Submission No. 10

Submission to the House of Representatives Industry, Science and Innovation Committee *Inquiry into Long-term Meteorological Forecasting in Australia*

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Overview:

Australia had well established capability in the field of climate forecasting – seasonal climate forecasting - and this capability extended into world-leading applications systems for farming and agriculture. However, this capability appears to have only been effective in regions where 'local champions', connected to regional research centres, provided the detailed analyses required to make climate forecasting a successful component of risk management, especially in agriculture, for their region. Delivery of climate forecast 'products' from national centres (federal government agencies) has been less effective.

Poorly trained rural extension officers and inappropriate and misleading media outputs provided counter capabilities to the hard science that had been hard won over many years. Alternative media coverage of 'long-range weather forecasters' who claimed '100% accuracy' ruined the overall understanding and over 20 years of scientific work in this field, largely to the detriment of rural industry needs. This type of media coverage instigated increased output of poor science or non-science in this area. Rural reporters new to the work were and are ill–equipped to understand the slight levels of complexity needed to make this type of work effective. Inter-agency and scientist or extension officer jealousies confounded and still confound the nature of the capabilities in this field.

Key centres such as the 'ASPRU' group, composed of national agencies (CSIRO) and university and state agencies was located in Queensland. Queensland provided input through its Climate and Systems Technologies Centre but also through its strong rural extension service). The NSW Department of Primary Industries also provided some valuable and strong capabilities in this area of agricultural extension systems related to climate forecasting. These capabilities in both regional centres existed form about 1991 until 2005. This overall capability has been well recognised by key world agencies (such as the United Nations' Commission for Agricultural Meteorology) but, oddly, has not been well recognised broadly in Australia. Instead, 'good money seems to follow bad' in attempts to start entirely new initiatives without any proper understanding of the advances made and mistakes learned over the past 20 years.

Australian capability in this field has been represented in very high-level scientific literature (climate science and agricultural science) and this has attracted the attention of many international scientific agencies. However, core, high quality work has been restricted to a small number of specialists in this field. Others have 'ridden on the shoulders' of those more capable without serious succession planning being made by the parent agencies.

Building upon the early successes in this area, an unusually high number of scientists/engineers/veterinary scientists from other disciplines were and are still engaged in various agencies to work in this overall area. However, most did not and still do not possess a single qualification in this field (not a single relevant undergraduate subject passed, let alone a PhD or post-graduate qualification in a relevant set of subjects) and, rather, these appointees started to claim authority in both climate science and climate applications research and development to the detriment of the needed capability in this field. Poor management of this scientific area (both climate science and climate applications science) has led to some poor outputs from many sources now being produced. Poor succession planning in this overall new area of science has led to the current quandary. In other words, the science was initially well developed but the management systems needed to harness and develop this new field have been poorly developed in Australia.

Gaps remain in the core science needs and some efforts in terms of new dynamic ocean-atmosphere modelling systems may overcome some of the developing shortcomings of various systems. However, means to integrate these newer climate forecast modelling systems with such as agricultural or water resource modelling have not been developed.

Personal background

My representation to this submission stems from over 30 years experience in climate science and climate forecast development and, as importantly, integrating climate forecasts with agricultural and water resources modelling systems. This background has included publishing newly developed climate forecast modelling systems in journals such as *Nature*, *Journal of Climate*, etc but also includes high level background in presenting the value of integrated climate forecasting and agricultural modelling systems to such institutions as the Royal Society (London) and the United Nations Commissions for Climatology and Agricultural Meteorology (Geneva). These aspects particularly relate to the value of advances made in Australia climate forecasting research and in harnessing that value in enhancing world food security and drought preparedness.

Additionally, while director of various Queensland government research centres I was responsible for provision of advice relating to climate forecast outputs and drought/water supply issues to government/Ministers and the State Premier between 1990 and 2007. Furthermore, I have addressed over 30,000 farmers in Australia at public meetings, workshops and seminars, primarily in Queensland, in respect to climate forecasting and its use in improving management of farming systems. In other words, I have experienced both the rigours of academic requirements in climate forecast science as well as ‘the hard knocks’ of explaining and working with farmers, often in bad drought situations, in relation to the value of climate forecasting for their region and needs.

Much of the early work in climate forecasting in Australia stems from the pioneering work of Dr Neville Nicholls (now Professor Nicholls). Dr Nicholls provided remarkably advanced and clear understanding of the remarkably strong relationship between the El Niño/Southern Oscillation (ENSO) and Australian rainfall, temperature, disease, crop production and streamflow and pointed out that this

relationship varied both spatially and temporally and was seasonally dependent. The work of Dr Nicholls led to the development of useful climate forecast systems by other agencies. However, poor provision of more practical outputs from these new forecast systems in some regions, less than satisfactory 'improvements' to the good initial systems, and a generally ignorant rural media led to problems of acceptability in some, but not all, regions.

A notable exception to this problem occurred in parts of Queensland, the Birchip Cropping Group of central Victoria and, to some extent, in the Tamworth/Liverpool Plains region of New South Wales where a concerted effort by a number of local 'champions' led to a reasonably high uptake of seasonal forecasting by rural industries in these regions. These 'local champions' developed a very close understanding of the intricacies of relevant climate forecast systems and could translate the information into practical outputs for rural industry in their regions.

However, it appears a remarkable lack of a unified national effort in Australia in the above fields has meant that many of the useful science initiatives developed in Australia have now, instead, been picked-up in a more concerted way by international agencies (eg in India, The United States, Republic of South Africa, etc) but now remain effective in only isolated examples in Australia.

I should add my long-term work in the above areas has included long on-going representation and provision of information to the Bureau of Meteorology's National Climate Centre (NCC) monthly meetings and exchange of information and concepts to NCC over 14 years. These meetings have been an excellent initiative of the Bureau of Meteorology and should be expanded. However, I have noticed a falling away in attendance and input from CSIRO and other agencies over recent years.

Key issues

Climate forecasting or 'long-range meteorological forecasting '(the latter is a misleading term as it implies 'long-range weather forecasting', often the realm of charlatans and similar who claim to forecast the likely weather for such as a wedding event in the distant future without any serious scientific backing) has been demonstrated to have considerable capabilities and modest but useful 'skill' for many regions of Australia. However, inter-agency jealousies, poorly trained (in climate systems) rural extension personnel, and poor representation in the media have all led to confusion and poor uptake in many sectors. It is believed a reason for this is that climate forecasting (eg: three-month seasonal forecasting) should more appropriately be represented as a 'risk management system' rather than a 'weather forecast' system.

Meteorological forecasting is based upon an understanding of the dynamics of meteorological parameters over a short period to produce 'weather forecasts'. However, climate forecasting is currently largely based upon sophisticated statistical and mathematical analysis of climate, pressure (eg the Southern Oscillation Index) and ocean systems over long-time periods. New dynamic climate forecast systems based on ocean-atmosphere modelling may add a valuable new dimension to climate forecasting in the future – as per the POAMA/ACCESS system of the Bureau of Meteorology-CSIRO. However, statistical systems if developed, published and applied correctly, remain the main operational climate forecast systems for Australia at this stage.

Outputs from climate forecasts (eg three or six month outlooks) are most appropriately described in probabilistic terms – very much akin to the same way medical outlooks and 'odds' are described (eg – 'there is a 30% probability of survival after 5 years in a medical diagnosis' and 'there is a 30% chance of receiving the long-term median rainfall for this time of the year for your region over the next three months'). However, most media and extension agencies fail to understand this distinction between weather/ meteorological forecasting and that related to climate forecasting that uses entirely different methods and provide different types of outputs.

Much work has been done to demonstrate which climate forecasting systems work well in Australia. However, the output from this work has been hampered by well meaning inputs from other discipline areas that have tended to miss core attributes in climate forecasting science. Additionally, while some of this type of analysis has been professionally done, much has been performed by those apparently with a vested (jealous) interest to see this area of science dismissed. Some Australian federal agencies (and various state government agencies) have 'lost the plot' in this field, a field in which it once had world leading capability.

Much advanced work in this field has been completed in Australia, especially in regards to agricultural applications at the 'APSRU' group in Queensland (Agricultural Production Systems Research Unit – a joint CSIRO, Queensland Government, University of Queensland agency) to show the value of integrating *tested and scientifically published* climate forecast systems with agricultural systems models. Work at 'APSRU' has been world leading in that it was one of the first in the world to demonstrate the full value of climate forecasting through its potential to usefully change and help on-farm management decisions and also in being able to provide formulae for testing climate forecast skill associated with a given forecast system.

In this respect the work of Prof Holger Meinke (now Wageningen Agricultural University, Netherlands), and Prof Graeme Hammer (part appointment, University of Queensland) are notable in respect to the manner in which climate forecasts have been shown to have enhanced value when they are properly integrated into crop simulation and similar whole-farm systems models.

This work described above easily 'led the world' but has largely been lost in Australia over the past 4 years due to loss of the core researchers involved to international and other agencies. This loss process has been hastened by inappropriate government policies or simply poor management in some state agencies in respect to understanding and appropriately physically locating this vital work effort. Ironically, much of this work is now in the process of being recommended in the United States (see Rosenzweig and Hillel, 2008) and in United Nations' agencies (see Stone and Meinke, 2006 and reports by the UN WMO Commission for Agricultural Meteorology). It seems that once again, Australia has lost a world-leading scientific capability through simple mis-management and poor or mis-representation nationally.

Suggested major gaps in core science areas in relation to climate forecast systems include:

- addressing the relevance or otherwise of any independent contribution provided by the Indian Ocean through the Indian Ocean Dipole (IOD) or similar. Climate forecast systems that incorporate the IOD (in addition to ENSO), including that provided by the Bureau of Meteorology, have encountered some problems in operational skill, possibly due to rapid warming of sea-surface temperatures in the Indian Ocean, I understand BoM is working on correcting this problem although the results do not seem to have improved to any extent. This issue needs to be urgently resolved.
- For southern Australia in particular, while useful research relating to the Southern Annular Mode has been completed in one section of the Bureau of Meteorology (within 'CAWCR') it has not been taken up by operational climate forecasting systems to assess its value as an adjunct to the strong ENSO signal inputs into climate forecasting.
- Harnessing the work completed so far on intra-seasonal (multi-week) forecasting that offers the potential to aid decision making in northern Australia but also may have application in high (further southern) latitudes in regions such as southern Queensland and NSW. Links to core decision-making needs in relevant industries is also needed.
- Continued research into fully dynamic ocean-atmosphere climate forecast systems need to be explored and incorporation of appropriate UK Hadley Centre modelling or similar into Australian systems is needed. However, may not need to interfere with the relatively inexpensive aspects associated with statistical climate forecast system improvements. This activity may also extend to intra-seasonal forecasting in relation to the Madden Julian Oscillation (MJO).
- Ensuring outputs from newly developed or current climate forecast systems have the capability to facilitate integration of climate model to agricultural or water resource modelling or economic modelling or similar. Some systems do this as a core component of their development while, unfortunately, others do not. This aspect hampers the uptake of such systems devoid of this capability in their initial construction.

Recommendations

Establishment of an appropriate risk management systems modelling centre in Australia, along the lines of the APSRU model, into which climate forecast systems, if deemed appropriate through publication and verification in real-time testing, would be integrated into decision systems for farming operations and other needs (eg: mining and tourism).

This new centre would harness and, without-prejudice, allocate the most effective climate science developments that have been published in high level scientific literature for Australian or regional needs and develop the most appropriate testing systems for industry application. (Note: development of one climate forecast system that suits 'all Australia's needs within one model may be inappropriate and, rather, a selection of more regionally focussed models may well be more appropriate for various regions in Australia. (One size does not, necessarily, 'fit all' in climate forecasting).

This proposed centre could be along the lines of a CRC model ('CRC for climate risk management and drought research') and have strong relevance to agriculture, water resource, insurance/finance, health, mining, tourism and policy needs.

Development (or re-development) of 'managing for climate workshops' for farmers and other users along the lines of the successful examples provided by the then Queensland Department of Primary Industries and similar efforts provided by Dr Peter Hayman of the then NSW Dept of Primary Industries – now in SARDI, Adelaide. This model is also now being taken up internationally but ironically being disbanded in Queensland.

Development of more appropriate professional training in this field. Being a 'day-to-day meteorologist' is not enough of a pre-requisite or necessarily appropriate, although such a qualification provides an extremely valid first qualification. Development of enhanced post-graduate training in climate science and climate applications science and similar is needed in Australia.

Need to address gaps in core science needs as described in the Key Issues section of this document.

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