WEATHER SERVICES

Weather Services encompass a wide range of forecast, warning and information services to the general public, national and international shipping and aviation, the Department of Defence and other users. Services are provided mainly through the seven Regional Forecasting Centres (RFCs) in the State capital cities and Darwin, and through the National Meteorological and Oceanographic Operations Centre (NMOC) located in Melbourne. All these Centres maintain a 24-hour weather watch every day of the year, issuing forecasts, warnings and other weather information as required.

Many of the Bureau’s offices in rural and remote areas, which function primarily to provide high quality weather observations (surface, upper air and weather watch radar), have an important complementary role in providing current weather information and a range of other services to their local communities. Some 43 such service outlets are distributed across Australia, with a further two at Australian bases in Antarctica.

Most of the Bureau’s weather services are made available to the Australian community through the mass media (radio, television, newspapers) and services are also accessible via the Internet, recorded telephone systems, marine high frequency (HF) radio and facsimile.

Weather Services are provided in line with the Bureau of Meteorology’s Service Charter for the Community. A broad range of ongoing consultative mechanisms is in place, involving Commonwealth and State authorities and major commercial and community user groups, to help ensure that services evolve and are continually improved in accordance with user needs and advances in science and technology.
**PLANNED OUTCOME 2003-04**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Enhanced community safety and well-being through the effective use of meteorological and related services by the general public and other major social and economic sectors.</th>
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<tbody>
<tr>
<td>Objective</td>
<td>To meet the needs of the general public and specialised users for relevant, accurate and timely weather data, information, forecast and warning services.</td>
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<tr>
<td>Effectiveness indicators</td>
<td>The extent to which:</td>
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<td></td>
<td>• meteorological and related services contribute to minimising loss of life and property and community disruption from bushfires, tropical cyclones and severe storms; minimising economic and other costs of disaster preparedness; the safety, comfort, convenience and general welfare and economic benefit of the public and major community groups; the safety and efficiency of shipping, small craft and maritime industries; the safety, regularity and efficiency of air navigation; the efficiency and effectiveness of the Australian Defence Force; government and community planning; and the economy and efficiency of primary and secondary industry;</td>
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<tr>
<td></td>
<td>• forecasts, warnings, information and advice are accurate and timely;</td>
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<td></td>
<td>• user needs (including the needs of specific users of special weather services on a cost recovery or commercial basis) are identified and satisfied and new services and products are developed as required; and</td>
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<td></td>
<td>• the public, major user groups and specialised users receive, understand and make optimum use of the services and express satisfaction with the services.</td>
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</table>

**OUTPUTS 2003-04**

Weather Services is one of the Bureau's eight major outputs and contributes towards Output 1.3 - Meteorological and Related Services. Outputs from Weather Services typically include information on current and forecast weather conditions for States, districts, cities and towns for dissemination through the mass media and use by the community at large; public warnings of severe weather events and major user-sector specific forecasts, warnings and information, tailored to meet the sectoral needs of the marine, agricultural, aviation and defence communities; and specialised weather information, forecast and warning services, provided on a cost-recovery or commercial basis, to meet the specific requirements of individual customers and user groups.
After very dry conditions in 2002-03, during which a record number of fire weather warnings were issued, 2003-04 saw a return to more normal conditions with good rains in some areas. As a consequence of these rains, the number of flood warnings issued during 2003-04 was three times the number in the previous year. Fire weather warnings, on the other hand, were around half the 2002-03 number. Another indicator of the return to less dry conditions was the large number of thunderstorm warnings issued. Overall the number of warnings issued was high, but not exceptionally so.

User surveys continue to indicate that the Bureau's weather services are held in high regard by the general public. Quality targets were exceeded in all categories except timeliness (87 per cent of those surveyed felt that forecasts were timely; a little below the target of 90 per cent).
though the 2003-04 figure was an increase on the previous year’s 80 per cent. It should be noted, though, that some variation in this category may be due to a change in this specific survey question in 2004, such that it allowed a greater range of responses. The value for winter 2003 was 81 per cent satisfied, whereas the summer 2004 figure was 93 per cent.

Accesses to weather services by telephone was below target, but not significantly different from recent years. Facsimile services in particular continued to decline. This trend was more than offset by the growth in the number of accesses via the Internet. The move away from facsimile and some telephone services to the Internet reflects a community trend in the way the Bureau’s information services are accessed.

ACHIEVING THE OUTCOME

Weather services are delivered through six individual outputs that contribute to the achievement of the desired outcome. The developments in each individual output during 2003-04 and their contribution to the outcome are considered below.

SEVERE WEATHER WARNING SERVICES

Severe Weather Warning Services assist the community in preparing for and responding to tropical cyclones, severe storms, bushfires and gales over land. These services are provided through the Bureau’s State-based Regional Forecasting Centres (RFCs), with national coordination by the Head Office Weather and Ocean Services Policy Branch and very close links with State and Commonwealth emergency services and disaster preparedness organisations. These services also contribute substantively to national and international disaster mitigation and hazard awareness programs with particular attention to improving effective communication of warnings and developing community awareness of hazards.

Tropical cyclone warning services are provided for northwest, north and northeast Australia, from Tropical Cyclone Warning Centres (TCWCs) co-located with the Perth, Darwin and Brisbane RFCs respectively. The accuracy of the tropical cyclone warning service is assessed in terms of the errors in key forecast parameters (Figure 20 and Figure 21). The planning and operation of the tropical cyclone warning service is closely linked to, and coordinated with, the State Emergency Services in Western Australia, the Northern Territory and Queensland to maximise the effectiveness of community preparedness and response.

Severe thunderstorms are particularly intense convective storms that produce destructive winds, damaging hail, tornadoes or heavy rain leading to flash-flooding. The Bureau provides forecasts of such thunderstorms in the form of Severe Thunderstorm Advices and Severe Thunderstorm Warnings. The accuracy of severe thunderstorm warnings is assessed in terms of the Probability of Detection and the False Alarm Ratio (Figure 22).

The fire weather warning service provides the public with routine forecasts of fire danger during the fire season and fire weather warnings when the fire danger is expected to exceed a certain critical level. It also provides fire management authorities, civil defence organisations, police and other emergency services with detailed routine forecasts, fire weather warnings and operational forecasts to assist in combating ongoing fires. This service includes special forecasts for hazard reduction burns and other advice to assist the assessment and management of fire risk and, where possible, out-posted support for fire control operations.
Figure 20. Average errors in tropical cyclone location in the Australian region as compared with the post-event best estimates (excluding Queensland). The 00hrs plot shows the accuracy of real time estimation of the current cyclone position. The 12hrs and 24hrs plots show the accuracy of the 12hr and 24hr forecasts. The straight lines show the long-term trend.

Figure 21. Average errors in tropical cyclone intensity (central pressure) in the Australian region as compared with the post-event best estimates (excluding Queensland). The 00hrs plot shows the accuracy of real time estimation of the current cyclone intensity. The 12hrs and 24hrs plots show the accuracy of the 12hr and 24hr forecasts. The straight lines show the long-term trend.
Major developments 2003-04

- Replacement of obsolete weather watch radars at Mount Gambier and Learmonth under the Radar Network and Doppler Services Upgrade Project (RNDSUP) for which the Government allocated $62.2m over five years commencing 2003-04 to upgrade the Bureau's radar network and improve its associated severe weather services.
- Installation of a new radar at Bowen as part of the Bureau's ongoing replacement program.
- Preparation and training for new services to be introduced following the installation of new radars with advanced severe weather detection capabilities.
- Preparation and user consultation for the introduction of an improved and nationally consistent warning service for severe thunderstorms, land gales, squalls, etc. in late 2004.
- Implementation of a new forecasting system incorporating software for the automated diagnosis of severe thunderstorm potential from the Bureau's numerical weather prediction models. This sophisticated software suite gives improved guidance on the likely severity of thunderstorms and assists in the provision of early alerts on the occurrence of these events.
- Effective contribution to the development of the Australian Government disaster mitigation policy and activities at the national and international levels.
- Active contribution to projects in the newly-established Bushfire Cooperative Research Centre including leading the research project on risk communication.
- Completion of a project funded by the Australasian Fire Authorities Council (AFAC) on smoke management, extending routine smoke prediction services for the New South Wales and ACT fire agencies.
- Submissions to bushfire related inquiries including the ACT Coroner's Inquiry and the Council of Australian Governments (COAG) National Inquiry on Bushfire Mitigation and Management.

Figure 22. Nationally-averaged values of Probability of Detection (POD - fraction of events for which advance warning was provided, ideally 1) and False Alarm Ratio (FAR - fraction of warnings which were false alarms, ideally 0) for the past eleven years (1994-2004) for severe thunderstorm warnings.
Contribution towards outcome

- The upgrade to weather watch radar coverage has improved the Bureau's ability to monitor severe weather, particularly tropical cyclones and severe thunderstorms.
- The expansion and restructure of the thunderstorm warning service will benefit the public by providing a nationally consistent and equitable service, better suited for effective communication.
- The new thunderstorm diagnostic forecasting system has helped improve the accuracy and timeliness of severe thunderstorm warning services to the community.
- The development of closer links with the community and Emergency Services organisations in disaster mitigation programs contributes to tuning the Bureau's severe weather warning services to meet the needs of both emergency service organisations and the broader community. It also ensures that information is available to mitigate the impact of hazardous weather, consistent with the government's Disaster Mitigation Program.
- As a Board Member of the Bushfire CRC, the Bureau is able to contribute to setting research directions and assisting in the achievement of outcomes to meet fire weather warning requirements.
- The routine smoke transport predictions allow better management by land management agencies of prescribed burning operations.
- Bureau submissions to inquiries have contributed to the formulation of recommendations that should lead to more effective management of the bushfire risk.

PUBLIC WEATHER SERVICES

The Bureau's Public Weather Services provide a wide range of weather information and forecasting services in the public interest for the benefit of the community at large in all Australian States and Territories. Weather forecasts are provided for more than 170 cities and towns and 60 separate forecast districts, according to community needs. The accuracy of the Bureau's maximum and minimum temperature forecasts has been verified for a number of years and continues to improve (Figure 23).

Public weather services are distributed through a variety of channels including the mass media, the Internet, and telephone information systems (Figure 24 shows the level of usage). Products provided include current and recent weather observations from the Bureau's extensive observing network, satellite and radar imagery, analyses of meteorological conditions and forecasts of a wide range of meteorological parameters covering geographically distributed localities, together with numerous warnings for weather conditions with potential to cause loss of life or damage to property.

The Bureau uses regular user surveys to monitor levels of community satisfaction and understanding of its forecasts to keep abreast of community needs for weather services which enhance public safety and support the daily decision making of individuals, households, businesses, community sectors and government organisations.

As part of its strategy of maximising the reach and utility of its public weather services to the community, the Bureau fosters its partnership relationships with the private meteor-
ological sector. The growing services provided by private meteorological companies augment and extend the opportunities for the community to access weather services originated by the Bureau. These relationships provide a significant benefit as the channels for obtaining public weather services continue to multiply and diversify with the rapid evolution of communications technologies and delivery systems.

**Major developments 2003-04**

- Commencement of a Public Weather Review to review the content and format of the State, metropolitan, district and provincial cities/towns forecasts, together with the explanatory notes and notes on the weather.
- Development of new Agricultural Observations Bulletins, which became operational on 30 June. The Bulletins, for all Regions, incorporate a large number of environmental parameters including maximum and minimum temperatures, terrestrial minimum temperature, air moisture, rainfall, evaporation, wind run, sunshine hours, solar radiation and soil temperatures at various depths.
- Upgrade of the Bureau’s external website on 30 June to improve usability and accessibility following a survey aimed at identifying shortfalls in this area and also to comply with government branding initiatives.

**Contribution towards outcome**

- The Public Weather Review will contribute to the more effective use of public weather services by the community, through improved standardisation of forecast formats and the information conveyed, and the resulting enhanced ease of access and utility for users.
- The new Agricultural Observations Bulletins will enhance the economic benefits of

![Figure 23. Trends in the mean modulus of error in daily maximum and minimum temperature forecasts.](image)
weather services to the farming sector. In particular, management of livestock, crops, irrigation and pest control will benefit from the routine information provided in the Bulletins.

- The upgrade to the Bureau website will encourage further use of information by the very large cross-section of the community that accesses the site as well as attracting new users to the site. The improved access to information and services will facilitate more effective use of the information available.

**Figure 24. Trends in the delivery mechanisms for Bureau services showing the number of web visits and the number of telephone calls (Weathercall, Weather by Fax, 1300 warnings and 1196 Dial-it services combined).**

**MARINE WEATHER SERVICES**

Marine Weather Services contribute to the safety and efficiency of shipping and offshore activities through the provision of relevant, accurate and timely marine meteorological services in accordance with the provisions of the International Convention for Safety of Life at Sea (SOLAS), Regulations of the World Meteorological Organization (WMO) and national laws governing safe navigation in Australian waters. Core services provided include:

- warnings of strong, gale-force and storm-force winds;
- forecasts for high seas, coastal waters, bays and harbours, and inland waterways;
- information on current coastal weather; and
- analyses and prognoses of ocean surface conditions including waves.

In order to fulfil mandated and identified requirements for services, several dissemination channels are used to communicate with mariners at sea, including Inmarsat satellite broadcasts of forecasts and warnings for high seas and selected coastal waters areas, and HF and VHF radio broadcasts of high seas and coastal waters forecasts and warnings. Numerous volunteer, coast guard and State marine agency groups around Australia’s coast provide VHF broadcasts, carrying the forecasts and warnings originated by the marine weather service.
Major developments 2003-04

- Implementation of a nationally consistent forecast format for coastal waters services as part of the Coastal Waters Review.
- Extension of the forecast validity period for coastal waters forecasts, for up to four days ahead, implemented as part of the Coastal Waters Review.
- Introduction of new graphical products for weekend forecasts for Sydney local waters as part of the implementation of the Australian Marine Forecasting System (AMFS) forecast production system (Figure 25).
- Completion of two national marine surveys, on the content and presentation of coastal waters forecasts related to the introduction of the AMFS, and usage of VHF marine weather broadcasts.

Contribution towards outcome

- Presentation of coastal marine forecasts in a standardised format will enhance the safety of marine users and the effective use of marine weather service outputs across all channels of communication (web, fax, television, radio and satellite).
- The extension of coastal forecasts to four days ahead will further enhance the safety of coastal waters users through the effective utilisation of the services provided, including improved opportunities to be warned of impending hazardous marine conditions.
- Implementation and further enhancement of the AMFS forecast production system will contribute to the improved effectiveness of services, and the well-being of users, through provision of user-friendly graphical outputs and an automatic verification function which will enable establishment of forecast accuracy benchmarks for coastal marine services.
AVIATION WEATHER SERVICES

Aviation weather services enhance the safety, regularity and efficiency of national and international aviation operations. Products include detailed forecasts of wind, visibility, weather and cloud for aerodrome or en-route operations in a range of user-specific formats.

Aviation weather services were generated and delivered through the following major service outlets:

• the Bureau's Aviation Weather Centre (AWC) which is part of the NMOC;
• each of the Bureau's capital city RFCs;
• the Sydney Airport Meteorological Unit (SAMU), which is co-located with Airservices Australia's Air Traffic Services Unit at Sydney Airport;
• the Aviation Monitoring Unit co-located with the Qantas Dispatch Centre at Sydney Airport;
• the Darwin Volcanic Ash Advisory Centre (VAAC) located in the Northern Territory Regional Office, which is one of the nine international centres established as part of the International Civil Aviation Organization (ICAO) International Airways Volcano Watch; and
• a number of other Meteorological Offices including Townsville, Cairns, Rockhampton and Canberra.

Services are provided within the international technical and regulatory framework of the ICAO and the WMO, which work in close cooperation. The Civil Aviation Safety Authority (CASA) regulates Australian domestic aviation while air traffic management is the responsibility of Airservices Australia. Under this international and domestic framework, the Bureau of Meteorology is the designated meteorological authority for Australia for the provision of aviation weather services.

User consultation and arrangements for ongoing service improvements continued to be coordinated by a variety of committees, working groups and focus groups involving the Bureau, CASA, Airservices Australia, the major Australian airlines, the Australian Airports Association and others. International consultation and coordination occurred through the WMO Commission for Aeronautical Meteorology and working groups, the ICAO Asia Pacific Air Navigation Planning and Implementation Regional Group and a number of ICAO study groups. In conjunction with the major airlines, the Bureau investigated all meteorological incident reports in order to identify deficiencies and explore opportunities to improve the effectiveness of the Aviation Weather Service.

Major developments 2003-04

• Establishment of a technical group comprising aviation industry and Bureau representatives to guide and develop a range of aviation projects and initiatives.
• Introduction of new products including a graphical Volcanic Ash Warning System and a graphical display of warnings of significant meteorological hazards (SIGMET) to aircraft.
• Development of aviation forecaster competencies, forecast guidelines and competency-based training packages.
**Contribution towards outcome**

- The technical group will ensure projects and service initiatives are focused on industry requirements.
- New graphical products enhance the usability and effectiveness of information for the aviation industry in Australia.
- The development of competencies and related training will contribute to a consistent and high-quality service.

**DEFENCE WEATHER SERVICES**

Defence Weather Services enhance the operations of the Australian Defence Force (ADF) through the provision of accurate, timely and relevant meteorological information. Services include the provision of forecasts, real-time meteorological observations and climatological data, meteorological training and professional advice to assist military decision-making processes.

Services are delivered through the following centres:

- the Defence Meteorological Support Unit (DMSU), located in Darwin, which provides a 24-hour point of contact and coordination for the ADF within Australia, South-East Asia and the southwest Pacific;
- Defence Weather Service Offices (WSOs) located at Royal Australian Air Force (RAAF) bases at Amberley (Queensland), East Sale (Victoria), Pearce (Western Australia), Tindal (Northern Territory) and Williamtown (New South Wales);
- the Defence WSO located at the Army Aviation Centre at Oakey (Queensland); and
- Defence-attributed staff at the Townsville Meteorological Office.

The DMSU provides particular expertise in the strategically important areas of tropical Australia, South-East Asia and the southwest Pacific and was set up to provide information in a secure environment. The DMSU complements and supports Defence WSOs which provide localised specialist meteorological services to support military aviation.

User consultation is a key part of the process for ensuring an appropriate level of service is provided to the Defence community. The primary relationship is with the RAAF Headquarters Air Command, which has the responsibility for meeting the bulk of the annual charge for Defence Weather Services. Consultation also occurred at many levels ranging from individual squadrons to joint ADF/Bureau working groups.

**Major developments 2003-04**

- Provision of meteorological support for ADF Operations in Iraq, Timor Leste and the Solomon Islands by the DMSU.
- Improvement of the Defence Weather Service web pages with usage peaking during Operation Anode, the Australian-led Regional Assistance Mission to the Solomon Islands, with 1.8 million hits for the month of July.
- Improvement of the lightning detection network, with the installation of a lightning sensor at Richmond and the development of the automated lightning alert system for Defence bases.
- Strengthening of the support for tactical Automatic Weather Stations with the inclusion of Weather and Terminal Reciter broadcasts and deployment of two units to Baghdad with the RAAF Mobile Air Operations Team.
- Commencement of work on establishing defined competencies for Defence forecasters, in conjunction with Aviation Weather Services.
Contribution towards outcome

- The DMSU meteorological support assisted ADF personnel to plan and operate safely in areas of conflict.
- Improved web pages led to enhanced understanding and more effective use of meteorological information.
- Automated lightning alerts provided warnings to Defence ground personnel leading to a safer working environment and protection of valuable equipment.
- Tactical AWS broadcast advice helped provide a safe aircraft landing environment.
- Establishing competencies for Defence forecasters will facilitate appropriate training and contribute to the provision of a high standard service.

SPECIAL WEATHER SERVICES

Special Weather Services aim to meet the requirements of the general public and the private meteorological sector for weather services and information beyond those available from the basic service.

This is achieved through the application of the infrastructure provided for the basic service with the costs for the provision of these services being recovered on an incremental basis.

Major developments 2003-04

- Implementation of formal, centralised procedures with the private meteorological sector and the conduct of two consultative meetings.
- Investigation into new delivery options for weather services including new Caller Line Identification (CLI) telephone and Short Message Service (SMS) warning alert services.

Contribution towards outcome

- Improving the delivery of Bureau services and products through the private meteorological sector will benefit the wider community.
- Wider dissemination of Bureau services to users through the use of new technologies will support increased public safety and well-being.