Documents used by Kenn Batt for pre-race meteorological briefing on 24th December 1998

Part 1

1A Introduction

1B General Information: Sydney to Gabo Island

1C General Information: Gabo Island to Tasmania

1D General Information: East coast of Tasmania

1E General Information: Storm Bay

1F General Information: The dreaded Derwent River

1G General Information: Where to get weather/oceanographic information

1H Weather Outlook: MSL Analysis valid 0400 hr Local Time 24/12/98.

1I Weather Outlook: Set of GASP model runs, initialised at 2300 hr Local Time 23/12/1998. Each chart valid at 2300 hr Local Time on the day indicated.

1J Weather Outlook: Outlook for each day as indicated.

1K Weather Outlook: NSW forecast policy issued at 0355 hr 24/12/1998.

1L Oceanographic information issued on behalf of CSIRO Marine Research.

Documents referred to by Kenn Batt during pre-race meteorological briefing on 24th December 1998

Part 2

2A Article by Kenn Batt titled "Cold Front" Australian Sailing January 1999

2B Article by Kenn Batt titled "Finding that weather information" Offshore Yachting December/January 1998/9.

Documents issued by Kenn Batt during pre-race meteorological briefing on 24th December 1998

Part 3

3A "Marine Weather Services- A guide to Australia's marine forecasts and warnings" BOM 1998

3B "Weather by Fax-Check the Weather" BOM 1998

3C "Weather Words"- BOM 1997

3D "The Weather Map"- BOM 1993

3E "Weather Information for the Sydney-Hobart, Telstra Cup and Sydney to Coffs Harbour Yacht Races".

Documents issued by Kenn Batt before pre-race meteorological briefing on 24th December 1998

Part 4

4A: Documents pertaining to the Bureau's HF Weatherfax system, telephone weather services, Weather by Fax service and Weather Information for the Sydney-Hobart, Telstra Cup and Sydney to Coffs Harbour Yacht Races were made available to the Sailing Office of the CYCA a few weeks before the Sydney to Hobart Yacht Race. To the best of my knowledge, these were copied at the CYCA and inserted by Sailing Office staff into each yacht's document bag. The bags were given to each skipper or navigator before the pre-race briefing on 24/12/1999.

Other

Part 5

5A: Brief resume of Kenn Batt

Part 6

6A: REFERENCES

Part 7

7A: SOME PREVIOUS PUBLICATIONS

Part 8

8A: MARINE COURSE STRUCTURE

Part 9

9A: SHORT FAMILY HISTORY

1A

1998 TELSTRA SYDNEY TO HOBART YACHT RACE METEOROLOGICAL AND OCEANOGRAPHIC BRIEFING

by

Kenn Batt

Bureau of Meteorology, NSW

* General Information

* Weather Outlook

* Oceanographic Conditions courtesy of CSIRO Division of Marine Research, Hobart (George Cresswell et al)

1B

SYDNEY TO GABO ISLAND

* Southerly changes (Southerly Buster) read Dec 1998 Australian Sailing article

* west of rhumb-line in S/SW flow

* east of rhumb-line in SE/E flow

* Pre-Frontal trough development

* East Coast Low (1993 Hobart Race)

* Strong sea breezes

* Thunderstorms

* Wind versus East Australia Current

1C

GABO ISLAND TO TASMANIA

* Frontal changes more west to southwest in direction

* Funnelling through Bass/Banks Straits

* "Corner effect", Gabo Island and Tasman Island

* Fully risen sea very quickly occurs in Bass Strait after onset of strong winds

* Pre-frontal trough development

* East Coast Low

* Sheltering effect of Flinders Island

* Thunderstorms

1C

* Bass Strait "suck in"

1D

EAST COAST OF TASMANIA

* 30NM OFF EDDYSTONE POINT

* Lee Vortex under broad westerly flow

- north of Freycinet (Cape Tourville) - generally OK

- South of Freycinet - NE to SE going SSW close to Tasman Is.

* 15 NM OFF MARIA

* Thunderstorms

* Tasman Island Effect

E

STORM BAY

* can live up to its name!!

* Not too close to Cape Raoul/Maingon Bay

* Is there an ebb tide?

* Has there been rainfall over southern Tasmania during the past few days?

* A flood tide could take you too far right

F

THE DREADED DERWENT RIVER

* Wind shuts down generally after 2200 hr.

* Starts up again after 0600 hr.

* Eastern side (at least to White Rock) of river generally pays, especially at night with an ebb tide and after heavy rain

* Doesn't pay to be west of line White Rock to John Garrow Light

* Standing wave/rotor activity in the lee of Mount Wellington during broad westerly flow

* Sea breeze is SE in the river and will draw more east out of eastern bays

1G

WHERE TO GET WEATHER/OCEANOGRAPHIC INFORMATION

*** See latest OFFSHORE magazine with article by KB and handout**

*** Bureau stand at CYCA on Boxing Day**

*** Internet sites (BoM, CSIRO AND TELSTRA)**

*** Weather by Fax (Bureau's poll fax service)**

*** 1900 recorded weather service**

*** 131236 Waterways service**

*** Bureau special race forecasts at sked times**

IG

* Telstra coastal stations

* Penta Comstat

* AM/FM radio

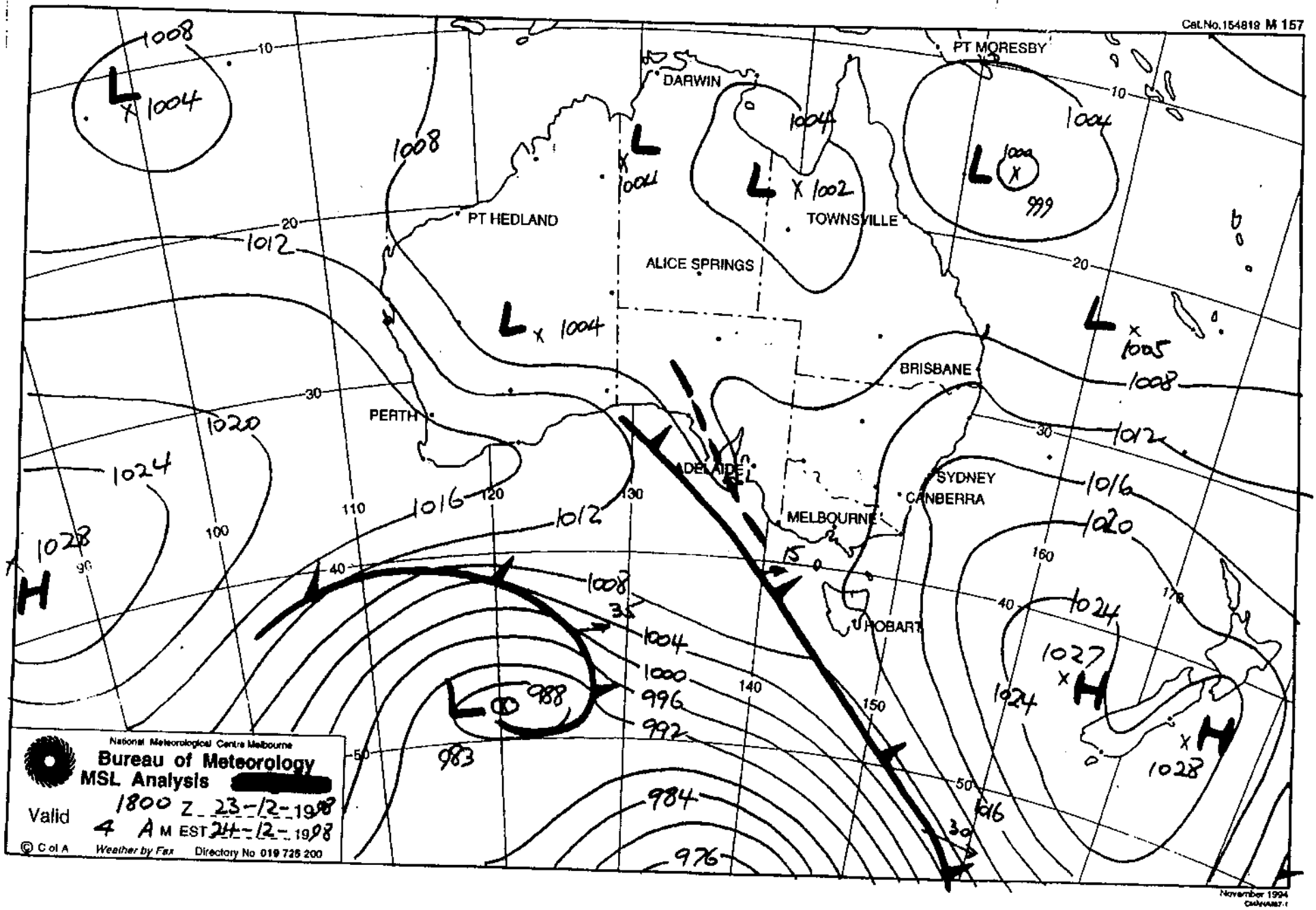
* HF weatherfax service

* Coatal patrol and coast guard

* Weatherlink pager service

* EYE BALL MARK 1 method!!! KEEP THE HEAD OUT OF THE BOAT AT ALL TIMES

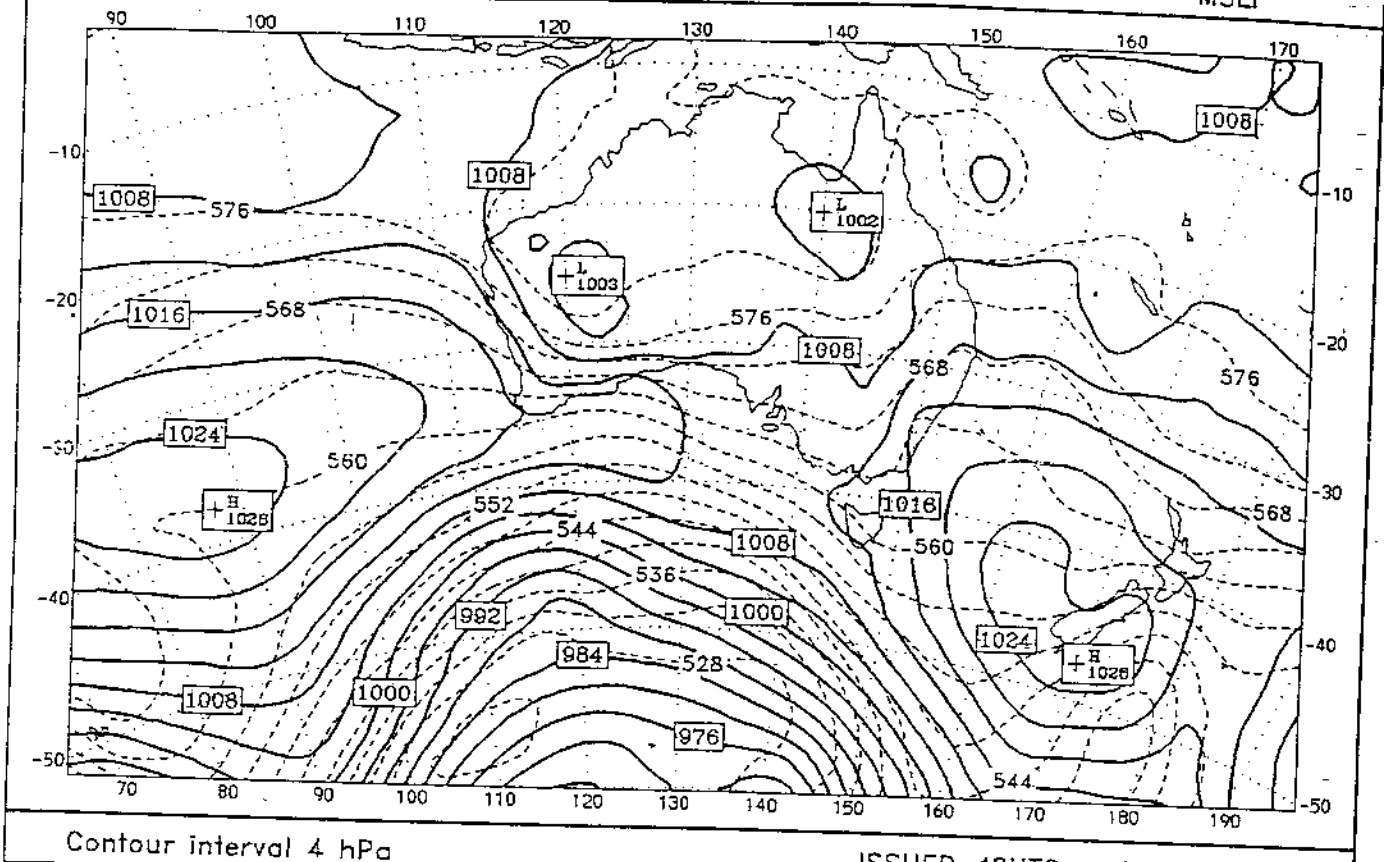
* Please send latest weather conditions by e-mail to whrsyd@bom.gov.au


Cat.No.154819 M 157
PT MORESBY
DARWIN
PT HEDLAND
TOWNSVILLE
ALICE SPRINGS
BRISBANE
PERTH
ADELAIDE
SYDNEY
CANBERRA
MELBOURNE
HOBART
1008
1004
1004
1002
1004
999
1012
1004
1005
1008
1020
1024
1016
1012
1016
1020
1028
1008
1004
1000
996
992
988
983
984
976
1024
1027
1028
1016
10
20
30
40
50
90
100
110
120
130
140
150
160
170
National Meteorological Centre Melbourne
Bureau of Meteorology
MSL Analysis [redacted]
Valid 1800 Z 23-12-1998
4 AM EST 24-12-1998
© C of A
Weather by Fax
Directory No 019 725 200
November 1994

II

NMC GASP T239L29 ANALYSIS

ANALYSIS VALID 1200 UTC Wed 23 DEC 1998 MSLP

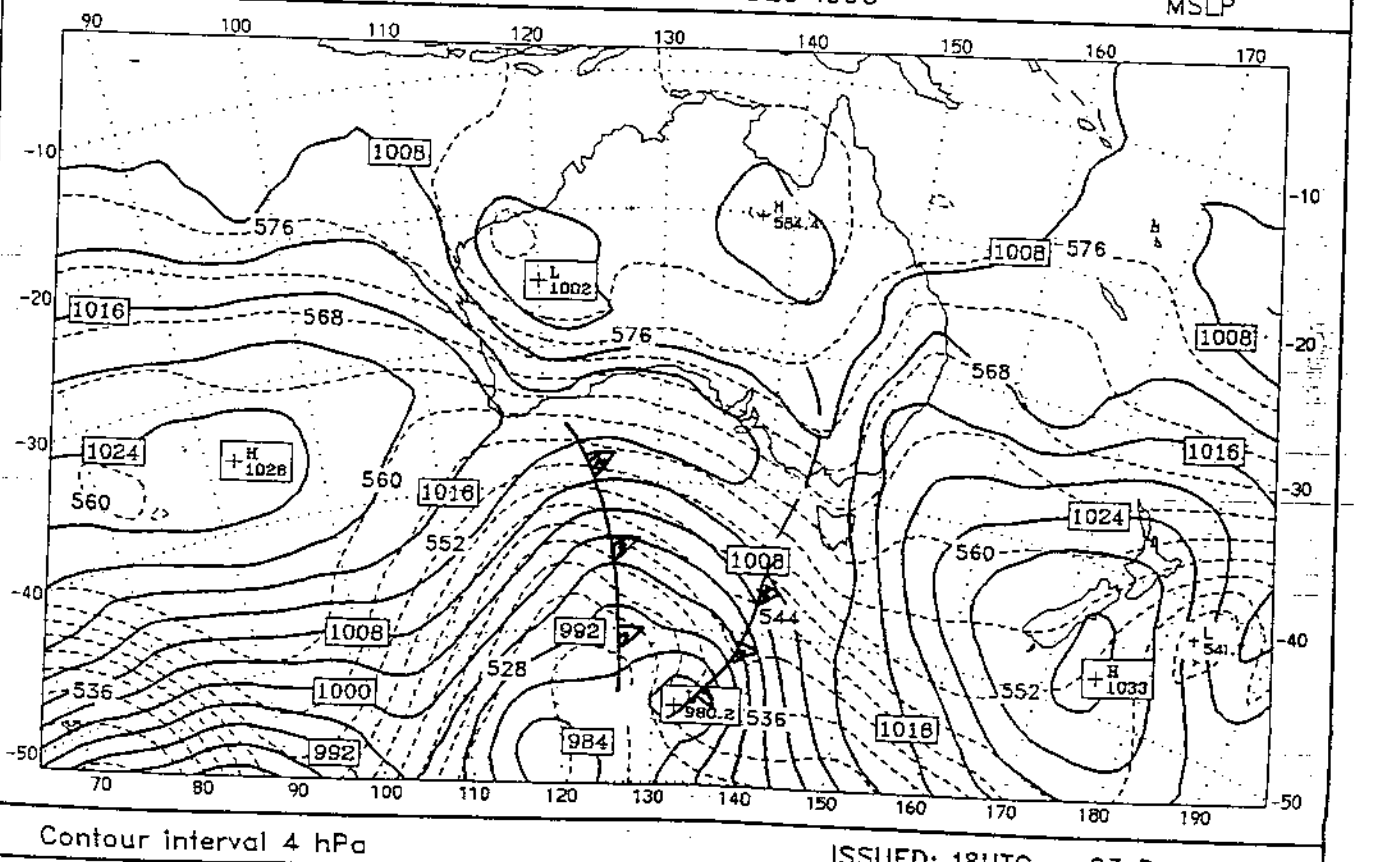


Contour interval 4 hPa

ISSUED: 18UTC 23 Dec 1998

NMC GASP T239L29 FORECAST

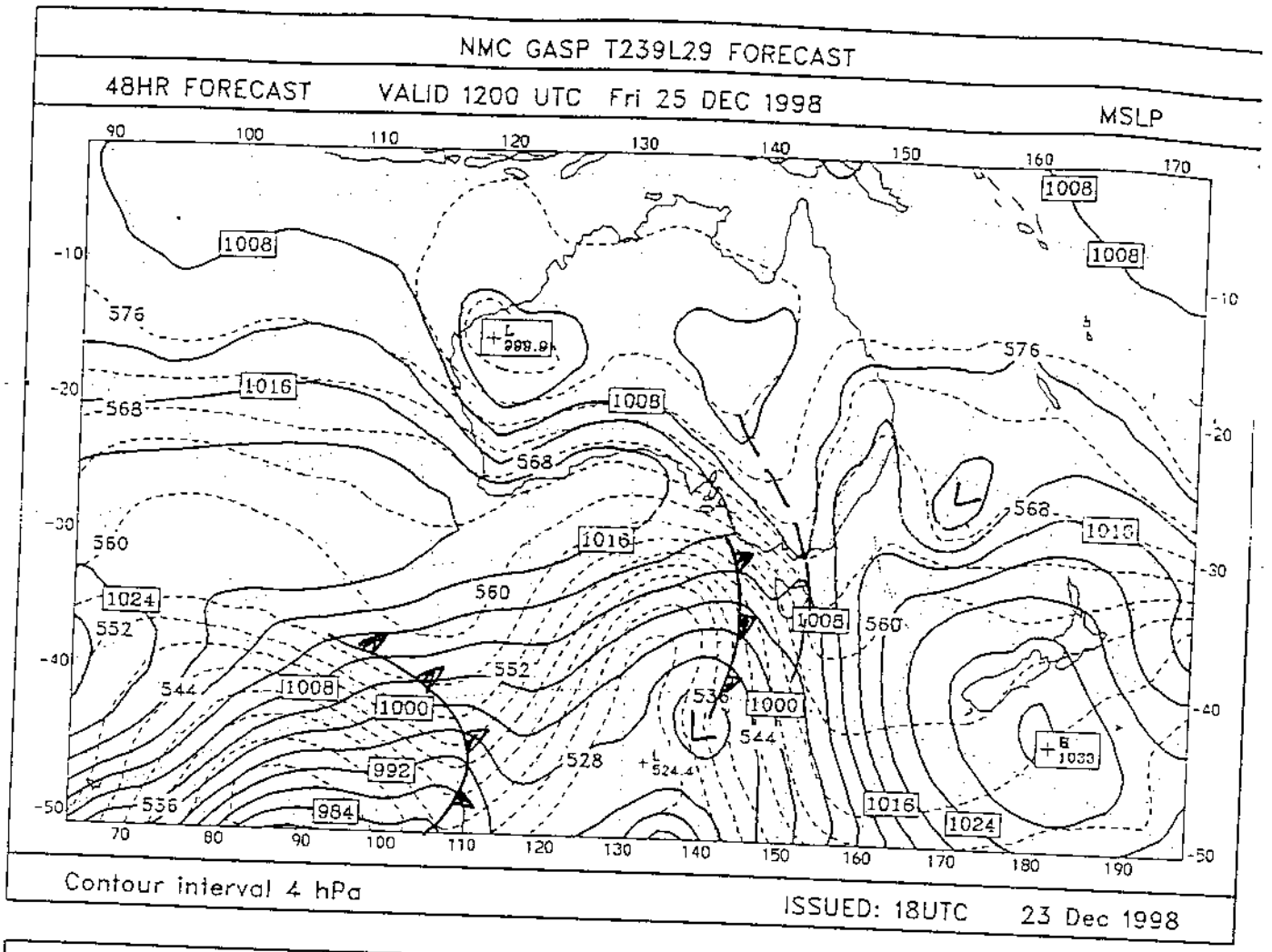
24HR FORECAST VALID 1200 UTC Thu 24 DEC 1998 MSLP

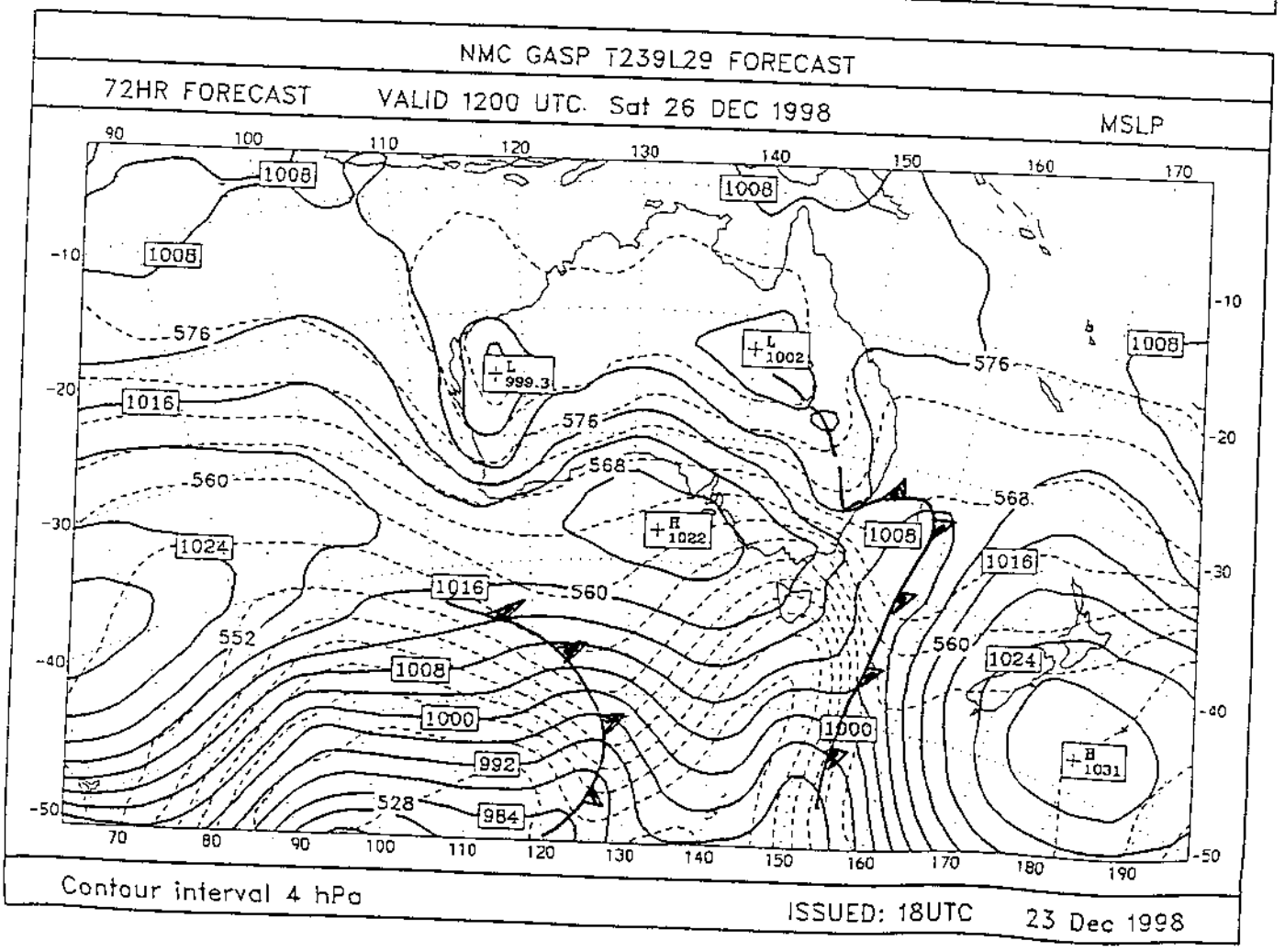


Contour interval 4 hPa

ISSUED: 18UTC 23 Dec 1998

11

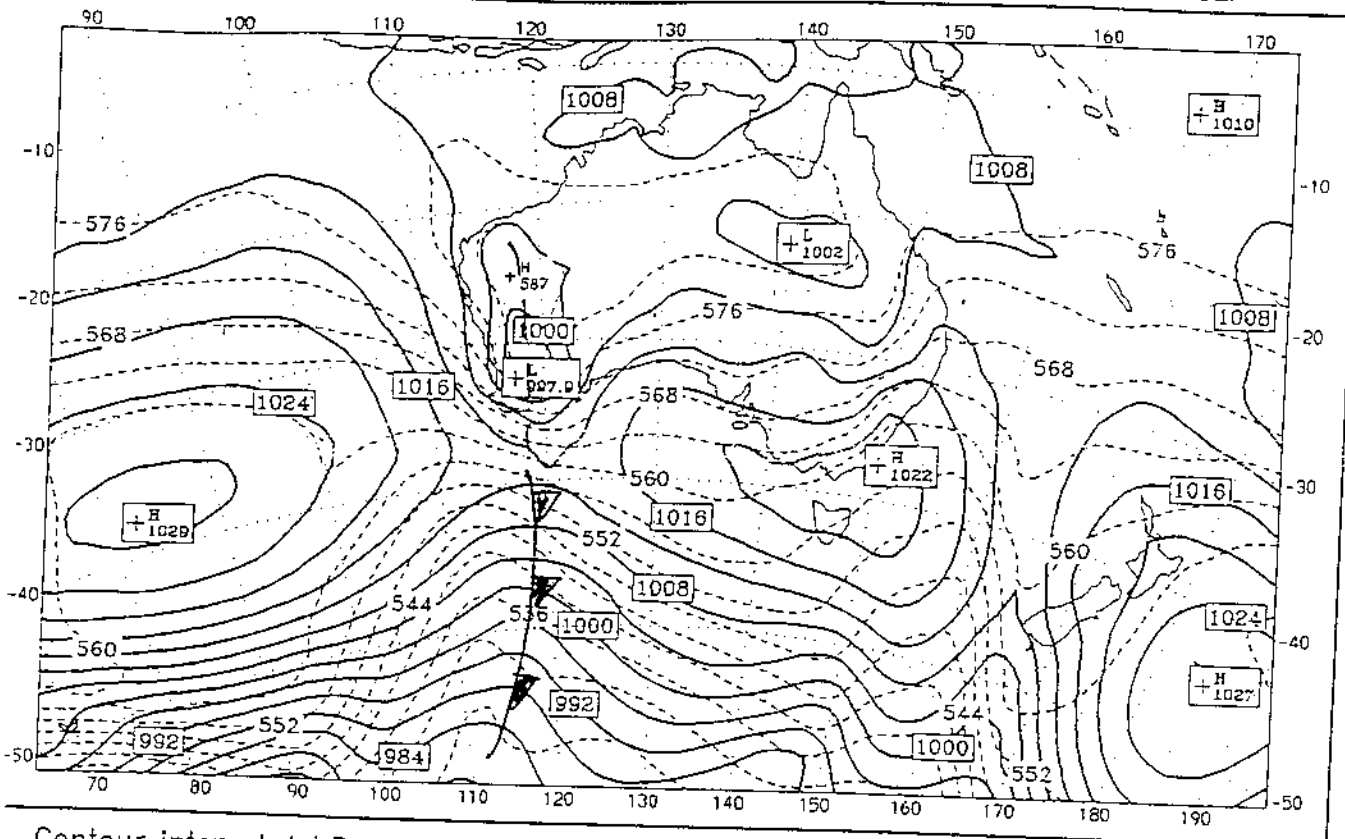

NMC GASP T239L29 FORECAST
48HR FORECAST VALID 1200 UTC Fri 25 DEC 1998
MSLP
Contour interval 4 hPa
ISSUED: 18UTC 23 Dec 1998


NMC GASP T239L29 FORECAST
72HR FORECAST VALID 1200 UTC. Sat 26 DEC 1998
MSLP
Contour interval 4 hPa
ISSUED: 18UTC 23 Dec 1998

11

NMC GASP T239L29 FORECAST

96HR FORECAST VALID 1200 UTC Sun 27 DEC 1998 MSLP

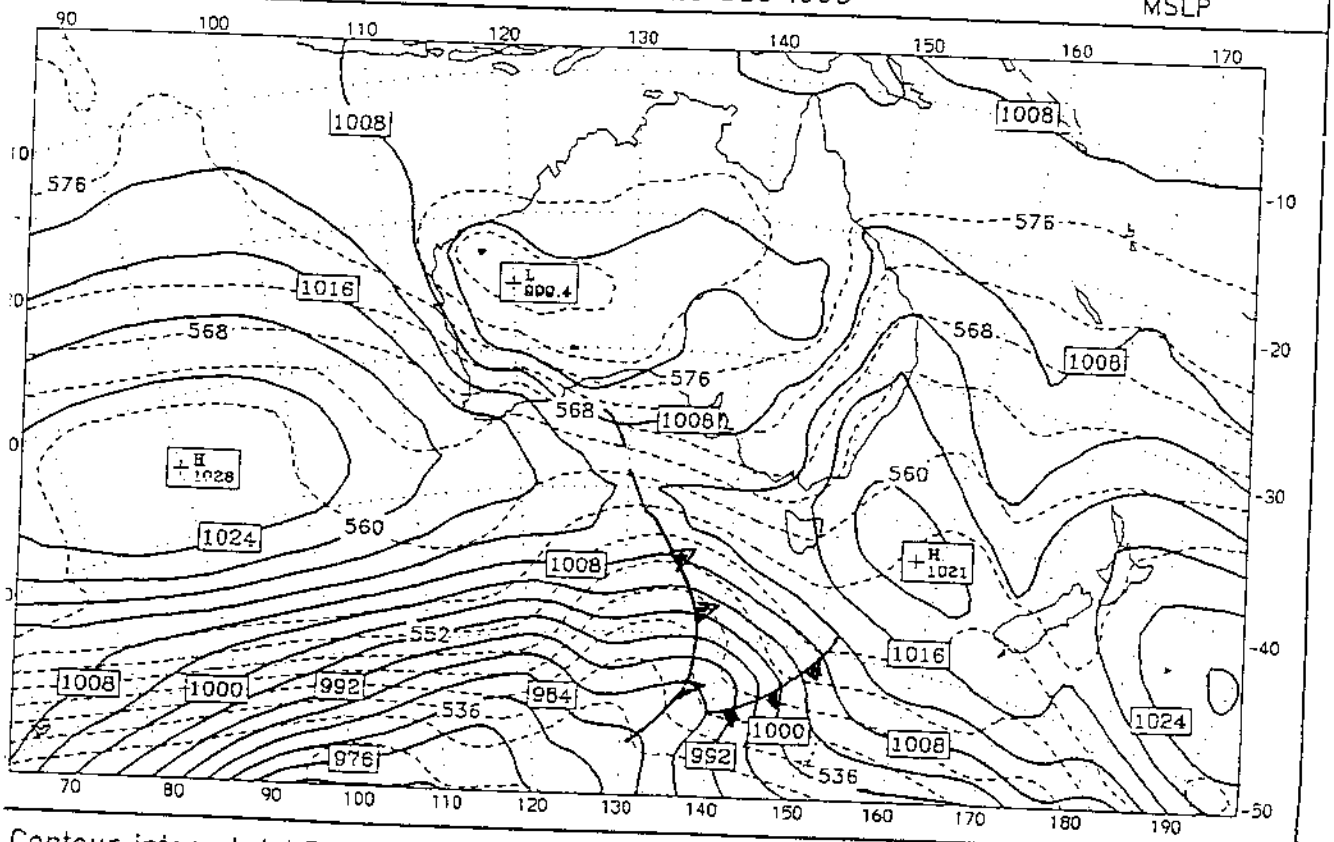


Contour interval 4 hPa

ISSUED: 18UTC 23 Dec 1998

NMC GASP T239L29 FORECAST

120HR FORECAST VALID 1200 UTC Mon 28 DEC 1998 MSLP



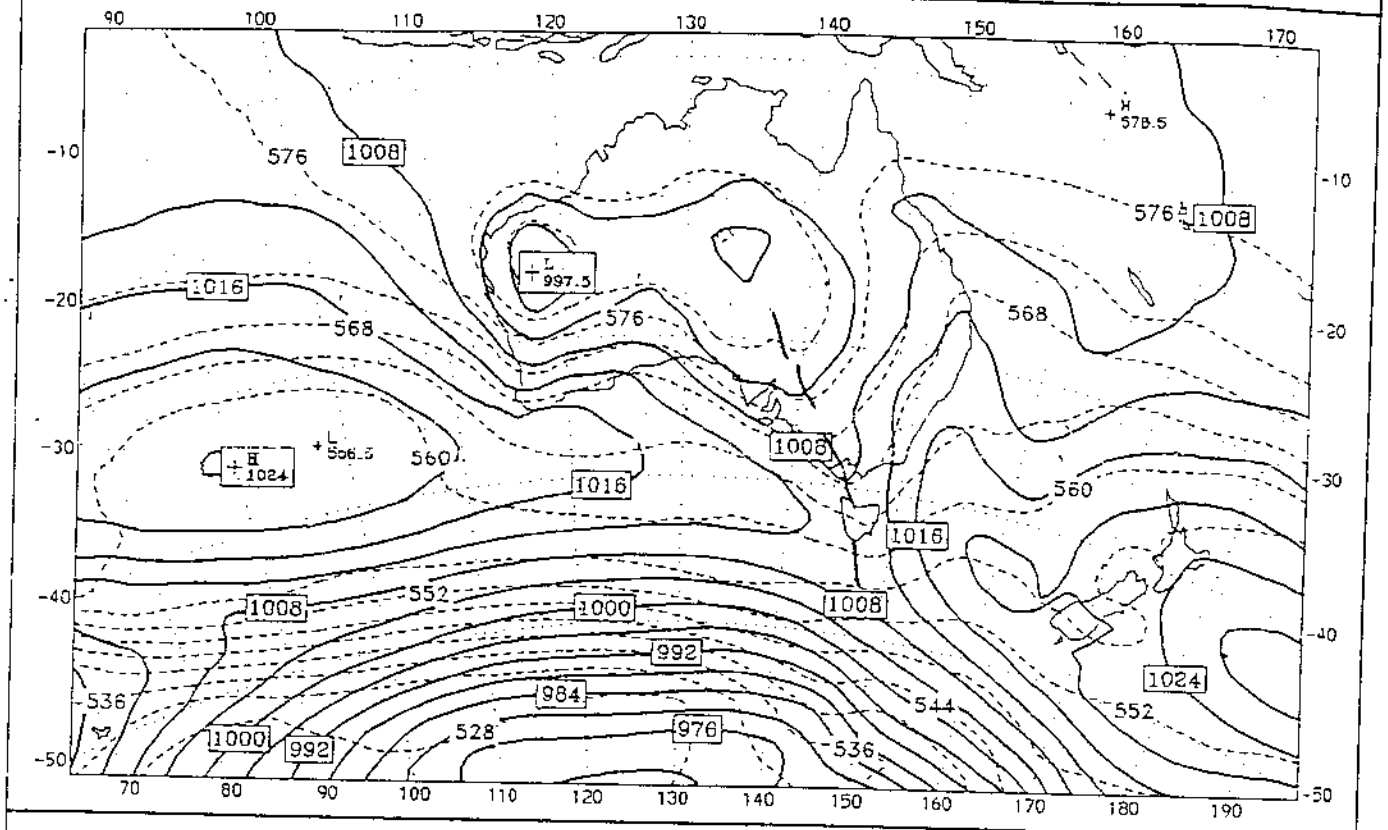
Contour interval 4 hPa

ISSUED: 18UTC 23 Dec 1998

II

NMC GASP T239L29 FORECAST

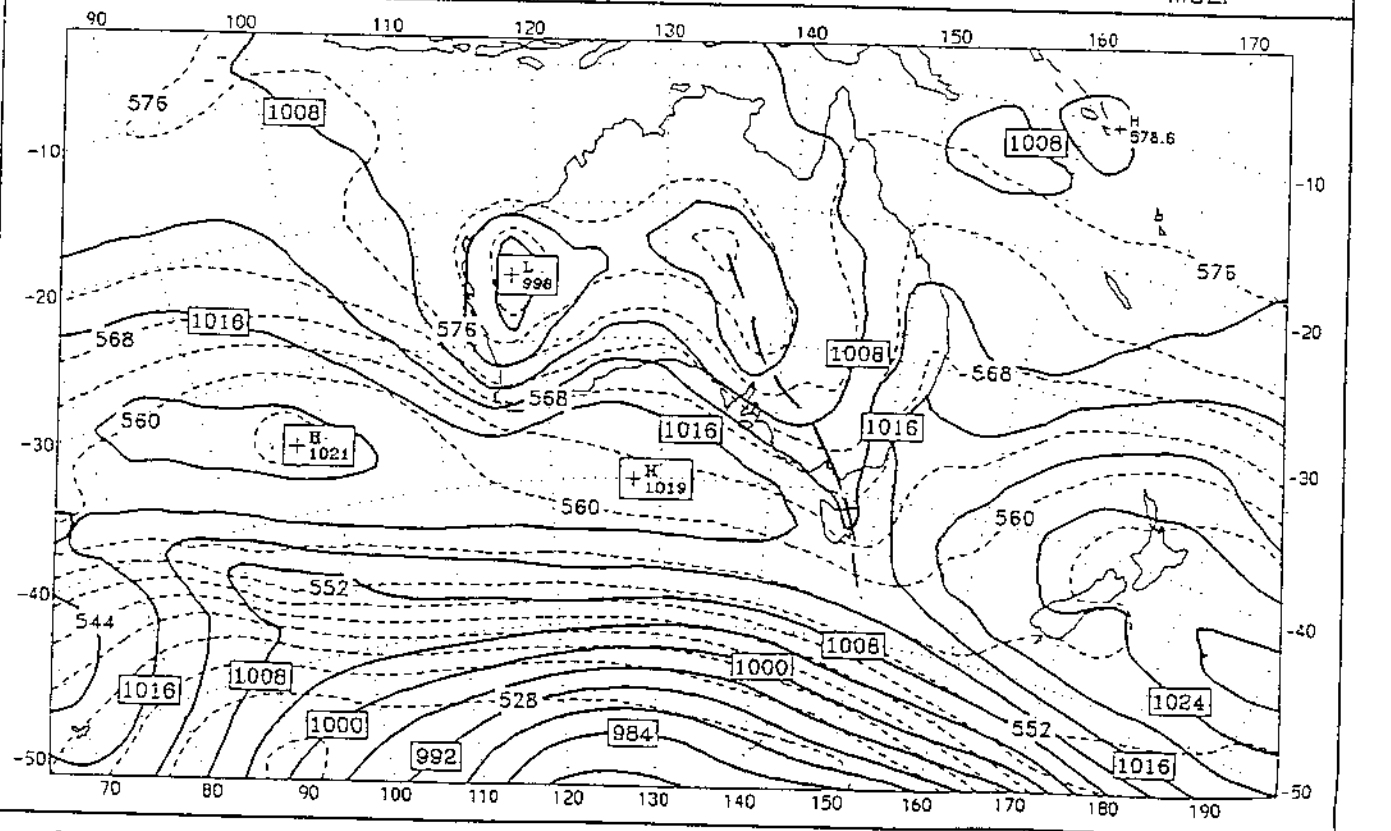
6DAY FORECAST VALID 1200 UTC Tue 29 DEC 1998 MSLP



Contour interval 4 hPa ISSUED: 19UTC 23 Dec 1998

NMC GASP T239L29 FORECAST

7DAY FORECAST VALID 1200 UTC Wed 30 DEC 1998 MSLP



Contour interval 4 hPa ISSUED: 19UTC 23 Dec 1998

FORECASTS

15

WEATHER OUTLOOK FOR 1998 TELSTRA SYDNEY TO HOBART YACHT RACE

Issued by the Bureau of Meteorology at 0830 hr 24/12/98

Saturday : SE/NE 10 to 15 knots ahead of a southerly change around 25 to 30 knots with stronger gusts expected late Saturday. Chance of showers and thunderstorms ahead of the change.

Sunday: SW winds around 15 to 20 knots south of Jervis Bay and into Bass Strait tending more SE around 15 knots over the day. North of Jervis Bay winds generally SE/E around 15 to 18 kt and gradually abating.

Monday: Winds tending NE to N in Bass Strait and the Tasmanian coast around 10 to 15 kt but increasing to 15 to 25 knots over the afternoon ahead of a cold front situated well to the west of Tasmania.
Winds along the NSW coast will tend N to NE around 10 to 15 knots, stronger at times on the south coast.

Tuesday: Winds generally around 20 to 25 knots from the NE to NW ahead of the cold front , turning W/SW at 20 kt during the early evening. Wind speeds should abate fairly quickly after the change. This front is showing signs of slipping away to the SE and as such will find difficulty making it to the NSW coast.

Please note: That this outlook is based on limited data and will need to be fine-tuned.

BASED ON EC RUN DAY BEFO

PARTICIPANTS WERE ALSO WARNED OF POSSIBLE LOW PRESSURE DEVELOPMENT TO THE SE OF GABO ISLAND ON SATURDAY/SUNDAY

1K

Note: This page will automatically refresh every 5 minutes.

IDA01N00
BUREAU OF METEOROLOGY
NEW SOUTH WALES REGIONAL OFFICE
NSW FORECAST POLICY
Issued at 3:55am on Thursday the 24th of December 1998

MSL PATTERN OVER THE NEXT THREE DAYS

Thursday 24/12/98 9am

On Thursday: the Tasman high will be moving further away from the continent, but onshore winds are still likely to generate a few showers on the northern and central coast and adjacent ranges, tending to rain periods on the north coast. The inland trough will still be a feature and should produce isolated thundery showers inlnad. A warm to very warm day over the inland, and mild to warm on the seaboard.

Friday 25/12/98 9am

On Friday,the high will be moving past New Zealand. A trough in the northern Tasman may tend to deepen, so that SE to NE winds will continue on the seaboard with a few coastal showers. in the north. The inland trough is also likely to deepen so that very warm to hot weather is expected over much of the interior with isolated afternoon thunderstorms in the west and southern inland.

Saturday 26/12/98 9am

On Saturday a cold front will move over much of the state and is likely to be located near the central coast in the evening. Some showers and local thunderstorms will be generated near the front which will be followed by cooler fresh southerlies, and perhaps strong about the south to central coast. There is some doubt about the position of the low. It is possible that a low may develop near Bass Strait rather than out in the Tasman Sea as shown.

Sunday 27/12/98 9am

On Sunday, thunderstorms should contract to the northeast or northern inland with the trough. Showers are expected elsehwere along the coast and east ranges and winds tend
cooler south to southeast, Conditions should be fine and mild to warm over the southern inland.

12

CSIRO
MARINE RESEARCH

1998 Sydney to Hobart Current Information

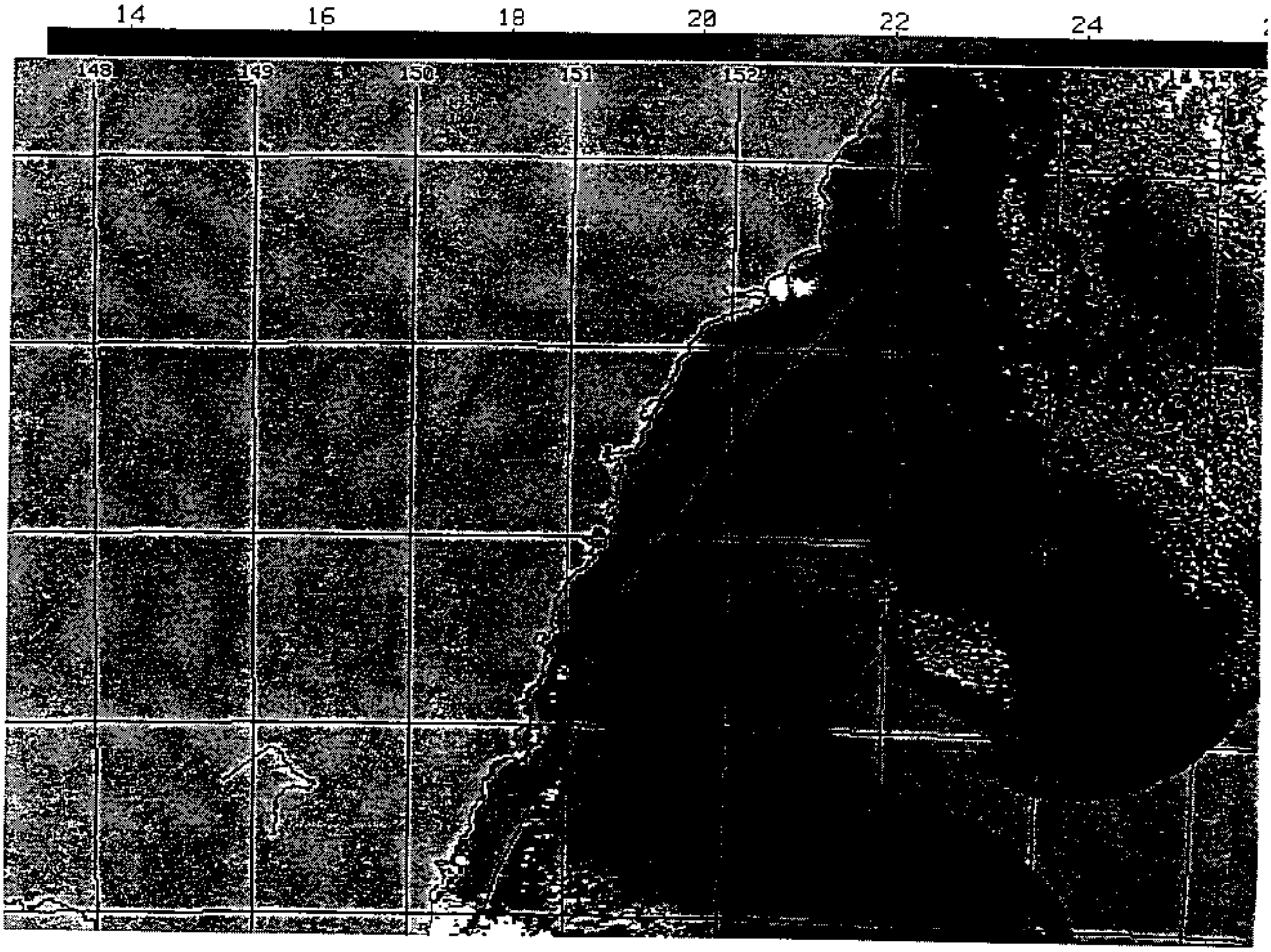
Back to the main yacht race page
http://www.marine.csiro.au/yacht_races/

The latest NOAA AVHRR SST imagery is here:
http://www.marine.csiro.au/~lband/SST/wwwSydHob98/

Update on latest sea surface conditions

Written by George Cresswell, December 1998
CSIRO Marine Research

Comments on 22 Dec 1998 0716Z-0857Z image



IL

The situation with the EAC meander and the large eddy centred at about 36 S, 152 E is largely unchanged. The eddy may slide southward by up to 100 km during the next week. There is a noticea band of warm water that peels off the EAC meander near Sugarloaf Point and runs southward on the shelf all the way to Jervis Bay, where it feeds into the eddy. We've seen bands like this before, but haven't surveyed them adequately.

In Nov 1989 we stemmed one between Jervis Bay and Sydney. We encountered it just north of Jervi Bay when the sounder read 125 m. The current was 2.2 knots southward and the warm EAC water extended all the way to the bottom. Even at the 75 m isobath off Pt Kembla (we'd come in closer) th current was 1.5 knots. There is a cold plume heading northward on the E Tas shelf past Flinders Is - probably about 1/2 knot. Out to sea from E Tas appears to be a warm eddy as was hinted in the write yesterday.

Previous updates on sea surface conditions

Comments on the image from 21 Dec 1998 1724Z-1901Z.

1L

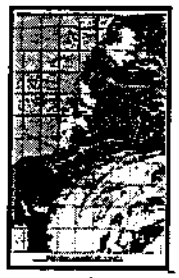
Click on the small image to view the full resolution image.

The pattern of the EAC system has evolved quite quickly since 19 Dec. The branch of the EAC that flowed in towards Pittwater has been cut off. All the EAC flow now follows the meander out to sea 3+ knots.

The anticlockwise eddy extends from Wollongong to Bass Str and from the shelf edge off Narooma about 350 km out to sea. It is big. A large amount of warm water peels off the eastern edge of the ed and reaches southward. Near Green Cape more water water from the eddy follows the shelf edge to t south. Perhaps an eddy will form or become more obvious to the east of Bass Str.

There is upwelling of 15 deg C water at the Gippsland coast. The eastern Tas region is partly cloud f and shows cold 14 deg C water nearshore, possibly the result of forcing by northerly winds. There is warmer 16 deg C water off the shelf and it is there that the currents are likely to be favourable (southward), but only to the extent of maybe 1 knot.

Comments on the image from 19 Dec 1998 0316Z-0634Z.



Click on the small image to view the full resolution image.

It appears that the EAC system off SE Australia is starting to fold into a recognisable pattern: A broa jet of 26 deg C water that has edged in near Smoky Cape shoots southward to 34 30'S. A branch of i spreads westward towards Pittwater and then splits, with most running southward to Eden. It then tu seaward and loops around a large anticlockwise eddy, closing back on itself off Jervis Bay.

The eddy is about 200 km north-south and 350 km east-west. These eddies usually precess anticlockwise - we can look at the images over the next few days to see if this does happen. We have seen in the past that the pressing of an eddy against the continental shelf edge seems to increase the slope of the sea surface, leading to enhanced southward currents on its western side. (Take a look at current measurements across the eddy in The Anticlockwise Eddies off South East Australia

---

Further Information:
CSIRO Division of Marine Research
GPO Box 1538
HOBART TASMANIA AUSTRALIA
Phone (03) 6232 5222 International +61 3 6232 5222
Fax (03) 6232 5000 International +61 3 6232 5000

Weather 2A

The air behind southerly busters can exhibit horizontal roll vortices.

Cold Front

How the summer-time cool change over south-east Australia works.

By Kenn Batt and Bruce Buckley of the Bureau of Meteorology

FOR THE sailing community, the cold front is one of the most significant features that can be seen every day throughout the year on the Bureau's weather map.

These fronts mostly affect the southern waters surrounding Australia, but from time to time, especially in the winter and spring months, can penetrate well north into tropical areas. Unfortunately few sailors fully understand what these fronts are and what to expect when they are encountered when sailing around the Australian coast.

A front is simply the way forecasters represent the boundary between two different air masses. It may be moving, in which case the front is named by the advancing air mass – cold or warm – or it can be stationary, with neither air mass advancing. In Australia cold fronts are far more common than warm fronts.

For those who have looked at the classic "text book" descriptions of cold fronts, you may remember the simple explanation given was of an advancing cold air mass pushing under an existing region of warmer air. This lifting of the warm air frequently produces a band of cloud with accompanying showers or rain.

The text-book description, although accurate in broad terms, does not fully explain the sometimes severe wind changes experienced along the NSW coastline, particularly during the warmer months. Two important factors of the weather situation largely determine the nature of these changes. The first of these relates to the properties of the air mass ahead of the change – it may not be moist or unstable enough to form cloud or rain even when forced to rise.

The second factor is the depth of the advancing cold air. In NSW during summer the advancing cold air is often very shallow, with sailors experiencing effects that differ greatly from those that would be expected based upon the earlier-mentioned simple description of the passage of a cold front.

The idea that a front is a single boundary is also frequently incorrect with the concept of a transition zone or frontal zone being more appropriate.

These "frontal" boundaries are seldom constant in their characteristics. They are continually progressing through a sequence of intensification then decay and will periodically completely dissipate, or regenerate from an initially very weak change, as they move across the waters.

Winds on each side of a front can increase the temperature difference across the front, which leads to a rapid strengthening of the front. Alternatively, a front may run up against a large slow-moving high-pressure system, known as a "blocking" high and cause the front to stall then quickly dissipate.

These and other more complicated factors make forecasting the arrival of a wind "change" (although vague and ambiguous, arguably a better term than "front" for the NSW coastline) a more complex matter than simply calculating its speed and extrapolating its movement across land and ocean.

South Australia and Victoria

The structure of the cold fronts that affect South Australia and Victoria during the summer was investigated during a field study called the Cold Fronts Research Program during the years 1980, 1981 and 1984. Two types of cold front were identified from this study.

The first was a cold front with an associated frontal transition zone. This was the most common type. A model of the structure of the frontal transition zone has been developed and is shown in diagram 1.

The transition zone typically extends for approximately 300km ahead of the front and contains several discontinuities in wind,

2A

pressure, temperature and humidity. These discontinuities are usually associated with bands of convective cloud (cumulus clouds, sometimes appearing from the ground as a series of lines of showers that would rapidly move through).

CFRP studies indicate that the speed of movement of the most significant frontal change depends on the orientation and strength of the winds behind the front and the extent to which the winds ahead of the front blow against the direction the cold front is approaching from.

The second type of front has a structure similar to a shallow layer of cold air – sometimes only about 900 metres thick – which slides under warmer air ahead. It can be thought of as an air flow whose speed depends on the density difference between the cold and warm air and the depth of the cold air, referred to as gravity currents in scientific circles. Winds ahead of the front also influence the front's speed.

A very strong pressure gradient occurs in the air immediately behind the front and usually there is little or no precipitation with this type of change. This type of front may often be experienced when sailing across Bass Strait during the warmer months, sometimes accompanied by a roll cloud and nearly always with strong winds. At times it will precede the first kind of front mentioned above by a number of hours, typically three to six hours.

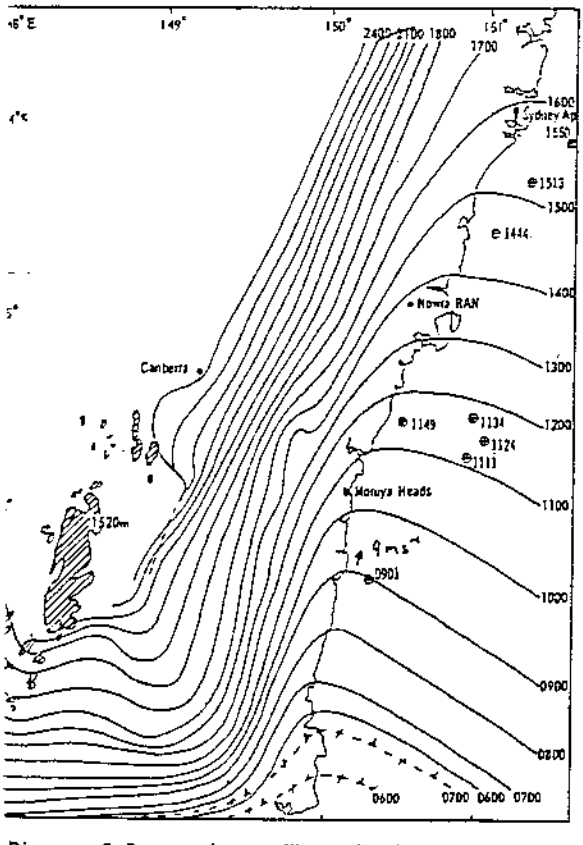


Diagram 2: Progressive positions of a shallow cold front from 6am to 1am next day.

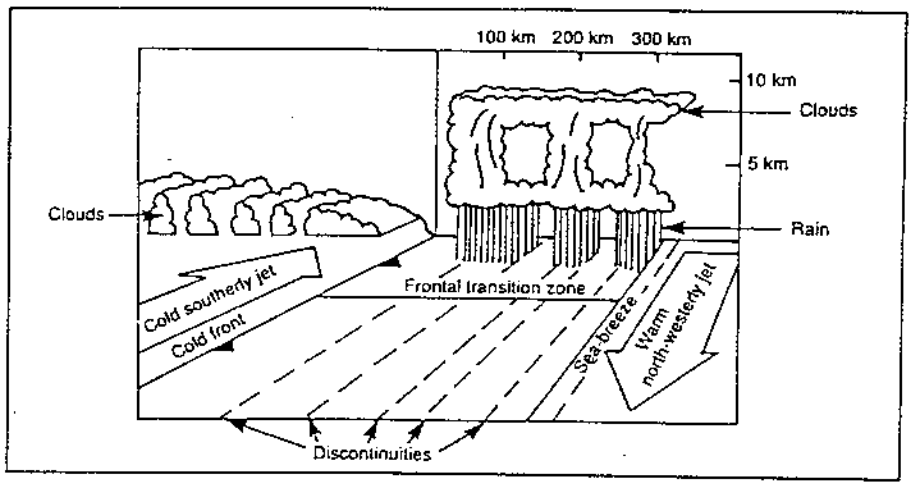


Diagram 1: The structure of summer-time cold fronts over south-eastern Australia.

Fronts over NSW

The second type of front described above is often not the result of a front originating in the Southern Ocean. Many of them form ahead of a major frontal system somewhere over central southern Australia, even as far east as Victoria or close to the NSW coast, and are sometimes associated with small low pressure systems.

These shallow fronts, besides being the most common summer-time front in NSW, are also the most difficult "cool change" to forecast as they may not exist 24 hours before the change arriving.

A significant problem in forecasting the movement of shallow fronts across NSW is that the mountains of southeastern Australia retard their progress. Because of this, the fronts develop a distorted shape as they move northwards along the NSW coastline – see the surface synoptic chart in diagram 2.

In these situations locations close to the coast receive the wind change long before the air behind the front becomes deep enough to move inland as far as the mountains.

Southerly buster

The most famous of the shallow fronts affecting NSW is the southerly buster (also known as the southerly burster) which is a change characterised by the sudden onset of strong southerly wind squalls as it speeds along the NSW coast.

The last two Sydney to Hobart yacht race fleets have experienced a southerly buster a short time into the race. The southerly winds are cool, originating from over the sea, and usually replace warm to hot northwesterly to northeasterly winds ahead of the front. The winds behind the change are very gusty and frequently reach at least 30 knots, with wind squalls up to 72 knots having been recorded. The strong and gusty winds may last for several hours.

Temperature changes with the southerly buster can be dramatic. A fall in temperature of 10 to 15 degrees C in a few minutes is common. Southerly busters are most intense during the afternoon as this is when the temperature difference between the pre-frontal and post-frontal air will be greatest and this is one of the contributing factors to the speed and strength of the front.

The meteorological conditions ahead of fronts can vary considerably. Strong northwesterly winds and hot conditions are quite common. However, if the winds are not strong, sea breezes may develop close to the coast and moderate temperatures by 10-12 degrees C. A short distance inland (10-20 kilometres) the temperature may still be very high.

The moisture content of the pre-frontal air can also vary a great deal, with consequent differences in the weather. The hot north-westerly winds are generally dry but when they are moist, conditions can be cloudy to overcast with some rain or scattered thunderstorms possible.

There are a few useful features of southerly busters affecting NSW:

- The speed of movement of the frontal wind change in the afternoon can be double that of the morning.
- Post-frontal winds can vary quite markedly as one moves from several kilometres offshore to inland areas. Offshore, wind directions can be anywhere from the south west through to the south east. Near the coast, winds tend to be strong southerly with the winds becoming lighter and turning progressively to the east-northeast as the change reaches the Blue Mountains.

West of the mountains, post-frontal winds are generally south westerly. The difference in post-frontal winds east and west of the

mountains can sometimes mean that the mountains may receive either an easterly or a westerly wind change depending on which change moves through first.

• The air behind southerly busters can exhibit horizontal roll vortices (see picture), which are rotating "cylinders" of air which have their axes parallel to the ground. **Diagram 3** shows a vertical cross-section through the type of front typically experienced near the NSW coast. Streamlines show airflow relative to the circulation centres. The front is moving towards the left-hand side of the page. There is ascending air immediately to the south of the front at the head of the first roll vortex, and coincident with the greatest instability.

The horizontal portions of the vortices can produce occasional brief lulls or short-lived increases in the surface wind speed. It must be emphasised that roll vortices are not associated with every front or southerly buster. Also not all southerly busters are associated with a roll or shelf cloud as many move along the coast cloud free.

• The pre-frontal air may not be unstable or moist enough to produce any showers or thunderstorms and for some time after the frontal passage the "new" air mass may not be deep enough for any significant cloud to form.

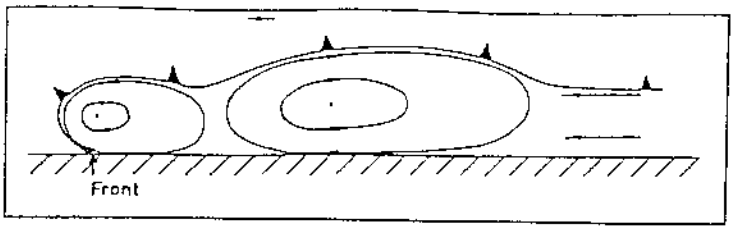


Diagram 3: Vertical cross section through a typical NSW coastal front.

However, a reasonably common occurrence is for a shallow layer of low cloud to come in with the change. One of the sure signs that the change is approaching is the sight of shreds of low cloud scudding from the south towards you. Once the change deepens sufficiently, this low cloud may thicken and drizzle or showers may form, depending on the characteristics of the post-frontal air.

Monitoring the location and movement of shallow fronts at sea is very difficult. Cloud, if present, is the most reliable indicator, with low cloud lines marking the surface position of the change.

Changes in atmospheric pressure as observed on the aneroid barometers used mostly on boats are not reliable indicators of the approach of the shallow fronts that frequent NSW waters as they often do not produce a large pressure fall. During daylight hours a decrease in the horizontal visibility to the south coupled with a darker coloured sea surface may give you a clue. It could be the only time in a race that you wished to have someone in front of you!

There is not a lot that you can do during the dark hours apart from hoping that the forecast arrival time is accurate and that you prepare early in anticipation. A call to the Coast Guard or the Coastal Patrol would prove to be very valuable since they are in constant contact with their colleagues and other boats up and down the coast.

With the technology now available one can obtain real-time observations and hence pinpoint the location of the change by linking into the Bureau of Meteorology's Weather by Fax service. Check out freepoll 1800 630100 for a comprehensive directory of services including cost details.

The next time that you are heading out on the water, especially during the warmer months and a southerly change is forecast, be aware of the problems that are associated with the summer-time cool change and plan accordingly.

CD

FROM "OFFSHORE YACHTING" DEC 1998 — JAN 1999 (OFFICIAL RACE PROGRAMME)

Weather Watch

Finding that Weather information

A guide to weather prediction at sea with a Hobart race bias

With the Telstra 54th Sydney to Hobart Yacht Race fast approaching it is time to consider once again the sources of weather and oceanographic information.

A number of useful articles on the weather and forecasting can be found in past editions of Offshore's Sydney to Hobart Race program, along with some tips on how to apply this information to your race strategies. This year a comprehensive listing of the sources of weather information for use before, during and after the race is provided in the sections that follow.

Before the race, during the race (if you have the relevant hardware, such as a mobile phone or satellite communications) and after (on the way home), you can obtain weather information by accessing the Bureau of Meteorology's internet home page (http://www.bom.gov.au) as well as the "Weather by Fax" (Freepoll 1800

28

630 100 for free main directory. Products are available for around 60 cents/minute).

Some of the more popular products are found at the following numbers:

MSL Analysis	1902 293 5201
MSL Prognosis	1902 293 5211
Satellite Cloud Picture (IR)	1902 293 5202
NSW coastal waters forecast	1902 293 5220
Radar - Sydney	1902 293 5749

For yachts with Inmarsat communication facilities, all products may be obtained through the "Weather by Fax" service by inserting 61 3 92738 before the last three digits of the product concerned. For example, the MSL analysis can be obtained by dialing 61 3 92738201.

Oceanographic information concerning the state of the East Australia Current can be obtained from the CSIRO's Division of Marine Research home page on

http://www.marine.csiro.au/yacht_races

from approximately one week prior to the commencement of the race through to it's completion.

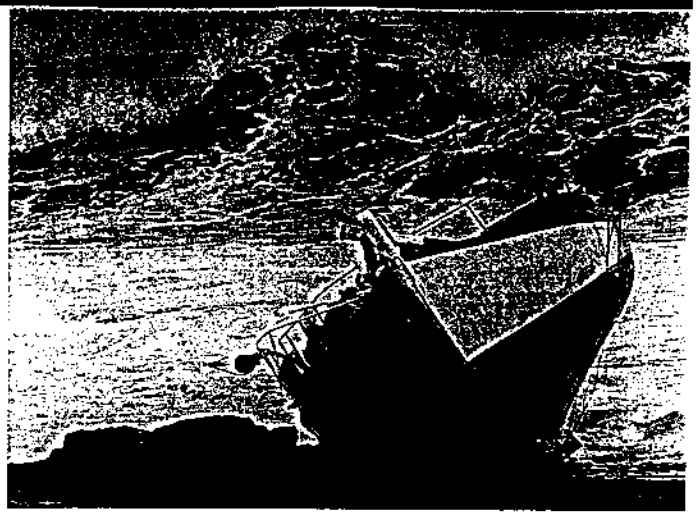
I was alerted recently to an excellent article that appeared in the September issue of the magazine The Cruising Helmsman with the title "Cowards Crossing", by Sally Andrew, also a sometime writer for Offshore.

With Sally's agreement from the distant shores of Canada, she has very kindly allowed me to reproduce part of her article, with some additions/modifications, which contains a comprehensive list of Bass Strait Weather Sources as well as others. I believe it will be of great interest to those brave souls heading south to Hobart.

Times quoted below are EASTERN DAYLIGHT SAVING TIME (EDST). For the stations marked by an * you would deduct an hour from the time shown below if you wish to use the information during non- Daylight Saving periods.

0048 - Melbourne Radio*(SE High Seas forecast)
0130 - Aus. Weatherfax* MSL Analysis valid 1200(Universal Co-ordinated Time,UTC)
0305 - Race Sked (Special Race weather forecast prepared by BoM)
0603 - Sydney Radio* (NSW weather with station reports and SE High Seas warnings)
0648 - Melbourne Radio* (Vic/Tas/SA weather)
0715 - Aus. Weatherfax* MSL Analysis valid 1800 UTC
0710 - Coastguard Lochsport SSB 2524
0725 - Penta Comstat (NSW coastal waters forecast) SSB 2524, 4483 & channel 608
0735 - Penta Comstat (Qld and Bass Strait forecast) SSB 4483 & channels 608 / 836
0745 - Tasmar VHF 67 and SSB 2524 (Tas. weather with station reports)
0848 - Melbourne Radio* (Vic / SA / Tas. weather with station reports)
0810 - Tascoast VHF 81 (Tas. weather)
0820 - Tascoast SSB 4483 (Tas. weather)
0825 - Coastguard Lochsport SSB 2524
0835 - Tascoast SSB 2524
0920 - Eden Coastal Patrol VHF 67
0925 - Penta Comstat (NSW weather

MARINE WEATHER SERVICES



Marine Forecasts and Warnings

Routine coastal waters and high seas forecasts and warnings are produced by the Bureau of Meteorology and broadcast by Telstra marine radio and are available from a variety of other sources.

Routine Coastal Waters Forecasts are for areas within 60 nautical miles (nm) of the coast (see map for coastal waters sections). They are issued by Regional Forecasting Centres in each capital city several times daily and monitored for changes which may occur.

Routine High Seas Forecasts are issued twice daily by the Regional Forecasting Centres in Perth, Darwin, Brisbane and Melbourne for the areas beyond the coastal waters surrounding Australia.

Warnings for Coastal Waters are issued whenever strong winds, gales, storm or hurricane-force winds are expected. The initial warning attempts to achieve a 12 to 24-hour lead-time and warnings are renewed every 6 hours.

Warnings to Shipping on the High Seas are issued whenever gale, storm or hurricane-force winds are expected. The initial warning attempts to achieve a 12 to 24-hour lead-time and warnings are renewed every 6 hours.

NOTE: Australian and International practice refers to weather system positions for marine use in DEGREES and TENTHS of a degree. For example 25.4 South is the latitude of twenty five decimal four degrees south, NOT twenty five degrees four minutes south. To convert the decimal to minutes, multiply by 6, i.e. 0.4 degrees = 24 minutes.

Winds

Winds flow in order to more evenly distribute heat between the equator and polar regions. Wind direction and speed is determined by the patterns of highs, lows and fronts seen on weather maps and by local effects such as sea-breezes. When the isobars (lines of equal pressure) around highs and lows become more closely spaced, then winds increase. That is, the higher (or tighter) the pressure gradient, the stronger the wind speed.

Stronger wind speeds are associated with tropical cyclones, lows and cold fronts. Sudden squalls are associated with thunderstorms, heavy showers or the passage of a cold front or low pressure trough and can happen in clear skies (e.g. the Southerly Buster in NSW). The very strongest winds are caused by tropical cyclones, deep mid-latitude low pressure systems and tornadoes/water spouts.

Definitions and Terminology

Wind speed mentioned in forecasts and coastal observations is measured as the average speed over a 10-minute period. Gusts may be 40 per cent stronger than the speed.

Wind direction is given in the 16 compass points and is the direction the wind is coming from. A knot (kn) is the unit given to a speed of one nautical mile per hour.

Strong wind: 25 to 33 kn (remembering this is a 10-minute average) **Gale force:** 34 to 47 kn **Storm force:** 48 to 63 kn **Hurricane force:** more than 63 kn.

Wave height is the vertical distance between the top of the crest and the bottom of the trough.

Wind (or sea) waves are generated by the local prevailing wind and vary in size according to the length of time a particular wind has been blowing, the fetch (distance the wind has blown over the sea) and the water depth.

Swell waves are the regular longer period waves that were generated by the winds of distant weather systems. There may be more than one set of swell waves travelling in different directions, causing a confused sea state.

Sea state is the combination of wind waves and swell.

The **forecasts of wave and swell height** are meant to represent the average of the highest one-third of the waves. Hence some waves will be higher and some lower than the forecast wave height.

King waves occur when wind waves and/or a combination of swell waves join to form a very high wave. The shape and depth of the seabed is also important.

UTC (Universal Time Coordinate): time references in warnings for high seas are given in UTC.

Forecast & Warning Delivery Systems

Coastal Marine Radio

Telstra operate marine radio transmitters around the Australian coastline with marine (Coastal and High Seas) forecasts and warnings broadcast at scheduled times on the following frequencies:

2201, 4426, 6507, 8176, 12365 kHz, and VHF Channel 67

Contact Townsville (VIT), Brisbane (VIB), Melbourne (VIM), Perth (VIP) and Darwin Radio (VID) for a list of their scheduled times. When a weather warning is issued it will be broadcast when first received, and then at routine scheduled broadcast times.

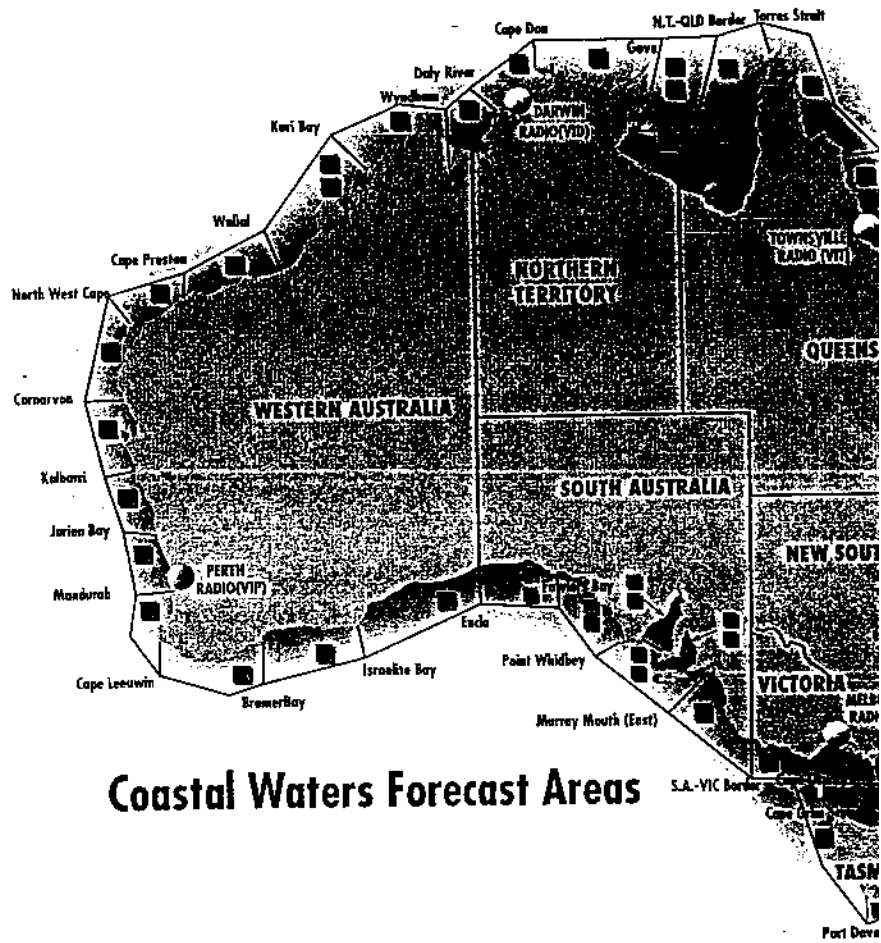
Public Broadcast Radio/TV Stations

The Bureau distributes coastal waters forecasts and warnings to the ABC and commercial networks (both city & country stations). Broadcasting of these varies between stations.

Recorded Telephone Services

The Bureau operates the following recorded services for coastal waters forecasts and warnings:

- **Local Waters Forecasts:** The Bureau & Telstra operate a number of Dial-it services with a '11' prefix. Check your local telephone directory or poll Weather By Fax on 019 725 254 for a list of your local numbers.
- **Severe Weather Warning Service:** This service carries coastal waters warnings. Check your local telephone directory or poll Weather By Fax on 019 725 254 for a list of your local numbers.



Coastal Waters Forecast Areas

- **0055 Marine Forecasts:** This service carries the coastal waters forecasts and latest reports. Check your local telephone directory, dial 0055 26113 or poll Weather By Fax on 019 725 254 for a list of your local numbers.

Weather By Fax

The Bureau of Meteorology uses the Telstra polling fax system (Infofax) and provides over 120 fax products, including weather charts (updated 3-hourly), satellite photos (updated hourly) and the latest warnings and the routine coastal waters forecasts. Reports of current wind and sea conditions are also available.

Set your Fax in 'Poll Receive' mode and dial 1800 630 100 for a Free Main Directory. This system can also be accessed through a personal computer or lap-top using a modem. Access is also available via Seaphone and Inmarsat.

AXM/AXI HF Radio Fax

This system is operated by the Royal Australian Navy on behalf of the Bureau of Meteorology using two HF radio transmitters at Canberra and Darwin. Reception requires a marine fax unit attached to your HF radio or a Personal Computer connected through a HF demodulator.

HF Radio Fax transmits a range of weather charts and warning summary on a 24-hour schedule which is available via Weather By Fax on 019 725 046 or by phoning one of the Bureau's capital city offices. It does not transmit routine forecast text or satellite pictures.

Satellite Communications

Telstra's Satcom services and Inmarsat can be used to access faxed marine weather forecasts and warnings through the Infofax system. Optus MobileSat currently can only be used to access recorded voice products. As part of the Global Marine Distress & Safety System (GMDSS) Telstra transmits via Satcom-C a complete range of marine safety information, including weather warnings, free of charge.

Internet

A full range of Bureau of Meteorology forecast and warning products is available on the Internet via the World Wide Web. The access address on the Internet is: **http://www.bom.gov.au.** Included on the Web menu is the latest satellite photo, weather maps, marine forecasts and warnings and a range of educational pages.

Bureau of

Brisbane: Tel: 07 38
Melbourne: Tel: 03 96
Adelaide: Tel: 08 83
Darwin: Tel: 08 89

Wind, Wav

A more detailed explanation
available for a number of
Meteorology Boating Weath
Contact the Bureau office in

1. Know the local fac
where to reach she
2. Learn how to read
3. Be aware that the
was drawn the da
4. Always check the
sea and know wh
5. Beware of rapidly
be imminent.
6. When at sea, liste
marine radio.
7. Be flexible – chan

Bu
DEPART

Bureau of Meteorology

B

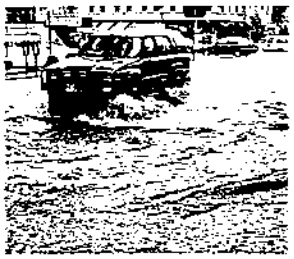
WEATHER BY FAX

check the weather!

Freefax Directory 1800 630 100

WEATHER BY FAX

Check the Weather! It may save you time, money, your property or even your life! If you are about to harvest, concrete, go fishing or sailing, or plan on doing something outdoors, you can access the latest information to help you make critical, weather related decisions. Bureau forecasts, warnings and supporting information, such as satellite and radar pictures are also available.

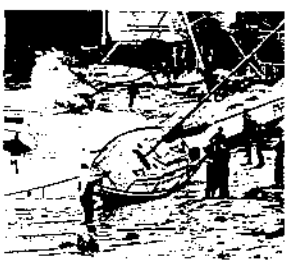


Radar pictures are the latest new service letting you know the location and amount of rain falling near you. The three levels of intensity are depicted as: light, moderate and heavy rain. Local area and regional mosaic pictures are available for over 40 radar sites around Australia and are updated about every 10 minutes. Notes to help you interpret these pictures can be obtained from **1902 93 5751**.

Satellite pictures provided on ***Weather by Fax*** are from the Japanese geostationary meteorological satellite and provided with the permission of the Japan Meteorological Agency. There will be occasions when the hourly imagery will be unavailable due to a fault or ground station scheduled maintenance. In these cases, the latest available picture will remain on the number. The outage schedule for the week is available from **1902 93 5479**

Directory Updates can be checked at any time on **1800 630 100** freefax.

International and Inmarsat access to Weather by Fax? This is available through **+61 3 9273 8xxx** , where **xxx** is the last 3 digits of the **1902 93 5xxx** service. Call costs for International, Inmarsat and mobile access may be higher than 60c per minute.



*The following **Weather by Fax** numbers are current as of 1 June 1998 .*

Service	Number	Approx Time
Main Directory 1800 630 100 freefax		
Directories		
Quick Reference	1902 93 5200	4
FarmWeather	1800 061 404	4
Voice Weather Services	1902 93 5254	3
Meteorological Explanations and Support		
Weather Maps	1902 93 5256	6
Severe Storms	1902 93 5425	5
Surviving Tropical Cyclones	1902 93 5474	6
Flood Warnings	1902 93 5471	5
El Niño	1902 93 5257	6
Ozone	1902 93 5258	8
Radar Interpretation	1902 93 5751	2
Satellite Interpretation	1902 93 5255	4
Aneroid Barometer Use	1902 93 5263	3
Design IFD Rainfall Curves (Order Form)	1902 93 5077	2
'Farming a Sunburnt Country' (Order Form)	1902 93 5353	1
Cyclone Plotting Map	1902 93 5473	2
Weather Charts		
Analyses and Forecasts		
Australian Region MSLP Analysis	1902 93 5210	2
Australian Region +24hr Forecast	1902 93 5211	2
Australian Region 4 day Forecast	1902 93 5002	2
Australasian MSLP Analysis	1902 93 5351	2
Indian Ocean MSLP Analysis	1902 93 5212	1
Pacific Ocean MSLP Analysis	1902 93 5003	1
Upper Level Pressure Analysis	1902 93 5353	4
Australasian Gradient Wind Analysis	1902 93 5213	1
SH Long Wave Component Analysis	1902 93 5349	1
LAPS Analysis +24hr Forecast	1902 93 5438	2
SH + GASP 48hr Forecast	1902 93 5007	1
GASP 2/3day Forecast	1902 93 5728	1
GASP 4/5day Forecast	1902 93 5003	1
GASP 6/7day Forecast	1902 93 5004	1
National Services 1800 061 440 freefax		
Miscellaneous		
National Warnings Summary	1902 93 5001	1
TC Advice and Gales	1902 93 5250	1
Australian Capital Cities Observations	1902 93 5718	1
Australian Cities Brief Forecast	1902 93 5472	1
Combined 201, 210 and 211	1902 93 5252	5
UV Index Forecast Map	1902 93 5018	2
3-month Climate Outlook	1902 93 5251	2
Australian Drought Statement	1902 93 5259	3
Southern Oscillation Index and Sea Surface Temperature Update	1902 93 5432	1

Directory Listings

Service	Number	Approx Time
Temperatures at Selected International Cities	1902 93 5047	1
Rainfall		
Australian Daily Rainfall Bulletin	1902 93 5253	4
Daily Rainfall Map	1902 93 5010	2
Weekly Australian Region Rainfall	1902 93 5261	3
Weekly Rainfall Map	1902 93 5011	2
Weekly Temperatures and Rainfall Extremes	1902 93 5430	2
Weekly Temperature and Rainfall Summary	1902 93 5431	2
Month to Date Rainfall Map	1902 93 5016	2
Monthly Rainfall Totals	1902 93 5700	2
1&3-month Australian Region Rainfall	1902 93 5262	2
Marine Forecasts and Analyses		
Directories		
AXM/AXI RadioFax Schedule	1902 93 5046	1
(Via Inmarsat	+61 3 9273 8046)	
Coastal Forecasts and Warnings See Under States		
Forecasts - Text		
South Eastern High Seas	1902 93 5268	1
Western High Seas	1902 93 5420	1
Northern High Seas	1902 93 5421	1
North Eastern High Seas	1902 93 5267	1
Forecasts - Sea Surface Wind (SSW)		
Eastern Australian (+12,+24,+36h)	1902 93 5475	4
Western Australian (+12,+24,+36h)	1902 93 5435	4
Forecasts - Waves		
Australian Region Total Wave	1902 93 5031	3
Australian Region Wind Wave	1902 93 5030	3
Australian Region Swell	1902 93 5266	3
Southern Pacific Total Wave +48hr	1902 93 5008	1
Analyses - Sea Surface Temperature (SST)		
Daily:		
- New South Wales	1902 93 5264	1
- Victoria/Tasmania	1902 93 5742	1
- South Australia and Bight	1902 93 5743	1
- South of Western Australia	1902 93 5265	1
- North of Western Australia	1902 93 5744	1
- Northern Territory	1902 93 5745	1
- Queensland	1902 93 5741	1
Satellite Pictures		
Hourly		
Australian Region	1902 93 5201	3
South Eastern Australia	1902 93 5203	3
South Western Australia	1902 93 5205	3
Western Australia	1902 93 5204	3
North Eastern Australia	1902 93 5202	3
Solomon Islands	1902 93 5208	3
Noumea	1902 93 5209	3
3 Hourly		
Full Earth Disc	1902 93 5206	3
Full Earth Disc Eastern Pacific & US	1902 93 5207	3
Scheduled Outages for Satellite Pictures	1902 93 5479	1
NSW & ACT Directory 1800 061 439 freefax		
Forecasts		
Notes on the Weather (+4day Forecast)	1902 93 5422	3
Coastal Waters	1902 93 5220	2
Sydney Metropolitan	1902 93 5222	1
South Eastern Districts	1902 93 5221	2
North Eastern Districts	1902 93 5781	2
Western Inland	1902 93 5791	2
Where are the District Boundaries?	1902 93 5032	1
ACT and Canberra Lakes	1902 93 5260	1
Snowy Mountains	1902 93 5227	1
Lord Howe Island	1902 93 5701	1
Norfolk Island	1902 93 5702	1
Warnings		
Marine	1902 93 5071	1
Severe Weather	1902 93 5073	1
ACT/NSW Land Warnings	1902 93 5072	1
ACT/NSW Fire Weather	1902 93 5074	1
Coastal Flood	1902 93 5075	1
ACT/ NSW Inland Flood	1902 93 5076	1
Observations		
Greater Sydney	1902 93 5226	1
Latest Coastal	1902 93 5229	1
Daily Rainfall Bulletin	1902 93 5223	2
River Heights Bulletin	1902 93 5020	1
Summaries		
State Monthly	1902 93 5224	3
Sydney Monthly	1902 93 5225	2
Canberra Monthly	1902 93 5470	2
Victorian Directory 1800 061 433 freefax		
Forecasts		
Notes on the Weather (+4day Forecast)	1902 93 5423	3
Boat Weather Port Philip and Western Port Bays	1902 93 5237	1
Coastal Waters	1902 93 5230	2
Greater Melbourne and Bays	1902 93 5232	1
Southern Districts	1902 93 5231	2
Northern Districts	1902 93 5731	2
Where are the District Boundaries?	1902 93 5033	2

Service	Number	Approx Time
Alpine	1902 93 5238	1
Fire Weather	1902 93 5039	2
Warnings		
Marine	1902 93 5012	1
Land	1902 93 5013	1
Flood (North of the Divide)	1902 93 5015	1
Flood (South of the Divide)	1902 93 5014	1
Observations		
Latest Coastal	1902 93 5239	1
Weather Bulletin at 9am and 3pm	1902 93 5029	1
Daily Rainfall Bulletin	1902 93 5233	2
River Heights Bulletin	1902 93 5028	1
Summaries		
State Monthly	1902 93 5234	3
Melbourne Monthly	1902 93 5235	2

Tasmanian Directory 1800 061 437 freefax

Forecasts		
Notes on the Weather (+4day Forecast)	1902 93 5424	3
Coastal Waters (Text)	1902 93 5240	3
Coastal Waters (Map)	1902 93 5246	3
State, Cities and Towns	1902 93 5242	2
Districts	1902 93 5241	2
Where are the District Boundaries?	1902 93 5037	1
Warnings		
Marine	1902 93 5049	1
Land	1902 93 5048	1
Flood	1902 93 5050	1
Observations		
Latest Coastal	1902 93 5249	1
Daily Rainfall Bulletin	1902 93 5243	1
Summaries		
Hobart Monthly	1902 93 5245	1

South Australian Directory 1800 061 435 freefax

Forecasts		
Notes on the Weather (+4day Forecast)	1902 93 5428	3
Coastal Waters	1902 93 5280	2
State and Adelaide	1902 93 5282	1
Districts	1902 93 5281	2
Provincial Towns	1902 93 5043	1
Where are the District Boundaries?	1902 93 5035	1
Warnings		
Fire, Sheep and Severe Weather	1902 93 5079	1
Marine	1902 93 5078	1
Flood	1902 93 5080	1
Observations		
Latest Coastal	1902 93 5289	1
Daily Rainfall Bulletin	1902 93 5283	2

Service	Number	Approx Time
Summaries		
State Monthly	1902 93 5284	6
Adelaide Monthly	1902 93 5285	2
Rain Monthly	1902 93 5286	1

Western Australian Directory 1800 061 436 freefax

Forecasts		
Notes on the Weather (+4day Forecast)	1902 93 5429	3
State, Perth & Metro	1902 93 5292	2
BoatWeather:		
- Perth Boatweather	1902 93 5720	3
- North West Coast	1902 93 5040	3
- West Coast	1902 93 5041	3
- South Coast	1902 93 5042	3
Coastal Waters:		
- Carnarvon to Eucla	1902 93 5290	3
- Wyndham to Jurien Bay	1902 93 5721	3
Districts	1902 93 5291	2
Where are the District Boundaries?	1902 93 5036	1
SW Land Division 4-day	1902 93 5296	1
Fire Weather for SW Land Division	1902 93 5295	1
Temperature for WA Towns	1902 93 5439	1
Christmas Island	1902 93 5703	1
Warnings		
Tropical Cyclone and Gales	1902 93 5298	1
Tropical Cyclone Outlook	1902 93 5730	1
Tropical Cyclone Threat Map	1902 93 5297	1
Marine	1902 93 5066	1
Land	1902 93 5067	1
Flood	1902 93 5068	1
Observations		
Latest Coastal	1902 93 5299	1
Daily Rainfall Bulletin	1902 93 5293	1
Summaries		
Perth Monthly	1902 93 5294	2

Northern Territory Directory 1800 061 438 freefax

Forecasts		
Notes on the Weather (+4day Forecast)	1902 93 5417	3
Coastal Waters	1902 93 5214	3
State and Provincial	1902 93 5215	2
Where are the District Boundaries?	1902 93 5038	1
Warnings		
Tropical Cyclone and Gale	1902 93 5218	1
Marine	1902 93 5069	1
Fire, Land and Gale	1902 93 5070	1
Observations		
Latest Coastal	1902 93 5219	1
Daily Rainfall Bulletin	1902 93 5216	1
Summaries		
Darwin and Alice Springs Monthly	1902 93 5217	2

Directory Listings

Service	Number	Approx Time
Queensland Directory 1800 061 434 freefax		
Forecasts		
Notes on the Weather	1902 93 5709	1
Notes on the Weather (+4day Forecast)	1902 93 5427	3
Coastal Waters	1902 93 5270	2
SE Queensland Boating Weather	1902 93 5704	1
BoatWeather Forecasts:		
- All Coastal Waters	1902 93 5710	4
- South Eastern Coastal Waters	1902 93 5711	3
- Eastern Gulf	1902 93 5734	3
- Torres Strait to Cooktown	1902 93 5735	3
- Cooktown to Cardwell	1902 93 5736	3
- Cardwell to Bowen	1902 93 5737	3
- Bowen to St Lawrence	1902 93 5738	3
- St Lawrence-Burnett Heads	1902 93 5739	3
- Hervey Bay	1902 93 5740	3
State, Brisbane and South East	1902 93 5272	1
All Districts	1902 93 5271	2
Northern Districts & Towns	1902 93 5705	1
Central Districts & Towns	1902 93 5706	1
South Eastern Districts & Towns	1902 93 5708	1
Western Districts & Towns	1902 93 5707	1
Cities Precis	1902 93 5019	1
Where are the District Boundaries?	1902 93 5034	1
4 Day Rainfall Map	1902 93 5045	1
Rural Weather Services:		
- North Queensland	1902 93 5712	3
- Central Queensland	1902 93 5713	3
- Western Queensland	1902 93 5714	3
- South Eastern	1902 93 5715	3
- South East Coastal	1902 93 5716	3

Service	Number	Approx Time
Warnings		
Tropical Cyclones, Severe Weather and Tsunami	1902 93 5278	1
Tropical Cyclone Threat Map	1902 93 5277	1
Marine	1902 93 5063	1
Thunderstorm, Fire Weather and Sheep Graziers Warnings	1902 93 5064	1
Flood	1902 93 5065	1
Observations		
Latest Coastal	1902 93 5279	1
Daily Rainfall Bulletin	1902 93 5273	2
Daily Rainfall Map	1902 93 5274	3
River Height Bulletins:		
- Nerang, Logan-Albert	1902 93 5051	1
- Brisbane, Bremer	1902 93 5052	1
- Maroochy, Noosa, Mary	1902 93 5053	1
- Burnett, Kolan Cherwell-Burrum, etc	1902 93 5054	1
- Dawson, Mackenzie, Fitzroy	1902 93 5055	1
- Pioneer, Proserpine, Haughton, Burdekin, etc	1902 93 5056	1
- Herbert, Tully, Johnstone, Barron	1902 93 5057	1
- Macintyre, Dumaresq, Weir, Moonie	1902 93 5058	1
- Condamine, Balonne, Maranoa, Wallam, etc	1902 93 5059	1
- Warrego, Paroo, Bulloo	1902 93 5060	1
- Thomson, Barcoo, Cooper, Diamantina, etc	1902 93 5061	1
- Flinders, Norman, Gilbert, Leichardt, etc	1902 93 5062	1
Summaries		
Brisbane Monthly	1902 93 5275	2
Townsville Monthly	1902 93 5044	1

Access difficulties?

Contact the Telstra Infofax Help Desk between 8am and 8pm, Monday to Friday on Freecall **1800 636 183**.

Faults with Bureau services?

These can be reported directly to our Help Desk quoting the service number, the time and the nature of the fault on **+61 3 9662 2182** or **webops@bom.gov.au**.

Feedback and suggestions?

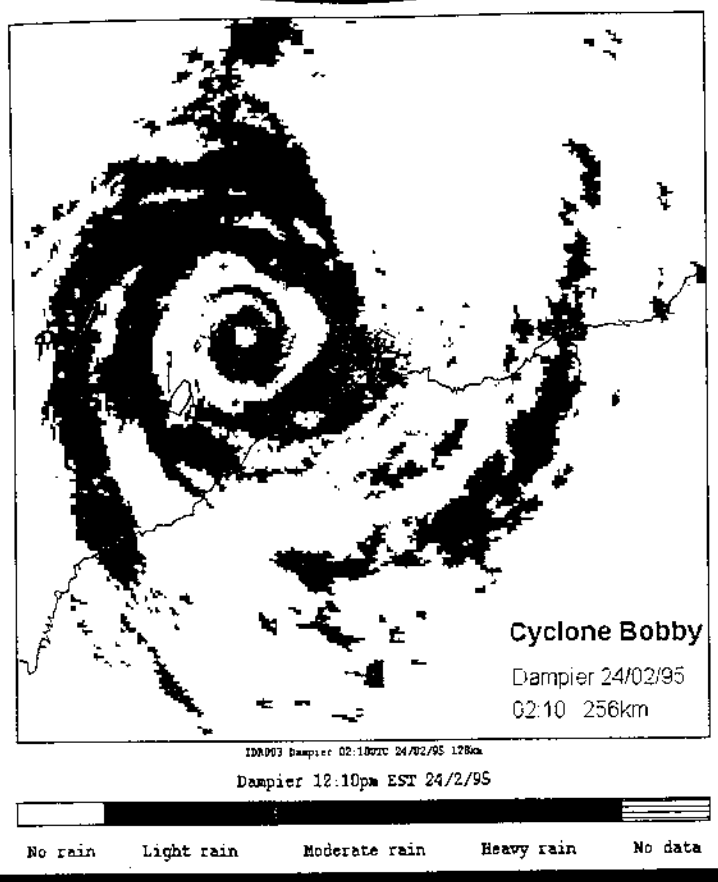
These may be forwarded straight to the Bureau's Service Manager on freefax **1800 630 101** or **webreg@bom.gov.au**.

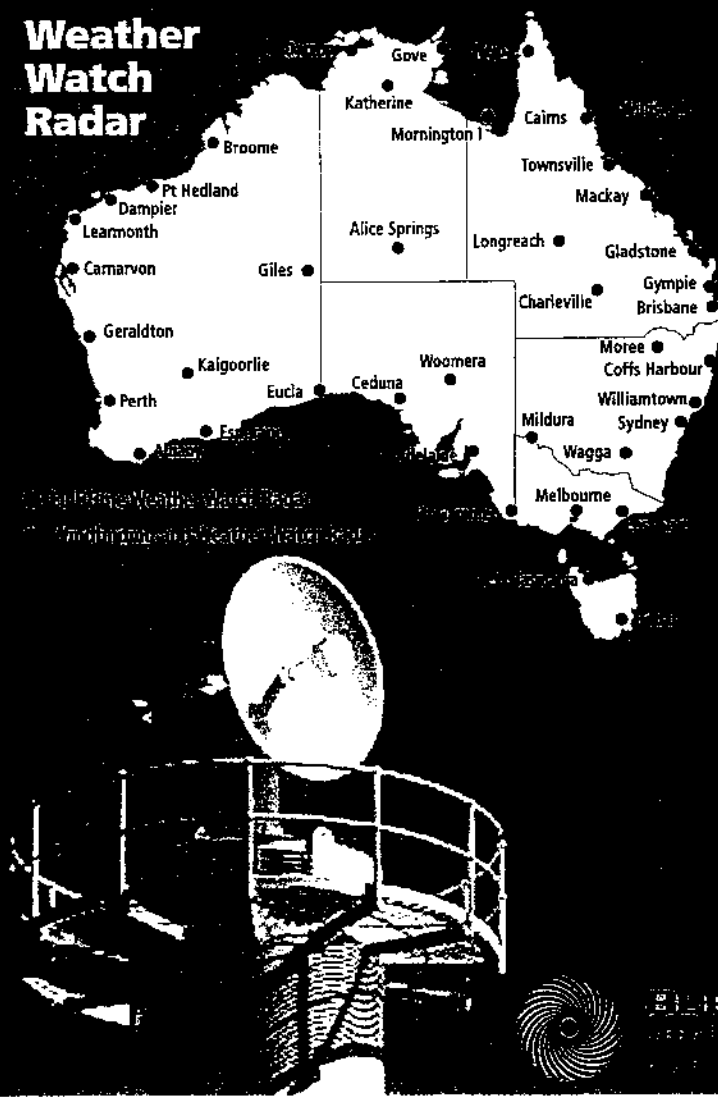
Other sources of Bureau forecasts and warnings:

- **Weathercall Services (Voice): 1800 687 999 (Freecall Directory)**
- **Internet : http://www.bom.gov.au**

RADAR PICTURES

new service





Service	Scale	Number	Approx Time

BS or LS denotes Broad or Local Scale picture
** Denotes the radar is sometimes used for other purposes and a picture may not be available.*
Notes on interpreting radar pictures can be obtained from 1902 93 5751.

NSW			
Sydney	BS	1902 93 5749	1
Sydney	LS	1902 93 5228	1
Williamtown *	BS	1902 93 5767	1
Coffs Harbour *	BS	1902 93 5765	1
Moree *	BS	1902 93 5766	1
Moree*	LS	1902 93 5777	1
Wagga *	BS	1902 93 5768	1
Victoria			
State	BS	1902 93 5750	1
Melbourne	LS	1902 93 5236	1
East Sale*	BS	1902 93 5792	1
Mildura *	BS	1902 93 5778	1
Mildura*	LS	1902 93 5725	1
Tasmania			
State	BS	1902 93 5724	1
Hobart*	LS	1902 93 5790	1
South Australia			
State	BS	1902 93 5746	1
Adelaide	LS	1902 93 5287	1
Mt Gambier*	BS	1902 93 5793	1
Woomera*	BS	1902 93 5794	1
Ceduna*	BS	1902 93 5798	1
Eucla*	BS	1902 93 5795	1
Western Australia			
SW WA	BS	1902 93 5747	1
Perth	LS	1902 93 5719	1
Kalgoorlie *	BS	1902 93 5773	1
Esperance *	BS	1902 93 5772	1
Albany *	BS	1902 93 5771	1
Geraldton *	BS	1902 93 5774	1
Carnarvon *	BS	1902 93 5775	1
Learmonth	BS	1902 93 5754	1
Dampier	BS	1902 93 5753	1
Port Hedland *	BS	1902 93 5779	1
Broome*	BS	1902 93 5752	1
Giles*	BS	1902 93 5797	1
Northern Territory			
Darwin	BS	1902 93 5723	1
Darwin	LS	1902 93 5727	1
Gove *	BS	1902 93 5769	1
Katherine	BS	1902 93 5755	1
Alice Springs *	BS	1902 93 5770	1
Queensland			
SE Qld	BS	1902 93 5748	1
Brisbane	LS	1902 93 5276	1
Gympie (Mt Kanighan)	BS	1902 93 5756	1
Gladstone	BS	1902 93 5757	1
Mackay *	BS	1902 93 5762	1
Townsville	BS	1902 93 5758	1
Cairns	BS	1902 93 5759	1
Cairns	LS	1902 93 5776	1
Willis Island*	BS	1902 93 5796	1
Weipa	BS	1902 93 5760	1
Mornington Island	BS	1902 93 5761	1
Longreach *	BS	1902 93 5763	1
Charleville *	BS	1902 93 5764	1

3C

WEATHER WORDS

Meteorologists preparing weather forecasts and warnings compress a lot of information into standardised, brief messages. Their predictions for electronic media and newspaper 'headline' forecasts must be particularly concise.

Working under frequent deadlines (all capital city forecasts, for instance, are updated several times a day), forecasters summarise information using consistent terminology to minimise the risk of misunderstanding.

Because forecasts are written for a specific timespan and area, they should not carry too much detail, as they must be valid over large areas, perhaps 10 000 square kilometres for a capital city.

The following definitions of some common forecasting terms will help you extract the maximum information from forecasts.

In particular, note that *fine* means the absence of rain or other precipitation such as hail or snow— not 'good' or 'pleasant' weather.

CLOUD COVER

Clear Free from cloud, fog, mist or dust haze.

Sunny Little chance of the sun being obscured by cloud. *(Note: High level cirrus clouds are often thin and wispy, allowing a considerable amount of sunlight to penetrate them, sufficient to produce shadows. In this case the day could be termed 'sunny' even though more than half the sky may be covered in cirrus cloud.)*

Cloudy Predominantly more cloud than clear sky. For example, during the day the sun would be obscured by cloud for substantial periods of time.

Overcast Sky completely covered with cloud.

- Forecasts of cloud cover normally give an average, if no significant variations are expected. A *clear day*, for example, may at some times see a few cloud patches.
- Forecasters expecting significant variations in cloud amount may use such terms as *sunny periods, sunny breaks, cloudy periods, cloudy at times, mostly/mainly sunny, mostly/mainly cloudy.*
- If expecting a major change in cloud cover, they usually indicate a distinct trend, e.g. *becoming sunny* or *cloud increasing.*

DRIZZLE

Fairly uniform precipitation composed exclusively of very small water droplets (less than 0.5 mm in diameter) very close to one another.

DRY

Free from rain. Normally used when preceding weather has also been relatively dry, and dry weather is expected to continue for at least a day or so.

FINE

No rain or other precipitation (hail, snow, etc). The use of *fine* is generally avoided in excessively cloudy, windy, foggy or dusty conditions.

FOG

Suspension of very small water droplets in the air, reducing visibility at ground level to less than a kilometre.

FROST

Deposit of soft white ice crystals or frozen dew drops on objects near the ground; formed when surface temperature falls below freezing point.

MIST

Similar to fog, but visibility remains more than a kilometre.

PRECIPITATION

Any or all of the forms of water particles, whether liquid (e.g. rain, drizzle) or solid (e.g. hail, snow), that fall from a cloud or group of clouds and reach the ground. (See Drizzle, Rain)

WEATHER WORDS

PRECIPITATION: HOW LONG? HOW INTENSE? HOW WIDESPREAD?

Length

Brief	Short duration.
Intermittent	Precipitation which ceases at times.
Occasional	Precipitation which while not frequent, is recurrent.
Frequent	Showers occurring regularly and often.
Continuous	Precipitation which does not cease, or ceases only briefly.
Periods of rain	Rain is expected to fall most of the time, but there will be breaks.

Intensity

Slight or light

Rain	Individual drops easily identified, puddles form slowly, small streams may flow in gutters.
Drizzle	Can be felt on the face but is not visible. Produces little run off from roads or roofs. Generally visibility is reduced, but not less than 1000 m.
Snow	Small sparse flakes. Visibility generally reduced but not less than 1000 m.
Hail	Sparse hailstones of small size, often mixed with rain.

Moderate

Rain	Rapidly forming puddles, downpipes flowing freely, some spray visible over hard surfaces.
Drizzle	Window and road surfaces streaming with moisture. Visibility generally between 400 and 1000 m.
Snow	Large numerous flakes and visibility generally between 400–1000 m.
Hail	Particles numerous enough to whiten the ground.

Heavy

Rain	Falls in sheets, misty spray over hard surfaces, may cause roaring noise on roof.
Drizzle	Visibility reduced to less than 400 m.
Snow	Numerous flakes of all sizes. Visibility generally reduced below 400 m.
Hail	A proportion of the hailstones exceed 6mm diameter.

Distribution of showers (or other weather phenomena)

Few	Indicating timing, not an area.
Isolated	Showers which are well separated in space during a given period.
Local	Restricted to relatively small areas.
Patchy	Occurring irregularly over an area.
Scattered	Irregularly distributed over an area. Showers which, while not widespread, can occur anywhere in an area. Implies a slightly greater incidence than isolated.
Sporadic	Scattered or dispersed in respect of locality or local distribution. Characterised by occasional or isolated occurrence.
Widespread	Occurring extensively throughout an area.

RAIN Precipitation of liquid water drops greater than 0.5 mm in diameter. In contrast to showers, it is steadier and normally falls from stratiform (layer) cloud.

SHOWERS Falls of rain, hail or snow which usually begin and end suddenly. Relatively short-lived, but may last half an hour. Often, but not always, separated by blue sky.

SMOG

Smog (contraction for 'smoke fog') is a fog in which smoke or other forms of atmospheric pollutant have an important part in causing the fog to thicken, and have unpleasant and dangerous physiological effects.

THUNDERSTORM

One or more sudden electrical discharges manifested by a flash of light (lightning) and a sharp rumbling sound (thunder). A **severe thunderstorm** produces one or more of hail at the ground with diameter of 2 cm or more; wind gusts at the ground of 90 kmh or more; tornadoes; very heavy rain likely to cause flash flooding.

TORNADO

A violent whirl, generally clockwise, averaging about 100 m in diameter.

WIND TERMS

The wind is a continuous succession of gusts and lulls associated with equally rapid changes of direction over a range which may exceed 30°. The mean wind speed over a period of time is therefore the mean of many gusts and lulls. Usually only the mean wind is forecast, unless the gusts are expected to be a significant feature. For instance, *Fresh, gusty southwest winds* indicates that the mean wind speed will be between 17 and 21 knots and the mean wind direction will be from the southwest, but that there will also be gusts to speeds significantly higher than the mean.

Gust

A gust is any sudden increase of wind of short duration, usually a few seconds.

Squall

A squall comprises a rather sudden increase of the mean wind speed which lasts for several minutes at least before the mean wind returns to near its previous value. A squall may include many gusts.

Wind descriptions (derived from the Beaufort Wind Scale)

	Limits in knots	km/h	Description on land	Description at sea
CALM	-		Smoke rises vertically.	Sea like a mirror.
LIGHT WINDS	**10 knots or less**	**19 km/h or less**	Wind felt on face; leaves rustle; ordinary vanes moved by wind.	Small wavelets, ripples formed but do not break; a glassy appearance maintained.
MODERATE WINDS	**11-16 knots**	**20-30 km/h**	Raises dust and loose paper; small branches are moved.	Small waves - becoming longer; fairly frequent white horses.
FRESH WINDS	**17-21 knots**	**31-39 km/h**	Small trees in leaf begin to sway; crested wavelets form on inland water.	Moderate waves, taking a more pronounced long form; many white horses are formed - a chance of some spray.
STRONG WINDS	**22-27 knots** *(Strong wind warning issued at 25 knots - 46 km/h)*	**41-50 km/h**	Large branches in motion; whistling heard in telephone wires; umbrellas used with difficulty.	Large waves begin to form; the white foam crests are more extensive with probably some spray.
	28-33 knots	**51-61 km/h**	Whole trees in motion; inconvenience felt when walking against wind.	Sea heaps up and white foam from breaking waves begins to be blown in streaks along direction of wind.
GALE	**34-40 knots** *(Gale warning issued at 34 knots - 62 km/h)*	**62-74 km/h**	Twigs break off trees; progress generally impeded.	Moderately high waves of greater length; edges of crests begin to break into spin drift; foam is blown in well marked streaks along the direction of the wind.
	41-47 knots	**75-87 km/h**	Slight structural damage occurs - roofing dislodged; larger branches break off.	High waves; dense streaks of foam; crests of waves begin to topple, tumble and roll over; spray may affect visibility.
STORM	**48-55 knots**	**88-102 km/h**	Seldom experienced inland; trees uprooted; considerable structural damage.	Very high waves with long overhanging crests; the resulting foam in great patches is blown in dense white streaks; the surface of the sea takes on a white appearance; the tumbling of the sea becomes heavy with visibility affected.
	56 knots plus	**103 km/h**	Very rarely experienced - widespread damage.	Exceptionally high waves; small and medium sized ships occasionally lost from view behind waves; the sea is completely covered with long white patches of foam; the edges of wave crests are blown into froth.

SEA TERMS

Sea waves Sea waves are those generated by the wind blowing at the time, and in the recent past, in the area of observation.

Swell waves Waves which have travelled into the area of observation after having been generated by previous winds in other areas. These waves may travel thousands of kilometres from their origin before dying away. There may be swell present even if the wind is calm and there are no 'sea' waves.

Wave period The average time interval between passages of successive crests (or troughs) of waves.

Wave height Generally taken as the height difference between the wave crest and the preceding trough.

Wave length The mean horizontal distance between successive crests (or troughs) of a wave pattern.

Sea (wind sea) and swell states

SEA (in open sea)

Description	Height (metres)	Effect
Calm (glassy)	0	No waves breaking on beach
Calm (rippled)	0 - 0.1	No waves breaking on beach
Smooth	0.1 - 0.5	Slight waves breaking on beach
Slight	0.5 - 1.25	Waves rock buoys and small craft
Moderate	1.25 - 2.5	Sea becoming furrowed
Rough	2.5 - 4	Sea deeply furrowed
Very rough	4 - 6	Sea much disturbed with rollers having steep fronts
High	6 - 9	Sea much disturbed with rollers having steep fronts (damage to foreshore)
Very high	9 - 14	Towering seas
Phenomenal	over 14	Precipitous seas (experienced only in cyclones)

SWELL

Description	Wave length	Period	Wave height
Low swell of short or average length	0 - 200 m	Less than 11 sec	0-2 m
Long, low swell	over 200 m	Greater than 11 sec	0-2 m
Short swell of moderate height	0-100 m	Less than 8 sec	2-4 m
Average swell of moderate height	100-200 m	Greater than 8 sec, less than 11 sec	2-4 m
Long swell of moderate height	over 200 m	Greater than 11 sec	2-4 m
Short heavy swell	0-100 m	Less than 8 sec	over 4 m
Average length heavy swell	100-200 m	Greater than 8 sec, less than 11 sec	over 4 m
Long heavy swell	over 200 m	Greater than 11 sec	over 4 m

BUREAU OF METEOROLOGY

BUREAU OF METEOROLOGY
DEPARTMENT OF THE ARTS, SPORT, THE ENVIRONMENT AND TERRITORIES

The Weather Map

The weather map is one of the most familiar images in the community. The best known map is the mean sea level analysis, compiled from hundreds of weather observations (synoptic data) taken simultaneously around the Australian region. It is seen daily on television and in the newspapers.

Its dominant features are the smooth, curving patterns of sea level isobars — lines of equal atmospheric pressure — which show the central elements of our weather systems: highs, lows (including tropical cyclones) and cold fronts. It incorporates the effects of atmospheric processes at higher levels.

Television and newspapers also often carry forecast weather maps which indicate how the weather patterns are expected to develop.

Meteorologists use a wide range of information and techniques to formulate weather forecasts. The weather map does not and cannot show all of these factors. It is a fairly simple representation of past and probable future locations of surface weather systems (highs, lows, fronts, etc.). Nevertheless it provides a useful guide to the weather.

Everyone benefits from a better understanding of the weather map, especially people whose activities are particularly weather-sensitive — pilots, farmers, mariners, builders, outdoor sports enthusiasts — who often find the maps valuable, sometimes essential, to enhance their understanding of media forecasts and help form their own ideas based on local experience.

Preparing the weather map

The weather map can be likened to a giant jigsaw puzzle, assembled several times a day (usually three-hourly) from thousands of observations taken at internationally agreed times. The Bureau of Meteorology, like all the world's Meteorological Services, operates a network of its own stations to gather surface and upper air observations. More than 440 paid and volunteer part-time observers also make daily surface observations essential to the national picture.

Surface reports usually comprise observations of mean sea level pressure, wind direction and speed, present and past weather, temperature, dew-point (a measure of atmospheric moisture), cloud and visibility. Their information is formatted in an international code and transmitted nationally, often globally. Complementary, if less detailed, surface data come from the Bureau's expanding system of more than 100 automatic weather stations, ship reports, and from drifting buoys in the surrounding oceans.

Specialist observers gather **upper air** information on wind speed and direction by radar-tracking weather balloons, which may also carry instrument packages to transmit temperature and dew-point information at various heights (pressures) in the atmosphere. Some aircraft transmit upper air data.

Weather satellite data are a vital part of the analysis process. Australian meteorologists focus on hourly images from the Japanese Geostationary Meteorological Satellite operating in geostationary orbit 36,500 kilometres over the equator. Computer enhancement adds colour for easier interpretation. The animated sequences often shown on television are a particularly powerful analysis tool.

The Bureau's National Meteorological Centre in Melbourne also draws on similarly enhanced images from US and European geostationary satellites, as well as high-resolution images and atmospheric temperature profiles from polar-orbiting US satellites.

Vast numbers of observations on national and global scale flow to the supercomputers at the Bureau's Melbourne headquarters. The computers' mathematical models (equations) simulate atmospheric processes to produce three-dimensional broadscale weather analyses and prognostic maps which form the basis of weather forecasts for up to four days ahead. The models simulate the physical processes that determine how the atmosphere reacts to constantly changing pressure, temperature and humidity.

Fine-scale surface weather maps are prepared manually in Bureau forecasting offices, particularly the Regional Forecasting Centres in each State capital and Darwin, and Meteorological Offices in Canberra and Townsville.

Meteorologists take account of the centrally produced computer surface and upper air predictions, local data and manual charts, and animated satellite and radar images when preparing forecasts and warnings.

What do weather maps show?

The most obvious features of the media's weather maps (Figure 1 is an example) are the patterns of high and low pressure, and the barbed lines identifying cold fronts. In the southern hemisphere, the earth's rotation causes air to flow clockwise around low pressure systems and anticlockwise around high pressure systems. (The opposite applies in the northern hemisphere.) Friction over the earth's surface causes the winds to be deflected slightly inwards towards low pressure centres, and slightly outwards from high pressure systems. Wind strength is directly proportional to the distance between isobars — the closer the lines, the stronger the winds. This rule does not apply in the tropics where the effect of the earth's rotation is weak. For this reason, tropical meteorologists usually replace isobars with streamline arrows which indicate wind and direction without directly relating to the pressure gradient. Shaded areas on weather maps show where there has been rain in the previous 24 hours, and wind direction is shown with arrows that have a series of barbs on their tails to indicate speed.

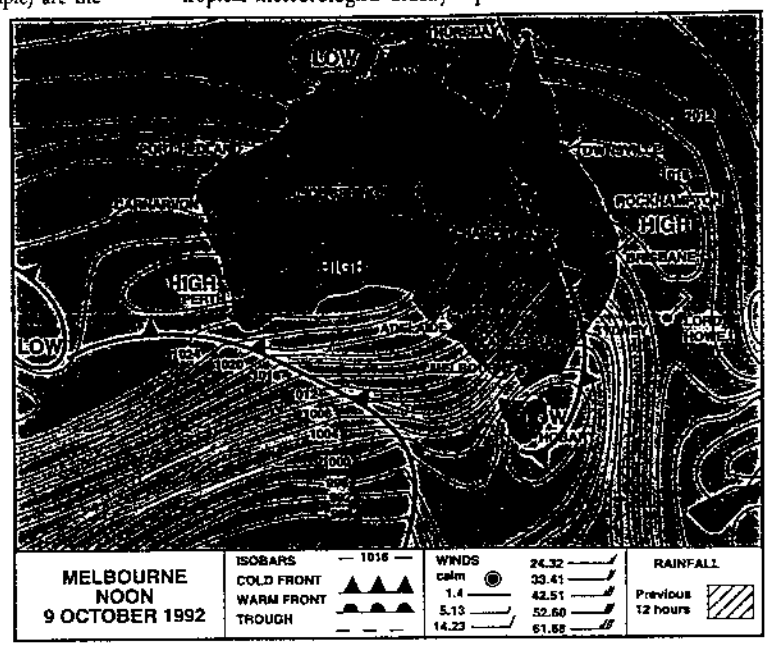


Figure 1 Typical newspaper weather map.

The coverage on media weather charts is usually limited to the continent and surrounding oceans. The Bureau also produces global charts to take account of weather systems interacting with each other over great distances. Global charts are necessary when preparing forecasts up to four days ahead, and framing the monthly climate monitoring bulletins.

Typical weather map patterns

An understanding of some systematic weather patterns is needed when interpreting a map.

- **Easterly winds** over the tropics and subtropics incorporate wave-like disturbances which usually travel westward. Important features of the tropical easterlies include the southeast trade winds, monsoon lows and sometimes tropical cyclones (known as hurricanes in the Americas and typhoons in Asia).
- **A high pressure belt in the mid-latitudes** (usually 30–50 degrees latitude) contains centres of varying strengths which generally move from west to east. Fluctuations in the intensity of these highs ('anticyclones') strongly influence the behaviour of the trade winds and the development and decay of tropical lows.
- **The belt of westerly winds** south of the high pressure region contains disturbances which usually travel from west to east. Barbed lines indicate the leading edge of travelling cold (and occasionally warm) fronts, the boundaries between different types of air. The term 'front' was applied during World War I by European meteorologists who saw similarities between atmospheric structures and the large-scale conflict along battle fronts.
- Nearer the pole, **a series of deep subpolar** lows is usually centred between latitudes 50–60 degrees South.
- **A high pressure area over Antarctica** — associated with extremely cold and dense air — is ringed by easterly winds which form the boundary with the subpolar low pressure belt.

These typical features vary in intensity and location according to the season. For instance, in summer the high pressure belt is usually found just south of Australia, while the subtropical easterlies cover most of the continent. Monsoon flows and associated lows over the tropics bring significant summer rain; tropical cyclones may develop. In winter the high pressure belt is usually located over the continent, allowing westerlies and strong cold fronts to affect southern Australia.

It is important to be alert to significant exceptions to this 'normal' situation when, for example, strong high pressure systems move slowly across the oceans well south of Australia. Closed or 'cut off' lows may then move across southern Australia or intensify over the Tasman Sea, possibly causing prolonged heavy rain.

It is also important to remember that all weather systems have a life cycle of development, maturity and decay. They occasionally show unusual behaviour. They may become stationary or even briefly reverse their usual direction of travel.

Hot or cold?

Remembering that air flows clockwise around low pressure systems and anticlockwise around high pressure systems, a fairly typical summer weather map (Figure 2) shows:

- **Northerly winds over eastern Australia** on the western flank of a Tasman Sea high. They carry hot, dry air from inland Australia southward over Victoria and Tasmania. With winds strengthening ahead of an approaching front, this represents a classic weather situation with extreme bushfire risk.
- **Moist, easterly flow** from the Coral Sea onto the Queensland coast causes very warm, humid and sultry weather east of the Great Dividing Range. This air, often susceptible to the development of showers and thunderstorms, is described as 'unstable'.
- The **cold front** passing South Australia replaces the hot, dry northwesterlies with southerlies carrying cooler, often relatively humid air from waters south of the continent. Such summer fronts are often quite shallow and may not penetrate far inland, particularly if they are distorted and slowed over the Victorian mountains.

In Figure 3, a relatively common winter weather map shows:

- **Very cold, unstable air** from well south of Tasmania flows northward over Tasmania, Victoria and southeast New South Wales, reducing normal day temperatures typically by

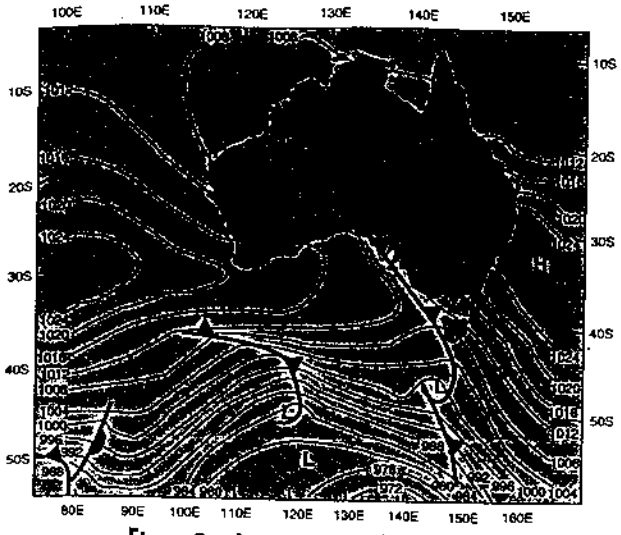


Figure 2 A summer weather map.

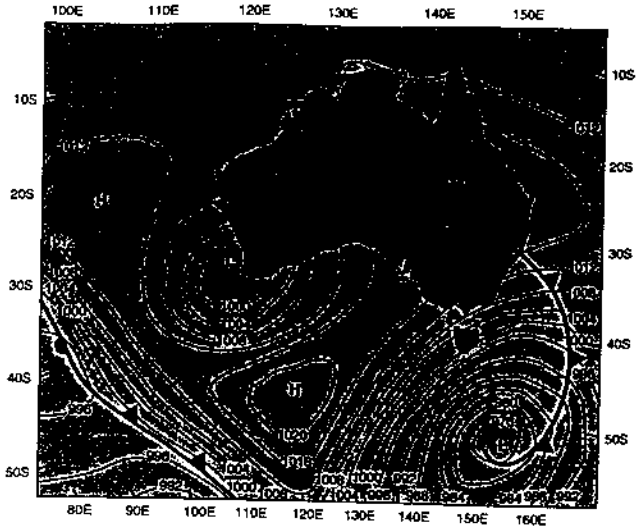


Figure 3 A winter weather map.

five degrees or more. Note the cold front, the deep low pressure (pressures below 976 hectopascals) south of Tasmania and the high (1020 hectopascals) south of the Bight. Occasionally, rapid interaction with other weather systems around the southern hemisphere can almost halt the pattern's eastward movement, causing successive cold fronts to bring a prolonged spell of cold, showery weather to southern Australia.

- **Easterly winds** over inland Australia. Although southern cold fronts become shallow and diffuse as they move into northern Australia they often trigger a surge in the strength of the easterlies and this, combined with their extreme dryness, creates a very high fire danger in the tropical savanna region.

- **An active low pressure system** near Perth is 'cut off' from the southern westerlies. Situations of this type may cause rain and rather cold weather over southern parts of Western Australia.

Rain or fine?

Features on the surface weather chart indicate likely rainfall patterns as well as temperature distribution and wind strength. In general, highs tend to be associated with subsiding (sinking) air and generally fine weather, while lows are associated with ascending (rising) air and usually produce rain or showers.

While cloud can exist without rain, the opposite is not the case.

Clouds form by the condensation of water vapour through cooling. Causes of cooling include:

- **Convection,** which may be caused through air mass instability. It may be initiated by warming of low-level air, forced ascent over mountainous country, or dynamic causes associated with severe weather systems. Cumulus clouds often form as a result of convection. The most exceptional forms are often associated with severe thunderstorms and occasionally, tornadoes. Cumulonimbus, for instance, may reach altitudes above 15,000 metres.

- **Systematic ascent of moist air** over large areas linked with large-scale weather systems such as low pressure systems, including tropical cyclones. In mid-latitudes this systematic ascent often occurs ahead of active fronts, or with 'cut off' lows. This type of rain may be persistent and heavy and cause floods, especially if enhanced by forced (orographic) ascent over mountains.

- **Orographic ascent** which occurs when air is forced upwards by a barrier of mountains or hills. Cloud formation and rainfall is often the result. Australia's heaviest rainfall occurs on the Queensland coast and in western Tasmania, where prevailing maritime airstreams are forced to lift over mountain ranges.

- **Cold and warm fronts** which also cause systematic ascent. A cold front is the boundary where cold air moves to replace, and undercut, warmer and less dense air. Associated cloud and weather may vary enormously according to the properties of the air masses, but tends to be concentrated near the front. As a typical cold front approaches, winds freshen from the north or northwest, and pressure falls. After the front passes, winds shift direction anticlockwise ('backing' to the west or southwest) and pressure rises. Cold fronts are much more frequent and vigorous over southern Australia than elsewhere. Warm fronts, relatively infrequent over Australia, are usually found in high latitudes where they can occasionally cause significant weather. They are often shown on weather charts over the Southern Ocean. Warm fronts progressively displace cool air by warmer air.

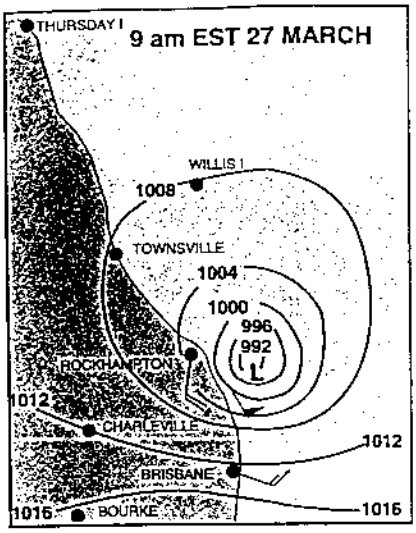
- **Convergence lifting** which occurs when more air flows into an area at low levels than flows out, leading to forced rising of large air masses. Convergence is often associated with wave-like disturbances in tropical easterlies and may also occur with broad tropical air masses flowing to the south. Given sufficient atmospheric moisture and instability, it may cause large cloud clusters and rain.

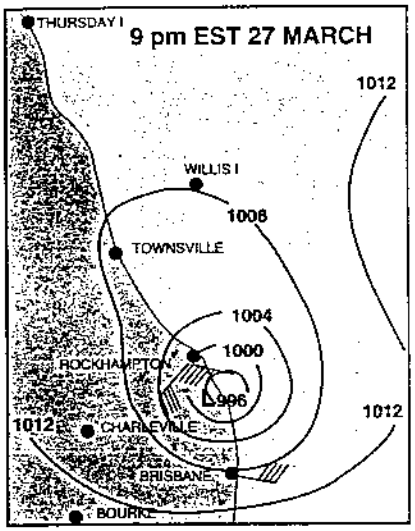
How strong will the winds be?

A mean sea level pressure chart shows the direct relationship between isobar spacing (pressure gradient) and orientation, and the strength and direction of surface winds. The general rule is that winds are strongest where the isobars are closest together. Thus the strongest winds are usually experienced near cold fronts, low pressure systems and in westerly airstreams south of the continent. Winds are normally light near high pressure systems where the isobars are widely spaced.

However, because of a latitude effect winds in middle latitudes are lighter than those in the tropics with similarly spaced isobars.

In Australia, the most destructive winds over broad areas are generated by tropical cyclones. (Tornadoes, associated with some severe thunderstorms, have the potential to generate higher wind speeds, but areas affected are much smaller than these tropical storms.)





Figures 4 (a) and (b) Charts of a cyclone moving from the Coral Sea to the Queensland coast demonstrate how isobars indicate wind speed and direction.

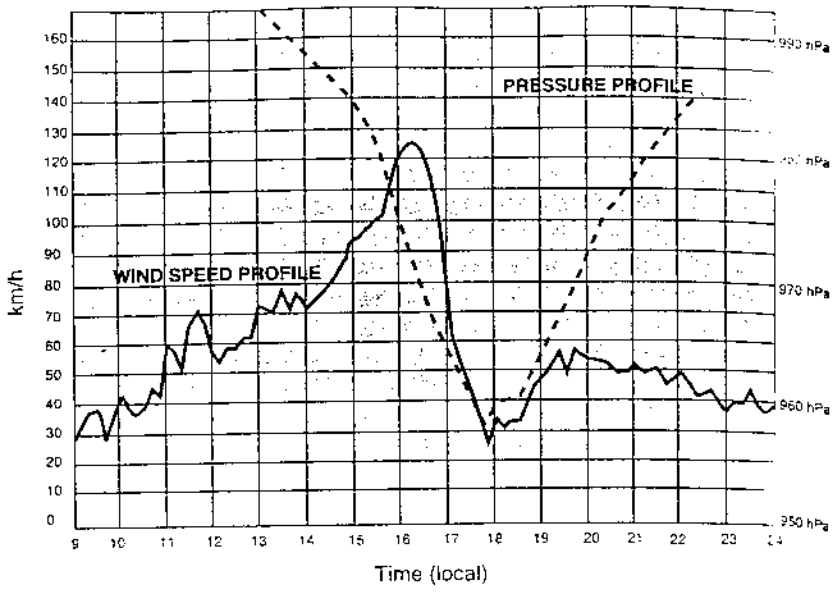


Figure 5 Typical wind speed and pressure relationships for a tropical cyclone - cyclone *Winifred*, Cowley Beach, Queensland, February 1986.

Tropical cyclones are low pressure systems in the tropics which, in the southern hemisphere, have well defined clockwise circulations with mean surface winds (averaged over ten minutes) exceeding gale force (63 kilometres per hour) surrounding the centre. Tropical cyclones exhibit a relatively clear eye, surrounded by dense wall clouds and a series of spiral rain-bands. The Bureau tracks cyclones with weather watch radar, special service reports and frequent satellite images. Figures 4(a) and (b) show a tropical cyclone approaching, and crossing the Queensland coast near Rockhampton. The pressure gradient is very steep towards the cyclone's centre and wind speeds on the nearby coast in this case would have been about 110 kilometres per hour with gusts 50 per cent or more above the mean wind speed. In Figure 4(b), 12 hours later, the cyclone has moved inland. Cut off from its heat energy source, the ocean, (it requires sea-surface temperatures above 26.5°C), its intensity has decreased and wind speeds have dropped to 85-90 kilometres per hour. Figure 5 graphs the relationship between wind speed and pressure as the eye of tropical cyclone *Winifred* crossed Cowley Beach, in Queensland, in February 1986. The relationship is characteristic of tropical cyclones.

Using weather charts

Preparation of weather charts which predict surface and upper level flow patterns up to several days ahead is integral to weather forecasting. The best and most objective way of doing this is to use computer models incorporating the equations which represent the motion of the atmosphere, and its associated physics. The Bureau's supercomputers run mathematical models on a global and regional scale for both daily forecasting and for research.

While predicted (prognostic) weather charts are essential to the forecast process, they must be interpreted by meteorologists to prepare specific weather forecasts and warnings. Forecast errors still occur, due to limitations in data or the forecast models, and the inherent complexity of the atmosphere, but forecast accuracy has increased very significantly since the introduction of satellite information and mathematical modelling. Prognostic charts shown routinely on television and in newspapers predict conditions up to three days ahead.

An inexpensive aneroid barometer enables weather map watchers to follow changes in surface air pressure over time, giving important clues to subtle alterations in weather systems. By combining information from the barometer, weather maps and forecasts from the media, and personal experience from sky watching, they can make the most of the Bureau's weather service.

It will be realised by now that a single weather map is only a forecasting aid and that a great deal of other data and information must be gathered and processed before a forecast is issued. However, the information in this leaflet should assist in understanding and interpretation.

For further information contact the Bureau of Meteorology Regional Office in your State or Territory

Published by the Bureau of Meteorology 1993

Cat. No. 474249