CHAPTER 2

CLIMATE AND PHYSICAL GEOGRAPHY OF AUSTRALIA

General description of Australia

This chapter has been prepared by the Bureau of Meteorology, Department of Science. It is mainly concerned with the climate of Australia, although some geographic comparisons and a summary of landform features influencing climate have been included together with a summary of atmospheric climatic controls.

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

The island continent of Australia is relatively dry with 50 per cent of the area having a median rainfall of less than 300 millimetres per year and 80 per cent less than 600 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 ocean to the south. 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.

Position and area

Position. Australia, including Tasmania, 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 East 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, Wilson's Promontory (South East Cape, Tasmania) is about 3,180 kilometres (3,680 kilometres) respectively and the longitudinal distance between Steep Point and Cape Byron is about 4,000 kilometres.

Area of Australia compared with areas of 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 U.S.S.R.) and 32 times greater than the United Kingdom. The following table shows the area of Australia in relation to areas of other continents and countries.

AREAS OF CONTINENTS AND COUNTRIES, *circa* 1970
('000 square kilometres)

Country	Area	Country	Area
Continental divisions—		Europe(a)—	
Europe(a)	4,936	France	547
Asia(a)	27,532	Spain (including possessions)	505
U.S.S.R. (Europe and Asia)	22,402	Sweden	450
Africa	30,319	Finland	337
North and Central America and West Indies	24,247	Norway	324
South America	17,834	Poland	313
Oceania	8,504	Italy	301
		Yugoslavia	256
		Germany, Federal Republic of	248
		United Kingdom	244
		Romania	237
Total, World excluding Arctic and Antarctic continents	**135,771**	Other	1,189

(a) Excludes U.S.S.R., shown below.

AREAS OF CONTINENTS AND COUNTRIES, *circa* 1970—*continued*
('000 square kilometres)

Country	*Area*	*Country*	*Area*
Asia(*a*)—		Africa—*continued*	
China, Peoples Republic of	9,561	Somalia	638
India	3,268	Central African Republic	623
Saudi Arabia	2,150	Madagascar	587
Iran	1,648	Kenya	583
Mongolia	1,565	Other	4,812
Indonesia	1,492		
Pakistan	947		
Turkey	781	North and Central America—	
Burma	678	Canada	9,976
Afghanistan	647	United States of America(*b*)	9,363
Thailand	514	Greenland	2,176
Iraq	435	Mexico	1,973
Other	4,058	Nicaragua	130
		Cuba	115
		Honduras	112
U.S.S.R.	22,402	Other	401
Africa—			
Sudan	2,506	South America—	
Algeria	2,382	Brazil	8,512
Congo, People's Republic of the	342	Argentina	2,777
Zaire	2,345	Peru	1,285
Libya	1,760	Colombia (excluding Panama)	1,134
Chad	1,284	Bolivia	1,099
Niger	1,267	Venezuela	912
Angola	1,247	Chile	757
South Africa, Republic of	1,221	Paraguay	407
Mali	1,240	Ecuador	284
Ethiopia	1,222	Other	653
Mauritania	1,031		
United Arab Republic	1,001		
Tanzania, United Republic of	945	Oceania—	
Nigeria	924	Australia	7,682
South-West Africa	824	New Zealand	269
Mozambique	783	Papua New Guinea(*c*)	462
Zambia	752	Other	91

(*a*) Excludes U.S.S.R., shown below. (*b*) Includes Hawaii. (*c*) West Irian is included in Other Asia.

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 Division of National Mapping, Department of Minerals and Energy, *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 kilometres. 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

NOTE. *See* paragraphs page 26 for methods of estimating area and coastline.

State or Territory	*Estimated area* — *Total*	*Estimated area* — *Percentage of total area*	*Length of coastline*	*Percentage of total area in* — *Tropical zone*	*Percentage of total area in* — *Temperate zone*	*Standard time* — *Meridian selected*	*Standard time* — *Ahead of G.M.T.*
	km²		km				hours
New South Wales . .	801,600	10.43	1,900	..	100	150°E	10.0
Victoria	227,600	2.96	1,800	..	100	150°E	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	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	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	10.0
Australia . . .	**7,682,300**	**100.00**	**36,735**	**39**	**61**	..	..

Landforms

The average altitude of the surface of the Australian land mass is only about 300 metres. Approximately 87 per cent of the total land mass is less than 500 metres and 99.5 per cent is less than 1,000 metres. The highest point is Mount Kosciusko (2,228 metres) and the lowest point is Lake Eyre (−15 metres).

Australia has three major landform features: the western plateau, the interior lowlands and the eastern uplands. The western half of the continent consists mainly of a great plateau of altitude 300 to 600 metres. The interior lowlands include the channel country of southwest Queensland (drainage to Lake Eyre) and the Murray–Darling system to the south. The eastern uplands consist of a broad belt of varied width extending from north Queensland to Tasmania and consisitng largely of tablelands, ranges and ridges with only limited mountain areas above 1,000 metres.

The rivers of Australia may be divided into two major classes, those of the coastal plains with moderate rates of fall and those of the central plains with very slight fall. Of the rivers of the northern part of the east coast, the longest are the Burdekin and the Fitzroy in Queensland. The Hunter is the largest coastal river of New South Wales, and the Murray River, with its great tributary the Darling, 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 total length of the Murray is about 2,520 kilometres, about 650 being in South Australia and about 1,870 kilometres from South Australia to the source. The Darling from its junction with the Murray to its junction with the Culgoa is 1,390 kilometres. The Upper Darling (1,140 kilometres) incorporates the Barwon which commences at the junction of the Culgoa to its junction with the Weir River and the Macintyre River from its junction with the Weir to its source near Maybole. The rivers of the north-west coast of Australia (Western Australia), e.g. the Murchison, Gascoyne, Ashburton, Fortescue, De Grey, Fitzroy, Drysdale, and Ord are of considerable size. So also are those 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.

The 'lakes' of Australia may be divided into three classes: true permanent lakes; lakes which, being very shallow, become mere morasses in dry seasons or even dry up, and finally present a cracked surface of salt and dry mud; and lakes which are really inlets of the ocean, opening out into a lake-like expanse. The second class, which are a characteristic of the interior lowlands are of considerable extent. The largest are Lake Eyre 9,500 square kilometres, Lake Torrens 5,900 square kilometres and Lake Gairdner 4,300 square kilometres.

For further information on the landforms and the geographical features of Australia earlier issues of the Year Book should be consulted. The list of special articles, etc., at the end of this volume indicates the nature of the information available and its position in the various issues.

Climate of Australia

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 interrupt the flow in the lower levels of the atmosphere.

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-eastern 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-tropic convergence zone, resulting in a hot rainy season.

Tropical cyclones develop over the seas to the north-west and the north-east of Australia in summer between November and April. Their frequency of occurrence and the tracks they follow vary greatly from season to season. On the average about three Coral Sea cyclones per season directly affect the Queensland coast; and about two Indian Ocean cyclones affect the north-western coast. Tropical cyclones approaching the coast usually produce very heavy rain 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 to three weeks.

Rainfall

Annual. The rainfall for the year 1973 is shown in plate 2, page 29. The annual 10, 50 and 90 percentile* rainfalls are shown in plates 3-5 respectively. The area of lowest rainfall is east of Lake Eyre in South Australia, where the median (50 percentile) rainfall is only about 100 millimetres. Murnpeowie with 70 years of record, has a median annual rainfall of 101 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 infrequently occur over extensive parts of the region, up to 400 millimetres of rain may fall within a few days resulting in widespread flooding.

* 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.

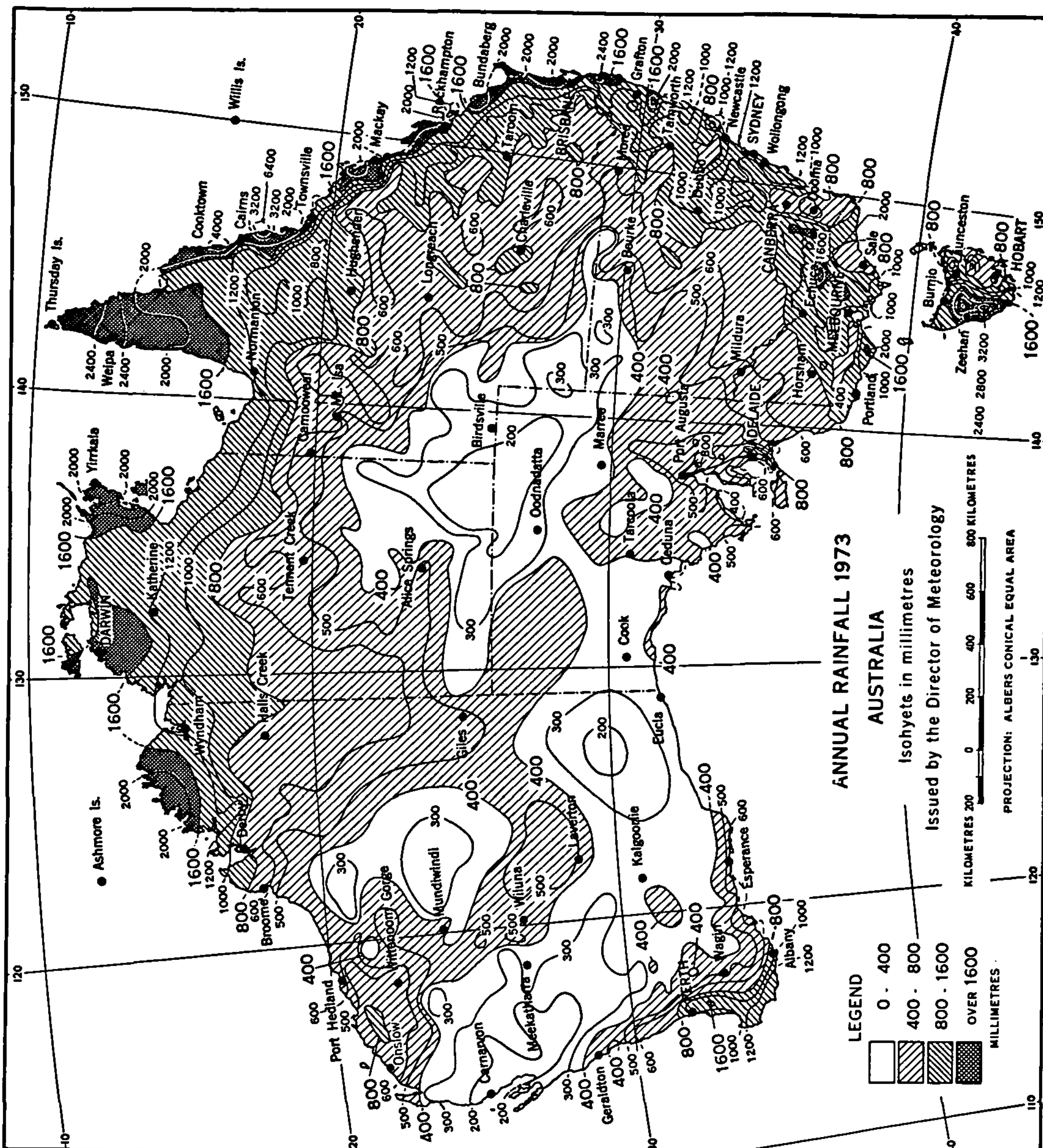
ANNUAL RAINFALL 1973
AUSTRALIA
Isohyets in millimetres
Issued by the Director of Meteorology
LEGEND
0 - 400
400 - 800
800 - 1600
OVER 1600
MILLIMETRES
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
DARWIN
BRISBANE
SYDNEY
CANBERRA
MELBOURNE
ADELAIDE
PERTH
HOBART
Alice Springs
Townsville
Cairns
Kalgoorlie

PLATE 2

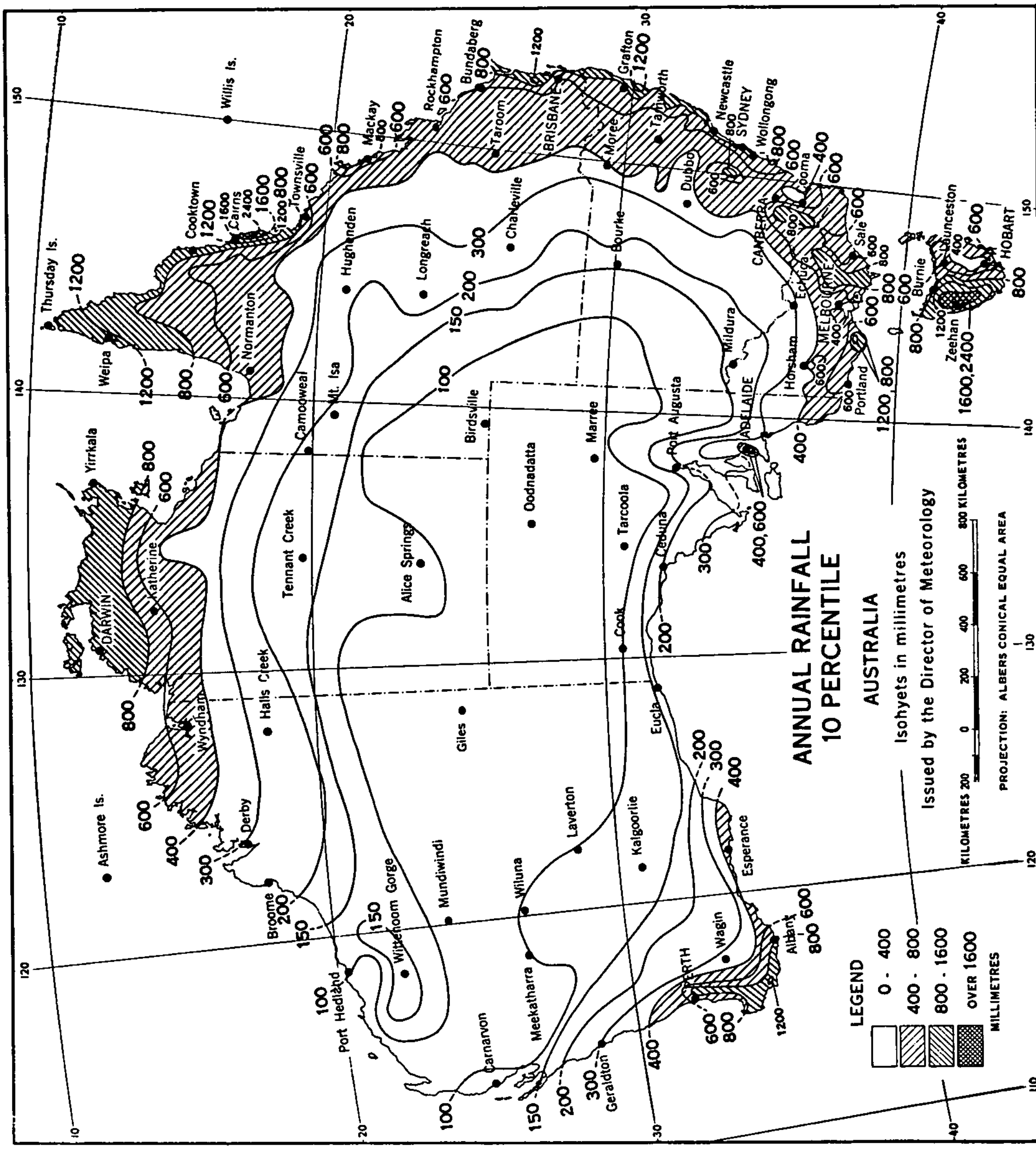
ANNUAL RAINFALL
10 PERCENTILE
AUSTRALIA
Isohyets in millimetres
Issued by the Director of Meteorology
LEGEND
0 - 400
400 - 800
800 - 1600
OVER 1600
MILLIMETRES
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
Thursday Is.
Willis Is.
Cooktown
Cairns
Townsville
Mackay
Rockhampton
Bundaberg
BRISBANE
Grafton
Tamworth
Newcastle
SYDNEY
Wollongong
CANBERRA
Cooma
MELBOURNE
Sale
Launceston
Burnie
HOBART
Zeehan
Portland
Horsham
Echuca
Mildura
ADELAIDE
Port Augusta
Ceduna
Tarcoola
Marree
Oodnadatta
Birdsville
Bourke
Dubbo
Moree
Charleville
Taroom
Longreach
Hughenden
Normanton
Weipa
Mt. Isa
Camooweal
Tennant Creek
Alice Springs
Yirrkala
DARWIN
Katherine
Wyndham
Halls Creek
Derby
Broome
Ashmore Is.
Port Hedland
Wittenoom Gorge
Mundiwindi
Giles
Wiluna
Meekatharra
Carnarvon
Geraldton
PERTH
Wagin
Albany
Esperance
Kalgoorlie
Laverton
Eucla
Cook

PLATE 3

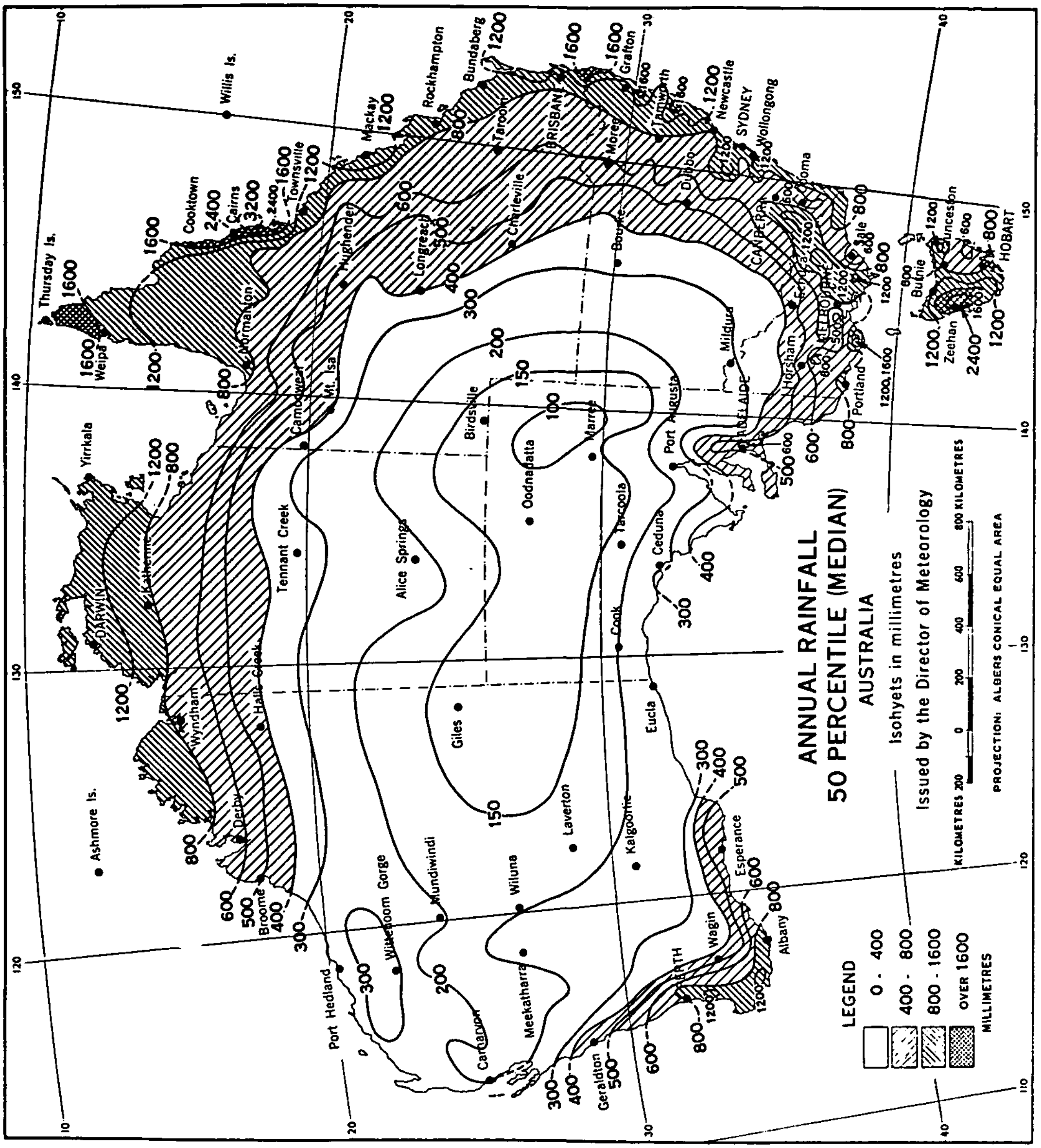
ANNUAL RAINFALL
50 PERCENTILE (MEDIAN)
AUSTRALIA
Isohyets in millimetres
Issued by the Director of Meteorology
LEGEND
0 - 400
400 - 800
800 - 1600
OVER 1600
MILLIMETRES
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
Thursday Is.
Weipa
Cooktown
Cairns
Townsville
Normanton
Willis Is.
Mackay
Rockhampton
Bundaberg
Taroom
BRISBANE
Grafton
Moree
Tamworth
Newcastle
SYDNEY
Wollongong
Dubbo
CANBERRA
Cooma
Sale
MELBOURNE
Horsham
Portland
Mildura
ADELAIDE
Port Augusta
Hughenden
Longreach
Charleville
Bourke
Cloncurry
Mt. Isa
Camooweal
Birdsville
Oodnadatta
Marree
Tarcoola
Ceduna
Cook
Eucla
Alice Springs
Tennant Creek
Yirrkala
DARWIN
Katherine
Halls Creek
Wyndham
Derby
Broome
Ashmore Is.
Port Hedland
Wittenoom Gorge
Mundiwindi
Wiluna
Meekatharra
Carnarvon
Geraldton
PERTH
Wagin
Albany
Esperance
Kalgoorlie
Laverton
Giles
Burnie
Launceston
Zeehan
HOBART

PLATE 4

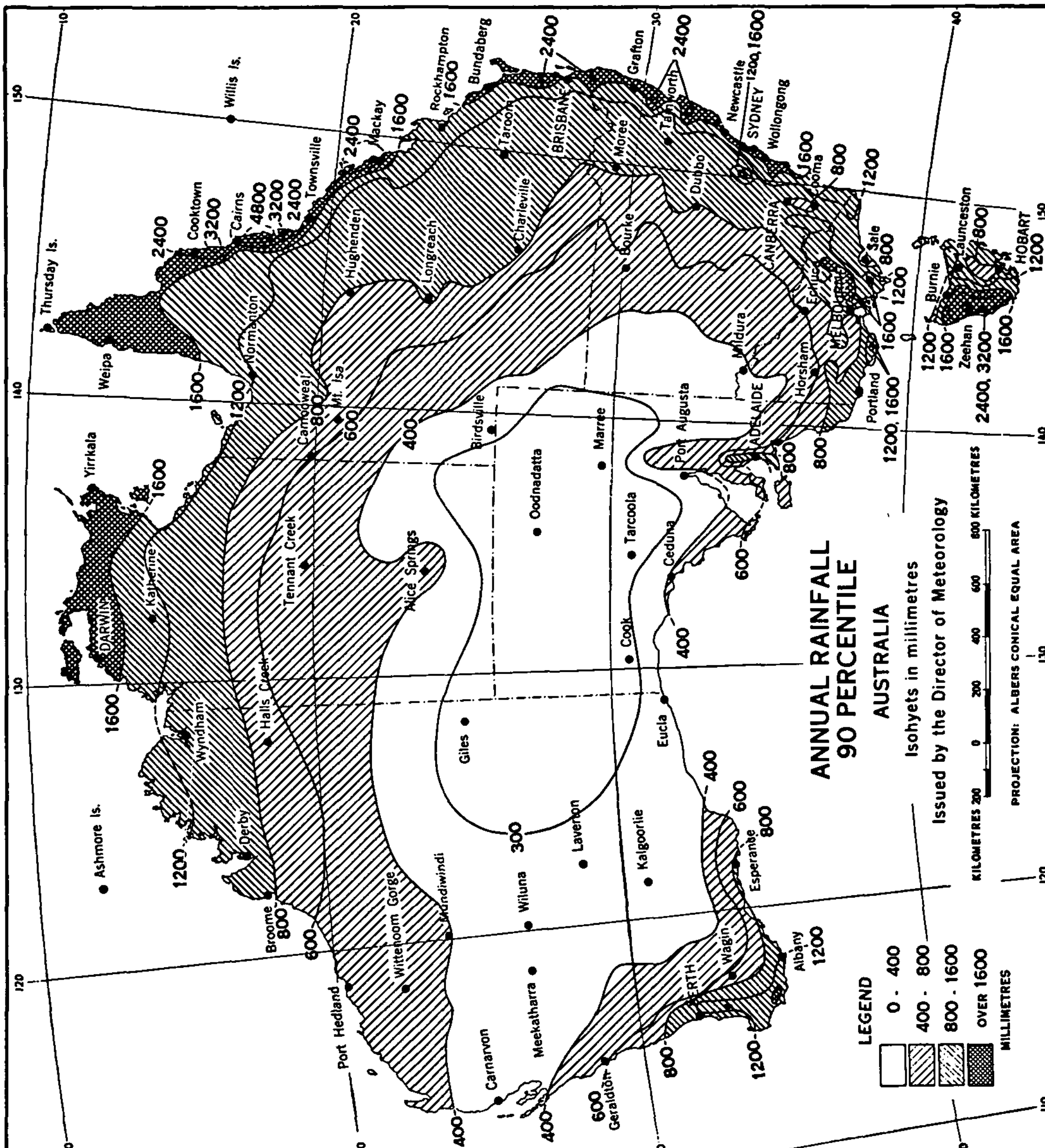
ANNUAL RAINFALL
90 PERCENTILE
AUSTRALIA
Isohyets in millimetres
Issued by the Director of Meteorology
LEGEND
0 - 400
400 - 800
800 - 1600
OVER 1600
MILLIMETRES
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
Thursday Is.
Weipa
Cooktown
Cairns
Townsville
Mackay
Rockhampton
Bundaberg
BRISBANE
Grafton
Tamworth
Newcastle
SYDNEY
Wollongong
CANBERRA
Cooma
Sale
MELBOURNE
Portland
Horsham
Mildura
ADELAIDE
Port Augusta
Ceduna
Eucla
Esperance
Albany
Wagin
PERTH
Geraldton
Carnarvon
Port Hedland
Broome
Derby
Wyndham
DARWIN
Katherine
Yirrkala
Normanton
Mt. Isa
Camooweal
Tennant Creek
Halls Creek
Alice Springs
Birdsville
Oodnadatta
Marree
Tarcoola
Cook
Giles
Laverton
Kalgoorlie
Wiluna
Meekatharra
Wittenoom Gorge
Mundiwindi
Hughenden
Longreach
Charleville
Taroom
Moree
Bourke
Dubbo
Echuca
Burnie
Launceston
Zeehan
HOBART
Ashmore Is.
Willis Is.

PLATE 5

The region with the highest median annual rainfall is the east coast of Queensland between Cairns and Cardwell, where Tully's median is highest (4,400 millimetres). The mountainous region of western Tasmania also has a high annual rainfall, with 3,600 millimetres at Lake Margaret. In the mountainous areas of north-east Victoria and some parts of the east coastal slopes there are small pockets with median annual rainfalls greater than 2,500 millimetres but the map scale is too small for these to be shown.

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. (Gaffney 1971 (i)).

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

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

Median annual rainfall	*W.A.*	*N.T.*	*S.A.*	*Qld*	*N.S.W.(a)*	*Vic.*	*Tas.*	*Aust.*
Under 200 mm . .	37.5	23.0	73.0	10.2	8.2	Nil	Nil	28.9
200 to 300 mm .	33.4	23.6	14.7	13.7	21.7	3.4	Nil	22.3
300 ,, 400 ,, .	10.8	11.4	4 5	9.8	18.0	16.6	Nil	10.8
400 ,, 500 ,, .	5.4	9.3	5.1	14.7	11.5	12.2	Nil	8.8
500 ,, 600 ,, .	4.5	6.3	1.9	12.1	8.5	17.7	0.2	7.1
600 ,, 800 ,, .	4.4	11.5	0.8	19.4	16.7	24.7	29.8	10.6
800 ,, 1,200 ,, .	3.9	7.5	Nil	14.9	12.1	19.9	29.1	8.1
Above 1,200 ,, .	0.1	7.4	Nil	5.2	3.3	5.5	40.9	3.4
Total . .	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

(*a*) Includes Australian Capital Territory.

Seasonal. As discussed under the heading of climatic controls, the rainfall pattern 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. These parameters are median annual rainfall and seasonal rainfall incidence (Gaffney 1971 (ii)). Plate 6, page 34, is a simplified version of the seasonal rainfall zones arising from this classification, originally developed on the basis of imperial rather than metric units of measurement.

Evaporation and the concept of precipitation 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:

(*a*) marked wet summer and dry winter of northern Australia;

(*b*) wet summer and relatively dry winter of south-eastern Queensland and north-eastern New South Wales;

(*c*) uniform rainfall in south-eastern Australia—much of New South Wales, parts of eastern Victoria and in southern Tasmania;

(*d*) marked wet winter and dry summer of south-west Western Australia and (to a lesser extent) of much of the remainder of southern Australia directly influenced by westerly circulation;

(*e*) arid area comprising about half of 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.

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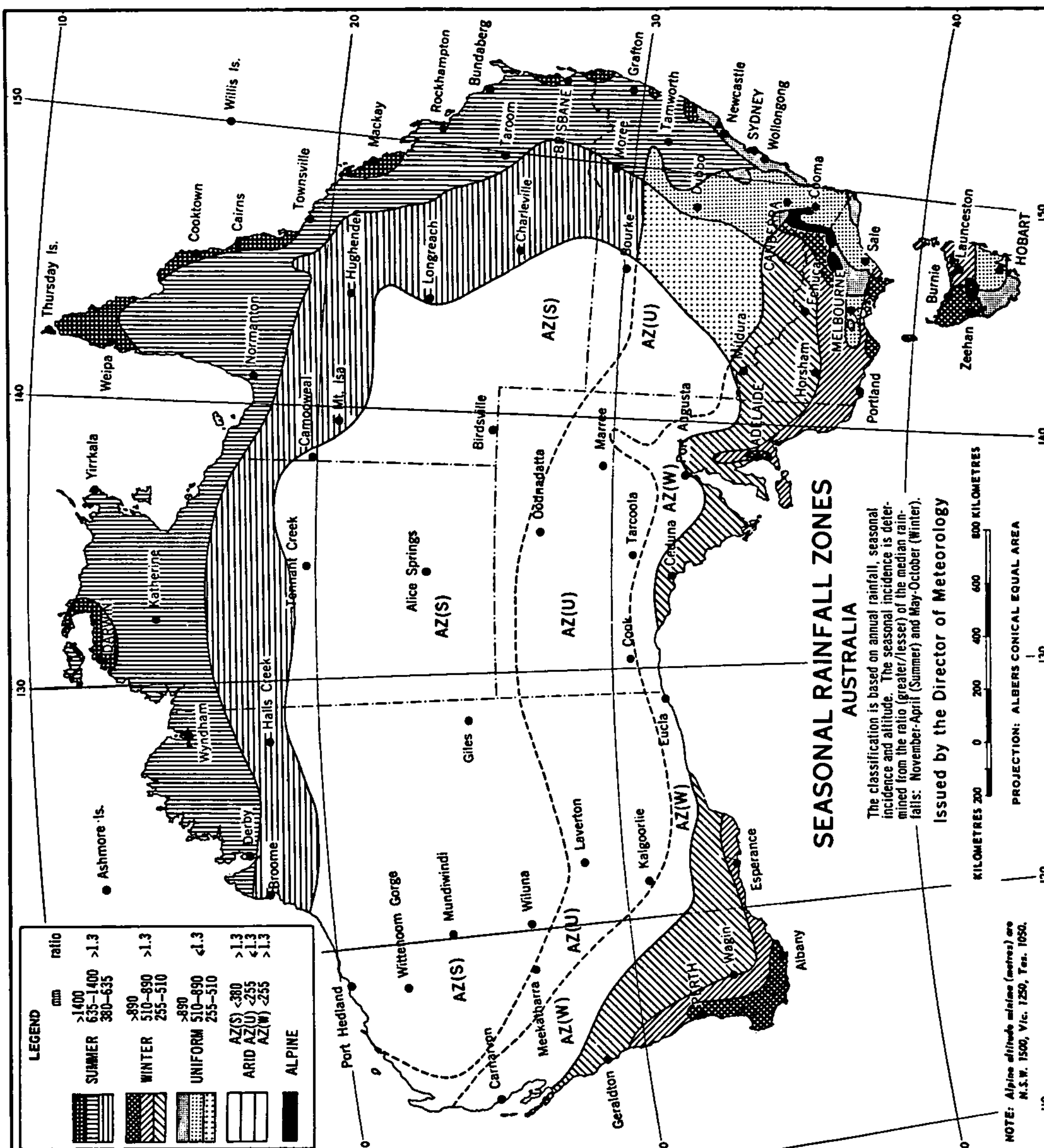

SEASONAL RAINFALL ZONES
AUSTRALIA
The classification is based on annual rainfall, seasonal incidence and altitude. The seasonal incidence is determined from the ratio (greater/lesser) of the median rainfalls: November-April (Summer) and May-October (Winter).
Issued by the Director of Meteorology
LEGEND
mm ratio
SUMMER >1400 635–1400 380–635 >1.3
WINTER >890 510–890 255–510 >1.3
UNIFORM >890 510–890 255–510 <1.3
ARID AZ(S) <380 >1.3
AZ(U) <255 <1.3
AZ(W) <255 >1.3
ALPINE
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
NOTE: Alpine altitude minima (metres) are N.S.W. 1500, Vic. 1250, Tas. 1050.

PLATE 6

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 indexes 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) i.e. Variability Index $= \left\{ \frac{90 - 10}{50} \right\}$ percentiles.

Variability based on this relationship is shown in Plate 7, page 36. The region of high to extreme variability shown in Plate 7, page 36, lies mostly in the arid zone with summer rainfall incidence, AZ(S), defined in Plate 6, page 34. 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 extremely great variations in rainfall from year to year. At Onslow (Western Australia) annual totals vary from 15 mm in 1912 to 1,085 mm in 1961 and in the four consecutive years 1921 to 1924 the annual totals were 566, 69, 682, 55 mm respectively. At Whim Creek (Western Australia) where 747 mm have been recorded in a single day, only 4 mm 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 7,899 mm in 1950 to 2,489 mm in 1961.

Rainday frequency. The average number of days per year with rainfall of 0.25 mm or more is shown in Plate 8, page 37.

The frequency of rain-days exceeds 150 per year in Tasmania, southern Victoria, parts of the north Queensland coast and in the extreme south-west of Western Australia with a maximum of over 200 in western Tasmania. Over most of the continent the frequency is less than 50 rain-days 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 rain-days per year. In the high rainfall areas of northern Australia the number of rain-days is about 80 per year, but heavier falls occur in this region than in southern regions.

Intensity The highest rainfall intensities for some localities are shown in the first table page 38. 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 by States in the second table page 38. Most of the very high 24-hour falls (above 700 millimetres) have occurred in the coastal strip of Queensland, where a tropical cyclone moving close to mountainous terrain provides ideal conditions for spectacular falls. The highest 24-hour fall, 907 millimetres occurred at Crohamhurst, Queensland on 3 February 1893.

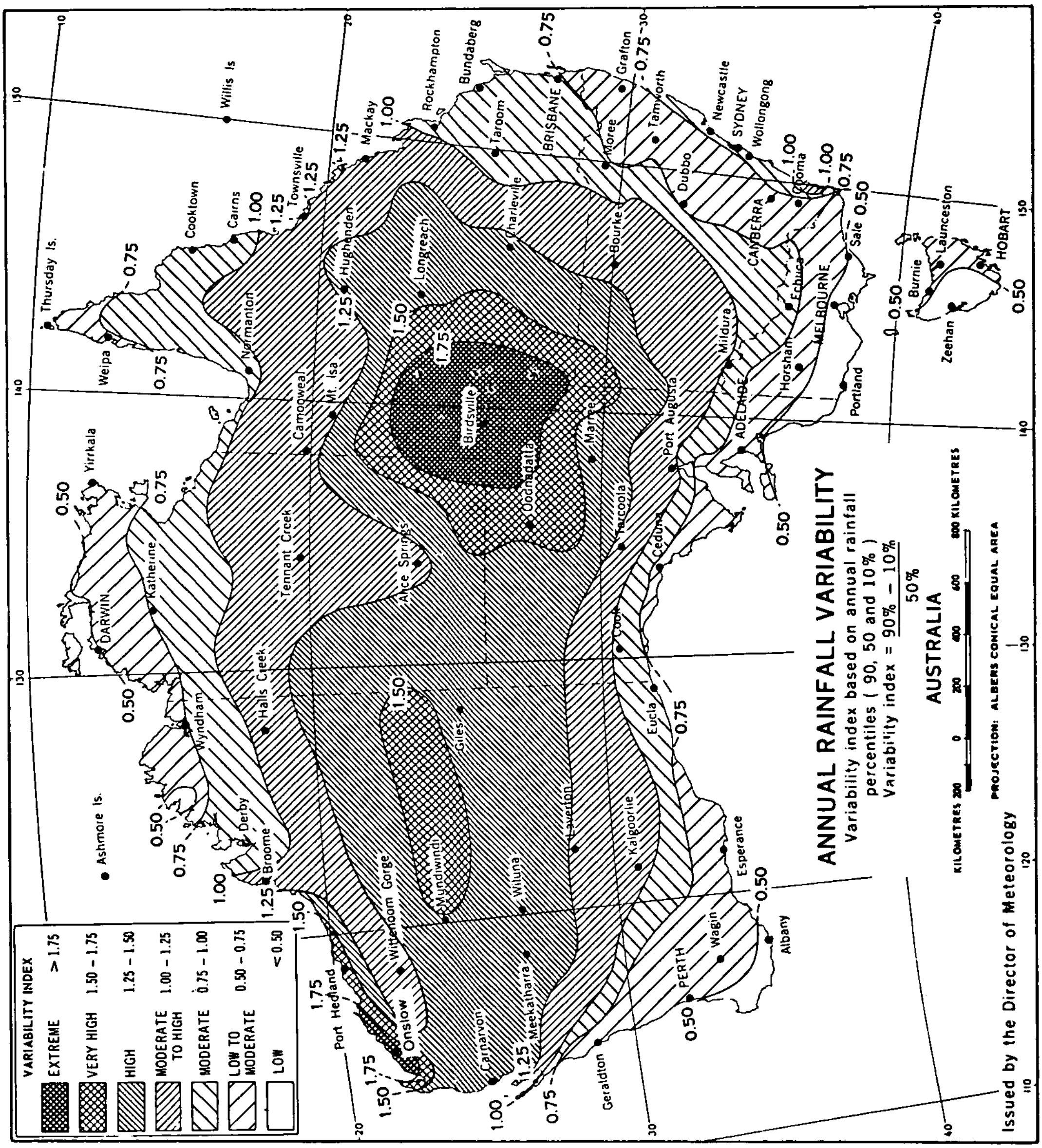

ANNUAL RAINFALL VARIABILITY
Variability index based on annual rainfall
percentiles (90, 50 and 10%)
Variability index = 90% – 10% / 50%
AUSTRALIA
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
Issued by the Director of Meteorology
VARIABILITY INDEX
EXTREME >1.75
VERY HIGH 1.50 - 1.75
HIGH 1.25 - 1.50
MODERATE TO HIGH 1.00 - 1.25
MODERATE 0.75 - 1.00
LOW TO MODERATE 0.50 - 0.75
LOW <0.50
Thursday Is.
Willis Is
Cooktown
Cairns
Townsville
Mackay
Rockhampton
Bundaberg
BRISBANE
Grafton
Tamworth
Newcastle
SYDNEY
Wollongong
Dubbo
CANBERRA
Cooma
Sale
MELBOURNE
Portland
Burnie
Launceston
HOBART
Zeehan
Weipa
Normanton
Hughenden
Longreach
Charleville
Bourke
Moree
Taroom
Mt. Isa
Camooweal
Birdsville
Oodnadatta
Marree
Port Augusta
ADELAIDE
Mildura
Horsham
Echuca
Tarcoola
Ceduna
Cook
Eucla
Yirrkala
DARWIN
Katherine
Tennant Creek
Alice Springs
Giles
Wyndham
Halls Creek
Derby
Broome
Ashmore Is.
Port Hedland
Wittenoom Gorge
Onslow
Carnarvon
Meekatharra
Mundiwindi
Wiluna
Laverton
Kalgoorlie
Esperance
Geraldton
PERTH
Wagin
Albany

PLATE 7

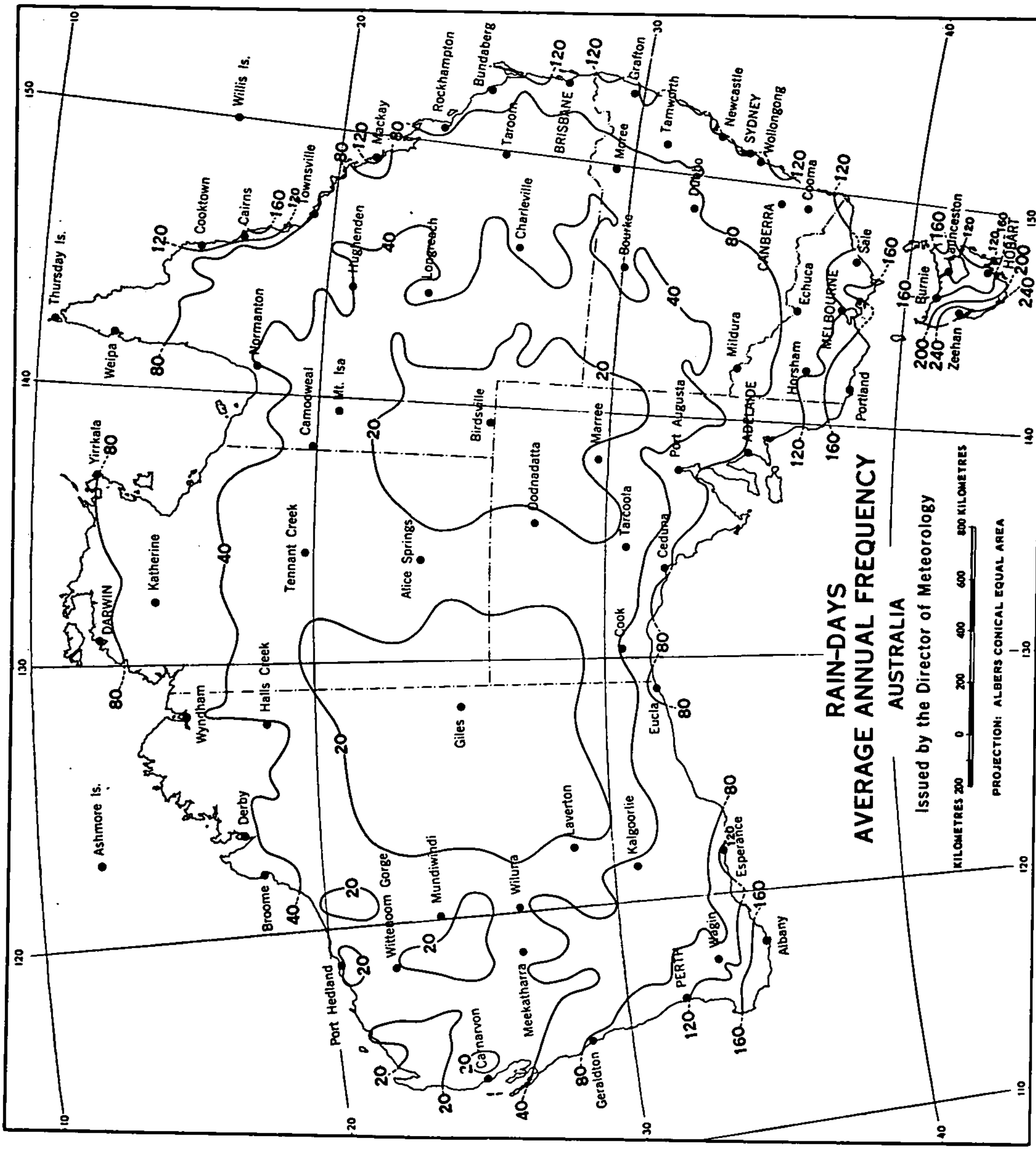

RAIN-DAYS
AVERAGE ANNUAL FREQUENCY
AUSTRALIA
Issued by the Director of Meteorology
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
Thursday Is.
Willis Is.
Cooktown
Cairns
Townsville
Mackay
Rockhampton
Bundaberg
Taroom
BRISBANE
Grafton
Tamworth
Newcastle
SYDNEY
Wollongong
Moree
Dubbo
CANBERRA
Cooma
Sale
MELBOURNE
Echuca
Horsham
Portland
Mildura
ADELAIDE
Port Augusta
Bourke
Charleville
Longreach
Hughenden
Normanton
Weipa
Mt. Isa
Camooweal
Birdsville
Marree
Oodnadatta
Tarcoola
Ceduna
Cook
Eucla
Alice Springs
Tennant Creek
Katherine
Yirrkala
DARWIN
Halls Creek
Wyndham
Giles
Derby
Broome
Ashmore Is.
Port Hedland
Wittenoom Gorge
Mundiwindi
Wiluna
Laverton
Kalgoorlie
Esperance
Meekatharra
Carnarvon
Geraldton
PERTH
Wagin
Albany
Burnie
Launceston
Zeehan
HOBART

PLATE 8

HIGHEST RAINFALL INTENSITIES IN SPECIFIED PERIODS

(millimetres)

Station	Period of record	Years of complete records	Period in hours 1	3	6	12	24
			mm	mm	mm	mm	mm
Adelaide	1897–1967	67	69	133	141	141	141
Alice Springs	1951–1970	18	54	55	64	87	106
Brisbane	1911–1968	14	88	144	182	244	308
Broome	1948–1970	23	72	119	130	172	228
Canberra	1932–1970	35	51	68	71	89	138
Carnarvon	1956–1971	16	32	63	82	95	108
Charleville	1953–1971	19	42	66	75	111	142
Cloncurry	1953–1972	17	46	118	164	173	204
Darwin	1953–1970	15	88	101	109	152	191
Esperance	1963–1972	8	23	45	62	68	79
Hobart	1911–1970	57	28	56	87	117	168
Meekatharra	1953–1971	17	26	67	80	98	112
Melbourne	1878–1969	79	49	57	86	102	129
Mildura	1953–1971	17	49	60	65	65	91
Perth	1946–1971	24	32	38	47	64	93
Sydney	1913–1967	51	69	134	162	180	281
Townsville	1953–1970	16	87	111	122	161	275

Source: Pluviograph records in Bureau of Meteorology archives.

HIGHEST DAILY RAINFALLS

(all years to 1973 inclusive)

State	Station	Date	Amount
			mm
Queensland	Crohamhurst	3.2.1893	907
	Finch Hatton	18.2.1958	878
	Mount Dangar	20.1.1970	869
	Port Douglas	1.4.1911	801
Western Australia	Whim Creek	3.4.1898	747
	Fortescue	3.5.1890	593
New South Wales	Dorrigo	24.6.1950	636
	Cordeaux River	14.2.1898	574
Northern Territory	Roper Valley	15.4.1963	545
	Groote Eylandt	28.3.1953	513
Tasmania	Mathinna	5.4.1929	336
	Cullenswood	5.4.1929	282
Victoria	Balook	18.2.1951	275
	Hazel Park	1.12.1934	267
South Australia	Ardrossan	18.2.1946	206
	Carpa	18.2.1946	199

Thunderstorms and hail A thunder-day at a given location is a calendar day on which thunder is heard at least once. Plate 9 page 39 shows isopleths (isobronts) of the average annual number of thunder-days which varies from 80 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 (40-60 annually) over the eastern upland areas is produced 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 sometimes causing widespread damage.

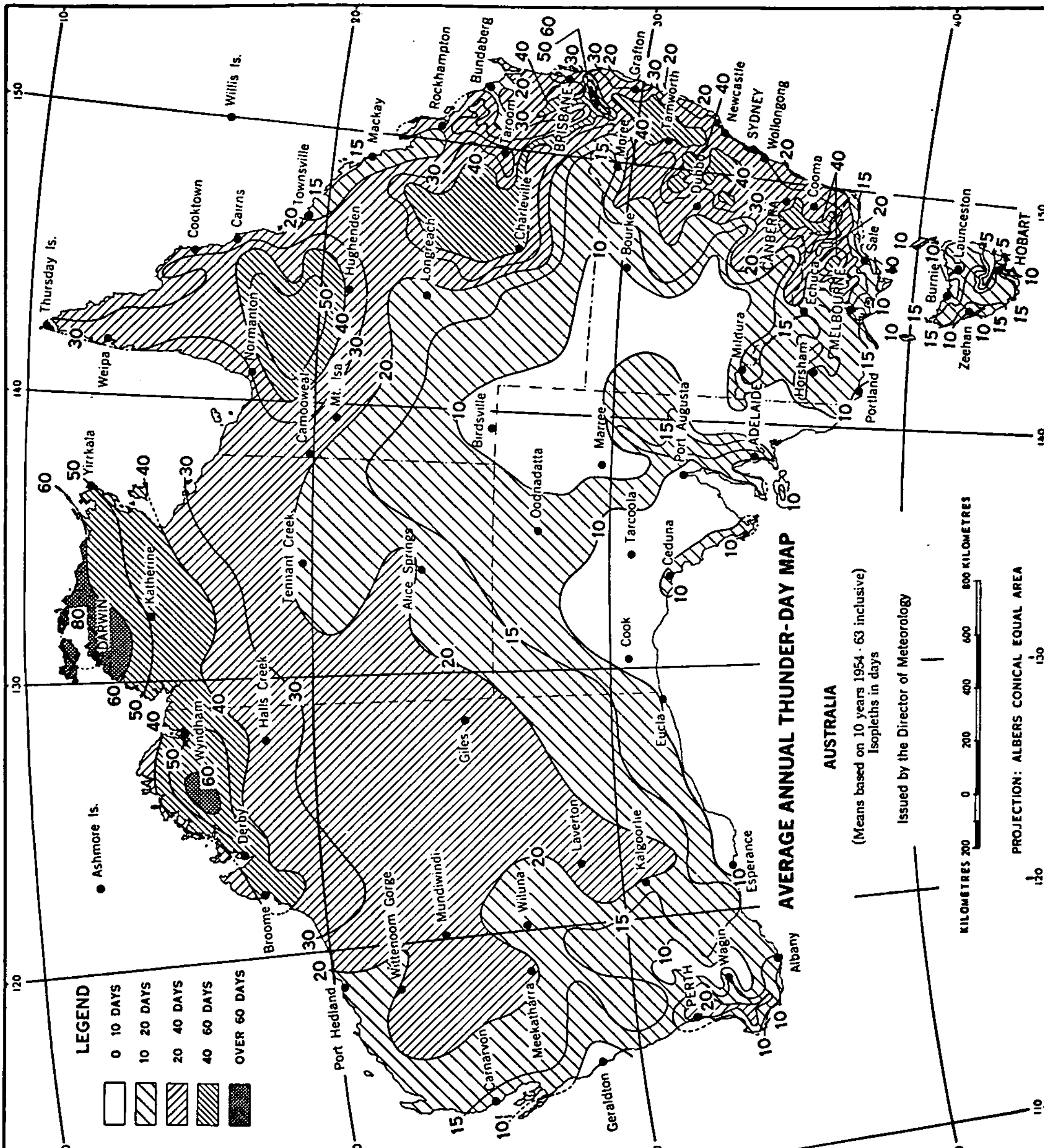

AVERAGE ANNUAL THUNDER-DAY MAP
AUSTRALIA
(Means based on 10 years 1954-63 inclusive)
Isopleths in days
Issued by the Director of Meteorology
LEGEND
0 10 DAYS
10 20 DAYS
20 40 DAYS
40 60 DAYS
OVER 60 DAYS
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
Thursday Is.
Weipa
Cooktown
Cairns
Townsville
Willis Is.
Mackay
Rockhampton
Bundaberg
BRISBANE
Grafton
Tamworth
Newcastle
SYDNEY
Wollongong
Cooma
CANBERRA
Sale
MELBOURNE
Echuca
Horsham
Portland
Mildura
Launceston
Burnie
Zeehan
HOBART
Normanton
Hughenden
Longreach
Charleville
Taroom
Moree
Bourke
Dubbo
Camooweal
Mt. Isa
Birdsville
Marree
Oodnadatta
Port Augusta
ADELAIDE
Tarcoola
Ceduna
Cook
Eucla
Yirrkala
DARWIN
Katherine
Tennant Creek
Alice Springs
Halls Creek
Wyndham
Derby
Broome
Ashmore Is.
Giles
Laverton
Kalgoorlie
Esperance
Wiluna
Mundiwindi
Wittenoom Gorge
Port Hedland
Meekatharra
Carnarvon
Geraldton
PERTH
Wagin
Albany

PLATE 9

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 and in the altitude range 500–1,000 metres no snow falls 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 Mt Kosicusko (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 plate 10, page 41 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.

Average monthly maxima. Maps of average maximum and minimum temperatures for the months of January and July are shown in plates 11–14 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 is around Marble Bar, 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.

Maximum temperatures percentiles for the months of January and July for selected stations are contained in the table, page 44. One measure of the variability of maximum and minimum temperatures is given in the magnitude of the ratio (percentage) of the 20 to 80 percentile range to the median (50 percentile). In January variabilities of maxima based on this criterion show marked spatial variation (Melbourne 50 per cent; Darwin 15 per cent).

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. The table shows that maxima are generally less variable in July than in January (Melbourne 25 per cent; Darwin 10 per cent).

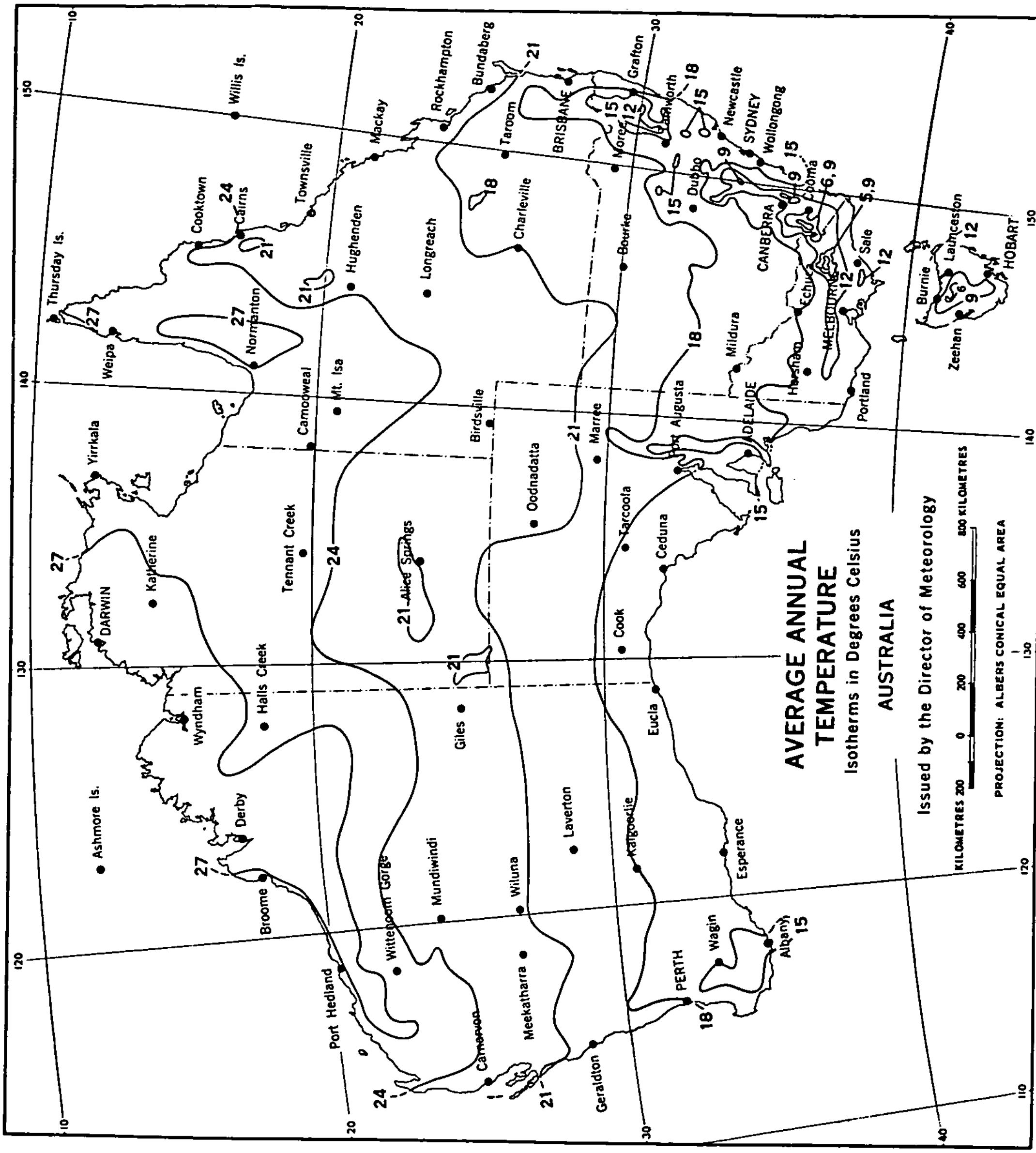
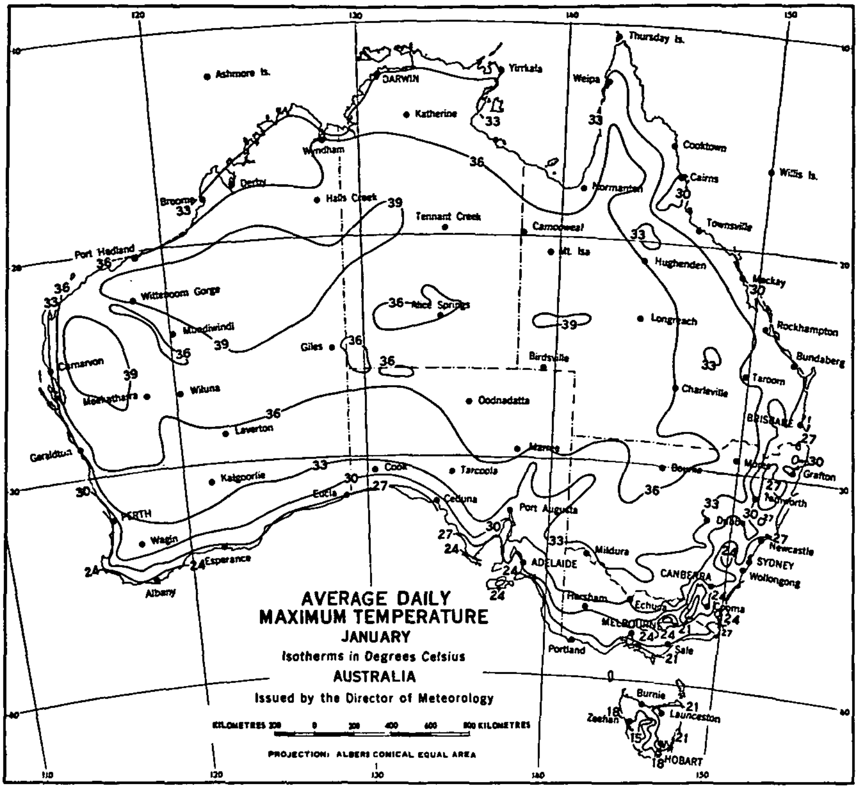
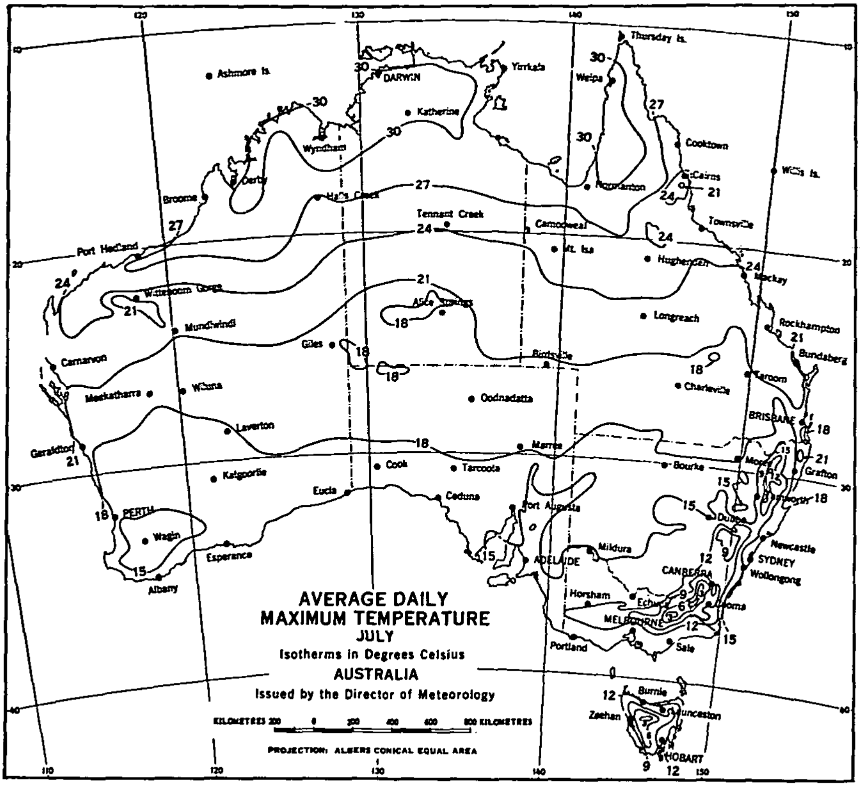
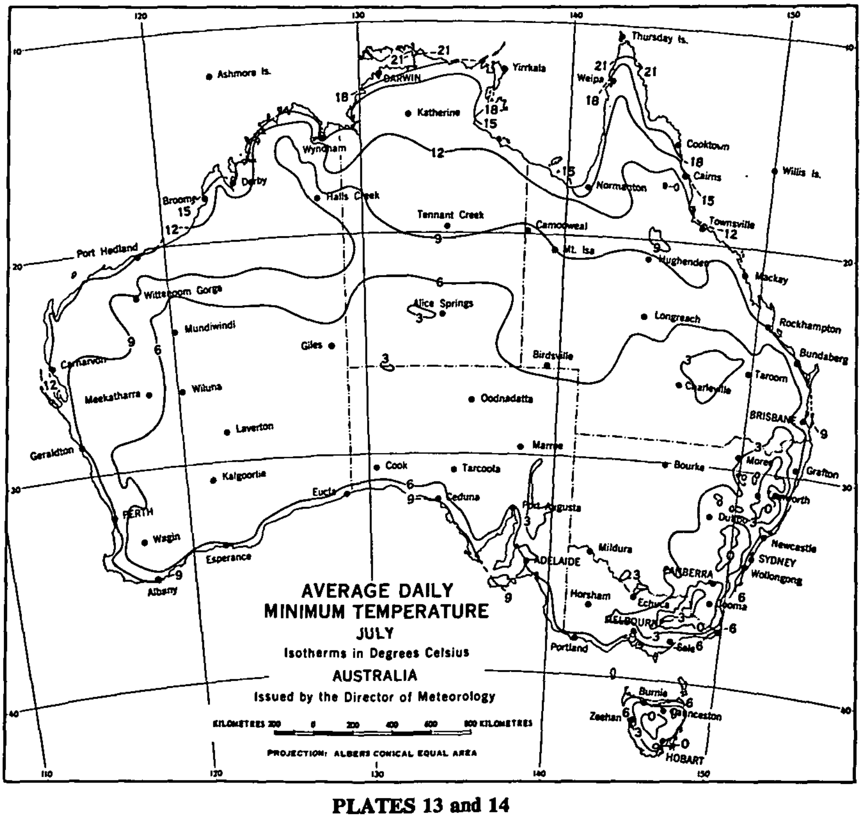

AVERAGE ANNUAL
TEMPERATURE
Isotherms in Degrees Celsius
AUSTRALIA
Issued by the Director of Meteorology
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
Thursday Is.
Weipa
Cooktown
Cairns
Willis Is.
Townsville
Mackay
Rockhampton
Bundaberg
Taroom
BRISBANE
Grafton
Moree
Gunnedah
Newcastle
SYDNEY
Wollongong
Dubbo
Cooma
CANBERRA
Sale
MELBOURNE
Echuca
Horsham
Mildura
Portland
ADELAIDE
Pt. Augusta
Bourke
Charleville
Longreach
Hughenden
Normanton
Camooweal
Mt. Isa
Birdsville
Marree
Oodnadatta
Tarcoola
Ceduna
Cook
Eucla
Alice Springs
Tennant Creek
Giles
Yirrkala
DARWIN
Katherine
Halls Creek
Wyndham
Derby
Ashmore Is.
Broome
Port Hedland
Wittenoom Gorge
Mundiwindi
Wiluna
Laverton
Meekatharra
Carnarvon
Geraldton
Kalgoorlie
Esperance
PERTH
Wagin
Albany
Burnie
Launceston
Zeehan
HOBART
27
24
21
18
15
12
9
6
10
20
30
40
110
120
130
140
150

PLATE 10



PLATES 11 and 12





PLATES 13 and 14

MAXIMUM TEMPERATURES DAILY: VARIABILITY IN JANUARY AND JULY
(20, 50 and 80 percentile values, °C.)

Station	Period of record	January Percentiles 20	January Percentiles 50	January Percentiles 80	July Percentiles 20	July Percentiles 50	July Percentiles 80
Adelaide	1955–70	22	26	33	13	14	16
Alice Springs	1949–68	33	36	38	15	18	22
Birdsville	1957–71	35	39	42	17	19	23
Brisbane	1948–68	27	28	30	18	20	22
Canberra	1950–59	23	27	32	9	11	13
Ceduna	1949–68	22	26	35	14	16	18
Charleville	1949–68	30	34	37	16	18	22
Cloncurry	1949–68	34	37	39	22	24	28
Daly Waters	1939–68	33	36	38	26	28	31
Darwin	1951–70	29	31	33	28	30	31
Halls Creek	1949–68	34	37	39	23	26	29
Hobart	1957–70	18	21	27	9	11	13
Kalgoorlie	1949–68	28	33	38	13	16	18
Mackay	1959–68	28	29	30	19	21	22
Marble Bar	1957–71	37	41	44	24	27	29
Melbourne	1955–68	21	24	33	11	13	14
Perth	1953–70	25	29	35	15	17	18
Port Hedland	1949–68	33	36	38	24	26	28
Sydney	1955–70	22	24	28	15	17	18
Thursday Island	1950–68	28	29	31	26	27	28
Wilcannia	1957–68	32	36	39	14	17	19

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. The table below contains minimum temperature percentiles for January and July at selected stations. In January variabilities of minima calculated from the 20–80 percentile range differ spatially, the value for Melbourne being 45 per cent and for Darwin 15 per cent. 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 average is as low as −5°C. The table below shows that minima are more variable in July (Melbourne, 85 per cent; Darwin 20 per cent) than in January.

MINIMUM TEMPERATURES DAILY: VARIABILITY IN JANUARY AND JULY
(20, 50 and 80 percentile values, °C.)

Station	Period of record	January Percentiles 20	January Percentiles 50	January Percentiles 80	July Percentiles 20	July Percentiles 50	July Percentiles 80
Adelaide	1955–70	13	16	20	6	8	9
Alice Springs	1949–68	17	21	24	0	3	7
Birdsville	1957–71	21	24	27	3	5	9
Brisbane	1948–68	19	20	22	7	9	12
Canberra	1950–59	9	12	15	−4	−1	7
Ceduna	1949–68	11	14	17	3	6	3
Charleville	1949–68	18	21	23	0	3	8
Cloncurry	1949–68	22	24	27	7	10	18
Daly Waters	1939–68	22	23	25	9	12	13
Darwin	1951–70	23	24	26	17	19	25
Halls Creek	1949–68	22	24	26	9	12	11
Hobart	1957–70	9	11	14	2	4	4
Kalgoorlie	1949–68	14	17	21	1	4	7
Mackay	1959–68	21	23	24	8	11	17
Marble Bar	1957–71	23	26	27	8	11	16
Melbourne	1955–68	10	14	16	3	6	3
Perth	1953–70	15	18	21	6	8	18
Port Hedland	1949–68	23	25	26	8	11	11
Sydney	1955–70	17	18	20	6	8	4
Thursday Island	1950–68	23	24	26	21	22	29
Wilcannia	1957–68	16	19	23	1	3	3

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 the highest temperature in Western Australia 50.7°C. 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 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 table below.

EXTREME MAXIMUM TEMPERATURES
(All years to 1973 inclusive)

Station	*°C*	*Station*	*°C*
Western Australia—		New South Wales—	
Eucla	50.7	Bourke	52.8
Roebourne	49.5	White Cliffs	51.1
Marble Bar	49.2	Walgett	50.1
Northern Territory—		Wilcannia	50.0
Charlotte Waters (near Finke)	48.2	Menindee	49.7
South Australia—		Australian Capital Territory—	
Oodnadatta	50.7	Canberra	42.2
Kyancutta	49.3	Victoria—	
Queensland—		Mildura	50.8
Cloncurry	53.1	Tasmania—	
Winton	50.7	Bushy Park	40.9
Birdsville	50.0	Hobart	40.7

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. 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 of −3.9°C has been recorded and at Swansea on the east coast of Tasmania, the temperature has fallen as low as −4.4°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 (−3.3°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 1973 inclusive)

Station	*°C*	*Station*	*°C*
Western Australia—		New South Wales—	
Dwellingup	−7.0	Charlotte Pass	−22.2
Booylgoo	−6.7	Kiandra	−20.6
Salmon Gums	−5.4	Kosciusko Hotel	−14.4
Northern Territory—		Cooma	−11.2
Alice Springs	−7.2	Australian Capital Territory—	
Tempe Downs	−6 0	Canberra	−10.0
South Australia—		Victoria—	
Yongala −	−8 1	Mount Hotham	−12.8
Kyancutta	−7.0	Omeo	−10.0
		Bairnsdale	−7.2
Queensland—		Tasmania—	
Stanthorpe	−11.0	Oatlands	−12.8
Nanango	−9.3	Bothwell	−12.5

Temperature range. The average annual temperature range values shown in plate 15, page 47, have been determined by subtracting the lowest average monthly minimum from the highest average monthly maximum. On the basis of this criterion the greatest average range is 33°C over the western interior and the least is 9°C at the tip of Cape York Peninsula. The strong gradient in average range around the coastline illustrates the continental effect. This is marked on the Kimberley coast of Western Australia, where the range varies from 15°C on the coast to 24°C on the plateau a few kilometres inland.

Extreme temperature range, which is mapped in plate 16, page 47, has been calculated by subtracting the lowest temperature on record for each station from its highest. The greatest absolute range yet recorded is 57.2°C at White Cliffs in north-western New South Wales. This extreme range is confined to an elongated area in far north-western New South Wales, where maxima exceeding 49°C in north-westerly air in summer have been recorded and minima about −8°C during cold southern outbreaks in winter. In general terms the extreme range is about 30°C on the northern coast, 45°C on the southern coasts and 50°C away from the coasts.

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-western 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.

Heat waves are experienced in the coastal areas from time to time such as during 11–14 January 1939, when a severe heat wave affected south-eastern Australia. During this period 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.

Frost. In Australia frost can cause serious losses in agricultural crops, and numerous climatic studies have been made relating to specific crops cultivated in local areas. Foley (1945 (i)) made a comprehensive study of the incidence of frost at stations recording minimum temperature. Since Foley's work was published the number of stations recording minimum temperatures has increased appreciably.

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); differences of 10°C have been recorded Only a small number of stations measure minima at ground level, the lowest recordings being −14.6°C at Stanthorpe (Queensland) and −13.4°C at Canberra. Lower readings may be recorded in alpine areas. The lowest readings of minimum temperature at ground level for the capital cities are shown in the table below.

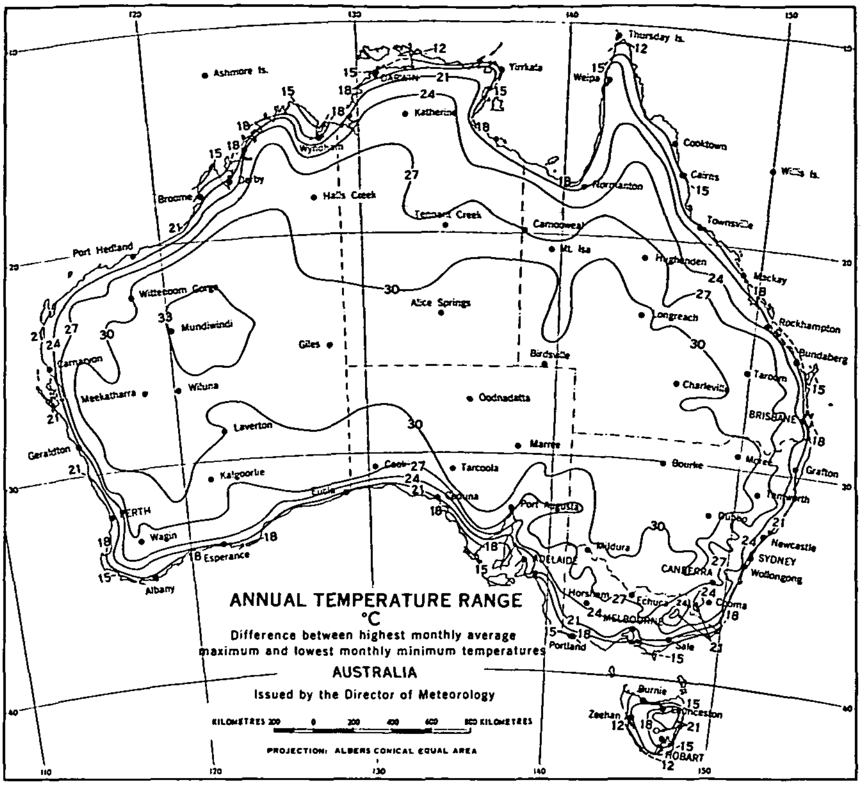
EXTREME MINIMUM TEMPERATURES RECORDED ON THE GROUND
(°C)

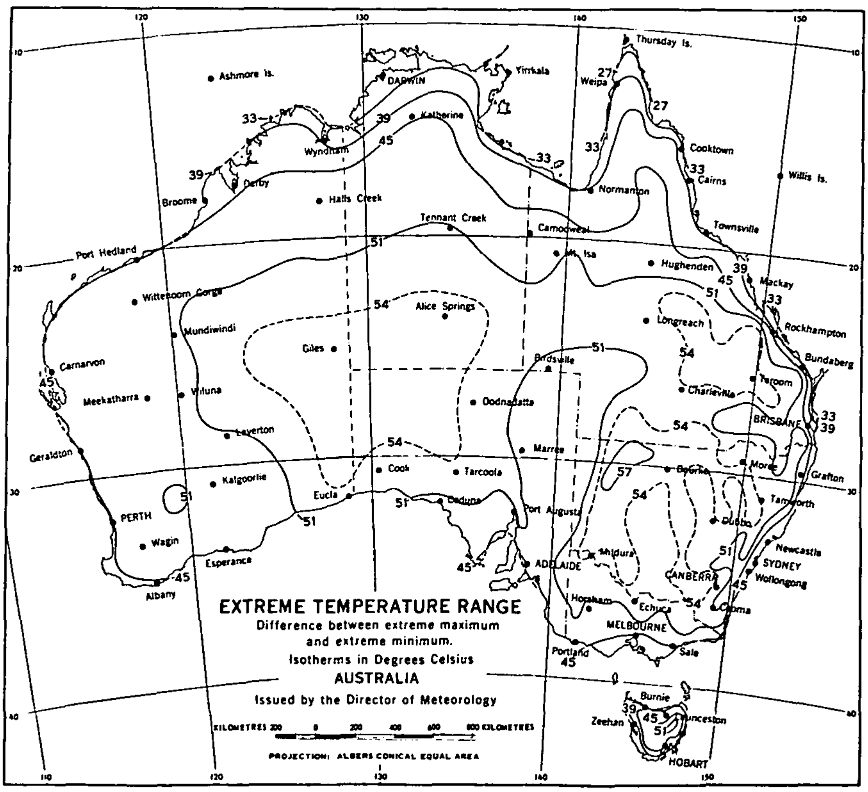
Station	*Years of record*	*Jan.*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Year*
Adelaide .	110	2.5	2.1	0.1	−2.2	−3.6	−6.1	−5.5	−5.1	−3.9	−3.0	−0.3	0.3	−6.1
Brisbane .	83	9.9	9.5	7.4	2.6	−1.2	−3.7	−4.5	−2.7	−0.9	1.6	3.8	9.5	−4.5
Canberra .	18	−0.4	0.3	−4.0	−8.3	−10.4	−13.4	−12.8	−12.8	−9.4	−6.2	−6.3	−3.9	−13.4
Hobart .	83	−0.8	−2.1	−2.5	−3.9	−6.7	−7.7	−7.4	−6.6	−7.6	−4.6	−3.3	−2.7	−7.7
Melbourne	111	−1.0	−0.6	−1.7	−3.9	−6.1	−6.7	−6.4	−5.9	−5.1	−4.0	−4.1	0.7	−6.7
Perth .	72	4.2	4.3	2.6	−0.7	−3.9	−3.4	−3.8	−3.0	−2.7	−1.2	1.6	3.3	−3.9
Sydney .	112	6.5	6.0	4.4	0.7	−1.5	−2.2	−4.4	−3.3	−1.0	0.4	1.9	5.2	−4.4

Frost frequency depends on location and orography, and even on minor variations in 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 the Northern Territory coast and most of the north Queensland coast.

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 plate 17, page 48.





PLATES 15 and 16

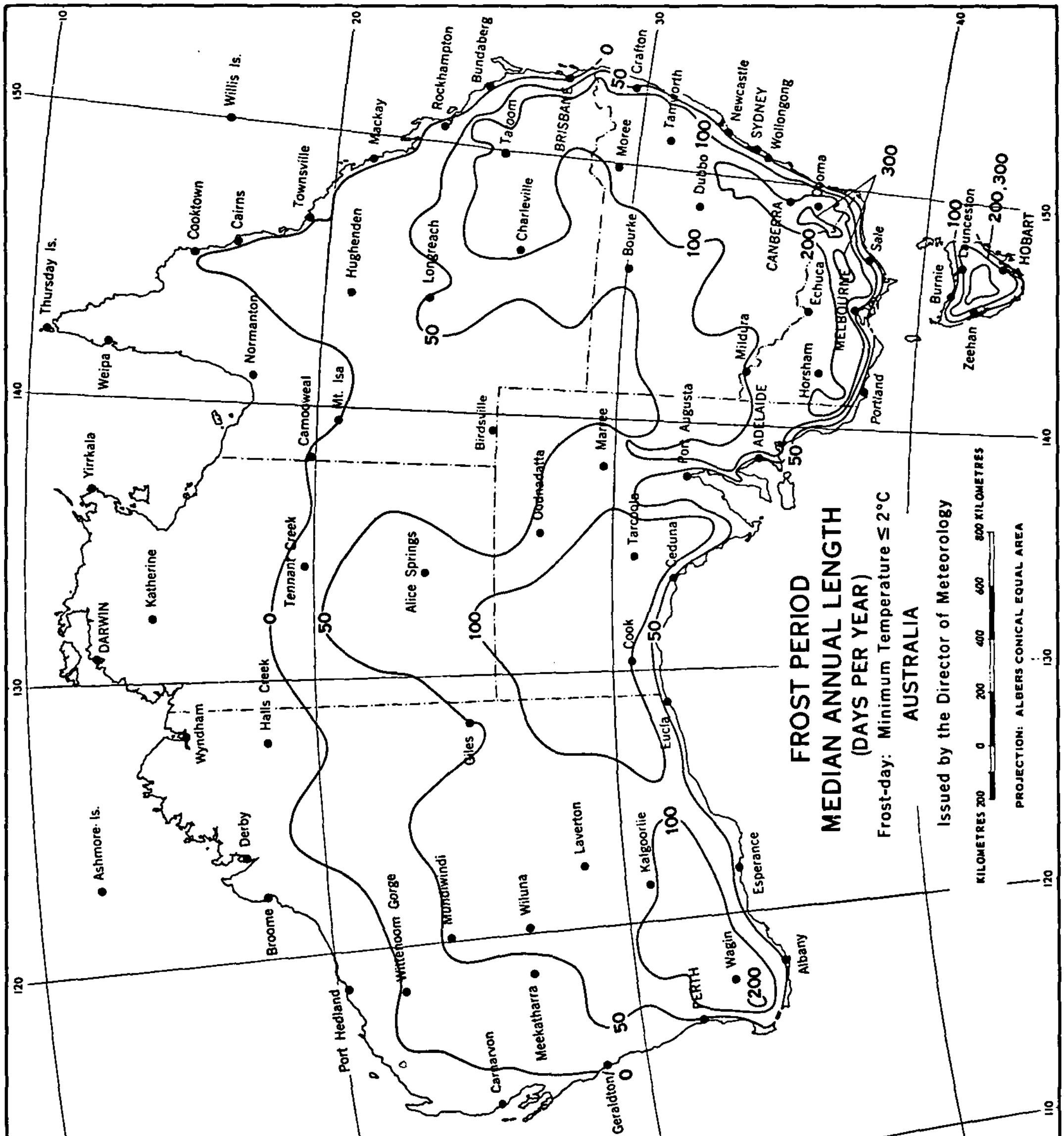

FROST PERIOD
MEDIAN ANNUAL LENGTH
(DAYS PER YEAR)
Frost-day: Minimum Temperature ≤ 2°C
AUSTRALIA
Issued by the Director of Meteorology
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
Thursday Is.
Weipa
Cooktown
Cairns
Townsville
Willis Is.
Normanton
Hughenden
Mackay
Rockhampton
Bundaberg
Longreach
Charleville
Taroom
BRISBANE
Moree
Grafton
Tamworth
Newcastle
SYDNEY
Wollongong
Dubbo
Bourke
CANBERRA
Cooma
Sale
MELBOURNE
Echuca
Mildura
Horsham
Portland
ADELAIDE
Port Augusta
Marree
Birdsville
Mt. Isa
Camooweal
Yirrkala
Oodnadatta
Tarcoola
Ceduna
Alice Springs
Tennant Creek
Katherine
DARWIN
Halls Creek
Wyndham
Giles
Cook
Eucla
Ashmore Is.
Derby
Broome
Laverton
Kalgoorlie
Esperance
Wiluna
Mundiwindi
Wittenoom Gorge
Port Hedland
Meekatharra
Carnarvon
Geraldton
PERTH
Wagin
Albany
Burnie
Launceston
Zeehan
HOBART
0
50
100
200
300
200,300

PLATE 17

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 in northern 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.

The table below includes the average annual frequency of minima of 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 27, at Alice Springs 33, Charleville 37, Canberra 105 and Melbourne 19.

FROST FREQUENCY

Average annual number of frosty nights (screen minimum ⩽2°C) and heavy frosts (⩽0°C)

Station	*Period of record*	*Altitude (metres)*	*Number of frosty nights*	*Number of heavy frosts*
Adelaide (airport)	1955–70	10	8	1
Alice Springs	1940–71	550	33	11
Ballan (near Ballarat)	1944–64	500	63	20
Birdsville	1957–71	40	7	1
Brisbane (Archerfield airport)	1939–49	10	9	3
Canberra	1939–71	570	105	65
Ceduna	1939–71	20	18	5
Charleville	1942–71	290	37	15
Hobart (Risdon)	1957–70	40	25	5
Kalgoorlie	1939–71	360	27	7
Kiandra	1957–69	1,400	226	176
Loch Valley (E of Melbourne)	1943–59	500	101	53
Melbourne (Essendon airport)	1939–71	80	19	4
Mount Gambier	1942–71	60	33	10
Perth (airport)	1944–71	20	5	0
Walgett	1957–71	130	30	7

The next table shows percentiles (20, 50 and 80) of the annual number of frosts at selected stations. The difference between the 20 and 80 percentile figures relative to the 50 percentile (median) shows that there is great variability in the number of frosts at individual stations from year to year.

FROST VARIABILITY

Annual number of frosty nights (⩽2°C) and heavy frosts (⩽0°C) 20, 50 and 80 percentiles

			Number of frosty nights			*Number of heavy frosts*		
			Percentiles			*Percentiles*		
Station	*Period of record*	*Altitude (metres)*	*20*	*50*	*80*	*20*	*50*	*80*
Alice Springs	1941–71	550	16	27	37	5	8	14
Bathurst	1957–71	705	83	101	111	51	69	76
Beechworth (SW of Albury)	1957–71	550	51	58	73	16	22	26
Bridgetown	1957–69	155	30	43	53	7	11	19
Canberra	1939–71	571	87	105	116	48	64	75
Charleville	1943–71	290	21	35	45	6	14	19
Dubbo	1957–71	262	39	43	50	10	14	27
Hay	1957–71	93	21	34	37	5	9	13
Kalgoorlie	1942–71	360	15	22	31	2	4	9
Kiandra	1957–68	1,400	206	228	250	163	175	193
Kyancutta	1957–69	58	31	39	40	7	14	20
Mount Gambier	1942–71	60	20	27	34	3	6	13
Mundiwindi	1957–69	575	8	11	29	2	3	11
Nhill (near Horsham)	1957–71	129	41	47	58	12	17	26
Oatlands	1957–71	435	85	101	111	38	46	57
Omeo	1957–71	660	115	132	138	59	74	83
Richmond (NW of Sydney)	1953–71	20	23	30	40	6	10	13
Sale	1945–71	5	25	34	45	5	11	17
Swansea	1957–71	8	38	45	61	7	13	19
Wandering (SE of Perth)	1957–69	335	41	57	70	13	25	34
Waratah	1957–71	627	104	117	131	35	44	53
Yongala (E of Port Pirie)	1957–69	515	62	75	90	32	39	52

By convention a heavy frost is taken as corresponding to a minimum screen temperature of 0°C or less—see the two previous tables. 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 coasts. Some places on the coast experience heavy frosts, for example Portland, Victoria; with 3 annually.

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, for example Swansea, 13.

The southern half of Western 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) and Yongala, South Australia (29). At Alice Springs the annual average frequency is 11.

Humidity

Australia is a dry continent in terms of the water vapour content (humidity) of the air. Humidity is measured at Bureau of Meteorology observational stations by dry and wet bulb thermometers mounted in standard instrument screens. These measurements enable moisture content to be expressed in a number of ways two of which are vapour pressure and relative humidity.

Vapour pressure. Vapour pressure is the pressure exerted by the water vapour in the air and, as such, is a measure of the actual amount of water vapour. The amount of water vapour does not normally vary greatly during the day although afternoon sea breezes at coastal stations may bring in moisture to increase the vapour pressure by amounts up to 5 millibars. The 9 a.m. figure may be taken as an approximation to the mean value for the day. The next table page 51, contains average 9 a.m. vapour pressure figures for selected stations. The average annual figures range from 8.2 millibars at Alice Springs to 25.9 millibars at Darwin and 27.6 millibars at Thursday Island. At the high level station Kiandra (1,400 metres) the average annual figure is 7.3 millibars. Excluding values at Kiandra monthly averages range from 6.0 millibars at Alice Springs in August to 31.1 millibars at Darwin in January and at both Darwin and Broome in February.

Vapour pressure in association with air temperature has been used as a measure of climatic discomfort as it affects human beings. Comfortable conditions are generally accepted as being within the vapour pressure range 7–17 millibars, with air temperatures in the range 15–30°C. Above these limits heat discomfort increases and below the limits cold discomfort increases. The wet bulb temperature may also be used as a simple measure of heat discomfort since discomfort increases as the wet bulb temperature rises above 20°C. Climatic discomfort is treated later in this chapter.

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. The relative humidity at 9 a.m. may be taken as an approximation of the mean relative humidity for the day (24 hours). As a measure of human discomfort this parameter is of limited value because it must be related to the temperature at the time.

The table, on page 51, contains average relative humidity (per cent) at 9 a.m. for selected stations. Average annual figures range from 30 per cent at Mundiwindi to 80 per cent at Thursday Island. Monthly averages range from 17 per cent at Mundiwindi in October to 89 per cent at Katanning in June, July and August and at Kiandra in June. In northern Australia the highest relative humidity occurs in the summer rainy season about February and the lowest in the winter dry season about July. Darwin averages 81 per cent in January and February and 62 per cent in July. In most of southern Australia the highest relative humidity is experienced in the winter rainy season about June or July and the lowest in the warmer months. Perth averages 76 per cent in July and 51 per cent in December, January and February. Over the interior, relative humidity is consistently low although higher averages occur in winter months when temperatures are low. At Alice Springs, October has the lowest average (24 per cent) and June the highest (62 per cent).

The pattern of variation of relative humidity differs from that of vapour pressure, particularly in the south. This is due to the difference in variation of the two parameters with temperature. If the amount of moisture in the air remains constant, vapour pressure decreases slightly with falling temperature, whereas relative humidity increases. Perth for example, has an average 9 a.m. vapour pressure of 14.8 millibars in January and 10.7 millibars in August; and corresponding relative humidity figures are 51 and 71 per cent.

AVERAGE VAPOUR PRESSURE AT 9 A.M.

(mb)

NOTE. The average monthly and annual figures in this and the next table are derived from the average monthly and annual dry and wet bulb temperatures respectively, using psychrometric formulae. Due to the nature of these formulae annual figures so derived may not equal averages of monthly figures.

Station	*Period of record*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Year*
Adelaide	1868–1971	11.9	12.3	11.7	11.3	10.8	9.9	9.4	9.7	9.9	10.1	10.5	11.1	10.7
Alice Springs	1957–1971	11.9	11.5	10.5	10.1	8.4	7.9	6.5	6.0	6.6	6.8	8.6	9.9	8.2
Armidale	1957–1971	15.1	15.5	14.1	11.7	8.7	7.5	6.3	7.3	8.3	10.1	11.5	13.3	10.2
Brisbane	1887–1950	21.7	22.0	20.9	17.5	14.3	12.1	11.1	11.7	13.8	16.0	18.1	20.1	16.6
Broome	1957–1971	29.4	31.1	29.4	22.4	14.6	14.2	11.8	11.8	15.8	21.7	25.3	28.8	20.8
Canberra	1940–1971	13.1	13.8	12.5	10.3	8.4	7.1	6.6	7.0	8.2	9.7	10.4	11.9	9.9
Carnarvon	1957–1971	21.7	21.9	19.9	16.9	13.8	14.0	11.8	11.6	12.3	13.8	15.9	18.8	15.8
Ceduna	1957–1971	13.8	14.3	14.1	12.0	11.1	9.7	9.4	9.6	10.3	10.3	10.9	12.2	11.1
Charleville	1957–1971	16.7	17.1	15.6	12.5	10.2	9.3	7.8	8.1	8.5	10.5	11.3	14.4	11.3
Cloncurry	1957–1971	19.9	21.2	17.8	13.3	10.4	9.2	7.6	6.9	7.5	9.9	11.8	15.4	12.0
Darwin	1882–1966	31.1	31.1	30.7	27.0	21.8	18.7	17.6	20.6	24.7	27.7	29.3	30.5	25.9
Esperance	1957–1969	16.0	16.7	15.7	14.4	12.7	12.1	11.1	11.1	11.7	12.9	13.9	15.3	13.5
Halls Creek	1957–1971	21.1	21.7	18.5	12.4	10.3	8.2	6.9	6.7	7.5	10.9	13.9	18.0	12.6
Hobart	1894–1970	11.0	11.7	11.0	10.0	8.8	7.9	7.6	7.9	8.3	9.1	9.6	10.6	9.5
Kalgoorlie	1957–1971	12.9	14.0	13.1	11.8	10.3	10.1	8.9	8.8	9.1	9.6	10.5	11.7	10.7
Katanning	1957–1972	13.2	13.9	13.2	12.5	11.0	10.5	9.3	9.7	10.2	9.4	10.6	11.5	11.1
Kiandra	1957–1972	11.1	11.3	10.3	7.6	5.9	5.4	4.7	5.2	5.5	7.3	8.1	10.3	7.3
Marble Bar	1957–1971	20.4	20.8	17.8	12.6	9.5	10.3	7.8	7.6	7.8	9.1	11.0	15.0	11.9
Melbourne	1907–1971	13.1	14.1	13.3	11.7	10.3	9.3	8.9	9.1	9.5	10.5	11.3	12.5	11.1
Mildura	1957–1971	13.6	13.7	13.1	11.7	10.3	9.0	8.7	9.0	9.9	10.4	10.8	11.9	10.8
Mundiwindi	1957–1972	13.1	14.4	11.8	10.6	8.5	8.8	7.2	6.8	6.7	6.4	8.2	10.2	8.9
Perth	1911–1940	14.8	14.7	14.7	13.4	12.4	11.4	10.9	10.7	11.6	11.7	12.7	13.9	12.7
Sydney	1876–1971	18.8	19.2	18.3	15.0	11.9	10.2	9.6	9.5	11.3	13.0	15.0	17.6	13.6
Thursday Island	1957–1971	30.2	30.4	30.3	29.0	28.0	25.8	24.1	24.5	24.7	26.1	28.0	29.6	27.6
Townsville	1957–1971	26.1	27.3	25.4	22.1	18.2	15.3	14.1	15.7	16.7	19.7	22.9	24.6	20.3

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*
Adelaide	1868–1971	41	43	47	56	67	75	76	70	60	51	45	40	56
Alice Springs	1957–1971	30	32	35	44	54	62	56	43	33	24	25	27	35
Armidale	1957–1971	63	68	70	73	77	80	74	73	63	56	54	57	66
Brisbane	1887–1971	66	69	71	71	71	72	70	67	63	60	59	61	67
Broome	1957–1971	69	74	69	56	46	52	48	43	46	54	58	64	58
Canberra	1940–1971	58	65	67	73	83	85	83	78	72	66	57	56	69
Carnarvon	1957–1971	62	59	59	59	60	73	68	63	55	53	55	59	61
Ceduna	1957–1971	49	54	60	61	75	77	80	74	63	49	45	48	59
Charleville	1957–1971	47	49	52	52	62	71	65	55	42	38	34	41	48
Cloncurry	1957–1971	48	54	49	42	45	49	43	34	28	27	28	35	40
Darwin	1882–1971	81	81	80	72	65	63	62	66	68	68	70	75	71
Esperance	1957–1969	61	67	66	71	75	82	83	77	71	63	62	62	69
Halls Creek	1957–1971	48	51	44	31	34	33	29	24	20	23	28	38	34
Hobart	1894–1971	58	62	65	70	75	78	78	73	66	62	58	58	67
Kalgoorlie	1957–1971	43	50	52	58	65	75	74	65	55	46	42	42	54
Katanning	1957–1972	58	65	68	78	78	89	89	89	83	54	51	48	69
Kiandra	1957–1972	63	68	72	75	85	89	88	87	71	64	58	64	71
Marble Bar	1957–1971	40	44	38	31	32	43	36	30	24	21	22	28	32
Melbourne	1907–1971	60	63	66	72	79	83	81	75	68	63	60	60	69
Mildura	1957–1971	49	52	59	69	82	87	88	81	69	56	48	48	63
Mundiwindi	1957–1972	28	35	30	35	40	50	46	37	28	17	19	21	30
Perth	1911–1940	51	51	57	61	70	75	76	71	66	60	52	51	62
Sydney	1876–1971	68	70	74	74	75	76	74	68	66	62	62	64	69
Thursday Island	1957–1971	84	86	85	81	82	80	79	79	75	73	73	77	80
Townsville	1957–1971	69	75	73	68	66	66	64	63	56	58	62	64	65

Sunshine, cloud and fog

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, pages 63–70.

Average daily sunshine (hours) based on all available data to 1971 inclusive, is shown in plate 18, page 53. In areas where there is a sparsity of data, estimates of sunshine derived from cloud data were used. Most of the continent receives more than 3,000 hours of sunshine a year, or nearly 70 per cent of the total possible and 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).

In southern Australia generally 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 gives the 20, 50 and 80 percentiles of daily bright sunshine for the months of June and December 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 June (160 per cent) and a low variability in the dry month of December (30 per cent). Darwin has a low variability in the dry season month of June (15 per cent) and a high variability in the wet season month of December (85 per cent).

BRIGHT SUNSHINE, VARIABILITY OF DAILY HOURS, JUNE AND DECEMBER

(20, 50 and 80 percentile values)

Station	Period of record	*June* Percentile 20	50	80	*December* Percentile 20	50	80
Adelaide	1955–71	1.0	3.5	7.5	4.0	9.0	12.5
Alice Springs	1954–71	5.5	9.5	10.0	6.5	11.0	12.5
Brisbane	1951–71	2.5	8.0	9.5	4.0	8.5	11.5
Canberra	1957–71	2.0	5.0	7.0	4.0	9.5	12.0
Darwin	1951–71	9.0	10.0	10.5	3.5	7.5	10.0
Hobart	1955–71	0.5	3.0	6.0	2.5	7.0	10.5
Melbourne	1955–70	0.5	2.5	6.0	3.0	7.5	11.5
Perth	1945–71	1.0	4.0	7.5	8.5	11.0	12.0
Sydney	1955–71	0.5	6.0	8.0	1.5	7.5	11.0
Townsville	1957–71	4.5	9.0	10.0	5.0	9.5	11.0

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.

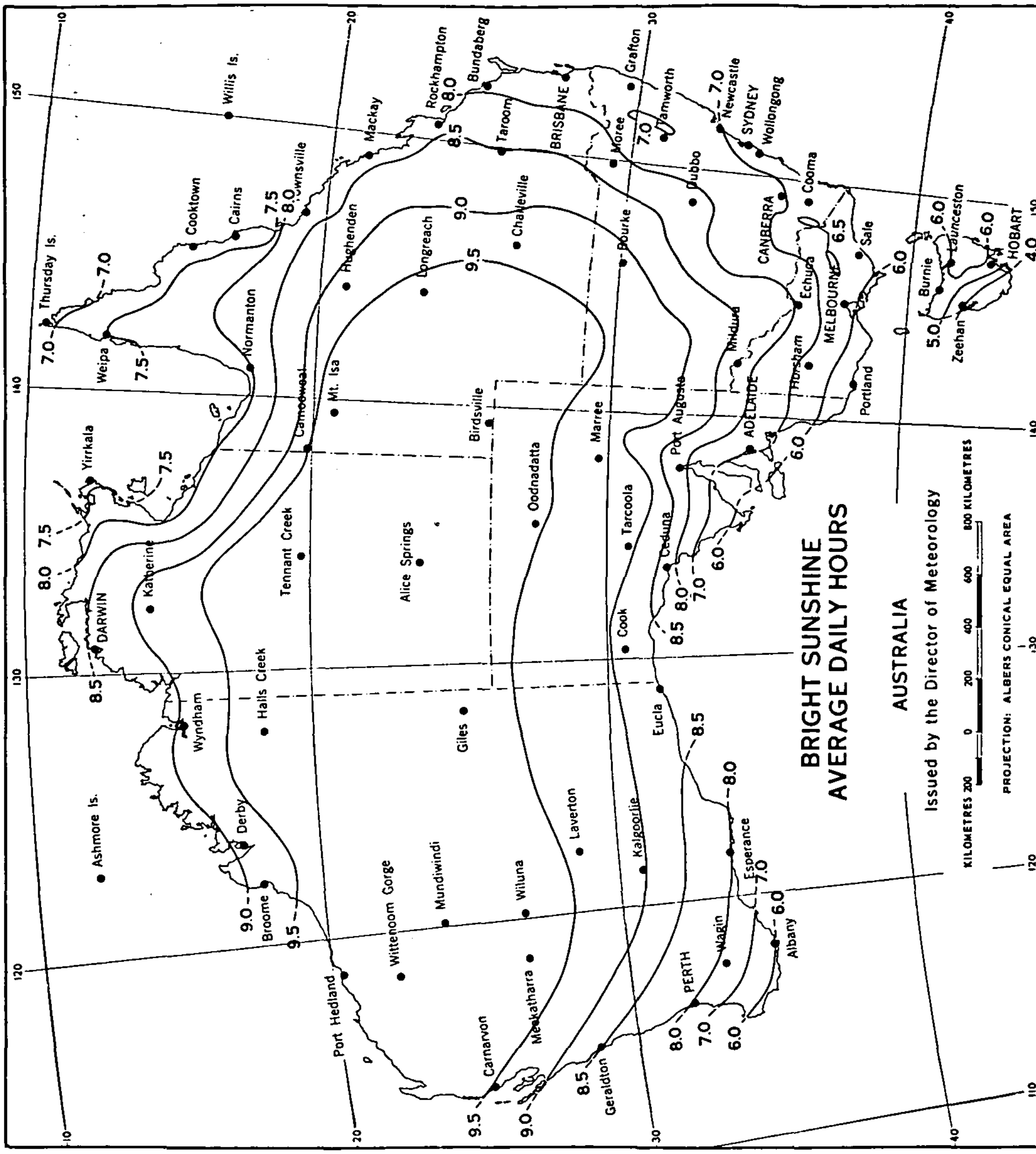

BRIGHT SUNSHINE
AVERAGE DAILY HOURS
AUSTRALIA
Issued by the Director of Meteorology
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
Thursday Is.
Weipa
Cooktown
Cairns
Willis Is.
Normanton
Mackay
Rockhampton
Bundaberg
Taroom
BRISBANE
Grafton
Moree
Tamworth
Newcastle
SYDNEY
Wollongong
Dubbo
Cooma
CANBERRA
Bourke
Charleville
Longreach
Hughenden
Mt. Isa
Birdsville
Marree
Oodnadatta
Alice Springs
Tennant Creek
Yirrkala
DARWIN
Halls Creek
Wyndham
Derby
Broome
Ashmore Is.
Giles
Wittenoom Gorge
Mundiwindi
Wiluna
Laverton
Kalgoorlie
Meekatharra
Port Hedland
Carnarvon
Geraldton
PERTH
Wagin
Albany
Esperance
Eucla
Cook
Tarcoola
Ceduna
Port Augusta
ADELAIDE
Mildura
Horsham
Echuca
MELBOURNE
Sale
Portland
Burnie
Launceston
HOBART
Zeehan

PLATE 18

The average monthly cloud amounts at Australian capitals are included in the climatic tables, pages 63–70. Darwin has the least average daily coverage of 3.2 eighths and Hobart the highest daily average of 5.0 eighths. The highest daily average for any month occurs at Darwin (5.9 eighths for January) and the lowest average daily is also at Darwin (1.1 eighths for August).

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 46 days per year on which fog occurs, 28 of which are in the period May to August. Brisbane averages 22 days of fog per year, 17 of which occur between April and September. Darwin averages only 3 days per year, June to September.

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.

Plate 19, page 55 shows the average global radiation received per day at the earth's surface. The table below shows the variability of daily global radiation for June and December (1968–72) at selected stations.

GLOBAL RADIATION: VARIABILITY OF DAILY AMOUNTS FOR JUNE AND DECEMBER
($mWh.cm^{-2}$)
(20, 50 and 80 percentile values in milliwatt hours per square centimetre (1964–68)

	June			*December*		
	Percentiles			*Percentiles*		
Station	*20*	*50*	*80*	*20*	*50*	*80*
Alice Springs	360	450	480	580	760	810
Darwin	520	570	590	440	570	620
Melbourne	130	190	240	470	640	780
Perth	180	260	330	770	870	910
Townsville	360	490	510	550	710	760
Williamtown	210	270	330	490	650	780

A high correlation exists between daily global radiation (plate 19, page 55) and daily hours of sunshine (plate 18, page 53). 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 conerage 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.

Evaporation

Evaporation is determined by measuring the amount of water evaporated from a free water surface exposed in a standard tank or 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 in 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 annual tank evaporation is mapped in plate 20, page 56 which shows a variation from 500 millimetres over the highlands of Tasmania to 3,500 millimetres in the dry north of South Australia with about 75 per cent of the continent exceeding 2,000 millimetres. In about 75 per cent of the continent, comprising most inland areas, rainfall does not exceed evaporation loss from a free water surface in any month of the year. In the central and north-west parts of the continent the annual evaporation exceeds ten times the rainfall.

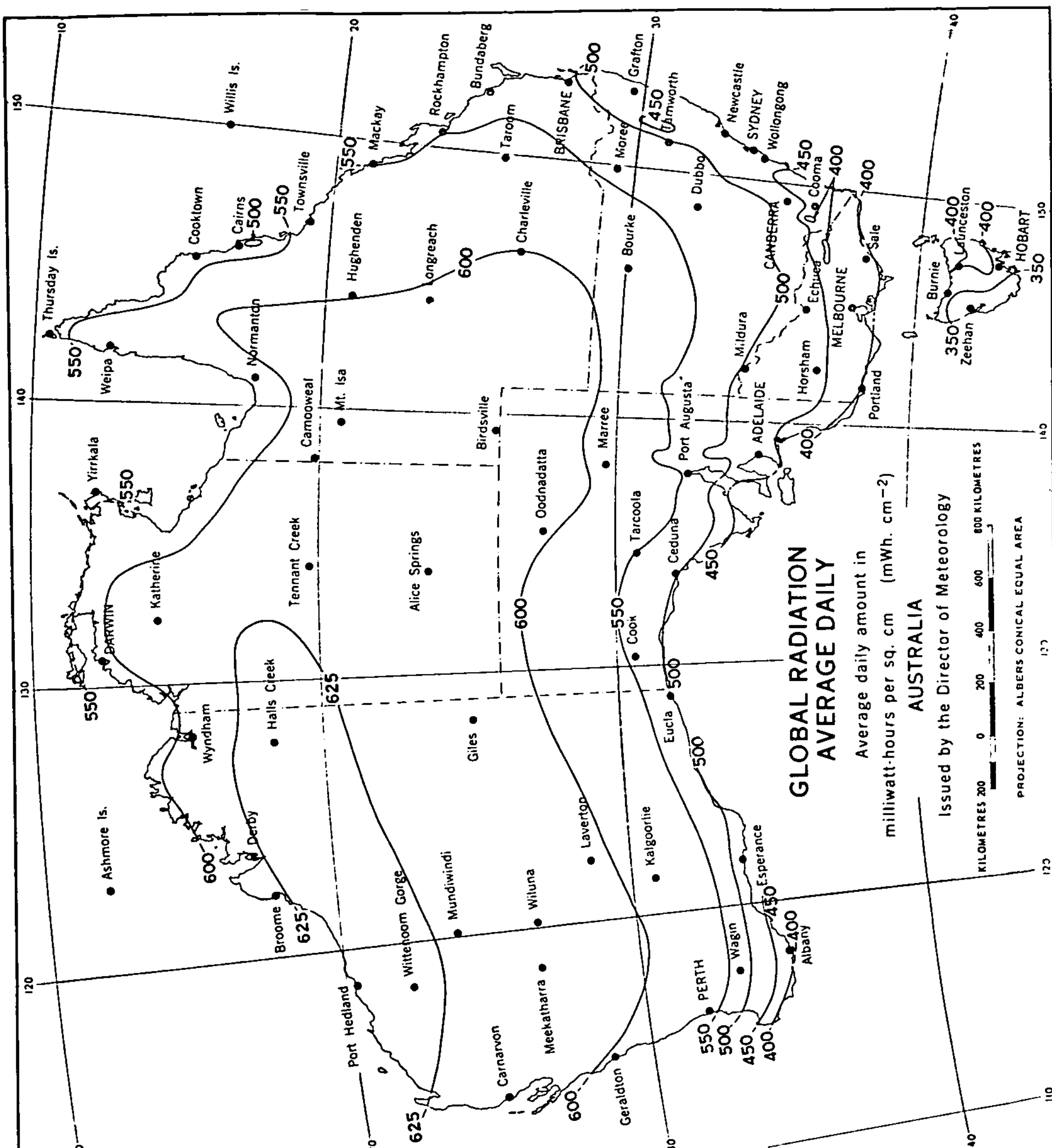

GLOBAL RADIATION
AVERAGE DAILY
Average daily amount in
milliwatt-hours per sq. cm (mWh. cm⁻²)
AUSTRALIA
Issued by the Director of Meteorology
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
Thursday Is.
Willis Is.
Cooktown
Cairns
Townsville
Mackay
Rockhampton
Bundaberg
BRISBANE
Grafton
Tamworth
Newcastle
SYDNEY
Wollongong
Cooma
CANBERRA
Moree
Dubbo
Bourke
Taroom
Charleville
Longreach
Hughenden
Normanton
Weipa
Mt. Isa
Camooweal
Birdsville
Marree
Oodnadatta
Alice Springs
Tennant Creek
Katherine
DARWIN
Yirrkala
Wyndham
Halls Creek
Giles
Derby
Broome
Ashmore Is.
Port Hedland
Wittenoom Gorge
Mundiwindi
Wiluna
Meekatharra
Carnarvon
Laverton
Kalgoorlie
Geraldton
PERTH
Wagin
Esperance
Albany
Eucla
Cook
Tarcoola
Ceduna
Port Augusta
ADELAIDE
Mildura
Horsham
Echuca
MELBOURNE
Sale
Portland
Burnie
Launceston
HOBART
Zeehan
350
400
450
500
550
600
625

PLATE 19

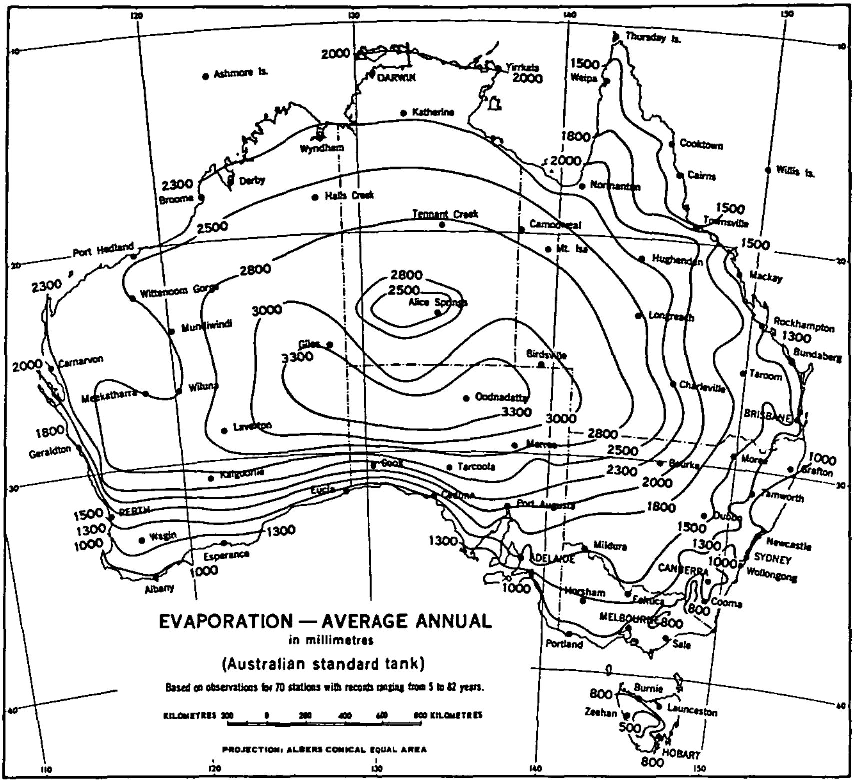


PLATE 20

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.

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 climatic tables, pages 63–70. 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 5.8 kilometres per hour.

The highest wind speeds and wind gusts recorded in Australia have been associated with tropical cyclones. The highest recorded gust was 232 kilometres per hour during a cyclone at Onslow, Western Australia in 1963 and gusts reaching 180 kilometres per hour have been recorded on several occasions in northern Australia with cyclone visitations. The highest gusts recorded at Australian capitals were 157 kilometres per hour at Darwin and 156 kilometres per hour at Perth.

Estimates of the extreme wind gust expected in a given return period* have been derived for places throughout Australia (Whittingham, 1964). On this basis, for example, Darwin would have an extreme gust for a return period of 10 years of 140 kilometres per hour, Melbourne 135 and Perth 130.

*Return period is the average period between successive occurrences equal to, or greater than, a given speed. For example the extreme wind gust for a return period of 10 years can be expected to occur once in 10 years on the average.

Floods

Widespread flood rainfall may occur anywhere in Australia but 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 summer rains, they may occur in any season.

The great Fitzroy and Burdekin river basins of Queensland receive flood rains during the summer wet season. 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, rarely reaching the lake in any 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.

Droughts have severe economic effects in Australia and during the years 1864–1973 inclusive there have been at least eight major droughts affecting the greater part of Australia and at least seven other droughts of lesser severity affecting extensive areas (Foley 1957 (ii)). The droughts of 1895–1903 and 1958–68 were probably the most disastrous in their effects on primary industry.

Gibbs and Maher (1967), having defined a drought year at a certain station as one with the year's rainfall in the first decile range, concluded that the occurrence of areas in the first decile range on annual decile maps for the period 1885–1965 corresponded rather well with drought areas discussed by Foley (1957).

One method of assessing the incidence of rainfall deficiency is the analysis of the distribution of annual rainfalls less than the median. The range between the 50 percentile (median) and the 10 percentile gives a measure of the variation in magnitude of annual rainfalls less than the median. The ratio of this range to the 30 percentile value may be used as an index of rainfall deficiency incidence or drought incidence, i.e.:

$$\text{Index of drought incidence} = \left\{\frac{50 - 10}{30}\right\} \text{percentile}$$

For example, the indexes for Onslow (north-west coast of Western Australia) and similarly, for Cape Otway (south coast of Victoria) are derived thus:

$$\text{Index for Onslow} = \left\{\frac{222 - 64}{145}\right\} \text{mm} = 1.09$$

$$\text{Index for Cape Otway} = \left\{\frac{865 - 716}{801}\right\} \text{mm} = 0.19$$

Plate 21, page 58 shows the distribution of the index of drought incidence over Australia. The intrusions of high index values from the interior to the central cost of Queensland and across western New South Wales are noteworthy. The extreme values on the north-west coast of Western Australia are among the highest in Australia (e.g. Onslow 1.09) due to the dependence of the rainfall on random cyclone tracks.

The Bureau of Meteorology commenced the issue of *Drought Reviews* in June 1965. These reviews provide a summary of serious rainfall deficiencies and are issued monthly when serious or severe deficiencies exist in any of the rainfall districts. The deficiency criteria are based on monthly rainfall decile analyses. A review of droughts in Australia to 1968 is included in Year Book No. 54, 1968. Summaries of subsequent drought periods may be obtained from the Drought Reviews.

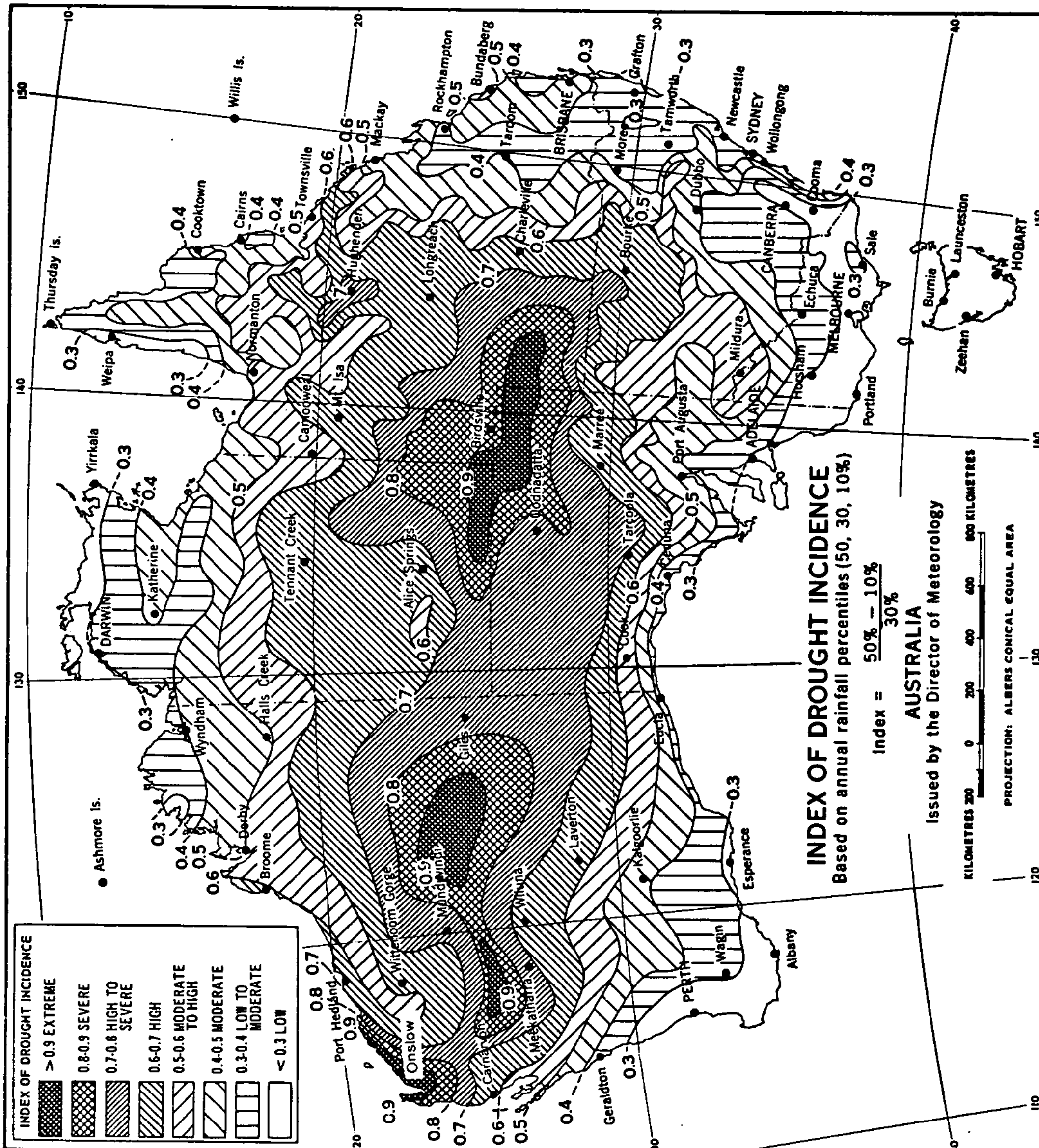

INDEX OF DROUGHT INCIDENCE
Based on annual rainfall percentiles (50, 30, 10%)
Index = 50% − 10% / 30%
AUSTRALIA
Issued by the Director of Meteorology
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
INDEX OF DROUGHT INCIDENCE
>0.9 EXTREME
0.8-0.9 SEVERE
0.7-0.8 HIGH TO SEVERE
0.6-0.7 HIGH
0.5-0.6 MODERATE TO HIGH
0.4-0.5 MODERATE
0.3-0.4 LOW TO MODERATE
< 0.3 LOW
Thursday Is.
Willis Is.
Ashmore Is.
Weipa
Cooktown
Cairns
Townsville
Mackay
Rockhampton
Bundaberg
BRISBANE
Grafton
Tamworth
Newcastle
SYDNEY
Wollongong
Cooma
CANBERRA
Sale
MELBOURNE
Echuca
Horsham
Mildura
Portland
Burnie
Launceston
HOBART
Zeehan
Normanton
Hughenden
Longreach
Charleville
Tambo
Moree
Dubbo
Bourke
Cloncurry
Mt. Isa
Birdsville
Oodnadatta
Marree
Port Augusta
ADELAIDE
Tarcoola
Ceduna
Cook
Eucla
Yirrkala
DARWIN
Katherine
Tennant Creek
Alice Springs
Wyndham
Halls Creek
Derby
Broome
Giles
Laverton
Kalgoorlie
Esperance
Port Hedland
Wittenoom Gorge
Mundiwindi
Wiluna
Onslow
Carnarvon
Meekatharra
Geraldton
PERTH
Wagin
Albany

PLATE 21

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 indexes based on the average response of subjects under specified conditions have been derived.

Effective Temperature. The effective temperature with respect to any environmental combination of temperature, humidity and wind is defined as the temperature of still, saturated air in which a normally clothed sedentary worker would feel the same level of comfort or discomfort.

Environment studies carried out at the research laboratories of the American Society of Heating, Refrigerating and Air Conditioning Engineers established values of effective temperature corresponding to various combinations of temperature, humidity and air movement. The results were published as a series of research reports commencing in 1923, and have been widely used to measure climatic discomfort (*see* 1960 report of the Society).

Normally clothed sedentary workers are mostly comfortable within a range of effective temperatures between 15°C and 27°C (air movement 5–8 metres per minute). At effective temperatures greater than 27°C, the majority of people feel heat discomfort and when less than 15°C they feel cold discomfort.

The table below contains the annual average frequency of effective temperature at 3 p.m. within specified limits at selected stations. The figures provide comparisons of daily occurrence of afternoon discomfort for the given environmental conditions.

CLIMATIC DISCOMFORT: EFFECTIVE TEMPERATURE

Annual average frequency of days when effective temperature at 3 p.m. is lower than 15°C (cold discomfort), within 15–27°C (comfort), and higher than 27°C (heat discomfort). Indoors, normally clothed sedentary workers, air movement 5–8 metres per minute.

Station	*Period of record*	*Average days per year* — *Less than 15°C*	*15–27°C*	*Greater than 27°C*
Adelaide	1955–72	128	234	3
Albury	1962–71	141	220	4
Alice Springs	1955–67	39	300	26
Brisbane	1951–70	6	356	3
Broome	1941–71	0	225	140
Canberra	1940–72	172	192	1
Carnarvon	1945–72	1	345	19
Ceduna	1955–71	77	279	9
Charleville	1942–72	28	316	21
Cloncurry	1940–72	1	268	96
Darwin	1955–69	0	225	140
Hobart	1944–67	239	126	0
Kalgoorlie	1940–72	66	281	18
Marble Bar	1957–71	0	220	145
Melbourne	1955–71	155	207	3
Mildura	1946–72	95	258	12
Perth	1944–71	57	302	6
Rockhampton	1940–72	2	337	26
Sydney	1955–72	69	295	1
Townsville	1941–69	0	333	32
Woomera	1954–72	73	279	13

Heat discomfort is greatest in the north-west, where Marble Bar averages 145 days of high heat discomfort annually; and least in the south-east, where Hobart has only one day every five years. Cold discomfort is least in the north, where Townsville has one day of cold discomfort in ten years; it is greatest in the south-east, where Hobart has 239 days annually when the effective temperature is sufficiently low to cause discomfort. By the suitable choice of clothing discomfort can be decreased significantly on cold days. On cold days also, workers tend to take opportunities to move around, thus increasing metabolic heat rates.

Effective temperature is a useful index but its application is limited because available criteria relate only to indoor workers in sedentary occupations. Furthermore, at lower air temperatures the effective temperature gives excessive weight to humidity.

Relative strain index. The relative strain index derived by Lee and Henschel (1963) has been applied in Australia to measure heat discomfort (Hounam, 1969, Gaffney 1973). 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 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 plate 22, page 61 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. Maximum discomfort generally occurs around 3 p.m. on days of high temperature.

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 coastal 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, for example, at Perth.

HEAT DISCOMFORT

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).

Station	*Period of record*	*Greater than* *0.3 RSI*	*Greater than* *0.4 RSI*
Adelaide	1955–72	7	1
Albury	1962–71	8	1
Alice Springs	1955–67	50	4
Brisbane	1951–69	6	<1
Broome	1940–72	155	48
Canberra	1940–72	2	<1
Carnarvon	1945–72	23	3
Ceduna	1955–71	16	3
Charleville	1942–72	42	3
Cloncurry	1940–72	126	28
Darwin	1955–69	165	23
Hobart	1944–67	<1	<1
Kalgoorlie	1939–72	30	5
Marble Bar	1957–71	173	69
Melbourne	1955–71	6	1
Mildura	1946–72	19	3
Perth	1944–72	12	1
Rockhampton	1940–72	33	5
Sydney	1955–72	2	<1
Townsville	1941–69	36	4
Woomera	1954–72	25	3

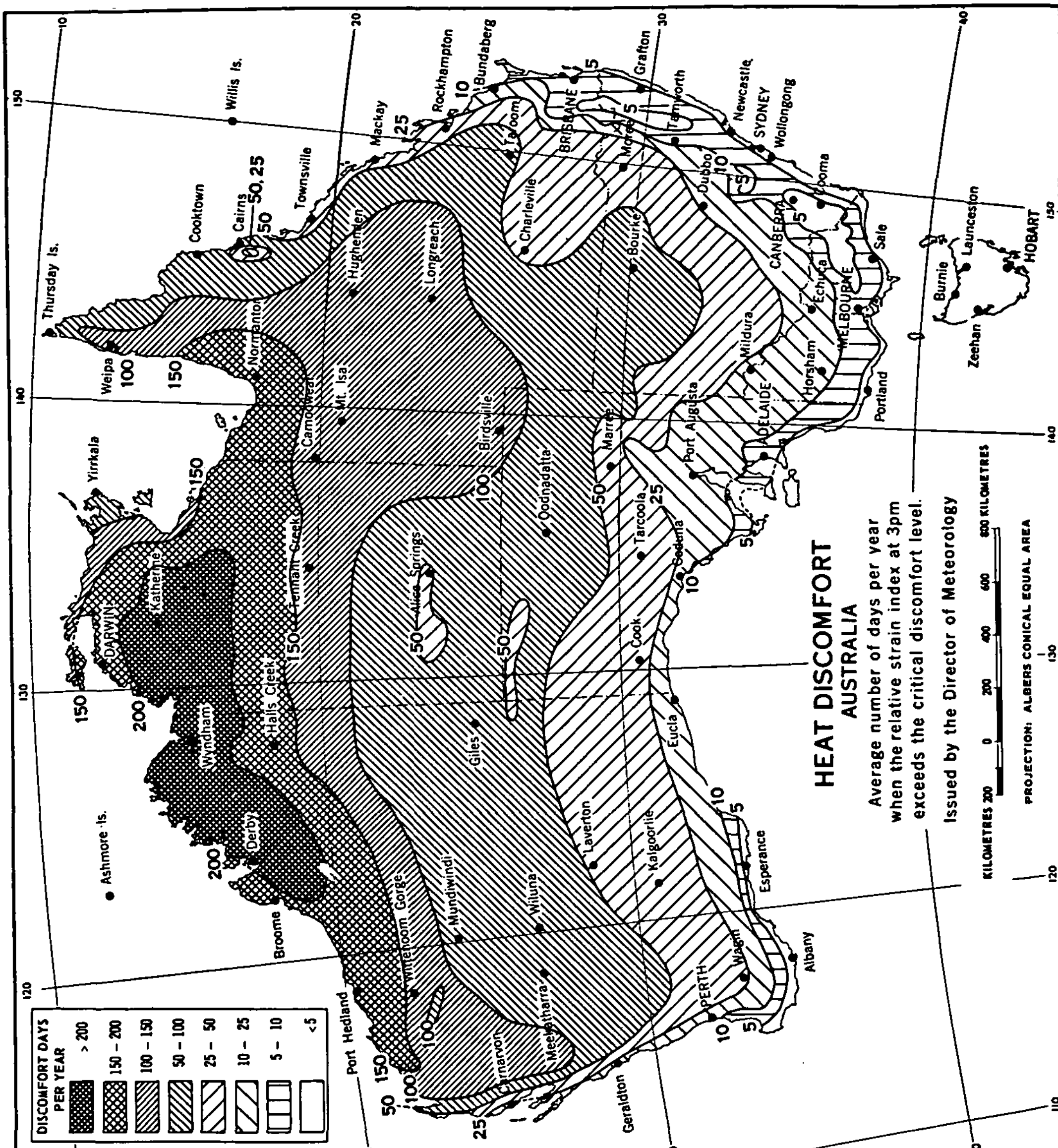

HEAT DISCOMFORT
AUSTRALIA
Average number of days per year
when the relative strain index at 3pm
exceeds the critical discomfort level.
Issued by the Director of Meteorology
DISCOMFORT DAYS PER YEAR
> 200
150 – 200
100 – 150
50 – 100
25 – 50
10 – 25
5 – 10
<5
KILOMETRES 200 0 200 400 600 800 KILOMETRES
PROJECTION: ALBERS CONICAL EQUAL AREA
DARWIN
BRISBANE
SYDNEY
CANBERRA
MELBOURNE
ADELAIDE
PERTH
HOBART

PLATE 22

The variability of the relative strain index in January by percentiles for 3 p.m. values at selected stations is shown in the table below. Melbourne has a significantly higher discomfort variability than Sydney, and Adelaide is more variable than Brisbane.

HEAT DISCOMFORT VARIABILITY, JANUARY

Relative strain index values at 3 p.m. not exceeded by 20, 50 and 80 per cent of all values. Indoors, lightly clothed manual workers, air movement 60 metres per minute.

Station	*Period of record*	*Percentiles* 20	50	80
Adelaide	1955–72	<0.10	0.10	0.25
Albury	1962–71	0.10	0.15	0.25
Alice Springs	1955–67	0.25	0.30	0.35
Brisbane	1951–70	0.10	0.15	0.25
Broome	1940–72	0.30	0.40	0.45
Canberra	1940–72	<0.10	0.10	0.20
Carnarvon	1945–72	0.15	0.20	0.30
Ceduna	1955–71	<0.10	0.10	0.25
Charleville	1942–72	0.20	0.30	0.35
Cloncurry	1940–72	0.30	0.35	0.40
Darwin	1955–69	0.25	0.35	0.40
Hobart	1944–67	<0.10	<0.10	0.10
Kalgoorlie	1939–72	0.15	0.25	0.35
Marble Bar	1957–71	0.35	0.45	0.50
Melbourne	1955–71	<0.10	0.10	0.25
Mildura	1946–72	0.10	0.20	0.30
Perth	1944–72	<0.10	0.15	0.25
Rockhampton	1940–72	0.20	0.25	0.35
Sydney	1955–72	<0.10	0.10	0.15
Townsville	1941–69	0.20	0.30	0.35
Woomera	1954–72	0.15	0.25	0.35

At inland places, relatively low night temperatures have recuperative effects after hot days. Marble Bar, Western Australia (150 km south-east of Port Hedland) for example, has median night minimum temperatures 5–10° C lower than Darwin, except in December–February. Even in this period although median minima at both stations are around 25° C, Marble Bar has median vapour pressures and relative humidities much lower than Darwin (by 10 millibars and 30 per cent respectively).

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 windward slopes allow optimal air movement, for instance, enabling more comfortable ventilation to be obtained. Regular sea breezes such as those experienced at Perth reduce discomfort and their full benefit may not be experienced until after 3 p.m. on some days.

Climatic data for capital cities

The averages and extremes for a number of elements determined from long-period observations at the Australian capitals *to 1973 inclusive*, are given in the following pages. Extremes generally cover all available data whereas averages may only refer to present sites.

CLIMATIC DATA: PERTH, WESTERN AUSTRALIA

(Lat. 31° 57′ S., Long. 115° 52′ E. Height above M.S.L. 15 metres)

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

Month	Mean of 9 a.m. and 3 p.m. atmospheric pressure reduced to mean sea level (mb)	Wind (height of anemometer 22 metres) Average (km/h)	Highest mean speed in one day (km/h)	Highest gust speed (km/h)	Prevailing direction 9 a.m.	Prevailing direction 3 p.m.	Mean amt evaporation (mm)	No. days thunder	Mean daily amt clouds 9 a.m., 3 p.m., 9 p.m. (a)	No. clear days
No. of years of record	89	30(b)	73	58	30(b)	30(b)	75	77	30(b)	30(b)
January	1,012.6	17.5	42.3 *27/98*	81	E	SSW	264	0.9	2.3	14
February	1,013.0	17.2	40.8 4/73	87	ENE	SSW	223	0.7	2.5	13
March	1,015.2	16.2	34.6 6/13	113	E	SSW	195	0.7	2.8	12
April	1,017.9	13.7	50.7 25/00	101	ENE	SSW	119	0.8	3.4	9
May	1,017.9	13.5	44.5 8/73	119	NE	WSW	73	1.8	4.3	6
June	1,017.6	13.5	48.6 17/27	129	N	NW	48	1.8	4.7	5
July	1,018.9	14.2	53.9 20/26	137	NNE	W	48	1.4	4.5	5
August	1,018.8	15.1	51.3 15/03	156	N	WNW	64	1.2	4.5	6
September	1,018.4	15.1	45.9 11/05	109	ENE	SSW	91	0.7	3.9	8
October	1,017.0	16.1	43.0 6/16	105	SE	SW	140	0.7	3.8	8
November	1,015.5	17.2	41.4 *18/97*	101	E	SW	194	0.7	3.1	9
December	1,013.4	17.7	41.2 6/22	103	E	SSW	247	1.0	2.6	13
Year: Totals	..	..	.. ..	..	..	..	1,706	12.4	..	108
Year: Averages	1,016.4	15.6	.. ..	..	E	SSW	..	..	3.5	..
Year: Extremes	..	..	53.9 20/7/26	156	..	..	..	..	..	..

(a) Scale 0–8. (b) Standard thirty years normal (1911–1940).

TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (°Celsius) Mean max.	Mean min.	Mean	Extreme air temperature (°Celsius) Highest	Lowest	Extreme temperature (°Celsius) Highest in sun	Lowest on grass	Mean daily hours sunshine
No. of years of record	77	77	77	77	77	63(a)	75	76
January	29.5	17.6	23.5	43.7 29/56	9.2 20/25	80.7 22/14	4.2 20/25	10.4
February	29.8	17.8	23.7	44.6 8/33	8.7 1/02	78.7 4/34	4.3 1/13	10.0
March	27.7	16.5	22.1	41.3 14/22	7.7 8/03	75.0 19/18	2.6 (b)	8.8
April	24.4	14.0	19.2	37.6 9/10	4.1 20/14	69.4 8/16	−0.7 26/60	7.2
May	20.6	11.5	16.1	32.4 2/07	1.3 11/14	63.3 4/25	−3.9 31/64	5.9
June	18.1	9.9	14.1	27.6 2/14	1.6 22/55	57.5 9/14	−3.4 27/46	4.8
July	17.2	8.9	13.1	24.7 21/21	1.2 7/16	56.2 13/15	−3.8 30/20	5.3
August	17.8	9.1	13.4	27.8 21/40	1.9 31/08	62.3 29/21	−3.0 18/66	6.2
September	19.3	10.1	14.7	32.7 30/18	2.6 6/56	67.5 29/16	−2.7 (c)	7.1
October	21.1	11.4	16.3	37.3 29/67	4.2 6/68	71.8 19/54	−1.2 16/31	8.2
November	24.6	13.8	19.2	40.3 24/13	5.6 1/04	75.0 30/25	−1.1 6/71	9.6
December	27.3	16.0	21.5	42.3 31/68	8.6 29/57	76.0 11/27	3.3 29/57	10.5
Year: Averages	23.1	13.1	18.1	.. ..	.. ..	.. ..	.. ..	7.8
Year: Extremes	..	..	..	44.6 8/2/33	1.2 7/7/16	80.7 22/1/14	−3.9 31/5/64	..

(a) Records discontinued 1963. (b) 8/1903 and 16/1967. (c) 8/1952 and 6/1956.

HUMIDITY, RAINFALL, AND FOG

Month	Vapour pressure mean 9 a.m. (mb)	Rel. hum. (%) at 9 a.m. Mean	Highest mean	Lowest mean	Rainfall (millimetres) Mean mthly	Mean No. of days of rain	Greatest monthly	Least monthly	Greatest in one day	Fog Mean No. days
No. of years of record	30(a)	30(a)	77	77	98	98	98	98	98	77
January	14.8	51	63	41	8	3	55 1879	Nil (b)	44 *27/79*	0.2
February	14.7	51	65	43	11	3	166 1955	Nil (b)	87 17/55	0.3
March	14.7	57	66	46	20	4	145 1934	Nil (b)	77 9/34	0.7
April	13.4	61	75	51	46	8	149 1926	Nil 1920	67 30/04	0.8
May	12.4	70	81	60	124	14	308 1879	14 1964	76 17/42	1.3
June	11.4	75	85	68	186	17	476 1945	55 1877	99 10/20	1.5
July	10.9	76	88	69	174	18	425 1958	61 1876	76 *4/91*	1.4
August	10.7	71	83	62	139	18	318 1945	12 1902	74 14/45	1.0
September	11.6	66	75	58	81	14	199 1923	9 1916	47 18/66	0.3
October	11.7	60	75	52	55	12	200 1890	1 1969	50 4/67	0.4
November	12.7	52	66	41	21	6	71 1916	Nil 1891	39 29/56	0.2
December	13.9	51	63	39	14	4	81 1951	Nil (b)	47 3/51	0.2
Year: Totals	..	..	..	..	879	121	.. ..	.. ..	.. ..	8.3
Year: Averages	12.7	62	..	..	..	..	.. ..	.. ..	.. ..	..
Year: Extremes	..	..	88	39	..	..	476 6/1945	Nil (b)	99 10/6/20	..

(a) Standard thirty years normal (1911–1940). (b) Various years.

Figures such as *27/98*, 29/56, etc. indicate, in respect of the month of reference, the day and year of the occurrence. Dates in italics relate to nineteenth century.

CLIMATIC DATA: DARWIN, NORTHERN TERRITORY

(Lat. 12° 28′ S., Long. 130° 51′ E. Height above M.S.L. 30 metres)

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

Month	Mean of 9 a.m. and 3 p.m. atmospheric pressure reduced to mean sea level (mb)	Wind (height of anemometer 36 metres) Average (km/h)	Highest mean speed in one day (km/h)	Highest gust speed (km/h)	Prevailing direction 9 a.m.	Prevailing direction 3 p.m.	Mean amt evaporation (mm)	No. days thunder	Mean daily amt clouds 9 a.m., 3 p.m., 9 p.m. (a)	No. clear days
No. of years of record	90	20	..	22(b)	..	..	14	35	35	35
January	1,006.2	9.3	..	106	W	NW	164	12.9	5.9	1
February	1,006.3	10.6	..	101	W	NW	141	10.2	5.8	1
March	1,007.2	7.5	..	157	W	NW	161	10.6	5.2	3
April	1,009.3	8.8	..	67	SE	NW	164	4.0	2.9	10
May	1,010.9	9.6	..	62	SE	E	172	0.5	2.0	16
June	1,012.2	10.1	..	64	SE	E	172	0.0	1.4	19
July	1,012.8	8.9	..	62	SE	E	176	0.0	1.3	20
August	1,012.6	8.6	..	72	SE	NW	182	0.0	1.1	20
September	1,011.7	8.6	..	64	ENE	NW	206	1.0	1.8	16
October	1,010.5	9.8	..	85	NE	NW	232	5.3	2.7	9
November	1,008.7	8.6	..	117	NW	NW	211	11.8	3.9	4
December	1,006.9	9.8	..	106	NW	NW	189	14.2	4.9	2
Year Totals	..	..	..	..	..	..	2,170	70.5	..	121
Year Averages	1,009.6	9.2	..	..	SE	NW	..	..	3.2	..
Year Extremes	..	..	..	157	..	..	..	..	..	..

(a) Scale 0–8. (b) Several incomplete years.

TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (°Celsius) Mean max.	Mean min.	Mean	Extreme air temperature (°Celsius) Highest	Lowest	Extreme temperature (°Celsius) Highest in sun	Lowest on grass	Mean daily hours sunshine
No. of years of record	90	90	90	92(a)	92(a)	26(b)	..	21
January	32.2	25.0	28.6	37.8 *2/82*	20.0 *20/92*	75.6 26/42	..	5.9
February	31.9	24.8	28.4	38.3 *20/87*	17.2 25/49	73.2 (c)	..	5.9
March	32.4	24.8	28.6	38.9 (d)	19.2 31/45	74.3 23/38	..	6.8
April	33.1	24.2	28.7	40.0 *7/83*	16.0 11/43	72.8 1/38	..	8.6
May	32.3	22.4	27.4	39.1 *8/84*	(e)14.2 28/67	71.2 5/20	..	9.3
June	30.9	20.4	25.7	39.0 *17/37*	12.1 23/63	68.5 2/16	..	9.7
July	30.4	19.6	25.1	36.7 *17/88*	10.4 29/42	68.9 28/17	..	9.8
August	31.4	20.8	26.1	37.0 *30/71*	13.6 11/63	69.1 28/16	..	10.4
September	32.7	23.2	27.9	38.9 *20/82*	16.7 9/63	69.5 (f)	..	10.0
October	33.6	25.0	29.3	40.5 *17/92*	19.4 8/66	71.4 30/38	..	9.5
November	33.8	25.3	29.6	39.6 *9/84*	19.3 4/50	77.0 14/37	..	8.6
December	33.2	25.3	29.3	38.9 *20/82*	18.3 4/60	76.2 26/23	..	7.1
Year Averages	32.3	23.3	27.9	.. ..	.. ..	.. ..	..	8.5
Year Extremes	..	..	..	40.5 17/10/1892	10.4 29/7/1942	77.0 14/11/37	..	..

(a) Years 1882–1941 at Post Office, 1942–1966 at Aerodrome; 1967–1971 at Regional office; sites not strictly comparable. (b) Records discontinued 1942. (c) 5/1938 and 23/1938. (d) 26/1883 and 27/1883. (e) Recorded at Darwin Aerodrome. All other Statistics from 1967 to 1971 at Regional Office. (f) 28/1916 and 3/1921.

HUMIDITY, RAINFALL, AND FOG

Month	Vapour pressure mean 9 a.m. (mb)	Rel. hum. (%) at 9 a.m. Mean	Highest mean	Lowest mean	Rainfall (millimetres) Mean mthly	Mean No. of days of rain	Greatest monthly	Least monthly	Greatest in one day	Fog Mean No. days
No. of years of record	85(a)	90	57(b)	57(b)	86(c)	74	107(d)	107(d)	107(d)	35
January	31.1	81	89	69	391	19	746 1974	68 1906	296 *7/97*	0.0
February	31.1	81	88	71	330	18	815 1969	13 1931	279 18/55	0.0
March	30.7	80	84	69	260	17	595 1965	21 1911	182 6/19	0.0
April	27.0	72	80	60	103	8	603 1891	Nil 1950	158 4/59	0.0
May	21.8	65	76	49	14	1	299 1968	Nil (e)	56 6/22	0.0
June	18.7	63	75	52	3	0	73 1973	Nil (e)	36 10/02	0.4
July	17.6	62	71	47	1	0	65 1900	Nil (e)	43 2/00	1.1
August	20.6	66	73	53	2	0	84 1947	Nil (e)	80 22/47	0.8
September	24.7	68	73	54	13	2	108 1942	Nil (e)	71 21/42	0.2
October	27.7	68	72	60	50	5	339 1954	Nil (e)	95 18/56	0.0
November	29.3	70	75	62	126	11	399 1938	10 1870	120 9/51	0.0
December	30.5	75	83	65	243	16	583 1965	25 1934	200 28/10	0.0
Year Totals	..	..	..	..	1,536	97	.. ..	.. ..	.. ..	2.5
Year Averages	25.9	71	..	..	..	..	.. ..	.. ..	.. ..	..
Year Extremes	..	..	89	47	..	..	815 2/69	Nil (f)	296 7/1/1897	..

(a) Records to 1966 at Aerodrome. (b) 1882 to 1938 at Post Office. (c) 1869 to 1962 at Post Office; 8 years missing. (d) Highest or lowest at either Post Office, Aerodrome or Regional Office Sites. (e) Various years. (f) April to October. Various years. Figures such as 2/82, 26/42, etc., indicate in respect of the month of reference, the day and year of occurrence. Dates in italics relate to nineteenth century.

CLIMATIC DATA: ADELAIDE, SOUTH AUSTRALIA

(Lat. 34° 46′ S., Long. 138° 35′ E. Height above M.S.L. 43 metres)

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

Month	Mean of 9 a.m. and 3 p.m. atmospheric pressure reduced to mean sea level (mb)	Wind (height of anemometer 22 metres): Average (km/h)	Wind: Highest mean speed in one day (km/h)	Wind: Highest gust speed (km/h)	Wind: Prevailing direction 9 a.m.	Wind: Prevailing direction 3 p.m.	Mean amt evaporation (mm)	No. days thunder	Mean daily amt clouds 9 a.m., 3 p.m., 9 p.m. (a)	No. clear days
No. of years of record	117	20(b)	20(b)	55	30(c)	30(c)	5(d)	102	100	58
January	1,013.2	12.8	32.2 12/70	116	SW	SW	268	1.5	2.9	12.3
February	1,014.3	12.1	28.8 25/67	106	NE	SW	233	1.1	3.0	10.7
March	1,017.2	11.4	30.7 24/64	126	S	SW	185	0.8	3.2	10.9
April	1,019.8	11.4	37.4 10/56	130	NE	SW	134	1.0	4.1	6.9
May	1,020.0	11.3	37.8 19/53	113	NE	NW	82	1.0	4.7	4.6
June	1,019.8	11.6	29.7 16/70	108	NE	N	59	0.9	5.0	3.9
July	1,020.0	11.8	32.9 13/64	148	NE	NW	59	0.8	4.9	3.5
August	1,019.0	12.8	38.2 8/55	121	NE	SW	77	1.1	4.2	4.8
September	1,017.6	13.2	34.9 16/65	111	NNE	SW	118	1.3	4.2	5.7
October	1,016.0	13.6	35.4 1/68	121	NNE	SW	180	1.9	4.2	5.7
November	1,015.1	13.9	36.3 14/68	130	SW	SW	205	2.0	3.9	6.7
December	1,013.3	13.5	31.1 18/69	121	SW	SW	250	1.5	3.4	9.0
Year: Totals	..	..	.. ..	..	..	..	1,851	15.0	..	84.7
Year: Averages	1,017.1	..	.. ..	..	NE	SW	..	..	4.0	..
Year: Extremes	..	..	38.2 8/8/65	148	..	..	..	..	..	..

(a) Scale 0–8. (b) Records of cup anemometer. (c) Standard 30 years normal (1931–1960). (d) Class 'A' pan.

TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (°Celsius): Mean max.	Mean min.	Mean	Extreme air temperature (°Celsius): Highest	Lowest	Extreme temperature (°Celsius): Highest in sun	Lowest on grass	Mean daily hours sunshine
No. of years of record	117	117	117	117	117	54(a)	111	92
January	29.6	16.4	23.0	47.6 12/39	7.3 *21/84*	82.3 *18/82*	2.5 *14/79*	9.9
February	29.4	16.6	23.0	45.3 *12/99*	7.5 23/18	76.9 10/00	2.1 23/26	9.3
March	26.9	15.0	21.0	43.6 9/34	6.6 21/33	78.9 *17/83*	0.1 21/33	7.9
April	22.7	12.6	17.7	37.0 5/38	4.2 *15/59*	68.3 *1/83*	−2.2 14/63	6.0
May	18.7	10.2	14.5	31.9 4/21	2.7 (b)	64.6 *12/79*	−3.6 19/28	4.8
June	15.9	8.3	12.1	25.6 4/57	0.3 (c)	59.3 *18/79*	−6.1 24/44	4.2
July	15.0	7.2	11.1	23.3 11/06	0.0 24/08	56.9 *26/90*	−5.5 30/29	4.2
August	16.4	7.8	12.1	29.4 31/11	0.2 *17/59*	60.0 *31/92*	−5.1 11/29	5.3
September	18.9	9.0	14.0	35.1 30/61	0.4 *4/58*	71.4 *23/82*	−3.9 25/27	6.2
October	22.1	10.9	16.5	39.4 21/22	2.3 *20/58*	72.2 30/21	−3.0 22/66	7.2
November	25.2	12.9	19.1	45.3 *21/65*	4.9 2/09	74.9 *20/78*	−0.3 2/09	8.5
December	27.8	14.9	21.4	45.9 29/31	6.1 (d)	79.8 *7/99*	0.3 *4/84*	9.4
Year: Averages	22.4	11.8	17.1	..	..	..	..	6.9
Year: Extremes	..	..	..	47.6 12/1/39	0.0 24/7/08	82.3 18/1/62	−6.1 24/6/44	..

(a) Discontinued 1934, incomplete 1931–1934. (b) *26/1895* and 24/04. (c) *27/1876* and 24/44. (d) *16/1861* and 4/06.

HUMIDITY, RAINFALL, AND FOG

Month	Vapour pressure mean 9 a.m. (mb)	Rel. hum. (%) at 9 a.m.: Mean	Highest mean	Lowest mean	Rainfall (millimetres): Mean mthly	Mean No. of days of rain	Greatest monthly	Least monthly	Greatest in one day	Fog Mean No. days
No. of years of record	106	106	106	106	135	135	135	135	135	74
January	11.9	41	59	29	19	4	84 1941	Nil (a)	58 *2/89*	0.0
February	12.1	43	61	30	20	4	155 1925	Nil (a)	141 7/25	0.0
March	12.0	47	62	29	24	5	117 1878	Nil (a)	89 *5/78*	0.0
April	11.5	57	72	37	44	10	155 1971	Nil 1945	80 *5/60*	0.0
May	10.8	67	77	49	69	13	177 1875	2 1934	70 *1/53*	0.4
June	10.0	75	84	63	72	15	218 1916	6 1958	54 1/20	1.1
July	9.5	76	87	66	66	16	138 1890	10 1899	45 *10/65*	1.3
August	9.7	70	80	54	62	16	157 1852	8 1944	57 *19/51*	0.6
September	9.9	60	72	44	51	13	148 1923	7 1951	40 20/23	0.2
October	10.2	52	67	29	44	11	133 1949	1 1969	57 16/08	0.0
November	10.5	45	64	31	31	8	113 1839	1 1963	75 12/60	0.0
December	11.2	41	56	31	27	6	101 1861	Nil 1904	61 23/13	0.0
Year: Totals	..	..	..	..	529	121	.. ..	.. ..	.. ..	3.6
Year: Averages	10.5	53	..	..	..	..	.. ..	.. ..	.. ..	..
Year: Extremes	..	..	87	29	..	..	218 6/1916	Nil (b)	141 7/2/25	..

(a) Various years. (b) December to April, various years.

Figures such as 3/55, *21/84*, etc. indicate, in respect of the month of reference, the day and year of the occurrence. Dates in italics relate to nineteenth century.

14158/74—3

CLIMATIC DATA: BRISBANE, QUEENSLAND

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

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

Month	Mean of 9 a.m. and 3 p.m. atmospheric pressure reduced to mean sea level (mb)	'nd (height of anemometer 32 metres)					Mean amt evaporation (mm)	No. days thunder	Mean daily amt clouds 9 a.m., 3 p.m., 9 p.m. (a)	No. clear days
		Average (km/h)	Highest mean speed in one day (km/h)	Highest gust speed (km/h)	Prevailing direction 9 a.m.	Prevailing direction 3 p.m.				
No. of years of record	87	58	58	58	30(b)	30(b)	65	87	82	66
January	1,011.7	12.2	31.8 23/47	109	SE	NE	178	4.7	4.6	3.4
February	1,012.4	12.0	35.7 21/54	108	SE	NE	140	3.7	4.8	2.4
March	1,014.6	11.9	32.7 1/29	106	S	E	135	2.3	4.3	5.6
April	1,017.3	10.7	26.9 3/25	104	S	E	111	1.4	3.5	7.9
May	1,018.6	10.3	28.8 17/26	87	SW	SE	86	0.6	3.3	10.0
June	1,018.4	10.3	30.6 14/28	95	SW	WSW	68	0.5	3.3	10.5
July	1,018.9	10.1	35.4 13/54	111	SW	WSW	73	0.4	2.9	13.3
August	1,018.9	10.3	26.9 4/35	100	SW	NE	96	1.4	2.6	13.5
September	1,017.5	10.5	25.9 1/48	102	SW	NE	118	2.8	2.7	12.6
October	1,015.9	11.1	16.8 1/41	100	S	NE	150	4.4	3.4	8.6
November	1,014.1	11.9	24.9 10/28	111	SE	NE	168	5.8	3.9	6.0
December	1,012.1	12.3	31.4 15/26	128	SE	NE	185	6.7	4.3	4.5
Year Totals	..	..	.. ..	..	..	..	1,508	34.7	..	98.3
Year Averages	1,015.9	10.9	.. ..	..	SW	NE	..	..	3.6	..
Year Extremes	..	..	35.7 21/2/54	128	..	..	..	..	..	..

(a) Scale 0–8. (b) Standard thirty years normal (1911–1940).

TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (°Celsius)			Extreme air temperature (°Celsius)		Extreme temperature (°Celsius)		Mean daily hours sunshine
	Mean max.	Mean min.	Mean	Highest	Lowest	Highest in sun	Lowest on grass	
No. of years of record	87	87	87	87	87	50(a)	87	65
January	29.4	20.6	25.0	43.2 26/40	14.9 *4/93*	76.2 2/37	9.9 *4/93*	7.5
February	28.9	20.4	24.7	40.9 21/25	14.7 21/31	74.0 6/10	9.5 22/31	7.0
March	27.8	19.1	23.5	38.8 13/65	11.3 29/13	72.5 6/39	7.4 29/13	6.8
April	26.2	16.4	21.2	36.1 19/73	6.9 25/25	67.7 11/16	2.6 24/25	7.1
May	23.1	13.1	18.0	32.4 21/23	4.8 30/51	63.9 1/10	−1.2 *8/97*	6.8
June	20.8	10.7	15.7	31.6 19/18	2.4 29/08	57.8 3/18	−3.7 *23/88*	6.5
July	20.3	9.3	14.9	29.1 23/46	2.3 (b)	63.4 20/15	−4.5 11/90	6.9
August	21.8	10.1	15.9	32.8 14/46	2.7 13/64	61.1 20/17	−2.7 *9/99*	7.8
September	24.0	12.7	18.3	38.3 22/43	4.8 1/96	68.6 26/03	−0.9 *1/89*	8.3
October	26.1	15.7	20.9	40.7 30/58	6.3 *3/99*	69.7 31/18	1.6 *8/89*	8.2
November	27.8	17.9	22.9	41.2 18/13	9.2 2/05	72.4 *7/89*	3.8 1/05	8.2
December	29.1	19.6	24.5	41.1 *26/93*	13.5 5/55	74.4 28/42	9.5 *3/94*	8.1
Year Averages	25.4	15.5	20.5	..	..	..	..	7.5
Year Extremes	..	..	..	43.2 26/1/1940	2.3	76.2 2/1/1937	−4.5 11/7/1890	..

(a) 1887–1926, 1936–March 1947. (b) *12/1894* and *2/1896*.

HUMIDITY, RAINFALL, AND FOG

Month	Vapour pressure mean 9 a.m. (mb)	Rel. hum. (%) at 9 a.m.			Rainfall (millimetres)					Fog Mean No. days
		Mean	Highest mean	Lowest mean	Mean mthly	Mean No. of days of rain	Greatest monthly	Least monthly	Greatest in one day	
No. of years of record	64	87	87	87	122	114	121	121	121	87
January	21.7	65	79	53	162	13	704 1895	8 1919	465 *21/87*	0.5
February	22.0	69	82	55	164	14	1,026 1893	15 1849	270 6/31	0.6
March	20.9	71	85	56	145	15	865 1870	Nil 1849	284 14/08	1.2
April	17.5	70	80	56	87	11	388 1867	1 1944	178 3/72	2.2
May	14.3	71	85	59	69	9	352 1876	Nil 1846	143 *9/79*	3.1
June	12.1	72	84	54	69	8	647 1967	Nil 1847	283 12/67	2.9
July	11.1	70	88	53	57	7	330 1973	Nil (a)	193 20/65	3.0
August	11.7	66	80	53	47	7	373 1879	Nil (b)	124 *12/87*	3.6
September	13.8	63	76	47	48	8	133 1886	3 1907	79 12/65	2.6
October	16.0	60	72	48	75	9	456 1972	(c) 1948	136 25/49	1.2
November	18.1	60	72	45	95	10	315 1917	Nil 1842	143 *8/66*	0.5
December	20.1	61	70	51	130	12	441 1942	9 1865	168 *28/71*	0.3
Year Totals	..	..	..	..	1,148	123	.. ..	.. ..	.. ..	21.7
Year Averages	16.6	67	..	..	..	..	.. ..	.. ..	.. ..	..
Year Extremes	..	..	88	45	..	..	1,026 2/1893	Nil Various	465 21/1/1887	..

(a) 1841 and 1951. (b) 1862, 1869 and 1880. (c) Less than 1 mm.

Figures such as 23/47, *4/93*, etc. indicate, in respect of the month of reference, the day and year of the occurrence. Dates in italics relate to nineteenth century.

CLIMATIC DATA: SYDNEY, NEW SOUTH WALES

(Lat. 33° 52′ S., Long., 151° 12′ E. Height above M.S.L. 42 metres)

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

Month	Mean of 9 a.m. and 3 p.m. atmospheric pressure reduced to mean sea level (mb)	Wind (height of anemometer 22 metres): Average (km/h)	Highest mean speed in one day (km/h)	Highest gust speed (km/h)	Prevailing direction: 9 a.m.	Prevailing direction: 3 p.m.	Mean amt evaporation (mm)	No. days thunder	Mean daily amt clouds 9 a.m., 3 p.m., 9 p.m. (a)	No. clear days
No. of years of record	63	25(b)	25(b)	25(b)	25(b)	25(b)	86	53	111	62
January	1,012.6	12.3	30.3 10/49	150	NE	NE	135	3.4	4.7	4.9
February	1,014.1	11.6	30.3 18/57	101	NE	ENE	107	2.6	4.8	4.6
March	1,016.4	10.5	33.3 10/44	93	WNW	ENE	93	1.7	4.4	5.7
April	1,018.3	10.2	36.2 24/44	116	W	ENE	69	1.3	4.1	7.4
May	1,018.6	10.5	33.8 18/55	101	W	ENE	49	1.0	3.9	7.8
June	1,018.9	11.6	36.0 10/47	135	W	WSW	38	0.8	4.0	8.1
July	1 018.5	11.5	34.3 20/51	106	W	WSW	40	0.8	3.5	10.6
August	1,017.9	12.1	39.6 9/51	109	WNW	WNW	51	1.5	3.3	10.5
September	1,017.0	11.6	35.1 23/42	113	WNW	NE	70	1.9	3.5	9.1
October	1,015.1	12.3	39.4 1/57	153	WNW	ENE	99	2.8	4.1	6.6
November	1,013.4	12.4	31.9 21/54	114	WNW	ENE	119	3.7	4.5	5.3
December	1,012.0	12.3	36.2 11/52	121	NE	ENE	137	4.0	4.6	4.9
Year: Totals	..	..	.. ..	..	..	..	1,006	25.5	..	85.5
Year: Averages	1,016.1	11.6	.. ..	..	WNW	ENE	..	..	4.2	..
Year: Extremes	..	..	39.6 9/8/51	153	..	..	..	..	..	..

(a) Scale 0–8. (b) Years 1938–1962 inclusive.

TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (°Celsius): Mean max.	Mean min.	Mean	Extreme air temperature (°Celsius): Highest	Lowest	Extreme temperature (°Celsius): Highest in sun	Lowest on grass	Mean daily hours sunshine
No. of years of record	114	114	114	114	114	84(a)	114	52
January	25.7	18.3	22.0	45.3 14/39	10.6 18/49	73.5 26/15	6.5 6/25	7.2
February	25.4	18.4	21.9	42.1 8/26	9.6 *28/63*	76.3 14/39	6.0 22/33	6.8
March	24.5	17.3	20.9	39.2 *3/69*	9.3 *14/86*	70.2 10/26	4.4 17/13	6.3
April	22.1	14.5	18.3	33.0 (b)	7.0 *27/64*	62.3 *10/77*	0.7 24/09	6.2
May	19.0	11.2	15.1	30.0 1/19	4.4 *30/62*	54.3 *1/96*	−1.5 25/17	5.7
June	16.6	9.1	12.8	26.9 11/31	2.1 22/32	52.1 2/23	−2.2 22/32	5.3
July	15.8	7.8	11.8	25.7 22/26	2.2 *12/90*	51.9 *19/77*	−4.4 *4/93*	6.1
August	17.4	8.8	13.1	30.4 24/54	2.7 *3/72*	65.0 *30/78*	−3.3 4/09	6.8
September	19.6	10.8	15.2	34.6 26/65	4.9 2/45	61.2 *12/78*	−1.1 17/05	7.1
October	21.9	13.3	17.6	37.4 4/42	5.7 6/27	66.8 20/33	0.4 9/05	7.3
November	23.5	15.3	19.4	40.3 6/46	7.7 1/05	70.3 *28/99*	1.9 21/67	7.6
December	24.9	17.2	21.1	42.2 20/57	9.1 3/24	73.5 *27/89*	5.2 3/24	7.3
Year: Averages	21.4	13.6	17.4	..	..	..	..	6.6
Year: Extremes	..	..	..	45.3 14/1/39	2.1 22/6/32	76.3 14/2/39	−4.4 4/7/1893	..

(a) Records discontinued 1946. (b) 1/36 and 10/69.

HUMIDITY, RAINFALL, AND FOG

Month	Vapour pressure mean 9 a.m. (mb)	Rel. hum. (%) at 9 a.m.: Mean	Highest mean	Lowest mean	Rainfall (millimetres): Mean mthly	Mean No. of days of rain	Greatest monthly	Least monthly	Greatest in one day	Fog Mean No. days
No. of years of record	97	97	97	97	114	113	114	114	114	52
January	18.7	67	78	58	98	13	388 1911	6 1932	180 13/11	0.3
February	19.2	70	81	60	113	13	564 1950	3 1939	226 *25/73*	0.7
March	18.3	74	85	62	128	14	521 1942	8 1965	281 28/42	1.6
April	15.0	74	87	63	127	13	622 1861	2 1868	191 *29/60*	2.2
May	11.9	75	90	63	124	13	585 1919	4 1957	212 *28/89*	3.3
June	10.2	76	89	63	131	12	643 1950	4 1962	131 *16/84*	2.7
July	9.6	74	88	59	105	11	336 1950	2 1970	198 *7/31*	2.2
August	9.5	68	84	54	81	11	378 1899	1 1885	140 22/71	1.8
September	11.3	66	79	49	70	11	357 1879	2 1882	145 *10/79*	1.0
October	13.0	62	77	46	75	12	283 (a)	2 1971	162 13/02	0.6
November	15.0	62	79	42	78	12	517 1961	2 1915	133 27/55	0.5
December	17.6	64	77	51	80	13	402 1920	6 1913	121 13/10	0.4
Year: Totals	..	..	..	..	1,209	149	.. ..	.. ..	.. ..	17.3
Year: Averages	13.6	69	..	..	..	..	.. ..	.. ..	.. ..	..
Year: Extremes	..	..	90	42	..	..	643 6/1950	1 8/1885	281 28/3/1942	..

(a) 1916 and 1959.

Figures such as 10/49, *28/63*, etc. indicate, in respect of the month of reference, the day and year of the occurrence. Dates in italics relate to nineteenth century.

CLIMATIC DATA: CANBERRA, AUSTRALIAN CAPITAL TERRITORY

(Lat. 35° 19′ S., Long. 149° 11′ E. Height above M.S.L. 571 metres)

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

Month	Mean of 9 a.m. and 3 p.m. atmospheric pressure reduced to mean sea level (mb)	Wind (height of anemometer 22 metres): Average (km/h)	Wind: Highest mean speed in one day (km/h)	Wind: Highest gust speed (km/h)	Wind: Prevailing direction 9 a.m.	Wind: Prevailing direction 3 p.m.	Mean amt evaporation (mm)	No. days thunder	Mean daily amt clouds 9 a.m., 3 p.m., 9 p.m. (a)	No. clear days
No. of years of record	34	43(b)	43(b)	34(c)	34(c)	34(c)	38(d)	34	34	34(e)
January	1,012.1	6.6	24 24/33	104	NW	NW	197	3.3	4.1	7.6
February	1,013.1	6.1	25 24/33	104	NW	NW	155	3.0	4.5	6.5
March	1,016.1	5.3	29 28/42	111	SE	NW	130	1.5	4.1	7.9
April	1,018.8	5.0	30 8/45	106	NW	NW	80	0.8	4.2	7.2
May	1,019.0	4.4	21 27/58	104	NW	NW	48	0.4	4.4	6.8
June	1,021.0	4.8	26 2/30	96	NW	NW	31	0.2	4.6	6.7
July	1,020.4	5.0	38 7/31	102	NW	NW	31	0.1	4.4	7.3
August	1,018.6	5.9	25 25/36	113	NW	NW	44	0.8	4.3	6.8
September	1,017.4	6.0	28 28/34	107	NW	NW	71	1.1	4.0	8.2
October	1,014.9	6.5	23 12/57	119	NW	NW	108	2.1	4.3	6.2
November	1,011.8	6.9	28 28/42	128	NW	NW	145	3.2	4.4	5.8
December	1,010.6	6.9	26 11/38	106	NW	NW	183	3.5	4.1	7.5
Year: Totals	..	..	..	..	..	..	1,223	20.2	..	85.5
Year: Averages	1,016.1	5.8	..	..	NW	NW	..	..	4.3	7.0
Year: Extremes	..	..	38 7/7/31	128	..	..	..	..	..	..

(a) Scale 0–8. (b) Recorded at Forestry and Timber Bureau, Yarralumla, where a cup anemometer is installed. (c) Recorded at Meteorological office, R.A.A.F. Fairbairn, where a Dines Pressure Tube anemometer is installed. (d) Australian tank, Yarralumla, 1929–1966. (e) 1940–72. Formerly assessed over 37-year period at Yarralumla.

TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (°Celsius): Mean max.	Mean min.	Mean	Extreme air temperature (°Celsius): Highest	Lowest	Extreme temperature (°Celsius): Highest in sun	Lowest on grass	Mean daily hours sunshine
No. of years of record	34	34	34	34	34	..	22	36
January	27.6	12.9	20.3	41.4 31/68	1.8 1/56	..	−0.4 1/56	8.9
February	26.6	12.6	19.6	42.2 1/68	3.0 16/62	..	0.2 17/70	8.2
March	24.4	10.4	17.4	36.4 9/40	−1.1 24/67	..	−4.0 (a)	7.5
April	19.7	6.4	13.1	32.6 12/68	−3.3 26/72	..	−8.3 24/69	7.0
May	14.8	2.7	8.7	24.5 10/67	−7.3 16/57	..	−10.4 26/69	5.6
June	12.0	0.8	6.4	20.1 3/57	−8.5 8/57	..	−13.4 25/71	4.7
July	11.0	−0.4	5.3	16.9 25/72	−10.0 11/71	..	−15.1 11/71	5.2
August	12.6	0.8	6.7	21.7 24/54	−7.7 11/69	..	−12.8 11/69	6.1
September	15.9	2.7	9.3	28.6 26/65	−5.6 5/40	..	−10.6 12/71	7.4
October	19.1	5.8	12.5	32.7 13/46	−3.3 4/57	..	−6.2 4/57	8.0
November	22.3	8.2	15.3	38.8 19/44	−1.8 28/67	..	−6.3 28/67	8.8
December	25.9	11.0	18.5	38.8 21/53	1.1 18/64	..	−3.9 18/64	9.0
Year: Averages	19.3	6.2	12.8	..	..	..	..	7.2
Year: Extremes	..	..	..	42.2 1/2/68	−10.0 11/7/71	..	−15.1 11/7/71	..

(a) 30/58 and 24/67.

HUMIDITY, RAINFALL, AND FOG

Month	Vapour pressure mean 9 a.m. (mb)	Rel. hum. (%) at 9 a.m.: Mean	Highest mean	Lowest mean	Rainfall (millimetres): Mean mthly	Mean No. of days of rain	Greatest monthly	Least monthly	Greatest in one day	Fog Mean No. days
No. of years of record	34(a)	34	34	34	34	34	34	34	34	34
January	13.1	59	75	42	59	8	164 1941	1 1947	95 12/45	1.2
February	14.0	65	81	53	57	7	145 1948	Nil 1968	53 3/46	1.2
March	13.1	69	81	53	52	7	312 1950	1 1954	66 5/59	3.0
April	10.0	75	84	38	47	7	154 1940	2 1942	75 2/59	4.2
May	8.7	83	96	73	52	9	150 1953	2 1961	96 3/48	7.5
June	7.1	85	97	73	38	9	126 1956	5 1971	45 25/56	7.4
July	6.6	84	93	68	37	10	103 1960	4 1970	35 10/57	7.7
August	7.1	80	92	58	45	12	106 1955	7 1944	28 3/51	5.0
September	8.1	73	82	55	48	10	116 1970	6 1946	41 16/62	4.1
October	10.0	66	82	50	69	12	148 1959	6 1940	105 21/59	3.1
November	10.7	59	76	38	64	10	135 1961	13 1940	64 9/50	1.4
December	12.3	58	74	43	58	8	215 1947	Nil 1967	87 30/48	0.6
Year: Totals	..	..	..	..	626	109	..	..	..	46.4
Year: Averages	10.0	71	..	..	..	..	..	..	..	..
Year: Extremes	..	..	97	38	..	..	312 3/50	Nil (b)	105 21/10/59	..

(a) Formerly assessed over 38-year period at Forestry and Timber Bureau, Yarralumla. (b) 12/67 and 2/68.

Data shown in the above tables relate to the Meteorological Office, R.A.A.F., Fairbairn, except where otherwise indicated, and cover years up to 1972. Figures such as 23/33, 31/68, etc., indicate, in respect of the month of reference, the day and year of the occurrence.

CLIMATIC DATA: MELBOURNE, VICTORIA

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

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

Month	Mean of 9 a.m. and 3 p.m. atmospheric pressure reduced to mean sea level (mb)	Wind (height of anemometer 28 metres): Average (km/h)	Wind: Highest mean speed in one day (km/h)	Wind: Highest gust speed (km/h)	Wind: Prevailing direction 9 a.m.	Wind: Prevailing direction 3 p.m.	Mean amt evaporation (mm)	No. days thunder	Mean daily amt clouds 9 a.m., 3 p.m., 9 p.m. (a)	No. clear days
No. of years of record	117	34(b)	61	64	55	55	94(c)	66	117	66
January	1,012.8	13.1	34.0 27/41	106	S	S	165	1.7	4.1	6.7
February	1,014.4	12.6	30.6 13/47	119	S	S	129	1.9	4.0	6.0
March	1,016.8	11.5	29.0 3/61	106	N	S	105	1.2	4.3	5.5
April	1,019.0	11.2	33.7 27/71	108	N	S	64	0.7	4.7	4.3
May	1,019.1	11.5	33.0 4/61	116	N	N	39	0.4	5.2	2.9
June	1,018.9	11.6	36.7 16/47	103	N	N	29	0.2	5.3	2.8
July	1,018.6	12.8	36.9 24/70	109	N	N	29	0.2	5.1	2.6
August	1,017.6	12.7	34.3 20/42	108	N	N	39	0.6	5.0	2.7
September	1,016.0	12.8	34.0 15/64	111	N	S	59	0.8	4.8	3.7
October	1,014.7	12.9	30.4 6/68	111	N	S	86	1.6	4.8	3.5
November	1,013.9	13.3	35.8 8/71	114	SW	S	115	2.0	4.9	3.2
December	1,012.4	13.3	33.8 12/52	100	S	S	147	2.2	4.5	4.4
Year: Totals	..	..	.. ..	..	..	..	1,006	13.5	..	48.2
Year: Averages	1,016.2	12.5	.. ..	..	N	S	..	..	4.7	..
Year: Extremes	..	..	36.9 24/7/70	119	..	..	..	..	..	..

(a) Scale 0–8. (b) Early records not comparable. (c) Records to 1966.

TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (°Celsius): Mean max.	Mean min.	Mean	Extreme air temperature (°Celsius): Highest	Lowest	Extreme temperature (°Celsius): Highest in sun	Lowest on grass	Mean daily hours sunshine
No. of years of record	118	118	118	118	118	86(a)	114	52(b)
January	25.7	13.9	19.8	45.6 13/39	5.6 *28/85*	81.4 *14/62*	−1.0 *28/85*	8.1
February	25.6	14.2	19.9	43.1 7/01	4.6 24/24	75.3 *15/70*	−0.6 *6/91*	7.5
March	23.8	12.8	18.3	41.7 11/40	2.8 *17/84*	73.6 *1/68*	−1.7 (c)	6.6
April	20.1	10.5	15.3	34.9 5/38	1.6 *24/88*	66.7 *8/61*	−3.9 *23/97*	5.1
May	16.5	8.3	12.4	28.7 7/05	−1.2 29/16	61.4 *2/59*	−6.1 26/16	3.9
June	13.9	6.6	10.3	22.4 2/57	−2.2 11/66	53.9 *11/61*	−6.7 30/29	3.4
July	13.2	5.7	9.4	20.7 22/26	−2.8 *21/69*	52.1 *27/80*	−6.4 12/03	3.7
August	14.8	6.4	10.6	25.0 *20/85*	−2.1 *11/63*	58.6 *29/69*	−5.9 14/02	4.6
September	17.1	7.6	12.3	31.4 28/28	−0.6 3/40	61.2 *20/67*	−5.1 8/18	5.5
October	19.5	9.2	14.4	36.9 24/14	0.1 *3/71*	67.9 *28/68*	−4.0 22/18	5.9
November	21.8	10.8	16.3	40.9 *27/94*	2.4 *2/96*	70.9 *29/65*	−4.1 *2/96*	6.5
December	24.1	12.6	18.3	43.7 *15/76*	4.4 *4/70*	76.8 *20/69*	0.7 1/04	7.3
Year: Averages	19.7	9.9	14.8	.. ..	.. ..	.. ..	.. ..	5.7
Year: Extremes	..	..	..	45.6 13/1/39	−2.8 21/7/69	81.4 14/1/62	−6.7 30/6/29	..

(a) Discontinued 1946. (b) Discontinued 1967. (c) 17/1884 and 20/1897.

HUMIDITY, RAINFALL, AND FOG

Month	Vapour pressure mean 9 a.m. (mb)	Rel. hum. (%) at 9 a.m.: Mean	Highest mean	Lowest mean	Rainfall (millimetres): Mean mthly	Mean No. of days of rain	Greatest monthly	Least monthly	Greatest in one day	Fog Mean No. days
No. of years of record	66	66	66	66	118	118	118	118	118	116
January	13.1	60	68	50	48	8	176 1963	(a) 1932	108 29/63	0.1
February	14.2	63	77	48	50	7	238 1972	(a) 1965	87 26/46	0.3
March	13.3	66	79	50	54	9	191 1911	4 1934	90 5/19	0.7
April	11.7	72	82	66	59	11	195 1960	Nil 1923	80 23/60	1.8
May	10.3	79	88	70	57	14	142 1942	4 1934	46 18/00	3.6
June	9.3	83	92	73	50	14	114 1859	8 1858	43 21/04	4.6
July	8.9	81	87	75	48	15	178 1891	15 1902	74 *12/91*	4.3
August	9.1	75	82	65	49	15	111 1939	12 1903	54 *17/81*	2.3
September	9.5	68	76	60	58	14	201 1916	13 1907	59 23/16	0.9
October	10.5	63	71	52	67	14	193 1869	7 1914	61 21/53	0.4
November	11.3	60	70	52	59	12	206 1954	6 1895	73 21/54	0.2
December	12.5	60	69	48	58	10	182 1863	1 1972	100 4/54	0.2
Year: Totals	..	..	..	..	657	143	.. ..	.. ..	.. ..	19.5
Year: Averages	11.1	69	..	..	..	..	.. ..	.. ..	.. ..	..
Year: Extremes	..	..	92	48	..	..	238 2/72	Nil 4/23	108 29/1/63	..

(a) Less than 1 mm.

Figures such as 27/41, *28/85*, etc., indicate, in respect of the month of reference, the day and year of the occurrence. Dates in italics relate to nineteenth century.

CLIMATIC DATA: HOBART, TASMANIA

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

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

Month	Mean of 9 a.m. and 3 p.m. atmospheric pressure reduced to mean sea level (mb)	Wind (height of anemometer 12 metres): Average (km/h)	Highest mean speed in one day (km/h)	Highest gust speed (km/h)	Prevailing direction: 9 a.m.	3 p.m.	Mean amt evaporation (mm)	No. days thunder	Mean daily amt clouds 9 a.m., 3 p.m., 9 p.m. (a)	No. clear days
No. of years of record	88	62	63	82	30(b)	30(b)	8(c)	63	88	30(b)
January	1,010.6	12.6	33.5 30/16	130	NNW	SSE	166	1.0	5.0	1.9
February	1,012.8	11.5	40.6 4/27	121	NNW	SSE	132	1.0	4.9	2.3
March	1,014.3	10.9	34.4 13/38	127	NW	SSE	111	0.7	4.8	2.4
April	1,015.4	10.9	38.8 9/52	119	NW	W	72	0.4	5.0	1.7
May	1,015.4	10.4	35.4 21/65	135	NNW	NW	40	0.0	5.0	2.4
June	1,015.2	10.2	38.2 27/20	132	NW	NW	22	0.0	5.0	2.4
July	1,014.1	10.7	36.9 22/53	129	NNW	NNW	26	0.0	4.8	2.0
August	1,012.8	11.0	41.0 19/26	140	NNW	NW	45	0.1	4.9	2.1
September	1,011.4	12.5	43.1 28/65	150	NNW	NW	77	0.1	4.9	1.5
October	1,010.3	12.6	32.4 3/65	140	NNW	SW	111	0.4	5.2	1.0
November	1,009.8	12.8	34.1 18/15	133	NNW	S	122	0.6	5.3	1.3
December	1,009.4	12.3	37.7 1/34	122	NNW	SSE	148	0.9	5.3	1.1
Year Totals	..	..	.. ..	..	..	..	1,072	5.2	..	22.1
Year Averages	1,012.6	11.8	.. ..	..	NNW	W	..	..	5.0	..
Year Extremes	..	..	43.1 28/9/65	150	..	..	..	..	..	..

(a) Scale 0–8. (b) Standard thirty years normal (1911–1940). (c) Class "A" American pan.

TEMPERATURE AND SUNSHINE

Month	Air temperature daily readings (°Celsius): Mean max.	Mean min.	Mean	Extreme air temperature (°Celsius): Highest	Lowest	Extreme temperature (°Celsius): Highest in sun	Lowest on grass	Mean daily hours sunshine
No. of years of record	104	104	104	90	89	57(a)	85	53
January	21.6	11.5	16.5	40.6 (b)	4.5 (c)	71.1 (d)	−0.8 *19/97*	7.8
February	21.6	11.7	16.7	40.2 *12/99*	3.9 *20/87*	73.9 *24/98*	−2.1 *—/87*	7.0
March	20.1	10.5	15.8	37.3 13/40	1.8 31/26	66.1 26/44	−2.5 30/02	6.4
April	17.0	8.6	12.8	30.6 1/41	0.7 14/63	61.1 *18/93*	−3.9 *—/86*	5.1
May	14.1	6.6	10.3	25.5 5/21	−1.5 30/02	53.3 (e)	−6.7 19/02	4.3
June	11.7	5.0	8.3	20.7 1/07	−2.8 25/72	50.0 *12/94*	−7.7 24/63	3.9
July	11.3	4.2	7.7	19.0 14/34	−2.4 (g)	49.4 *12/93*	−7.4 *16/86*	4.3
August	12.7	5.0	8.9	22.0 28/14	−1.8 5/62	54.4 *—/87*	−6.6 7/09	5.0
September	14.9	6.1	15.0	28.2 29/73	−1.1 *12/41*	58.9 *23/93*	−7.6 16/26	5.9
October	16.9	7.5	12.2	33.4 24/14	0.0 *12/89*	68.9 *9/93*	−4.6 (f)	6.3
November	18.6	9.0	13.8	36.9 26/37	1.7 16/41	55.6 *19/92*	−3.3 1/08	7.0
December	20.4	10.6	15.5	40.7 *30/97*	3.4 3/06	71.9 10/39	−2.7 *—/86*	7.2
Year Averages	16.7	8.0	12.3	.. ..	.. ..	.. ..	.. ..	5.8
Year Extremes	..	..	..	40.7 30/12/1897	−2.8 25/6/72	73.9 24/2/1968	−7.7 24/6/1963	..

(a) Period 1934–1938 not comparable; records discontinued 1946. (b) 1/1900 and 19/1959. (c) 09/1937 and 11/1937. (d) 05/1886 and 13/1905. (e) –/1899 and –/1893. (f) 1/1886 and 1/1899. (g) 11/1895 and 7/1973.

HUMIDITY, RAINFALL, AND FOG

Month	Vapour pressure mean 9 a.m. (mb)	Rel. hum. (%) at 9 a.m.: Mean	Highest mean	Lowest mean	Rainfall (millimetres): Mean mthly	Mean No. of days of rain	Greatest monthly	Least monthly	Greatest in one day	Fog Mean No. days
No. of years of record	77(a)	81	81	81	131	89	131	131	131	61
January	11.0	58	81	45	45	11	150 1893	4 (b)	75 30/16	0.1
February	11.7	62	83	49	41	10	232 1985	3 1914	56 1/54	0.0
March	11.0	65	78	52	44	11	255 1946	7 1943	88 17/46	0.3
April	10.0	70	84	57	52	12	248 1960	2 1904	133 23/60	0.3
May	8.8	75	86	51	50	14	214 1958	4 1913	47 3/73	1.1
June	7.9	78	91	61	57	15	238 1954	7 1886	147 7/54	1.5
July	7.6	78	87	72	54	15	155 1967	4 1950	64 18/22	1.3
August	7.9	73	86	59	49	15	258 1858	8 1892	58 *14/90*	0.5
September	8.3	66	81	52	53	15	201 1957	10 1951	156 15/57	0.2
October	9.1	61	74	52	61	17	193 1947	10 1914	65 4/06	0.1
November	9.6	59	73	49	61	14	227 1849	8 1921	94 *30/85*	0.1
December	10.6	57	73	42	56	13	229 1875	4 1931	85 5/41	0.1
Year Totals	..	..	..	..	623	162	.. ..	.. ..	.. ..	5.6
Year Averages	9.5	67	..	..	..	..	.. ..	.. ..	.. ..	..
Year Extremes	..	..	91	42	..	..	258 8/1858	2 4/1904	156 15/9/57	..

(a) 1894–1970. (b) 1915 and 1958.

Figures such as 30/16, *12/99*, etc. indicate, in respect of the month of reference, the day and year of the occurrence. Dates in italics relate to nineteenth century.

Climatic data for selected Australian localities

The following table shows some of the more important climatic data for selected Australian localities.

CLIMATIC DATA FOR SELECTED AUSTRALIAN LOCALITIES

(Temperature and humidity generally over years 1957–1973)

	Rainfall			*Temperature*				*Relative humidity*			
Town	*No. of years of record*	*Average annual rainfall (mm)*	*Average number of wet days*	*Average maximum, January (°C.)*	*Average maximum, July (°C.)*	*Average minimum, January (°C.)*	*Average minimum, July (°C.)*	*Average 9 a.m., January*	*Average 9 a.m., July*	*Average 3 p.m., January (%)*	*Average 3 p.m., July (%)*
WESTERN AUSTRALIA											
Albany	94	948	184	25.8	15.7	13.3	7.4	73	84	65	70
Broome	63	574	38	33.3	28.5	26.2	13.6	75	46	62	43
Bunbury	97	881	122	26.9	16.7	16.5	9.1	63	78	59	69
Carnarvon	67	229	35	30.8	21.9	22.6	11.0	62	69	61	54
Esperance	85	675	128	25.9	17.0	15.9	7.9	70	81	63	65
Geraldton	86	462	78	31.6	19.4	18.7	9.2	61	68	60	57
Kalgoorlie	57	243	52	33.6	16.5	18.3	4.9	44	66	24	49
Meekatharra	51	236	36	37.8	18.6	24.2	7.3	29	62	17	37
Narrogin	82	506	96	30.9	14.5	14.7	5.3	58	84	33	67
Port Hedland	50	323	19	36.5	27.0	25.2	11.8	67	42	63	47
Wyndham	81	693	56	36.4	31.1	26.2	18.7	64	33	49	27
NORTHERN TERRITORY											
Alice Springs	100	266	33	36.6	21.8	22.2	4.8	31	49	19	30
Tennant Creek	100	362	33	37.7	24.4	24.8	11.1	46	39	25	24
SOUTH AUSTRALIA											
Ceduna	67	293	73	28.5	17.2	15.1	5.8	47	79	42	53
Mount Gambier	113	774	162	25.6	13.1	10.8	4.9	65	79	50	73
Oodnadatta	50	117	20	38.2	19.4	23.2	5.8	27	49	15	33
Port Augusta	101	242	60	32.3	16.6	19.5	7.1	44	66	31	49
Port Lincoln	108	486	125	25.5	15.9	15.7	8.4	65	79	54	66
Port Pirie	97	343	74	31.4	15.9	17.3	7.5	51	75	31	55
QUEENSLAND											
Atherton	72	1,412	135	28.8	21.6	18.3	10.0	76	78	65	55
Bundaberg	91	1,159	94	29.8	21.5	21.4	10.1	68	66	60	48
Cairns	76	2,224	141	31.5	25.4	23.6	16.7	71	72	62	56
Charleville	82	497	55	34.6	19.4	21.2	4.3	46	66	27	35
Charters Towers	90	650	63	33.6	24.4	21.7	10.5	65	63	42	47
Cloncurry	87	468	39	37.8	25.2	25.0	10.7	40	40	28	26
Ipswich	104	876	94	32.1	20.9	20.7	6.9	65	65	55	68
Longreach	80	442	46	37.9	23.0	22.7	6.9	43	53	26	28
Mackay	79	1,666	117	29.7	21.2	23.1	12.2	74	75	70	66
Maryborough	103	1,200	115	29.8	21.2	20.3	7.8	73	77	62	51
Normanton	102	932	57	35.4	29.2	25.0	15.2	71	44	53	27
Rockhampton	96	943	86	31.4	22.9	21.7	10.7	69	70	52	39
Roma	89	575	61	34.1	20.2	20.5	4.8	55	64	34	37
Toowoomba	102	955	105	26.9	16.2	16.5	4.7	73	79	53	48
Townsville	41	1,105	63	31.3	24.9	23.8	15.4	75	63	62	59
NEW SOUTH WALES											
Albury	96	705	96	30.8	12.0	14.1	3.0	45	74	24	67
Armidale	110	795	110	26.6	12.7	13.5	1.0	66	61	47	51
Bega	90	871	85	26.1	16.6	14.0	1.4	65	70	57	51
Bourke	102	346	46	35.0	18.0	20.7	4.8	41	64	28	40
Broken Hill	84	241	45	32.1	14.9	18.8	5.5	41	70	28	45
Cooma	109	503	90	25.7	9.3	11.1	−1.0	59	67	32	53
Dubbo	102	584	74	33.4	15.4	17.7	3.1	51	74	32	50
Goulburn	102	712	105	26.8	11.1	13.0	2.9	57	74	43	70
Grafton	93	983	104	31.7	20.3	19.5	5.5	72	75	58	45
Katoomba	86	1,405	122	23.4	9.3	12.9	2.9	61	71	60	65
Leeton	59	432	81	32.1	13.9	17.4	4.0	46	76	28	57
Moree	86	578	59	35.6	17.8	19.5	4.2	51	75	32	44
Newcastle	108	1,145	132	24.4	16.6	19.2	8.2	76	73	72	55
Orange	82	877	100	28.8	9.6	11.5	−0.3	58	84	49	64
Port Kembla	80	1,136	88	24.1	16.7	18.4	9.8	76	63	74	56
Tamworth	93	673	80	32.8	15.3	17.1	3.6	52	77	35	46
Taree	90	1,178	112	28.6	18.8	17.0	4.9	65	69	61	47
Wagga Wagga	101	554	88	31.1	12.3	16.4	3.2	50	77	34	67

CLIMATIC DATA FOR SELECTED AUSTRALIAN LOCALITIES—*continued*

Town	Rainfall: No. of years of record	Rainfall: Average annual rainfall (mm)	Rainfall: Average number of wet days	Temperature: Average maximum, January (°C.)	Temperature: Average maximum, July (°C.)	Temperature: Average minimum, January (°C.)	Temperature: Average minimum, July (°C.)	Relative humidity: Average 9 a.m., January	Relative humidity: Average 9 a.m., July	Relative humidity: Average 3 p.m., January (%)	Relative humidity: Average 3 p.m., July (%)
VICTORIA											
Ballarat	91	744	161	25.5	9.9	11.4	3.5	59	81	40	74
Bendigo	112	546	123	29.2	11.9	14.4	3.7	50	75	32	65
Geelong	99	538	128	24.5	13.5	13.3	5.2	62	83	52	68
Horsham	99	449	102	30.8	13.5	12.9	4.1	45	77	26	63
Mildura	59	268	58	32.1	15.3	16.9	4.4	48	71	27	56
Sale	75	610	122	25.4	13.5	12.9	3.7	66	86	..	..
Seymour	92	596	94	27.8	11.5	12.9	3.4	52	79	35	73
Shepparton	95	509	89	30.2	13.2	15.2	3.3	51	77	..	..
Wangaratta	96	640	96	30.9	12.6	15.0	3.4	49	75	28	68
Warrnambool	76	726	169	23.2	13.6	13.1	5.9	73	83	62	71
TASMANIA											
Burnie	83	990	158	18.4	12.4	12.2	4.7	66	83	59	2
Launceston	80	719	140	23.3	10.7	10.4	3.1	61	77	42	70
Zeehan	77	2,444	239	20.3	10.7	8.1	4.0	69	81	58	75

NOTE. The table on the next page gives the latitude, longitude, and altitude of the weather recording station at each of the above towns.

LOCATION CO-ORDINATES FOR SELECTED AUSTRALIAN LOCALITIES

Station	*Lat.*	*Long.*	*Altitude (m)*
Western Australia—			
Albany	34° 57′	117° 48′	69
Broome	17° 57′	122° 13′	12
Bunbury	33° 19′	115° 38′	1
Carnarvon	24° 35′	113° 39′	4
Esperance	33° 51′	121° 53′	4
Geraldton	28° 48′	114° 42′	28
Kalgoorlie	30° 46′	121° 27′	360
Meekatharra	26° 36′	118° 29′	517
Narrogin	32° 54′	117° 09′	351
Port Hedland	20° 23′	118° 37′	6
Wyndham	15° 31′	128° 09′	6
Northern Territory—			
Alice Springs	23° 48′	133° 53′	546
Tennant Creek	19° 38′	134° 11′	375
South Australia—			
Ceduna	32° 08′	133° 42′	17
Mount Gambier	37° 45′	140° 47′	63
Oodnadatta	27° 33′	135° 29′	113
Port Augusta	32° 33′	137° 47′	4
Port Lincoln	34° 47′	135° 53′	4
Port Pirie	33° 11′	138° 01′	3
Queensland—			
Atherton	17° 17′	145° 27′	752
Bundaberg	24° 52′	152° 21′	2
Cairns	16° 35′	145° 44′	3
Charleville	26° 25′	146° 17′	290
Charters Towers	20° 03′	146° 08′	306
Cloncurry	20° 40′	140° 30′	189
Ipswich	27° 38′	152° 44′	20
Longreach	23° 26′	144° 15′	187
Mackay	21° 07′	149° 10′	3
Maryborough	25° 32′	152° 42′	6
Normanton	17° 39′	141° 05′	10
Rockhampton	23° 23′	150° 29′	8
Roma	26° 36′	148° 42′	305
Queensland—*contd*			
Toowoomba	27° 33′	151° 57′	586
Townsville	19° 15′	146° 46′	3
New South Wales—			
Albury	36° 06′	146° 54′	183
Armidale	30° 32′	151° 38′	980
Bega	36° 40′	149° 50′	15
Bourke	30° 05′	145° 58′	107
Broken Hill	31° 57′	141° 28′	298
Cooma	36° 13′	149° 08′	838
Dubbo	32° 10′	148° 37′	262
Goulburn	34° 45′	149° 43′	632
Grafton	29° 41′	152° 56′	6
Katoomba	33° 43′	150° 19′	1,000
Leeton	34° 33′	146° 24′	151
Moree	29° 28′	149° 51′	207
Newcastle	32° 55′	151° 49′	37
Orange	33° 18′	149° 06′	869
Port Kembla	34° 29′	150° 55′	20
Tamworth	31° 05′	150° 56′	390
Taree	31° 54′	152° 28′	9
Wagga	35° 08′	147° 25′	219
Wollongong	34° 25′	150° 56′	46
Victoria—			
Ballarat	37° 35′	143° 50′	437
Bendigo	36° 46′	144° 17′	223
Geelong	38° 07′	144° 22′	17
Horsham	36° 40′	142° 12′	133
Mildura	34° 14′	142° 05′	48
Sale	38° 06′	147° 08′	15
Seymour	37° 02′	145° 08′	141
Shepparton	36° 23′	145° 24′	113
Wangaratta	36° 22′	146° 19′	150
Warrnambool	38° 24′	142° 29′	10
Tasmania—			
Burnie	41° 04′	145° 54′	4
Launceston	41° 33′	147° 13′	166
Zeehan	41° 54′	145° 23′	180

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The Seasonal Rainfall of 1973 (December 1972 to November 1973).

The following is a summary of rainfall experienced during the four seasons, commencing December 1972 and ending November 1973. Plate 2, page 29, shows the rainfall distribution for 1973.

Summer 1972–73 (December 1972 to February 1973) Summer rainfall in Western Australia was well below average in the south but slightly above average in the north.

In the Northern Territory above average rainfall was received except for the eastern part of the Alice Springs district and small areas of the Barkly and Victoria districts.

In South Australia rainfall was above average in most areas. The coast of the Western Agricultural district, Kangaroo Island and the Lower South-east district were slightly below average.

Queensland's rainfall was chiefly above average especially in the south-west. The Peninsula and isolated parts of the Central Highlands and northern Maranoa districts received slightly below average rainfall.

New South Wales rainfall was above average except in the Upper Western area, parts of the North-west Plains, the Goulburn–Monaro area of the Southern Tablelands and in coastal areas which were generally below average.

Victoria was average or above, except in the East Gippsland district which was mainly below average.

Tasmania was above average except for parts of the East Coast, the South-east and Lower Derwent Valley, and areas of the Tamar Valley.

Autumn 1973 (March 1973 to May 1973) Autumn rainfall in Western Australia was below average in the south-west portion and in parts of the De Grey district, but mainly above average elsewhere.

In the Northern Territory above average rainfall was received in the Arnhem and eastern Barkly districts with mainly average falls elsewhere in the "Top End". The southern areas of the Territory were mostly below average.

In South Australia rainfall was above average, the chief exception being the southern Mt Lofty Ranges and eastward to the Murray River.

Queensland rainfall was chiefly average or above in the north, but appreciably below average in the south.

New South Wales rainfall was above average in most of the western areas and the Riverina and below average in the north-east and southern coastal areas.

Victoria was average or above, except in East Gippsland.

Tasmania was much above average grading to average falls in eastern coastal areas.

Winter 1973 (June 1973 to August 1973) Winter rainfall in Western Australia was generally above average with near average falls in the agricultural areas of the south-west.

The whole of the Northern Territory received much above average rainfall, most of which fell in June.

In South Australia rainfall was generally much above average, except for some areas towards the south-east coast which were about average or slightly below.

Most of the south of Queensland received above-average rainfall, but much of the north was below average.

In New South Wales west of the highlands rains were generally above average. East of the highlands rainfall was about average or below.

Rains in Victoria were above average in the north and chiefly average in the south.

Tasmania's rainfall was chiefly below average, except for a few areas about average in the north.

Spring 1973 (September 1973 to November 1973) Spring rainfall in Western Australia was generally above average.

In the Northern Territory rainfall was generally very much above average.

South Australia was well above average with some very much above average falls in Murray Valley areas.

Queensland's tropical areas were well above average, particularly along the far north coast. In the south, rainfall was average or above, but there were small pockets below average.

New South Wales was above average throughout with some districts within the highest 10 per cent of recorded spring rains.

Victoria was chiefly above average, except for isolated pockets below average in the south.

Tasmania was chiefly average or above.