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In the face of a permanent reduction in his groundwater irrigation licence, John Hamparsum (pictured), an irrigator from the Tamworth region in northern NSW, is learning to minimise the amount of water he needs and keep it 'in the bank' until dry times with the help of weather and climate forecasting tools. John is one of 14 'Masters of the Climate' farmers who offer outstanding examples of the innovative and profitable use of climate tools. Read more about the 'Masters of the Climate' project on page 2, and John's story on page 3. Photo: Jessie Blackadder

Pan evaporation defying the trends: new research

Pan evaporation, a measure of potential evapotranspiration (PET), could actually be steadily decreasing in some regions as the enhanced greenhouse effect warms the earth, despite the assumption that the reverse has been happening.

Until now, the general theory has been that as the enhanced greenhouse effect warms the earth its terrestrial surface becomes more arid as a result of increasing evaporative demand.

However, new analysis of pan evaporation measurements shows potential evapotranspiration has actually been steadily decreasing for the last 30–50 years, a trend observed around the world and also in some regions of Australia.

These new findings will form the basis for a new Australian research project – *Agro-ecological implications of changes in the terrestrial water balance* – led by Dr Michael Roderick and Professor Graham Farquhar from the CRC for Greenhouse Accounting.

According to Dr Roderick the project will extend earlier work which looked at changes in annual pan evaporation to changes on a seasonal basis.

"We know that in most areas across Australia, pan evaporation is decreasing, but what we don't know is at what times of year this is occurring," he said.

"We aim to find out whether it is decreasing evenly across the whole year or more so in summer or winter. The results will be important for agriculture and particularly the cropping industry as we will be able to see what the effect of changes in evaporative demand are when farmers are going about activities such as sowing crops.

"Essentially it will help farmers further assess the likely impact of climate change on their properties."

A parallel project, *Calculation, Verification and Distribution of Potential Evapotranspiration (PET) Data for Australia*, funded by the Managing Climate Variability R&D Program, is reconstructing historical pan evaporation records prior to the 1970s using climate data from the CLIMARC project.

Greenhouse research is showing that night time or minimum temperatures are increasing around the world. However the research is also showing that maximum temperatures are not rising as fast.

Importantly, the research is only looking at potential evapotranspiration – what actually happens to water availability (or actual evapotranspiration) will be affected by rainfall as well.

Climate researchers are also interested to determine what will happen to pan evaporation as temperatures rise by an expected one to six degrees Celsius over the next 100 years due to the greenhouse effect.

The debate about the direction of future trends in pan evaporation and evaporative demand is extremely important for planning the use of Australia's water resources.

The importance of this topic has led to The Australian Academy of Science hosting a special workshop. *Pan evaporation: An example of the detection and attribution of trends in climate variables* will be held at the Shine Dome in Canberra on the 22–23 November. For further information and registrations, visit www.science.org.au



MANAGING
CLIMATE
VARIABILITY
R & D PROGRAM



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Masters of the Climate revisited – Innovative farmers coming through drought

A series of follow-up interviews with farmers post-drought has revealed how farmers are remastering the climate forecasting tools that were showing promise in 1999.

Communications consultant Jessie Blackadder, who conducted the interviews, said that in 1999 many farmers had examples where they had improved profitability from applying climate tools to their farming systems.

“However, in 2004 there were few examples of this in the aftermath of such a severe drought,” she said.

The interviews were conducted as part of the Managing Climate Variability R&D Program’s *Masters of the Climate* project. In 1999, Jessie Blackadder visited and interviewed 23 farmers chosen for their innovative and profitable use of climate tools. In 2004 she revisited 14 of these original ‘Masters of the Climate’ to see how they had fared during, and in the aftermath, of extreme drought.

According to Managing Climate Variability R&D Program coordinator, Dr Barry White, the high SOI values through much of 1998 to 2000 had brought good rains to many Australian farmers.

“More opportunities came along to take advantage of favourable forecasts, for example to sow an additional crop during a La Niña summer in the northern areas,” he said. “But the mixed year in 2001 saw many farmers already into drought before the El Niño really began to have an impact in mid 2002.

“As one Master said: *‘The main thing I learned was to accept the lack of certainty’*. This is a good example of how farmers are becoming more sophisticated risk managers.

“The shift is from farmers as punters to farmers as bookies! In other words, whether a farmer uses seasonal forecasts or not, they have to manage for a range of possible outcomes.

Dr White said the previous *Masters of the Climate* survey was just after the 1997 drought.

“It is interesting to see how many of the farmers realised that there was a big difference in the two events,” he said.

“During 1997 we experienced a major El Niño event but not as serious or widespread a drought as 2002 – a less intense El Niño event as shown for example by SOI values. This shows the need to take a broader view of drought experience and look back over a longer period.”

As part of the new project, Jessie’s aim was to discover how farmers who had previously been working out ways to manage climate variability had coped in the severe drought of 2002. She set out across the country to take in the full spectrum of experiences and, in the process, find out what climate variability methods had worked and which tools had done the test of time and were still in use.

Interestingly Jessie found that climate change was rarely discussed in 1999; in 2004, however, it’s a different story.

“Most farmers believe that climate change is the cause of increasing climate variability and they are developing different ways of dealing with this uncertainty.

Another of Jessie’s observations was that, since the drought, farmers are taking opportunistic rather than long term approaches to farming decisions.

“They are watching weather patterns and forecasts closely and are ready to act in response to what happens on the ground,” Jessie said.

Dr White said climate change is increasingly being seen as a ‘now’ issue.

“There is now general recognition that temperatures are increasing,” he said. “But most of Australia has such high rainfall variability, that trends are hard to detect.”

The case studies developed as a result of Jessie’s interviews are to be published in the special climate issue of *Australian Landcare* magazine, and also in the March 2005 edition. In addition, the case studies, photographs and video footage will be distributed to Landcare groups in early 2005.

... www.managingclimate.gov.au

MCV million dollar boost

Further Managing Climate Variability (MCV) projects are being developed in conjunction with the Department of Agriculture, Fisheries and Forestry to accelerate the uptake of tools for improved climate risk management.

Additional Australian Government Natural Heritage Trust funding of \$1 million from the department was announced in June 2004.

New faces for MCV

Anwen Lovett has recently been appointed as the Manager, Sustainable Primary Industries within Land & Water Australia, and as such will have responsibility for management of Managing Climate Variability activities. Catherine Viljoen has been appointed as Program Officer for the program, replacing Melanie King.

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Irrigator banks on climate risk management tools



Northern NSW irrigator John Hamparsum is matching paddock moisture content using neutron probes with seasonal climate forecasts to improve watering regimes for crops such as cotton.

In the face of a permanent reduction in his groundwater irrigation licence, John Hamparsum, an irrigator from the Tamworth region in northern NSW, is learning to minimise the amount of water he needs and keep it 'in the bank' until dry times with the help of weather and climate forecasting tools.

John's 1480 hectare property, 'Drayton' at Breeza, produces irrigated and dryland cotton, sorghum, sunflowers and wheat. As a result of a new water sharing plan for the district, the Hamparsums are facing a 69 per cent permanent reduction in their groundwater irrigation licence as of July 2005.

"The information we're getting on weather and climate is going to be even more important to us when we lose a large portion of our groundwater licence, because we're going to be in the lap of the gods as far as rainfall goes," said John.

"Previously irrigation has been a saviour during drought – it's going to be a massive change for us to adjust to not having as big a tap."

Having had a number of years to adjust and plan for the new situation, John has explored new technologies and approaches to keep the farm sustainable after the change. One of these approaches is matching neutron probe technology with weather forecasts.

Under the system, a neutron probe is lowered into an aluminium tube in the ground sending neutrons into the soil which bounce off hydrogen ions. The number that comes back is then downloaded into a computer showing soil moisture content at various levels.

"The process is repeated two days later enabling you to work out how many millimetres a day the crop is using so you can then predict when you are going to run out of moisture," John said.

"With that information, you know how many days you are from an irrigation and you can use it in conjunction with weather forecasts. For example if we are 10 days away from irrigation but there is a possibility of rain in seven days, then I would keep watching the weather and perhaps save myself a watering by not going out early and missing the benefit of the rainfall."

John is also interested in the local Kamilaroi people and indigenous understanding of climate.

"Indigenous Australians have had 40,000 years experience in this climate and I think it is important to tap into their knowledge of climate and integrate it with modern science," he said.

"My father learned a few things from an Aboriginal local about monitoring native plants, which he passed on to me. Native trees can suddenly put out shoots in the middle of a drought – when this happened in the last drought I made a note of it and usually within five to six weeks we had a rain event.

"Although this drought was far too severe for it to make much difference, at times it helped us to make irrigation decisions or to wait to try to pick up some rainfall."

John is also a firm believer of more research into Australian weather and climate.

"We need the best science available, particularly in relation to climate change. This means we have got to invest more money in research so we can understand our weather and where it is going."



How valuable are seasonal forecasts?

By Dr Barry White, Managing Climate Variability R&D Program coordinator

A growing number of farmers taking seasonal forecasts into account in farm decisions have a consistent answer when asked about climate and risk management: *"It depends, how big is the shift in the odds?"*

One of the Managing Climate Variability research projects in the *Land, Water & Wool Program** has used a shift to about two out of three in its research, based on grazer surveys.

This means that instead of the usual equal chance of above or below the median, the research has found a shift from 50 per cent to 66 per cent (to about two out of three) is enough for many farmers to shift into gear.

The question then becomes: *'How much is that 16 per cent shift worth?'*

El Niño and *La Niña* events, which each occur on average about one year in four, can shift the odds from 50:50 by up to 30 per cent in much of eastern Australia during winter and spring.

It is interesting that another Land Water & Wool project showed that graziers in western New South Wales and Queensland who took more note of seasonal climate forecasts were happy to respond to smaller shifts in the odds than those who rated forecasts less useful.

An unpublished study by the Mackinnon group at University of Melbourne has claimed the Bureau of Meteorology seasonal outlooks are not valuable, largely because they do not produce big shifts in the odds often enough. The six-year sample used as an example had about 20 per cent of forecasts with more than a 10 per cent shift from the 33 per cent baseline.

The Mackinnon study used a Cost/Loss approach to demonstrate lack of value. In contrast, there are many examples where seasonal forecasts have been shown to be of value using models simulating up to a hundred years of SOI-based forecasts.

* (Land Water & Wool is an initiative of Australian Wool Innovation Ltd and Land & Water Australia).

A Cost/Loss example

With a simple budgeting approach such as Cost/Loss, it is easy to show some of the principles involved in evaluating a forecast, and even draw some general conclusions. Of course, there will often be better tools than Cost/Loss, but they are more complex.

As Table 1 shows over six seasons, the assumption is made that a farmer will invest at a COST (C) if a DRY season is forecast in order to avoid a LOSS (L) if a DRY season eventuates.

Using this example, let's assume a farmer (Farmer A) uses seasonal forecasting as part of his business decision making, while his neighbour (Farmer B) does not.

Table 1 shows out of six seasons, on average three will be WET (above average rainfall) and three will be DRY (below average rainfall). Let's assume on average three seasons are forecast as WET and three forecast as DRY. But the forecast system only gets two out three right, so we need six years to be across all the possible combinations of forecast and outcome. One of the three forecast WET years is actually DRY and one of three forecast DRY year ends up being WET.

When the forecast is DRY, Farmer A invests in a drought reserve and incurs a COST in order to avoid a possible LOSS. For two out of the three forecast dry years the drought reserve is used and the LOSS avoided. Farmer B doesn't respond to the forecasts and incurs a LOSS in two out of the three forecast DRY years.

When the season is forecast as WET, neither farmer takes any action. Therefore both incur losses in the one year it turns out to be DRY. However, importantly, this is the only LOSS year for Farmer A in six years, while during the same period, Farmer B suffered three.

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Why pan evaporation matters

Pan evaporation is a measure of the atmospheric demand, commonly called potential evapotranspiration, rather than actual evapotranspiration. Small 'pans', approximately 120 centimetres in diameter and 25 cm deep, have been established around the world to measure evaporative demand. There are approximately 40 such pans in Australia with suitable long-term records.

Pan evaporation is a formal measure of evaporative demand and is generally between one and 10 millimetres per day, depending on conditions. The measure, which is recorded each day typically at 9.00am, can be significantly affected by the amount of energy from the sun, the humidity deficit in the atmosphere (a function of temperature) and wind speed and direction. The impact of shade,

birds (with a bird guard) and other influences must also be taken into account.

It is important to distinguish between potential evapotranspiration and actual evapotranspiration. For example, during a drought, pan evaporation can be very high, but actual evaporation can be zero due to lack of rainfall and soil moisture.

Long-term trends are difficult to identify because the standard pan changed during the 1960s and many old records are of poor quality. This compares with temperature records which date back to the 1890s and therefore offer researchers a much higher level of confidence in detecting long-term trends.

Savings from using the forecasts = 2 Losses – 3 Costs

If we assume the COST of drought preparations is \$10,000, and the LOSS incurred during a DRY year with no drought reserve is \$20,000, Farmer A will spend \$30,000 on drought reserves and incur one \$20,000 loss by following the seasonal forecasts – a total of \$50,000. Farmer B, who does not use seasonal forecasts, incurs three losses at \$20,000 each – a total of \$60,000.

So the return for Farmer A for using seasonal forecasting is \$10,000 over the six years, the difference between the two losses the farmer avoided (\$40,000) and the costs of reserves to avoid that loss (\$30,000). The saving represents a 33 per cent return on the additional \$30,000 cost of the drought reserve.

The forecast's value

Whether a particular forecast is valuable will clearly depend on the shift in the odds and on the ratio of the costs and losses. Intuition would also tell you that much. But the above example can be used to conclude two further things:

- In general, forecast systems with modest shifts in the odds can have considerable value; and
- The percentage return on extra costs to avoid losses can be up to twice the shift in the odds for the case when the forecast is of above or below median rainfall.

And there is a bonus. As Table 1 shows, there is less variability in the expenses for the forecast system. The simple analysis has shown, for shifts not all that infrequent, there can be a significant return on costs to reduce the losses from adverse seasons.

Similar results can be demonstrated for responses to forecasts of favourable seasons.

We can therefore conclude that when the odds show a significant shift in the chances of either a wetter or drier season, it is time to shift into gear and look for profitable opportunities to make use of the shift in the odds.

Table 1: Example of the Cost/Loss approach over six hypothetical seasons

Savings from using a forecast of a WET or DRY season		
(The chances of a dry season are assumed to be two out of three when a dry season is forecast, compared with one out of two for all years).		
Outcome (6 forecasts)	Farmer A (uses seasonal forecasts)	Farmer B (Seasonal forecasts not used)
	Forecast = DRY	
DRY	C	L
DRY	C	L
WET	C	
	Forecast = WET	
WET		
WET		
DRY	L	L
TOTAL EXPENSES	3C + L	3L

\$ SAVINGS FROM USING THE FORECAST

Investing a COST (C) to avoid the potential LOSS (L) when a DRY season is forecast = $2L - 3C$.

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➡ www.managingclimate.gov.au

ClimEd launched

A *Managing Climate Risk* training package funded through FarmBiz and developed by Queensland Department of Primary Industries and Fisheries and AgForce Queensland was launched at the Brisbane exhibition in August.

The course has been developed with input from a range of organisations and farmers around Australia. Known as *ClimEd*, the package will fill a gap; courses were available at University and at 'Level 3' but there were no accredited courses available at the farm business management level (i.e. Level 5).

The roll-out of *ClimEd* is being led by industry through AgForce Queensland. *ClimEd* has inputs from industry, teaching, and research so that the course is practical, based on principles of lifelong learning, and has cutting-edge science and technology. Several organisations are now ready to deliver.

➡ **AgForce Queensland, agforce@agforceqld.org.au**
➡ **Department of Primary Industries and Fisheries, callweb@dpi.qld.gov.au**



NHT projects provide new insights into climate variability

In this edition of CLIMAG, the Managing Climate Variability R&D Program profiles the 12 projects funded by the Natural Heritage Trust (NHT) as part of the previous Climate Variability in Agriculture R&D Program.

For further information about any of the projects listed, visit www.managingclimate.gov.au

SUMMARY OF COMPLETED PROJECTS

ABA11 An Enhanced ABARE System for Predicting Farm Performance

Principal investigator: Dr Philip Kokic, ABARE

This project established a statistical relationship between two biophysical measures of climate variability and an index of whole-farm yield used in ABARE's farm income simulation model (Kokic et al. 1999, 2000). The results of the work are promising, and very strong statistical relationships have been established for most broadacre agricultural regions across Australia.

ANU41 Improved water management incorporating risk and climate awareness

Principal investigator: Professor Tony Jakeman, ANU

Using the Namoi Basin in NSW as a case study, the aim of this project was to examine the gains that can be obtained for water allocation mechanisms and water use efficiency using knowledge from streamflow forecasts. The project combined hydrological forecasting, hydro-economic modeling and human values. The study revealed significant barriers to widespread adoption of such forecasting tools, barriers which reflect both the nature of the forecasts themselves and the complex nature of decision-making in any rural agricultural enterprise.

BOM7 DroughtCom – Improving drought management through better communication

Principal investigator: Mr Neil Plummer

In July 2003, the Commonwealth Bureau of Meteorology (BoM) held a two-day workshop which drew together farmers and climatologists with specialists from agriculture, water management, natural resources, fire and land management, the media and other stakeholders. The aim of the workshop was:

- To record and analyse the communication strategies used during the current drought; and
- To develop improved strategies for communicating climate information in order to enhance the ability of Australians to manage with climate variability, including climate change.

The workshop identified seven key areas that required attention (and included recommendations) in order for Australia to move forward in better communicating climate information.

CLW61 Seasonal climate forecasts for risk-based irrigation area and environmental management

Principal investigator: Dr Shabaz Khan, CSIRO

The objective of this project was to help understand the value of the seasonal forecasts to rice-based cropping systems the Murrumbidgee Catchment of NSW. Key outputs included:

- A review of the current seasonal forecasting methods for water allocation and environmental management;
- Study of El Niño Southern Oscillation (ENSO) effects (SOI and SST) on rainfall and run-off in South-East Australia;
- Use of seasonal forecasts for risk-based cropping decisions to maximise potential from irrigation; and
- Identification of economic and environmental benefits of currently available seasonal forecasts and barriers to their use by irrigators, irrigation area managers and state and federal water managers.

CLW62 Incorporating climatic variability into the assessment of alternative vegetation patterns

Principal investigator: Dr Hamish Cresswell, CSIRO

This project analysed the interactions between (a) topographic position, (b) climate variability, and (c) vegetation growth, yield, and water balance using a simulation framework which explicitly incorporates lateral flows of water between topographic elements in parts of southern NSW. Project outcomes included an assessment of risks and benefits of siting alternative land uses in different topographic positions to meet both environmental and production goals in a way that considers climate variability.

CSE16 Enhancing NRM by incorporating climate variability into tree establishment decisions

Principal investigator: Dr Deborah O'Connell, CSIRO

This project investigated the effect of seasonal climate variation on revegetation and forestry establishment and the effect of long-term climate change on tree establishment. Based in northern NSW and south-east QLD, the project recommended species and establishment techniques for a range of plants matched to sites and future climates.

KON5 Enhancing NRM by incorporating climate variability into tree establishment decisions

Principal investigator: Mr David Buckley (for Kondinin Group)

The January 2004 edition of Farming Ahead magazine included a 15-page insert on 'Climate Risk for Graziers'. The insert has a particular focus on southern Australia and showed that graziers rely on many tools including rainfall records, monitoring pasture growth, and seasonal climate forecasts. Knowledge of current pasture growth and soil moisture is important in determining the implications of a particular seasonal forecast.

QNR 31 Managing agricultural systems in a variable non-stationary climate Part 2: grazing systems

Principal investigator: Mr Steven Crimp, QDNR&M

This two-part project (QNR 31 and QPI 148) assessed recent climate trends and explored the resultant impacts on the cropping and grazing industries. In addition, a consideration of the implications of current and projected climate changes for on-farm and government policy decisions was addressed.

The research undertaken for this project (grazing systems) was focused on the Burnett district in Queensland where the analysis of raw rainfall and temperature data revealed a number of important issues regarding climate trends.

QPI 148 Managing agricultural systems in a variable, non-stationary climate – Part I: cropping systems

Principal investigator: Dr Holger Meinke, QDPI (APSRU)

This project (cropping systems) concentrated on climate data gathering and quality checking and the establishment of the simulation approach needed for simulating a north-south transect through the cropping regions of north-eastern Australia.

QPI 49 Sponsorship of the National Drought Forum – Science for Drought

Principal investigator: Dr Roger Stone, QDPI (APSRU)

The Forum gave researchers the opportunity to review the state of the science in the aftermath of the record 2002 drought. The Forum proceedings include 26 papers on a wide range of topics including climate change and the extent to which droughts are more severe, research in climate variability, and reviews of how farmers are using science to inform their risk management.

Science for Drought – Proceedings of the National Drought Forum, Brisbane, April 2003, (edited by Roger Stone and Ian Partridge), Queensland Department of Primary Industries. 173 pp.

Targeted seasonal forecasts: delivery via RAINMAN and the web

Principal investigator: Dr Jeff Clewett, QDPI

This project sought to empower Australia's rural and regional communities to make better use of existing climate information and seasonal forecast technology. It has done this by promoting the RAINMAN StreamFlow software (Clewett et al. 2003) as a way to evaluate climatic risks and target the use of seasonal climate forecasts for management decisions. A great strength of this package is the seasonal forecast capabilities based on El Niño/Southern Oscillation (ENSO) using the Southern Oscillation Index (SOI) and Sea Surface Temperatures (SST) as predictors.

Final reports of all projects can be accessed from the Managing Climate Variability R&D Program website.

➤ www.managingclimate.gov.au

Victorian Climate Priority

In its White Paper on Water, the Victorian Government has made a commitment to participating in research which is aimed at:

- Determining the key factors affecting climate for different regions of Victoria; and
- Improving the understanding and predictability of key climate parameters for specific regions over a range of time-scales (eg. short-term, seasonal, multi-seasonal, annual, inter-annual, and longer term).

The climate priority is part of *Our Water Our Future*, an action plan to enable smarter water use and management across the State.

The plan is driven by recent trends: 'Eight years of low rainfall, a growing population, climate change and degrading river systems have shown why the State needs new and better ways to secure water for the future.'

➤ <http://www.dse.vic.gov.au/dse/nrenlwm.nsf>

Indian Ocean Climate Initiative (IOCI)

The August meeting of the Indian Ocean Climate Initiative (IOCI) in Perth presented a diversity of material on global circulation which reinforced the association between the 70s changes in circulation and observed change of the South West WA rainfall regime.

The meeting also heard several new insights into these changes and possible causes. Natural variability and the Enhanced Greenhouse Effect remain as likely prime contributors through impact on the large scale circulation. Local influence from land clearing is not discounted.

➤ See Bulletin No 5 <http://www.ioci.org.au>

AGO call on Agriculture and NRM

The Australian Greenhouse Office (AGO) is calling for Expressions of Interest for research and development that addresses identified priorities in agriculture and natural resource management in relation to managing greenhouse gas emissions and responding to climate change. The Strategic R&D Investment Plan forms a major component of the innovative R&D to be conducted as part of the Greenhouse Action in Regional Australia Programme.

➤ <http://www.greenhouse.gov.au/agriculture/rdplan.html>



STOP PRESS ...

Managing Climate Variability R&D Program

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Farmer-friendly workshop a success for delegates from 'down under'

An Australian delegation successfully participated in a major workshop in California recently hosted by the US National Academy of Sciences for Harvard University's John F. Kennedy School of Government. The workshop was investigating decision-support systems for seasonal to inter-annual climate forecasting.

Dr Barry White from the *Managing Climate Variability R&D Program* accompanied Holger Meinke (QDPI/APSRU), Peter Hayman (ex-NSW Agriculture, now with SARDI), and Queensland farmer Wayne Newton to the event, which had an underlying theme of 'What characteristics of forecasting and decision support systems lead to effectiveness?'

The quartet presented a case study on the Queensland and Australian experience.

Wayne Newton's experience of the event was overwhelmingly positive. The key message from the workshop was the importance of a user partnership. As a farmer Wayne said what was important to him was managing risk; seasonal climate forecasts had to fit into that context.

... www.managingclimate.gov.au

Climag calendar

16th Australia New Zealand Climate Forum (ANZCF2004)

8–10 November 2004, Lorne, Victoria

ANZCF2004 brings together climate science researchers with users of strategic climate information. Recent droughts have focused attention on the importance of water.

... www.bom.gov.au/events/anzcf2004/

Keep up to date with climate events and conferences.

... www.managingclimate.gov.au

2005 AMOS National Conference

31 January – 4 February 2005, Canberra, ACT

Australian Meteorological and Oceanographic Society – the 2005 AMOS National Conference will be held at the Australian National University in Canberra from 31st January to 4th February 2005 forming part of the Australian Institute of Physics Congress.

... www.amos.org.au/2005_AMOS_Conference.htm

Pan evaporation workshop: An example of the detection and attribution of trends in climate variables

22–23 November 2004, Canberra, ACT

A workshop to be held at the Shine Dome, Gordon Street, Canberra, ACT

Arranged by the National Committee for Earth System Science. Sponsored by the Australian Greenhouse Office and the Australian Academy of Science.

... <http://www.science.org.au/natcoms/panevap1104.htm?casid=13961>

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Further information about the program can be found at the website www.managingclimate.gov.au

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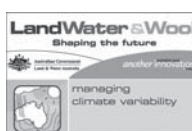
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Land & Water Australia
Rural and Industries
Research and Development
Corporation
Sugar Research and
Development Corporation



Grains
Research &
Development
Corporation



The voice of Australian farmers for 25 years

