

Comparison of published palaeoclimate records suitable for reconstructing annual to sub-decadal hydroclimatic variability in eastern Australia: implications for water resource management and planning

5 Anna L. Flack¹, Anthony S. Kiem¹, Tessa R. Vance², Carly R. Tozer^{2,3} and Jason L. Roberts⁴

¹Centre for Water, Climate and Land (CWCL), Faculty of Science, University of Newcastle, Callaghan, NSW 2308, Australia

²Institute for Marine and Antarctic Studies (previously Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)), University of Tasmania, Hobart, Tasmania 7004, Australia

10 ³CSIRO Oceans & Atmosphere, Hobart, Tasmania 7004, Australia

⁴Australian Antarctic Division, Kingston, Tasmania 7050, Australia

Correspondence to: Anthony S. Kiem (Anthony.Kiem@newcastle.edu.au)

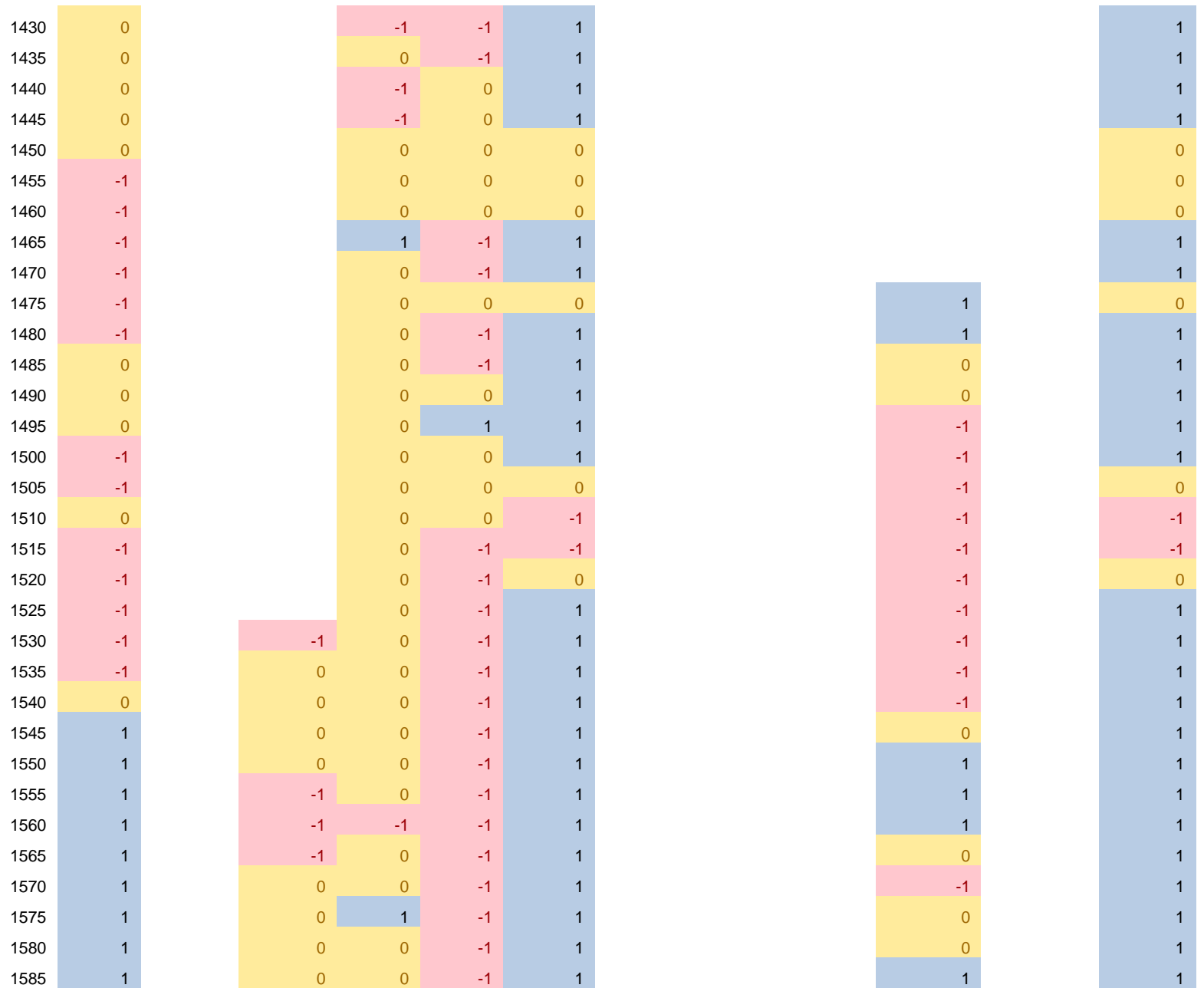
Supplementary Material

S1. 5-year wet/dry/neutral classifications for all palaeoclimate records used in this study

| 5-year period | Local reconstructions | | | Remote reconstructions | | | | | | PDO reconstruction | IPO reconstruction |
|---------------|-----------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-------------------------------|---|--------------------------------------|----------------------------------|--------------------------|-----------------------|
| | Speleothems | Tree rings Heinrich et al. (2009) | Tree rings Allen et al. (2015a,b) | Lake sediments Barr et al. (2014) | Lake sediments Barr et al. (2014) | Ice cores Vance et al. (2015) | Corals Hendy et al. (2003); Lough et al. (2011) | Multiproxy Gallant and Gergis (2011) | Multiproxy McGowan et al. (2009) | | |
| WET=1 | | | | Lake sediments Barr et al. (2014) | Lake sediments Barr et al. (2014) | | | | | Verdon and Franks (2006) | Buckley et al. (2019) |
| DRY=-1 | Ho et al. (2015b) | | | Lake Elingamite | Lake Surprise | | | | | | |
| Neutral=0 | Aridity index | | | | | | | | | | |
| 1000 | 0 | | | 1 | -1 | -1 | | | | | |
| 1005 | 0 | | | 1 | -1 | -1 | | | | | |
| 1010 | 0 | | | 1 | -1 | -1 | | | | | |
| 1015 | 1 | | | 1 | -1 | -1 | | | | | |
| 1020 | 1 | | | 0 | -1 | -1 | | | | | |
| 1025 | 1 | | | -1 | -1 | 0 | | | | | |
| 1030 | 1 | | | 0 | 0 | 0 | | | | | |
| 1035 | 0 | | | 0 | 0 | 0 | | | | | |
| 1040 | 0 | | | -1 | -1 | -1 | | | | | |
| 1045 | 0 | | | -1 | -1 | 0 | | | | | |
| 1050 | 0 | | | -1 | -1 | -1 | | | | | |
| 1055 | 0 | | | -1 | -1 | -1 | | | | | |
| 1060 | 0 | | | -1 | 0 | 0 | | | | | |
| 1065 | 0 | | | -1 | 1 | 0 | | | | | |
| 1070 | -1 | | | -1 | -1 | -1 | | | | | |
| 1075 | -1 | | | -1 | -1 | 0 | | | | | |
| 1080 | 0 | | | -1 | -1 | 0 | | | | | |
| 1085 | 0 | | | -1 | -1 | 0 | | | | | |
| 1090 | 0 | | | -1 | 0 | 0 | | | | | |
| 1095 | 0 | | | -1 | 1 | 0 | | | | | |
| 1100 | 0 | | | -1 | 1 | 0 | | | | | |
| 1105 | 0 | | | -1 | 1 | -1 | | | | | |

| | | | | |
|------|----|----|----|----|
| 1110 | 0 | -1 | 1 | -1 |
| 1115 | 0 | -1 | 1 | 0 |
| 1120 | 0 | 0 | 1 | -1 |
| 1125 | 0 | 0 | -1 | 0 |
| 1130 | -1 | -1 | -1 | 0 |
| 1135 | -1 | 0 | -1 | -1 |
| 1140 | -1 | 0 | 0 | -1 |
| 1145 | -1 | 1 | 1 | -1 |
| 1150 | 0 | 1 | 1 | 0 |
| 1155 | 0 | 1 | 0 | 0 |
| 1160 | 1 | 0 | -1 | 0 |
| 1165 | 0 | -1 | 0 | 0 |
| 1170 | -1 | 0 | 1 | -1 |
| 1175 | -1 | -1 | -1 | -1 |
| 1180 | -1 | -1 | -1 | -1 |
| 1185 | 0 | -1 | -1 | -1 |
| 1190 | 0 | 0 | -1 | -1 |
| 1195 | 0 | 0 | 0 | -1 |
| 1200 | 0 | 0 | 1 | -1 |
| 1205 | 0 | 0 | 1 | -1 |
| 1210 | 0 | 0 | 1 | -1 |
| 1215 | 0 | 0 | 1 | 0 |
| 1220 | 0 | 0 | 1 | 0 |
| 1225 | 0 | 1 | -1 | 0 |
| 1230 | 0 | 1 | -1 | 0 |
| 1235 | 0 | 1 | -1 | 0 |
| 1240 | 0 | 1 | -1 | -1 |
| 1245 | 0 | 1 | -1 | -1 |
| 1250 | 0 | 1 | -1 | -1 |
| 1255 | 0 | 0 | -1 | -1 |
| 1260 | 0 | 0 | 0 | 0 |
| 1265 | 0 | 0 | -1 | 0 |

| | | | | | |
|------|----|----|----|----|---|
| 1270 | 0 | 0 | -1 | 1 | |
| 1275 | 0 | 0 | 0 | 0 | |
| 1280 | 0 | 0 | 1 | 0 | |
| 1285 | 0 | 0 | 1 | 0 | |
| 1290 | 0 | 0 | 1 | 0 | |
| 1295 | 0 | 0 | 0 | 0 | |
| 1300 | 0 | 0 | 0 | 0 | |
| 1305 | 0 | 0 | -1 | 0 | |
| 1310 | 0 | 0 | 0 | -1 | |
| 1315 | 0 | 0 | 1 | 0 | |
| 1320 | 0 | 0 | 1 | 0 | |
| 1325 | 0 | -1 | 1 | 0 | |
| 1330 | 0 | -1 | 1 | 0 | |
| 1335 | 0 | -1 | 1 | 1 | |
| 1340 | 0 | -1 | 1 | 0 | |
| 1345 | 0 | -1 | 0 | -1 | |
| 1350 | -1 | -1 | 0 | 0 | 0 |
| 1355 | -1 | -1 | 0 | 1 | 1 |
| 1360 | -1 | -1 | 0 | 1 | 1 |
| 1365 | -1 | -1 | 0 | 1 | 1 |
| 1370 | -1 | -1 | 0 | 0 | 0 |
| 1375 | -1 | -1 | -1 | 0 | 0 |
| 1380 | -1 | -1 | -1 | 0 | 0 |
| 1385 | 0 | -1 | -1 | 0 | 0 |
| 1390 | 0 | -1 | -1 | 0 | 0 |
| 1395 | 0 | -1 | 0 | 0 | 0 |
| 1400 | 0 | -1 | -1 | 0 | 0 |
| 1405 | 0 | -1 | -1 | 0 | 0 |
| 1410 | 0 | -1 | -1 | 0 | 0 |
| 1415 | 0 | -1 | -1 | 0 | 0 |
| 1420 | 0 | -1 | -1 | 1 | 1 |
| 1425 | 0 | -1 | -1 | 1 | 1 |



| | | | | | | | |
|------|----|----|----|----|----|----|---|
| 1590 | 1 | 1 | 0 | -1 | 1 | 1 | 1 |
| 1595 | 1 | 1 | 0 | -1 | 1 | 1 | 1 |
| 1600 | 1 | -1 | 0 | 0 | 1 | 1 | 1 |
| 1605 | 1 | -1 | 0 | -1 | 1 | 1 | 1 |
| 1610 | 1 | -1 | 0 | -1 | 1 | 1 | 1 |
| 1615 | 1 | 1 | 0 | -1 | 1 | 1 | 1 |
| 1620 | 1 | 1 | 1 | -1 | 0 | 1 | 1 |
| 1625 | 0 | -1 | 0 | -1 | 0 | 0 | 0 |
| 1630 | 0 | -1 | 0 | -1 | -1 | 1 | 1 |
| 1635 | 0 | 1 | 0 | -1 | 0 | 0 | 0 |
| 1640 | 0 | 1 | 0 | -1 | 0 | 1 | 1 |
| 1645 | 0 | 0 | 0 | -1 | 0 | 1 | 1 |
| 1650 | 0 | 0 | 0 | -1 | 0 | 0 | 0 |
| 1655 | 0 | 0 | 0 | -1 | 0 | 0 | 0 |
| 1660 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| 1665 | -1 | 1 | 0 | 1 | 0 | 0 | 0 |
| 1670 | -1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1675 | -1 | -1 | -1 | 1 | 1 | 1 | 1 |
| 1680 | -1 | -1 | -1 | 0 | 1 | 0 | 0 |
| 1685 | -1 | -1 | 0 | 0 | 1 | 1 | 1 |
| 1690 | -1 | -1 | 0 | 0 | 1 | -1 | 1 |
| 1695 | 0 | 0 | 0 | -1 | 0 | 1 | 1 |
| 1700 | 0 | 0 | 0 | -1 | 0 | 1 | 1 |
| 1705 | 0 | 1 | 0 | -1 | 1 | 1 | 1 |
| 1710 | 0 | 1 | 0 | 0 | 1 | -1 | 1 |
| 1715 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| 1720 | 0 | -1 | 0 | 1 | 0 | -1 | 1 |
| 1725 | 0 | -1 | 1 | -1 | -1 | 0 | 0 |
| 1730 | 0 | -1 | 1 | 0 | -1 | 1 | 1 |
| 1735 | 0 | 0 | 1 | 0 | 0 | -1 | 1 |
| 1740 | 0 | -1 | 1 | 1 | 0 | -1 | 1 |
| 1745 | 0 | -1 | 1 | 1 | -1 | -1 | 1 |

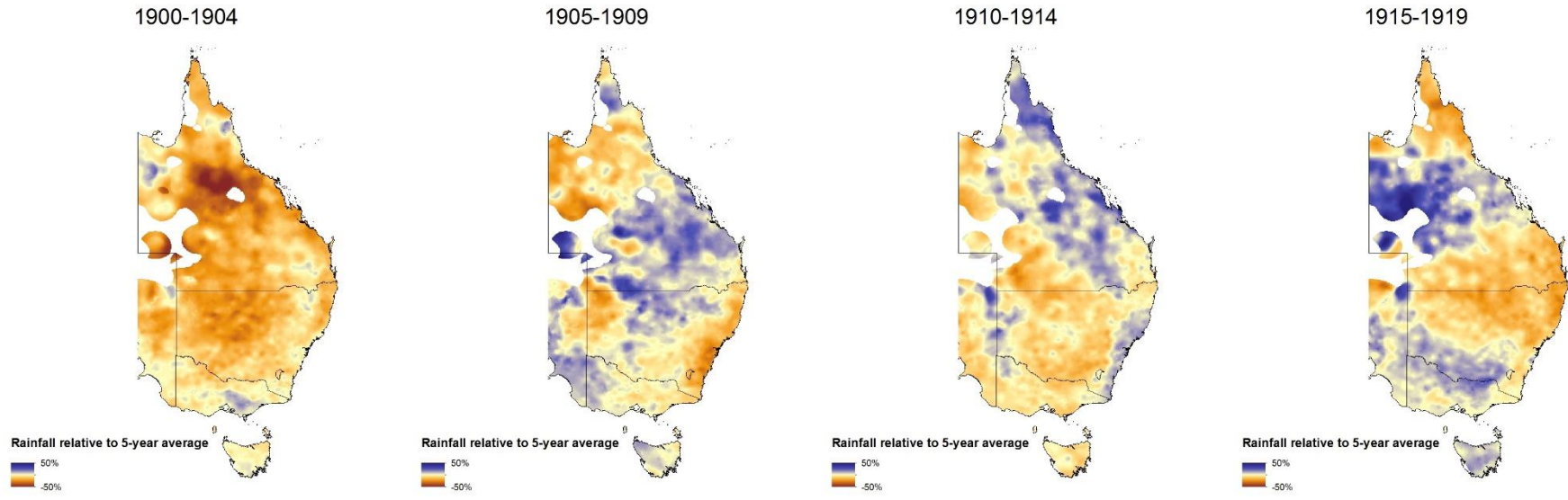
| | | | | | | | | | | | |
|------|----|----|----|----|---|----|----|----|----|----|----|
| 1750 | 0 | | -1 | 1 | 1 | -1 | -1 | | 1 | -1 | -1 |
| 1755 | 0 | | 1 | 1 | 1 | 0 | 1 | | 1 | -1 | 0 |
| 1760 | 0 | | 1 | 1 | 0 | 0 | 0 | | 1 | -1 | 0 |
| 1765 | 0 | | 1 | 1 | 0 | 0 | -1 | | 0 | -1 | 0 |
| 1770 | -1 | | 0 | 1 | 0 | 0 | -1 | | 0 | -1 | 0 |
| 1775 | -1 | | 0 | 1 | 0 | 0 | -1 | | 1 | 1 | 0 |
| 1780 | -1 | | 1 | 1 | 0 | 0 | -1 | | 1 | 1 | 0 |
| 1785 | -1 | | 0 | 1 | 0 | 1 | -1 | | 0 | 1 | 1 |
| 1790 | -1 | | 0 | 1 | 1 | 1 | -1 | 0 | -1 | 1 | 1 |
| 1795 | 0 | | 1 | 1 | 1 | 0 | -1 | 0 | 0 | 0 | 0 |
| 1800 | 0 | | 1 | 1 | 1 | 0 | -1 | 1 | 1 | 1 | 0 |
| 1805 | 0 | | 1 | 1 | 1 | 1 | -1 | 0 | 0 | 1 | 1 |
| 1810 | 0 | | 1 | 1 | 1 | 1 | -1 | -1 | 0 | 1 | 1 |
| 1815 | 0 | | 1 | 1 | 1 | 1 | -1 | -1 | -1 | 1 | 1 |
| 1820 | -1 | | 1 | 1 | 1 | 0 | -1 | 1 | -1 | 0 | 0 |
| 1825 | -1 | | 1 | 1 | 1 | 0 | -1 | 1 | 0 | -1 | 0 |
| 1830 | -1 | | 1 | 1 | 1 | 0 | -1 | 0 | 0 | -1 | 0 |
| 1835 | -1 | | 0 | 1 | 1 | 1 | -1 | -1 | 1 | 0 | 1 |
| 1840 | 0 | | 0 | 1 | 0 | 1 | -1 | -1 | 0 | 0 | 1 |
| 1845 | 0 | | -1 | 1 | 0 | 1 | -1 | 0 | 0 | 0 | 1 |
| 1850 | 0 | | 0 | 1 | 1 | 1 | -1 | 0 | 1 | 0 | 1 |
| 1855 | 0 | | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 1860 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 1865 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | -1 | 1 | 0 |
| 1870 | 0 | 0 | 1 | 0 | 1 | 0 | -1 | 0 | -1 | 1 | 0 |
| 1875 | 0 | -1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1880 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 |
| 1885 | 0 | 1 | 1 | -1 | 1 | 0 | -1 | 1 | 1 | 1 | 0 |
| 1890 | 0 | 1 | 1 | -1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| 1895 | 0 | 0 | 0 | -1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| 1900 | -1 | -1 | -1 | -1 | 0 | 0 | -1 | -1 | 0 | 1 | 0 |
| 1905 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | -1 | 0 | 1 | 0 |

| | | | | | | | | | | | |
|------|----|----|----|----|----|----|----|----|----|----|----|
| 1910 | -1 | -1 | -1 | -1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| 1915 | -1 | -1 | -1 | | 0 | -1 | 0 | 0 | 1 | 1 | -1 |
| 1920 | -1 | 0 | 0 | | 0 | -1 | -1 | -1 | 0 | 1 | -1 |
| 1925 | -1 | 1 | 0 | | -1 | -1 | 0 | -1 | -1 | 1 | -1 |
| 1930 | 0 | 1 | 1 | | 0 | -1 | -1 | 0 | -1 | 0 | -1 |
| 1935 | 0 | 0 | 1 | | 0 | 0 | -1 | -1 | -1 | 0 | 0 |
| 1940 | 0 | -1 | 1 | | 0 | 0 | 0 | -1 | -1 | -1 | 0 |
| 1945 | 0 | -1 | 0 | | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1950 | 0 | 0 | 0 | | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| 1955 | 0 | 0 | 0 | | -1 | 0 | 1 | 1 | 1 | 1 | 0 |
| 1960 | 0 | 0 | 0 | | -1 | 0 | -1 | 0 | 1 | 1 | 0 |
| 1965 | -1 | 1 | 0 | | 0 | -1 | -1 | 1 | 0 | 1 | -1 |
| 1970 | -1 | 1 | 1 | | 1 | -1 | 1 | 1 | 1 | -1 | -1 |
| 1975 | -1 | 0 | 0 | | -1 | -1 | 0 | 0 | 0 | | -1 |
| 1980 | 0 | 0 | -1 | | -1 | -1 | -1 | 0 | -1 | | -1 |
| 1985 | 0 | 0 | 0 | | -1 | -1 | | | 0 | | -1 |
| 1990 | 0 | 0 | 1 | | -1 | -1 | | 1 | | | -1 |
| 1995 | 0 | | 1 | | -1 | 0 | | | | | 0 |
| 2000 | | | | | | | | | | | |

S2. Pre-instrumental 5-year periods classed as equivalent to instrumental 5-year periods

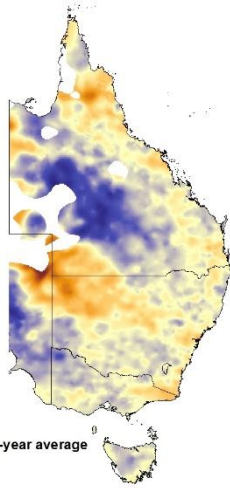
| Year | Equivalent pre-instrumental 5-year periods | | | | | | | | | | | | | | | | |
|-------------|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1900 | 1350 | 1370 | | | | | | | | | | | | | | | |
| 1905 | 1350 | 1370 | | | | | | | | | | | | | | | |
| 1910 | 1350 | 1370 | | | | | | | | | | | | | | | |
| 1915 | 1140 | | | | | | | | | | | | | | | | |
| 1920 | 1140 | | | | | | | | | | | | | | | | |
| 1925 | 1070 | 1135 | 1175 | 1180 | | | | | | | | | | | | | |
| 1930 | 1195 | 1310 | 1345 | 1510 | | | | | | | | | | | | | |
| 1935 | 1035 | 1060 | 1090 | 1155 | 1165 | 1260 | 1275 | 1295 | 1300 | 1395 | 1450 | | | | | | |
| 1940 | 1035 | 1060 | 1090 | 1155 | 1165 | 1260 | 1275 | 1295 | 1300 | 1395 | 1450 | | | | | | |
| 1945 | 1035 | 1060 | 1090 | 1155 | 1165 | 1260 | 1275 | 1295 | 1300 | 1395 | 1450 | | | | | | |
| 1950 | 1035 | 1060 | 1090 | 1155 | 1165 | 1260 | 1275 | 1295 | 1300 | 1395 | 1450 | | | | | | |
| 1955 | 1045 | 1080 | 1085 | 1125 | 1225 | 1230 | 1235 | 1265 | 1305 | 1385 | 1390 | 1400 | 1405 | 1410 | 1415 | | |
| 1960 | 1045 | 1080 | 1085 | 1125 | 1225 | 1230 | 1235 | 1265 | 1305 | 1385 | 1390 | 1400 | 1405 | 1410 | 1415 | | |
| 1965 | 1140 | | | | | | | | | | | | | | | | |
| 1970 | 1145 | 1170 | | | | | | | | | | | | | | | |
| 1975 | 1070 | 1135 | 1175 | 1180 | | | | | | | | | | | | | |
| 1980 | 1000 | 1005 | 1010 | 1040 | 1050 | 1055 | 1185 | 1190 | 1240 | 1245 | 1250 | 1255 | | | | | |
| 1985 | 1000 | 1005 | 1010 | 1040 | 1050 | 1055 | 1185 | 1190 | 1240 | 1245 | 1250 | 1255 | | | | | |
| 1990 | 1000 | 1005 | 1010 | 1040 | 1050 | 1055 | 1185 | 1190 | 1240 | 1245 | 1250 | 1255 | | | | | |
| 1995 | 1045 | 1080 | 1085 | 1125 | 1225 | 1230 | 1235 | 1265 | 1305 | 1385 | 1390 | 1400 | 1405 | 1410 | 1415 | 1635 | 1640 |

S3. Rainfall relative to 5-year instrumental average for each 5-year instrumental periods

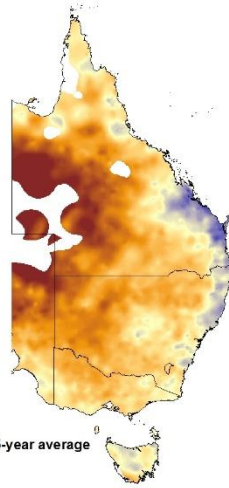


S4.

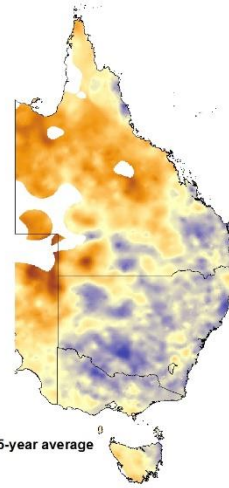
1920-1924



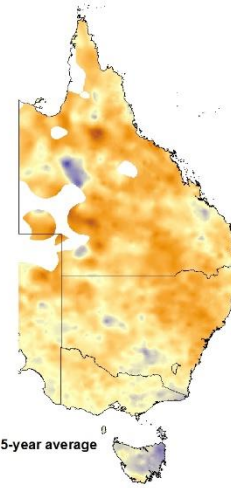
1925-1929



1930-1934

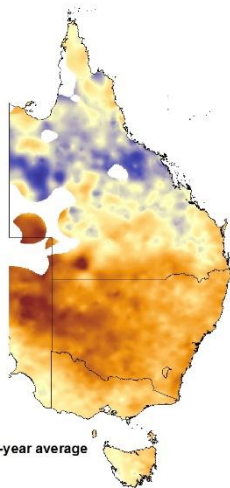


1935-1939

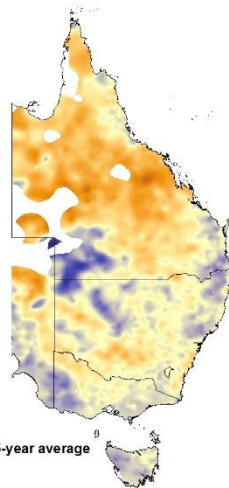


S5.

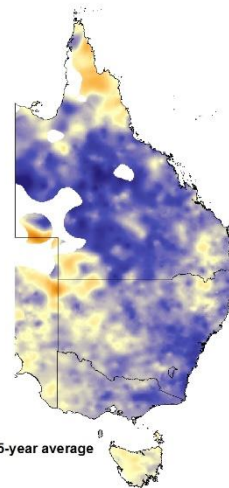
1940-1944



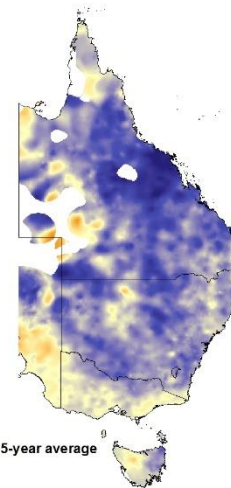
1945-1949



1950-1954

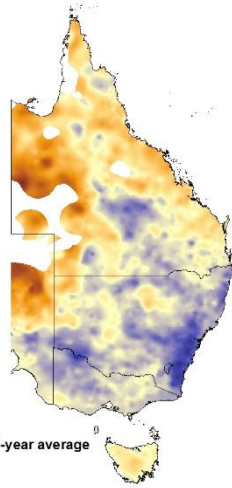


1955-1959

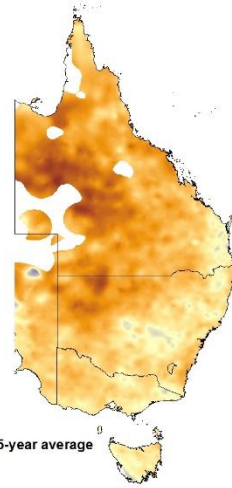


S6.

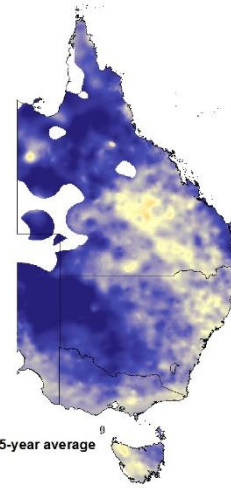
1960-1964



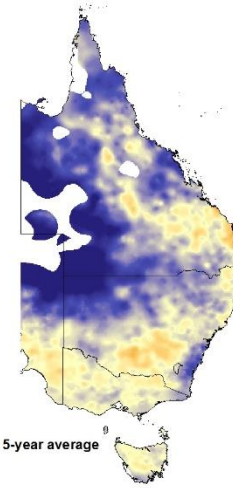
1965-1969



1970-1974

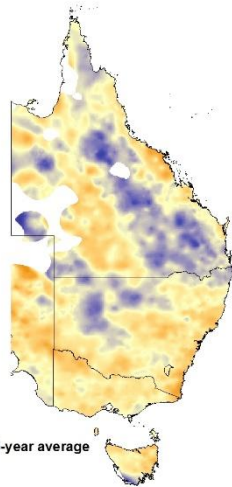


1975-1979

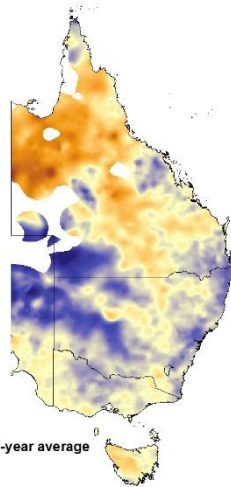


S7.

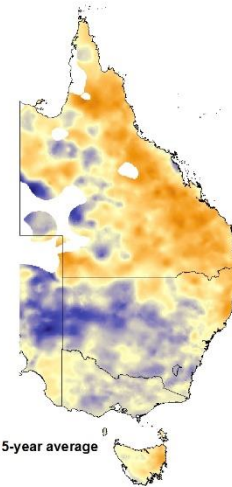
1980-1984



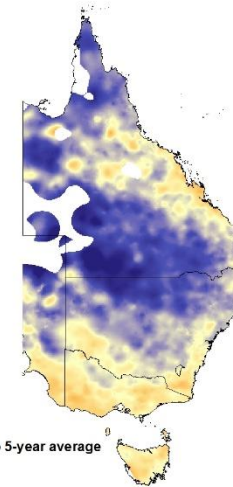
1985-1989



1990-1994



1995-1999



S8.

