Doc 1

These are the most up to date versions of my drafts in case you do not have them. Many thanks for your comments to date

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DRAFT PAPER

Heat Islands in Country Towns
South Eastern Australia

Summary

The concentration of Bureau of Meteorology climate recording stations in South East Australia provides many instances where temperature records from towns can be compared to records from nearby greenfields sites, such as Agricultural Research Stations.

An examination of seventeen such dual record locations indicates a Heat Island Effect of between .45°C and 1.52°C for the periods examined. Pro-rated, this implies a heat island effect of about 1.2°C per century, an amount which exceeds published empirical observations of global temperature increases by a substantial margin.

Recent Research

The mainstream meteorological position on the significance of heat islands in Australia is probably expressed in the recent letter to *Nature* by P.D. Jones et al. (1990). Eastern Australian data is used, and one of the authors is from the Bureau of Meteorology's Climate Data Centre in Melbourne.

To sum up the Australian section of the paper, one can say that the trends in two series of records are compared, one series is that used by P.D. Jones et al. (1986) in their Southern Hemisphere study, which includes capital cities. The other series, more recently developed consists of 49 country stations, mainly small towns, including seven lighthouses. The difference in trend between these series is 0.05°C over a 58 year period and the conclusion reached is that this figure represents the magnitude of any average heat island effect that may be present in the P.D. Jones et al (1986) series. No consideration is given to the possibility of any heat islands in the series with 42 country towns.

Project Details

In a 750 km long belt trending NNW from north central Victoria to Walgett in northern NSW, many instances of heat islands are apparent in Bureau of Meteorology temperature records. Where "greenfields" recording stations are situated at rural research facilities in close proximity to towns a direct comparison can be made between the temperatures at the two (or more) sites.

Sometimes these periods of comparison are short, many stations are only open for a decade or two. Comparisons of this nature can be likened to a snapshot of a brief period and several examples are discussed on pages 3 and 4.

Where "greenfields" records are present over a longer period, say 40 years or more, a comparison can be made with the trends in town records. Several graphs are presented showing two or more records, where the trends over time can be seen to diverge or converge and the possibility that this can be due to the development of heat islands in towns, can be considered.

Long Term Trend Comparisons

Yenda Post Office and Griffith CSIRO

In the Griffith district the CSIRO station is cooler than the Yenda Post Office record except prior to 1930 (see Attachment 4). This indicates a growth in the Yenda heat island of approximately 0.8°C over a fifty year period.

Coonabarabran and Baradine State Forest

Coonabarabran (see Attachment 3) is 207m higher than Baradine State Forest, hence has a cooler climate. The graphs (Attachment 5) show that the heat island effect in Coonabarabran, growing at about 1° in thirty years, could result in that town overtaking the State Forest in temperature by about the year 2030.

Bathurst Agricultural Research Station compared to Walgett, Dubbo and Cooma

Bathurst Agricultural Research Station shows a divergent trend relative to Walgett and Dubbo and taking the difference in the ten year average from

1910 to 1985 Walgett has increased 1.39° over Bathurst, and Dubbo has increased 0.34° (see Attachment 6). Cooma being cooler is on a converging trend with Bathurst and has warmed 0.94° relative to Bathurst over the 1910-85 period. If the trend continues, Cooma will have an average temperature equal to that of the Bathurst district, late next century.

It may be significant to note that a period of rapid convergence between the Cooma and Bathurst 10 year average trends between 1950 and 1970 correlates with the expansion of Cooma due to the Snowy Mountains construction activity.

In P.D. Jones et al (1990) both Walgett and Dubbo are included in their series of rural stations assumed to have no heat island component.

Hay compared to Griffith CSIRO

Comparing Hay to Griffith CSIRO 100 km east-north-east a heat island component in Hay is seen (see Attachment 7) with an expansion of 0.9° over 55 years.

Looking at the trend for Hay (approximately 100 km north of Deniliquin) we see Hay diverge warmer than Deniliquin from 1940-1990 by approximately 1.0° (see Attachment 7). This is presumably due to a feature of the thermometer exposure at Hay making the readings more sensitive to urban heating influences than at Deniliquin.

P.D. Jones et al (1990) used Hay as one of 49 rural stations which they assumed to have a negligible heat island component.

Short Term Comparisons

North Central Victoria

An unusual concentration of Bureau of Meteorology temperature recording stations between Rochester and Rutherglen (see Attachment 1) for the years 1965-1971 has allowed a comparison between five small towns and five rural stations. That particular span was chosen to given maximum coverage as several stations are not long term and some are now closed. (See Attachment 8) The gentle topography,

slight natural temperature gradients and the elongation of the cluster of stations along isotherms, generate a favourable situation to detect the heat island effect in temperature records, as shown in graph (Attachment 9).

Kerang Post Office is compared to Koondrook State Forest for nine years between 1942 and 1955 (details see Attachment 10) and the Post Office is 0.69° warmer than the State Forest. Rutherglen Post Office is compared to the nearby Research Station and Viticultural College for the years 1913 to 1920 (inclusive). For details see Attachment 10. The Post Office averages 0.79° warmer than the Research Station and College.

Southern New South Wales and M.I.A.

In the Deniliquin district, four greenfields recording stations were open for short periods from 1907 to 1969 (see Attachment 1). These stations - Werai, Wanganella, Gulpa Island and Mathoura State Forest are generally cooler than Deniliquin and are located approximately 40 km. from the town. Because of their distribution around the town it is difficult to see any natural reason for the temperature differences shown in the graph (Attachment 11).

Leeton Post Office is compared to Leeton Rice Research for 5 years between 1941 and 1949 and to Yanco Experimental Farm for seven years between 1923 and 1932. (See Attachment 10). Leeton shows an average heat island of 0.83°C.

Northern New South Wales

The Pilliga West Forest station recorded temperatures from 1941-52 and is located central in a triangle between Walgett, Narrabri and Coonamble (see Attachments 3 and 11). The suggested average heat island magnitudes are 1.52° from Walgett, 0.84° for Coonamble and 0.76° for Narrabri.

Conclusions

There is no reason yet to believe that these results are not typical of the contrast generally existing in Australia between small country towns and the surrounding countryside. Seventeen towns of varying sizes scattered through a typical area of rural Australia demonstrate a heat island effect in excess of the generally accepted "global warming". This raises more questions about the validity of the IPCC "Global

Warming" data and adds to the case that a re-assessment of the global temperature time series is required.

All maps are 1:1,000,000 Scale

List of Attachments

1. Map Rochester, Rutherglen Research - Deniliquin, Kerang
2. Griffith map
3. Walgett District Map
4. Yenda Griffith CSIRO graph
5. Coonabarabran graph
6. Bathurst Agricultural Research Station graph
7. Hay, Griffith CSIRO graph
8. {Rochester-Rutherglen Research Station time spans
   {Rochester-Rutherglen Research Station data spreadsheet
9. Rochester Rutherglen Research average temperature graph
10. Leeton-Kerang Rutherglen Post Office spreadsheet
11. {Deniliquin and rural satellites, Hay 10 year average graph
    {Pilliga West State Forest spreadsheet
12. Table summarizing calculations of average heat island effects

References

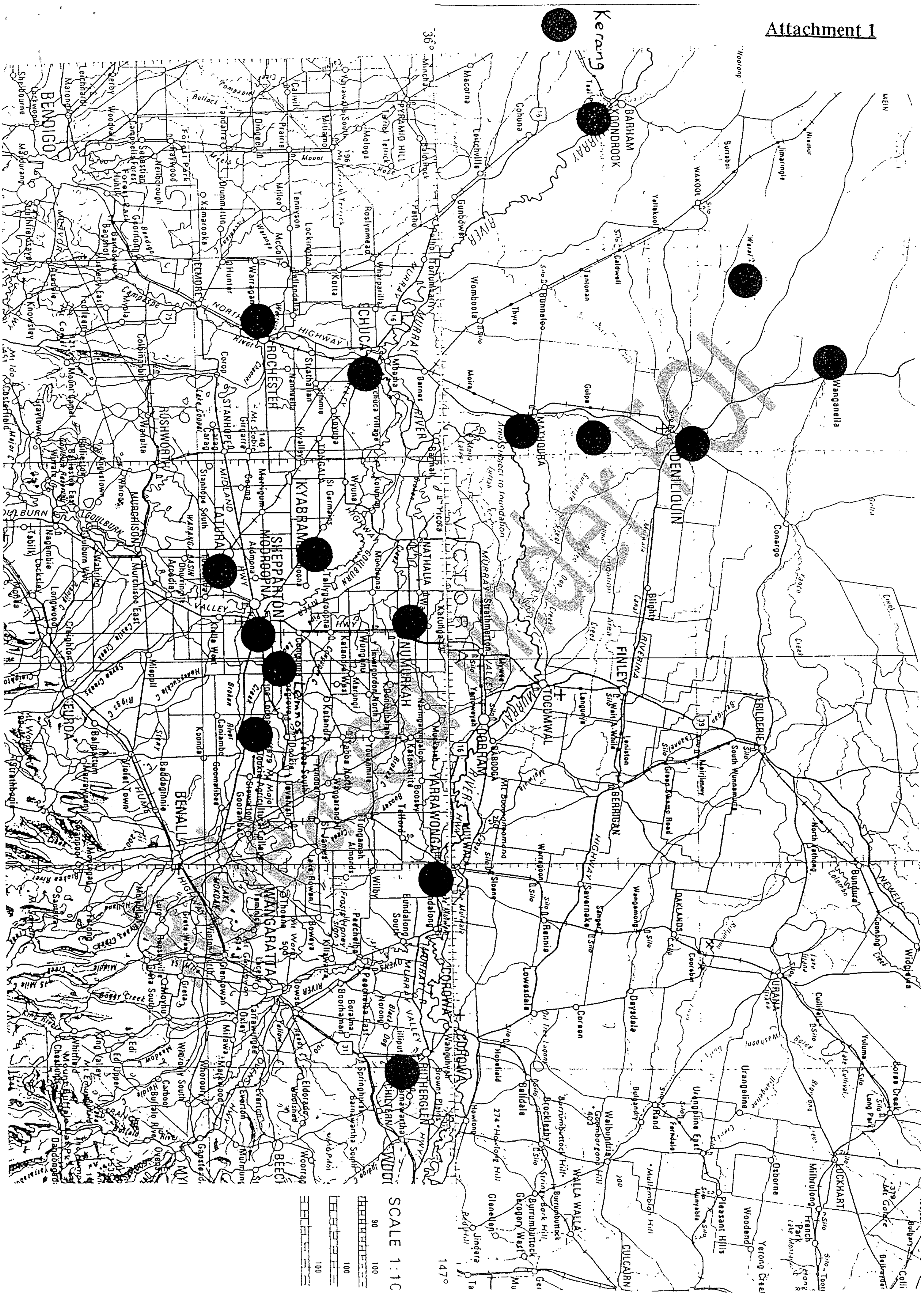
Balling, R.C., Jr. and Idso, S.B., 1989 "Historical temperature trends in the United States and the effect of urban population growth" *Journal of Geophysical Research*, 94, 3359-3363

Jones, P.D., Raper, S.C.B., Wigley, T.M.L. 1986 "Southern Hemisphere Surface Air Temperature Variations 1851-1984" *J. Clim. Appl. Met.* 25, 11213-1230

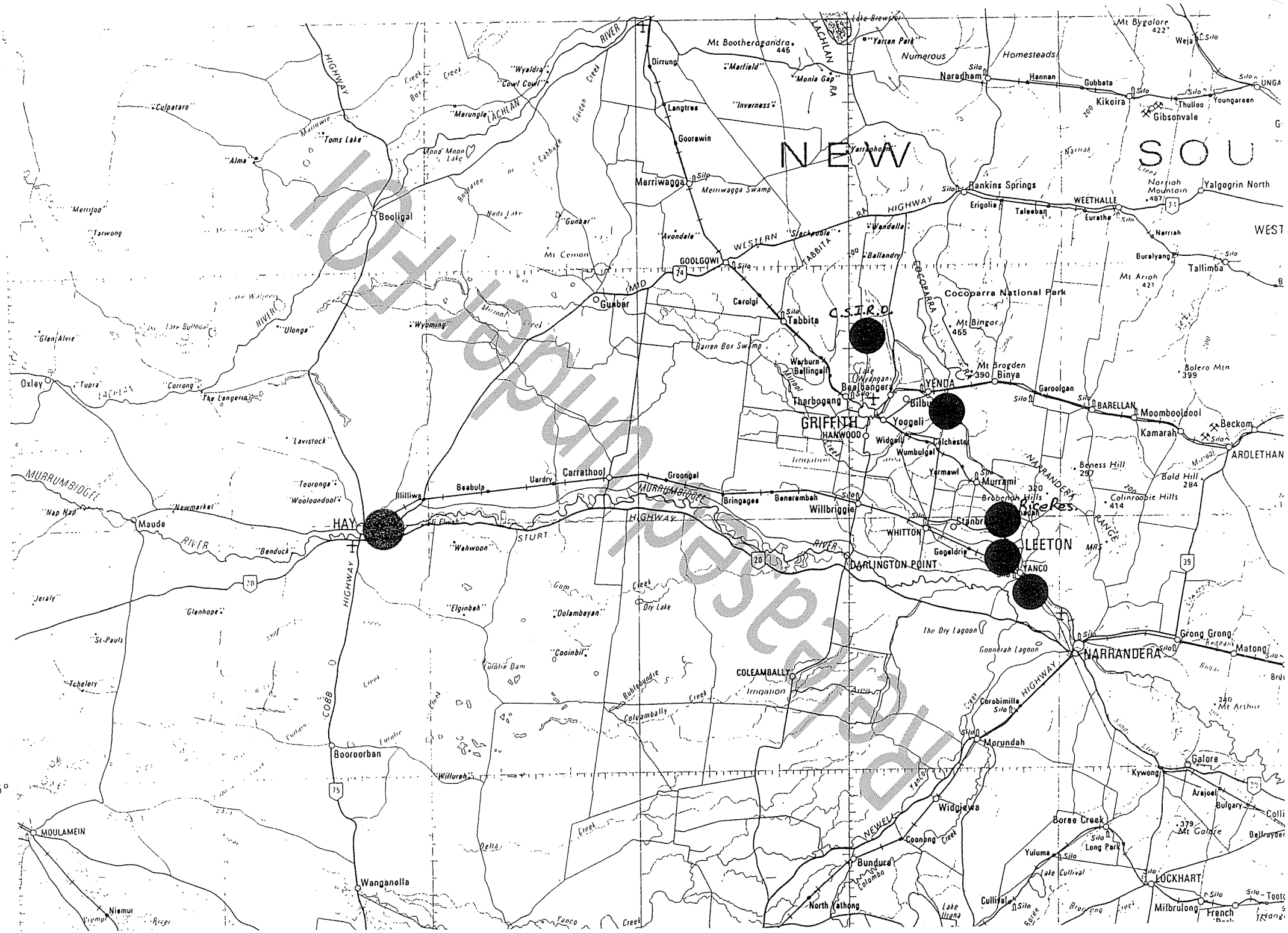
Jones, P.D., Grosiman, P.Y., Coughlan, M., Plummer, N., Wang W.C. and Karl, T.R., 1990 "Assessment of urbanization effects in time series of surface air temperatures over land" *Nature*, 347, 169-172

W.S. Hughes

Attachment 1



Attachment 2



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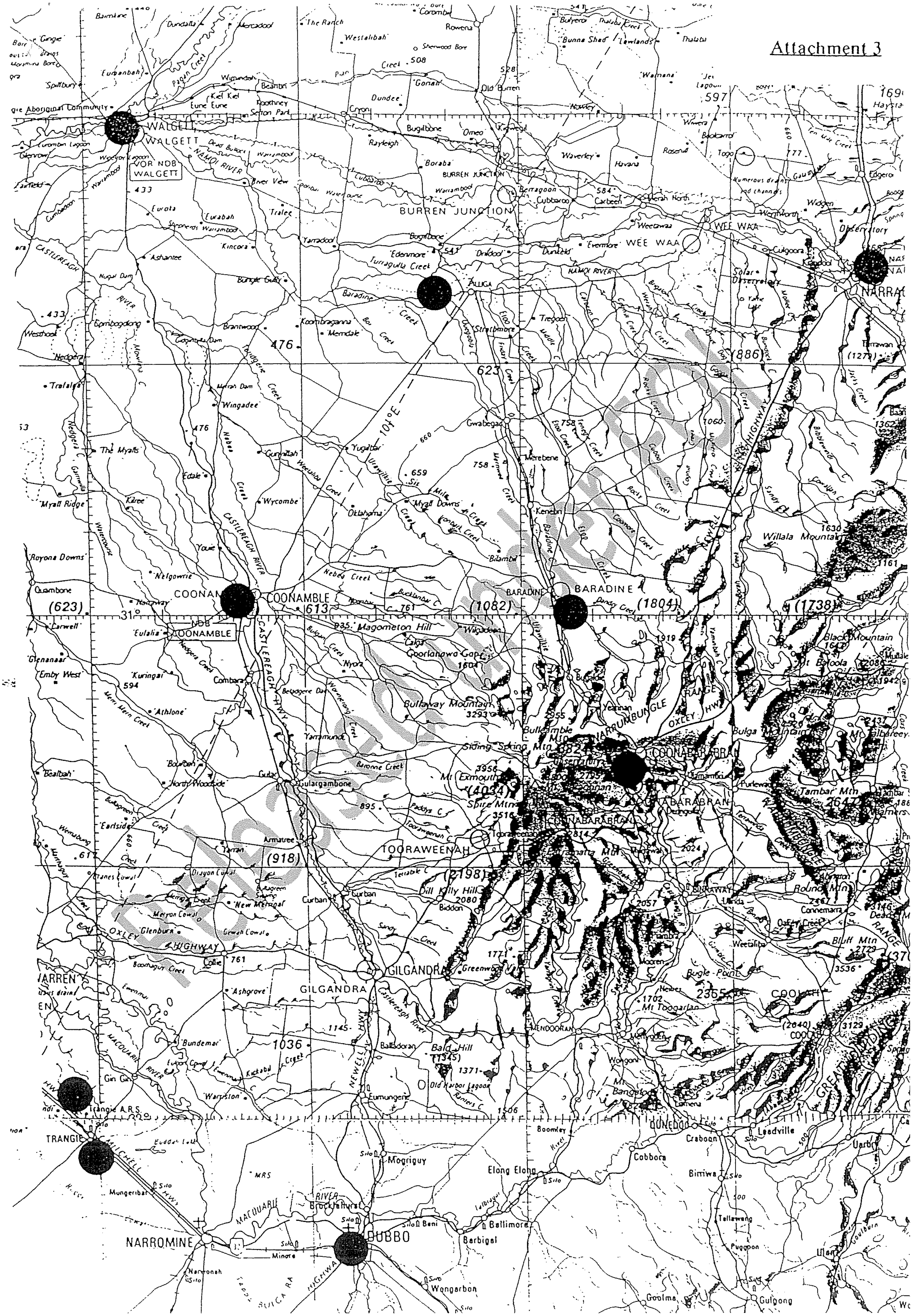
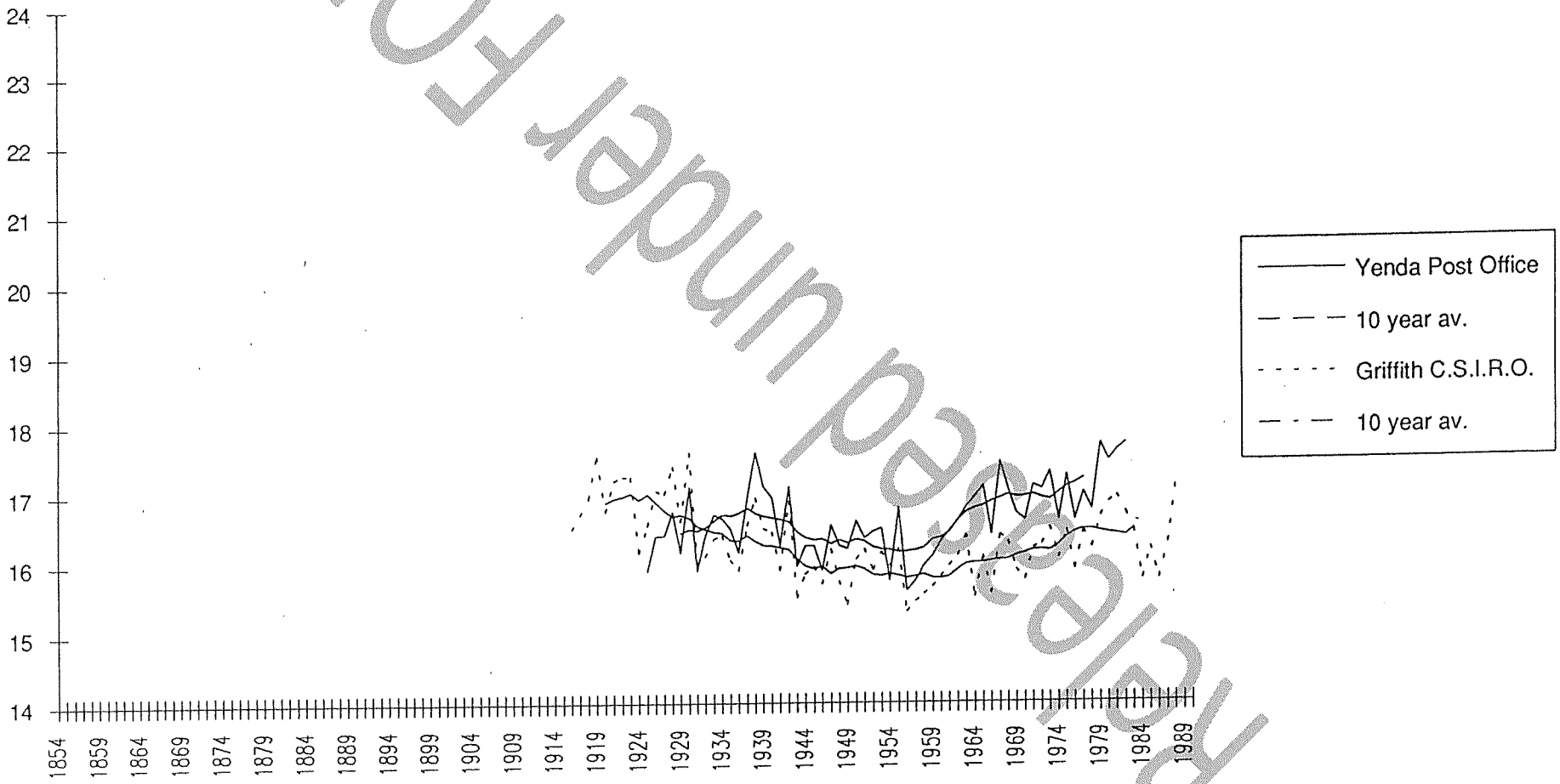
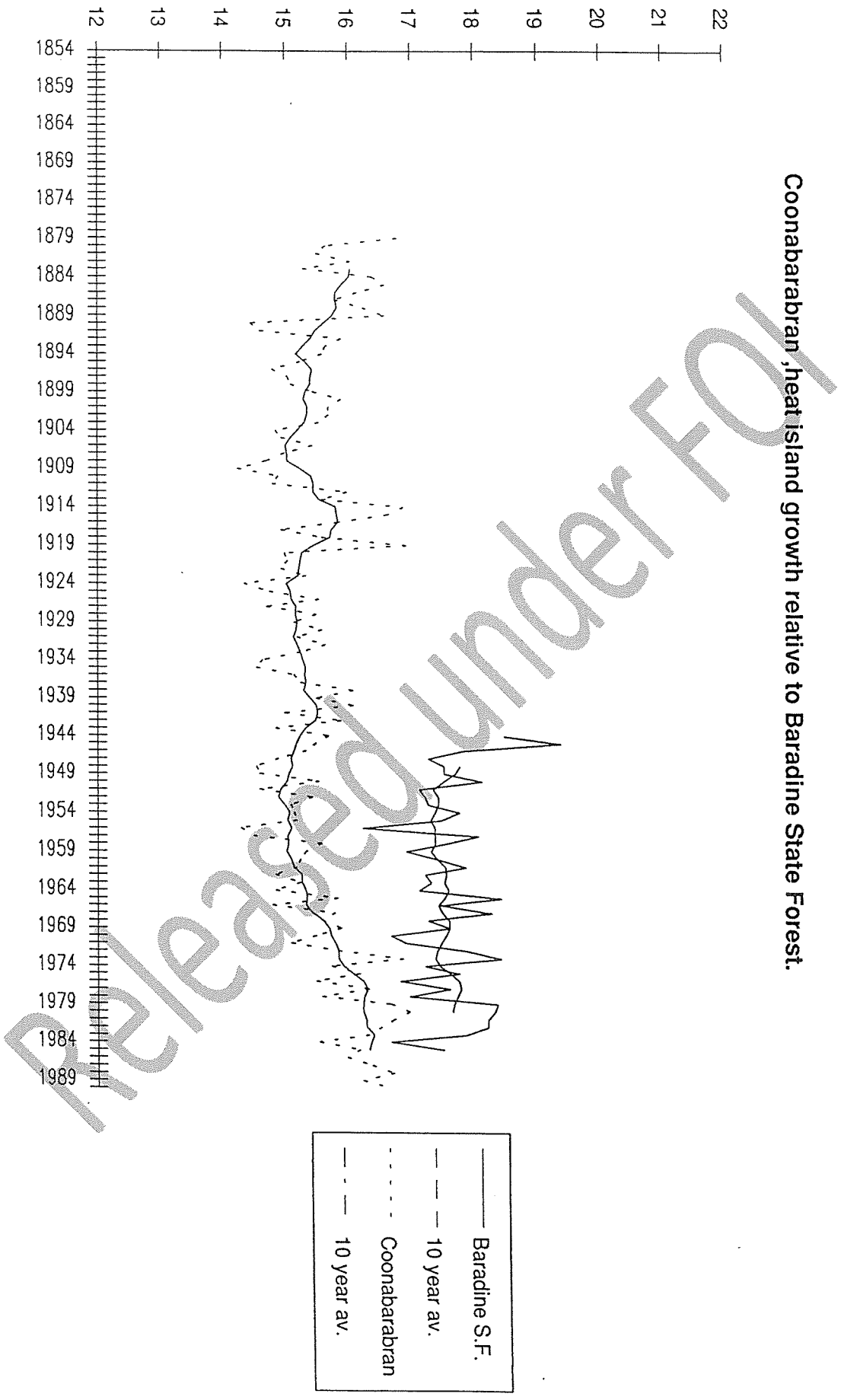


Attachment 4

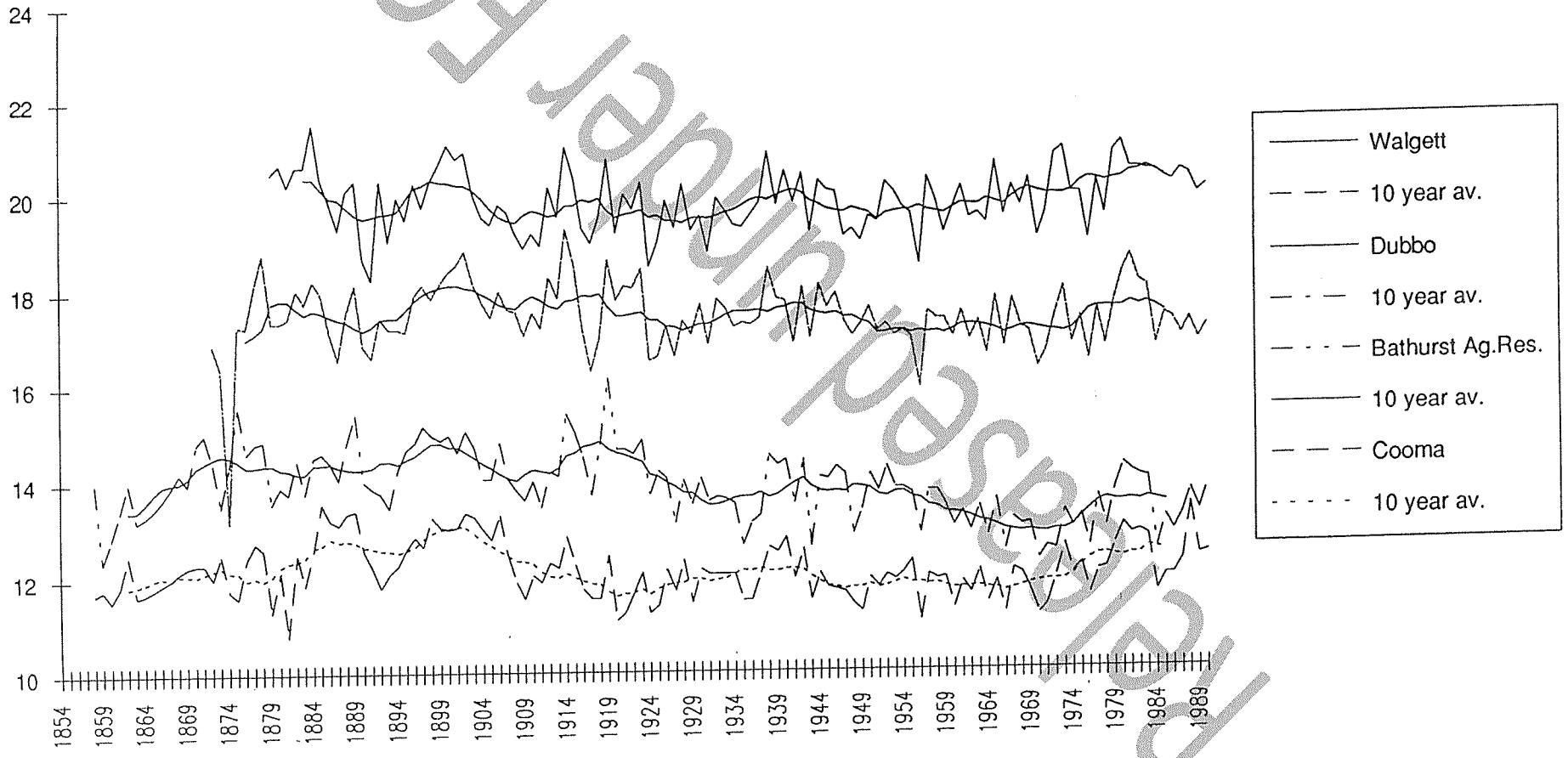
Growth in Yenda Post Office heat island,compared with Griffith C.S.I.R.O.

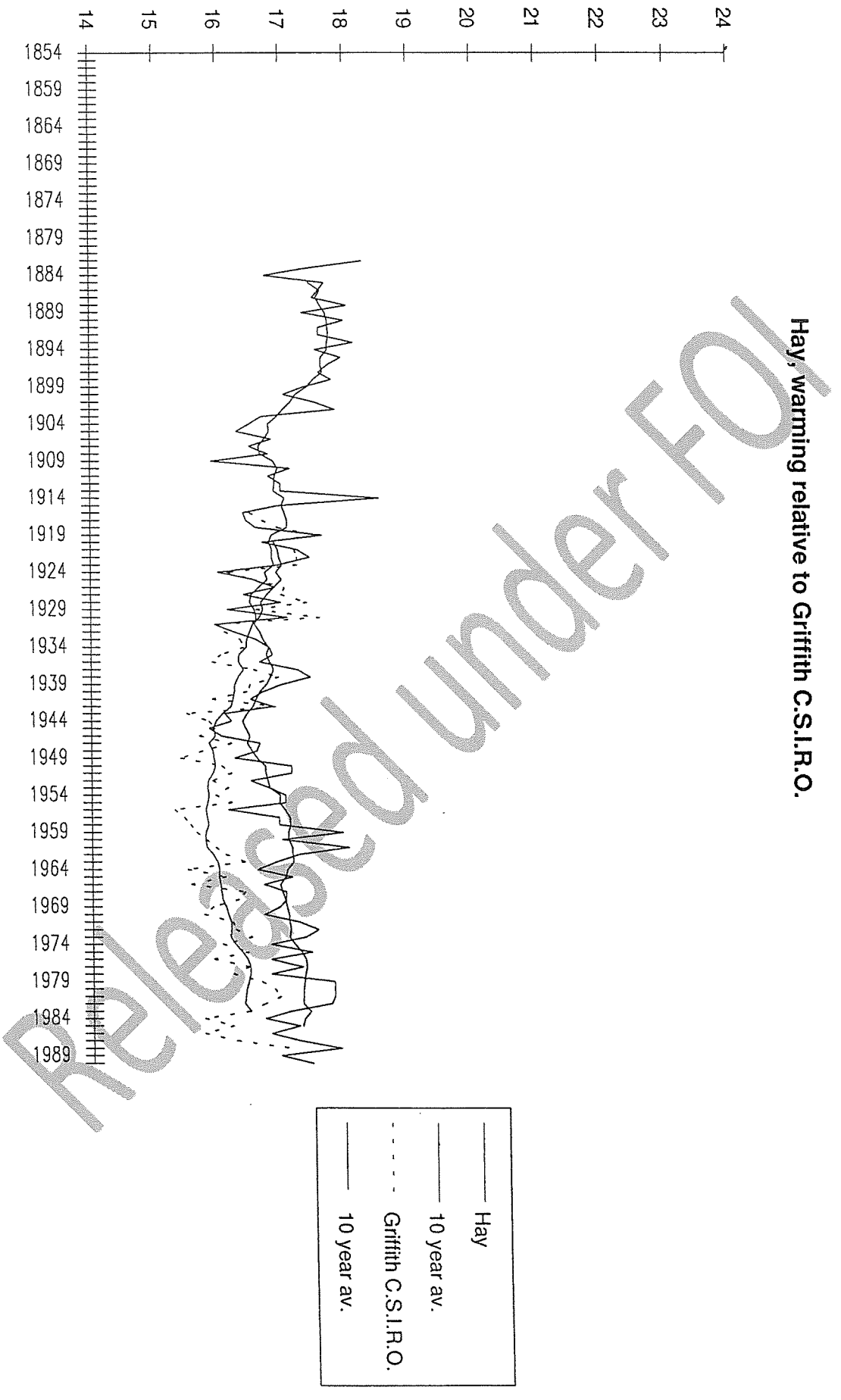




Attachment 6

Heat island growth in Walgett, Dubbo and Cooma,relative to Bathurst Ag. Res. Station(1909-90)

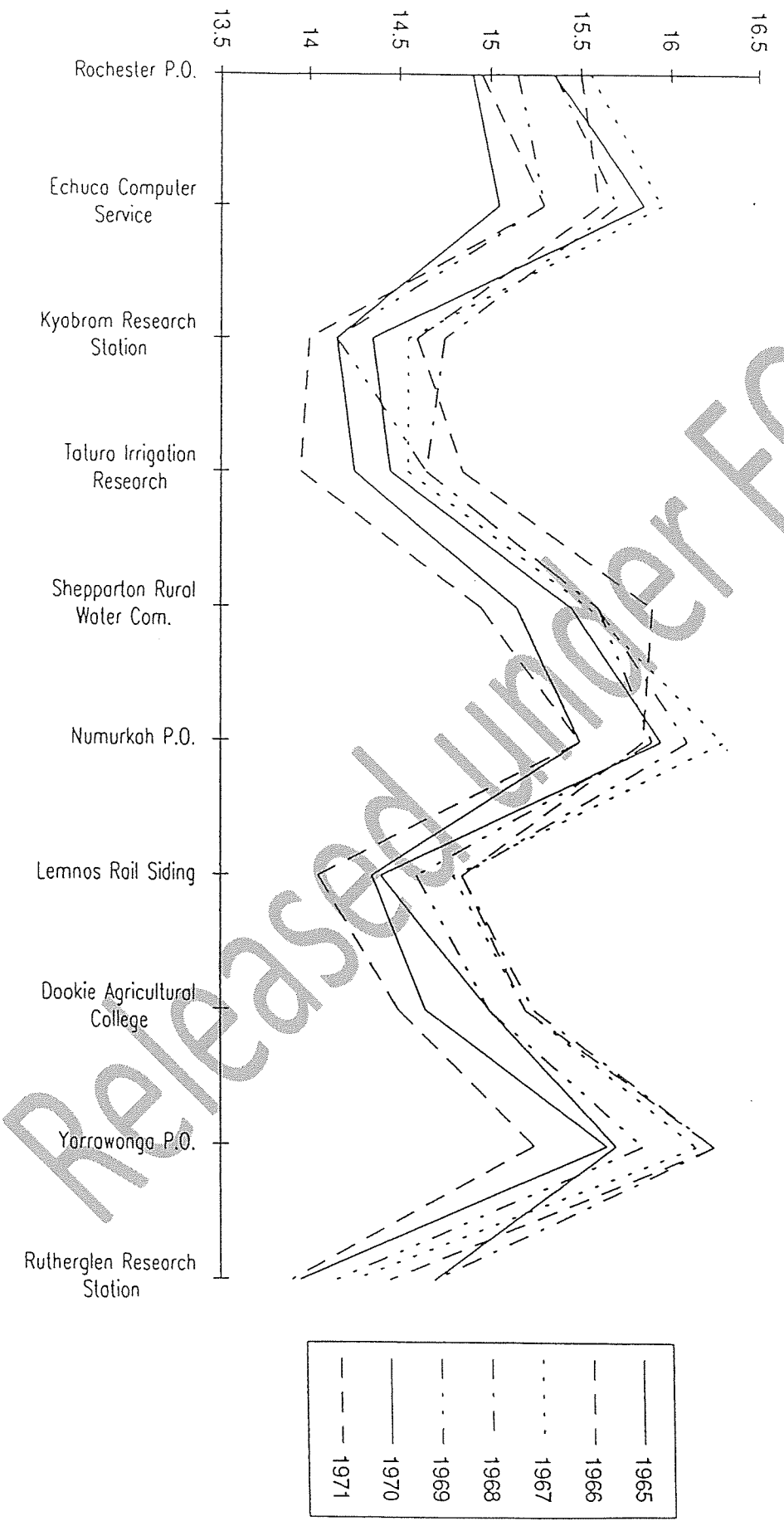




Attachment 8

STATION	RECORDS START	FINISH
Rochester Post Office	1941	1974
Echuca Computer Service	1881	1990
Kyabram Research Station	1965	1985
Tatura Irrigation Res.	1965	1990
Shepparton R.W.C.	1965	1971
Numurkah Post Office	1908	1976
Lemmos Rail Siding	1965	1985
Dookie Agricultural College	1965	1974
Yarrawonga Post Office	1965	1974
Rutherglen Research Station	1913	1990

Average Temperatures	1965	1966	1967	1968	1969	1970	1971
Rochester P.O.	15.35	14.95	15.55	15.35	15.15	14.9	15.5
Echuca Computer Service	15.85	15.3	15.95	15.7	15.3	15.05	15.6
Kyabram Research Station	14.35	14	14.55	14.75	14.15	14.15	14.6
Tatura Irrigation Research	14.45	13.95	14.55	14.65	14.65	14.25	14.85
Shepparton Rural Water Com.	15.45	14.95	15.55	15.6	15.6	15.15	15.9
Numurkah P.O.	15.95	15.5	16.3	16.1	15.9	15.5	15.85
Lemnos Rail Siding	14.4	14.05	14.8	14.85	14.6	14.35	14.85
Dookie Agricultural College	15	14.5	15.2	15.25	15	14.65	15.2
Yarrawonga P.O.	15.7	15.25	16.15	16.25	15.85	15.65	16.25
Rutherglen Research Station	14.7	13.9	14.25	14.7	14.15	13.95	14.45



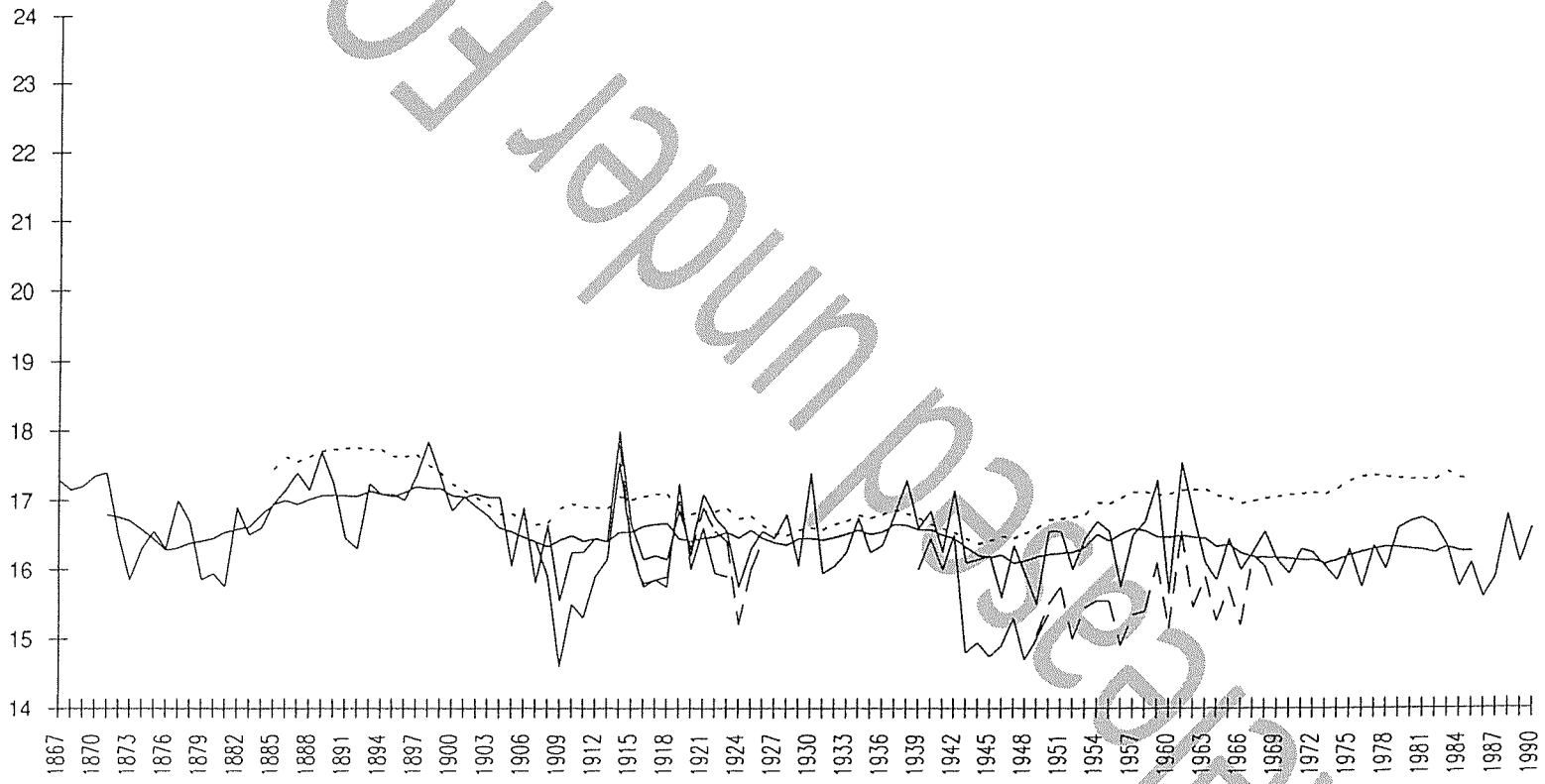
Northern Victoria, towns contrasted with rural stations, Avtemp 1965 to 1971. Diagrammatic cross section.

Attachment 10

Average Temperature		1941	1942	1943	1948	1949			
Leeton Post Office		16.95	17.45	16	16.3	16.1			
Leeton Rice Research		15.6	16.4	15.15	14.9	15			
P.O.is 1.15 hotter than Rice Research									
Average Temperature		1923	1925	1926	1927	1930	1931	1932	
Leeton Post Office		17.15	16.45	16.95	16.55	17.25	15.95	16.4	
Yanco Exp. Farm		16.45	16.05	16.25	15.55	16.55	15.5	16.1	
P.O. is 0.6 hotter than Yanco									
Average heat island effect in Leeton is 0.83 degrees C									
Average Temperature		1942	1944	1946	1949	1950	1951	1952	1953	1955
Kerang Post Office		16.45	15.75	15.3	15.25	16.25	16.35	15.6	15.95	15.65
Koondrook State Forest		16.15	14.95	14.75	14.3	15.1	15.25	14.95	15.35	15.6
Post office is 0.69 hotter than State Forest										
Average Temperature		1913	1914	1915	1916	1917	1918	1919	1920	
Rutherglen Post Office		15.45	17.55	16.1	15.75	15.05	15.7	17.1	16.2	
Rutherglen Viticultural College		15.35	17.15	15.9	15.45	15.35	15.75	16.75	15.1	
Rutherglen Research Station		14.35	15.75	14.5	14.25	14.3	14.5	15.5	15.15	
Average heat island effect in Rutherglen is 0.79 degrees										

Attachment 11

Deniliquin,warmer than Werai(1907-23),Wanganella(1914-26),Gulpa Is.(1939-50)and Mathoura State Forest (1949-69). The uppermost line is the 10 year av. for Hay.



Average Temperature	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952
Walgett	19.8	20.4	19.2	20.25	20.05	20	19.1	19.25	19	19.5	19.4	20.2
Narrabri Bowling Club	18.65	19.5	18.3	19.4	19.25	19.45	18.75	18.85	18.4	19.15	18.6	18.75
Coonamble	19.1	20	19.05	19.65	19.7	20.25	19.2	18.05	18.05	18.55	17.95	18.5
Pilliga West Forest	17.65	18.65	17.45	18.7	18.45	18.45	18.1	18.35	17.6	18.4	17.85	18.25
Average "Heat Island", Walgett=1.52, Narrabri=0.84 ,Coonamble=0.89												

Table Summarising Calculation of Average Heat Island Magnitude

(A) Calculations from trends

Station	Temperature Rise over	Years	Temperature Rise per Century
Yenda Post Office	0.8°	50	1.6°
Coonabarabran	1.0°	30	3.33°
Walgett	1.39°	75	1.85°
Dubbo	0.34°	75	0.45°
Cooma	0.94°	75	1.25°
Hay	0.9°	55	1.64°
			1.685° Average heat island effect per century

(B) Calculations for heat islands over short period of years

Station	Heat Island Magnitude		Date	Implied Temperature Rise per century
Echuca } Rochester } Shepparton } Numarkah } Yarrawonga }	1.064°	at	1970	0.967°
Kerang	0.69°	at	1950	0.77°
Rutherglen	0.79°	at	1920	1.32°
Deniliquin	~0.5°	at	1965	0.476°
Leeton	0.83°	at	1940	1.04°
Walgett	1.52°	at	1950	1.7°
Coonamble	0.84°	at	1950	0.93°
Narrabri	0.76°	at	1950	0.84°
				Average = 0.992° per century

The temperature rise per century in *(B)* is calculated assuming that settlement commenced in 1860.

Overall average for 17 towns = 1.22° per century.

Doc 2

DRAFT

The Australian Record on "Global Warming"[1]

By

Warwick S Hughes

A statistical report prepared by
Tasman Economic Research Pty Ltd

2nd Edition
November 1991

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1 A Review of: *"A Grid Point Surface Air Temperature Data Set for the Southern Hemisphere"* by P D Jones, S C B Raper, C M Goodness, B S G Cherry and T M L Wigley Climate Research Unit University of East Anglia Norwich, UK.

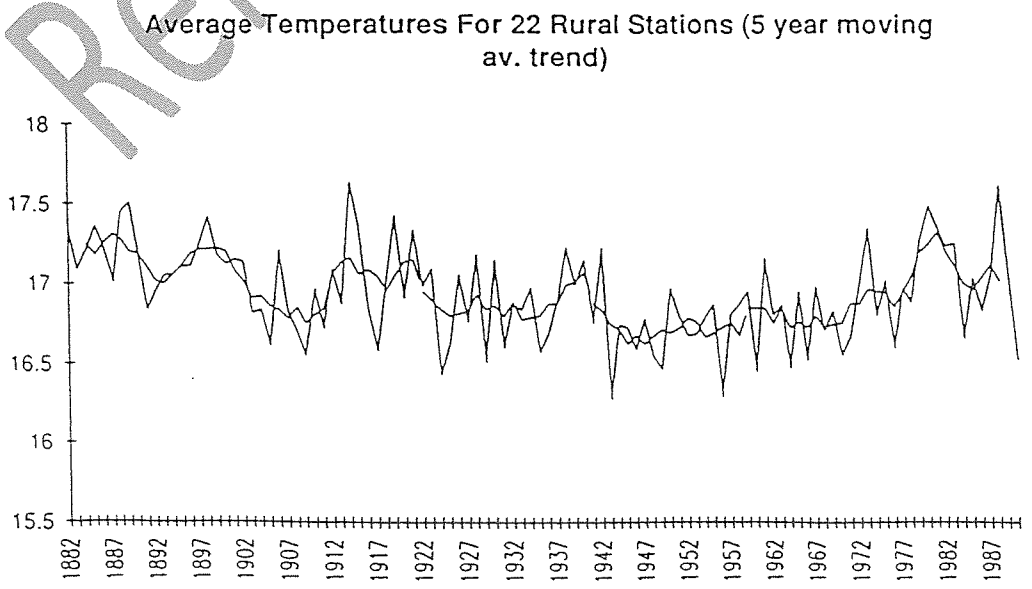
Executive Summary

The major work by P.D. Jones and his team at the Climate Research Unit, University of East Anglia (Jones, et al 1986a) is the most up-to-date compilation of a Southern Hemisphere Land Temperature trend. This paper seeks to cast light upon the long term trend in temperature records for Australia. In doing so, it provides a critique of the East Anglia Study's Australian data.

Our conclusion is that the Australian based findings reported by East Anglia Study cannot be taken to indicate a warming trend over the continent. The East Anglia Study included a number of heat island affected city records while excluding other long term records from rural Australia. It may be argued that there are deficiencies in temperature measurements in earlier years. However, an examination of peaks and troughs for city and remote sites indicates a consistent pattern after adjustment for the trend. This indicates that one possible source of error - human error - is unlikely to be systematically present.

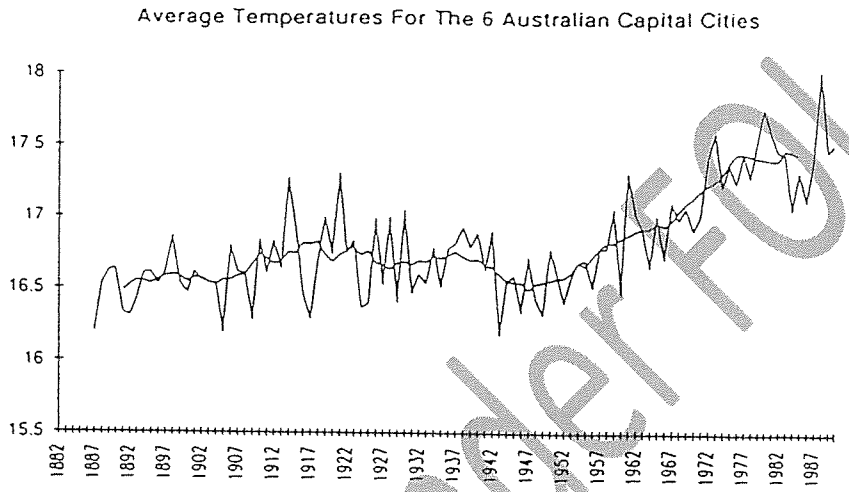
We conclude from an examination of the stations used in the East Anglia Study and a comparison of their trends with stations situated in the same geographic region, that the predominant effect that study reports is due to local heat islands rather than a continental warming trend. Our own analysis of Australian heat island effects demonstrates comparable findings to that conducted by others, especially in the U.S.

The following chart is the average temperature trend for the 22 remote Australian stations for which data was available over the years since 1882.

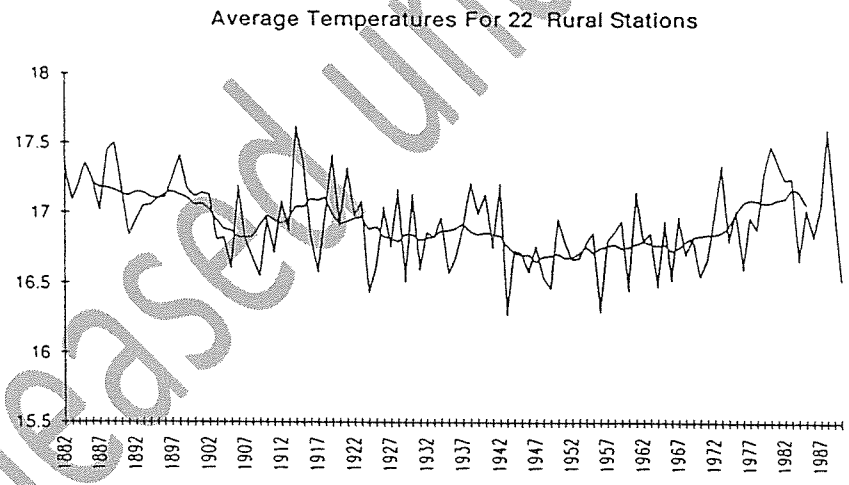


In view of the political and economic consequences of some suggested policy responses to data on "global warming", there is a pressing need for a reassessment of global land temperature trends.

Graph 1



Graph 2



Geraldton	Strathalbyn	Hay
Rottnest Is. Lighthouse	Narrabri	Deniliquin
Cape Naturaliste Lighthouse	Walgett	Cooma
Albany	Bourke	Moruya Heads Pilot Station
Darwin	Dubbo	Gabo Island Lighthouse
Alice Springs	Bathurst	Wilsons Promontory Lighthouse
Mt Gambier	Newcastle Signal Station	Omeo
		Cape Otway Lighthouse

Comments on the East Anglia Team Southern Hemisphere Temperature Study

The Climate Research Unit at the University of East Anglia, under the leadership of P.D. Jones, has compiled graphs of land temperature trends from 1850 to 1980 for both hemispheres.

These trends have been influential in providing apparent confirmation of the enhanced global warming theories and they feature prominently in the IPCC process. It seems that the accuracy of these trends is widely accepted. Most of the "global warming" debate is about how much and how soon, rather than about the facts themselves.

The data set and survey methods used to arrive at the Southern Hemisphere Temperature Series 1858-1984 (see Fig. 1) are reported in two papers, Jones et al (1986a, b).

This review puts the case that the Australian component of the Southern Hemisphere trends is seriously flawed, because of the inclusion of inappropriate records from "heat islands" and because of the rejection of Australian records many of which exhibit a cooling trend over much of the past century. In our view, if the East Anglia team's station selection on the African and South American components of their study is comparable with that for Australia, the trend they offer for the Southern Hemisphere is highly questionable.

The present study does not attempt to produce a temperature trend for Australia as a whole, although we do average the trend for the twenty four remote stations for which long term data is available. The prime aim is to argue for a thorough re-assessment of global land temperature trends, by noting that once data from "heat islands" are removed, there appears to be little evidence from Australian data of global warming.

Major issues discussed

(1) There appears to be a gross under-estimation of the bias due to the "urban heating" effect resulting from the inclusion of all capital city records, a bias which explains the apparent warming. The inclusion of many short term

(1950-1980) records from small towns, many of which are located at or near airports and can be demonstrated to incorporate a local "heat island" effect, is another source of upward bias.

(2) The total rejection of rural data from NSW and Victoria, where the greatest number and concentration of long term (~ 120 year) records are available.

(3) A selection which excludes or shortens much long term pre-1910 data in the 610 stations considered for inclusion.

All temperature records used in this study are from the Bureau of Meteorology, Climate Data Centre.

All temperatures are annual average temperatures in ^{0}C, that is $\frac{\text{Max+Min}}{2}$ unless otherwise stated.

All graphs show a ten year moving average curve in addition to the temperature trace.

(1) Urban Heating Effect

The charts of average temperatures displayed in Appendices A to E allow a comparison between capital city temperature trends and those for nearby localities with much smaller populations. The capital city trends are stand out as showing a rising trend which is not present in nearby localities.

Australia's experience in this respect is similar to that overseas. For the U.S., Balling and Idso (1989) found that *"even very small towns have a heat island bias in their temperature trends"*.

In Section (2) below, evidence demonstrates that some aerodromes can show "heat island" effects when compared to nearby lighthouses or other stations more rural in nature. During the 1940s many recording sites were moved from towns to nearby aerodromes often for administrative and staffing reasons. It is likely that since then most of these aerodromes would have been affected by increasing areas of sealed tarmac and additions to hangars and terminal structures, all of which add to a localized heating effect.

Jones et al (1986b) state on page 1216, that *"very few stations in our final data set come from large cities."* This is difficult to reconcile with the fact of the numbers of "large city stations" as recorded in Jones et al (1986a). Indeed, for the Australian component, the six capital cities are included out of a total of twelve mainland long term stations.

A cursory examination of data from other continents reveals that cities comprise 10 out of 15 long term (i.e. pre 1910) stations for Africa and 12 out of 22 long term stations for South America.

Aside from their statement that there are very few large city stations in their data set appearing to be incorrect, Jones et al (1986a and b) seems to have underestimated the importance of urban warming. Out of the up to 0.6°C increase which they estimate to have globally occurred over the past century, they attribute 0.2°C as the upper limit for heat island effects. In the following section capital city trends are compared to those from nearby rural stations. The abnormal warming trends in the capital city records is both apparent and of a greater magnitude than that indicated by Jones et al.

Brisbane

Comparing the trend for Brisbane with that for the more remote Sandy Cape Lighthouse, Moreton Island Lighthouse, Yamba Pilot Station and the small town of Goondiwindi, one can see a relative increase of between 0.5° and 0.7° in Brisbane over a century or so. (See Appendix A.)

Sydney

Comparing Sydney to Newcastle Signal Station, Bathurst, Moruya Heads Pilot Station, it appears that relative to its surrounding area Sydney has warmed by from 1° to 2.5° over a century. (See Appendix B.)

Melbourne

Over the past century Melbourne has warmed 1.5° to 2° compared to surrounding more remote centres. (See Appendix C.)

Adelaide

There is very little difference between Adelaide and the surrounding rural stations. A warming in Adelaide of 0.5^0 over a century is seen when compared to Kapunda-Roseworthy College. Adelaide shows little trend, being much the same temperature 90 years ago as it is today. (See Appendix D.)

Perth

Comparing Perth with Bunbury-Cape Naturaliste Lighthouse, Katanning or Southern Cross suggests that Perth has warmed relative to these more rural stations $+1.0^0$ over a century. (See Appendix E.)

(2) Short term records

This section comments on nine instances where short term (1950-80) records are used in the Jones et al (1986a) study, to the exclusion of longer term records available, either at the same station or nearby more rural sites. Localities are shown on the maps Figures 5 and 6. The stations used are compared below with others in their locale.

(i) Mt. Gambier (Appendix D)

From 1951-80 this Aerodrome station shows a strong warming trend. When the Post Office records are spliced on the trend 1860s to 1990, it is close to neutral.

(ii) Charleville (Appendix F)

The trend for this station 1951-80 also shows a strong warming trend. Cunnamulla, a smaller centre approximately 170 kms south, shows a much flatter trend over about 80 years.

(iii) Townsville (Appendix F)

This station like many others from 1951-80 shows a clear warming trend. However the longer trends for the nearby more rural station, Ayr (Shire Council 1908-1970, then D.P.I. Research Station) is much closer to zero. The flat spots in the Ayr temperature trace are missing years but do not affect the sense of the trend.

(iv) Longreach (Appendix F)

For the period 1951-80 this trend is sharply upward, yet if the Longreach Post Office record is spliced to the Aerodrome record (post 1940s) the trend becomes markedly flatter. When Longreach is compared to Isisford, a much smaller rural centre 80 kms south, the trend is almost neutral over about 70 years. Longreach 1951-80 as a contributory data series to southern hemisphere temperature series may well distort the overall series. Its available records date back to circa 1910; the pre-1950s period shows a trend which was falling in the first decade of the century, rising until the late 1930s and falling during the subsequent decade.

(v) Mackay and Rockhampton (Appendix G)

The A.M.O. record 1951-80 shows a clearly steeper warming trend for Mackay when compared with Clermont and Pine Islet Lighthouse.

Compared to Bustard Head Lighthouse and Sandy Cape Lighthouse, Rockhampton shows a warming trend of about 0.5^0 over 70 years. Rockhampton data was used only for the period 1951-1970. Although it exhibits a warming trend over a long period, the two nearby lighthouses show similar temperature pattern but a negligible temperature change over 70 years.

(vi) Kalgoorlie (Appendix H)

The Aerodrome record 1941-80 shows a well defined warming close to 2^0 per century when scaled up. However, when Post Office records are spliced on the position is much closer to zero over 90 years. Looking at Southern Cross, a continuous Post Office record, approximately 200 kms west, the trend is very similar - flat over some 90 years.

(vii) Meekathara (Appendix H)

The Aerodrome record 1951-80 shows a clear strong warming trend. The small centre of Cue, 120 kms south west, however has a flat trend over 90 years.

(viii) Port Hedland (Appendix H)

The Aerodrome records 1951-80 shows a clear warming trend. Marble Bar, 150 kms south east, shows a similar trend over that period but a flat trend over 80 odd years.

(3) Rejection of rural data

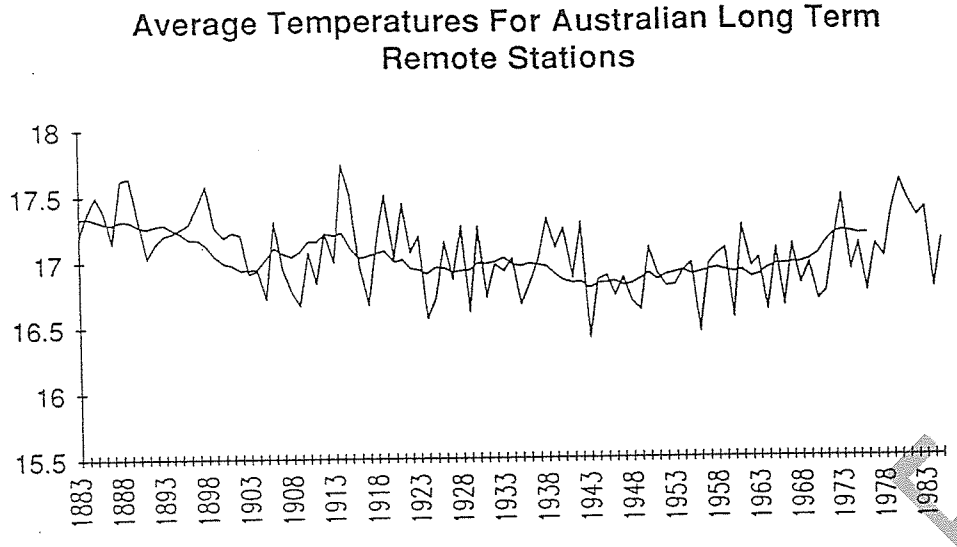
Looking at the choices of stations in Jones et al (1986a) it is remarkable that Sydney and Melbourne aside, there is not one station, long term or short, between Brisbane and Mt. Gambier. This area includes all of NSW and Victoria and contains the greatest concentration of long term recording stations in Australia. Figures 2 and 3 demonstrates the important potential of South East Australia as providing data to examine Australia's long term temperature history.

Many of the rural temperature trends from South East Australia show a marked fall often of the order of a degree, in the period immediately prior to 1900 (Ref. graphs for Gabo Island, Omeo, Deniliquin, Mildura, Kapunda, Broken Hill, Strathalbyn, Cape Otway, Moruya and Yamba). This prominent feature, which coincides with the end of Australia's most widespread and severe drought, is not mentioned in either of the Jones et al papers (1986a, b).

This regional fall in temperature may be an Australian manifestation of the similar features seen on the worldwide marine temperature trends published by Folland et al (1984) Figure 4. Folland's trends are derived from 46 million sea surface temperatures, and 24 million night marine air temperature readings.

It is interesting that Folland et al (1984) comment that, although for the period after 1900, the marine temperature trends are in fairly close agreement with the Northern Hemisphere land temperature trends of Jones et al (1982), they are sharply different before 1900. This suggests that the data used by Jones et al (1982) may have also excluded much of the circa 1900 temperature fall in their Northern Hemisphere study.

Average temperatures over the years 1883 to 1985 for the twenty two Australian remote stations for which data is available are plotted below. The trend is remarkably flat, with the 0.4^0 fall in the period prior to the early years of the century barely being recouped in the following eighty years.



South East Australia Rural Stations

One can surmise that the East Anglia Group rejected the NSW and Victorian rural suite in its entirety because they felt the records had shortcomings. Many meteorologists consider that the pre-1910 records are suspect, partly because of equipment changes. In particular, the introduction of Stevenson screens at some time prior to this date is thought to have resulted in more reliable data which would, however, offer a record slightly below that of the pre-Stevenson screen measurements.

Records of a doubtfully representative nature are unquestionably present for other reasons, especially shortly after the commencement of recording at some stations. Badly situated equipment is likely to be left in place for a few years at remote sites before "head office" corrected matters. Nonetheless, comparisons between stations show similarities in trends and trace details to the extent that for the great majority of cases the records can be verified as being reasonably reliable.

Three sets of temperature traces are presented in Figure 7 from different transsects through New South Wales rural centres. All were rejected by the East Anglia study. Bearing in mind the large distances involved, sufficient correlation exists in trace details and ten year moving averages, to suggest that variations for the entire suite are consistent with those of stations considered to be acceptable.

Coastal stations

Staff at the Climate Data Centre, Bureau of Meteorology, Melbourne, are sceptical about the validity of records which show marked falls in temperature circa 1900. This applies in particular, to the lighthouse and coastal stations from Cape Otway to Yamba in northern New South Wales. This unreliability is attributed to equipment/operator failing or change. The Sydney and Melbourne records, which were more closely scrutinized are considered to be more accurate.

However, comparisons are presented below and in Figure 8 showing that the Sydney and Melbourne temperature patterns are comparable to nearby coastal stations, despite radical differences in trends before 1902. This process allows a logical synthesis to be made between the hitherto rejected south-east Australian records and the sea surface temperature data of Folland et al (1984).

Cape Otway and Melbourne

Figure 8 allows Cape Otway to be juxtaposed relative to Melbourne, and reveals a close agreement between the traces between 1872 to 1898. This suggests that Lighthouse Keepers and their temperature recording equipment were producing records in parallel with Melbourne over this period.

The cooling seen in south-east Australian coastal stations post 1896 is widespread throughout inland NSW but in a relatively subdued form. It does not stand out as a unique event but as one of a series of wave like fluctuations in the ten year moving average. The failure of the marine air cooling to significantly penetrate to Melbourne means that the temperature traces for Cape Otway and Melbourne diverge at 1896 and, although many spikes and minor trace details are shared, the Melbourne urban micro-climate ensures that the city's pattern is one of progressive warming to the present time.

Wilsons Promontory and Omeo

Comparing these two stations there is considerable similarity in trends and pattern details despite their differing climatic environments. Neither was considered for the East Anglia Study.

Sydney compared to Moruya Heads and Newcastle

When Sydney and Moruya Heads are juxtaposed (see Figure 9) a fair relationship can be seen in the period 1878 to 1896, particularly if Moruya is rotated slightly anti-clockwise. The comments for Melbourne/Otway above apply here too.

In the case of Newcastle, this was a growing industrial centre with a developing urban heating micro-climate, which may account for the absence of any observable post 1896 marine air cooling. Correlations with the Sydney trace are seen 1878-1888 and 1899-1908 with the greater heat island effect of the larger city causing a progressive divergence to the present day.

Yamba

This record with a smooth fall over four years (1898-1901) has been analysed by plotting monthly readings from 1878-1905 (see Figure 10). A steady fall is seen and considerable regularity is apparent in the entire record when plotted in this way. There seems no reason to invoke any equipment/operator failings, errors or changes to produce such a smooth (albeit large amplitude) fall in temperature.

(4) Data Selection Process

The Jones et al (1986a) study considered 610 stations in total. Table A sets out the extent of exclusion of long term material in the non-Australian sector of the study.

TABLE A

Use of Non-Australian Stations in the Southern Hemisphere Temperature Study, by categories (long term = pre 1910)

Non-Australian Stations		Non-Australian Stations used in Grid Survey	
Total	524	Total	253
Short Term Rejects	254	Short Term Used	176
Long Term Rejects	17	Long Term, Shortened	40
Total Used in Grid Survey	253	Long Term Used	37

It seems obvious that when we are hoping to cast light on the issue of world temperature changes, the cause of which is presumably accelerating cultural CO_2 emissions, dating from the time of the Industrial Revolution, it makes little sense to concentrate on records from the last half of this century. Yet we see from Table A that the selection of data used to produce their final graph (Fig. 1) is heavily weighted against the inclusion of records running back to last century.

The 40 stations shortened include only those with a minimum of 30 years amputated and the average shortening is 53 years.

Table B summarises the treatment of the 86 Australian temperature recording stations in the Jones et al (1986a) Southern Hemisphere survey.

TABLE B

Australian Stations Considered		**Australian Stations Used in Grid Survey**		
Total	86	Total used		40
Short Term Rejects	25	Short Term		24
Long Term Rejects	21	Long Term Shortened		2
		Long Term		14
		Breakdown of the Long Term		
Used in Grid Survey	40	Capital Cities	6}	
		Minor Cities, Small Towns	4}	
		Islands	2}	
		Lighthouses	2}	14

Of the 40 stations used to generate the Australian component to the Figure 1 graph, only 8 could be said to be really useful in the compilation of a single temperature that is fairly representative of Australia's historic temperature variations since the significant commencement of record taking in say the 1880s.

Only two stations, Cloncurry and Alice Springs, represent inland Australia.

The majority of stations used (twenty-six out of forty) are short term and only contribute to refining the uncontroversial general warming that occurred between the 1950s to 1980.

Modifications to records

A total of eight out of 86 records considered for the Jones et al (1986a) study have been "corrected", sometimes for site changes, sometimes because of comparisons that have been made with other station trends.

Only three of the records commented on in this paper have had corrections applied, Sydney, Adelaide and Townsville. Further comments on this subject are made in Appendix J.

Analysis of Australia's long term temperature records suggests that there is a general integrity about the entire group. This is supported by the recognition of regional suites with their own characteristics. Exceptions to this are the cities, which are so distorted to be virtually unusable, and smaller centres showing "heat island" effects, that perhaps could be "corrected". The vast majority of other remote stations' long term records show a clear relationship to their regional suites.

References

Balling, Robert C. (Jr.) and Idso, Sherwood B., "Historical Temperature Trends in the United States and the Effect of Urban Population Growth". Journal of Geophysical Research, Vol. 94, No. D3 pp. 3359-3363. (1989)

Folland, C.K., Parker, D.E. and Kates, F.E., 1984: "Worldwide marine temperature fluctuations. 1856-1981". Nature, 310, 670-673. (1984)

Jones, P.D., Raper, S.C.B., Cherry, B.S.G., Goodess, C. and Wigley, T.M.L., 1986b: "A grid point surface air temperature data set for the Southern Hemisphere, 1851-1984". DOE Tech. Rep. No. 27, Carbon Dioxide Research Division, 73 pp. (1986a)

Jones, P.D., Raper, S.C.B. and Wigley, T.M.L., "Southern Hemisphere Surface Air Temperature Variations 1851-1984". J. Clim. appl. Met. 25, 1213-1230. (1986b)

Jones, P.D., Wigley, T.M.L. and Kelly, P.M., Mon. Weath. Review 110, 59-70 (1982).

Figure 1 Southern Hemisphere Temperature Series 1958-1984 (anomalies relative to 1951-70) Jones et al (1986a)

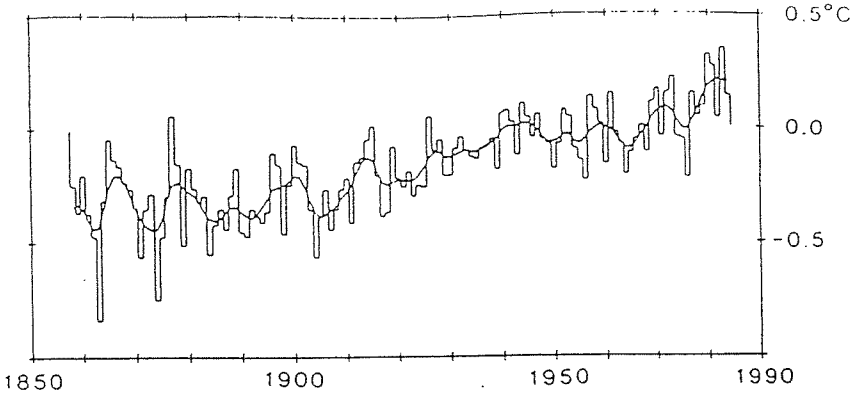


Figure 2 Climate Stations Open with long record

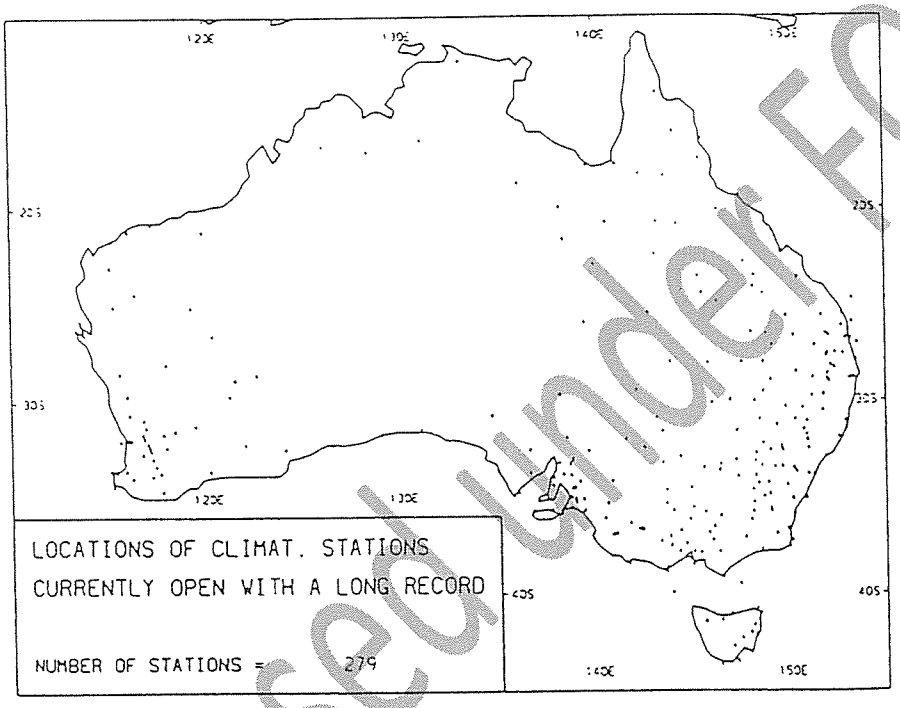
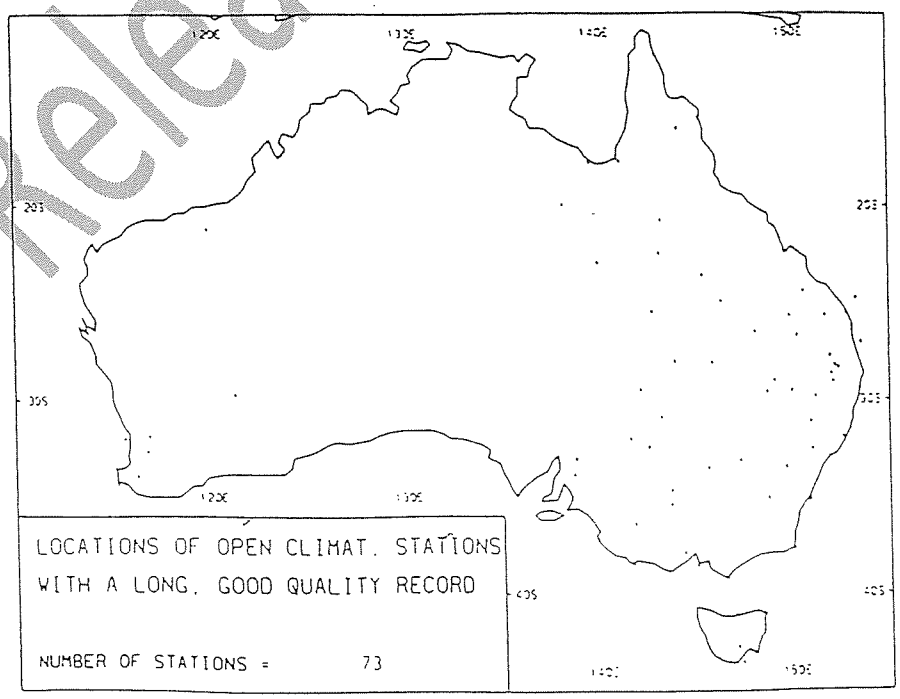


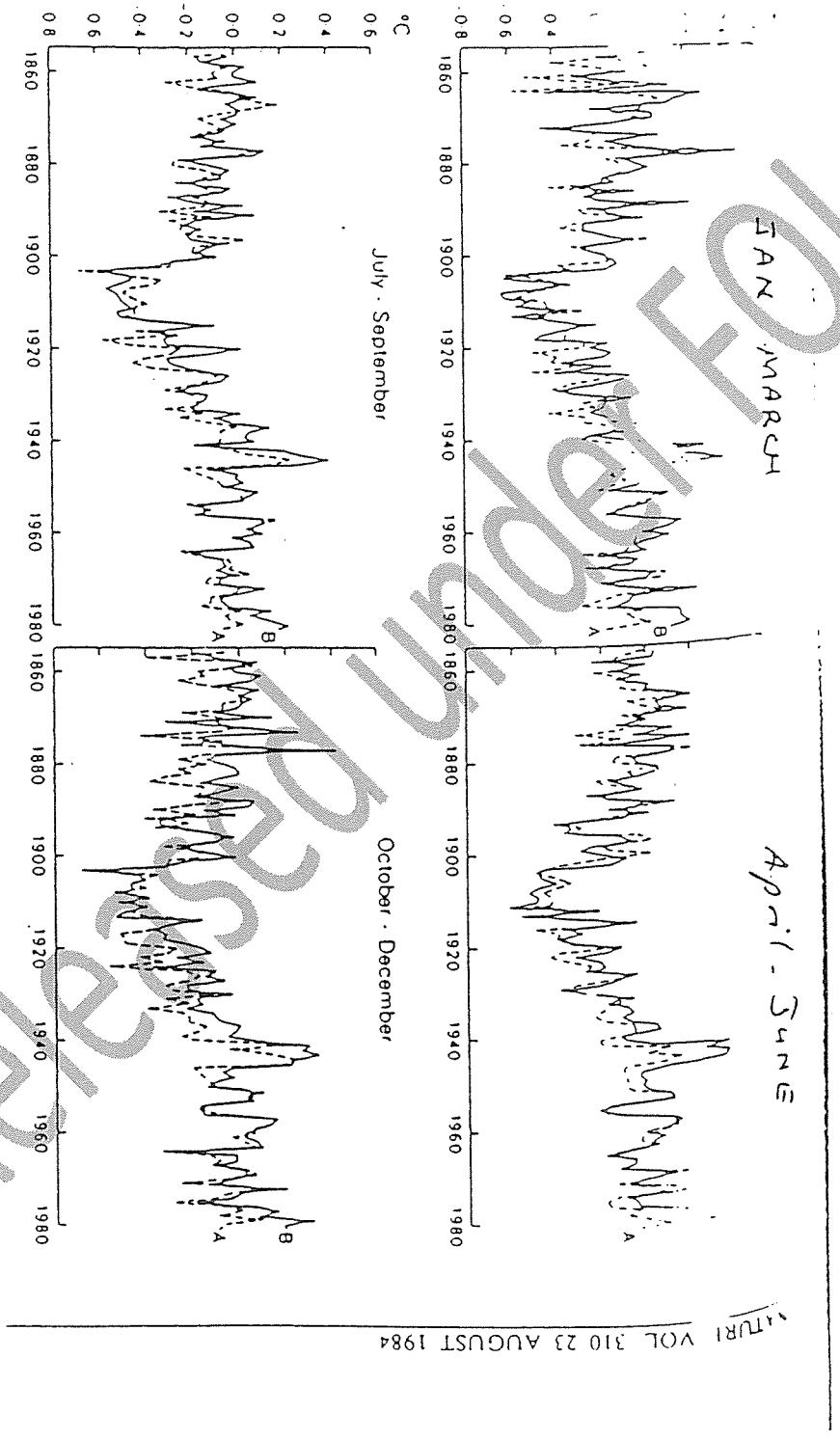
Figure 3 Climate Stations Open with long, good quality record



Map courtesy of Professor Budd, Meteorology Department, University of Melbourne and Mr Simon Torok, Ph D. student and Climate Data Centre, Bureau of Meterology, Melbourne

Figure 4 Graphs from Folland et al (1984)

Corrected anomalies (relative to 1951-60) of
A - Global sea surface temperature
B - Global nighttime marine air temperature



NATURE VOL 310 23 AUGUST 1984

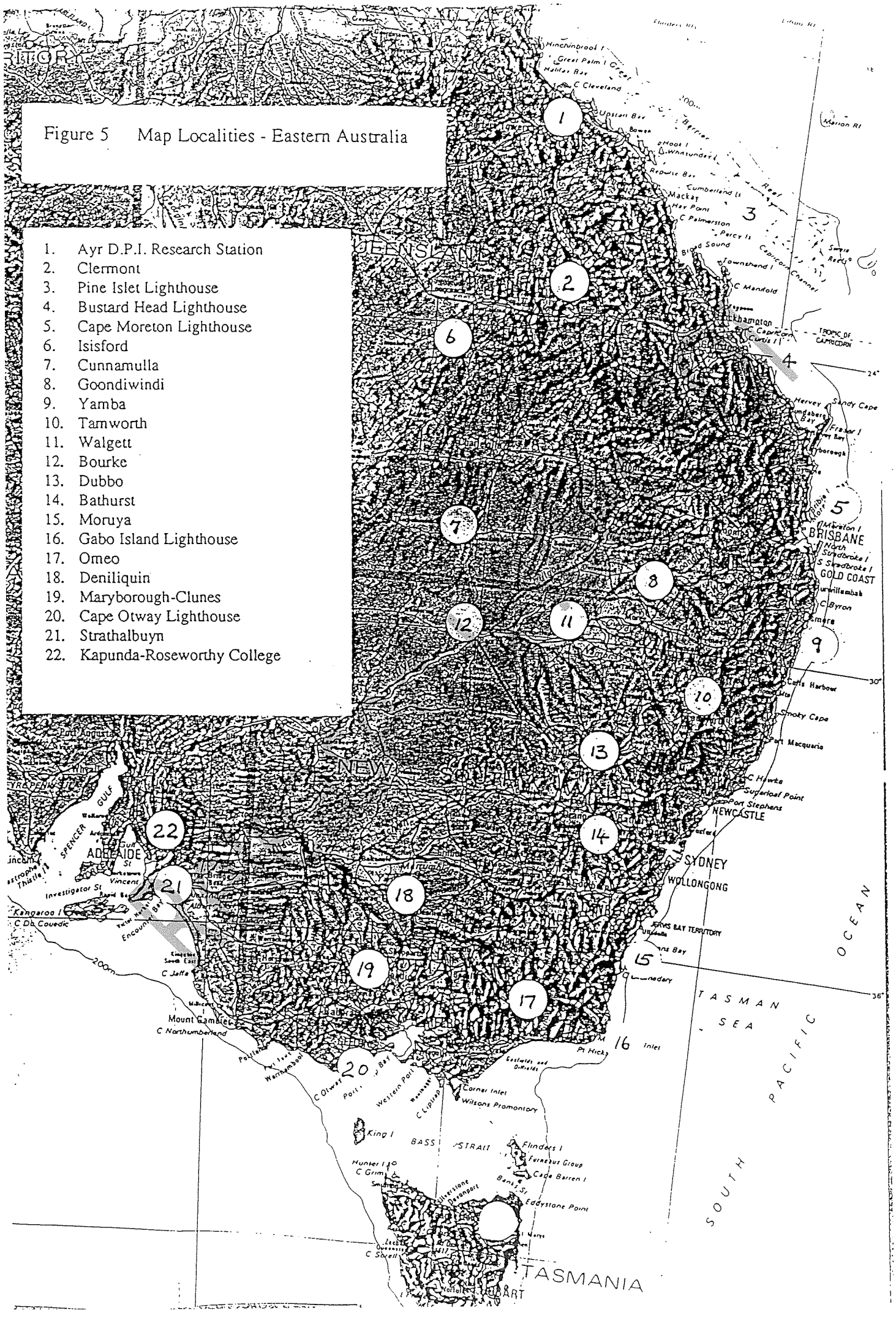
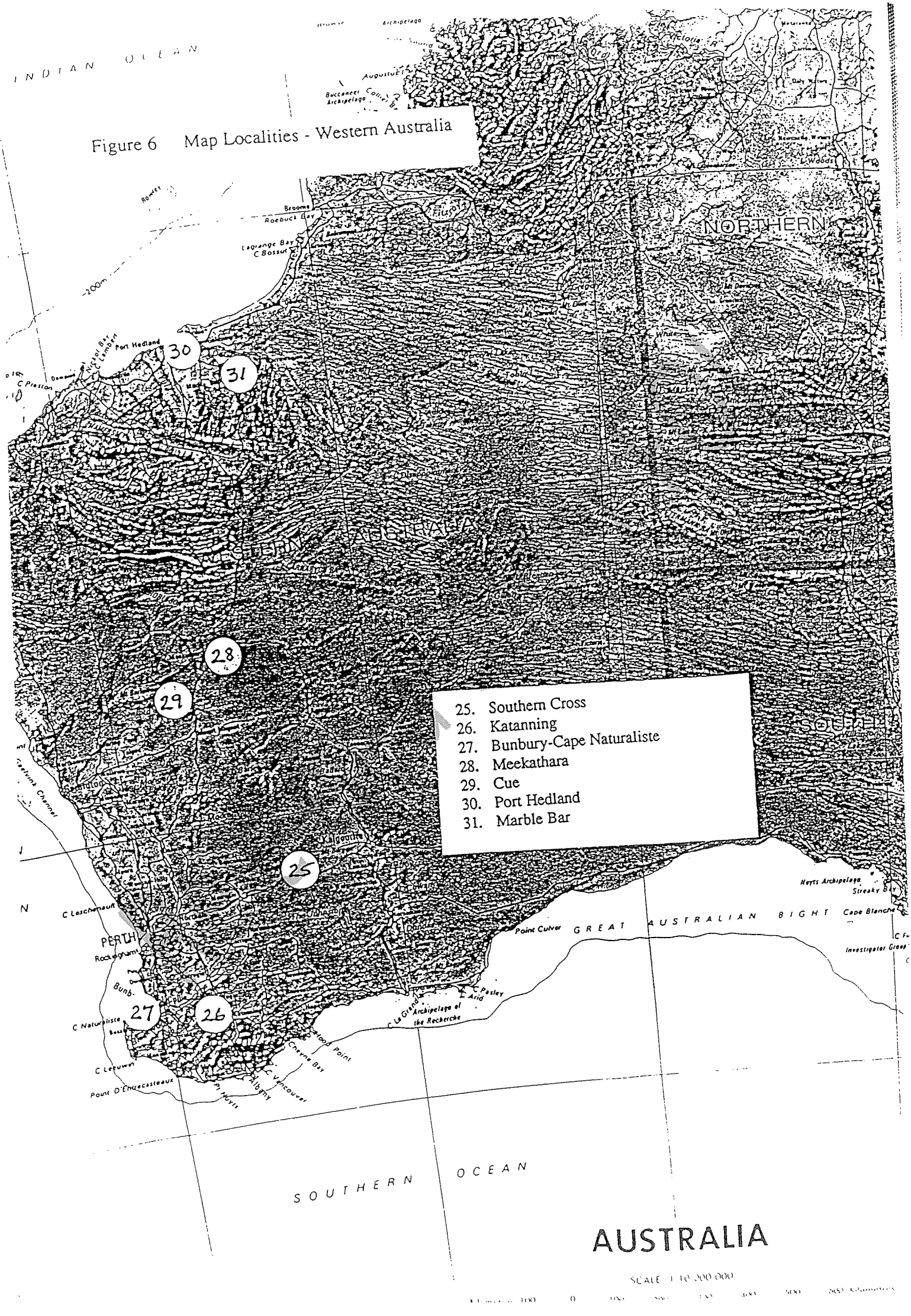


Figure 5 Map Localities - Eastern Australia

Figure 6 Map Localities - Western Australia



25. Southern Cross
26. Katanning
27. Bunbury-Cape Naturaliste
28. Meekathara
29. Cue
30. Port Hedland
31. Marble Bar

Figure 7

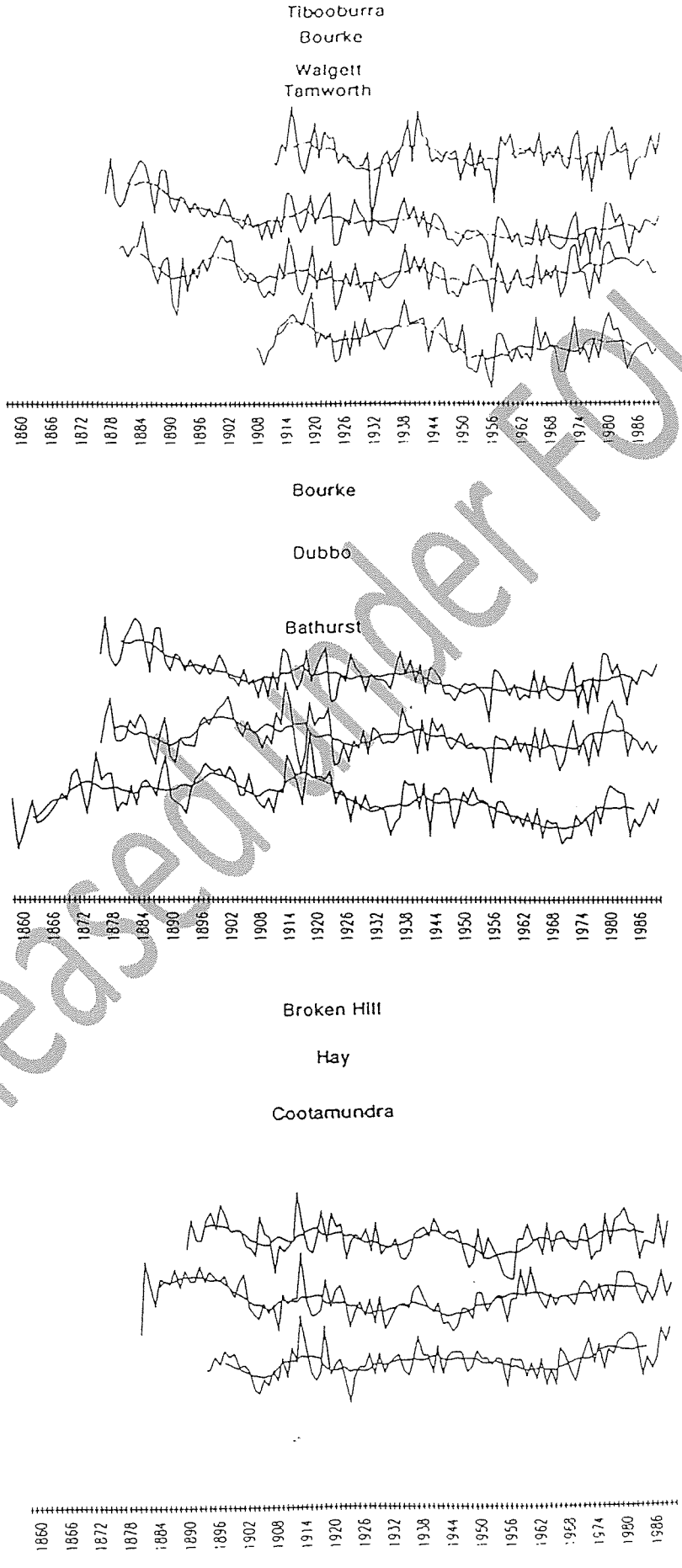
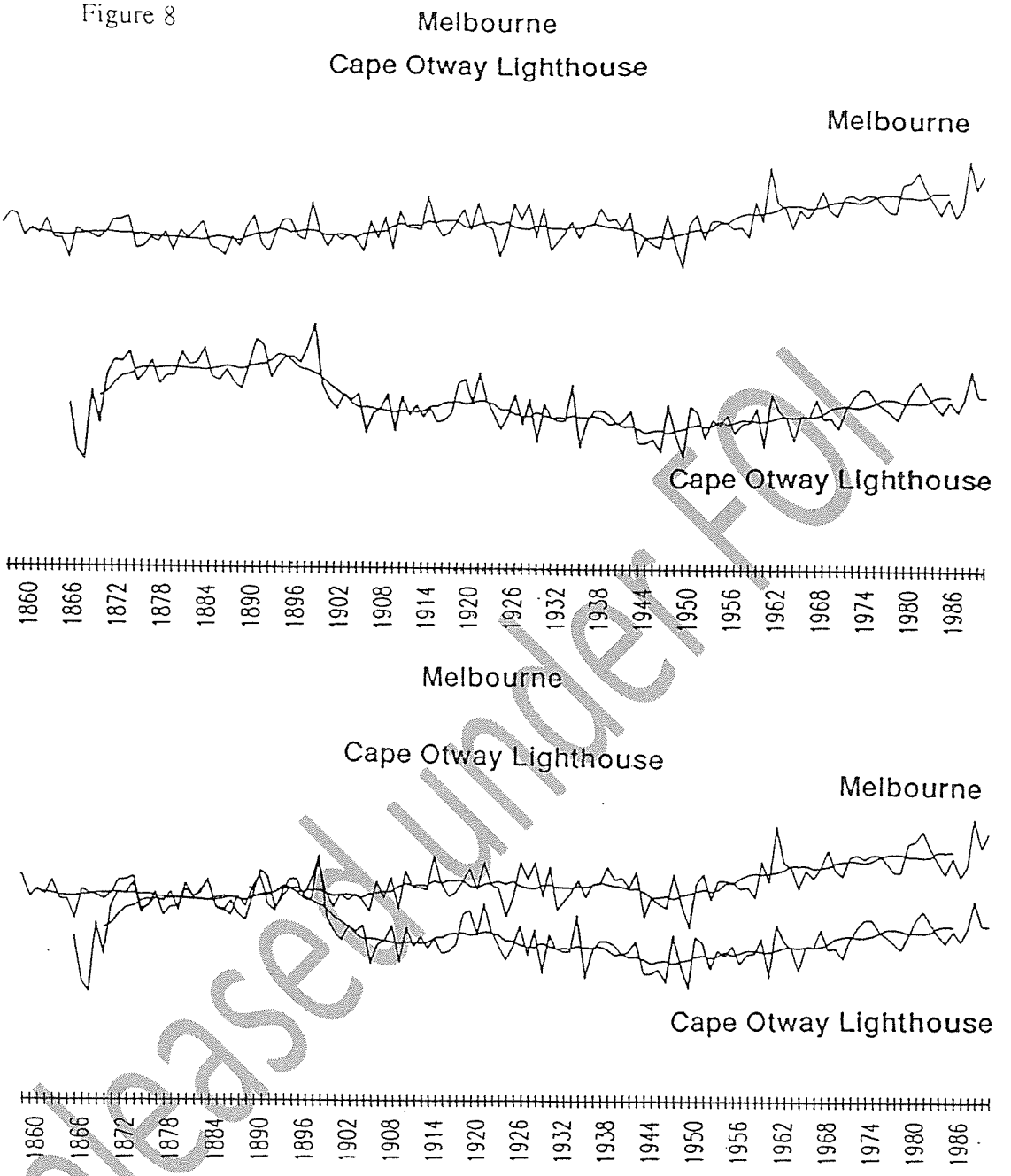


Figure 8



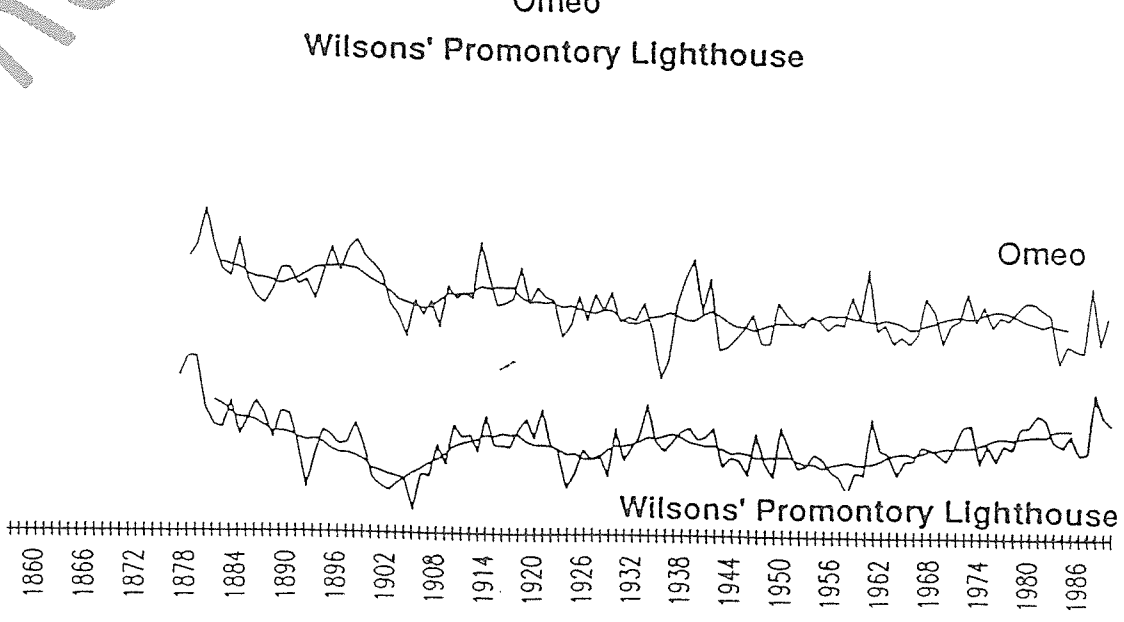


Figure 9

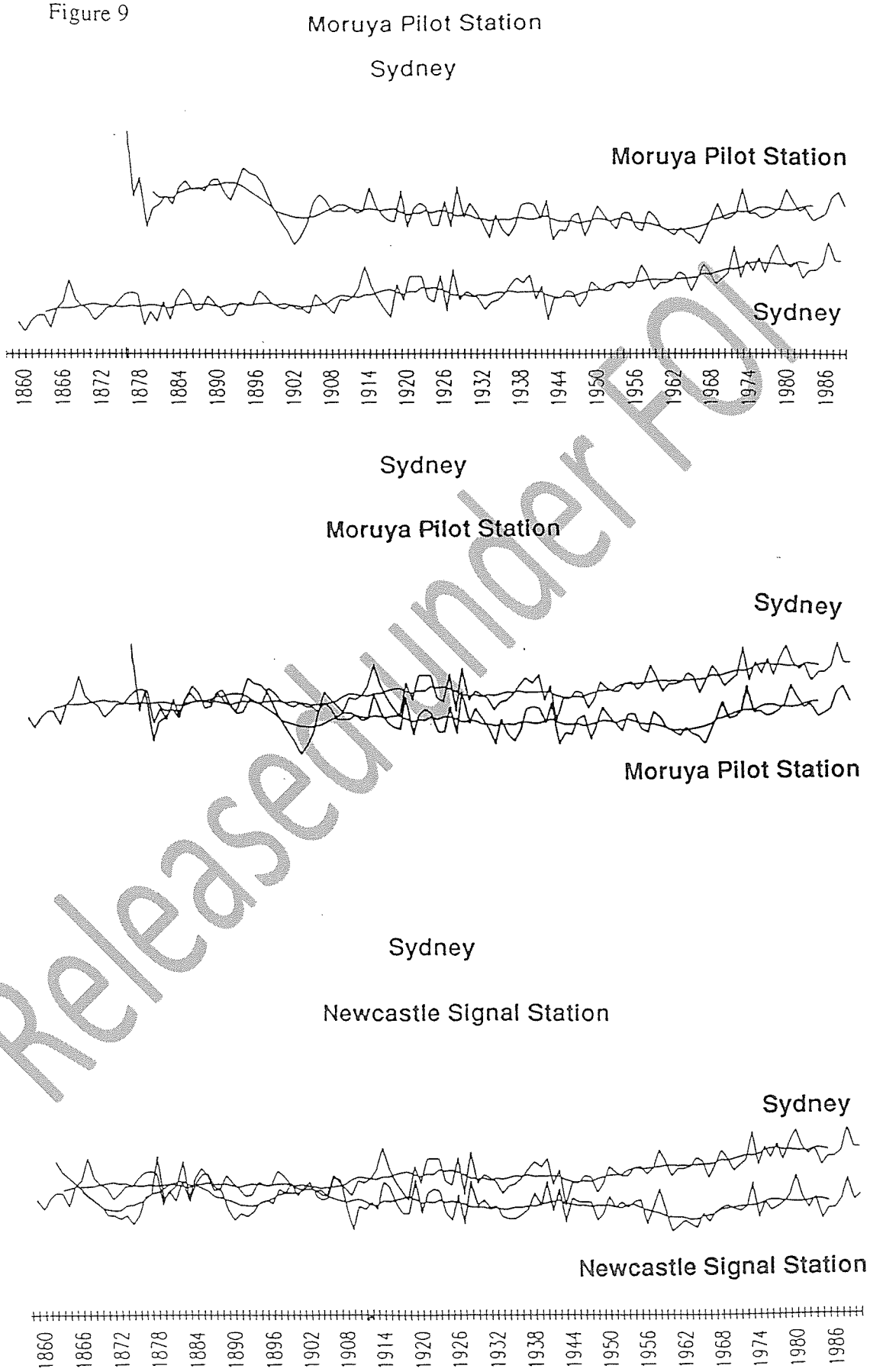
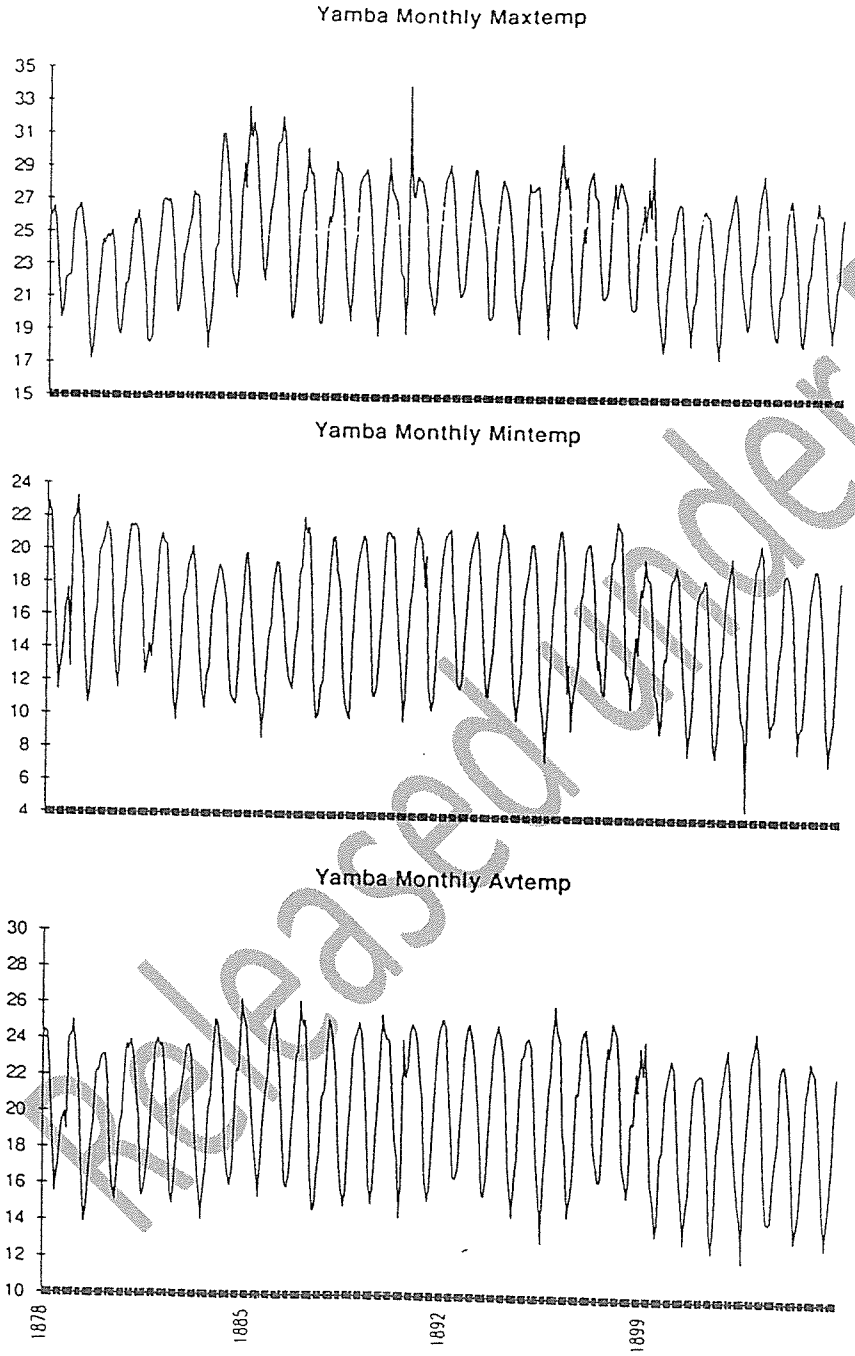
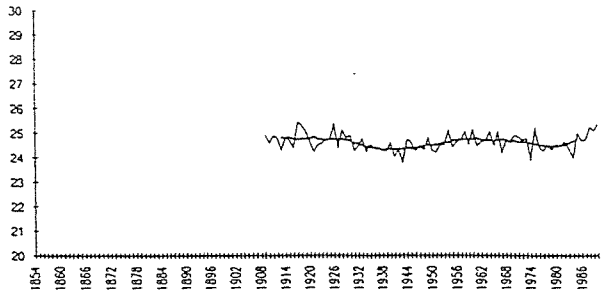


Figure 10

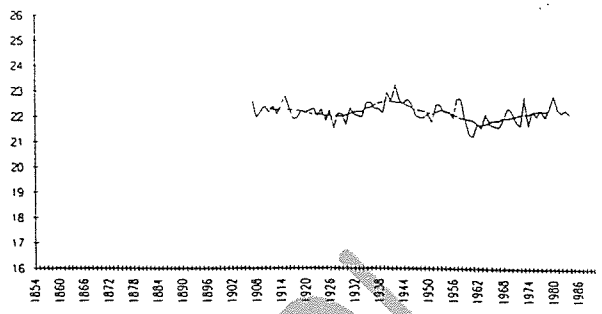


Appendix A Brisbane

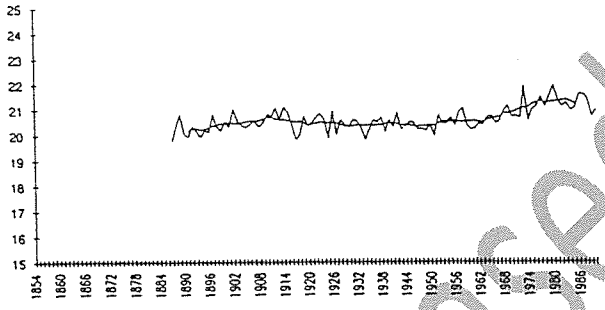
Cairns



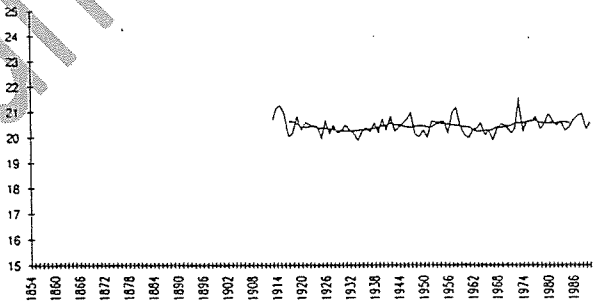
Sandy Cape Lighthouse



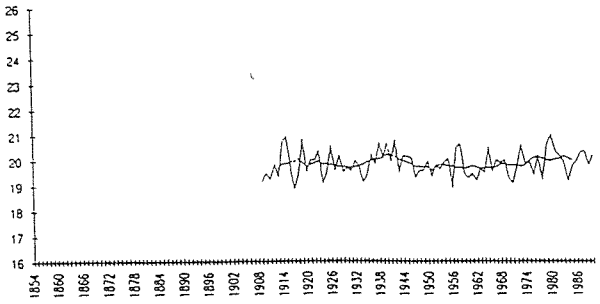
Brisbane



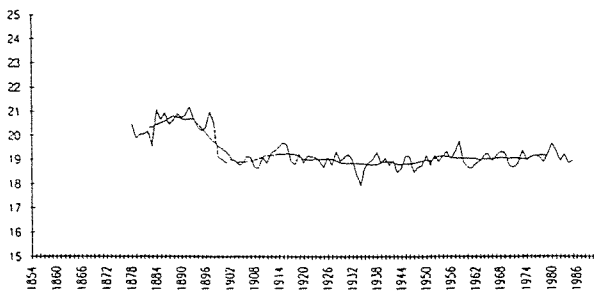
Cape Moreton Lighthouse



Goondiwindi

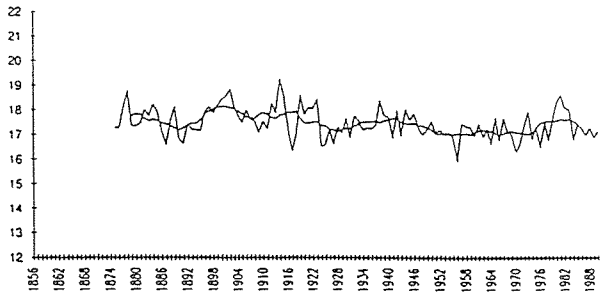


Yamba Pilot Station

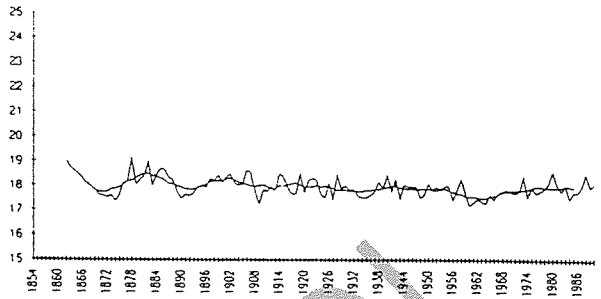


Appendix B Sydney

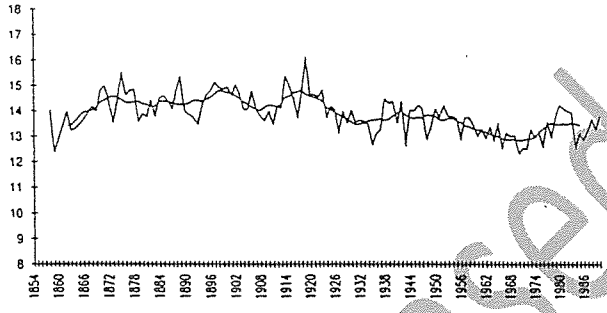
Dubbo



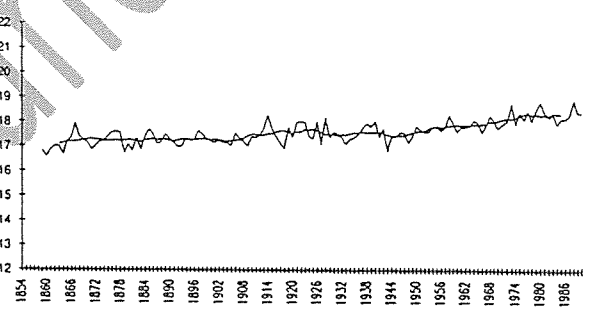
Newcastle Signal Station



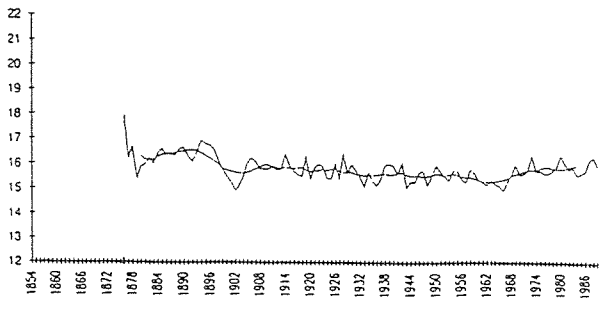
Bathurst



Sydney



Moruya Pilot Station



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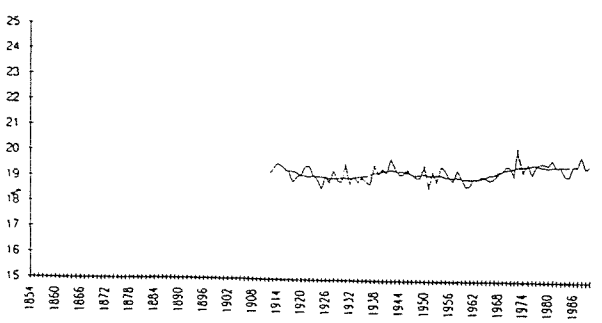
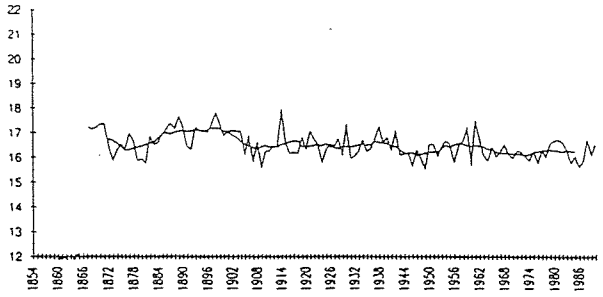
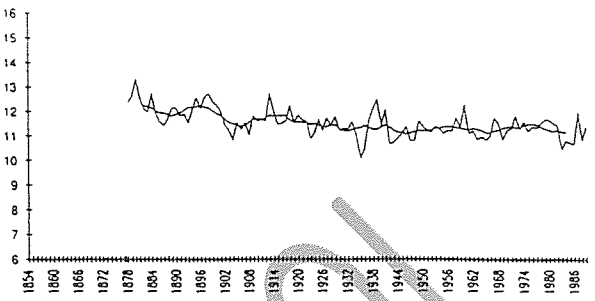


Appendix C Melbourne

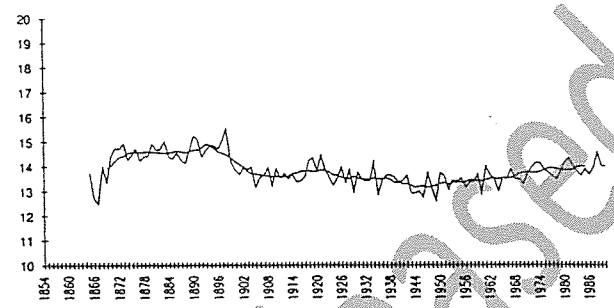
Deniliquin



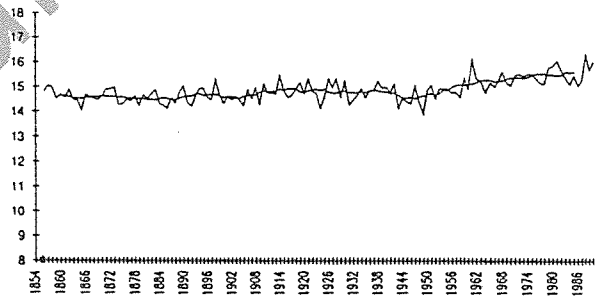
Omeo



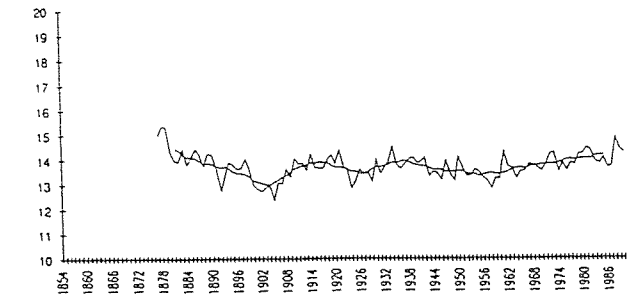
Cape Otway Lighthouse



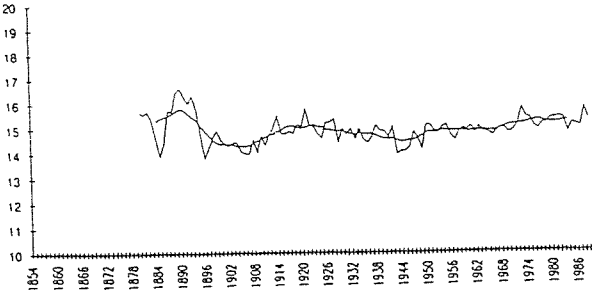
Melbourne



Wilsons' Promontory Lighthouse

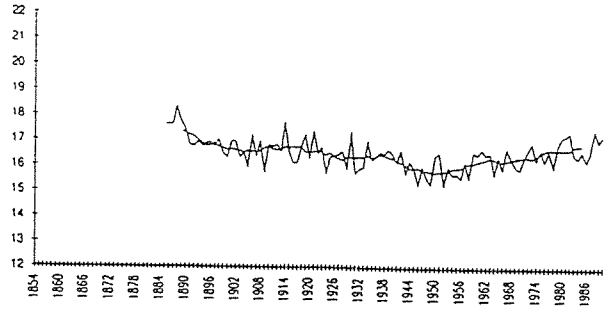


Gabo Island Lighthouse

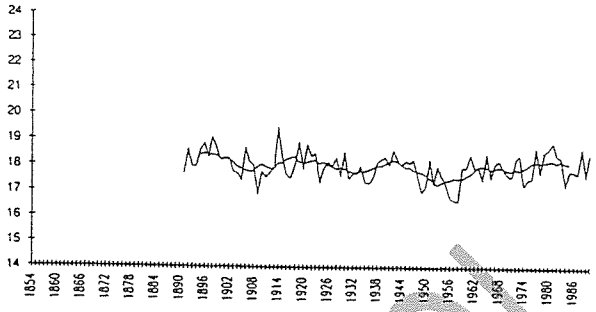


Appendix D Adelaide

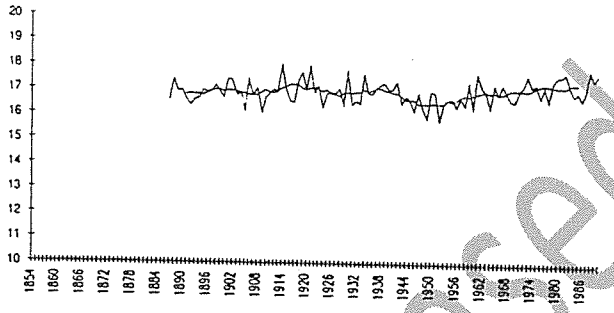
Kapunda - Roseworthy College



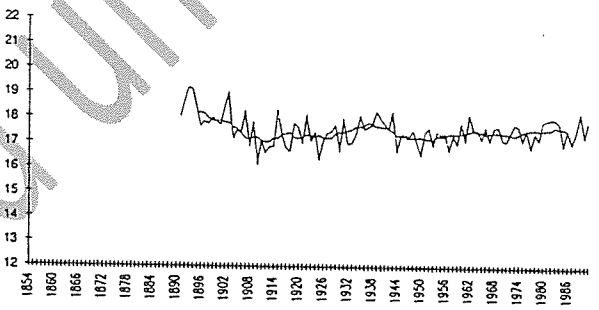
Broken Hill



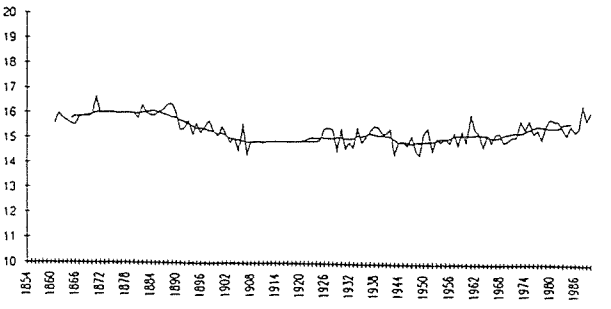
Adelaide



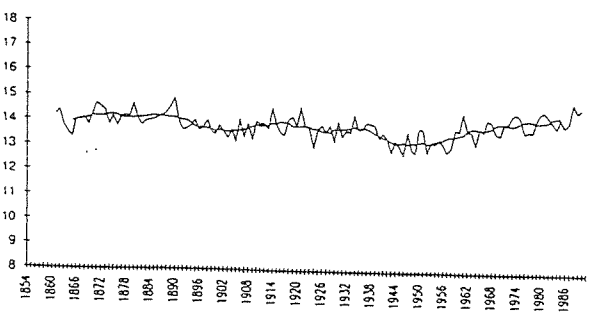
Mildura



Strathalbyn

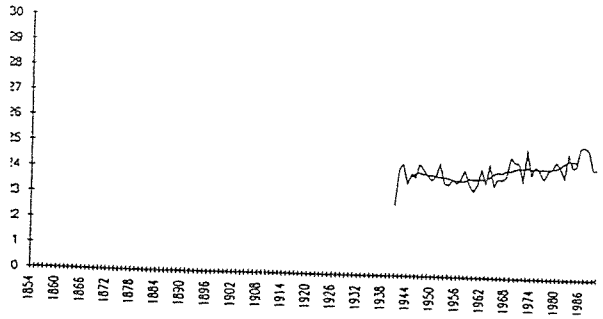


Mount Gambier

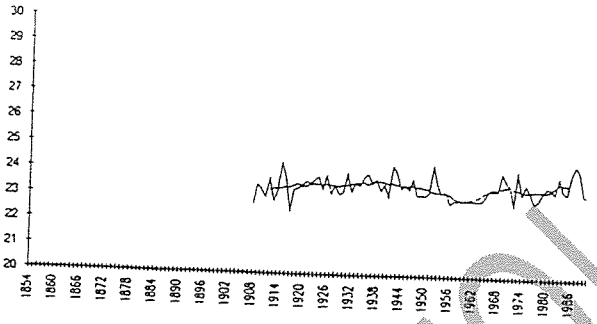


Appendix F Townsville, Longreach - Charleville

Townsville AMO



Ayr Dep't of Primary Industry



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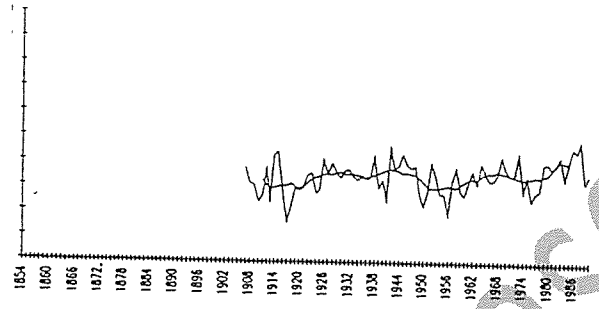
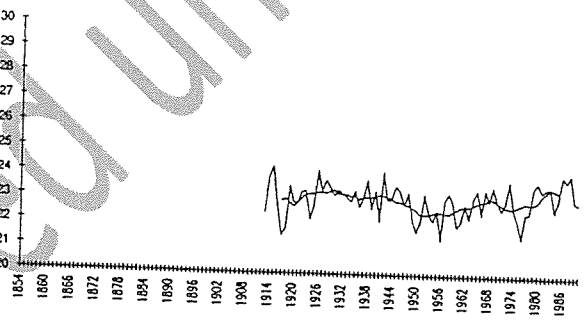
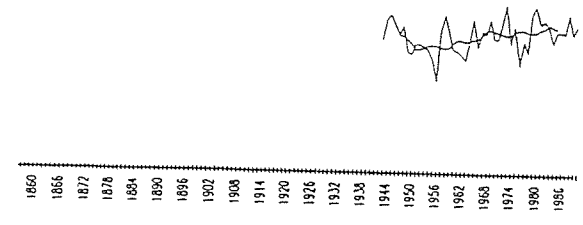


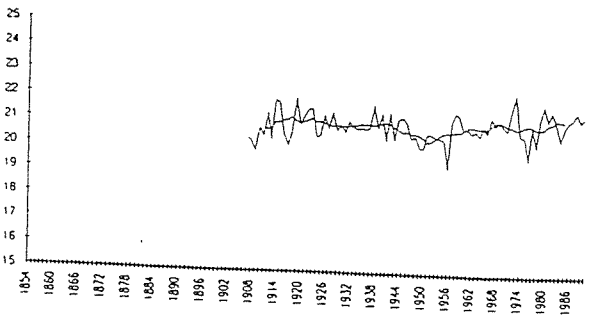
Isisford



Charleville

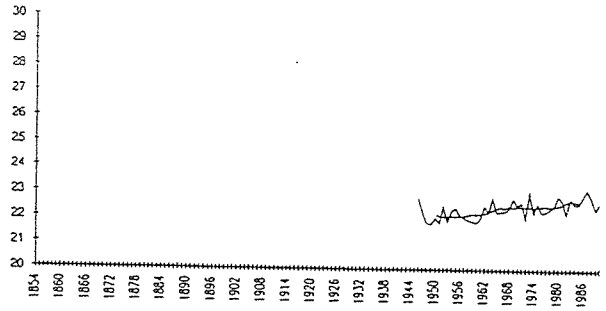


Cunnamulla

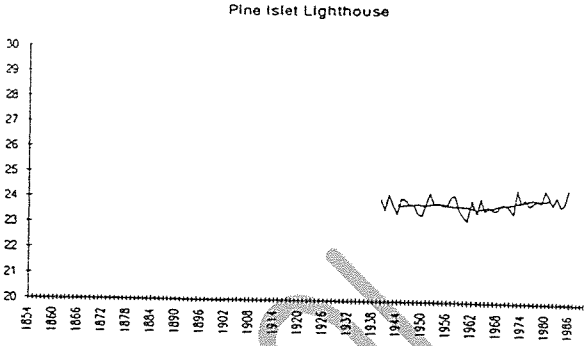


Appendix G Mackay and Rockhampton

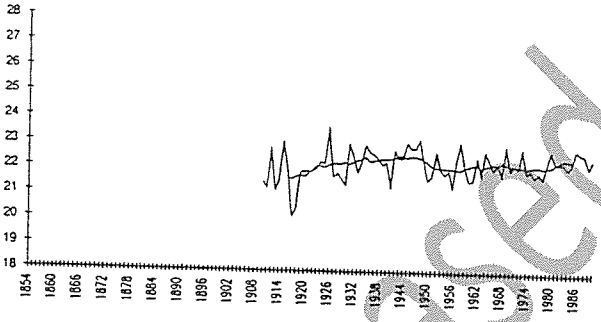
Mackay A.M.O.



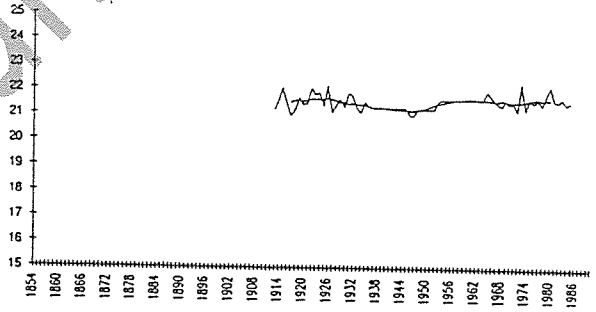
Pine Islet Lighthouse



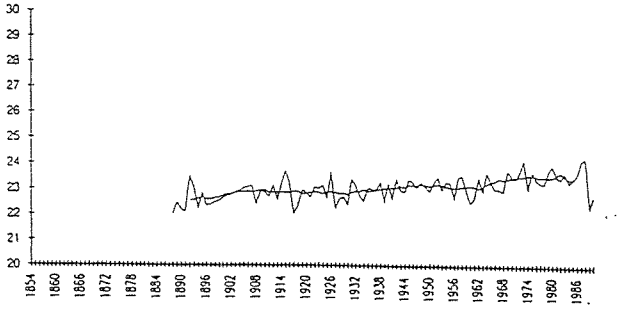
Clermont



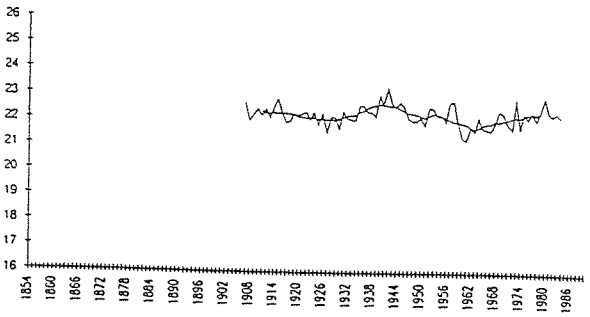
Bustard Head Lighthouse



Rockhampton

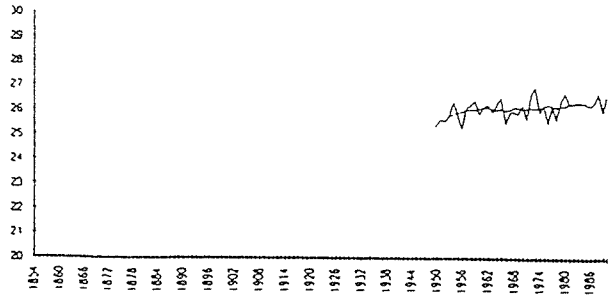


Sandy Cape Lighthouse

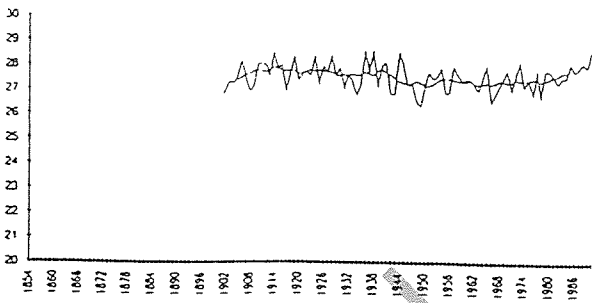


Appendix H Port Hedland, Meekathara-Kalgoorlie

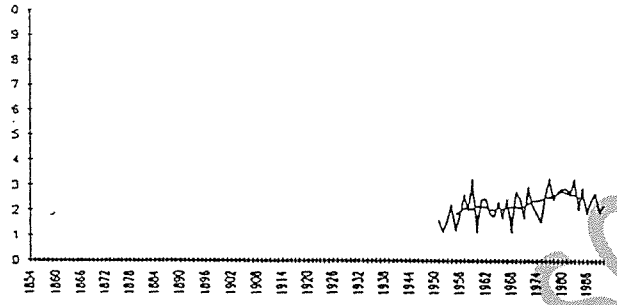
Port Hedland AMO



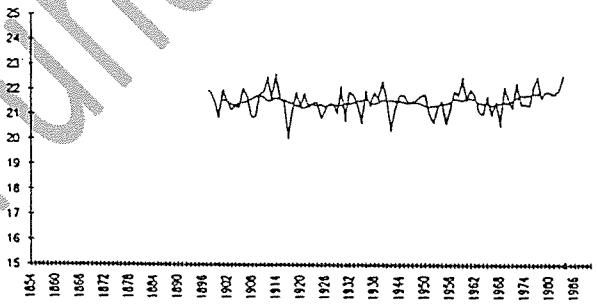
Marble Bar



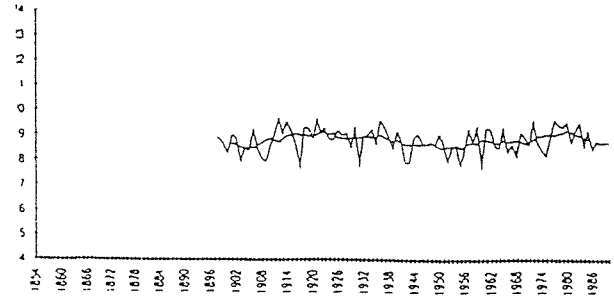
Meekathara



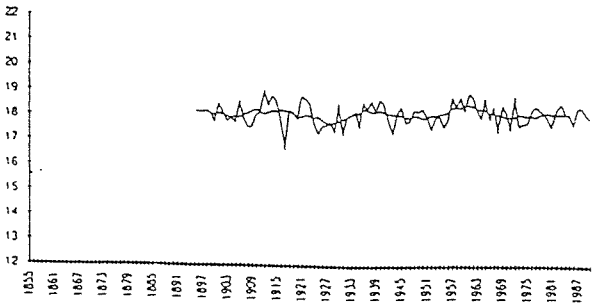
Cue



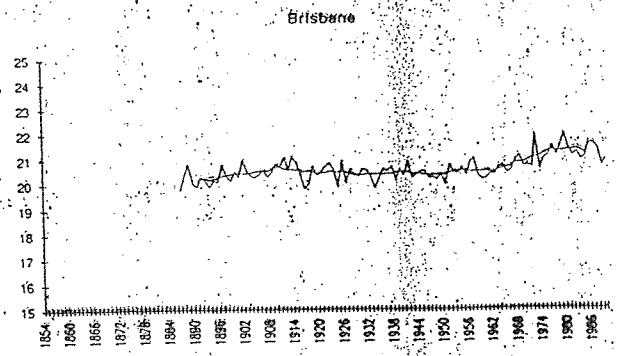
Kalgoorlie

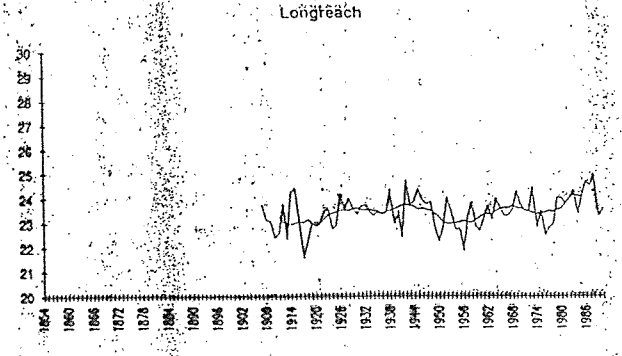


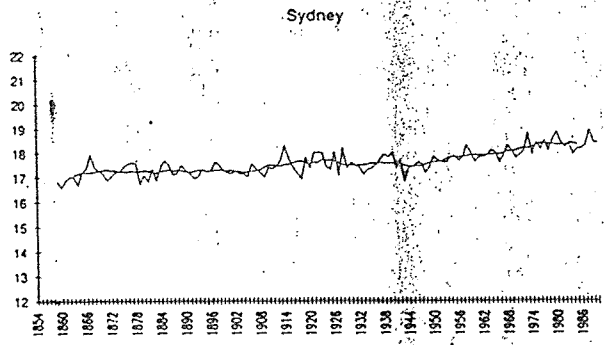
Southern Cross

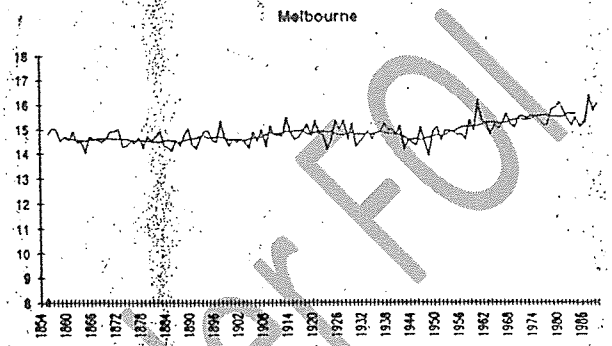


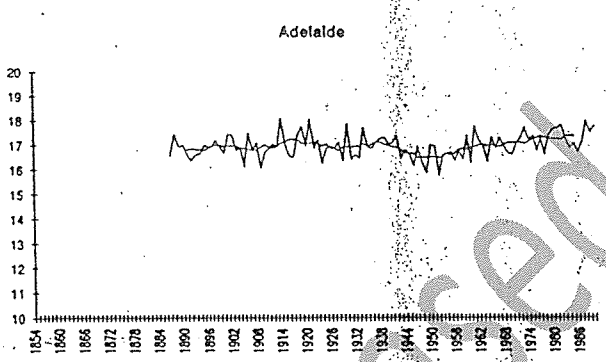
Appendix I Transparent overlay to assist comparisons

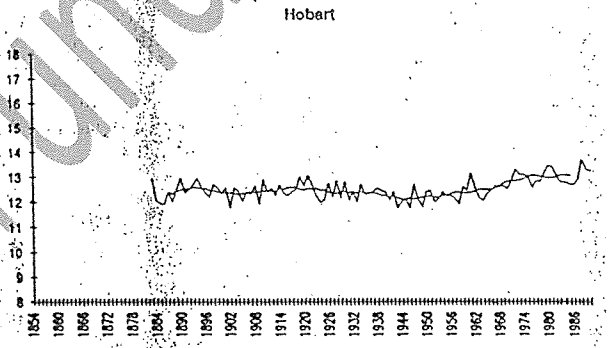


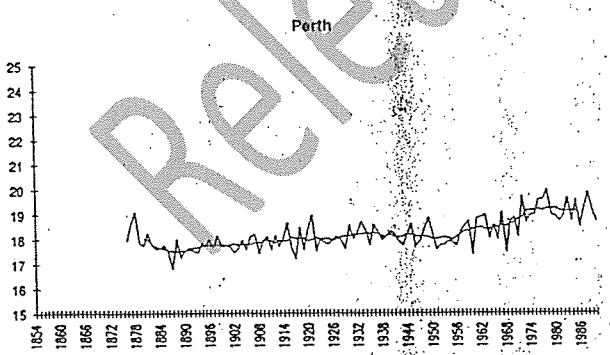


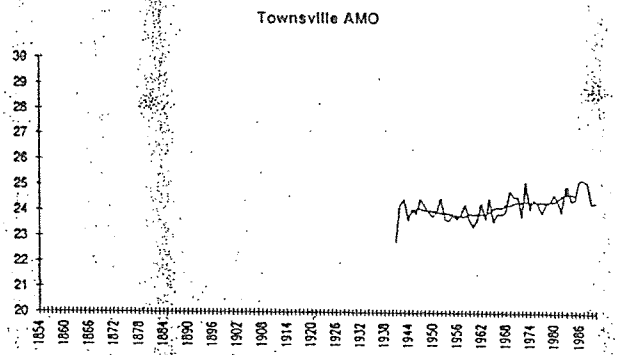


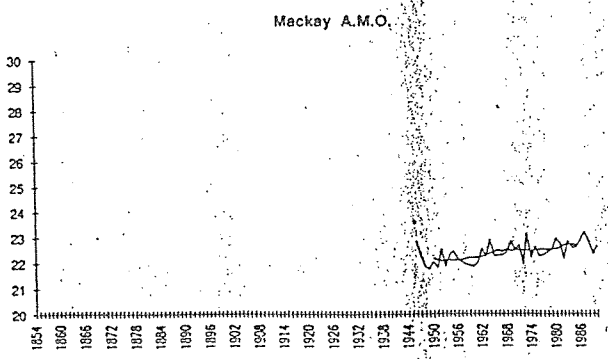


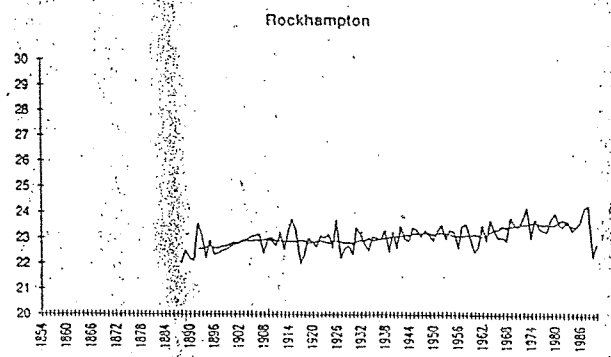












APPENDIX J

COMMENTS ON SOME CORRECTIONS USED IN JONES et al (1986a)

1. Townsville

Using the transparency to compare with Mackay and Rockhampton, etc. it is difficult not to conclude that these stations are a closely related suite. Jones et al (1986a) compares Townsville with Cairns and Willis Island. Cairns receives about twice the rainfall of Townsville, and has a sufficient contrasting climate not to have been used. Overlaying Cairns and Townsville one is struck by the contrary nature of many of the spikes, surely a hint not to compare the two stations. Perhaps a better process would have been to compare Townsville to Ayr, then reject Townsville from the survey and include Ayr.

2. Darwin

This is a long term station with an immense "area of influence", corrected by P.D. Jones et al (1986a) to be cooler prior to 1939 and warmer after and was compared to Alice Springs, Cairns and Port Moresby, all a long distance away.

Comparing Darwin to Alice Springs, there is surprising correlation considering the great distance and contrasting climate between them. Apart from the warm hump in Alice Springs during the 1960s, the graphs are in close harmony over the 110 years span.

Although Cairns has a shorter record than Darwin, agreement is fairly close and the comparison does not support the "corrections" in Darwin listed by Jones et al (1986a).

The recording station was moved from the Post Office to the airport in 1941 and the trace is spliced at this point. Daly Waters Composite conveniently extends from 1926 to 1950 unbroken and being the closest station to Darwin for that period was used by this paper to compare Darwin P.O. and Darwin A.M.O. This comparison showed that the P.O. was 0.7^0 hotter than A.M.O. in minimums. However in maximums the P.O. and A.M.O. were equivalent.

Jones et al (1986a) notes above refer to "jumps" in the Darwin record at 1939-40 and 1964-65. A close examination of the graph and spreadsheet fails to reveal those jumps.

The wave in maximum temperatures (and average temperatures) around 1941 was a concern but compared to Daly Waters and Alice Springs, the feature looked real. This wave is even seen in South Australian stations, even more reason to consider Darwin to be normal and a reliable record.

3. Adelaide

Similarly to Darwin, the trend for Adelaide is rotated about 1960 in the direction of an increased warming trend. Using the transparency the relationship of Adelaide to its surrounding more rural stations can be seen to be a close one, particularly post 1930. As commented on page 6 Adelaide seems to be the capital city station least affected by urban warming. The Jones et al (1986a) correction will put some urban heating effect back into the record by dragging the older part of the graph downwards.

The choice of stations to compare Adelaide with is Alice Springs, Walgett, Mt. Gambier and Melbourne. The first and third named did not support any alteration to Adelaide. If Jones et al (1986a) required another rural centre as a comparison, there are several closer than Walgett. Walgett is in a totally different climatic environment to Adelaide. Walgett and Adelaide are as far apart as Oslo and Amsterdam.

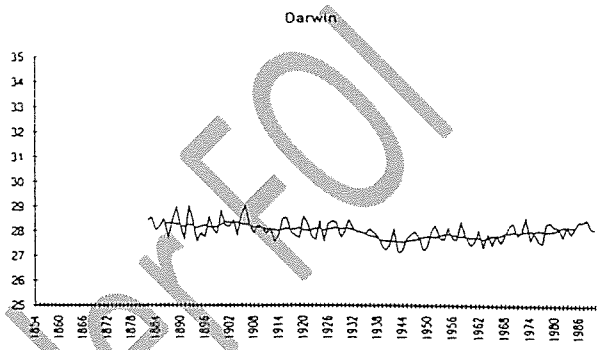
Comparing Adelaide with Melbourne, the second most severely affected station after Sydney in terms of urban heating, is perhaps where the justification comes from to "correct" Adelaide cooler before 1960.

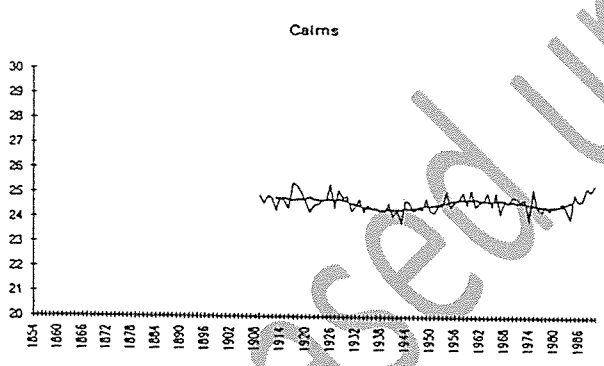
4. Sydney

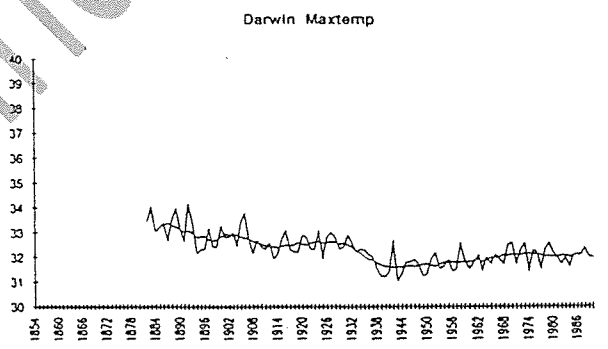
Jones et al (1986a) recognises that the Sydney record is not perfect. However there seems little point in trying to correct Sydney when there are many long term remote station records surrounding.

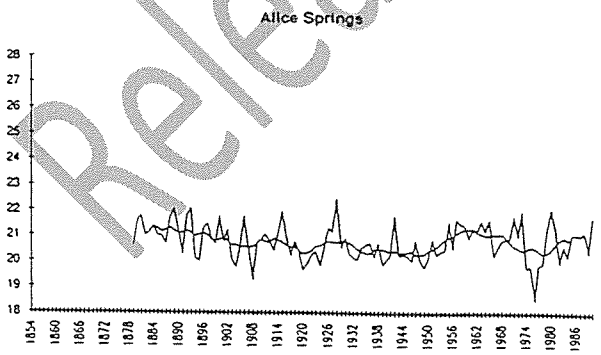
It is noted that comparisons are made to Brisbane and Dubbo. One can only repeat, as per Adelaide and Walgett, that Brisbane is a long way away with many more relevant stations in the intervening countryside. As for Dubbo, little notice could have been taken of the comparison.

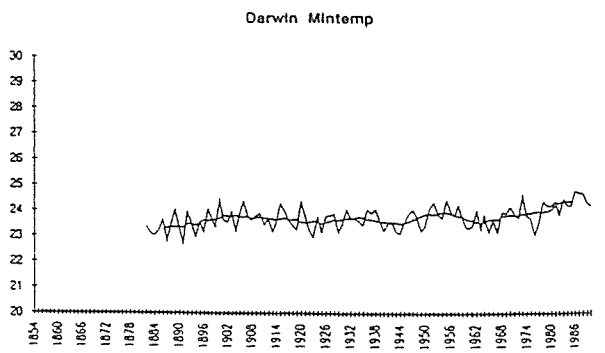
Appendix K Stations referred to in Appendix J

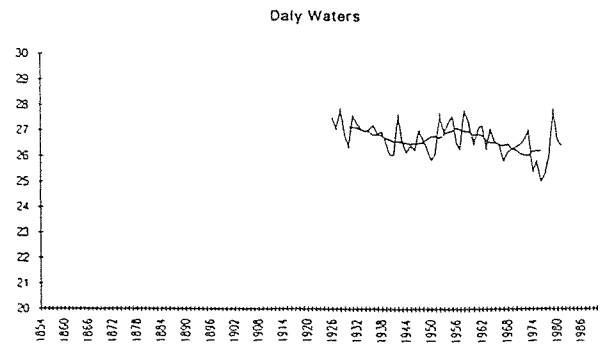












...44m. Minor site changes occured in 1954, 1956, 1957 & 1959. A109: No details available. A175: No details available. Reliability: compared with 939999 & 938940 for the years 1878-1982.

939970: RAOUL IS/KERMADEC IS NEW ZEALAND 29.3S 177.9E 49m 1937-1982 10 1940
Sources: A1, A175

Notes: A1: alt = 49m. 1/2(max + min). No other details available. A175: No details available. Reliability: compared with 918430 for the years 1940-1982.

939998: MASTERTON NEW ZEALAND 41.0S 175.7E 1906-1984 10 1907
Sources: A175

Notes: A175: No details available. Reliability: compared with 934340 & 935450 for the years 1907-1984.

939999: LINCOLN COLLEGE NEW ZEALAND 43.5S 172.7E 1864-1984 10 1864
Sources: A175

Notes: A175: No details available. Reliability: compared with 937800 & 938940 for the years 1864-1984.

940140: MADANG PAPUA NEW G. 5.2S 145.8E 12m 1951-1980 40
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 5 13'S 145 48'E, alt = 6m. 1961-1970; 5 13'S 145 47'E, alt = 4m. Reliability: compared with 940350 & 940270 for the years 1951-1980.

940270: LAE PAPUA NEW G. 6.7S 147.0E 9m 1945-1975 10 1949
Sources: A1

Notes: A1: 1945-1950; 6 43'S 147 00'E, alt = 12ft. 1/2(max + min). 1951-1970; 6 44'S 147 00'E, alt = 8m. Reliability: compared with 940350, 940440 & 940850 for the years 1949-1975, 1961-1975 & 1949-1975.

940350: PORT MORESBY AP PAPUA NEW G. 9.5S 147.2E 30m 1891-1980 10 1903
Sources: A1, A108, A109

Notes: A1: Means of 1/2(mean daily max + mean daily min). Some early figures were unreliable & so were computed from the 09h dry bulb observations, by corrections given on p62, vol 79 & on p36, vol 90. Alt; 1891-Sept 1895 = 51ft, Oct-Dec 1895 = 39ft, July 1902-1940 = 126ft, 1941-1950 = 140ft, 1951-1960 = 28m. 1961-1970; 9 26'S 147 13'E, alt = 35m. A108: Temp; 1/2(max + min). Press; 1/2(09 + 15) corrected & reduced to 32F, MSL & standard gravity. A109: No details available. Reliability: compared with 941200 for the years 1903-1980.

940850: RABAUL NEW BRITAIN I PAPUA NEW G. 4.2S 152.2E 6m 1891-1980 10 1949
Sources: A1, A9, A108

Notes: A1: Means of 1/2(max + min). Alt; 1946-1950 = 20ft, 1951-1960 = 6m, 1961-1970 = 4m. A9: No details available. A108: No details available. Reliability: compared with 940270 & 940350 for the years 1949-1975 & 1949-1980.

941200: DARWIN AIRPORT AUSTRALIA 12.5S 130.9E 29m 1870-1980 20 1882
Sources: A1

Notes: A1: Means of 1/2(max + min). 1882-1940; alt = 97ft, 1941-1950 = 88ft. Prec data for 1921-1940 are adjusted to allow for defects found in the gauge, this makes their homogeneity rather doubtful. 1951-1960; alt = 27m, 1961-1970; 12 25'S 130 52'E, alt = 31m. Reliability: compared with 943260, 942870 & 940350 for the years 1882-1980, 1907-1980 & 1903-1980. Corrected for jumps 1939/1940 & 1964/1965. Correction Factors: Stations used: 940350, 942870 & 943260. Calculation dates: 1907-1939, 1940-1964 & 1965-1980. Correction dates: 1882-1939 & 1940-1964. Factors: i) 1882-1939, -1 -3 -6 -3 -4 -7 -5 -6 -5 -6 -6 0. ii) 1940-1964, 4 3 0 6 5 0 3 4 4 2 2 5.

941750: THURSDAY ISLAND AUSTRALIA 10.6S 142.2E 61m 1951-1980 20 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 10 35'S 142 13'E, alt = 61m. 1961-1970; alt = 58m. Reliability: compared with 940140, 940270, 940350, 940440 & 940850 for the years 1951-1980, 1951-1975, 1951-1980, 1961-1980 & 1951-1980. Corrected for a jump 1958/1959. Correction Factors: Stations used: 940140, 940350 & 940850. Calculation dates: 1951-1958 & 1959-1980. Correction dates: 1951-1958. Factors: -3 -3 -7 -3 -8 -5 -9 -3 -1 -3 -4 -4.

942030: BROOME AUSTRALIA 18.0S 122.2E 9m 1890-1980 11 1951
Sources: A1, A74

Notes: A1: Means of 1/2(max + min). 1951-1960; alt = 19m, 1961-1970 = 17m, 18.0S 122.3E. A74: Temp; 1/2(max + min). Press; 1881-1885; means of 12 noon. 1886-1899; 1/2(09 + 15). Alt; 9m. Reliability: compared with 942120 & 942340 for the years 1898-1980 & 1951-1970. Earlier years considered incorrect.

942120: HALLS CREEK AUSTRALIA 18.3S 127.6E 406m 1891-1980 10 1951
Sources: A1, A74

Notes: A1: 1/2(mean max + mean min). 1951-1960; 18.3S 127.6E, alt = 406m, 1961-1970; 18.2S 127.7E, alt = 410m. A74: 1/2(max + min). No other details available. Reliablity: compared with 942030 for the years 1898-1980. Early record considered incorrect.

942140: WYNDHAM AUSTRALIA 15.4S 128.1E 7m 1889-1899 60
Sources: A74

Notes: A74: Alt; 7m. Temp; 1/2(max + min). Press; 1/2(09 + 15). Reliability: uncheckable.

942340: DALY WATERS AUSTRALIA 16.3S 133.4E 214m 1951-1970 10 1951
Sources: A1, A40

Notes: A1: 1950-1960; alt = 214m, 1961-1977; alt = 212m. 1/2(max + min). A40: No details available. Reliability: compared with 942030 & 942120 for the years 1951-1970.

942380: TENNANT CREEK M.O. AUSTRALIA 19.7S 134.2E 376m 1969-1980 60
Sources: A1, A40

Notes: A1: 1/2(max + min). No other details available. A40: No details available. Reliability: uncheckable.

942750: GEORGETOWN AUSTRALIA 18.3S 143.6E 1951-1960 60
Sources: A1

Notes: A1: 1951-1960; 1/2(max + min). 18 17'S 143 33'E, alt = 302m. Reliability: uncheckable.

942770: MT. SURPRISE AUSTRALIA 18.2S 144.3E 453m 1951-1963 60
Sources: A1

Notes: A1: 1951-1960; 1/2(max + min). 18 09'S 144 15'E, alt = 453m. Reliability: uncheckable.

942870: CAIRNS AUSTRALIA 16.9S 145.7E 5m 1882-1980 10 1907
Sources: A1

Notes: A1: 1/2(max + min). Alt; 1882-1950 = 16ft, 1951-1960 = 5m, 1961-1970 = 3m. Reliability: compared with 941200 for the years 1907-1980.

942940: TOWNSVILLE AUSTRALIA 19.3S 146.8E 4m 1951-1980 20 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 19 15'S 146 46'E, alt = 4m. 1961-1970; alt = 6m. Reliability: compared with 942870 & 942990 for the years 1961-1980 & 1951-1980. Corrected for a site change 1968/1969. Correction Factors: Stations used: 942870 & 942990. Calculation dates: 1961-1968 & 1969-1980. Correction dates: 1951-1968. Factors: 8 8 7 6 4 4 3 2 4 5 6 7.

942990: WILLIS IS. AUSTRALIA 16.3S 150.0E 8m 1951-1980 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 16 18'S 149 59'E, alt = 8m. 1961-1970; alt = 6m. Reliability: compared with 942870 & 942940 for the years 1961-1980 & 1951-1980.

943000: CARNARVON AUSTRALIA 24.9S 113.7E 4m 1883-1980 10 1951
Sources: A1, A74

Notes: A1: 1951-1960; alt = 5m, 1961-1970 = 4m. 1/2(max + min). A74: Temp; 1/2(max + min). Press; 1/2(09 + 15). Alt; 4m. Reliability: compared with 943050 for the years 1951-1975.

943020: NORTH WEST CAPE AUSTRALIA 21.8S 114.2E 1975-1980 60
Sources: A1

Notes: A1: 1/2(max + min). No other details available. Reliability: uncheckable.

943050: ONSLOW AUSTRALIA 21.7S 115.0E 4m 1886-1975 10 1938
Sources: A1, A74

Notes: A1: 1/2(max + min). Alt; 1886-1950 = 14ft, 1951-1960 = 4m, 1961-1970; 21.6S 115.1E, alt = 4m. A74: Temp; 1/2(max + min). Press; 1/2(09 + 15). No other details available. Reliability: compared with 943000 & 942030 for the years 1951-1975.

943120: PORT HEDLAND AUSTRALIA 20.4S 118.6E 11m 1951-1980 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 20 23'S 118 37'E, alt = 8m. 1961-1970; alt = 9m. Reliability: compared with 943050 for the years 1951-1975.

943160: NULLAGINE AUSTRALIA 21.9S 120.1E 386m 1951-1964 60
Sources: A1

Notes: A1: 1951-1960; 1/2(max + min). 21 54'S 120 06'E, alt = 386m. Reliability: uncheckable.

943260: ALICE SPRINGS AUSTRALIA 23.6S 133.6E 549m 1874-1980 10 1879
Sources: A1, A40

Notes: A1: 1/2(max + min). 1874-1931; alt = 1926ft. In Feb 1932 instruments moved 2 miles to an alt of 1901ft. 1951-1960; alt = 546m. 1961-1970; alt = 545m, 23.8S 133.9E. A40: No details available. Reliability: compared with 943350 & 941200 for the years 1907-1975 & 1882-1980. Record seems correct but is a long way from comparison stations.

943320: MT. ISA AUSTRALIA 20.7S 139.5E 1975-1980 60
Sources: A1

Notes: A1: 1/2(max + min). No other details available. Reliability: uncheckable.

943350: CLONCURRY AUSTRALIA 20.7S 140.5E 191m 1884-1975 10 1907
Sources: A1

Notes: A1: 1/2(max + min). Alt; 1884-1950 = 639ft, 1951-1960 = 188m, 1961-1970 = 189m. Reliability: compared with 943260 & 942870 for the years 1907-1975.

943460: LONGREACH AUSTRALIA 23.5S 144.2E 187m 1951-1980 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1965; 23 26´S 144 15´E, alt= 187m. 1966-1970; 23 26´S 144 16´E, alt = 191m. Reliability: compared with 943350 & 945100 for the years 1951-1975 & 1951-1980.

943670: MACKAY AUSTRALIA 21.1S 149.0E 4m 1951-1980 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 21 07´S 149 10´E, alt = 31m. 1961-1970; 21 07´S 149 13´E, alt = 31m. Reliability: compared with 942990 & 943740 for the years 1951-1980 & 1951-1971.

943740: ROCKHAMPTON AUSTRALIA 23.4S 150.5E 14m 1951-1971 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1970; 23 23´S 150 29´E, alt = 10m. Reliability: compared with 942990 for the years 1951-1971.

943800: GLADSTONE AUSTRALIA 23.9S 151.3E 76m 1951-1980 20 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 23 51´S 151 16´E, alt = 75m. 1961-1970; 23 50´S 151 17´E, alt = 75m. Reliability: compared with 942990 & 943670 for the years 1951-1980. Corrected for a site change 1957/1958. Correction Factors: Stations used: 942990 & 943670. Calculation dates: 1951-1957 & 1958-1980. Correction dates: 1951-1957. Factors: 5 6 5 6 9 9 6 11 8 7 3 2.

943870: BUNDABERG AUSTRALIA 24.9S 152.4E 1961-1970 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 24 52´S 152 21´E, alt = 14m. Reliability: uncheckable.

944000: HAMELIN POOL AUSTRALIA 26.3S 114.2E 5m 1897-1899 60
Sources: A74

Notes: A74: Alt; 5m. Temp; 1/2(max + min). Press; 1/2(09 + 15). Reliability: uncheckable.

944030: GERALDTON AUSTRALIA 28.8S 114.7E 37m 1877-1980 60
Sources: A1, A74

Notes: A1: 1/2(max + min). 1961-1970; 28 48´S 114 42´E, alt = 37m. A74: Temp; 1/2(max + min). Press; 1/2(09 + 15). No other details available. Reliability: uncheckable.

944300: MEEKATHARRA AUSTRALIA 26.6S 118.5E 518m 1951-1980 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 26 36´S 118 29´E, alt = 511m. 1961-1970; 26 35´S 118 30´E, alt = 522m. Reliability: compared with 943120 for the years 1951-1980.

944570: WARBURTON RANGE AUSTRALIA 26.1S 126.6E 366m 1951-1964 60
Sources: A1

Notes: A1: 1951-1960; 1/2(max + min). 26 05´S 126 36´E, alt = 366m. Reliability: uncheckable.

944610: GILES AUSTRALIA 25.0S 128.2E 599m 1956-1980 10 1956
Sources: A1

Notes: A1: 1/2(max + min). 1956-1960; 25 02´S 128 18´E, alt = 514m. 1961-1970, alt = 588m. Reliability: compared with 944760 & 943260 for the years 1956-1980.

944760: OODNADATTA AUSTRALIA 27.6S 135.5E 113m 1951-1980 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 27 33´S 135 27´E, alt = 116m. 1961-1970; 27 33´S 135 28´S, alt = 118m. Reliability: compared with 944610 & 943260 for the years 1956-1980 & 1951-1980.

944800: MARREE AUSTRALIA 29.7S 138.1E 49m 1951-1963 60
Sources: A1

Notes: A1: 1951-1960; 1/2(max + min). 29 39´S 138 04´E, alt = 49m. Reliability uncheckable.

945100: CHARLEVILLE AUSTRALIA 26.4S 146.3E 304m 1951-1980 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 26 25´S 146 17´E, alt = 299m. 1961-1970, alt = 306m. Reliability: compared with 943350 & 943460 for the years 1951-1975 & 1951-1980.

945270: MOREE AUSTRALIA 29.5S 149.9E 212m 1964-1980 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 29 28´S 149 51´E, alt = 212m. Reliability uncheckable.

945420: DALBY AUSTRALIA 27.2S 151.3E 345m 1951-1964 60
Sources: A1

Notes: A1: 1951-1960; 1/2(max + min). 27 11´S 151 16´E, alt = 345m. Reliability: uncheckable.

945680: AMBERLEY AUSTRALIA 27.6S 152.7E 26m 1951-1970 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 27 38´S 152 43´E, alt = 26m. 1961-1970; alt = 25m. Reliability: compared with 945780, 945760 & 949950 for the years 1951-1970.

945760: BRISBANE APT AUSTRALIA 27.5S 153.0E 41m 1951-1970 80
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 27 28´S 153 02´E, alt = 41m. 1961-1970; alt = 38m. Reliability: compared with 945780 & 945680 for the years 1951-1970.

945780: BRISBANE APT AUSTRALIA 27.5S 153.0E 0m 1860-1980 10 1887
Sources: A1, A40

Notes: A1: 1/2(daily max + daily min). Alt; 1887-July 1911 = 137ft, Aug 1911-July 1918 = 38ft, Aug 1918-1930 = 125ft, 1931-1950 = 134ft, 1951-1960 = 41m. Eagle Farm; 1951-1960, 27.5S 153.1E, alt = 4m. A40: No details available. Reliability: compared with 947670 & 949950 for the years 1887-1980 & 1915-1980.

945910: COOLANGATTA AUSTRALIA 28.2S 153.5E 1962-1970 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 28 10´S 153 30´E, alt = 6m. Reliability: uncheckable.

946010: CAPE LEEUWIN AUSTRALIA 34.2S 115.3E 1897-1899 60
Sources: A74

Notes: A74: Temp; 1/2(max + min). Press; 1/2(09 + 15). Reliability: uncheckable.

946080: PERTH AUSTRALIA 32.0S 115.8E 60m 1852-1970 80
Sources: A1, A40, A74

Notes: A1: 1/2(max + min). 1876-1950; alt = 210ft, 1951-1960 = 60m. 1961-1970; 31 57´S 115 30´E, alt = 19m. A40: No details available. A74: Temp; 1/2(max + min). Press; 1/2(09 + 15). No other details available. Reliability: compared with 946100 for the years 1951-1970.

946100: PERTH AUSTRALIA 32.0S 115.7E 60m 1852-1980 11 1876
Sources: A1, A40, A74

Notes: A1: 1/2(max + min). 1951-1960; 31.9S 116.0E, alt = 18m, 1961-1970; 31 55´S 115 58´E, alt = 20m. A40: No details available. A74: Temp; 1/2(max + min). Press; 1/2(09 + 15). No other details available. Reliability: compared with 946370 & 943260 for the years 1941-1980 & 1879-1980.

946290: KATANNING AUSTRALIA 33.7S 117.6E 310m 1885-1964 11 1951
Sources: A1, A74

Notes: A1: 1/2(max + min). Alt; 310m. A74: Temp; 1/2(max + min). Press; 1/2(09 + 15). Reliability: compared with 946370 for the years 1951-1964. Early years considered incorrect.

946340: SOUTHERN CROSS AUSTRALIA 31.3S 119.3E 1895-1899 60
Sources: A74

Notes: A74: Temp; 1/2(max + min). Press; 1/2(09 + 15). Reliability: uncheckable.

946370: KALGOORLIE AUSTRALIA 30.8S 121.5E 361m 1941-1980 10 1941
Sources: A1

Notes: A1: 1941-1950; 1/2(max + min). 30 45´S 121 30´E, alt = 1247ft. 1951-1960; 30 46´S 121 27´E, alt = 361m. 1961-1970; 30 47´S 121 27´E, alt = 360m. Reliability: compared with 946100 for the years 1941-1980.

946380: ESPERANCE M. O. AUSTRALIA 33.8S 121.9E 25m 1883-1980 60
Sources: A1, A74

Notes: A1: 1/2(max + min). Alt; 25m. A74: Temp; 1/2(max + min). Press; 1/2(09 + 15). Reliability: uncheckable.

946460: FORREST AUSTRALIA 30.9S 128.1E 157m 1951-1980 20 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 30 51´S 128 06´E, alt = 160m. 1961-1970; 30 50´S 128 06´E, alt = 156m. Reliability: compared with 946530 & 946590 for the years 1951-1980. Corrected for a site change 1968. Correction Factors: Stations used: 946530 & 946590. Calculation dates: 1951-1968 & 1969-1980. Correction dates: 1951-1968. Factors: 6 4 9 4 4 2 1 5 6 6 8 7.

946500: MARALINGA AUSTRALIA 30.2S 131.6E 1961-1967 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 30 09´S 131 35´E, alt = 294m. Since 1970 WMO number has been allocated to Yalata. Reliability: uncheckable.

946530: CEDUNA AUSTRALIA 32.1S 133.7E 17m 1951-1980 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-Feb 1969; 32 08´S 133 42´E, alt = 19m. Mar 1969-1970; alt = 24m. Reliability: compared with 946590 for the years 1951-1980.

946590: WOOMERA AUSTRALIA 31.2S 136.8E 169m 1951-1980 10 1951
Sources: A1

Notes: A1: 1951-1960; 31 09´S 136 48´E, alt = 169m. 1961-1970; 31 09´S 136 49´E, alt = 165m. Reliability: compared with 946530 for the years 1951-1980.

946720: ADELAIDE AUSTRALIA 35.0S 138.5E 43m 1839-1980 20 1857
Sources: A1, A40

Notes: A1: 1/2(daily max + daily min). 1839-1950; alt = 140ft, 1951-1960 = 43m, 1963-1977 = 11m. Prec site moved in 1879, average annual difference between 2 sites was 0.26 inches, so 2 records can be considered uniform. In the early years observations were made at a private house in Adelaide & N.Adelaide, also in Government House grounds. Observatory opened in May 1860. A40: No details available. Reliability: compared with 943260, 947150, 948210 & 948680 for the years 1879-1980, 1879-1945, 1951-1980 & 1951-1970. 1961 on too cold & corrected, may be a site change or observation time change. Correction Factors: Stations used: 948210 & 948680. Calculation dates: 1951-1960 & 1961-1970. Correction dates: 1857-1960. Factors: -14 -9 -17 -11 -9 -6 -4 -8 -5 -7 -9 -8.

946740: LEIGH CREEK AUSTRALIA 30.5S 138.4E 1961-1970 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 30 28´S 138 25´E, alt = 200m. Reliability: uncheckable.

946750: ADELAIDE AUSTRALIA 34.9S 138.6E 1961-1970 60
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 34 56´S 138 35´E, alt = 43m. 1961-1970; At some stage station moved from W. Terrace to Regional Office. This latter site moved in 1977, no details given. Reliability: uncheckable.

946890: BROKEN HILL AUSTRALIA 32.0S 141.5E 1961-1970 10 1961
Sources: A1

Notes: A1: 1/2(max + min). No other details available. Reliability: compared with 946720 for the years 1961-1970.

946900: BROKEN HILL AUSTRALIA 32.0S 141.5E 2m 1951-1964 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 31 58´S 141 27´E, alt = 286m. 1961-1970; alt = 304m. Reliability: compared with 946720 for the years 1951-1964.

946930: MILDURA AUSTRALIA 34.2S 142.1E 51m 1961-1980 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 34 14´S 142 05´E, alt = 51m. Reliability: uncheckable.

947030: BOURKE AUSTRALIA 30.1S 145.9E 110m 1951-1964 60
Sources: A1, A40

Notes: A1: Alt; 110m. 1/2(max + min). A40: Alt; 107m. No other details available. Reliability: uncheckable.

947110: COBAR AUSTRALIA 31.5S 145.8E 221m 1962-1980 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 31 32´S 145 49´E, alt = 221m. Reliability: uncheckable.

947150: WALGETT AUSTRALIA 30.0S 148.2E 1879-1945 10 1879
Sources: A49

Notes: A49: No details available. Reliability: compared with 946720 for the years 1879-1945.

947190: DUBBO AUSTRALIA 32.3S 148.6E 265m 1875-1964 11 1875
Sources: A1, A40, A49

Notes: A1: Alt; 265m. 1/2(max + min). A40: No details available. A49: No details available. Reliability: compared with 949950 & 945780 for the years 1912-1964 & 1887-1964.

947500: NOWRA AUSTRALIA 35.0S 150.5E 1961-1970 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 34 57´S 150 32´E, alt = 108m. Reliability: uncheckable.

947530: RICHMOND AUSTRALIA 33.6S 150.8E 1961-1970 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 33 36´S 150 47´E, alt = 19m. Reliability: uncheckable.

947620: TAMWORTH AUSTRALIA 31.1S 150.9E 1961-1970 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 31 05´S 150 51´E, alt = 404m. Reliability: uncheckable.

947670: SYDNEY AUSTRALIA 34.0S 151.1E 92m 1859-1980 20 1859
Sources: A1, A40

Notes: A1: 1/2(daily max + daily min). Prec; 1840-1855; site was 5 miles from city & from 1856-1859 was at Petersham before moving to temperature site at the Observatory. Alt; 1859-1917 = 146ft, April 1917-June 1922 = 133ft, July 1922-1950 = 138ft, 1951-1960 = 42m, 1961-1970 = 92m. Station moved in Sept 1963, no details given. A40: No details available. Reliability:

[illegible], 949950 & 949960 for the years 1887-1980, 1875-1964, 1912-1980 & 1915-1980. Corrected for a site change 1912. Correction Factors: Stations used: 945780 & 947190. Calculation dates: 1887-1912 & 1913-1945. Correction dates: 1859-1912. Factors: 3 6 3 4 6 5 6 7 4 8 1 1.

947760: WILLIAMTOWN AUSTRALIA 32.8S 151.8E 9m 1951-1980 60
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 32 49'S 151 50'E, alt = 4m. 1961-1970; alt = 9m. Reliability: uncheckable.

947910: COFFS HARBOUR AUSTRALIA 30.3S 153.1E 5m 1961-1980 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 30 19'S 153 07'E, alt = 5m. Reliability: uncheckable.

948020: ALBANY AUSTRALIA 35.0S 117.8E 71m 1877-1980 60
Sources: A1, A74

Notes: A1: 1/2(max + min). 1951-1960; alt = 69m, 1961-1970 = 71m. A74: Temp; 1/2(max + min). Press; 1/2(09 + 15). No other details available. Reliability: uncheckable.

948210: MT. GAMBIER M.O. AUSTRALIA 37.8S 140.8E 69m 1951-1980 10 1951
Sources: A1, A40

Notes: A1: 1/2(max + min). Alt; 1951-1960 = 69m, 1961-1970 = 65m. A40: No details available. Reliability: compared with 948680 for the years 1951-1970.

948650: LAVERTON AIRPORT AUSTRALIA 37.9S 144.8E 14m 1951-1980 60
Sources: A1

Notes: A1: 1951-1960; 37 52'S 144 46'E, alt = 14m. 1961-1970; 37 53'S 144 45'E, alt = 14m. Reliability: uncheckable.

948680: MELBOURNE AUSTRALIA 37.8S 145.0E 44m 1941-1970 10 1951
Sources: A1, A40

Notes: A1: 1/2(max + min). Alt; 1941-1950 = 114ft, 1951-1960 = 44m, 1961-1970 = 35m. Station moved in Sept 1962 & Sept 1966, both within 500m of the original site. A40: No details available. Reliability: compared with 948210 for the years 1951-1970.

948690: DENILIQUIN AUSTRALIA 35.5S 145.0E 95m 1863-1964 10 1941
Sources: A1, A49

Notes: A1: 1/2(max + min). Alt; 1941-1950 = 311ft, 1951-1960 = 95m. A49: No details available. Reliability: compared with 948680 for the years 1941-1964.

949070: EAST SALE AUSTRALIA 38.1S 147.1E 5m 1961-1980 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 38 06'S 147 08'E, alt = 5m. Reliability: uncheckable.

949100: WAGGA AUSTRALIA 35.2S 147.5E 221m 1961-1980 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 35 10'S 147 28'E, alt = 221m. Reliability: uncheckable.

949260: CANBERRA AUSTRALIA 35.3S 149.2E 577m 1951-1980 80
Sources: A1

Notes: A1: 1/2(max + min). 1951-1960; 35 18'S 149 12'E, alt = 560m. 1961-1970; alt = 576m. Reliability: compared with 947670 for the years 1951-1980.

949680: LAUNCESTON AP AUSTRALIA 41.6S 147.2E 177m 1951-1976 10 1951
Sources: A1

Notes: A1: 1951-1960; 1/2(max + min). 41 33'S 147 13'E, alt = 174m. 1961-1970; alt = 171m. Reliability: compared with 949750 for the years 1951-1976.

949700: HOBART, TASMANIA AUSTRALIA 42.9S 147.3E 54m 1951-1970 10 1951
Sources: A1

Notes: A1: 1/2(max + min). 1951-June 1966; 42 53'S 147 20'E, alt = 54m. July 1966-1970; alt = 55m. Reliability: compared with 949680 for the years 1951-1970.

949750: HOBART, TASMANIA AUSTRALIA 43.0S 147.2E 54m 1841-1980 11 1884
Sources: A1, A40

Notes: A1: 1/2(daily max + daily min) 150E meridian time. Alt; 1931-1940 = 197ft, 1941-1950 = 177ft. 1951-1977; airport, 42 50'S 147 32'E, alt = 4m. A40: No details available. Reliability: compared with 947670 for the years 1859-1980. Earlier years are too warm.

949800: PATS RIVER AUSTRALIA 40.1S 148.0E 1962-1970 60
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 40 06'S 148 01'E, alt = 10m. Reliability: uncheckable.

949950: LORD HOWE ISLAND AUSTRALIA 31.5S 159.1E 46m 1886-1980 10 1912
Sources: A1, A108, A109

Notes: A1: 1/2(max + min). Alt; 1886-1950 = 35ft, 1951-1960 = 11m, 1961-1970 = 5m, 1971-1977 = 46m. A108: No details available. A109: No details available. Reliability: compared with 947190 & 945780 for the years

949960: NORFOLK ISLAND AUSTRALIA 29.1S 167.9E 109m 1890-1980 20 1915
Sources: A1, A108, A109

Notes: A1: 1/2(max + min). 1891-1950; 29 03´S 167 56´E. 1951-1960; alt = 110m. 1961-1970; 29 04´S 167 58´E, alt = 113m. A108: 29.1S 168.0E. No other details available. A109: No details available. Reliability: compared with 949950 for the years 1915-1980. Corrected for site changes Feb 1939 & July 1948. Correction Factors: Stations used: 949950. Calculation dates: 1915-1938 & 1940-1947. Correction dates: 1915-1938 (Feb 1939) & 1940-1947 (July 1948). Factors: i) 1915-1938, -10 -8 -6 -11 -6 -4 -6 -5 -5 -6 -4 -8. ii) 1940-1947, 9 7 3 2 2 8 5 4 4 3 9 6.

949970: HEARD ISLAND AUSTRALIA 53.1S 72.5E 1948-1954 60
Sources: A1

Notes: A1: 1948-1950; 1/2(max + min). 53 06´S 72 31´E, alt = 15ft. 1951-1954; alt = 5m. Reliability: uncheckable.

949980: MACQUARIE ISLAND AUSTRALIA 54.5S 159.0E 6m 1948-1980 10 1948
Sources: A1

Notes: A1: 1/2(max + min). 1951-1970; 54 30´S 158 57´E, alt = 6m. Reliability: compared with 939440 for the years 1948-1980.

957357: BATHURST AUSTRALIA 33.4S 149.6E 672m 1858-1945 80
Sources: A49

Notes: A49: Alt; 672m. No other details available. Reliability: compared with 947670 for the years 1858-1945.

962210: PALEMBANG INDONESIA 2.9S 104.7E 10m 1961-1980 12 1961
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 2 54´S 104 42´E, alt = 10m. Reliability: compared with 962370 for the years 1961-1980.

962530: BENGKULU INDONESIA 3.5S 102.3E 14m 1961-1980 62
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 3 32´S 102 20´E, alt = 14m. Reliability: uncheckable.

962730: MENGGALA ASTRAKSETRA INDONESIA 4.5S 105.2E 14m 1961-1980 62
Sources: A1

Notes: A1: 1961-1970; 4 27´S 105 11´E, alt = 14m. 1/2(max + min). Reliability: uncheckable.

Notes: A1: 1961-1970; 1/2(max + min). 5 16´S 105 11´E, alt = 88m. Reliability: uncheckable.

966850: BANDJARMASIN/ULIN INDONESIA 3.5S 114.8E 20m 1954-1980 62
Sources: A1

Notes: A1: 1/2(max + min). 1954-1970; 3 27´S 114 45´E, alt = 20m. Reliability: uncheckable.

967370: SERANG INDONESIA 6.1S 106.1E 40m 1961-1980 62
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 6 07´S 106 08´E, alt = 40m. Reliability: uncheckable.

967390: CURUG INDONESIA 6.2S 106.7E 46m 1961-1980 62
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 6 14´S 106 39´E, alt = 46m. Reliability: uncheckable.

967430: JAKARTA(KEMAYORAN) INDONESIA 6.2S 106.9E 3m 1961-1980 82
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 6 09´S 106 51´E, alt = 3m. Reliability: compared with 967450 for the years 1961-1980. Record shows a jump 1968/1969 followed by a data gap, 1971-1975.

967450: DJAKARTA OBS. INDONESIA 6.2S 106.8E 8m 1864-1980 10 1866
Sources: A1

Notes: A1: 1866-1950; means of 24 hours. Alt; 1864-1920 = 7m, 1921-1960 = 8m. 1951-1960; 1/2(max + min). 1961-1970; alt = 6m, 06 11´S 106 50´E. Reliability: compared with 961630, 965810 & 967810 for the years 1866-1980, 1912-1980 & 1912-1980. Oct 1961 value is too low.

967470: JAKARTA (HALIM P.K.) INDONESIA 6.3S 106.8E 24m 1961-1980 82
Sources: A1

Notes: A1: 1961-1970; 1/2(max + min). 6 15´S 106 50´E, alt = 24m. Reliability: compared with 967450 for the years 1961-1980. Record shows a jump 1971-1975 associated with a data gap.

967810: BANDUNG INDONESIA 6.9S 107.6E 740m 1912-1980 12 1912
Sources: A1, A155

Notes: A155: 6 55´S 107 36´E. Alt; 1912-1943 = 730m, 1944-1945 = 768m. 1912-1932; 1/12(02 + 04 + ...24). 1933-1945; 1/3(06 + 14 + 20). A1: 1961-1970; 6 54´S

List of 40 Australian stations used in gridded survey from paper by Jones et al (1986a)

ID	LAT	LONG	ALT	STATION NAME	COUNTRY	STATUS
937800	-435	-1725	8	CHRISTCHURCH	NEW ZEALAND	1 1864 1984 GP 1905 11
938440	-464	-1683	1	INVERCARGILL AERO	NEW ZEALAND	1 1948 1984 GP 1948 10
938940	-459	-1705	2	DUNEDIN	NEW ZEALAND	1 1853 1984 GP 1853 20
939440	-525	-1691	19	CAMPBELL ISLAND	NEW ZEALAND	1 1941 1984 GP 1941 10
939860	-440	-1766	49	CHATHAM ISLAND 2	NEW ZEALAND	1 1878 1982 GP 1878 11
939970	-293	-1779	49	RAOUL IS/KERMADEC IS	NEW ZEALAND	1 1940 1982 GP 1940 10
939998	-410	-1757	-999	MASTERTON	NEW ZEALAND	1 1906 1984 GP 1907 10
939999	-435	-1727	-999	LINCOLN COLLEGE	NEW ZEALAND	1 1864 1984 GP 1864 10
940270	-67	-1470	9	LAE	PAPUA NEW G.	1 1949 1975 GP 1949 10
940350	-95	-1472	30	PORT MORESBY AP	PAPUA NEW G.	1 1903 1980 GP 1903 10
940850	-42	-1522	6	RABAUL NEW BRITAIN I	PAPUA NEW G.	1 1949 1980 GP 1949 10
941200	-125	-1309	29	DARWIN AIRPORT	AUSTRALIA	1 1882 1980 GP 1882 20
941750	-106	-1422	61	THURSDAY ISLAND	AUSTRALIA	1 1951 1980 GP 1951 20
942030	-180	-1222	9	BROOME	AUSTRALIA	1 1894 1980 GP 1951 11
942120	-183	-1276	406	HALLS CREEK	AUSTRALIA	1 1898 1980 GP 1951 10
942340	-163	-1334	214	DALY WATERS	AUSTRALIA	1 1951 1970 GP 1951 10
942870	-169	-1457	5	CAIRNS	AUSTRALIA	1 1907 1980 GP 1907 10
942940	-193	-1468	4	TOWNSVILLE	AUSTRALIA	1 1951 1980 GP 1951 20
942990	-163	-1500	8	WILLIS IS.	AUSTRALIA	1 1951 1980 GP 1951 10
943000	-249	-1137	4	CARNARVON	AUSTRALIA	1 1951 1980 GP 1951 10
943050	-217	-1150	4	ONSLOW	AUSTRALIA	1 1938 1975 GP 1938 10
943120	-204	-1186	11	PORT HEDLAND	AUSTRALIA	1 1951 1980 GP 1951 10
943260	-236	-1336	549	ALICE SPRINGS	AUSTRALIA	1 1879 1980 GP 1879 10
943350	-207	-1405	191	CLONCURRY	AUSTRALIA	1 1907 1975 GP 1907 10
943460	-235	-1442	187	LONGREACH	AUSTRALIA	1 1951 1980 GP 1951 10
943670	-211	-1490	4	MACKAY	AUSTRALIA	1 1951 1980 GP 1951 10
943740	-234	-1505	14	ROCKHAMPTON	AUSTRALIA	1 1951 1971 GP 1951 10
943800	-239	-1513	76	GLADSTONE	AUSTRALIA	1 1951 1980 GP 1951 20
944300	-266	-1185	518	MEEKATHARRA	AUSTRALIA	1 1951 1980 GP 1951 10
944760	-276	-1355	113	OODNADATTA	AUSTRALIA	1 1951 1980 GP 1951 10
945100	-264	-1463	304	CHARLEVILLE	AUSTRALIA	1 1951 1980 GP 1951 10
945680	-276	-1527	26	AMBERLEY	AUSTRALIA	1 1951 1970 GP 1951 10
945780	-275	-1530	0	BRISBANE APT	AUSTRALIA	1 1887 1980 GP 1887 10
946100	-320	-1157	60	PERTH	AUSTRALIA	1 1852 1980 GP 1876 11
946370	-308	-1215	361	KALGOORLIE	AUSTRALIA	1 1941 1980 GP 1941 10
946460	-309	-1281	157	FORREST	AUSTRALIA	1 1951 1980 GP 1951 20
946530	-321	-1337	17	CEDUNA	AUSTRALIA	1 1951 1980 GP 1951 10
946590	-312	-1368	169	WOOMERA	AUSTRALIA	1 1951 1980 GP 1951 10
946720	-350	-1385	43	ADELAIDE	AUSTRALIA	1 1857 1980 GP 1857 20
947670	-340	-1511	92	SYDNEY	AUSTRALIA	1 1859 1980 GP 1859 20
948210	-378	-1408	69	MT. GAMBIER M.O.	AUSTRALIA	1 1951 1980 GP 1951 10
948680	-378	-1450	44	MELBOURNE	AUSTRALIA	1 1941 1970 GP 1951 10
949680	-416	-1472	177	LAUNCESTON AP	AUSTRALIA	1 1951 1976 GP 1951 10
949700	-429	-1473	54	HOBART, TASMANIA	AUSTRALIA	1 1951 1970 GP 1951 10
949750	-430	-1472	54	HOBART,TASMANIA	AUSTRALIA	1 1841 1980 GP 1884 11
949950	-315	-1591	46	LORD HOWE ISLAND	AUSTRALIA	1 1912 1980 GP 1912 10
949960	-291	-1679	109	NORFOLK ISLAND	AUSTRALIA	1 1915 1980 GP 1915 20
949980	-545	-1590	6	MACQUARIE ISLAND	AUSTRALIA	1 1948 1980 GP 1948 10
967450	-62	-1068	8	DJAKARTA OBS.	INDONESIA	1 1866 1980 GP 1866 10
967810	-69	-1076	740	BANDUNG	INDONESIA	1 1912 1980 GP 1912 12
969330	-72	-1127	3	SURABAJA/PERAK	INDONESIA	1 1951 1980 GP 0 62
969367	-76	-1129	5	PASURUAN	INDONESIA	1 1912 1960 GP 1915 10
969960	-123	-967	8	COCOS ISLAND	INDONESIA	1 1952 1980 GP 1952 20
971800	-51	-1196	14	MAKASSAR/MANDAI	INDONESIA	1 1951 1980 GP 0 62
999006	-517	577	16	CAPE PEMBROKE	ANTARCTIC	1 1895 1947 GP 1895 60
999990	-344	-1151	22	CAPE LEEUWIN	AUSTRALIA	1 1897 1984 GP 1897 10
999991	-335	-1150	110	CAPE NATURALISTE	AUSTRALIA	1 1904 1984 GP 1904 10
999992	-140	-1264	16	ANGURURU	AUSTRALIA	1 1938 1984 GP 1938 20