

# CLIMATE SERVICES

Climate Services encompasses a range of activities: the management of meteorological and related data collected by the Bureau; the derivation of products from the data that describe Australia's climate; the development of techniques for applying the data in a wide range of social, economic and environmental contexts; and the provision of information and advice to the general public and specialist users about the nature of climate in general and Australia's climate in particular. Drought and climate change have both been major features of the Australian social and political landscape in recent years and the demand for related information and services has increased rapidly.

Meteorological and related data, obtained from observation networks, are quality controlled and archived in the national climate database and other related databases. These databases are available for the generation of products that range from copies of the basic climate data through processed data-sets to a diverse suite of climate summaries, atlases and specialised analyses. Products are made available in hard copy and computer-compatible forms for use in research, design, planning and other applications where there is sensitivity to variations in climate. As part of Climate Services, the Bureau also monitors short and long-term climatic fluctuations, including extremes such as drought and flooding rains, and issues predictions of seasonal climatic anomalies and projections of trends that affect the environment, agriculture and other weather and climate-sensitive sectors of the community.

Collaboration with other organisations is essential for the Bureau to fully understand the information needs of end-user decision-makers. Particular attention is given to communication strategies to help ensure that services are delivered effectively, including to the media. Due to the global nature of climate, the Bureau collaborates closely with international organisations, and especially with the climate-related programs of the World Meteorological Organization (WMO) and the National Meteorological and Hydrological Services of the Pacific region.

The climate-related components of Climate Services are coordinated by the National Climate Centre (NCC), located in the Central Operations Branch within Head Office, and are provided directly from the NCC, or through the Regional Climate Services Centres (RCSCs) and field offices around Australia.

The Analysis and Prediction component of Climate Services generates a wide range of products, mostly on a national scale, based on near real-time analyses of the state of the atmosphere and ocean and on computer-generated forecasts of the meteorological and oceanographic situation out to about eight days ahead. Users include the general public and private meteorological providers as well as Bureau units generating other services outputs such as Weather Services. The products are provided mainly through the National Meteorological and Oceanographic Centre (NMOC) located in Melbourne, and through the Regional Forecasting Centres in Darwin and Hobart. The Darwin office is designated a WMO Regional Specialised Meteorological Centre (RSMC).

## 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 present and future needs of the general public and specialised users for reliable, responsive, climate data, information, monitoring, prediction and advisory services.</p>
<p><b>Effectiveness indicators</b></p>	<p>The extent to which:</p> <ul style="list-style-type: none"> <li>• climate services contribute to: <ul style="list-style-type: none"> <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>- 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>• information and advice are accurate and timely;</li> <li>• user needs 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 receive, understand and make optimum use of the services and express satisfaction with the services; and</li> <li>• the data stored in the National Climate Centre (NCC): <ul style="list-style-type: none"> <li>- are appropriate in terms of types of parameters included;</li> <li>- comply with relevant national and international guidelines in respect of density, frequency and length of period of observations stored;</li> <li>- have been subject to appropriate quality control; are of acceptable quality; and</li> <li>- are stored optimally in terms of security and accessibility;</li> </ul> </li> <li>• the National Meteorological and Oceanographic Operations Centre (NMOC) provides reliable, timely analysis and forecast guidance products that impact positively on the quality of services; and</li> </ul>

<b>Effectiveness indicators</b>	<ul style="list-style-type: none"> <li>the NMOC and the Regional Forecasting Centres (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 effective warning services along with routine basic and special weather services.</li> </ul>
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## OUTPUTS 2007-08

Climate Services forms one of the Bureau’s eight Major Outputs and contributes to Output Group 1.3 - Meteorological and Related Services and Products.

Climate Services outputs include: a quality-controlled archive of Australian climate data in basic and processed forms; the provision of basic and processed climate data and information from that archive in various formats and on various media; routine Australian, southern hemisphere and global analyses of the monthly, annual and longer-term behaviour of climate; seasonal climate outlooks for Australia; information on climate change; and products describing the current and future state of the atmosphere and ocean in the Australian region up to eight days ahead.

### OUTPUT PERFORMANCE 2007-08

Output performance is measured against a number of quality, quantity and price targets. The results achieved for 2007-08 are provided below along with a commentary on significant variations.

Quality	Target	Actual
Percentage of users surveyed are ‘satisfied’ or ‘very satisfied’ with climate data services	85%	95%
Percentage of users surveyed are ‘satisfied’ or ‘very satisfied’ with consultative meteorological services	85%	95%
Percentage of regular observation entries into the national climate database successfully completed within preset quality control standards	96%	96%
Accuracy of Seasonal Climate Outlook (SCO) products as measured by SCO skill score	exceeds climatology (50%)	64%
Percentage of numerical guidance products delivered before the scheduled deadlines for dissemination	95%	99%
Percentage of users satisfied with the value of forecast guidance product components	90%	100%

Quality (cont.)	Target	Actual
Number of hours downtime per annum for mission critical software systems managed by NMOC, including the central real-time database	<5	2.8
Accuracy of centralised analysis and forecast guidance products as measured by statistical evaluation procedures:		
• gain in skill of 24-hour model forecasts over persistence (points)	30	37
• error in 24-hour statistical guidance for maximum temperatures (°C)	<3	1.7
• error in 24-hour statistical guidance for minimum temperatures (°C)	<2.5	1.5
• 72, 120 and 168-hour Anomaly Correlations	>75%, 50%, 40%	87%, 69%, 50%
• error in 24-hour sea-state predictions (m)	<0.7	0.52
<b>Quantity</b>		
Number of climate data, information, monitoring, prediction and advisory services provided	430,000	870,329
Number of consultative services provided	7,500	7,492
Number of groups of numerical guidance products issued by the National Meteorological and Oceanographic Centre (NMOC)	2400	2447
Number of NMOC systems providing distinctive guidance products	10	19
Number of telephone, facsimile and internet accesses to automated climate service delivery systems	3,000,000	7,448,966
<b>Price</b>		
Climate Data	\$8.572m	\$7.487m
Climate Monitoring Service	\$4.365m	\$4.989m
Analysis and Prediction Products	\$5.991m	\$8.748m

## **Comments on output performance**

The demand for Climate Services outputs continued to rise and was dominated by the increase in services accessed via the internet. This is consistent with the prominence of climate change and the continued dry period over large parts of Australia as major public issues in 2007-08, as judged from the degree of media attention afforded these topics.

The number of data and related services provided was well above the target and an increase on the previous year's total. The percentage of users satisfied with data services and consultative services was judged from feedback received via the Bureau's website and exceeded the target.

The percentage of regular archived entries into the national climate database that were successfully completed within preset quality-control standards was on target at 96 per cent.

The seasonal outlook service produced more accurate predictions than would have been the case had it been based solely on climatological information. This is consistent with verifications of the service over the past several years, which have shown useful levels of accuracy in both seasonal temperature and rainfall predictions.

Numerical guidance products were delivered on time and at levels of reliability and user satisfaction which were above the targets. The accuracy of centralised forecast guidance products continued to improve and also exceeded the targets set.

The discrepancy between target and actual prices for the Analysis and Prediction Products output was a result of a number of adjustments to the Bureau's internal organisation and program structure made during the year, the net effect of which was an increase in the resources, including staff, attributed to this output.

## **ACHIEVING THE OUTCOME**

Climate Services is delivered through the Climate Data, Climate Monitoring, and Analysis and Prediction outputs. The major developments in these output areas and their contribution to outcomes in 2007-08 are considered below. Climate Policy activities are also described.

### **OVERVIEW OF 2007-08**

The climate during the year as usual provided context for the activities associated with this Major Output. A La Niña event developed in late 2007 following the decay of the 2006-07 El Niño event. While the La Niña was associated with good rainfall and indeed flooding in northern New South Wales and several regions in Queensland, it was relatively short lived, and very severe and extended rainfall deficiencies continued over large areas of the continent for the remainder of the year. Special briefings were provided by the NCC and RCSCs to State and Federal agencies, including those involved with water management, while the community more generally was kept informed through regular product updates, numerous media interviews, and a wide range of talks, seminars and training courses.

The increasing awareness of climate change and related environmental issues is consistent with an increase in the demand for access to and application of meteorological data, particularly by research organisations, the renewable energy sector and local and State government agencies. The Bureau has responded to this increased demand by focusing on the

development of interactive online systems for data provision and by continued improvement and automation of database access systems. In addition, there has been a greater focus on providing value-added services to both general and specialist users, such as gridded datasets of meteorological parameters for Australia for use in modelling, and suitability analyses used to identify the most favourable geographic locations for new initiatives within the agricultural sector and the energy industry.

The production of special climate statements continued to meet the Australian community's demand for concise factual data relating to significant events where there is a notable departure from expected climatic conditions, together with explanation of the underlying causes. Two such statements were produced during the year, in November, covering the extended drought across southern and eastern Australia, and in March, for the heatwave which occurred over the southeast of the country.

Progress was also made with transferring historical data from paper records to digital format for inclusion in the climate database - see Figure 25.

Significant involvement continued in international activities, including contributions to major monitoring and prediction statements and publications such as WMO statements on the status of the global climate and on El Niño, and the Annual Global Climate Summary published by the American Meteorological Society. The Bureau remained active in programs of the WMO concerned with the establishment of international standards for climate data management and quality control, which are aimed at ensuring the reliability of the global climate record. Major contributions to climate-related activities in the South-West Pacific region included involvement in the monthly Pacific Island Climate Update teleconference, the production of monthly South Pacific Seasonal Outlook Reference Material, which describes the current state of the climatic conditions in the Pacific region and expected developments based on broadscale patterns, and the continuation of the Pacific Islands - Climate Prediction Project. This project is helping to build capacity in national meteorological services throughout the South-West Pacific region so that they are better equipped to assist their communities to cope more effectively with climate variability and climate change.

Australia's high level of commitment to engagement in international collaborative activities in operational climatology has contributed to its reputation for excellence in this important area of global interest, and the nation has additionally benefited through the improved access to world class climate modelling systems and data which results from this collaboration. The growth in targeted capacity-building activities by the Bureau in the South-West Pacific enables Pacific Island Countries to more effectively manage risks associated with weather and climate and is part of a broader range of capacity-building activities, which is covered in the International Meteorological Activities chapter of this report.

Significant improvements were made to the two major numerical weather prediction models used by the Bureau and also to the coupled ocean-atmosphere model developed by the Bureau and used for seasonal prediction.

## **CLIMATE DATA**

Climate Data covers the archival, management and quality control of meteorological data, as well as the provision of client-focused services to a broad range of users, including government, industry, research and the general public.

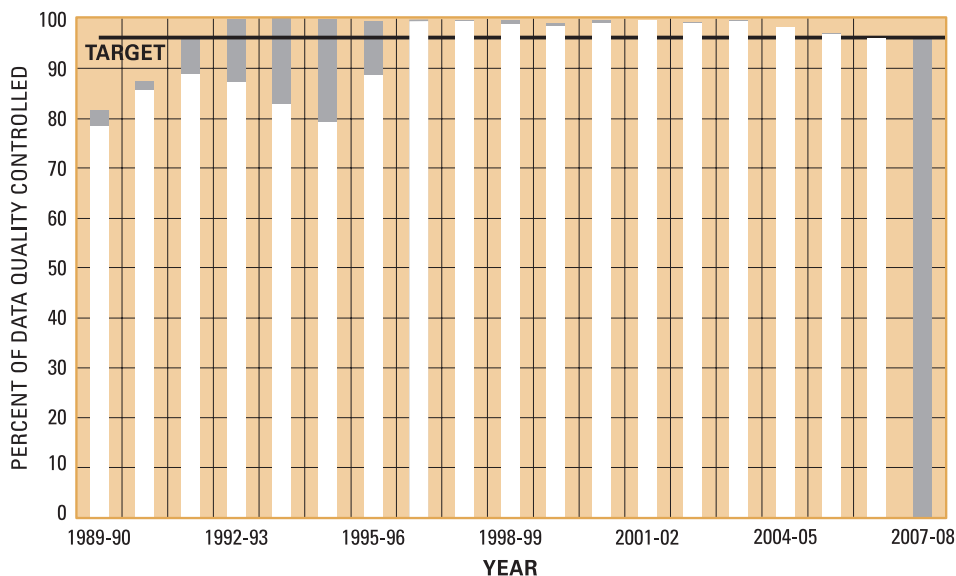


Figure 25. The percentage of regular archived entries into the national climate database that were successfully completed within preset quality-control standards (target is 96 percent, as indicated by the black line). In the past year efforts have been made to key in data from previous years (1989-96) not previously digitised. The shading shows the change from last year's graph.

Data archival and management is focused on the collection, storage and quality control of observed meteorological and related data. Meteorological observations, and a number of derived data and products, are stored in the national climate database, known as the Australian Data Archive for Meteorology (ADAM). These data are subject to various levels of quality control depending on their quantity and type. The data bank continues to expand in both volume and data type, and this expansion will continue in line with technological developments, funding opportunities and through network extensions.

General and specialist services to the Australian community include the provision of raw and analysed data as well as mapped information and user-specific advisory and consultative services.

**Major developments 2007-08**

- A partnership with the Department of Climate Change (formerly the Australian Greenhouse Office) has seen the completion of the Coastal Digitisation Project involving the computerisation and transfer into the ADAM database of shipborne meteorological observations recorded in ship log books and selected land-based coastal meteorological observations, extending the available historical time series of meteorological data.
- Development continued on an enhanced Quality Monitoring System which improves the Bureau's data quality-control procedures for identifying erroneous data in the climate database, and the system was implemented operationally during the year.
- The Bureau extended its assistance to Pacific Island Countries in the identification,

preservation, storage and digitising of climate data, through the placement of a database management system into an additional four Pacific Island nations – the Cook Islands, Tonga, Niue and Tuvalu. As in previous years, this work was done in collaboration with New Zealand’s National Institute of Water and Atmospheric Research and with the financial support of the Department of Climate Change (formerly the Australian Greenhouse Office) and the Australian Agency for International Development (AusAID).

- Building on the previous year’s developments in online data provision, interactive access for the public via the Bureau’s website was provided to time series of monthly historical rainfall datasets and confirmation reports for strong winds and thunderstorms. The new rainfall system enables the community to freely access all available years of monthly rainfall data from more than 10,000 rainfall stations across Australia (see example at Figure 26). A dynamic graphing capability was also made available on the website for graphing and visualisation of the historical data. The reports of strong winds and thunderstorms, available by subscription, provide storm-related confirmation information for major population centres in New South Wales, Queensland and Western Australia.
- A new data access tool for the marine community was developed which facilitates the extraction of marine observations recorded by ships and buoys. This tool has been integrated into the Bureau’s internal database access system for use by staff answering requests for data from external users.
- Preparatory work was completed for an update of the *Climate of Australia* publication. This major climate publication is produced from time to time by the Bureau and provides the community with a wealth of reference climate information, including a range of climate maps, statistical datasets and explanatory information. The revised version will incorporate updates and significant enhancements to the previous version (published in the 1980s).
- The Bureau’s suite of mapped climatological products was enhanced through the update and development of a number of standard climatological data-sets for Australia. The cover various periods of time and statistical quantities as appropriate for the parameter being mapped. The existing lightning (two map sets), tropical cyclone (four map sets) and solar exposure (13 map sets) products were updated to include more recent data, and a new rainfall percentages product (24 map sets) was implemented which shows the proportion of rainfall occurring in each month and season across Australia. These mapped products are readily available through the Bureau’s website and the full gridded datasets in GIS-compatible format are available on request from the Bureau.


### **Contribution towards outcome**

- The digitisation of historical data from coastal sites and ship log books supports the assessment of risks to coastal areas from climate change by increasing the availability of the data to a wide range of users. In addition, these digitised data are a valuable resource for scientific studies and ultimately for government policy formulation.
- The Quality Monitoring System allows users of these data-sets to more effectively identify the suitability of the data for their particular applications. Improved products and services based on the higher-quality data will enable users to make better informed weather and climate-related decisions.

## Monthly rainfall

### HOBART BOTANICAL GARDENS

About Monthly Rainfall
  Data file (csv)
  Print file for this site (pdf)
  Site information menu

Site name: HOBART BOTANICAL GARDENS	Site number: 24239	Commenced: 1941	
Latitude: 42°37'S	Longitude: 147°35'E	Elevation: 37 m	Operational status: Open

Rep: Units are millimetres, 12.2 = 1 inch (quality controlled)

Highlight data in table:  no highlight
  Period for calculating statistics:  All years
  1951-1999

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Pos	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
1941	0.0	78.7	8.4	29.2	12.0	21.2	20.7	33.0	20.9	91.2	44.0	7.9	354.1
1942	48.0	26.7	1.8	20.8	83.1	112.0	87.0	26.1	37.4	49.2	148.3	2.8	686.4
1943	14.0	2.8	0.0	49.8	2.0	48.9	75.4	27.7	76.1	77.5	43.0	14.7	541.0
1944	51.1	8.0	49.0	27.4	50.9	69.0	53.8	29.5	101.4	65.3	39.6	5.9	606.0
1945	14.7	48.0	28.4	0.1	78.2	108.0	18.2	10.0	18.0	20.2	90.2	9.9	422.7
1946	30.1	87.1	34.0	68.1	55.0	58.2	88.9	58.9	20.8	49.9	72.9	29.0	558.0
1947	10.0	1.8	67.8	44.2	37.8	14.0	43.0	15.0	0.0	44.2	68.1	13.0	367.1
1948	26.4	20.1	20.0	93.0	111.3	28.4	01.7	67.8	48.7	32.3	102.0	59.0	609.0
1949	18.2	25.9	99.2	27.1	37.0	57.2	107.9	99.9	49.0	20.9	227.1	22.9	807.9
1950	20.0	27.9	7.4	60.0	14.0	17.0	7.0	32.9	42.4	0.0	109.9	10.0	288.0
1951	88.2	14.7	18.8	4.0	83.8	80.7	29.7	27.0	84.0	29.1	106.4	42.0	488.7
1952	31.1	4.0	7.9	126.7	37.1	0.0	79.0	80.1	91.0	40.0	35.0	51.9	800.0
1953	36.2	26.2	20.2	20.0	20.0	8.9	12.0	22.1	73.9	00.0	12.0	12.2	368.9
1954	12.7	232.4	193.0	69.1	21.0	8.4	8.4	0.0	48.2	44.2	80.0	41.1	770.0
1955	27.0	28.0	18.8	14.9	114.6	47.8	58.8	78.0	82.2	86.0	46.8	73.8	676.6
1956	80.7	40.0	60.0	10.7	40.1	42.4	27.7	54.0	40.0	60.0	53.0	24.2	633.0
1957	80.0	18.0	0.4	4.0	42.9	21.2	11.2	69.1	21.2	25.9	23.1	82.9	457.4
1958	46.2	20.0	79.0	19.0	20.2	32.0	17.2	22.4	100.0	24.4	223.8	39.7	650.6
1959	74.7	82.0	21.8	60.0	41.4	3.0	14.8	54.4	21.2	74.8	68.8	13.0	664.4
1960	80.7	12.7	80.0	10.0	28.4	27.0	80.1	0.0	70.4	26.1	32.8	20.2	471.7
1961	29.2	2.0	22.1	72.9	20.2	0.0	20.0	20.2	11.7	20.4	40.0	22.4	294.9
1962	62.1	20.2	12.0	64.1	22.8	217.0	48.8	14.0	22.4	10.0	97.0	66.7	776.1
1963	17.0	86.0	13.0	42.1	29.4	141.8	61.3	83.8	22.8	80.1	13.8	27.1	900.1
1964	67.9	11.0	20.4	20.0	60.2	34.2	87.1	29.7	0.1	42.8	48.0	62.0	622.6
1965	51.0	0.0	21.0	40.2	90.2	44.7	49.0	0.4	37.9	23.9	26.1	40.0	447.4

Figure 26. An example of monthly historical rainfall information, available for more than 10,000 stations, which is readily accessible through the climate area of the Bureau's website (<http://www.bom.gov.au/climate/averages/>).

- Supporting Pacific Island Countries in data management and 'data rescue' efforts assists them to better manage their meteorological records and thereby to contribute more effectively to regional and global climate monitoring efforts which also benefit the Australian community.
- The community's access to, and effective use of, recent and historical meteorological data are improved through the development of online data and information delivery systems. These highly accessible updated datasets and information tables support decision-making processes for general users in the community as well as specific industry groups such as the Australian insurance sector. Subscribers to the strong wind and thunderstorm reports can use them to quickly assess the occurrence and severity of storms at locations of interest.
- The efficient intranet-based data retrieval tools for ocean and coastal data allow Bureau staff to quickly provide these types of information to both general and industry-specific users in the marine community, thereby contributing to maintaining the safety and well-being of Australians working in the maritime environment.



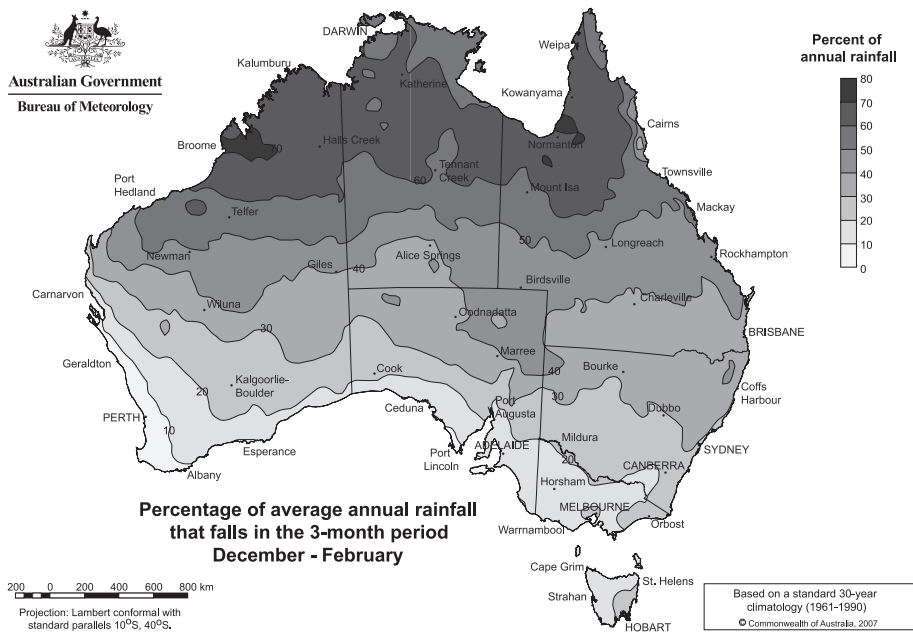
*Bureau personnel have played a key role in assisting preservation of climate data under the Pacific Island Countries climate 'data rescue' project'.*

- Reference climate publications provide a resource for the Australian community, raise general awareness and knowledge of the Australian climate and contribute to understanding and effective use of meteorological and related services by many sectors of the community.
- Standard climatological data-sets support effective analysis and research by public sector and industry users. Their availability in electronic formats provides users with a choice of access methods for this base-line climate information. An example of the new rainfall percentages maps is shown at Figure 27.

### **CLIMATE MONITORING SERVICE**

The Climate Monitoring Service covers the monitoring and prediction of climate, including its variability from year to year and change over longer periods of time. The service provides a real-time climate watch for Australia and its surrounds, including the Pacific and Indian Oceans. The emphasis is on extreme climate events, such as El Niño-related drought, which have substantial social, economic and environmental costs. Data from the Bureau's national observation network form the primary basis for this service, augmented by a range of national and international remotely sensed data-sets. The Bureau's ADAM database is central to the Bureau's climate monitoring activities, providing the means for accessing both historical and current climate data for Australia.

Climate change remains of high importance to this output, and is now clearly evident in the recent trends observed in the climate record of Australia. Data-sets and analyses relevant to climate change are updated in near real-time, allowing monitoring of climate variability and change over the country to be based on all available data including those recently



*Figure 27. New maps of rainfall provide a percentage comparison of monthly or seasonal rainfall with annual rainfall. These are available as high-resolution maps or in GIS-compatible format.*

collected. A key area of activity is the production of high-quality data-sets, which form the core information base for climate change analyses and allow short-term climate variations and recent extreme climate events to be placed in a long-term context.

The Bureau continues to produce seasonal outlooks of climatic conditions. A national Seasonal Climate Outlook is published every month, which gives the likelihood of warm or cool, and wet or dry conditions based on statistical analyses. The Bureau's coupled atmosphere-ocean climate model, the Predictive Ocean Atmosphere Model for Australia (POAMA), is used to provide long-range forecasts of the likely evolution of oceanic conditions and large-scale climate drivers such as the El Niño/La Niña phenomenon in the Pacific Ocean. The value of this modelling system has been demonstrated in recent years by, for example, an excellent forecast at long lead-time of the development of the 2007 La Niña event.

The Climate Monitoring Service output is primarily delivered through the Climate Analysis subsection of the NCC, but with some significant contributions from the RCSCs.

### Major developments 2007-08

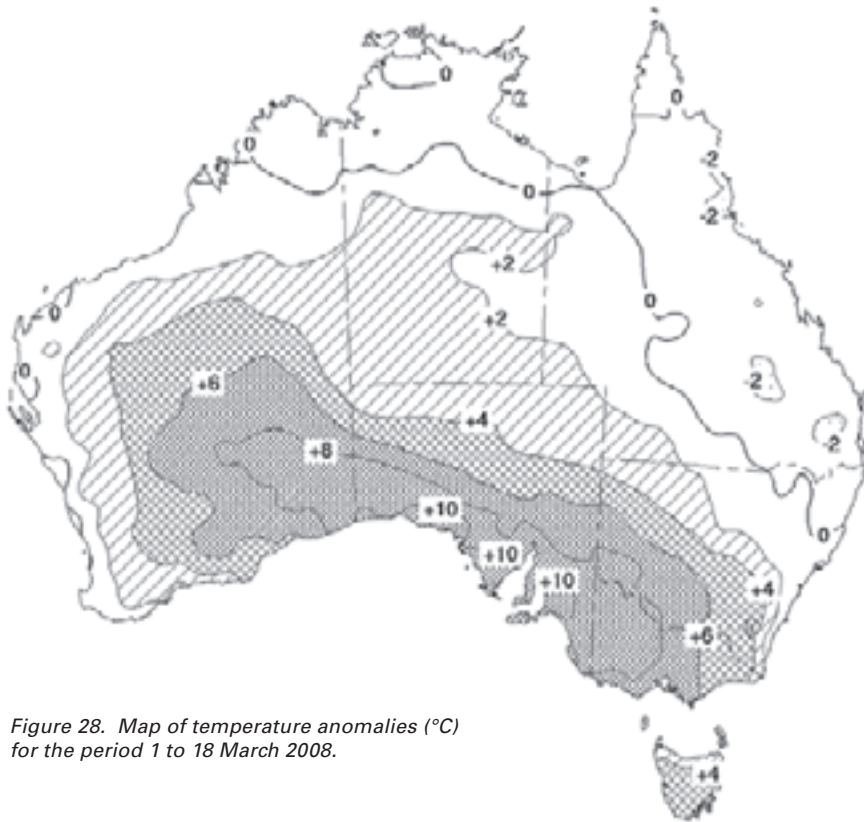
- The slow development of a La Niña event through 2007 following the decay of the 2006-07 El Niño event placed additional demands on the Climate Monitoring Service in forecasting climate developments through the year and promulgating related information to the community. Special reports were produced on particular aspects of the unfolding event over Australia and specific briefings were provided to State and Federal agencies includ-

ing water managers. The general community were kept informed through regular product updates, numerous media interviews and the Bureau's participation in talks, seminars and training courses.

- Improved spatial analyses and products generated by innovative analysis methods and fusion of data from various sources including satellites were trialled for Australia. The new analysis methods were run in quasi-operational mode and the results provided on a trial basis to registered users and researchers in universities, the CSIRO and the Bureau, testing the utility and robustness of the new systems. These improvements have been largely undertaken within the Australian Water Availability Project, a collaborative effort of the Bureau of Meteorology, the CSIRO and the Bureau of Rural Sciences. The resulting data-sets are substantially more detailed and accurate than those produced previously.
- A revised set of climate extremes for Australia which has undergone additional quality control was prepared for use, in particular, in the production of special climate statements. A map showing maximum temperature anomalies for southern Australia's 'heat-wave' in March is at Figure 28.
- A new version of the coupled atmosphere-ocean climate model POAMA was introduced into operations. This model has higher skill for the prediction of the El Niño/Southern Oscillation phenomenon and also promises some skill for the prediction of rainfall and temperatures over land areas in Australia.
- Further development of the Bureau's Water and the Land (WATL) website pages encompassed the addition of a suite of educational tools describing the main weather and climate drivers for Australia. The WATL pages combine weather forecast and climate information in a coherent website package for primary industries and natural resource management. Funding agencies such as the Managing Climate Variability program have supported the implementation of upgraded monitoring, weather forecast and seasonal outlook information through the website.

### **Contribution towards outcome**

- Special reports and briefings and other forms of communication about climate developments contribute to meeting the urgent need for greater community understanding of climate variability and change at a time when issues surrounding the drought, El Niño and climate change are of critical importance. They also assist in the planning and management of climate-sensitive sectors and industries and in better informing government policy development.
- More accurate and timely climate analysis products from the Australian Water Availability project will contribute to improved climate monitoring over Australia, especially of the emergence and course of drought conditions.
- Extreme events which are outside current climatic expectations or unseasonal can be costly and damaging, and may reflect broader-scale shifts in the climate system. Better reporting, documenting and understanding of these events provides the community with important background information in identifying sectors which are sensitive to climate, as well as a basis for improved planning and management of future such events.
- The potential for more timely and accurate forecasts of El Niño and La Niña events through upgrades of POAMA provides an improved foundation for increased preparedness for, and



*Figure 28. Map of temperature anomalies (°C) for the period 1 to 18 March 2008.*

better management of, climate variability and change by many sectors of the community.

- The new educational tools on the WATL website were developed in response to feedback received via the site itself and via consultative mechanisms with such organisations as Land and Water Australia. They assist users of the site to better interpret the products presented, including some of the terminology used, and hence to make more effective use of these Bureau products.

## **ANALYSIS AND PREDICTION PRODUCTS**

Analysis and Prediction products flow from the basic meteorological operations of: analysis of real-time datasets to establish the current state of the atmosphere and oceans; and subsequent prediction of their evolution out to about seven days ahead. These operations are essential to the provision of weather, climate and oceanographic services and contribute to fulfilling Australia's international obligations under the Convention of the WMO. The NMOC in Melbourne, the RSMC 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 to produce a range of manual and automated guidance products which support 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 which generate information on current or predicted conditions in the atmosphere or the ocean, with differing emphasis according to the various applications. Figure 29 shows the improvement in the prediction skill of the numerical models over time.

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

- The Bureau's four main computer-based weather prediction models were upgraded during the year. The upgrade comprised an increase in the vertical resolution used in the Australian region, tropical region and global models, and a doubling of the frequency of model runs (to 6-hourly) for the high-resolution mesoscale model.
- The ocean forecasting system, OceanMAPS (Ocean Model Analysis and Prediction System), was implemented as part of the BLUElink project, providing forecasts of ocean currents, salinity and temperature out to seven days ahead for ocean waters surrounding Australia and its islands and territories.
- The coupled ocean-atmosphere model POAMA, used for seasonal climate predictions, was upgraded with a new initialisation scheme and improved representations of the physics of the wind-water interface.
- A new version of the Operational Consensus Forecast (OCF) system, which provides high-frequency (up to hourly) forecast guidance for temperature, humidity, pressure and cloud cover at regular grid-points across all of Australia, was brought into routine operations.
- The On-Screen Analysis (OSA) system was implemented in the Darwin RSMC, allowing the generation of weather charts showing surface pressure patterns over the area to the north of Australia in a form compatible with the surface pressure charts covering Australia and the Southern Ocean which are already produced by the NMOC using the OSA system.

### **Contribution towards outcome**

- Improved resolution and frequency of runs to the weather prediction models increased the accuracy of the guidance provided to Bureau forecasters and other users, resulting in better weather forecasts and warnings for the Australian community. The increase in model quality is demonstrated by Figure 29.
- The OceanMAPS forecasts of ocean conditions constitute new products not previously available which assist the Royal Australian Navy, the fishing industry and research scientists to achieve greater efficiency in their operations in the waters around Australia.
- The seasonal climate predictions generated by POAMA are an important input to drought and water resource planning for Australia. The new version of the model provides more accurate predictions of the state of the El Niño/La Niña phenomenon which will better support effective decision-making by users.
- The gridded OCF system is a vital step in the development of the Graphical Forecast Editor project and offers potential for providing Australians with more localised weather forecast information for a greater number of localities with longer lead times than is currently available.
- The tropical analysis charts generated by the Darwin centre are produced electronically



Figure 29. Values for the S1 skill score, a measure of the errors in prediction (lower score indicates higher skill), for 24-hour forecasts of mean sea-level pressure from operational and persistence prognoses over the Australian region. The values shown are 12-month running means. The persistence predictions, based on the assumption that today's pattern will continue unchanged tomorrow, show relatively large errors and no long-term trend. The original base analysis used for verification purposes has been discontinued. The results during the overlap period show a slight shift in the measure of skill, but the trends are similar.

rather than being prepared by hand, resulting in a product which can be reproduced on web pages at higher quality, and saving staff time. Analysed features shown on the charts, such as fronts and high and low pressure centres, can be transferred from the charts produced by other offices, leading to greater consistency in analyses across border areas. The charts are utilised within Australia and by neighbouring countries to the north, and contribute to meeting the Bureau's obligations under the Convention of the World Meteorological Organization to produce meteorological analyses for a designated area of the globe.

## CLIMATE POLICY ADVICE

Climate variability and change have significant consequences for Australian society, the environment and the economy. The Bureau participates in numerous national and international activities and interactions that generate policy advice to government on climate variability and climate change, including high-level briefings to Ministers, Ministerial Councils and their supporting committees, and to other State and Federal government departments, on climatic conditions and outlooks and climate-change related issues. Such activities inform decision-making on national priority areas such as drought and climate change, and thereby contribute to government planning and the development of policy and responses.

More specifically, the Bureau contributes information and advice to governments through face-to-face briefings of bodies which are part of the Council of Australian Governments process, such as the Primary Industries Ministerial Council and the Natural Resource Man-

agement Ministerial Council, and is represented on several of the subsidiary groups established under these inter-jurisdictional structures. It also provides regular reports to other bodies such as the Murray-Darling Basin Commission.

In addition, the Bureau informs policy through involvement in government inquiries and the development of plans for climate-sensitive sectors of the economy. Indirectly, advice is also given through background material contained in proposals made to funding initiatives managed by agencies such as the Department of Climate Change (formerly the Australian Greenhouse Office) and AusAID, as well as through the implementation of funded projects.

Many Commonwealth and State Government agencies regularly use the Bureau's climate data and products in their development of policy as well as in carrying out their operational functions. In particular, the Bureau works with the Bureau of Rural Sciences in providing routine inputs to drought monitoring and the related Exceptional Circumstances process, which has served as a major basis for decisions on the distribution of government funding for drought relief. The Bureau's Regional Offices engage with State and Territory government agencies on climate matters through consultative committees or regular seminars. In addition, the Bureau collaborates with the Department of Climate Change (formerly the Australian Greenhouse Office) and CSIRO to develop and implement the scientific agenda for climate change research as well as the communication strategies for informing governments and industry of the results of that research.

At an international level, the Bureau contributes strongly to climate policy initiatives on several fronts. The Bureau has a seat on the Management Committee of the WMO Commission for Climatology and scientific input is also provided on climate change issues through Australia's negotiations under the UN Framework Convention on Climate Change (UNFCCC), specifically, involvement in discussions of the UNFCCC Subsidiary Bodies focusing on Climate Change Research and Systematic Observations. The Bureau also actively supports the Global Climate Observing System (GCOS) and, in collaboration with climate organisations elsewhere in the Pacific, assists in the implementation of the Pacific Island GCOS initiative.

The Bureau also makes a very significant contribution to the activities of the Intergovernmental Panel on Climate Change (IPCC), continues to coordinate Australian efforts to further develop the Global Earth Observation System of Systems initiative and provides a coordinating role for climate science and monitoring projects being proposed and implemented under various climate bilateral partnerships, including those with the US, New Zealand, the European Union, Japan and China.