

# WEATHER SERVICES

Weather Services encompasses the wide range of analysis and prediction products and forecast, warning and information services provided 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 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) and very high frequency (VHF) radio and facsimile, and Inmarsat (marine) satellite broadcasts.

A broad range of ongoing consultative mechanisms, involving Commonwealth and State or Territory 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 2007-08

<p><b>Outcome</b></p>	<p>Enhanced community safety and well-being through preparation of meteorological and related products and information and the effective use of meteorological and related services by the general public and other major social, environmental and economic sectors.</p>
<p><b>Objective</b></p>	<p>To meet the needs of the general public and specialised users for relevant, accurate and timely weather data, information, forecast and warning services.</p>
<p><b>Effectiveness indicators</b></p>	<p>The extent to which:</p> <ul style="list-style-type: none"> <li>• meteorological and related services contribute to: <ul style="list-style-type: none"> <li>- minimising loss of life and property and community disruption from bushfires, tropical cyclones, severe storms and tsunamis;</li> <li>- minimising economic and other costs of disaster preparedness;</li> <li>- the safety, comfort, convenience and general welfare and economic benefit of the public and major community groups;</li> <li>- the safety and efficiency of shipping, small craft and maritime industries;</li> <li>- the safety, regularity and efficiency of air navigation;</li> <li>- the efficiency and effectiveness of the Australian Defence Force;</li> <li>- government and community planning;</li> <li>- the management of the environment, including natural resources; and</li> <li>- the economy and efficiency of primary and secondary industry;</li> </ul> </li> <li>• forecasts, warnings, information and advice are accurate and timely;</li> <li>• needs (including the needs of specific users of special weather services on a cost recovery basis) are identified and, within available resources, are satisfied and new services and products are developed as opportunities arise;</li> <li>• the public, major user groups and specialised users including emergency services, aviation, defence and the private sector receive, understand and make optimum use of the services and express satisfaction with the services; and</li> <li>• an Australian Tsunami Warning System is developed in collaboration with Geoscience Australia (GA), Emergency Management Australia (EMA), and a joint warning centre is established with GA that delivers reliable and timely warnings of tsunamis.</li> </ul>

## OUTPUTS 2007-08

Weather Services is one of the Bureau's eight Major Outputs and contributes towards Output Group 1.3 - Meteorological and Related Services and Products. The services and products typically include: analysis and prediction products describing the state of the atmosphere, information on current and forecast weather conditions for States or Territories, 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 2007-08

Output performance is measured against a number of targets, including quality, quantity and price. The performance against each of these output targets during 2007-08 is provided below.

Quality	Target	Actual
Percentage of users surveyed indicating that public weather forecasts and warnings are substantially accurate	90%	95%
Percentage of users surveyed indicating that public weather forecasts and warnings are becoming more accurate or are maintaining current levels of accuracy	90%	88%
Percentage of users surveyed indicating that they are 'satisfied' or 'very satisfied' with weather forecast, warning and information services	90%	90%
Percentage of users surveyed indicating that weather forecasts, warnings and information services are received in time for them to make their decisions	90%	95%
Percentage of Australian Tsunami Bulletins issued in conjunction with Geoscience Australia that are available to emergency services and the public within 40 minutes of a significant event anywhere in the Pacific or Indian Oceans	99%	100%
Percentage downtime for Internet access services	0.1%	0.05%
Percentage of users surveyed that are 'satisfied' or 'very satisfied' with atmospheric dispersion and air quality services	90%	see Note
<b>Quantity</b>		
Number of public weather warnings issued	15,000 to 20,000	24,455
Number of public weather forecast and information bulletins issued	300,000 to 350,000	250,594

Quantity (cont.)	Target	Actual
Number of accesses by telephone/facsimile for automated weather service delivery systems	5 to 7 million	3.17 million
Number of accesses by the internet for automated weather service delivery systems	4.0 to 4.5 billion	16.9 billion
Number of Regional Forecasting Centres	7	7
Price		
Disaster Mitigation Activities	\$5.328m	\$7.561m
Public Weather Services	\$13.277m	\$10.997m
Marine Weather Services	\$4.720m	\$4.444m
Aviation Weather Services	\$18.874m	\$18.736m
Defence Weather Services	\$4.247m	\$4.324m

Note: These services are currently at a development stage and a full survey of users could not be made. Identified potential users commented favourably on progress to date.

### Comments on output performance

User surveys continued to indicate that the Bureau's services are held in high regard by the Australian community. Quality targets were exceeded in most categories, although the percentage of users perceiving accuracy to be increasing or staying the same showed a small deficit in the actual value compared with the target. More detailed analysis of these figures indicated that the underlying reason for the deficit was a slight decrease from the previous year in perceived accuracy as judged by people in rural southeast Australia. This may indicate a greater reliance on, and hence greater demand for, information on which to base decision making, which is becoming more critical with the prolonged drought conditions. A full analysis of 2007 figures showed that, during 2007-08, 90 per cent of users surveyed were satisfied or very satisfied with the Bureau's weather services, a statistic that has remained fairly steady over the past five years.

A new metric this year was the performance of the Joint Australian Tsunami Warning Centre which aims for high levels of operational performance related to the timeliness of the Bureau response to initial advice of seismic events which are the fundamental cause of tsunamis, and these were achieved during 2007-08.

During the year the attribution of some activities, staff and resources among the various outputs were altered, leading to differences between the actual and target values for prices of individual outputs in some cases.

## ACHIEVING THE OUTCOME

Weather Services are delivered through five individual outputs that contribute to the achievement of the desired outcome. The developments in each individual output during 2007-08 and their contributions to the outcome are considered below.

### OVERVIEW OF 2007-08

Wider access to Bureau services was a major outcome for Weather Services this year. With new Doppler radars being introduced in major centres, new high-resolution radar data became available and the existing web-based displays of radar information were enhanced with representations of accumulated rainfall and Doppler winds for Adelaide, Brisbane and Melbourne. New products in various graphical formats were added to the Bureau's Water and the Land website, including graphical frost potential, wind forecasts and climate products. Feedback received through the website itself, and letters from funding bodies which have supported the development of the Water and the Land site in previous years, indicated that the improvements were welcomed by both the public and specialist agencies.

Planning of a pilot project for an advanced forecasting system using the jointly developed US/Australia Graphical Forecast Editor (GFE) was commenced during the year.

Tropical cyclone warning services provided by Darwin, Brisbane and Perth Regional Forecast Centres are an essential component of emergency response and community protection, especially for coastal communities, and these continued to meet high standards in 2007-08. There were heavy workloads for operational staff in these locations as a result of the lengthy life-cycle of some of this year's cyclones, for example tropical cyclone *Nicholas*, whose impact on the Pilbara coast (Western Australia) and off-shore rigs continued for ten days. Nevertheless, the long-term trend in forecast accuracy indicators continued to demonstrate improvements in ability to detect and accurately predict these systems, as illustrated by the case of tropical cyclone *Helen*. Although it followed an erratic track, all affected communities in the Northern Territory were well informed.

An additional major development this year was the establishment by the Indonesian national meteorological service, Badan Meteorologi dan Geofisika, of a new Tropical Cyclone Warning Centre (TCWC) in Jakarta, achieved with assistance from the Bureau of Meteorology. The Jakarta TCWC, which commenced operations in January and detected and named its first tropical cyclone *Durga* in April, has now resumed responsibility for cyclone warnings in the Indonesian Region, an undertaking that Australia had been covering in recent years as an interim measure, by agreement with Indonesia reached in 1998 under the aegis of the Region V Tropical Cyclone Committee of WMO.

Fire weather services saw even closer interaction with State fire agencies than in previous years, with more Bureau staff being out-posted to major emergency coordination centres. This continued trend is aimed at meeting increasing demands for these agencies resulting from developments in practice and procedures for both fire management and fuel reduction burning which rely heavily on more detailed meteorological information. Following the successful introduction of a joint operational arrangement in 2006-07, fire weather forecasters from the US again joined Bureau staff in three States during the Australian summer fire season, and there was a reciprocal deployment to New Mexico, Idaho and Florida in the

US during the Australian off-season, which coincides with the peak of the US fire season.

The Bureau of Meteorology, in conjunction with its partners in Geoscience Australia, achieved a significant milestone in July when the Joint Australian Tsunami Warning Centre commenced operations. The Centre has the capacity to identify and issue a potential tsunami threat bulletin for Australia within 30 minutes of the detection of the causative undersea earthquake.

Aviation Weather Services marked a major change in its services delivery model matching new developments in the aviation industry. The new services will be based on different areas of airspace, including Upper Airspace for high-level flights and commercial airliners, Regional Services for lower-level flights and smaller aircraft and Major Terminal Services for the area immediately surrounding major international airports. In February the Bureau commenced its role in the new Airservices Australia National Operations Centre in Canberra. The role of the new centre is to better manage air traffic nationally for reduced time delays at various points during flights, leading to reductions in the amount of fuel burned, with the added impact of lower carbon emissions from aircraft. The Bureau's Aviation Weather Services also achieved the goal of implementing and reaching certification to AS/NZS ISO 9001:2000 Quality Management Standard. Certification was performed by Lloyds Register Quality Assurance Ltd.

The Bureau's Defence Weather specialists were deployed with RAAF squadrons to Malaysia and Alaska to support defence exercises. They also provided substantial forecasting support for multinational exercises near Rockhampton and Darwin.

In response to the new strategic directions of the Australian Defence Force (ADF), involving the centralisation and consolidation of their command operations for the Army, Navy and Air Force, the Bureau's Defence Weather Services commenced the process of relocation of its Defence Meteorological Support Unit from Darwin to the ADF's new Headquarters Joint Operations Command in Canberra.

## **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 RFCs, with national coordination by Weather Services Policy Branch in Head Office, 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 cyclone position and intensity (Figures 16 and 17). 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.

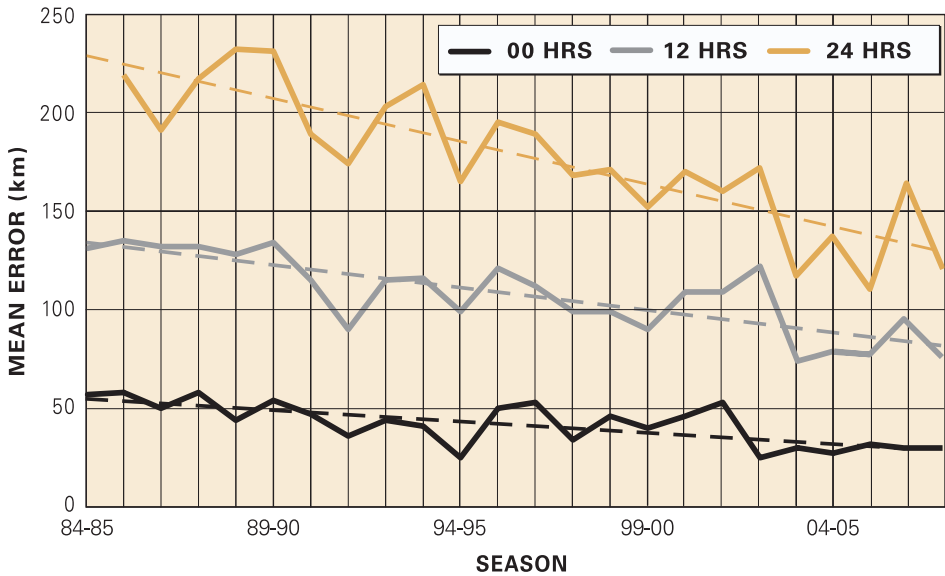


Figure 16. Average errors in tropical cyclone location in the Australian region compared with post-event best estimates. The three lines show the accuracy of real-time estimation (00 hrs) and forecasts (12 hrs and 24 hrs). The associated straight lines show the long-term trend.

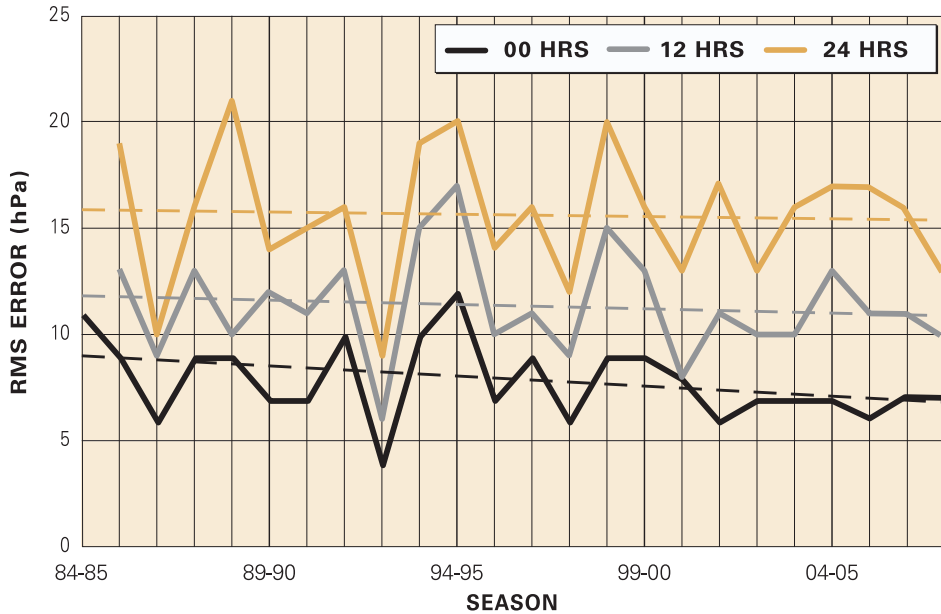


Figure 17. RMS (root-mean-square) errors in tropical cyclone intensity (as measured by central pressure) in the Australian region compared with the post-event best estimates. The three lines show the accuracy of real-time estimation (00 hrs) and forecasts (12 hrs and 24 hrs). The associated straight lines show the long-term trend.

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 False Alarm Ratio (Figure 18). The Probability of Detection measures the proportion of events that were forecast, whereas the False Alarm Ratio measures the fraction of forecasts for which no event was observed. Severe Weather Warnings are 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 and land 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, out-posted support provided by Bureau staff located at fire management operations centres. The accuracy of Fire Weather Warnings is also assessed in terms of the Probability of Detection and the False Alarm Ratio (Figure 19) and in recent years has been improving, as shown by the increasing values of Probability of Detection and decreasing values of False Alarm Ratio.

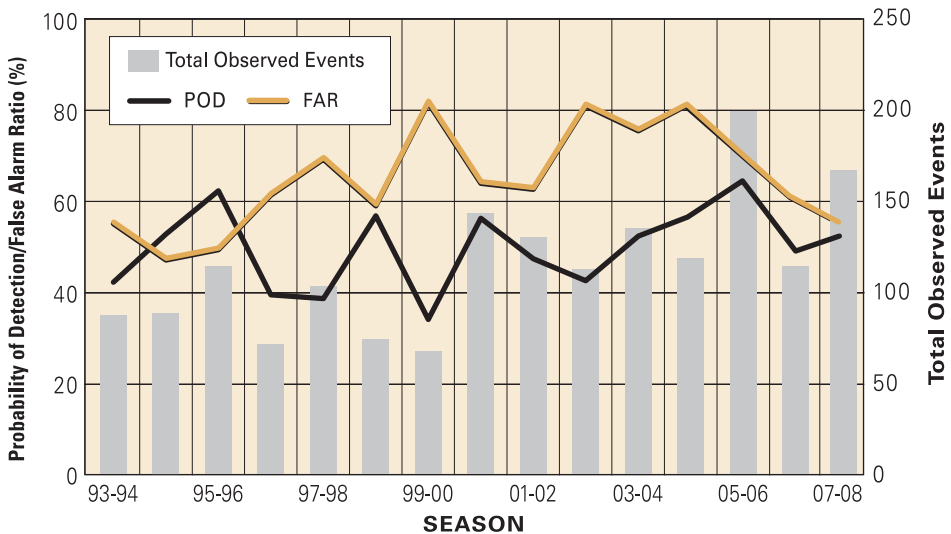


Figure 18. Nationally-averaged values of Probability of Detection (POD – fraction of events for which advance warning was provided, ideally 1) and False Alarm Ratio (FAR – fraction of warnings that were false alarms, ideally 0) for the past 15 years (1993 – 2008) for Severe Thunderstorm Warnings. The columns show the total number of observed events for the year. While the FAR has increased slightly, the ability to detect events, indicated by the total observed, has more than doubled over this period.

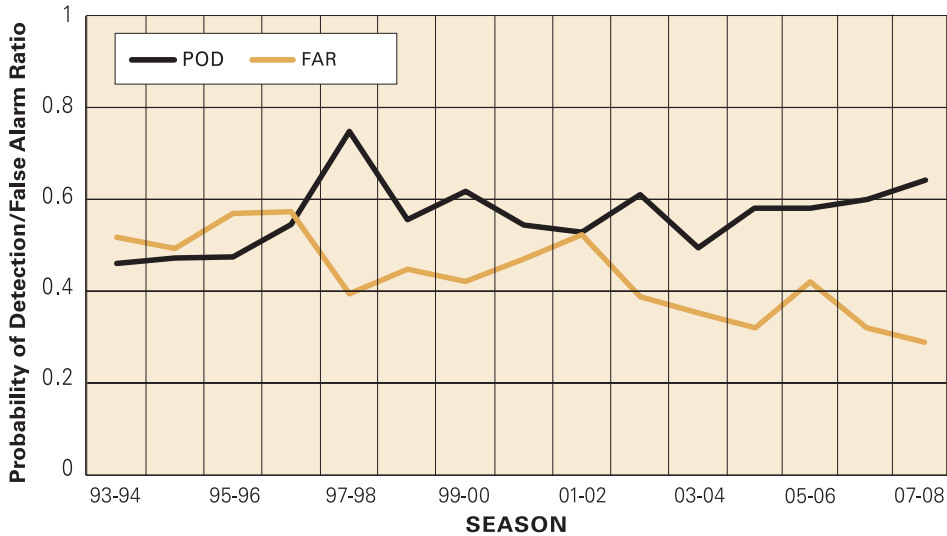


Figure 19. Nationally-averaged values of Probability of Detection (POD – fraction of events for which advance warning was provided, ideally 1) and False Alarm Ratio (FAR – fraction of warnings that were false alarms, ideally 0) for the past 15 years (1993-2008) for Fire Weather Warnings.

### Major developments 2007-08

- During the 2007-08 fire weather season in Victoria, the Bureau and the Victorian Department of Sustainability and Environment (DSE) collaborated to locate Bureau forecasters from the Victoria Regional Office in the DSE Emergency Coordination Centre. Forecasters worked closely with fire staff and regularly presented briefings in conjunction with fire behaviour specialists. In South Australia, Bureau forecasters were stationed at the Kangaroo Island fire incident management centre during a major fire in December, providing specialised weather briefings. In Western Australia, the Department of Environment and Conservation funded a 12-month project in which their fire management staff worked closely with Bureau forecasting staff in the development of new forecasting methodologies for improving fire weather forecasting tools, with Bureau staff also providing specialised briefing services. The project covered the whole of Western Australia with special focus on the southwest corner.
- Following their successful deployment over the 2006-07 fire season, and in anticipation of another extended fire season in Australia based on the early start to the season the previous year, seven forecasters from the US National Weather Service and Bureau of Land Management bolstered fire weather forecasting services provided by Bureau offices in Melbourne, Hobart and Sydney. Two Bureau staff made reciprocal visits to the United States, assisting in fire weather forecasting in Albuquerque (New Mexico), Boise (Idaho) and Tampa (Florida) during the US fire weather season.
- At the start of the 2007-08 tropical cyclone season, a new national tropical cyclone web page was launched on the Bureau’s public website. The page provides a ‘one-stop shop’

for tropical cyclone-related services and information, including a map displaying the position of all existing cyclones in the Australian region that allows the viewer to get an immediate picture of the overall current situation.

- Radar-based services benefited from the installation of new or upgraded radars at Laverton in the west of Melbourne, Yarrowonga in northeast Victoria, Bairnsdale in East Gippsland, Victoria, and Gympie in Queensland. The radars at Laverton and Yarrowonga now have Doppler capability.
- The radar data displays on the Bureau's website of the high-resolution radars in Adelaide, Brisbane and Melbourne were enhanced in August by changes to the geographical map information, as well as the addition of accumulated rainfall and Doppler velocity information for those radars with Doppler capability.
- Bureau staff contributed chapters on meteorological hazards for the publication of the book *Natural Hazards in Australia – Identifying Risk Analysis Requirements*, coordinated by Geoscience Australia as an activity under the Natural Disaster Mitigation Program which developed out of the Review of Australia's Disaster Mitigation and Relief Arrangements instigated by the Council of Australian Governments (COAG).
- The Bureau has engaged fully in several cross-government disaster mitigation working groups constituted under the Australian Emergency Management Committee to implement aspects of the Natural Disaster Mitigation Program. The Bureau also co-chaired the National Forum on Emergency Warnings to the Community held in February in Brisbane and funded under the National Disaster Mitigation Program.
- The Joint Australian Tsunami Warning Centre (JATWC), operated by Geoscience Australia and the Bureau of Meteorology as part of the Australian Tsunami Warning System project, commenced operations in July. The JATWC has the capacity to identify and issue a potential tsunami threat bulletin for Australia within 30 minutes of the detection of the causative undersea earthquake. Bureau Regional Forecasting Centres are also playing a significant liaison role with the State response agencies to ensure a total warning service is provided.

#### **Contribution towards outcome**

- The co-location of forecasters with fire managers at land management agency coordination centres during the fire season results in more effective use of fire weather services through the provision of more targeted meteorological information to fire managers and ultimately assists in improving community safety from bushfires.
- The exchange of fire weather forecasting staff between Australia and the US has assisted each country in managing the increased workload during the peak fire season. The program has also led to an exchange of knowledge and experience that is contributing to improving fire weather services in both countries.
- The new tropical cyclone web page provides a unified national view of current cyclone activity as well as associated background information about cyclones, constituting an improved service to the public through easier navigation between different types of information.
- The upgrade to the weather watch radar network improves the Bureau's ability to monitor severe weather, particularly thunderstorms and heavy rainfall. The new Doppler capabili-

ties of the radars at Laverton and Yarrawonga has also improved such service aspects as the detection of wind changes that can affect bushfire-fighting operations. The radar installation at Bairnsdale has extended radar coverage to eastern areas of Gippsland that previously did not have local radar services.

- The changes to the radar data displays on the Bureau's website provide both the community and emergency services with better information on which to base planning of weather-sensitive activities which in turn contributes to improved public safety. An on-line survey designed to assess the Australian public's feedback on the new products was conducted over the summer of 2007-2008, and showed that the imagery was being used for a wide range of purposes of both general and commercial nature, that 80-90 per cent of respondents found the products useful and easy to understand, and over 60 per cent found them at least 'mostly accurate'.
- The *Natural Hazards in Australia* publication assists agencies in the development of consistent and systematic natural disaster risk assessments that can be used as a basis for nationally-consistent approaches to designing and implementing disaster mitigation measures.
- The Bureau's participation in national working groups supports the implementation of a coordinated whole-of-government approach to disaster mitigation, in line with recommendations and action developed by the COAG Review. The Bureau is an integral part of Australia's disaster mitigation infrastructure, since most natural hazards and warnings issued relate to weather or floods.
- The JATWC provides Australia with an independent capability to detect, monitor and verify potential tsunami in our region. The lead time that the JATWC aims to provide is critical for state and emergency management agencies to activate emergency management plans to protect any communities at risk.

## **PUBLIC WEATHER SERVICES**

The Bureau's Public Weather Services provide a wide range of recent, current and forecast weather information and warning services for the benefit of the general community in all Australian States and Territories. Weather forecasts are provided for more than 170 cities and towns and 60 forecast districts. Products provided include weather observations from the Bureau's extensive observing network, satellite (cloud) images and the very popular radar rainfall images. Weather warnings are issued whenever conditions have the potential to cause loss of life or damage to property. Public Weather Services are distributed through a variety of channels including the internet and telephone information systems (Figure 20) as well as the mass media.

The Bureau monitors its performance in a variety of ways including verifying forecast temperature against observed. Figure 21 shows that the accuracy of temperature forecasts continues to improve. This has been achieved through regular improvements to forecasting guidance, technology and procedures. Another performance measure is the twice-yearly telephone survey that monitors overall levels of community satisfaction with Bureau services, the use made of the various weather services and the general public's understanding

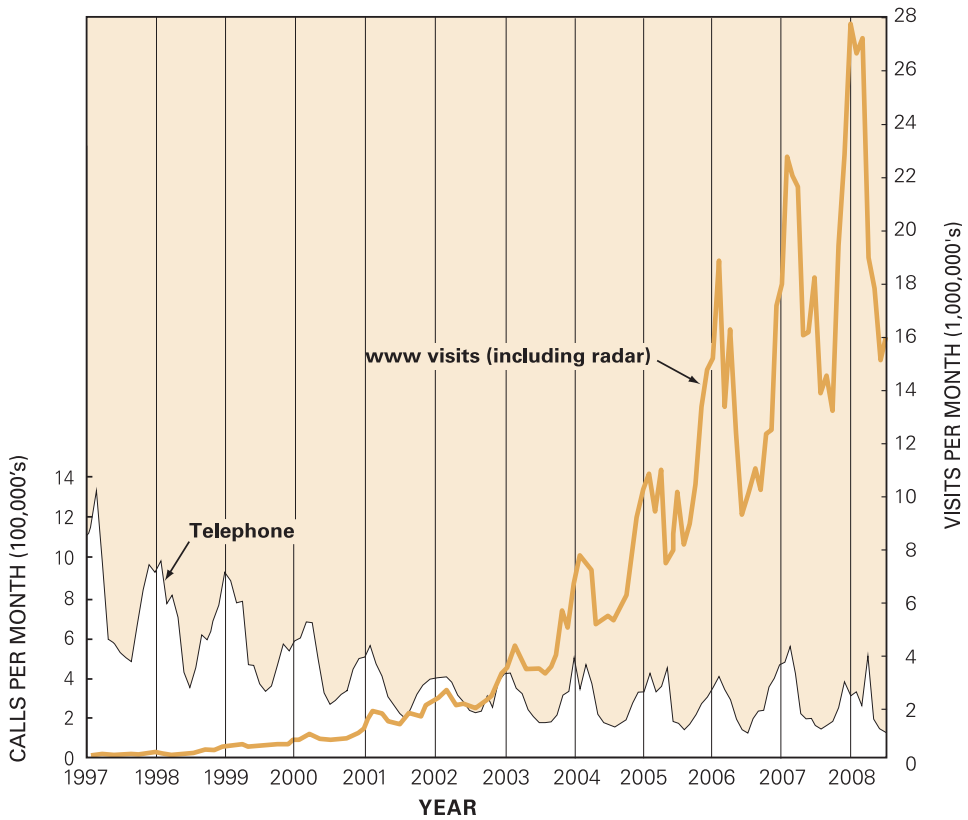


Figure 20. Comparison of internet versus telephone access to weather information.

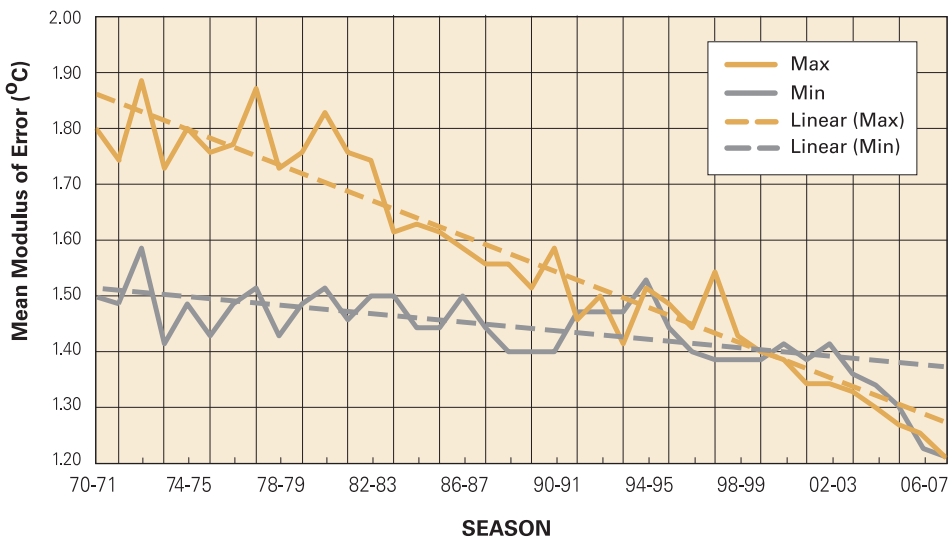


Figure 21. Trends in the mean modulus of error ( $^{\circ}\text{C}$ ) in daily maximum and minimum temperature forecast for all capital cities except Darwin.

of forecasts. This assists in identifying potential areas for improvement based on community needs. The latest trends in the survey results show that in city and regional centres a high proportion of users feel they are well served by, and generally satisfied with, the level of weather services they receive from the Bureau (Figure 22), while in rural Australia there is increasing demand for more comprehensive and detailed weather information, particularly in New South Wales and Victoria.

As part of its strategy of maximising the reach and utility of its Public Weather Services to the community, the Bureau fosters partnerships with Federal, State or Territory agencies wherever possible, as well as with the commercial meteorological sector. The growing range of services provided by commercial meteorological companies augments and extends the opportunities for community access to weather services originated by the Bureau. The Bureau also holds regular consultative meetings with various industry sectors that provide opportunities for feedback and input into weather services development. These relationships with both public and private sector agencies facilitate monitoring of community needs in an environment where the channels for obtaining Public Weather Services continue to multiply and diversify with the rapid evolution of communications technologies and delivery systems.

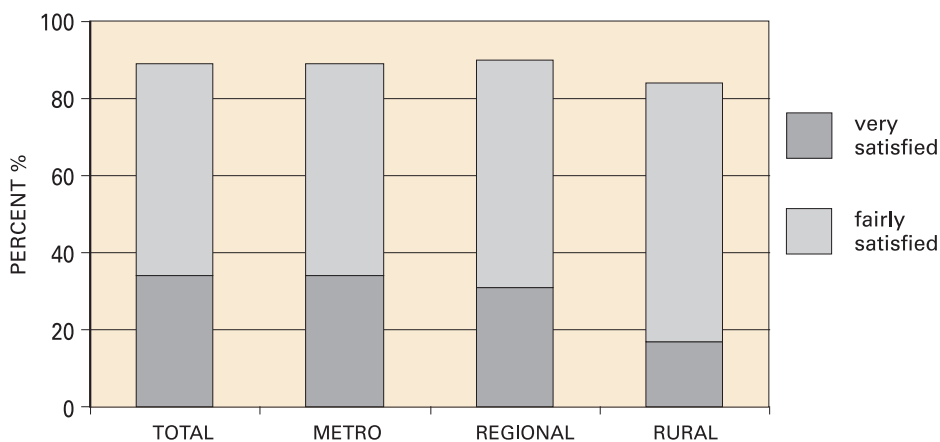


Figure 22. Results of the Public User Survey, showing higher proportions of 'satisfied' users in metropolitan and regional centres than in rural areas.

### Major developments 2007-08

- New services were introduced on the Water and the Land pages of the Bureau's website, including maps and tables of frost potential for numerous locations across Australia, graphical depictions of wind forecasts and other information about climate influences.
- As outlined above under 'Disaster Mitigation Activities' the Bureau's radar displays on the web were updated to include additional layers of geographical and weather information.
- Further enhancements were made to the capability of the GFE system which is under development, including the ability to produce forecasts for a greatly increased number of

locations, extension of the forecast lead-time from four days out to seven days for many locations, and the production of interactive graphical forecasts that can be made accessible via the Bureau's website. Planning commenced for a pilot implementation project of the GFE system in Victoria.

### **Contribution towards outcome**

- The enhancements to the Water and the Land page of the Bureau's website are primarily aimed at the rural sector to assist in their decision-making processes and to provide better planning tools in both the short and long-term. These products contribute to the improved efficiency of the primary industry sector, but are also being used by others in the community to better plan weather-related activities. Feedback received online via the Water and the Land page indicates strong user satisfaction with these new services.
- As outlined in more detail under 'Disaster Mitigation Activities', the new features on the web radar display allow the public and specialised users to receive, understand and make optimum use of radar data. Feedback received by the Bureau indicates strong user satisfaction with these new services and hits on the Bureau's radar website pages continue to grow strongly.
- Regular surveys of rural and metropolitan users of the Bureau's weather services have consistently shown a strong demand for more comprehensive forecast information, and more graphical products. Equally, many users are demanding forecasts for their specific location. The pilot project in Victoria will evaluate whether the GFE system will meet these requirements into the future.

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

In order to fulfil its responsibilities under the International Convention for the Safety of Life at Sea and identified community requirements for services, the Bureau of Meteorology uses several dissemination channels to communicate with mariners at sea, including Inmarsat satellite broadcasts and HF and VHF radio broadcasts for 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 important medium through which users access Bureau forecast services, and as the Bureau improves its forecasting systems, national consistency in the suite of forecast products available online has also been improved.

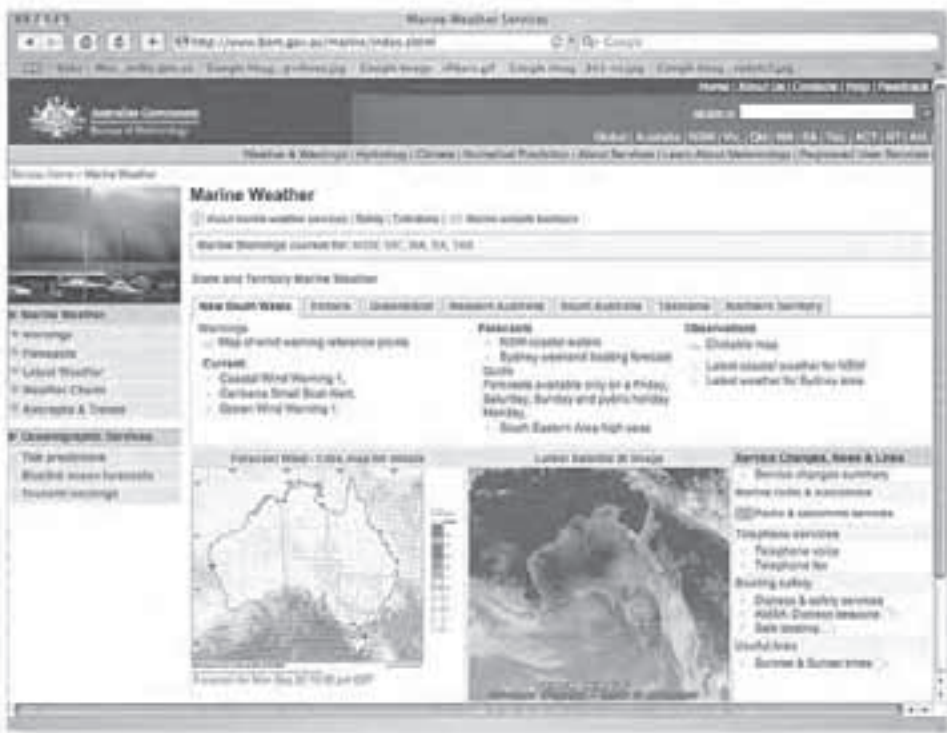


Figure 23. The new Marine Weather Services page on the Bureau's website.

### Major developments 2007-08

- To enhance the usability and navigation of the Bureau's Marine Weather Services website pages, a significant restructure of the site was undertaken during the year (Figure 23). The enhancements included new marine graphical products giving forecast wind guidance for up to seven days in advance (Figure 24).
- A revision and update of the Marine Weather Service mini-guides for Western Australia and South Australia was completed.
- A survey of users who receive their marine services via Very High Frequency (VHF) radio was undertaken in Western Australia and Queensland, to determine how services could be delivered more efficiently in those States.
- As part of the ongoing assessment of the delivery of marine weather products through the Bureau's High Frequency (HF) radiofax service, 14 unwanted products were removed from the fax schedule and a number of popular and frequently-used products are now being repeated at different times, following responses to a survey of users undertaken in 2006.

### Contribution towards outcome

- The restructure of the Marine Weather Services website pages and the addition of the marine graphical wind forecast products better serve the needs of maritime safety and the efficiency of shipping, small craft and maritime industries. Online feedback received

by the Bureau on the new marine website pages since its relaunch has been overwhelmingly positive, with many users expressing appreciation for the new products, as well as reporting that it has satisfied a previously unmet requirement and made accessing relevant weather forecast, warning and observational data much easier.

- The revision and update of the Marine Weather Services mini-guides for Western Australia and South Australia assists in advising users of marine weather information of recent developments in these services.
- Access to weather information through VHF radio services is a key safety issue for all mariners and contributes to the overall safety and efficiency of the maritime industry in general. The survey of users of the marine VHF radio service undertaken in Western Australia and Queensland provided information on the future requirements of this group.
- The changes to the broadcast schedule of the Bureau's HF radiofax service have improved the efficiency of the service and resulted in a better match of the service to user needs.

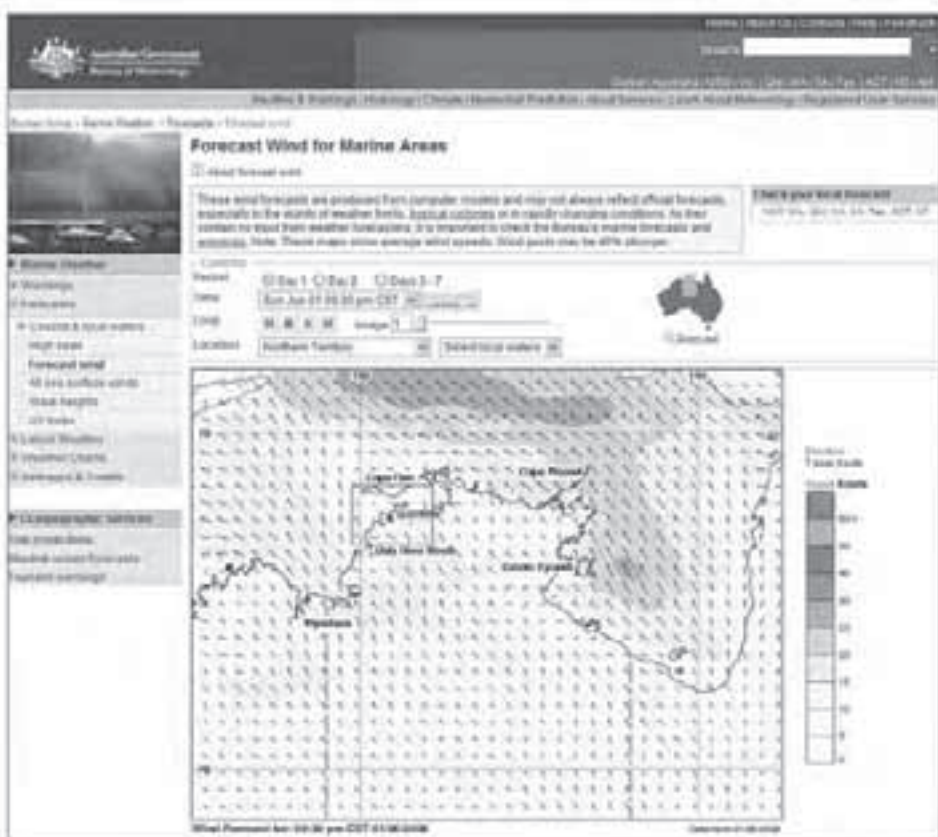


Figure 24. An example of the new metropolitan area wind forecast product showing average wind speeds.

## **AVIATION WEATHER SERVICES**

Aviation Weather Services enhance the safety, regularity and efficiency of national and international aviation operations through the provision of accurate, timely and relevant forecasts, warnings and information for aerodromes and en-route operations.

During 2007-08, Aviation Weather Services were generated and delivered through the following major service outlets:

- the Bureau's Aviation Weather Centre in Melbourne;
- each of the Bureau's capital city RFCs;
- the Sydney Airport Meteorological Unit (SAMU), which is co-located with Airservices Australia;
- meteorological offices in Cairns, Townsville and Canberra;
- the Volcanic Ash Advisory Centre in Darwin; and
- the Aviation Meteorological (AvMet) Units in Sydney and Brisbane.

The Bureau of Meteorology's role in providing services for civil aviation is established through the Meteorology Act. Under the Convention for International Civil Aviation (the Chicago Convention) the Bureau is the designated Meteorological Authority for Australia and also provides meteorological services for civil aviation in Australia in accordance with the standards and practices set out in Annex 3 to the Convention. In fulfilling this mandate it works closely with Airservices Australia, which is responsible for air traffic services, and the Civil Aviation Safety Authority (CASA), which is responsible for the safety regulation of civil aviation in Australia.

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, the Department of Infrastructure, Transport, Regional Development and Local Government and related agencies (CASA, Airservices Australia and the Australian Transport Safety Bureau), and representatives of international, domestic and regional airlines, general aviation, and other industry groups. International consultation and coordination occurred through the WMO Commission for Aeronautical Meteorology and working groups, the International Civil Aviation Organization (ICAO) Asia Pacific Air Navigation Planning and Implementation Regional Group and a number of ICAO study groups.

In conjunction with major stakeholders, the Bureau investigated all significant meteorological incidents in order to identify any deficiencies in the aviation weather service and explore opportunities to improve its effectiveness.

### **Major developments 2007-08**

- A quality management system for the management of aviation weather services by the Bureau's Aviation Weather Services National Program Office, and for the provision of aviation weather services by the SAMU and the Sydney AvMet Unit, was implemented and certified under the AS/NZS ISO 9001:2000 Quality Management Standard.
- As part of preparation for an audit of aviation safety in Australia under ICAO's Universal Safety Oversight Programme, the Bureau conducted a comprehensive review of its Aviation Weather Services documentation and practices and its compliance with international standards and practices for aviation as set out in Annex 3 to the Chicago Convention. The audit report contained no negative findings or recommendations for improvement in rela-

tion to the Bureau's Aviation Weather Services documentation and practices.

- In response to a request by Airservices Australia, the Bureau established a meteorological presence in its National Operations Centre in Canberra for the purpose of assisting with air traffic management.
- A centralised process was implemented for managing meteorological investigations relating to aircraft accidents and incidents, whereby all requests from airlines for such investigations are submitted to the Bureau online, and are dealt with in a nationally coordinated and consistent manner.
- The Automated Thunderstorm Alert Service (ATSAS) was implemented at Adelaide and Coolangatta Airports.
- As part of the aviation forecaster competency program, assessment of aviation forecasters in Victoria was conducted.
- The first national Aviation Client Satisfaction Survey was conducted to ascertain the level of satisfaction of the Bureau's aviation clients with the quality of products and the delivery of aviation weather services. The survey was conducted through the Bureau's Aviation Weather Services web page and Airservices Australia's National Aeronautical Information Processing System Pilot Briefing Services web page.

#### **Contribution towards outcome**

- The quality management system will ensure rigorous ongoing independent scrutiny of the management and delivery of aviation weather services, and provide a firm basis for continuous improvement of aviation weather services to meet industry needs.
- The preparation for, and findings of, ICAO's audit under its Universal Safety Oversight Programme provided a comprehensive and authoritative confirmation of the close compliance of the Bureau's Aviation Weather Services with international aviation standards, practices and documentation.



*Mr Steve Naylor (far left) from Lloyd's Register of Quality Assurance Australasia, presents Director of Meteorology Dr Geoff Love (centre), and staff from the Bureau's Aviation Weather Services National Program Office with a certificate signifying the section's compliance with the AS/NZS ISO 9001:2000 Quality Management Standard.*

- A meteorological presence in Airservices Australia's National Operations Centre allows more frequent and timely communication between air traffic management and meteorological staff, and hence more timely provision of meteorological information targeted at the particular areas of interest at any given time. This assists the operational air traffic management decision-making capability, providing safer and more efficient international and domestic air traffic flow.
- Meteorological investigations relating to aviation accidents and incidents assist in identifying deficiencies in, and possible improvements to, aviation weather services. The implementation of a centralised process for managing meteorological investigations has resulted in a nationally-consistent, more streamlined and more efficient response to investigation requests. Consistency in such investigations allows the Bureau to more easily identify widespread or common issues with the services, and also facilitates archiving of paperwork for future reference.
- ATSAS contributes to the safety of airport ground crew operations during thunderstorm events.
- Competency training and assessment reflects what an aviation meteorologist would be expected to do while exercising due care on the job and hence provides the foundation for service-focused, operationally-relevant training. It also provides a tool for benchmarking the required skills and knowledge.
- Annual aviation client satisfaction surveys will provide important user feedback which will assist the Bureau in identifying and addressing areas in which aviation weather services may be improved and aligned more closely with the needs of the aviation industry. The results of the survey were very positive in regard to the Bureau's services.

## **DEFENCE WEATHER SERVICES**

Defence Weather Services enhance the operations of the 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 and overseas;
- 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 Williamstown (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, the Middle East 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 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 the RAAF, which meets the largest part of the annual charge for Defence Weather Services, although the Army is increasing its use of the services.

### **Major developments 2007-08**

- The relocation of the DMSU from Darwin to the ADF Headquarters Joint Operations Command at Bungendore near Canberra in the Australian Capital Territory was approved by the ADF.
- Defence WSO staff from Tindal and Williamtown were deployed to Alaska and Malaysia with RAAF squadrons providing meteorological support for exercises Red Shield and Bersama Shield.
- Defence WSO staff provided substantial forecasting support to the multinational exercise Talisman Sabre held at the Shoalwater Bay Training area near Rockhampton from late June 2007 extending into July.
- Geospatial satellite images and surface observation products were provided to the Navy and the Defence Science Technology Organisation in real-time on a trial basis in support of tactical operational planning requirements.

### **Contribution towards outcome**

- The new location of the DMSU within Headquarters Joint Operations Command positions it to provide the most effective service in meeting ADF requirements for meteorological services by having meteorologists working in conjunction with ADF tactical planners. This development will enhance the robustness of service provision by creating a tri-service weather centre covering all ADF operational requirements.
- The support for Australian squadrons on overseas exercises provided by Defence WSO staff contributes to the safety of aircraft operations and economy of missions through a timely and dedicated provision of weather conditions for each mission.
- Provision of specific tailored forecasts for exercise operations provides a safer exercise environment and more efficient, cost-effective use of deployed troops and operational equipment.
- The use of geospatial weather products improves the integration of weather data into ADF operational planning by allowing overlaying of current meteorological information on tactical operation maps, leading to safer operations for the ADF both within and outside Australia.



*Royal Australian Air Force (RAAF) personnel prepare a portable tactical automatic weather station for use by a Bureau meteorologist deployed with a RAAF squadron on exercise in Asia. (Photo courtesy of RAAF)*