PUBLIC WEATHER SERVICES

- Warnings and forecasts in a timely, reliable and comprehensive manner - ensuring the safety of life, the protection of property and the well-being of their nations' citizens; and

- Forecasts and other information on weather- and climate-related events that are a vital component in the decision making processes for many weather-sensitive sectors, as well as for disaster management.

Water Management -The need for reform

- Continually increasing demand;
- Insecure urban water supplies;
- Reduced certainty to water entitlements → increased investment exposure;
- Immature water planning – including for environmental needs;
- Gaps in knowledge
    - Deficiencies in measurement, metering, accounting;

The need for reform….

- Underdeveloped markets;
- Lack of consistent standards;
- Entrenched tensions between production and environmental users; and
- Disparate progress in water reform below the national level (e.g. local, regional levels).

Water Management Objectives

- Secure access to entitlements
- Statutory based water planning
- Provision for environmental and other public benefit outcomes
- Environmentally sustainable levels of extraction
- Removal of barriers to trade – facilitate market development

Water Management Objectives …

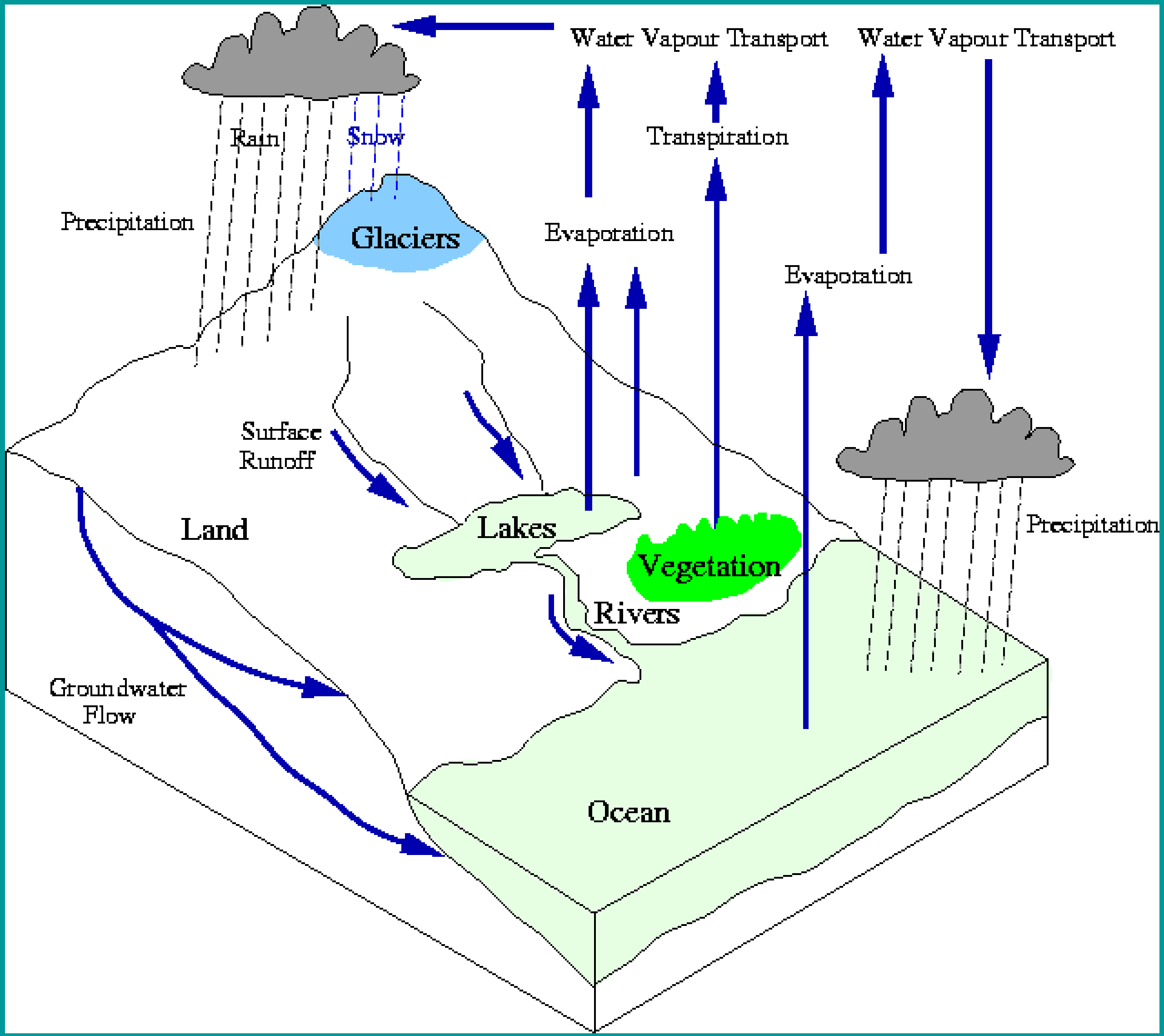
continued

- Clarity around the allocation of risk
- Water accounting to meet information needs of planning, monitoring, trade, environment
- Enhanced urban and rural water use efficiency
- Recognition of connectivity between surface and ground water
- Addressing future adjustment pressures on communities

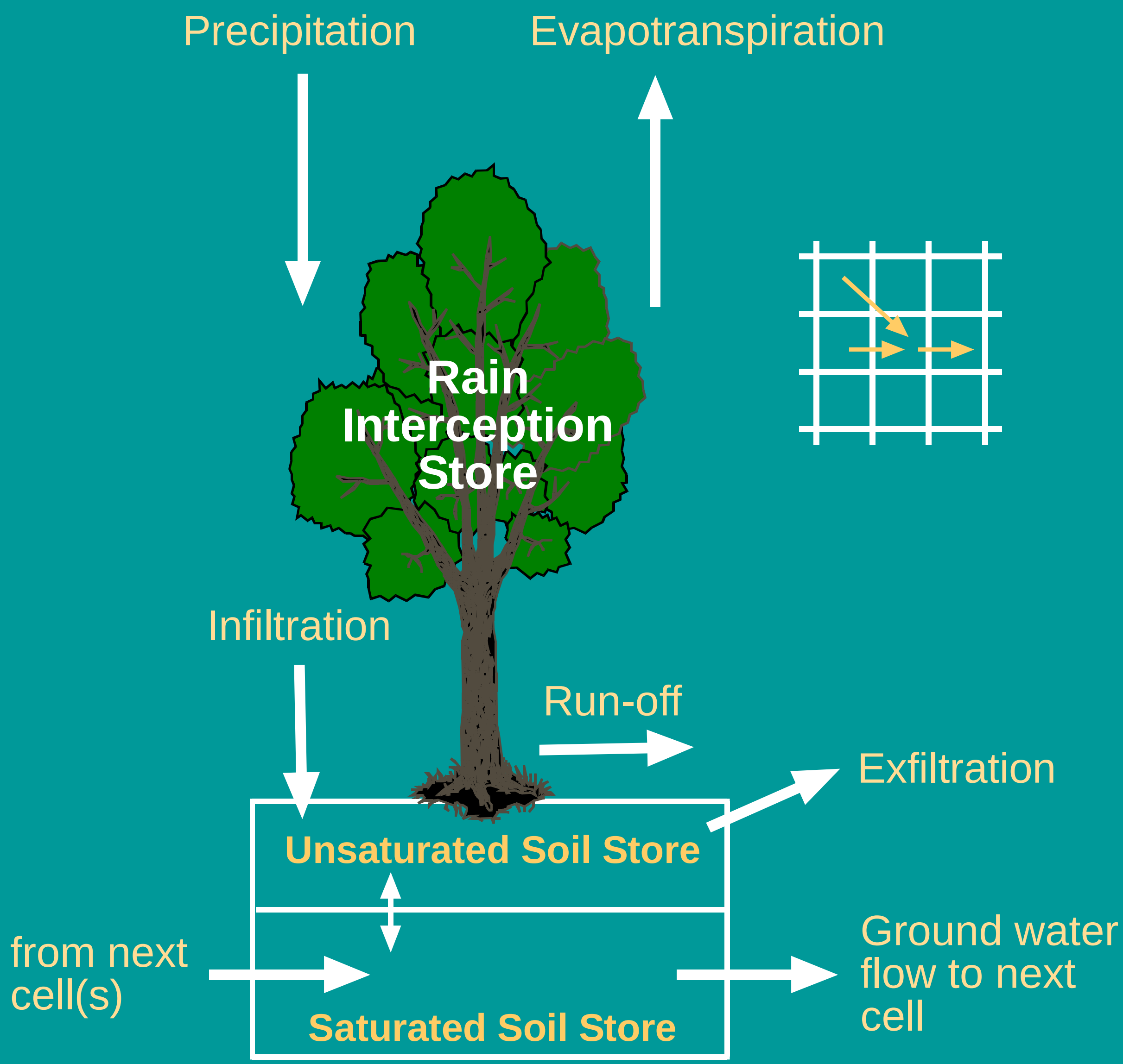
Field of application	Hydrological element needed	Meteorological element needed	Type of input Meteorological data	
			Time scale	Space scale
Data processing, plausibility check of hydrological data	runoff	precipitation	d, m	s, a
Water balance (non real-time)	runoff evaporation soil moisture groundwater	precipitation radiation sunshine duration[1] air temperature[1] air humidity[1] windspeed[1]	y, m, d d, m d, m d, m d, m d, m	a s, g s, g s, g s, g s, g
Simulation of time series (non real-time)	runoff groundwater water temperature dissolved matter[2]	precipitation radiation air temperature air humidity	y, m, d d, m h, d, m	a s, g s, g
Extreme value statistics of floods and low flow (non real-time)	runoff water level	precipitation	y, m min, max	s
Forecasting (real-time)	runoff water level snow cover, water equivalent of snow snowmelt soil moisture	precipitation radiation air temperature	h, d d h, d h, d	s, a s, a s s

s = point values a = areal values g = grid values
y = annual values m = monthly values d = daily values
h = hourly values min = minimum values max = maximum values
1 = meteorological elements needed for calculation of evaporation
2 = averages of selected weather situations (dry and wet weather conditions)

ACTIVITY		Rainfall	Water Level	Stream Discharge	Water Quality
Water Resources Management	Water allocation policy	X	X	X	X
	Water resources planning	X	X	X	X
	Land-water relations	X		X	X
	Impact of climatic changes	X		X	X
	Riparian rights			X	
Land Resources Management	Forests	X		X	X
	Agricultural lands	X		X	X
	Mining	X	X	X	X
	Land zoning		X	X	X
	Flood plains	X	X	X	X
Environmental Management	Estuaries	X	X	X	X
	Wetlands & lakes	X	X	X	X
	Rivers	X	X	X	X
	Waste disposal	X		X	X
	Pollution control	X		X	X
Primary Industry	Agriculture	X	X	X	X
	Forestry	X	X	X	X
	Fisheries		X	X	
	Mining	X	X	X	X
	Land drainage	X		X	X
	Soil conservation	X	X	X	
Power	Hydro-electricity	X	X	X	X
	Thermal power			X	X
Water Supply	Drought	X		X	X
	Irrigation	X		X	X
	Commercial/domestic	X		X	X
	Industrial/stock and rural	X		X	
Transport	Roads (rural and urban)	X	X	X	
	Railways	X	X	X	
	Navigation		X	X	
	Airports		X		
Flood Mitigation	Channels/levees	X		X	
	Reservoirs/retarding basins	X	X	X	X
	River bank protection	X	X	X	X
	Flood forecasting	X	X	X	
Other	Defence	X	X	X	
	Construction (contract admin)			X	
	Insurance			X	
	Research/education	X	X	X	X
	Recreation	X	X	X	X


Water Vapour Transport
Water Vapour Transport
Rain
Snow
Transpiration
Precipitation
Glaciers
Evaporation
Evaporation
Surface
Runoff
Lakes
Precipitation
Land
Vegetation
Rivers
Groundwater
Flow
Ocean

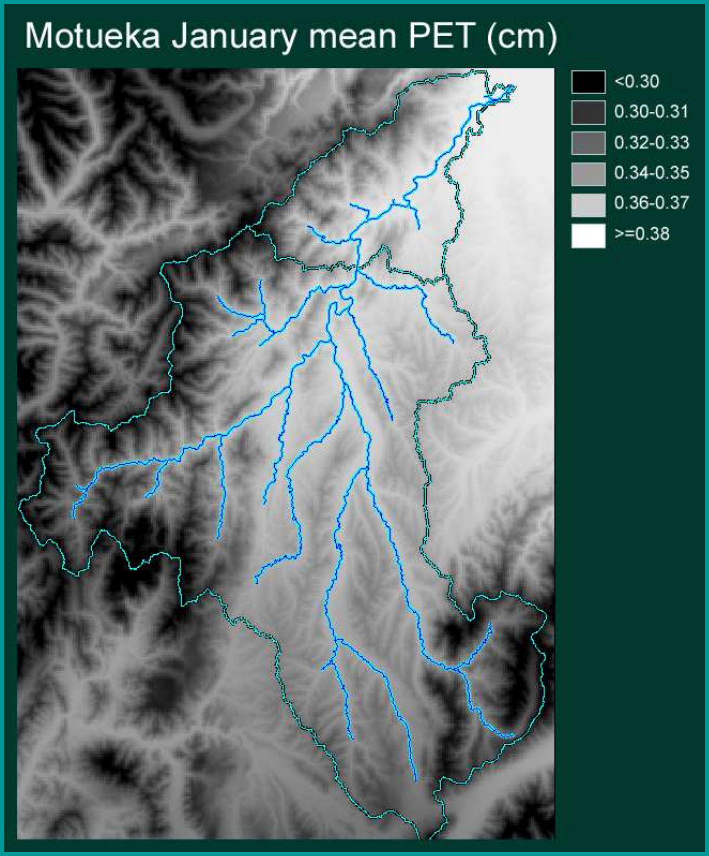
The Hydrological Model

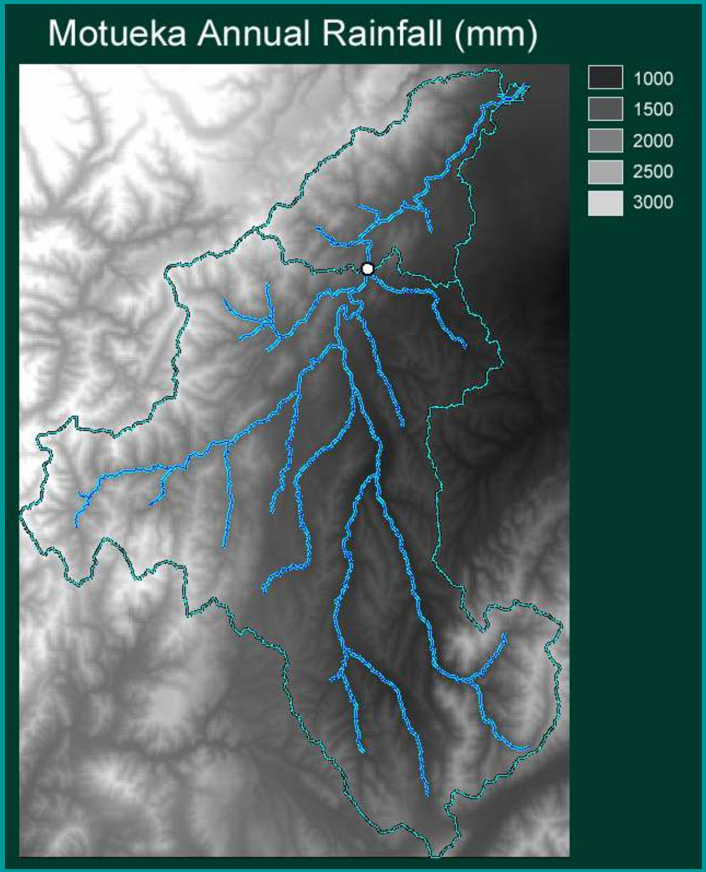


Climate Averages

Affect evapotranspiration and rain interpolation

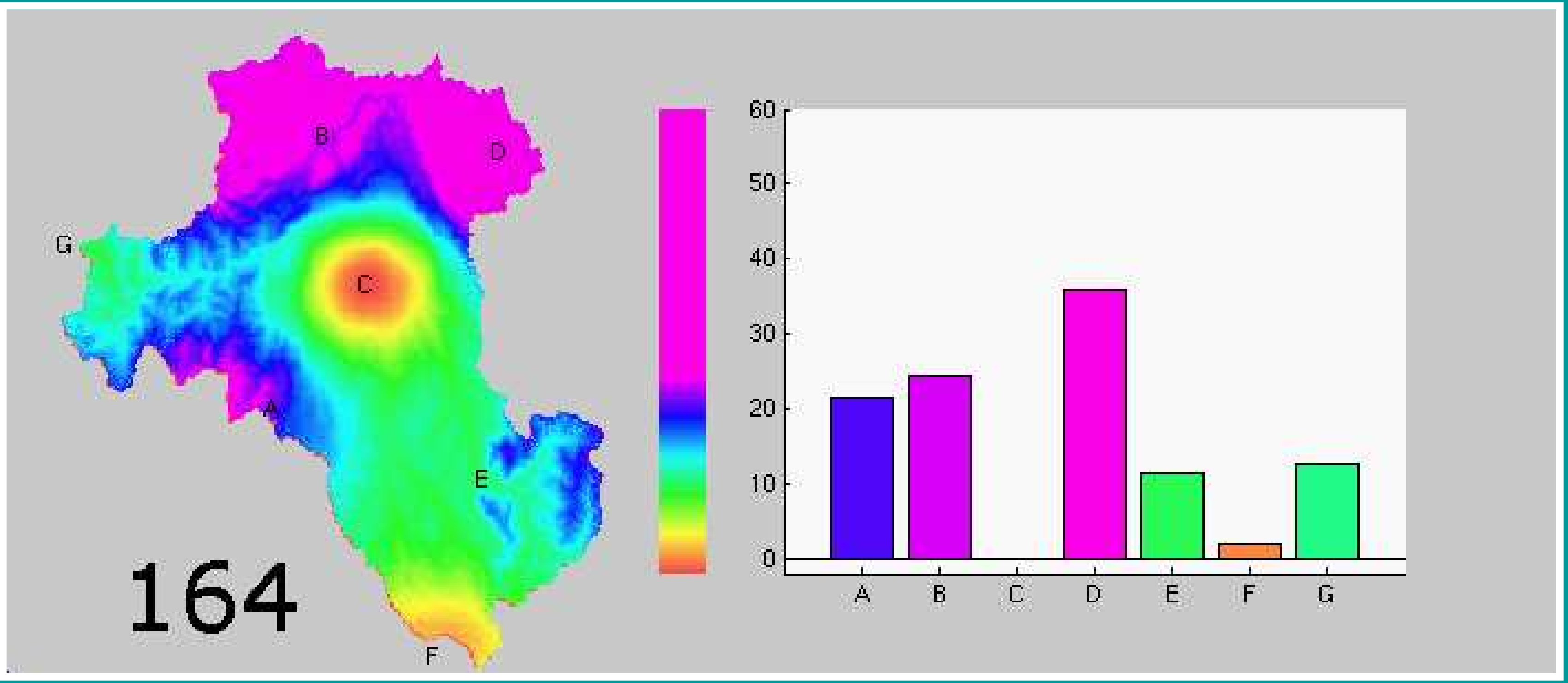
Source: Splines surfaces fitted to long-term climate data (John Leathwick, Landcare Research Ltd, Hamilton)





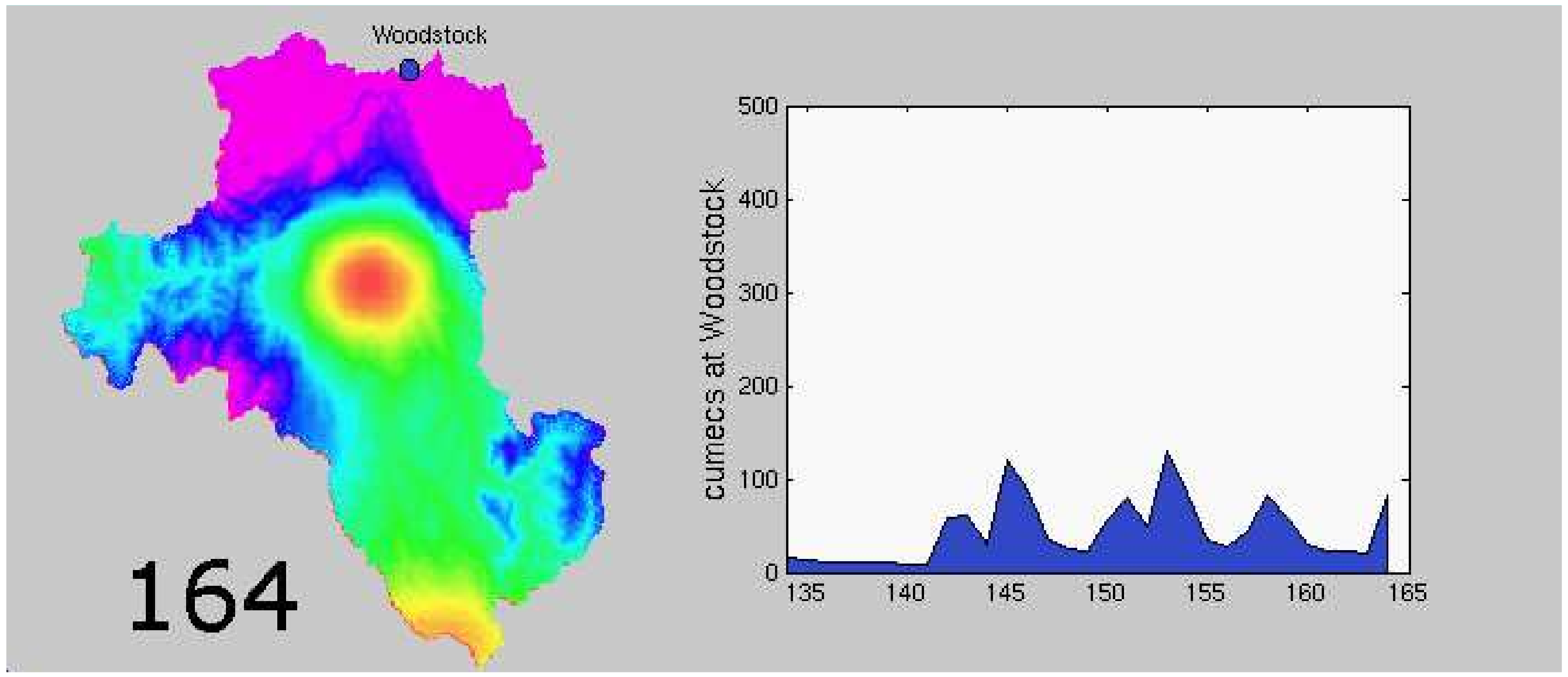
Daily Rainfall

- Interpolated dynamically from daily gauge station data
- Weighted by distance from stations and mean annual rainfall

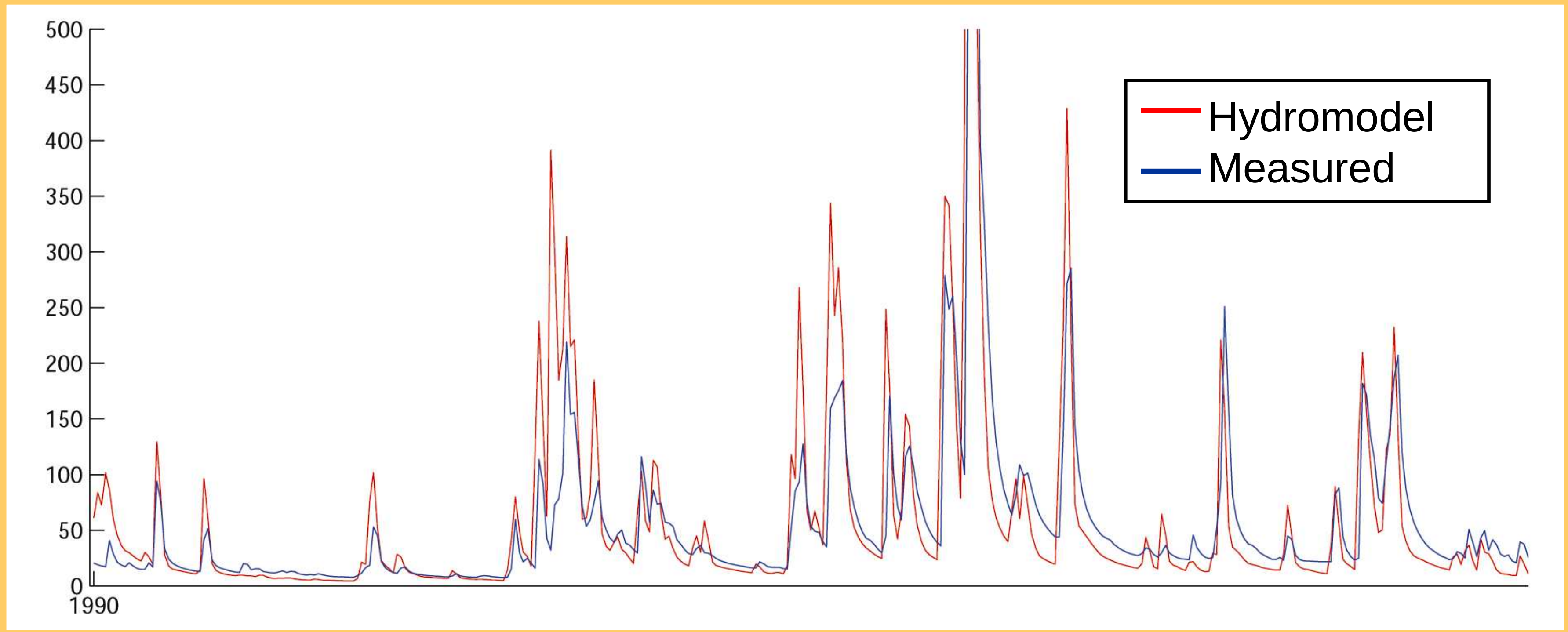


Source: Daily gauge station data (NIWA and TDC) and Mean Annual Rainfall surface

Results – Simulated Hydrograph



Results – Hydrograph Comparison

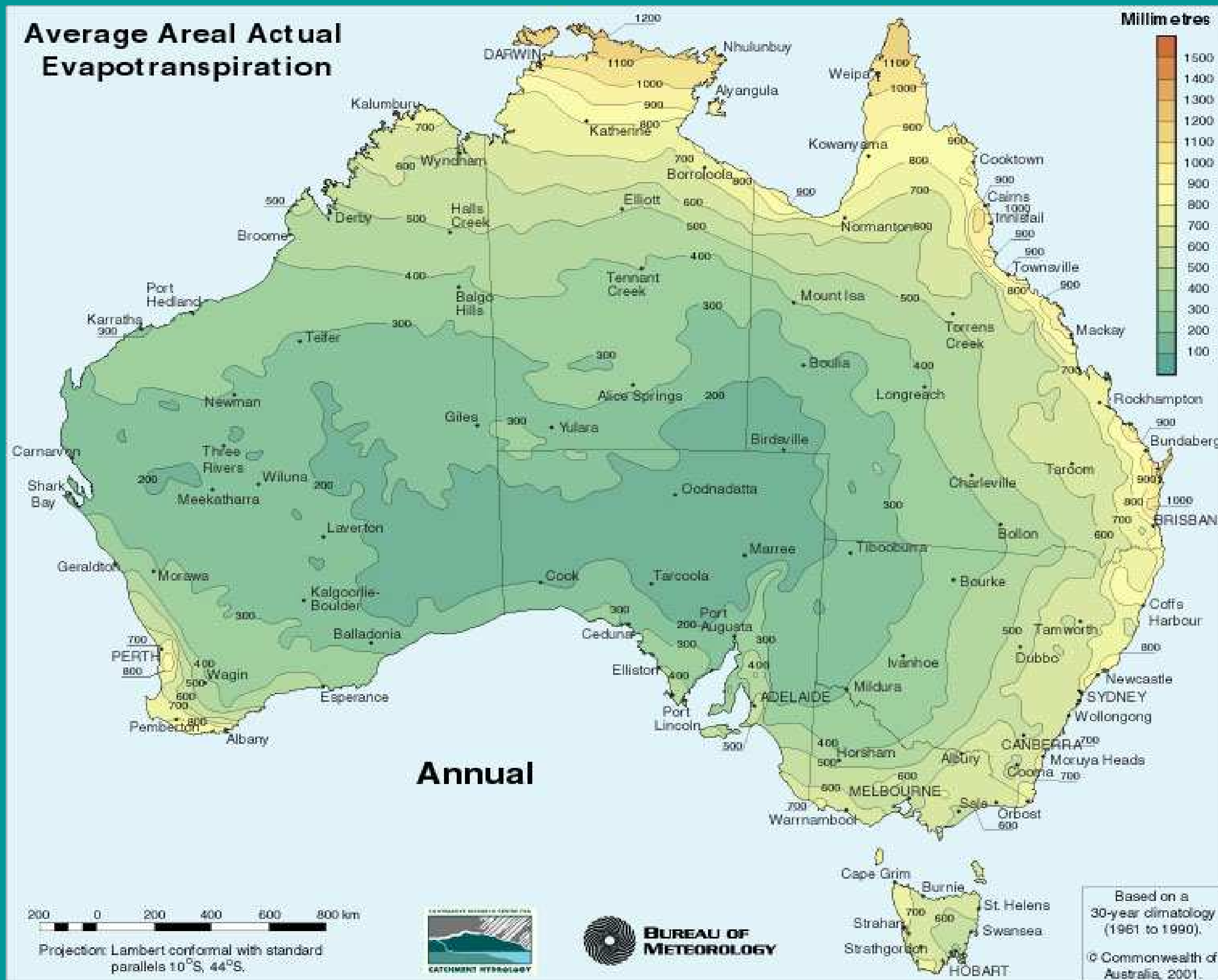


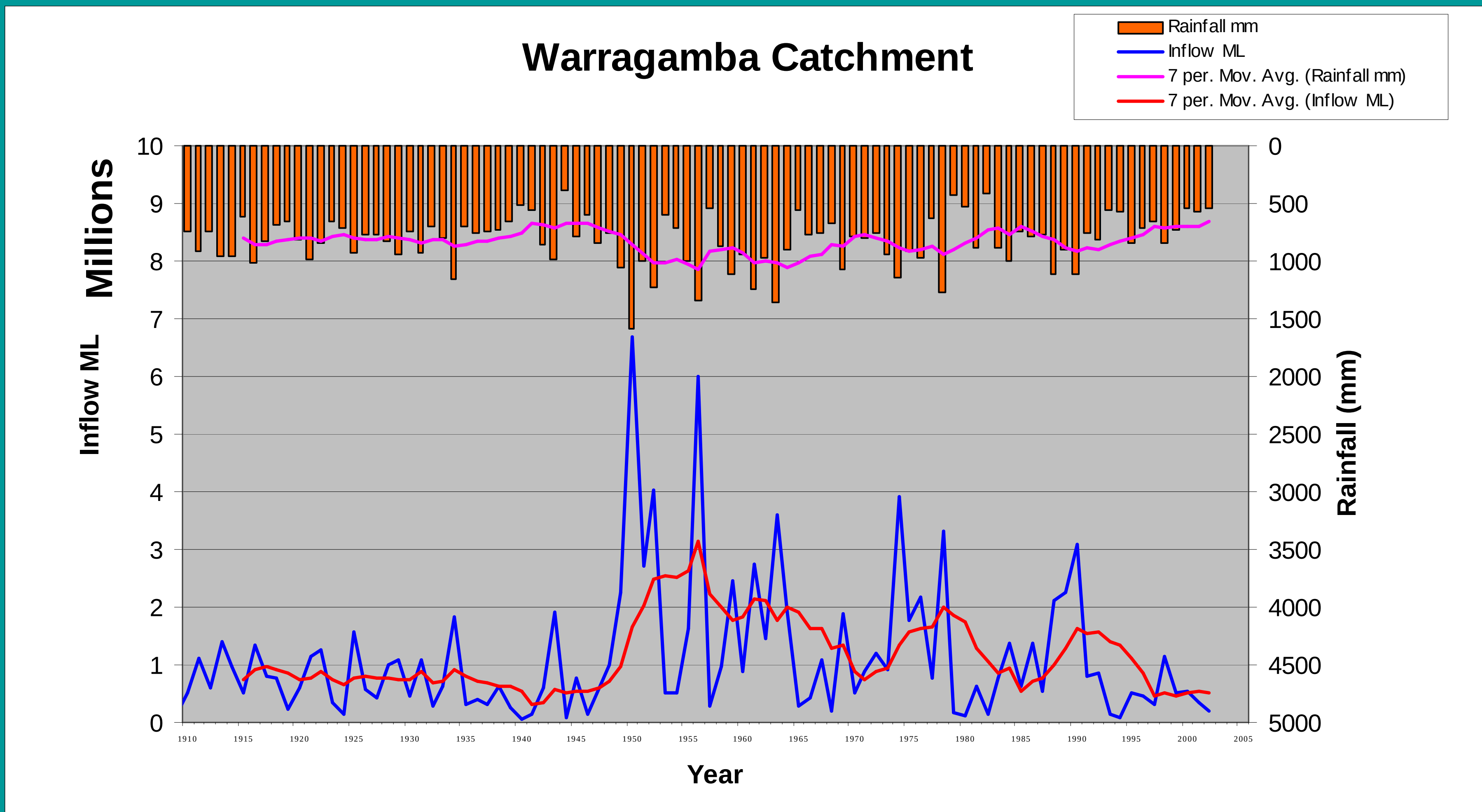
CLIMATE DETERMINES WATER SUPPLY

Climate is a fundamental driver of the water cycle.
It determines how much water is available (supply) and how much water we need (demand) in the short and long term.
In the short and medium term, weather patterns determine variability in water supply and demand on a day-to-day and season-to-season basis – the weather one year may be drier or wetter than the last.

In the long term climate, that is the average of the weather over a period, differs from decade to decade. This alters our perception of what we regard as the normal climate. In eastern Australia the period from 1900 to 1940 was generally drier, while the period from 1940 to 1980 was generally wetter.
In recent decades it has been generally drier.

EVAPOTRANSPIRATION





Warragamba Catchment
Rainfall mm
Inflow ML
7 per. Mov. Avg. (Rainfall mm)
7 per. Mov. Avg. (Inflow ML)
Millions
Inflow ML
Rainfall (mm)
Year
0
1
2
3
4
5
6
7
8
9
10
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
1910
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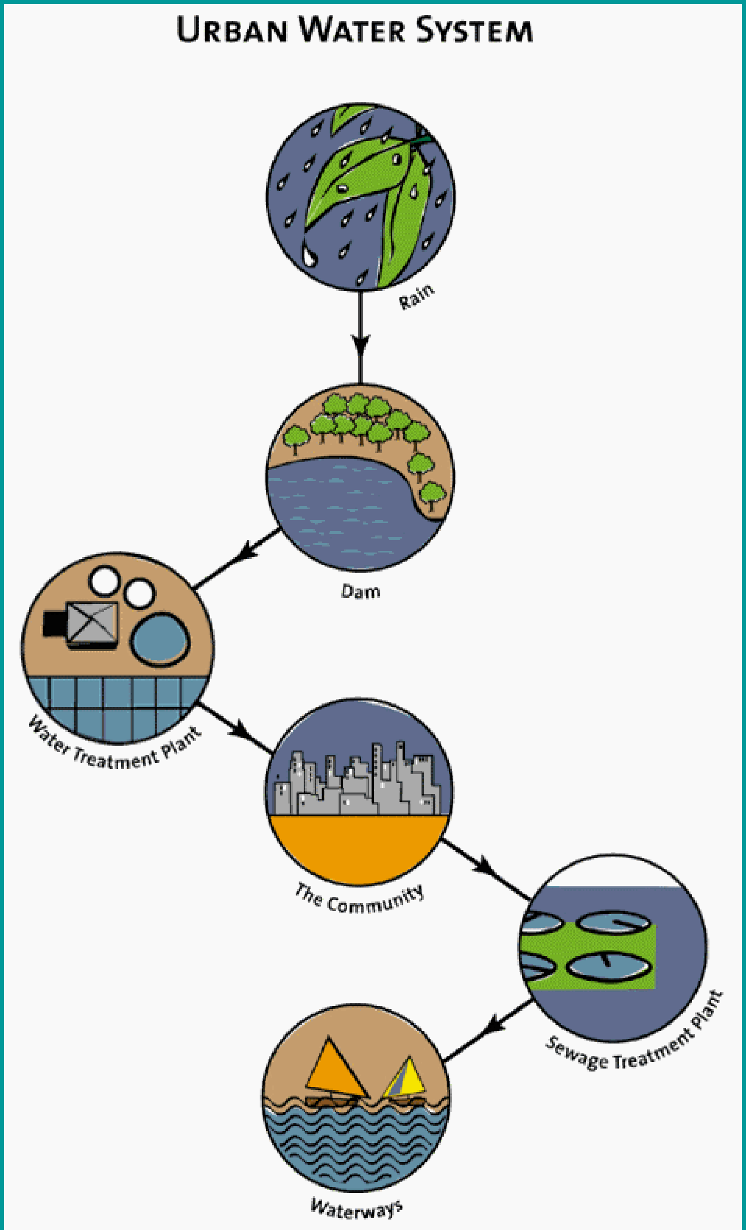
1985
1990
1995
2000
2005

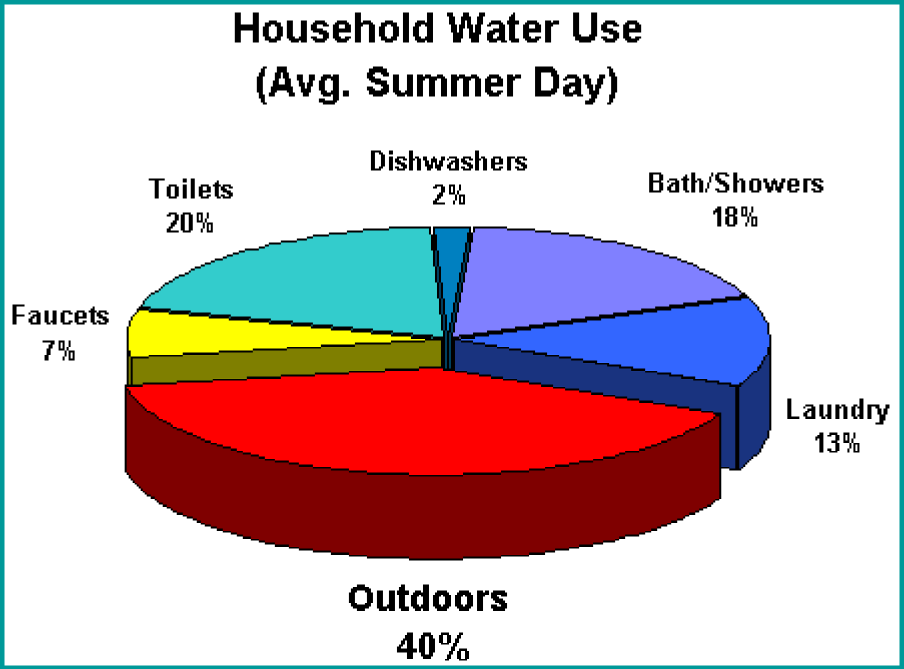


IMPROVED WATER USE EFFICIENCY URBAN AREAS

Outdoor Water Conservation

The importance of water conservation in Vancouver was emphasized when the City experienced water shortages in the summers of 1990, 1992 and 2003.

The average household water demand can more than double during the summer with approximately 40% of the total water being used for lawn sprinkling.



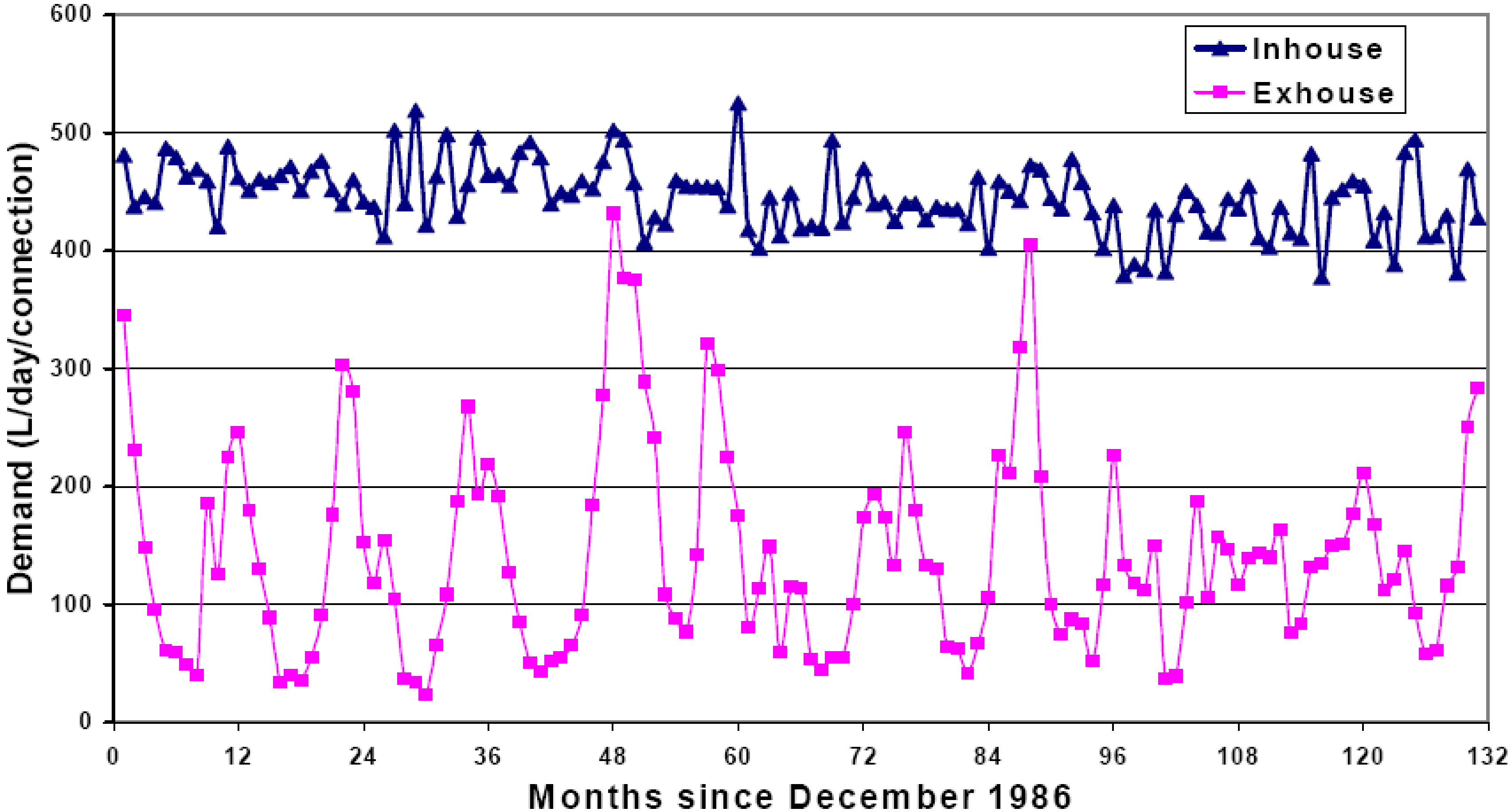


Figure 1: Domestic water use in the Lower Hunter Region

BENEFITS OF WEATHER INFORMATION

The model uses daily rainfall depth, maximum daily temperature and monthly average daily exhouse water use to simulate daily exhouse water use. Exhouse water use is shown to be most likely on days without rain. On days without rain the volume of water used is influenced by normal water use habits and temperature. There is also a small probability of exhouse water use on days with rainfall; however, the volume of water used is limited by the depth of rainfall. When the rainfall depth is large there is no exhouse water use for several days regardless of rainfall.

A reliable daily exhouse water use model for the Lower Hunter Region has been developed that will improve assessment of demand reduction strategies and allow optimum use of rainwater, stormwater and wastewater as an urban water supply augmentation strategy of the future.

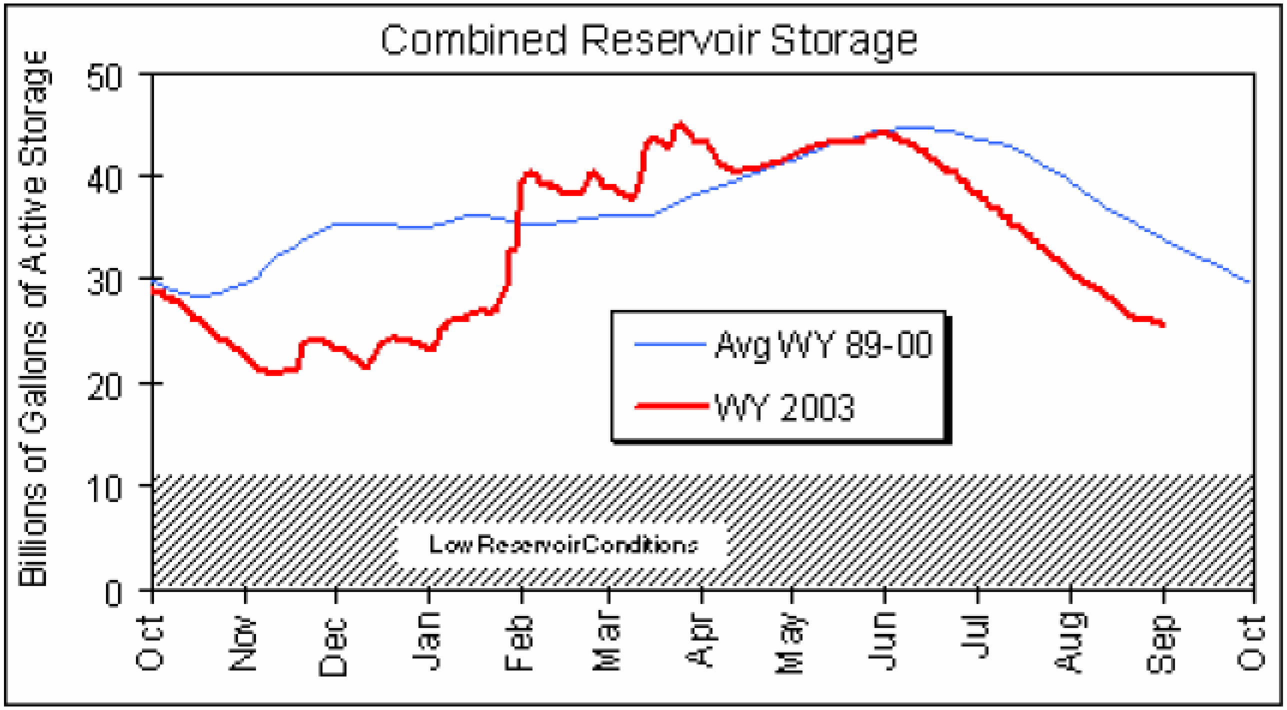


Figure 2. Combine Reservoir Storage, Seattle Public Utilities, August 2003.

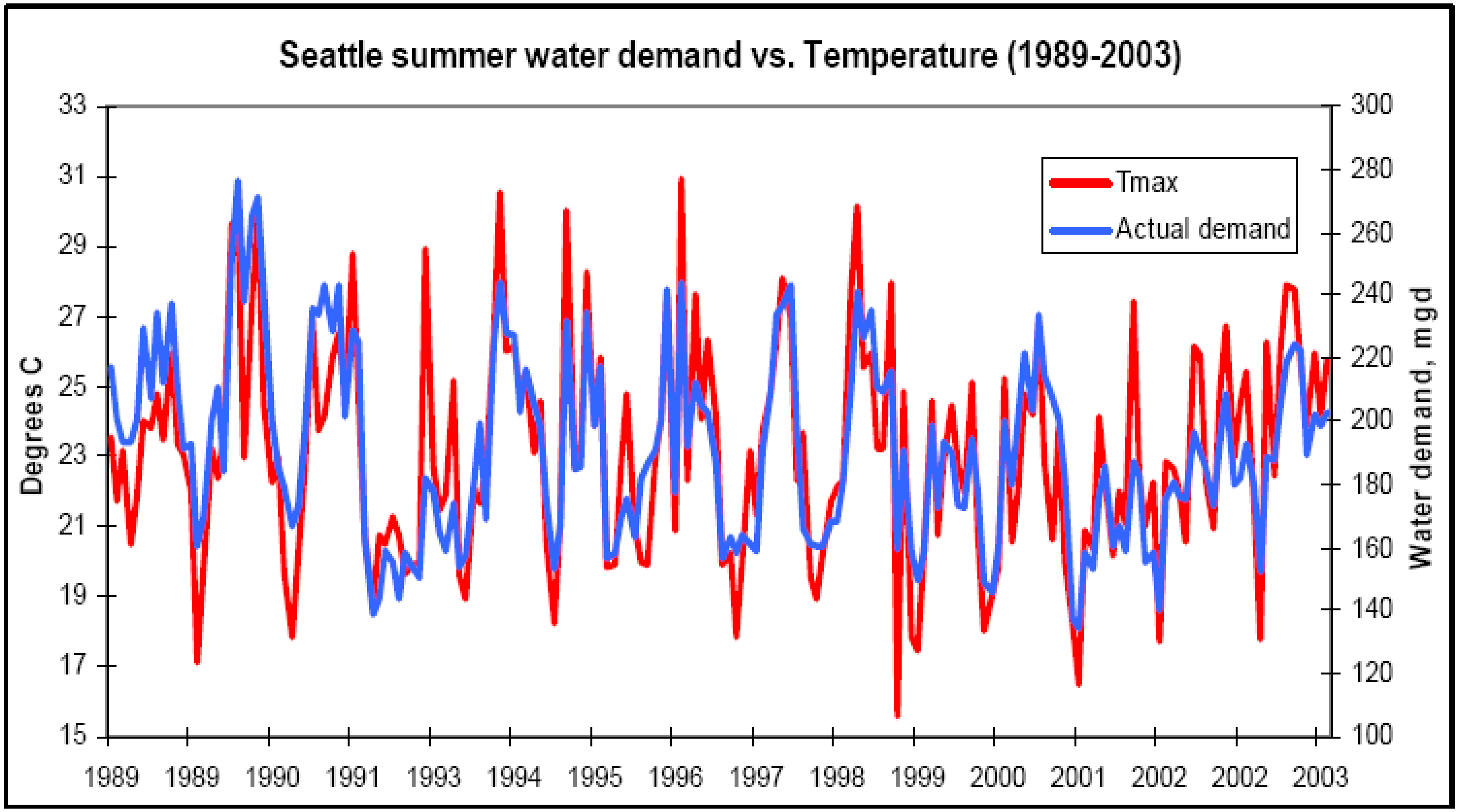


Figure 3. Seattle summer water demand plotted against the average weekly maximum temperature (Tmax) for 1983 through 2003. Summer months are June through August.

IMPROVED WATER USE EFFICIENCY
IRRIGATION AREAS

BENEFITS OF TAKING ACCOUNT OF PREDICTED RAINFALL EVENTS IN SCHEDULING IRRIGATION

- One of the main benefits identified is in avoiding waterlogging situations and maintaining crop quality.
- Maintenance of crop quality was also identified as a major issue, rather than water savings.
- Short-term forecasting works best on farms with water-on-demand, rather than farms with prior water ordering arrangements.

Under-watering for example, can lead to:

Loss in market value through yield reduction
Reduction in fruit size and quality.

Whereas over-watering can cause:

Unwanted vegetative growth
Losses of valuable water to the watertable and run off
Increased operational costs (labour and pumping)
Leaching of nutrients
Downgraded product quality and reduced yield.

DEMAND FORECASTING FOR IRRIGATION WATER DISTRIBUTION SYSTEMS

The best results were obtained when water demand and maximum temperature variables from the two previous days were used as input data.

J. Irrig. and Drain. Engrg., Volume 129, Issue 6, pp. 422-431 (November/December 2003)

ALGAE GROWTH

Algae occurs naturally in the water supply.
During warm weather, algae grows rapidly and has an unpleasant affect on the taste and odour of drinking water. While the taste is unpleasant, the water is still safe for drinking and cooking purposes. Copper sulphate can be applied in the reservoirs to help control algae growth and improve the taste of drinking water.
We apply copper sulphate in a manner which complies with all environmental and health standards.

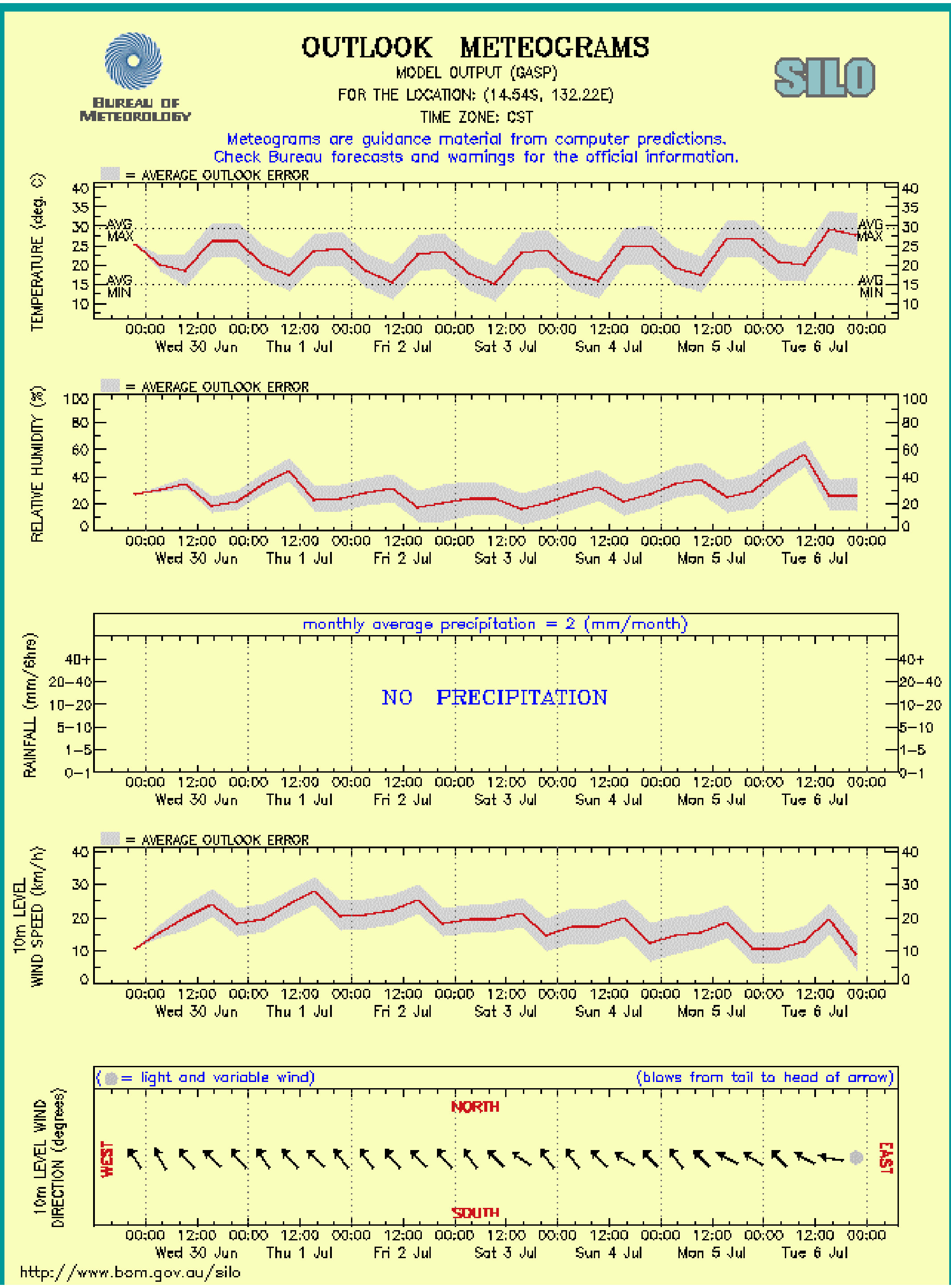
WHAT IS THE PALMER INDEX?

The Palmer Index (more properly called the Palmer Drought Severity Index) was developed by Wayne Palmer of the U.S. Weather Bureau (now the National Weather Service) in the 1960's and uses temperature and rainfall information in a formula to determine dryness. It has become the semi-official drought index.

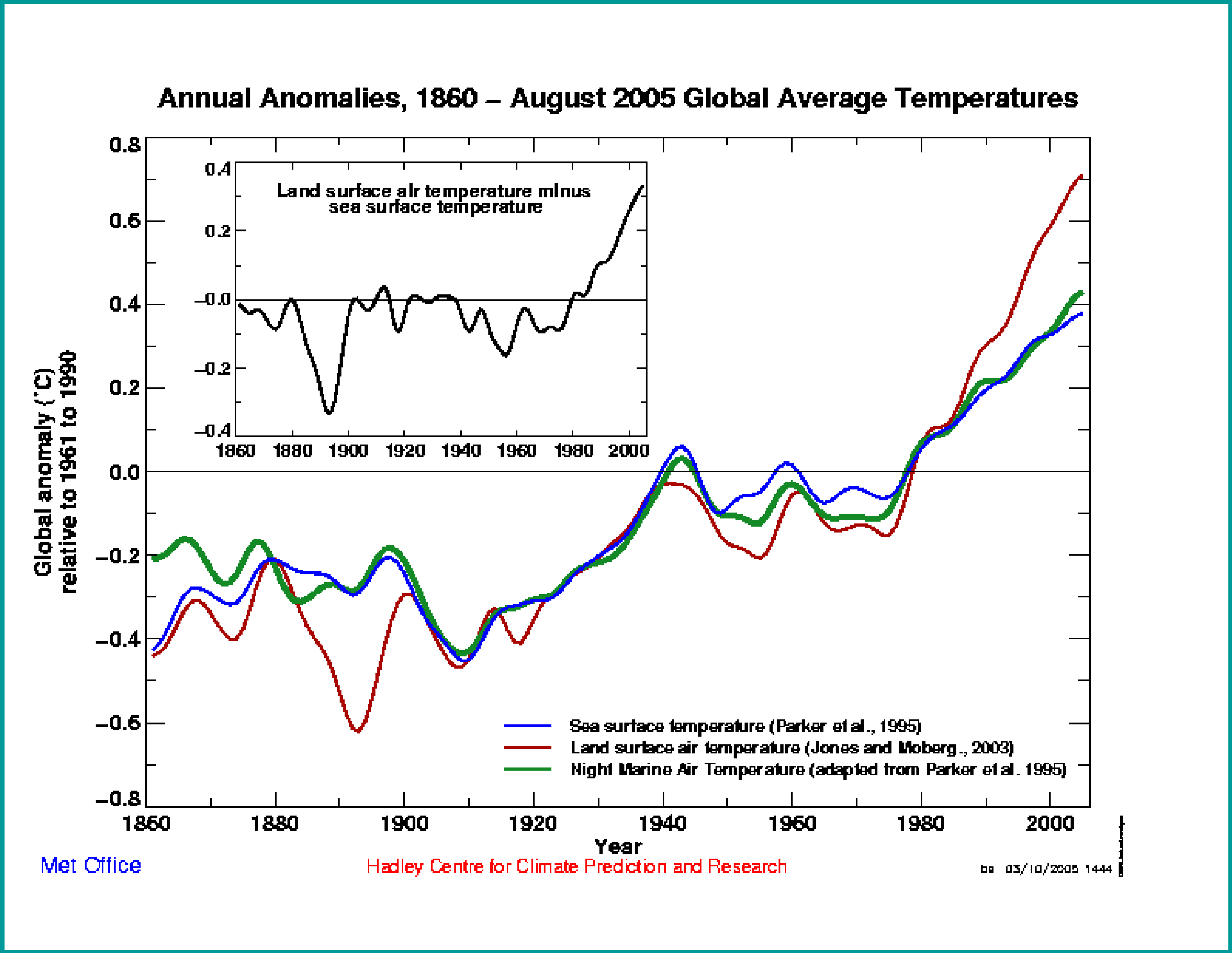
The Palmer Index is most effective in determining long term drought —-a matter of several months—-and is not as good with short-term forecasts (a matter of weeks). It uses a 0 as normal, and drought is shown in terms of minus numbers; for example, minus 2 is moderate drought, minus 3 is severe drought, and minus 4 is extreme drought.

The Palmer Index can also reflect excess rain using a corresponding level reflected by plus figures; i.e., 0 is normal, plus 2 is moderate rainfall, etc.

The advantage of the Palmer Index is that it is standardized to local climate, so it can be applied to any part of the country to demonstrate relative drought or rainfall conditions. The negative is that it is not as good for short term forec and is not particularly useful in calculating supplies of water locked up in snow so it works best east of the Continental Divide.


OUTLOOK METEOGRAMS
MODEL OUTPUT (GASP)
FOR THE LOCATION: (14.54S, 132.22E)
TIME ZONE: CST
BUREAU OF METEOROLOGY
SILO
Meteograms are guidance material from computer predictions.
Check Bureau forecasts and warnings for the official information.
= AVERAGE OUTLOOK ERROR
TEMPERATURE (deg. C)
AVG MAX
AVG MIN
RELATIVE HUMIDITY (%)
monthly average precipitation = 2 (mm/month)
NO PRECIPITATION
RAINFALL (mm/6hrs)
10m LEVEL WIND SPEED (km/h)
(= light and variable wind)
(blows from tail to head of arrow)
NORTH
SOUTH
WEST
EAST
10m LEVEL WIND DIRECTION (degrees)
00:00 12:00 00:00 12:00 00:00 12:00 00:00 12:00 00:00 12:00 00:00 12:00 00:00 12:00 00:00
Wed 30 Jun Thu 1 Jul Fri 2 Jul Sat 3 Jul Sun 4 Jul Mon 5 Jul Tue 6 Jul
http://www.bom.gov.au/silo

CLIMATE CHANGE



Climate Change Challenges

1. Urban water supply
   - Some major cities facing water supply challenges
   - Climate change forecasts will be key inputs to the public debates to settle these cities' plans
   - Must enable evidence based policy formulation

Challenges

2. Irrigated agriculture

- Accounts for the majority of water consumption
- Possible reductions in rainfall and runoff Possible changes in variability

3. Natural resource management

- Groundwater: increased demand likely as runoff declines
- Minimising negative impacts on water-dependent ecosystems
- Maximising opportunities – including counterseasonal
- Salinity: perhaps mixed effects

Impacts of climate change

- Uncertain impacts: Uncertainties around climate change and its impact on communities
- Differential impacts: Impacts on sectors of the economy and communities differ
- More certainty and regional definition required for decision making to help identify risks and opportunities from regional changes to seasons and climate

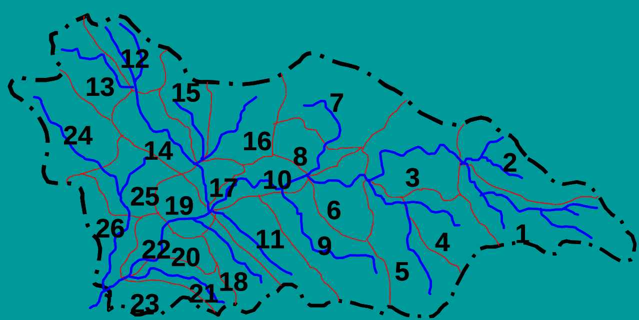
Water management needs from forecasters

- Improved certainty
- Improved regionalisation
- Capacity to focus on hot spots
- Climate – seasons – weather
  - greater focus on seasons?
- More even forecasting quality
- Accessibility for range of users
- Help for the layman - “science explained”
- Analysis as well as data
- Knowledge management

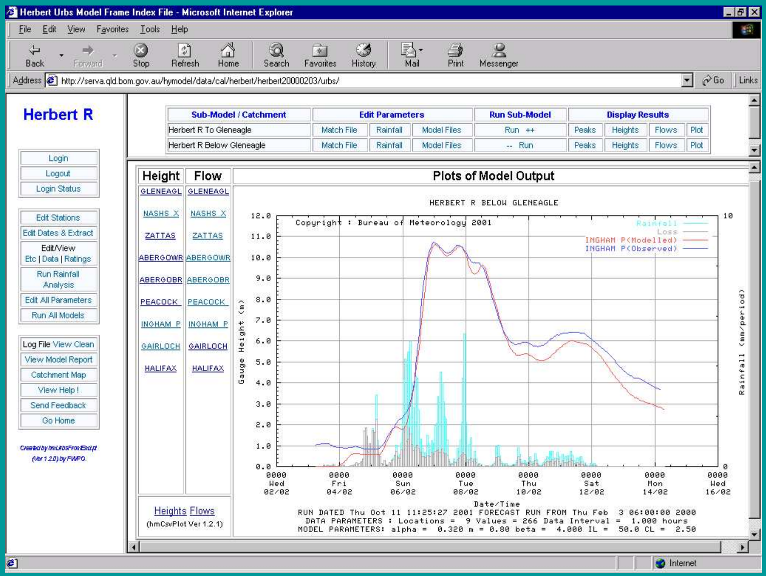
IMPROVED FLOOD FORECASTING

Hydrological Forecast Modelling

Rainfall (Observed & Forecast) and River Height Data



URBS Catchment Model



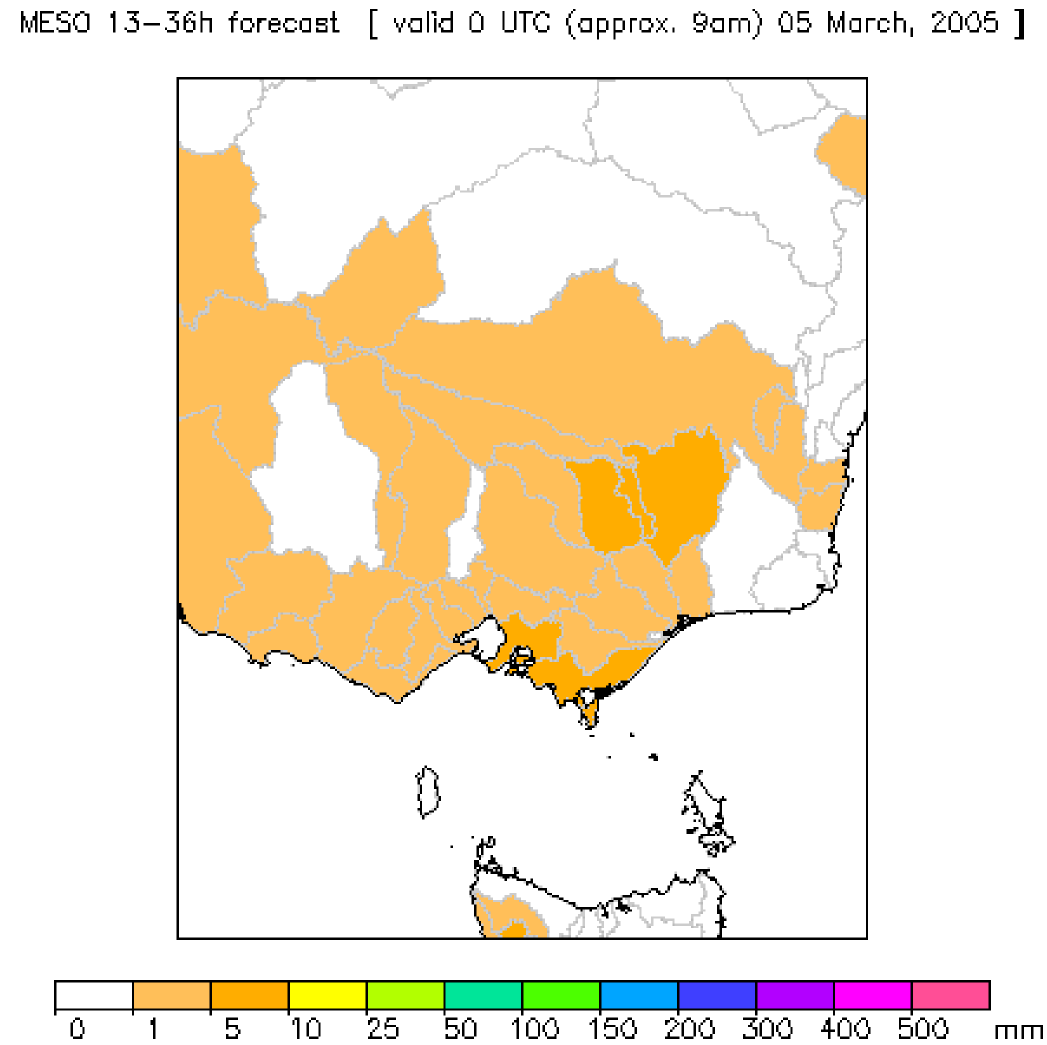
HYMODEL Modelling System

Real-Time Data Collection

- Technologies
  - Radio telemetry (event-reporting)
  - Polled telemetry (telephone, satellite)
  - Other Bureau (AWS)
  - Inter-agency transfer (Internet)
- Activities
  - Network design
  - Equipment selectio
  - Installation




Catchment Specific Rainfall Forecasts



Technical Improvements

Web Products

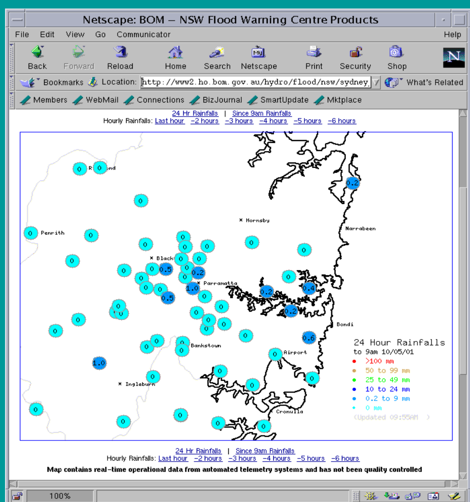
- Maps and data bulletins
- Updated hourly – daily

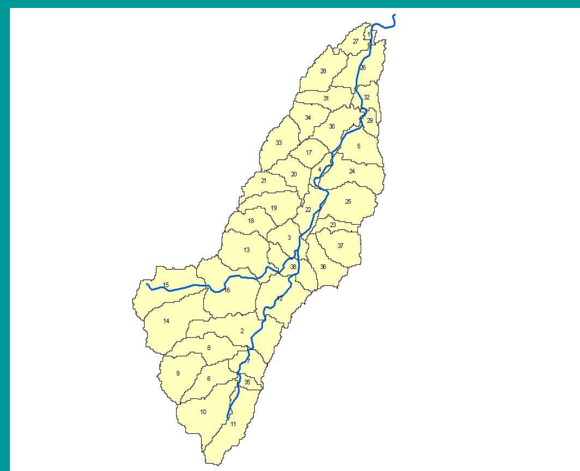
Modelling

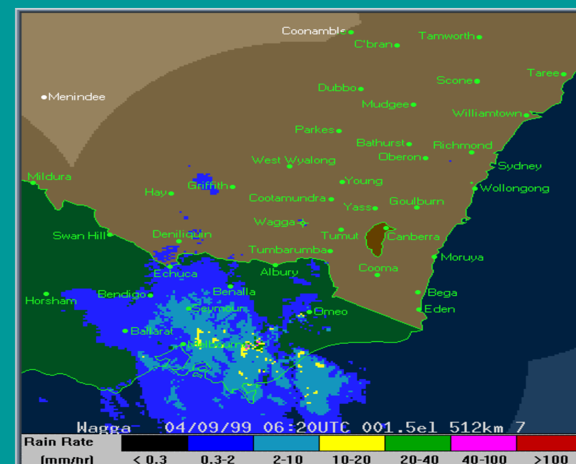
- Spatially distributed, event-based
- National system - scaleable

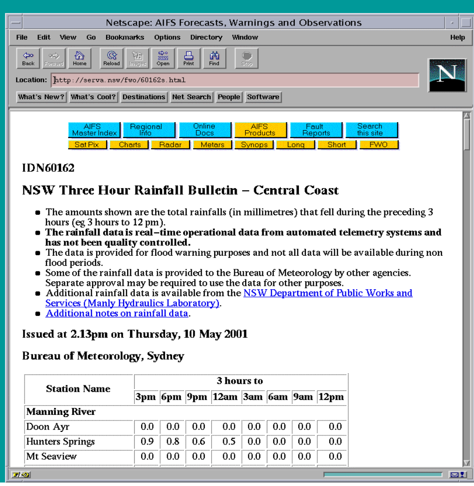
Hydromet Inputs

- Quantitative radar rain
- NWP, QPF

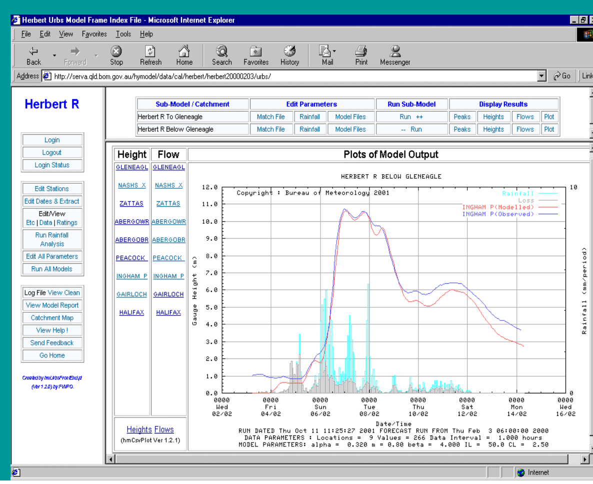


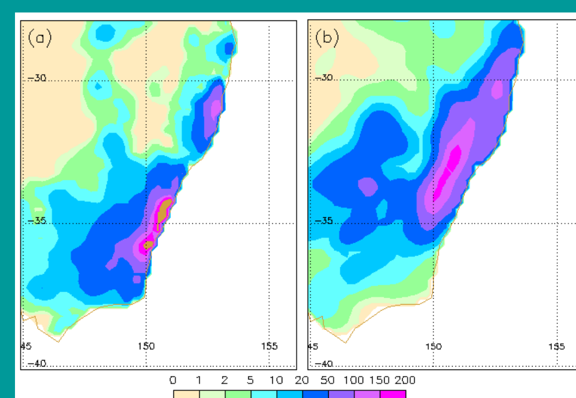


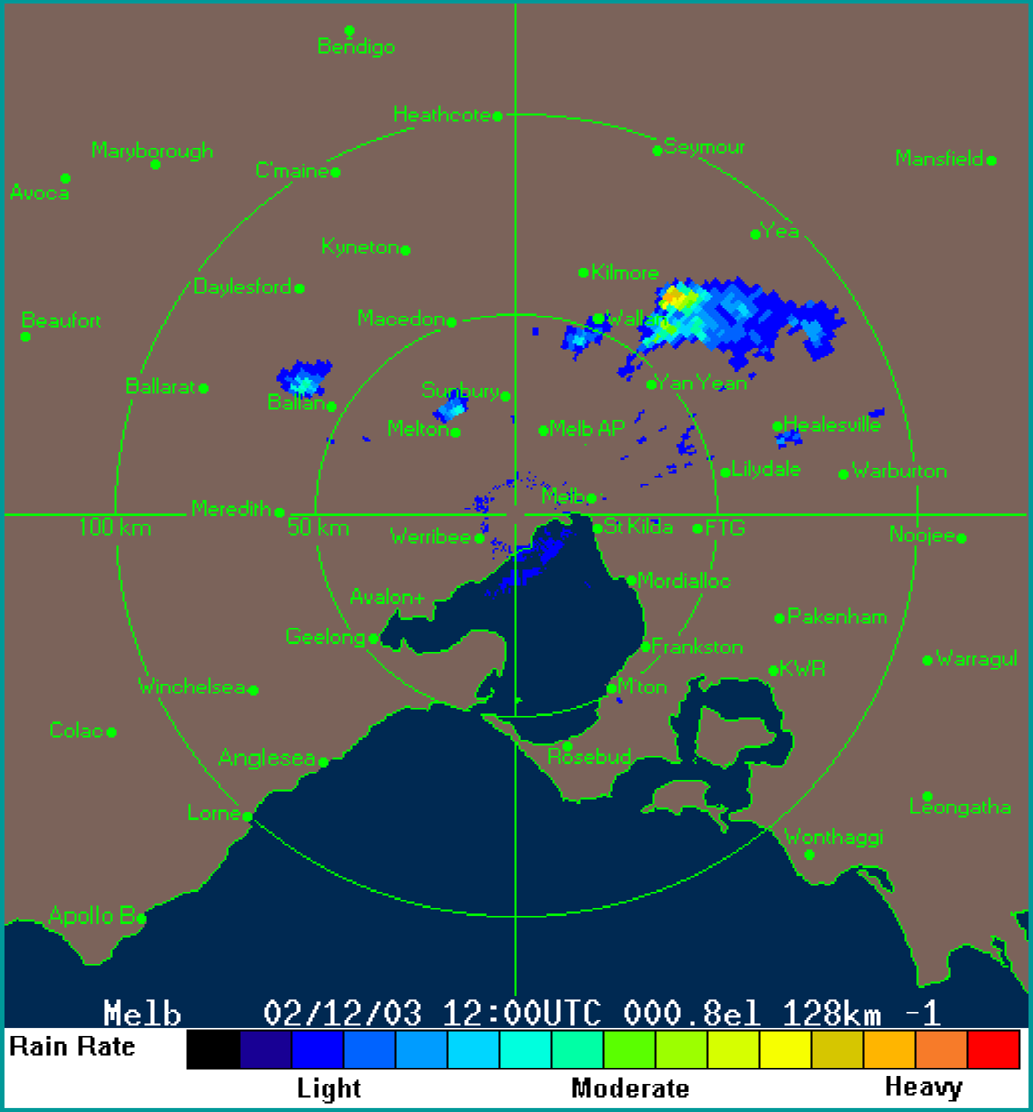




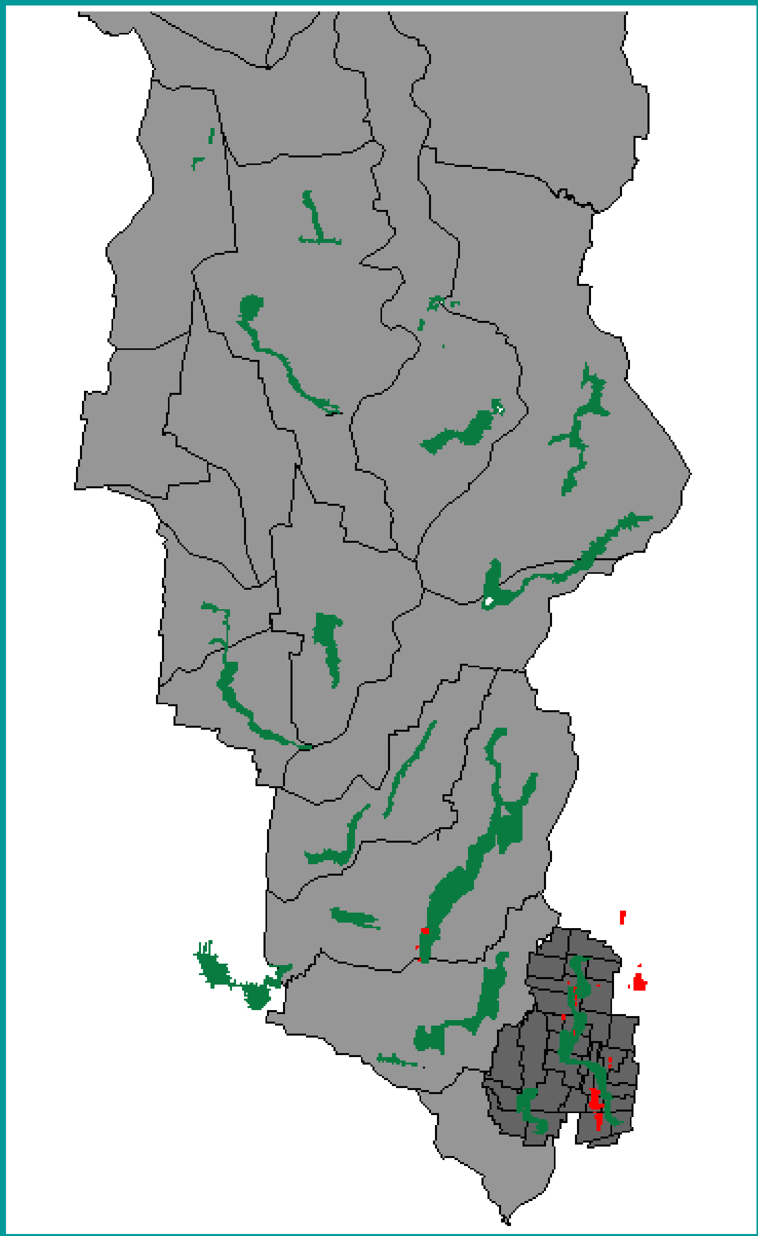
Station Name	3pm	6pm	9pm	12am	3am	6am	9am	12pm
Manning River								
Doon Ayr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hunters Springs	0.9	0.8	0.6	0.5	0.0	0.0	0.0	0.0
Mt Seaview	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



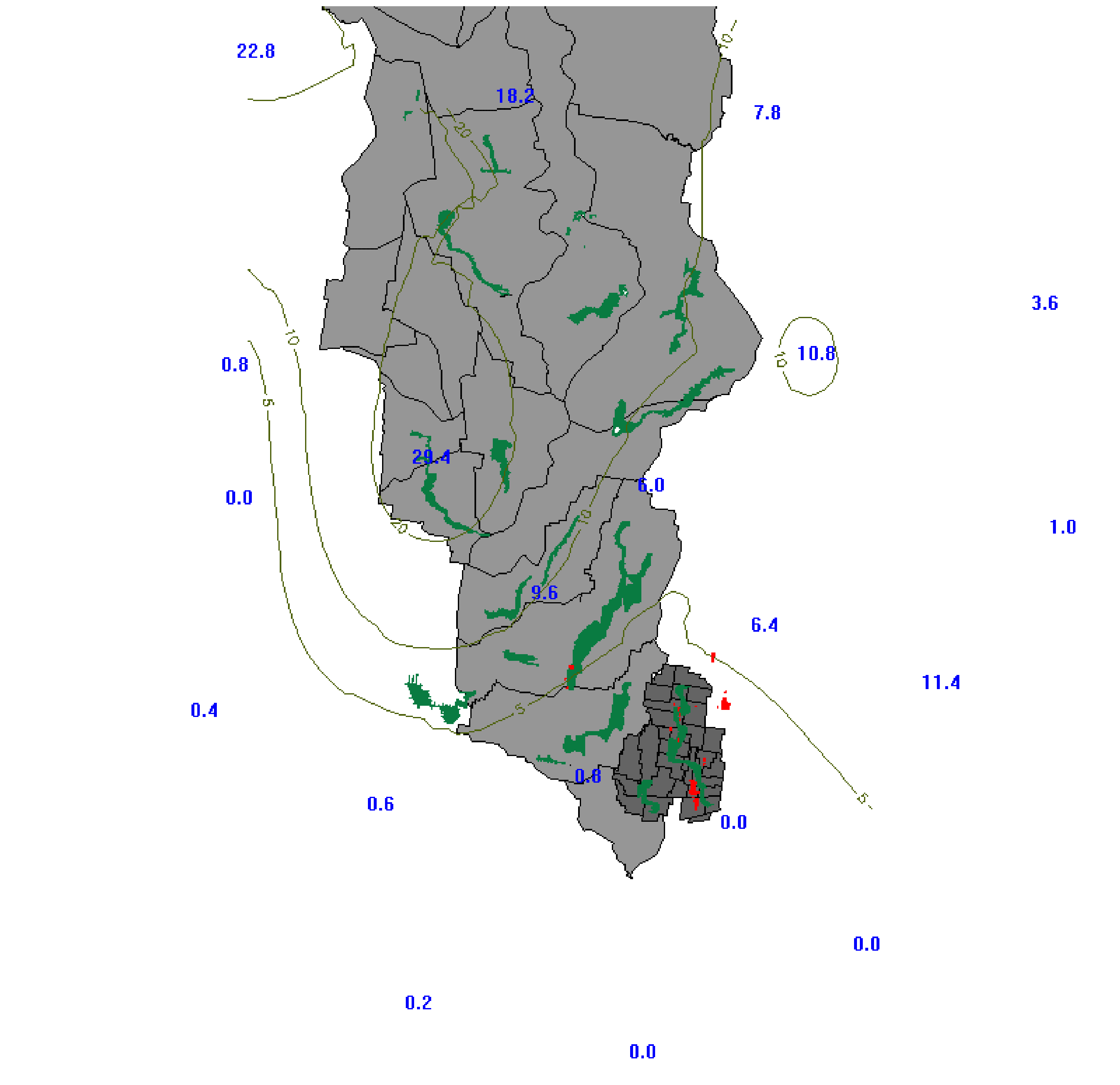




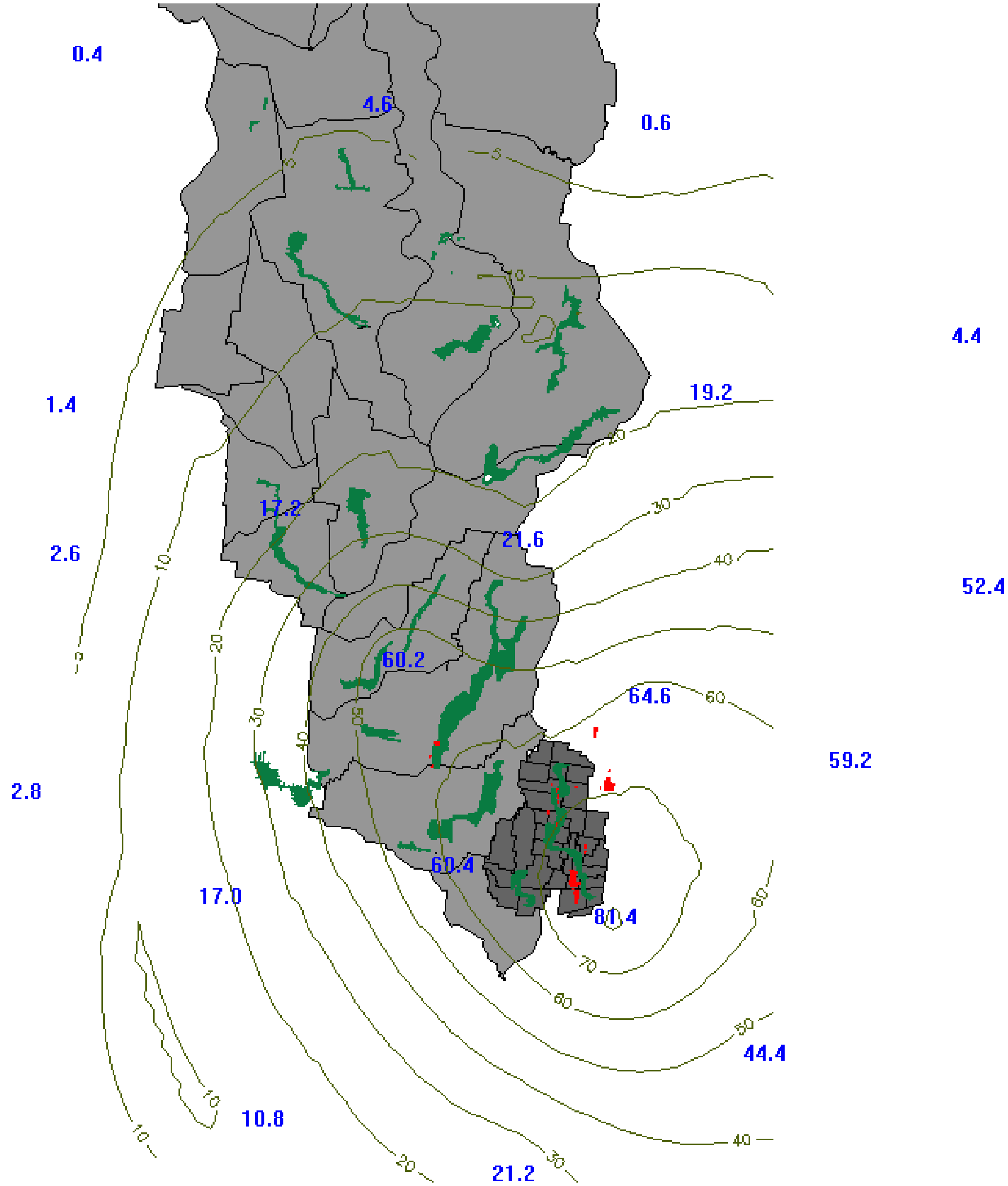
Bendigo
Heathcote
Maryborough
C'maine
Seymour
Mansfield
Avoca
Yea
Kyneton
Kilmore
Daylesford
Beaufort
Macedon
Wallan
Yan Yean
Ballarat
Ballan
Sunbury
Melton
Melb AP
Healesville
Lilydale
Warburton
Melb
Meredith
100 km
50 km
Werribee
St Kilda
FTG
Noojee
Mordialloc
Avalon+
Pakenham
Geelong
Frankston
KWR
Warragul
Winchelsea
M'ton
Colac
Anglesea
Rosebud
Leongatha
Lorne
Wonthaggi
Apollo B
Melb 02/12/03 12:00UTC 000.8el 128km -1
Rain Rate
Light
Moderate
Heavy



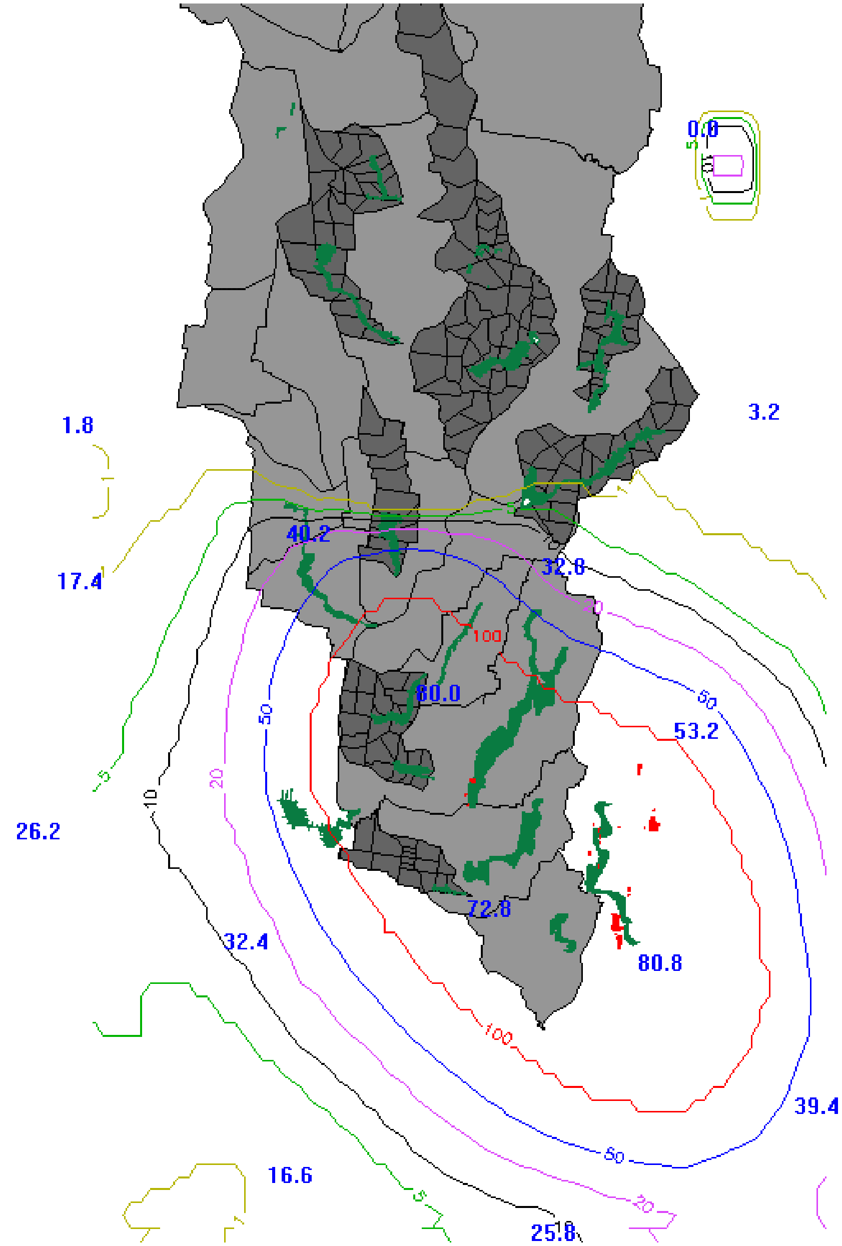
Accumulation over 60mins for period ending 0018EDST 03/12/2003 (1317Z 02/12/2003)



Accumulation over 60mins for period ending 0148EDST 03/12/2003 (1447Z 02/12/2003)



Accumulation over 60mins for period ending 0128EDST 03/12/2003 (1427Z 02/12/2003)



IMPROVED SEASONAL OUTLOOKS

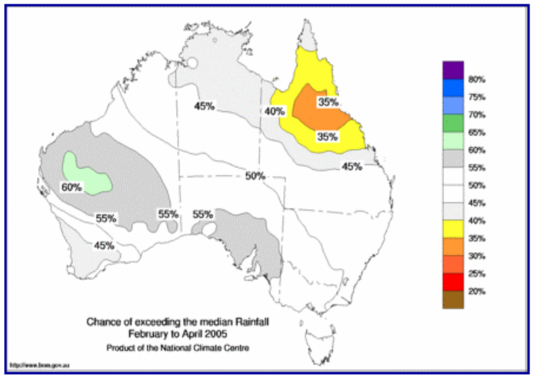
Seasonal Rainfall Outlook

National Seasonal Rainfall Outlook: probabilities for February to April 2005, issued 18th January 2005

Drier season more likely in north Queensland

There is a moderate shift in the odds towards below average rainfall for the late summer to mid-autumn quarter (Feb-Apr) in north Queensland, the Bureau of Meteorology announced today. Contrasting this, is an increase in the likelihood of wetter than average conditions in parts of western WA. But for most of the country, the chances of accumulating at least average rain between February and April are close to 50%.

For the February to April period, the chances of above median rainfall are between 30 and 40% in Queensland north of about St Lawrence (see map), which means that below median falls have a 60 to 70% chance of occurring. So in years with ocean patterns like the current, about six or seven seasons out of ten are expected to be drier than average in north Queensland, with about three or four out of ten being wetter. This outlook pattern is mostly due to above average temperatures in the tropical Pacific Ocean.



In parts of Western Australia near and to the northwest of Meekatharra, the odds favour above average falls for the coming season. The chances of exceeding the February to April median in this area are about 60%, which equates to about six years in every ten.

Outlook confidence is related to the influence of Pacific and Indian Ocean temperatures on seasonal rainfall. During the February to April period, history shows this influence to be moderately consistent through the northern halves of both Queensland and the NT, most of WA, the far west of SA and southeast NSW. Elsewhere the influence is only weakly or very weakly consistent (see background information).

Climate patterns across the Pacific continue to show some signs that are consistent with El Niño (eg warm central Pacific temperatures), and some that are not (eg wind and cloud patterns). The Southern Oscillation Index (SOI) was –8 in December following –9 in November. The approximate SOI for the 30 days ending 15th January was –3.

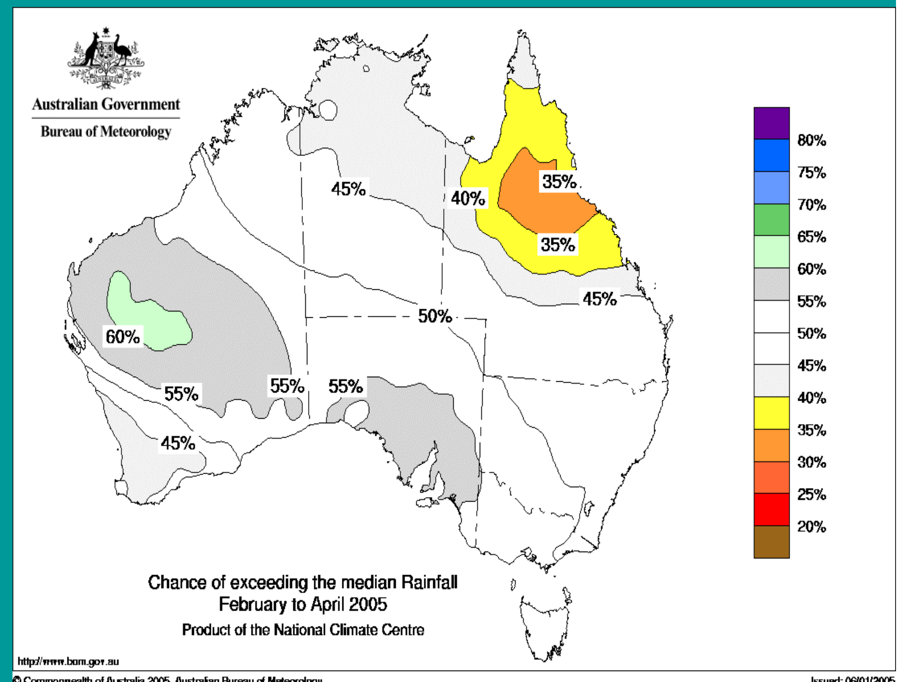
For routine updates on the latest data relating to El Niño, together with details on what the phenomenon is and how it has affected Australia in the past, see the El Niño Wrap-Up.

Click on the map above for a larger version of the map. Use the reload/refresh button to ensure the latest forecast map is displayed.

The following climate meteorologists in the National Climate Centre can be contacted about this outlook: Grant Beard on (03) 9669 4527, Felicity Gamble on (03) 9669 4256, David Jones on (03) 9669 4085

Regional versions of this media release are available: | Qld | NSW | Vic | Tas | SA | WA | NT |

Regional commentary is available from the Climate and Consultancy Sections in the Bureau's Regional Offices:



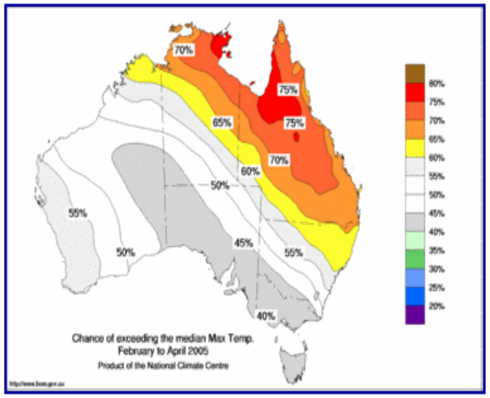
Seasonal Temperature Outlook

National Seasonal Temperature Outlook: probabilities for February to April 2005, issued 18th January 2005

Higher temperatures likely in north and east

There is a moderate to strong shift in the odds towards above average maximum temperatures for the late summer to mid-autumn quarter (Feb-Apr) in parts of northern and eastern Australia, the Bureau of Meteorology announced today. For most other parts of the country there are no strong shifts in the odds towards either a warmer or cooler than average season. This outlook pattern is mainly the result of above average temperatures in the tropical Pacific Ocean.

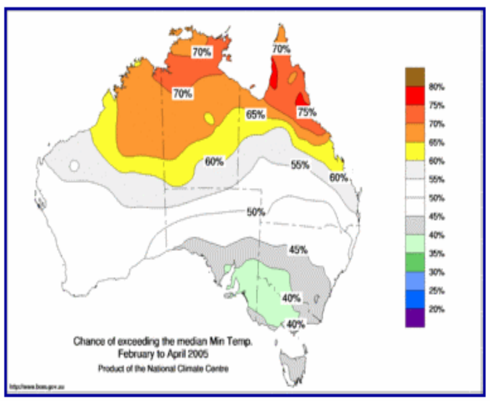
For the February to April period, the chances of above average seasonal daytime temperatures are over 60% northeast of a line from near Derby in far northern WA to Newcastle in NSW. Within this region, the chances peak in the 75 to 80% range in eastern Arnhem Land and in parts of north Queensland (see map). So in years with ocean patterns like the current, about six or seven seasons out of every ten are expected to be warmer than average across these parts of the country, with about three or four out of ten being cooler.



Across the rest of Australia, the chances of exceeding the median maximum temperature for the three months from February to April, are between 40 and 60%.

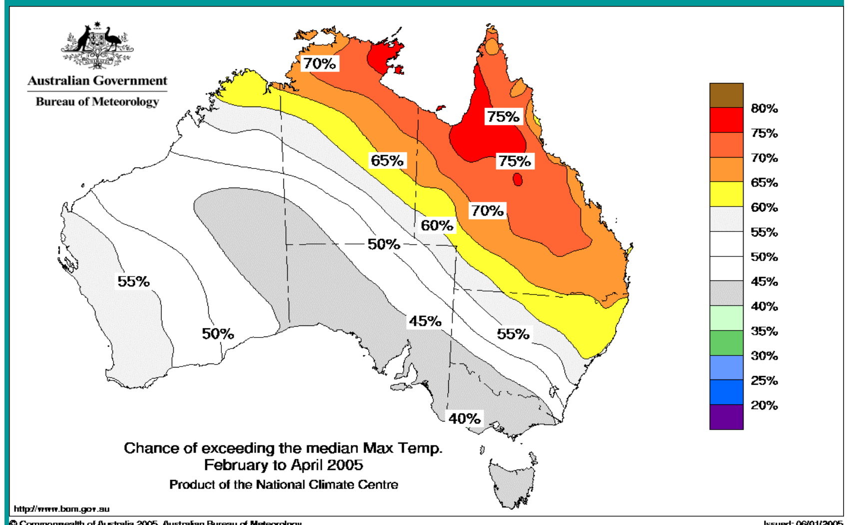
Outlook confidence is related to the consistency of the influence of Pacific and Indian Ocean temperatures on seasonal temperatures. During the February to April period, history shows this influence on maximum temperatures to be moderately consistent over Queensland, the northern NT, central WA and patches in SA, Victoria, NSW and Tasmania (see background information).

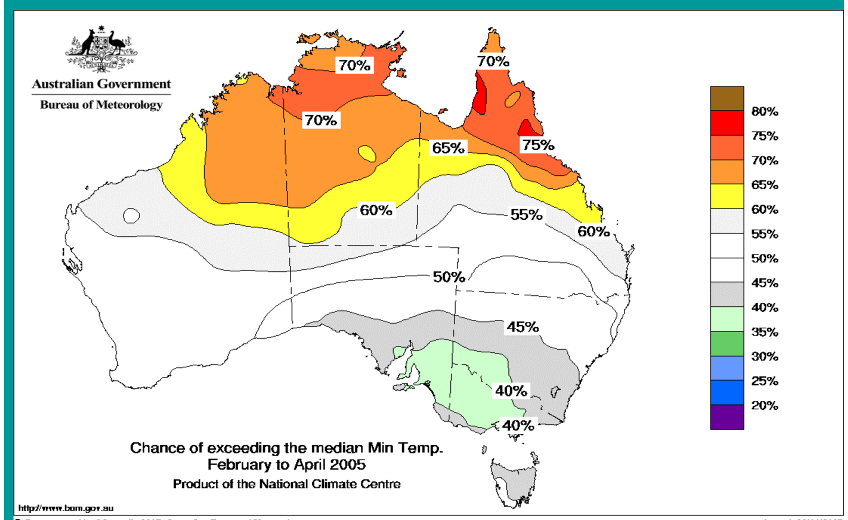
Mean seasonal minimum temperatures have an increased chance of being above normal over much of northern Australia, with probabilities above 60% across most of both the NT and the northern half of Queensland, together with northeast WA. In parts of southeastern Australia the reverse is true, with a shift in the odds towards cooler than average seasonal minimum temperatures. Elsewhere, the chances of above normal overnight temperatures averaged over the next three months, range between 40 and 60%. This outlook pattern is mostly due to above average temperatures in the Pacific Ocean.

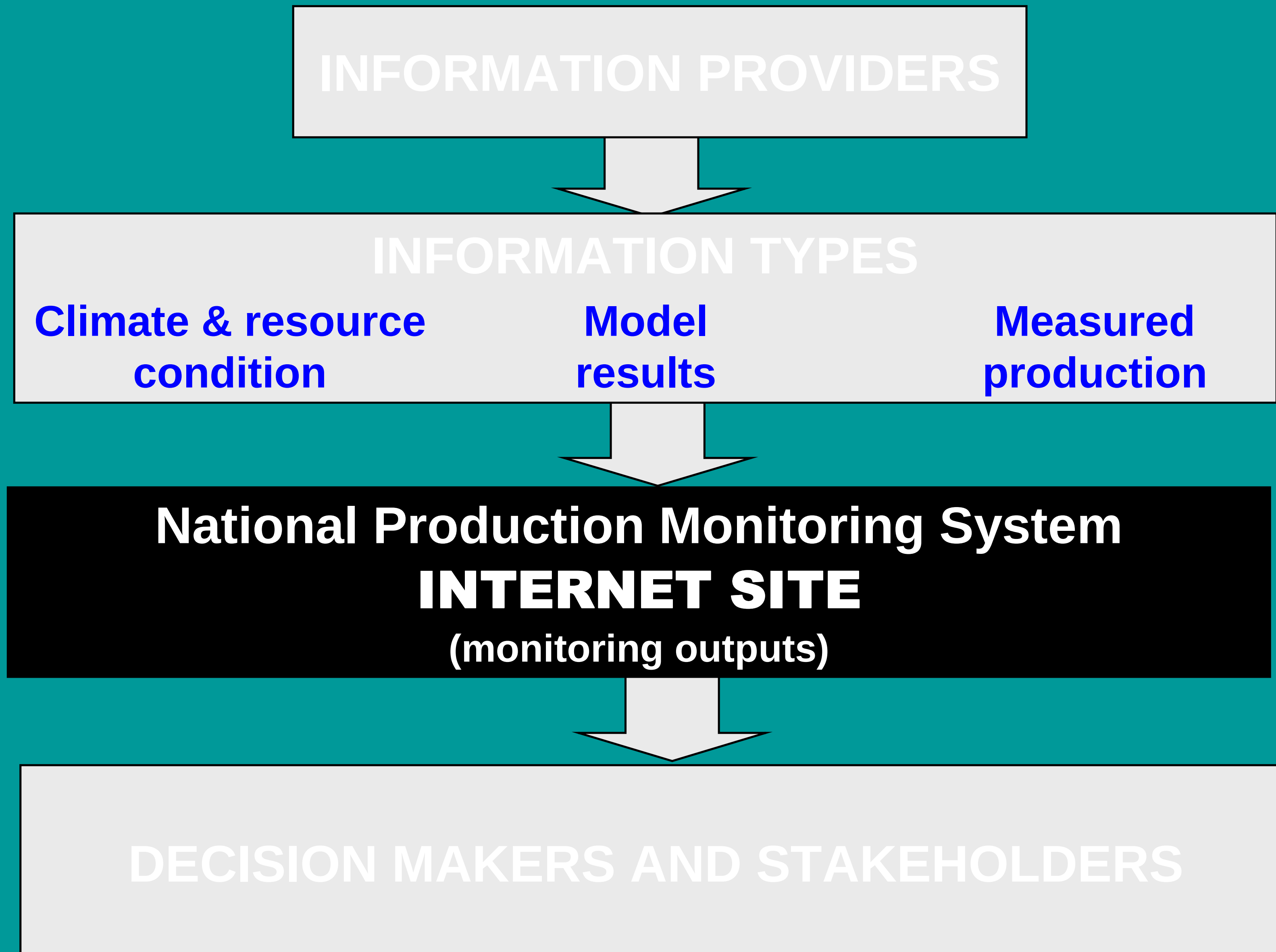


History shows the oceans' influence on minimum temperatures in the February to April period to be moderately consistent over large parts of the country.

Click on the maps above for larger versions of the maps. Use the reload/refresh button to ensure the latest forecast maps are displayed.







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