



FACILITATOR: Ladies and gentlemen, Brad is a genius. Brad, I'm asking you if you could award one Kit-Kat to the Governor, and the rest you can share randomly up near the back of the room. But can I just tell you – if you'd like to sit back down again, ladies and gentlemen, a round of applause for my mate, Brad.

And I have to admit, I do feel envious when he just leaps down like that, I honestly can't do it, but that's just facing the humility of aging. But I just want to tell you, this Governor, I just want to tell you how committed she is to high heel shoes and to grooming, because not that long ago the Governor had a fall and had quite a major break and had to have major surgery, and within six weeks she was back in high heels at the Sydney Gay and Lesbian Mardi Gras. She then gave herself to that silly dance with a little bit more enthusiasm than was required in all the circumstances.

Well, ladies and gentlemen, we will be climaxing the end of this opening session of our conference with the Fruit Bats, and the Fruit Bats are getting ready out the back. If you don't know about the Fruit Bats you're in for a tremendously entertaining surprise, but I'll tell you a little bit more about the Bats later, but we will be climaxing with the Bats and then moving back to our original registration area for a reception where there'll be even more entertainment, including a man with clowning skills, but don't be afraid, I have checked, there is no red nose involved. I just feel that's going too far, but he evidently has a ferret. I don't want you to be frightened by this. There will be a funny ferret that also prevents cardiovascular disease a little bit later this evening.

But now it gives me great pleasure to invite our first keynote speaker to the stage, Professor Tony McMichael. Tony is the Director of the National Centre for Epidemiology and Population Health at the Australian National University, but even more interesting, when he was a boy he went to a place called Naracoorte in south-east of South Australia where he drenched and crutched sheep. He's evidently going to incorporate sheep crutching in his presentation in some sort of unique epidemiological way.

Also as a boy he caught and hauled sheep for the shearers and took hay into the paddock, so whatever happens next, we know we had an honest job as a child. Ladies and gentlemen, please welcome Tony McMichael.

Climate change, prolonged drought conditions and health: implications for rural Australia

[Tony McMichael](#), Professor and Director, National Centre for Epidemiology and Population Health, Australian National University

Well, thank you very much for the introduction, Julie, and I was delighted to hear you get the phrase, "sheep crutching" correct. When I discussed it with you briefly you repeated it back to me as "sheep crunching". It sounds like the sort of thing you do with a rather overcooked barbecued lamb chop. Where are you, Julie? I was going to have a go at jumping up but I'm afraid I expended all my energy on the jiggling, so I've had to forego that.

But, your Excellency, other distinguished guests, ladies and gentlemen, it's an honour to be speaking in this opening session, and it's an honour in two senses. The usual sense, that one is speaking in the opening session of a major national conference, but also in the sense that I don't professionally have a strong even a very perceptible connection with rural health. I'm in the company of many people, much engaged over a long time working with, working in, rural communities, and in that sense it's an honour for me to be asked to give this talk.

Julie's mentioned that I'm an epidemiologist. I should say at the outset also what I'm not because I'm going to be talking about climate, climate change, the possible relationships to drought, the prospects for future climatic conditions in this country. I'm not a climate scientist, but I have worked very closely with them over a number of years. I've been much involved with the work of the United Nations Intergovernmental Panel on Climate Change, particularly co-ordinating the assessment of the health

risks from climate change, and within that very multi-disciplinary context I've had a lot to do with not only climate scientists but very many other interesting disciplines, of course.

So, in this talk I'm going to touch on these five themes, and I just draw your attention particularly to— I'm going to have to use the mouse for this because there are two screens. I looked for a laser pointer and then I thought—some of you may remember James Galway who was able to play two tin whistles, one out of each side of his mouth like that, and I figured one day a conference presenter is going to turn up on the podium with two laser pointers, but it's not me so I'm going to use the mouse.

But the third and fourth items here I particularly want to focus on because that's where I want the presentation really to converge, but I do need I think to try and present some background as to what we know or think we know about climate change and its implications for human health.

But in saying that, I should mention two other disclaimers: that we're not talking about certainties, we're talking about a very complex phenomenon about which we've still got some things to learn, but we are talking about things that are understood with increasing certainty and about some things that now seem very probable.

Nor do I—in anything that I wish to say about the risks to rural health—want to detract from the resilience and the capacity of many of those communities to cope with adversity, but the prospect of long-term drying is actually an unprecedented adversity.

Now, I've got about 20 slides to show, it's about one each minute. The other privilege I have in speaking in this session is that you haven't yet developed slide fatigue. These will be the first slides that you've seen. A couple of them are just a little technical, but all the detail doesn't matter. Some of you will be interested to know a little about the state of knowledge with respect to climate change, globally and within Australia, and I do want to give you at least a sort of passing summary of where the story is at.

Doubts about the reality of human-induced climate change have now largely dissipated. The process is complex and some uncertainties persist, but the basic science is well understood. Well, in the spirit of healthy science some scientists still dispute detail, a dwindling and an increasingly marginal minority disagree rather—interestingly, a recent all-inclusive survey of 928 published peer reviewed scientific papers found that none rejected the reality of global warming.

Now, this is one of the very few rather technical slides, but the Intergovernmental Panel on Climate Change has just begun to issue its fourth assessment report. These come at five year intervals, and this was from the work of working group one updating the science of what we know about climate change and the extent to which human actions via the emission of greenhouse gases are contributing to it and are likely to continue to force that process over the coming century and beyond; it doesn't stop at 2100.

You see here some of the results for three of the six scenarios of plausible future greenhouse gas emissions in the world at large, depending on various assumptions about population growth, economic activity, technology choices and so on. But I think the point to note in particular is that out there on the right-hand side is the estimated range of temperature increase for this coming century now represented across those six scenarios, and the range is 1.8 to 4.0 degrees centigrade.

There's uncertainty, yes, but there's less uncertainty in this estimate than in the previous third assessment report estimate. The science is getting tighter. We understand better the details of how the climate system responds to a change in atmospheric composition. There's still a lot of things that we can't know, of course, about human societal futures.

We're not just talking about increases in average conditions, and I should have also mentioned that those figures apply for the world at large as an average, but of course, there will be regional differences in warming. The land masses will warm more than the oceans and temperature increases will increase with distance from the equator.



But variability is also expected to play an important part in this story and you've already heard mention I think of this particular event in Canberra just a week or so ago, an extraordinary hailstorm with golf ball sized hailstones covering the streets and denting the car roofs.

The other thing I should say is that it's a reasonable assessment to say that the IPCC's recent report is probably a bit conservative. Firstly, the only admissible science was that published up until late 2005 and things have happened since then, and that includes quite a bit of research more recently showing some upwards tilt in the rates of greenhouse gas emissions and global temperature rise and the rate of ice melting and sea level rise.

So in place of further procrastination we really need to get serious about this challenge. The primary task, of course, is to reduce emissions. However, since anyway the climate change genie is already partly out of the bottle we must also devise ways of adapting to or lessening adverse impacts.

And I just want to show here a schema of how we might think about the research needs. On the left what you might refer to as primary research. We need to understand how climatic conditions affect human health outcomes, and with respect to climate change we're in a position now to begin to observe some of those impacts in some parts of the world, and particularly we need unusually to pay a lot of attention to trying to foresee the range of risks over coming decades. That then puts us in a position to move to applied research on the right-hand side. Of course, the primary public health obligation is to reduce or eliminate the exposure, and that's what we call mitigation, reducing emissions, but anyway we're going to have to introduce adaptive strategies to lessen the risks to health.

The impacts of climate change will encompass more than we initially recognised. Much of the early public discussion focused on the need to keep the economy ticking over, to protect infrastructure, and maintain tourism and recreational facilities. The real problem though goes much deeper. Climate change if not constrained is ultimately a biological threat, a threat to health and life on earth, and we've been rather slow to grasp this fundamental point.

Many studies have documented how warming is now affecting physical and biotic systems; ice sheets are melting faster than was expected just five years ago. Long-term drying is emerging in southern and western Africa, southern Europe, India and Australia. The seasonal cycles of birds, bugs, bears and buds are changing and they're getting out of kilter with one another. So this sort of evidence that climate change is disrupting earth's life support systems means that human health must also be at risk

Now, this is a rather cluttered slide but it's a sort of quick summary of the major categories of pathways via which climate change would affect population health. At the top is the most obvious category, the direct impacts of things like more severe and frequent heatwaves, floods, bushfires and so on. That second category referring to indirect processes mediated via disruption of biophysical and ecological processes includes, for example, changes in the generation, the dispersal of various air pollutants and aero allergens, fungal spores and so on, freshwater supplies.

Changes to biological processes and their timing and nature, to do with, for example, mosquito numbers; crop yields; photosynthesis; changes to whole ecosystems; ocean fisheries and so on, all of those obviously have potential to affect human health. And then the third category, more elusive, hard to quantify, potentially very grave, arising out of these and interactions with other processes relating to changing patterns of land use, population pressures, other demands on freshwater supplies, biodiversity losses and so on, the sorts of social, economic and demographic disruptions, not just in parts of Australia but in the world at large, and particularly probably in the Asia-Pacific region. So you can imagine a whole repertoire, a diverse list, of risks to health arising.

Expert assessments concur that at least initially the risk will be greatest in – though certainly not confined to – poorer and vulnerable populations, and many of these are in tropical and sub-tropical regions. In Australia climate change will cause increases in death, illness and injury from heatwaves, storms, floods and bushfires, as mentioned.

And here I just summarise some work that we did with CSIRO atmospheric research a couple of years ago, we did it for capital cities, and that's interesting to mention at this conference, all the work to date

on heatwaves and heat-related deaths has been done in urban populations, that's where the easy statistics are, the big numbers, and that's where you have a first look.

For Sydney you see the projection that we've made, and it's a bit heroic, looking out to 2100, but for a low emission scenario we foresee an approximate doubling in the rate of heat-related deaths in persons aged over 65, and for a high emission scenario, which hopefully we won't come near if we can get our act together internationally, a very much greater increase in that rate of heat-related deaths.

Heatwaves pose greater risks to health in large cities than in small towns and rural settings, primarily because cities with their mass of concrete, masonry and asphalt and their lack of green space and ventilation retain heat and there's little overnight relief. On the other hand, access to hospitals for the ensuing heat-induced heart attacks, strokes or other health events is often easier in cities than in the countryside.

Climate change in Australia will also influence the range and seasonality of various infectious diseases. For example, outbreaks of the mosquito borne viral disease, dengue, will tend to extend southwards down both western and eastern coasts. And, again, these are some estimations we did with colleagues, including CSIRO, several years ago.

On the left you see the map showing where the dengue vector *Aedes Aegypti* mosquito could currently be – well, would currently survive. In fact, it's not present, or hasn't been present, in the Northern Territory because of great vigilance, although a couple of years ago they were alarmed to find that the mosquito was found in Tennant Creek, a bit further south than would have been expected, which may be an interesting tiny little signal.

But on the right you see the map of where the disease could be transmitted by this mosquito in 2050 for two different climate change scenarios associated with medium and high global emissions. It's not saying where the disease will be, it's saying where it could be, and at the very least it has great implications, of course, for public health structures and costs.

Elsewhere in the world there's an accrual of research findings which taken together I think suggest that there is already an emerging pattern of changes in infectious disease occurrence in response to the observed regional warming that's been reported, and this includes malaria and its effect on mosquitos moving to higher altitudes in some regions. Tick-borne viral encephalitis moving northwards in Scandinavia in association with warmer winters. Increasingly regular summer epidemics of coastal oyster bed contamination by the diarrhoeal disease bacterium, *vibrio parahaemolyticus*, now that the critical coastal water temperature has risen high enough, 15 degrees centigrade in cooler parts of the world. And the northward shift in the Shanghai region over past several decades of the water snail, it's spread schistosomiasis in association with a northward shift in the winter freezing zone.

Changes in climate will also impair various ecological processes that underpin the health of human populations, and crop yields, for example, will be affected by changes in soil moisture, pollinating insect activity and temperature sensitive photosynthesis. Recent research, particularly in the Asian region, shows that rice yields decline with warmer temperatures. Such changes in local rural food production, and hence prices, will affect food choices, nutrition and health, including child growth and development.

Now, let's look at Australia's recent drought, the severity of this has raised this other worrying longer term prospect and the next three slides will summarise the background climate trends over the past half century and then the past half decade. And here's the map for temperature trends since 1950 in Australia from the Bureau of Meteorology, and with one exception in the north-west you can see that temperatures have been increasing.

The legend on the right is showing us degrees centigrade average for that region – degrees centigrade increase per 10 year period over the last half century. And here's the equivalent map for changes in annual rainfall in Australia over that same period, and a great disparity between – well, basically, between east and south-east and south-west on the one hand and the centre and the north-west.



Here in a little more detail just for this last very dry period you see the changes in rainfall, and again quite a contrast between very approximately the east and the centre and west of the country, but again note what's happening in the south-west in and below Perth. And for a number of those areas shown with the darkest red, those are the lowest rainfalls on record.

Of course, there are many natural phenomena that affect rainfall, and these are across a scale from days to decades, and we won't go through these, and you'll have heard of some of them, including particularly the El Nino Southern Oscillation, the ENSO phenomenon. But notice that there are, of course, very many natural influences. So it's not appropriate to ask, is Australia's current drought due to climate change. The correct question asks to what extent the drought has been influenced by the superimposing of human-induced climate change on natural climate processes.

The Australian Bureau of Meteorology concluded in 2006 that the underlying unusual warming had exacerbated drought conditions. There are several pointers to a likely influence of climate change on our drought, although uncertainties persist, and I've mentioned three of them here. There has been a relatively shared decline in winter rainfall in the south, and I'm going to say something a little more about that in just a moment.

Higher temperature affects evaporation rates, although that's a complex relationship, but depending on cloud cover and rates of temperature increases, soil drying can occur, surface water storage can be affected. And it's very likely, the climate scientists think, that higher sea surface temperature may intensify the El Nino events that are so influential on our droughts.

The latitude dot point at the top, climate scientists anticipate that climate change will cause geographic shifts in Australia's rainfall systems. As the world warms weather systems are pushed towards the poles, and indeed some such southward shifts may now be emerging over parts of Australia. While rainfall has increased in Australia's north-west since 1950 there's been less rain in the south, south-east and south-west, as we saw.

Now, a bit of detail here, but this shows us the main rainfall zones, and you can see the code down in the left. Of particular interest is the greyish category that refers to the winter rainfall zone, and the light colour over much of the centre is the arid zone, and then the dark pink at the top is the summer dominant – most rain in summer.

The question is being raised, are these zones now being pushed south by warming? Is that why much of Victoria is losing winter rainfall, critical, of course, for wheat production? And you would expect at the top end of the country a similar change with that pink zone being pushed a little further south, something that's happening to monsoon systems all around the low latitude world.

Much of rural southern Australia may therefore be destined for long-term drying. Recent CSIRO modelling indicates that drought frequency is likely to increase over much of Australia this century. An approximate estimate from CSIRO is that by 2030 there will be a 20 per cent increase in probability of drought over much of Australia.

On the international front a prominent paper of late 2006 projected an increase in the area of severe drought around the world over coming decades, especially in the mid latitude regions, such as southern Europe and southern and south-east Australia. And those results are here now.

I'm not sure, I think Minister Abbott might have left, is that correct? Yes.

You might note the name of the first author here at the bottom. I was going to point out to him that it's Burke E., not Burke B., and that the statistics are actually trustworthy. But you see there the projection for the world at large, and it's not a cheering one, is it? Now, again, the science is not perfect here but this is the best attempt to foresee the expansion of regions of drought, particularly in mid latitude around the world.

The issue, of course, is not just to do with formally defined drought events. The prospect is for a progressive drying in parts of Australia and this casts a long shadow over the outlook for rural

livelihoods and living conditions, including these sorts of processes that would affect farm yields. I won't go through those, but you'll be quite familiar with the ways in which climatic conditions I think can affect those sorts of critical processes, parameters.

Meanwhile, of course, some rural communities in Australia may benefit from localised increases in rainfall, although it's important to note that farming types and practices everywhere are finally attuned to prevailing conditions and changes in any direction can be disruptive, and anyway, warming is expected to occur pretty much everywhere. Rural communities that experience long-term drying are likely to suffer then a range of adverse health impacts because of environmental changes and because of economic and social stresses.

Mental health will inevitably be at risk, as we've heard. We know especially that this will be a problem in more vulnerable communities and families, perhaps where collective resources and resilience are relatively lower. We know from earlier studies and from ongoing programs of monitoring of mental health outcomes and service needs and service use of this problem. At this conference we'll hear a number of presentations bearing on this topic.

There's an understandable uneasiness I think about public discussion of suicide rates in rural communities. Nevertheless, there is widespread assumption that this is a problem associated with adverse economic conditions in rural Australia, yet rather little formal research has been done. During the 1990s several studies were carried out in different geographic regions, and these underscored the likelihood that suicide patterns are both complex across place, time and person and very situation-dependent.

Some recent anecdotal evidence, for example, suggests that particular communities, such as Swan Hill in Victoria, Sheffield in Tasmania, have responded to the recent drought conditions in ways that have ensured a high level of collective resilience and a sense of "We're all in this together".

Andrew Page and Lyn Fragar have shown for Australia during 1988 to '97 that suicide rates in male farm managers and agricultural labourers were higher than those for both the total national male population and the wider rural population. A subsequent paper published by Nichols and colleagues showed, or examined, how annual suicide rates in New South Wales as a whole varied in relation to annual rainfall averaged across the state. The limitations of this whole state approach are obvious, and this was explicitly only a first-cut effort. Nevertheless, even with these blunt measures an inverse relationship was observed: the lower the rainfall, the higher the state suicide rate.

While this association probably reflects in large part the experience of rural New South Wales, that rural relationship should now be specifically examined in time series fashion. Subsequent research should follow to understand better for regions experiencing different levels of drought conditions, the cause of it, and modifying factors at individual, family and community levels.

Well, I'm not going to go through these in detail because most of these have not been subjected to formal research, but I just want you to note the various risks to health that are likely to ensue from long-term drying conditions. Child health in particular, the second bullet point, sometimes is overlooked, and it will be jeopardised, especially in relation to emotional experiences, family tensions and the loss of community facilities for play and development.

In addition to this important focus on mental health and child emotional development, other health outcomes that warrant research are shown in this list. And note towards the bottom, the reference to some additional risks faced by remote Indigenous communities from the climate change induced loss of traditional plant and animal food species, and then the possibility, of course, of some benefits; apparently mosquito numbers are lower in parts of Victoria under these dryer conditions.

So, here we have a major research challenge. We need to understand the health risks, we need to understand how different patterns of community response can modify the impacts on health, and this will help us shape intervention strategies, social policies and health care. So, a national program of research on climate change, long-term drought conditions and health would encompass these categories of research, the first one giving us a running start from existing data sets to get the measure



of where some of the risks to health might lie. The second category, getting in there and doing more in-depth work, working with appropriate agencies, communities and so on, those that know the local landscape, and, of course, all of this pointing towards the development and the assessment of appropriate methods and levels of intervention of what I referred to earlier as adaptive strategies.

So, in conclusion, I anticipate that this research will have international significance as well. Australia, the world's driest continent, much reliant on primary production, now looms as the first major developed country to enter long-term drying conditions due to climate change. Research findings here will I think be of increasing research and policy relevance elsewhere.

Indeed, such health protecting interventions are now needed more generally in Australia. We should be developing adaptive strategies to protect all communities against the health risks from climate change, and this is a discussion that's already frankly pretty well advanced in Europe, Canada and recently even the United States.

So, in winding up, remember the basics of climate change and its risks, two things are clear. First, some degree of human-induced climate change has very likely already occurred. Second, more warming is in the pipeline from recent greenhouse gas emissions whose climate effects have not yet been fully realised. Yet for the moment we've not really understood the full biological and ecological import of this remarkable human-induced environmental change.

The UK Stern Report highlighted the long-term risks to our economic system. Awareness of the risks to species survival, to ecological systems, and to human health, should now draw our attention to the more serious fundamental prospect of damage to the world's life support system. There can be no national or global economy worth discussing if we fail to sustain life support systems and thus maintain a stable and healthy society.

Presenter

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