Australian Government
Bureau of Meteorology

Special Climate Statement 57—extensive early June rainfall affecting the Australian east coast

Issued 17 June 2016

Version number/type | Date of issue
Version 1.1 | 17 June 2016

Published by: Bureau of Meteorology
Photo credit: Mark Wilgar

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1 Summary

In early June 2016, much of the east coast of Australia and Tasmania experienced very heavy rainfall as a result of an extensive upper-level trough and the formation of an East Coast Low complex in the Tasman Sea. From 4–7 June very heavy rainfall resulted in flooding in many areas stretching from southeast Queensland, eastern New South Wales, eastern Victoria, and large areas of northern Tasmania.

Many locations in southeast Queensland and eastern New South Wales recorded highest on record rainfall for June, and daily totals were unprecedented for any month across several locations in the northern half of Tasmania. Major flooding occurred across Tasmania's northern river basins as a persistent and very moist northeasterly airstream delivered rainfall in excess of 200 mm across northern districts of the State, with the heaviest falls on 5 and 6 June.

The principal purpose of this Statement is to document the rainfall aspects of the event. Severe weather aspects of the event will be documented separately.

2 Extensive trough off east coast Australia

An upper level trough developed over central and eastern Australia in the first week of June 2016. The upper trough and an accompanying low pressure surface trough intensified on 3 June as the system tracked across southeast Queensland. Moist air drawn into the eastern flank of the trough from the Coral Sea resulted in heavy rainfall in southeast Queensland. There were totals in excess of 100 mm in the 24 hours to 9am on 4 June at many locations. The system moved off the northeast coast of New South Wales and developed into an East Coast Low early on 5 June, producing heavy rainfall, strong winds and a large sea swell along the New South Wales coast. Rainfall totals for the 24 hours to 9am across the State's northeast coast were well in excess of 200 mm (Figure 1).

A strong and near-stationary high pressure system over New Zealand maintained a northeasterly airstream into the trough, allowing a continuous feed of moisture into the low pressure system. As the main low complex tracked slowly southwards and interacted with multiple centres of low pressure, a very moist northeasterly flow was directed over Tasmania from 5 to 7 June.

Heavy rainfall brought major flooding to Tasmania's northern river basins. Twenty-four hour totals to 9am on 6 June saw northern Tasmanian locations receive over 200 mm of rainfall, with several reporting their wettest day for any month on record (Table 1). Rainfall eased as the system tracked to Tasmania's southeast on 7 June, although significant flooding continued for several days. Moisture feeding into the system extended from as far north as the central Coral Sea, where New Caledonia also recorded rainfall accumulations in excess of 200 mm in 6 hours on 5 June[1].

While East Coast Lows are not uncommon to Australia, this event was particularly notable with respect to the spatial extent of the heavy rainfall. Averaged across eastern New South Wales[2], 5 June was the wettest day on record with a regional average of 73.11 mm, surpassing the previous record of 68.89 mm set on 19 January 1950 (Table 2). It is noteworthy that previous extreme daily rainfall totals approaching this volume over eastern New South Wales had all occurred during summer months, and were all associated with tropical cyclones or former tropical cyclones. East Coast Lows are typically smaller-scale systems whose major impacts are confined to a few hundred kilometres of the coastline. For example, in the case of the April 2015 East Coast Low rainfall in excess of 200 mm was largely confined to areas from the Hunter to the Illawarra regions of New South Wales, with only light falls north of Taree.

[1] http://www.meteo.nc/en-savoir-plus/accueil/actualites/8-actualites/452-pluies-et-vent-du-dimanche-05-juin-2016 (in French)

[2] Eastern New South Wales defined by ABARES as the combined New South Wales Tablelands and New South Wales Coastal regions: see http://apps.daff.gov.au/agsurf/regions.html

3 Evolution of the rain event

3.1 Queensland—upper level trough and surface trough bring heavy rain

Embedded thunderstorms that formed along an upper trough produced moderate to heavy falls across central Queensland and parts of central New South Wales on 3 June, with totals generally between 50 and 100 mm. This rain was in areas suffering long-term rainfall deficiencies and, despite June typically being seasonally dry, it was the most significant rainfall for many months across large parts of the region.

Rainfall increased as the trough deepened and tracked further east, drawing moisture from the Coral and Tasman seas. Precipitation rates increased early on 4 June, resulting in totals in excess of 100 mm for the Gold Coast hinterland, while the Brisbane metropolitan region reported totals ranging from 60 to 120 mm. Heavy rains continued through much of the day, contracting further into the southeast corner of the State later in the day. Locally, very heavy rain occurred in the evening near the Gold Coast with 163 mm in three hours at Coolangatta Airport (Figure 2). Totals in excess of 200 mm were reported near the New South Wales–Queensland border for the 24 hours to 9am on 5 June.

3.2 New South Wales—deepening low pressure forms an East Coast Low

Heavy rainfall continued along much of the New South Wales coast, particularly over the northeast of the State as the low pressure trough moved off the coast early on 5 June. The low intensified further, developing into a multi-centred East Coast Low. The low pressure system brought widespread, heavy rainfall about the northern coast and ranges, before the main rainfall focus shifted southwards to impact the southeastern coast and ranges. Heavy falls were recorded along most coastal districts of New South Wales.

The largest area of heavy rain along a stretch of the New South Wales north coast extended from Newcastle to Coolangatta. Daily totals for the 24 hours to 9am on 5 June exceeded 100 mm with several locations in the far north reporting rainfall in excess of 300 mm; the highest being Tweed Heads with a total of 330 mm, though locally, heavier falls were recorded at non-Bureau gauges (for example, Wooli, north of Coffs Harbour, had 468 mm in 24 hours on 5 June). Further south, totals ranged from 130 to 180 mm for many locations extending from Sydney down to the State's south coast, several of which reporting new daily records for June. Heavy rainfall persisted along the south coast of New South Wales on 6 June. Camden, to the southwest of Sydney, recorded nearly 230 mm in eighteen hours (Figure 3) while Robertson (the Pie Shop), in the Illawarra district, observed 301.6 mm in the 24 hours to 9am on the 6th, following 285.2 mm recorded in the previous 24 hours. Rainfall totals over the 2-day period resulted in several other locations reporting their wettest June on record in the first week of the month.

3.3 Tasmania—interacting broad complex of low pressure

Rainfall in Tasmania first developed on 5 June as a strong northeasterly flow was directed over the State. Moderate to heavy rainfall was recorded over the northern and northeastern areas of the State. Daily totals generally ranged from 50 to 100 mm, with the highest total in the 24 hours to 9 am on 5 June being 129.4 mm at Pyengana in the northeast of the State. Significant rainfall continued the next day with broad areas of rainfall producing totals in the 24 hours to 9 am on the 6th well in excess of 150 mm.

Both Loongana and Yolla, in the State's northwest, reported 248 mm to 9am on 6 June, resulting in the wettest day on record for these locations. Several more locations also reported their wettest day on record with daily totals in excess of 100 mm being widespread. The rainfall rate was notably consistent during the event; for example, at Sheffield, rainfall fell at a nearly constant rate for 36 hours (Figure 4).

The next 24 hours saw the rain shift to the southeast of the State, though totals were significantly less than in the north. Totals were generally in excess of 30 mm across much of the southeast quadrant of the State, with several locations reporting 50 to 80 mm closer to the coast. Rainfall totals over the three days from 5 to 7 June resulted in many locations reporting their wettest 3-day period for June on record (Table 3).

3.4 Other phenomena

The event was notable for the number of catchments that received high rainfall resulting in flood. Minor to major flooding was observed in river systems across four States, from far southeast Queensland to Tasmania. In total, 32 rivers, mainly along the New South Wales coast and in Tasmania were in flood during this event including:

- In Queensland, minor flooding was brief on the Barcoo River.
- For New South Wales, nearly all east-flowing rivers were in flood during the event. A major flood which developed on the Georges River (Sydney) coinciding with the high astronomical tide.
- In Victoria, moderate to major flooding occurred in Far East Gippsland, along the Snowy River.

Flooding in Tasmania was exceptional, with Launceston experiencing the most significant flood on the South Esk River in 90 years. The Mersey River set a new record for highest flood level resulting in widespread impacts in rural and regional areas.

Along the southeast Queensland and New South Wales coasts, the East Coast Low was associated with a relatively moderate storm surge; near 30 cm in the vicinity of Sydney. However, the storm surge combined with high astronomical tides and damaging waves resulted in local inundation of low-lying areas and widespread coastal erosion along the New South Wales coast. This has occurred on an increasing sea level trend. At Fort Denison (Sydney Harbour), the sea level trend over the period 1966 to 2010 is 1.33 mm/year, equating to an overall rise in sea level of more than 5 cm over that period (Climate Change in Australia, 2015).

As the low pressure system intensified during 5 and 6 June and slowly tracked southwards along the New South Wales coast, peak wind gusts were recorded up to 100–120 km/h. Strong northeasterly winds were also experienced about the north and east of Tasmania on 5 and 6 June. The strongest wind gusts were: 133 km/h on Maria Island; 113 km/h on Mount Read; 111 km/h on Mt Wellington; and 107 km/h on Tasman Island.

The persistent and very moist northeasterly flow over Tasmania also resulted in very warm minimum temperatures with many locations reporting their warmest June night on record (Table 4)[3]. On 5 June, St Helens Aerodrome reported a minimum of 15.3 °C and Flinders Island reported 15.9 °C, both surpassing the previous highest on record for the State— The previous warmest for Tasmania was at Swan Island (2 June 2014) and Flinders Island Airport (7 June 1991) which both observed 15.2 °C. The Tasmanian statewide average for minimum temperature on 6 June 2016 was 11.62 °C, surpassing the previous highest of 10.60 °C set on 1 June 1973. Minimum temperatures across much of the eastern half of the State were in excess of 8 °C above average (Figure 5). Minimum temperatures remained above average during the following two days, with several locations breaking their warmest June minimum on two or three consecutive days.

One aspect to be considered when comparing this event to previous ones is that in the lead-up to the event, sea surface temperatures to Australia's east, including the Coral and Tasman seas, were exceptionally high. Sea surface temperatures in the Coral and Tasman seas have been warmest on record through autumn 2016 and warmest on record for May. The May 2016 sea surface temperature anomaly for the Coral Sea was +0.99 °C (0.21 °C warmer than the previous highest set in 2006), while the Tasman Sea recorded an anomaly of +1.33 °C (0.6 °C warmer than the previous highest set in May 2001 and May 1998) (Figure 6).

With warmer waters, there is the potential for increased moisture availability for precipitation. The atmospheric moisture levels associated with this East Coast Low event were more typical of those recorded during the warmer months of the year. An estimate of the amount of moisture in the atmosphere, given by precipitable water[4], and measured at several locations along the east coast, were close to highest on record for June. At Hobart Airport, precipitable water was reported at its highest June value on record, exceeding the previous highest June value by nearly 38% (Figure 7). The new record-high June 2016 value is comparable to the precipitable water measured during the extreme rainfall event that affected northern and eastern Tasmania in late January 2016.

[3] During the period covered by this Statement abnormally high temperatures were reported in northern Australia, including; an Australian record-high June maximum (37.9 °C at Bradshaw (Northern Territory) on 7 June) and June minimum (28.8 °C at Troughton Island (Western Australia) on 6 June). These were not directly associated with extreme rainfalls discussed in this statement.
[4] Precipitable water is the total water vapour contained in an atmospheric column of unit cross-section, expressed in terms of the depth of an equivalent mass of liquid water of the same cross-section.

4 Significant rainfall totals

While heavy rainfall was widespread, the most significant rainfall totals occurred in northern Tasmania. A number of stations had their wettest day on record for any month, especially in the region inland from Devonport and Burnie, where totals were in excess of 200 mm. Yolla, southwest of Burnie, with over 100 years of observations, had 248 mm in the 24 hours to 9am on 6 June, nearly double its previous record of 139 mm set in April 2003. Eight long term stations in Tasmania reported their wettest day on record. Most of northern Tasmania, except for the extreme northwest and the area around Launceston, had at least 100 mm over the three days from 5 to 7 June, with three-day totals above 200 mm occurring widely on the north side of the Central Plateau, and in the northeast highlands. Averaged over northern Tasmania[5], 6 June was also the wettest day on record as a whole, with a regional average of 114.5 mm exceeding the previous record of 102.9 mm set on 19 February 1946 (Table 2).

Rainfall for the period from 4 to 7 June exceeded 150 mm over most areas on and east of the coastal ranges in New South Wales (except for the Hunter region), extending north to the Brisbane area and south into the far east of Victoria. Totals in this range also occurred over parts of the Snowy Mountains and Brindabella Ranges. Four-day rainfall totals above 300 mm occurred over most coastal areas south from Sydney to Bega, and locally near the New South Wales–Queensland border and around Coffs Harbour. Much heavier falls occurred locally, especially near the Illawarra escarpment where Robertson had an event total of 618 mm, while Wooli, north of Coffs Harbour, had 468 mm in 24 hours to 9am on 5 June.

On the mainland, the event was more notable for its spatial extent rather than its local intensity at individual locations. Despite it being the wettest day on record averaged over eastern New South Wales as a whole, only one location with 50 or more years of data (Snowball, east of Cooma) had its wettest day on record for any month, with a number of other sites setting records for their wettest June day.

As an indicator of the event's extent, of the 20 major coastal river regions[6] into which eastern New South Wales (east of the Great Dividing Range) is divided, 19 of the 20 had a catchment average rainfall on 5 June of at least 75 mm (the only exception being the Hunter), with 13 exceeding 100 mm on 5 June and a 14th on 6 June (Table 5). No river region set an all-months daily record, but five set June records (the Brunswick and Hastings on the 5th, and the Moruya, Tuross and Bega on the 6th), and eight had daily totals which ranked in their ten wettest days on record.

[5] This is the Bureau's rainfall district 91, which encompasses northern Tasmania north of approximately the Central Plateau, except for areas east of Scottsdale and Avoca which are in the East Coast district. See http://www.bom.gov.au/climate/cdo/about/rain-districts.shtml for further details.
[6] Details of drainage divisions and river regions are available at http://www.bom.gov.au/water/geofabric/inuse.shtml .

5 Comparison to previous events

The June 2016 rainfall event ranks as one of the most significant on record for northern Tasmania. Over the Northern district, 6 June 2016 was the wettest day on record with a district average of 114.5 mm, although two- and three-day totals fell short of those experienced in the April 1929 event. In the April 1929 event, two- and three-day district averages were 156.6 and 191.4 mm, compared with 153.6 and 163.4 mm respectively in the June 2016 event.

Other significant rainfall events in this region include those of February 1946, January 2004, January 2011 and January 2016. Maximum three-day district averages in these events ranged from 120.9 mm (January 2011) to 100.1 mm (January 2016).

A comparison of the April 1929 event, which produced the most significant floods on record at Launceston and many other parts of northern Tasmania, and the June 2016 event is shown in Figure 8. The overall rainfall pattern of both events is similar, with substantial areas of event rainfall exceeding 200 mm in the northeast highlands, and on the northern side of the Central Plateau inland from the coast. Comparing the two events, broadly speaking, three-day rainfall totals were similar in the western area for heavy rain, but the April 1929 event saw higher totals in the northeast highlands, and the highest totals of the 1929 event (336.6 mm in one day and 468.7 mm in two days at Mathinna) were not matched in 2016.

Rainfall totals during the June 2016 event generally exceeded those of January 2016 over most of the Northern district (except around Launceston), but the January 2016 rains were heavier along most of the East Coast.

6 Summary figures and tables

6.1 Figures and tables

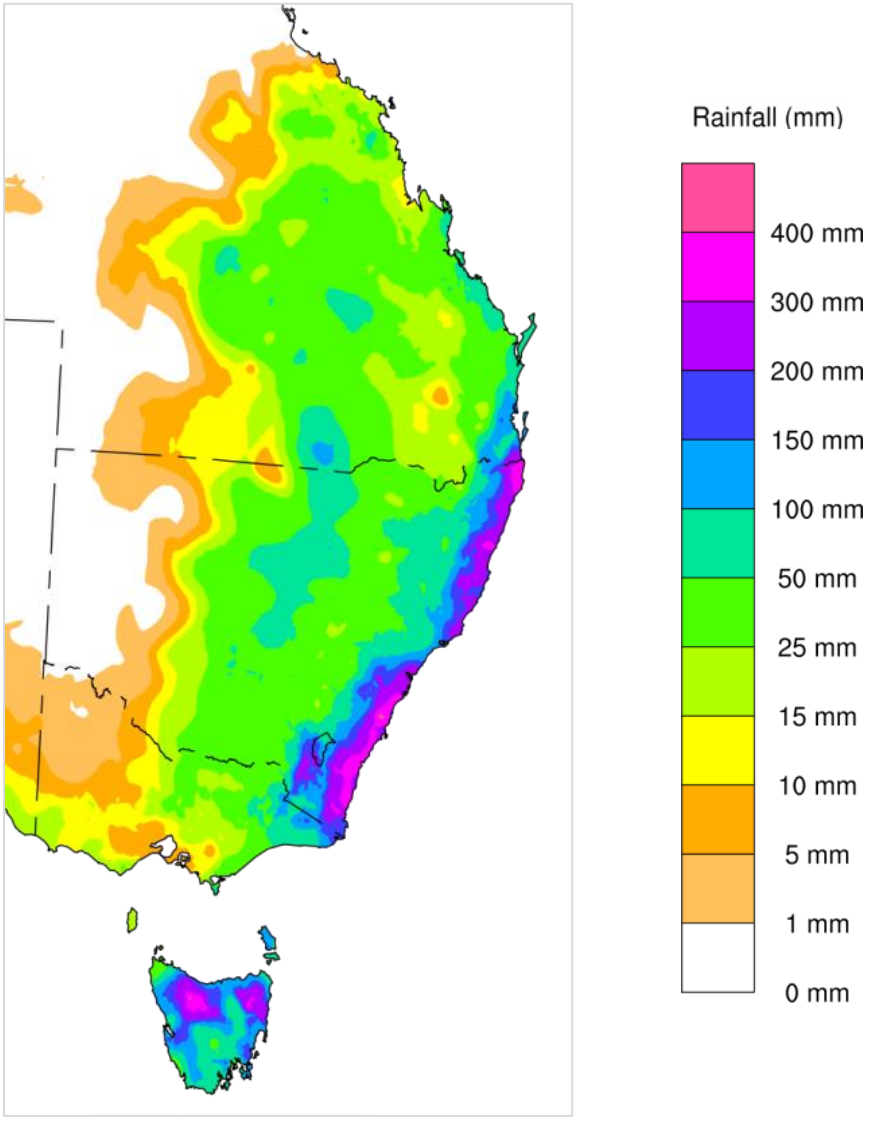

Figure 1. Total rainfall between 4 and 7 June 2016 across eastern Australia

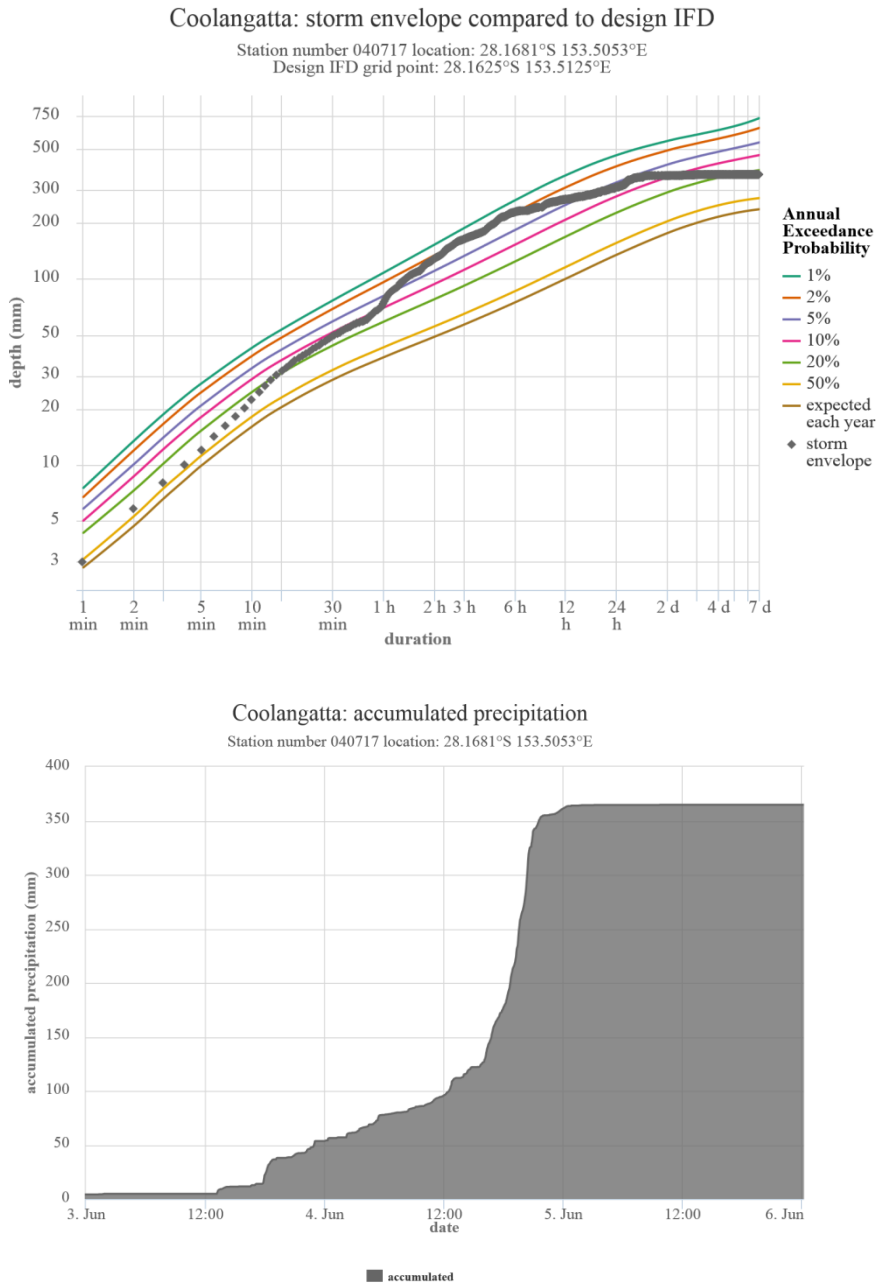

Figure 2. Storm envelope (top) at Coolangatta (Queensland) compared to the design Intensity-Frequency-Duration (IFD) curves. Storm envelope is the greatest amount of rainfall recorded over various durations through the event. The observed rainfall at durations from one hour to two days had a less than 10% probability of exceedance in any given year. The accumulated precipitation (bottom) shows more than half of the total rainfall occurred between 16:00 to 22:00 on 4 June, corresponding to a 2% probability of exceedance.

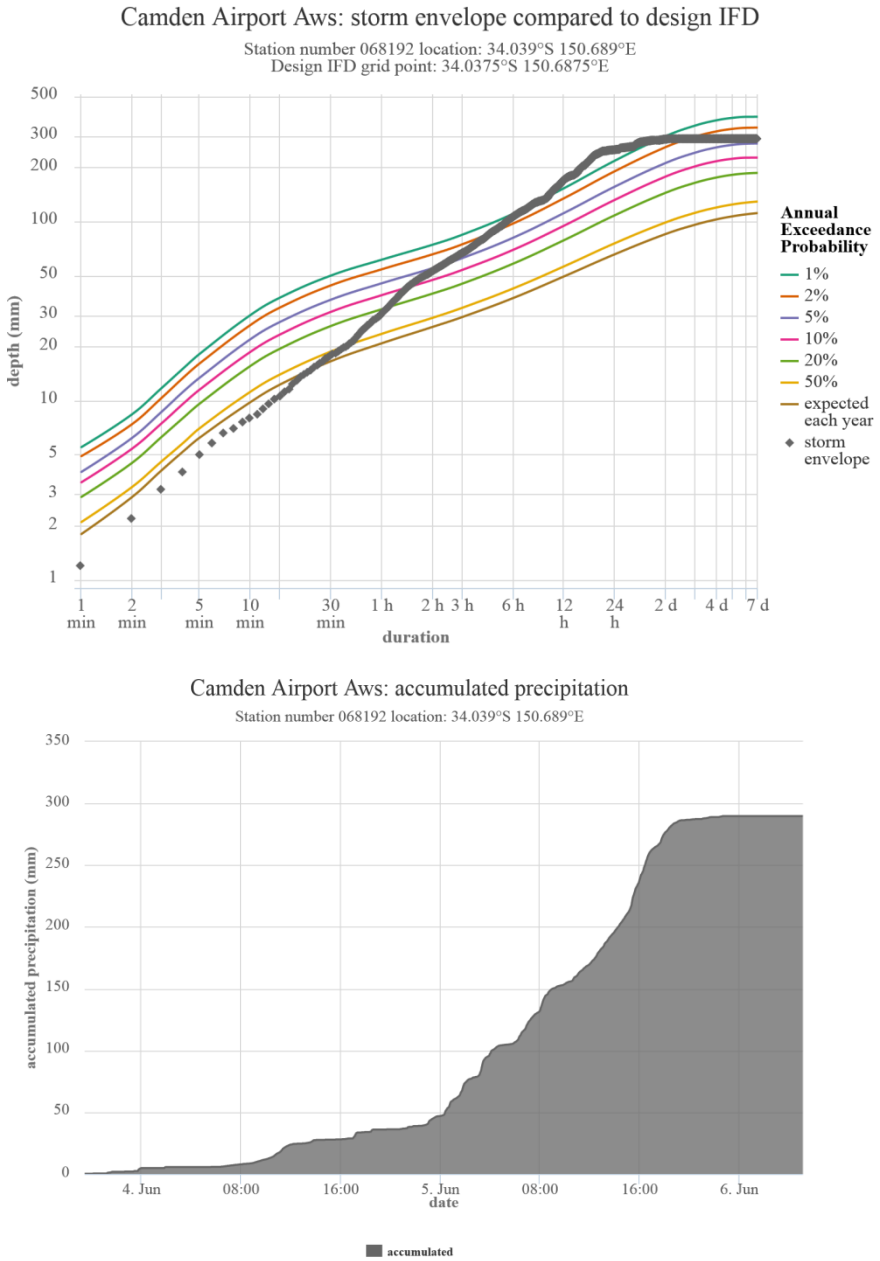

Figure 3. Storm envelope (top) at Camden (New South Wales) compared to the design IFD curves. Storm envelope is the greatest amount of rainfall recorded over various durations through the event. The observed rainfall at durations from 12 to 36 hours had a less than 1% probability of exceedance in any given year. The accumulated precipitation (bottom) shows rainfall was nearly constant between 00:00 to 18:00 on 5 June, resulting in nearly 230 mm in eighteen hours.

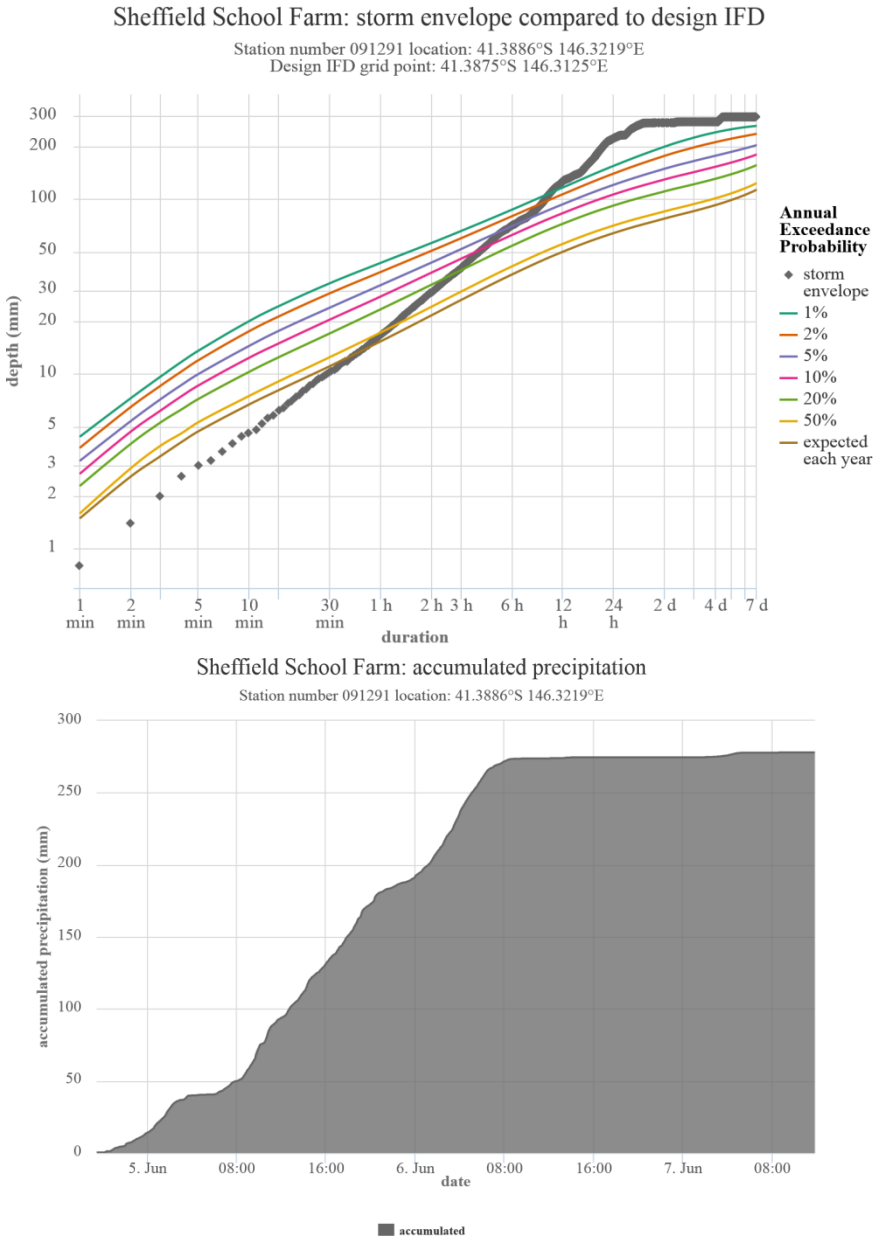

Figure 4. Storm envelope (top) at Sheffield (Tasmania) compared to the design IFD curves. Storm envelope is the greatest amount of rainfall recorded over various durations through the event. The observed rainfall at durations from 12 hours to more than 4 days had a less than 1% probability of exceedance in any given year. The accumulated precipitation (bottom) shows that the rainfall rate was approximately constant for thirty six hours, between 20:00 4 June to 08:00 6 June, resulting in nearly 272 mm.

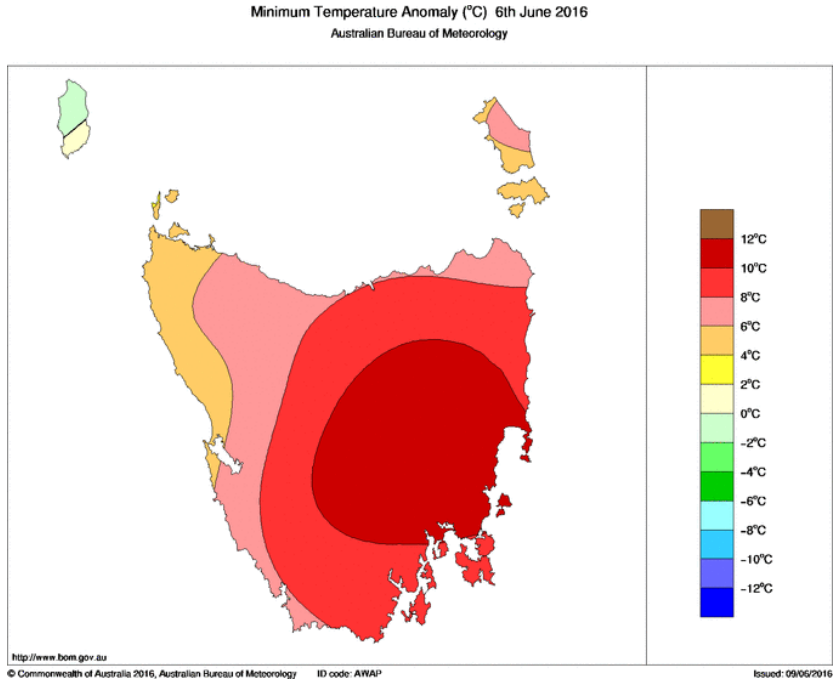

Figure 5. Minimum temperature anomaly (departure from 1961–90 average) for 6 June 2016 for Tasmania.

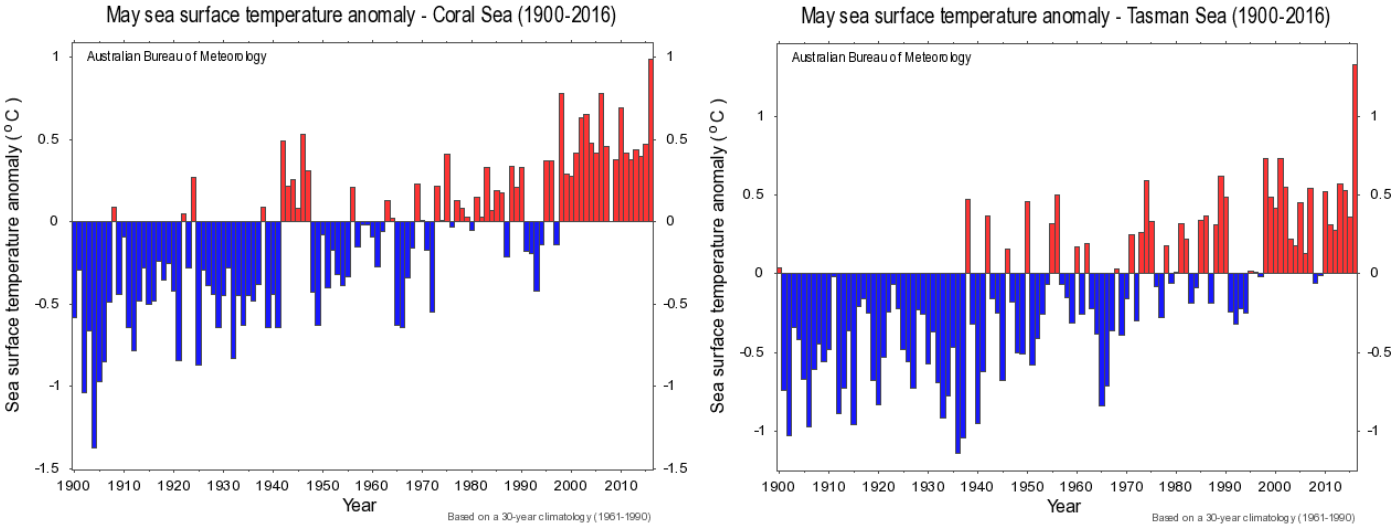

Figure 6. May 2016 sea surface temperature anomalies in the Coral Sea (left) and Tasman Sea (right) highlighting the record warmth in the oceans which served as a source for the low pressure system.

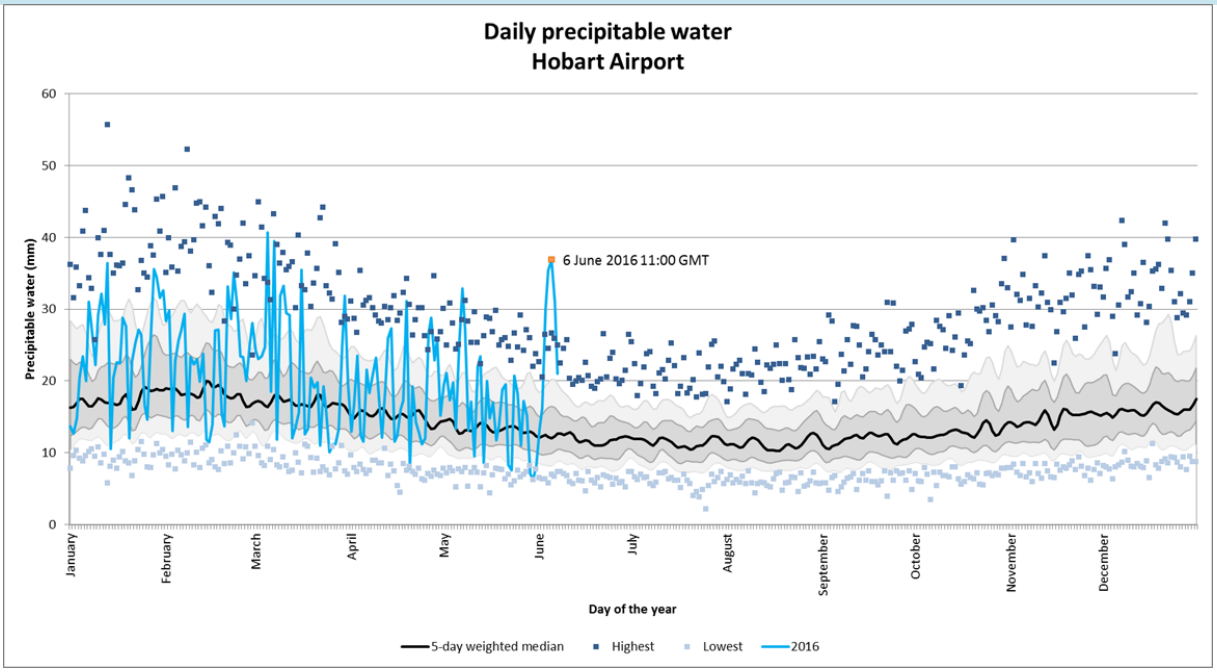

Figure 7. Precipitable water, as indicated by the light blue line, at Hobart Airport showing the record high June value. The new June 2016 value of 36.9 mm, on 6 June 2016 at 11:00 GMT, surpassed the previous observed June record of 26.7 mm on 5 June 1998 at 23:00 GMT

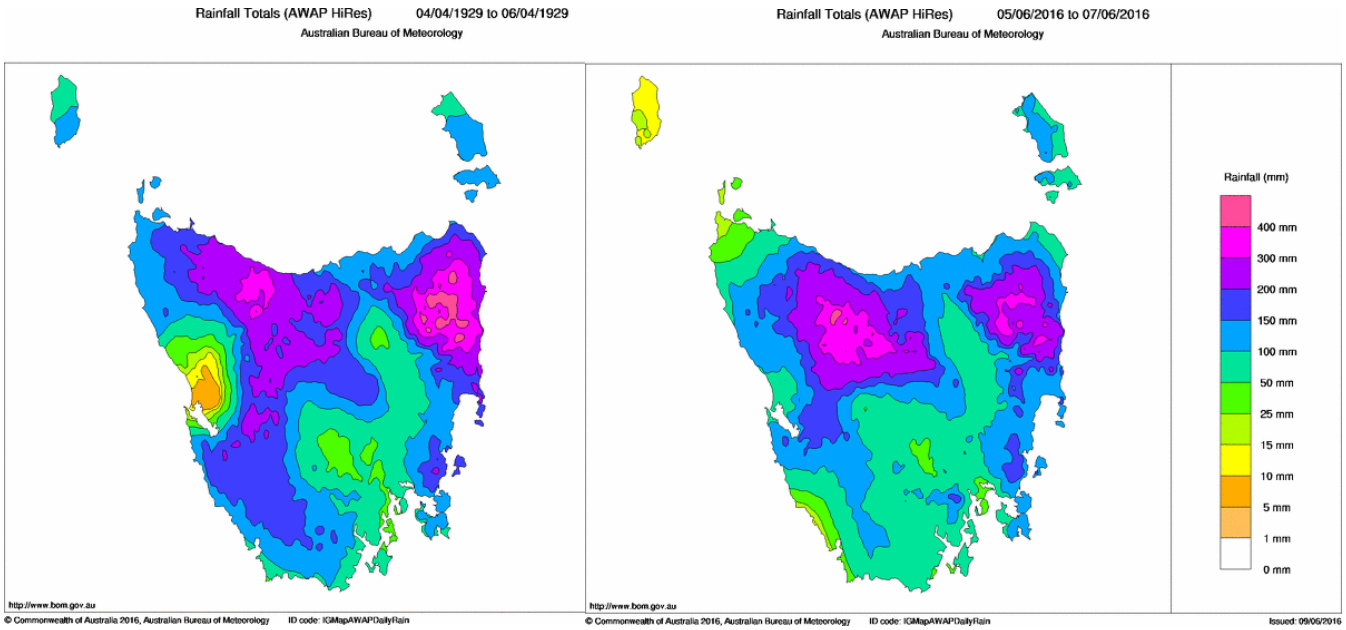

Figure 8. Three-day rainfall totals for (left) April 4–6 1929, and (right) to 5–7 June 2016.

Table 1. June record daily rainfalls set between 4 and 7 June 2016 at locations with 40 or more years of data. Values which are records for any month are shown in bold.

Station number	Station name	State	New daily record (mm)	Date of new record	Previous record (mm)	Date of previous record
35049	Gillespie	QLD	66	3/6/2016	56.4	4/6/1923
40693	Highvale	QLD	135.2	4/6/2016	133.4	11/6/1967
44137	Rosehill	QLD	94.4	4/6/2016	62	9/6/2001
44154	Whyenbah	QLD	105	4/6/2016	85	19/6/1983
48031	Collarenebri (Albert St)	NSW	71.8	4/6/2016	61	25/6/1931
52023	Pilliga Post Office	NSW	87.4	3/6/2016	65.8	25/6/1931
52067	Rowena Post Office	NSW	66.6	4/6/2016	50.6	21/6/1979
55067	Goonoo Goonoo Station	NSW	66.2	5/6/2016	56.5	1/6/1993
55136	Woolbrook (Danglemah Road)	NSW	50	5/6/2016	37	23/6/1998
55195	Gowrie (Lallybroch)	NSW	65.7	5/6/2016	59.6	1/6/1981
58002	Bangalow (Fowlers Lane)	NSW	240	5/6/2016	181.4	11/6/1966
58040	Mullumbimby (Fairview Farm)	NSW	303	5/6/2016	287	30/6/2005
58137	Kingscliff (Marine Parade)	NSW	240.8	5/6/2016	144.2	18/6/1984
58148	Lillian Rock (Williams Road)	NSW	202	4/6/2016	175.4	30/6/2005
58158	Murwillumbah (Bray Park)	NSW	194	5/6/2016	174.4	30/6/2005
59060	Wittitrin	NSW	198	5/6/2016	148	4/6/2008
60013	Forster - Tuncurry Marine Rescue	NSW	151.4	5/6/2016	144.8	01/6/1897
60085	Yarras (Mount Seaview)	NSW	263.6	5/6/2016	192.8	4/6/2008
66006	Sydney Botanic Gardens	NSW	125.8	5/6/2016	123.7	29/6/1890
66036	Marrickville Golf Club	NSW	104	5/6/2016	81	9/6/2007
66047	Pennant Hills (Yarrara Road)	NSW	132	6/6/2016	127.5	10/6/1964
66047	Pennant Hills (Yarrara Road)	NSW	136	5/6/2016	127.5	10/6/1964
68054	Robertson (Caalong Street)	NSW	365	6/6/2016	289.8	12/6/1964
68192	Camden Airport AWS	NSW	139.8	6/6/2016	135	11/6/1991
68192	Camden Airport AWS	NSW	141	5/6/2016	135	11/6/1991
69006	Bettowynd (Condry)	NSW	150	6/6/2016	121	22/6/1975
69022	Narooma (Marine Rescue)	NSW	139.7	5/6/2016	130	28/6/1997
69023	Nelligen (Thule Road)	NSW	128.6	6/6/2016	128.3	12/6/1964
69062	**Snowball**	**NSW**	**168**	**6/6/2016**	**128**	**9/6/1991**
70016	Captains Flat (Foxlow St)	NSW	101.4	6/6/2016	100	22/6/1975
70060	Lower Boro (Calderwood)	NSW	102.8	6/6/2016	80	27/6/1997

Station number	Station name	State	New daily record (mm)	Date of new record	Previous record (mm)	Date of previous record
70247	Canberra (Australian National Botanic Ga	NSW	59.8	6/6/2016	52.8	28/6/1997
71022	Berridale (Bolton Street)	NSW	82.6	6/6/2016	50	28/6/1997
75041	Griffith Airport AWS	NSW	29.4	4/6/2016	29	1/6/2014
84016	Gabo Island Lighthouse	VIC	93.2	6/6/2016	90.2	27/6/2007
91002	Blackwood Creek (Kopanica)	TAS	121	5/6/2016	76.2	17/6/1962
91009	Burnie (Round Hill)	TAS	82.4	6/6/2016	54	8/6/1995
91019	Connorville (Lake River)	TAS	82	6/6/2016	46.4	14/6/1988
91029	Dunorlan (Sharmans Road)	TAS	124.2	6/6/2016	63.5	21/6/1945
91033	**Frankford (Rossville)**	**TAS**	**143**	**6/6/2016**	**77**	**19/6/1904**
91039	Northdown (Hamley)	TAS	97.8	6/6/2016	56.1	29/6/1910
91040	**Hampshire (Neena Road)**	**TAS**	**174.6**	**6/6/2016**	**99.3**	**4/6/1929**
91041	Hillwood (Hillwoodville)	TAS	91	6/6/2016	45	8/6/1995
91048	Latrobe (Coal Hill Road)	TAS	104	6/6/2016	89.4	13/6/1889
91055	Lorinna	TAS	63.8	5/6/2016	63.5	16/6/1961
91055	**Lorinna**	**TAS**	**243.4**	**6/6/2016**	**63.5**	**16/6/1961**
91086	Ringarooma (Main Street)	TAS	118	6/6/2016	85.1	17/6/1962
91088	St Patricks River (Targa Farm)	TAS	143.4	6/6/2016	85.1	4/6/1929
91090	Selbourne (Kirnbrae)	TAS	105	6/6/2016	70.1	4/6/1929
91095	Windermere (Acacia House)	TAS	82.6	6/6/2016	50.5	19/6/1931
91102	Ulverstone (Knights Road)	TAS	113.4	6/6/2016	83.6	18/6/1955
91107	Wynyard Airport	TAS	127.6	6/6/2016	65	2/6/1947
91109	**Yolla (Sea View)**	**TAS**	**248**	**6/6/2016**	**92.7**	**20/6/1945**
91121	Waterhouse(Barooga)	TAS	78	6/6/2016	39	4/6/1988
91126	Devonport Airport	TAS	88	6/6/2016	50.6	11/6/1988
91153	**Barrington Post Office**	**TAS**	**164.6**	**6/6/2016**	**78**	**17/6/1989**
91161	Parkham (Avenue Road)	TAS	116	6/6/2016	60	14/6/1988
91171	**East Sassafras (Elphin Grove)**	**TAS**	**119.4**	**6/6/2016**	**50.6**	**6/6/2003**
91173	Tomahawk (Carisbrooke)	TAS	64	6/6/2016	39.4	13/6/2008
91219	Scottsdale (West Minstone Road)	TAS	69.6	6/6/2016	56.6	17/6/2010
92029	Ormley	TAS	65	6/6/2016	64.5	5/6/1923
92051	Pyengana (Forest Lodge Road)	TAS	129.4	5/6/2016	71	17/6/2010
92051	**Pyengana (Forest Lodge Road)**	**TAS**	**211**	**6/6/2016**	**71**	**17/6/2010**
93014	Oatlands Post Office	TAS	77.4	6/6/2016	54	2/6/1981

Station number	Station name	State	New daily record (mm)	Date of new record	Previous record (mm)	Date of previous record
96046	Miena Dam	TAS	73.6	6/6/2016	53.8	5/6/1923
97021	**Renison Bell**	**TAS**	**115.4**	**6/6/2016**	**73.2**	**16/6/1935**
97047	Savage River Mine	TAS	88.2	6/6/2016	56.8	29/6/1988
97054	Zeehan (West Coast Pioneers Museum)	TAS	119.4	6/6/2016	73.4	15/6/1994
99005	Flinders Island Airport	TAS	77.2	6/6/2016	73.7	17/6/1952
99014	Memana (Babel Farm)	TAS	52.2	6/6/2016	46.2	9/6/1977
99015	Whitemark Post Office	TAS	104.2	6/6/2016	37.6	7/6/2009

Table 2. Highest 1-day regional average rainfalls for eastern New South Wales and northern Tasmania.

Eastern New South Wales		Northern Tasmania	
Value (mm)	**Date**	**Value (mm)**	**Date**
73.11	5/06/2016	114.51	6/06/2016
68.89	19/01/1950	102.89	19/02/1946
64.97	21/02/1954	97.34	5/04/1929
57.25	4/02/1990	71.53	9/10/1992
54.1	29/01/2013	71.36	2/04/1989

Table 3. Highest on record 3-day rainfall totals for June

Station number	Station name	State	New record (mm)	New record start date	Previous record (mm)	Previous record start date	All-months record (mm)	
60013	Forster-Tuncurry	NSW	217.2	4/06/2016	201.4	24/06/1956		
66052	Randwick	NSW	237.8	4/06/2016	222.2	10/06/1991		
66070	Strathfield	NSW	265	4/06/2016	208.8	10/06/1964		
66080	Castle Cove	NSW	305	4/06/2016	257	10/06/1991		
66182	Frenchs Forest	NSW	327	4/06/2016	262.1	10/06/1964		
68044	**Mittagong**	**NSW**	**349**	**4/06/2016**	**324.1**	**10/06/1991**	**324.1**	**10/06/1991**
68054	Robertson	NSW	580	4/06/2016	548.6	10/06/1964		
69002	Bega	NSW	346.6	4/06/2016	280.1	14/06/1952		
70060	Lower Boro (Calderwood)	NSW	178.2	4/06/2016	162	26/06/1997		
70083	Tharwa	NSW	110	4/06/2016	73.2	27/06/1997		
71005	Dalgety	NSW	128.8	5/06/2016	86	08/06/1991		
91002	**Blackwood Creek (Kopanica)**	**TAS**	**193.2**	**4/06/2016**	**87.2**	**9/06/1988**	**158.2**	**22/02/1969**

Station number	Station name	State	New record (mm)	New record start date	Previous record (mm)	Previous record start date	All-months record (mm)	
91019	Connorville (Lake River)	TAS	119.6	5/06/2016	73.7	11/06/1953		
91029	Dunorlan	TAS	151.4	5/06/2016	85.2	15/06/1961		
91033	Frankford	TAS	188.8	5/06/2016	115.2	5/06/2003		
91039	Northdown	TAS	121.6	5/06/2016	105.1	23/06/1955		
91040	**Hampshire**	**TAS**	**243.6**	**5/06/2016**	**147.8**	**3/06/1929**	**228.1**	**4/04/1929**
91041	Hillwood	TAS	124	5/06/2016	90.7	23/06/1955		
91086	Ringarooma	TAS	192.2	5/06/2016	143.8	30/05/1969		
91088	**St Patricks River (Targa Farm)**	**TAS**	**218.4**	**5/06/2016**	**140.7**	**4/06/1929**	**214.9**	**4/04/1929**
91090	Selbourne	TAS	131.6	5/06/2016	113.5	4/06/1929		
91095	Windermere	TAS	117	5/06/2016	73.7	25/06/1938		
91102	Ulverstone	TAS	148.4	5/06/2016	114.3	23/06/1955		
91107	Wynyard	TAS	157.2	5/06/2016	94.2	23/06/1955		
91109	**Yolla**	**TAS**	**310.6**	**5/06/2016**	**117.6**	**16/06/1947**	**299.7**	**4/04/1929**
91126	Devonport	TAS	107	5/06/2016	74.2	25/06/1975		
91149	**Kimberley**	**TAS**	**192**	**5/06/2016**	**74.6**	**8/06/1995**	**182.3**	**29/01/2016**
91153	**Barrington**	**TAS**	**216.2**	**5/06/2016**	**84.4**	**13/06/2004**	**198**	**13/01/2011**
91161	Parkham	TAS	148.6	5/06/2016	70	8/06/1995		
91171	East Sassafras	TAS	146.2	5/06/2016	93.8	5/06/2003		
91173	Tomahawk	TAS	112.2	5/06/2016	51.4	17/06/2010		
91219	Scottsdale	TAS	111.2	5/06/2016	98.2	8/06/1995		
92006	**Buckland**	**TAS**	**233.8**	**5/06/2016**	**181.9**	**5/06/1923**	**194.3**	**22/04/1960**
92011	Gladstone	TAS	130	5/06/2016	121.4	7/06/1922		
92024	Mathinna	TAS	211	5/06/2016	151.4	10/06/1970		
92030	Pioneer	TAS	176	5/06/2016	172.2	30/05/1969		
92051	Pyengana	TAS	367.4	5/06/2016	310.6	30/05/1969		
93014	Oatlands	TAS	133.7	6/06/2016	90	8/06/2011		
94014	Colebrook	TAS	83.4	5/06/2016	78.5	30/05/1969		
94140	Melton Mowbray	TAS	65.8	5/06/2016	63	27/06/1980		
96046	Miena Dam	TAS	107.8	5/06/2016	82.6	30/05/1969		
97047	Savage River Mine	TAS	104.2	5/06/2016	89.4	19/06/1974		
99005	Flinders Island	TAS	113.8	5/06/2016	101.1	16/06/1952		
99014	Memana	TAS	81.4	5/06/2016	74	6/06/2009		
99015	Whitemark	TAS	149.2	5/06/2016	57.4	6/06/2009		

Table 4. Minimum temperature records for June.

Station number	Station name	State	New daily record (°C)	Date of new record	Previous record (°C)	Date of previous record
61425	Gosford AWS	NSW	15.5	5/6/2016	15.5	4/6/1974
69128	Nerriga AWS	NSW	12	5/6/2016	12	26/6/1991
70278	Cooma Visitors Centre	NSW	10	6/6/2016	10	26/6/1991
94029	Hobart (Ellerslie Road)	TAS	15	6/6/2016	14.4	1/6/1976
94010	Cape Bruny Lighthouse	TAS	14.7	7/6/2016	14.4	7/6/1957
94198	Cape Bruny (Cape Bruny)	TAS	14.6	7/6/2016	14.4	7/6/1957
94008	Hobart Airport	TAS	15.1	6/6/2016	12.5	8/6/1991
94220	Grove (Research Station)	TAS	14.6	6/6/2016	13.3	1/6/1973
92120	St Helens Aerodrome	TAS	15.3	6/6/2016	14	8/6/1991
92148	Swansea (Francis Street)	TAS	15	6/6/2016	14.4	5/6/1965
95003	Bushy Park (Bushy Park Estates)	TAS	14.8	6/6/2016	13.3	8/6/1957
99005	Flinders Island Airport	TAS	15.9	5/6/2016	15.2	7/6/1991
91291	Sheffield School Farm	TAS	11.8	6/6/2016	11.7	6/6/1998
91219	Scottsdale (West Minstone Road)	TAS	13.4	5/6/2016	12.7	9/6/1995
92027	Orford (Aubin Court)	TAS	14.9	6/6/2016	13.1	8/6/1991
92133	Spring Bay NTC AWS	TAS	15.1	6/6/2016	13.1	8/6/1991
92003	Bicheno (Council Depot)	TAS	15.1	6/6/2016	14.4	7/6/1991
95063	Maydena Post Office	TAS	11.9	6/6/2016	11.1	5/6/1965
91306	Cressy Research Station	TAS	12.7	6/6/2016	11.8	1/6/2004
94087	Kunanyi (Mount Wellington Pinnacle)	TAS	8.5	7/6/2016	7.1	1/6/1993
92012	Fingal (Legge Street)	TAS	14.4	6/6/2016	13	12/6/2002

Table 5. Catchment area rainfall averages. Catchments which had their wettest June day on record are shown in bold.

Catchment	Rainfall 5 June (mm)	Rainfall 6 June (mm)	Ranking of wettest day (all months)	June record	All-months record
Tweed	176.34	0.06	37	227.92 (11/6/1945)	325.05 (6/2/1931)
Brunswick	**262.17**	**0.2**	**4**	**258.54 (30/6/2005)**	**277.40 (2/2/2001)**
Richmond	129.28	0.08	23	165.72 (30/6/2005)	235.24 (21/2/1954)
Clarence	89.89	0.7	28	110.56 (13/6/1967)	186.60 (21/2/1954)
Bellinger	209.13	0.36	5	217.18 (24/6/1950)	304.40 (21/2/1954)
Macleay	92.79	3.24	20	125.18 (2/6/1903)	148.41 (27/8/1949)
Hastings	**163.92**	**9.57**	**6**	**154.06 (19/6/1930)**	**199.25 (23/2/2013)**
Manning	90	13.92	17	105.09 (15/6/2011)	150.37 (20/3/1978)
Karuah	126.16	30.9	7	160.27 (18/6/1949)	236.13 (16/4/1927)
Hunter	38.38	9.33	153	117.59 (9/6/2007)	125.75 (24/2/1955)
Macquarie Lakes	84.79	48.45	88	205.35 (9/6/2007)	216.18 (3/2/1990)
Hawkesbury	75.83	62.69	23	100.64 (21/6/1975)	118.38 (6/8/1986)
Sydney/Georges	132.7	122.87	10	165.48 (11/6/1991)	189.61 (6/8/1986)
Wollongong Coast	152.6	108.35	33	232.09 (11/6/1991)	232.41 (19/11/1961)
Shoalhaven	101.09	122.12	29	132.64 (21/6/1975)	160.73 (11/5/1925)
Clyde/Jervis	139.21	138.03	11	147.37 (12/6/1991)	197.65 (9/4/1945)
Moruya	**120.1**	**177.53**	**3**	**150.59 (9/6/1991)**	**260.41 (9/4/1945)**
Tuross	**117.8**	**146.81**	**4**	**130.32 (28/6/1997)**	**180.95 (6/2/1971)**
Bega	**109.48**	**152.55**	**10**	**127.31 (26/6/1956)**	**280.72 (6/2/1971)**
Towamba	79.88	114.58	20	179.01 (3/6/1978)	270.82 (27/2/1919)

7 References and further information

Values in this statement are current at 16 June 2016, and subject to the Bureau's quality control processes. It is expected that additional data will be received over the coming weeks and the statement will be updated if required.

Further information is available from:
http://www.bom.gov.au/climate

Further information about total atmospheric water vapour and precipitable water available at:
http://www.bom.gov.au/water/designRainfalls/document/HRS12.pdf

Figure 7 data: The graph shows precipitable water calculated from all available digitised upper air observations since January 1992. The black line is the median. The darker grey shading is 25th to 75th percentile. The lighter grey shading is 10th to 90th percentile.

Further information on Intensity-Frequency-Duration design rainfall available at:
http://www.bom.gov.au/water/designRainfalls/ifd/index.shtml

Further information on Topographic drainage divisions and river regions available at:
http://www.bom.gov.au/water/geofabric/inuse.shtml

Detail on extreme rainfall in Tasmania in January 2016 can be found in Special Climate Statement 54—*extreme rainfall in northern and eastern Tasmania*
Detail on Australia's warmest autumn can be found in Special Climate Statement 56—*Australia's warmest autumn on record*

Climate Change In Australia, 2015: CSIRO and Bureau of Meteorology 2015, Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report, CSIRO and Bureau of Meteorology, Australia
See: http://www.climatechangeinaustralia.gov.au/en/