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REPRESENTATIVES**

STANDING COMMITTEE ON INDUSTRY, SCIENCE AND
INNOVATION

Reference: Long-term meteorological forecasting

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HOUSE OF REPRESENTATIVES
STANDING COMMITTEE ON INDUSTRY, SCIENCE AND INNOVATION

Monday, 29 June 2009

Members: Ms Vamvakinou (*Chair*), Fran Bailey (*Deputy Chair*), Mr Bidgood, Mr Champion, Mr Cheeseman, Dr Jensen, Mr Johnson, Mr Ramsey, Ms Rishworth and Mr Symon

Members in attendance: Ms Vamvakinou, Fran Bailey, Mr Ramsey and Mr Symon

Terms of reference for the inquiry:

To inquire into and report on:

Long-term meteorological forecasting with particular reference to:

- The efficacy of current climate modelling methods and techniques and long-term meteorological prediction systems;
- Innovation in long-term meteorological forecasting methods and technology;
- The impact of accurate measurement of inter-seasonal climate variability on decision-making processes for agricultural production and other sectors such as tourism;
- Potential benefits and applications for emergency response to natural disasters, such as bushfire, flood, cyclone, hail, and tsunami, in Australia and in neighbouring countries; and
- Strategies, systems and research overseas that could contribute to Australia's innovation in this area.

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Committee met at 8.59 am**JAKOB, Professor Christian, Private capacity****NICHOLLS, Professor Neville, Australian Research Council Professorial Fellow, Australian Meteorological and Oceanographic Society**

CHAIR (Ms Vamvakinou)—I declare open this public hearing for the inquiry into long-term meteorological forecasting in Australia being conducted by the House of Representatives Standing Committee on Industry, Science and Innovation. The inquiry arises from a request to this committee by Senator the Hon. Kim Carr, the federal Minister for Innovation, Industry, Science and Research. Written submissions were called for, and 33 have been received to date. The committee is now conducting a program of public hearings and inspections. This hearing is the fifth of the inquiry. I now call Professor Nicholls and Professor Jakob to give evidence. Do you have anything to say about the capacity in which you appear before the committee?

Prof. Nicholls—I am appearing both as a private person and also representing AMOS, the Australian Meteorological and Oceanographic Society, of which I am vice-president.

CHAIR—Thank you. Although the committee does not require you to give evidence under oath, I should advise you that these hearings are formal proceedings of the parliament. Consequently, they warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. We thank you for your submissions and now invite you to make a brief opening statement before we proceed to questions.

Prof. Nicholls—Thanks for taking the time to investigate this important but challenging subject and for providing me with the opportunity to meet with you today. I am an Australian Research Council Professorial Fellow at Monash University, where I research climate and its impacts. From 1971 to 2005, I was a climate researcher at the Bureau of Meteorology. I have published more peer-reviewed scientific papers on Australian modern climate variations than any other scientist.

Australia is a land ‘of droughts and flooding rains’ because of the El Nino southern oscillation, which amplifies rainfall variability in this country compared to countries where it does not have a role. This extra rainfall variability compared to other countries with more benign climates makes farming a challenge. However, ENSO is to a limited extent predictable, and methods developed over the last 25 years to predict the phenomenon and its impacts can help us cope with the extra climate variability.

Including phenomena other than ENSO in the forecast systems may lead to better predictions, but progress in this area has been slow. Australia was a world leader in seasonal climate forecasting research and its applications up to about 15 years ago, but we are now slipping behind world’s best practice. This is because of limited resources; over-reliance on competitive funding of small, short-term research projects; and institutional barriers to collaboration among universities and between universities and government research centres. Other countries are now showing the benefits of funding long-term centres for research and application in this field to maximise collaboration and to provide a clearer focus.

I am also representing the Australian Meteorological and Oceanographic Society, or AMOS. The president, Dr Richard Wardle, provides a submission but cannot be here today. The main points from the AMOS submission are that, if Australian long-term prediction abilities are to remain close to state of the art, there is a need for increased supercomputing resources and the employment of more permanent staff in the Bureau of Meteorology and CSIRO, as well as a well-coordinated national research program that embraces the academic sector.

I am also representing my long-term colleague Ms Mary Voice, who was head of the bureau's National Climate Centre and was instrumental in improving the use of seasonal climate forecasts. Mary is unable to be here today, and she hopes I can field any questions regarding her submission. She is actually looking at the declining glaciers of Alaska at the moment. She hopes you will examine table 2 in her submission.

FRAN BAILEY—We could go there and interview her!

Prof. Nicholls—You could take me there to interview me! Table 2 in her submission lists the components that need to be combined to produce a comprehensive seasonal climate prediction system. She makes the point that it is not just about the science that she, Christian and I do but also about involving all sorts of stakeholders to make sure the forecasts are used appropriately. Mary also notes that it is new resources that are needed if we are going to make major improvements in prediction, not just a shift of resources within existing organisations. Thank you.

Prof. Jakob—I would also like to thank you for taking the time to read my submission and to listen to my statement and for talking to me. My background is in computer modelling of the atmosphere. I currently hold the chair of climate modelling at Monash University, and before that I was a senior research scientist at the European Centre for Medium-Range Weather Forecasts. I was a principal research scientist at the Bureau of Meteorology for a few years. So, not surprisingly, my submission mostly deals with the role of computer models in this problem.

I want to start by talking about weather prediction before we move to the longer term prediction. Weather prediction by computer models has been one of the most revolutionary and probably one of the most unnoticed developments in the second half of the 20th century. Most people out on the street do not know that their weather forecast is largely made by computer. It is a huge scientific success story. Five-day forecasts today, as you have heard in other submissions, are as good as three-day forecasts were 20 years ago. People at the World Meteorological Organisation estimate—and that is all we can do—that the use of these forecasts saves society trillions of dollars and thousands of lives per annum worldwide. The exact number is very difficult to determine, but just imagine, if we were not to make weather forecasts for the next three months, what impact that would have on society. The hurricane season is just around the corner in the United States. Imagine they had no forecasts for the next three months. So there is a huge impact from weather forecasts.

Similar computer models that are not identical in construction but very, very close and contain more components are also used to determine the future of our climate. It is essentially the same kind of computer modelling framework that we are using. These models are now being used to estimate the global impacts of climate change and are being refined everywhere in the world to actually help predict the regional effect of these changes. The nature of the predictions is quite

different to a weather prediction, in that we are not trying to predict a particular day but more the statistics of the weather. However, the computer models used to do that are very, very similar in construction to those for weather. It has now been shown the predictions between those two scales of time that I was talking about, between weather and climate, are also possible using similar computer models that are, again, very similar in construction. The scientific questions that you need to address vary with the length of the prediction you want to make. Depending on whether it is a week, six months or 100 years, the science changes a little bit. But the general principles of (a) using a computer model to do it and (b) the basic makeup of what that computer model looks like are the same for all those timescales.

Given this, the international community is actually beginning to treat the problem as one of what we call 'seamless prediction'. It is a problem where we would like to try to use the same sort of computer models to make predictions across all timescales. A meeting last year of the world's leading scientists in this area, called the world modelling summit, of which I was a member of the organising committee and also an invited keynote speaker, concluded that this seamless approach is not only feasible but actually desirable for a variety of reasons, which we can go into in more detail if you want. Given sufficient effort, we can imagine providing the world and individual countries like ours with forecasts from one day to 100 years in this sort of seamless fashion and we can imagine providing end users of these forecasts with products which are seamless to them and with which they can make decisions all the way from a few days out to 50 to 100 years from now.

You might ask: what does it take to achieve that? It takes a sustained and well-resourced research effort and—I am sure you have heard this before—a very big computer. Where does Australia stand in this internationally? On both counts, human and computational resources, we have actually fallen behind the rest of the world significantly. I am co-chairing the World Meteorological Organisation's working group on numerical experimentation, and we review the computing at operational numerical weather prediction centres on a regular basis. I can tell you from the last meeting last year that Australia is at the bottom of the list now and will be at the bottom of the list with its plans for the foreseeable future. A report on this is available on the website, and I can point you to that if you are interested. We are well behind countries like Brazil, Korea, Canada, India and China, so I am not even talking about big economies like the United States, the UK or Germany. We are well behind much smaller economies.

It is important to note and it is often forgotten that the computer required needs to be many times bigger than what you need to make the actual forecasts so that the research to improve those forecasts can be carried out in parallel. Often we buy computers that are just about right to make the predictions operationally so that we have forecasts but there is no space to run experiments to improve them, and that is a very big problem in many, many countries. Here, for instance, I have heard recently that the bureau and CSIRO have sufficient computing resources for weather and climate but it is a struggle to actually do the very large set of experiments that is required to improve the seasonal prediction system, because that is a very, very big computational task.

Another question of your inquiry was: 'Why can't we leave it to the international community to make the forecasts for us? There are big efforts in other countries—why can't we just use them?' I want to give at least three reasons why we cannot. Firstly, there are scientific reasons and there are regional issues in the predictions that have to do with Australia that no other

country will address. Secondly, the users are all equally important, and the users of the forecasts are local—they live in this country. They want particular forecasts for particular applications in this country, so a strong engagement with those users is required. The users actually need to drive part of the process of designing the forecasting system, and that will not happen if the forecasts are made overseas. Last but not least, the country with the best forecasts will have a competitive advantage. I think it is worth while thinking about giving Australia that competitive advantage.

What we really need is a national research effort with significantly increased resources on both the human and the computational side both in the government research sector and in academia, and we need a very strong user engagement—Neville has already alluded to that—that leads ultimately to a sort of climate service that a lot of other countries are talking about. We have such a service in place.

I mentioned the economic and social benefits of weather forecasts. These benefits can be easily extended to longer-term forecasts. If the problem is addressed properly we will save billions of dollars and we will save lives by making these forecasts and making them well. Forecasts can be made now but they need to be improved. That is rather obvious to everybody. They can be improved through better research, and I believe that science and politics need to come together to make this happen in this country.

CHAIR—Thank you very much. I might open with the most obvious question to you, Dr Jakob, and that is: presumably government does not a seamless approach to the funding and support of weather forecasting and its challenges. Are you able to give us an appraisal of why we are at the bottom? It is obvious we are at the bottom of the list because maybe governments have not provided enough funding. Is it just about the funding, or are there other things that have occurred along the way? For how long have we been heading towards the bottom?

Prof. Jakob—I want to make this clear. We are at the bottom of the list in computing capacity. I would not say we are at the bottom of the list in scientific knowledge and scientific effort. We are actually quite far from that.

CHAIR—So the two are out of kilter with each other and they should not be.

Prof. Jakob—That is right, and they need to be brought together again so that the scientific talent we have in this country is actually being used in an appropriate way. So that is one point. Neville might want to comment on this as well, but I would say that one of the big problems we are facing is these institutional boundaries that we have set up for ourselves. It is very hard for an academic to collaborate with the Bureau of Meteorology Research because the ARC linkage scheme, for instance, excludes the bureau of research and the CSIRO as possible partners. So it becomes very difficult for us to work with them and to write scientific proposals on issues like this.

The second thing is: the seamless idea is relatively new scientifically. There have been good efforts in Australia in numerical weather prediction and climate, and the emergence of the ACCESS system—the Australian Community Climate and Earth-System Simulator—is actually a step into the seamless prediction that we have made. The reason we cannot make it happen quickly is that we do not have the resources to do all the problems. So we are doing the problems

that we perceive as most urgent, which is weather prediction—which is a thing that society needs—and climate, and the seasonal has sort of fallen through the cracks a little bit in that system. It is quite expensive. I think we are on a good path through this ACCESS system, because it will bring the different strands and the different prediction tasks together into one technical system, but we will really need to increase the number of people who do research on that system and the computer power that they have available to do their research.

CHAIR—Presumably we have that human resource here already, or are we suffering from shortages in that area as well?

Prof. Nicholls—I can get to that question. Could I add another rider on Christian's answer to your first question? I am old enough that I remember the long-term development of weather prediction and climate prediction research in this country. In the 1970s and the late 1960s we were behind the leaders in terms of physical computing resources and human resources, but the leaders were basically the US and some of the European countries—but not many of the European countries. The difference now, compared with 30 or 35 years ago is: we are slipping behind almost everybody, including Korea, India, China and Brazil—as well as many countries in Europe.

Over my professional lifetime we have slipped further and further behind. We were competitive in the 1970s even with the big economies. We are not now even with the more middle sized economies. Christian also said I would probably like to talk about the institutional barriers as well as the limited resources. I have forgotten your second question.

CHAIR—The computing stuff is obviously a new phenomenon and I can understand our falling behind in the development of that but you also need the human resources to deal with the detail. Are we slipping behind there?

Prof. Nicholls—Yes, we are. It comes back to one of these institutional problems that Australia has faced in the change over the last 30 years. We have changed from a situation where in the old days people were full-time public servants even researchers and they could devote their time without any problems to long-term challenging problems such as seasonal climate prediction. Now for all sorts of reasons, many of them good, we work on short-term projects funded for a few years and we try still to train postgraduate students and postdoctoral people to get to their highest ability knowing that we only have a very short time to train them, get them up to scratch and then they have to find a job somewhere. That system causes us problems with a challenging long-term problem such as seasonal climate prediction, which requires a long-term focus from an individual. If you have a problem with a long-term focus but you are actually funding people from year to year or for a couple of years, it is a challenge and I think we are facing that challenge increasingly.

CHAIR—So you are training people and then at some point they do not have a job.

Prof. Nicholls—They do, but it is in Europe or America.

CHAIR—I am talking about Australia. So they do not have a job here with us and the paradox is that we are actually supposedly in the throes of having to develop in an area that requires a long-term commitment from employment and resource.

Prof. Nicholls—Yes. It is a problem. I am sure it is not the only area where this is a problem but we do perceive this is a problem in Australia.

CHAIR—Effectively, the current situation means that even if we wanted to address some of those issues, we really need to address employment issues.

Prof. Nicholls—Yes, we certainly do.

Prof. Jakob—I want to expand. One of the things you need to do to make forecasts better is to make the systems that make them better. That is work that is bordering on the scientific and engineering areas which means the people who do it are often very good scientists but the way we measure scientists today, by how papers they have published and so on, is actually very counterproductive to what these particular people have to do. So it is very hard to attract people into this area and to say this is an exciting area, come and work in it. In the past we have overcome this by giving those people, as Neville mentioned, long-term perspectives. So we say: 'We want you to do this really hard job. You will not be writing a lot of scientific publications, so some of your peers will say you're not a good scientist, but we value you. We know you are good and we will give you a long-term perspective and long-term job perspective.' More and more we are going away from that. At the Bureau of Meteorology some of the core development is now done by people on two- or three-year contracts.

CHAIR—It seems like the issue again of how a good academic demonstrates their capability by writing papers. If you do not have those papers then you cannot move forward. That seems to be the case everywhere not just in this area. It has come up quite a few times in terms of whether that system of assessing people's abilities is now restrictive and inhibitive. It is not for us to decide, that is obviously for the academic world, but it is coming up quite a bit.

Prof. Jakob—It is inhibitive in this particular area more so than in others I would say. I want to add one more thing. There is a circular argument here. To attract the best scientists you need to give them the equipment that they need to do the best science. Once you have fallen behind in that it becomes harder to attract the scientists over here. They would rather go to a centre where there is the fastest supercomputer in the world and do their work there. So we really have to work on that.

Prof. Nicholls—There is another inhibition, another institutional barrier. This is an unusual field in that, even though the ultimate product of this work, forecasts, are commercially valuable as well as societally valuable, they are going to be produced, basically, by one or two organisations—the Bureau of Meteorology by itself or in collaboration with the CSIRO. But there is quite a deal of expertise in academia, so it would be really nice if academia could work collaboratively with the bureau and with the CSIRO. We really want to, but you will see from some of the submissions that that is not as easy as it seems. Personally and scientifically we would like to do that. We need to do it because that is where the core computing facility is residing and will reside. As an academic I cannot get enough funding to produce a competitive climate forecasting computing system, so I have to work with the Bureau of Meteorology. But there are institutional barriers that stop academics from collaborating with the bureau and the CSIRO on this sort of work. We rabbit on constantly about these institutional barriers to people and we are not getting anywhere in breaking them down.

FRAN BAILEY—I would like to follow up on just that point. I am not sure that this is correct, but it is my understanding that at the WMO there are these links, especially between the mathematical science academics, with the work that is being done in a number of the programs at the WMO. I have been picking this up from literature I have read.

Prof. Nicholls—Internationally there is strong collaboration, and even on a person-to-person basis there is strong collaboration, but I am talking about really nitty-gritty details of how you get a project, say, between Monash University, Christian and me on one side and the Bureau of Meteorology and the CSIRO on the other.

FRAN BAILEY—I understand. I just wanted to get a point of difference. I appreciate the points that you are making about us really being behind in the computer technology. It is my understanding now that they have moved beyond the supercomputer to a project which I think is called Blue Storm—the super supercomputer. It seems to be the case for us here in Australia that we are missing out on access not only to the computer technology but also to the satellite technology. From what I have read, there has been a program where the computer technology links with the EU. I think it is called the METSAT program. It strikes me that Australia is missing out on those aspects of collaboration as well. Is this the case in your experience?

Prof. Jakob—I am not aware of that. It is a little bit outside my expertise. Satellite data and data generally is shared freely through agreements in the World Meteorological Organisation. There are of course issues. The volume of modern satellite data is huge, and so accessing that data and being able to transport it to Australia via the internet is often difficult. But there are ways around that. There is a small technical restriction but there is no restriction in accessibility as such. I think we would always like to have the ability to get the data from where it actually resides to Australia faster—and more of it—and that can become a limitation, but I do not think it is a severe limitation right now.

Prof. Nicholls—No, I do not believe that either.

FRAN BAILEY—This inquiry is also of course very concerned about the application of the research. For example, I am aware that in Europe a farming organisation or in fact an individual farmer, as long as they have the satellite dish and a PC, can tap into the most up-to-date seasonal forecasting. While there are some organisations that provide that sort of service—we have heard from them in Australia—there is not that degree of open access to the application for research. Can you give us some examples—maybe it is more funding, maybe it is the people with the skills, maybe it is greater areas of collaboration? At the end of the day governments have to get a return on their investment, and that return in the science case is the application of that.

Prof. Nicholls—Seasonal climate forecasting researchers in Australia have long been aware that it is not just a scientific problem but a problem of access to the forecasts and using those forecasts appropriately. You have a submission from my Queensland colleague Professor Roger Stone, who is one of the leaders in Queensland. He and his colleagues over the last 25 years have worked very hard to look at delivery of climate forecasts, particularly to the agricultural sector, and they were very effective for a very long time. They developed systems where an individual farmer could actually work out how to apply particular forecasts to work out whether to plant, what to plant and when to harvest. They were the world leaders over a long time in actually applying seasonal forecasts.

What they do and did has now been taken over by other organisations. There is an organisation in the US called the International Research Institute for Climate and Society, which is a multimillion dollar institute set up to do seasonal forecasting and its application. A Queensland scientist, Dr Graeme Hammer, sits on its scientific and technical advisory board. He has forced this recognition that you have to make sure these forecasts are applied in a proper way and are delivered. They are now very good at that, and we have not really moved on in the last 10 years to do that. We were doing it as well 10 years ago as we do now, probably. Again, that is one of the problems that we have faced over the last decade. We have slipped behind in being world leaders in getting the forecasts delivered to a user and make sure the user uses them the appropriate way. We were world leaders in that, without doubt, 10 years ago and we are not now.

FRAN BAILEY—I am particularly interested in any research that is being done into chaotic weather behaviour and its application to emergency management organisations. It seems that is just not happening.

Prof. Jakob—I would like to answer the previous question and then allude to that one.

FRAN BAILEY—Sure.

Prof. Jakob—What I like to call ‘making forecasts usable’—which is about making systems that make forecasts better but also working with the users so that they actually see the value of those forecasts—is actually one of the hardest problems that you can imagine, and I want to give you an example of that. The reason is this: they are quite different from the weather forecasts that you see in the *Age*, which tell you that tomorrow it will be 25 degrees. But what we call ‘probabilistic forecasts’, rather than telling you it is going to be 25 degrees, say the chance of the temperature being between 23 and 26 degrees is 30 per cent and the chance of it being between 26 and 30 degrees is 50 per cent. That is a much more difficult forecast to use, but the nature—and this comes to the chaotic behaviour of the atmosphere—of the problem is such that one can feasibly make only a forecast that is a probabilistic estimate of the various scenarios and what probability is attached to each scenario.

There is a very similar problem in weather prediction once you go beyond three days, and it is something in which Australia has also fallen behind. Most of the world is now using what is called the ‘ensemble prediction system’, which instead of making one forecast essentially makes 50 or 100 every day. From those, it calculates what the chances are that it will rain or that we will have extreme conditions, extreme winds, extreme heat and so on and so forth. As an example, the European Centre for Medium-Range Weather Forecasts, where I work, introduced such a system into their day-to-day operations in 1993, 15 years ago, and even today they are still many countries in Europe that do not know how to effectively use the product.

This is a very difficult problem, and it is a decision-making and an uncertainty problem. How do you make decisions given that you have various scenarios that all might come true, admittedly with different chances? That is a research area in itself. That is what the weather people have found—every user of the information is different. You cannot develop a one size fits all system. An agricultural user will be very different from an energy company, a gas supplier and so on and so forth. That is why it takes a lot of people to do that sort of work. The person who works with the farmer will not necessarily be able to work with the gas supplier, because

the problems that both are facing a quite different and the questions they are asking of the forecaster are quite different. It is a really, really difficult problem that requires a lot of attention and a lot of investment, just as the improvement of the systems themselves does.

Mr RAMSEY—Can I ask a supplementary while we are on the subject? It is something I had listed down to ask you in relation to the different products that are being offered in different countries. I want to explore what you were saying a bit further. If I log onto the bureau site here in Australia I am given information that over the next three months there is a 55 per cent chance of less than average rainfall or whatever and less than decile 5. Are you saying that in Europe or other countries I will log and there will say there is a 55 per cent chance of less than decile 5 and there is a 45 per cent chance of less than decile 4? How does that forecast change in the application of what I actually get on my computer when I want to look at those seasonal forecasts?

Prof. Jakob—Actually I am not aware of what other countries do in that respect. But if there is a 55 per cent chance of something then there is a 45 per cent chance of something else. That could be broken down further.

Mr RAMSEY—That is right. In Australia we get the two options, like 55, 70, 30 or whatever it wants to be, and one is dryer and one is wetter than the mean. I am wondering how you actually expand that further to give these different ranges of forecasts because I understand there must be more than two.

Prof. Jakob—It depends on what forecast system used. You have heard about this. I saw in submissions and at your previous hearings about statistical versus dynamical systems. The statistical systems are more limited in what information they can provide and the dynamical systems can actually provide any information you want. The question is how reliable it is. So they are new and they are scientifically less certain than the statistical systems and still need lots of improvement. In theory they can provide a very high detail. But the question is: is that detail reliable; can we rely on that? Research is required to find out what level of detail is justified given the uncertainties and the problem is a really good question, and it will depend, again, on the application.

The point I was trying to make in the previous question is: we really need to get to a point where the users drive some of the development of the system. If you are a farmer, you have a particular need that needs to feed back to the people who develop the system and to the products so that they can think about supplying you with better products for your needs. The difficulty is that every user community has a different set of needs. Some people might be happy with just having two options. Others might say that they are not interested in the mean temperature and would like to know how many hot days we are going to have. In principle, with a dynamical forecasting system, I can get that information out quite easily but it is a lot of research to find out whether it is reliable enough that the user can actually make decisions based on it. That is a research question; it is not something we know right now I would say. And it varies from user to user and from variable parameter to parameter that people are interested in. Rain will be different from temperature for instance.

Mr RAMSEY—I think, Madam Chair, that when Fran comes back from her tour it will be very interesting, Fran, if you can bring back some of the products that they actually present in the final forum for us to have a look at.

FRAN BAILEY—I am leaving tomorrow for Portugal and going to the WMO.

Mr RAMSEY—Sorry Maria, that was just a supplementary.

CHAIR—We will come back to that.

Prof. Nicholls—It is really important and it is something we have worried about in Australia for 20 years. It comes back to: how do you get the information that we have across to, on the one hand, the general public, the media and people who have broad interest in whether there is going to be a drought next season or not, and to an individual user who is worried about the farm gate, his or her particular farm and what decisions he or she might be making now. We have really struggled with this. It is a really complex problem and it is easy to get confused. Because of the chaotic nature of the atmosphere, which Ms Bailey raised, these forecasts are all probabilistic. So we are always saying 60 per cent chance of above average rainfall or below average rainfall. But we do not have to stop there. We can cut the previous distribution and we could tell you what percentage likelihood of a decile 1 rainfall, a very low rainfall, is. We can do that.

If we provide that to everybody on a website, we find that people sometimes overreact to the information or underreact to the information, so we would rather tailor the forecasts and work with the crucial stakeholders to work out how that should be structured and what information they actually need to make those decisions. Again my colleagues in Queensland have been the world leaders in doing this—going out to the farm gate and talking to individual farmers about how we can match what we can do with the needs of individual users.

This is feasible but it is very person intensive. It is not the sort of science that Christian and I tend to do. It is very demanding to have people sit down with farmers or groups of farmers and say: ‘You’re really interested in this decision. This is the sort of information that the science can provide that will be useful,’ but we ain’t going to put that on a website or publish it in the *Australian* or a weekly rural magazine because it is too much information for most people and we find that most people overreact to it or underreact to it.

Mr RAMSEY—We had the GRDC and CSIRO Land and Water in last week or the week before talking about yield profit, which I have got a bit of experience with but probably the rest of the panel would not. That is what you are talking about, isn’t it—feeding it into the models that those organisations will then disseminate in the form that they need to?

Prof. Nicholls—Getting farmers to work out how to use this information in the best possible way. The bureau can quite easily provide more information about those details than you see on their website, but we do not think it is useful in a broad sense. What we would like people to do is not make decisions based on a one-inch headline on the front of the *Herald Sun*. We would like for them—

Mr RAMSEY—They vote on that.

Prof. Nicholls—Yes. We think it is really important to get that message across. For instance, we are concerned at the moment we are slipping into a new El Nino which may increase the chances of drier than normal conditions over much of eastern Australia over the next few months. We are concerned at the moment. It is great to have a one-inch headline in the *Herald Sun*, but we do not want farmers to go out and sell the whole kit and caboodle and bet their last shirt that there is going to be a drought. It just depends on what sorts of decisions you are making, how much you should value that forecast. We would like the situation where they can come to an adviser, who understands the science, understands the farmers' decision-making processes and what they have to do, and match the needs of farmers with the abilities of the science much better than we can just by broadcasting a very broad forecast.

CHAIR—We are talking about a possible prediction but there is no capacity to explain or assist in this case the farmers, who are the obvious stakeholders, in their understanding of that prediction, what it means for them and what they need to do or not do. That capacity is not there. Is that what you are saying? You can make the prediction and express the concern but there does not seem to then be the ability to assist the stakeholders in understanding what that prediction would mean for them.

Prof. Nicholls—There is capacity and we have done that in the past. Again my Queensland colleagues, who you may speak with sometime soon, have been the world leaders in the delivery of information and making sure that the stakeholders or the potential users understand what they need and match their needs with the abilities rather than just take the broad scale forecast. So there is that, but it is demanding of human resources to sit down with farmers or groups of farmers and work out how to do it. They have actually worked out ways of delivering the information to the farm gate, to individual farmers, using computer software that allows them to not make the forecast themselves but take the information they can gather from the web and see what it means for their farm.

Again, they have been world leaders in this. We are better—or we were 10, 15 years ago—than most other countries in the world at doing that. But resources have not really been put into it in the last decade to enable us to continue holding on that and then building in the improved science that we are trying to get out of the computer models. Most of that original work that I have just been talking about is based on statistical forecasting, which has been my main expertise over a long time. It ain't going to be helpful in the next few decades. As we move into a changing climate and all sorts of other problems, we would like move to these dynamical models but still have the systems that mean that individuals could use the information appropriately. It is a challenging problem.

CHAIR—Hence, one of the weaknesses really is that once we move into the dynamical model there may not have enough people power to assist in that transition and to establish the capability that is required for the future. Are we at that point?

Prof. Nicholls—Yes. It was easier 20 or 25 years ago—and again, I hate to talk about history all the time. Most state departments of primary industries had officers who were out there translating all sorts of scientific information down to the farm gate level. They do not have those resources anymore. They were a natural group of people that we could use 15, 20 years ago to make sure that farmers could actually use that information appropriately.

Prof. Jakob—The products that come out of these forecast systems are so complex now—and that, in essence, is what Neville alluded to—that you almost need an education program for the users.

CHAIR—You need a new generation of—

Prof. Jakob—They are quite different, as I said.

FRAN BAILEY—You will need lots of mathematicians.

Prof. Jakob—People know about probabilities. They bet on horses so they must know something about probabilities.

Prof. Nicholls—They lose money.

Prof. Jakob—They lose money usually in the process so maybe they do not know enough. But the point is, we have talked about the agricultural sector but there are other sectors that do not make optimal use of existing forecast information on all timescales—on seasonal timescales and also on weather timescales. There is a lot that could be done, working with the users to make them use the products in an optimal way. There is no perfect way. It is difficult because of the chaotic nature of the problem, the probabilistic nature of the forecasts. It is much harder to deal with. If you have a barbecue on Saturday and someone tells you that there is a 30 per cent chance of rain, will you have a barbecue or will you call it off?

CHAIR—At 30 per cent, I would have it.

Prof. Jakob—It actually depends upon who is attending. If they are all good friends who do not mind getting wet—no problem. If it is some foreign dignitary who would get really upset when it is wet, you might call it off. You might say, ‘Let us have something else.’ This is exactly the problem. What you do with the information changes with the decision that you need to make.

CHAIR—Absolutely.

Prof. Jakob—That is why every user has a different need and so the agricultural sector will not have the same need as someone else. That is why it is such a labour-intensive, human resource intensive problem, because you need to work with all these sectors and it is all very complicated and different. So it is a big problem.

Mr SYMON—Professor Nicholls, I would like to talk about operational seasonal forecast systems based on statistics. I note in your submission, going to warming Australian temperatures and increasing global temperatures, that the data that we have collected and use is now going to be biased on the cool side. Is that a proper understanding for me to read it that way?

Prof. Nicholls—Yes, that is right.

Mr SYMON—So in going forward with an increase in temperatures that bias is going to become larger for a period of time?

Prof. Nicholls—Yes, we expect that to happen. The other bias is related to rainfall, because rainfall variation is related to sea surface temperatures. Our statistical forecast systems have been built using historical data. Relationships now between spring rainfall in Melbourne, for instance, and our sea surface temperature patterns are different from the way they were in the past, because the sea surface temperatures have been gradually warming over the last 50 years. So that causes us a problem which we have not solved. It is a problem that I have been trying to work a way around for the last 10 years, and I have not worked out how to do it. No-one else in the world has worked out how to do it—except to go to these dynamical models which Christian has mainly talked about. They are a natural framework within which we can include the factors that are changing the climate as well. It is very difficult in the statistical forecast systems, which are the basis of our seasonal climate forecast systems at the moment, to include these other factors that are changing the climate.

Mr SYMON—Being a Melbourne person I can certainly attest to the lessening of our rainfall over many years. I do not think that anyone who lives in Melbourne could argue the opposite.

Prof. Nicholls—No, and it is over much of southern Australia and it just means that these relationships that we have used—with sea surface temperatures, which are the core of our forecast system—are biased in ways which are really quite challenging for us to be able to diagnose and to work out a way around them in a statistical forecast sense. That is why even old-fashioned statisticians like me can see that the way forward is the dynamic coupled ocean-atmosphere models that Christian has been talking about.

Mr SYMON—The question then is: with the dynamic model, is there any scope within that to include previously collected statistical data and make that a computation in the dynamic model?

Prof. Jakob—You cannot make it a computation; however, there are what we call hybrid approaches. So if, for instance, you want to predict rainfall in Melbourne three months from now, you have three options. You could take a statistical forecast system; you take the SST today and you apply your statistical system and it gives you rainfall three months from now. You could take a dynamical model and you could calculate SST from three months from now and then use the much stronger statistical relationships between SST now and rainfall now, and that is the hybrid approach. So the dynamical system provides the forecast of the sea surface temperature and the statistical system actually translates that into rainfall. Or you can use the dynamical system's forecast of rainfall. In a sense, all three are happening, and there are strengths and weaknesses in all of them at the moment. For instance, the dynamical systems are relatively good at predicting sea surface temperatures. They are not as good yet at predicting rainfall. Research at the bureau, that I know of, is trying to build this hybrid approach between the dynamical and statistical systems.

The dynamical systems are built on the physical so therefore feeding in statistical information in general is difficult. There are some aspects of these models where that is happening as well. As you probably heard, because computing resources are limited, these models work by cutting the world into boxes. The size of the boxes that we need to use depends on the size of the computer we have and partially on the scientific understanding that we have. They are very large but there are things that happen inside them that are important that we cannot represent with the computer as such: things like clouds, thunderstorms—little things in the atmosphere, for instance. There are quasi-statistical relationships that we use between what happens on the big

box and what happens inside with the little things. So there are statistical methods that are being used in those models, directly or indirectly, in that capacity. There is always a mix of the dynamical, physical and statistical approaches happening in all these systems.

Mr SYMON—From a layman's point of view, the best of each is obviously where I would like to think it would come from. If there is something that has worked, surely parts of it may still work, but if you have now got the power through computing to do more—which would lead me on to one last question: last time we had a hearing in Melbourne we were down at the Bureau of Meteorology and we had a look at their new supercomputer being installed. Do you have a time share of that computer, being outside the direct organisation? Or does this go back into the splitting up of research and responsibilities because you each come from different backgrounds and organisations?

Prof. Jakob—The university's main computing facility is the national computing infrastructure in Canberra, and we have access to that, and that is now shared with CSIRO. So we will have access to the computer models that the bureau has available in the near future, once the new computer in Canberra has gone in, which is scheduled to happen towards the end of this year.

I do have indirect access to the bureau's computer if I have a research project with someone at the bureau. I personally could not access the computer, but if I work with someone at the bureau on some piece of research then they can, obviously. The way this would work is that they would do the computations for the project based on their computing time.

Mr SYMON—I have one last question. Do the different computers all operate on the same platform? Is there a problem going from one facility to another? Do you have to re-code particular things or are they all common?

Prof. Jakob—The ACCESS system that we have installed, which is based on the unified model of the Hadley Centre in the UK, is actually quite portable and for a scientific user it has been designed in such a way that all the computing differences that sit behind should be invisible. So from a scientific point of view, that is not an issue. That does not mean from a computational point of view it is simple. There is still an IT person and a computer scientist together who need to install the system on various computers. Since I am not one of them, I cannot tell you how difficult exactly this is. If I listen to them it is very difficult.

CHAIR—There was an article in the *Weekly Times* on 17 June which discusses the use by Victorian farmers of the Japanese forecast warning of unfavourable conditions for the winter growing season. Just so I can put you into the picture, this is a quote from the article:

Swan Hill grain grower Geoff Nalder said farmers would pay a lot of attention to Prof Yamagata's forecast.

"He's been right on the money for the past three years," Mr Nalder said. "It's going to make us more cautious. We'll put our purchases on hold and trim back in other areas."

Why are Australian farmers relying on international forecasts instead of those projected by our own Bureau of Meteorology? Are you familiar with this? This one It intrigued us all.

Prof. Nicholls—I am a close friend of Professor Yamagata. He knows my family well and visits us whenever he is in Melbourne. He and his colleagues have done interesting work following work that I did 20 years ago on the role of the Indian Ocean in governing Australian climate and rainfall variability. It has led to some really interesting scientific disputes. We have interesting and civilised disagreements over dinner. He would suggest that there is a stronger influence of the equatorial Indian Ocean on rainfall over southern Australia that I believe is appropriate. I think there is still a much stronger influence coming from the equatorial Pacific, but Toshio Yamagata thinks otherwise. I am not surprised and certainly not disappointed that Australian farmers are actually aware of that sort of information as well as the information that comes from the Bureau of Meteorology. But the Bureau of Meteorology forecasts do include information from the Indian Ocean and have for more than a decade based on work we did 15 or 20 years ago. So it is not really an either/or situation at the moment; it is not just that our Japanese colleagues have worked all of this out and we haven't. It is a bit more interesting than that.

CHAIR—So they have a different view about the impact and you have a different view. Our farmers, according to this article, seem to think that their view is correct. I cannot make a determination one way or the other. I can understand that there are differences of opinion, but we are talking about a very complex process of weather forecasting and we are discussing all the things that we would need to actually improve those sorts of forecasts in all their minutiae, detail and complexity. Where does the idea that the science differs come into the picture? One thinks this and the other thinks that. Are there commonalities that can be worked in? What are we to think of that and how would you deal with that in terms of a global relationship?

Prof. Nicholls—It is a challenging problem for someone from outside the science. It is difficult enough inside science. It is not only Professor Yamagata, for instance, who believes in the primacy of the influence of the equatorial Indian Ocean on Australian rainfall. We have colleagues in the University of New South Wales who have a very similar approach. They would also maintain that forecasts based on their work in the last few years for southern Australia would have been very good also.

The problem we face comes back to Mr Symon's question about the bias of changing forecasts. We have been in a La Nina for the last two years. La Ninas generally bring good rains over eastern Australia, including southern Australia as well, and we certainly have not had it. The Indian Ocean signal, if you just look at those last couple of years, looked like it worked very well. It was suggesting that we should have dry conditions over southern Australia, drier than normal, and that is what we have got even though we are in a La Nina, where my idea of the influence from the Pacific would have been that we should have had much better rains and now we are slipping into an El Nino. I think it comes back to this bias problem. Not all of my colleagues would agree with me. If we get back to the problem of how does a farmer make his mind up, this is again something that I try to address in my submission but this is a really challenging problem because the climate is changing and our old data do not include all the ramifications of that changing climate. It makes it really hard for the scientists and so devilishly difficult for a potential user to sort out these problems: which bits are climate change, which bits are the natural climate variability that we have been able to predict in the past and how do they interact? I admit I have no simple answer to this because I do not have a simple answer even to myself and it is something I have been thinking about for a long time.

FRAN BAILEY—I have one final question. It was put to us at a previous hearing that it would be unwise for Australia to simply rely totally on the Hadley method, that perhaps we would be better off looking at European models or maybe a hybrid model of our own. What would be your reaction to that?

Prof. Nicholls—Perhaps Christian might answer that.

Prof. Jakob—My understanding of the ACCESS system is that it has only one component, and that is very important to note, coming from the Hadley Centre, which is the atmospheric component, the ocean, that is coming basically from the US but with modifications made by Australian scientists; and the part of the model that describes the land surface is actually home-grown. I do not think there is the intention to always copy what the Hadley Centre is doing but we have got their model and we are working in collaboration with them to improve that. It has given us a new baseline to start from and it has jumpstarted the effort in Australia, which had fallen behind a little bit. I would say there is no problem if Australian scientists are working with scientists in the UK, which is the vision here for the ACCESS model, to build the best model for Australia, which is what we want to do, in collaboration with people in the UK. I do not see any problem in just having the one model. Other countries will always develop other models at the same time.

The science is difficult, and on the previous question I was going to say this is a typical example where information is used at the cutting edge of the science. Not many fields face that problem. Meteorologists always face that problem. The public wants information, users want information, and they want it at the cutting edge of science. They do not want what we knew 10 years ago; they want what we do now. Finding the right balance of releasing into the public domain the new science, the new findings, versus being cautious and saying, 'Let's test this, let's make sure it is really the best we can do at this point,' is always very difficult. Some people will claim they have made a new discovery and will release it earlier. Others will be more cautious. This will work itself out, but only over many years. An individual forecast by one centre, there will always be one forecast that was the best in a particular year or on a particular day for weather. That does not mean that is the best forecast to use on average, and using them all might be a good idea. All these other centres with all these other models will make forecasts too. In weather this has been the case for many years in seasonal forecasting and it will be no different. People will take note and do take note of the forecasts other forecasting centres make. Often decisions and ultimate forecast release are build on not just our own system but on systems that are run elsewhere. It is using all of the information that is the best approach.

The reason we need our own system is that that is the one we can influence. If a particular user has a particular need and comes to us and says, 'Can I get this piece of information?' to get that from an overseas system would be very difficult because we do not control that system. Here we can build it into our own system quite easily.

FRAN BAILEY—And the land component—

Prof. Jakob—Is Australian; it is home grown.

FRAN BAILEY—is so different.

Prof. Jakob—Yes. I would expect that, if the scientific collaboration on the atmospheric part with the UK Met Office goes the way everybody envisages—and early signs are already indicating that—Australian produced science will ultimately be used in the UK. So this will be a true collaboration; this will not be the UK telling us what we ought to do or we telling them what they ought to do. It will be a true collaborative effort. And this is already happening. Certain components developed here in Australia are now being tested in the UK for implementation in their models. So, ultimately, we will have a joint model. I think that is the vision that both sides have of this endeavour.

Mr RAMSEY—I have a couple of questions. On page 6 you make reference to the possibility of a meteorological CRC, and I assume this is a way of addressing the silo mentality of how you researchers break into what is seen as the Bureau of Meteorology-CSIRO field. Are there any serious proposals about trying to get a CRC up like that? Does it have support from the CSIRO—because, presumably, if there was one, they would want to be one of the participants?

Prof. Nicholls—There have been in the past. We have made several efforts to get either a CRC or something like a CRC—a national approach to making sure the academics, the state instrumentalities that have an interest, the CSIRO and the bureau all in bed together working at this complicated end-to-end problem of doing the science, the delivery and the application of seasonal climate forecasts. We have never got through the funding barriers to get one of those. There is still considerable interest in us developing that sort of national CRC.

Mr RAMSEY—Do you think that is because the people who get the major part of the funding—now being, predominantly, the CSIRO and the bureau—actually see a threat to their current funding?

Prof. Nicholls—No, I do not believe so. They have in the past been involved in these efforts to get something up. I think it is due to the fact that some of us are not very good politicians. Scientists are not very good politicians and we are not very good at timing these things, I suspect. To my knowledge, there has never been strong opposition from any of the individual groups. The individual groups do see this as a really important thing. If you look through a variety of submissions to this inquiry, there is this continual theme—

Mr RAMSEY—I would have thought that there is a very good argument for something like this. A cooperative research centre that has that longer term focus—seven to possibly 14 years—would be very beneficial in this area, and with lots of good reasons to do so.

Prof. Nicholls—I do not think you would find any of my colleagues who would disagree with that in either academia, the universities or in organisations like the federal department.

Mr RAMSEY—Whose role do you think it is to try to drive that process?

Prof. Nicholls—Someone younger and less jaded than me!

Mr RAMSEY—Is he sitting alongside you?

Prof. Nicholls—He could be.

CHAIR—That is how you become politicians.

Prof. Nicholls—Yes.

Mr RAMSEY—You mentioned Brazil, India, Canada or whatever as having programs that now exceed ours. Do you know how they are funded? Do they have funding systems that give a long-term research capability?

Prof. Nicholls—The main centre that is funded anywhere in the world to actually do this end-to-end process is the International Research Institute for Climate and Society in the US. That has long-term funding. It has been going now for over 14 years. It is a multimillion dollar program.

Mr RAMSEY—Is that totally government funded or does it have industry partners?

Prof. Nicholls—I think it is totally government funded, and it has long-term time horizons. It is a very international program; it provides forecasts for most of the world and works hard at delivering those forecasts in such a way that countries in Africa and Asia, for instance, can actually use those forecasts. So that is the major core centre. I believe South Korea is putting a lot of time and effort into a centre of that sort, but I am not well enough aware of the South Korean organisations to understand how much that looks like a CRC or something of that sort.

Europe has had a different approach to overcoming some of the silo problems that we face here and that they have faced there. There is now a lot of funding in Europe for research that is targeted at big, multinational, multi-institutional, specifically collaborative research programs. So, if your researchers want lots of money to do big tasks for a long time, they can go to the EU and get funding, but only if you have five countries or so collaborating—

Prof. Jakob—Twenty partners.

Prof. Nicholls—and 20 partners—that is, from academia and government organisations. You have probably heard lots and lots of scientists come here and say, ‘If you want me to do this particular task, just give me the money; just show me the cheque.’ But it really is something that does drive scientists, not so much for their own salaries—because we are all quite well paid anyway—but to get things together to work. We do follow the money. The EU has been very successful in getting collaboration in long-term research projects by saying, ‘We’re only going to fund the projects that are collaborative.’ Something like that would help here on the research end of it, but it still does not help on the application end. You have to have other mechanisms to do that. I think the IRI in the US is an example of how it can be done.

Mr RAMSEY—What about your Japanese friend? How is the program addressed in Japan, given that you have some kind of relationship there?

Prof. Nicholls—Yes. In Japan there has been very strong funding for global change research over the last decade or more, and a lot of that has gone into funding for the sort of work that Professor Yamagata has done and also to providing very advanced computing resources for very advanced coupled ocean-atmosphere models. But there has not been an attempt that I am aware of to do what the IRI does or what we would like to do in Australia, which is to put everything together in an end-to-end approach in some sort of centre that takes you from the science

through to the delivery and the applications of seasonal forecasts. I do not think that is done in Japan to my knowledge. They have really focused very hard on the science.

Prof. Jakob—I will make a comment also on this question. I think it is also important—and I have outlined that in my submission—that all countries are currently repositioning themselves. Most countries had a weather effort and a climate effort, and the seasonal effort, just as it is here, is something that is emerging now. There is a newly emerging effort, by the way, which is called decadal prediction and which is making forecasts for 10 to 30 years or something like that. The science of that is the youngest, and it is not clear how far this can be pushed.

Because of these emerging things, most advanced countries are now trying to build a seamless approach, which in this country requires, I believe, a national strategy that does not have bodies saying, ‘We are the national climate change research program,’ and, ‘We are the national weather research program,’ and not having anything to do with each other, which is often how we operate. We say, ‘I’m working on climate; I have nothing to do with weather,’ or, ‘I’m working on weather; I have nothing to do with climate.’ We really need a national strategy that is not built on these silos but that takes this approach.

I believe there is a push for national climate change science. The Australian Climate Change Science Program is changing from a mainly bureau- and CSIRO-oriented program to a national program that includes academia more strongly. I think that is a really good start, and if you could extend that to the other problems—the problem of seasonal prediction, for instance—then in my view that would be very good. That does not preclude the research being done in an ARC centre of excellence or a corporate research centre, but the strategy ought to be put in place, together with the actual practical implementation of that strategy. I do not think the thought process of building that strategy has been taken on; we are not really doing that yet.

CHAIR—Thank you very much. We are running a little over time. It has been a very interesting discussion and an eye-opener. I am sure that you will look forward to our recommendations as we look forward to our continued series of hearings. Themes are emerging and they seem to be consistent. That is always very helpful.

[10.10 am]

MOORE, Mr John Desmond, Director, Institute for Private Enterprise

CHAIR—Welcome. Although the committee does not require you to give evidence under oath, I should advise you that these hearings are formal proceedings of the parliament. Consequently, they warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. We thank you for your submission and now welcome you to make a brief opening statement before we proceed to questions.

Mr Moore—Thank you very much for inviting me to appear unlike two other committees to which I applied to appear, not in the House but in the Senate, which did not accept my application. I will give you a copy of what I am about to say. You might want to follow it. I welcome any discussion that comes afterwards.

My principal reason for making a submission to the House committee examining long-term meteorological forecasting relates to the existing approach to forecasting by government funded institutions. This appears largely to be based on an assumption that humans are threatened by dangerously rising temperatures predominantly caused by the increasing emissions of greenhouse gases, particularly CO₂, that result from increasing human activity. My examination of the evidence alleged to support this assumption has led me to conclude that the assumption is either falsely based or that it has many uncertainties that are not adequately identified. Accordingly, I submit that it would be inappropriate for the federal government to continue the existing basis of funding or otherwise supporting further research and experimentation by institutions principally involved in long-term forecasting.

The case for changes in such funding arrangements is partly based on the apparent rejection by CSIRO of qualifications to forecasting analyses and the refusal of the magazine published by CSIRO, *ECOS*, to publish any views that do not agree with the basic assumption. The more recent reports by the IPCC have similarly removed major qualifications to the inherent capacity to assess meteorological trends. But climatology is a very recent science and there are necessarily many uncertainties about the science that should be recognised openly by those involved in it.

This is not to suggest that government funded research into long-term forecasting should be abandoned. My proposal is that it be made conditional that any taxpayer funded research should involve comprehensive examinations and explanations of the full range of possible influences on meteorological developments, including change ends in the earth's orbit and in solar energy. The conditions applying to such funding should be determined by the government after consideration of a report by a committee, the majority of whose members should be those not at present being funded directly from government sources.

As I am not a scientist, it may be asked on what basis I am qualified to make the foregoing submission. Having worked in the federal Treasury for 28 years, I do have some qualifications for interpreting relationships between statistical variables and assessing trends in those variables.

Treasuries are frequently asked to analyse proposals for government assistance based on statistics that purport to show or predict economic or social problems unless governments come to the rescue. They even have to analyse claims that have the support of academes or prominent professional societies of one kind or another, but one does not need to be a physical scientist to undertake such analysis. Neither does one need to be a physical scientist to participate in the technology of forecasting, which, among others, Treasuries and central banks have developed. Such forecasting of economic trends, both short and long term, is based on analysis of likely relationships between variables such as changes in employment and wages, in budget deficits and domestic demand, in the supply of money and inflation, in productivity and education and so on. However, experience demonstrates the difficulty of producing accurate economic forecasts on a consistent basis, as currently illustrated by the almost universal failure to predict the current recession and the current disagreements among professional economists on the most appropriate remedial measures. The underlying reason for such difficulties and disagreement is that relationships between economic variables are not stable over a long period and are susceptible to what are sometimes described as ‘shocks’. That is another way of saying that humans sometimes act in unpredictable ways.

My concern about the current analysis of long-term temperature trends by government funded research institutions such as the CSIRO and the Bureau of Meteorology is that it is also not based on stable relationships between variables that may influence meteorological developments. To that extent, it becomes very difficult to accept that, as claimed, there is a proven case supporting the view that humans face dangerously rising temperatures if greenhouse gas emissions are allowed to continue increasing. The fact that analyses by such bodies may be supported by the current boards of meteorological societies or science academies does not mean they must be accepted without further examination.

Relevant here are the very many analyses, including peer reviewed ones that reject all heavily qualified the so-called consensus view. By way of example, I refer the committee to the assessment of Minister Wong’s written reply to Senator Fielding’s three questions on climate change. This assessment, which is on the senator’s website, has been made by four experts who are highly qualified to analyse climatic trends. Any unbiased reader of the assessment would have to conclude that the uncertainties surrounding the basic assumption are so large as to mean that that assumption should not form the basis of government decisions to operate an emissions reduction policy. The four experts clearly reject any thesis that the late 20th century warming will continue unabated throughout the 21st century. Let me make three points in support of my conclusion that current long-term forecasting is not based on stable relationships between variables.

I note first that published analyses in support of the basic assumption have included major errors that either have required subsequent major changes in the supporting analyses or should do so. Perhaps the most infamous error is the so-called hockey stick analysis in 1999 of historical temperatures that was included in an IPCC report but has subsequently been dropped. Another error relates to the measurement of recent temperatures. A major analysis that has not been challenged has demonstrated that the measured temperatures since about 1980 considerably overstate their height because insufficient allowance has been made for urban heating effects. Although this inadequate measurement has not been recognised in the last IPCC report, it means that the rise in temperatures over the last 100 years or so is less—possibly considerably less—than the IPCC’s claimed three-quarters of a degree.

My second point relates to the interpretation of recorded temperatures since 1850. If the data published by the UK Hadley Centre is used, it can be seen that there are five distinctly different periods. These periods show the following changes in temperature: from 1850 to 1920, from 1940 to 1976 and from 1997 to 2008 temperatures declined or were not changing; and from 1920 to 1940 and from 1976 to 1997 temperatures increased. During the periods of decline or static temperatures there were continuing increases in emissions of greenhouse gases. What this means is that, despite those continuing emission increases over 158 years, there were 117 years in which temperatures were going nowhere or falling and only 41 years where they were increasing. It is difficult to believe that any acceptable correlation of cause and effect could be established on the basis of this analysis. Further, although the period from 1997 to 2008 is a bit too short statistically to permit a definitive conclusion that it is a period of declining or stable temperatures, it is certainly suggestive of such a trend.

One of the interesting years in the temperature record is 1976. I note that the IPCC has acknowledged the often referred to Pacific climate shift of 1976 as having affected temperatures across the Pacific basin and further afield. Although the reasons for the Pacific climate shift remain speculative and it is uncertain whether its impact will be long lasting, this shift illustrates the possibility that the post-1976 increase in temperatures may have been at least partly due to natural causes.

As to the possible effect of aerosols, I note that the IPCC itself admits that there is a low level of understanding of the radiative forcing that can be attributed to them. Indeed, my understanding is that there are no useful measurements that can be applied for the purpose of computer modelling. As to the possible inference of social flares on temperatures, although this is a matter of dispute, some analyses suggest more than the small influence attributed by the IPCC. It may also be worth mentioning that an analysis of the current solar cycle 23 presented at a recent symposium at Monash University that I attended—and this was not mentioned by the previous presenters—led the presenter, Dr Archibald, to conclude that severe cooling is likely over the next 20 years.

My third point is that, although believers in the basic assumption frequently point out that recent years are among the warmest in the instrumental record, that record only covers the later part of the recovery from the little ice age from which one would naturally expect some increase, regardless of whether or not there were anthropogenic greenhouse gas emissions. Analysis of the medieval warm period, from 900 AD to 1,300 AD, which was shown in the IPCC report for 2001 but subsequently removed, and the Greco-Roman warm period, from 250 BC to 450 AD, indicate that it is very likely that temperatures in recent years have been lower than they were then. These earlier warm periods were of course recognised by the IPCC in its first and second reports but dismissed in the third report because of the prominence given to the infamous hockey-stick presentation. My basic point here is that historical analyses indicate that there have been many periods of wide fluctuations in temperatures that can only have been due to natural causes. Any idea that such natural influences have disappeared and been replaced by human influences that can be controlled can only be described as human arrogance. There are other aspects of the basic assumption that can be disputed but I think the foregoing is sufficient to explain my belief that there is a need to change the basis of government funding of long-term forecasting.

CHAIR—Thank you very much for that very comprehensive presentation, Mr Moore. While listening to you to reading that out, I was thinking about this. Our inquiry is very much into seasonal forecasts. Do you personally have any confidence in the methodology and models used by Australian climate researchers in increasing the accuracy of long-term or seasonal forecasts? What sort of methodology or models should Australian climate researchers be using?

Mr Moore—No, I do not have any confidence because the whole of the system is geared and biased towards this assumption that we are going to have a continuing rise in temperatures to a danger point, a so-called tipping point, of over two degrees by about 2150. As I have tried to say in my opening remarks, I think the basis of the research needs to be much more comprehensive to take account of other things, other natural influences on temperatures, and to examine the extent to which they may or may not be predictable. I include there one of the things I mentioned, which is the influence of solar energy and solar flares, and the effects of changes in the orbit of the Earth and also many other things which have influences and which have been spelt out in many papers and books by people such as scientists and others who are sceptical of the so-called consensus view. The latest one of those—and I do not know whether you will be taking evidence from him—is Professor Plimer but he is not by any means the only one and there are the four experts that have addressed the answers provided by Senator Wong’s advisers—another example of expertise that shows the need for a broadening of the matters that are taken into account by the CSIRO and the Bureau of Meteorology.

I think it is highly regrettable that the CSIRO has ceased to publish what it was publishing a few years ago. Whenever it published a forecast, it had a qualifying commentary that said in effect that the difficulty of predicting climate change has to be recognised and ‘we cannot guarantee the forecasts or the analyses that we have made’. The same thing has happened with the IPCC. It started off by saying, because climatology is a relatively new science and because of the great uncertainties, exactly the same thing. I can give you the exact quote if you want it. It said that its analyses need to be taken, in a sense, with a grain of salt. It did not literally use those words but that is the gist of what it was saying.

CHAIR—I am going to go to Fran, but I am just wondering where that leaves the status of forecasting the weather, before anything else.

FRAN BAILEY—I guess there might be some people who would say that the most inexact science is the science of forecasting weather. I want to play devil’s advocate a little bit.

Mr Moore—I am happy for that to happen.

FRAN BAILEY—You are dismissing quite a large body of published scientific evidence. In dismissing that, you are challenging the findings of that body of scientific evidence. To substantiate your argument, it would appear to me that you are more raising questions about that body of established science. I am straying a little bit from the terms of our reference here, as does your submission. Coming back to the benefactors of the application of scientific research in the whole area of weather, would it not be prudent to make a stance that there is a big question mark, at best? The one thing I would add as a rider is that there have definitely been examples of chaotic weather patterns not just in Australia but in other parts of the world. Would it therefore not be prudent to at least enable the modelling to continue where people are raising the issues of the negative impacts of these changing, chaotic, climatic conditions?

Mr Moore—I think I said that in my opening remarks. I said that I was not opposing continued research into long-term forecasts, and I do not understand your comment that my submission is not in accordance with your terms of reference. Your terms of reference relate to long-term forecasting.

FRAN BAILEY—I meant in relation to seasonal forecasting, actually—the question that the chair asked you, which is—

Mr Moore—I do not understand what you mean by ‘seasonal forecasting’. You mean the incidence of droughts or hurricanes or whatever it might be? Is that what you mean?

FRAN BAILEY—Yes.

Mr Moore—That is long-term forecasting, and what I have said is highly relevant—

FRAN BAILEY—I am not going to argue the toss over a definition.

Mr Moore—to this. You are shaking your head there, Madam Chair.

CHAIR—No, I am not shaking my head. Sorry, I was just thinking. In terms of our terms of reference and Fran trying to put this in the context of what we are looking at, the previous speakers were talking about the farm gate and how they get information to the farmers, for example, who have to make decisions. I was just wondering: in the context of what you are talking about, a very broad argument about climate change and whatever, how does this help farmers?

FRAN BAILEY—Essentially, you are arguing—about the established CSIRO-Bureau of Meteorology view of climate change—that that does not exist and you are challenging the IPCC’s statistics. I was really just putting that aside. Given the role that this committee is performing, as the chair was just saying there, we are very interested, obviously, in the application of the scientific research, whether it be for the agricultural sector or assisting emergency management authorities. What I was putting to you—and I am stirring the pot a little—is: given the enormous impact that chaotic weather patterns have been having not just on Australia but in other countries, would it not be prudent to at least be willing to accept that there is some worthwhile benefit in what the CSIRO and the Bureau of Meteorology are saying, based on their scientific analysis of the whole debate about climate change, rather than dismissing that, which is essentially what you are doing?

Mr Moore—I think the short answer to your very long question, if I may say so, is that, if you do not have the basic science right, it is no good talking about what is going to come out of the CSIRO or the Bureau of Meteorology for the farmer at his gate because, if the science is wrong, they will get wrong answers. I thought the evidence given by the two people who were here before indicated—they did not actually address the thing specifically—quite clearly that there is enormous disagreement within the profession and there is enormous disagreement about the results of modelling. If you take the modelling side of the thing, which I am not an expert on but I have examined, there is very considerable dispute about the validity of all the modelling that is being done not only by the CSIRO and the Bureau of Meteorology but by overseas international institutions. If you are travelling overseas, I hope you will call on some of those institutions in

England and Europe and examine it yourself or explore it and ask what I would call ‘Senator Fielding’s nasty questions’—in other words, try to drag out of them what the answers are to those sorts of questions, because there are not satisfactory answers to those questions, as is demonstrated by the preliminary assessment by the four experts. But it is not simply confined to those; there are hundreds of peer reviewed papers that are questioning it. It is not just me questioning it; there are an enormous number of peer reviewed papers. I hope you are getting evidence from some of those people. We have in Melbourne the former deputy head of the Bureau of Meteorology, who attended hundreds of international conferences on climate. He is now retired—only just retired—but he is right on top of the whole thing. Are you hearing evidence from Mr Kininmonth?

Mr RAMSEY—I am not sure—

CHAIR—No—

Mr Moore—You should have asked him to attend you. It is extremely important that you get those sorts of views. It is not just me. I am not discarding it; what I am saying is that the concentration of the CSIRO and the Bureau of Meteorology on predictions and analyses that are based on the assumption that we are going to have continuous dangerous warming is wrong. It should not be concentrated on. By all means, it has to be done, because there is a big group of people—the so-called consensus—who believe in it. But there is also an enormous group of people who do not believe in it. Their perspective should be done; it is not.

They are closing up shop. They are becoming almost a quasi monopoly of information. The example is that I have tried to get articles published in the CSIRO magazine. Most magazines do allow people who have different views. The CSIRO will not allow a different view to be published in their magazine.

Mr RAMSEY—I understand your frustration with this. I think it is a very poor reflection on many in our community who are ridiculing those who question assumptions. Let me say that from the outset. But, for those of us who are not scientifically trained, and I am not, how are we meant to weed our way through this argument where we have two absolutely totally opposed points of view on where we are going on anthropogenic warming? Great economic decisions around the world are being made on this at the moment. Do you expect this debate to be solved in a medium length of time because the weather will prove it one way or the other? How do we weed our way through this?

Mr Moore—I will answer the first thing first. You do not have to be scientifically trained to assess this; all you have to do is apply a little bit of common sense by looking at the basic data that comes out for everybody. I tried in my opening statement this morning to point out what has happened to temperatures since 1850. There have been three distinct periods when they have been falling or not rising. The scientists have been saying that, if CO2 emissions go up, temperatures will go up. But they have not, so what is the answer? That is in fact the first question Senator Fielding put to Senator Wong. Senator Fielding is not a scientist; he is an engineer, I understand—I do not know the man. He just put a common sense question, and you can make a judgement about the answer. From what I have learnt so far—and we have not got the full answer because it has not been released and the full assessment has not been made—the answer in part is: ‘We do accept that there are natural causes of changes in temperature. They

occur from time to time.’ That was not what we were told not so long ago. So the scientists are already making qualifications in their assessment. They are already qualifying what they said.

You do not have to be a scientist to make a judgement in this area. As to when the answer will emerge, the problem at the moment is that just about every government in the world and all political parties have supported in one way or another the adoption of an emissions reduction policy. Even though there is great debate in America about that, they are in the process of trying to get legislation through Congress. They have got it through the House of Representatives, but it remains to be seen whether they will get it through the Senate. We are faced with a high degree of political acceptance even though we know from contact with people in various parties that there is a considerable degree of difference of opinion within parties. Even within the Labor Party here, we know there are sceptics.

Once you have got the system entrenched it is going to be extremely difficult to unwind it. What will happen is that there will be very slow progress towards reducing emissions because of the difference of opinion that exists amongst politicians and in the community. Not so much in Australia, but in America and the UK polling suggests that there is a considerable degree of scepticism about global warming. In the most recent Gallup poll in the United States people were asked their views about eight environmental problems, including things like water shortages, pollution in the air and so on, and global warming came last on the list. The proportion of the population who regard the global warming scare, as it were, as being exaggerated has risen quite a bit. There is still a majority who are worried about it, but over 40 per cent think it is greatly exaggerated.

Mr RAMSEY—Regarding the Pacific climate shift that you referred to, is there a correlation around the world of similar things happening in a similar time frame? Have we seen major shifts in ocean currents around the world doing similar things in other continents, or is this a fairly isolated phenomenon?

Mr Moore—Because I am not a scientist I cannot answer you fully on this, but there are other things that are happening or have happened that have led people to conclude, ‘Well, here is proof of global warming.’ One is the melting of ice in the Arctic, which occurred in 2007. There was an enormous amount of publicity in the media about that melting. It is said that that was due primarily to a change in wind and it has now reversed. The extent of ice in the Arctic is now above the average it was back to 1980. But even if the ice had melted: so what? It does not add to the sea level because it is already floating on the sea and there are many historical examples where the Arctic ice has melted. The Northwest Passage across North America was travelled earlier in the century. And then there are a lot of these things in Australia. For example, we are concerned about the Murray-Darling Basin. The rainfall in the Murray-Darling Basin is bad—it has been bad in the last 10 years or whatever it is—but it is not as bad as it was back in the 1930s.

CHAIR—Thank you for your evidence.

[10.59 am]

NELSON, Mr Charles Julian, Managing Director, Foreseechange Pty Ltd

CHAIR—Welcome.

Mr Nelson—I am here as someone who has in their spare time analysed weather patterns and applied my professional skills to them with some fairly important conclusions.

CHAIR—Thank you. Although the committee does not require you to give evidence under oath, I should advise you that these hearings are formal proceedings of parliament. Consequently, they warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. We thank you for your submission and now welcome you to make a brief opening statement before we proceed to questions.

Mr Nelson—Thank you for the opportunity to appear here today. I am also pleased that this committee exists because it is a very important juncture in time with the changing climate in Australia in particular. I understand that I have up to five minutes to make some remarks, so there are five points that I wish to emphasise in that time. The first is that, as I have mentioned, I am a professional statistician with a Bachelor of Science degree and over 35 years experience of analysing data and forecasting. While my career has focused mainly on marketing and economic data, I have also analysed other data. In particular over the last six years given the changes in climate I have been very concerned about that and felt that I ought to apply my professional skills to the data so that I could better understand what is going on and maybe see some things that people had not seen before.

So far, as I said in my submission, I have found a statistically significant correlation between the lunar node cycle of 18.6 years and variations in average rainfall over Melbourne, central Victoria, and the Murray-Darling Basin. I note the earlier question about how does this affect farmers. It does affect farmers because if you know that in the next three years you are going to have an average rainfall of 680 millimetres, you will do something different from if you think the average rainfall is only going to be 600 millimetres over the next three years.

Second, while my submissions here concern the impact of natural factors on rainfall in Melbourne and surrounding areas I have also analysed global and local temperature data. It is evident to me that there are many natural and human causes of changes in temperature. Some of these are positive and some of these are negative impacts on temperature. However, I am in no doubt that increasing concentrations of greenhouse gases are trending temperature upwards. I would be happy to discuss any of those issues if you so wish later on.

Third, my analysis is important for long-term forecasting of rainfall especially for several years and decades ahead. The decision to build a new dam, a desalination plant or a pipeline to transfer water has to be economically sound over a period of decades. Also any decision to massively shift farming activity from one region to another must be made on the basis of an outlook for many years into the future.

Fourth, my analysis to date has not fully explained the link between the lunar nodes cycle and rainfall nor the reason for the current deviation from that cycle. This is the subject of further research which is proceeding in my limited time. I am investigating opportunities for funding so that I can devote more time to this research. I have spoken to Melbourne Water for example. The focus of my ongoing research involves the moon's influence on the Leeuwin current as a physical connection and on another cycle of the moon or possibly the Boxing Day tsunami as being factors which could disturb the cycle.

The Leeuwin current is a band of warm, low-salinity water of tropical origin which flows south from Exmouth to Cape Leeuwin and on to the Great Australian Bight. It is caused by warmer low-salinity water flowing through the Indonesian archipelago from the Pacific to the Indian Ocean being captured by the effects of the Earth's rotation. Variations in the temperature, salinity, volume and flow rate of this current are likely to impact on the moisture of the atmosphere flowing on to south-east Australia. The varying angular velocity of the moon caused by the lunar node cycle is likely to influence the volume and flow rate of that Leeuwin current and in turn rainfall over south-east Australia. The power of the moon to influence the Leeuwin current may also vary over the course of what is called the lunar apse cycle. The moon orbits the earth not in a circular path but in an elliptical one, so sometimes it is closer and sometimes it is further away. If the lunar node cycle occurs at the time when the moon is closest, that can have an amplifying effect or if it occurs when the moon is furthest away, it can have an attenuating effect. The Boxing Day tsunami of 2004 off the west coast of Sumatra in Indonesia may have significantly impacted the temperature and salinity of water which feeds the Leeuwin current. This coincides with the departure from the cycle of rainfall in Melbourne. Apart from the wettest day on record in Melbourne in February 2005 annual rainfall has fallen by one-third of the average since the Boxing Day tsunami.

The relationship between the lunar node cycle and the cycle of rainfall in Melbourne was also disturbed approximately between 1883 and 1923. Perhaps it is no coincidence that Krakatoa in the Indonesian archipelago erupted on 27 August 1883. This generated huge tsunamis which could have affected the normal current. I feel that the other cycle of the moon is more important but we cannot rule out the tsunamis, which would have mixed cold water beneath the surface with warm water above the surface.

My fifth and final point is I hope my research has demonstrated that there is still much that can be learned from analysing historical data. While climate change may signal a need to develop other methodologies for seasonal and long-term forecasting, I hope that we will not reduce the investment of analysis of historical data. Indeed, I believe that I have demonstrated a need for greater and urgent investment into this line of research in this critical time for Australia. The moon is a vagabond, which does not complete its combined nodes and apse cycles for 186 years, and we have only 153 years of rainfall data in Melbourne. I would be very happy to answer your questions.

CHAIR—I am going to ask you about the lunar nodal cycle because I found it very interesting. I have not come across it in any other submissions and certainly not in any of the discussions.

Mr Nelson—No-one is talking about it.

CHAIR—No-one is talking about it. Do you mind expanding on it?

Mr Nelson—Expanding it?

CHAIR—Yes, because I do find it a little bit challenging.

Mr Nelson—It is very hard to understand.

CHAIR—It is interesting because it is certainly something totally different.

Mr Nelson—It is hard to understand. If you allow me, I have brought a globe of the world along with me and will use it to explain.

CHAIR—Certainly.

Mr Nelson—As you know the Earth's axis of spin is offset by 23 degrees, and that causes summer and winter. We have just been through the winter solstice, which means that the sun is overhead at the Tropic of Cancer, and we do not get as much direct sunlight as the Northern Hemisphere. As the Earth goes through its year, come next Christmas we will be pretty close to the summer solstice with the moon overhead at the Tropic of Capricorn. So that is I think fairly straightforward; the moon goes around the sun and that causes the seasons.

CHAIR—Yes, it is.

Mr Nelson—The moon goes around the Earth in 28 days, so we expect that the moon would be overhead at the Tropic of Capricorn again in 28 days time, and 14 days after that it would be overhead at the Tropic of Cancer. The moon goes through the same deviations but over 28 days. However, the moon orbit around the Earth is offset by five degrees to that line between the centre of the Earth and the centre of the sun, which means that instead of the orbit being like so, it is actually like that, what we call a minor standstill, so that the sun is overhead more over Geraldton and it is going through the north.

CHAIR—Why is it offset?

Mr Nelson—Why? In the creation of the solar system it was offset by five degrees. It is actually varying between about 4.7 and 5.3 degrees but it is offset. All the planets are offset to some degree to the line of the Earth and the sun, that ecliptic plain. They are all offset to some degree. That is how, for example, we could have the transit of Venus a few years ago. It does not happen very often but it was exactly aligned with the sun and the Earth. So it is offset by five degrees which brings the moon further north and south on what we call a major standstill. It is a much greater angle of velocity over that period of the 28 days that the moon goes around the sun.

Mr RAMSEY—What does angle of velocity mean?

Mr Nelson—It is shifting from further north and south than it does at other times. So, over the same period of time, it has to shift further north and south.

Mr RAMSEY—I got that. It just sounded a bit like jargon to me, and I wanted it clarified.

Mr Nelson—It has taken me a long time to understand it. This five-degree angle, because of the gravitational force of the sun, means that over a period of 18.6 years this alignment goes around, it precesses, so that after 9.3 years it is oriented that way, which means that the moon is not going as far north and south relative to the tilt of this axis as it is in the earlier phase.

FRAN BAILEY—Where is it now?

Mr Nelson—In 2006 we went through the major standstill, which meant that we should have entered a wetter period here in Victoria. The fact that we did not is a matter for concern. The last minor standstill was about 1996, and so the drying that we had between 1997 and about 2004 was pretty much on cycle. It was a little bit drier than the cycle normally is, but not of serious concern. Especially since that wet day in February 2005 onwards, we have had a very severe drying; and it has gone against the cycle. I believe that could be related to how close the moon is to the earth—because it is an elliptical orbit sometimes the moon is much closer to the earth and at other times it is further away. That positioning actually rotates around the earth too because of the processional effect of the moon's gravity. That takes 8.85 years to go around.

So if, for example, the major standstill when the moon is overhead at Geraldton occurs when the moon is closest to the earth, about 360,000 kilometres from the earth rather than 400,000 kilometres at its furthest, then there could be a very strong gravitational effect which would lead to a very wet period. Whereas if the major standstill occurred when the moon was further away then we could have a weak or even a reversed effect, because the moon being close up to the north is dragging water perhaps northwards rather than southwards. So these are the things that I am working on. I hope that at least gives you some clarity over how it works. It is very complicated.

FRAN BAILEY—That is interesting. So, just so that I understand, the weather patterns as a result of the position of the moon have not been behaving as you would expect them to.

Mr Nelson—No. Not in terms of the lunar node cycle. So the rainfall of Melbourne and surrounding areas followed that pattern from around about the 1930s to 2004. Earlier in time it followed it pretty closely from 1856 to about 1893 or thereabouts. There was a period where the cycle seemed to be delayed by six years, which could have been caused by either the lunar seed cycle, which needs to be taken account of in my model, which has not been done yet, or possibly other factors like the tsunamis that I talked about before. This opens up the possibility, once we have identified the causes of the aberration, of forecasting quite some periods ahead. Therefore investments in infrastructure would need to be cognisant of the fact that they may need to operate only for short periods of time rather than continuously.

FRAN BAILEY—So would this be an even greater reason for a move towards the dynamical forecasting rather than statistical forecasting?

Mr Nelson—No, I think we need both. I think we do need what the CSIRO and the Bureau of Meteorology have spoken to you about. There is no question about that. We need to better understand the connections between the oceans and the implications over the next three to six months. It is vital that we continue with that research. They are quite right that the climate is

changing. However the biggest impact on the oceans is the moon, at least in terms of tides and other factors too.

CHAIR—And you need the statistical and historical data.

Mr Nelson—Yes, we need the statistical and historical data to fully understand that. As you said in your introduction, no-one is looking at the moon—which is the obvious thing to look at when we are looking at tides and ocean currents.

CHAIR—Can I ask you again, as someone who is not a scientist: why isn't anyone looking at the moon? I know that generally people understand that the moon influences tides and therefore that relationship is there. Now that you have pointed it out, it has become obvious that no-one is talking about the moon. Why is that?

Mr Nelson—You would have to ask other people because I cannot answer for them.

CHAIR—I am just wondering about your own experiences, because you have obviously been observing this area for some time.

Mr Nelson—What I would say from my experience in this area and others is that people can become fairly fixated on their work—quite rightly; they are experts in their work, and they should be—and they sometimes do not see the broader picture. I am speaking generally here not purely in this field. People do not see the broader picture.

As an example, General Motors did not see the fact that petrol prices were going to go up and did not manage the risk that they could go up. They are the experts in their field but they did not see this. I consult for the automotive industry and I could see it. But I am afraid that that can happen.

The ancients knew about this lunar node cycle. It was very important to them because it was probably the only way they could understand the connections between the heavens and their weather. They needed to understand these things. Now with computers and everything else, perhaps we do not need to understand them quite as much but the need has not gone away. We do need to understand this. There are some people in the scientific community looking at this, but I do not believe anybody has ever really connected the lunar node cycle to a significant variation in rainfall like I have as statistically significant and undeniable.

FRAN BAILEY—What does your research tell you about rainfall for central Victoria?

Mr Nelson—Central Victoria is very strongly correlated with the Melbourne area, as is the Murray-Darling Basin. We do not have as much historical data for central Victoria. However, I do have a couple of properties at Nagambie and Daylesford, and I frequently visit other parts of Victoria, and I have observed the same trends in all of the regions around Victoria. They are suffering from much the same conditions. Obviously Gippsland is different because it gets the occasional east coast low, as happened pretty much three years ago today when we had huge floods. But where the rain is mainly coming from the west or south-west they are going to be subject to the same influences.

FRAN BAILEY—So would your research looking at the lunar module be in agreement with CSIRO's predictions that, for example, Lake Eildon will never reach more than 30 per cent of its capacity over the next 30 to 40 years?

Mr Nelson—No, it would not be because, assuming that this aberration of the last four years can be explained by some other natural phenomenon, what this will mean is that some time between now and the next couple of years we will return to a more normal rainfall pattern. Then eventually we could have another filling of the lake. The wettest period was in the fifties. We have had had several wet periods since—

FRAN BAILEY—Are you saying that you believe from your research that Lake Eildon could fill in the next few years?

Mr Nelson—It could.

FRAN BAILEY—So Mr Brumby consulted you before he built his pipeline, did he?

Mr Nelson—He did not—of course not. However, the impact of climate change is usually fairly slow. Temperatures have been going up slowly. There are abrupt changes. Of course there are. And there is no doubt that higher temperatures caused by global warming will tend to result in higher evaporation rates. Therefore, for a given level of rainfall, we will have less water flowing to the roots of plants and into dams. However, there is hope that rainfall will improve here in Victoria.

FRAN BAILEY—But every scientific prediction except yours says otherwise.

Mr Nelson—It does. They are not looking at the moon. Where I would agree with them is that rising temperatures would increase evaporation and therefore flows into dams and so on. I think we are all agreed on that. But I would disagree with them a little bit with regard to rainfall. I think that, subject to further research, they are—

FRAN BAILEY—Eildon is currently under 13 per cent. Are you saying that it will rise from under 13 per cent to filled?

Mr Nelson—The Thompson Dam filled in 1996, which was the last peak of this lunar node cycle that I have spoken of. It filled then. Eildon may well have been full then; I do not remember specifically.

FRAN BAILEY—No, it was not.

Mr Nelson—It was not? Okay. Eildon may have filled in that 1950s period, which was the wettest period on record. We had a particularly strong reaction to the lunar node cycle.

FRAN BAILEY—I do not think it has actually been full since.

Mr Nelson—Yes. Well, we have not had such a period since and we probably never will have for 186 years perhaps, which is the full period. So will it fill? I would have to say no, it probably will not fill. Will the Thompson dam fill? Possibly. Where we agree, I would think, is on the

evaporation rate being higher due to increasing temperatures and where we would disagree is on the likelihood that rainfall could improve in Melbourne, central Victoria and the Murray-Darling Basin over the next three to 10 years.

CHAIR—Can we just keep this going, Mr Symon?

Mr SYMON—Yes—most interesting. The first question that springs to my mind is that you have applied this model to south-eastern Australia, Melbourne in particular: does the model have the same effect, for instance, in the south-west of Australia or in other countries on the same latitude?

Mr Nelson—I cannot speak for other countries, but the ancients' interest in this cycle suggests that there would be places where it is an important factor. I would expect it to be. I would expect it to affect parts of the Northern Hemisphere like it does here. Does it affect other parts of Australia? I have not devoted as much research to other parts of Australia because Melbourne has the longest historical data and it is suffering the most from drought, but my initial perusal of other data suggests no. Sydney seems to be influenced to some degree by the cycle, but there are other factors as well because Sydney of course gets rainfall from other parts, other sources. In terms of south-west Australia, the answer seems to be no. Even though the Leeuwin current is so close to south-western Australia, I have not, at first glance, seen any such relationship. So there would be other drivers in different parts of the country. The north of Australia has had increased rainfall over the last 20 or 30 years, I believe. That is also apparently not influenced by this behaviour of the moon—although it could be influenced by other behaviours of the moon.

Mr SYMON—So, following the pattern you have put here, the closer you get to the equator, the less effect this would have?

Mr Nelson—It seems to be concentrated on the south-east part of Australia—correct. Other parts of Australia do not appear to be influenced as much by this particular cycle of the moon.

Mr SYMON—Are you aware of anyone else doing research in this regard across the world?

Mr Nelson—In my submission I mentioned one paper, and I have seen a few others: Charles D Keeling and Timothy P Whorf, 'The 1,800-year oceanic tidal cycle: a possible cause of rapid climate change'. So there are cycles that are quite long, not just the 186 years I mentioned, if you take in so many other factors, like the sun and so on. So there is a small amount of work going on, but I do not believe anybody is applying it specifically to the measurements like I have done here, to the actual rainfall data.

Mr SYMON—I must say it is quite interesting. It is not something we have had put to us before.

Mr Nelson—I am glad I put the submission in, then.

Mr SYMON—It is from outside the square, and I am particularly glad you have come along and told us this. Thank you.

Mr Nelson—Thank you.

Mr RAMSEY—Outside the ellipse!

CHAIR—A square peg in a round orb!

Mr RAMSEY—I just made the reference; it is funny to talk about an orb as a square! I have two or three questions, Charles. On page 1, you refer to the 18.6-year lunar cycle, yet most of the graphs that you have presented seem to revolve around a seven-year cycle. You did demonstrate the difference between a couple of different cycles on the globe here before. I am just wondering why that is.

Mr Nelson—It is a very good question; thank you for that. If I had used a nine-year moving average, for example, it would have been half the lunar node cycle and therefore any cycle that I observed could have been an artefact of that.

Mr RAMSEY—Yes.

Mr Nelson—I had to be very careful not to choose a period which either smoothed out any cycle or amplified any cycle, and so I looked at different moving average periods. We get the same result if we use five years, but I had to be very careful not to use too short a period, like three years, which would not illustrate the cycle as much, or a very long period, especially nine years, which would have confused matters with the actual lunar node cycle. So I believed that seven years was the moving average period which best and most reliably demonstrated the cycle.

I should point out to you that I have used more technical analyses, including what the time series model has called autocorrelation and spectrum analysis. So I have used robust statistical techniques to identify this cycle in the rainfall, but in presenting it to you I did not want to go into all that technical detail. I decided to use this seven-year moving average as demonstration of the existence of the cycle in a reliable way.

Mr RAMSEY—Can you refer then to the corresponding periods, going back in 18-year intervals, and explain what we have seen in correlation. I understand that you have identified that something has slipped out of gear in the last five years.

Mr Nelson—Yes, something has slipped out of gear since the start of 2005. We have gone backwards rather than forwards in rainfall and we need to explain why that is. For the previous 70 or so years we were pretty much in lock-step with the cycle. There was, however, a period certainly from around 1890, and possibly earlier, to about 1920 when the cycle seems to have been delayed by six years. The cycle did not go away; it seemed to be out of step—and not by nine years but by six years. That suggests to me the possibility of the influence of the other cycle I mentioned, the lunar apse seed cycle, when the closest approach of the moon can have an effect. Given that it is an 8.85-year cycle, you would expect that potentially to influence the impact of the lunar node cycle by a period of four to six years. Historically, the deviations seem to have been from four to six years, which is why I am forming that connection.

In other words, from around 1856 through to about the early 1900s it fitted very well and again from about the 1920s through to the early 2000s it fitted very well. We are talking about maybe 100 of the 156 years. During that 20- or 30-year period from the late 1800s to about 1930 and during the last four of five years we have come out of lock-step. That is what gives me hope

that we will resynchronise. Hopefully, it will explain why we are out of step and we will indeed see improved rainfall in Victoria. Of course I cannot guarantee that to you until we have done more research.

Mr RAMSEY—What do you say to those who propose that the solar cycle, the sun flare activity and the intensity of the sun have a large influence on our weather? I think that is a 15-year cycle.

Mr Nelson—Yes. There are many factors. In my analysis I have found that the sunspot cycle, which is 11 years, has a major impact on temperatures globally and in parts of Australia. The solar sunspot cycle was rising in 1998, when we had that very hot year globally, and it is now very low. The fact that we have not had very much of an increase in temperatures globally in this last decade is not surprising, because the sunspot cycle would tend to bring that about. In 1998 we had an exceptionally hot year, which was caused by a combination of the rising sunspot cycle and a very strong El Nino, which also increases global temperatures.

Mr RAMSEY—Global temperatures or Australian temperatures?

Mr Nelson—Global temperatures—very strongly. It must be releasing heat into the atmosphere. I have proven that by the same sort of statistical correlation that I have used here and I have quantified its impact. That means that we had a very hot 1998 because of the global warming trend, the sunspot cycle and the strong El Nino. Without wishing to discredit anybody unnecessarily, the statement that we have cooled since 1998 is a bit misleading because 1998 was a very hot base year to use as a comparison to now. The fact is that now it is hotter than 1997, it is hotter than 1999 and it is hotter than any other year in the 1900s. It just happens that it is less hot than in 1998.

When we looked at factors that influence temperature we had to take into account the sunspot cycle and El Nino, as I said, and we also needed to take into account sulphur dioxide emissions which came from coal-fired power stations. The reason the earth cooled between the 30s and the mid-1970s was because of rising sulphur dioxide levels coming out of power stations. These reflect heat; they do not let heat come through in the first place. So we actually cooled over that period. When the clean air acts came in in the mid-70s and got rid of those sulphur dioxide emissions then the world started warming again very quickly. So these things are very easily explained. It may be that now, for example, China's growth in coal burning is not as environmentally friendly in terms of sulphur dioxide emissions as ours are now and so there could be cooling over China, for instance, caused by this. So there are many factors.

Another very important greenhouse gas is methane—it is not just carbon dioxide. As I understand it, methane levels have not risen for the last few years, which would also tend to not lift the temperature. But the carbon dioxide impact is probably about 0.1 degree per decade, so over a decade other factors could very easily outweigh that.

The basic science of climate change was established in 1859 by John Tyndall, a scientist who did the experiments. He passed the sort of infrared radiation that comes from the earth's reflected heat back into space through different gases. He found that the major constituents of the atmosphere, which are nitrogen and oxygen, are transparent to both heat coming in and heat going out. He found, however, that gases such as carbon dioxide, methane, carbon monoxide and

water vapour quite effectively block heat going out of the earth. So the basic science was established in 1859. He repeated those experiments in front of the Royal Society a few years later, and I think that it would be very handy if all physics departments in Australia repeated those experiments for anybody who wanted to see them.

Mr RAMSEY—With indulgence, as you have your globe there: can you explain to me why we get our king tides on a full moon rather than a new moon? You would think that when the moon is on the same side of the earth as the sun, which is new moon, that is when you would get the bigger tides.

Mr Nelson—What seems to happen is that when the moon is here, let us say, we get a high tide here and a high tide over here. How does that happen? Loosely speaking, the moon is dragging water away from the earth and it is also dragging the earth across slightly, which means that the water here rises slightly.

Mr RAMSEY—And it rises more on the side away from—

Mr Nelson—I could not tell you whether it rises more or not, but that is the reason. It is dragging water this way and it is dragging the earth that way as well, and the water here is less affected by the gravitational impact of the moon and therefore is not moving as much as the earth itself, so it bulges like that. Of course they are even stronger when the sun joins in, which has about half the impact on the tides as the moon does. So it is extremely complicated.

Mr RAMSEY—We will have to get someone else to do that because it will take too much time. I want to get my fishing times right. Thank you.

CHAIR—I am keen to know whether your analysis has been reviewed at all or considered—

Mr Nelson—It has not, no. I was spurred into action to present it by the existence of this committee, and I am very pleased that this committee has come into existence. So while I had been working away on this in my spare time, I accelerated my work and sent it to you for the deadline. Since then I have personally sent that work to the Murray-Darling Basin Authority. It has also been sent by one of my colleagues who is working in the university in this area to other people to have a look at. So it has not been submitted to any journal yet. That may well occur, especially if I can get some funding from one of the organisations I spoke of. That would obviously be a necessary part of taking this work further to publish it and have it peer reviewed.

CHAIR—With the intention, presumably, that it could be incorporated into our climate model?

Mr Nelson—There is every reason why it should be incorporated into our climate models, I believe, yes.

CHAIR—Thank you. It has been most interesting.

FRAN BAILEY—We are expanding our knowledge exponentially.

[11.35 am]

QUIRK, Dr Thomas William, Private capacity

CHAIR—Welcome. Although the committee does not require you to give evidence under oath, I should advise you that these hearings are formal proceedings of the parliament and consequently they warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. We thank you for your submission and now welcome you to make a brief opening statement before we proceed to questions.

Dr Quick—I thought, having put in this note which is really on the independence of advice, that one of the other things I could very quickly talk about is the issue of meteorological forecasting or modelling. I think that if I were doing long-term forecasting I would not be as bold as to call it ‘forecasting’. I would reckon it is ‘modelling’. If you want an example of forecasting, the Bureau of Meteorology is actually a very honest outfit. In their annual reports they show you how good they have been in their previous year in hitting maximum and minimum temperatures for the next day. If you look at that, they are only accurate to about a degree. It has got better over the last 10 years with the application of more computing power, but I think that the only one that has got better is the maximum. They have not had much luck with minimum. If you think of that with a one-degree certainty and you are worrying about modelling or forecasting over 100 years, you might well worry about how useful it is going to be for any sort of policymaking.

The best way of thinking about it, at least in my terms, is a digital camera, where you think of pixels: how many pixels do you need for an image? In terms of modelling the atmosphere, it is: how do you break it up? Do you break it up into chunks which are 200 by 200 kilometres square or cubed? How far do I go in terms of the detail? Given the way that the climate works, there is always something going on, at any level that you care to define, which may well have an impact on the pattern of the climate. There are published papers that show that even by going to greater and greater definition you have not actually improved the performance of your modelling or predictions. That is one point.

The second point I want to make is the use of models. I am a nuclear physicist, and there have been, in terms of modelling, some not totally disastrous but quite serious problems in the modelling of nuclear weapons, where the models got the yields wrong by a factor of two, which had quite serious consequences for the first of the hydrogen bombs. The subprime mortgage collapse is partly enabled by modelling of risk assessment. Taken on by all of the banks where in fact if you do not actually know all of the circumstances surrounding something, it is actually not possible to model.

Of course, the final one that impacts on making projections is the economic modelling. In terms of looking forward 100 years, you are going to have to decide how the country is going to develop. Are they all going to follow the pattern of Western Europe or the United States? If you had sat at the start of the 20th century, you would not have had a hope of forecasting where we might be at the end of the 20th century. There is no way that you could, even in the fifties, predict the change that happened when we went from using valves in computers to using

transistors. I think you should follow the advice of Sam Goldwyn, who said he ‘never liked making predictions, particularly about the future’.

Underlying all of this, there is actually a fundamental problem called ‘deterministic chaos’, which is that the mathematics of this problem may not lend itself to a precise answer. If you talk to the weather forecasters you will discover what they do. When they run a forecast for the next day, they change the input variables by a little amount to see if the end result is stable or if it goes haring off in some direction.

So there are a whole lot of these worries. My view of all of this is that it might be much better to go off and look at measurements. The oceans are the great unknown in all of this. In the submission that I made I gave you the example of another way of looking at what happened to the Australian temperature record in the 20th century. When you actually look at it statistically, you can see there is a little blip in 1976-78 where the temperature jumped by about half a degree. That is probably the great pacific climate shift, which was a deep change in the currents. There is not enough information at the moment to know what the real cycles of these sorts of things are. The ocean is the sort of flywheel of the atmosphere. It is where all the energy is. The most conspicuous examples are the currents and the control of the weather and the climate in North Europe through that currents flowing up across the Atlantic. So, if I was looking at anything, I would be seriously urging people to have a real look at the oceans. There is not enough data there.

The other thing which I think is missing is people thinking about what is going on. I come from a generation where we started with computers but we were very early—probably the earliest years of the internet in this country, from about 1973—but the kids who came after us, who became our research associates and research students, spent most of their lives staring at computer screens, and we used to say to them, ‘Go and think about what is going on.’ At the moment, if there is any change, it is all put to climate change. It is the easiest way and we can model it, and a lot of it has no content.

I have used modelling in my professional career, but the sort of modelling that I have been used to is, if you like, geometry—where are the walls of something; where are the windows? You are not going to have a big argument about whether that wall exists. But, with a lot of what goes on in here, there are great subtleties and uncertainties, and to pretend otherwise is, I think, very misleading.

CHAIR—You were here when the previous witness was giving evidence before us. It was certainly a theory that we had not come across before. Do you mind making a comment?

Dr Quirk—I am experimental physicists, so I tend to look at measurements. There is absolutely no doubt that the sun is the primary heat engine which beats down on the planet and then the secondary source is the ocean, which can store heat or take up heat and give it back at various times. How the sun interacts with the earth and the moon is very complicated.

There is no doubt if you follow the sun spot cycles and you go back and you look at the little ice age when there was a sun spot minimum and crops failed and the Pope ratified witch burning—a most extraordinary time. But what is the actual mechanism? I do not think people know what the mechanism is. I would not pretend to know. It certainly is not just the output of

the heat energy from the sun. If it is something, it is much more complicated. It may be the magnetic field, it may be the streams of particles which come out, but I would say the jury is out on all of that.

CHAIR—You mentioned witch burning. It takes you back historically to the whole concept of people reading the planets and a whole series of other things to understand weather and to make predictions. I feel that somehow today we are being taken back to that wanting to understand the intricacies of those relationships. It is not a new way of doing things, is it?

Dr Quirk—It most certainly is not. I do not think it is a state of being a useful tool yet. I tend to steer very clear of all of those sorts of arguments.

CHAIR—It would have been a tool to people may be 1,500 to a thousand years ago. Was it a tool? They were trying to read the heavenly bodies.

FRAN BAILEY—From crops and so on.

CHAIR—That is what I was trying to say. We are talking about computer modelling and all sorts of things, but the discussion today seems to go back to a time in human history where they did not have any computers or anything but they seemed to be a lot more sensitive and more aware of factors that today, for example, we were asked to look at.

Dr Quirk—You can go even further back. You can go back to the cave paintings, where people think that they were signals lining up on the positions of the sun during the seasons.

FRAN BAILEY—Or the construction of the pyramids.

Dr Quirk—Maybe our modern pyramids are large computers.

CHAIR—Maybe not as efficient as the ones that were built 2,500 years ago. I do not know.

FRAN BAILEY—Given, as you said, the amount of inexact science, while this inquiry is not coming out with a recommendation specifically about global warming, why did you suggest in your submission that the Productivity Commission be the body that does an assessment?

Mr Nelson—In short, desperation. In terms of government and public servants, if the government has a policy then the Public Service will carry out that policy. If you have concluded that you want to follow the IPCC and you are going to do something about it, then it seems to me that public servants will follow their masters and do more or less as they are told. My second point here was, what about the Chief Scientist? If the government has got a policy on climate change and appointing a new Chief Scientist, they are hardly likely to go against, at least publicly, the expressed view of the government. So in thinking about that, where is the other shop you might go to? It is the CSIRO. But they are getting money from councils, from state governments, from everybody to make forecasts, to worry about how to make clean coal or clean cows to stop them emitting methane. They have got every conceivable project that they can. Having been an academic, it is a perfectly natural response. If somebody lays out a program, you try to figure out whatever you are doing, how does that make it relevant, how can I help? So I thought, because there is nothing like the Office of Technology Assessment in Congress, which

got done in by the Republicans, where do you go if you want advice which is not, if you like, rent seeking? The nearest thing I could think of is the Productivity Commission. It does not have scientists in it but that could be solved. That may not be a satisfactory answer. I think it is a real dilemma.

FRAN BAILEY—This is a very personal thing, but I have never had good experience with the Productivity Commission.

Mr SYMON—I suppose my question is along a similar line. The Productivity Commission is still government financed in the end, but getting them to review information that is there is going to give an answer a lot different to what is currently accepted? That is a very rhetorical question, I might add.

Mr Nelson—Part of the basis though for the climate modelling is actually economics and the economic modelling of all of the countries. There is something within the Productivity Commission which would serve as a partial basis for looking at this. What you need to think about is the equivalent of an office of technology assessment. You have had to cope with genetically modified crops and foods—and I have been involved with genetically modified organisms for health care. There are a whole series of issues coming up which are technology based. Do you have somebody you can go to who gives independent advice?

FRAN BAILEY—That is actually a very good point.

Mr Nelson—That may not have answered your rhetorical question.

Mr SYMON—I am not sure that there is an answer to it.

Mr RAMSEY—In a similar vein once again on the Productivity Commission, you have a pretty healthy skepticism of modelling per se. What basis would the Productivity Commission use to evaluate if they were to disregard models?

Mr Nelson—I suppose experience of economic modelling shows the uncertainties that are involved in the economic projections which take you forward. I would argue that people who have experience in handling statistics are probably pretty good at dealing with these things. I will be honest with you, in my career as a scientist, I was inclined never to give anything to a statistician to analyse. We would go to statisticians when we had a problem and ask them how we would solve it. When you go to look at a problem, there is so much more than statistics; there is knowing how the system works. From that point of view the Productivity Commission as constituted does not help you because you have to have an understanding of the physics and the processes which are involved. It was desperation—

Mr SYMON—It was not so much that you nominated the Productivity Commission; I was wondering what basis it goes back then to look at things. To re-examine all of the models is going to be outside anybody's field of expertise.

Mr Nelson—In the last five years or so there have been a new set of satellites which have looked at essentially clouds in the atmosphere. The result of that shows that the models have underestimated, if you like, the humidity or the amount of water vapour in the atmosphere by

about a factor of three. Some of the modelling groups, particularly the one at Princeton, have gone back to see if they can fix this because there is no doubt that the published results of the models do not fit with the actual measurements. It is a serious flaw.

If the models predict less water in the atmosphere than is actually there then they are going to overestimate the rise in temperature, because the reason that the water gets up into the atmosphere is the sun beating down on the ocean. Evaporation takes the heat out of the radiation and puts it into the latent energy by making the water vapour, and that carries the energy up into the atmosphere, but it does not change the temperature as much. So this may be resolved, but there are very interesting things as people measure more of what is up there in the atmosphere. Of course, you still have this great gap with the ocean. So the answer is that you need people with an understanding of the particular system you are attacking, and you need people with experience of statistics, but you should not let statistics rule and overwhelm the other side.

CHAIR—For every question we ask, we open up another six areas of inquiry.

Mr Nelson—Yes.

FRAN BAILEY—We all need our thinking caps on.

CHAIR—Thank you very much.

Mr Nelson—I was quite surprised to be asked, so thank you.

CHAIR—Thank you.

Proceedings suspended from 11.55 am to 1.01 pm

McLEAN, Mr John, Private capacity

CHAIR—Although the committee does not require you to give evidence under oath, I advise you that these hearings are formal proceedings of the parliament. Consequently, they warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. We thank you for your submission and now invite you to make a brief opening statement before we proceed to questions.

Mr McLean—Thanks to the committee for inviting me here today. I come from an IT background, so I am perhaps not that different to a lot of climate people who come from biology backgrounds, and even engineers, but at least I bring some analysis, some logic and some data-processing skills to all this. What interests me in particular are claims about accuracy of different models and what goes on.

I saw that in the UK the Met Office has been using modelling for seasonal forecasts over the last few years. 2007 was one of the wettest summers since, I think, 1913 and they had predicted a very hot summer. They tried again the next year and it was, again, a very wet summer. Last winter they predicted quite a mild and dry winter, and they had very heavy snow. They ran out of salt and grit for the roads. I think we can assume that there were accidents as a result of that—probably fatal accidents—which means that inaccurate forecasts actually contributed to the deaths of some people. So I think if we are doing seasonal forecasts we need to find some way to make sure they are accurate.

Mr RAMSEY—One of the first things I noted in your submission was WeatherAction, the London based company. If they are achieving some kind of accuracy which you consider to be greater than the average, can you tell me what are they basing their scientific analysis on?

Mr McLean—WeatherAction actually produced accurate forecasts for the last three years in the UK. So their record does seem fairly good, but it has not been independently assessed, as far as I know. I understand that they are working well with solar charged particles, which are a little bit like cosmic rays. The charged particles trigger cloud formation, or certainly encourage it. The IPCC, perhaps the Bureau of Meteorology and certainly the CSIRO do not believe that there are many solar influences, but this one does seem to be consistent.

I did some work for the principal of WeatherAction, Piers Corbyn. He asked me to have a look at some of the weather records here in Australia from 1966 and 1967 and he made some predictions based on that. But how he worked out the actual timing and whether he has some sort of modulation factor over time, I really do not know. That is ultimately what it is based on. I know not much more than that. But it does look to be an interesting technique and I think it something the Bureau of Met should be looking at.

Mr RAMSEY—You also say in your submission that those that have questioned the current scientific models have lost their funding. Do you have any specific examples of that or is it more of a general term—or is it an urban myth or scuttlebutt?

Mr McLean—Can you give me a page number? I know that people who have questioned the conventional wisdom have—

Mr RAMSEY—That may be right. I am paraphrasing.

Mr McLean—There have been several instances in the US of state climatologists being fired and people at universities no longer getting research funding to do particular tasks. That is what I base it on. I would have to do a bit of searching to find the specific examples.

CHAIR—But it would not be something that you would find occurred here in Australia?

Mr McLean—I honestly do not know. As far as I can tell, the majority of the funding goes towards proving a human influence on climate. I do not see too much funding going in any other directions. Just the other day I got a list of 460 research projects that had received funding under ARC that ticked the boxes for climate change—or the title or the abstract mentioned climate change. Some of them looked, shall I say, quite remote from climate change. They just happened to tick the right boxes, so they appeared in this list. What I did not get was the amount of funding to climatology and meteorology research that did not tick those boxes. I suspect there is very little but I do not have the figures, so I am really not sure.

Mr RAMSEY—Someone else raised it this morning. It is one of those common themes of all scientific funding, of course, not just climate variability—whatever funding pool is there, everyone will tailor the program to tie-up football boots around whatever is available and preface their argument to suit that.

Mr McLean—It is the problem, I think, of having policy-relevant funding. That makes perfectly good sense when the scientific field is fairly well established, and you also do not want to be wasting money if you can avoid it. But I regard climatology as still being very immature science. We are still arguing about what causes rainfall in Australia; we have had weather records since the 1860s or so and we still do not exactly know. There are still a lot of very basic things to be discovered. So I think policy relevance probably should not be applied in this instance. We should be looking at a wider spectrum until we can narrow the field a bit.

CHAIR—Do you have anything that you want to ask, Mike?

Mr SYMON—I do. I would like to go back to the part of your submission that deals with long-term weather forecasting. You say that the UK company, WeatherAction, made three predictions for Australia versus the outcomes of the Bureau of Meteorology. Did they make any other predictions, in that time frame, for Australia?

Mr McLean—As far as I know those are the only predictions they made for Australia. No, I take that back. There was one last year. I did some research across a particular month, looking at every single weather map published in the newspapers. There was one prediction, I think, made from all that, that was not successful.

Mr SYMON—So the predictions they have there are all for tropical cyclones? Do they specialise in that area?

Mr McLean—No, not at all. They may specialise in low-pressure cells, because this could be a development of a cloud formation. The listing of the tropical cyclones is simply because I was asked to have a look across the whole year of 1967. I looked in the yearbook and these were the only notable meteorological instances for the year. I have had a request to go back through every month but I just do not have the time at the moment.

Mr SYMON—I imagine it would be very labour intensive.

Mr McLean—Somehow, Piers Corbyn is matching what we were seeing back then to the conditions today. I do not exactly know how it works.

Mr SYMON—I would be interested in what computer modelling they are using to get to that point. What have they got?

Mr McLean—I do not think it is any computer modelling at all.

CHAIR—What are they doing?

Mr McLean—I think it is a comparison between the situation then and the situation now. With their charged particles I would assume they are saying that there are similar conditions but perhaps there is some kind of multiplier effect if we have an El Nino or there are changes in the earth's magnetic field. I honestly do not know.

Mr SYMON—So really it is a statistical model based on what has happened previously and if the same conditions come up again then they are predicting the chance of event X happening.

Mr McLean—Yes, that is right. I am not sure what his 'special sauce' is that he adds to all this. It has proved to be quite an interesting technique. I had an email from him yesterday talking about recent adverse weather in the US that was successfully predicted, I think, six or eight weeks ago. They were coming into summer and had had a lot of snowstorms, heavy hail and rain, and this had all been predicted. He has made predictions up to nine months ahead with quite good accuracy.

CHAIR—I guess that is interesting in the context of our being here having discussions about models and abandoning the statistical for the dynamic modelling. There seem to be a lot of inconsistencies and contradictions. How do you rate the bureau's systems and methods? Where are their weaknesses, where are they steering in the wrong direction and where are they doing it right? This is becoming extremely confusing.

Mr McLean—I think the probability based models are often not much better than useless. To say that, across an entire season, there is a probability of 60 per cent that rainfall is going to be more than average; I mean a whole season—three months—can make a lot of difference to a farmer. I think we need something much more precise if they can do it. It is too vague at the moment. But I am not convinced that the modelling that they are using, or that the UK is using, is worthwhile because it has had such major inaccuracies. The track record shows how inaccurate it is.

I think there is an assumption that they can take some climate modelling features, but I have a very low impression of climate modelling. They modelled everything they knew and said it is not accurate but everybody else, including the IPCC, is saying, 'There are all these things that you do not know very well.' The inaccuracies could be because they just do not know. The level of scientific knowledge is not good enough to formulate a model.

CHAIR—Why is that the case? Why isn't the level of scientific understanding and knowledge good enough at a time when, certainly in terms of technology, there have been such advances? You said at the beginning we are still trying to work out rainfall accurately.

Mr McLean—I do not know why. It is simple to say that if we did more research and had more money we would find out all these things. But I am not so sure. I think sometimes people get into a certain kind of a pattern from their training and their work and think down some quite narrow paths. This idea of the solar-charged particle would be something quite new to most meteorologists, I am sure. They are just locked into a certain way of thinking. But that is only a guess and an opinion. I have never thought very hard about it.

I see what they are trying to do with their models but they are just not up to scratch. The accuracy is fairly appalling, the assumptions are pretty gross and broad sweeping. If they do not understand something then they will put in a parameter, or a couple of parameters, to say that is how they will assume it is going to be.

Recently we were told that the modellers assume that clouds are a consequence of weather whereas some of the key researchers in the United States are saying clouds are a cause of the weather. So if you have a cloudy day, it is probably going to be a cool day. The clouds are not there because it is a cool day; it is a cool day because the clouds are there, which makes perfect sense. I do not know how you would actually shake up the whole industry.

CHAIR—I was just thinking, could you shed some light on what government should make of this?

Mr McLean—I think one of the things is to pull back from the policy of relevant funding and listening too much to IPCC. It was set up only with the function of looking at a human influence. If there is no human influence, there is no need for the IPCC. It is in its interests to promulgate this hypothesis. It is really a hypothesis in search of evidence and still is after 20 years, which is a total contradiction to normal science where you look at the data. From the data you formulate a hypothesis and then you test it—you do not work backwards. I think really that the funding has to go into a broader area of just looking at different meteorological phenomena.

CHAIR—Which are not being looked at currently?

Mr McLean—I do not think they are being looked at adequately at all.

CHAIR—'Adequately', yes.

Mr McLean—I know that there are people in the Bureau of Meteorology who have done quite a reasonable job of looking at the El Nino southern oscillation. But I get the impression that in the bureau there are two camps: the firm believers in the IPCC's ideas and the others who

just go away and do their own work quite happily and ignore all that crew. The second group is actually turning out some interesting information.

CHAIR—Are they able to make an impact, though, with what they are doing? It just strikes me that if you are not in with, let us say, the accepted view of things, like in any other place, if you came in from left field with something totally different, people are likely to say, ‘Well’—so what happens to those people and their capacity to influence the agenda and to broaden it?

Mr McLean—They would probably get marginalised.

CHAIR—Yes, they would.

Mr McLean—Let us face it: these days research is a business. If you are the manager of the research organisation, you are concerned about the funding coming in, and you are not going to rock the boat and threaten the funding too much. It is just not in your interest to do so.

You may have read that last week the EPA in the US released a fairly influential report talking about carbon dioxide. It has only just come to light that there was a 100-page internal report that cast doubt about the whole thing that they decided to ignore. The two authors of that report were told, ‘You are too late; we want to move on,’ and the whole report was put aside. I have not managed to get a copy of it. It appeared recently on the websites. What they were saying was very interesting. But it was not in the EPA’s interest to turn all this down.

So the whole climate field at the moment is just too racked by vested interests. The funding is going into one thing and one thing only. And, if you can twist your research to pay at least lip-service to that idea, that is fine. You will get your money and, as long as you say in the conclusions much the same thing, you will probably get your money next time.

CHAIR—Do you think the whole movement into dynamic modelling is influenced by the current thinking towards and focus on climate change?

Mr McLean—They have this centre in the UK that has got an enormous amount of money to undertake this research into a human influence. I also think the Met Office Hadley Centre was set up basically to service the IPCC, because it was set up as a branch of the Met Office at the time. John Houghton was the head of the Met Office. John Houghton was also the chairman of Working Group 1 of the IPCC, which is a scientific group. So he was basically pushing this organisation, and it has become extremely influential with the IPCC. The Hadley centre collects the temperature data on which the IPCC bases a lot of its claims. I think the historical data is seriously flawed. The Hadley centre does a lot of the modelling for the IPCC. I think I showed—I think it was in my submission—that 10 of the 53 authors of the key chapter of the IPCC report came from the Hadley centre. So they are pushing it along. They are getting all this funding and pushing the business their way.

Mr SYMON—You just touched on the accuracy of observation stations and you have on page 13 some examples of how the environment around those monitoring stations has changed. Have you looked at the data recorded by those stations before and after? Is there any particular spike or change that you can notice because of those changes in the environment?

Mr McLean—In the two instances that I listed, I do not think so. Cape Nelson, down at Portland, would be very difficult, because you would have a slow change over time as the vegetation grew. I have seen examples out of the US where there have been quite sudden jumps, and they can attribute it to some change in the local environment. But a slow change over time is much more difficult to spot.

Mr SYMON—Would that be true as well for Laverton, which you mentioned is gradually turned into a housing estate?

Mr McLean—It is becoming a part of the metropolitan area, yes, at a slow change. That one is interesting because it is blocking the south and south-westerly winds, or interfering with those, and they are our core winds here in Melbourne.

Mr RAMSEY—On that subject, does anyone pull out separate figures for weather stations that would not be influenced by the weather change? I will use the classic example of Giles. There is not a lot of urban build-up around Giles at this stage and I do not anticipate any in the next 4,000 years, barring the tide coming in about 3,000 feet. But there must be plenty of rural measurement stations which, while they might have houses around them, do not have acres of houses around them and are not affected to the same degree?

Mr McLean—I do not know. The bureau of met is supposed to log these changes—as far as I am aware, they are supposed to. I was speaking to Bill Kininmonth, who is now retired. He is something of a sceptic about all this himself.

Mr RAMSEY—His name came up earlier.

Mr McLean—Bill was involved in the set-up of the entire reference network—what were supposed to be high-quality stations with quite long data. Part of this was supposed to be keeping a log of what had changed in the local area that could conceivably have impacted temperatures. I do not know whether this has been done. I think some questions should be asked to find out if it has been done and, if the information has been collected, how it is being used. I am afraid I cannot help you. You mentioned Giles weather station—in a good year it probably has some grass underneath it.

Mr RAMSEY—Highly unlikely.

Mr McLean—Is it?

Mr RAMSEY—This is in Western Australia.

Mr McLean—Just over the border?

Mr RAMSEY—It is in the middle of Western Australia, just out of my electorate.

Mr McLean—I just thought that after some rainfall you might get some of the native grasses.

Mr RAMSEY—I think it properly happens once every seven or eight years.

Mr McLean—Right, maybe we will see these seven- or eight-year spikes in the growth.

Mr SYMON—I suppose the classic weather station for change is just up the road here—the city weather station. There the old Commonwealth offices were knocked down a few years ago and were replaced by a new building a couple of years later. The buildings were so close to that particular monitoring station that I suspect there was some effect, because what was shadow and what was a wind break—various other things—disappeared for a period of time and was then replaced by something larger than what was there before. Is that the sort of the situation that you are talking about—changes that should be logged for a weather station?

Mr McLean—That would be one of the most obvious changes, but Melbourne city is not part of the reference network, so it avoids that problem. But you are quite right: there is a big Telstra building almost to the immediate south, I think, and to the south-east there is a block of units or city apartments. One thing I notice, and I think it is on my website somewhere, is that in relation to temperatures and wind speeds all around Melbourne—just the observations in the metropolitan area—the city stood out because when everyone else had wind from the south-west it was getting wind from the east. It was bouncing off some of the tall buildings, I imagine, and being redirected. It is that kind of thing; but it is a fairly extreme case here in Melbourne. I have got into the habit of trying to take pictures of country weather stations, just to see how good they are. You would be surprised how many have actually moved, as well. There was one at Lemnos, near Shepparton, near the Campbell's soup factory, which probably kept it nice and warm in winter. It has closed and a new station has been opened at Shepparton Aerodrome. It probably has different local characteristics, so you will get slightly different weather.

It is a real problem. In the States they have found that something like over 80 per cent of stations are not cited in accordance with the defined standards. They have been put in parking lots or near air-conditioning ducts, barbecues and things like this. It has been an absolute shocker. I think they expected maybe 20 per cent, but there would be lucky to be 20 per cent that actually comply with their requirements.

Mr RAMSEY—I was of the understanding, though, that the programs were there to try and filter that out, but I am going to ask the secretary to see if we can find out.

Mr McLean—Regarding the Australian reference network, the data that are recorded by the bureau and released are the true recordings. There has been no modification made by the bureau. I think there is a recommendation that researchers should modify the data for themselves, but I guess they do not have much guidance on how much the data should be modified. You get situations like you have here in the city with the buildings to the south and south-east. Presumably a northerly wind is fine and the temperature reading is more or less what it should be, but if it is from a different direction then it is wrong. So you have to play around with all these factors. The information should be available, but nothing is done by the bureau to modify it for you. So they are reporting verbatim readings. There is no other way they could reasonably do it. Otherwise, you would need to know what assumptions they were using and why they were using them.

Mr RAMSEY—So your underlying argument is not that they are under-resourced but that they spend all their resources in one area exclusively because of the funding.

Mr McLean—I do not know enough about the internal workings of the bureau to know that, but my feeling is that far too much money is being pushed into one area, more than that area actually justifies. It may mean that other areas are being starved of funds but I honestly do not know. Perhaps if you took that money that is being pushed into one area and spread it out over the entire bureau they would be doing a better job right across the board.

Mr RAMSEY—Graph 1 in your supplementary submission has three figures that show the inaccuracy or accuracy of climate modelling, and it has aerosols, halocarbons and so on. I really do not have a clear understanding of what you are trying to say there. Is that graph saying that we understand the effect that halocarbons have on the atmosphere and we do not understand what effect solar activity has on the atmosphere?

Mr McLean—The level of scientific understanding is very low. We do not know exactly what effect they have, and we do not exactly know what it will do to the temperature.

Mr RAMSEY—What do you mean by ‘solar’?

Mr McLean—The IPCC said ‘solar’. In their terms it is usually radiation, but more than radiation comes from the sun, including magnetic winds, charged particles and solar magnetism.

Mr RAMSEY—So the IPCC are saying we do not understand what effect the sun has on the atmosphere. Is that what you are saying?

Mr McLean—They are trying to claim that there is not much variation in the radiation from the sun, and that is quite correct. There is not a great deal of variation. It works out to some very small percentage. They are trying here, I think, to estimate watts per square metre. They can calculate watts per square within their error margins. It is when they convert their watts per square metre into temperature that it is a whole different ball game. There are all sorts of figures thrown around—anything from three point something to five point something, or even down as low as one. If you have radiation on something it is like putting a hair dryer on something damp: it will spend most of its energy evaporating the moisture. If you have a wet surface, if it has rained, your sunshine is going to spend a lot of time just evaporating, so you cannot translate it directly into so many degrees.

The two graphs there in particular show that the scientific knowledge of these things is very, very poor. So it is basically impossible to model them with any confidence. That, of course, has never stopped modellers. I work in computer programming; I know that you do get attached to software that you have written and you tend to overlook some of the flaws in it sometimes. This is a bit too important. They really should be more honest about what is known and what is not known and needs to be done. As I said in my submission, I think the main thing they needed to do is more research into these areas to resolve some of these unknowns so they can refine the model and improve the accuracy.

CHAIR—Can you develop that a bit and tell us what you would see as an alternative model for more accurate timescale weather and climate forecasting? Clearly it is understood that you feel the present situation is inadequate, but are there any alternatives that you have thought about?

Mr McLean—It is a very difficult question because it almost requires me to know what is unknown. It is the old story of the known unknowns and all that. I think one glaring omission from the CSIRO's models was the effect of the El Nino southern oscillation. They talk a lot about them in their reports but when it comes to the modelling they do not mention a word. They also do not mention the change in 1976, the Great Pacific Climate Shift. No one seems to know why that shift occurred, but it has meant that we are getting more El Ninos and fewer La Ninas and the average is about halfway towards an El Nino. This seems to be our normal state, which is a bit worrying.

CHAIR—Do you have any ideas as to why that might be happening?

Mr McLean—It happened quite abruptly in very early 1976, I would say about February or March. I think it may have been a result of some earthquake or something like that, but I honestly do not know. There was some very sudden change for reasons which are just not clear at the moment.

We tend to assume that climate goes along and everything stays nice and balanced, nice and even, but we do get these changes and then we change to another state which is also stable in its own situation. There has been this jump between the two and that, I think, is what has happened. Whether we can ever undo it is another matter. When you get a sudden step like that it is very easy for people to look at the data and say, 'We have a trend which is always going upwards' when, in fact, what they have is a step that has gone up. It is a point that I make in my submission.

CHAIR—You have left us with a lot of questions to think about.

Mr McLean—I am afraid that I do not have the answers because I am so deep in the climatology and meteorology world. All I can do is look at the results and say that what they are saying does not really match the data terribly well and they are being rather coy about their accuracy.

I first found this by looking at a CSIRO study of the Murray-Darling Basin, back in about 1995 or 1996, something like that. It was a widely quoted report and it had the data going back to 1950. One day I decided to take a look and see how it compared to the observational data. The rainfall estimates were about 40 per cent short—that is, about 40 per cent less—and the temperature was also wrong. This report was being widely circulated and quoted as if it were gospel and yet it was perfectly obvious that the accuracy of their predictions, from 1950 to 1990, was basically appalling.

It is a bit like being a sports fan and knowing that your team is playing badly. You do not have to play well to know that they are playing badly; you do not have to be an expert to see that something is wrong. That is the position I am coming from.

CHAIR—You have certainly left us with a lot of questions but it always very important to have various perspectives on this because it is no easy science.

Mr McLean—I am sure you are being assured that models are perfectly accurate.

CHAIR—No, actually I am not necessarily getting that view.

Mr McLean—Good.

CHAIR—The view that I am getting is that it is highly susceptible to inaccuracies at this stage. I do not know where we will be at the end of the inquiry but there are certainly a lot of questions around. We are trying to think about them in terms of what we do as a committee making recommendations. As non-scientific people, being politicians we are charged with making recommendations to government—and possibly having recommendations picked up. There is no clarity, put it that way, in the new trend, certainly not in the modelling.

Mr RAMSEY—Except that most people think more money would help.

CHAIR—That is right. That is true. That is a constant, that more money would help.

Mr McLean—Have you ever had an example where somebody has said, ‘We want less money’?

Mr RAMSEY—Not that I can think of in recent experience—

CHAIR—No.

Mr McLean—Funny about that!

Mr RAMSEY—in any part of my life!

CHAIR—And I guess this is one area where the requests for more money will help. You cannot seem to get a picture of how it would help, because you are saying, ‘I don’t know what I don’t know.’ There are a lot of unknowns.

Mr McLean—I think you need to be careful. As I said, the UK has just had a new £30 million computer system. If your computer system is telling you that two plus two equals five, a new supercomputer is just likely to tell you the same answer faster, unless something else changes.

CHAIR—You could wait awhile!

Mr McLean—So you really have to make sure you get value for what is being put into it. From what I have seen of regional forecasts, which I know the Bureau of Meteorology or the CSIRO are trying to move to, I do not believe that they are much better than what we have now. Onshore winds are still a problem. I saw a report for coastal Victoria—in fact, the Victorian government is looking at the coastal strategy—and they had climate projections for coastal Victoria, and I took it with a grain of salt, just because of the difficulty of onshore winds. We are particularly susceptible to south-westerly and southerly winds here. In fact, if you are here later on this week—on about Thursday, I think it is—we will start getting into some very cold weather. The forecast for next Sunday is from five to 12 degrees, which is a bit chilly, but a big blast is coming up from the south, from the Antarctic.

CHAIR—Thank you.

[1.37 pm]

BORGAS, Dr Michael Stewart, President, Commonwealth Scientific and Industrial Research Organisation Staff Association

LONG, Ms Monica, Section Secretary, Community and Public Sector Union

PERSSE, Ms Louise, National President, Community and Public Sector Union

CHAIR—Welcome. Is there anything you would like to add about the capacity in which you appear before the committee?

Dr Borgas—The CSIRO Staff Association is a section of the CPSU. So I am here today representing the members in the CSIRO Staff Association.

Ms Long—I am the section secretary for meteorology in the CPSU, so I am representing the Bureau of Meteorology staff in the CPSU.

CHAIR—Although the committee does not require you to give evidence under oath, I should advise you that these hearings are formal proceedings of parliament. Consequently, they warrant the same respect as proceedings of the House itself. It is customary to remind witnesses that giving false or misleading evidence is a serious matter and may be regarded as a contempt of parliament. We thank you for your submission and now invite you to make a brief opening statement before we proceed to questions.

Ms Persse—Thanks, Madam Chair. I might start and then hand over to Monica and Michael. I should point out as well that they are each the senior honorary office holders for our union in their respective agencies, the Bureau of Meteorology and the CSIRO, so they are well qualified to speak on these matters. I will make some opening commentary and then hand over to them.

The CPSU's interest in the inquiry really goes to our concern about quality public services. We have been concerned for a number of years that governments have failed to invest in the long-term capacity of the public sector to deliver essential services. Our members raise this consistently as an issue in their own workplaces. They have a view not just about their own workplace but about the capacity of the wider public sector. Therefore, our union has resolved to campaign in the community to restore and increase funding for services provided by the public sector. Long-term meteorological forecasting is one example of a service that will only increase in importance. As one of our members has said, climate change will force our hand to produce better seasonal outlooks. We say that these will be vital for disaster planning and economic decisions made by key industries.

I might also note when speaking about the public perception of the bureau that it is certainly one area of our membership in which there is intense public interest. We have made previous submissions to previous inquiries about the level of public demand upon the bureau and the importance the public places upon its work. We believe that the scientific and technical case for the importance of long-term meteorological forecasting is clear and that what needs to be put in

the forefront of the debate is how we perform this vital service. If this task is worth doing then in our view it needs to be fully funded by government.

CPSU members have made it clear to us that the private sector will not be able to fulfil growing community expectations in this area. There are some examples in our submission of what our members say is a poor quality of information being provided by some private sector providers. We say that the public sector has a central role in building and improving long-term meteorological forecasting capacity. In that context the key to delivering a quality service is to maintain adequate numbers of permanent, skilled and experienced employees in agencies like the bureau. That has been something that has been problematic for many years for our members. Monica will outline some of those matters in more detail.

Even in the good times we have experienced this. Budgetary pressures such as accrual accounting, the efficiency dividend, project rather than ongoing funding—a big issue at the bureau—and a lack of supplementation for pay increases have all combined to create funding pressures on the bureau. In 1998, according to the Public Service Commission, the bureau had 1,357 permanent staff but in 2008 it had 1,265 ongoing staff. So we do not think it is sustainable to argue that the need for a quality meteorological service has remained static during that time. Our population has grown, and the global warming issue, which was not really in our awareness 10 or more years ago, has become one of great importance to the community. It is difficult to see how that quality of service can be sustained through a declining staff profile.

The bureau's assistant director of observations and engineering, Dr Sue Barrell, has pointed out that the value of all Australian meteorological services to the economy is around \$2 billion to \$3 billion per year. In that context we think the bureau is excellent value for money. But any organisation has its limits and the bureau has been pushing up hard against those for a number of years. The funding increases in the most recent budget are welcome but, with climate change and extreme weather events, community expectations on the bureau will only grow further. Inevitably, we think that situation will create trade-offs between important services.

Long-term meteorological forecasting, which is the subject of this committee's concern, is a vital task for the bureau and will only become more so. One of our concerns at the moment is that any capacity in that area will come at the expense of other important services because of a lack of resources—for example, short-term forecasting, which is very important to the community and to the economy. We do not want to see an investment in this area—looking at the long-term impacts in relation to climate change—to be given priority at the expense of very important immediate services. We do not think the bureau will want to be robbing Peter to pay Paul in order to do the work that is expected of it by government and the community. We fear, or we know, that that is the situation at present. I will hand over to Monica to speak in some more detail about the particular pressures in the bureau.

Ms Long—One of the main things about which people talk to me, as their representative, all the time is the staffing pressure felt around the bureau. Around 50 per cent of the bureau's overall budget is spent on salaries for staff. So in a shrinking budget situation either we pay people less or we have fewer people to do the same amount of work. That is the reality. In 2007-08 it was a particularly bad year and there was so much pressure on funding that we did not have any new observers or meteorologists recruited. I work in the training centre and we run training

courses for new recruits, but in that year we did not run them because there was simply no money to pay those people, because they get paid when they do their training as well.

We did have a few wins with the budget this year. But I think those are more for project driven initiatives rather than for the general pool of money that would help pay for the bureau's core functions or for the staff to carry out those functions. We do certainly welcome that new money but we really need to have the money focused on maintaining our core functions. This has resulted in staffing pressures, particularly with roster reductions in operational forecasting areas.

In the Northern Territory, for example, staffing pressures reduced a 13-person roster down to an 11-person roster during 2008, but that workload remained the same. Because of the staffing pressures, particularly in the Northern Territory, they have completed a workload assessment to see how much time is actually needed to complete everything required on this shift. They found that forecasters need 14 to 18 hours to do their work properly but they have to shove this into a 12-hour shift. So these pressures jeopardise the quality of the service that is being output by those forecasters.

In Western Australia, as well, the roster has been reduced from 13 to 11 people. One person—previously there were two people—is responsible for all the aviation-type forecasting for about a third of the country, with Western Australia being one of the largest areas we have. In South Australia, again, a roster which previously had 10 people on it has now been reduced to about eight people. There has been further pressure to reduce that to seven, although the forecasters have fought this strongly. They believe eight is the minimum number needed to complete the jobs.

In Tasmania there have been two contractors used to fill gaps in the roster over the past few years. Sometimes this was for periods of about a fortnight and sometimes it was for several months. Contractors have also been required to fill gaps in the South Australian Severe Weather Section. Severe weather watch, such as for bushfires and severe thunderstorms, is one of the most high-impact things we deal with. We are relying on contract staff to come in and fill these gaps. Here in Victoria we lost one full-time severe weather position as well. This required some US forecasters to come in and fill those gaps over the past summer. So, in one of the worst fire seasons we have had, we had one less full-time position and backfilling from overseas staff.

So these are some of the pressures we are seeing in our operational areas and it is our operational areas that are getting the message out about what is happening in the short-term or long-term. Whatever the type of forecasting, these are the people who are talking to the community and informing people of what is happening.

Another area of concern for people at the moment is the observations area, which is also under threat from staffing pressures. The number of technical officers—both observers and engineering staff—has been continually reducing since 2003. In 2003 we had 560 technical officer staff, whereas now we are down to 476 technical officer staff as at 30 June 2008. So that is decreasing. We have taken some new technologies on board to help fill some of these gaps, but technology needs to be serviced—we need to have engineers who are able to go out—and it is a very broadly-spread network. If we do not have these people who can maintain these instruments then the quality of that information could be impacted upon as well.

Within Australia we have 17 global upper-air network stations, and they are particular stations which are part of our Global Climate Observing System. That is something that is a really important part of the worldwide network. It is a program that is supported by the World Meteorological Organisation, the United Nations Educational, Scientific and Cultural Organisation as well as some other organisations, to make sure that we have the information so that we can observe and see what is actually happening in our climate right around the world. That information is used not just for our own research purposes but also for climate research worldwide.

Those observations are critical, not just for observing the climate but also as input to the forecasting models that are going to be used for long-term forecasting, as well as those that are used for short-term forecasting. A model is fantastic and we certainly need research into improving what our models can do, but unless we have observations to input into those models then it is a case of rubbish in, rubbish out. If you do not have good observations to know exactly what is happening now, you cannot expect to have a good understanding of what is going to happen into the future.

We also need those observations to be able to, after the fact, ground-truth the models. If the modelling is saying that it is going to be wetter in the next three months then we need to have the observations to be able to say, 'Was it wetter or was it drier?' It is used for verifying the models, as well as initialising the models before they go on. Of those 17 global upper-air network stations, five of them—Learmonth, Broome, Woomera, Townsville and Lord Howe Island—actually face a reduction in the number of qualified bureau staff who are going to be working there under a current observations reconfiguration plan, and that observations reconfiguration plan has been brought about because of staffing pressures.

We have certain equipment that can take some things and we are always looking to improve those technologies, as I said. But the number of observers that we have is just getting lower and lower, so people have to be spread around this network in a more efficient way. If we had more money to support these then, in an ideal world, certainly at these particular stations we would have the highest staffing level required to do the duties to the proper level that we need.

I have talked mostly about staffing pressures and how that is affecting the operational parts of the bureau, particularly in short-term forecasting, which also leads into long-term forecasting, as well as our observations. My other point is about innovation within the bureau. With these staffing pressures it is very hard to be innovative, because you are so busy doing every other job you have to do that you do not have time to contribute to the general direction of where things should be going.

We do not necessarily have those opportunities to do things better, because we are just catching up with what we have to do on a day-to-day basis. The bureau as an organisation has some really talented people and we want to make sure that we keep those people. Unfortunately, particularly in the research area, a lot of the jobs are non-ongoing. So people might be there for a short period, but they do not have the job security to say: 'Yes, I'll be here for a long period of time. We can really look at ways that we can improve this.' That turnover impacts upon the skill and the knowledge levels of the staff, because people do not have ongoing job security.

We need to make sure that the overall directions are being influenced by the people who are doing the operational jobs day to day, talking to the people out there, taking the observations and explaining the forecasts. They are the people with the expertise about what is really going on and they need to have the time, first of all, to have a say in that broader context, as well as the opportunity to influence those kinds of decisions.

CHAIR—Michael, would you like to make some comments?

Dr Borgas—Yes, and I will be quite brief because mainly I want to support the position taken by the CPSU and the bureau. I would highlight that the CSIRO perspective is mainly coming from the research side, not the operational side, of things. I full endorse all the statements made about the importance of operational issues and that there be proper resourcing. In particular, the science point of view which emerges out of the CSIRO would be very strongly supportive of the need for quality long-term observations maintained with as much integrity as you can possibly afford. It has been quite pleasing for us to note some of the investments made in the budget around ocean observation, around a renewed program of space research and space observation, around new computing infrastructure and also around some operational facilities, with new investments in the bureau for radar observations. Those things are all very important at the research level. But I would have to say that the proper resourcing of routine observations for the bureau is something that should not be neglected in the race for research innovation. Such things have got to go hand-in-hand to get the best out of the system. We do need a lot more people for modelling, particularly if you want to develop proper medium-range forecasting, which is very early in the innovation and development phase. There is no other way to do it other than by having more people trying out lots of things using all the observations and having increased observations and developing the service to improve on what we have. That is where I will finish my opening statement.

CHAIR—Thank you for that. I think you have all presented a very comprehensive picture of what goes on in relation to operational shortages. That has given us a pretty good idea. Most of the submissions have been dealing with the new science, with the dynamic modelling and with issues such as a lack of resources, even of human resources, with the lack of those being an inhibitor to perfecting our models and our understanding. So it is quite interesting that this afternoon we are presented with what appears to be the reality on the ground in relation to the operational side of the bureau and of the CSIRO. How serious is the problem? Why has it developed to the point that it appears to be quite serious? How does it get addressed? Is that being compromised by the focus on the new science and on the funding for trying to grasp the new innovations, at the expense potentially of staff expenditure? I am trying to understand where it is going.

Dr Borgas—I would be happy to give one answer, and again I would support the CPSU in their campaign for quality public services. This all goes to issues like efficiency dividends, which have been driving all organisations, including the CSIRO to a lesser extent, over many years. It is a culture that effectively innovation will enable you to provide services cheaper every year when in an area like this constant research and trying out new technologies and new innovations do not make the job any cheaper to do. They enable you to do a better job and get a better understanding of the world we live in—and all that costs more money all the time. So the pressures are enormous. When you see that the budget of the bureau is 50 per cent salaries, that would be very nice to have for an organisation like the CSIRO, but what it means is that there is

a tremendous investment in infrastructure to gather data and to process the data. That infrastructure gets very expensive. Year in and year out there are new and better ways of doing things. If we are prepared to take services of less quality we can backslide and provide what we have cheaper every year. But I do not think anyone is really prepared to have poorer meteorological prediction and forecasting services.

The reason it has arisen, I think, is a cultural one which we have been labouring under for a long while, at least in the smaller agencies. There was a parliamentary inquiry last year that highlighted the trouble that smaller agencies can get into under the inexorable drive for constant efficiencies, in the belief that that is how systems evolve. Well, other systems, particularly in the science area, evolve in slightly different ways. We know our equipment will get more expensive every year. We are always faced with having to try to do more than we can do with our budgets, and sometimes things just grind down to a state where they are not functioning as well as they can.

Ms Long—People are always expecting more of the bureau, never less. The people who work for the bureau love their jobs and they want to give more and do the best they can. So this pressure builds up and builds up and builds up where fewer people are doing that work and going the extra mile because they want to do well and to provide this good service for the public. I think the main thing is that the efficiency dividend cutting into core funding year after year after year has led to the budgetary pressures which therefore lead to staffing pressures. That is my view, in a nutshell, of how it has come about.

CHAIR—Do you want to add to that, Louise?

Ms Persse—No. I think Michael and Monica have covered that very well.

Mr SYMON—I have lots of questions. You mentioned the increase in this year's budget for various project related items. Did that cover an increase for current staffing costs as well or was that just left to one side?

Ms Persse—There are a couple of new projects: next generation weather forecasts—

Mr SYMON—That was ACCESS.

Ms Persse—and the strategic radar enhancement project. There is a small increase that is called 'additional funding' which seems to be related to the possibility of the bureau retaining revenue, which it has previously tipped into consolidated revenue, from services provided to the aviation and defence sectors. That is an additional \$16 million. We are not sure exactly what that is slated to and how far that will go to address some of the shortcomings; that is a discussion we want to have with the bureau very shortly. We do not know that that will go tremendously far in the stretch that we have, but it is certainly welcome.

Mr SYMON—As I understand it, you have still got the standard efficiency dividend applied this year, as have just about every other department.

Ms Persse—That is right. We have certainly seen no indications that any of these staffing pressures are going to be ameliorated soon. Additional funding is always welcome and we are

conscious that some parts of the Public Service have experienced a significant cuts while the bureau has got a small increase in staffing of, I think, 25. But as Monica has outlined, and Michael has alluded to, the bureau has an ever-increasing range of functions which are expected of it, particularly in relation to the concerns of this committee, as more and more emphasis is placed on hydrology, climate change research and so forth. In terms of the link between that work and the observations and forecasting done every day, from our point of view there is tension around how those things fit together because the one relies on the other. In order to do the longer term work we are seeing a squeeze on other areas, as well as that work itself not being funded in a way that allows people to do it properly. The project basis of the funding also means that it is quite a problematic area in terms of the organisation being able to retain those skills and knowledge and develop a base of understanding around these matters, which are not going to be solved immediately. If there were a quick solution that would be lovely, but I think everyone accepts that you need really skilled people whose work is dedicated to this research. The mode of engagement for many of those people is contracts of probably two or three years; that would be the standard. While I am sure a working scientist would be happy to score a contract with the bureau, it does not really allow that person to develop expertise in that field on an ongoing basis or for the organisation to develop—

Mr SYMON—You get into the job each day rather than looking ahead to the next decade with the one project?

Ms Persse—Yes, I suppose that is so. I assume that that group would be working across various parts of the research sector, whether that may be CSIRO or the bureau or the tertiary sector, but, in terms of an organisation or a group of government organisations developing a real expertise and a research base on these matters that will see us into the future, that form of funding is very problematic. If you get 18 months through your two-year contract, you are looking for another job at that point, so it is very difficult for individuals and for the organisation to sustain an ongoing interest in these areas on that basis.

Mr SYMON—One of the points you touched on there was there is more expected from the bureau with regard to long-term forecasting and climate change patterns. Has there been recently any step up in the budget to the bureau to perform those functions, or is that all coming out of the same pot of funding that has always been there to do what was, up till recently, the daily job of the bureau?

Ms Persse—I think that is all coming out of the same thing, that same money. We have always been responsible for talking about forecasting, whether that is long-term or short-term forecasting, and we have had a seasonal climate outlook program that has been in place for a while now—I am not sure exactly how long. But the expectation is that that will continue to improve, and that is just part of the core functions of the bureau, coming out of the National Climate Centre. That is their operational part, to talk about what the current state of the climate is and what we are expecting for the near future—except I guess people are expecting always better and higher quality services.

Dr Borgas—Yes. From the research point of view, which I think goes a little bit to that question, the decision was made to form CAWCR as a joint venture between the bureau and CSIRO, to consolidate effort. Part of that involved ditching the legacy models that were there—that is the strategy that was employed—and taking a new system on as a way of getting a step

change in capability. So, while there is some additionality there in getting that step change, the way that was achieved was by trying to ditch legacy models overnight and go to a new system, which, from a lot of CSIRO scientists' point of view, was a bit disappointing because there is no overlap there to do side-by-side comparisons to get a proper handover to a new technology. I think simply the cost pressures meant that they tried to achieve an outcome within the budget parameters that they had. Essentially the way that was achieved was by cutting off legacy models scientists may have worked on for decades, where they knew how the system responded and they knew what they could get out of that in a scientifically meaningful way. They are now expected to deliver a new system which has a greater planned capacity, but from the working scientists' point of view it was not always a satisfactory way to achieve that the expansion of capability.

Mr SYMON—I will ask one more question and then let Rowan have some, because I am hogging them all at the moment. I think it was Louise who spoke about the reduction of people in the observation area from 560 down to 476. Has that come about because of the conversion to automatic weather stations or are you actually losing skilled people out of those areas and you have fewer people to maintain them? Is it a combination?

Ms Long—I think it is a combination. These numbers have come from our annual reports. In our annual reports we say how many admin officers, professional officers and technical officers we have. These are staff from the technical officer category, which includes engineers as well as the technical officer observers. So, yes, it is a combination of the people who actually perform the observations, which also includes people who work in head office who manage the observations program and do development in new technologies—they test the new technologies before they are implemented and that sort of thing—as well as the people who are out in the field actually maintaining the automatic weather stations, the radars and all that other equipment. It is a combination of all those people.

In particular, I know that a lot of new automatic weather stations and new automated equipment has gone in over the past decade. A lot of that has perhaps replaced the cooperative observers who are not actually staff employed by the bureau. But a lot of the new observations reconfiguration plan that is on the table at the moment is about replacing human observers, bureau trained observers, at their stations. So that number has been constantly decreasing—particularly, I would say, in the last five years.

Dr Borgas—I would like to make a follow-up point here, which I discussed earlier with Monica. It was indicated to me then that they are attempting a program of multiskilling the observers so that they can do some of the routine maintenance on the equipment. I have seen that sort of thinking in the CSIRO in the maintenance of high-end scientific equipment where they have tried to cut corners. It can be a false economy. The real value of some of the highly trained people looking at equipment and servicing it regularly is in spotting problems when they are minor. It takes a lot of expertise to do that. They might not have to make serious interventions on a day-to-day basis but if they spend years looking at equipment they have enough skill and understanding to detect problems before they become catastrophes, and that is a great efficiency in the system which is hard to capture.

It is a false economy, and I see it a lot. You just cannot afford to cut corners like that. Expensive equipment requires dedicated people with a lot of knowledge to maintain it, keep it

running and keep the integrity at the plant level. You cannot find that as an efficiency, particularly if you try to cut corners by saying, 'We'll buy better equipment. It should require less maintenance. We can train our operator to just change the oil or whatever, and she'll be sweet.' Sad to say, that thinking does operate in organisations. But I have to caution against that and make sure that I put in a word to support technical people on the ground, who probably are not recognised enough in organisations and can sometimes bear the brunt of the costs and have workloads shifted onto them, which ultimately causes a lot of problems for the organisation. It is a long-term, insidious change. I always feel that technical people should get more support and recognition. That has been a statement from my little soapbox.

Ms Persse—I might just add something to that in relation to the observation stations, which I think was the background to the question. According to the information I have about the observer reconfiguration, 160 of those technical staff work across the 50 stations that are staffed. About 140 are permanently located at one station or another, and the rest are relief staff. They move around quite a lot, as you can imagine, because people need to take leave and they get sick. Last October, which is when these figures are from—and I think the situation remains the same—most of those stations had between two and five employees. A proposal of the bureau is that 23 stations each be staffed by a single trained observer. That obviously goes to the points that have been made about the staffing needed to cover those areas, even with our improved equipment.

Our members who work in that area have a range of industrial concerns. As you can imagine, these stations are spread across the country, so it is not like they can be redeployed from one section to another in a city office. So there are those issues for them and of course you would expect that we would hear about those. Those industrial issues at single-person stations include health and safety. Our members who work in this area and at the bureau generally, as Monica has said, are very passionate about their work and they have a range of very strong concerns that they have asked us to represent on their behalf about the integrity of data collection.

It really concerns them that some of the changes being made in this area are going to mean that data is not as good as it could be. As we have outlined, that has impacts when you are trying to do your long-term science and check your previous hypotheses. This is an area of considerable contention for our members and we have had discussions over some time with the bureau about it, and those are still ongoing. This is a clear example of where those funding pressures are biting.

From the point of view of management, they need to look at where they can make some savings to do all of the things that they need to do. This is where the savings regime takes them and it is an area of great concern. I have to say that when we raised this issue last October I had never had so much interest from a large number of local media representing local issues from around the country—every regional radio station and local newspaper—reflecting the concerns of regional and rural communities about this particular issue.

There was an intense level of support for the work that the bureau does in those communities and there was concern that the immediate role of observation and the provision of information to local communities would be affected. There was also quite a lot of appreciation of the longer-term issue of data integrity and collection. So there is real community interest in this aspect of the bureau's work and an increasingly sophisticated understanding among the community about

these issues. People want a reliable daily, three-daily and weekly forecast, but they also see that the work that is done is critical to improving our understanding of the challenges that we face in the community in relation to climate change. That is a big issue for us.

Mr RAMSEY—I had questions about the observers too, but you have largely answered them. To clarify, the observers you lost are not of the part-time variety, are they? These are full-time positions that are associated with the manned weather stations.

Ms Persse—These are full-time positions, yes, and it has not yet occurred. There are three stations that are down to one staff member already.

Mr RAMSEY—I think I have one in my electorate and another about to become one.

Ms Persse—You may well have. It is a plan that has not yet been implemented, but it has been under discussion for some years now.

Mr RAMSEY—This morning we had some evidence given by some people in the professional scientific community who were concerned about their ability to link into Bureau of Met and CSIRO programs with their scientific studies and research—testing the barriers and whatever. This feeds back into your belief about a strong, independent one-stop shop, basically, for this level of government funded research. But their concerns were about the silo mentality—the university sector finds it difficult to access the good computers in the Bureau of Met and to have input into those programs. One of the suggestions was that we could perhaps have a meteorological CRC. So it was wide ranging. I am just wondering, with your expressed commitment to a one-stop shop: does the way it is set up isolate other thought processes and more intellectual horsepower that we would like to feed into these programs?

Ms Long—I am not in research but I use the output of what the researchers do, having worked in operations myself. One example I can think of is the bushfire CRC. I used to work in the severe weather section and we would use a lot of the outputs that came out of different research that was done by the bushfire CRC as a model for getting information from all different sorts of agencies. That collaboration between different agencies is certainly something that I would encourage. I do not think it is an idea to try and exclude other people.

Mr RAMSEY—Do you feel, though, that it is happening at the moment? Is that your perception? It was not the perception coming from the people we spoke to this morning.

Ms Long—I do not know that I could speak about that. Maybe Michael, being more in a research area, would be able to.

Dr Borgas—I can make comments about this, and I already have in a sense around the forced phase out of legacy models. It is an approach to reduce all the diversity, to focus the effort onto the ACCESS model. There would be people that would question that strategy overall. The committee has had evidence from people arguing for the community models in the US as alternative approaches, compared to the approach that we have now with the Hadley Centre model licensed to be used with some models that we integrate in here as our research effort. But that is a sort of closed innovation loop, if you like, and I can see that it was difficult for other

people to get into and to exploit the diversity of science, which I think maximises the chances of good innovations coming along.

Mr RAMSEY—I think that is really exactly what they were saying.

Dr Borgas—That argument is there. It is not actually debated a lot internally, I think to working scientists' frustration, because it has purely been a management issue of how to deliver this service with the resources that are available. I cannot criticise them for that. If the powers that be decided that we were going to have a joint venture, consolidate with one Australian model and deliver the forecasting services and do it with this amount of money then something would have to give. Personally, as a scientist I think it is a risk to take that is maybe a risk too far in the long-term because there are other innovations that will come from outside of that loop that will take a long time to break through and be adopted in a very bureaucratic sort of process. But the people that have the responsibility to deliver things and to manage the resources may not have had very much choice in this matter, and I think that some consolidation of models was warranted in this country. With the choices that are made, you will have to wait and see, I guess—the proof might well be in the pudding. But it is certainly a risk and I think for the universities I can see that it is not an easy market to break into, if you like.

Mr RAMSEY—Are there any particular risks with that ACCESS model that you see as a weakness?

Dr Borgas—The difficult is going to be getting enough resources to do all of the climate processes properly. I think the ACCESS model is already successfully doing single forecasts with data assimilation, which was really part of the main driver for the change—to get that capability into Australia for short-term forecasting. That has been delivered, and the short-term forecasts are improving and are really world competitive. That needed to happen, but that is only for short-term forecasting. To go on to the other processes, where you worry about climate and the longer term properties of the system, a lot more resources and manpower are needed to bring that model up to speed. I think that is what the researchers would say. So, having gone down this path and committed to having a model that does those sorts of forecasts—essentially having to build it and having to migrate it onto new computing platforms and arguing for enough resources to do all that—it is a fly by the seat of the pants affair at the moment. If you had unlimited resources you could try it on, but it could all just fail.

Mr RAMSEY—So you are expressing some scientific concerns here? So you are actually saying that we might be riding the wrong horse or going the wrong way around the track?

Dr Borgas—That is certainly a possibility. I think one of the real concerns is the difficulty that people have in working with the model that has been chosen. That is in contrast with the other approaches that are operating in the US, which are more around open-source types of models which have risks of a different sort attached to them. It is not clear, and I did not have to make that decision so—

Mr RAMSEY—We are all fervently hoping we have got the VHS model, not the one that starts with 'B'. Just on something else, Louise, you were talking about three-year contracts. In the community that I come from there is great frustration that we do not have a long enough period for people to really get into it. In fact, at the end of about 18 months they are starting to

look around for their next contract. That might well mean that you lose that person after two years. But I think that to go fully to the other position, whereby we actually give permanent tenure in an ongoing position, also has limits as to research capacity because you get stuck with dead wood and people run out of ideas. In the scientific communities you do need people moving around to make it all happen. I have always advocated a five-year contract, which I have always thought would be better. But, given that governments tend to be three-year arrangements, we are probably not going to change the world overnight. I wonder if you would like to reflect on that, because in my mind there are difficulties with giving people permanency.

Dr Borgas—We have grappled with that issue in the CSIRO for a long time. We have campaigned on this from a staff point of view for a long time. The argument you make is fair, but the problem is the culture that emerges in organisations and the risk aversion of management. If you are prepared to take a risk as to people, then more likely than not it will pay off, but for whatever reason people cannot bear the dead wood argument. I will get back to the point that we fought for a long while in our organisation to get more equity for term people, so we got severance payments for them and other conditions. In effect, they became the equivalent of full-time employees if you wanted to get rid of anyone at any particular time. So if a person was on a three-year contract and that came to an end they were entitled to a severance payment so they may as well have been ongoing. Even with those cultural changes, the management position was still to churn staff because of risk aversion. It was sheer stupidity because the cost of recruiting new people and integrating them into an organisation was almost a year's full-time salary. So there was this massive inefficiency in the system. At any time you can get rid of dead wood with all kinds of processes and procedures that we have agreed to in our organisation. In fact, it becomes a matter of management laziness not to implement proper performance processes. So to shift all the risk to short-term contract staff is, in my experience, probably one of the worst sorts of management responses that I have seen in my time to try to keep renewal and performance going in an organisation. I cannot see any strong arguments for doing it as an official across-the-board policy.

There have always been special projects that have come and gone without an ongoing need. But to have a culture in our public service organisations, which you know are going to deliver services for ongoing needs in the long term, you want to have efficient management processes that deal with people fairly and equitably and do not force any more churn than you really have to have because it is a tremendous strain on organisations to have to stop projects, recruit new people, restart the whole thing and away you go on the merry-go-round.

I do not want to be accused of arguing for just sinecures for life, as I have been accused of doing from time to time. That is an evil to be avoided as well. We have had a very strong policy in the staff association for many years that the interests of new starters and short-term contract people should be addressed fairly urgently. Everyone would be a winner if we were able to manage people better and not have unnecessary churn—we need to just manage that risk in keeping things moving and alive.

Ms Long—I know that there are a lot of people who work in our research centre who have been there for many, many years, but have been employed in short-term position after short-term position. The amount of time and effort required in the recruitment process and all that is so detrimental to the whole thing when they could be just doing their job as they should be doing their job.

Mr RAMSEY—It is my observation that, by and large in the sector I am dealing with, good people do get the new contracts and they move hell and high water to make sure that they keep them. I have always thought that three years is too short and I would have thought that five or even six years would be better use of that. But you would argue for longer.

Ms Long—I guess it also depends on the nature of the project and I think that, as you identified, the three-year cycle has a particular logic around the electoral cycle.

Mr RAMSEY—Yes, it is probably fairly illogical full stop. But I know how we got there.

Ms Long—That may not equate with the research requirements of the problem that you are investigating. I think while it may be the case, and would be the experience of many of our members, that they do get the next contract and maybe another one after that, you run the risk that at some point they might get jack of that and you lose your experienced staff member because someone makes them a more attractive offer or they decide to do something else. It is not a good base for developing that long-term expertise that some of these problems warrant. We appreciate that sometimes project funding may be the basis on which these decisions are made and there are provisions for that in the Public Service Act, such as the terms of appointment and so on.

Mr RAMSEY—I did mention in passing earlier today the option of a CRC, where you have 70 contracts presumably because you can go out to hunt people down and tie them in for a period of time.

Ms Long—That will always be an aspect of working in this sector. From our point of view, it is an industrial concern for people as most people want to have security at their work, to know where they are going in the longer term and to have that option. It is also a concern in terms of the quality of the work that the organisation is able to produce if both individuals and the organisation do not have that longer-term capacity to plan what they are doing. I think it does create difficulties.

Dr Borgas—A slight innovation in our last enterprise agreement, which goes back to the point again, is that we now have five-year reviews of staff at a lower level in the organisation—five-year reviews have been operating at a higher level—and that does not win us any friends of our members when we implement those sorts of changes. But, on the whole, the science community recognises that performance has to be a key part of the whole deal, and I would still argue that it is a more efficient way of dealing with people. If you are managing people properly and reviewing performance and setting directions, people who know they are not performing are likely to move on anyway. But, if you have a hard contract, I have seen it turn out to be just so inefficient so many times. People use the last year of the contract, even if it is the fourth or fifth year of a five-year contract. It is still a huge inefficiency in the system compared to proper review and workforce planning and minimising the use of contracts. We have a lot of support for that basic position from the membership and even among managers, I suppose, in the organisation; they can see benefits in that. But it is a never-ending battle to maintain that position in the fight because of the culture of using short-term contracts, which I find particularly galling in a long-term science organisation.

Mr SYMON—I have one more question. You have spoken about significant changes within the organisation in terms of who does what, and when and where. As an employee organisation can you tell us what type of consultation, discussions or involvement in those decisions is out there for the members or for the union as a whole. Is that a process that is driven from the shop floor or is it totally management driven?

Ms Persse—I think what our members in the Bureau of Meteorology would say, and have said, is that they would like to see more consultation in the early stages of decision making, prior to a direction being set. The bureau is always very assiduous, I would say, about meeting its requirements to consult around the industrial impacts on members, so it is consultative in that sense. But what our members would like to see is more opportunity to have a say early on, to provide ideas and to have the capacity to contribute to and develop those ideas in the way that Michael was describing earlier. People always have a lot of good ideas about their work. Our members are doing the absolute front-line work in the bureau and sometimes feel that a decision is made and there will then be discussion about what the implications are for individuals and how it perhaps might be done, but they have not necessarily had any involvement in the lead-up to that.

A joint steering committee has been established on the Forecast Streamlining and Enhancement Project, and we are pleased that that now has a forecaster on it; it did not previously. It always had a senior manager on it. That is a new development, to have a front-line person on a committee like that, and we would like to see more of that kind of engagement so that our members are able to contribute. They really want to do good work and they have got lots of ideas about how things could be better. They are very conscious of the resource constraints and they have got ideas for improvements, so they would like to be able to contribute.

Ms Long—I would say a lot of people feel that decisions are made and then they get consulted about how to implement those decisions, rather than being consulted about making that initial decision in that place. So that is one thing that I think a lot of people, particularly those on the front line in operational areas who are going to be doing these things, feel that could be done better and improved in the future.

Dr Borgas—That is, I have to say, an issue with CACWR as well, with the senior management levels there and the level of expertise in forecasting. It really is an opportunity to have more input from high-level scientists, which has not been the case up to this point.

CHAIR—Thank you for appearing before us and thank you very much for your very comprehensive insight.

Resolved (on motion by **Mr Symon**):

That this committee authorises publication of the transcript of the evidence given before it at public hearing this day.

Committee adjourned at 2.40 pm