Australian Government
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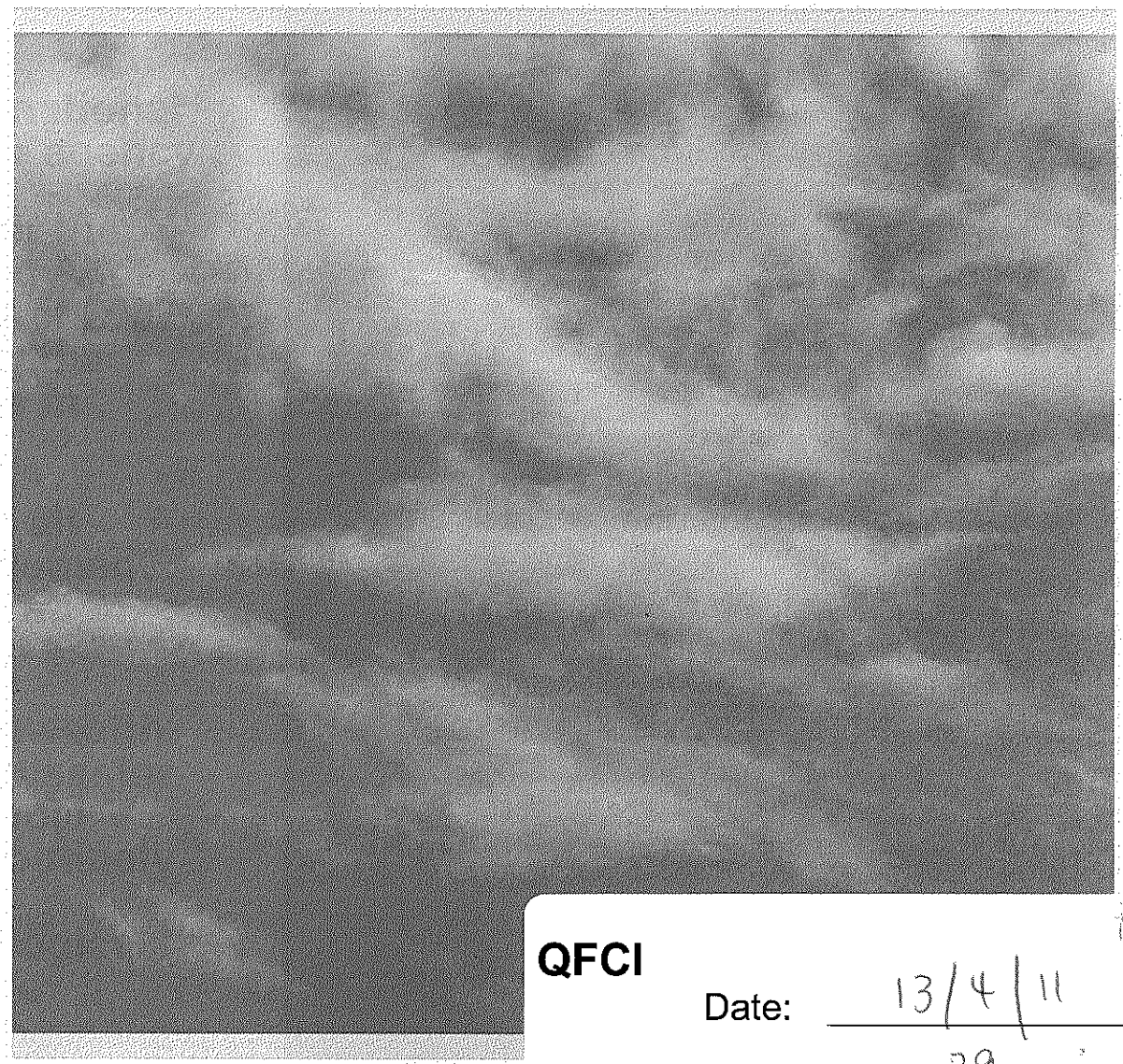
Report to Queensland Floods Commission of Inquiry:

provided in response to a request for information from the Queensland Floods Commission of Inquiry received by the Bureau of Meteorology on 4 March 2011.

Meteorological and Hydrological Overview of the Widespread Rainfall and Flooding in Queensland during December 2010 and January 2011



Jim Davidson
Regional Director (Queensland)
Bureau of Meteorology

Presentation slides provided to the Queensland Floods Commission of Inquiry on 8 April 2011

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Meteorological and Hydrological Overview of the Widespread Rainfall and Flooding in Queensland during December 2010 and January 2011

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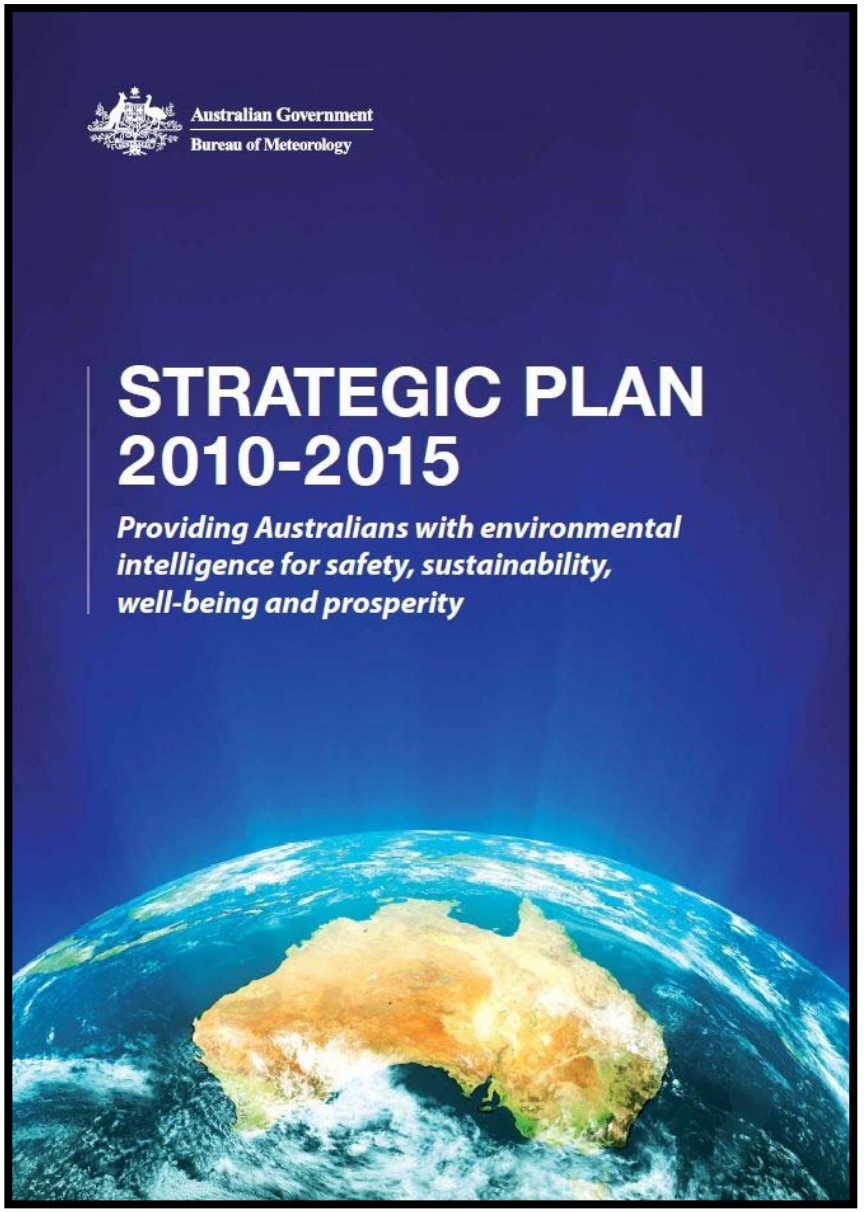
Bureau of Meteorology

- The Bureau is Australia's national weather, climate and water agency
- The Bureau operates under the authority of the Meteorology Act 1955 (Cth) and the Water Act 2007 (Cth), the former providing the legal basis for its activities in disaster mitigation
- The Bureau contributes to all aspects of disaster management including planning, preparation, response and recovery
- The Bureau (as a Commonwealth agency) works with state disaster managers and state and local governments in order to routinely provide the best possible meteorological and hydrological advice and warning service



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Overview of the Presentation

Section 1: Bureau Offices and Networks

Section 2: La Nina and its Impacts

Section 3: Queensland Rainfall to January 2011

Section 4: Bureau Media Releases and Briefings

Section 5: Bureau Communication Channels

Section 6: Forecast Rainfall from October 2010

Section 7: Weather Events December 2010 and January 2011

Section 8: Flood Events December 2010 and January 2011

Section 9: Forecasts and Warnings for Weather and Flood

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Section 1

Bureau Offices and Networks

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Bureau Offices in Queensland

Brisbane Regional Forecast Centre
Co-located Qld Flood Warning Centre
Qld Tropical Cyclone Warning Centre

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Weather Watch Radar Network

Of the radars used by weather forecasters in southeast Queensland, the Brisbane (Mt Stapylton) radar operates at the highest resolution and has 'Doppler' capability to a range of 150km, which extends about 25 km west of Toowoomba area. Of the other radars only the Gympie (Mt Kanighan) radar operates in Doppler mode but at a lower resolution than the Mt Stapylton radar. The Marburg and Grafton radars operate in the lowest resolution mode. Only the Mt Stapylton radar operates with updates every 6 minutes; the other radars update every 10 minutes.

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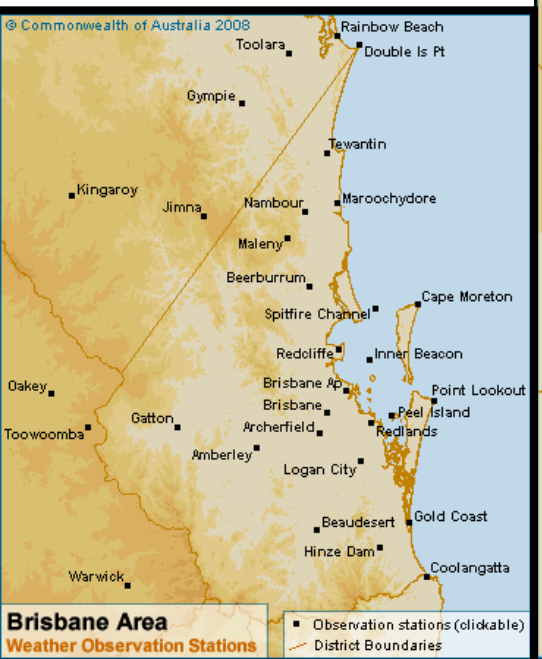
Queensland Weather Observing Stations

Over 100 Automatic Weather Stations (AWS)



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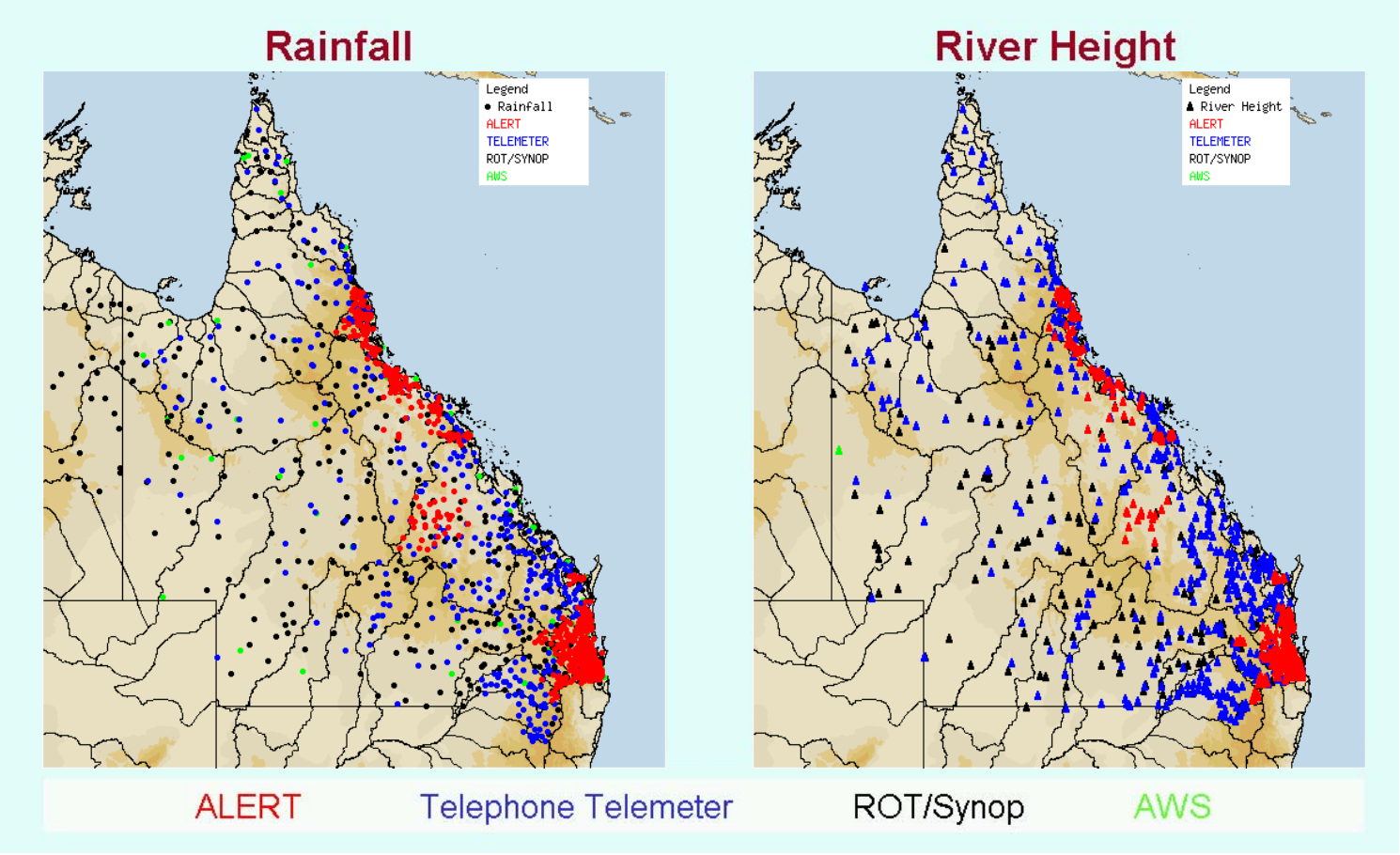
Flood Warning Rainfall & River Height Stations in Queensland



The Queensland Flood Warning Centre (FWC) has access to about 2200 stations owned by the Bureau and various partner agencies providing rainfall and/or water level information. Most stations automatically transmit the data to the FWC.

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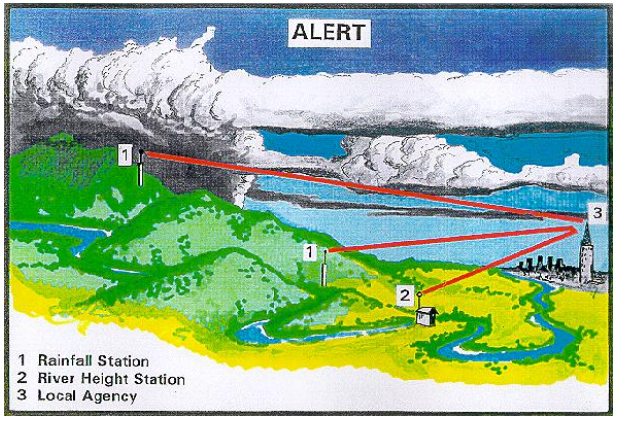
Flood Warning Data Collection Methods

- **Manual Observations**
  - Via Remote Observer Terminal and telephone or via Internet to computer
- **Telemeters/loggers**
  - Via Landline/mobile Telephone to computer
- **ALERT**
  - VHF radio communication
  - Real-time (event) data
  - Backup via UDP on Internet
- **FTP**
  - From other water resources and management agencies
  - Computer to computer

Ownership of 2200 stations used for flood warning in Qld: Bureau-owned ~40%
Bureau & other agency (shared) ~20%
Other agencies ~40%



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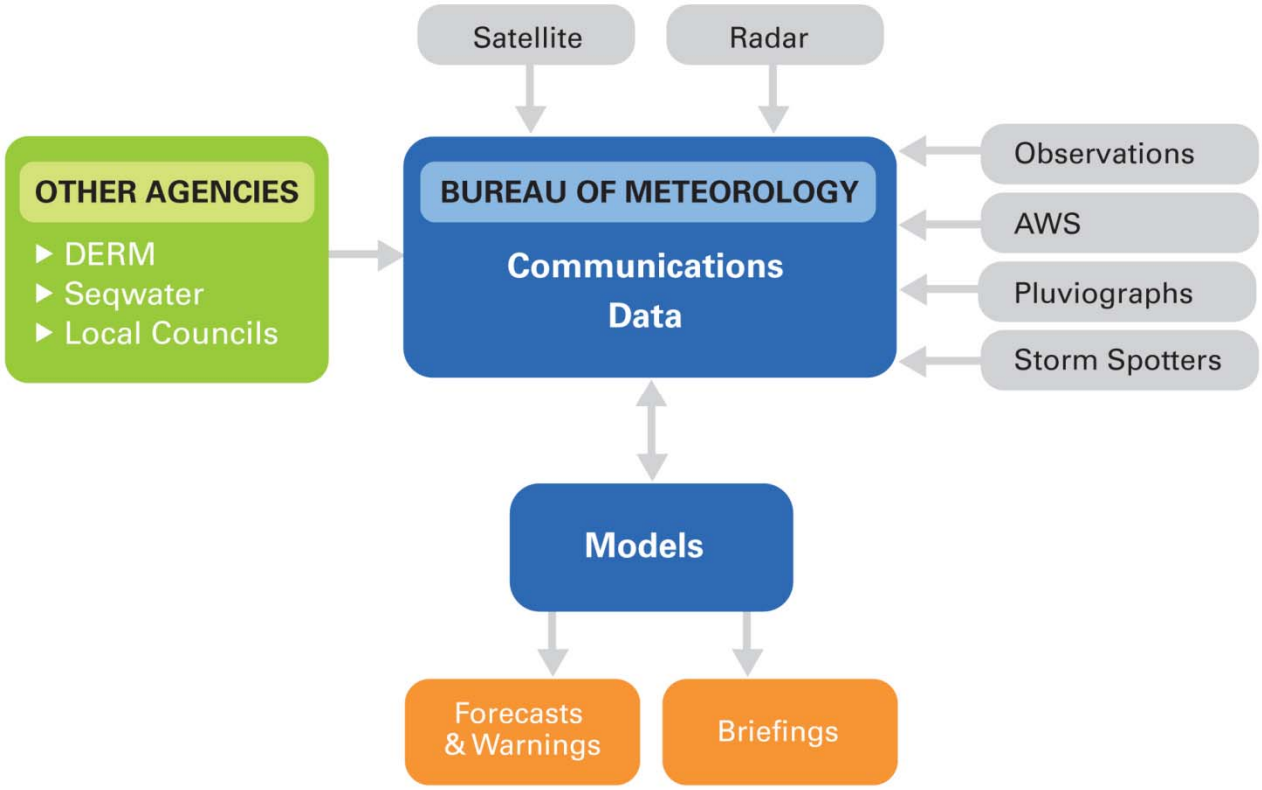
Meteorological and Hydrological Information Data Flow



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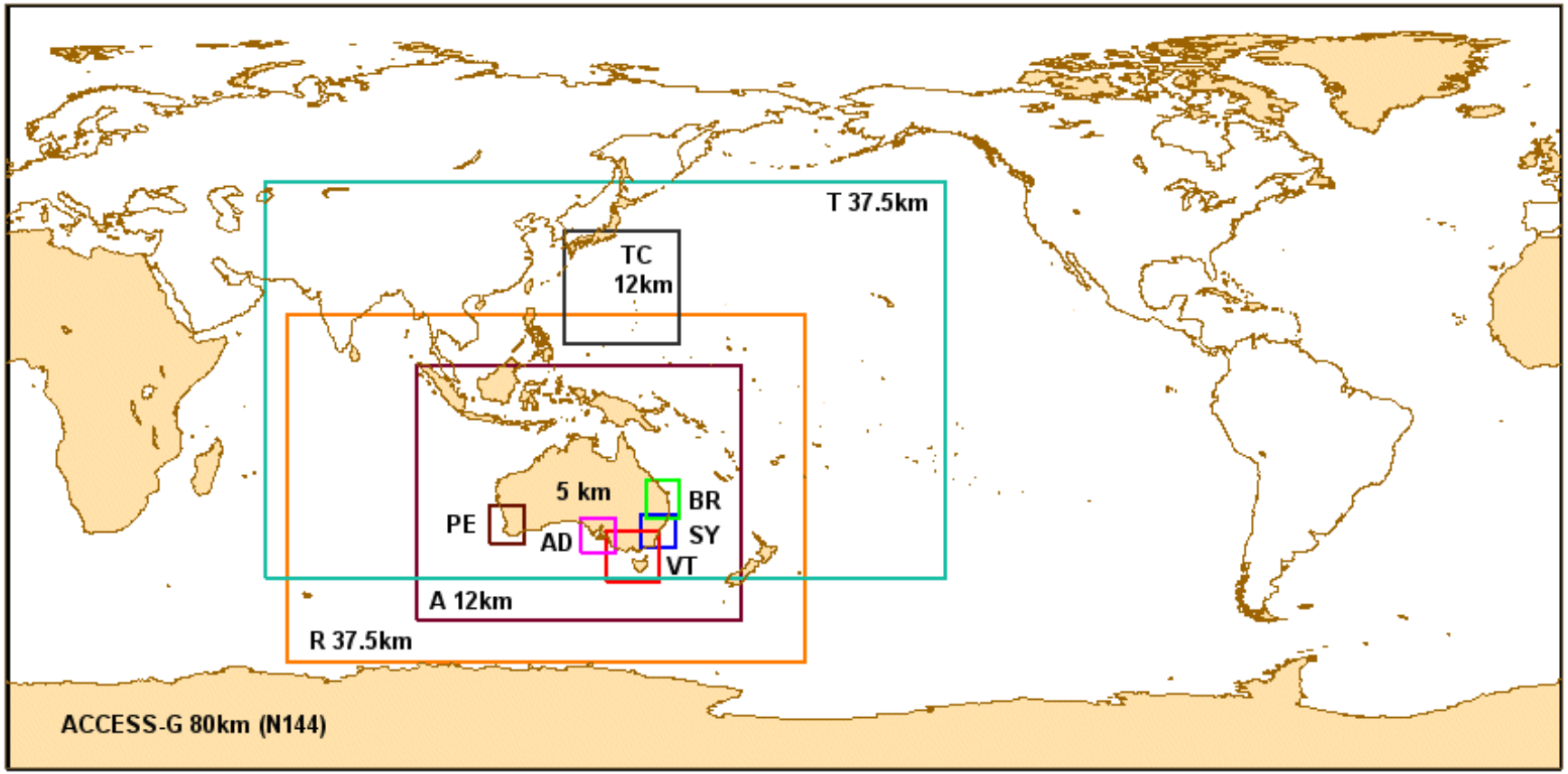
Bureau's Numerical Model – "ACCESS"

ACCESS is the "Australian Community Climate and Earth-System Simulator" which forms the basis of the Bureau's operational numerical weather prediction system. ACCESS is based on the UK Met Office Unified Model.



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Section 2

La Nina and its Impacts

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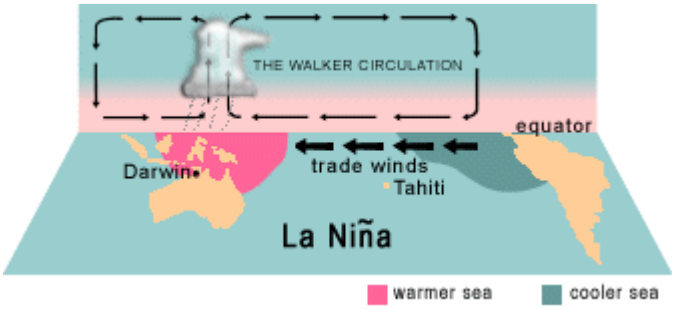
What is La Nina ?

La Nina: The Southern Oscillation Index (SOI) is POSITIVE. SOI is the normalised pressure difference between Tahiti and Darwin



Relatively High Pressure

Relatively Cool Oceans

Decreased Cloudiness

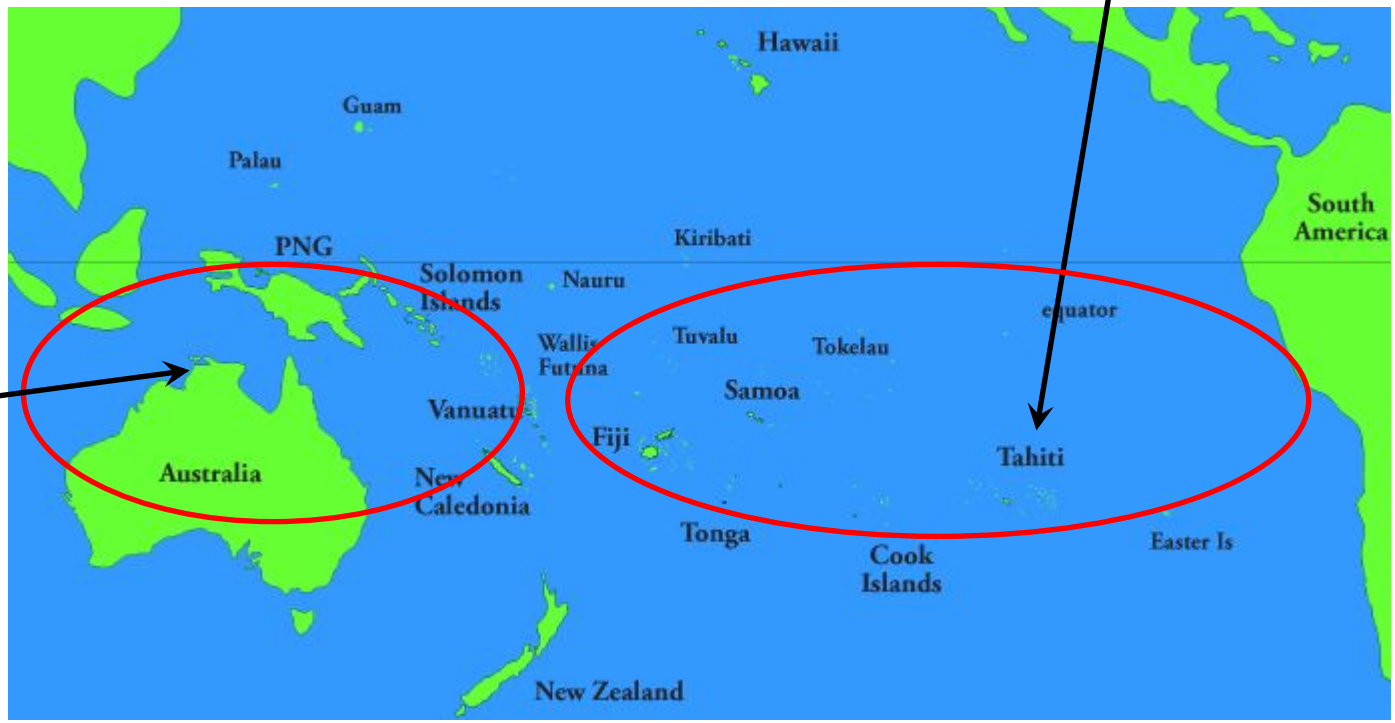
Lower likelihood of Rain & Tropical Cyclones

Relatively Low Pressure

Relatively Warm Oceans

Increased Cloudiness

Higher likelihood of Rain & Tropical Cyclones



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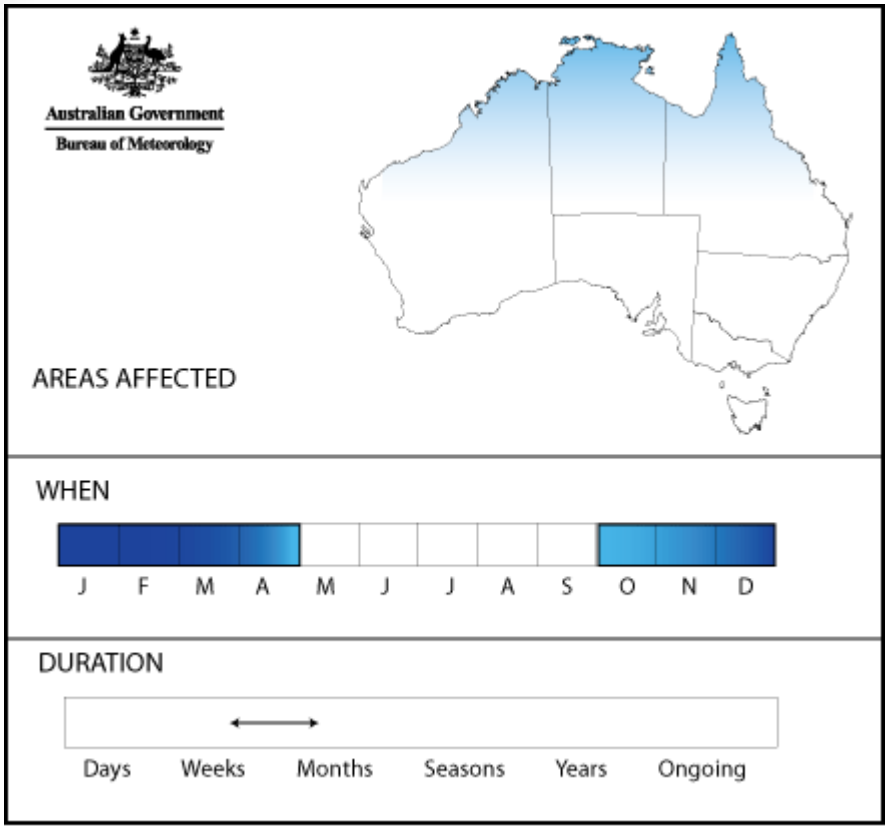
Queensland Wet Season and the Monsoon



- **The Queensland wet season extends from October to April. Active monsoon periods may occur at any time during this period, however the initial monsoon onset normally occurs in late December.**
- **Later than normal onsets are often associated with EL NINO conditions in the Pacific, while LA NINA is usually associated with early onset.**
- **A typical wet season consists of a prolonged inactive period during the buildup (period before the initial onset), followed by 2 or 3 active/inactive cycles, each full cycle lasting from about 4 to 8 weeks. Inactive periods are usually longer than active ones (but not always as we clearly witnessed this season).**

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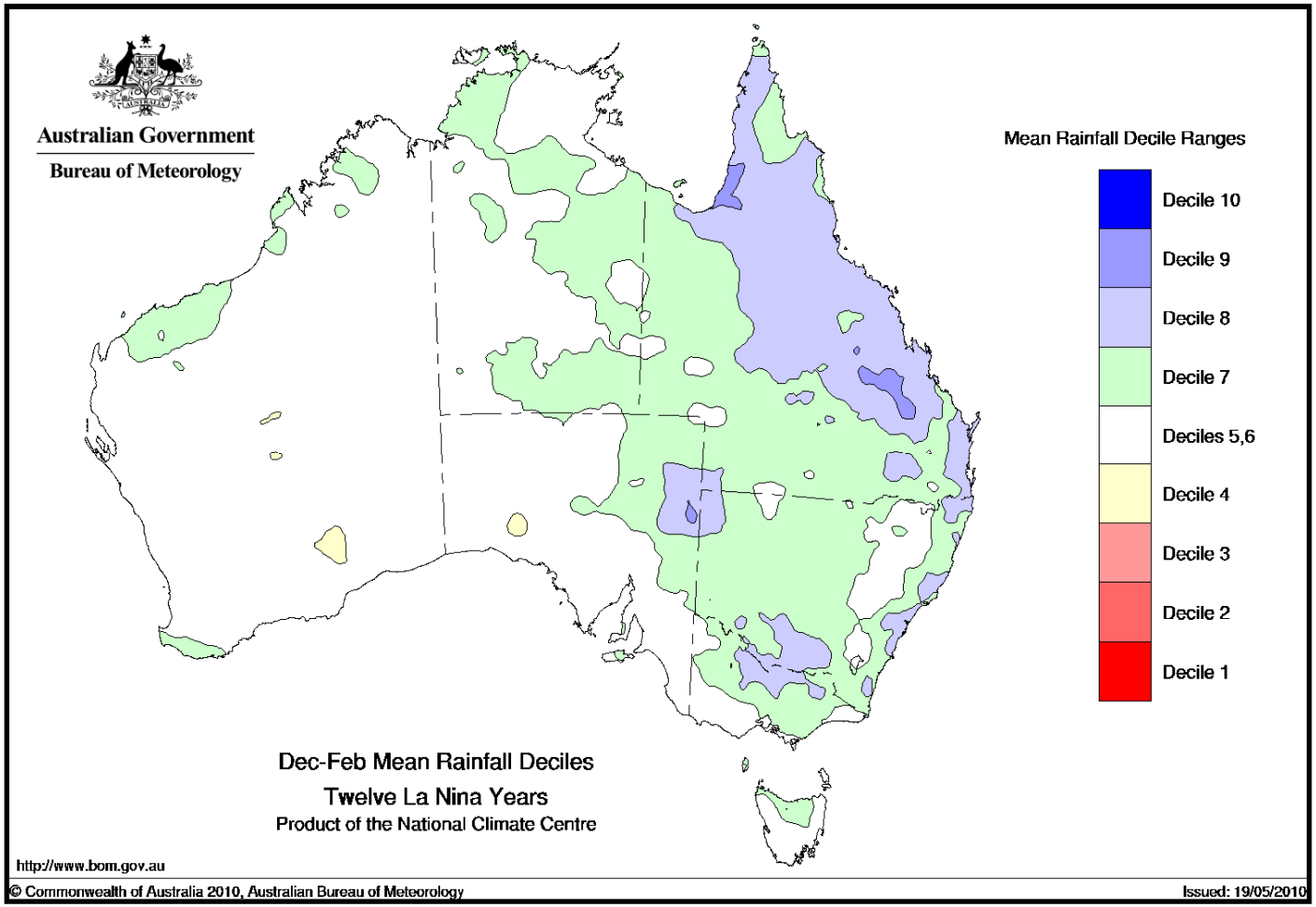
Summer Rainfall Deciles in La Nina Years

DECILE maps show where the rainfalls have been above or below average.

The darker the BLUE – the more above average.

The darker the RED – the more below average.



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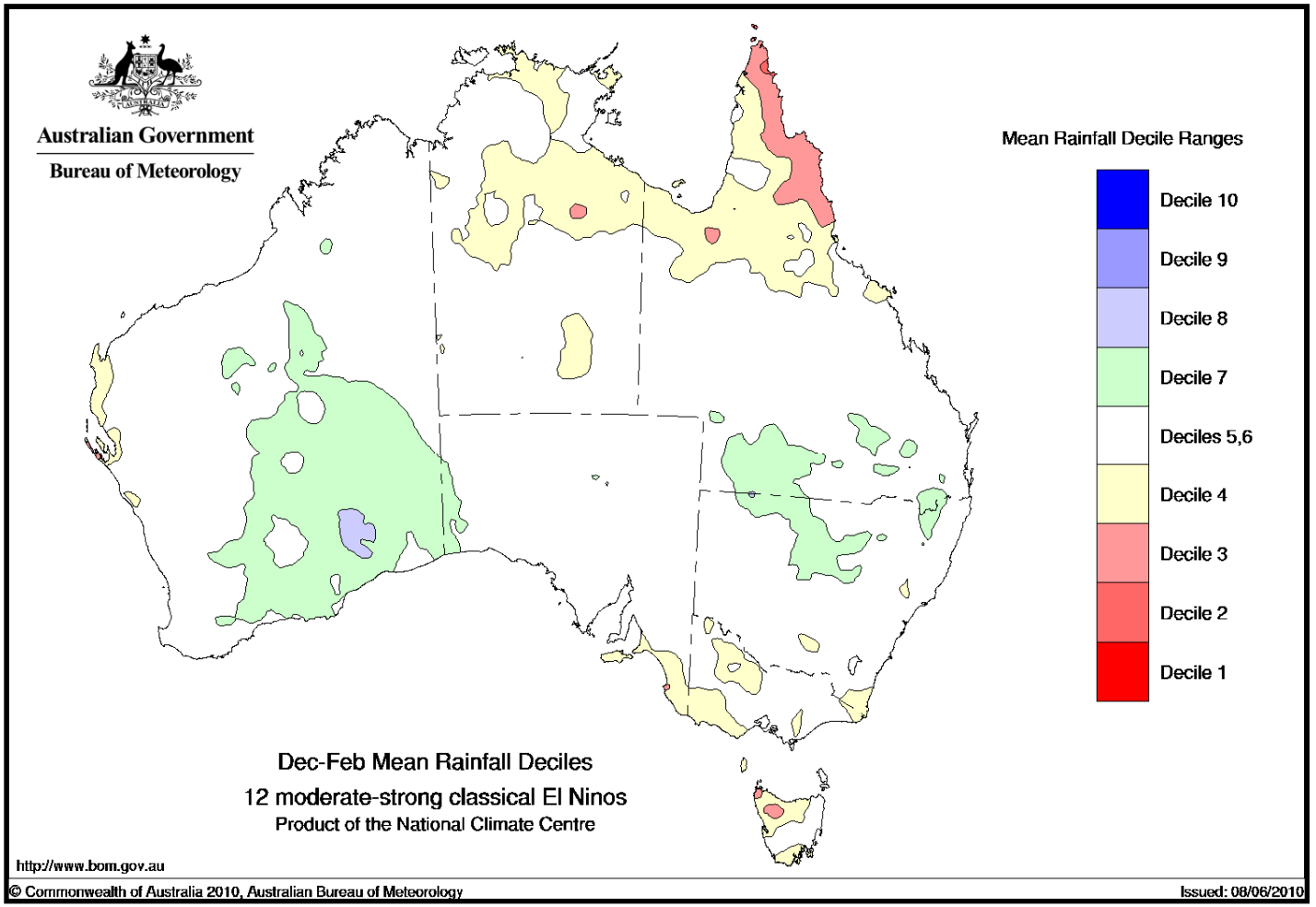
Summer Rainfall Deciles in El Nino Years



Average annual number of tropical cyclones - El Niño years

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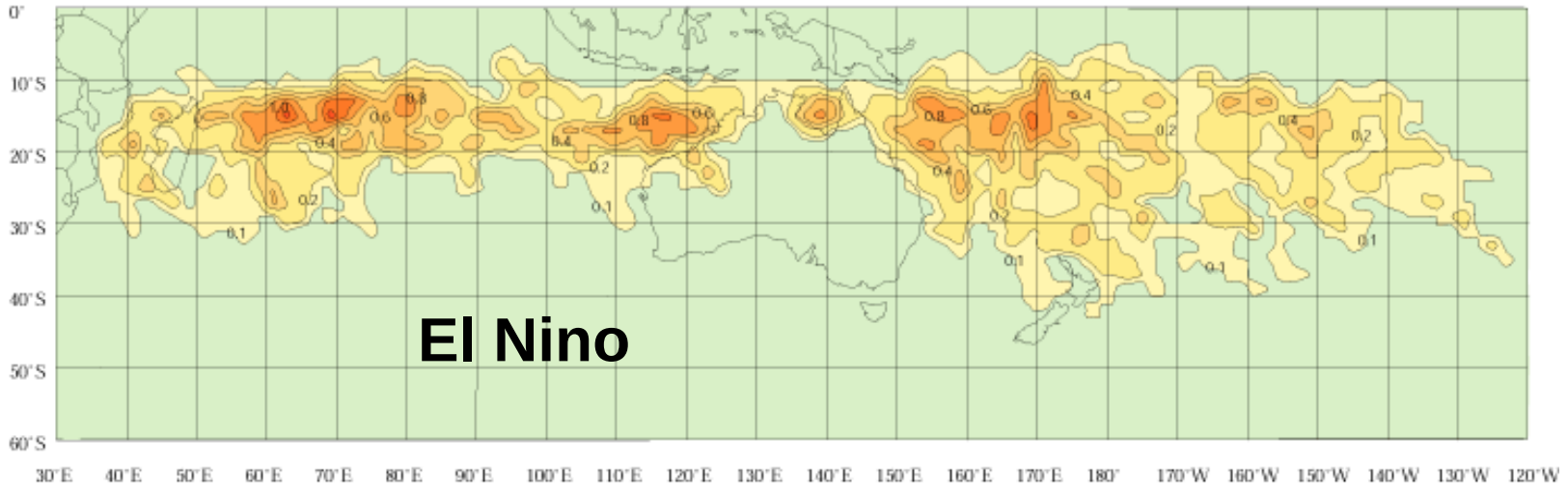

Natural climate variability is a dominating factor in Queensland especially in regards to tropical cyclone and monsoonal activity

Average annual number of tropical cyclones - La Niña years

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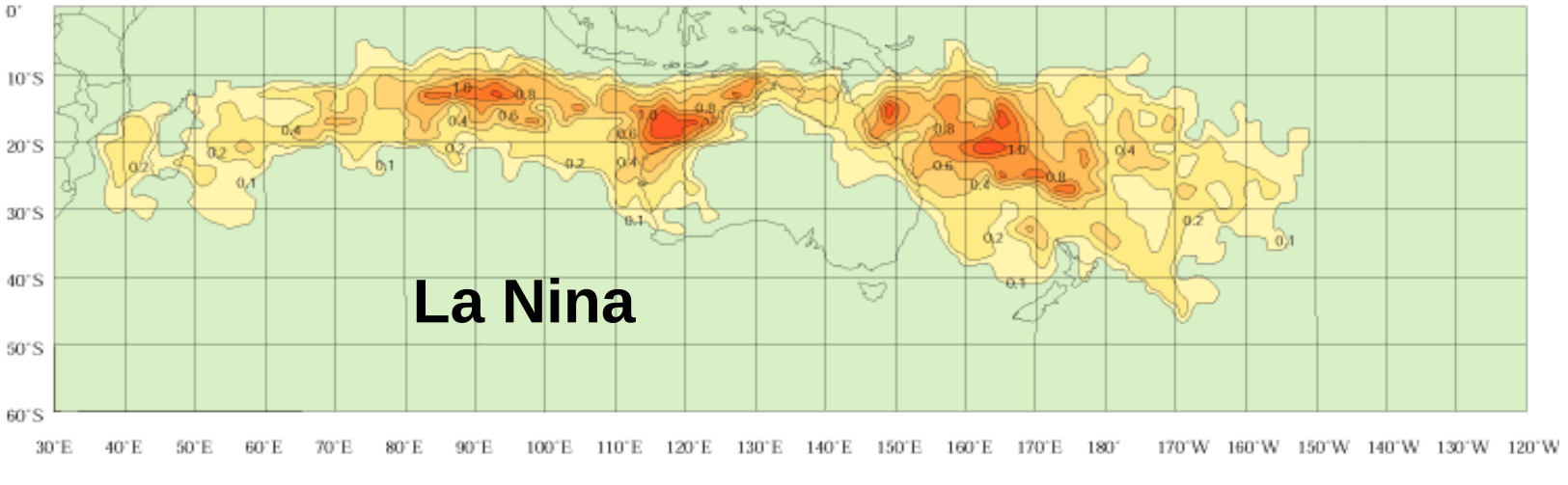
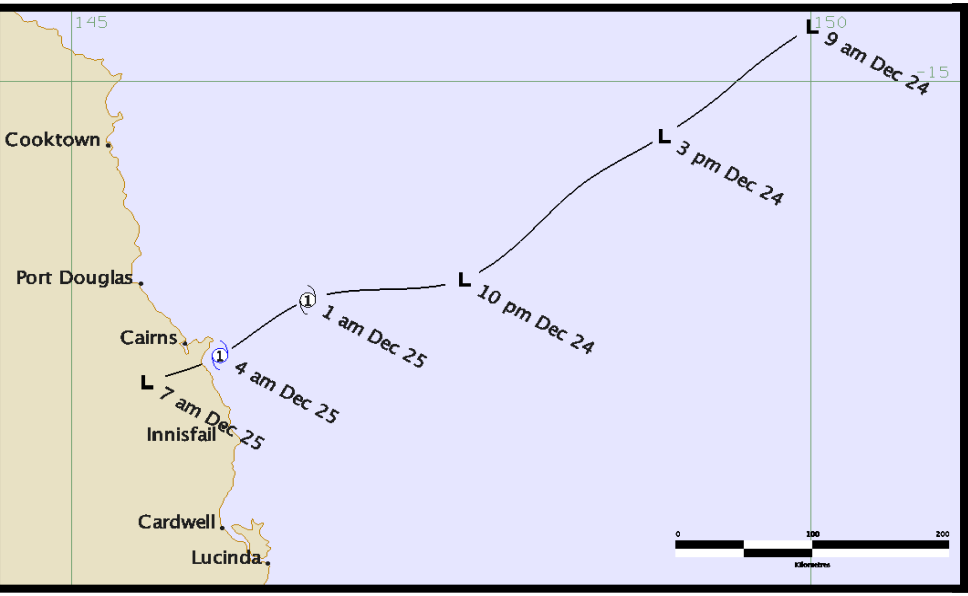
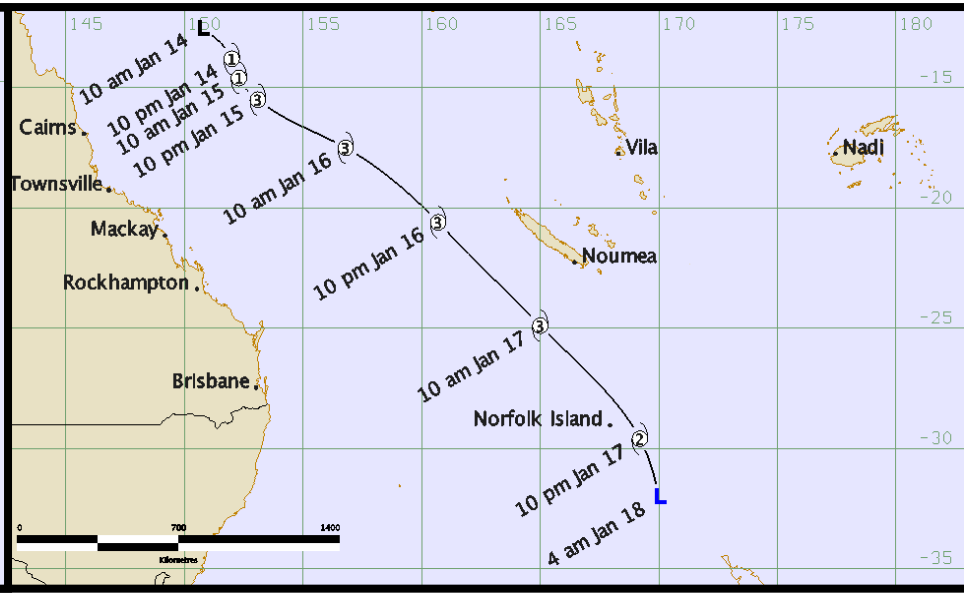


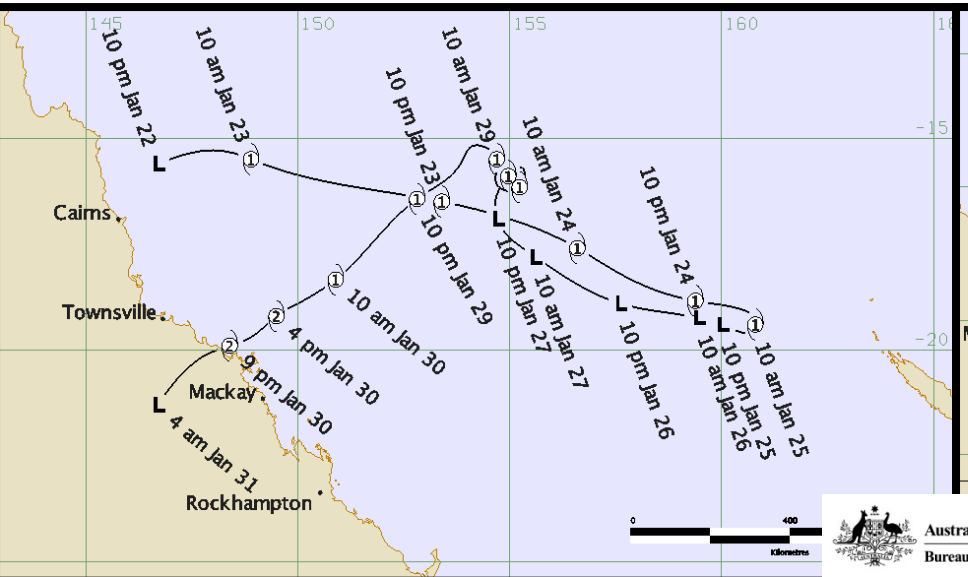
Tropical Cyclone TASHA



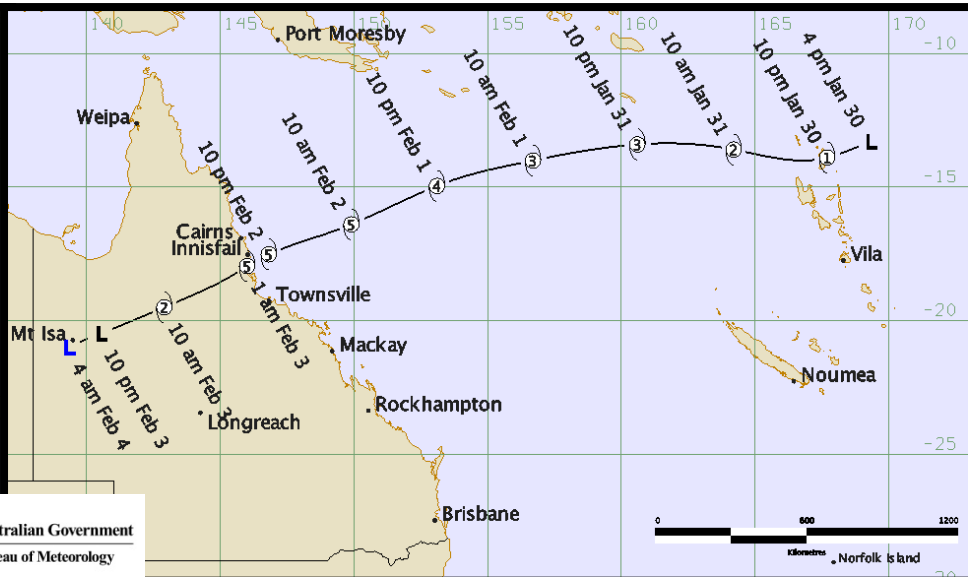
Tropical Cyclone ZELIA



Tropical Cyclone ANTHONY



Tropical Cyclone YASI



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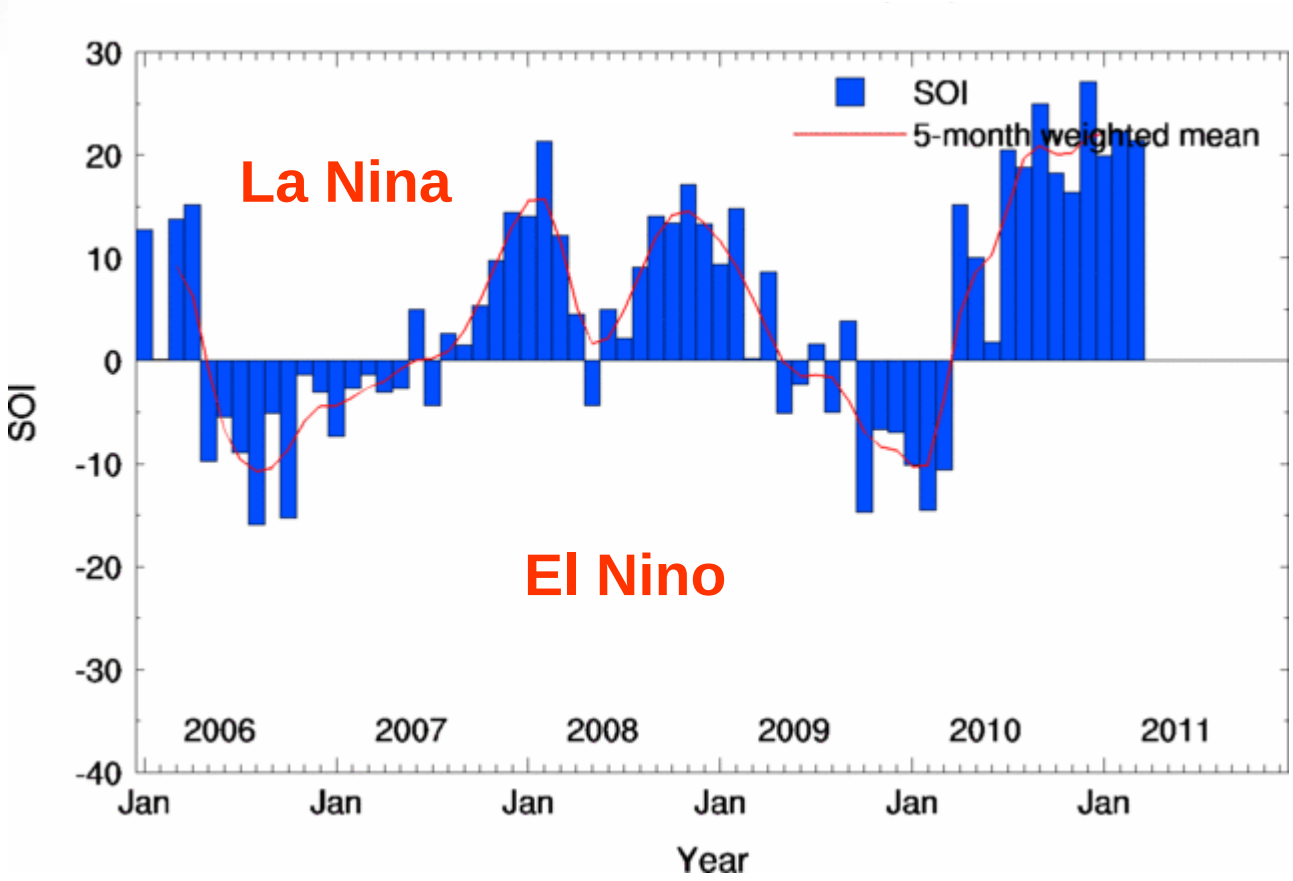
Southern Oscillation Index (SOI)



This La Nina was the 2nd strongest on record after 1917-18

2010-11 is the 4th very wet season in a row in Queensland

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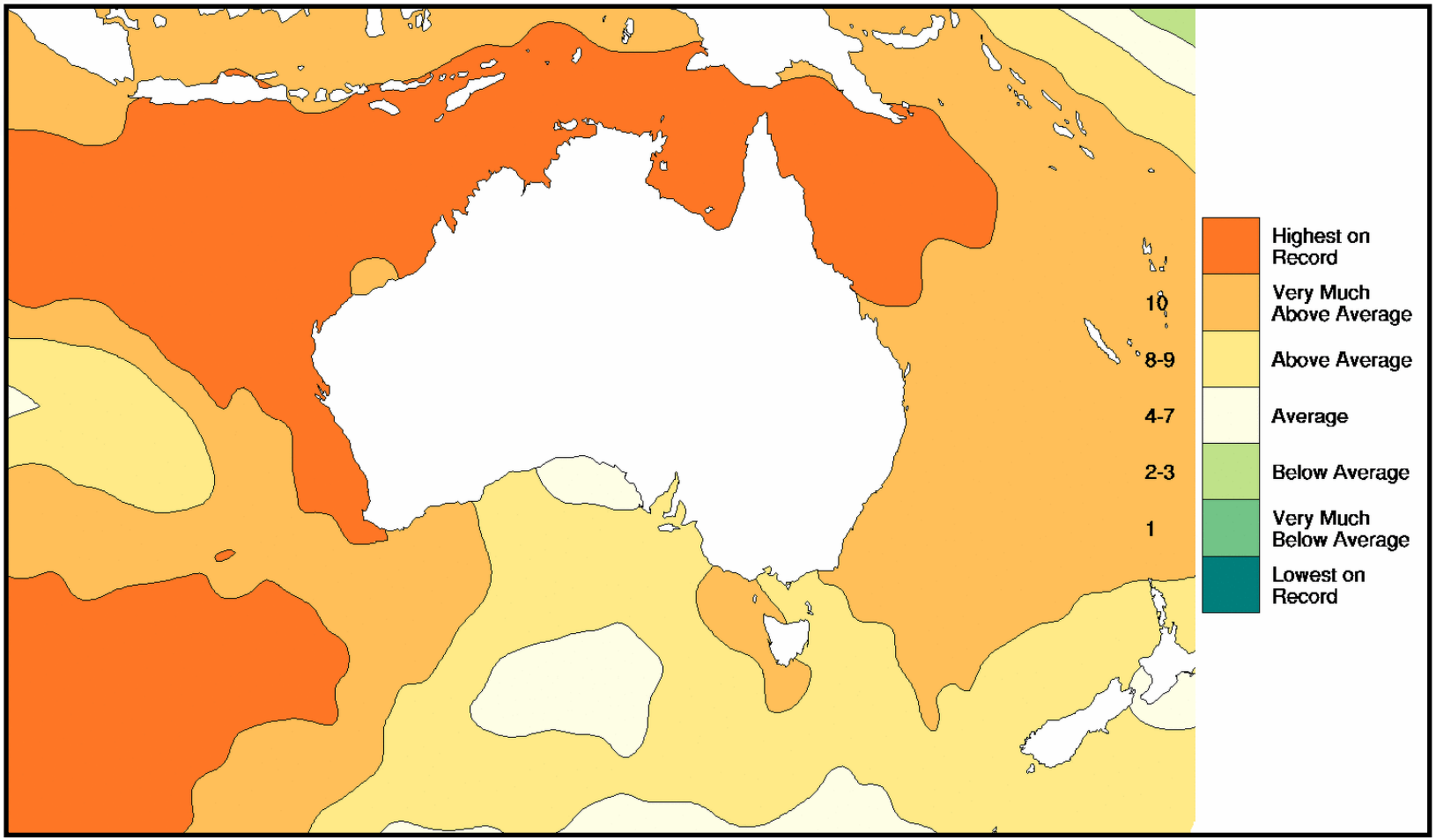
Sea Surface Temperatures
September – December 2010



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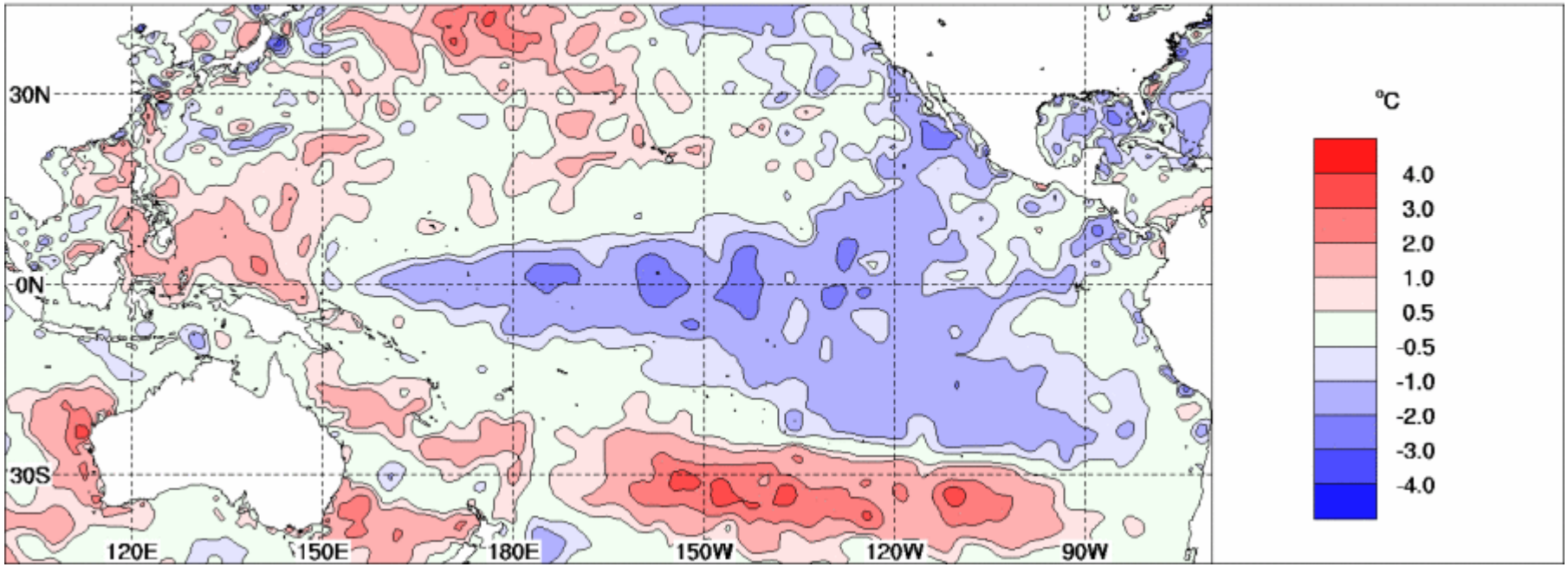
Sea Surface Temperature Anomalies during the week 9-16 January 2011

Sea Surface Temperature Anomalies for 9-16 January 2011
RED is warmer than normal – BLUE is cooler than normal



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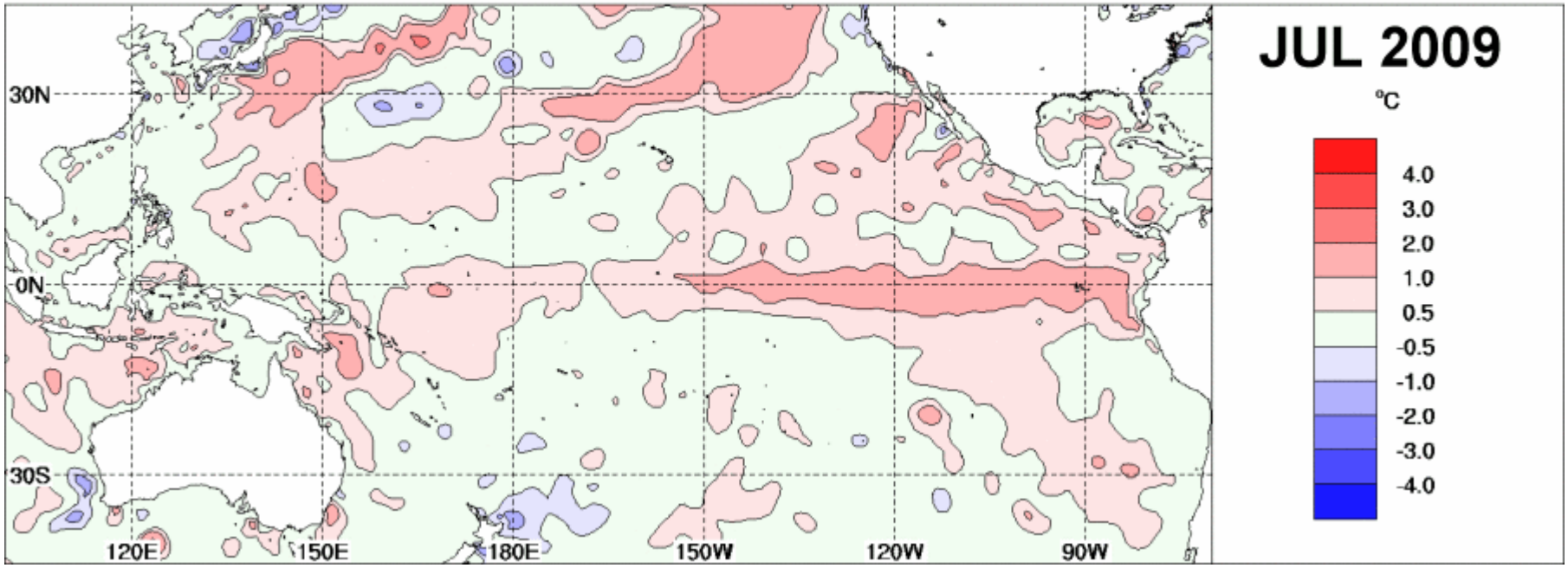
Movie Loop of the Sea Surface Temperature Anomalies since July 2009

Sea Surface Temperature Anomalies for last 20 months
RED is warmer than normal – BLUE is cooler than normal



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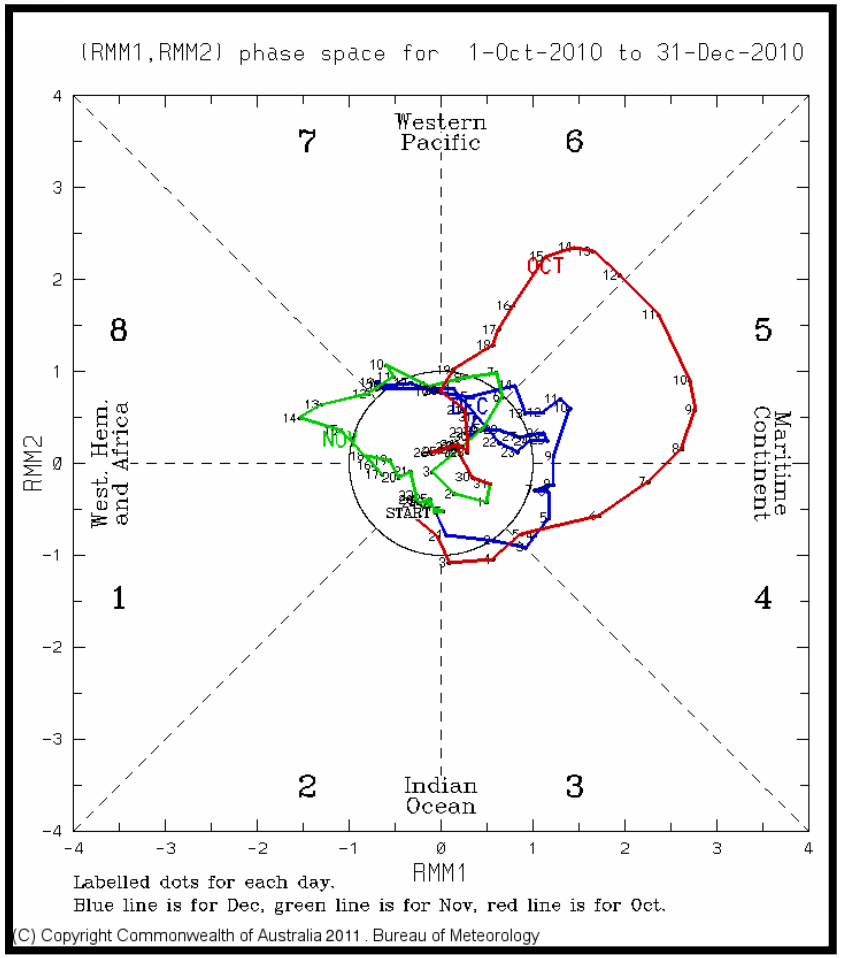
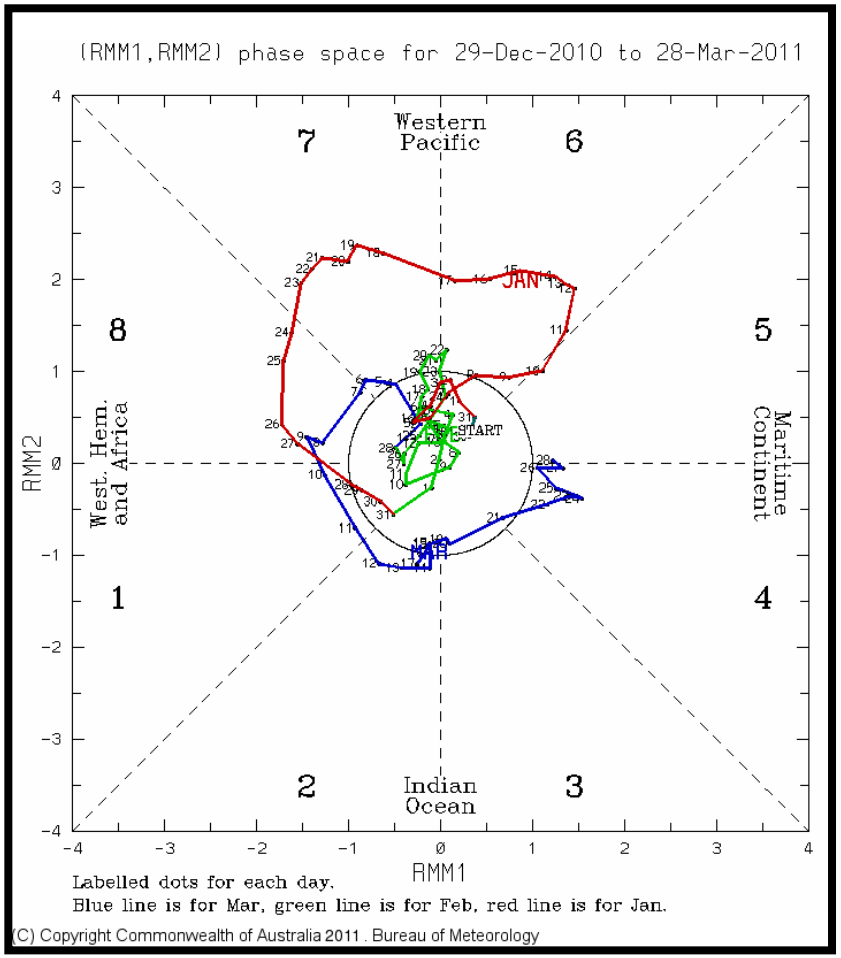
The presence of the Madden Julian Oscillation (MJO) - which enhances the strength of the monsoon - was particularly strong in the Australian Region (zones 4-6) during October 2010 and January 2011 and hovered in a weaker state for much of December 2010





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Section 3

Queensland Rainfall to January 2011

Australian Government
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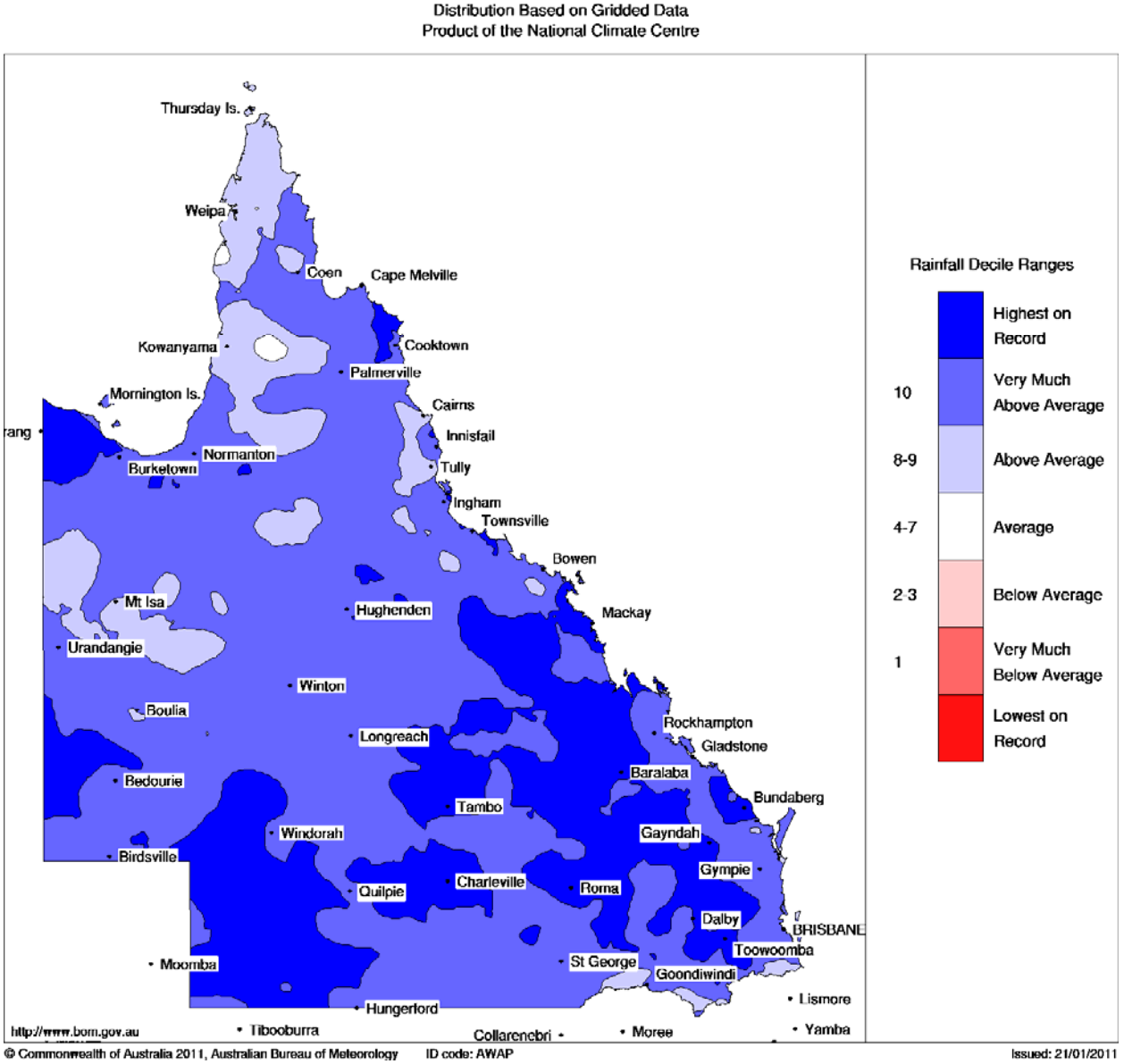
Rainfall Deciles 1 January to 31 December 2010
Queensland's Wettest Year on Record

DECILE maps show where the rainfalls have been above or below average.

The darker the BLUE – the more <u>above</u> average.

The darker the RED – the more <u>below</u> average.



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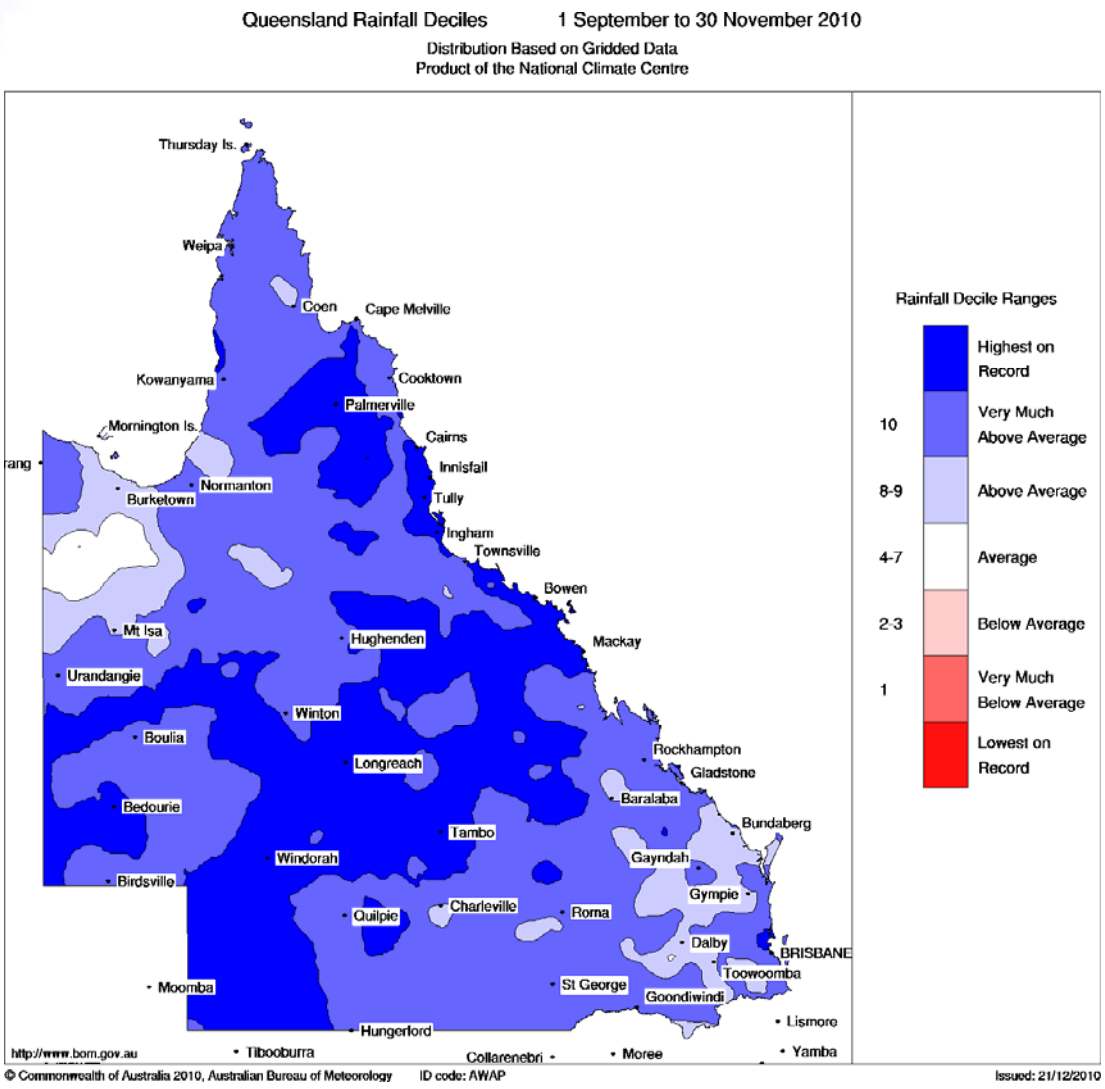
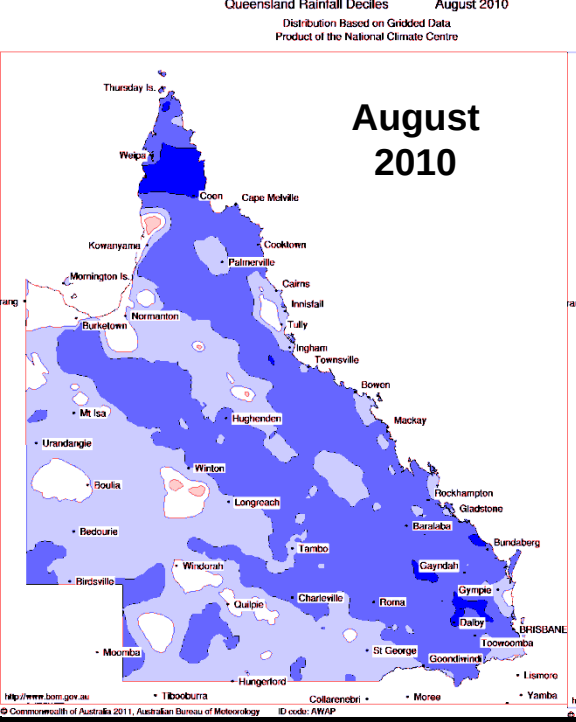
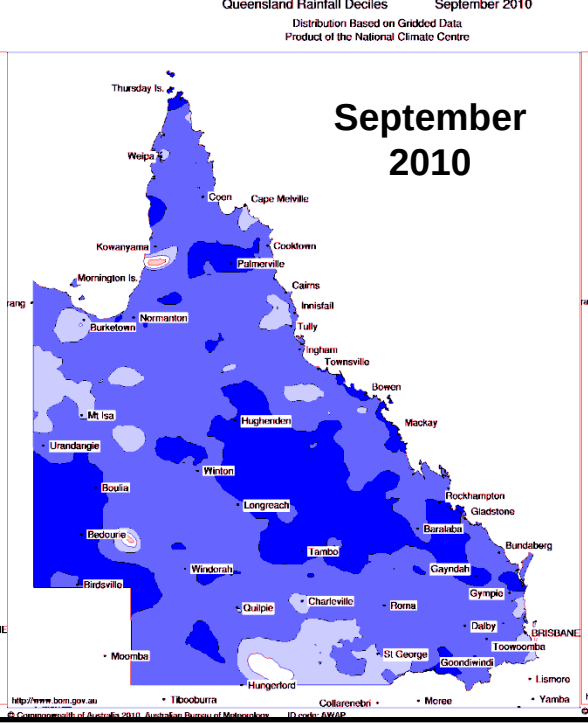
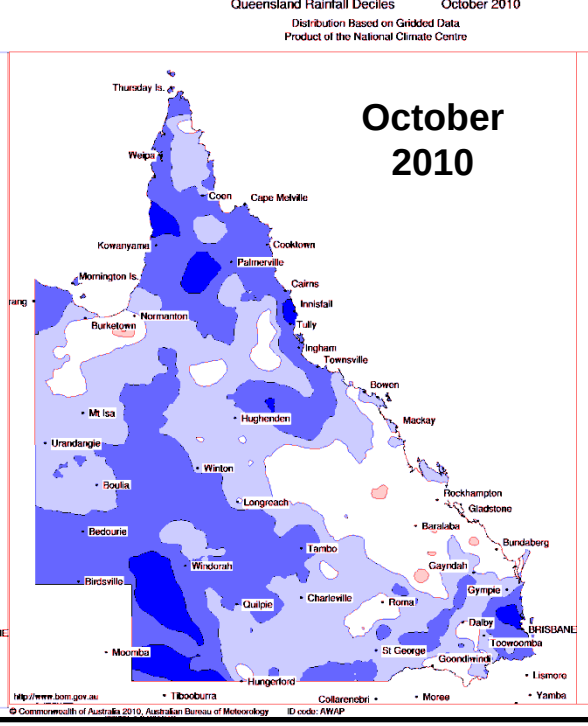
Rainfall Deciles 1 September to 30 November 2010
Queensland's Wettest Spring on Record

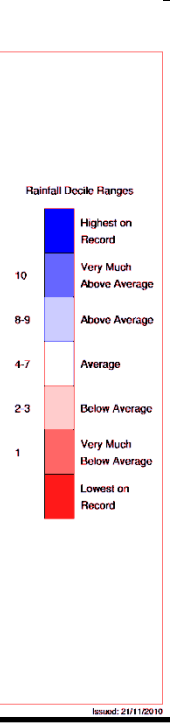


Queensland also experienced its wettest September and December on record

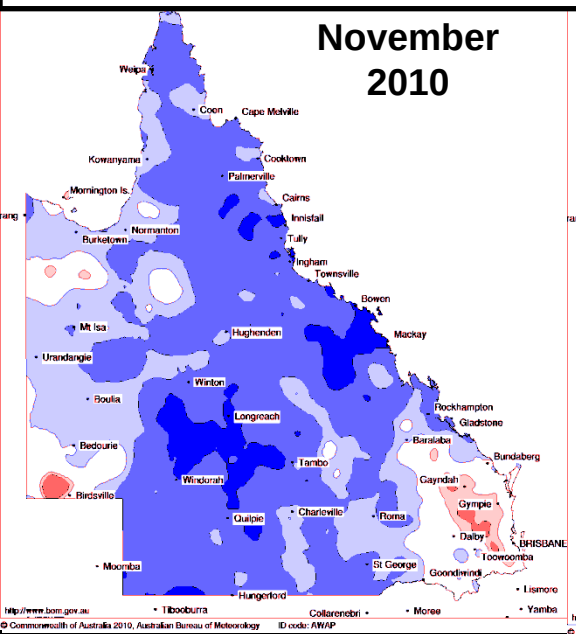


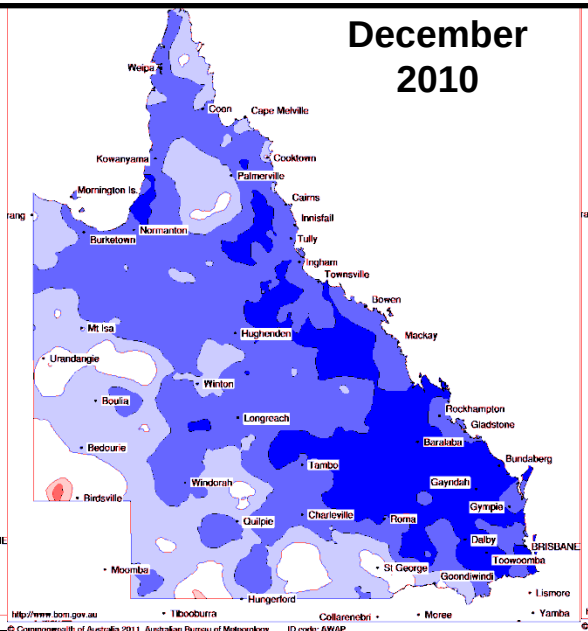


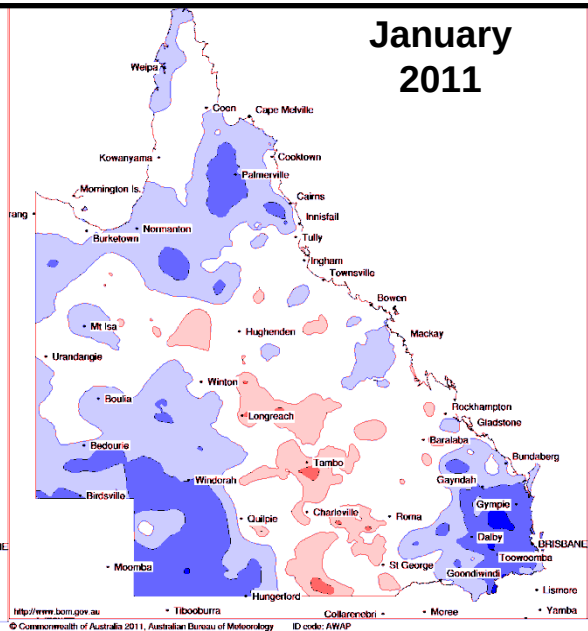


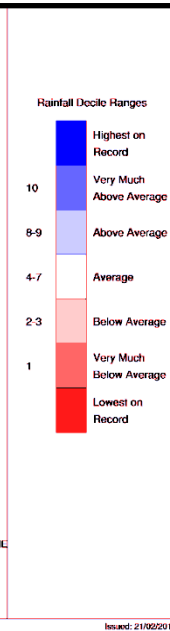


Rainfall Deciles for the 6 months from August 2010









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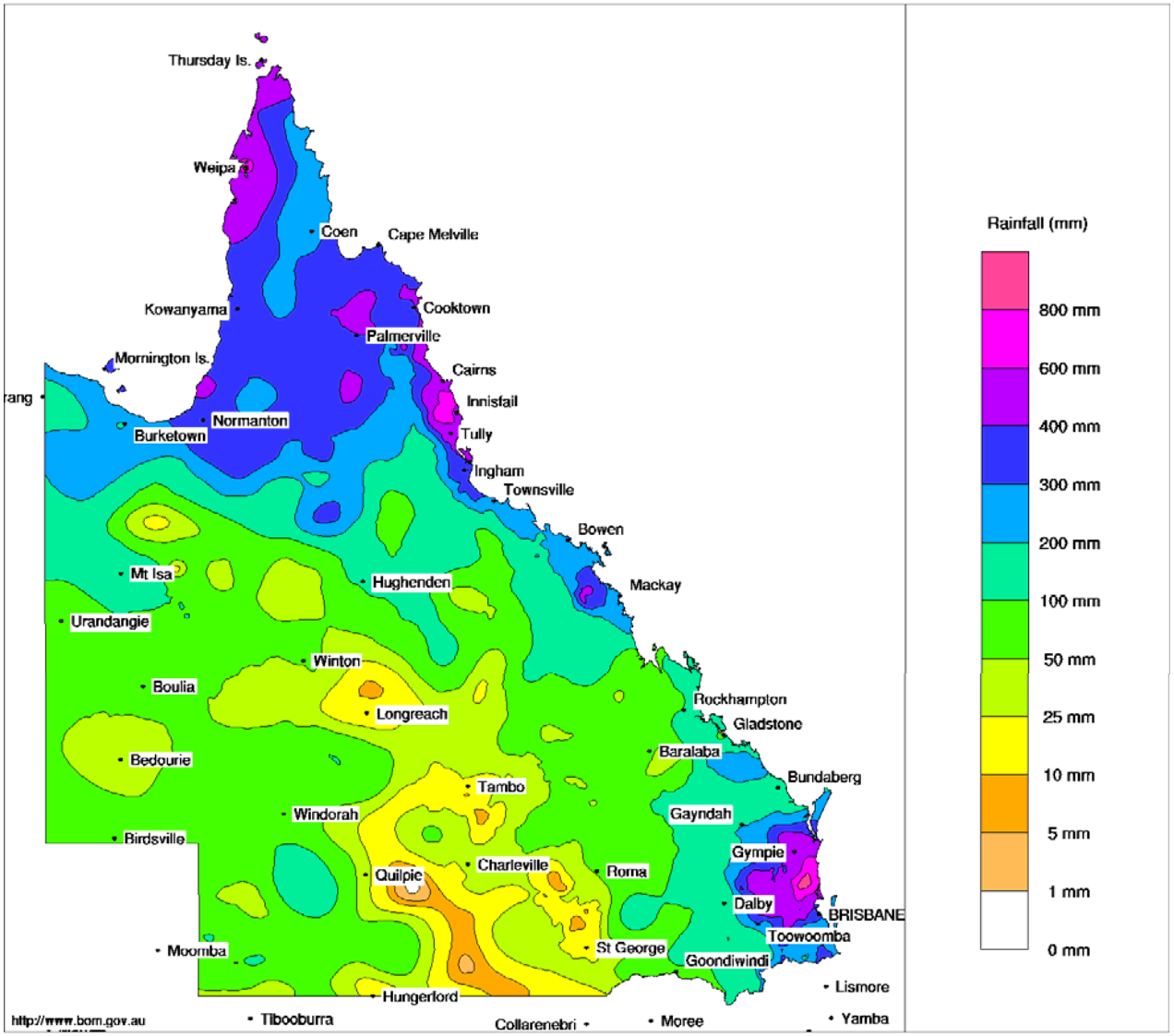
Rainfall Totals for January 2010 highlighting the extreme rainfalls associated with the SEQ floods



 ID code: AWAP

Issued: 03/02/2011

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Bureau of Meteorology

Section 4

Bureau Media Releases and Briefings

Australian Government
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Bureau Seasonal Outlook Media Release and Associated Briefings

On 4 October 2010, the Bureau issued its seasonal outlook for Queensland. The Regional Director Jim Davidson said in a public Media Release:

“prepare early not only for cyclones but also for floods as we have already experienced record September rainfalls across the state”; and

“preparation is the key to safety, and we encourage communities to factor in the possibility of a destructive cyclone or major flood into their pre-season planning”.

This message was reinforced by the Bureau at various briefings to government and disaster management authorities in the lead-up to the wet season, including an invited briefing to Premier and Cabinet on 18 October .

Australian Government
Bureau of Meteorology

Seasonal Outlook for Queensland
(slide used in several pre-season briefings)

- **This is not a run-of-the-mill La Nina**
- **The current La Nina event is now quite strong and well established - and the majority of global computer models indicate that it will persist until at least March next year**
- **No two La Ninas are the same although La Nina events are usually - but not always - associated with enhanced tropical cyclone activity in the Coral Sea and above normal rainfall over much of Queensland**
- **Therefore expect with some degree of confidence a fairly active cyclone season and a continuation of the above average rains and associated flooding**
- **Unable to predict very far in advance where cyclones will cross the coast or which rivers will flood**
- **Many catchments are saturated so runoff is likely to occur with less rainfall than normally required**

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Pre-Season Public Awareness Campaign Seminars and Flood Workshops/Exercises

Charleville	7 September
St George	9 September
Mackay	7 October
Beenleigh	12 October
Gladstone	13 October
Rockhampton	14 October
Innisfail	19 October
Charters Towers	21 October
Gympie	25 October
Kowanyama	27 October
Flood Exercise ORKO (Toowoomba & Lockyer Valley)	1-3 November
Flood Seminar - Coastal Areas Maryborough to NSW border	6 December

Each year during Spring, senior Bureau meteorologists and hydrologists participate in seminars held in storm, cyclone and flood prone centres with the goal of preparing disaster management officials and the wider community for the wet season ahead.

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Bureau Media Release on 23 December warned Queenslanders to brace for more rain and flooding

“Queenslanders and visitors to the state are being warned to prepare for heavy rain and flooding during the holiday period.”

“The Bureau of Meteorology’s Queensland Regional Director, Jim Davidson, said that many river catchments have become so thoroughly soaked that any further rain is likely to spill over very quickly into rivers and streams.”

This message was reinforced by the Bureau at an extraordinary State Disaster Management Group meeting the following day.

Tropical Cyclone TASHA subsequently crossed the north Queensland coast on Christmas Day and quickly transformed in to a rain-bearing monsoon depression.

Australian Government
Bureau of Meteorology

Bureau Briefings ahead of the Weather Events of 9-12 January

On 4 January, the Queensland Regional Director and the Regional Hydrology Manager briefed an extraordinary meeting of the State Disaster Management Group - and on the next day 5 January, gave a similar briefing by invitation to Premier and Cabinet.

At both briefings, reference was made to the large and intense upper level low developing over southeast Queensland and the impact that it was likely to have on rainfall and flooding during the following week.

Australian Government
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Key Bureau Briefings to Government and Disaster Managers Sep 2010 – Feb 2011

Ministerial Briefing	3 September
SDMG meeting	12 October
Premier and Cabinet	18 October
Commonwealth Briefing	12 November
SDMG meeting	8 December
Extraordinary SDMG meeting	24 & 30 December
Extraordinary SDMG meeting	4 January
Premier and Cabinet	5 January
Extraordinary SDMG meeting	10 January
Extraordinary SDMG meeting	11 January (2 that day)
Extraordinary SDMG meeting	12 January (2 that day)
Extraordinary SDMG meeting	13 January (2 that day)
Extraordinary SDMG meeting	14 & 15 January
Extraordinary SDMG meeting	16 & 17 January

Bureau participated in twice daily teleconferences hosted by the SDCC each day between 24 December and 20 January inclusive

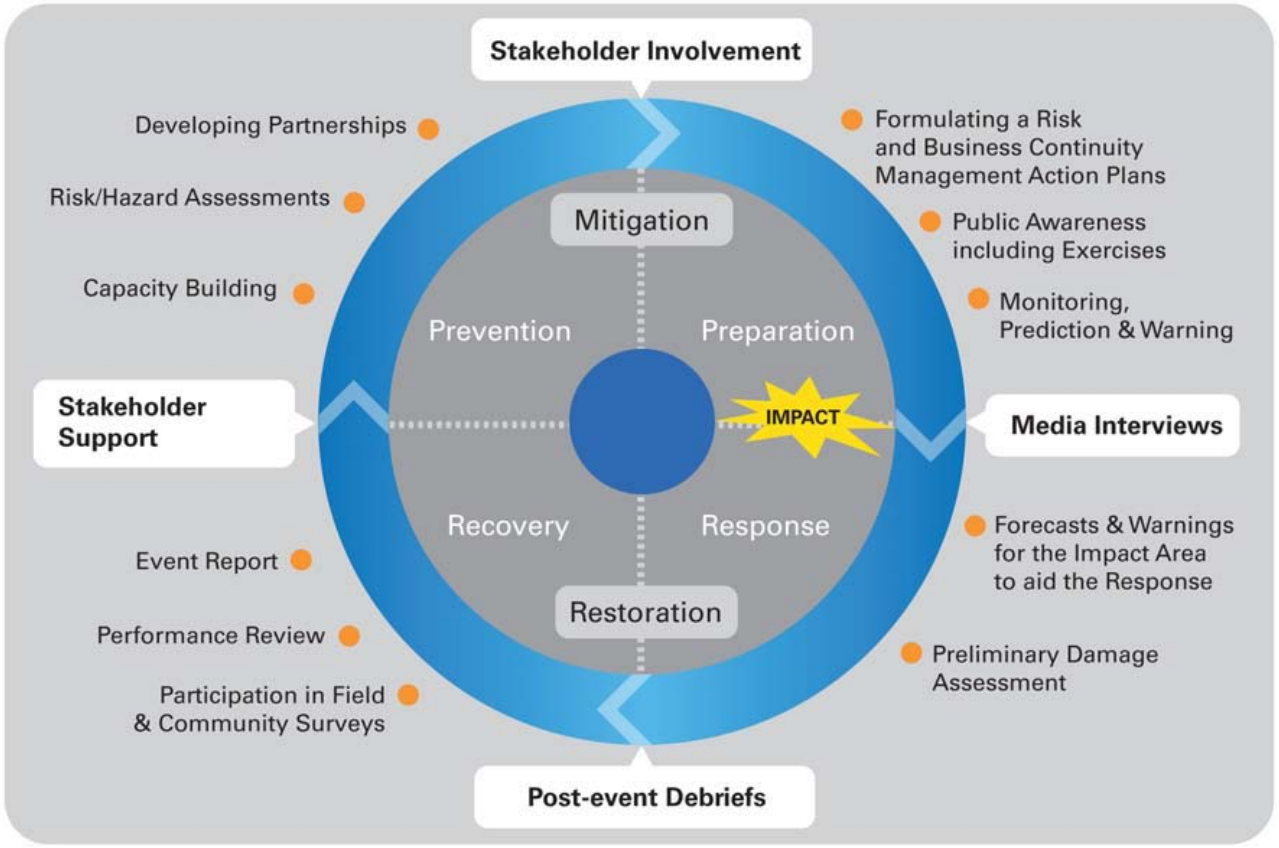
Australian Government
Bureau of Meteorology

Section 5

Bureau Communication Channels

Australian Government
Bureau of Meteorology

Communications between the Bureau and Disaster Management Authorities



The Bureau (as a Commonwealth agency) has a role in all phases of the disaster management cycle, working with state disaster managers and state and local governments in order to routinely provide the best possible meteorological and hydrological advice and warning service.

Australian Government
Bureau of Meteorology

Bureau Communication Channels

In fulfilling it's disaster management role, the Bureau engages with a broad range of agencies.

Regular briefings are provided in the lead-up to the wet season with these becoming more frequent during events.

Information to the general public is mostly via the Bureau's web site and the media.

A dedicated telephone hotline between the Bureau and the State Disaster Coordination Centre enables direct, secure and rapid transfer of key information and a special email is available to share important information among and between the Bureau and key clients.

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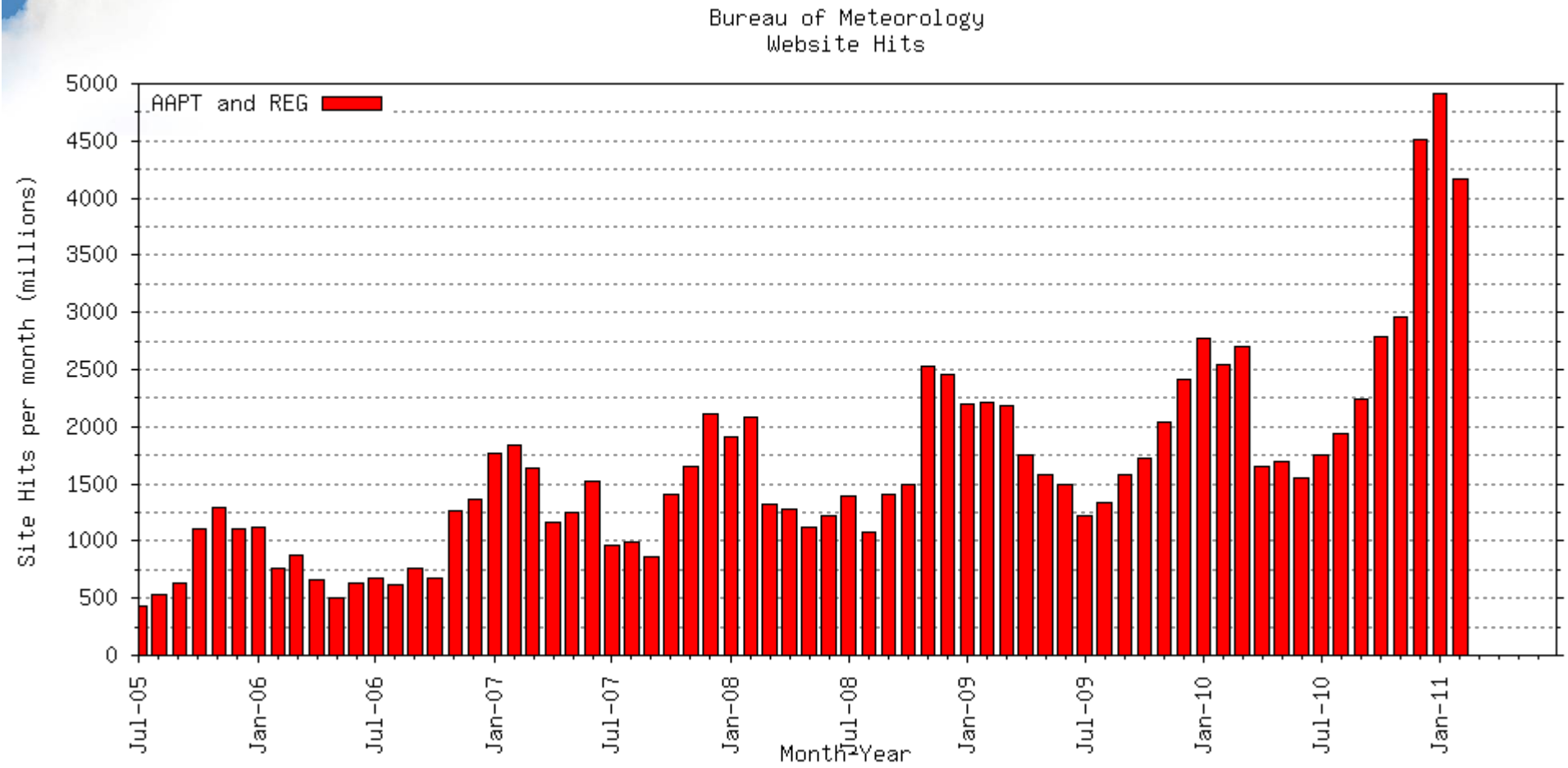
Bureau of Meteorology

Bureau of Meteorology Website Hits - July 2005 to February 2011 – with approximately 9.3 Billion hits during the December - January period



Australian Government
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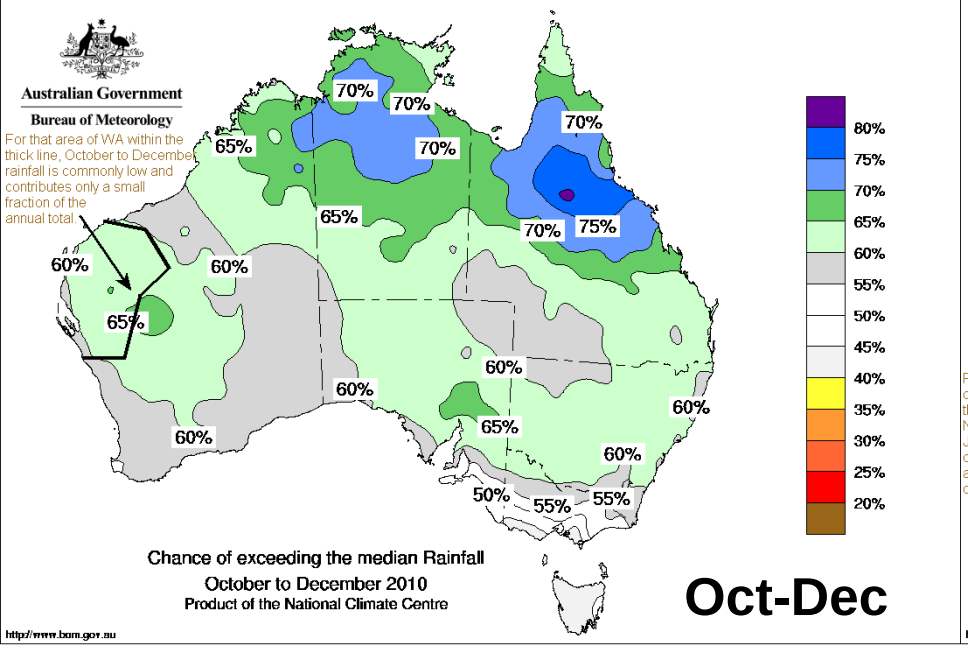
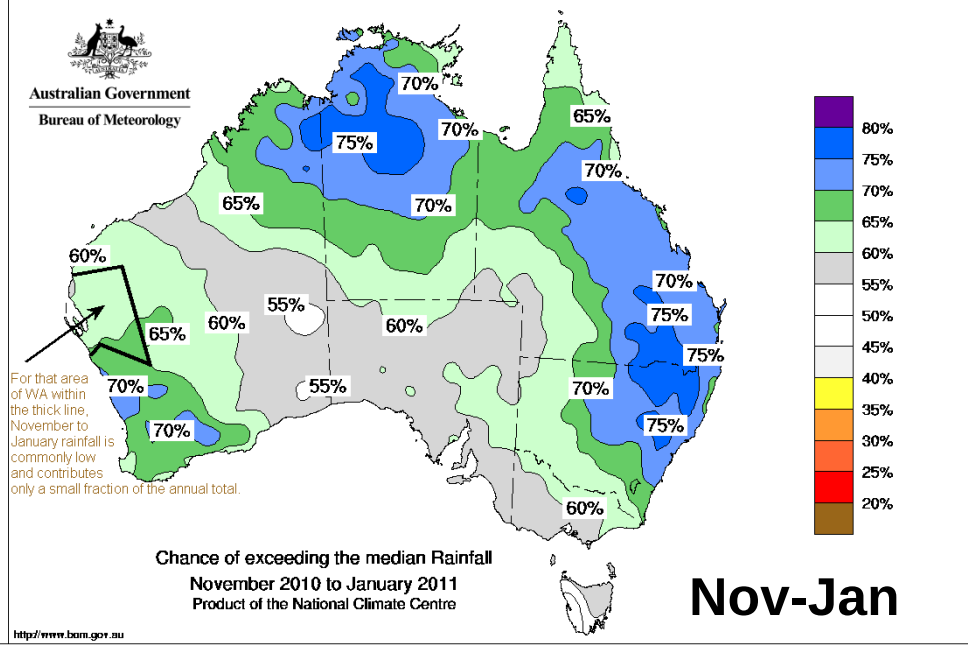
Section 6

Forecast Rainfall from October 2010

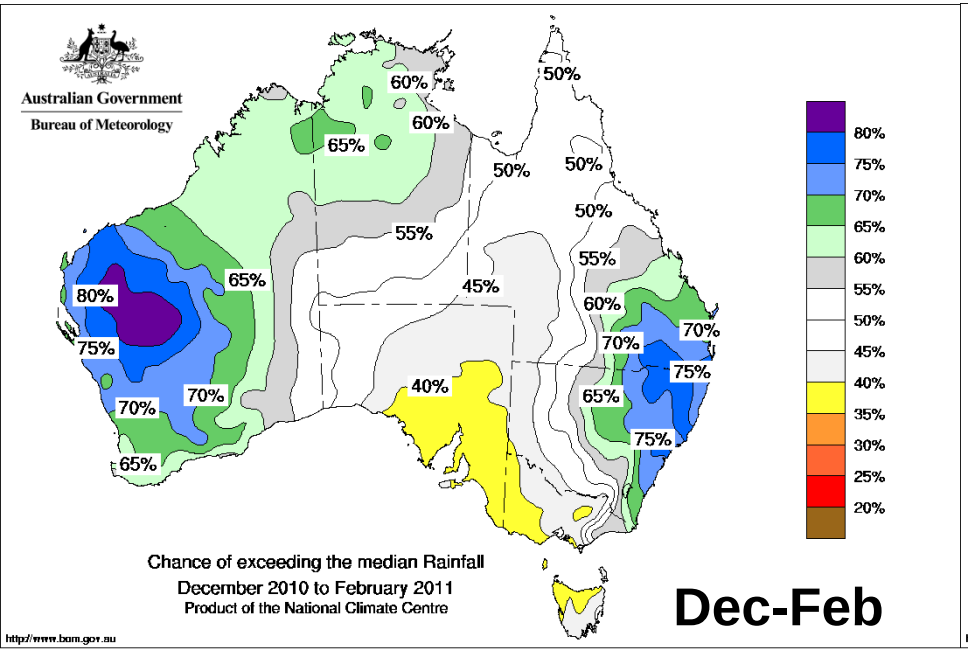


Oct-Dec

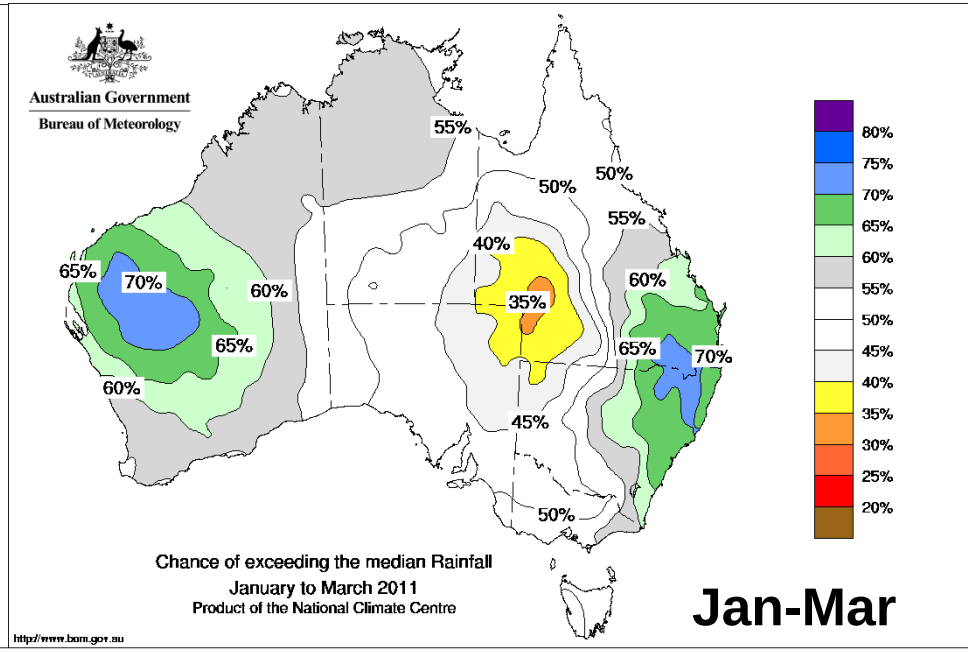


Nov-Jan

Sequence of Bureau of Meteorology 3 month Rainfall Outlooks

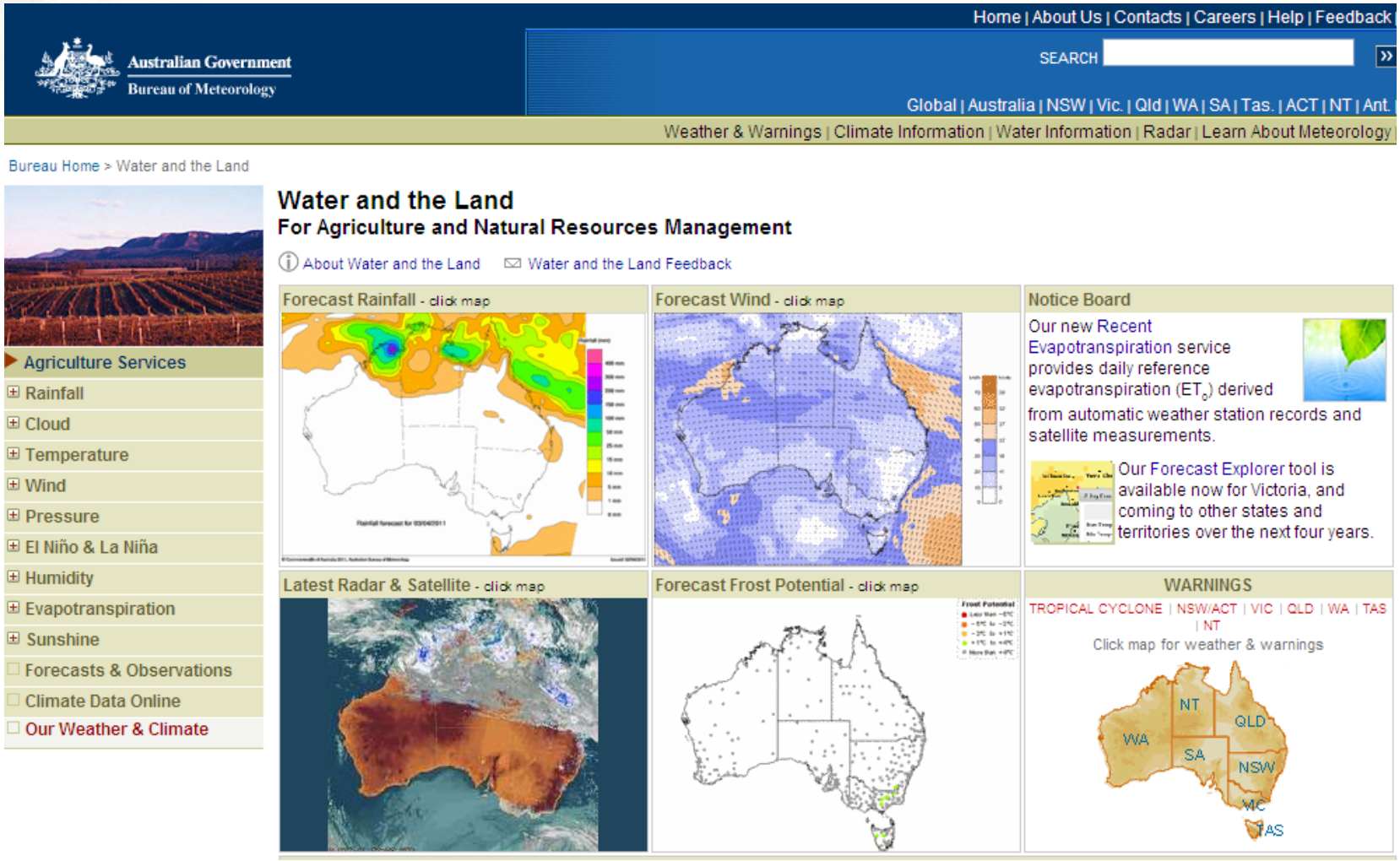


Dec-Feb

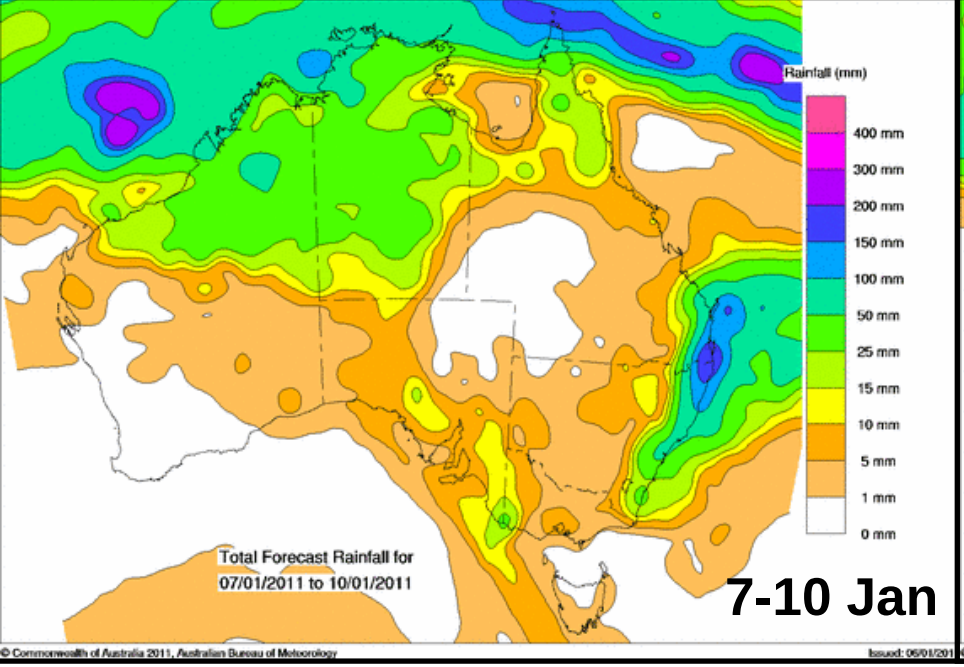


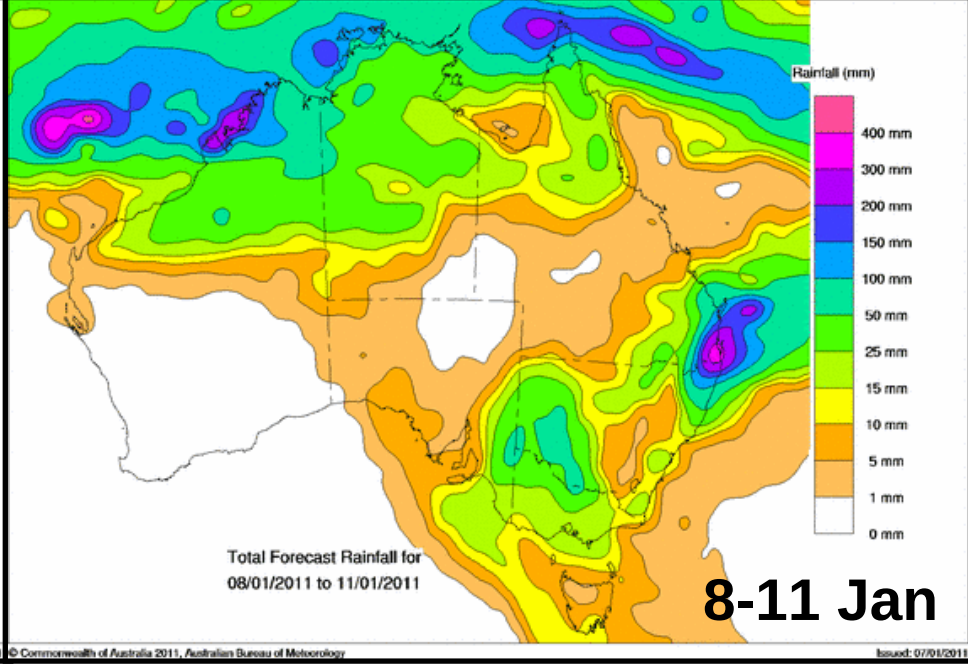
Jan-Mar

Bureau's "Water and the Land" (WATL) Web Site

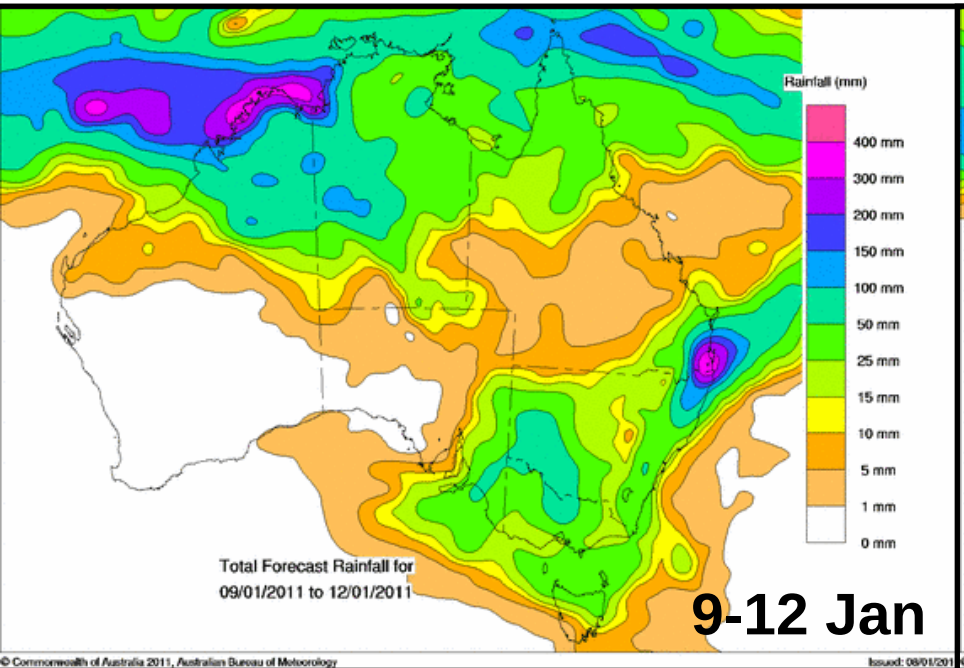


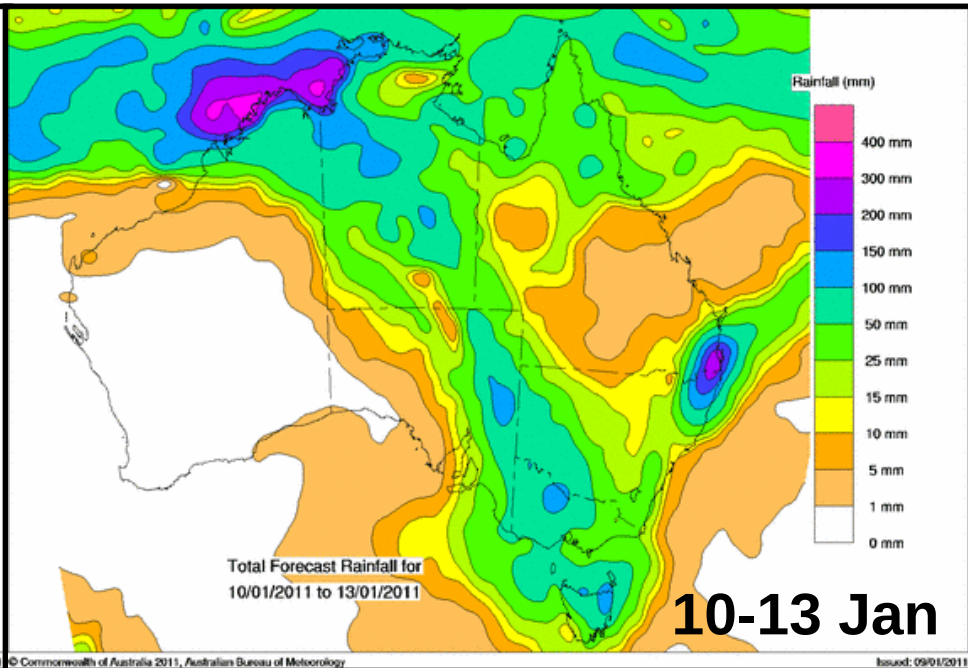
WATL rainfall forecast maps are generated automatically by weather forecast NWP models. Up to 8 models are combined – using the "probability matched ensemble mean" technique – to produce the rainfall forecasts.





4 Day WATL Rainfall Forecasts available on the Bureau's Web Site





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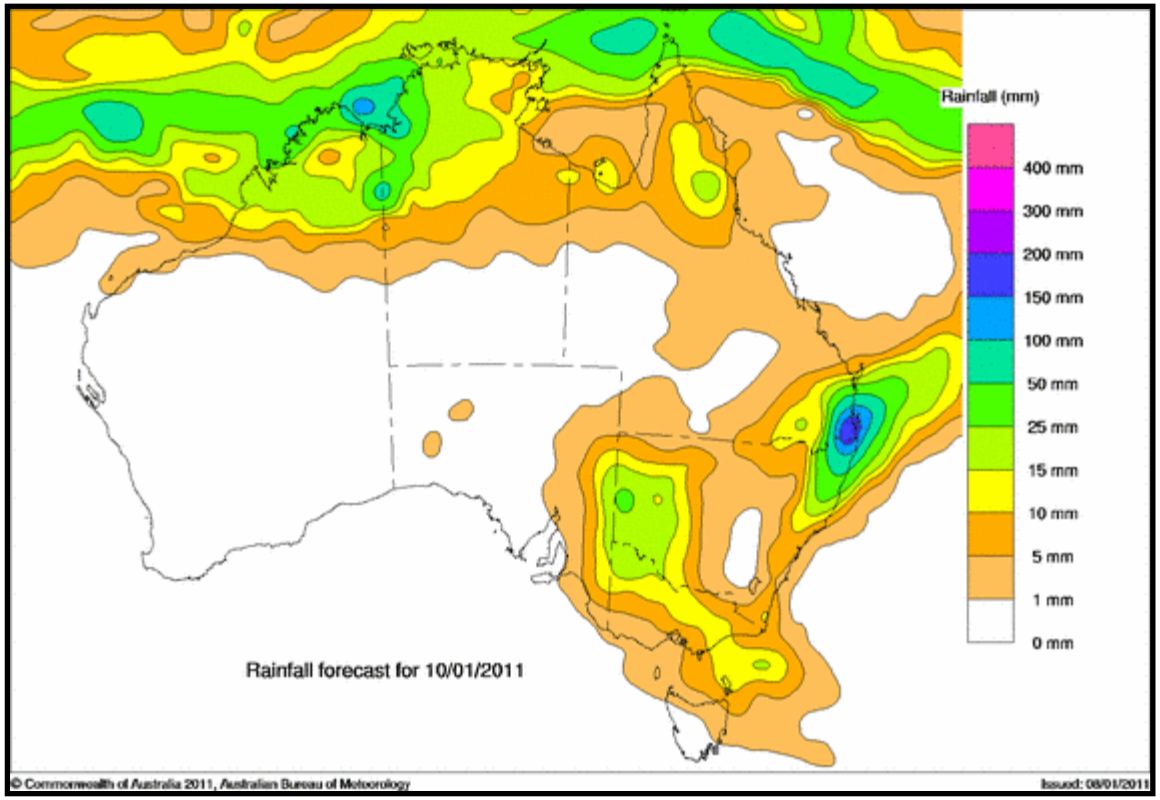
Rainfall Forecast for Monday 10 January issued on the Sunday



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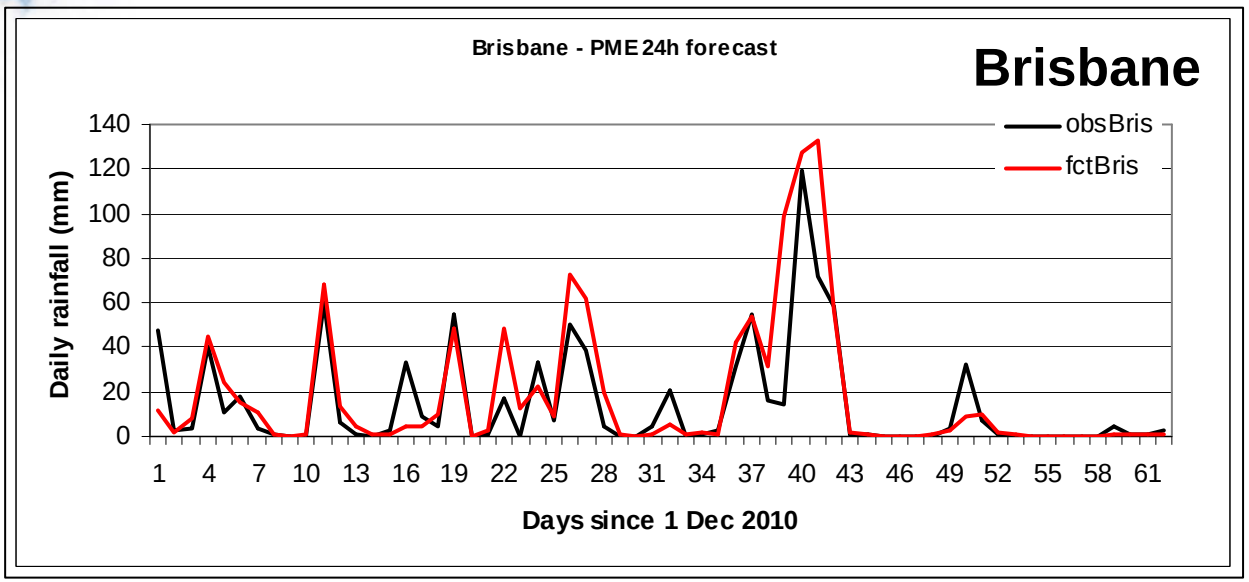
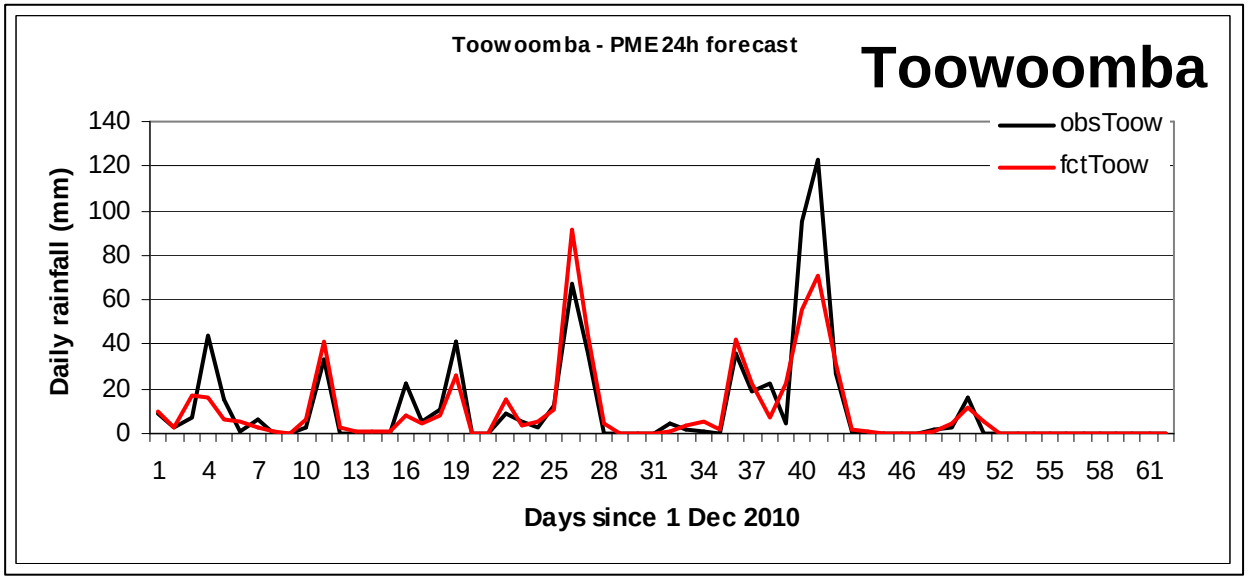
Verification of Brisbane and Toowoomba WATL rainfall forecasts for the following day for December and January (Correlation coefficients > 0.8 are considered a very good match)



Correlation = 0.84



Correlation = 0.88

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Quantitative Precipitation Forecasts

- **The Bureau's longer-range forecasts for the wet season, and during the critical heavy rainfall periods in SEQ during December and January, provided good quality guidance for disaster managers and dam owners and operators regarding the expected very heavy rainfalls**

- **The Bureau also believes that the WATL rainfall products are useful in providing advanced notice of a possible heavy rainfall situation, especially when the rainfall forecast pattern is reasonably consistent from one model run to the next**

- **However, the provision of accurate and reliable forecasts of rainfall amounts and intensities for a 1, 3 and 5 day forecast period on the spatial scale of Somerset and Wivenhoe Dam catchments is currently limited by the state of the meteorological science and modelling, although improvements are being made through active research by the Bureau and the international meteorological community**

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Quantitative Precipitation Forecasts

- **The improved skill of NWP models in recent years has been largely in forecasting the development and movement of broad-scale synoptic features that would likely produce high rainfalls - these large-scale features include decaying tropical cyclones, east coast lows, and significant upper level troughs and lows**
- **However while these systems may be well forecast on a time scale of 2 to 3 days the very heavy rainfall concentrations are dependent on finer scale (mesoscale) and convective features**
- **While there is often the ability to forecast the potential for a significant rain event to occur, it is difficult (if not impossible) to predict the actual location of the heaviest rain, even with only a few hours notice**
- **For larger catchments, it is more likely that the area-averaged NWP rainfall forecasts will be more reliable, although, in Queensland, runoff generation may still be dominated by embedded heavy rain over parts of the catchment**

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Section 7

Weather Events December 2010 and January 2011

Australian Government
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The Climate Drivers in December and January

The widespread rainfall and flooding resulted from a number of primary longer time-scale influences (or "climate drivers"):

- **Heavy rainfall in the prior months**
- **The monsoonal wet season**
- **The La Nina event; and**
- **The Madden Julian Oscillation (MJO)**

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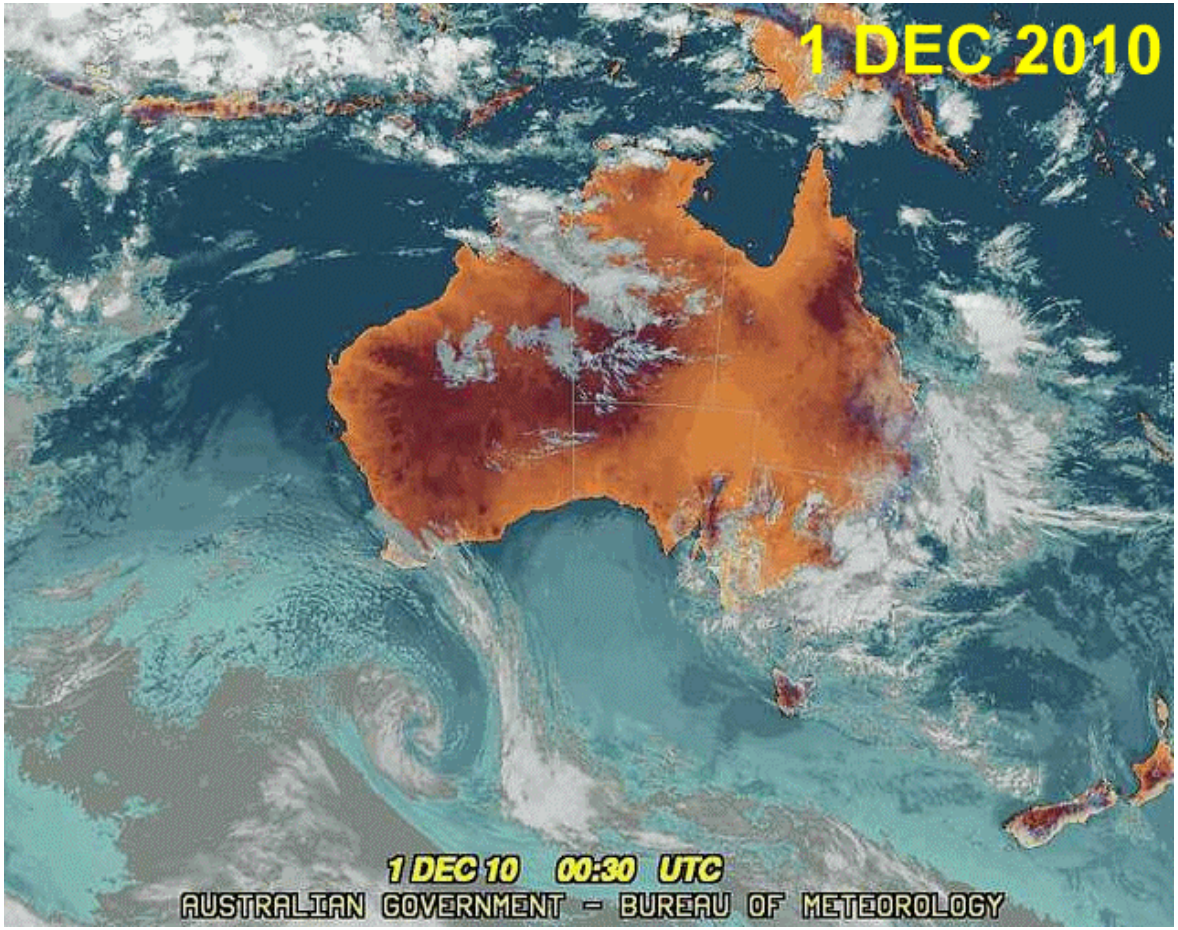
Movie Loop of Satellite Imagery through December, January and early February



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The Major Rainfall Events leading to the Queensland Floods

Rainfall and flooding during the 2010-11 wet season was widespread, sustained and exceeded all previous meteorological and hydrological records in many areas of Queensland

Event 1 : 28 November 2010 – 22 December 2011	**A sequence of large scale rain events across the state**	**Major flooding of rivers across the southern half of the state**
Event 2 : 23-28 December 2011	**A single 6 day event covering almost the entire state with record rainfalls**	**Record flooding in central and southern Queensland with inundation of the cities of Bundaberg, Rockhampton, Emerald and many other towns**
Event 3 : 10-12 January 2011	**A concentrated rainfall event on the scale of several hundred kilometres, occurring directly over several small river basins**	**Flooding of the cities of Brisbane and Ipswich and many other towns**
Event 4 : 10 January 2011	**Intense rainfall from a thunderstorm complex over several hours directly over a saturated region with steep topography channelling the flow**	**Flash Floods in Toowoomba and the Lockyer Valley**

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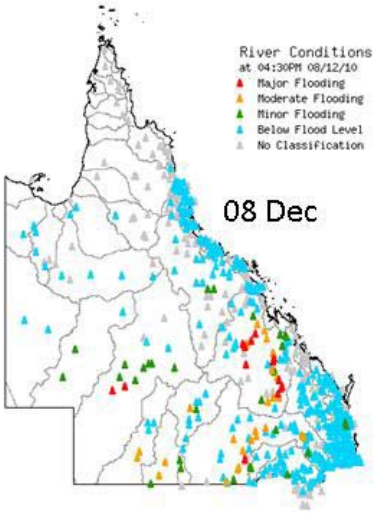
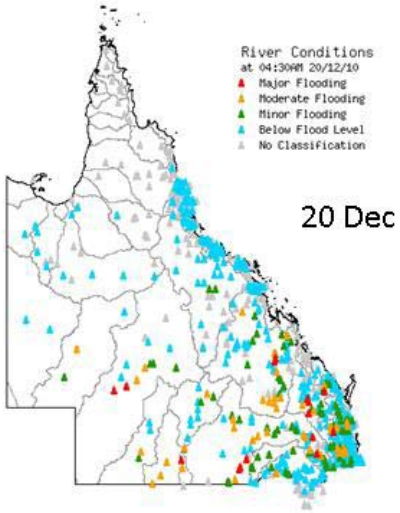
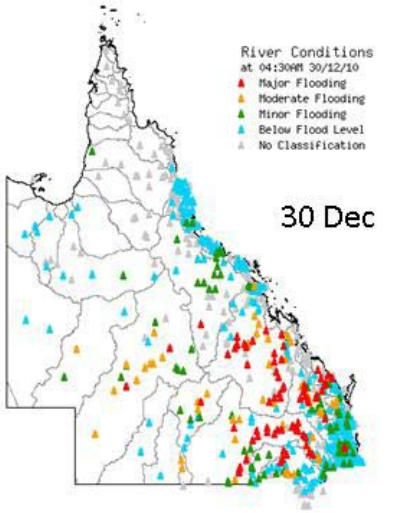
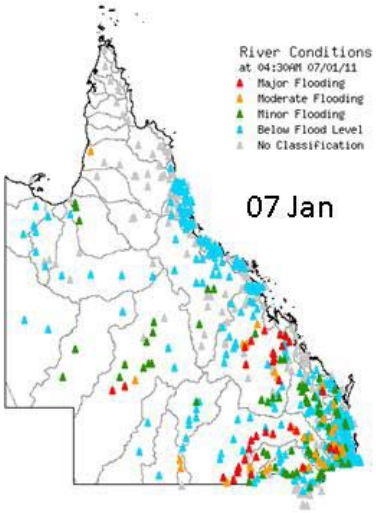
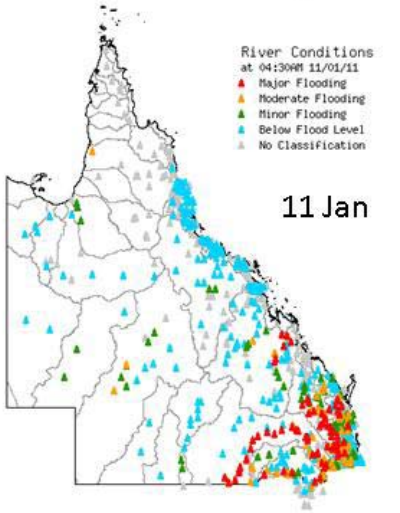
Snapshot of River Conditions during and after the Sequence of Rainfall Events

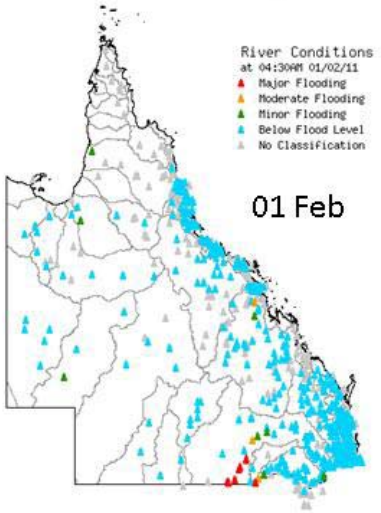












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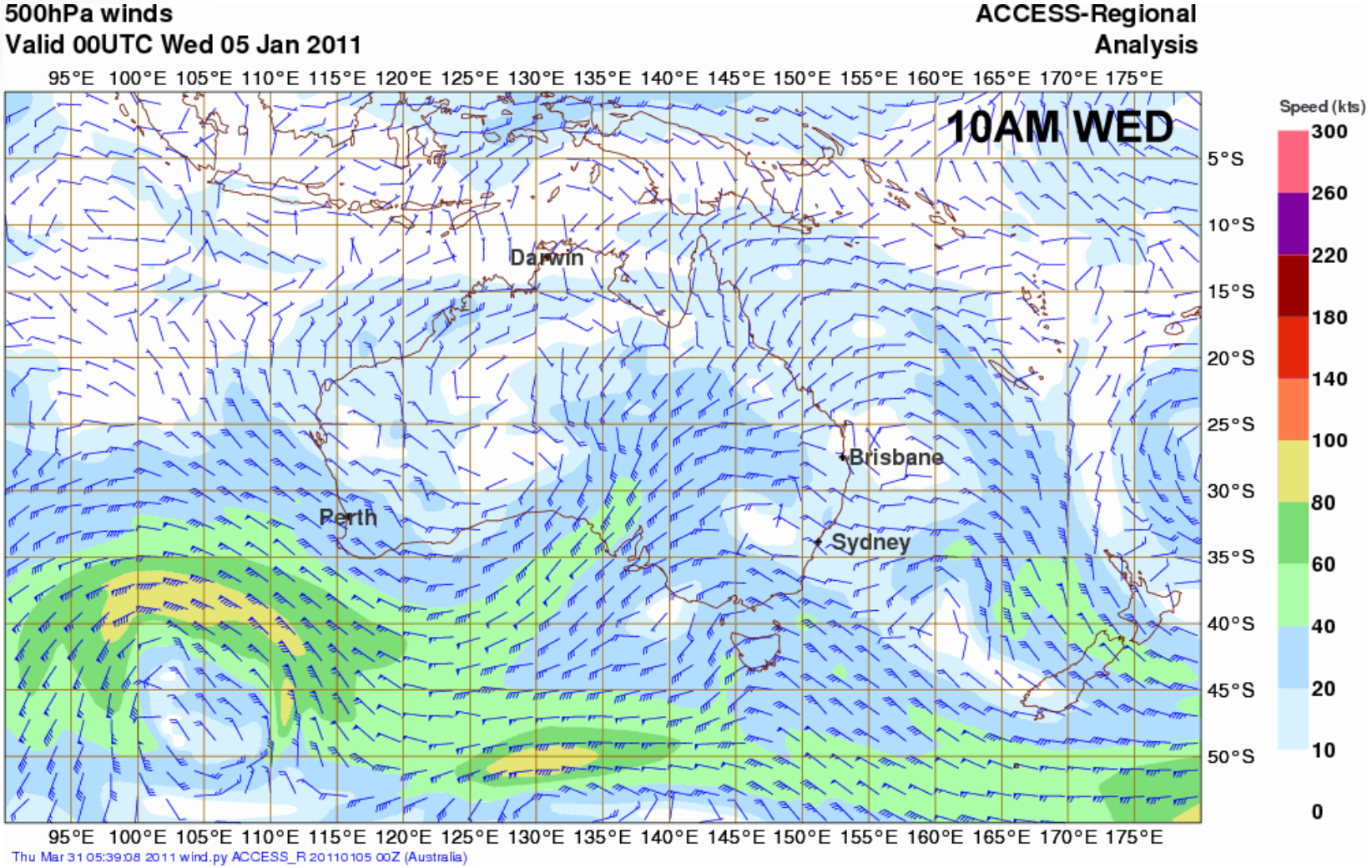
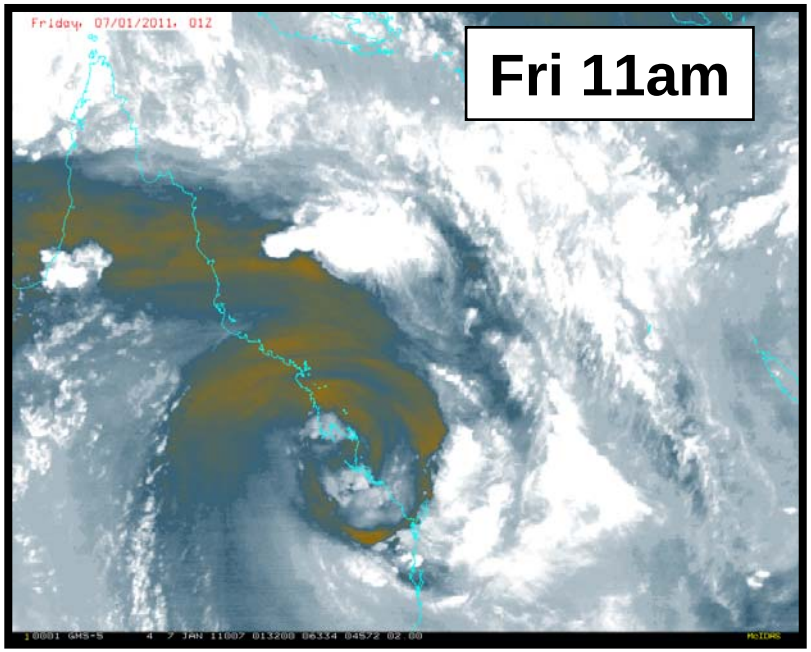
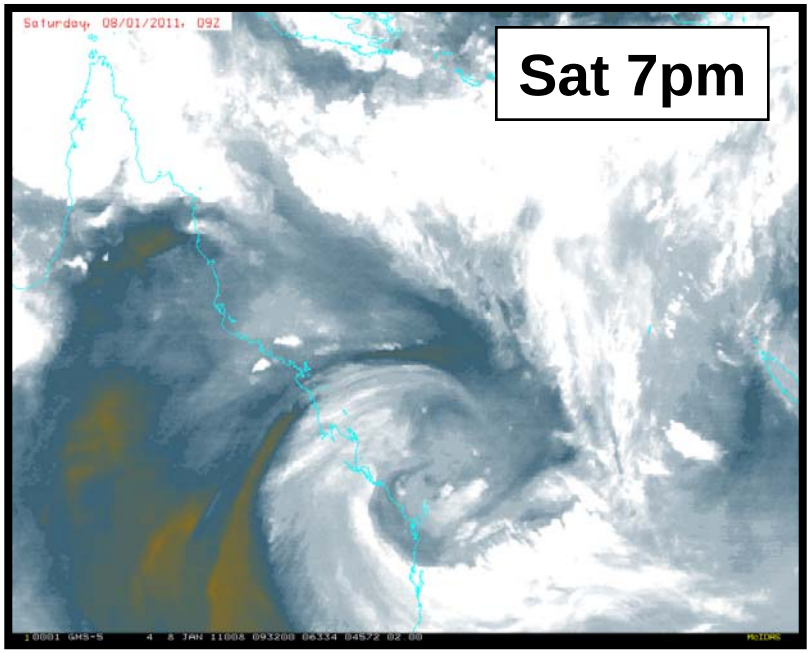
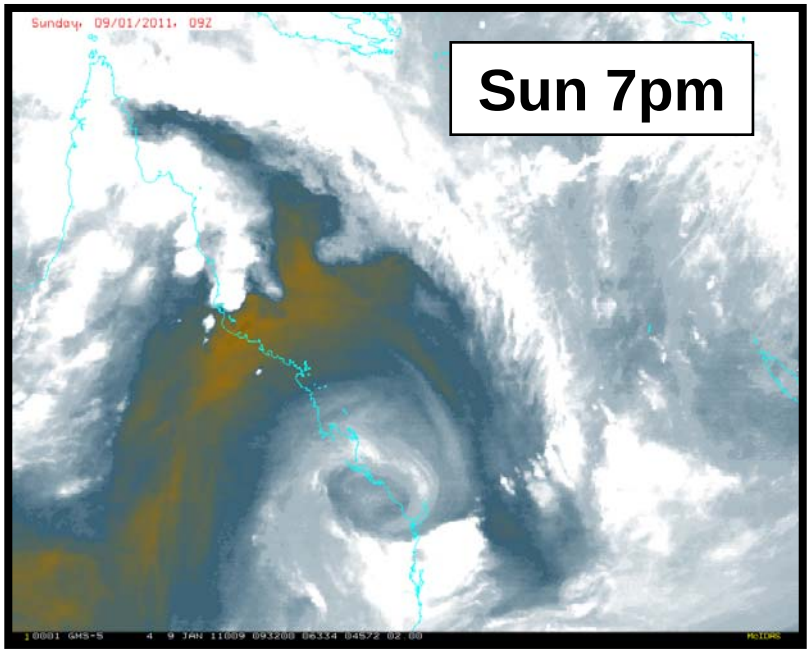
Movie Loop showing the passage of the Upper Low over Southeast Queensland

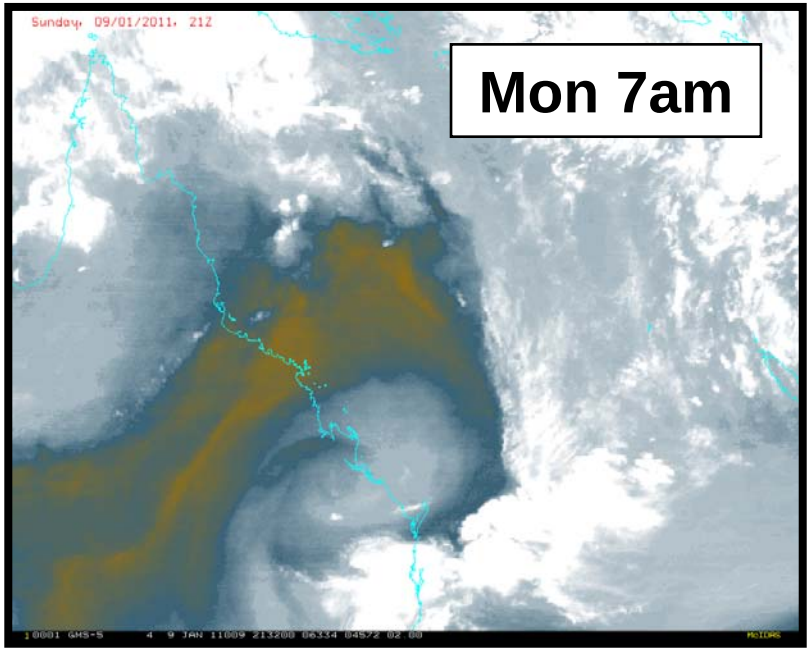






Movement of the Upper Low leading up to the Flash Flood





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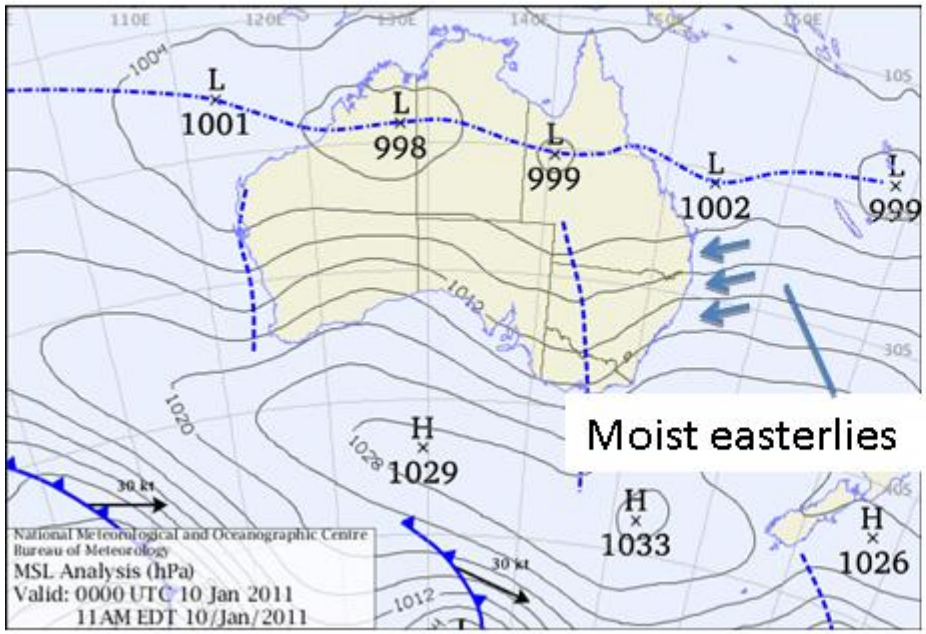
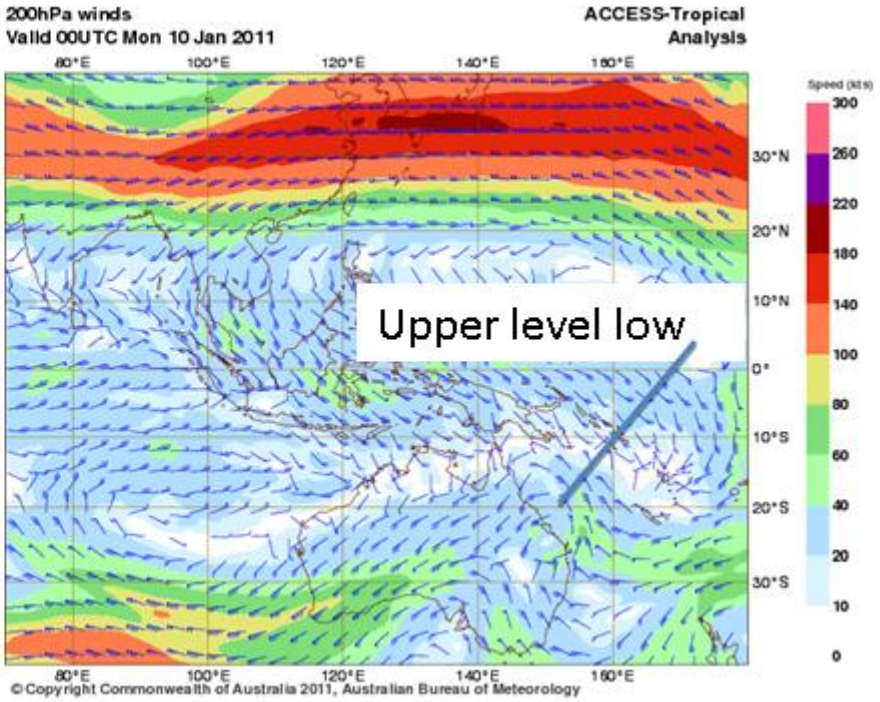
Low Level and Upper Level Features on 10 January Weather Charts





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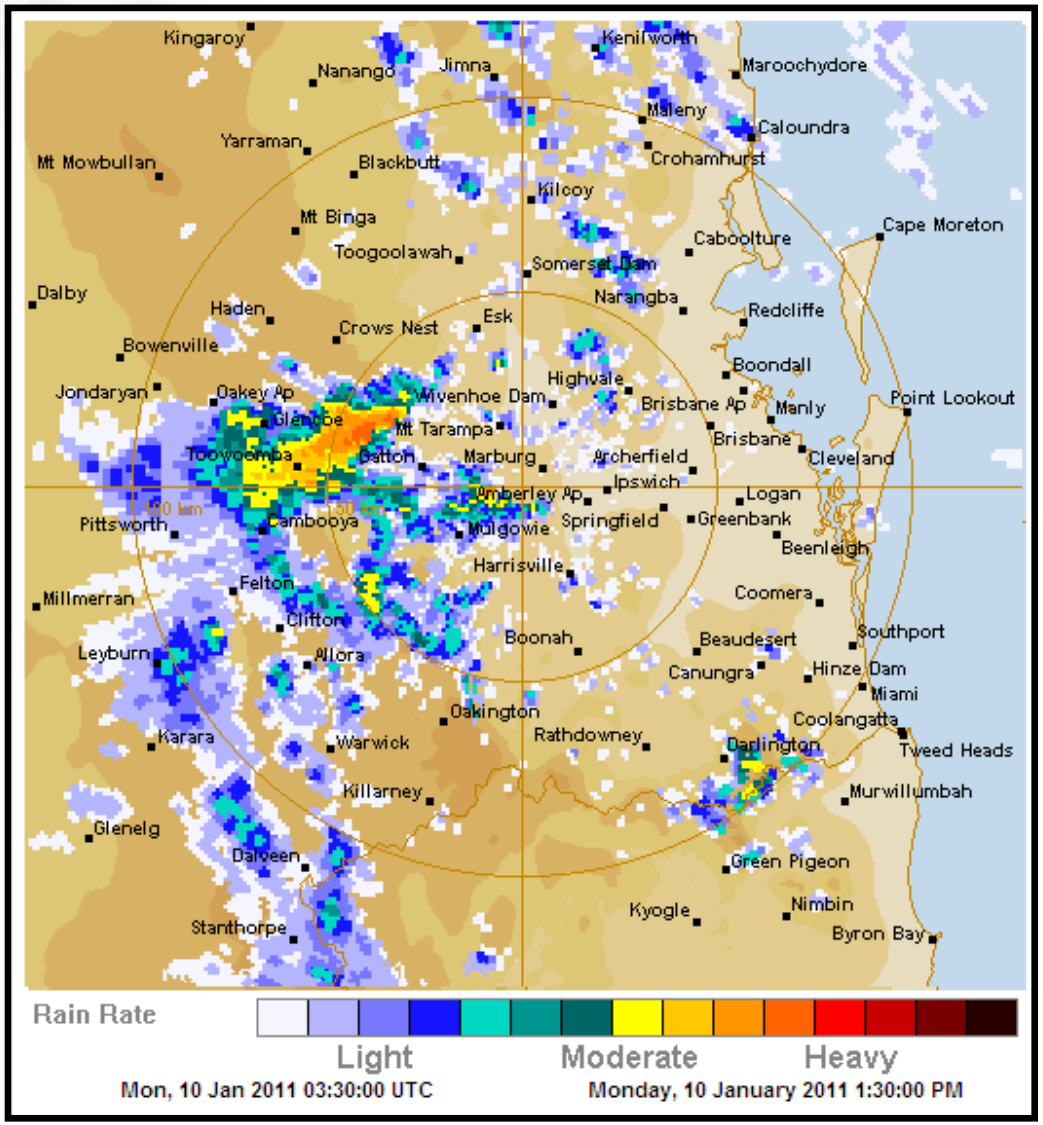
Factors Contributing to the Flash Flood on 10 January



- Monsoon trough lying to the immediate north
- Low level easterly onshore winds producing an inflow of moist tropical air
- Upper level low (unusual for this time of year) providing dynamic ascent of the airmass
- Very wet catchments
- Unusual SW movement of the storm complex
- Steep escarpment providing physical uplift of the airmass

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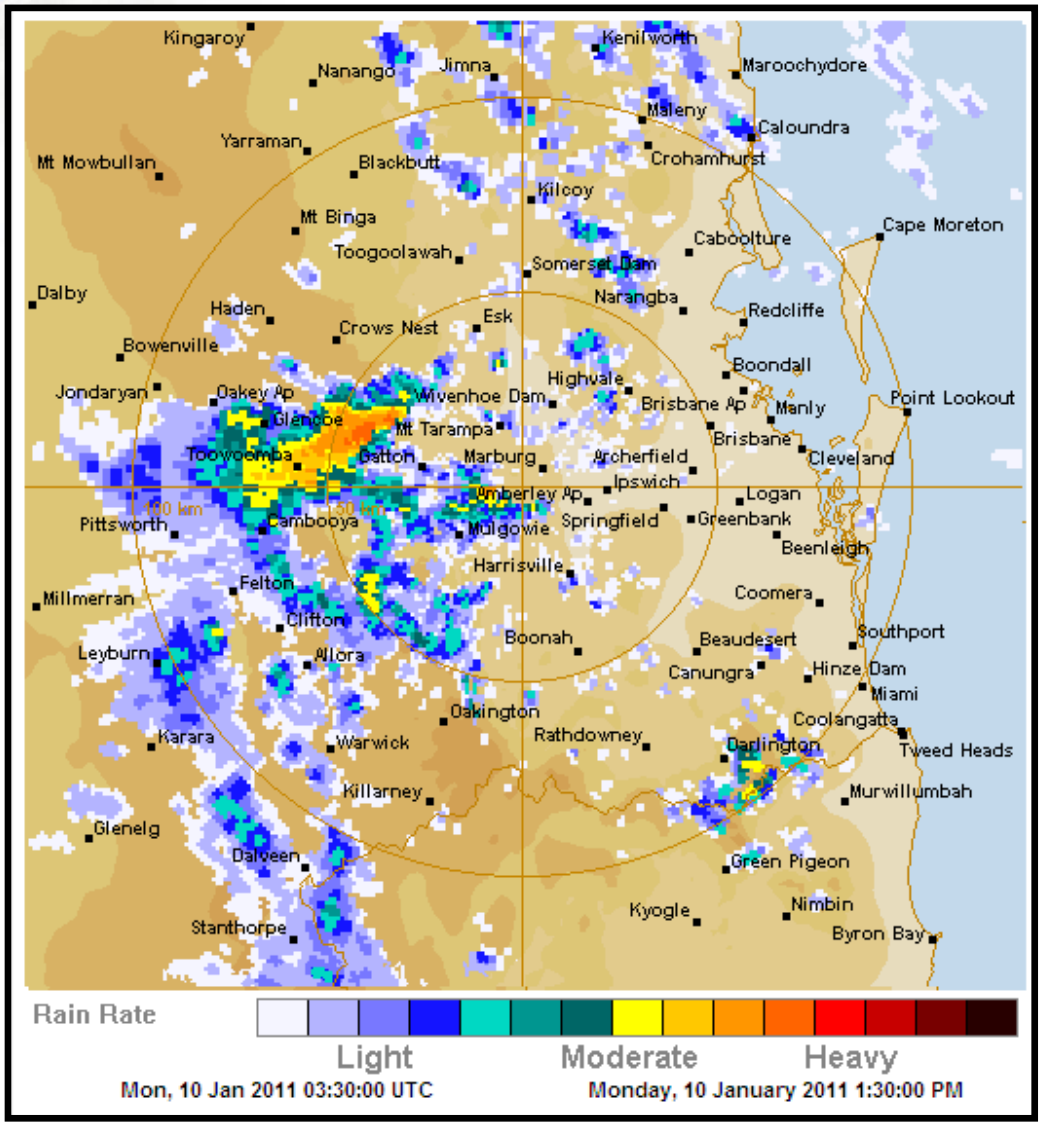
Radar and Rainfall on 10 January



- The storm complex had relatively low intensity radar returns for a storm in southeast Queensland of such high rainfall amounts
- On many occasions during the season, higher intensity radar returns were observed by the Bureau's radar network
- None of the gauges that the Bureau had access to in real time sampled the areas believed to have received the heaviest rain

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Bureau Warnings on 10 January

- **In the days leading up to Monday 10 January, Bureau forecasters were involved in numerous media interviews and briefings to emergency services outlining a deteriorating situation. The Bureau had already heightened awareness in the community through riverine flood warnings and severe weather warnings for parts of Queensland.**

- **From Wednesday 5 January, severe weather warnings were being issued for the Southeast Coast District (which includes the Lockyer Valley area) and being updated regularly, warning the community about very heavy rain and thunderstorms which may lead to localised flash flooding and/or worsen existing river flooding.**

- **Severe Weather Warnings for heavy rain and thunderstorms conducive to flash flooding were issued for the Darling Downs and Granite Belt District (including Toowoomba) from the afternoon of Sunday 9 January and continued through Monday 10 January.**

- **Flood Warnings were also current for the Lockyer, Bremer, and Warrill Creeks and the Brisbane River below Wivenhoe including Brisbane City.**

- **As soon as the Bureau became aware of the existence and magnitude of the flash flood, an extraordinary Flash Flood Warning was issued for Lockyer Creek – and the use of the SEWS by broadcasters was authorised.**

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Section 8

Flood Events December 2010 and January 2011

Australian Government
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Regional Areas and Catchments that were flood affected during December 2010 and January 2011

Regional Area	Catchments
North Tropical Coast	Johnstone, Herbert, Tully, Murray, Russell-Mulgrave
Central Coast	Haughton, Pioneer, Don, Lower Burdekin, Belyando
Coastal Streams Mackay to Maryborough	Nogoa, Mackenzie, Connors/Isaac, Dawson, Fitzroy, Kolan, Burnett, Baffle Creek, Burrum
Coastal Streams Maryborough to the Gold Coast	Mary, Caboolture, Brisbane, Bremer, Lockyer Creek, Pine, Mooloolah, Maroochy, Noosa, Logan-Albert
Border Rivers including the Darling Downs	Upper Condamine, Myall Creek, Charleys Creek, Condamine-Balonne, Maranoa, Moonie, Macintyre
South West	Warrego, Paroo, Bulloo, Barcoo, Cooper Creek, Thompson

At over 100 river height stations used for flood warning in Queensland, the peak flood height experienced in the 2010-11 floods was the highest on record. In many cases the recent floods were the highest in living memory, and in several cases, the highest in 50 to 100 years of records.

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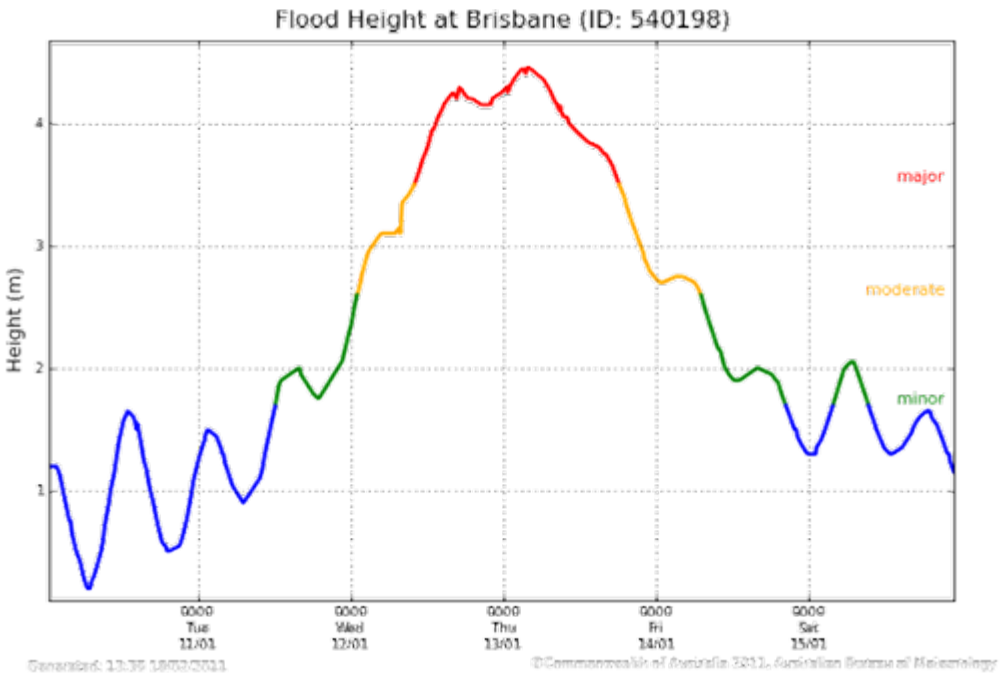
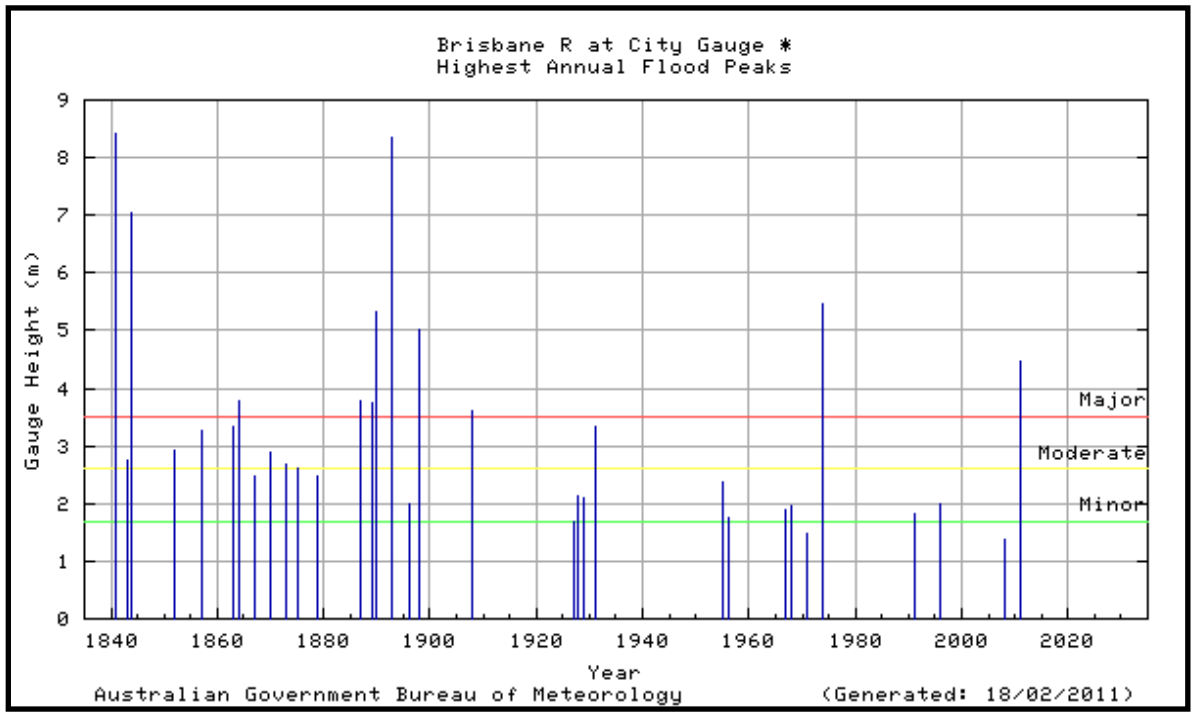
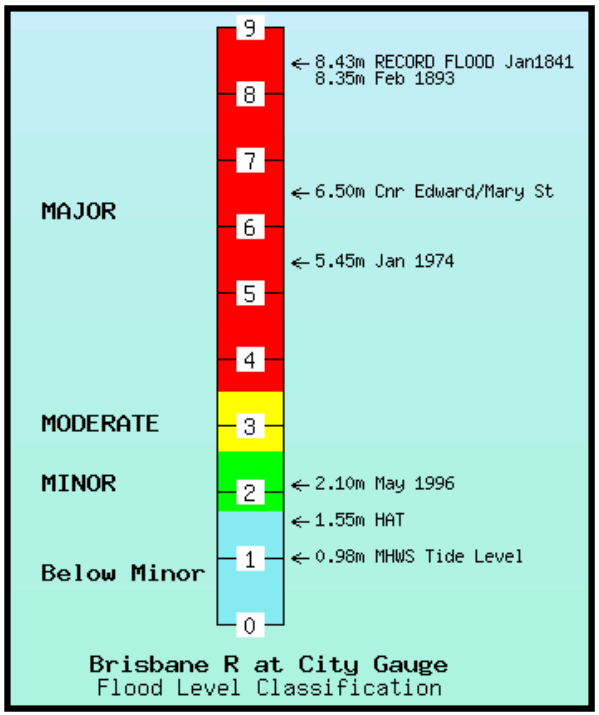
Brisbane River Floods

OPPOSITE: Flood Height 10-16 January



BELOW: Historical Annual Flood Peaks





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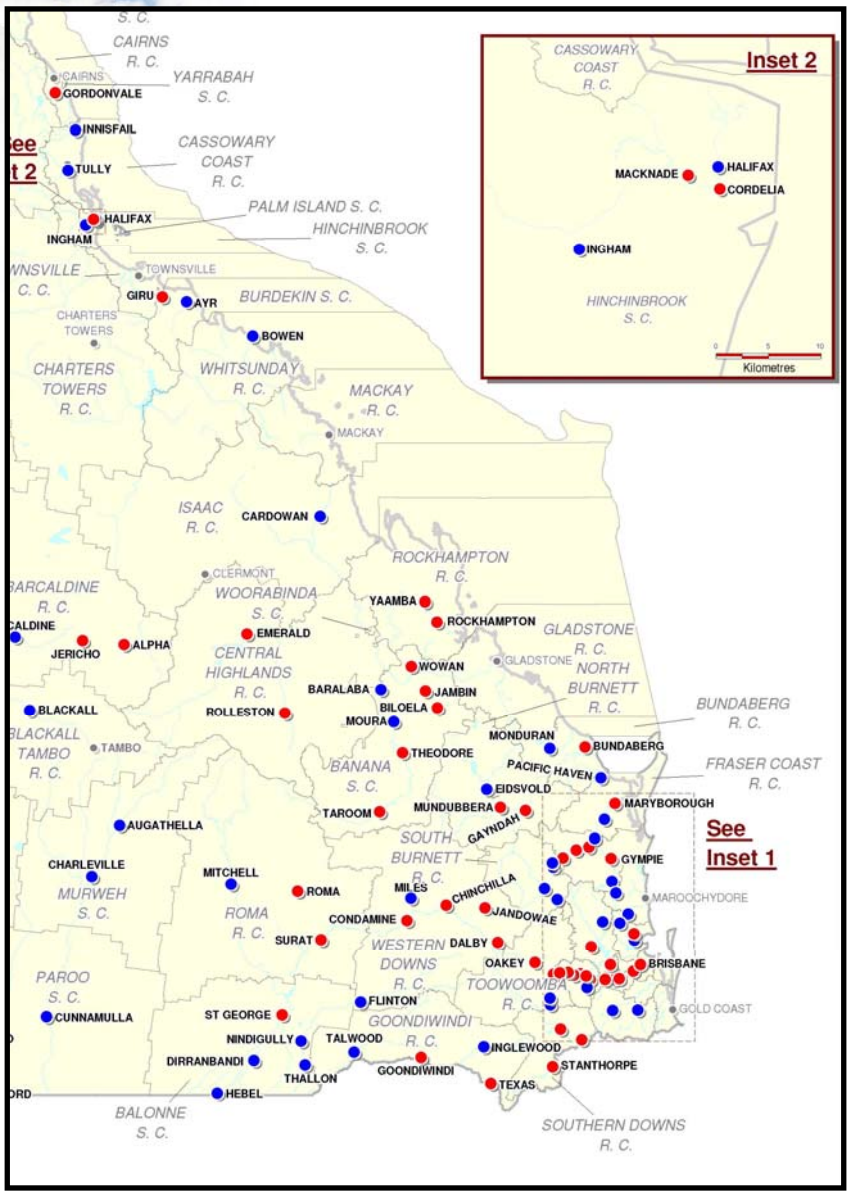
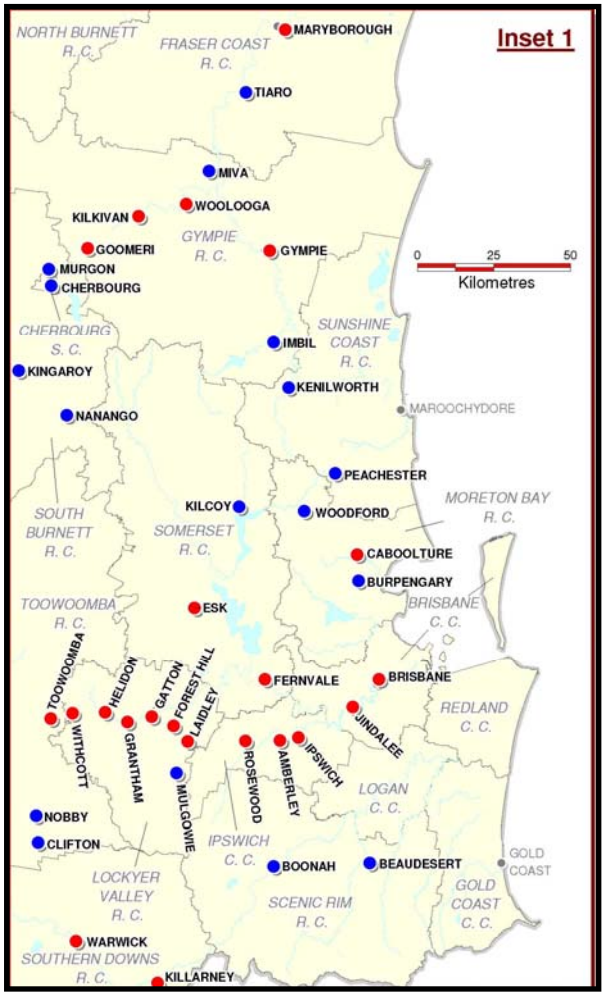
Flood Affected Towns
Local Government Area Maps





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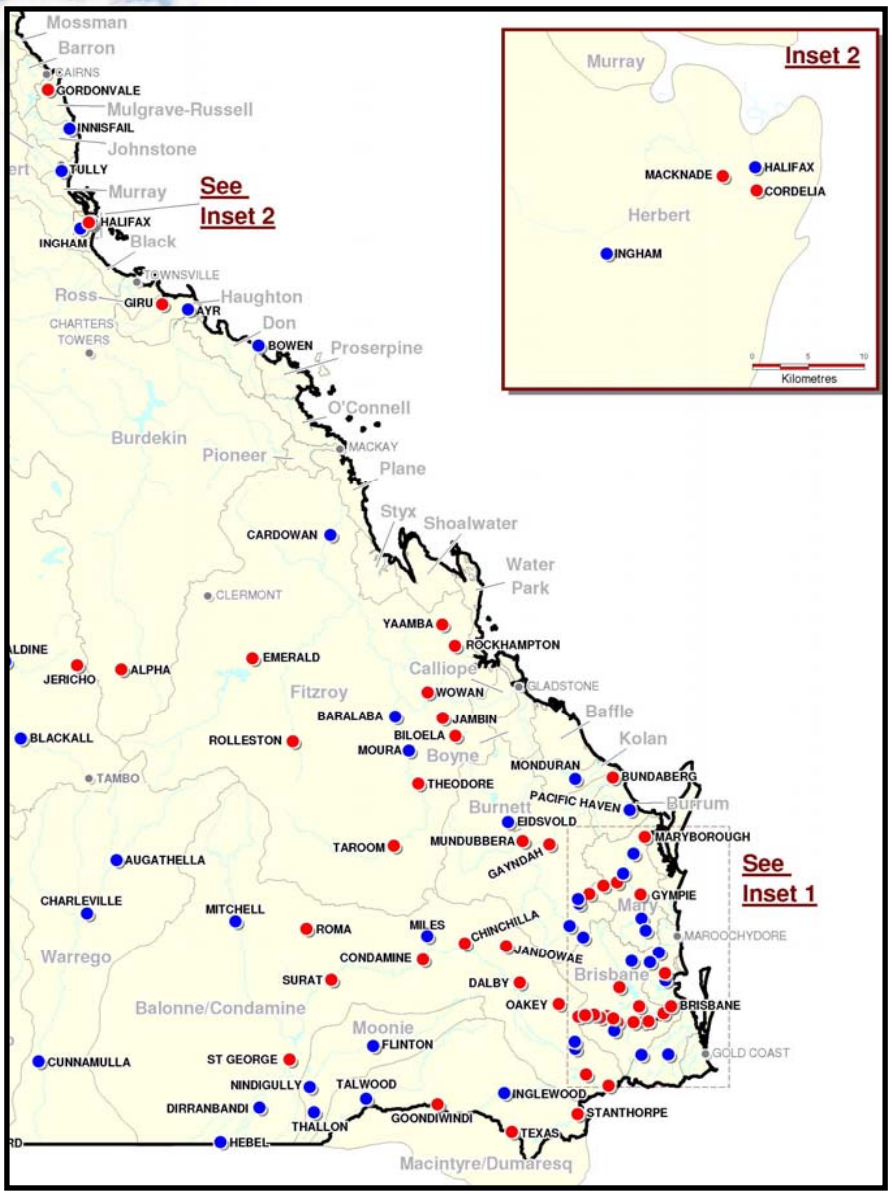
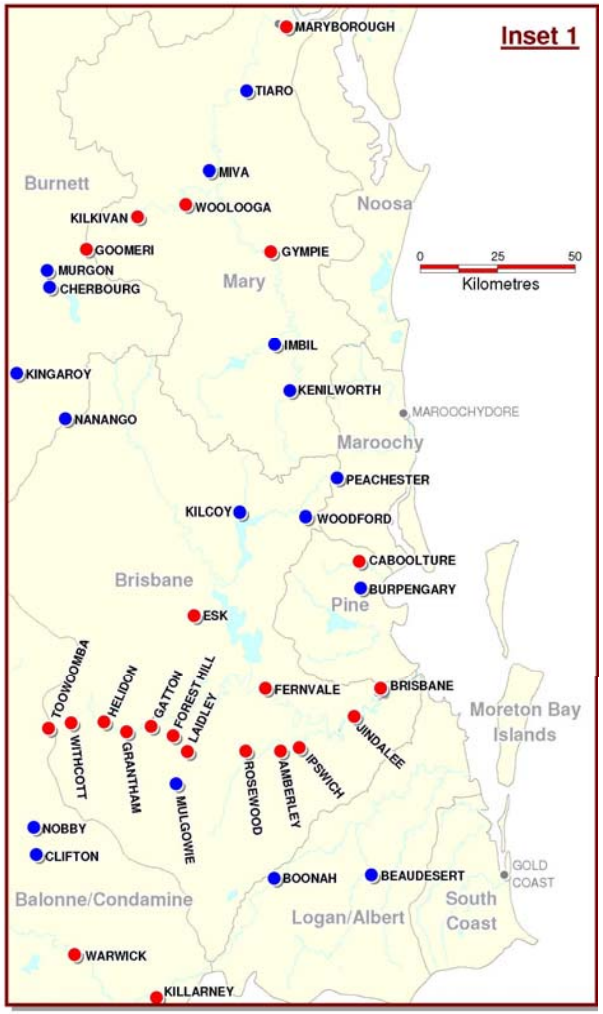
Flood Affected Towns
River Catchment Maps





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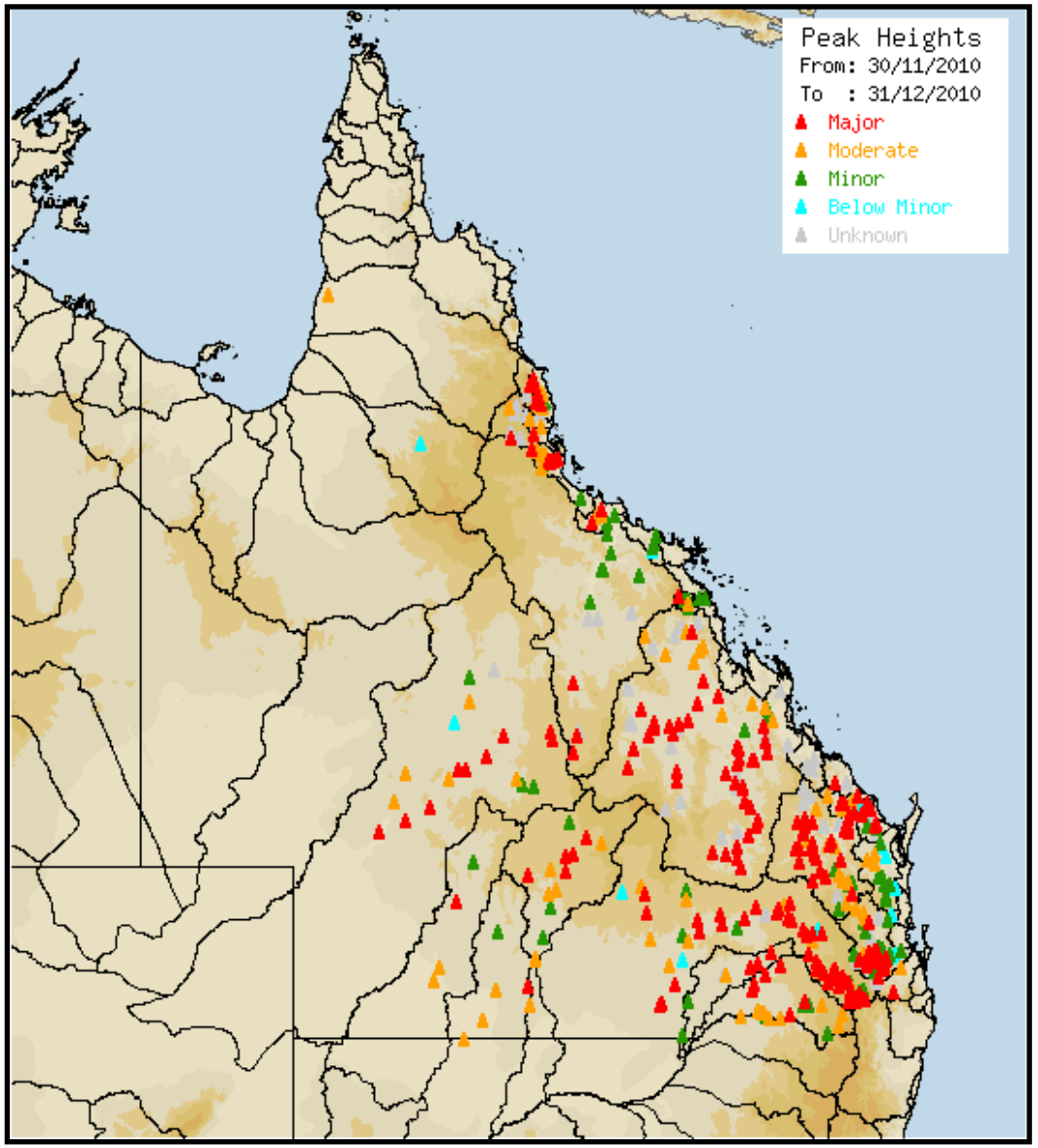
Floods in December 2010

Date	Towns Affected
1-7	Charleville, Bowen , Cardowan, Emerald, Jundah, Cunnamulla, Mitchell, Mulgowie, Yaamba, Eulo, Gatton, Roma, Rosewood, Taroom, Emerald, Isisford, Windorah
8-14	Charleville, Eulo, Surat, Thargomindah, Hungerford, Theodore, St George, Moura, Pacific Haven, Augathella, Baralaba, Gympie, Isisford, Mitchell, Quilpie, Roma, Windorah, Amberley, Quilpie, Yaamba
15-19	Charleville, Rosewood, Thargomindah, Eulo, Flinton, Helidon, Rockhampton, Amberley, Rosewood, St George, Theodore, Cunnamulla, Helidon, Mitchell, Moura, Surat
20-21	Alpha, Amberley, Blackall, Dalby, Gatton, Gympie, Kenilworth, Peachester, Roma, Rosewood, Taroom, Windorah, Woodford, Augathella, Baralaba, Eidsvold, Isisford, Mundubbera
22-24	Brisbane City, Hungerford, Jindalee, Charleville, Euramo, Gatton, Halifax, Ingham, Surat, Thargomindah, Amberley, Bowen, Chinchilla, Gayndah, Isisford, Mundubbera, Rosewood
25	**(TC Tasha)** Flinton, Gordonvale, Innisfail, Theodore
26	Euramo, Halifax, Helidon, Ingham, Cordelia, Macknade, Laidley, Mulgowie, Giru
27	Ayr, Biloela, Dalby, Gatton, Helidon, Ipswich, Jambin, Killarney, Laidley, Mulgowie, Warwick
28	Alpha, Amberley, Chinchilla, Eidsvold, Gayndah, Inglewood, Ipswich, Jericho, Kowanyama, Moura, Mundubbera, Miles, Pacific Haven, Roma, Theodore, Rolleston
29	Baralaba, Barcaldine, Cunnamulla, Flinton, Gympie, Mitchell, Monduran, Taroom
30	Augathella, Blackall, Bundaberg, Goondiwindi
31	Emerald



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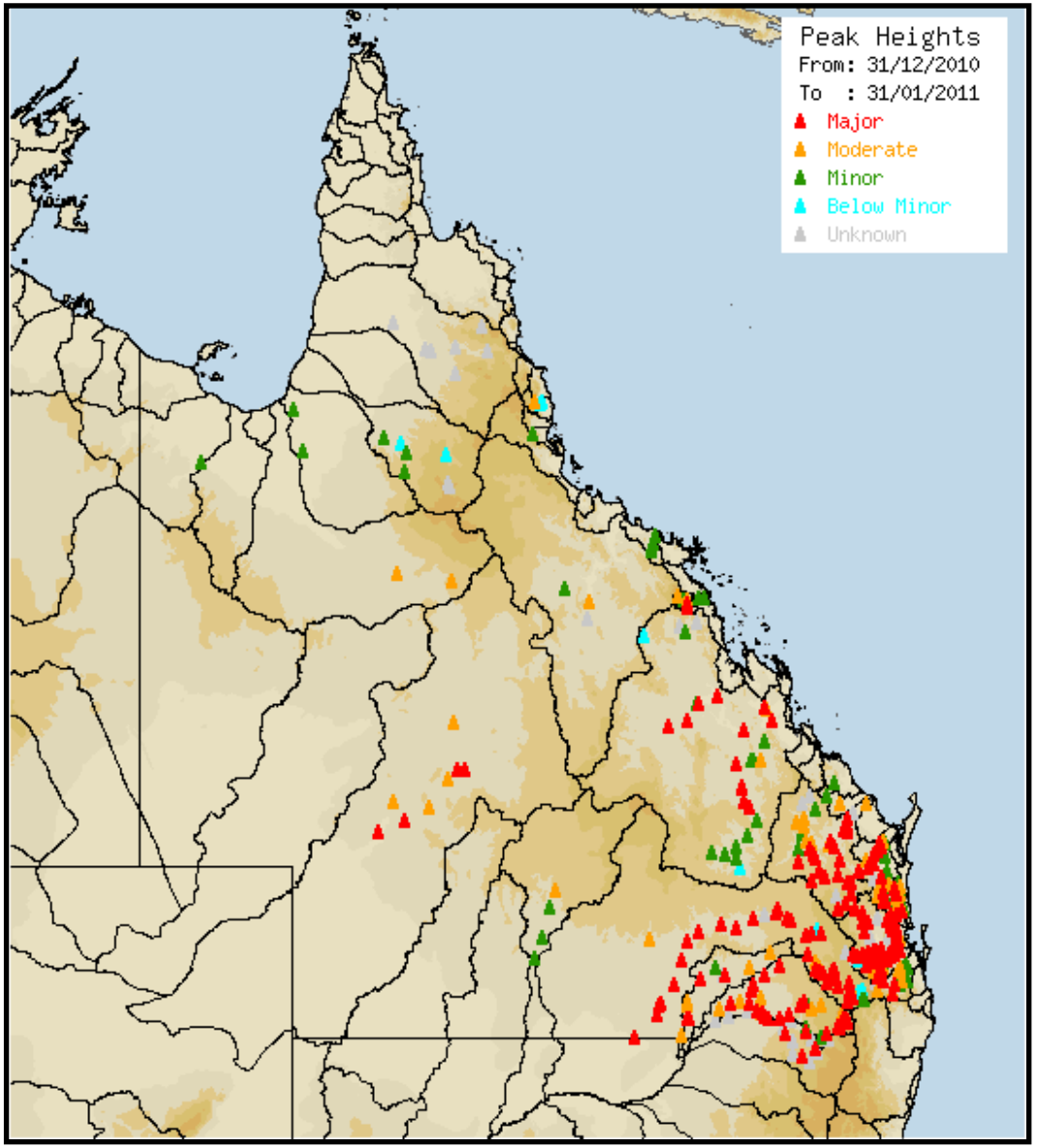
Floods in January 2011

Date	Towns Affected
1-2	Charleville, Condamine Town, Isisford, Theodore, Longreach, Flinton, Jundah
3-6	Bowen Rockhampton, Surat, Yaamba, Gatton, Helidon, Mulgowie, Nindigully
7	Dalby, Eidsvold, Goomeri, Helidon, Imbil, Inglewood, Kenilworth, Kilkivan, Rosewood, Taroom, Windorah, Woodford
8	Amberley, St George, Talwood, Taroom, Tiaro, Woolooga
9	Goondiwindi, Grantham, Helidon, Imbil, Kenilworth, Mundubbera, Peachester, Thallon, Kilcoy
10	Boonah, Clifton, Bundaberg, Dalby, Esk, Toowoomba, Withcott, Helidon, Grantham, Gatton, Laidley, Kenilworth, Killarney, Mulgowie, Nobby, Stanthorpe, Woodford
11	Beaudesert, Boonah, Burpengary, Caboolture, Cherbourg, Fernvale, Grantham, Gympie, Inglewood, Kilkivan, Kingaroy, Laidley, Mundubbera, Murgon, Nanango, Peachester, Rosewood, Stanthorpe, Warwick, Woodford, Miva
12	Amberley, Chinchilla, Dalby, Dirranbandi, Flinton, Inglewood, Ipswich, Jindalee, Maryborough, Oakey, Texas, Tiaro, Jandowae
13	Brisbane City, Bundaberg
14	Eidsvold, Goondiwindi
15-22	Windorah, Condamine Town, Hebel, Nindigully, Flinton, Surat, Bowen, Hughenden, Laidley, Amberley, Rosewood
23-31	St George, Dirranbandi, Hebel, Bowen, Cardowan



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Section 9

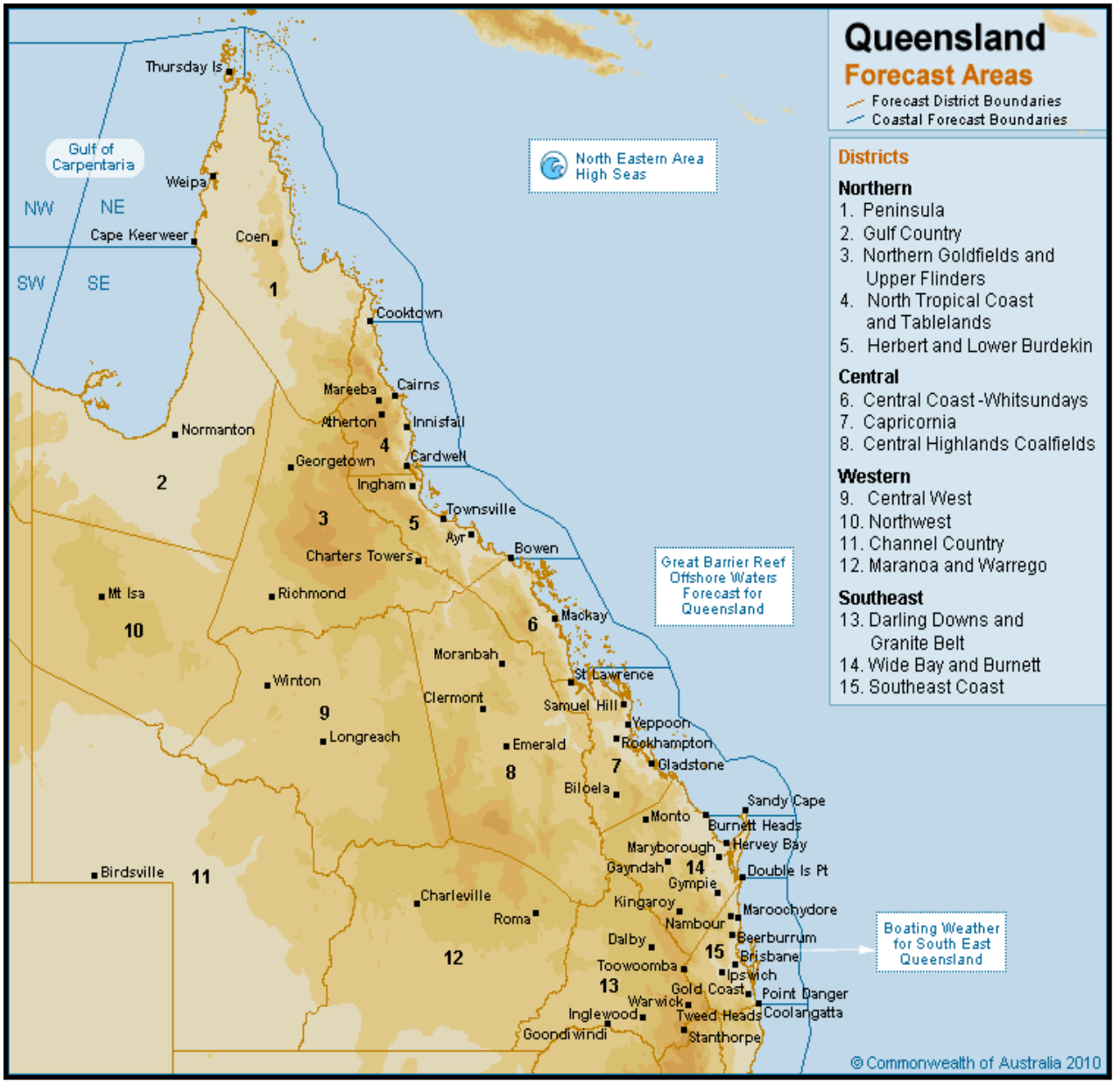
Forecasts and Warnings for Weather and Flood

Australian Government
Bureau of Meteorology

Queensland Weather Forecasts

Routine Forecasts are issued by the Brisbane RFC for the state of Queensland, 15 Forecast Districts, 38 Cities and Towns, and 12 marine zones.

Forecasters also relay this information to the public through their many radio crosses.



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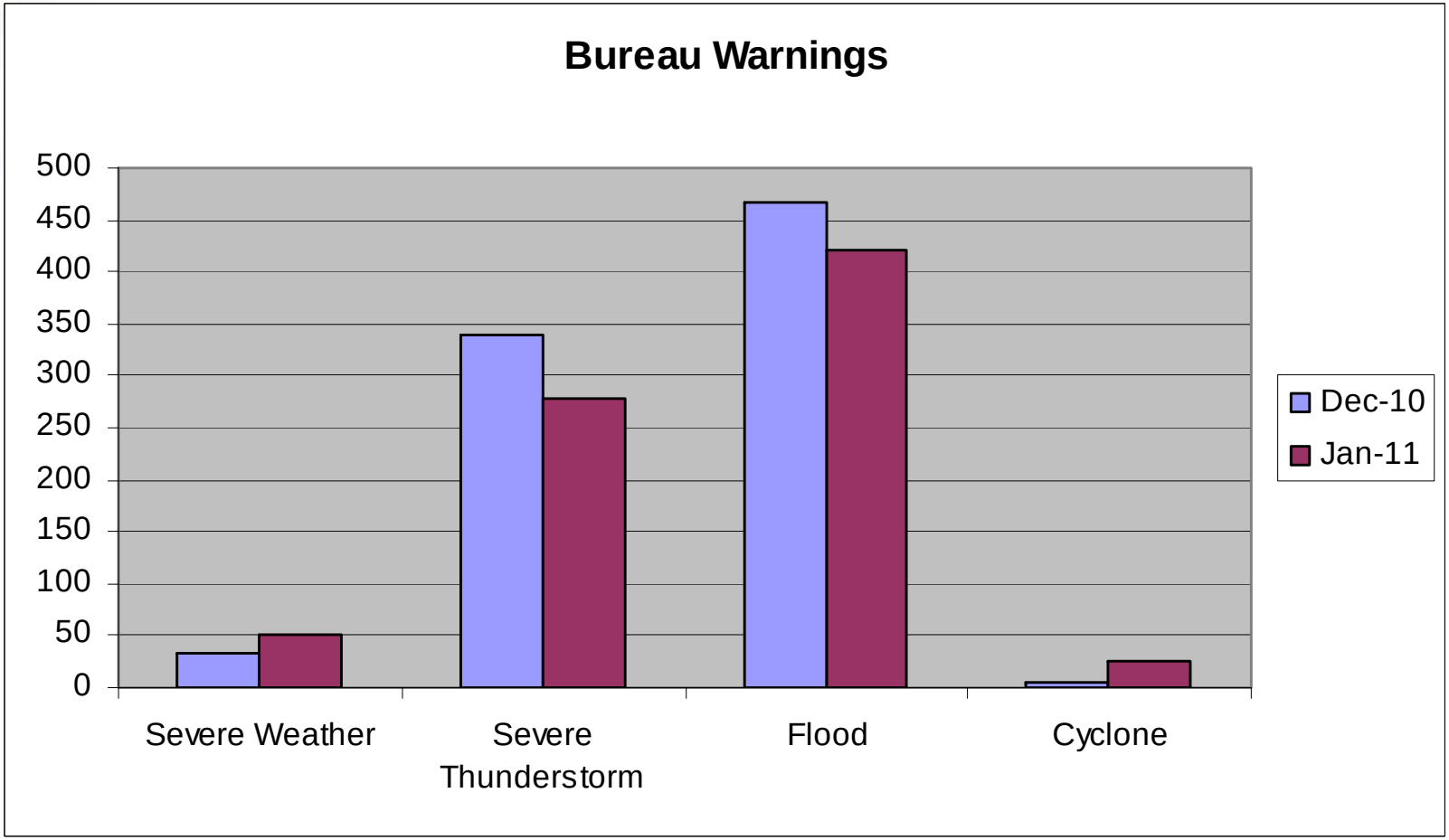
Number of Bureau Warnings issued during December and January



Almost 900 Flood Warnings were issued with 350 per year being the long-term average

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Severe Weather Warnings and Severe Thunderstorm Warnings

Severe Weather Warnings are issued when one or more of the criteria in the Table below are met and:

- severe weather is expected to affect land-based communities within 6-24 hours;
- it is not directly the result of severe thunderstorms; and
- it is not covered by tropical cyclone or fire weather warnings.

Phenomenon	Severe Thunderstorm Warning	Severe Weather Warning
Wind (Gusts)	Gusts 90 km/h or more	Gusts 90 km/h or more
Wind (Average)		Widespread winds >= 63 km/h
Tornado	All Tornados	
Blizzard		Widespread blizzards in alpine areas
Flash Flood	Heavy Rainfall that is conducive to flash flooding or a reported flash flood	Heavy Rainfall that is conducive to flash flooding or a reported flash flood
Large Hail	Hail with diameter >= 2cm	
Storm Tide		Abnormally high tides expected to exceeed the highest astronomical tide
Large Waves		Unusually large surf waves expected to cause dangerous conditions on the coast

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Severe Weather Warnings and Severe Thunderstorm Warnings

- **It is uncommon for Severe Weather Warnings and Severe Thunderstorm Warnings to be issued concurrently for the same area**
- **The practicality of maintaining clear and concise communication generally leads the Bureau to opt for simplicity of message**
- **One situation where warnings will be issued concurrently is where the severe thunderstorms are expected to produce additional hazardous phenomena such as large hailstones or damaging winds**

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Flood Forecasting and Warning

- **The provision of flood forecasting and warning services in Australia is a cooperative arrangement between all three levels of government, which describe the responsibilities of agencies for the establishment and operation of flood warning and forecasting systems. A distinction is made between flash flood warnings (described as situations where the rain-to-flood time is less than 6 hours) and other (non-flash flood or riverine) warnings.**

- **Flood forecast and warning services are provided through the Queensland Flood Warning Centre (FWC) which is an extension of the Regional Forecasting Centre (RFC). The FWC is staffed by hydrologists, meteorologists and technical officers, who work closely with the meteorologists in the RFC.**

- **The Bureau operates a hydrologic forecasting system involving the real-time collection of rainfall and water level data from a network of stations operated in partnership with State and other agencies. This data is used in hydrologic forecasting models which, combined with recent and forecast rainfalls enable the predictions of future flood levels to be made.**

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Flood Forecasting and Warning

The primary roles for the Bureau in the total flood warning system are:

- **to prepare and issue flood warnings on a river basin scale;**
- **to make predictions of future flood levels at locations within designated basins; and**
- **to provide these warnings and predictions in the form of flood warning messages direct to a range of stakeholder agencies involved in disaster management and response, as well as to the general public through the media and the Bureau website.**

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Flood Forecasting and Warning

Under the disaster management arrangements that the Bureau has with state agencies and local governments, <u>the Bureau has no role in</u>:

- **the issuance of flash flood warnings for specific locations or individual creeks;**
- **the interpretation of the impact of the expected flooding and predicted flood levels on people and infrastructure in the floodplain; and**
- **the further dissemination of this more targeted information down to individual affected parties sits within the overall disaster management arrangements of the state.**

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Flood Forecasting and Warning

- **While the Bureau is responsible for forecasting floods, predicting river height levels, and forecasting heavy rain that is conducive to flash flooding, the Bureau is not responsible for forecasting flash flooding in specific locations or individual creeks. However reports received of flash flooding will be included in warnings.**

- **The Bureau does not have the systems, capacity or detailed local knowledge to provide a flash flood service for the many thousands of headwater valleys across Australia. Flash flood warning services for individual locations require full end-to-end systems.**

- **Where this is a known flash flood threat local agencies can operate ALERT systems consisting of a dense network of automatic radio reporting rainfall and water level stations and a local computer to display, analyse and alarm on the data. The Bureau's role is to assist local agencies to develop such a system.**

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Flood Forecasting and Warning

- **Threshold based River Height Bulletins (RHBs) are issued by the Bureau as a part of the flood warning system in Queensland.**
- **RHBs are a list of flood warning stations and their latest river height and where available, additional information relating to a bridge, road, lake or spillway level.**
- **During rain-flood periods, RHBs are automatically issued every 3 hours where the water level at any one of the stations on the list has exceeded a pre-set threshold height.**

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Forecasting for Dams

The Bureau models 47 river basins in Queensland using over 150 operational rainfall-runoff flood models that includes the modelling of about 28 large dams.

Each dam is different in that it needs to be individually modelled by having different:

- **data networks,**
- **operating procedures,**
- **physical characteristics, and**
- **downstream effects.**

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Forecasting for Dams

Flood warning operations are different for dams with gated spillways compared to fixed spillways:

- **For gated spillways**
  - **Bureau needs estimates of future dam releases from the dam operator to be able to predict for downstream locations**
- **For fixed spillways**
  - **Bureau models the inflows and the characteristics of the dam to predict outflows and downstream locations**

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Report to Queensland Floods Commission of Inquiry:

provided in response to a request for information from the Queensland Floods Commission of Inquiry received by the Bureau of Meteorology on 4 March 2011.

End of Presentation

Questions Invited

Presentation slides provided to the Queensland Floods Commission of Inquiry on 8 April 2011