The purpose of this meeting was for researchers to identify and discuss fundamental scientific issues that were currently inhibiting the performance of climate impact studies. These issues were termed “roadblocks”, defined as aspects of climate change science that are insufficiently understood, thus causing large uncertainties in climate impact studies.

**ENSO**

It could be argued that one such roadblock is our inadequate understanding of ENSO. Richard Kleeman (NYU) gave a presentation on the current ability of climate models to simulate ENSO. Overall, no climate model gives a genuinely good simulation of ENSO. In simulations of global warming, there is a general tendency for a more El Niño-like response in the models, but there is a big range of responses even so. The representation of upwelling and the mean stratification in the ocean appears crucial for a good simulation of ENSO; the models must simulate the mean state very well. Resolution appears important. Several factors were identified that may lead to model improvements. The representation of moist convection in the models needs to be improved, due to its influence on surface temperatures. One way to do this might be to use cloud-resolving models at very high resolutions (1 km horizontal) to construct parameterizations for the coarser-resolution global climate models. This work is already being undertaken at NCAR. The PUMP field program (2005-2009, William Kessler) aims to improve observations of vertical mixing so that this is better understood. Richard noted that there were very few people in the world working directly on this issue, and that this could be an area where Australian scientists, in collaboration with overseas groups, could make some progress.

A robust discussion ensued. It was suggested that perhaps the essential physics of the delayed action oscillator, the main mechanism of ENSO, could be extracted in a simpler model and thus the theoretical impact of global warming ascertained. Richard noted that this might be possible, and that Axel Timmerman was working on something similar, but the mean state is complex, crucial to the sensitivity of the system to global warming and not necessarily well captured in a simple model.

Andy Pitman commented that perhaps Richard’s assessment of model performance was too pessimistic. Richard disagreed. Some possible strategies were suggested for moving forward. A high resolution model was necessary. The size of groups working on these fundamental issues was seen as being too small, partly because the number of climate models being run was too large. Accordingly, rather than run our own cloud-resolving model, it was thought best to link into groups that are already doing this.

Penny Whetton commented that for a genuine assessment of how crucial ENSO was to a climate impact, the impact of ENSO needed to be separated out from other effects.
Climate impact work could still continue despite the large uncertainty created by this roadblock [and has to – ed.].

**Decadal variability**

Scott Power gave a talk on decadal variability. One of the crucial issues in current research on decadal variability is whether it is predictable or not. Even if decadal variability is unpredictable (e.g. stochastic), it can still influence ENSO relationships. Decadal variability has been proposed as being merely ENSO plus noise, but this cannot explain the differences between the geographical pattern of ENSO and the decadal pattern. The decadal pattern is broader in the north-south direction, an off-equatorial response. Since it is known from theory that the speed of off-equatorial oceanic Rossby waves is slower than ones along the equator, this might be an explanation of why the off-equatorial amplitude is greater in the slower decadal pattern. Decadal variability associated with variations in the thermohaline circulation would be predictable, and some model results suggest that this may be linked to changes in southern hemisphere temperatures. It is difficult to analyse decadal variability because of its long timescale and the limited deep ocean data that we have, where longer period oscillations would be most likely to be seen.

In the discussion that followed, it was pointed out that it would be useful to be able to say what portion of a long-term signal was decadal variability and what portion was greenhouse-related, to detect and attribute the decadal signal. Those who are interested in mitigation issues appear to be only interested in whether a phenomenon is greenhouse-related or not. However, those who are interested in adaptation issues are interested in increasing the confidence of projections, and thus the issue of decadal predictability is important.

**Climate change policy**

Dale Dominey-Howes gave a talk on this topic. In this context, the roadblock was the difficulty in putting climate change science into action. Policy makers have other concerns than climate change, which may be low on their priority list. Indeed, though, not all of the factors inhibiting policy uptake of the conclusions of physical science are known. It was suggested that perhaps not enough work is being done on very specific issues, and that the interface between the science and policy makers is poorly designed. Research undertaken within a pre-existing policy framework is most useful to decision makers. Integrated assessments are needed, including climate impact and vulnerability assessments running in parallel.

A number of issues were identified in the discussion that followed. Mixed messages in the media were a continual problem i.e. the media treads the careful middle ground between sound science and nonsense. What is needed in the media are success stories. It was considered difficult to know how exactly to counter the climate “skeptics”: no market research had been done on relevant attitudes in the various social and economic sectors.
It was emphasized in Dale’s talk that very specific, local issues needed to be addressed for climate change science to have policy impact. But of course this is very time consuming, and it would be useful if such studies led to rules of thumb that could be more generally applied in other locations. It was considered important to have stakeholders involved in projects from the start, and indeed that stakeholders could aid in extending science in new, profitable directions. While stakeholder consultation was viewed as essential, there was the risk of stakeholder fatigue from too much consultation [especially if they know that previous scientific studies have had limited policy impact – ed.]. The structure of the IOCI project (http://www.ioci.org.au/) might serve as a template for other, similar projects that merge science and policy.

The discussion ended with a consideration of what this community needed to get better scientific results. Neville Nicholls noted that the physical impacts community needs more and better data, including paleoclimate data. Perhaps also the idea of reanalyses could be extended to things such as tropical cyclones, to create a genuinely consistent tropical cyclone data set, one without artificial trends created by changes in observing practices.

Kevin Walsh