

MANAGING CLIMATE VARIABILITY

Strategic Review of Climate Science Directions and Priorities

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KEY FINDINGS & INVESTMENT STRATEGY FOR *MANAGING CLIMATE VARIABILITY III*

1. Climate Forecasting Research

- **Statistical Forecasting** - With a changing climate, further research efforts on statistical climate forecasting systems are likely to result in relatively poor returns on investment. [eg Skills Analysis done by BOM as part of South Eastern Australia Climate Initiative 1]. The actual rate of loss of skill of existing statistical forecasts will depend on how fast climate changes and may be regionally specific.
- **Statistical Analysis** – The key ongoing value of statistical forecasting techniques is that they highlight statistical relationships as an input to improving dynamical models. Statistical relationships can be investigated to try and understand the processes underlying these relationships, which can then be represented or improved in climate models.
- **Dynamical Models** - Coupled and regionally constrained climate models, by virtue of the models being a physically based systems approach that attempts to represent climate drivers, existing sea and atmospheric conditions and hypothesise climate teleconnections, provide the best opportunity to improve seasonal climate forecasts in a changing climate, especially in the timeframes of 7 day to multi-week to seasonal climate forecasts. [eg Teleconnections and Drivers Analysis done by CSIRO – McIntosh, Risbey and Pooke]. Ensemble techniques add considerably to the outputs of models. As with statistical forecasting, the skill and reliability of dynamical forecasts will decrease with lead time.
- **Exploiting Research Outputs** - The skill and flexibility of forecasts already available from coupled and regionally constrained climate models [such as POAMA], compared to what can be derived from statistical forecasts in the timeframes of 7 days to multi-week to seasonal, have yet to be fully exploited in Australia [pers comm. – National Climate Centre]. Investment to take advantage of this skill and produce improved forecasts is warranted. Closer relationships between those producing the forecasts and those using the forecasts are part of the processes of maximising benefits from these forecasts.
- **Climate Drivers** - Existing Climate Forecast systems, both statistical and dynamic have yet to represent well some key climate drivers [eg Monsoonal circulations]. To deliver on the likely potential of dynamical climate forecasts to key regions of Australia further investment in understanding climate drivers and how they wax and wane is warranted. Therefore adequately representing climate drivers and

processes in models is a very high priority. [e.g. tropical Australia, work led by Meinke].

- **Short Timescale Extreme Events** - A key need of climate science is to better assess the probabilities of extremes during a particular season – the significant rain events, the floods, frosts and heatwaves. These events are especially important to agriculture for both profitability and sustainability outcomes. Ensemble analysis may prove particularly useful in forecasting short timescale extremes in that they explore the end points of the prediction distribution.
- **Limitations in Predicting Short Timescale Extreme Events** - As many of these short timescale extreme events are weather events, climate forecasting needs to be careful not to suggest to users that short timescale extreme events can be explicitly predicted at the beginning of a season. Generally short timescale extreme events may be predictable with some skill at up to one month lead time at most.
- **Long Timescale “Extremes”** – Long periods of years above expected annual rainfall or continued dry to drought conditions over periods of years, if able to be predicted, would benefit Australian agriculture. Particularly being able to predict continuing drought conditions provides certainty for on-farm climate risk management strategies such as de-stocking, reduced to nil crop planting, reduced to nil irrigation and increased feed purchase.
- **Limitations in Predicting Long Timescale “Extremes”** – Australian climate science is still building an understanding of key climate drivers, how they might wax and wane, their interaction and how this manifests through climate. It is far more complex than previous research suggested as simply being a correlation to the Southern Oscillation Index. Recent analysis suggests that the Federation, WWII and early 21st century droughts were caused by differing combinations of climate drivers [eg Kiem et al]. Further research to understand climate driver interaction and to explore the opportunities to improve predictability of prolonged drought or wet conditions is warranted.
- **Improving Forecast Skill** - One of the main barriers to the uptake of climate risk management strategies in Australian agriculture is the lack of skill, real or perceived, in many of the current operational forecast products. This is clearly the highest priority for climate science research.

Climate Forecasting Research Investment Strategy

- **Investing in Improving Forecast Skill** - Recognising the imperative of improving skill towards 70% or higher for multi-week and seasonal forecasts *Managing Climate Variability* will allocate up to 50% of its budget to climate science projects aimed at improving forecast skill.
- **Mitigating Factors** - This investment may be reduced in favour of climate products for agriculture investment if there is clear evidence of:
 - substantial investment in climate forecasting R&D from other sources [eg Australian Government following the House of Representatives Standing Committee on Industry, Science and innovation review of *Seasonal forecasting in Australia*]; or
 - limited likelihood of *Managing Climate Variability* investment leading to immediate improvement in skill via POAMA – ACCESS because of externalities such as computing capability available
 - limited available science capacity because much of the science capability has been allocated to longer term 2030 / 2070 IPCC related climate change science
 - substantial delays in the transition from statistical to dynamical forecasting by the Bureau due to whatever circumstances that are beyond *Managing Climate Variability*'s position to influence.

2. Climate Forecasting Development and Services

- **Global Frameworks for Climate Services** - Through the World Meteorological Organisation there is a proposal to develop an internationally based *Global Framework for Climate Services*. *Managing Climate Variability* as a major investor in Climate R&D to has an opportunity to help shape Australia's input to this Framework and derive benefit for Australian agriculture from it. [see proceedings World Climate Conference 3]. Countries including USA, UK and Germany are in the process of establishing National Climate Services. The Bureau of Meteorology has this role for Australia. Australian climate information users would benefit from stronger interaction between end users and climate information providers as part of world-wide emphasis on improving Climate Services.
- **Climate Forecast Products** - In terms of value, once a skilful forecast is provided, the key investment opportunity for *Managing Climate Variability* is to facilitate exchange between users and climate scientists to better specify products required, and to identify the means of delivering these products on a routine basis. This requires climate scientists skilled in the development and regular updating of climate

products, an expertise that builds on the outputs of climate forecasting research scientists.

- **Delivery of Climate Products** - Much of the on-farm innovation of climate risk management will occur by individuals within their own decision frameworks once forecasts of sufficient skill and utility are delivered to meet their needs. It also requires an informed and responsive user community as the knowledge flow has to work both ways. Scientists need to understand the user needs just as much as the users need to understand how to use the forecasts.
- **Assessing Skill Level as part of Climate Products** - World Meteorological Organisation protocols provide a consistent framework within which to assign skill levels to forecasts. Defining when operational forecasts have or do not have skill in clear and unambiguous terms is essential. Parallel activities are required so that users understand these skill levels.
- **Delivery Mechanism, core Climate Forecasting Products** - the Water and the Land [WATL] component of the Bureau of Meteorology website has very substantial and increasing levels of use by Australian Agriculture. This in part reflects the partnership between the Bureau and *Managing Climate Variability* to ensure products meet user needs. Continued effort in fine tuning delivery and expansion of products to support on-farm decisions is warranted.
- **Delivery Mechanism, peripheral Products** – there are a suite of products useful to agriculture that go beyond the remit of the Bureau of Meteorology. These products generally involve linking climate information to other components of on-farm decision support. www.ClimateKelpie has been developed for this purpose and will continue to be improved by *Managing Climate Variability III* as part of product delivery to Australian Agriculture.

Climate Forecasting Services Investment Strategy

- **Investing in Delivery of Climate Products** *Managing Climate Variability III* will continue to invest at least 15% and up to 25% of its budget in translating climate forecasting research outputs into climate forecasting products for Australian Agriculture.
- **Key Activities** – Most of this investment will be in partnership with the Bureau of Meteorology to continuously improve WATL. Part of this investment will be in ensuring two way flow between users and scientists such as via Climate Champions and in enhancing peripheral product delivery via www.ClimateKelpie.
- **Mitigating Factors** - This investment may be reduced in favour of climate

risk management R&D if there is substantial delays in the transition from statistical to dynamical forecasting and the commensurate lack of progress in improving climate forecast skill

- This investment may be substantially increased and may become the pre-eminent role of *Managing Climate Variability III* if substantial investment in multi-week to seasonal forecasting R&D is achieved from other sources

3. Climate Risk Management for Agriculture

- **Climate Risk Management Tools** - The uptake of decision support tools that translate climate information into applications is limited. Studies suggest that this uptake is likely to be less than 20% of farmers [eg Hochman, 2009].
- **Criteria for Decision Support Tools** - A set of criteria for Decision Support investment has been agreed to by *Managing Climate Variability II* and will be applied to all investments.

Climate Risk Management Tools Investment Strategy

- **Tools** - Recognising the issues of decision support uptake and the imperative to improve climate forecast skill, *Managing Climate Variability III* will allocate about 10% and at most up to 15% of its budget to decision support applications.
- This low level of investment may be increased if there are substantial investments from other sources to improve multi-week to seasonal forecasting skill.
- **Commodity Specific Tools** - Investment into commodity specific tools by *Managing Climate Variability III* partners and other RDC's will be encouraged. These R&D projects will be project managed by *Managing Climate Variability III* to foster synergies with climate science investments and climate forecasting products. Enhancements to the accuracy of Yield Prophet and the delivery of improved Pasture Tools for both Temperate and tropical Pastures are perceived to be the key investment opportunities for companion projects.

4. Climate Knowledge, Adoption and Communication

- **Knowledge Needs** – Interest in climate has increased as Australian Agriculture seeks to fine-tune its profitability, improve its sustainability,

respond to a variable and changing climate and understand the developing climate change policy, both Australian and international.

- **Climate Change Knowledge** - Many Australian Government and State Agencies have responded to this need and have increased their short term investment in Climate Knowledge activities, especially concentrating on long term Climate Change predictions and policy. This contrasts with the overall trend in agricultural extension investment, which continues to decline as a Government role.
- **Managing Climate Variability role** – *Managing Climate Variability* is tasked to foster adoption of climate risk management by providing the information that helps farmers manage risks and exploit opportunities given Australia's variable and changing climate. The emphasis is on real time climate risk management information as support to decision making during a cropping or livestock production cycle. In undertaking this task *Managing Climate Variability* may assist in fostering private sector activities in extension but does not invest in offsetting the decline of mainstream extension by Government agencies.
- **Managing Climate Variability's focus** - *Managing Climate Variability's* remit is especially on climate forecasts and adoption of climate risk management to respond to climate variability. *Managing Climate Variability* undertakes its knowledge and communication activities for real time decision-making in the context of a longer term changing climate but has no role in investing neither in the implications of long term [2030 or 2070] climate change projections nor in developing climate change mitigation policy.
- **Climate Champions** – Many of the Rural RDC's recognise the importance of farmer leadership in the issues of understanding and promoting climate risk management in a changing climate. Grains, Meat and Livestock and Rural Industries have all allocated additional funds so that through *Managing Climate Variability III* over 40 champions across Australia can be resourced. These Champions will be kept up to date with developments in climate forecasting and climate change policy and will facilitate farmer input to improving climate products and decision support.
- www.ClimateKelpie – Increasingly farmers are using the internet to access information. Increasingly farmers are seeking a readily available conduit to the plethora of climate information beyond routine forecasts that is becoming available. www.ClimateKelpie has been specifically designed to fill this niche and will require ongoing investment to keep it both up to date and improve its functionality to meet farmer needs.
- **Communication Products** – At the same time paper products such as CLIMAG are well regarded and fill a niche – especially for those users not yet well versed in internet based communications. *Managing*

Climate Variability III will continue to invest in these activities while continuing the transition to such products predominantly being made available only electronically.

- ***Managing Climate Variability Program Communications*** – Recognising the importance of fostering adoption of climate risk management, *Managing Climate Variability III* will reduce its investment in Program-related communications such as the *Managing Climate Variability* program website [www.mcv] to the barest minimum.

Climate Knowledge and Communication Investment Strategy

- **Climate Knowledge and Communication** – *Managing Climate Variability III* will allocate up to 15% of its budget to knowledge and communication.
- **Emphasis** - Most of this investment will be towards fostering increased adoption of climate risk management on-farm through vehicles such as Climate Champions and www.ClimateKelpie.
- **Mitigating Factors** – Initiatives such as Climate Champions are attractive to other investors and should such investment occur, *Managing Climate Variability III* will re-direct some of its limited funds to Climate Forecasting Services.