WEATHER SERVICES

Weather Services encompass a wide range of analysis and prediction products and 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 of 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, involving Commonwealth and State authorities and major commercial and community user groups, is in place to help ensure that services evolve and are continually improved in accordance with user needs and advances in science and technology.
## PLANNED OUTCOME 2004-05

<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>
</tr>
</thead>
<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>
</tr>
<tr>
<td>Effectiveness indicators</td>
<td>The extent to which:                                                                 [- 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;] [- forecasts, warnings, information and advice are accurate and timely;] [- user needs (including the needs of specific users of special weather services on a cost-recovery basis) are identified and satisfied and new services and products are developed as required;] [- the public, major user groups and specialised users receive, understand and make optimum use of the services and express satisfaction with the services;] [- the NMOC provides reliable, timely analysis and forecast guidance products that impact positively on the quality of services; and] [- the NMOC and the RFCs provide, in combination, a sufficiently comprehensive and responsive nationwide and regional scale weather watch operation to detect and react immediately to the first evidence of developing dangerous weather and provide a foundation for the provision of routine basic and special weather services.]</td>
</tr>
</tbody>
</table>
OUTPUTS 2004-05

The Weather Services output is one of the Bureau’s eight major outputs and contributes towards Output 1.3 - Meteorological and Related Services and Products. Outputs from this group typically include analysis and prediction products describing the state of the atmosphere, 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; user-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 basis, to meet the specific requirements of individual clients and user groups.

OUTPUT PERFORMANCE 2004-05

<table>
<thead>
<tr>
<th>Quality</th>
<th>Target</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of users surveyed indicating that public weather forecasts and warnings are partly or completely accurate</td>
<td>90%</td>
<td>94%</td>
</tr>
<tr>
<td>Percentage of users surveyed indicating that public weather forecasts and warnings are becoming more accurate or are maintaining current levels of accuracy</td>
<td>90%</td>
<td>93%</td>
</tr>
<tr>
<td>Percentage of users surveyed indicating that they are satisfied or very satisfied with weather forecast, warning and information services</td>
<td>90%</td>
<td>89%</td>
</tr>
<tr>
<td>Percentage of users surveyed indicating that weather forecasts, warnings and information services are received in time for them to make their decisions</td>
<td>90%</td>
<td>87%</td>
</tr>
<tr>
<td>Percentage downtime for internet access services</td>
<td>0.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Percentage of numerical guidance products delivered before the scheduled deadlines for dissemination</td>
<td>95%</td>
<td>99.4%</td>
</tr>
<tr>
<td>Percentage of users satisfied with the value of forecast guidance product components</td>
<td>90%</td>
<td>not available</td>
</tr>
<tr>
<td>Accuracy of centralised analysis and forecast guidance products as measured by statistical evaluation procedures:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- gain in skill of model forecasts over persistence (points)</td>
<td>30</td>
<td>37</td>
</tr>
<tr>
<td>- error in 24-hour statistical guidance for maximum temperatures (°C)</td>
<td>3</td>
<td>1.66</td>
</tr>
<tr>
<td>- error in 24-hour statistical guidance for minimum temperatures (°C)</td>
<td>2.5</td>
<td>1.57</td>
</tr>
<tr>
<td>- 72, 120 and 168-hour Anomaly Correlations</td>
<td>75%, 55%, 40%</td>
<td>87%, 66%, 49%</td>
</tr>
<tr>
<td>- error in 24-hour sea state predictions (m)</td>
<td>0.7</td>
<td>0.51</td>
</tr>
</tbody>
</table>
Output Performance 2004-05 (continued):

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Target</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of public weather warnings issued</td>
<td>15,000-</td>
<td>19,976</td>
</tr>
<tr>
<td>Number of public weather forecasts and information bulletins issued</td>
<td>400,000-450,000</td>
<td>26,610</td>
</tr>
<tr>
<td>Number of accesses by telephone/facsimile for automated weather service delivery systems</td>
<td>5-</td>
<td>3,705,093</td>
</tr>
<tr>
<td>Number of accesses by the Internet for automated weather service delivery systems</td>
<td>1.5-2.0 billion</td>
<td>5.2 billion</td>
</tr>
<tr>
<td>Number of Regional Forecasting Centres</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Number of AIFS (Australian Integrated Forecast System) equipped offices</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>Number of numerical guidance products issued by NMOC</td>
<td>2,400</td>
<td>2,125</td>
</tr>
<tr>
<td>Number of systems providing distinct guidance products</td>
<td>10</td>
<td>17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Target</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis and Predication Products</td>
<td>$5.994m</td>
<td>$7.802m</td>
</tr>
<tr>
<td>Disaster Mitigation Activities</td>
<td>$4.965m</td>
<td>$6.121m</td>
</tr>
<tr>
<td>Public Weather Services</td>
<td>$13.630m</td>
<td>$12.916m</td>
</tr>
<tr>
<td>Marine Weather Services</td>
<td>$1.397m</td>
<td>$1.856m</td>
</tr>
<tr>
<td>Aviation Weather Services</td>
<td>$14.886m</td>
<td>$15.447m</td>
</tr>
<tr>
<td>Defence Weather Services</td>
<td>$3.324m</td>
<td>$4.000m</td>
</tr>
<tr>
<td>Cost Recovery Services</td>
<td>$3.912m</td>
<td>$1.339m</td>
</tr>
</tbody>
</table>

Comments on output performance

The number of fire weather warnings issued was the highest in recent years, apart from the 2002-3 season, reflecting the dry conditions over much of Australia. Tragically, although there were relatively few major fires, the bushfire related death toll was the highest in recent years due to the loss of life in the fire on the Eyre Peninsula, South Australia, in January.

The number of numerical guidance products issued by the NMOC in 2004-05 was less than the target due to changes in the way this quantity is measured. A particular product issued for several different lead-times was previously counted as multiple products; it is now counted as a single product type. For example, a prognosis chart of mean sea-level pressure issued for lead times of +6, +12 and +24 hours is now counted as a single product type rather than as three separate product types. Consequently, although the achieved performance figure of 2125 suggests a decrease in the volume of numerical guidance issued by the NMOC, the volume of guidance products actually increased through the addition of new numerical models to the operational suite.
In terms of the accuracy of centralised analysis and forecast guidance products, the Bureau met or exceeded all performance targets.

User surveys continue to indicate the Bureau’s weather services are held in high regard by the general public. Quality targets were exceeded in all categories except the level of satisfaction (89 per cent compared with the target of 90 per cent).

Access to weather services by telephone was below the target and this figure exhibits a continuing downward trend, being further reduced from the numbers achieved last year. This is attributable to the continued growing preference for the internet as a weather services delivery mechanism, with more than 5 billion hits recorded in 2004-05.

ACHIEVING THE OUTCOME

Weather services are delivered through seven individual outputs that contribute to the achievement of the desired outcome. The developments in each individual output during 2004-05 and their contributions to the outcome are considered below.

ANALYSIS AND PREDICTION PRODUCTS

Analysis and prediction outputs flow from the basic meteorological operations of analysing real-time datasets to establish the current state of the atmosphere and then predicting its evolution out to about eight days ahead. These operations are essential to the provision of weather, climate and oceanographic services and to the fulfilment of Australia’s international obligations under the Convention of the World Meteorological Organization (WMO). The NMOC in Melbourne, the Regional Specialised Meteorological Centre in Darwin, the seven RFCs in the State capital cities and Darwin, the Townsville and Canberra Meteorological Offices and the Antarctic Meteorological Centre at Casey function as an integrated national network, producing a range of manual and automated guidance products in support of the nationwide operational forecast and warning services provided by the Bureau.

The NMOC serves as the central operational hub, combining the roles of operational communications and computing with meteorological and oceanographic analysis and prediction functions. The NMOC runs several complex numerical analysis and prediction systems to provide current or predicted conditions in the atmosphere and the ocean, with differing emphasis according to the various applications.

Major developments 2004-05

• The Operational Consensus Forecast (OCF) system was made operational in March, providing guidance to forecasters (up to seven days ahead) on: maximum, minimum and ground temperatures; rainfall amounts and associated probabilities; sunshine hours; and evaporation, for more than 600 sites throughout Australia. The OCF system statistically combines guidance from eight numerical weather prediction systems from Australia and overseas to produce a ‘consensus’ forecast which shows greater accuracy than any single system.

• A new version of the National Thunderstorm Forecast Guidance System (NTFGS) was made operational, increasing the number of thunderstorm forecast guidance products for forecasters.

• Versions of the highest resolution numerical weather prediction model run in NMOC
MesoLAPS were made operational for the Adelaide and Perth regions, adding to the existing domains that cover Victoria/Tasmania, the Sydney region and southeast Queensland.

- A new version of the Bureau’s global numerical model (GASP), with 33 levels in the vertical, began running in parallel with the operational version, which has 29 vertical levels.
- The Australian region numerical model (LAPS) was substantially upgraded with a new data assimilation scheme, taking advantage of satellite wind observations over the oceans (Figure 20).
- The Bureau’s tropical region numerical model was replaced with an improved version with more advanced data assimilation capability and an extended domain.

Contribution towards outcome

- The OCF system has shown significantly greater skill in maximum and minimum temperature forecasts than existing statistical guidance systems. Improved accuracy in this guidance results in improved quality of public forecasts and warnings.
- The new high-resolution numerical models for the Adelaide and Perth regions will be particularly helpful in preparing fire weather forecasts, where accurate positioning of wind changes is important.
- Improvements in data assimilation for the numerical models will allow increased use of
the growing variety of input data from satellites, automatic weather stations, weather balloons, aircraft and other sources, resulting in more accurate model guidance, which in turn leads to better forecasts and warnings.

DISASTER MITIGATION ACTIVITIES

Disaster Mitigation Activities assist the community in preparing for and reducing the impacts of tropical cyclones, severe storms, bushfires and gales over land. These services are provided through the Bureau’s RFCs, with national coordination by the Head Office Weather and Ocean Services Policy Branch, and through very close links with State and Commonwealth emergency services and disaster preparedness organisations. An important complementary role is to contribute substantively to national and international disaster mitigation and hazard awareness programs, with particular attention to improving effective communication of warnings, developing community awareness of hazards and documenting the risk of natural disasters.

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 accuracy of forecasts of position and intensity (Figure 21 and Figure 22). The planning and operation of the tropical cyclone warning service is closely linked to, and coordinated with, emergency services organisations in Western Australia, the Northern Territory and Queensland to maximise the effectiveness of community preparedness and response.

The Bureau provides forecasts of severe thunderstorms, which are particularly intense convective storms producing destructive winds, damaging hail, tornadoes and/or heavy rain leading to flash flooding, in the form of Severe Thunderstorm Warnings. The accuracy of severe thunderstorm warnings is assessed in terms of the Probability of Detection and the

![Tropical Cyclone Forecast Verification](image)

*Figure 21. Average errors in tropical cyclone location in the Australian region compared with post-event best estimates. The three lines show the accuracy of real-time estimation (00 hrs) and forecasts (12hrs and 24hrs). The associated straight lines show the long-term trend.*
False Alarm Ratio (Figure 23). The Probability of Detection (POD) measures the success of the forecast in correctly predicting the occurrence of events, whereas the False Alarm Ratio (FAR) measures the fraction of forecasts for which no event was observed. Severe Weather Warnings are also issued for conditions such as land gales, dangerous surf and blizzards that may not necessarily be associated with thunderstorms.

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 and 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, in some cases, when practical, out-posted support for fire-control operations. The accuracy of fire weather warnings is assessed in terms of the Probability of Detection and the False Alarm Ratio (Figure 24).

Major developments 2004-05

- Replacement of obsolete weather watch radars at Gladstone and Port Hedland under the Radar Network and Doppler Services Upgrade Project (RNDSUP) to upgrade the Bureau’s radar network and improve its associated severe weather services. Installation and preliminary testing of the first capital city Doppler Radar at Buckland Park north of Adelaide which is expected to be commissioned by early in 2006.

- Implementation of an improved, nationally consistent warning service for severe thunderstorms, land gales, squalls, and other types of severe weather. The upgraded service brings together several different types of warnings, some of which were confusing or
Figure 23. 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 12 years (1994-2005) for severe thunderstorm warnings. The columns show the total number of observed events for each year. While the FAR has increased slightly, the ability to detect events, indicated by the total observed, has quadrupled over this period.

Figure 24. 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 12 years (1994-2005) for fire weather warnings.
limited to small areas, under two nationally consistent categories: Severe Weather Warnings and Severe Thunderstorm Warnings.

- Commencement of a graphical severe thunderstorm warning service, initially in New South Wales.
- Effective contribution to the development of the Australian Government disaster mitigation policy and activities at the national and international levels, such as participation in Commonwealth and multi-jurisdictional working groups progressing the commitments of the Council of Australian Governments (COAG) to reform Australia’s Natural Disaster Management.
- Further progress on projects to improve the effectiveness of warnings in remote indigenous communities and non-English speaking households.
- Active contribution to projects conducted within the Bushfire Cooperative Research Centre, including leading the research project on risk communication.
- Contribution to the implementation of the government response to the findings and recommendations of the COAG National Inquiry on Bushfire Mitigation and Management and the House of Representatives Select Committee on the Recent Australian Bushfires (Nairn Report).

**Contribution towards outcome**

- The upgrade to the weather watch radar coverage has improved the Bureau’s ability to monitor severe weather, particularly tropical cyclones and severe thunderstorms and reduced maintenance costs through the replacement of older, less reliable systems.
- The changes to the warning service for severe thunderstorms, land gales, squalls, and other types of severe weather benefit the public by providing a nationally consistent and less complex service better suited for effective communication through the media.
- The graphical warnings introduced initially in New South Wales provide a more readily interpreted presentation of the areas forecast to be affected by thunderstorms than the previously available text products. This improved means of communicating warning messages encourages users to take appropriate action.
- 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 groups. It also facilitates the distribution of information to reduce the impact of hazardous weather, consistent with the government’s Disaster Mitigation Program.
- The effective development of warning services was demonstrated during the ten-day life of tropical cyclone *Ingrid* during March 2005. *Ingrid* was a long-lived cyclone and the first in recorded history to impact, as a severe tropical cyclone, on the coastline of three different States or Territories. Its path took it very close to many remote communities, but there were no significant injuries and communities were well warned and well prepared.
- Through its participation in the Bushfire CRC and membership of its Board, the Bureau is able to contribute to setting research directions, assisting fire control agencies to
benefit from Bureau-led research into fire weather and improving Bureau services through application of research findings from other areas of fire science.

- The Bureau’s contribution to the implementation of recommendations from State and Commonwealth bushfire inquiries should assist in the adoption of measures to more effectively manage 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 25).

Public Weather Services are distributed through a variety of channels including the mass media, the internet, and telephone information systems (Figure 26) shows the level of usage). Products provided include current and recent weather observations from the Bureau’s extensive observing network, satellite and radar imagery, 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 and/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.

![Temperature Verification Graph](image)

*Figure 25. Trends in the mean modulus of error in daily maximum and minimum temperature forecasts for all capital cities except Darwin.*
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 meteorological 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 2004-05**

- The radar display on the Bureau’s public website was enhanced to show 16 intensity levels of radar data and coloured topographic backgrounds, which have been specifically designed to assist users with colour blindness.

- New ‘clickable’ maps of district weather forecasts and the latest weather observations were introduced to the Bureau website using the same topographic backgrounds as those used on the new radar display. With a single mouse click, users can now obtain a district forecast, or synoptic observations for the most recent 72 hours.

- Information on public assessment of the Bureau’s forecast performance for each capital city, derived from the bi-annual user surveys, is now being published on the Bureau web site.

- A web page was implemented that provides information on Wet Bulb Globe Temperatures (WBGT) in sun and shade. WBGT is used in conjunction with guidelines provided by Sports Medicine Australia to determine the most appropriate levels of sporting and recreational activity for given temperature and humidity conditions.
Contribution towards outcome

• The redesign of the on-line radar display, aimed at providing more detail in rainfall images and improved colour acuity for colour-blind users, has improved the utility of the service for the broader community.

• Introduction of easy to use ‘clickable’ maps for district forecasts and weather observations enhances the online experience for users and simplifies the task of obtaining weather information, now more specifically targeted for their local area.

• Publication of user assessment of the quality and relevance of Bureau forecasting services enhances community understanding by demonstrating how well the Bureau is meeting community needs for reliable and accurate forecasts, whilst highlighting service requirements that need further attention.

• Introduction of the WBGT service enhances the safety and well being of people undertaking outdoor activities, in hot weather particularly, by informing participants and organisers about the degree of physical stress which may arise from weather conditions.

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 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 and HF and VHF radio broadcasts for the dissemination of forecasts and warnings for high seas and selected coastal waters areas. Numerous volunteer, coast guard and state marine agency groups along the Australian coastline also undertake VHF broadcasts, carrying the forecasts and warnings originated by the Bureau’s marine weather service. As the internet becomes an increasingly dominant medium through which users access Bureau forecast services, consistency of the suite of forecast products available on-line has become a significant factor in enhancing the level of utility. This is being continuously improved so that there is consistency in format and design elements and independence of the location of users, leading to higher user satisfaction levels.

Major developments 2004-05

• Coastal waters forecasts were extended to four days in all regions and a nationally consistent format template was applied from 1 July.

• A new nationally consistent format for coastal waters wind warnings was introduced, providing a more user-friendly structure and specific cancellation messages when warning conditions have abated below the strong wind threshold of 25 knots.
• Revised coastal wind warning lead times and amendment criteria were introduced nationally, including the introduction of a 15 knot threshold specifically aimed at improving safety for recreational boaters.

• The Bureau contributed a section on its marine weather services to the *Australian Seafarers Handbook*, a ready reference guide for professional and recreational mariners published by the Australian Hydrographer and launched on 17 December.

• The Bureau's marine web page was completely revised, improving its utility and integrating it more effectively with the rest of the Bureau's website.

**Contribution towards outcome**

• Extension of the period of coastal forecasts to four days and adoption of the nationally consistent format enhances the safety and preparedness of marine users in the longer term, and further encourages the use of the service across a diverse range of access channels (web, telephone, fax, television, radio and satellite).

• Implementation of the new marine weather warning format and revised warning lead times provides critical information in a clear manner to mariners, in particular to highly weather-sensitive small craft operators.

• The Bureau's contribution to the *Australian Seafarers Handbook* provides the operators of vessels sailing in Australia's region of maritime interest with guidance to the range of marine weather services available and the means of accessing those services.

• The revision of the marine web page encourages use of marine weather services, enhances on-line ease of use through the improved design and utility, and contributes to safety on the water through ready accessibility to up to date forecasts, warnings and coastal observations.
AVIATION WEATHER SERVICES

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

During 2004-05, 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 National Meteorological and Oceanographic Operations Centre;
• each of the Bureau's capital city Regional Forecasting Centres;
• the Sydney Airport Meteorological Unit (SAMU), which is co-located with Airservices Australia's Air Traffic Services Unit at Sydney Airport;
• the Av-Met units at Sydney and Brisbane Airports;
• 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.

Aviation Weather Services are provided within the international technical and regulatory framework of the ICAO which works in close cooperation with the World Meteorological Organization (WMO). Australian domestic aviation is regulated by the Civil Aviation Safety Authority (CASA) and 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.

Throughout the year, 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 of Meteorology, Civil Aviation Safety Authority, 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 to identify deficiencies in, and explore opportunities to improve the effectiveness of, the Aviation Weather Service. An Industry Technical Group was implemented and is providing valuable directions on underpinning science and technical requirements for the industry.

Major developments 2004-05

• As part of the consultative process with the aviation industry, a Technical Group was formed to provide a focus for research and development activities undertaken in the Bureau of Meteorology in support of Aviation Weather Services. The group includes key industry representatives and will provide guidance to Bureau researchers and will make recommendations to the annual Bureau of Meteorology/Air Industry Consultative Meeting.
• The Automated Thunderstorm Alert Service (ATSAS), a new service in response to industry
requirements for thunderstorm information in the terminal area, underwent trials at Brisbane, Sydney and Melbourne Airports. The ATSAS product is a web-based display of weather radar, including forecast storm tracks and information from lightning sensors. The system will now be brought into operations and extended to other airports.

- An automated system for producing Area QNH (the barometric altimeter setting which will cause the altimeter to read altitude above mean sea level within a certain defined region) as both text and graphics from computer model output underwent successful trials during the year. After some modifications the system will be made fully operational through the NMOC.

- Temperature and QNH fields are being automatically generated from Operational Consensus Forecast (OCF) data to provide guidance for the production of Terminal Aerodrome Forecasts (TAFs). During 2004-05 the system was available to forecasters in New South Wales, the Northern Territory, South Australia and Queensland.

- The Bureau continued to develop training programs specifically for aviation to support accreditation of aviation forecasters as fully competent to perform their functions. Two new training positions were established and links were expanded with the COMET (Cooperative Program for Operational Meteorology, Education and Training) distance learning program based at the National Center for Atmospheric Research at Boulder, Colorado.

- An Av-Met office for operations monitoring was opened at Brisbane Airport. The unit provides a national alerting system for aviation forecasters within the Bureau and helps improve the understanding of industry requirements through facilitating communication between forecasters and the airline operators.

**Contribution towards outcome**

- The new Industry Technical Group will help direct projects and service initiatives to meet industry requirements.

- New graphical products enhance the usability and effectiveness of information.

- Automated generation of some aviation products from computer models provides more time-and cost-effective services.

- Training and assessed competencies help underpin a consistent and high quality service.

- Av-Met units associated with airline operations in Sydney and Brisbane provide a strong user-focus for industry-wide provision of services.
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 and providing 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 Townsville Meteorological Office.

The Darwin-based DMSU provides particular expertise in the strategically important areas of tropical Australia, South-East Asia and the southwest Pacific and was established to provide information in a secure environment. The DMSU complements and supports Defence WSOs which provide localised specialist meteorological services to support military aviation. Electronic media, using both the Internet and the Defence Secret Network, are becoming key delivery platforms.

Users were consulted throughout the year as a key part of the process for ensuring the appropriate levels of service. The primary user is RAAF Headquarters Air Command, with responsibility for meeting the bulk of the annual charge for Defence Weather Services, but consultation also occurred with base commanders and individual squadrons.

Major developments 2004-05

- The Defence Meteorological Support Unit received an "Appreciation of Service" award from Army Aviation in recognition of services provided for operations in East Timor and the Solomon Islands.
- The Defence Weather Services website continued to have a steady rise in usage hitting a new monthly peak usage of 2.4 million hits in September.
- Defence Weather Services staff were successfully deployed to Butterworth, Malaysia with 75 and 77 Squadrons.
- Two Defence Weather Service Tactical Automatic Weather Stations (TACMETs) were deployed by RAAF Technicians at Baghdad Airport to assist ADF Air Traffic Controllers.
- New 64km-range weather radar displays, which use remapped data centred over RAAF bases, were developed to meet ADF Air Traffic Control requirements. These displays were incorporated into re-designed web pages based around each ADF facility.

Contribution towards outcome

- DMSU meteorological support has assisted ADF personnel to plan and operate safely in areas of conflict.
- Improvements to web pages have led to a greater 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.

Information broadcast by TACMETs have assisted with creating a safe landing environment for aircraft.

The new weather radar displays have improved ADF Air Traffic Control services.

**COST RECOVERY SERVICES**

The overall objective of Cost Recovery Services is 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 additional services recovered on either a marginal or incremental basis.

**Major developments 2004-05**

- Bureau Staff in all Regions were provided with presentations on the Trade Practices Act (TPA) as part of the Bureau’s Trade Practices Act compliance process.
- Two consultative meetings were held with representatives of the Private Meteorological Service Providers (PMSP), one of which was attended by the Parliamentary Secretary with ministerial responsibility for the Bureau and a member of the Bureau of Meteorology Advisory Board.

**Contribution towards outcome**

- TPA awareness was improved for Bureau staff resulting in a better understanding of interactions with the PMSPs.
- The utility of meteorological data services for specialised users was enhanced through the development of tailored weather services by private meteorological service providers.