970	635
Tasmania	Cullenswood	22.7.1974	352
	Mathinna	5.4.1929	336
Northern Territory	Roper Valley Station	15.4.1963	544
	Angurugu (Groote Eylandt)	28.3.1953	513

*Note: Bellenden Ker (Top Station) has recorded a 24 hour total of 960 mm from 3 p.m. to 3 p.m. on the 3rd and 4th January 1979. The standard daily rainfall period is 9 a.m. to 9 a.m.

The highest annual rainfalls are listed by State in the following table.

HIGHEST ANNUAL RAINFALLS
(All years to date)

State	*Station*	*Year*	*Amount*
			mm
New South Wales	Tallowood Point	1950	4,540
Victoria	Falls Creek SEC	1956	3,738
Queensland	Bellenden Ker (Top Station)	1979	11,251
South Australia	Aldgate State School	1917	1,852
Western Australia	Armadale (Jarrahdale PO)	1917	2,169
Tasmania	Lake Margaret	1948	4,504
Northern Territory	Elizabeth Downs	1973	2,966

Thunderstorms and hail

A thunder-day at a given location is a calendar day on which thunder is heard at least once. Figure 8 shows isopleths (isobronts) of the average annual number of thunder-days which vary from 74 per year near Darwin to less than 10 per year over parts of the southern regions. Convectional processes during the summer wet season cause high thunderstorm incidence in northern Australia. The generally high incidence of thunder-days (40–60 annually) over the eastern upland areas is caused mainly by orographic uplift of moist air streams.

Hail, mostly of small size (less than 10 millimetres diameter), occurs with winter–spring cold frontal activity in southern Australia. Summer thunderstorms, particularly over the uplands of eastern Australia, sometimes produce large hail (greater than 10 millimetres diameter). Hail capable of piercing light gauge galvanised iron occurs at irregular intervals and sometimes causes widespread damage.

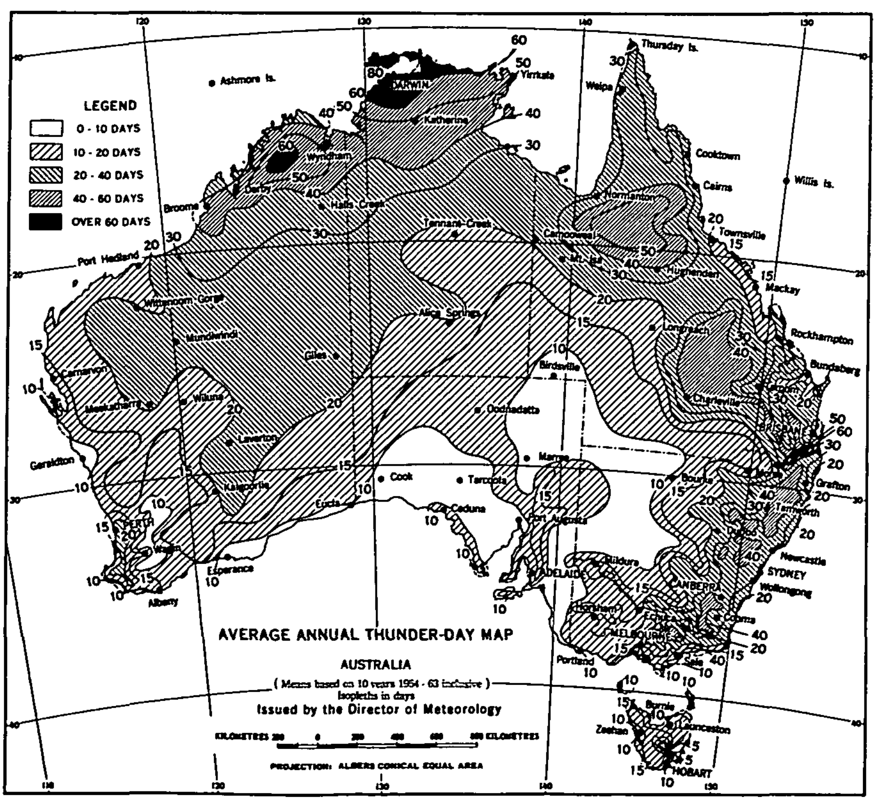


FIGURE 8

Snow

Generally, snow covers much of the Australian Alps above 1,500 metres for varying periods from late autumn to early spring. Similarly, in Tasmania the mountains are covered fairly frequently above 1,000 metres in these seasons. The area, depth and duration are highly variable. No snow falls in the altitude range of 500-1,000 metres in some years. Snowfalls at levels below 500 metres are occasionally experienced in southern Australia, particularly in the foothill areas of Tasmania and Victoria, but falls are usually light and short lived. In some seasons, parts of the eastern uplands above 1,000 metres from Victoria to south-eastern Queensland have been covered with snow for several weeks. In ravines around Mount Kosciusko (2,228 metres) small areas of snow may persist through summer but there are no permanent snowfields.

Temperature

Average temperatures

Average annual air temperatures, as shown in Figure 9, range from 28°C along the Kimberley coast in the extreme north of Western Australia to 4°C in the alpine areas of south-eastern Australia. Although annual temperature may be used for broad comparisons, monthly temperatures are required for detailed analyses.

July is the month with the lowest average temperature in all parts of the continent. The months with the highest average temperature are January or February in the south and December in the north (except in the extreme north and north-west where it is November). The slightly lower temperatures of mid summer in the north are due to the increase in cloud during the wet season.

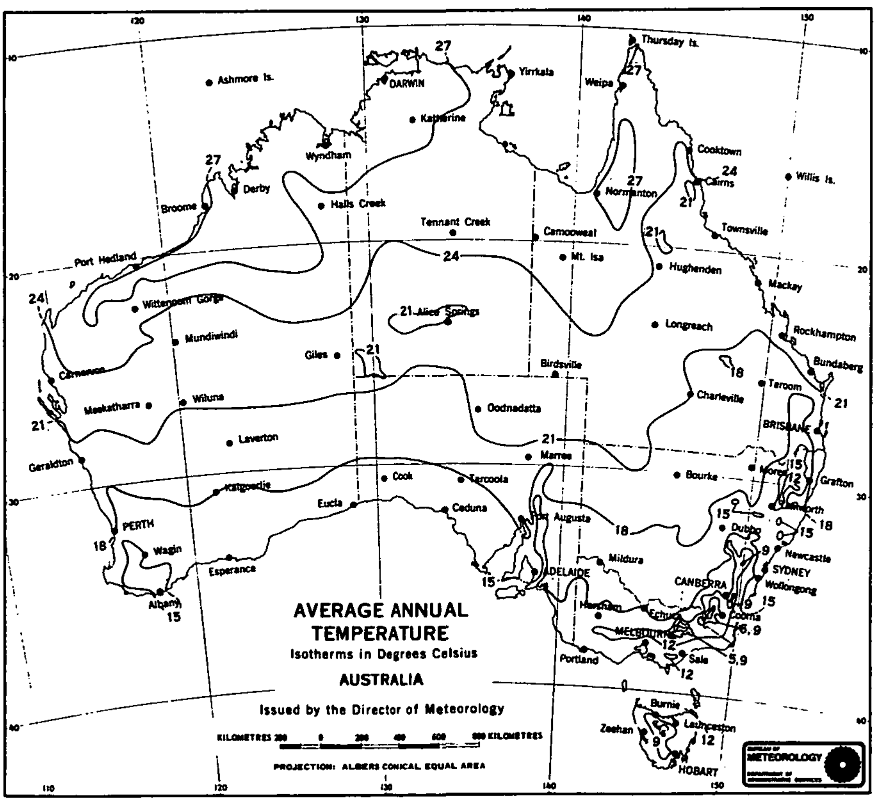


FIGURE 9

Average monthly maxima

Maps of average maximum and minimum temperatures for the months of January and July are shown in Figures 10 to 13 inclusive.

In January, average maximum temperatures exceed 35°C over a vast area of the interior and exceed 40°C over appreciable areas of the north-west. The consistently hottest part of Australia in terms of summer maxima is around Marble Bar in Western Australia (150 kilometres south-east of Port Hedland) where the average is 41°C and daily maxima during summer may exceed 40°C consecutively for several weeks at a time.

The marked gradients of isotherms of maximum temperature in summer in coastal areas, particularly along the south and west coasts, are due to the penetration inland of fresh sea breezes initiated by the sharp temperature discontinuities between the land and sea surfaces. There are also gradients of a complex nature in south-east coastal areas caused primarily by the uplands.

In July, a more regular latitudinal distribution of average maxima is evident. Maxima range from 30°C near the north coast to 5°C in the alpine areas of the south-east.

Average monthly minima

In January, average minima range from 27°C on the north-west coast to 5°C in the alpine areas of the south-east. In July, average minima fall below 5°C in areas south of the tropics (away from the coasts). Alpine areas record the lowest temperatures; the July average is as low as -5°C.

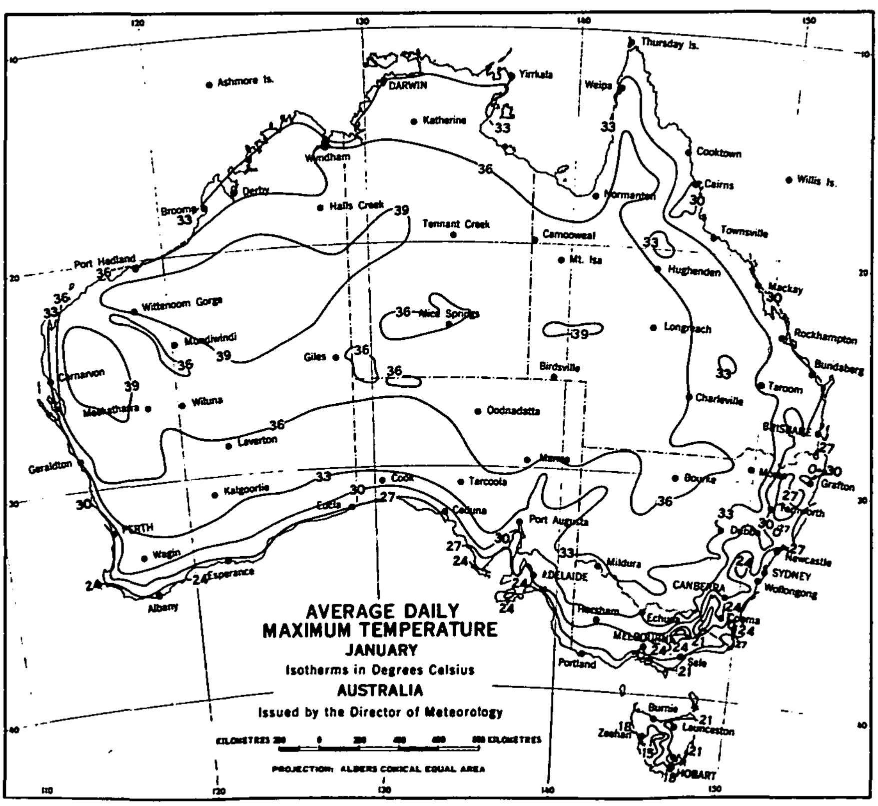
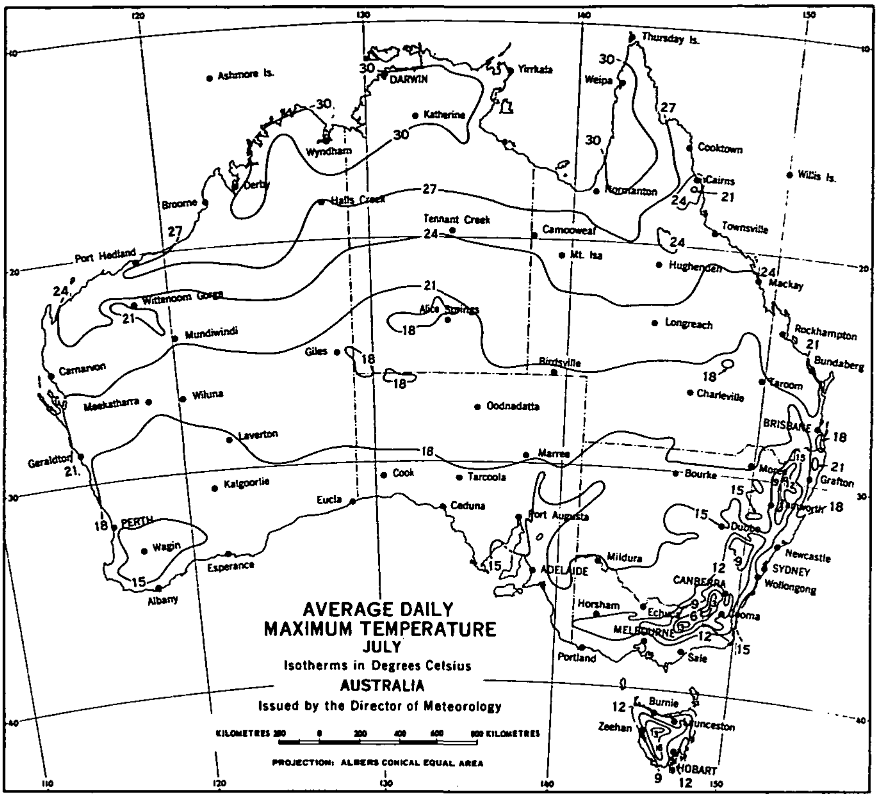
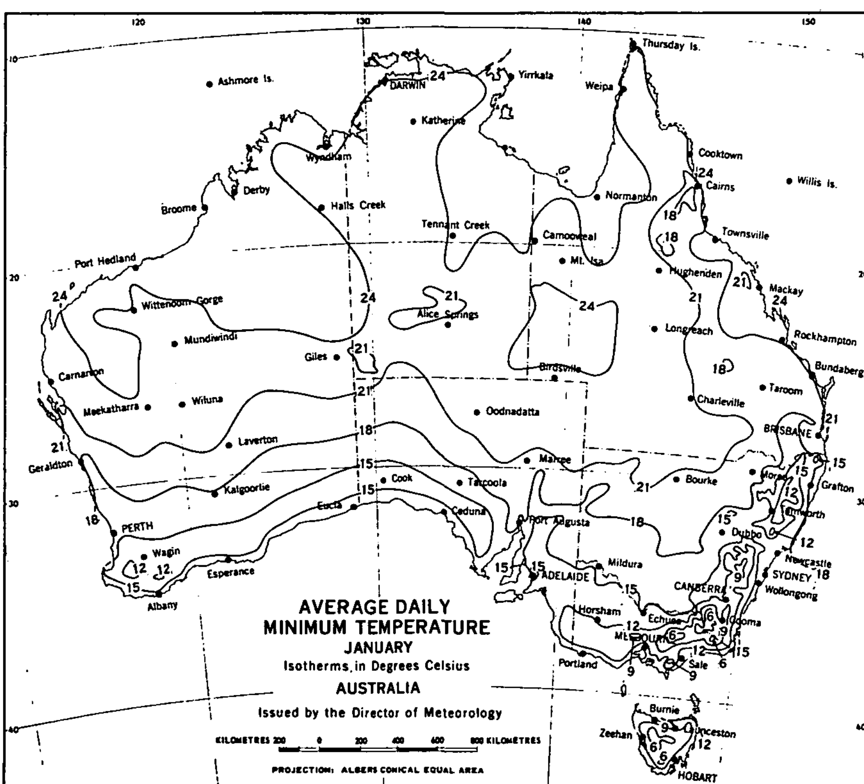


FIGURE 10





FIGURES 11 AND 12

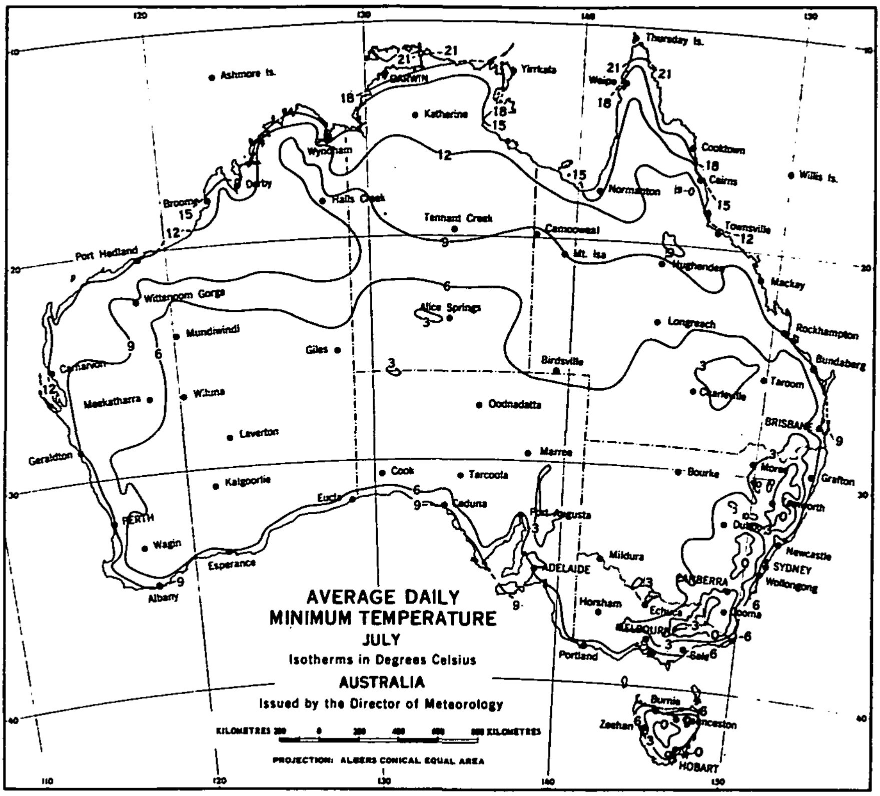


FIGURE 13

Extreme maxima

Temperatures have exceeded 45°C at nearly all inland stations more than 150 kilometres from the coast and at many places on the north-west and south coasts. Temperatures have exceeded 50°C at some inland stations and at a few near the coast. It is noteworthy that Eucla on the south coast has recorded 50.7°C, the highest temperature in Western Australia. This is due to the long trajectory over land of hot north-west winds from the Marble Bar area. Although the highest temperature recorded in Australia was 53.1°C at Cloncurry (Queensland), more stations have exceeded 50°C in western New South Wales than in other areas due to the long land trajectory of hot winds from the north-west interior of the continent.

Extreme maximum temperatures recorded at selected stations, including the highest recorded in each State, are shown in the following table.

EXTREME MAXIMUM TEMPERATURES
(All years to date)

Station	*°C*	*Date*	*Station*	*°C*	*Date*
New South Wales—			Western Australia—		
Bourke	52.8	17.1.1877	Eucla	50.7	22.1.1906
Wilcannia	50.0	11.1.1939	Mundrabilla	49.8	3.1.1979
Menindee	49.7	10.1.1939	Forrest	49.8	13.1.1979
Victoria—			Madura	49.4	7.1.1971
Mildura	50.8	6.1.1906	Tasmania—		
Swan Hill	49.4	18.1.1906	Bushy Park	40.8	26.12.1945
Queensland—			Hobart	40.8	4.1.1976
Cloncurry	53.1	16.1.1889	Northern Territory—		
Winton	50.7	14.12.1888	Finke	48.3	2.1.1960
Birdsville	49.5	24.12.1972	Jervois	47.5	3.1.1978
South Australia—			Australian Capital Territory—		
Oodnadatta	50.7	2.1.1960	Canberra (Acton)	42.8	11.1.1939
Marree	49.4	2.1.1960			
Whyalla	49.4	2.1.1960			

Extreme minima

The lowest temperatures in Australia have been recorded in the Snowy Mountains, where Charlotte Pass (elevation 1,760 metres) has recorded –22.2°C on 14 July 1945 and 22 August 1947. Temperatures have fallen below –5°C at most inland places south of the tropics and at some places within a few kilometres of southern coasts. At Eyre, on the south coast of Western Australia, a minimum temperature of –4.3°C has been recorded, and at Swansea, on the east coast of Tasmania, the temperature has fallen as low as –5.0°C.

In the tropics, extreme minima below 0°C have been recorded at many places away from the coasts—as far north as Herberton, Queensland (–5.0°C). Even very close to the tropical coastline, temperatures have fallen to 0°C, a low recording being –0.8°C for Mackay.

The next table shows extreme minimum temperatures recorded at specified stations, including the lowest recorded in each State.

EXTREME MINIMUM TEMPERATURES
(All years to date)

Station	*°C*	*Date*	*Station*	*°C*	*Date*
New South Wales—			Western Australia—		
Charlotte Pass	–22.2	14.7.1945	Booylgoo	–6.7	12.7.1969
		22.8.1947	Wandering	–5.7	1.6.1964
Kiandra	–20.6	2.8.1929	Tasmania—		
Perisher Valley	–19.5	23.7.1979	Shannon	–13.0	30.6.1983
Victoria—			Butlers Gorge	–13.0	30.6.1983
Mount Hotham	–12.8	13.8.1947	Tarraleah	–13.0	30.6.1983
Omeo	–11.7	15.6.1965	Northern Territory—		
Hotham Heights	–11.1	15.8.1968	Alice Springs	–7.5	12.7.1976
Queensland—			Tempe Downs	–6.9	24.7.1971
Stanthorpe	–11.0	4.7.1895	Australian Capital Territory—		
Warwick	–10.6	12.7.1965	Gudgenby	–14.6	11.7.1971
Mitchell	–9.4	15.8.1979			
South Australia—					
Yongala	–8.2	20.7.1976			
Yunta	–7.7	16.7.1976			
Ernabella	–7.6	19.7.1983			

Heat waves

Periods with a number of successive days having a temperature higher than 40°C are relatively common in summer over parts of Australia. With the exception of the north-west coast of Western Australia, however, most coastal areas rarely experience more than three successive days of such conditions. The frequency increases inland, and periods of up to ten successive days have been recorded at many inland stations. This figure increases in western Queensland and north-west Western Australia to more than twenty days in places. The central part of the Northern Territory and the Marble Bar–Nullagine area of Western Australia have recorded the most prolonged heat waves. Marble Bar is the only station in the world where temperatures of more than 37.8°C (100°F) have been recorded on as many as 161 consecutive days (30 October 1923–7 April 1924).

Heat waves are experienced in the coastal areas from time to time. During 11–14 January 1939, for example, a severe heat wave affected south-eastern Australia: Adelaide had a record of 47.6°C on the 12th, Melbourne a record of 45.6°C on the 13th and Sydney a record of 45.3°C on the 14th.

The Kimberley district of Western Australia is the consistently hottest part of Australia in terms of annual average maximum temperature. Wyndham, for example, has an annual average maximum of 35.6°C.

Frost

Frost can cause serious losses of agricultural crops, and numerous climatic studies have been made in Australia relating to specific crops cultivated in local areas.

Under calm conditions, overnight temperatures at ground level are often as much as 5°C lower than those measured in the instrument screen (base height 1.1 metre) and differences of 10°C have been recorded. Only a small number of stations measure minima at ground level, the lowest recordings being –15.1°C at Canberra and –11.0°C at Stanthorpe (Queensland). Lower readings may be recorded in alpine areas.

Frost frequency depends on location and orography, and even on minor variations in the contour of the land. The parts of Australia which are most subject to frost are the eastern uplands from north-eastern Victoria to the western Darling Downs in southern Queensland. Most stations in this region experience more than ten nights a month with readings of 0°C (or under) for three to five months of the year. On Tasmania's Central Plateau similar conditions occur for three to six months of the year. Frosts may occur within a few miles of the coasts except in the Northern Territory and most of the north Queensland coasts.

Regions in which frosts may occur at any time of the year comprise most of Tasmania, large areas of the tablelands of New South Wales, much of inland Victoria, particularly the north-east, and a small part of the extreme south-west of Western Australia. Over most of the interior of the continent, and on the highlands of Queensland as far north as the Atherton Plateau, frosts commence in April and end in September. Minimum temperatures below 0°C are experienced in most of the subtropical interior in June and July.

The length of the frost period for the year is taken as the number of days between the first and last recording of an air temperature of 2°C or less. The median duration of the frost period in days per year is shown in Figure 14.

The median frost period over the continent varies from over 200 days per year in the south-eastern uplands areas south of the Hunter Valley, to zero days in nothern Australia. In the southern regions of the continent, the annual frost period generally decreases from about 100 days inland to below 50 days towards the coast. However, there are appreciable spatial variations depending mainly on local orography. In Tasmania the frost period exceeds 300 days on the uplands and decreases to 100 days near the coast.

More strictly, a frost is taken as corresponding to a minimum screen temperature of 2.2°C or less. A light frost is said to occur when the screen minimum temperature is greater than 0°C but less than or equal to 2.2°C. A heavy frost corresponds to a minimum temperature of 0°C or less.

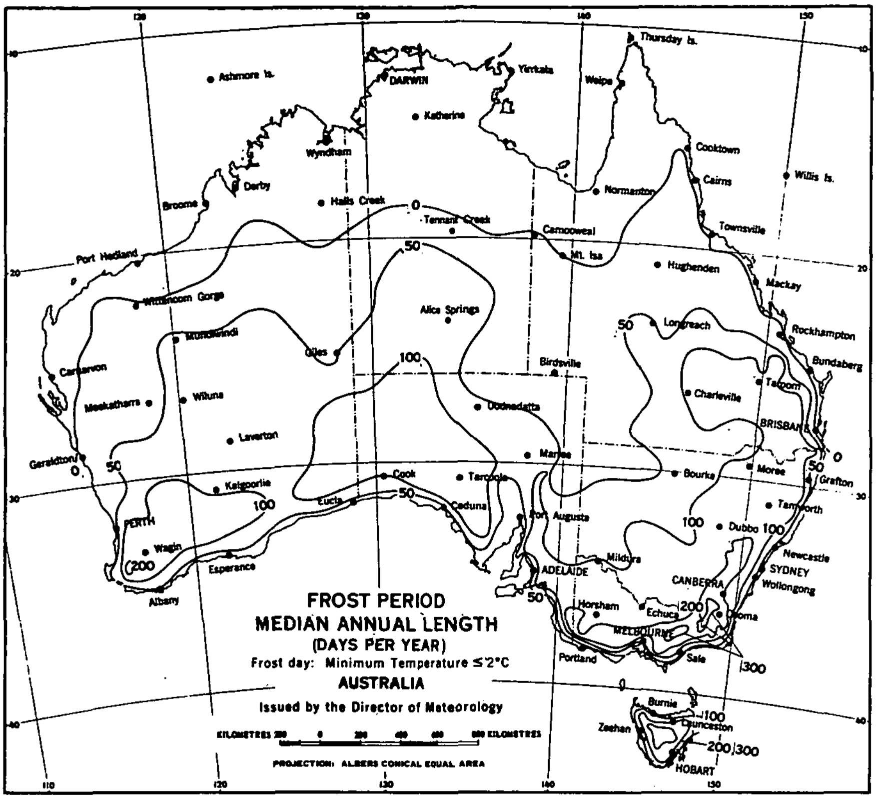


FIGURE 14

The table below includes the average annual frequency of minima of 2.2°C or less for a wide selection of stations, particularly those prone to frosts. These data show the high spatial variability of frost frequency across Australia. The south-eastern alpine areas, as represented by Kiandra (elevation 1,400 metres), have a frequency exceeding 200. At Kalgoorlie the average annual frequency is 20.4 days, at Alice Springs 32.7, Charleville 32.3, Canberra 101.1 and Essendon Airport (Melbourne) 14.2.

FROST FREQUENCY

Station	*Period of record*	*Altitude (metres)*	*Average number of frosty nights ≤2.2°C*	*Average number of heavy frosts ≤0°C*
Adelaide Airport	1956–85	6.0	6.2	0.9
Alice Springs	1942–85	545.0	32.7	11.9
Ballan	1957–68	442.0	62.3	20.5
Birdsville	1957–83	43.0	4.7	0.4
Brisbane Airport	1950–85	6.0	0.2	0.0
Canberra Airport	1940–85	571.0	101.1	63.6
Ceduna Airport	1943–85	24.0	18.4	4.2
Charleville Airport	1943–85	306.0	32.3	12.9
Essendon Airport (Melbourne)	1940–70	86.0	14.2	2.6
Hobart	1949–85	55.2	17.1	1.7
Kalgoorlie Airport	1943–84	360.0	20.4	4.6
Kiandra	1957–68	1,395.4	228.3	176.7
Mount Gambier Airport	1943–85	63.0	26.0	6.9
Perth Airport	1945–86	20.0	2.8	0.1
Walgett	1957–84	131.0	23.3	5.7

The regions of mainland Australia most prone to heavy frosts are the eastern uplands and adjacent areas extending from Victoria through New South Wales to south-eastern Queensland. Stations above 1,000 metres in altitude in the southern parts of these uplands have more than 100 heavy frosts annually, and in the upland areas below 1,000 metres the annual frequency ranges from 100 to about 20. Over the remainder of southern Queensland, New South Wales and Victoria, although there are great spatial variations, the average annual frequency of heavy frosts typically ranges from about 20 inland to 10 towards the coast.

In Tasmania, uplands above 1,000 metres have more than 100 heavy frosts annually and, in neighbouring areas, the frequency is about 100 decreasing to 20 towards the coasts. Even some coastal stations have a relatively high frequency (Swansea, for example, has 15.7).

The southern half of Westen Australia, the whole of South Australia, and the Alice Springs district of the Northern Territory experience heavy frosts. Differences in annual frequencies between places are great but in general the frequency is about 10 inland decreasing towards the coasts. Some places average more than 20 heavy frosts annually, notably Wandering, Western Australia (21.5) and Yongala, South Australia (41.8). At Alice Springs the annual average frequency is 11.9.

Humidity

Australia is a dry continent in terms of the water vapour content or humidity of the air and this element may be compared with evaporation to which it is related. Humidity is measured at Bureau of Meteorology observational stations by a pair of dry and wet bulb thermometers mounted in a standard instrument screen. These measurements enable moisture content to be expressed by a number of parameters, the most commonly known being relative humidity.

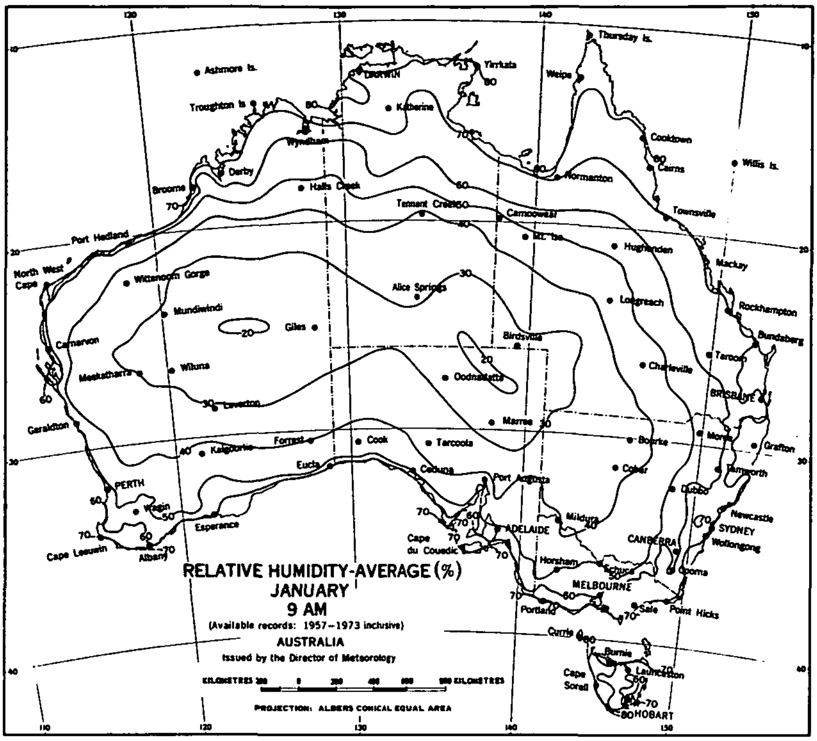
Relative humidity at a given temperature is the ratio (expressed as a percentage) of actual vapour pressure to the saturated vapour pressure at that temperature. As a single measure of human discomfort, relative humidity is of limited value because it must be related to the temperature at the time.

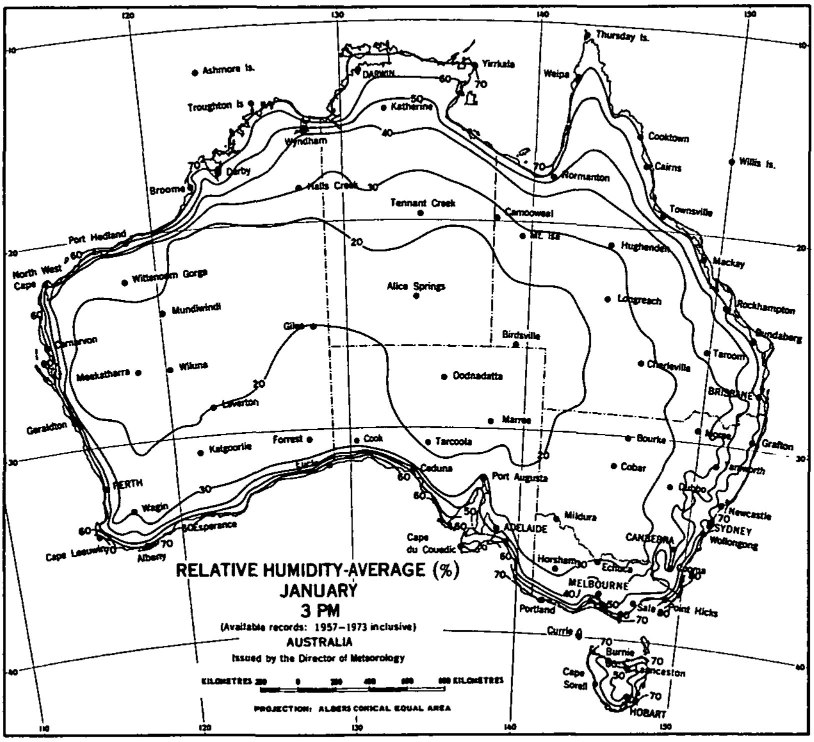
Since the temperature at 9 a.m. approximates the mean temperature for the day (24 hours), the relative humidity at 9 a.m. may be taken as an estimate of the mean relative humidity for the day. Relative humidity at 3 p.m. occurs around the warmest part of the day on the average and is representative of the lowest daily values.

Relative humidity isopleths for January and July at 9 a.m. and 3 p.m. shown in Figures 15–18 are extracted from the *Climatic Atlas of Australia, 1988.*

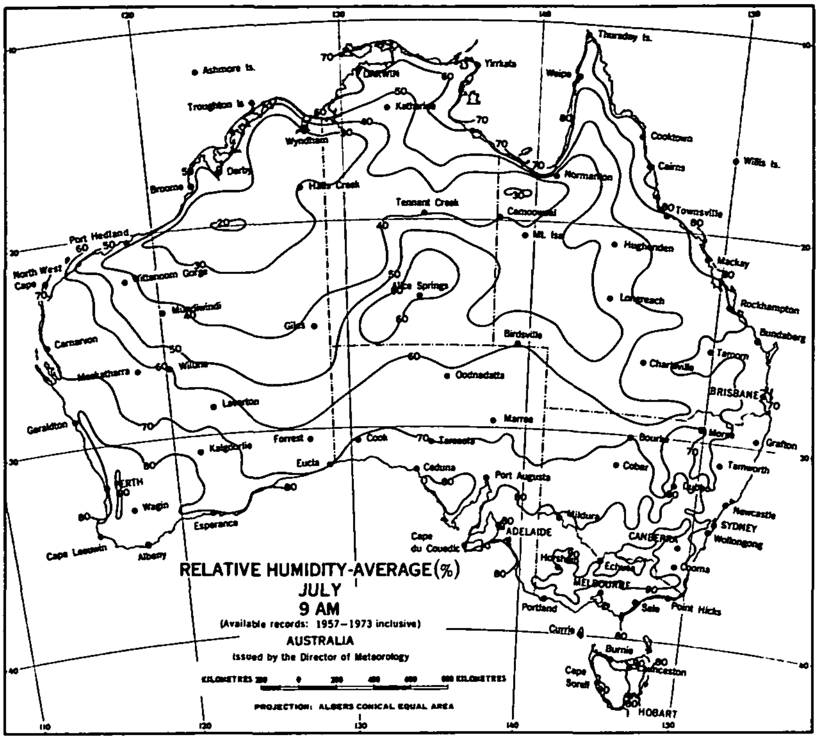
The main features of the relative humidity pattern are:

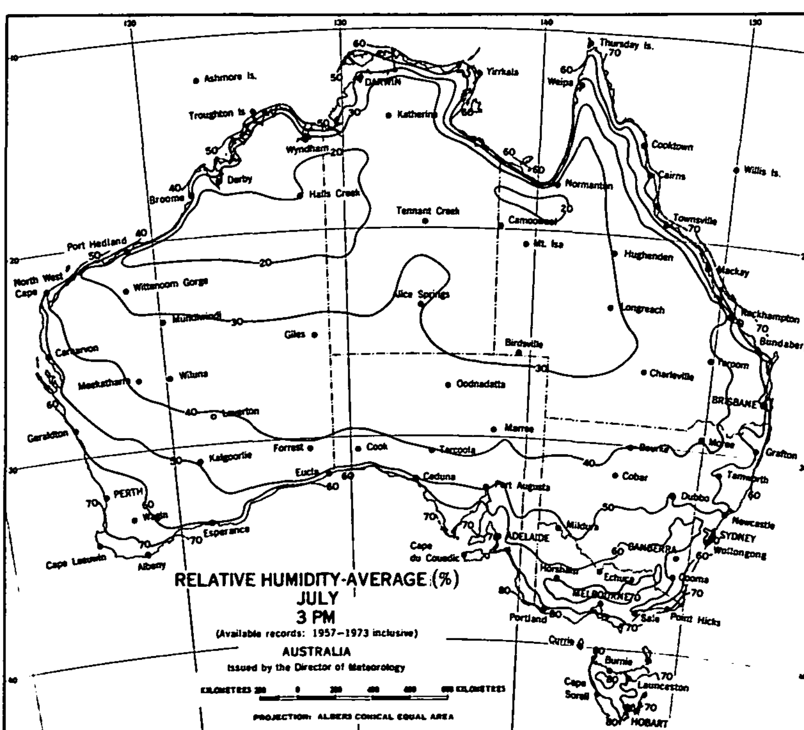
- over the interior of the continent there is a marked dryness during most of the year, notably towards the northern coast in the dry season (May–October);
- the coastal fringes are comparatively moist, although this is less evident along the north-west coast of Western Australia where continental effects are marked;
- in northern Australia, the highest values occur during the summer wet season (December–February) and the lowest during the winter dry season(June–August);
- in most of southern Australia the highest values are experienced in the winter rainy season (June–August) and the lowest in summer (December–February)





FIGURES 15 AND 16





FIGURES 17 AND 18

The tables below contain average relative humidity at 9 a.m. and 3 p.m. for each month and the year, for selected stations. Humidity values for the capital cities are contained in the detailed capital city statistical tables found further on.

AVERAGE RELATIVE HUMIDITY AT 9 A.M.
(per cent)

Station	*Period of record*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Year*
Alice Springs	1941–87	34	39	40	45	56	65	59	47	35	31	29	29	42
Armidale	1907–87	63	69	71	73	78	80	77	71	61	57	56	57	68
Broome	1939–87	71	74	69	55	49	49	47	45	48	53	58	64	57
Carnarvon	1945–87	58	57	56	57	59	69	69	64	54	51	54	57	59
Ceduna	1939–87	53	59	61	66	76	81	80	75	64	54	51	51	64
Charleville	1942–87	47	53	52	53	63	71	66	56	44	40	37	39	52
Cloncurry	1939–75	52	60	52	45	47	51	45	37	31	31	31	40	43
Esperance	1969–87	58	60	64	70	74	77	77	74	68	61	60	57	67
Halls Creek	1944–87	51	56	44	34	34	34	31	25	22	25	30	39	36
Kalgoorlie	1939–87	45	51	53	59	68	74	74	67	54	48	44	43	56
Katanning	1957–87	57	64	66	75	83	88	88	86	80	68	59	56	72
Kiandra	1907–74	61	66	72	79	84	89	90	87	76	67	62	62	75
Marble Bar	1937–87	44	47	40	33	39	42	39	32	27	26	26	33	36
Mildura	1946–87	50	55	59	70	82	88	86	79	67	58	52	48	66
Mundiwindi	1938–81	31	35	34	37	44	53	49	39	28	23	22	23	35
Thursday Island	1950–87	84	86	85	82	82	81	80	78	75	73	73	77	80
Townsville	1940–87	72	76	74	69	68	67	67	63	60	61	63	66	67

AVERAGE RELATIVE HUNIDITY AT 3 P.M.
(per cent)

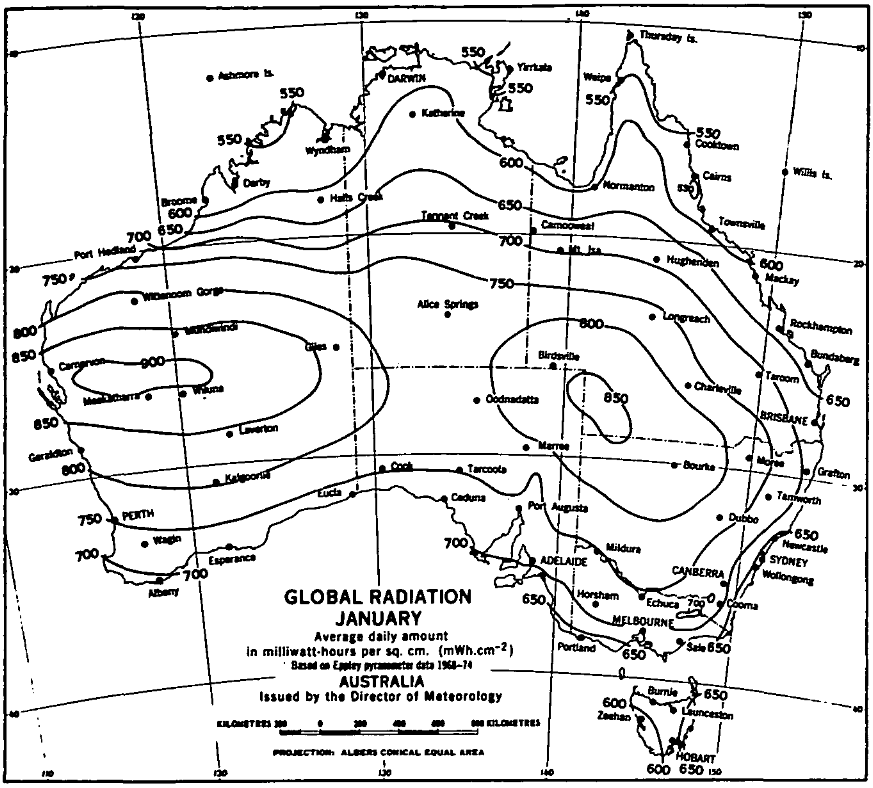
Station	*Period of record*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Year*
Alice Springs	1941–87	20	23	23	25	31	34	30	24	20	19	18	18	23
Armidale	1909–87	44	47	47	48	52	56	52	47	42	42	40	41	46
Broome	1939–87	65	66	59	43	38	36	34	33	42	52	57	60	32
Carnarvon	1945–87	59	58	57	56	53	53	52	52	52	53	55	58	55
Ceduna	1939–87	42	45	45	45	51	54	55	50	45	43	40	42	46
Charleville	1942–87	28	33	32	31	36	39	35	29	24	24	21	23	29
Cloncurry	1939–75	32	38	34	29	29	30	26	22	20	19	19	24	27
Esperance	1969–87	56	58	58	57	58	60	58	57	57	56	57	57	57
Halls Creek	1944–87	34	38	31	25	27	25	22	19	17	18	20	26	25
Kalgoorlie	1939–87	24	29	31	37	43	49	47	40	31	27	25	23	33
Katanning	1957–87	30	34	37	48	56	66	66	62	56	44	36	30	46
Kiandra	1912–74	50	52	55	61	70	75	78	73	62	58	54	51	62
Marble Bar	1937–87	25	28	24	23	26	27	25	21	18	17	16	19	23
Mildura	1946–87	26	30	33	40	50	56	54	47	39	34	29	26	39
Mundiwindi	1938–81	19	22	21	22	27	32	28	22	15	13	13	14	20
Thursday Island	1951–87	78	81	79	74	71	69	67	65	65	65	65	71	71
Townsville	1940–87	66	67	65	60	57	52	51	51	52	55	57	60	58

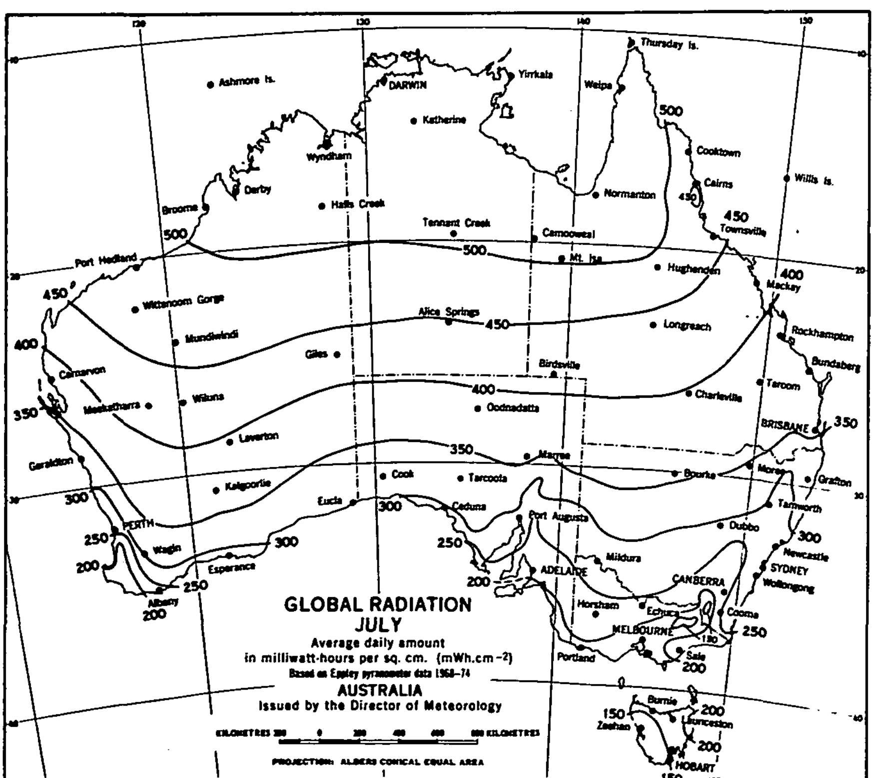
Relative humidity is dependent on temperature and if the water content of the air remains constant, relative humidity decreases with increasing temperature. For instance Perth, for January, has a mean 9 a.m. relative humidity of 50 per cent, but for 3 p.m., when the mean temperature is higher, the mean relative humidity is 41 per cent.

Global radiation

Global (short wave) radiation includes that radiation energy reaching the ground directly from the sun and that received indirectly from the sky, scattered downwards by clouds, dust particles, etc.

Figures 19 and 20 show the average global radiation for the months of January and July.





FIGURES 19 AND 20

A high correlation exists between daily global radiation (Figures 19 and 20) and daily hours of sunshine (Figures 21 and 22). On the north-west coast around Port Hedland, where average daily global radiation is the highest for Australia (640 milliwatt hours), average daily sunshine is also highest, being approximately 10 hours. Sunshine is more dependent on variations in cloud coverage than is global radiation, since the latter includes diffuse radiation from the sky as well as direct radiation from the sun. An example is Darwin where, in the dry month of July, sunshine approaches twice that of the wet (cloudy) month of January but global radiation figures for the two months are comparable.

Sunshine

Sunshine as treated here refers to bright or direct sunshine. Australia receives relatively large amounts of sunshine although seasonal cloud formations have a notable effect on its spatial and temporal distribution. Cloud cover reduces both incoming and outgoing radiation and thus affects sunshine, air temperature and other climatic elements at the earth's surface. Sunshine amounts at Australian capitals are included in the climatic tables at the end of this chapter.

Average daily sunshine (hours) in January and July based on all available data to August 1974 is shown in Figures 21 and 22. Sunshine for April and October and annual amounts are included in the *Climatic Atlas of Australia, 1988*. In areas where there is a sparsity of data, estimates of sunshine derived from cloud data are used. Most of the continent receives more than 3,000 hours of sunshine a year, or nearly 70 per cent of the total possible. In central Australia and the mid-west coast of Western Australia totals slightly in excess of 3,500 hours occur. Totals of less than 1,750 hours occur on the west coast and highlands of Tasmania; this amount is only 40 per cent of the total possible per year (about 4,380 hours).

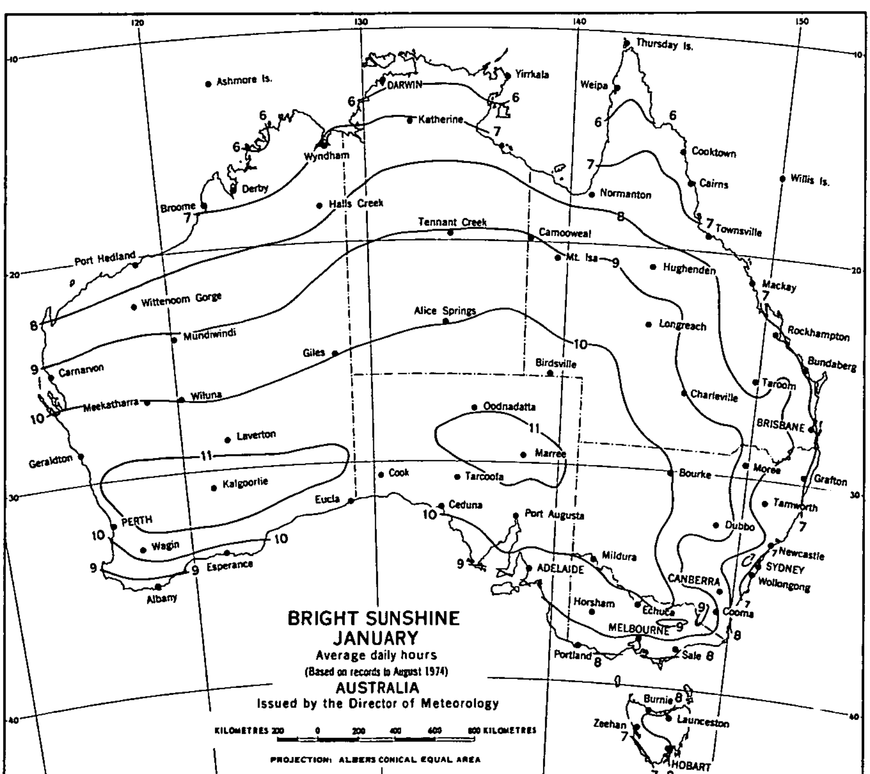


FIGURE 21

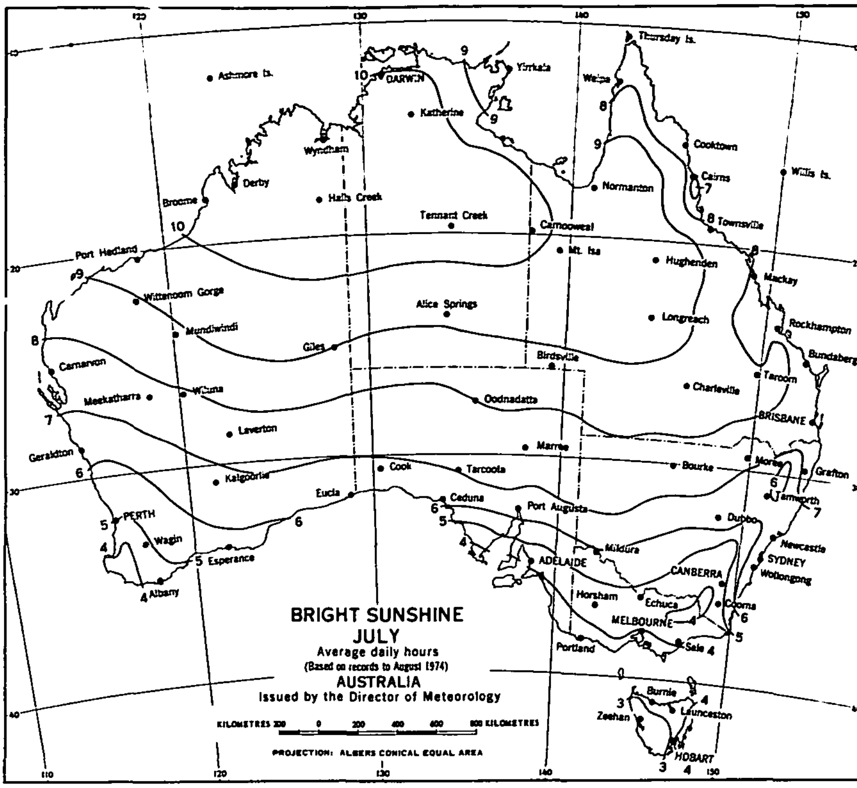


FIGURE 22

In southern Australia the duration of sunshine is greatest about December when the sun is at its highest elevation, and lowest in June when the sun is lowest. In northern Australia sunshine is generally greatest about August–October prior to the wet season, and least about January–March during the wet season. The table below gives the 20, 50 and 80 percentiles of daily bright sunshine for the months of January and July at selected stations. These values give an indication of the variability of daily sunshine hours. Perth, for example, has a high variability of daily sunshine hours in the wet month of July and a low variability in the dry month of January. Darwin has a low variability in the dry season month of July and a high variability in the wet season month of January.

BRIGHT SUNSHINE, VARIABILITY OF DAILY HOURS
(20, 50 and 80 percentile values)

		January			*July*		
		Percentile			*Percentile*		
Station	*Period of record*	*20*	*50*	*80*	*20*	*50*	*80*
Adelaide	1955–1986	6.8	11.9	13.3	1.1	4.0	7.3
Alice Springs	1954–1986	7.8	11.8	13.0	7.6	10.4	10.7
Brisbane	1951–1985	2.6	8.4	11.5	4.5	9.0	9.9
Canberra	1978–1986	7.0	11.3	12.7	2.4	6.4	8.3
Darwin	1951–1986	1.5	5.9	9.4	9.8	10.6	10.9
Hobart	1950–1986	4.3	8.7	12.1	1.5	4.4	7.2
Melbourne	1955–1986	5.5	9.9	12.6	0.8	3.6	6.3
Perth	1942–1986	9.2	12.0	12.7	2.5	5.4	8.6
Sydney	1955–1986	1.9	8.1	11.6	3.2	7.5	9.3
Townsville	1943–1986	3.0	9.0	11.3	6.7	10.0	10.6

Evaporation

Evaporation is determined by measuring the amount of water evaporated from a free water surface exposed in a pan. Evaporation from a free water surface depends on a number of climatic elements, mainly temperature, humidity and wind. Evaporation data are useful in water conservation studies and estimating potential evapotranspiration for irrigation and plant growth studies. In Australia, where surface water storage is vital over large areas, evaporation is a highly significant element.

Average January, July and annual (Class A) pan evaporation is mapped in Figures 23, 24 and 25 respectively.

Due to the relatively short records at some stations, the maps may not be representative of climate averages in some areas. Dashed isopleths on the maps over some coastal fringes to aid interpolation do not represent evaporation from ocean surfaces or expanses of water.

Evaporation varies markedly with exposure of the instrument. Sheltering from wind and shading of pans cause local variations in measured evaporation of as much as 25 per cent. Instruments near expanses of water such as coastal inlets, rivers, reservoirs or irrigation systems may record lower evaporation than the surrounding country due to local effects on meteorological elements, notably humidity. Such reductions are about five to ten per cent.

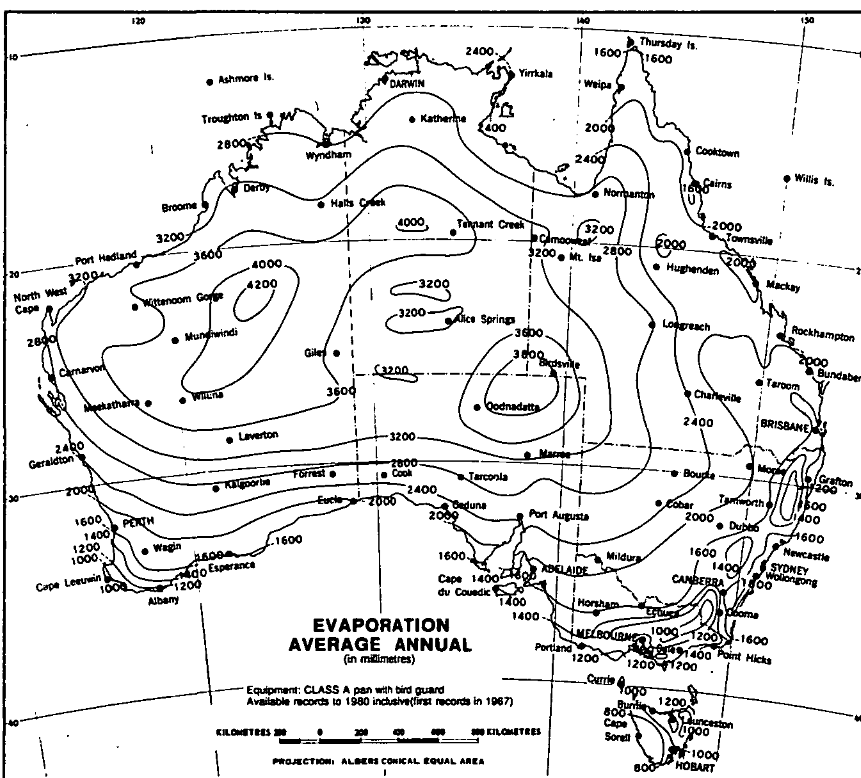
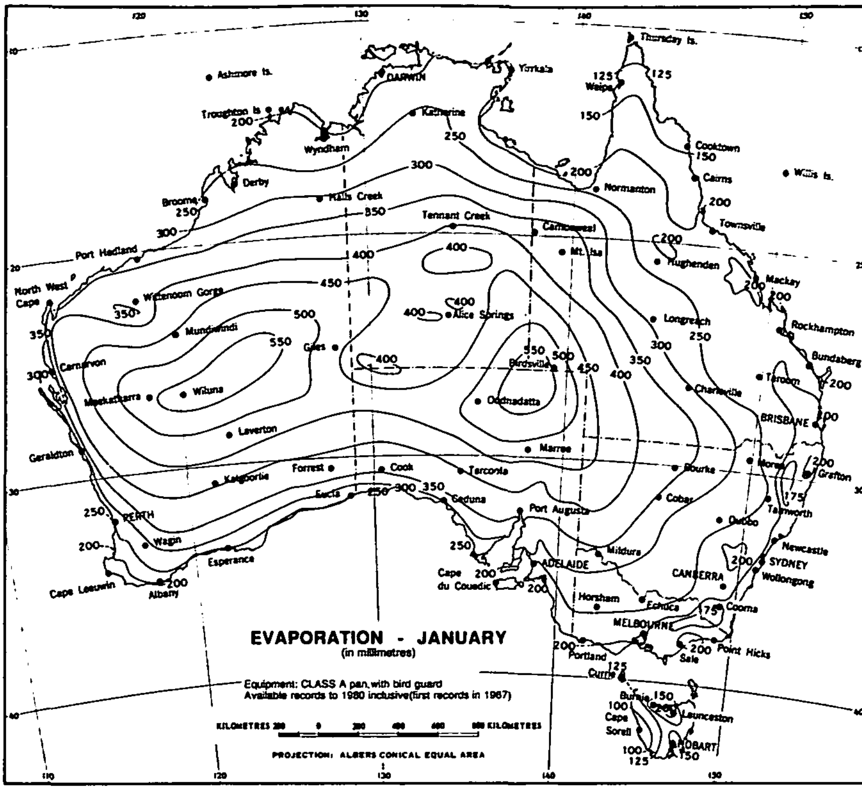
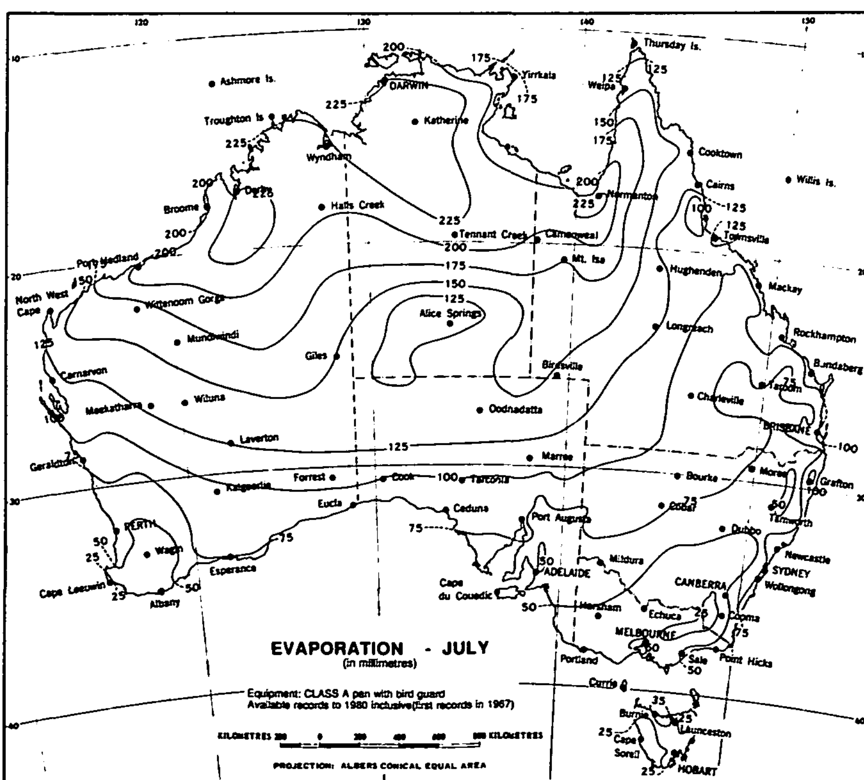


FIGURE 23





FIGURES 24 AND 25

The Class A pan instruments have a wire mesh bird guard, which reduces the measured evaporation. An estimate of the unguarded average Class A pan evaporation for any locality may be derived by applying a seven per cent increase to the value interpolated from the maps.

Average annual Class A pan evaporation ranges from more than 4,000mm over central Western Australia to less than 1,000mm in alpine areas of south-east Australia and in much of Tasmania.

In areas south of the tropics, average monthly evaporation follows seasonal changes in solar radiation, giving highest evaporation in December and January, and lowest in June and July. In the tropics, onset of summer brings increasing cloudiness and higher humidity, causing reduced evaporation in these months. Maximum evaporation in tropical areas occurs around November on average, but high evaporation is sustained when summer rains are delayed or are persistently below average.

Cloud and fog

Cloud

Seasonal changes in cloudiness vary with the distribution of rainfall. In the southern parts of the continent, particularly in the coastal and low lying areas, the winter months are generally more cloudy than the summer months. This is due to the formation of extensive areas of stratiform cloud and fog during the colder months, when the structure of the lower layers of the atmosphere favours the physical processes resulting in this type of cloud. Particularly strong seasonal variability of cloud cover exists in northern Australia where skies are clouded during the summer wet season and mainly cloudless during the winter dry season. Cloud coverage is greater near coasts and on the windward slopes of the eastern uplands of Australia and less over the dry interior.

The average monthly and annual number of cloudy days (days when the cloud coverage was greater than or equal to seven-eighths of the sky) and clear days (less than or equal to one-eighth) is included for the capital cities in the detailed capital city statistical tables.

Fog

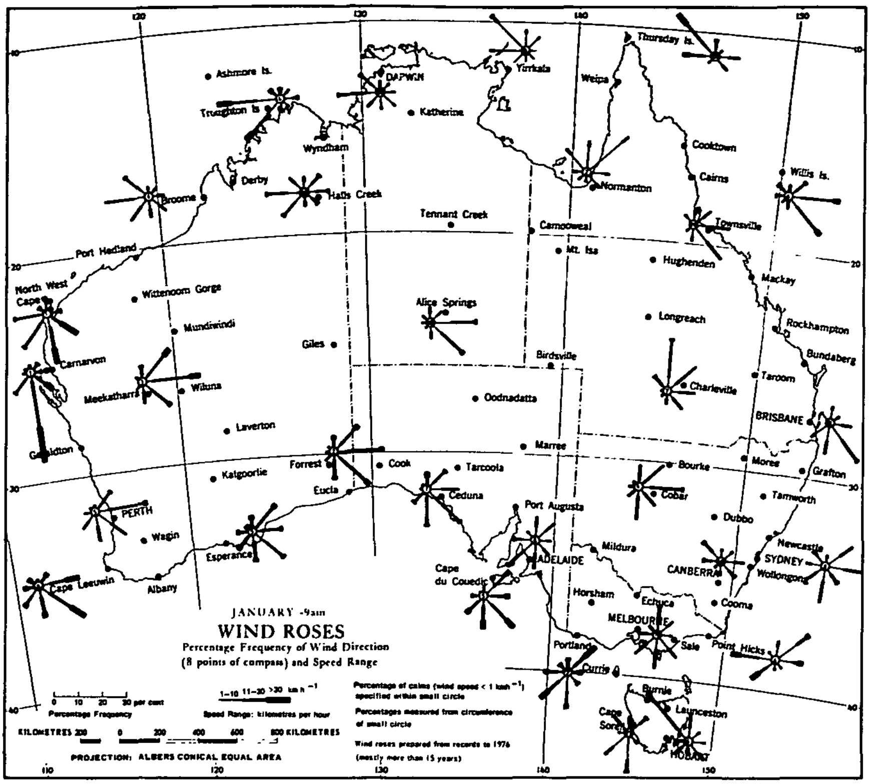
The formation of fog depends on the occurrence of favourable meteorological elements—mainly temperature, humidity, wind and cloud cover. The nature of the local terrain is important for the development of fog and there is a tendency for this phenomenon to persist in valleys and hollows. The incidence of fog may vary significantly over distances as short as one kilometre.

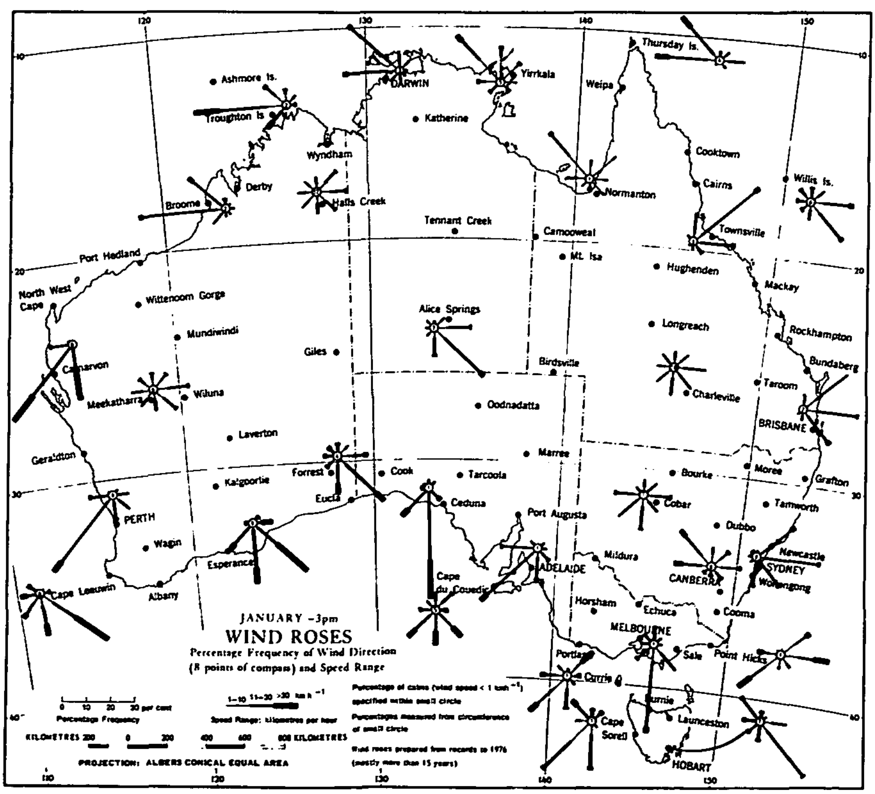
Fog in Australia tends to be greater in the south than the north, although parts of the east coastal areas are relatively fog prone even in the tropics. Incidence is much greater in the colder months, particularly in the eastern uplands. Fog may persist during the day but rarely until the afternoon over the interior. The highest fog incidence at a capital city is at Canberra which has an average of 47 days per year on which fog occurs, 29 of which are in the period of May to August. Brisbane averages 20 days of fog per year. Darwin averages only 2 days per year, in the months of July and August.

Winds

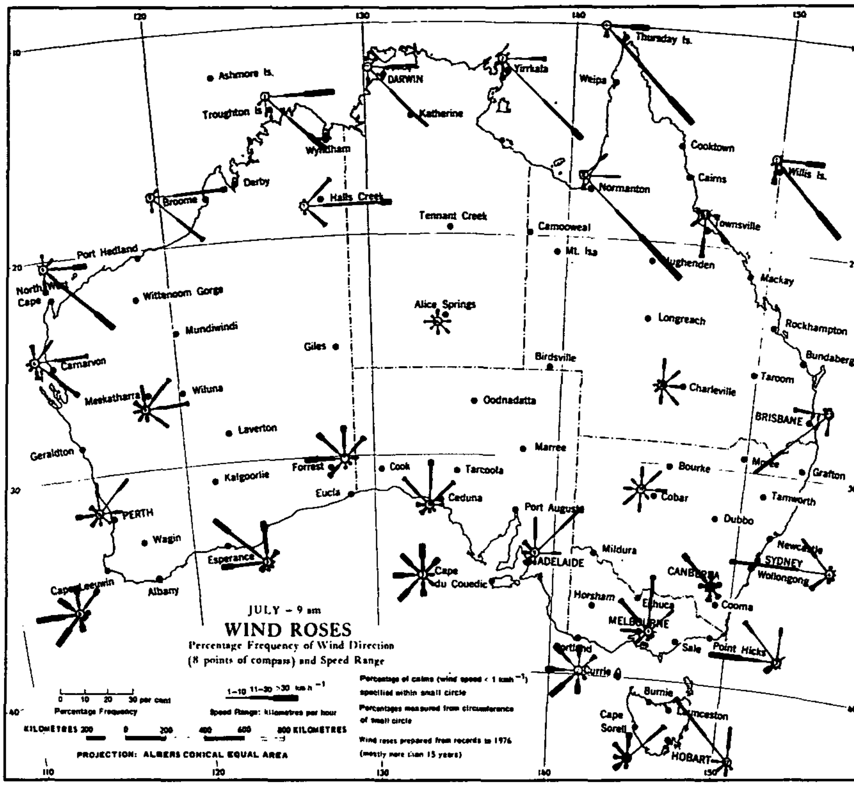
The mid-latitude anticyclones are the chief determinants of Australia's two main prevailing wind streams. In relation to the west-east axes of the anticyclones these streams are easterly to the north and westerly to the south. The cycles of development, motion and decay of low pressure systems to the north and south of the anticyclones result in diversity of wind flow patterns. Wind variations are greatest around the coasts where diurnal land and sea breeze effects are important.

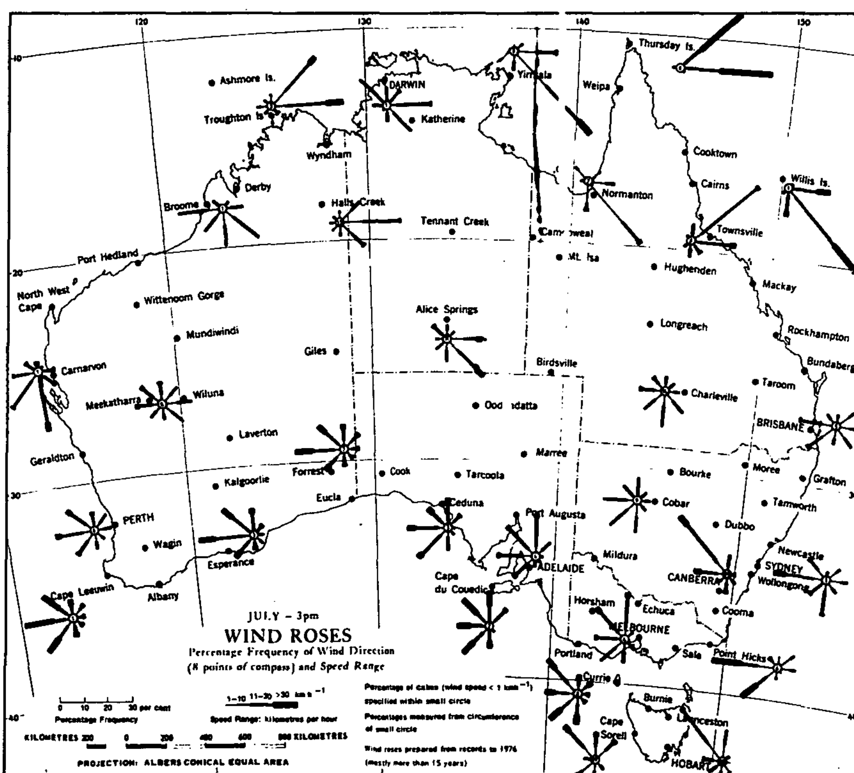
Wind roses for the months of January and July at 9 a.m. and 3 p.m. at selected stations are shown in Figures 26 to 29 inclusive, extracted from *Climatic Atlas of Australia, 1988*. The wind roses show the percentage frequency of direction (eight points of compass) and speed ranges of winds.





FIGURES 26 AND 27





FIGURES 28 AND 29

Orography affects the prevailing wind pattern in various ways such as the channelling of winds through valleys, deflection by mountains and cold air drainage from highland areas. An example of this channelling is the high frequency of north-west winds at Hobart caused by the north-west – south-east orientation of the Derwent River Valley.

Average wind speeds and prevailing directions at Australian capitals are included in the detailed climatic tables. Perth is the windiest capital with an average wind speed of 15.6 kilometres per hour; Canberra is the least windy with an average speed of 5.4 kilometres per hour.

The highest wind speeds and wind gusts recorded in Australia have been associated with tropical cyclones. The highest recorded gust was 259 kilometres per hour at Mardie (near Onslow), Western Australia on 19 February 1975, and gusts reaching 200 kilometres per hour have been recorded on several occasions in northern Australia with cyclone visitations. The highest gusts recorded at Australian capitals were 217 kilometres per hour at Darwin and 156 kilometres per hour at Perth.

Floods

Widespread flood rainfall may occur anywhere in Australia but it has a higher incidence in the north and in the eastern coastal areas. It is most economically damaging along the shorter streams flowing from the eastern uplands eastward to the seaboard of Queensland and New South Wales. These flood rains are notably destructive in the more densely populated coastal river valleys of New South Wales; the Tweed, Richmond, Clarence, Macleay, Hunter and Nepean–Hawkesbury; all of which experience relatively frequent flooding. Although chiefly caused by summer rains, they may occur in any season.

The great Fitzroy and Burdekin river basins of Queensland receive flood rains during the summer wet seasons. Much of the run-off due to heavy rain in north Queensland west of the eastern uplands flows southward through the normally dry channels of the network of rivers draining the interior lowlands into Lake Eyre. This widespread rain may cause floods over an extensive area, but it soon seeps away or evaporates, occasionally reaching the lake in quantity. The Condamine and other northern tributaries of the Darling also carry large volumes of water from flood rains south through western New South Wales to the Murray and flooding occurs along their courses at times.

Flood rains occur at irregular intervals in the Murray–Murrumbidgee system of New South Wales and Victoria, the coastal streams of southern Victoria and the north coast streams of Tasmania.

Droughts

Drought, in general terms, refers to an acute water shortage. This is normally due to rainfall deficiency but with other parameters contributing to the actual water availability. The best single measure of water availability in Australia is rainfall, although parameters such as evaporation and soil moisture are significant or even dominant in some situations.

For further information on droughts in Australia *see Year Book* No. 71 page 620.

Climatic discomfort

In Australia climatic discomfort is significant in most areas. During the summer half of the year (November–April), prolonged high temperatures and humidity around the northern coasts and high temperatures over the inland cause physical stress. In winter, low temperatures and strong cold winds over the interior and southern areas can be severe for relatively short periods. However, cold stress does not cause prolonged physical hardship in Australia at altitudes lower than 1,000 metres, that is, over more than 99 per cent of the continent.

The climatic variables determining physical discomfort are primarily air temperature, vapour pressure and wind. The complete assessment of physical discomfort also requires analyses of such parameters as thermal conductivity of clothing, vapour pressure at the skin and the metabolic heat rate arising from activity of the human body. The cooling system of the human body depends on evaporation of moisture to keep body temperature from rising to lethal levels as air temperature rises. Defining criteria of discomfort is difficult because personal reactions to the weather differ greatly according to a number of variables including health, age, clothing, occupation and acclimatisation (Ashton, 1964). However, climatic strain has been measured experimentally, and discomfort indices based on the average response of subjects under specified conditions have been derived. One of the most commonly used indices is the relative strain index. The index, derived by Lee and Henschel (1963), has been applied in Australia to measure heat discomfort. The results obtained with Australian data are useful for purposes of comparison but interpretation of the actual results is tentative until empirical environmental studies are carried out in this region. In addition to temperature, humidity and air movement, the relative strain index has facilities for the incorporation of metabolic heat rate, net radiation and insulation of clothing. It has the advantage of being applicable to manual workers under shelter and expending energy at various metabolic heat rates.

The discomfort map, Figure 30, shows the average number of days per year when the relative strain index exceeds 0.3 discomfort level at 3 p.m. assuming standard conditions as defined (see following table). Maximum discomfort generally occurs around 3 p.m. on days of high temperature.

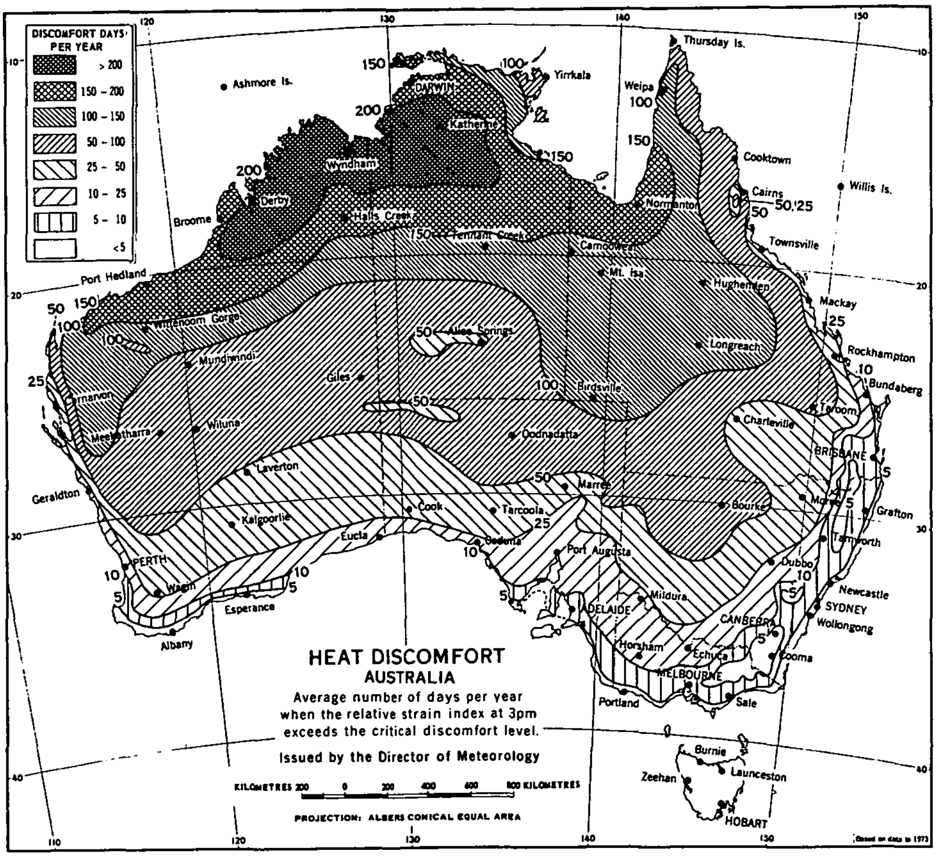


FIGURE 30

A notable feature is the lower frequency of days of discomfort in Queensland coastal areas in comparison with the northern coastal areas of Western Australia. This is due to the onshore winds prevailing on the Queensland coast and the cooling effect of the adjacent eastern uplands. Lower frequencies on the Atherton Plateau in the tropics near Cairns show the advantage of altitude. Relatively low heat discomfort frequencies are evident in upland and coast areas of south-east Australia. Tasmania is entirely in the zone of least discomfort, experiencing on the average less than one day of heat discomfort per year. In Western Australia most of the Kimberley region in the north lies in the highest discomfort zone with the frequencies decreasing southwards to a strip of lowest discomfort towards the south-west coast. A steep gradient of discomfort frequency on the west coast shows the moderating effect of sea breezes.

The average annual frequency of days when the relative strain index at 3 p.m. exceeds specified discomfort levels is shown in the table below. The Sydney frequencies were derived from observations at the regional office of the Bureau of Meteorology, which is representative of eastern coastal suburbs; frequencies are higher in western suburbs. The Melbourne frequencies were derived from observations at the Bureau's regional office, which may be taken as fairly representative of inner northern and eastern suburbs; frequencies are lower in bayside suburbs. Similarly, in other capital city areas significant variations occur with distance from the coast.

HEAT DISCOMFORT (a)

Station	*Period of record*	*Greater than—*	
		0.3 RSI	*0.4 RSI*
Adelaide	1956–86	6	2
Alice Springs	1942–87	52	4
Brisbane	1951–85	7	2
Broome	1941–67	163	66
Canberra	1940–87	3	<1
Carnarvon	1950–87	25	6
Ceduna	1943–87	15	3
Charleville	1943–87	45	6
Cloncurry	1942–74	132	37
Cobar	1964–85	23	3
Darwin	1943–87	173	32
Hobart	1944–87	<1	<1
Kalgoorlie	1943–87	28	4
Marble Bar	1957–74	179	86
Melbourne	1955–87	6	2
Mildura	1947–87	20	4
Perth	1942–87	13	2
Rockhampton	1940–87	42	8
Sydney	1955–86	3	<1
Townsville	1941–87	48	5
Wagga	1945–85	12	2
Woomera	1950–87	28	5

(a) Average number of days per year when relative strain index (RSI) at 3 p.m. exceeds 0.3 (discomfort) and 0.4 (high discomfort) under standard conditions (indoors, manual activities, light clothing, air movement 60 metres per minute)

At inland places, relatively low night temperatures have recuperative effects after hot days.

Acclimatised people would suffer discomfort less frequently than shown by the relative strain index figures. For example, Australians living in the north evidently experience less discomfort at high air temperatures than those in the south, if humidities are comparable.

Both direction and speed of prevailing winds are significant for the ventilation of buildings. In the tropics, for instance, windward slopes allow optimal air movement enabling more comfortable ventilation to be obtained. Regular sea breezes such as those experienced at Perth reduce discomfort although on some days their full benefit may not be experienced until after 3 p.m.

Climatic data for capital cities

The means or extremes for a number of elements determined from long-period observations at the Australian captials are given in the following pages. In general, all data up to and including 1987 are covered. Data for other localities are contained in *Climatic Averages Australia, 1988.*

CLIMATIC DATA: SYDNEY, NEW SOUTH WALES
(Lat. 33° 52′ S., Long. 151° 12′ E. Height above mean sea level (M.S.L.) 42 metres)

BAROMETER, WIND, EVAPORATION, THUNDER, CLOUDY AND CLEAR DAYS

Month	Mean of 9 a.m. and 3 p.m. atmospheric pressure reduced to mean sea level (hPa)	Wind (height of anemometer 22 metres) Average (km/h)	Highest gust speed (km/h)	Prevailing direction 9 a.m.	Prevailing direction 3 p.m.	Mean amount evaporation (mm)	Mean No. days thunder	Mean No. cloudy days (a)	Mean No. clear days (b)
No. of years of record	72	32	62	(c)	(c)	(d)7	67	31	76
January	1,012.7	12.3	150	S	E	220	3.2	12	5.1
February	1,014.3	11.6	111	S	E	178	2.5	11	4.6
March	1,016.4	10.5	96	W	E	164	1.6	10	5.9
April	1,018.3	10.2	116	W	E	123	1.2	8	7.7
May	1,018.9	10.5	135	W	S	93	0.8	8	7.9
June	1,018.8	11.6	135	W	S	78	0.8	9	8.2
July	1,018.6	11.5	109	W	W	90	0.7	6	10.7
August	1,017.9	12.1	113	W	W	115	1.3	6	10.9
September	1,017.0	11.6	131	W	E	141	1.8	7	9.0
October	1,015.3	12.3	153	W	ENE	171	2.6	10	6.5
November	1,013.6	12.4	118	S	E	192	3.5	10	5.3
December	1,012.0	12.3	121	S	E	239	3.6	10	5.0
Year Totals	..	..	..	..	..	**1,804**	**23.7**	**107**	**86.8**
Year Averages	**1,016.1**	**11.6**	..	**W**	**E**	..	..	..	..
Year Extremes	..	..	**153**	..	..	..	..	..	..

(a) Mean number of days when cloud cover equalled or exceeded seven-eighths. *(b)* Mean number of days when cloud cover was less than or equal to one-eighth. *(c)* Years 1895–1988 inclusive. *(d)* Sydney Airport, Class A Pan (1974–80)

TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (°Celsius) Mean max.	Mean min.	Mean	Extreme air temperature (°Celsius) Highest max.	Date	Lowest min.	Date	Extreme temperature (°Celsius) Lowest terrestrial min.	Date	Mean daily hours sunshine
No. of years of record	123	123	123	123		123		124		61
January	25.8	18.4	22.1	45.3	14/3	10.6	18/49	6.5	6/25	7.2
February	25.5	18.5	22.0	42.1	8/26	9.6	28/63*	6.0	22/33	6.8
March	24.6	17.4	21.0	39.2	3/69*	9.3	14/86*	4.4	17/13	6.3
April	22.2	14.6	18.4	33.9	5/86	7.0	27/64*	0.7	24/09	6.3
May	19.7	11.3	15.5	30.0	1/19	4.4	30/62*	−1.5	25/17	5.8
June	16.7	9.2	12.9	26.9	11/31	2.1	22/32	−22	22/32	5.3
July	15.9	7.9	11.9	25.7	22/26	2.2	12/90*	−4.4	4/93*	6.3
August	17.5	8.9	13.2	30.4	24/54	2.7	3/72*	−3.3	4/9	6.9
September	19.7	10.9	15.3	34.6	26/65	4.9	2/45	−1.1	17/05	7.2
October	21.9	13.4	17.7	37.4	4/42	5.7	6/27	0.4	9/05	7.3
November	23.5	15.5	19.5	40.3	6/46	7.7	1/05	1.9	21/67	7.6
December	25.0	17.3	21.1	42.2	20/5	9.1	3/24	5.2	3/24	7.5
Year Averages	**21.5**	**13.6**	**17.4**	..	..	..	..	..	..	**6.7**
Year Extremes	..	..	..	**45.3**	**14/1/39**	**2.1**	**22/6/32**	**−4.4**	**4/7/1893**	..

NOTE: Figures such as 14/39, 18/49, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century.

CLIMATIC DATA: SYDNEY, NEW SOUTH WALES — *continued*
(Lat. 33° 52′ S., Long. 151° 12′ E. Height above mean sea level (M.S.L.) 42 metres)

HUMIDITY, RAINFALL AND FOG

	Rel. hum (%)		*Rainfall (millimetres)*								
Month	*9 a.m. mean*	*3 p.m. mean*	*Mean monthly*	*Mean No. of days of rain*	*Greatest monthly*		*Least monthly*		*Greatest in one day*	*Date*	*Mean No. days fog*
No. of years of record	31	31	123	123	123		123		123		61
January	69	62	102	13	388	(1911)	6	(1932)	180	13/11	0.3
February	72	64	113	13	564	(1954)	3	(1939)	226	25/73*	0.6
March	72	62	135	14	521	(1942)	8	(1965)	281	28/42	1.3
April	71	58	124	13	622	(1861)	2	(1868)	191	29/0*	1.9
May	72	55	121	13	585	(1919)	4	(1957)	212	28/89*	3.0
June	74	57	131	12	643	(1950)	4	(1962)	131	16/84*	2.4
July	69	50	101	11	336	(1950)	2	(1970)	198	7/31	1.9
August	66	49	80	11	471	(1986)	1	(1885)	328	6/86	1.5
September	62	51	69	11	357	(1879)	2	(1882)	145	10/79*	0.9
October	61	56	78	12	283	*(a)*	2	(1971)	162	13/02	0.6
November	63	57	81	12	517	(1961)	2	(1915)	235	9/84	0.5
December	65	59	77	12	402	(1920)	3	(1979)	126	9/70	0.4
Totals	..	..	**1,214**	**148**		..		..	..	..	**15.2**
Year Averages	**68**	**57**	..	..	..	..	..	..	..		
Extremes	..	..	..	..	**643**	**(6/1950)**	**1**	**(8/1885)**	**281**	**28/3/1942**	..

(a) 1916 and 1959.
NOTE: Figures such as 13/11, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century. Bracketed figures indicate year of occurrence.

CLIMATIC DATA: MELBOURNE, VICTORIA
(Lat. 37° 49′ S., Long. 144° 58′ E. Height above M.S.L. 35 metres)

BAROMETER, WIND, EVAPORATION, THUNDER, CLOUDY AND CLEAR DAYS

	Mean of 9 a.m. and 3 p.m. atmospheric pressure reduced to mean sea level (hPa)	*Wind (height of anemometer 28 metres)*							
Month		*Average (km/h)*	*Highest gust speed (km/h)*	*Prevailing direction 9 a.m.*	*Prevailing direction 3 p.m.*	*Mean amount evaporation (mm)*	*Mean No. days thunder*	*Mean No. cloudy days (a)*	*Mean No. clear days (b)*
No. of years of record	130	*(c)*47	77	68	68	*(d)*20	79	31	79
January	1,012.9	11.9	106	S	S	204	1.6	7	6.5
February	1,014.4	11.5	119	S	S	179	1.7	7	6.2
March	1,016.8	10.5	106	N	S	135	1.3	10	5.4
April	1,019.0	10.1	108	N	S	91	0.7	11	4.2
May	1,019.2	10.6	116	N	N	57	0.4	14	2.9
June	1,019.0	10.8	103	N	N	36	0.2	13	2.7
July	1,018.6	12.1	109	N	N	43	0.2	12	2.6
August	1,017.6	12.1	108	N	N	61	0.6	13	2.7
September	1,016.0	12.4	120	N	S	85	0.7	11	3.6
October	1,014.8	12.2	111	N	S	125	1.5	12	3.6
November	1,014.0	12.5	114	SW	S	151	1.9	12	3.2
December	1,012.4	12.3	104	S	S	187	2.1	10	4.2
Totals	..	..	..	..	..	**1,356**	**12.8**	**132**	**48.0**
Year Averages	**1,016.2**	**11.7**	..	**N**	**S**	..	..	..	..
Extremes	..	..	**120**	..	..	..	..	..	..

(a) Mean number of days when cloud cover equalled or exceeded seven-eights. *(b)* Mean number of days when cloud cover was less than or equal to one-eighth. *(c)* Early records not comparable. *(d)* Class A Pan.

CLIMATIC DATA: MELBOURNE, VICTORIA — *continued*
(Lat. 37° 49′ S., Long. 144° 58′ E. Height above M.S.L. 35 metres)

TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (°Celsius) Mean max.	Mean min.	Mean	Extreme air temperature (°Celsius) Highest max.	Date	Lowest min.	Date	Extreme temperature (°Celsius) Lowest terrestrial min.	Date	Mean daily hours sun-shine
No. of years of record	131	131	131	131		131		122		(a)52
January	25.8	14.0	19.9	45.6	13/39	5.6	28/85*	—1.0	28/85*	8.1
February	25.7	14.3	20.0	43.2	8/83	4.6	24/24	—0.6	6/91*	7.5
March	23.8	13.0	18.4	41.7	11/40	2.8	17/84*	-1.7	(b)	6.6
April	20.1	10.6	15.3	34.9	5/38	1.6	24/88*	-3.9	23/97*	5.1
May	16.5	8.5	12.5	28.7	7/05	-1.2	29/16	-6.1	26/16	3.9
June	13.9	6.7	10.3	22.4	2/57	-2.2	11/66*	-6.7	30/29	3.4
July	13.3	5.7	9.5	23.1	30/75	-2.8	21/69*	-6.4	12/03	3.7
August	14.8	6.5	10.7	26.5	29/82	-2.1	11/63*	-5.9	14/02	4.6
September	17.1	7.7	12.4	31.4	28/28	-0.6	3/40	-5.1	8/18	5.5
October	19.5	9.3	14.4	36.9	24/14	0.1	3/71*	-4.0	22/18	5.9
November	21.8	10.9	16.4	40.9	27/94*	2.4	2/96*	-4.1	2/96*	6.5
December	24.1	12.7	18.4	43.7	15/76	4.4	4/70*	0.7	1/04	7.3
Year Averages	**19.7**	**10.0**	**14.9**	..	..	..	..	..	..	**5.7**
Year Extremes	..	..	..	**45.6**	**13/1/39**	**-2.8**	**21/7/69***	**-6.7**	**30/6/29**	..

(*a*) Discontinued 1967. (*b*) 17/1884 and 20/1897.
NOTE: Figures such as 13/39, 28/85*, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century.

HUMIDITY, RAINFALL AND FOG

Month	Rel. hum. (%) 9 a.m. mean	3 p.m. mean	Rainfall (millimetres) Mean monthly	Mean No. of days of rain	Greatest monthly		Least monthly		Greatest in one day	Date	Mean No. days fog
No.of years of record	78	78	131	131		131		131	128		129
January	59	46	47	8	176	(1963)	(*a*)	(1932)	108	29/63	0.1
February	63	48	48	7	238	(1972)	(*a*)	(1965)	87	26/46	0.3
March	65	50	53	9	191	(1911)	4	(1934)	90	5/19	0.7
April	72	54	58	11	195	(1960)	Nil	(1923)	80	23/60	1.7
May	78	61	58	14	142	(1942)	4	(1934)	51	15/74	3.4
June	82	65	49	14	115	(1859)		8(1858)	44	22/04	4.3
July	81	63	48	15	178	(1891)	9	(1979)	74	12/91*	4.1
August	75	58	51	15	111	(1939)	12	(1903)	54	17/81*	2.2
September	68	54	59	14	201	(1916)	13	(1907)	59	23/16	0.8
October	62	52	68	14	193	(1869)	7	(1914)	61	21/53	0.4
November	61	50	59	12	206	(1954)	6	(1895)	732	1/54	0.2
December	59	47	58	10	182	(1863)	1	(1972)	100	4/54	0.2
Year Totals	..	..	**655**	**143**		..		..	..	..	**18.2**
Year Averages	**69**	**54**	..	..		..		..	..	..	..
Year Extremes	..	..	..	..	**238**	**(2/72)**	**Nil**	**(4/23)**	**108**	**29/1/63**	..

(*a*) Less than 1 mm.
NOTE: Figures such as 29/63, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century. Bracketed figures indicate year of occurrence.

CLIMATIC DATA: BRISBANE, QUEENSLAND
(Lat. 27° 28′ S., Long. 153° 2′ E. Height above M.S.L. 41 metres)

BAROMETER, WIND, EVAPORATION, THUNDER, CLOUDY AND CLEAR DAYS

Month	Mean of 9 a.m. and 3 p.m. atmospheric pressure reduced to mean sea level (hPa)	Wind (height of anemometer 32 metres) Average (km/h)	Highest gust speed (km/h)	Prevailing direction 9 a.m.	Prevailing direction 3 p.m.	Mean amount evaporation (mm)	Mean No. days thunder	Mean No. cloudy days (a)	Mean No. clear days (b)
No. of years of record	99	70	71	(c)	(c)	(d)19	99	99	78
January	1,011.7	11.7	145	SE	NE	176	4.4	4	3.2
February	1,012.5	11.5	108	SSW	NE	142	3.5	4	2.5
March	1,014.5	11.1	106	SSW	ENE	140	2.2	4	5.5
April	1,017.1	10.1	104	SW	SE	114	1.4	2	7.7
May	1,018.5	9.5	87	SW	SE	81	0.5	3	9.5
June	1,018.4	9.8	95	SW	W	64	0.5	2	10.5
July	1,018.9	9.6	111	SW	W	70	0.3	2	13.3
August	1,018.9	9.7	100	SW	NE	98	1.3	2	13.5
September	1,017.8	10.1	102	SW	NE	128	2.7	2	12.4
October	1,016.1	10.6	100	SW	NE	152	4.1	3	8.3
November	1,014.2	11.1	111	SE	NE	168	5.6	3	5.8
December	1,012.1	11.4	127	SE,N	NE	193	6.5	3	4.5
Year Totals	..	..	..	..	..	**1,526**	**33.0**	**34**	**96.7**
Year Averages	**1,015.9**	**10.5**	..	**SW**	**NE**	..	..	..	..
Year Extremes	..	..	**145**	..	..	..	..	..	..

(a) Mean number of days when cloud cover equalled or exceeded seven-eighths. (b) Mean number of days when cloud cover was less than or equal to one-eighth. (c) 1887-1986. (d) Class A Pan.

TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (°Celsius) Mean max.	Mean min.	Mean	Extreme air temperature (°Celsius) Highest max.	Date	Lowest min.	Date	Extreme temperature (°Celsius) Lowest terrestrial min.	Date	Mean daily hours sunshine
No. of years of record	99		99	99		99	98		77	
January	29.4	20.8	25.0	43.2	26/40	14.9	4/93*	9.9	4/93*	7.6
February	29.0	20.6	24.8	40.9	21/25	14.7	23/31	9.5	22/31	7.0
March	28.0	19.4	23.7	38.8	13/65	11.3	29/13	7.4	29/13	6.8
April	26.1	16.7	21.3	36.1	19/73	6.9	25/25	2.6	24/25	7.2
May	23.2	13.4	18.3	32.4	21/23	4.8	30/51	−1.2	8/97*	6.8
June	20.8	10.9	15.9	31.6	19/18	2.4	29/08	−3.7	23/88*	6.7
July	20.4	9.6	15.0	29.1	23/46	2.3	(a)	−4.5	11/90*	7.0
August	21.8	10.3	16.1	32.8	14/46	2.7	13/64	−2.7	9/99*	8.0
September	24.0	12.9	18.5	38.3	22/43	4.8	1/96*	−0.9	1/89*	8.3
October	26.1	15.9	20.9	40.7	30/58	6.3	3/99*	1.6	*	8.2
November	27.8	18.2	22.9	41.2	18/13	9.2	2/05	3.8	1/05	8.2
December	29.1	19.9	24.5	41.2	7/81	13.5	5/55	9.5	3/94*	8.2
Year Averages	**25.5**	**15.7**	**20.6**	..	..	..	..	..	..	**7.5**
Year Extremes	..	..	..	**43.2**	**26/1/1940**	**2.3**	(a)	**−4.5**	**11/7/1890**	..

(a) 12/1894 and 2/1896.
NOTE: Figures such as 26/40, 4/93*, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century.

CLIMATIC DATA: BRISBANE, QUEENSLAND — *continued*
(Lat. 27° 28′ S., Long. 153° 2′ E. Height above M.S.L. 41 metres)

HUMIDITY, RAINFALL AND FOG

	Rel. hum. (%)		Rainfall (millimetres)								
Month	9 a.m. mean	3 p.m. mean	Mean monthly	Mean No. of days of rain	Greatest monthly		Least monthly		Greatest in one day	Date	Mean No. days fog
No. of years of record	47	44	135	126	135	135	135			99	
January	66	58	164	13	872	(1974)	8	(1919)	465	21/87*	0.5
February	70	60	161	14	1,026	(1893)	15	(1849)	270	6/3	0.5
March	71	59	143	15	865	(1870)	Nil	(1849)	284	14/0	1.1
April	69	54	87	11	388	(1867)	1	(1944)	178	3/7	2.1
May	70	52	73	10	410	(1980)	Nil	(1846)	149	9/80	2.9
June	70	51	68	8	647	(1967)	Nil	(1847)	283	12/67	2.7
July	68	47	57	7	330	(1973)	Nil	*(a)*	193	20/6	2.7
August	64	44	46	7	373	(1879)	Nil	*(b)*	124	12/87*	3.3
September	61	46	47	8	138	(1886)	*(c)*	(1979, 80)	80	12/65	2.3
October	60	52	76	9	456	(1972)	*(c)*	(1948)	136	25/49	1.2
November	60	55	99	10	413	(1981)	Nil	(1842)	143	8/66*	0.5
December	62	57	130	12	441	(1942)	9	(1865)	168	28/71*	0.3
Year **Totals**	..	..	**1,151**	**123**	..		..		..	..	**20.0**
Year **Averages**	**66**	**53**	..	..	..		..		..	..	..
Year **Extremes**	..	..	..	..	**1,026**	**(2/1983)**	**Nil**	**(Various)**	**465**	**21/1/1887**	..

(a) 1841 and 1951. *(b)* 1862, 1869, 1880 and 1977. *(c)* Less than 1 mm.
NOTE: Figures such as 21/87*, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century. Bracketed figures indicate year of occurrence.

CLIMATIC DATA: ADELAIDE, SOUTH AUSTRALIA
(Lat. 34° 56′ S., Long. 138° 35′ E. Height above M.S.L. 43 metres)

BAROMETER, WIND, EVAPORATION, THUNDER, CLOUDY AND CLEAR DAYS

Month	Mean of 9 a.m and 3 p.m. atmospheric pressure reduced to mean sea level (hPa)	Wind (height of anemometer 22 metres) Average (km/h)	Highest gust speed (km/h)	Prevailing direction 9 a.m.	Prevailing direction 3 p.m.	Mean amount evaporation (mm)	Mean No. days thunder	Mean No. cloudy days *(a)*	Mean No. clear days *(b)*
No. of years of record	121	*(c)*23	63	*(d)*	*(d)*	*(e)*12	105	45	62
January	1,013.2	12.8	116	SW	SW	254	1.5	3	11.9
February	1,014.3	12.1	106	SW	SW	216	1.1	3	10.8
March	1,017.2	11.4	126	NE	SW	180	0.8	4	10.7
April	1,019.9	11.4	130	NE	SW	120	1.0	6	6.7
May	1,020.1	11.3	113	NE	WSW	79	1.0	7	4.5
June	1,019.9	11.6	108	NE	NNW	56	0.9	7	3.8
July	1,020.8	11.8	148	NE	NNW	60	0.8	8	3.5
August	1,019.0	12.8	121	NE	WSW	78	1.1	6	4.6
September	1,017.7	13.2	111	NE	W	110	1.3	6	5.5
October	1,016.0	13.6	121	NE	SW	164	1.9	6	5.6
November	1,015.0	13.9	130	SW	WSW	196	2.0	5	6.5
December	1,013.3	13.5	121	W	SW	242	1.5	4	8.7
Year **Totals**	..	..	..	..	..	**1,751**	**14.9**	**65**	**82.6**
Year **Averages**	**1,017.1**	..	..	**NE**	**SW**	..	..	..	..
Year **Extremes**	..	..	**148**	..	..	..	..	..	..

(a) Mean number of days when cloud cover equalled or exceeded seven-eighths. *(b)* Mean number of days when cloud cover was less than or equal to one-eighth. *(c)* Records of cup anemometer. *(d)* 1887–1977. *(e)* Class A Pan.

CLIMATIC DATA: ADELAIDE, SOUTH AUSTRALIA — *continued*
(Lat. 34° 56′ S., Long. 138° 35′ E. Height above M.S.L. 43 metres)

TEMPERATURE AND SUNSHINE

Month	*Air temperature daily readings (°Celsius)* Mean max.	Mean min.	Mean	*Extreme air temperature (°Celsius)* Highest max.	Date	Lowest min	Date	*Extreme temperature (°Celsius)* Lowest terrestrial min.	Date	Mean daily hours sunshine
No. of years of record	122	122	122	125		125		119		95
January	29.5	16.4	23.0	47.6	12/39	7.3	21/84*	1.8	3/77	10.0
February	29.3	16.6	23.0	45.3	12/99*	7.5	23/18	2.1	23/26	9.3
March	26.8	15.1	21.0	43.6	9/34	6.6	21/33	0.1	21/33	7.9
April	22.7	12.6	17.7	37.0	5/38	4.2	15/59*	–3.5	30/77	6.0
May	18.7	10.3	14.5	31.9	4/21	(*a*)1.5	22/85	–3.6	19/28	4.8
June	15.8	8.3	12.1	25.6	4/57	(*a*)–0.4	8/82	–6.1	24/44	4.2
July	15.0	7.3	11.1	26.6	29/75	0.0	24/08	–5.5	30/29	4.3
August	16.4	7.8	12.1	29.4	31/11	0.2	17/59*	–5.1	11/29	5.3
September	18.9	9.0	13.9	35.1	30/61	0.4	4/58*	–3.9	25/27	6.2
October	22.0	10.9	16.5	39.4	21/22	2.3	20/58*	–3.0	22/66	7.2
November	25.1	12.9	19.1	45.3	21/65*	4.9	2/09	–0.6	17/76	8.6
December	27.7	15.0	21.3	45.9	29/31	6.1	(*b*)	–1.0	19/76	9.4
Year Averages	**22.3**	**11.9**	**17.1**	..	..	..	..	..	..	**6.9**
Year Extremes	..	..	..	**47.6**	**12/1/39**	**–0.4**	**24/7/08**	**–6.1**	**24/6/44**	

(*a*) Recorded at Kent Town. (*b*) 16/1861 and 4/1906.
NOTE: Figures such as 12/39, 21/84*, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century.

HUMIDITY, RAINFALL AND FOG

Month	*Rel. hum. (%)* 9 a.m. mean	3 p.m. mean	*Rainfall (millimetres)* Mean monthly	Mean No. of days of rain	Greatest monthly		Least monthly		Greatest in one day	Date	Mean No. days fog
No. of years of record	122	111	140	140		140		140	140		77
January	42	34	20	4	84	(1941)	Nil	(*a*)	58	2/89*	0.0
February	45	35	21	4	155	(1925)	Nil	(*a*)	141	7/25	0.0
March	49	39	24	5	117	(1878)	Nil	(*a*)	89	5/78*	0.0
April	58	47	44	9	154	(1971)	Nil	(1945)	80	5/60*	0.0
May	69	57	68	13	197	(1875)	3	(1934)	70	1/53*	0.4
June	76	64	72	15	218	(1916)	6	(1958)	54	1/20	1.1
July	77	64	66	16	(*b*)160	(1890)	10	(1899)	44	10/65*	1.3
August	71	58	61	15	157	(1852)	8	(1944)	57	19/51*	0.6
September	62	52	51	13	148	(1923)	7	(1951)	40	20/23	0.2
October	53	45	44	11	133	(1949)	1	(1969)	57	16/08	0.0
November	46	39	31	8	113	(1839)	1	(1967)	75	12/60	0.0
December	43	36	26	6	101	(1861)	Nil	(1904)	61	23/13	0.0
Year Totals	..	..	**528**	**119**		..		..	..	..	**3.6**
Year Averages	**58**	**48**	..	..		..		..	..	..	..
Year Extremes	..	..	..	..	**218**	**(6/1916)**	**Nil**	**(*c*)**	**141**	**7/2/25**	..

(*a*) Various years. (*b*) Kent Town. (*c*) December to April, various years.
NOTE: Figures such as 2/89*, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century. Bracketed figures indicate year of occurrence.
In February, 1977, the Adelaide Regional Office of the Bureau of Meteorology moved from West Terrace to Kent Town. Averages presented is this table are calculated from the observations recorded at West Terrace. Extremes recorded at Kent Town are marked.

CLIMATIC DATA: PERTH, WESTERN AUSTRALIA
(Lat. 31° 57′ S., Long. 115° 51′ E. Height above M.S.L. 19.5 metres)

BAROMETER, WIND, EVAPORATION, THUNDER, CLOUDY AND CLEAR DAYS

Month		Mean of 9 a.m and 3 p.m. atmospheric pressure reduced to mean sea level (hPa)	Wind (height of anemometer 22 metres) Average (km/h)	Highest gust speed (km/h)	Prevailing direction 9 a.m.	Prevailing direction 3 p.m.	Mean amount evaporation (mm)	Mean No. days thunder	Mean No. cloudy days (a)	Mean No. clear days (b)
No. of years of record		94	46	68	(c)	(c)	(d)12	82	45	46
January		1,012.6	17.5	81	E	SW	285	0.9	2	14
February		1,013.0	17.2	113	E	SW	242	0.7	2	13
March		1,015.2	16.2	113	E	SW	213	0.7	2	12
April		1,017.9	13.7	130	E	SW	132	0.9	5	9
May		1,017.9	13.5	119	NE	SW	94	1.7	6	6
June		1,017.6	13.5	129	NE	NW	69	1.8	7	5
July		1,018.8	14.2	137	NE	NW	75	1.5	6	5
August		1,018.8	15.1	156	NE	W	87	1.3	5	6
September		1,018.4	15.1	109	E	SW	118	0.7	4	8
October		1,017.0	16.1	105	E	SW	173	0.7	3	8
November		1,015.5	17.2	101	E	SW	216	0.8	3	9
December		1,013.4	17.7	103	E	SW	275	0.9	2	13
	Totals	..	..	..	..	..	**1,979**	**12.6**	**47**	**108**
Year	**Averages**	**1,016.4**	**15.6**	..	**E**	**SW**	..	..	..	..
	Extremes	..	..	**156**	..	..	..	..	..	..

(a) Mean number of days when cloud cover equalled or exceeded seven-eighths. *(b)* Mean number of days when cloud cover was less than or equal to one-eighth. *(c)* 1942-1988. *(d)* Class A Pan.

TEMPERATURE AND SUNSHINE

Month		Air temperature daily readings (°Celsius) Mean max.	Mean min.	Mean	Extreme air temperature (°Celsius) Highest max.	Date	Lowest min.	Date	Extreme temperature (°Celsius) Lowest terrestrial min.	Date	Mean daily hours sunshine
No. of years of record		85	85	85	85		85		84		81
January		29.6	17.7	23.5	44.7	12/78	9.2	20/25	4.2	20/25	10.5
February		29.9	17.9	23.7	44.6	8/33	8.7	1/02	4.3	1/13	10.1
March		27.8	16.6	22.2	41.3	14/22	7.7	8/03	2.6	(a)	9.0
April		24.5	14.1	19.2	37.6	9/10	4.1	20/14	-0.7	26/60	7.4
May		20.7	11.6	16.1	32.4	2/07	1.3	11/14	-3.9	31/64	5.9
June		18.2	9.9	14.1	28.1	5/75	1.6	22/55	-3.4	27/46	4.9
July		17.3	9.0	13.2	26.3	17/76	1.2	7/16	-3.8	30/20	5.3
August		17.9	9.1	13.5	27.8	21/40	1.9	31/08	-3.0	18/66	6.2
September		19.4	10.1	14.8	32.7	30/18	2.6	6/56	-2.7	(b)	7.2
October		21.2	11.5	16.3	37.3	29/67	4.2	6/68	-1.2	16/31	8.3
November		24.6	14.0	19.2	40.3	24/13	5.6	1/04	-1.1	6/71	9.7
December		27.3	16.2	21.7	42.3	31/68	8.6	29/57	3.3	29/57	10.6
Year	**Averages**	**23.2**	**13.1**	**18.2**	..	..	..	..	..	..	**7.9**
	Extremes	..	..	..	**44.7**	**12/1/78**	**1.2**	**7/7/16**	**-3.9**	**31/5/64**	

(a) 8/1903 and 16/1967. *(b)* 8/1952 and 6/1956.
NOTE: Figures such as 12/78, 20/25 indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century.

CLIMATIC DATA: PERTH, WESTERN AUSTRALIA — *continued*
(Lat. 31° 57′ S., Long. 115° 51′ E. Height above M.S.L. 19.5 metres)

HUMIDITY, RAINFALL AND FOG

		Rel. hum. (%)		Rainfall (millimetres)								
Month		9 a.m. mean	3 p.m. mean	Mean monthly	Mean No. of days of rain	Greatest monthly		Least monthly		Greatest in one day	Date	Mean No. days fog
No. of years of record		44	44	106	102	106		106		102		79
January		50	41	8	3	55	(1879)	Nil	(a)	44	27/79*	0.2
February		53	40	12	3	166	(1955)	Nil	(a)	87	17/55	0.3
March		57	42	20	4	145	(1934)	Nil	(a)	77	9/34	0.6
April		65	49	45	8	149	(1926)	Nil	(1920)	67	30/04	0.9
May		72	53	124	14	308	(1879)	14	(1964)	76	17/42	1.3
June		78	60	183	17	476	(1945)	55	(1877)	99	10/20	1.4
July		78	60	174	18	425	(1958)	61	(1876)	76	4/91*	1.6
August		74	57	137	17	318	(1945)	12	(1902)	74	14/45	1.0
September		68	54	80	14	199	(1923)	9	(1916)	47	18/66	0.3
October		59	49	55	11	200	(1890)	1	(1969)	55	1/75	0.4
November		54	46	21	6	71	(1916)	Nil	(1891)	39	29/56	0.2
December		51	44	14	4	81	(1951)	Nil	(a)	47	3/51	0.2
	Totals	..	..	**873**	**119**		..		..	..	..	**8.1**
Year	**Averages**	**63**	**50**	..	..		..		..	..	. .	..
	Extremes	..	..	..	..	**476**	**(6/1945)**	**Nil**	**(a)**	**99**	**10/6/20**	..

(a) Various years.
NOTE: Figures such as 27/79*, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century. Bracketed figures indicate year of occurrence.

CLIMATIC DATA: HOBART, TASMANIA
(Lat. 42° 53′ S., Long. 147° 20′ E. Height above M.S.L. 54 metres)

BAROMETER, WIND, EVAPORATION, THUNDER, CLOUDY AND CLEAR DAYS

		Mean of 9 a.m and 3 p.m. atmospheric pressure reduced to mean sea level (hPa)	Wind (height of anemometer 12 metres)							
Month			Average (km/h)	Highest gust speed (km/h)	Prevailing direction 9 a.m.	Prevailing direction 3 p.m.	Mean amount evaporation (mm)	Mean No. days thunder	Mean No. cloudy days (a)	Mean No. clear days (b)
No. of years of record		99	76	96	(c)	(c)	(d)11	75	42	44
January		1,010.6	12.7	130	NNW	SE	142	1.0	10	1.9
February		1,012.9	11.7	121	NNW	SE	123	0.9	9	2.3
March		1,014.3	11.1	127	NW	SE	92	0.8	11	2.4
April		1,015.5	11.0	141	NW	NW	59	0.3	11	1.7
May		1,015.5	10.8	135	NW	NW	36	Nil	13	2.4
June		1,015.4	10.2	132	NW	NW	20	Nil	11	2.4
July		1,014.1	10.9	129	NNW	NW	24	Nil	10	2.0
August		1,012.8	11.1	140	NNW	NW	43	Nil	11	2.1
September		1,011.4	12.5	150	NNW	NW	59	0.1	10	1.5
October		1,010.5	12.6	140	NW	SE	90	0.4	12	1.0
November		1,009.9	12.8	135	NW	SE	121	0.6	12	1.3
December		1,009.4	12.5	122	NW	SE	144	0.8	12	1.1
	Totals	..	..	..	..	..	**953**	**4.9**	**132**	**22.1**
Year	**Averages**	**1,012.7**	**11.7**	..	**NW**	**SE**	..	..	..	..
	Extremes	..	..	**150**	..	..	..	..	..	..

(a) Mean numbers of days when cloud equalled or exceeded seven-eighths. (b) Mean number of days when cloud cover was less than or equal to one-eighth. (c) 1944-1988. (d) Class–A with Bird Guard.

CLIMATIC DATA: HOBART, TASMANIA — *continued*
(Lat. 42° 53′ S., Long. 147° 20′ E. Height above M.S.L. 54 metres)

TEMPERATURE AND SUNSHINE

Month	*Air temperature daily readings (°Celsius)* Mean max.	Mean min.	Mean	*Extreme air temperature (°Celsius)* Highest max.	Date	Lowest min.	Date	*Extreme temperature (°Celsius)* Lowest terrestrial min.	Date	Mean daily hours sunshine
No. of years of record	101	101	101		101		101	99		75
January	21.5	11.7	16.5	40.8	4/76	4.5	9/37	-0.8	19/97*	7.7
February	21.6	11.9	16.7	40.2	12/99*	3.4	10/80*	-2.0	—/87*	6.9
March	20.0	10.7	15.2	37.3	13/40	1.8	31/26	-2.5	30/02	6.2
April	17.1	8.8	12.9	30.6	1/41	0.6	14/63	-3.9	—/86*	5.0
May	14.9	6.8	10.5	25.5	5/21	-1.6	30/02	-6.7	19/02	4.2
June	11.8	5.1	8.5	20.6	1/07	-2.8	25/72	-7.7	24/63	3.8
July	11.5	4.4	7.9	21.0	30/75	-2.8	11/81	-7.5	1/78	4.2
August	12.9	5.1	9.1	24.5	26/77	-1.8	5/62	-6.6	7/09	4.9
September	14.9	6.3	10.6	28.2	29/73	-0.6	16/97*	-7.6	16/26	5.7
October	16.9	7.6	12.2	33.4	24/14	0.0	12/89*	-4.6	*(a)*	6.3
November	18.5	9.1	13.8	36.8	26/37	1.6	16/41	-3.4	1/08	6.9
December	20.2	10.6	15.4	40.7	30/97*	3.3	3/06	-2.6	—/86*	7.2
Year Averages	**16.8**	**8.2**	**12.4**	..	..	..	..	..	..	**5.8**
Year Extremes	..	..	..	**40.8**	**4/1/1976**	**-2.8**	**11/7/81 and 25/6/72**	**-7.7**	**24/6/1963**	..

(a) 1/1886 and 1/1899
NOTE: Figures such as 4/76, 9/37, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century.

HUMIDITY, RAINFALL AND FOG

Month	*Rel. hum. (%)* 9 a.m. mean	3 p.m. mean	*Rainfall (millimetres)* Mean monthly	Mean No. of days of rain	Greatest monthly		Least monthly		Greatest in one day	Date	Mean No. days fog
No. of years of record	86	86	105	105		101		101	101		73
January	59	53	48	11	150	(1893)	4	(1958)	75	30/16	0.1
February	63	55	40	10	171	(1964)	3	(1914)	56	1/54	Nil
March	66	55	47	11	255	(1946)	7	(1943)	88	17/46	0.2
April	70	59	53	12	248	(1960)	2	(1904)	132	23/60	0.3
May	76	63	49	14	214	(1958)	4	(1913)	47	3/73	1.2
June	79	68	57	14	238	(1954)	2	(1979)	147	7/54	1.6
July	78	66	53	15	157	(1974)	4	(1950)	64	18/22	1.3
August	74	60	52	15	161	(1946)	8	(1892)	65	2/76	0.6
September	66	56	53	15	201	(1957)	10	*(a)*	156	15/57	0.2
October	62	56	63	16	193	(1947)	9	(1982)	66	4/06	0.1
November	60	55	56	14	188	(1885)	9	*(b)*	94	30/85*	0.1
December	59	58	57	13	206	(1985)	5	*(c)*	85	5/41	0.1
Year Totals	..	..	**628**	**160**		..		..	..	..	**5.8**
Year Averages	**68**	**59**	..	..		..		..	..	..	..
Year Extremes	..	..	..	..	**255**	**(3/1946)**	**2**	***(d)***	**156**	**15/9/57**	..

(a) 1891 and 1951. *(b)* 1919 and 1921. *(c)* 1897,1915 and 1931. *(d)* 4/1904 and 6/1979.
NOTE: Figures such as 30/16, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century. Bracketed figures indicate year of occurrence.

CLIMATIC DATA: DARWIN AIRPORT, NORTHERN TERRITORY
(Lat. 12° 25′ S., Long. 130° 52′ E. Height above M.S.L. 31 metres)

BAROMETER, WIND, EVAPORATION, THUNDER, CLOUDY AND CLEAR DAYS

Month		*Mean of 9 a.m and 3 p.m. atmospheric pressure reduced to mean sea level (hPa)*	*Wind (height of anemometer 36 metres)*				*Mean amount evaporation (mm)*	*Mean No. days thunder*	*Mean No. cloudy days (a)*	*Mean No. clear days (b)*
			Average (km/h)	*Highest gust speed (km/h)*	*Prevailing direction 9 a.m.*	*Prevailing direction 3 p.m.*				
No. of years of record		95	45	(c)29			(d)13	45	45	45
January		1,006.4	9.7	100	W	NW	185	15	21	0
February		1,006.4	11.1	96	W	NW	162	11	19	0
March		1,007.6	9.3	107	W	NW	172	11	16	1
April		1,009.6	9.7	117	SE	NW	189	4	9	4
May		1,010.9	10.5	63	SE	E	200	0	5	9
June		1,012.6	10.7	67	SE	E	189	0	3	13
July		1,013.1	9.7	61	SE	E	201	0	3	16
August		1,012.6	9.7	65	SE	NW	203	0	2	15
September		1,012.1	11.0	67	ENE	NW	232	1	2	11
October		1,010.6	10.9	96	NE	NW	254	5	4	6
November		1,008.7	9.1	117	NW	NW	230	12	8	2
December		1,007.4	9.7	217	NW	NW	205	15	15	0
	Totals	..	..	..	..	..	**2,422**	**74**	**105**	**77**
Year	**Averages**	**1,009.8**	**10.1**	..	SE	NW	..	..	..	..
	Extremes	..	..	**217**	..	..	..	..	..	..

(a) Mean number of days when cloud cover equalled or exceeded seven-eighths. *(b)* Mean number of days when cloud cover was less than or equal to one-eighth. *(c)* Several incomplete years. *(d)* Class A Pan.

TEMPERATURE AND SUNSHINE

Month		*Air temperature daily readings (°Celsius)*			*Extreme air temperature (°Celsius)*				*Extreme temperature (°Celsius)*		*Mean daily hours sun-shine*
		Mean max.	*Mean min.*	*Mean*	*Highest max.*	*Date*	*Lowest min.*	*Date*	*Lowest terrestrial min.*	*Date*	
No. of years of record		45	45	45	(a)100		(a)100				31
January		31.7	24.7	28.2	37.8	2/82*	20.0	20/92*	..	..	5.6
February		31.4	24.6	28.0	38.3	20/87*	17.2	25/49	..	..	5.9
March		31.8	24.4	28.1	38.9	(b)	19.2	31/45	..	..	6.6
April		32.6	23.9	28.3	40.0	7/83*	16.0	11/43	..	..	8.7
May		31.9	21.9	26.9	39.1	8/84*	14.2	28/67	..	..	9.5
June		30.4	19.8	25.1	39.0	17/37	12.1	23/63	..	..	9.9
July		30.3	19.2	24.8	36.7	17/88*	10.4	29/42	..	..	10.1
August		31.2	20.6	25.9	37.0	30/71*	13.6	11/63	..	..	10.2
September		32.4	23.0	27.7	38.9	20/82*	16.7	9/63	..	..	9.8
October		33.0	24.9	29.0	40.5	17/92*	19.4	8/66	..	..	9.4
November		33.1	25.2	29.2	39.6	9/84*	19.3	4/50	..	..	8.4
December		32.5	25.2	28.9	38.9	20/82*	18.3	4/60	..	..	7.2
Year	**Averages**	**31.9**	**23.1**	**27.5**	..	..	..	..	..	..	**8.4**
	Extreme	..	..	..	**40.5**	**17/10/1892**	**10.4**	**29/7/1942**	..	..	..

(a) Years 1882–1941 at Post Office; 1942–1981 at Aerodrome; 1967–1973 at Regional office; sites not strictly comparable.
(b) 26/1883 and 27/1883.
NOTE: Figures such as 2/824, 20/92*, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century.

CLIMATIC DATA DARWIN AIRPORT, NORTHERN TERRITORY — *continued*
(Lat. 12° 25′ S., Long. 130° 52′ E. Height above M.S.L. 31 metres)

HUMIDITY, RAINFALL AND FOG

		Rel. hum. (%)		Rainfall (millimetres)								
Month		9 a.m. mean	3 p.m. mean	Mean monthly	Mean No. of days of rain	Greatest monthly		Least monthly		Greatest in one day	Date	Mean No. days fog
No. of years of record		41	41	45	45	116	(a)	45	116	(a)		45
January		82	70	409	21	906	(1981)	136	(1965)	296	7/97*	Nil
February		84	72	355	20	815	(1969)	103	(1959)	250	18/55	Nil
March		83	67	316	19	1,014	(1977)	88	(1978)	241	16/77	Nil
April		75	52	99	9	357	(1953)	1	(1946)	143	4/59	Nil
May		67	43	17	2	299	(1968)	Nil	(b)	58	23/79	Nil
June		63	39	2	Nil	41	(1973)	Nil	(b)	36	10/02	Nil
July		64	38	1	Nil	10	(1955)	Nil	(b)	43	12/00	1
August		68	41	6	1	84	(1947)	Nil	(b)	80	2/47	1
September		71	48	18	2	130	(1981)	Nil	(b)	71	21/42	Nil
October		71	53	72	6	339	(1954)	Nil	(1953)	95	28/56	Nil
November		74	59	142	12	371	(1964)	17	(1976)	120	19/51	Nil
December		77	65	224	16	665	(1974)	56	(1961)	277	25/74	Nil
	Total	..	..	**1,661**	**108**		..		..	..	..	**2**
Year	**Averages**	**73**	**54**	..	..		..		..	..	..	..
	Extremes	..	..	..	..	**1,014**	**(3/77)**	**Nil**	**(c)**	**296**	**7/1/1897**	..

(a) Highest or lowest, at either Post Office, Aerodrome or Regional Office Sites, Regional Office 1964–1973 only. *(b)* Various years. *(c)* April to October. Various years.
NOTE: Figures such as 7/97*, indicate, in respect of the month of reference, the day and year of occurence. Dates marked with an asterisk (*) relate to the nineteenth century. Bracketed figures indicate year of occurrence.

CLIMATIC DATA: CANBERRA, AUSTRALIAN CAPITAL TERRITORY
(Lat. 35° 19′ S., Long. 149° 11′ E. Height above M.S.L. 577 metres)

BAROMETER, WIND, EVAPORATION, THUNDER, CLOUDY AND CLEAR DAYS

		Mean of 9 a.m and 3 p.m. atmospheric pressure reduced to mean sea level (hPa)	Wind (height of anemometer 10 metres)							
Month			Average (km/h)	Highest gust speed (km/h)	Prevailing direction 9 a.m.	Prevailing direction 3 p.m.	Mean amount evaporation (mm)	Mean No. days thunder	Mean No. cloudy days (a)	Mean No. clear days (b)
No. of years of record		35	(c)23	47	43	43	(d)20	47	47	47
January		1,012.1	6.1	121	NW	NW	259	3.9	8	7.3
February		1,013.8	5.3	104	SE	NW	205	3.5	8	6.1
March		1,016.1	4.7	111	SE	NW	172	1.9	9	6.8
April		1,018.9	4.2	106	NW	NW	109	1.1	7	6.7
May		1,019.9	4.5	104	NW	NW	70	0.5	9	6.6
June		1,020.9	4.2	96	NW	NW	48	0.2	10	6.2
July		1,020.4	4.9	102	NW	NW	53	0.1	8	7.1
August		1,018.5	5.6	113	NW	NW	79	0.8	8	6.7
September		1,017.4	6.0	107	NW	NW	110	1.5	8	7.6
October		1,015.1	6.4	121	NW	NW	157	2.5	9	5.9
November		1,012.7	6.6	128	NW	NW	195	3.5	9	5.1
December		1,011.0	6.8	106	NW	NW	261	3.7	8	6.7
	Totals	..	..	..	..	..	**1,718**	**23.2**	**101**	**78.8**
Year	**Averages**	**1,016.4**	**5.4**	..	**NW**	**NW**	..	..	..	**6.6**
	Extremes	..	..	**128**	..	..	..	..	..	..

(a) Mean number of days when cloud cover equalled or exceeded seven-eighths. *(b)* Mean number of days when cloud cover was less than or equal to one-eighth. *(c)* Recorded at Yarralumla, where a cup anemometer was installed up to 1980. *(d)* Class A Pan.

CLIMATIC DATA: CANBERRA, AUSTRALIAN CAPITAL TERRITORY — *continued*
(Lat. 35° 19′ S., Long. 149° 11′ E. Height above M.S.L. 577 metres)

TEMPERATURE AND SUNSHINE

	Air temperature daily readings (°Celsius)			*Extreme air temperature (°Celsius)*				*Extreme temperature (°Celsius)*		*Mean daily hours sun-shine*
Month	*Mean max.*	*Mean min.*	*Mean*	*Highest max.*	*Date*	*Lowest min.*	*Date*	*Lowest terrestrial min.*	*Date*	
No. of years of record	47	47	47		47		47		36	12*(a)*
January	27.7	12.9	20.3	41.4	31/68	1.8	1/56	–0.4	1/56	9.7
February	26.9	12.9	19.9	42.2	1/68	3.0	16/62	–0.5	9/80	9.3
March	24.4	10.7	17.5	36.5	8/83	–1.1	24/67	–4.0	*(b)*	7.8
April	19.6	6.5	13.1	32.6	*(c)*	–3.6	*(d)*	–8.3	24/69	7.3
May	15.1	2.9	9.0	24.5	10/67	–7.5	30/76	–11.0	17/79	5.5
June	12.0	0.8	6.4	20.1	3/57	–8.5	8/57	–13.4	25/71	5.4
July	11.1	–0.3	5.4	19.7	29/75	–10.0	11/71	–15.1	11/71	5.7
August	12.8	0.8	6.8	24.0	30/82	–7.8	6/74	–13.0	3/79	6.7
September	15.9	2.9	9.4	28.6	26/65	–6.4	10/82	–10.7	10/82	7.3
October	19.1	5.9	12.5	32.7	13/46	–3.3	4/57	–7.0	1/82	8.3
November	22.5	8.4	15.5	38.8	19/44	–1.8	28/67	–6.3	28/67	8.9
December	26.0	11.1	18.5	38.8	21/53	1.1	18/64	–3.9	18/64	9.3
Year Averages	**19.4**	**6.3**	**12.9**	..	..	..	..	..	..	**7.6**
Year Extremes	..	..	..	**(e)42.2**	**1/2/68**	**–10.0**	**11/7/71**	**–15.1**	**11/7/71**	..

(a) Composite of Airport and city. *(b)* 30/58 and 24/67. *(c)* 12/68 and 4/86. *(d)* 27 and 28/78. *(e)* 42.8 recorded at Acton on 11/1/39.
NOTE: Figures such as 31/68, 1/56, indicate, in respect of the month of reference, the day and year of occurence.

HUMIDITY, RAINFALL AND FOG

	Rel. hum. (%)		*Rainfall (millimetres)*									*Mean No. days fog*
Month	*9 a.m. mean*	*3 p.m. mean*	*Mean monthly*	*Mean No. of days of rain*	*Greatest monthly*		*Least monthly*		*Greatest in one day*	*Date*		
No. of years of record	47	47	47	47	47		47		47			47
January	60	34	60	8	185	(1984)	1	(1947)	95	12/45		1.0
February	66	39	57	7	148	(1977)	Nil	(1968)	69	20/74		1.0
March	68	41	54	7	312	(1950)	1	(1954)	92	21/78		2.7
April	75	46	50	8	164	(1974)	1	(1980)	75	2/59		4.1
May	81	55	48	9	150	(1953)	Nil	(1982)	96	3/48		7.8
June	84	60	37	9	126	(1956)	4	(1979)	45	25/56		8.1
July	84	58	39	10	104	(1960)	4	*(a)*	35	10/57		7.8
August	78	53	49	12	156	(1974)	7	(1944)	48	29/74		5.2
September	72	49	52	11	151	(1978)	6	(1946)	43	8/78		3.9
October	65	47	69	11	161	(1976)	2	(1977)	105	21/59		3.0
November	60	40	62	9	135	(1961)	Nil	(1982)	68	19/86		1.3
December	57	34	49	8	215	(1947)	Nil	(1967)	87	30/48		0.7
Year Totals	..	..	**626**	**109**		..		..	..	..		**46.6**
Year Averages	**71**	**46**	..	..		..		..	..	..		..
Year Extremes	..	..	..	..	**312**	**(3/50)**	**Nil**	***(b)***	**105**	**21/10/59**		..

(a) 1970 and 1982. *(b)*12/67, 2/68, 5/82 and 11/82.
NOTE: Data shown in the above tables relate to the Canberra Airport Meteorological Office, except where otherwise indicated, and cover years up to 1987.
Figures such as 12/45, indicate, in respect of the month of reference, the day and year of occurence.

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