VCCCAR think tank report

Climate services for adaptation in Victoria

A joint think tank from the Victorian Centre for Climate Change Adaptation Research and the Bureau of Meteorology

vcccar
victorian centre for climate change adaptation research

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Cover photo
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Executive summary

Provision of information on climate and weather is important as it contributes to economic and societal resilience in Australia and worldwide. 'Climate Services' involve managing meteorological data, deriving products that describe climate and applying these products for social, economic and environmental benefit. In adapting to climate change, effective provision of climate services requires presenting information relevant to long-term planning and early warning of significant climate risks.

Understanding and predicting weather and climate requires strong international cooperation. International meteorological bodies have initiated a process to reconsider the way information is managed and presented to help achieve greater societal benefits and assist communities and industries adapt to climate change. The Global Framework for Climate Services aims to make climate information accessible and easier to use.

This think tank brought together 36 participants from the Bureau of Meteorology (BoM), Victorian State Government departments, local government, research and academic institutions and industry users of climate information. The three goals were to:

1. assess the current situation on climate information and adaptation
2. build a greater common understanding of the expectations of climate information users and the capacity of information providers in providing information for adaption to climate change
3. provide recommendations for policy and guidance for research on improved climate services in a changing climate.

Key findings

There were eight key findings from the think tank discussions.

1. Most users do not distinguish between weather and climate information. The needs for climate information vary considerably among different types of users and for different types of events. Even within a sector such as agriculture, the climate information and advisory needs of different types of farming businesses vary considerably.
2. Communication of climate information needs to be tailored to the ways that intended recipients receive messages about climate. Some users in government agencies and industry are comfortable with more complex written reports or web-based tools, while farmers often prefer radio or other forms of verbal reports. Visual presentation and design is critical (more pictures — less text). Repeated and consistent messaging is important.
3. Too much information may be a problem. People needing to respond rapidly to urgent emergency events such as floods or bushfire require simple checklists that can guide their decision-making in stressful situations.
4. High-impact floods or fire events typically result from a combination of extreme weather conditions and preconditions (either extended drought or rain). This requires different types of monitoring and analysis for effective prediction and is difficult to estimate over the longer time scales relevant to climate change.

5. There are many intermediaries in the 'supply chain' of climate and weather information from the Bureau of Meteorology to potential users. This can include state and local government, emergency managers, private information providers and print, TV and radio media. The roles of these different bodies need to be clearly recognised and understood. Communication among these groups needs to be improved. Different user groups need to build up trust and respect for those people and agencies providing information on climate.
6. Framing of messages about climate is critical to whether and how users take up information. For example, farmers want to talk about drivers of weather and short-term climate variability rather than long-term climate change.
7. The incidence and nature of extreme events are more important than change in average conditions when considering the impact of climate. Extreme events are less easy to predict and less easy to build into climate change scenarios.
8. The density of the observation network can at times limit the ability to provide high-level services. For example, flood forecasting is dependent on the continued availability of sufficient data from observation networks.

Research needs

The following research needs were identified at the think tank.

- Improved understanding and prediction capacity of extreme events and combinations of events that lead to major climate-related emergency events such as flood or wildfire.
- Major bushfires are episodic and operate on a different time scale from climate change. More analysis is required of bushfire incidence, climate variability and past patterns or events.
- There is a complex set of psychological and social issues that lie between climate information and decision-making. Improved understanding of how to frame weather and climate communication messages is required to increase engagement and response from different types of user communities.
- Better climate and sea level information is required to improve long-term planning and control development in coastal settlements that are vulnerable to flooding and sea level rise.

Policy recommendations

- Local government and regional bodies have a potential role to communicate with and educate the local community about climate.
- The Victorian State Government might introduce school education programs on climate to increase understanding of and response options to climate risks.
- Investment is required for improved prediction services for extreme events, such as the Hazard Warning Service in the USA.
- The Victorian State Government could implement policies to foster communication and networking between the BoM, government agencies and other climate services users through activities such as the Seasonal Bushfire Assessment Workshop.
- Policy arrangements should consider supporting climate risk management using financial products (e.g. weather derivatives).
- Policy should support the role of the private sector in presenting targeted climate and weather information to different types of user groups.
- Weather-related warnings and communication should consider that many people living in areas exposed to bushfire and flood are newcomers who do not have a long-term history with, or understanding of, the landscape.

Think tank evaluation

- Seventeen participants (44%) filled out an evaluation of the event (Appendix 15). The overwhelming majority of respondents (94%) rated the scope and relevance of the issues discussed at the think tank as either 'good' or 'excellent'. Eighty-two per cent agreed or strongly agreed that the event improved their understanding of the role of the BoM in providing climate information relevant for long-term planning and climate risk early warning. Participants responded positively to the use of 'front line' researchers and planners as presenters and the emphasis on the development of practical services.
- Other respondents felt the structure of the think tank could have been broadened to include a greater emphasis on user needs for climate services as well as more background information on past experiences in using climate services. There were suggestions that the event was too focused on the National Meteorological Services to the detriment of discussion on urban planning. Participants advised the event would have benefitted from greater industry attendance and participation.
- Overall, the think tank was highly rated and all participant observations provided useful guidance for the Victorian Centre for Climate Change Adaptation Research (VCCCAR) to move forward with the issues raised and for future event planning.

Introduction

The Bureau of Meteorology (BoM) contributes to national social, economic, cultural and environmental goals by providing observational, meteorological, hydrological and oceanographic services. The BoM also undertakes research into science and environment related issues in support of its operations and services. Data are made available to generate products that range from copies of basic climate data, through to providing processed datasets and a diverse suite of climate summaries, atlases and specialised analyses in various forms.

Climate services encompass a range of activities including:

- managing meteorological and related data collected by the BoM
- deriving products from the data that describe Australia's climate
- developing techniques for applying the data in a wide range of social, economic and environmental contexts
- providing information and advice to the general public and specialist users about the nature of climate in general and Australia's climate in particular.

This think tank brought together 36 participants from the BoM, Victorian Government departments, local government, research and academic institutions and industry. The three goals were to:

1. assess the current situation on climate information and adaptation
2. build a greater common understanding of the expectations of climate information users and the capacity of information providers in providing information for adaption to climate change
3. provide recommendations for policy and guidance for research on improved climate services in a changing climate.

Introduction: Professor Rod Keenan - University of Melbourne and VCCCAR Director

In introducing the speakers, Rod provided an introduction to Victorian Centre for Climate Change Adaptation Research (VCCCAR) and explained that the three goals of the think tank were to:

1. direct policy and practice and inform further research
2. derive clear ideas about the direction of climate services
3. provide recommendations to improve data services from data providers including the BoM.
4. Rod asked the participants to reflect on their reasons for attending the think tank. Several participants shared their motivations for attending, which included:
    - understanding the implementation and education systems around climate information and the challenges these pose for adaptation
    - better sharing of data and research to enable researchers to conduct more efficient and consistent adaptation studies
    - exploring an interest in the natural resource management (NRM) aspects of adaptation.

Rod then emphasised the importance of understanding how users interact with climate information and how a local understanding of climate and its interaction with the broader ecological and social systems can assist in adaptation planning. The BoM, as a co-sponsor for this think tank, is at the forefront of providing data and generating information as well as communicating to a diverse range of stakeholders.

Speaker 1: Dr David Walland - Manager of Climate Data Services at the BoM and Representative for the WMO GFCS

David Walland provided an introduction to the Global Framework for Climate Services (GFCS), a new initiative led by the World Meteorological Organization (WMO) to enable climate information to be more accessible and usable. The main objective of the GFCS is to develop a co-ordinating framework that uses existing programs and activities and matches the resultant climate information to the needs of users. Of key importance is a mutual understanding of the role and usability of climate information and its potential to inform decision-making. The GFCS is not a new system to deliver all of this, but uses existing infrastructure including the Global Climate Observing System (GCOS), World Climate Research Programme (WCRP), Global Telecommunications System (GTS) and Global Data-Processing and Forecasting System (GDPFS). These programs will improve the capacity to deliver climate services globally. The GFCS will enable these other global programs to better deliver information to the community and avoid duplication of effort.

The GFCS also focuses on building capacity, not just in developing countries but also across the wider user community. National Meteorological Services (NMS) will need to engage with the user community under the GFCS; however there may also be information distributed at a global level directly to other organisations such as the World Health Organization (WHO). The WHO will share information through its own Members.

Documents for the GFCS are currently being produced and are due for endorsement during October 2012, including an implementation plan. Dave encouraged participants of the think tank to take part in the open review process. The report is available at www.wmo.int/hlt-gfcs/

Dave concluded the presentation with the following questions:

- How should climate services be set up in Australia?
- What institutional arrangements would facilitate the best possible engagement and service such as consultative committees or a national implementation plan?

Discussion points raised

Partner countries participating in the development of GFCS are keen to see priorities delivered at all levels from global through to local. UN Agencies have experience in delivering projects at the global level. At the national and local levels, relationships with agencies like the BoM and its users will be important to delivering the outcomes of the GFCS.

The GFCS has helped identify a broad range of potential users. The benefit of having one provider agency, for example an NMS, to engage with has been proven. Many users do not distinguish between weather and climate data and so the BoM is in a key position. The GFCS aims to improve user engagement through mutual understanding between providers and users. The challenges will be getting decision-makers to take notice of climate information and presenting the information in a way that is easily used by stakeholders, particularly those who require information at a local level.

Discussion at tables raised the following points:

- there is a need to better integrate and implement the process of disseminating information to stakeholders, such as having centralised body for certain industry-specific information
- local government has a role in educating and communicating with users
- there is a need to reduce the disconnect between policy and user needs.

Case study on agriculture

Speaker 1: Graeme Anderson - Senior Subject Specialist - Climate Change, DPI, Victoria

The work of the Department of Primary Industry's (DPI's) industry extension program provided an excellent starting point for the case study on agriculture. Graeme explained that the DPI's Climate Change Team focused on building capabilities within the organisation about climate. The extension program also delivered innovative services to the community. These included hosting numerous workshops and seminars across Victoria over the past 4 years. The BoM has also developed email and web-based products to communicate their information and products and help users understand these products better. Recent surveys conducted by the DPI indicated that the BoM's products and services have helped users improve their awareness and understanding of climate variability, local climate drivers and large-scale systems.

Graeme emphasised that much of the work has identified the importance of framing climate information. For example, using climate variability or climate drivers elicits a much better response in the farming community than starting the discussion with climate change. The DPI has also tried to help stakeholders see the benefit and relevance of climate information to their industry. An 'upscaling' technique developed by DPI relates local temperature and rainfall time series to large-scale climate drivers such as the El Niño Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD). This approach has received positive feedback from stakeholders.

A particular challenge DPI identified with the agricultural sector was the need for short-term outlooks for the month, season and year. Some key themes for the effective provision of climate services include improving information timeframes, including providing predictions in the short term (days), as well as seasonal (months) and longer term (years) trends. Focusing on the information needs of different users such as farmers, industry and the supply chain is essential. It is also essential to improve the capacity and literacy of the community through the use of 'trusted messengers' — these are organisations with the authority and experience to provide reliable and useable climate information.

Speaker 2: Dr Leanne Webb - Climate Scientist and Viticulturist, CSIRO

Leanne explained the impact that climate and weather has on perennial horticulture. Greenhouse-induced changes to wine grapes poses a threat to viticulture on longer time scales. Interseasonal weather and climate information can also affect berry growth, composition and water use, for example.

The timing of heatwaves, frost and extreme fire weather are important determinants of crop quality and the quality of the wine produced. Information that can inform decision-making at seasonal time scales and shorter, particularly around harvest time, is incredibly important to the industry.

Speaker 3: Dr Andrew Watkins - Manager, Climate Prediction Unit, BoM

Andrew explained some of the BoM's existing and developmental services for agricultural industries. The BoM produces three kinds of climate services for agriculture: real-time data, information on weather and extremes, and data for understanding local and long-term climate trends. For example, the ENSO Wrap-Up looks at the season ahead and together with the Seasonal Climate Outlook (SCO) provides valuable information to decision-makers. Information about extremes is useful in weather planning and analyses across areas such as the Murray Darling Basin and can be useful for short-term decisions such as irrigation management. One of the most significant challenges is educating users how they can use climate information when making decisions.

The BoM is currently developing a prediction service for multi-week time scales to enable better preparation for extremes. This product has the potential for offering a Hazard Warning Service similar to that currently offered in the USA.

For the farming community there is a current preoccupation with shorter term adaptation — minimising losses during extremes and maximising benefits during favourable periods.

Transforming data into intelligence for stakeholders to incorporate into their decision-making is a fundamental component of the BoM's service.

Discussion points raised

Discussion at tables raised the following points about agriculture and climate services:

- relationships between information providers and users are important for ensuring uptake of information
- framing of communication is fundamental to engagement and understanding
- formally recognised communication and delivery channels are essential
- there is a need to better understand how people currently access climate information
- farmers are business operators — organised and more competitive farmers use the best current data for decision-making but competition may prevent full sharing of information with others in their business community
- risk management using financial products (e.g. derivatives) is largely unknown in Australia compared with other countries
- climate change communication requires transformational change
- organisations should focus on providing certain aspects of climate information and communication well and allow other organisations (including in the private sector) to tailor information for industry groups
- concern about climate change adaptation depends on organisation size — individuals are less likely to be concerned about adapting to climate change
- means of communication are important; for example, farmers may choose to obtain more information from radio than from newsletters or other print publications
- the agricultural industry is one of the best users of climate information as the industry works on a short-term horizon and there is an immediacy of impact on businesses
- climate information is important for risk and business management regardless of the overall climate change debate.

Case study on bushfire

Speaker 1: Fred Cumming - DSE, Victoria

The land area of Victoria is over 21 million hectares, of which one-third is public land. Managing the fire risk for this land is an important role of Department of Sustainability and Environment (DSE). The major cause of bushfires on public land is lightning, especially when accompanied by dry conditions. Understanding how often these conditions have occurred in the past and how they may change in the future is fundamental to managing future bushfire risk.

The likelihood of conditions conducive to bushfires occurring and the timing and the scale of the event are all-important variables that can affect seasonal planning for emergency services as well as planning by local communities. Information about the amount and distribution of rainfall in time and space is of particular value. Changes to wind patterns and understanding the influence climate change will have on vegetation ecology and biodiversity are also important. This information would allow research into changes to burning regimes and potentially inform decision-making around land use planning.

Climate information can assist in prioritising planned burns and strategic planning of resourcing in the short and long terms. Seasonal outlooks over 3–6 months and longer term projections for the next 2–3 years and 10–20 years are the most essential climate time scales for bushfire management.

Speaker 2: Professor Jim McLennan - Senior Research Fellow, School of Psychological Science, Latrobe University

Jim is a psychological and behavioural scientist who has been involved with conducting 500 interviews with survivors of the recent Black Saturday and Western Australian bushfires. The research was designed to get a better understanding of who we are warning about bushfires and discover what they know about bushfires in their area.

The research identified that despite saturation coverage by the media prior to the Black Saturday events of 7 February 2009, only 50% of the people interviewed were aware of the full danger of the event and around 20% had no awareness of the warnings. Depending on the location of their property, the respondents' awareness levels for the event were broken into three groups with high awareness reported in rural and town fringe locations and no awareness reported by those living in urban areas.

Of the people who were aware of the warnings for the event, only 80% were prepared. Of the people interviewed approximately half stayed and defended. Of these, 80% were successful with the remaining survivors fleeing, often at the last minute.

More information about these interviews can be found in the report on the Bushfire Cooperative Research Centre (CRC) at www.bushfirecrc.com/resources/presentation/how-householders-make-decisions-during-bushfires

The learnings from this study for climate information services are that the message can go out to the community but the awareness levels of the public need to be factored in. Many people are not interested in warnings unless there is certainty that the event will impact on them. People respond to methods of receiving information differently. For example, some required text messages or door knocks before recognising the seriousness of the event. The communication streams for information are essential if people are to understand messages and put actions into place.

Speaker 3: Dr Chris Lucas - Researcher, CAWCR

Chris concluded the case study for bushfire by summarising the research that has been taking place over the last few years at the Centre for Weather and Climate Research (CAWCR) in conjunction with the Bushfire CRC. This research has focused on gaining a better understanding of fire weather conditions and behaviour. Chris has been involved in developing the historical fire weather dataset for Australia, which is a station-based dataset using 38 high-quality sites.

Weather indices have been linked to property loss to estimate risk levels of events. An example of this is the Forest Fire Danger Index (FFDI), which when exceeding the value of 50 has been linked to events with significant loss (more than 10 houses). Chris is also working with Geoscience Australia to grid the data and estimated return periods. Research in these fields is still ongoing but can provide valuable information to emergency services about the scale of a forecast event and allow for better event planning.

Currently research is being conducted to identify the climate drivers of FFDI variability and how large-scale atmospheric circulations (e.g. ENSO and IOD) can influence bushfire seasons. The conditions experienced in the early 2000s may, for example, be indicative of average conditions in 2050.

This research can be used to inform decision-making but better working relationships still need to be established with the end users to ensure that the information provided and analyses conducted are fit for purpose. Currently the BoM is working with other agencies to establish a regular Seasonal Bushfire Assessment Workshop.

Discussion points raised

Discussion at tables raised the following points on bushfire:

- fire information for all stakeholders should be provided through defined channels to ensure that the community receives and acts on vital communications and messages
- an understanding of the likelihood of future fire events and how weather extremes and vegetation profiles may change in future is important to planning
- rational decision-making is difficult in pressured situations and this should be incorporated into communication techniques by agencies, such as by providing checklists and standard procedures
- fuel reduction burning is an important measure to manage bushfire risk – this requires different types of climate information for effective planning and may require different types of warnings, such as air quality
- people relocate and communities change and expand, so it can be difficult to retain important local knowledge about past bushfires in an area
- more people are moving to rural areas with high bushfire risk for 'tree change' lifestyles but have little understanding or awareness of the risks
- research into the science of bushfires is ongoing
- bushfires are episodes that operate on a different time scale from climate change – information about climate variability and past patterns or events is perhaps the most valuable for bushfire management.

Case study on flood

Speaker 1: Rod Keenan - presented on behalf of Andrew Gissing, SES

Climate data inform the emergency management of floods. Recent heavy rain events have occurred in areas with already saturated catchments, creating widespread flooding. It is essential to understand current catchment conditions and how the event forecasts may compare to previous flood events to ensure that communities can prepare. The timing of warnings is also essential for emergency management, with the longest lead time offering the largest planning window. Longer term climate information and forecasts can assist with future planning and risk assessments for flood events.

Speaker 2: Viktor Brenners - Floodplain management, DSE

There are numerous challenges in dealing with floods in Victoria as there is a short historical record and the landscape has changed dramatically within the recording period. The uncertainty associated with the lack of information makes future planning for managing floods very difficult.

As sea level data is also sparse, monitoring sea level rise and event impacts is difficult. Inundation maps are becoming available to catchment management authorities (CMAs) and councils and can assist with planning.

Providing information and sharing knowledge can create issues when appropriate guidance is not provided on what to use and in which situations. The existing tools for decision-making do not necessarily assist with planning activities. This situation needs to be addressed to enable better adaptation planning.

Detailed coastal hazard assessments are currently being carried out at Port Fairy, Corio Bay and the Bellarine Peninsula. The learnings from these projects should provide a good basis for ongoing assessments of coastal hazards, particularly under climate change. The DSE is also contributing funding to the South-East Australia Climate Initiative (SEACI).

There is a need in the community to allow coastal settlements to remain viable while not allowing the future flood problem to escalate. If we plan ahead, we can reduce future impacts by controlling development sensibly, such as by upgrading infrastructure over time.

Speaker 3: Dr Dongryeol Ryu - Senior Lecturer, University of Melbourne

Flood forecasting is being conducted over a range of different time scales and Dongryeol is currently working on a project between the University of Melbourne and the BoM to improve short-term flood forecasting on the scale of a few hours to a week.

The spatial distribution of flood gauges across the network makes analysis difficult. There is a strong relationship between the accuracy of forecasts and the density of rain gauges available for forecast verification. Historical and real-time rainfall records are essential to providing this forecasting service.

Speaker 4: Soori Sooriyakumaran - Manager, Flood Forecasting and Warning Unit, BoM

Soori concluded the presentations in the case study of floods by describing the BoM's role during flood events. The main role of the BoM is to provide flood warnings and forecasts to the community and to collect real-time rainfall and river data. Recent events have indicated that the three levels of government work well together during flood events.

A national flood risk assessment is underway to ensure that changes to flood risk are identified in a timely manner to enable better emergency management planning. This will augment the current state-based systems. New developments in flood warnings will look at continuous monitoring and evaluation of river levels to assess flood risk.

Summary

Professor Nigel Tapper - School of Geography and Environmental Science, Monash University

The think tank achieved its three overall aims. The think tank:

1. assessed current climate information and approaches that individuals and industries are using for adaptation
2. created common understandings of expectations between users of climate change information and the capacity of the providers of that information
3. discussed and recommended policy and guidance for research on improved climate services in a changing climate.

'Climate services' means providing data, services and products to decision-makers who create policy about how to deal with the effects of climate change. David Walland of the BoM gave an overview of developments in the Global Framework for Climate Services (GFCS) and its role in helping those decision-makers manage risks from climate change. A roll-out of the GFCS is still being planned for Australia. A challenge is that the end user base is broad and expanding.

The effects of climate change on the agricultural industry, and on the severity and frequency of bushfires and flood, were examined during presentations and break-out sessions. The presentations are described in earlier sections of this report and in the appendices. Appendix 16 summarises the responses that arose during the break-out sessions as well as recommendations from participants.

For agriculture, recurring themes during discussions highlighted that farmers are extremely proficient adaptors to climate change because their businesses depend on responding to the environment. However, agricultural workers tend to focus on immediate weather variation rather than take a long-term view of changing climate trends. This means that getting the climate change message across through trusted experts and radio rather than print media is important. Equally important is avoiding complex data when communicating messages about climate change. Here, fewer words and more intelligent visuals are key.

Approaching bushfire risk under climate change involves making decisions on forest ecology, burning regimes and land use. Climate data providers need to generate outlooks for the short term (3–6 months, for the duration of the fire season), medium term (2–3 years, climate scale) and for strategic planning in the longer term (10–20 years, on the scale of climate trends).

In bushfires, it is important to understand the behaviour and mindsets of the people likely to be directly affected during a major event — termed 'warnees'. Their behaviour is modified by knowledge of bushfires and expectations of who will help them and when during a crisis event. Many of these people have no experience of bushfire, as they have recently moved to a bushfire-prone area. Further, they are often not interested in warnings unless the danger is immediate and guaranteed.

Fire agencies such as the DSE and the Country Fire Authority (CFA) have particular spatial and temporal data requirements. Data providers such as the BoM need to continue to tailor their information and products for these agencies. Information includes improved real-time data during fire events. While past rules-of-thumb (such as the FFDI) hold, it can be difficult to interpret past fire data because data are inhomogeneous and incomplete; major fires are also infrequent so do not provide constant data.

The importance of providing the right warning information, in the right quantities, in the right language and at the right time is a theme that arises frequently with bushfire as well as flood. Another similarity is that major floods and bushfires typically occur when there are adverse weather conditions on top of adverse climate conditions (extended drought for fire, and extended preceding rain for flood).

Recent Victorian floods have again highlighted that emergency services become quickly overwhelmed at times of a climate-induced crisis. The data providers need to provide monitoring for both preceding and current extreme events. Flood forecasting is dependent on the continued availability of sufficient data from observational networks. The BoM's flood warnings based on real-time rainfall and river data are well supported by modelling — but issues of data quality remain.

Even after recent large fires, it is difficult to communicate the increased risk of more major bushfires. There is also much public scepticism about the link between climate change and fire. Even so, climate science does not provide all the answers about how the climate will change and about the changing risk of bushfires.

This gives rise to the question of responsibility. While it is the responsibility of data providers such as the BoM to monitor climate and weather for catastrophic events, the agencies should not overprotect or remove personal responsibility from the 'warnees', who should make their own decisions about when to act, including whether and when to evacuate. Further, are the agencies being realistic expecting the public to be prepared when the experts themselves are not? In summary, the role of the Victorian State Government is to provide guidance based on information provided by agencies such as the BoM, while local communities need to make the final adaptation decisions.

Appendix 1: Invitation and program

Climate services for adaptation in Victoria

A think tank sponsored by the Victorian Centre for Climate Change Adaptation Research and the Bureau of Meteorology

Date: Friday 13 July 2012

Location: Melbourne Business School, Rooms MLR 1 & 2, 200 Leicester St, Carlton

Introduction

The Bureau contributes to national social, economic, cultural and environmental goals by providing observational, meteorological, hydrological and oceanographic services and by undertaking research into science and environment related issues in support of its operations and services. Date is made available for 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 in a variety of different forms.

Climate Services encompass 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.

In adapting to climate change, 'climate services' involves the provision of climate information that is relevant for long-term planning and for early warning of climate risks.

The aims of this event are to:

(i) assess the current situation on climate information and adaptation,

(ii) build a greater common understanding of the expectations of climate information users and the capacity of information providers in providing information for adaption to climate change, and

(iii) provide recommendations for policy and guidance for research on improved climate services in a changing climate

The think tank will begin with an introduction from David Walland, on international developments in climate services and developments in the Bureau in automating and presenting weather and climate information. The think tank will consider examples of information requirements and potential outputs for case studies in agricultural land management, bushfire management and flood risk.

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Program

9.30 Registration and morning tea.

10.00 – 10.15 Introductions and burning questions

10.00- 10.45 David Walland, 'International developments in climate services and links to BOM objectives, products and services'

10.45 Case study on agriculture
10.45-10.55 Graeme Anderson (DPI)
10.55-11.05 Leanne Webb (CSIRO)
11.05-11.15 Andrew Watkins (BOM)
11.15-12.00 Discussion and report back

12.00 - 1.00 Lunch

1.00 Case study on bushfire
1.00-1.10 Fred Cumming (DSE)
1.10-1.20 Jim McLennan (Latrobe)
1.20-1.30 Chris Lucas (BOM)
1.30-2.15 Discussion and report back

2.15 – 2.30 Break

2.30 Case study on floods
2.30-2.40 Andrew Gissing (SES)
2.40-2.50 Tim Loffler (NECMA)
2.50-3.00 Dongryeol Ryu (Univ. Melbourne)
3.00-3.10 Soori Sooriyakumaran (BOM)
3.10-4.00 Discussion and report back

4.00 – 4.15 Summary and review (Nigel Tapper, Monash)
4.15-4.30 Next steps (Rod Keenan and Dave Walland)

4.30 Close

Questions for discussion

1. Do you think that climate information is currently being used to inform decision making around this topic (bushfire risk etc.)? If so is it being applied appropriately?
2. Do you think the people using climate information understand the data, its limitations and uncertainty?
3. How well are we dealing with current climate variability? How can weather and climate information improve adaptation?
4. What kind of information is needed to improve decision making under current and future climate?
5. How do we integrate and present climate information at different scales?

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Appendix 2: List of participants

Gippsland think tank participants

Name	Organisation
Graeme Anderson	Farm Service Victoria, Department of Primary Industries
Hans Baer	School of Social and Political Sciences, University of Melbourne
Belinda Campbell	Bureau of Meteorology
Lisa Cowan	Service Design Research, Department of Primary Industries
Alison Creighton	Environment manager, Bass Coast Shire
Fred Cumming	Project Officer, Fire Risk Analysis, Department of Sustainability and Environment
Thomas Duff	Forest and Ecosystem Science, Melbourne School of Land and Environment, University of Melbourne
John Edwards	Manager Environmental Sustainability, Bayside City Council
Christine Forster	Primary producer
Peter Forster	Primary producer
Quentin Farmar-Bowers	Research Fellow, Deakin University
Andrew Gissing	State Emergency Service
Philip Ingamelis	Park Protection Project, Fire Project, Victorian National Parks Association
Svenja Keele	Senior Consultant, Environment and Sustainability, Arup
Rod Keenan	Victorian Centre for Climate Change Adaptation Research
Christine Kilmartin	Manager, Sustainability Analysis, Department of Planning and Community Development
Tim Loffler	North East Catchment Management Authority
Chris Lucas	Bureau of Meteorology
Malcolm McCaskill	Department of Primary Industries – Future Farming Systems Division
Gabrielle McCorkell	Mornington Peninsula Shire Council
Jim McLennan	La Trobe University
Tim Morrissey	Senior Policy Analyst, Office of the Commissioner for Environmental Sustainability
Jane Mullett	Research Fellow, Climate Change Adaptation Project, RMIT University
Milos Pelikan	Spatial Vision
Scott Rawlings	Manager, Environmental Monitoring and Analysis, Office of the Commissioner for Environmental Sustainability
Dongryeol Ryu	University of Melbourne
Harvey Stern	Bureau of Meteorology
Soori Sooriyakumaran	Bureau of Meteorology
Jennifer Sutton	Business Development Manager, Commonwealth Scientific and Industrial Research Organisation – Marine and Atmospheric Research Division
Nigel Tapper	Victorian Centre for Climate Change Adaptation Research
Suu Lam Thi Thu	Director, Centre for Social Research and Development, Vietnam
David Walland	Bureau of Meteorology
Andrew Watkins	Bureau of Meteorology
Leanne Webb	Commonwealth Scientific and Industrial Research Organisation
Penny Whetton	Commonwealth Scientific and Industrial Research Organisation – Marine and Atmospheric Research Division
Madeliene Wilson	Catchment Planning, Department of Sustainability and Environment
Tom Worthington	Climate Change Institute and Research School of Computer Science, The Australian National University
Celeste Young	Victorian Centre for Climate Change Adaptation Research
John Zillman	Victorian Centre for Climate Change Adaptation Research – Bureau of Meteorology

Appendix 3: Presentation by David Walland (BoM)

International developments in climate services – Global Framework for Climate Services

David Walland
Bureau of Meteorology

Climate Services For Adaptation in Victoria
Friday 13 July 2012

Overview

- Philosophy and purpose of the GFCS
- What is the GFCS?
- Who benefits and how?
- Key players involved
- Timeline of activity
- Next steps
- Available climate services and information

The philosophy and purpose of the GFCS

- There is a need for better mutual understanding between the provider and user community around the available climate information and the decisions that users make.
  - error bars, uncertainty, limits of usability of the data
  - timeliness, well targeted to inform decision making
- A great deal of climate information already exists
- If there could be better alignment between this information and decisions that users were making we stand to see **better management of the risks of climate variability and change and adaptation to climate change**

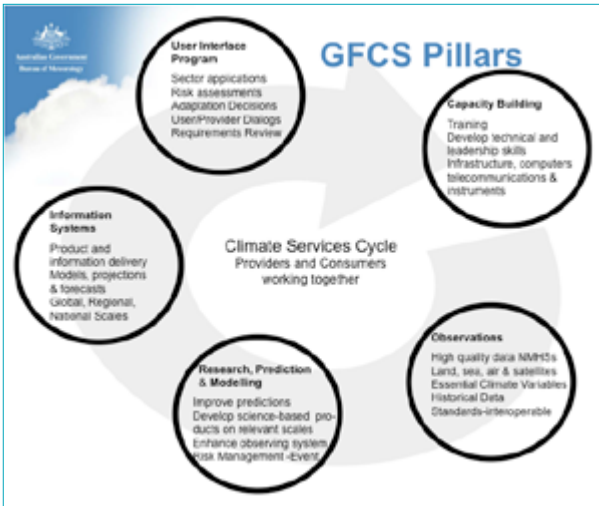
3
http://www.wmo.int/gfcs

What is the GFCS?

GFCS is a coordinating framework

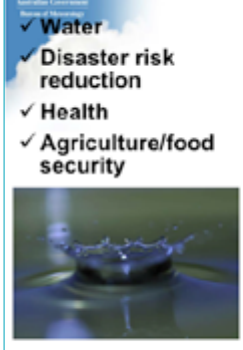
- Not a system that duplicates all of the existing elements.
- Challenge will be to utilise all of the existing infrastructure
- About taking the climate information that this produces but ***go the extra mile*** to ensure it is used by decision makers.
- WMO is driving GFCS but cannot succeed without participation of the user community

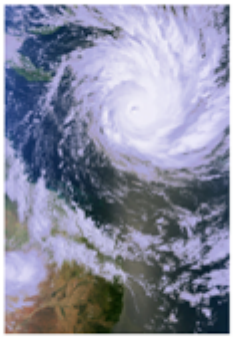
GFCS Pillars

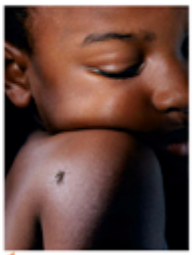


GFCS short term priority areas

- ✓ **Water**
- ✓ **Disaster risk reduction**
- ✓ **Health**
- ✓ **Agriculture/food security**





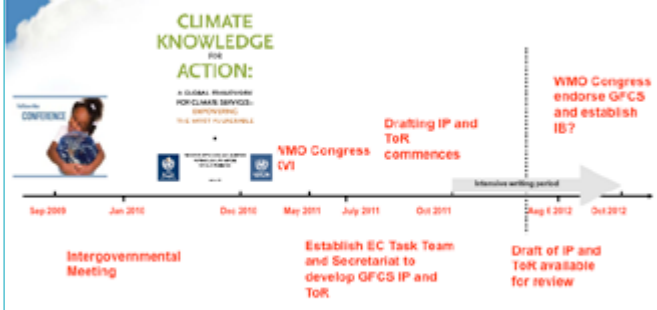


- Countries with little capacity
- Countries like Australia

Key Players

- WMO is a key driver of the GFCS
  - The NMS is likely to be central to delivery at a national scale
- WMO cannot alone deliver the GFCS
  - Union between the provider and user community to aid mutual understanding
- Stakeholder Community
  - Global level – FAO, IFRC, UNISDR, WHO, UNWater
  - National level – DAFF/DPI, EMA/SES, Dept Health, BoM/State water agencies.

Progress

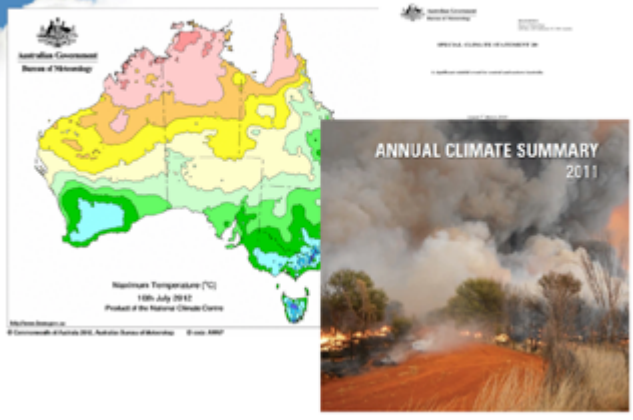


What next?

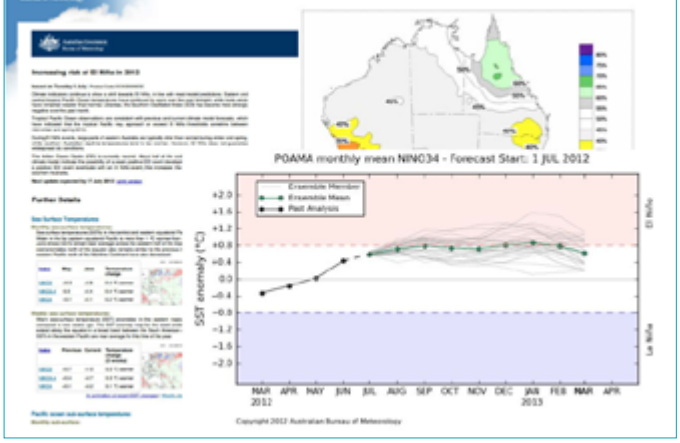
- Endorsement of GFCS will see activities commence (priority in least developed)
- From Top Down engagement of WHO, FAO etc should see message filter down to Members
- Australia
  - institutional arrangements?
    - Interagency coordination mechanism/consultative committees?
    - National Implementation Plan?
  - Activities
    - Many already exist but how do we do more?

Climate Services in Australia

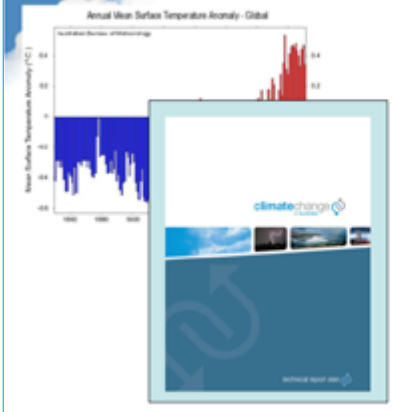
Climate Services in Australia



Climate Services in Australia



Climate Services in Australia



- Climate projections primarily reside in the research space presently without a service orientation

Climate Services in Australia

Summary

- GFCS is about building relationships between users and providers
- GFCS is a coordinating framework not a system
- Users benefit and advocate on behalf of providers. Water, DRR, Food and Health top-4
- Global level/National level – sectors.
- Review lead up to October endorsement
- User engagement – governance arrangements?
- Key climate information available

Appendix 4: Presentation by Graeme Anderson (DPI)

DPI Climate extension

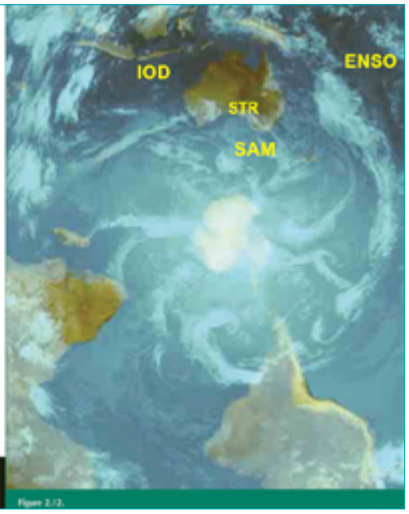
- 4 yr state govt program Future Farming - $1M yr
- Climate integrated into industry extension teams (Grains, Dairy, Horticulture, Meat & Wool)
- Market research & Farmer surveys on climate and carbon issues
- E-newsletters such as The Break, The Fast Break, Milking the Weather, ClimateReady Hort, Carbon Toolkits in Ag,
- Climate risk website, climate webinars, training & capability events, case studies, Climatedog
- Face to Face – 854 sessions to 22,606 people

DEPARTMENT OF PRIMARY INDUSTRIES

Key climate influencers for Victoria's rainfall:

- **ENSO** – Pacific Ocean moisture source
- **IOD** – Indian Ocean moisture source
- **SAM** – the fronts….
- **STR** – the highs…..

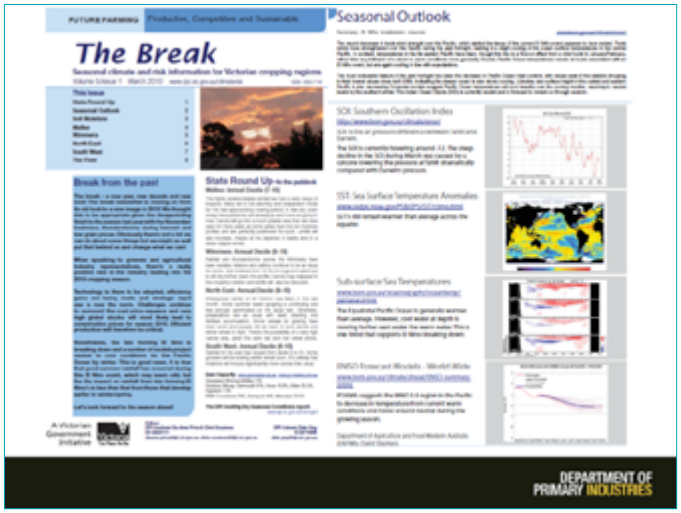
Key drivers of our seasonal variability in Victoria – always have been and always will be! (BOM, CSIRO reports etc)



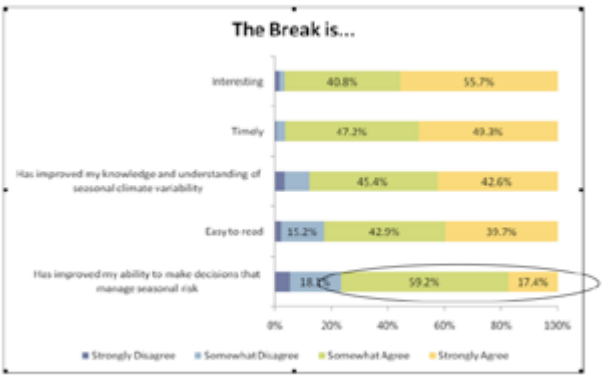
Upscaling – providing local data and context.

Acknowledge local history, observations and experience as a foundation

DEPARTMENT OF PRIMARY INDUSTRIES



"The Break" Survey & effect on decision making?



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Belief vs Knowledge……

Percentage of Victorian farmers aware of the climate driver AND agree it affects their local district seasonal rainfall

	2009		2011
ENSO	68%	⇨	81%
IOD	37%	⇨	50%
STR	6%	⇨	17%
SAM	4%	⇨	16%

Website, Climatedogs, e-newsletters, face to face sessions

DEPARTMENT OF PRIMARY INDUSTRIES

Farmers say…..

"It's not just about the average……..

….if your head's in the freezer

and your bum's in the oven…

….an average would say you are okay!"

DEPARTMENT OF PRIMARY INDUSTRIES

Climate change …….

"Will only ever appear to us as the season & the weather we're having, and the outlook for the coming months……."

DEPARTMENT OF PRIMARY INDUSTRIES

Key themes for climate services:

1. Short term(1-7 days), seasonal (mths) and trends (yrs)
2. Understand needs of farmers/industry/supply chain (MR)
3. Build capability/literacy of trusted messengers (extension links and partnerships in each region & industry)
4. Package key information into good products – where are people most likely to see/hear about it?
5. Make information & services readily accessible – expand our approach to partnering with others
6. Ensure information is timely & relevant (currency – for decision making today!)

DEPARTMENT OF PRIMARY INDUSTRIES

Thank You

www.dpi.vic.gov.au/climaterisk

Site has Climatedog animations, seasonal climate newsletters, carbon toolkits, case studies of farmers taking action , webinars series etc……

graeme.anderson@dpi.vic.gov.au

DEPARTMENT OF PRIMARY INDUSTRIES

Appendix 5: Presentation by Leanne Webb (CSIRO)

www.csiro.au

Impacts to perennial horticulture

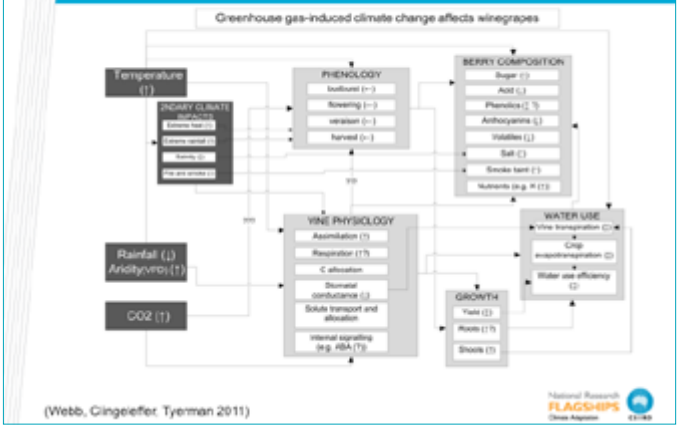
Dr Leanne Webb
CSIRO Division of Marine and Atmospheric Research

THE UNIVERSITY OF MELBOURNE

National Research FLAGSHIPS Climate Adaptation

CSIRO

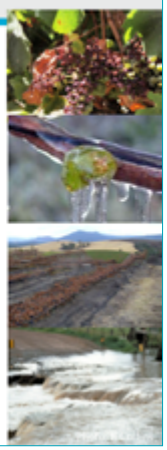
Impacts to viticulture



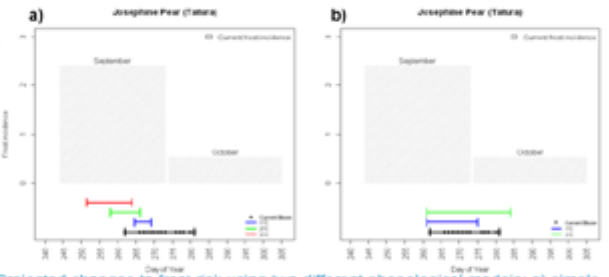
(Webb, Clingeleffer, Tyerman 2011)

Extreme events

- Heatwaves (SE Australia)
  - 2008 vintage: Harvest period
  - 2009 vintage: Veraison period
  - 2010 vintage: Flowering
- Frost (?)
  - earlier budburst
  - projections of lower rainfall, drier soils, fewer clouds and lower dew points
  - An increase in day-to-day climate variability
- Increased number of days with high and extreme fire weather
  - Smoke taint
- Extreme rain
  - Botrytis
  - erosion



Frost

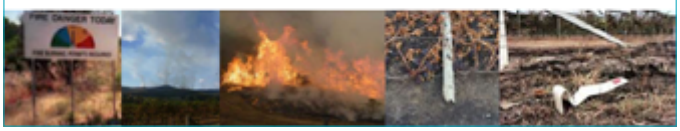


- Projected changes to frost risk using two different phenological models: a) simple spring warming where increases to temperature progressively advance bloom and b) modelling the sequential effects of winter chilling and spring growth. The maximum is the 90th percentile, the minimum is the 10th percentile.
- The frost incidence is mean monthly frost occurrence (frost is defined when Tmins≤0°C). It is also only for current conditions, no projections.

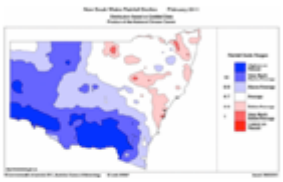
Courtesy: Rebecca Darbyshire

Bushfires

- Wine is adversely affected by smoke taint-related compounds (guaiacol and 4-methylguaiacol) that are released throughout the fermentation process.
- "Bushfires have again impacted on north east Victoria, in 2006–07 growers were unable to salvage much of the crop leading to an estimated loss of value of wine of approximately $75–90m." (Whiting and Krstic, 2007)
- One large winery has elected to move to a region with lower risk of bushfires after 3 years of being impacted by smoke taint.



Extreme Rainfall



Very wet February 2011

- Lower lying parts of vineyards affected
- Increased disease pressure
- Berry splitting
- Transport/logistics affected
- Difficulty obtaining fungicide

Appendix 6: Presentation by Andrew Watkins (BoM)

Agriculture Case Study – Adaptation Information for Agriculture from BoM

Andrew Watkins, Manager Climate Prediction Services

VCCCAR Climate services for adaptation in Victoria 2012

Adaptation and the Bureau – its not just about projections…

- Climate Change Projections
- ~~Decadal Prediction~~
- Long Range (e.g., El Niño/La Niña) outlooks
- Seasonal (3-month) Outlooks
- Climatology and Historical Comparisons

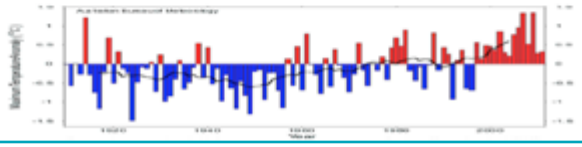
} Dealing with real time Climate Variability

- Multi-week predictions
- Weather forecasts

} Dealing with weather and extremes -- Optimising for benefit/minimising loss

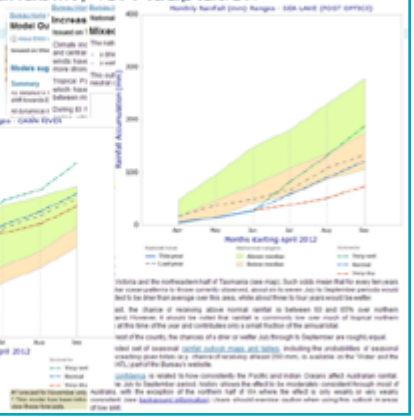
- Trends (mean and extremes)
- Climate Variability (climate drivers)

} Understanding local climate/ long term planning/education



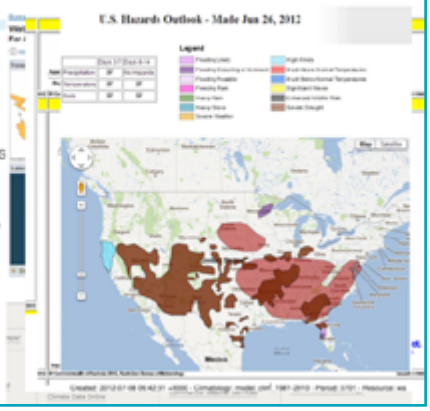
Dealing with Real Time Climate Variability for Adaptation

- Using climate intelligence for the season/year/cycle ahead to a broa… adap
- Clima…
- ENSO…
- Seas…
- Rainf…



Dealing with Weather Variability for Adaptation

- Using weather intelligence to minimise losses during extremes and maximise returns during favourable events
- Water and the Land (BoM Agriculture Portal)
- Forecast Explorer
- Multi-week predictions (watch this space)
- Potential for 'Red Flag' services (extremes and Hazards)



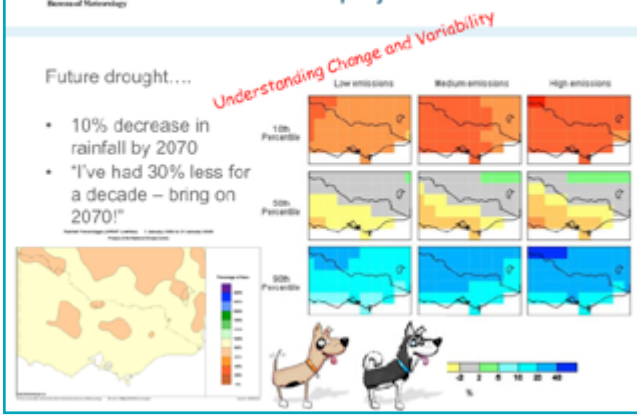
Understanding local/regional Climate trends and drivers for Adaptation

- Understanding past climate and drivers to better understand the future
- Climate Tracker (mean and extremes)
- Australian climate influences (drivers)
- Drought Watch
- Trends in Ag Indices (e.g., brown rot, cow pant, frost etc)?

Climate Intelligence; future climate projections

Future drought….

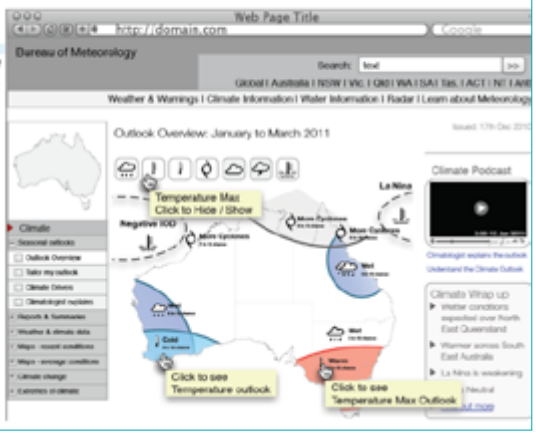
- 10% decrease in rainfall by 2070
- "I've had 30% less for a decade – bring on 2070!"



Improving Climate Services

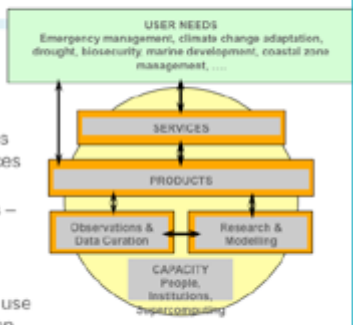
➢Best data in the world is pointless if it cannot be understood…

➢SCO
•Five stages of market research
• Qualitative & Quantitative
• 961 responses
• User Centred Design



Conclusions…

- Massive amount of climate data held by the Bureau
- Bureau is increasingly converting 'data' into information that provides climate intelligence: climate services
- Increased engagement with users – careful consultation ensures well targeted products
- Many aspects of adaptation (e.g., use of seamless forecasting) don't even mention the 'cc' words... Just good practice.



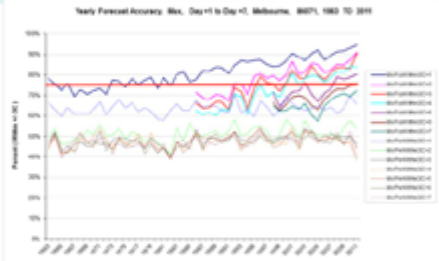
Sectoral Climate Sensitivity – Sims (2011)

Aus. Industry Sector	Equiv. U.S Sectoral Climate Sensitivity[1]	Aus. Industry 10-year (2001-10) average Gross Value Added[2]	Estimated Annual Climate Sensitivity of Australian Industry Sectors	
	%	($2010) $ million	($2010) $ million	% GDP
Mining	14.4	101868	14560	1.33
Services	3.3	344917	11382	1.03
Manufacturing	8.2	109892	9011	0.79
Financial/Insurance	8.1	107759	8729	0.77
Construction	4.7	73581	3459	0.31
Ag, Forest, Fish	**12.1**	**26544**	**2970**	**0.26**
Transport, postal, warehouse	3.5	53364	1868	0.16
Electricity, gas, water, waste	7.0	24068	1686	0.15
Information, media, telecomms	4.7	33610	1580	0.14
Wholesale	2.2	50382	1108	0.10
Retail	3.3	47864	1601	0.10
GDP		**1133812**	**57854**	**5.1**

Improving climate intelligence (i.e., models and communication) can have significant impact

[1] Lazo et al., BAMS, 2011, doi: 10.1175/2011BAMS2928.1
[2] 5240.0 - Australian National Accounts: National Income, Expenditure and Product, Mar 2011

Progress in Weather Forecasting to benefit adaptation

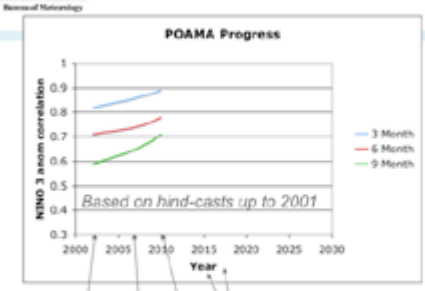


Improvements due to

- Increased supercomputing
- Improved forecast system (model, physics, initialisation strategy)
- New observing networks

- Incremental change over long periods
- Rarely a radical leap in skill
- Each model builds upon the last and brings an improvement over time

Reflected in POAMA (seasonal outlook)…



Improvements due to

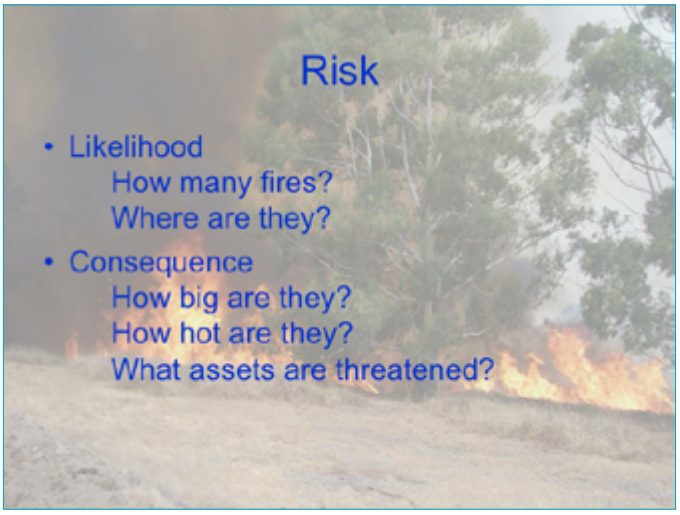
- Increased supercomputing
- Improved forecast system (model, physics, initialisation strategy)
- (New observing networks ?)

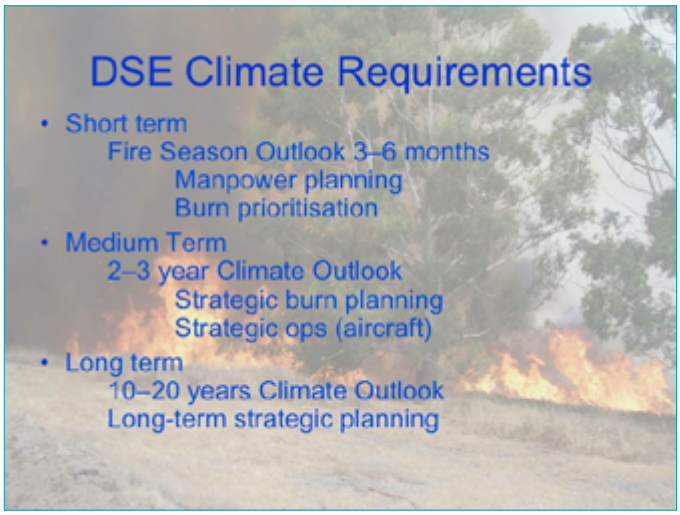
V1 V1.5 V2 V3 (ACCESS)

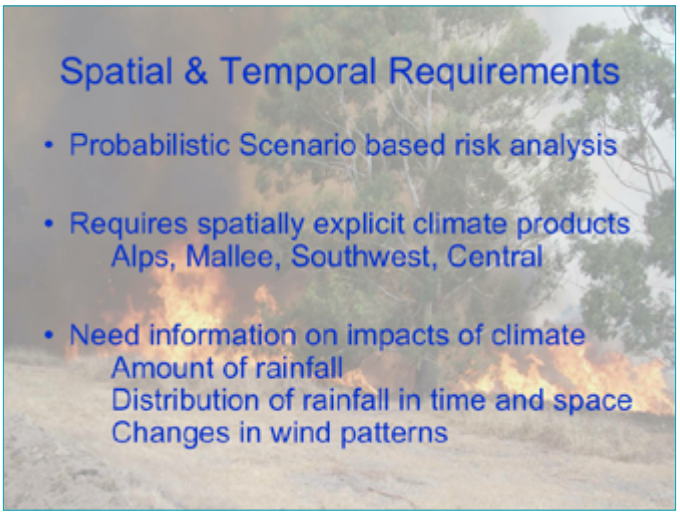
Process of continual, incremental improvement
Each stage relies upon the last

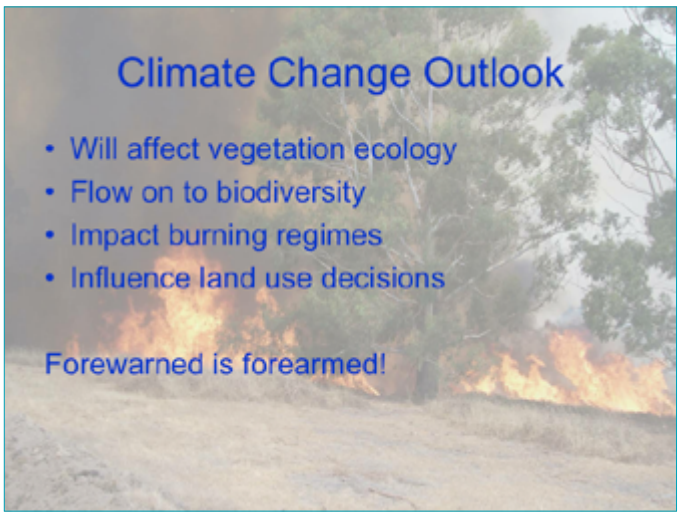
Appendix 7: Presentation by Fred Cumming (DSE)


Fire – Managing the Risk
Fred Cumming
Department of Sustainability & Environment


Risk
• Likelihood
How many fires?
Where are they?
• Consequence
How big are they?
How hot are they?
What assets are threatened?


DSE Climate Requirements
• Short term
Fire Season Outlook 3–6 months
Manpower planning
Burn prioritisation
• Medium Term
2–3 year Climate Outlook
Strategic burn planning
Strategic ops (aircraft)
• Long term
10–20 years Climate Outlook
Long-term strategic planning

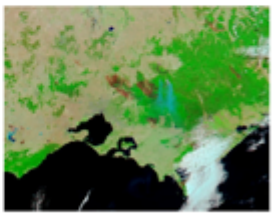

Spatial & Temporal Requirements
• Probabilistic Scenario based risk analysis
• Requires spatially explicit climate products
Alps, Mallee, Southwest, Central
• Need information on impacts of climate
Amount of rainfall
Distribution of rainfall in time and space
Changes in wind patterns


Climate Change Outlook
• Will affect vegetation ecology
• Flow on to biodiversity
• Impact burning regimes
• Influence land use decisions
Forewarned is forearmed!

Appendix 8: Presentation by Chris Lucas (CAWCR)

Bushfires and climate: past, present and future

Chris Lucas
CAWCR



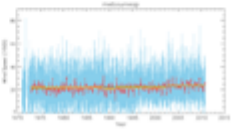
Presented at VCCCAR Climate Services Think Tank, 13 July 2012

Outline

- Briefly discuss projects I participated in as part of Bushfire CRC from 2004 to 2009
  - something of a research perspective
  - needs and uses for climate services
  - by and large, these products are not part of services offered by the Bureau of Meteorology

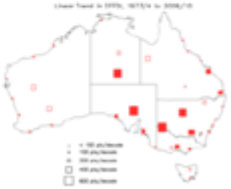
Historical Fire Weather Dataset

- A foundation for understanding
- see Lucas [2010], *AMOJ*
- Consistently calculated (and documented!) station-based dataset
  - National coverage
  - 77 stations, with 38 best quality
- Some issues with data inhomogeneity



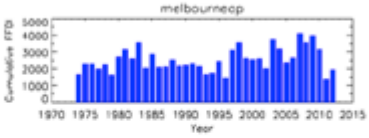
The Past

- Basic climatology of fire weather in Australia
- Historical relationship between house loss and FFDI (Blanchi et al. 2010, IJWF)
  - Significant house loss begins to occur when FFDI exceeds 50 (lower in TAS)
- Historical trends (1973–2010) in Australian fire weather, Clarke et al. [2012] *Int. J. Clim.*
- Ongoing work with GA gridding the data and estimated return periods
- Climate drivers of FFDI variability



The 'Present'

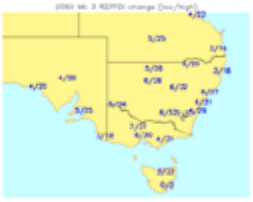
- Ongoing monitoring of state of climate vis-à-vis bushfire



- Major effort to develop the Seasonal Bushfire Assessment Workshop
  - What conditions can we expect for upcoming fire season
  - Bring together fire agencies, meteorologists, land managers, etc
  - To my knowledge, this continues today (with some Bureau of Meteorology involvement)
  - Some limitations of approach

The Future

- Combined with information from climate models, we made projections of future bushfire weather conditions
  - Hennessey et al [2005], CSIRO consultancy report
  - Lucas et al. [2007], Bushfire CRC report (Climate Institute of Australia)
  - Williams et al. [2009], DCC report
- Historical record suggests levels levels projected for 2050 were observed earlier this century. An analogue for the future?
- Other researchers have used different approaches to make projections



Appendix 9: Presentation by Rod Keenan on behalf of Andrew Gissing (SES)

Using Climate Data to Inform Emergency Management of Floods

- SES currently use short-term weather forecasts (less than 5 days) to allocate resources
- Long-term season forecasts are used to assist with assessing readiness, but are not largely used to inform resource allocations due to their often vague nature

Using Climate Data to Inform Emergency Management of Floods

- Large scale events have recently tested ESOs
- ESOs are trying to better manage their capability and capacity
- Climate forecasts can assist to ensure that ESOs can conduct scenario planning to assess capability and capacity gaps and plan to manage these

Using Climate Data to Inform Emergency Management of Floods

- Climate change information should be considered in risk assessments and future strategic planning

Appendix 10: Presentation by Viktor Brenner (DSE)

Policy Developments

Adapting to Climate Change

Department of Sustainability and Environment

Dealing with uncertainty

- Science tells us that sea level will rise and changes in weather patterns will occur but we don' t know how quickly or how much change
  - Sea level rise
  - Changes in precipitation
  - Changes in antecedent conditions
- Local communities want government to provide more guidance about what will happen and how it should be controlled
  - Many departments and local government authorities involved
  - Community expects tools and policy guidance

Existing Sea Level Rise policy

- Plan for sea level rise of not less than 0.8 m by 2100 plus storm tides (Dec 2008)
- Govt recently introduced new threshold of planning in infill areas based on existing 1% level plus 0.2 m increase in sea level by 2040 (June 2012)
- Bathtub inundation maps and other spatial products are being made available plus coastal hazard guidelines (www.climatechange.vic.gov.au)
- Guidelines have been prepared to help CMAs and Melbourne Water assess planning permit applications
- Detailed coastal hazard assessments are being carried out along Port Fairy, Corio Bay and Bellarine Peninsula, Western Port Bay and Gippsland Lakes/90 Mile Beach to inform future adaptation planning

Riverine and stormwater flooding

- Govt is reliant on better scientific and technical information becoming available, e.g. through revision of Australian Rainfall and Runoff
- DSE is contributing funding and expertise to SEACI, to investigate the causes and impacts of climate change and climate variability
  - PHASE 1: (2006–2009) characterisation of our current climate; projecting our future hydroclimate; improving seasonal forecasts
  - PHASE 2: (2009–2012) holistic and better integrated understanding of climate change and climate variability to support water managers and policy makers under 3 themes - understanding past hydroclimate variability and change; long-term hydroclimate projections; seasonal hydroclimate prediction
- Until better methodologies are determined, DSE is encouraging sensitivity testing for increases in rain intensity, e.g. 32% increase for Melbourne Water studies, 10-20% for regional studies

Transition to new policy

- Balancing act to allow coastal settlements to remain viable while not allowing the future flood problem to escalate
- If we plan ahead then can reduce future impacts by controlling development sensibly (e.g. upgrading infrastructure over time, saving up for a sea wall when it is needed
- Adaptation planning needs to be done locally, not by head office
- Policy changes will be reflected in updated state and regional flood management strategies (post ENRC)

Appendix 11: Presentation by Dongryeol Ryu (University of Melbourne)

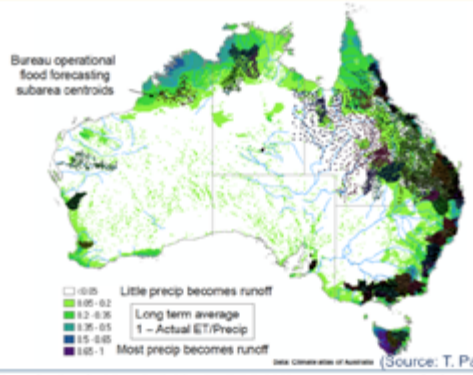
MERIT
MELBOURNE ENGINEERING RESEARCH INSTITUTE

Flood Forecasting Using Spaceborne Observations

Dongryeol Ryu, Andrew Western (Univ. Melbourne)
Chris Leahy, Soori Sooriyakumaran (BoM)
Wade Crow (USDA), Jeff Walker (Monash)
QJ Wang, David Robertson, Luigi Renzullo (CSIRO)

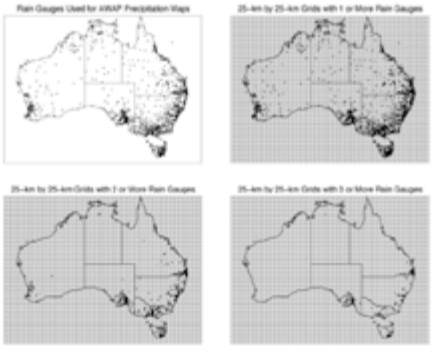
VCCCAR – Climate Services for Adaptation in Victoria, 13 July 2012

Operational Flood Forecasting

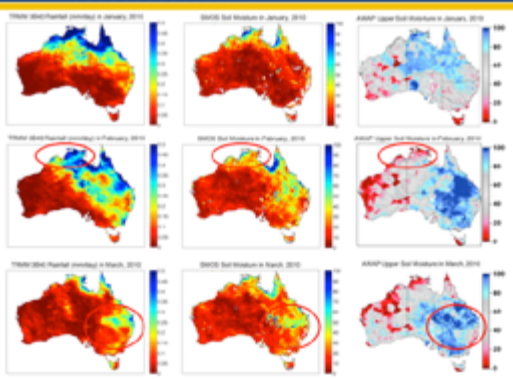


(Source: T. Pagano, CSIRO)

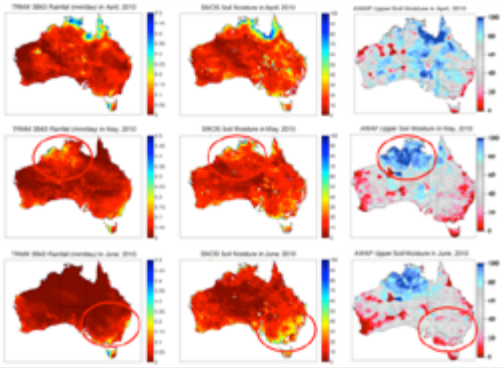
Rain Gauges Used for AWAP



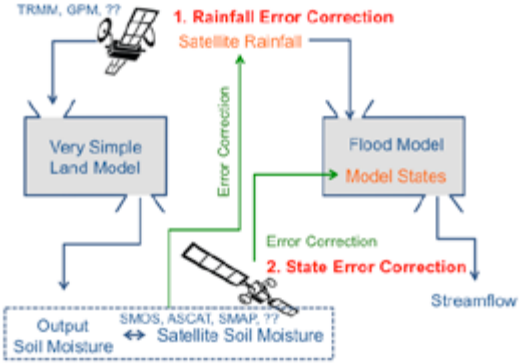
Monthly Surface Soil Moisture



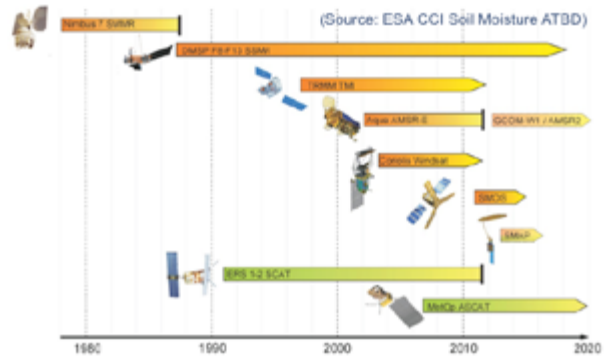
Monthly Surface Soil Moisture



Dual Data Assimilation of Satellite Observations for Flood Forecasting



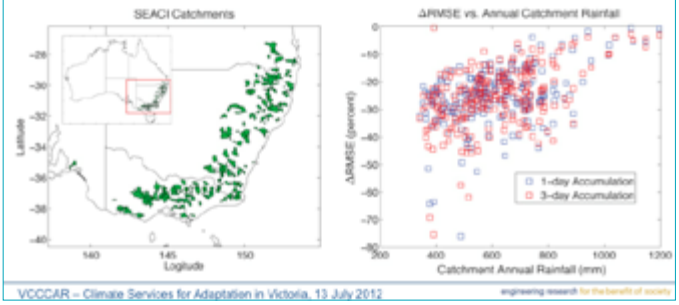
Microwave Satellite Soil Moisture Available from 1978



Example: Rainfall Error Correction

Would it still work in the small coastal catchments?

- 240 South Eastern Australia Climate Initiative study catchments
- TRMM 3B42RT rainfall error was corrected using AMSR-E soil moisture



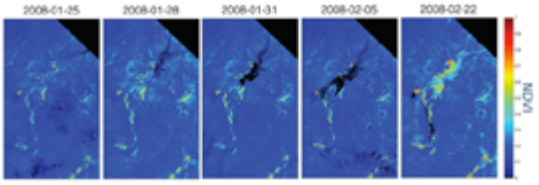
Extra Slides

Other spaceborne observations that can be utilized for monitoring and forecasting floods

What Can Be Further Integrated?

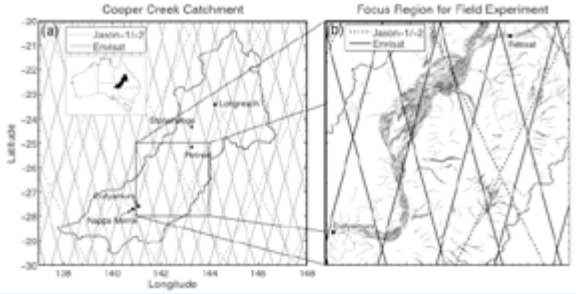
For even more data-poor catchments, flood extent mapped by optical satellites

- Snapshots of MODIS during Jan-2008 flood in the Cooper Creek catchment



What Can Be Further Integrated?

River height measured by satellite altimeters (ARC DP130101718, under review)



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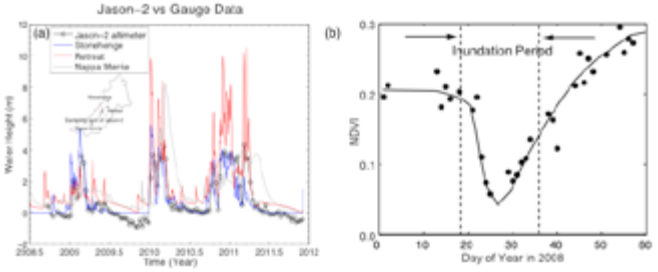

Appendix 12: Presentation by Soori Sooriyakumaran (BoM)

Australian Government
Bureau of Meteorology

Water Information

Climate Information and Floods

A Warning perspective

Soori Sooriyakumaran

13 July 2012

- Bureau's role in flood risk management
- Current development
- Climate information used
- Some issues and points to note

The Bureau's flood warning service

- Collect real-time rainfall & river data
  - Updated half hourly on Web as maps, tables and plots
- Flood modeling
  - Simple peak flood height relationships and semi-distributed hydrologic models
- Flood warnings & river height predictions
- Direct briefings & discussions with agencies
  - Local Government, Emergency Services, Media
- Store & analyse historical flood information
  - Including flood warning data, peak heights, effects, flood history
- Field work/network management and assistance to local government

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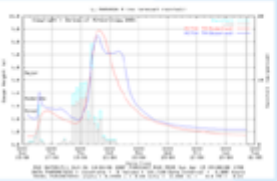
Flood warning data collection methods

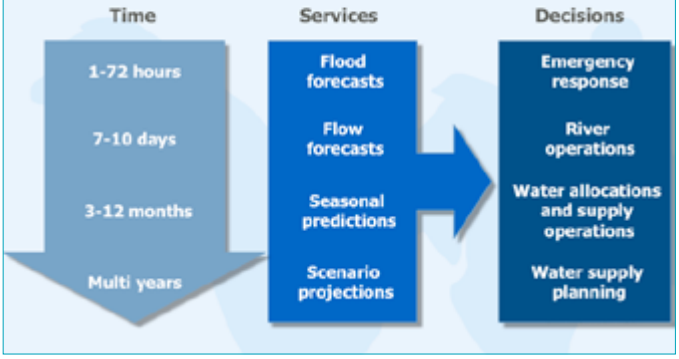
- Manual Observations
  - Via Remote Observer Terminal and telephone or via Internet to computer
- Telemeters/loggers
  - Via landline/mobile/satellite telephone to computer
- ALERT
  - VHF radio communication
  - Real-time (event) data
  - Backup via UDP on Internet
- FTP
  - From other water resources and management agencies
  - Computer to computer

Flood forecasting models



- Hydrologic flood forecast models of over 150 river basins (350 to 250,000 km²) in Australia using over 700 rainfall-runoff flood models
- Includes the modelling of about 28 large dams
- Simple single catchment models to multiple linked models
- Models calibrated on numerous floods in each river basin (ie. Climate information)
- Large archive of significant flood events
- Archive of flood peaks
- Used with 'flood intelligence' to 'interpret' forecasts to warnings to on-ground effects.

Water forecasting services



Forecasting informing decisions

Short Term Flow Forecasting

- Continuous 7 day streamflow forecasts
- Combine hydrological models with weather forecasting models
- Ovens river pilot catchment
- Modelling system developed by CSIRO (SWIFT)
- An extension to the flood forecasting service
- Unregulated inflows to regulated systems

Seasonal Streamflow Forecasts

- Public release in December 2010
- Now providing forecasts for 36 sites in NSW and Victoria
- Using CSIRO developed statistical model
- Further testing on sites in all states and territories
- Aim to extend to 70+ sites over the next year
- 2013–14 operational statistical and dynamic forecasts

Climate information used

- 'Design rainfall' to estimate probability of flooding from observed climate data
- Flood frequency analysis from observed stream gauging
- Flood behaviour from past flooding
- Long lead time or delays in getting climate data used
- Need for continuous high quality gauging (reference networks)

Points to note

- Only now there is a national effort getting underway to get consistent flood risk assessment
- Changes to flood risk are not monitored sufficiently quickly
- Flood risk management is not adapted to climate variability (mostly reactive)
- 'Operational readiness' is directly impacted by frequency of flooding

More to discuss...

Soori Sooriyakumaran 03-9669 4518 S.Sooriyakumaran@bom.gov.au
Water Forecasting Services

Appendix 13: Summary presentation by Nigel Tapper (Monash University)

Climate Services for Adaptation in Victoria

Summary and Review

Nigel Tapper (Monash)

Partner Universities: The University of Melbourne; Monash University; La Trobe University; RMIT University

Project Sponsor: Victoria; Department of Sustainability and Environment

Climate Services for Adaptation in Victoria

Aims of Workshop

- Assess the current situation in relation to climate information and adaptation
- Build common understandings of expectations of users and capacity of providers
- Provide recommendations for policy and guidance for research on improved climate services in a changing climate

Key Messages

David Walland (BoM)

- Global Framework for Climate Services – WMO initiative to better align climate data/info with end users to manage climate risks
- Capacity building is a key component in both developed and developing country contexts
- Prioritising water, disaster risk reduction, health and food security; global and national end users
- Roll-out in Australia still being planned; end users broader than originally envisaged

Key Messages - Agriculture

- Framing is critical – farmers want to talk about drivers of weather and short-term climate rather than climate change (Graeme Anderson)
- Local upscaling – interest in how your locality relates to larger picture (GA)
- Extremes are critical for primary producers (GA)
- Timeliness and relevance critical (GA)
- Critical need to build capacity of trusted messenger (GA)
- Critical role of phenology and interaction with climate change in perennial horticulture (PH) (Leanne Webb)

Key Messages - Agriculture

- PH also less interested in longer term climate change than inter- and intra-seasonal variablity (LW) *but might depend on size of organisation?*
- Again in PH a major preoccupation with extreme events; heat, frost, fire weather, extreme rainfall – forecasting the timing is critical (LW)
- BoM three kinds of climate services for agriculture, real time, weather and extremes, understanding local and long-term climate trends (Andrew Watkins)
- Current preoccupation with shorter-term adaptation – minimising losses during extremes and maximising during favourable periods (AW)

Key Messages - Agriculture

- Weather intelligence old favourites (e.g. Ag Portal, Forecast Explorer, but working on new products (Red Flag services, Multi-Week forecasts (AW)
- Simplification of complex data is key (AW)
- Adaptation = best farming practice but don't mention CC (AW)

Breakout

- Farmers are about the best climate adaptors
- Much easier to deal with short-term climate variability rather than longer-term climate change

Key Messages - Agriculture

Breakout

- Knowledge equity is critical – up to individuals and organisations to make best of it. Therefore education/capacity building is key.
- Farmers are inherently competitive – mitigates against full sharing of information. Organised and more competitive farmers use best current data
- Risk management using financial products (e.g. derivatives) largely unknown is Australia in comparison with other countries
- Presentation of complex information is an issue – innovative visualisation may be a way forward

Key Messages - Bushfires

- DSE (and CFA?) moving towards a risk management approach; how many fires, where, consequences (Fred Cumming)
- Climate requirements short-term 3-6 m (fire season outlook), medium-term 2-3 y (climate outlook), longer-term 10-20 y (climate trend) – strategic planning (FC)
- Fire agencies have particular spatial and temporal data requirements (FC)
- CC outlook not just about fire (ecology, burning regimes, land use decisions (FC)
- In fire warnings, warnee! Is the key player and their behavior is modified by prior knowledge/expectations (Jim McLennan)

Key Messages - Bushfires

- Key message is that warnee is not interested unless there is guarantee of fire hitting (JM) (is this related to overwarning?)
- Climate change is incremental but fires are a dramatic one-off; this is an issue in terms of long-term planning (JM)
- Interpreting past fire weather data hindered by data inhomogeneity (Chris Lucas)
- Past rules-of-thumb (e.g. FFDI 50) appear to hold (CL)
- Critical link of SO and IOD for SE Aust FFDI (CL)
- Early 2000's an analogue for 2050? (CL)

Key Messages - Bushfires

Breakout

- Too much information can be a critical issue during emergency
- Critical problem of public vs scientific understanding of uncertainty (CC and fire warnings)
- Issues related to fuel reduction burning (FRD)
  - Protected areas (amenity/conservation, etc.) can limit effectiveness of fire warnings based on weather
  - FRD a critical part of future fire protection/ adaptation and is a difficult science – weather data only part of picture

Key Messages - Bushfires

Breakout

- Much public skepticism of link between climate change and fire – may need to couch in terms of general preparedness/best practice (al la farming community)
- Need for more research on CC impacts on fire behaviour, size, intensity, etc.
- Need for improved real-time data during fire events
- Personal vs someone else's responsibility for final decisions (e.g. to evacuate)
- Can climate science tell us all the answers? No
- Problem of absolute certainty – a unrealistic requirement of climate science

Key Messages - Floods

- Emergency services overwhelmed by recent events (Andrew Gissing) – shape of things to come?
- Floods similar to fires – weather conditions of the time AND preconditions – two different types of monitoring
- Are we being realistic expecting all to be prepared when we (supposed experts) are clearly not? (Vic Brenner)
- More tools, less understanding. Are we overprotecting – removing personal responsibility? (VB)
- SL rise is incremental (as with other CC related effects) – people do not readily react to this, but rather the catastrophic, episodic event (VB)
- Role of state government to provide guidance, local communities make final adaptation decisions (VB)

Key Messages - Floods

- Existing observational network of rain gauge and soil moisture inadequate for flood forecasting (Dongryeol Ryu)
- Forcing data best supported with satellite remote sensing (DR)
- BoM flood warnings based on real-time rainfall and river data supported by modelling – but issues of data quality (mentioned by DR)

Appendix 14: Notes from group breakout session

Agriculture

Services work when they provide critical information on 'something that matters to the user'

Lots of great data and info; lots of it is underused

Lots of user needs and trusted networks that need to be partnered with

Challenges around 'who' facilitates supply chain of climate and agriculture services

Climate variability and change services are seen as a continuum (not separate)

Lots required to use 'trusted' messengers to influence decisions

BoM is great. Increase accessibility and products and services means many more people will use it (e.g. DPI uses BoM products all the time)

Visualisation is important. Lots of approaches to displaying information visually

Setting context 'uncertainty'

Remember there are valuable adaptation responses or practices that do not require climate info; for example change in business management, risk management

Use of climate data is dictated by political views and other beliefs

Intermediaries are delivering information to users such as state government

Use and interpretation of climate data are dictated by the relationships between users and data providers and/or intermediaries

What is the best model for distributing data/information? For example, BoM to farmer, or BoM to intermediaries (government/commercial etc.) to farmer?

Incremental change vs step change — how to deal with both?

BoM shares specialist non-standard products with third parties for industry-specific forecasts

Dodgy climate consultancies exist and operate

University and industry training on climate science needs to be examined

Insurance needs to be examined for consultancies that bear a risk from climate and climate change such as drainage design from return periods building and road design

Graphical interface on BoM website much better

Climate information is well used by the agricultural sector

Other industries do not see immediate impact – rail lines on mining – timing of impacts needs to be examined

Interest and engagement is determined by the immediacy of impact

Climate data are used for long-term decision-making – short term decision-making horizons → aligning the information with the decision-makers' time horizon?

Changing perceptions and expectations of users and community may change over time

Do not talk about climate change or global warming: framing of the language is important, and psychology is important

Farmers have to understand uncertainty on risks – but still want certainty

Farmers deal with variability better than others – they need to for survival

Information should involve more pictures and fewer words – this will improve adaptation – see Climatedogs website at www.dpi.vic.gov.au/agriculture/farming-management/weather-climate/understanding-weather-and-climate/climatedogs

Accessibility vs economics

What decision-making? Range of models output

Agriculture is very diverse

Competition among farmers decreases disclosure of information

Farmers have adapted using climate data to become the best adapters

Identify source of information

Educating to take advantage of the information and resources available from BoM and other providers of climate data and other information

Agricultural sector is the greatest user (not share)

Climate information to keep sustainability (make available to all)

Advantage – access to information; risk management – warranty, range of crops (weather derivatives)

Time frames – short means the next two seasons; long means buy up land closer to the poles

Knowledge equity

More effort for long term – towns must be accessible long term e.g. Hay, Echuca

More organised farmers

Need decent internet connection

Longer term projects required for changing enterprises e.g. grape producers moving

Need decadal variability digested for farmers – use intermediaries – private consultants play a key role here

Parts of world cannot make projections reliably, while other areas can speak with confidence

Farmers do not want just average figures – more targeted probabilities present challenges and new presentation options are being developed

Climate information is commonly used but not always appropriately used e.g. extreme events – misguided decisions

Communication – not everyone is comfortable with the BoM website

Complexity – how to convert, incorporate and integrate the information into policy decision-making – often looking for one data point

Scientists are not always clear about communicating variability combined with inherent uncertainty

Bushfire

Issues around staff and individual liabilities

Capability — need to grow — agency staff and public 'warnees'

Prepared for 'scale' of response if events become bigger?

Be aware of maladaptation; i.e. if agencies are better prepared will the public put more faith in them?

Will we learn and prepare for 'one extreme event at a time'?

Differences between climate information and services (agencies = good, public = not good enough) and what people actually do (behaviour)

Make the most of adaptation windows after major events (i.e. when government and public are receptive and money available)

Information not being used — Royal Commission for Victoria Bushfires

Black Saturday an anomaly

Bushfires are unexplainable and random events — mitigation activities for reducing fuel load (asset protection)

Other drivers — amenity value, mitigation against bushfire protection

Most 'warnees' have really conflicted understanding of the science of bushfires

Climate change a trend, bushfires as an episode — probably a longer term trend

Frequency an extremity

Climate change is not a bushfire BBQ stopper — there is scepticism about the link

Agencies should do more interpretation for people — give better warnings

Information — can be there, but may not be recognised. How to communicate? Who is the authority?

Climate effects — link climate to fire, averages or extremes? What threshold is important? How will other things change (e.g. biodiversity)?

Define one authority, for example the Country Fire Authority (CFA), for fire information

Communication (interagency and with public) during bushfire, before and after and during non-standard operating conditions

Provision of real-time warnings and weather information during an extreme event

Public expectation of weather warnings following (vs before) a major event (e.g. bushfires post-2009, floods post-2011)

Communicating and understanding warnings e.g. new scales, new messages, too many signs, alternative media (e.g. apps, social media)

If public warnings are not very effective, does this mean we need to consider forced evacuation? Based on what climate or weather prediction and information?

Information at different time scales — strategic (long range), tactical (seasonal), warning (1–2 days a week), and management of a crisis (real-time)

Conflict between information and warnings issued vs validation with own observation and experience

Mentality of assuming someone else will fix the problem and rescue you

Does information or warning have to be personalised and specific and in language understandable to the receiver? For example, text messages using appropriate language

Do people need warnings multiple times from multiple sources?

Can climate scientists provide the types of projections bushfire managers want? For example, change in number of lightning strikes in dry weather

Information is required for decision-making but people do not seem to make rational decisions

All the best warnings were given — people did not take notice

How many times do warnings lead to fires?

Should people be ordered to leave?

People moving into areas do not have a culture of understanding fire

Perhaps if too much information is given, people will tend to stay too long

Do warnings need to be more local?

Role for climate services information in aftermath e.g. relating to rebuilding

People listen most carefully after the event — at that time they might pick up the climate change message

Anchor climate information on a major event

'Uncertainty' means different thing to scientists and general public

Checklists are needed to react in emergency situations

We think climate information is being used to inform decision-making, but the problem is whether the public takes notice of the warnings

Typically, the DSE people watching for the risk of fires interpret BoM data as well as making their own observations

DSE people are trained and understand statistical and graphical data

It all comes down to again whether the warnings are listened to by the public

The window of opportunity open for fire and warning planners is VITAL!

Prelogistic work into planned bushfires is also vital; e.g. wind has to be in the right direction and weather and personnel available can limit this

We think now that after the Black Saturday fires, current information is being taken more seriously and climate outlooks are being taken into account

The BoM is always improving its weather and climate information regarding bushfires — it all comes down to how the information connects with certain people, such as through radio, TV and newspapers

In 1983 a large area of Aireys Inlet was burnt but only 10% of the residents there would remember the event

Adaptation — never give up on getting the message out — use ENSO forecasts to plan backburns and reduce fuel load

Part of the problem is communicating what resources we need from Treasury

Recommendations to improve climate services

Individual participants offered recommendations, which are quoted here.

'Clarification of and agreement to roles and responsibilities in interpreting and applying climate change adaptation information — there seems to be sufficient info out there, [but] it is how it is applied or communicated that needs to be improved.'

'Changes to seasonal/climate forecasting — it needs to be upscaled in terms of more maps being produced by the BoM, which the general public could access, that explain what the current projections [are] for climate change in affecting rainfall, temperatures etc. But this would most likely involve more manpower in the BoM's climate section, therefore more funding from the federal government is needed! ([Use] social media!)'

'Climate info → complex social science → decision-making.'

'Bureau of Meteorology convenes annual meetings of state government users of climate information to help better align services with needs.'

'Deliver climate information in the language and modes people like to use.'

'People need to hear things three times and from three different sources. Coordinated by state government.'

'More diverse communication mediums — need to look at communication models — [must be] fit for purpose and users. Feedback loops.'

'Take a long-term view of providing information to encourage individuals to take more responsibility. Information flows are critical. Regional bodies should do it (ask climate change services to provide long-term information).'

'Empower stakeholders to take responsibility to access climate information — it will be beneficial to them.'

'Need greater interaction between end users and service providers regarding interpretation, needs etc.'

'More institutional efforts should be made to better communicate the variability and uncertainty of the projected climate change for decision-makers and the other end users.'

'People need the same information in different formats from the BoM.'

'Need to focus on the "customer" to effectively use information.'

'Improve information provision via more coordinated approach [among] levels of government — state government should have [a] coordination role.'

'More pictures, less text. Everyone (You).'

'Develop relationships with farmers to increase trust in information and increase relevance of info.'

'A central agency which synthesises and summarises climate prediction information for 'the general lay member of the public,' which then has portals/links to the various, special-purpose organisations data presentations.'

'Improve the communication of climate variability/change information.'

'Simple, accessible product, designed with users in mind, on things that matter to them, that helps them make decisions to adapt to the future!'

'Communicate by Design. Design to Communicate.'

'Consequences should be better recorded. Changes should be better recorded.'

'Have climate scientists speaking more frequently and widely about addressing managing risk of climate variability and climate change via the use of financial market tools such as weather and climate derivatives.'

'Natural events [and] disasters should be taught as a subject [in] schools.'

'More info on climate analogues and return periods related to past historical extremes by CAWCR (BoM and CSIRO) and communication of this.'

'Relate climate change info more strongly to current extreme events.'

'Clarify role of BoM and/or intermediaries in the analysis and interpretation of climate data.'

'Better 3–6-month rainfall estimates with uncertainty estimates.'

'Develop formalised communication plans [and] channels for specific information types.'

'Climate information should be properly translated and transmitted at all different levels (national, state and local level[s]).'

Appendix 15: Participant evaluations

Participant evaluation

Question	Tally	Comments
Question 1: Which of the following best describes your affiliation?		
Government (federal)	0	
Government (state)	6	
Government (local)	1	
Industry	2	
University/other higher education	7	
Other – please specify	1	Non-government organisation (NGO)
Question 2: Why did you attend the think tank?		
To present	4	
To network	7	
To represent a workplace	5	
For personal interest	4	
Professional development	6	
Other – please specify	1	All of the above
Question 3: Which sessions did you attend?		
Introductions and burning questions	17	
International developments in climate services	16	
Case study on agriculture	16	
Case study on bushfire	16	
Case study on floods	16	
Summary and review	14	
Next steps	15	
Question 4: How would you rate the scope and relevance of the issues discussed at the think tank?		
Neither good nor poor	1	
Good	11	
Excellent	5	
Question 5: How would you rate the level of opportunity that you had to contribute to the think tank?		
Fair	4	
Good	5	
Excellent	8	

Question	Tally	Comments
Question 6: How would you rate the level of discussion and input from participants at the think tank?		
Poor	1	
Undecided	0	
Fair	2	
Good	8	
Excellent	6	
Question 7: Did the think tank improve your understanding of the role of the Bureau of Meteorology in the provision of climate information that is relevant for long-term planning and for early warning of climate risks?		
Disagree	2	
Neither agree nor disagree	1	
Agree	11	
Strongly agree	3	
Question 8: Were there any issues that you felt should have been included / given more attention by the think tank?		More holistic or integrated approach to discussing the issues, to better reflect the interconnected nature of climate change impacts User needs – it was very BoM/government-focused, and I would have liked to have heard from CSIRO about climate projections – most important piece of puzzle for adaptation BoM structure and services for climate risks Past experience in use of climate services Who should carry forward – I might have missed [this] because [I] had to leave Needed to test the assumption that all clients want services – e.g. many may want data
Question 9: Were you introduced to any people, organisations or projects at the think tank that may assist you to improve your/your organisation's adaptive response to climate change?		Good to meet local government people on the 'front line' Very impressed with the agriculture contribution
Yes	12	
No	2	
Please comment	2	

Question 10: Which aspects of the think tank did you find most useful?		Meeting new contacts The key elements were it was around developing some practical services with a bunch of people at the coalface and not just academics Presentations of Graeme Anderson, Andrew Watkins and Dongryeol Ryu Questions think tank groups were asked to respond to were pertinent BoM presentations were engaging and clearly relevant to topic Brainstorming useability of data for adaptation planning in different sectors Discussions Presentation by David Walland 'Burning question' Meeting the cross-section of people interested in the topic Meeting others – the agriculture session was most relevant to me and my work Overviews and Rod's overall conduct of the discussion process Topics and opportunities to talk to and listen to others Table conversations Robust discussion Networking Well-balanced program

Question 11: Which aspects of the think tank did you find least useful?		Sometimes the adaptation research space can get lost in academia and I congratulate this VCCCAR event for bringing together people across the spectrum and looking at real issues now Writing on butcher's paper – since we didn't actually present to what we had written, perhaps there can be more modern ways of scribing, such as a team member typing on a laptop Discussion and feedback from participants not particularly targeted or extensive – I didn't feel we were providing useful responses to guide services and policy, etc. Too many presentations from BoM, perhaps too much focus on NRM and not enough on adaptation planning for urban systems or service delivery – too little focus on climate projections or limitations of satellite rainfall presentation Presentations on research people were doing, in a level of detail that focused on selling their own work, rather than the bigger picture It was all too short! We could have spent a day on each of the case studies I found the time to delve into things as a small group frustratingly short – you just start to talk and then it was time to come back together – a perennial issue for such events I am sure The butcher's paper stage No water on the tables! None of it was all useful I was surprised that there was not a land use planning theme
Question 12: Did you think the number and mix of participants and presenters was appropriate?		Right number – overly heavy representation from BoM and state government – what about private industry, other councils, the community, NGOs etc? Possibly could have fewer presenters – it worked well though There was only one female presenter when about one-third of the room was women Could have had a few more from the industry side – also something on the economics of climate service provision and application Yes, given the specific identification of the agricultural sector

Question 13: Do you have any suggestions of groups or people that didn't attend the workshop that would be interested in future work in this area? Please put names here.		Science education Victorian State Government department representation should have been stronger More State Government representatives Probably local governments, particularly regional Yes, same sort of workshops but with other sectors, e.g. local government, infrastructure More state government representatives would have been useful
Question 14: Overall, how would you assess the value and importance of the Climate services for adaptation in Victoria think tank as a forum to discuss climate adaptation issues?		
Poor Undecided Fair Good Excellent	1 2 3 7 4	
Question 15: Do you have any other comments/ suggestions regarding the Climate services for adaptation in Victoria think tank that may assist with planning future events?		Getting together the right people at the right time – and involving more with users Was too structured – try an un-conference format for the afternoon Keep the same facilitator – Rod was great A slightly more formal 'big picture' view of VCCCAR and the BoM at the beginning would have been helpful Format of whole day very good – good introductory speakers, good chance to talk to others, good selection of attendees who could make a contribution A theme on planning, a theme on communication and a theme on delivery pathways The focus was on climate services not on adaptation per se

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