Dear Professor Pitman,

International Networking for Young Scientists Workshop: Abrupt Climate Change: Is It a Northern Hemisphere Phenomenon?  
19 February – 1 March 2006

Workshop Report

Please find attached the final report for the above workshop. I think you'll see from the report that the workshop was an outstanding success – the event indeed achieved a high level of interaction and enthusiasm amongst the young scholars who participated, and the prospects for long-term collaboration and networking are excellent. In fact, many of the participants are already working towards a follow-up workshop in the UK next year.

The organisers and participants are most grateful to the British Council for the core support for this event, without which the workshop would not have been possible. We also thank the other financial and other sponsors of the workshop, who made various important contributions.

We believe that the format of this workshop, with its mix of presentations, long discussion periods and social events, is a good model for future workshops. Also, the leadership roles played by the young participants themselves during the workshop was an important part of the capacity-building.

In summary, both organisers and participants very much enjoyed the workshop, and are grateful to the British Council and others sponsors for making it possible.

Yours sincerely,

[Signature]

Professor Will Steffen  
Director, ANU Institute for Environment  
Australian Workshop Coordinator
Abrupt Climate Change: Is it just a Northern Hemisphere Phenomenon?

February 19th – March 1st 2006

Bureau of Meteorology, Melbourne
The Australian National University, Canberra
University of NSW, Sydney
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Section 1: Workshop Organisers’ Summary

Prepared by co-hosts Professor Will Steffen (Australia) and Professor John Schellnhuber (UK)

1.1 Background and Goals
1.2 The Human Dimension of the Workshop
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1.1 Background and Goals

Facilitating the development of the next generation of Earth System scientists is a crucial challenge for maintaining and enhancing this new and growing area of interdisciplinary research. Contributing to this goal was the objective of the workshop “Abrupt climate change: is it just a northern hemisphere phenomenon?”, generously supported by the British Council and co-hosted by the Australian National University and the Tyndall Centre for Climate Research in the UK.

The workshop was part of the British Council’s “International Networking for Young Scientists” initiative, which supports the Council’s goal of ‘nurturing mutually beneficial relationships with other countries’ by encouraging and facilitating the mobility of, and direct contact between, young researchers. The initiative supports face-to-face meetings between young scientists and engineers from the UK and other countries for the exchange of ideas, knowledge and information and the building of international connections that assist the research and innovation processes.

The strategy for the workshop was to introduce young scientists from the UK and Australia to the world of international science, where travel is the extended laboratory - a powerful source of new ideas and a strong driver for creativity. While teleworking and electronic networks make it possible to create virtual centres of excellence and support a wide range of collaborations, it is direct people-to-people contact that make international science the powerful vehicle it has become for Earth System science. Beyond introducing young scholars to the pertinent fields, the workshop aimed to build longer lasting collaboration among the young scholars, leading to joint research projects.

The theme of the workshop was abrupt climate change and its implication for societies, with a special focus on southern hemisphere phenomena. Until now, much of the interest in abrupt climate change has focused on the northern hemisphere (e.g., the stability of the thermohaline circulation in the North Atlantic Ocean), so the workshop aimed to achieve a more balanced perspective by exploring the nature of potential abrupt climatic change in the southern hemisphere and its impacts.

The program for the workshop is presented in Appendix A and the List of Participants in Appendix B.
1.2 The Human Dimension of the Workshop

The nature of the event required a departure from the usual pattern of organising and implementing an international workshop on Earth System science. To achieve the goals of the British Council and the participating research institutions, much more effort than normal was devoted to the “human dimensions” of the workshop – the nature of the participants, the structure and pace of the workshop, the mix of lecturers and the blend of work and social events. In particular, we strongly emphasised:

• **Careful selection of participants.** Our objective here was to ensure that all participants (i) had demonstrated open and inquisitive minds in their PhD and post-doctoral research; (ii) represented a wide range of disciplines, ranging from oceanic, cryospheric and atmospheric dynamics through palaeo studies of various types to the social and economic dimensions of the impacts of abrupt change. The strongly interdisciplinary nature of the participants was undoubtedly a major feature important to the success of the workshop, confirming our belief that the early post-doctoral phase is the right time for researchers to begin to think seriously beyond their own disciplines.

• **Mix of speakers.** We took care in selecting lecturers who (i) were at the cutting edge in their fields of research, (ii) spanned the natural and socio-economic sciences, and (iii) represented expertise in data collection, modelling, synthesis and assessment. Two other features enhanced the range of lecturers. First, holding much of the workshop in Canberra allowed a session on the science-policy interface, from the perspective of policymakers in the Australian Government. Second, the use of ‘aperitif talks’ late in the day exposed participants to some unusual, contrasting perspectives on the workshop theme – e.g., viewing the Earth from space and using art to explore the human-environment relationship.

• **Workshop format:** The workshop was designed to allow time for reflection, discussion and exchange of ideas, as opposed to simple information transfer. Thus, in general, only two substantive lectures were given each day, with copious time for the participants to interact with the lecturers. The afternoons were entirely devoted to group discussion and work, with each session led by one of the participants.

• **“Travelling” workshop feature.** The event was rather unusual in that it was held in three different locations – Melbourne, Canberra and Sydney – which exposed the participants to three different research institutions and settings. The Melbourne segment of the workshop coincided with an Australian meeting on Earth System Models of Intermediate Complexity (EMICs), a topic of direct relevance to the workshop theme. The trip from Canberra to Sydney via ground transport gave the UK participants an introduction to Australian landscapes and ecosystems, and the potential impacts on this part of Australia from abrupt climate change, such as severe and extended droughts.

• **Social events.** Team-building was an important outcome of the workshop, and this was achieved as much by the social activities associated with the workshop as by the more formal part of the event. The social component of the event was a mix of informal, self-organised evenings and more formal events, kindly hosted by the British High Commission and the Forum for European-Australian Science and Technology Cooperation (FEAST).
1.3 Workshop Outcomes

The most important outcomes of the workshop go well beyond the written reports contained herein. The event clearly achieved the capacity-building goals set out at the beginning of the planning phase, and also were consistent with the overall aims of the British Council’s initiative on international networking for young scientists.

The networking and collaboration achieved by the end of the meeting clearly transgressed our expectations. The four research proposals developed by the group demonstrate a high level of interaction, from initial discussion to problem-framing and even the early elements of research design. The individual participant reports almost universally pointed to the high level of networking achieved in just 12 days, manifested both in the interaction during the meeting itself and the longer term commitment to collaboration. It is important to emphasise again that the participants organised and led the discussions which resulted in the proposals, with very little input from the workshop organisers. This level of leadership and teamwork was, in its own right, an important outcome of the workshop.

The research ideas embodied in the four proposals showed a high level of sophistication and innovation. For example, the proposal on an integrated assessment of abrupt climate change over the 20th century shows an appreciation of the importance of instrumental observations, in addition to model projections, in integrated assessment, and gives a detailed implementation plan. Much of the effort towards a viable structure for a concrete proposal to a funding agency has been achieved. As another example, the proposal on climate change and abrupt change in economic systems is highly innovative, turning the attention on nonlinearities in the economic system rather than abrupt changes in the climate.

A third major outcome was the influence of the workshop on the future direction of the careers of the participants. Nearly all of the participants noted in their reports how the workshop had changed their perspective on the future. A common comment was that the event rekindled their interest in climate-related research or broadened their perspective on the work they had already carried out. Contingent events, such as this workshop, can often be decisive in changing or reinforcing career pathways.

Finally, an additional outcome was the almost universal appreciation by the individual participants of research well beyond his or her own discipline. The level of interdisciplinarity achieved in the short time of the workshop is reflected in the nature of the research proposals, all of which were framed in ways that required multiple disciplines to address the key questions. Three out of the four proposals required integration across the natural and social/economic sciences. Such strong interdisciplinarity was not an explicit goal of the workshop, but rather arose from the nature of the participants themselves, the topics raised by the lecturers and the lively and effective discussion sessions.
1.4 The Long-term Perspective

One the explicit goals of the workshop was to build longer lasting collaboration among the young scholars, leading to joint research projects. Four such research proposals were developed during the workshop, and the proponents of at least two of them have developed a specific timeline for moving the proposal forward towards the funding stage. This cements longer-term collaboration and represents an important first step towards developing a career in the international Earth System science arena.

The international dimensions of the workshop also promise to be long-lasting. At more senior levels, Earth System science is largely carried out by networks of researchers, often working through international programs or other more formal networks of institutions. The first step in this process is often informal collaboration that builds into longer relationships. It was clear that the first stages of this process were occurring with the young scholars, and even in one or two cases, collaborative work between young scholars in Australia and more senior scientists in Europe was developing. The format and style of this workshop was far more conducive, we believe, in initially introducing young scholars to the world of international research than the larger conferences where young scholars have less chance for substantive two-way interaction with senior scientists.

The participants themselves identified a follow-on workshop, perhaps in the UK, as a valuable and important next step in their career development and in their international collaborative research. The approach is to build on a core group of participants from the 2006 Australia workshop, with their base of shared knowledge and understanding, and bring in a cohort of new participants. This is an interesting case of both expanding the international network of young scholars as well as capacity building within the community of young scholars. The proposed 2007 workshop would focus on some challenging issues, such as tipping points in various components of the Earth System (including the human components) and communicating Earth System science to a variety of audiences.

1.5. Summary

We believe that this workshop was an outstanding example of capacity building in a sustained, long-term way. The networking and collaboration developed over only 12 days is a significant step in the careers of young scientists towards becoming “practicing international scientists”. Good progress was made on developing four research proposals, although several participants noted that they needed further skills in how to write a proposal before being able to develop a more complicated, fundable proposal. Nevertheless, at the level of idea or question generation, they showed considerable skills. In terms of interdisciplinarity, the workshop was a splendid success, beyond our expectations. The ability of the young scholars to quickly move beyond their own training and engage colleagues from other disciplines was most impressive and rewarding. In summary, we believe this workshop has furthered the careers of these young scholars, and enhanced their capability to work collaboratively in an international setting.
1.6 Acknowledgements

We are grateful to the British Council for their generous support of the workshop, and to Dr Neil Hamilton of the Forum for European-Australian Science and Technology Cooperation for his help with the British Council proposal. From the Australian side, we are grateful to the ANU, Macquarie University, Monash University and the University of New South Wales for financial support. In addition, we thank the ARC Network for Earth System Science both for financial support and for assistance with the identification of some Australian participants. We thank Professor Amanda Lynch, organiser of the workshop on Earth System Models of Intermediate Complexity, for allowing the workshop participants to attend one day of that meeting. Professor Lawrence Cram, Deputy Vice Chancellor for Research at the ANU, is thanked for opening the workshop. All of the lecturers, listed in the workshop program in Appendix A, are gratefully acknowledged for their contributions.

We are particularly grateful to Sean Hannan of the ANU Institute for Environment, who was the main on-the-ground organiser for the event and assisted us and the participants in so many other ways. Sean’s efforts ensured that the workshop, which was challenging logistically, operated smoothly; and his energy, enthusiasm and dedication to detail, was greatly appreciated by all associated with the event.

Section 2: Participants Executive Summary

2.1 General comments
2.2 Ideas for future research themes
2.3 Future connections among the group
2.4 Do we need another workshop?
2.5 Acknowledgements

2.1 General comments

The British Council INYS Workshop on “Abrupt Climate Change: is it just a Northern Hemisphere Phenomenon?” proved to be extremely successful. The workshop brought together an impressive line-up of speakers (prominent academics and public servants) and a group of young scientists who interacted very well both at the academic and social level. Discussion in the small group was vigorous and focused. Besides establishing friendships, we expect this workshop to produce long-term research collaborations between young Australian and UK scientists. A sense of the potential can be gleaned from the ideas for future research below.

2.2 Ideas for future Research Themes

Half-way through the course the group was given a brief to split into sub-groups and work on developing ideas for future research, based upon four questions identified by the group during an earlier brainstorming session. The following is a brief summary of the findings of each group.
1. Climate change and abrupt changes in economic systems
   • Economic systems may change abruptly in response to abrupt changes in climate, or if thresholds in societies’ systems are crossed in response to gradual change. The research would use historical data (statistical and paleological) to improve understanding of economic system behaviour in the face of large-scale environmental change. These findings would then be applied in economic scenario modelling of future potential climate change impacts, such as a shutdown of the North Atlantic conveyor belt or entrenched El Niño conditions in Eastern Australia.

2. Integrated assessment of abrupt climate change over the 20th century
   • This project would use case studies to investigate 20th century abrupt changes (i.e. discontinuities, non-monotonic changes) in regional climate. Case studies could include rainfall decreases in southwest Western Australia, the Sahel or the Iberian Peninsula, where abrupt changes have been observed. The project would investigate how humans have responded to the impacts of these abrupt changes, and how this can inform planning given model projections of future climate and socio-economic changes.

3. Palaeo data: validation in an assessment of climatic extremes and the nature of ecosystem response
   • The current palaeodata in Australasia is limited by skill set (the number and spatial scale of study sites) and our stated outcomes for our data. There is also an urgent need to extend existing regional and local proxy records to before the instrumental records to put recent abrupt variations into proper context (assisting in model validation). Models could be used by the palaeo-community to create an optimized palaeodata network for Australasia (helping to address the current spatial scale of data).

4. Attribution of climate change in extreme events: heat wave impact estimation
   • By using paleo data (tree rings) it was hoped to extend the observational data set in the European region to improve estimations of natural climate variability and establish better evidence for the attribution of single extreme events to climate change (similar to Schar et al., Science, 2004). However, the limited spatial and temporal resolution of available tree ring data, and the difficulty of separating out water and temperature stress signals, make this approach unlikely. Other extreme events where tree ring temperature proxies could perhaps be used to extend the instrumental record would be hurricane formation (and subsequent damage costs).

These research proposals would all need further development and review. Some may go forward, others not.

Some comments about the process, and suggestions for the future:
• Working in small groups helped develop friendships and further interest in other people’s fields.
• The context for the exercise was somewhat ambiguous: was it a thought experiment, or were we to actively work towards a funding application? If the latter, then we were hampered by gaps in expertise (as there were not enough people with the requisite expertise to sit in all the groups), and lack of time to search the literature or seek expert feedback.
• The potential pool of good research that could be undertaken by the participants was not exhausted as a result of just one after-lunch brainstorming session.
• It might have been more useful to focus on fewer issues and to have worked on them as a whole group. This would have allowed the full breadth of disciplines and expertise across the group to be concentrated.

2.3 Future connections among the group

The following outcomes are expected:
• A website (part of ANUIE) which will post the powerpoint presentations from the workshop, contact details etc.
• An email network is encouraged to facilitate: sharing papers that people have had published of their own work; sending around seminal papers from our respective fields, new data sites, software; details about upcoming conferences of mutual interest.
• Specific small research projects have been identified between some individuals
• Several participants are likely to enter loose collaborations and share ideas in future.
• Data exchange.

2.4 Do we need another Workshop?

There was discussion about the next steps in relation to this particular British Council programme. One approach would be to use members of the current workshop (assuming some natural attrition) to form a core group for a new workshop. This would enable continuation of research development and learning among existing participants – given the now shared base of knowledge and understanding. New participants could be targeted to fill skills gaps from the current participants’ portfolio. It would also provide other young scientists with the chance to be exposed to a similar experience.

Such a workshop could focus on, as a starting point, some key issues identified at the end of the current workshop, including:
1. Communicating climate change (to politicians, media, and broader community)
2. When are climate modelling results meaningful? (spatial and temporal scale, application validity)
3. Tipping points in systems (physical, biological and human): vulnerability and resilience.

2.5 Acknowledgements

The group would like to thank all parties involved in making the workshop possible. In particular, we felt privileged to have had so much time with the workshop hosts, Profs. John Schellnhuber and Will Steffen, who freely shared their knowledge, insights and perspectives. We would also like to acknowledge Sean Hannan and Prof. Will Steffen for the smooth running of the workshop.
Section: 3: Participants Research Proposals

3.1 Integrated Assessment of Abrupt Climate Change over the 20th Century
3.2 Climate change and abrupt changes in economic systems
3.3 Understanding the impacts of climatic extremes in the Northern and Southern Hemispheres on an eco-system using palaeo-data.
3.4 Attribution of climate change in extreme events: heat wave impact estimation

3.1 Integrated Assessment of Abrupt Climate Change over the 20th Century

*Prepared by Suraje Dessai, Agus Santoso, Pauline Treble, Marko Scholze*

3.1.1 Introduction

Studying abrupt climate change and in particular its implications for society is difficult because we are currently living in a non-analogous state (also known as the anthropocene) due to large scale human interference with the planet (rise in greenhouse house gas emissions, land-use change, nitrogen changes, etc.). One approach to prepare human societies for the potential of abrupt climate change is to study recent adaptation to observed climate changes that are deemed abrupt. By “abrupt” we mean a discontinuity in the climate system be it globally, regionally or locally. This abrupt change could be human-induced or the result of natural variability. The 20th century presents a few examples of abrupt climate change at the regional level, e.g., rainfall decline in southwest Western Australia (SWWA; Sadler, 2001); significant rainfall decrease in the Iberian Peninsula in March (Trigo et al. 2006); desiccation of the Sahel (Hulme, 2001); decreases in rainfall in southern California. These examples provide excellent case studies of how societies (and ecosystems) have coped with abrupt shifts in the climate. Only by understanding past changes in the climate and the human response to these changes can we inform future planning to mitigate and adapt to abrupt climate change. The project proposed here brings these three aspects together to provide knowledge that would not result from a single discipline. This is the basis of integrated assessment and interdisciplinarity. We explain the framework of the project using the case study of southwest WA, but this can be applied to any of the other case studies listed above as well.

3.1.2 Work plan

The work proposed in this project is divided into three main themes. The first theme puts the “abrupt shift” in the context of past climate. In order to do this the first task of this theme (Task 1) is to investigate the spatio-temporal characteristics of the natural climate variability (at a range of scales from interannual to multi-decadal depending on the case study). This is performed by looking at recent instrumental record (in the case of SWWA rainfall this goes back to 1910) and also by using proxies from paleodata (using speleothems data from the region at the annual precipitation resolution) which extends back 300-500 years. Given the large uncertainties associated with this paleodata, modelled data of unforced multi-century runs of fully-coupled GCMs will also be examined (e.g., HadCM3, CCCma and CSIRO models). This allows us to put the abrupt shift in rainfall in the context of past changes. We then propose to examine the physical
processes that could explain this abrupt shift (Task 2). This includes further analyses of natural multi-decadal variability, anthropogenic climate change (due to changes of greenhouse gas emissions), land-use change, changes in ocean circulation, etc. This task could include gathering information from various studies (e.g., Timbal et al. 2006), new modelling studies, and implementation of statistical analyses. Task 3 would examine changes in streamflow for the 20th century, which can extend to other aspects of the ecosystems depending on data availability.

The second theme studies the recent institutional responses to this abrupt climate shift. For SWWA this will imply a range of elite interviews and surveys (with water managers, state officials, farmers, policy-makers and also the general public) and examining historic documents (planning documents, newspapers, etc.) to analyse the decision making within this context.

Theme three aims to inform future planning. It does so through a number of tasks. Task 1 analyses future changes in climate as modelled by GCMs. Particular attention will be given to models that can reasonably simulate observed processes (in their control run), but no models will be excluded (the issue of model evaluation and a “gold standard” for GCMs could be explored here). The planning horizon (25, 50 years) will match the GCM projections. Task 2 would explore future population and land-use changes with the use of scenario analysis. Task 3 would convert the climate projections into streamflow changes taking into account future land-use changes. Task 4 would calculate the supply-demand balance for the region based on Task 3 and population changes (demand). Task 5 would present the results of this work to stakeholders in an effort to elicit acceptable management options to mitigate any adverse effects. This task would involve careful communication of scientific and socio-economic uncertainties to those participating. The aim of the final workshop would be to identify options that are socially acceptable (to those involved), robust to uncertainties and cost-effective.

3.2 Climate change and abrupt changes in economic systems

Prepared by Frank Jotzo, Doug McNeall, Dave Brayshaw and Matt Brookhouse

3.2.1 Fundamentals

Abrupt changes may happen in the earth system, as well as in economic systems in response to environmental change. The project will provide a framework for analysis of such abrupt changes and aim to identify the possible sources, nature and magnitude in some case studies.

The project looks at two broad sweeps historical and future: First, an examination of abrupt change in historical economic systems. Second an identification of possible sources of discontinuities in natural and economic systems in the future.

3.2.2 Nonlinear damage functions

Adverse impacts on human and economic system can be described by damage functions, relating the magnitude of the external forcing to the magnitude of its impacts, both physical and economic.
In most economic analysis to date, impacts from climate change on economic systems are described as continuous and typically linear damage functions. However, these changes are unlikely to be linear, and in many cases may even be discontinuous (Figure 1).

The economic damage function may differ significantly from the physical impacts function. Figure 2 shows a situation where a gradual greenhouse gas forcing results in a nonlinear physical impacts function over time and in a series of discontinuous shifts in the economy. The economic system initially damps the climatic impacts through its adaptive capacity, until some critical threshold is reached.

This threshold is internal to the economic system and once passed, the economic system is forced into abrupt change. Systems may therefore collapse even as a result of small perturbations.

This research will aim to investigate past interactions between environmental change and economic system response, including limits to resilience of human systems, and investigate scenarios for potential future climate change impacts and resulting economic impacts.

### 3.2.3 Past observations and future scenarios

Past disturbances in environmental systems and their effects on the economy can provide data about possible future impacts of climate change on the economy.

Insights about past natural events and economic system responses will be gained by literature review and primary data analysis of events such as the Potato Famine, the American Dust Bowl, and the abrupt drying in Western Australia during the 1970s. Though the spatial scale of past climate anomaly events may differ from that under any future climate change impacts, these events are expected to provide useful insights, especially for analysis at the regional scale. Methods would focus on historical economic data, but may extend to the paleo record of disruptions or demise of past societies.

Future scenarios will be modelled by linking the emerging literature and modelling of possible physical impacts of abrupt regional climate change with new understanding of how economic systems may react to such impacts. Analysis will include assessment of nonlinearities internal to the economic systems, informed by historical research. The research would aim to enhance qualitative insights, but may also help in the larger quest
for estimates of potential economic costs from climate change impacts.

Examples of future scenarios might include effects of a shutdown of the thermohaline circulation in the North-Atlantic on North-West Europe, and effects of increasing frequency and intensity of El Nino events in South-Eastern Australia. The work might also consider more regionalized potential climate impacts such as the effect on tourism-based economies such as coral bleaching on the Great Barrier Reef, or reduced snow cover in the Australian and European Alps; or impacts of precipitation and glacial changes on hydroelectric schemes.

### 3.2.4 Linkages and extensions

The research programme could link up with analytical work done at (re-)insurance companies, perhaps utilising their data.

By choosing different regional case studies, the research could compare and contrast climate change impacts and economic responses in different parts of the world. The examples given above are chiefly for Europe/UK and Australia, but other countries and continents could be addressed also. Investigating potential responses to climate impacts in developing countries could be particularly fruitful.

The findings from this research could also inform the choice of economic policy instruments for greenhouse gas mitigation. Whether damage functions are nonlinear/discontinuous or not has important implications for the choice between using emissions targets (as under the Kyoto Protocol), or tax instruments.

### 3.3 Understanding the impacts of climatic extremes in the Northern and Southern Hemispheres on an eco-system using palaeo-data.

*Prepared by Cassandra Rowe, Cecilia MacFarling, Tiernan Williams and Eun-Pa*

#### 3.3.1 Aim

The aim of this research discussion is to consider the links between Northern and Southern hemisphere climatic events, in the context of the impact of climatic events and there impacts on a regions eco-systems.

#### 3.3.2 Timescales

It was decided that the Holocene would be the best period to apply this research. More specifically, the last 2000 years; this is period where modern vegetation analogues may still be found thus facilitating the palaeo data, also being a period of increasing human activity within the environment. The latter provides an opportunity to establish human-climatic relationships within any given region.
3.3.3 Region

As already mentioned the aim is to look at connections between the northern and southern hemispheres, of the degree of global verses regional events and signals. There are numerous climatic events within the last 2000 years which have been identified in specific regions and not in others, providing study focus. What of the medieval warm period or little ice-age – how local are such events? With Australia and Europe (UK) the focus of the workshop, and understanding the variations in environments (past and present) could it be that such events are expressed differently?

3.3.4 Methodology

The task is to link together models (GCMs) with sedimentary palaeo data. Perhaps the key issue is scale, and finding a scale which is suitable for both. The spatial resolution of palaeodata in Australia is a particular issue. In one way there is a need for pre-existing and future palaeodata sets to be linked regionally via a model system, to provide greater and more confident spatial and temporal coverage. Smaller local-scale palaeo-records should also be used to test and/or validate those prominent long-core and regional records – in turn those regional, typically older long-core records provide data for model use. Such an aspect to the methodology could be used to avoid the often poor temporal resolution of smaller palaeo studies, as well as preservation issues.

The methodology would appear to require less up-scaling of the local terrestrial palaeo records, and less down-scaling of GCMs – for the relationship to work. Could the palaeodata be used to test the down-scaling process.

3.3.5 Data

What do we need?
- GCM Data
- Two sets of palaeodata; for NH and SH (or collaborated sets of data)
- Multi-proxies
- Improved ecosystem data (modern tolerances, distributions)

3.3.6 Conclusions

The issue of palaeodata, in itself, and of its relationship with the model community, is broad and may be difficult to incorporate fully within the objectives of the workshop. The issue of communication was a common topic of conversation and as the very first step communication between the two groups needs to be encouraged and expanded.

3.3.7 Notes

Abrupt climatic events are difficult to detect within the palaeo record; often the resolution (temporal) is too coarse. The role of palaeo data may be as a test of the degree of extremeness within the modern and instrumental record.
In the context of the workshop, a distinction may need to be made between sedimentary data and tree-ring data. Tree-ring data appears to be of greater application as an extension of the instrumental (and historical) records. The role of sedimentary data would then extend from the time-span of tree-rings.

In palaeo records, a vegetation response is known before the cause. The distinction between human impact signals and climatic influences is a huge issue for palaeo work in Australia. Could it be that the model community (global or regional) can help with the differentiation between human/climate?

3.4 Attribution of climate change in extreme events: heat wave impact estimation

Prepared by Gab Abramowitz, Sarah Keeley, Andrew Sole, Rosalie Woodruff

3.4.1 Aim

To improve estimation of the contribution of human-induced climate change to the European 2003 heatwave.

3.4.2 Objectives

- Use palaeo data to substantially extend the available time-series of surface air temperature beyond the instrumental record and thus increase the ability to assess natural climate variability.
- Construct a probability density function of the natural variation in seasonal temperature across the heatwave-affected regions, and use this to estimate the likelihood that the occurrence of the 2003 European heatwave was due to human-induced climate change (following the method used by Schar et al., 2004).

3.4.3 Data

The temporal resolution of ice cores is not high enough to resolve individual heat wave events. However, heatwaves have been identified in tree ring records for Europe, as elsewhere. Anomalously high temperatures result in isotope signatures and visual damage in tree rings. The 2003 event was clearly recorded in reported tree ring records. Detailed temperature proxy data are available from trees at temporal resolution of at least seasons, and for approximately the last three hundred years.

One potential problem is that the “heatwave” signal may also constitute a sign of water stress due to drought, rather than to higher temperatures. Although it is theoretically possible to distinguish between heat and water stress, to our knowledge this has not been done. Another issue would be the ability to distinguish short extreme heat events from extended moderate heat events.
3.4.4 Method

Assuming the above issues were not insurmountable, a probability density function of seasonal temperature could be constructed. To estimate the extent of anthropogenic climate change over a given period, a ‘moving window’ of the last 50/100/200 years would be used to observe where in the 300 year ‘natural variability’ probability density function the last 200/100/50 years occurred. Were the 2003 heatwave event still at the very extreme end of this function, we could be more confident that it was the result of human-induced climate change.

By observing the position of the seasonal temperatures of this recent period within the 300yr ‘natural variability’ probability density function we could also estimate the probability of future heatwave trends. In addition, based on this trend, we could increase our confidence in the methods used by Stott et al. 2004, and hence improve estimates of the health impacts.

3.4.5 References


Section 4: Individual Participant Reports

Two questions were asked of each participant:
• Where do you see yourself in 10 years?
• Has this event had an influence on your career?

All 16 workshop participants responded.

Participant #1

In the next ten years I would like to think that I could achieve some of the following:
• Some good solid population-level research into the impact of heat and cold on human physiology and behaviour (with particular emphasis on vulnerable populations and thresholds), and into social and health adaptive responses that are effective.
• More excellent science about the patterns of infectious diseases (vector-borne, food-borne, water-borne) and climate.
• Expanded the boundaries of epidemiological methods to include techniques for analysing the more indirect effects of climatic and environmental conditions on human health.
• Contributed to establishing a climate change health impacts network in Asia (with initial emphasis on heatwaves in urban environments, and then research collaborations, health skills transfer etc).
• Documented the early impact of climate change on health in the Australian region.
• Helped forward understanding of the integral connection between environment and health – within the research world and without.
• Have a more sophisticated understanding of communicating science to the media, politicians and the public.
• Helped stimulate a research programme for younger scientists.
• Have read more broadly into the areas of human histories, systems theories, physics (esp. wave dynamics), microbiology, urban design…

**Has this event had an influence on my career?**

Some thoughts about this question:
• I had in-depth discussions about speleothem and dendrochronology data collection and interpretation, about statistical methods for climate modelling, and glacial formation that it is unlikely I would have had otherwise. The size of the group, level of informality, and the time we spent with each other all supported these discussions. In general, the combination of information that I received during the ten days has moved my understanding of climate change science to a much higher level of sophistication.
• I will follow up the possibility of a research collaboration with a group in Europe, via funding from the EU, that I would not have otherwise heard about.
• I’m planning to continue working with one participant (a climate modeller in Britain) to explore the potential of extracting information relevant to estimating the health impacts of heatwaves.
• We have initiated an ongoing email list to help maintain communication between the group about recent research published by participants, and seminal papers from the literature in our disparate fields. In the absence of face-to-face contact, this will (hopefully) maintain a connection between participants.
• I met two people at my own research institution (the ANU) who I had not met before – I expect to continue a connection with both of these people.

**General comments about the workshop**

• The group discussions worked very well – the best I have been involved in in such a context. It was a good idea to get people from the group to take responsibility for the chairing and rapporteur roles (increased ownership).
• The talks were universally excellent – a fine balance of large scale and smaller scale topics, and a reasonable spread of the disciplines involved in climate change research. Some of the best people in their field in the world spoke.
• It would have been great to have had another palaeo researcher represented, and someone else from the area of conservation/biological systems – these areas were slightly under-represented.
• The administrative support and meeting arrangements were excellent: people involved in doing this were friendly, helpful and clear.
• The guidance and input from Will and John was the most significant factor in making this a highly successful event. They essentially acted as mentors, sharing their experiences and providing kind and constructive feedback. It was a terrific opportunity to spend so long with two people who have been involved in significantly shaping the research and political agendas of many countries on climate change.
Participant #2

Where do you see yourself in 10 years?

I hope to continue research in relation to climate change. Broadening the scope of my knowledge and skills in climate research will be the main focus in the next 10 years. In particular, I would like to improve my ability in climate modelling as my past and present research has been focused on data analysis. Having experiences in cloud parameterisation scheme and ocean, sea-ice and biosphere sub-models in GCMs will be a good way to meet the goal of having better understanding about Earth System.

In addition, I would like to be involved in science education for school children. From my experiences at school and university training as a secondary school science teacher, helping children to be interested in science and social issues related to science has great impact on their decision making for their career and their communication with their family and friends as well as on improving their scientific knowledge. Organising workshops for school teachers and children and developing teaching materials are something I want to do in the 10 years of time.

How did workshop impact on my research career?

First of all, this workshop provided great opportunities to meet young fellow scientists. Spending 10 days with these young scientists and discussing various issues all day except for sleeping hours was such a unique and useful experience for me. I believe this has built the good base of friendship and network.

Secondly, I have obtained new knowledge from the young researchers and their research interests and from talks presented by experts in very different areas related to climate change. Presentations and following discussions were helpful to stretch my interest and understanding to the topics which had not been familiar to me. Some of the talks were particularly inspiring for me and posed some interesting ideas for future research.

Having a privilege of spending 10 days with Dr. Schellnhuber and Dr. Steffen was also a wonderful experience in sharing their excellent knowledge in earth system and climate change and having an excellent role model as a scientist.

Last but not least, this workshop was a crucial point for me to see myself as a “scientist” rather than a student doing science, which means more of professionalism and responsibility in my research activity.

Participant #3

Ten year agenda

My principal goals for the next ten years lie within advancement of dendrochronological research in Australia through generating research results and improving connectivity with the international community. The main aims I have during this time include developing multi-century scale eucalypt tree-ring chronologies for the Australian Alps.
and commencing dendrochronological investigation of the highlands of Papua New Guinea.

The Australian alps chronologies would permit detection of climate impacts of subalpine woodlands, reconstruction of climate preceding European arrival and provide a master chronology for subsequent studies. Achieving this goal is highly dependent upon personal skill development and collaboration/involvement with an international tree-ring laboratory in either the USA or Europe. Consequently I hope to spend at least twelve months working abroad on the Australian alps project.

The prospect of working within Papua New Guinea holds many attractions. Its geographic position provides the opportunity to connect south-east Asian tree-ring records with those of Australia and New Zealand to gain a regional climate perspective. Further the PNG highlands support a range of southern conifer genera found in Tasmania and New Zealand suggesting that the world’s next multi-millennial tree-ring chronology may be preserved there. Since no dendrochronological studies have been conducted in the country, Papua New Guinea also presents the opportunity to physically pioneer the science in a biologically diverse tropical country. The opportunities to work within a climatically diverse and rugged topography and gain experience with the PNG people are particularly alluring.

I also plan to be engaged with forestry in Australia. I believe that in the decade to come forestry will face several critical challenges. A fundamental step in dealing with these problems is focussing on knowledge-based management rather than the crisis management that characterises forestry today. I am aiming to be a significant part of this redirection through facilitating and participating in forest research programs and working within review panels or undertaking consultancy.

Of course the goals I’ve identified will require additional researchers and development of local expertise. Thus, within ten years I aim to participate in the establishment of a local tree-ring laboratory. I hope to attract research students with the prospects of contributing to an expanding field, possibilities for international collaboration and PNG based research.

**Workshop impacts**

This workshop has allowed me to explore the broader context for my work in terms of climate change outside of its impact on forest ecosystems. I often find it difficult to identify the broader implications of the work research disciplines other than climatological and ecological sciences. Exposure to individuals from a range of research disciplines during discussion and lectures assisted in greatly modifying this limited perspective. In addition is has facilitated discussion with individuals with whom genuine opportunities exist for collaboration for verification of Western Australian speleothem data and examination of tree growth response and the subsequent economic impacts for the forest industry to abrupt change in rainfall.

I have also felt encouraged by the workshop to explore alternatives for international collaboration in my own research field that I had not previously considered and has provided personal contacts within institutions supporting globally significant tree-ring research facilities.
Finally, the workshop has provided me with a much needed break from my PhD and allowed me to meet a diverse group of interesting people whom I look forward to meeting again.

**Participant #4**

**Where do I see myself in 10 years from now and how did this BC-INYS workshop have any influence on this decision?**

From the scientific point of view I certainly have already found a niche to occupy and in which I also gained a reputation within the community and am regarded as one of the leading experts. However, considering my personality and character I don’t see myself completely devoted to this niche in the long term. I rather like to move on to a different topic once I understand a problem (here, I mean understanding in a broader sense and not necessarily all the tiny details of the problem) and thus satisfy my own curiosity – essentially this is a life-long learning position. Nevertheless, I also don’t see myself sitting in an ivory tower and only do research for the sake of science. I think it is essential to do usable science. But the attitude of ‘moving on’ for different fields makes it rather difficult to become a professional researcher/scientist in a particular field at least this is my understanding of the current academic system. Further, I also don’t commit myself to a 150% to my research career, which I think is essential for becoming a professional scientist (Professor) in academia or related research organisations. Having said that I do like doing research and work within academia and if there will be the opportunity for me to become a professor I certainly will pursue it. This is of course an opportunistic position rather than active career planning which means that I have to be open for alternatives and different pathways such as working for international organisations such as WMO, UNFCCC or also in the consultancy (for both governments and industry) field.

Of course, there are lots of other perspectives than the professional aspect on this question which are at least equally important such as personal circumstances (e.g. in which country or even city do I want to live, can my partner find a job there as well). Clearly, there is no straightforward answer to the question of where in my professional career I will end up in 10 years time.

This workshop hasn’t directly contributed to the decision making process and I very much doubt that it will in a direct sense and especially at this moment. But as I am having a fairly opportunistic approach it might contribute at a later stage through building up a greater network. Maybe in 10 years time looking back to my career development I can attribute the workshop to be helpful in one or the other way for my career.

**Participant #5**

The future is unpredictable, in particular where human choice is concerned, so I will not attempt to predict where I will be in my career in 10 years time. Instead I will provide several scenarios of where I could be in 10 years time. The path to get to any of these scenarios is unknown and depends on the decisions I take over the next 10 years.
Scenario A sees me as a Lecturer (also known as Assistant Professor in the US) in climate change (or environmental sciences) in a good university (location unknown). Scenario B would see me entering yet another post-doc position in climate change in some university. Scenario C would see myself entering the Foreign Service (country unknown, but only really feasible in Portugal, India or UK) in pursuit of a diplomatic career (that in the long term would focus on environment). Scenario D would see me working for the United Nations Development Programme (UNDP) on “real” on the ground adaptation projects that make a real difference to people. Scenario E would see me devoting my life to kite surfing in some shape or form (perhaps opening a shop, etc. given that with my age with would be impossible to ever become a professional).

It is extremely difficult to say how this workshop will impact the path to any of these scenarios (or other futures). What I can say is that this workshop has rekindled my interest in climate change science, which was rather down in my esteem after the completion of my PhD recently. This perhaps boosts scenarios A and B. As I’ve told the organisers I think this workshop has extremely well organised (I have nothing to complain about except the lack of internet connection in Sydney, but perhaps that is a good thing!), it’s had an impressive line-up of lectures (all of which delivered their goods, i.e. the talks were extremely good), it’s brought together a good group of young scientists that have definitely “clicked”, and it is very likely to produce long term collaborations.

**Participant #6**

Ten years ago I thought I would be a professional musician. Five years ago a mathematician. While a guess at my inspirations and directions in ten years time is ambitious, I can at least say the INYS workshop has solidified my resolve to stay in climate change science. If anything, I am now inspired to take part in other areas of the field such as education and communications - something we all identified as the key challenge in this area in the coming years.

Perhaps most importantly, the workshop has allowed me to consider international and interdisciplinary cooperation as a strength rather than a difficulty when considering how address climate change issues. Its success certainly came from the participants' unhesitating desire to engage in discussion. I think this surprised many of us, including the organisers. Some reasons why things worked so well:

The participants gave no formal prepared presentations. While in the first instance this meant less pressure, the more important effect was to make people feel that their contribution to discussion was worthwhile and even essential. It ensured that interactions were collaborative rather than competitive and forced participants to bridge the gap between their fields of interest.

- Equally important was the presence and guiding hand of senior climate figures (John and Will). The workshop was given purpose and importance by the fact that these people felt it important to give two weeks of their time to it. The respect given by these figures to the views of participants is another reason why everyone engaged so willingly.
The relatively relaxed timetable and social schedule meant participants came to know each other as individuals as well as scientists. This, together with the small group size, saw a positive and engaging group dynamic develop from day one. This was only strengthened by the group's travel through three cities. It was a courageous decision on the part of organisers.

The emphasis on continuing collaboration, through mechanisms such as FEAST's online discussion facility and targeted group projects, has provided real opportunities to build on the ground made during the meet.

Choosing participants with a relatively wide range of backgrounds and interests was also important. It allowed the small group to feel that between them they could tackle big questions. Face to face contact removed the barriers of international interdisciplinary collaboration.

Overall, I cannot imagine any one of the participants would put the workshop in a negative light. The balance between inspirations, pleasures and responsibilities kept everyone engaged for the ten day period. It was a powerful and empowering experience that effectively communicated the importance, complexities and urgency of the problems we are facing. Without doubt, it is the most important conference/workshop I have attended; I keenly await the possibility of similar event next year.

Participant #7

What have I got out of the workshop?

- A much improved understanding of the opportunities and limits of earth systems modelling.
- A clearer view of how my field (environmental economics) can be connect with earth systems science.
- New ideas and inspiration for a possible cross-disciplinary research agenda on abrupt climate change (see project idea note ‘Climate change and abrupt changes in economic systems’).
- An understanding of the differences in priorities and approaches in climate change science between Europe and Australia.
- Valuable new contacts with colleagues in the UK, and also Australia, who are at a similar stage in their careers and work in different, but related fields.
- A better appreciation of the broader context and big-picture issues in climate change, especially the science-policy interaction. This is thanks to the contribution by John Schellnhuber, Will Steffen and the guest speakers at the workshop.

Specific comments about the workshop

- This has certainly been one of the better workshops that I have taken part in.
- Most important positive feature: Plenty of time for discussion and to get to establish a climate of trust and collaboration with other participants.
- Also of note: Great to have plenty of time with the workshop hosts.
- A follow-up meeting could be very fruitful, perhaps to bring some of the project ideas from this workshop to fruition.
Where do I see myself in 10 years' time?

- Ideally, running a research programme on global change and economic/societal issues in a think tank that is engaged with policy advice.
- Or in an academic position, doing policy-relevant research on global change and economic/societal issues.
- I would be working either in Europe or in Australia, with a strong international orientation.

Participant #8

_The British Council INYS workshop was indeed a rare opportunity and has provided me with an invaluable and memorable experience as a young researcher in climate science._

The Earth climate system is non static and involves complex interactions between its four major physical components: biosphere, atmosphere, ocean, and ice. Human civilisations depend very much on the current climatic state which sustains distribution of water and vegetation. Thus, significant climate variations or extremes have a profound impact on life forms and various aspects of our society (e.g., health, economy, politics, infrastructures). Abrupt climate change has recently been a topic of intense debate based on the concern of the alarming rate of global temperature increase since the industrial revolution, accompanied by a rapid increase in greenhouse gas emissions. This is because we are still uncertain of the fragility of the climate system especially in response to such rapid warming. My research in the climate science has focused mainly on the ocean component, specifically on characterising the natural variability of the Southern Ocean water masses which play an important role in global climate variations on decadal time scales and beyond. I utilise climate models to conduct investigations of the system on such long time scales which are otherwise hampered by the spatio-temporal sparsity of observational data, particularly in the Southern Ocean. Through my participation in the _British Council INYS workshop_, I have been made aware of recent developments in palaeo-climate data - an important aspect which will certainly be integrated into my next research agenda in terms of characterising the natural climate variability.

The workshop has provided me with a rare opportunity to listen to some of the world’s leading scientists speaking on different aspects of the climate system and climate change issues in a time frame which allows for sufficient follow-up questions and discussions. Furthermore, the diverse background of the speakers (ranging from palaeo science to visual art) helps to expand my vision in realising the complexity of the climate system, the urgency in tackling climate change issues, and thus the importance of collaboration with other scientists of different research background, as well as communicating science to policy makers and the public in general. The workshop has also provided me with a unique opportunity to discuss and exchange ideas with other participants from both Australia and the UK who also come from different research backgrounds (e.g., economy, health, meteorology, and glaciology). This allows all of the participants to work together toward a common goal – resolving the uncertainties and impacts of abrupt climate change, despite the diversity in our research interests. I have enjoyed the constructive discussions and debates within and outside the allocated workshop time, as
well as at the organised social outings (e.g., European Researchers Night). As a result, friendships are fostered among the participants, which form a good foundation of networking and future collaborations. Overall, I have had a wonderful and unforgettable experience at the workshop. My personal appreciation goes to the organisers for the well organised workshop.

Climate science is still relatively young and its challenges ahead are clear. I believe that climate research will prevail for decades to come. The workshop has broadened my awareness on the scientific, socio-economic and political issues of climate change. It has also provided me with the knowledge on networking and friendships within the scientific community which I now believe are crucial as a whole community to act together to solve the emanating issues. In addition, identifying key questions and constructing research proposals in the workshop have been found to be a helpful exercise for my future research undertakings. In the next ten years, I believe to be still pursuing my effort in the climate/environmental area, its variability, sustainability, and impact. Perhaps, I will still be a researcher at a university investigating the interactions of climate components or managing a climate research, an environmental officer, or even as a policy maker – making sure every decision we make is as responsible and thoughtful as possible, because the climate system may actually be more fragile than we thought.

Participant #9

Where do I see myself in 10 years?

I hope to remain an experimental scientist pursuing atmospheric composition variability and attributing observed changes to causal mechanisms. I like to work as part of a team and hope that I have many opportunities to do so. I would consider myself successful in ten years if I am able to continue research that is interesting, challenging and of relevance to society.

Has this event had an influence on my career?

I think the best outcome from the workshop for me was a feeling of being re-enthused about science. I think sometimes we get a bit lost in our own fields and get tunnel vision, so the workshop was a great opportunity to see what other people (people who are enthusiastic about their work) are thinking and doing. As a result I am applying new thinking to my own work.

Participant #10

Immediate career plans:

As I am approaching the end of my PhD (due towards the end of 2006), I am currently investigating the next steps of my career. Having developed a good background in many areas of climate science and modelling through the PhD, I am hoping to move into new areas to broaden my knowledge base.
I am interested in learning about how systems work. I am particularly keen to be involved with projects that broaden our understanding of the climate system and its relationships with new processes (e.g. biological processes). I would also like to work on problems that have a human dimension, e.g. impacts on hydrology and interactions with economics and social systems.

I am currently looking for postdoc positions that allow me to pursue these interests. However, I am also considering some job opportunities with a stronger technical (software) aspect as I have previous background as a software engineer.

**Longer term career plans (~10-20 years):**

In the longer term, there are two main aspects that I would hope to develop. Firstly, I would like to move into more senior positions where I can be involved with a broader range of research than I could pursue individually, preferably bridging into several disciplines.

I believe that climate science is gradually moving towards a more integrated view of the whole climate system. I would hope to be involved with developing this system-wide view, particularly in the area of human-climate interactions.

Secondly, I am interested in being involved in communicating science to provide input into policy decisions, moving away from smaller detailed technical problems onto more strategic issues.

The details of this “grand plan” are by no means fixed - I would also be keen to be involved with commercial projects as well as pure science. The key things for me are that I continue to be challenged and to have the opportunity to learn. I would like to work in countries other than the UK for part of my career.

**Benefit from INYS workshop:**

I have learned a lot from this workshop. It has provided further insight into related disciplines (e.g. paleoclimatology) and the power and limitations of these approaches. I believe that having the experience of working on complex technical problems with scientists from other backgrounds is very valuable, and the relationships that have developed will provide useful contacts for research questions and collaborations outside of my immediate work area. I have also gained a new appreciation of the EMIC modelling technique as a means for understanding the climate system.

There has been much to take in during the workshop and it will require some time to consider how it may impact my future career. In providing an opportunity to talk to scientists from other backgrounds, it has helped me realise how valuable the cooperation between the different subjects is and how much I can contribute to that.

I have also enjoyed the experience of being in Australia immensely and feel that I have learned a lot on a cultural level as well as the science.
Participant #11

Where do you see yourself in 10 years?

I would like to see my research in climate change continue. As well as increasing my knowledge in Atmospheric Dynamics. I would like to make sure that future post-docs give me an opportunity to broaden my understanding of the whole climate system. I think that as climate research moves forward the new boundaries in knowledge will be between different fields of study such as the physics of the atmosphere and how this interacts with the ecosystem etc. The largest question that will need to be addressed I think will involve the complex feedback loops and where I want my research to move into. A key interest I have is in communicating science and education; within 10 years I would like to have developed my career so that I would have a lectureship post in a university. To achieve this I think I need to be exposed to different methods of research and the different areas of the climate community. In future I think this involves collaboration with different academic institutions and disciplines in climate science.

Has this event had an influence on my career?

The workshop has been a fantastic way to interact with other young scientists who are not specialists in the field. It has shown me that it is possible for me to direct my career even at this stage. It has highlighted where different disciplines intersect and we have been able to see where our knowledge could be combined to move the science forward.

The strength of the workshop has been to give us large amounts of time for discussion of different ideas as well as developing friendships. It has definitely made me more aware of the similarities between British and Australian research style/working environments. This in turn I think will influence my decision as to where I might work or have collaboration in the future.

One of the difficulties in collaboration early on in your career seems to be to make links and I think this opportunity has provided a great environment to do this.

Having a chance to discuss scientific issue with leading scientists and with my peers has given me real motivation to try to excel in my understanding so that I can continue to contribute to the discussion.

I would be keen to continue the interaction between the UK and Australian Scientists with the possibility of a return visit to the UK and the formation of links through scientific collaboration.

I really have enjoyed the experience and feel it has given me a broad view of where my research fits in the broader community and my current level of skills. I think it has been empowering to be given the challenge to shape future research and to be given tools or a chance to develop the ideas to do so.
Participant #12

Where do you see yourself in 10 years?

I have just started my PhD at the age of 23. In ten years time I would hope to have at least finished this!

I suppose by 2016 I would like to have undertaken one (or more) Post Doctorate positions whether abroad or in the UK in glaciological aspects of climate change. Ideally this academic right of passage would be accompanied by a series of decent publications in relevant journals and perhaps also in a medium more accessible to the public.

By the age of 33 I would like to be in a position where I could influence the way science is presented to undergraduate students and perhaps the public more generally.

However, more than this, perhaps at a more basic level, I would like to make a valuable contribution to my chosen field, be it as a post-graduate, post-doctorate or academic lecturer.

Has this event had an influence on my career?

Definitely; the workshop has provided me an insight into the many fields of research that are necessary to investigate climate change. Although I was aware of this already, it is very difficult, with the volume of specialist publications now available, to glean such a large amount of information in such a short period of time.

This exposure to the cutting edge research of other academic communities, provided not only by the speakers, but also by fellow participants, has allowed me to put into context the present and future directions of my research.

I am also undoubtedly more aware of the possibilities for doing research abroad. For example, I had no idea of the breadth and depth of Australian climate change research, as well as the funding opportunities through the EU. Although at the moment I have no definite plans as to where I might do my postdoc(s) the workshop provided me with a variety of new opportunities.

On a more personal level, the workshop has allowed me to make many new friends. I see no reasons why these relationships should not continue to evolve into research collaboration in the near and more distant future. For me, this is important with regard to the other UK participants as well as those from Australia. In other words I feel as though I (and the group as a whole) have made valuable inter – and intra-national contacts.

Finally, having the opportunity to speak on a personal level with leading climate scientists has made me more aware than ever before that what we are studying is a globally important issue and has reinforced my enthusiasm for researching climate change science.
Participant #13

Where do you see yourself in 10 years?

I am currently in my first year of my PhD, looking into glaciological modelling on a
global level. The project has been on-going for some time now, and my part is only a
small part of the larger project. With this in mind my short term goals would be to
expand my work in this project, from statistical analysis of the Canadian Artic to the
final global analysis.

Over the next 10 years then, I would like to do the ground work for a career in research,
specifically statistical modelling. Until recently, I felt my research could continue within
the UK but having the opportunity to meet and work with Australian scientists has
excited me about the prospect of overseas research. Although glaciology and Australia
might not seem like an obvious connection there is certainly a need for methods to
connect palaeo-data modelling. There have been several themes during this workshop,
highlighted in the discussion write-up, but as well as these the opportunity to break-up
and talk individually during the workshop has provided smaller, helpful projects.; for
example I’m able to apply models to some data which an Australian colleague has
collected – a simple opportunity to test the validity of the data.

There is a clear direction for the field of climate change; more interaction between the
individual research groups. The talk by Andy Pitman highlighted the amount of
information available in a field where less and less generalisation is possible. As such
often the themes are lost (divide and rule!). This seems to be resulting in new methods,
such as this workshop to make sure one’s research is kept firmly in context.

Has this event had an influence on my career?

I have not been able to move between universities during my education so both
undergraduate and postgraduate study was/is conducted at Bristol. With this in mind the
workshop has had an enormous influence on my life, providing an opportunity to
interact with other scientists in a way not possible before. As well as the general
interaction the opportunity to work with Australian Scientists has opened my eyes to a
whole new Scientific Community, for example I had never heard of charcoal dating
before this workshop, or understood the possibility of comparing glaciological results
with tree-ring data!

The group is going to set up an email list to ensure the opportunities gained from this
workshop are not lost. A close bond has been created during this period and
collaboration is inevitable. If future work can be developed within the group it would be
a great opportunity to ask some of the questions about differences in the paleo-data
between North and South without and ‘ego centric’ view.

If this program did not continue it would be a great loss to the field and a lot of great
opportunities would be missed. There has been talk of running a similar program in the
UK next year. I feel this would be an enormous benefit to any scientists who took
advantage of it. I would certainly be interested in taking part and supporting the program
in the future and talking to future participants.
Participant #14

Where do you see yourself in 10 years?

Although I realise the benefits of a long term career perspective I find the question of ‘Where will you be in 10 years’ a difficult one to answer in detail. I am currently in a 12 month post-doc; this year incorporates my putting together an ARC application as an early career researcher and I have already applied for further post-doc research experience overseas (South-western USA and the UK). I do not expect to remain at the ANU unless the ARC application is successful but I do feel it is a good base from which to build on my interests.

Has this event had an influence on my career?

I feel this workshop has provided a lesson in looking wider, not just from local to regional but regional to global. Is has encouraged me to continue looking for work overseas and may be considered a stepping stone in that sense. Prior to the workshop I had almost no exposure to climatic/environmental modelling so I feel I have learnt a lot about the research field as well as the status of my own palaeo-field; how others outside receive and understand it. The latter can only improve my own work and to consider the role of pollen and charcoal beyond the strict pathway of environ-reconstruction. That the palaeo-data was considered difficult to uncover was a comment I found surprising.

If I was to make a comment on the workshop I would have to say that the lack of a group discussion devoted to the morning palaeo-date session (Fri 24th) was most disappointing and unbalanced. I feel that people’s backgrounds could have been better matched on either side, Australia vs UK. To have had a UK representative within the palaeo field would have been most beneficial, and I suspect, would have resulted in far more networking, exchange of ideas and project development, and ultimately long-term correspondence. This I feel has also affected the status of the paleo-data working group outcomes which are not at all well developed in comparison with the other groups. The lack of focus within the written report for the palaeo group is a major disappointment for me as I was keen to see fossil data compared equally with model-data. To speak of this in a positive light however – such an outcome provides something to build on in the future. I can also say that in conversation with students from the UK the idea that smaller, low resolution (temporal and spatial) palaeo studies may be collated within a climate model to provide a more confident ‘story’ for the Holocene monsoonal tropics has been encouraging.

Participant #15

Where do you see yourself in 10 years?

I hope to still be active in the field of climate change research. In the ideal world of course, we would have consensus on the scientific research regarding dangerous change, and would be actively working on reducing the risks. My education to this point has been of a gradually shifting focus, taking in the fundamental physics, oceanography, statistic and more. I believe that it will be important in the future to bring in people with more and more diverse backgrounds to the field of climate change. The challenge is to
develop educational structures capable of training the researchers of the future. I hope to be part of this restructuring and I strongly support the spirit and ideas that led to the INYS workshop on Abrupt Climate Change.

Has this event had an influence on my career?

This week I have learnt that the magnitude and speed of current climate change is much greater than I, with a keen interest in the subject, had hitherto appreciate; if I have learned this much, how much we still have to teach others. The basis of this learning was the high quality of presentations given, and access to individuals at the centre of the science. It is impossible for an experience like this not to have an impact on a young scientist.

This experience has confirmed a great deal in my mind. I am becoming more confident that my research is relevant, and even may be valuable to the wider scientific community. I feel on a more personal level that my research is valuable to an even wider public.

I have had enlightening conversations with people directly on the same problems as I am, without this workshop I may not have come across the works of these people for many years,, I am certain at the very least, I will share ideas with at least one (Australian) of the young scientists –and that some of the ideas will work there way into my thesis.

Several of the members of the workshop have independently told me that they find learning about other aspects of the science of climate change refreshing and beneficial. I share their views. I have been exposed to at least two other fields that I have direct interest in, which may become a direct research interest.

A good point made during the workshop was of the difficulty of keeping abreast of the fundamental literature, when it is expanding at an ever increasing rate. I believe that in the face of this, it is vital to maintain face-to-face contacts, and develop personal relationships.

Participant #16

Where do you see yourself in 10 years?

By 2016, I would like to have had some work experience overseas, preferably in Canada or Europe, perhaps having acquired an assistant professorship position in a university, or a research staff position in a meteorological institution. With this in mind, I foresee either one of the following:
1. Having commenced an assistant professorship position around 2008 after my current postdoctoral position, it will be my 8th year researching and lecturing at a university.
2. Having worked for several years as a researcher in an international meteorological institution, I will have returned to Australia to continue my research career. (I am, after all, one of those to become nostalgic about the Australian lifestyle when travelling abroad!)
In any case, I find the question somewhat challenging to answer, as it is not often that I end up following the path that I predict. While open-minded and excited about possible career opportunities, I consider it important to retain a healthy balance between my career and other interests and pursuits in my life.

**Has this event had an influence on my career?**

This event was pivotal in introducing me to the wider European and Australian young scientists’ network, which I strongly believe will influence my developing career in the years to come. Even though my participation only spanned 2 days of the workshop, in that time I met some people with whom I am actively staying in touch, and beginning to build research links with. I also feel that I would have gained more from full participation in the meeting, which indicates to me the strong influence that the entire meeting will have on the careers of the other participants.
**Appendix A: Program**

<table>
<thead>
<tr>
<th>Sunday 19th, Melbourne</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accommodation:</strong></td>
<td>Darling Tower Apartments, 233 Collins Street</td>
</tr>
<tr>
<td>INYS workshop participants meet Sean Hannan at Darling Tower Apartments</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Monday 20th, Melbourne</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Accommodation:</strong></td>
<td>Darling Tower Apartments, 233 Collins Street</td>
</tr>
<tr>
<td><strong>EMIC (Earth System Models of Intermediate Complexity) Workshop</strong></td>
<td>Bureau of Meteorology Research Centre, 700 Collins St, Docklands.</td>
</tr>
<tr>
<td>0900</td>
<td>Welcome and Intro - Amanda Lynch</td>
</tr>
<tr>
<td>0915</td>
<td>Welcome to Young Scientists - Will Steffen</td>
</tr>
<tr>
<td><strong>Setting the scene: Data</strong></td>
<td>Session Chair: Ian Simmonds</td>
</tr>
<tr>
<td>0925</td>
<td>Peter Kershaw: Compilation and analysis of proxy records of climate and vegetation for the Australasian region over the last glacial cycle</td>
</tr>
<tr>
<td>0955</td>
<td>Neville Nicholls: Relationships between climate variables in the instrumental record. Implications for paleclimatic research</td>
</tr>
<tr>
<td>1025</td>
<td>BREAK</td>
</tr>
<tr>
<td>1045</td>
<td>David Etheridge: Long term atmospheric composition data for constraints of EMICs</td>
</tr>
<tr>
<td>1145</td>
<td>Kate Harle: The key ways that palaeo-science can constrain uncertainties about climate change and its potential impacts in Australia</td>
</tr>
<tr>
<td>1215</td>
<td>Panel discussion - What are the outstanding needs for palaeoclimate modeling in Australian and global palaeodata? Chair: Ian Simmonds. Panellists: Peter Kershaw, Neville Nicholls, Kate Harle, David Etheridge</td>
</tr>
<tr>
<td>1245</td>
<td>LUNCH</td>
</tr>
<tr>
<td><strong>Palaeoclimate Modeling Strategies</strong></td>
<td>Session chair: Will Steffen</td>
</tr>
<tr>
<td>1400</td>
<td>Lawrence Mysak: Glacial Inceptions: Past and Future</td>
</tr>
<tr>
<td>1445</td>
<td>Klaus Dethloff: Limits of atmospheric models for climate simulations</td>
</tr>
<tr>
<td>1530</td>
<td>BREAK</td>
</tr>
<tr>
<td>1550</td>
<td>Ian Simmonds: Simplified treatments for the simulation of oxygen isotopic concentration of ocean waters</td>
</tr>
<tr>
<td>1620</td>
<td>Matthew England: Global Ocean Thermohaline Circulation studies using the University of Victoria (Canada) EMIC</td>
</tr>
<tr>
<td>1650</td>
<td>Jozef Syktus: The Relative role of orbital and CO2 forcing in the interglacial to early glacial transition: Implications for the next glacial cycle.</td>
</tr>
<tr>
<td>1720</td>
<td>CLOSE, Evening Free</td>
</tr>
<tr>
<td>1900</td>
<td>EMIC workshop dinner Royal Melbourne Hotel</td>
</tr>
</tbody>
</table>
**Tuesday 21st, Melbourne / Canberra (ANU)**
**Accommodation:** Liversidge Court Apartments
**Seminar venue:** Innovations Building Seminar Room 2.07

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>All participants depart Melbourne for Canberra. Check into accommodation</td>
</tr>
</tbody>
</table>
| 1215   | **Press Preview of “Avoiding Dangerous Climate Change”**  
*John Schellnhuber (Innovations Building Foyer)*  |
| 1300   | Lunch                                                                    |
| 1330   | Official Welcome to ANU from the Vice Chancellor  
- Introductions and overview of workshop theme |
| 1500   | Afternoon tea                                                            |
| 1530   | Summing up (Will Steffen)                                                |
| 1600   | Day Concludes                                                            |
| 1800-1900 | **John Schellnhuber, Academy of Science Shine Dome**  
**Public Lecture: Abrupt Climate Change** |

**Wednesday 22nd Canberra (ANU)**
**Accommodation:** Liversidge Court Apartments
**Seminar venue:** Innovations Building Seminar Room 2.07

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| 0900   | Evidence for abrupt change in the instrumental record (60 + 30)  
*Mike Hutchinson & Janette Lindesay, ANU*  |
| 1030   | Morning Tea                                                              |
| 1100   | Climate change and the carbon cycle: Nonlinearities & uncertainties  
(60+30)  
*Graham Farquhar, ANU*  |
| 1230   | Lunch                                                                    |
| 1330   | Participant-led discussion: Methods and approaches to studying abrupt  
climate change and its consequences |
| 1530   | Afternoon tea                                                            |
| 1600   | Discussion concludes                                                     |
| 1700   | Aperitif talk: *Miriam Baltuck, ANU: The Earth from Space*               |
| 1800   | Day concludes                                                            |
| 1900-2100 | **Reception at the British High Commission**  
Commonwealth Avenue Yarralumla High Commission Grounds.  
The dress code for the BBQ is smart-casual  
The Deputy High Commissioner, Tim Gurney, will host the BBQ.  
A range of government, research and university contacts have also been invited to attend in an effort to introduce the group to a wide range of people involved in climate change and science in general.  
**Pickup at Liversidge Apartments @ 1845**  
**Pickup at BHC @ 2115 (drop off Liversidge Apartments)**  
(3236170) |
**Thursday 23rd Canberra (ANU)**  
**Accommodation:** Liversidge Court Apartments  
**Seminar venue:** Innovations Building Seminar Room 2.07

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>Climate and Policy in Australia I: Impacts, Adaptation and Vulnerability (30 + 30) <strong>Jo Mummery, AGO</strong></td>
</tr>
<tr>
<td>1000</td>
<td>Morning tea</td>
</tr>
<tr>
<td>1030</td>
<td>Presenting the ANUIE Climate Impacts Research Initiative <strong>Will Steffen</strong></td>
</tr>
<tr>
<td>1100</td>
<td>Climate and Policy in Australia II: Risk Management in Agriculture (30+30) <strong>John Sims, BRS</strong></td>
</tr>
<tr>
<td>1200</td>
<td>FEAST (No, this isn’t lunch!) <strong>Neil Hamilton, ANU</strong></td>
</tr>
</tbody>
</table>
| 1230  | Lunch Tour of Canberra  
|       | • Museum  
|       | • Parliament House  
|       | • Gallery  
|       | Questacon/Discovery Centre CSIRO                                      |
| 1800-2100 | **European Researchers Night**                                        |

National Europe Centre, Building 67, 1 Liversidge St., ANU

FEAST will host Australia’s first “European Researchers Night” to celebrate the achievements and linkages between Australians and European individuals, groups, and organizations.

The evening will provide the opportunity to see the outstanding British Council photographic exhibition documenting the impacts of climate change, entitled “North – South – East – West”, and to hear Prof. Mike Gore (foundation director of Questacon) from the Centre for the Public Awareness of Science deliver “A little Cocktail of Science”, an inspiring and amusing exploration of our domain.

Food and drink provided.

RSVP: info@feast.org  
By Friday 17th February
**Friday 24th Canberra (ANU)**  
**Accommodation:** Liversidge Court Apartments  
**Seminar venue:** Innovations Building Seminar Room 2.07

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>Palaeo aspects of abrupt change in the Southern Hemisphere (60 + 30)</td>
</tr>
<tr>
<td></td>
<td><em>John Chappell, ANU</em></td>
</tr>
<tr>
<td>1030</td>
<td>Morning tea</td>
</tr>
<tr>
<td>1100</td>
<td>Climate change and health: possible 'tipping points' (60 + 30)</td>
</tr>
<tr>
<td></td>
<td><em>Tony McMichael, ANU</em></td>
</tr>
<tr>
<td>1230</td>
<td>Lunch</td>
</tr>
<tr>
<td>1330</td>
<td>Participant-led discussion: Topics for networking and collaboration</td>
</tr>
<tr>
<td></td>
<td>between UK and Australian young scientists</td>
</tr>
<tr>
<td>1530</td>
<td>Afternoon tea</td>
</tr>
<tr>
<td>1600</td>
<td>Discussion continues: Formation of 2 or 3 working groups and definition</td>
</tr>
<tr>
<td></td>
<td>of topics for networking</td>
</tr>
<tr>
<td>1730</td>
<td>Discussion Concludes</td>
</tr>
<tr>
<td>1800</td>
<td>Aperitif talk: <em>John Reid, ANU: Art and Environmental Change</em></td>
</tr>
<tr>
<td>1900</td>
<td>Day concludes</td>
</tr>
<tr>
<td></td>
<td>Evening Free</td>
</tr>
</tbody>
</table>

**Saturday 25th, Sydney**  
**Accommodation:** The Oaks Maestri Tower, 298 - 308 Sussex Street

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>Depart Canberra for Sydney; transport via bus</td>
</tr>
<tr>
<td></td>
<td>• Discussion along the way on landscapes, human-environment systems, vulnerabilities to abrupt climate change.</td>
</tr>
<tr>
<td></td>
<td><strong>Pickup at Liversidge Apartments: 0900</strong> (3233764)</td>
</tr>
<tr>
<td>1330</td>
<td>Arrive in Sydney, check into accommodation, Free afternoon</td>
</tr>
<tr>
<td></td>
<td>Evening Free</td>
</tr>
</tbody>
</table>

**Sunday 26th, Sydney**  
**Accommodation:** The Oaks Maestri Tower, 298 - 308 Sussex Street

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>FREE DAY</td>
</tr>
<tr>
<td>1900</td>
<td>Harbour cruise (incl dinner) with ARC Earth System Science Network people</td>
</tr>
<tr>
<td></td>
<td>Pickup at Sydney Casino Wharf 1900 sharp. Walk from hotel ~40mins</td>
</tr>
<tr>
<td></td>
<td>(lovely walk around the water). Meet at pickup point at 1845; no later!</td>
</tr>
</tbody>
</table>
## Monday 27th, Sydney (UNSW)

**Accommodation:** The Oaks Maestri Tower, 298 - 308 Sussex Street  
**Seminar venue:** Arcade Room UNSW

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>Stability of Southern Hemisphere thermohaline circulation (60 + 30) <strong>Matt England, UNSW</strong></td>
</tr>
<tr>
<td>1030</td>
<td>Morning tea</td>
</tr>
<tr>
<td>1100</td>
<td>Recent advances in global climate change science: next challenges (60 + 30) <strong>Andy Pitman, Macquarie</strong></td>
</tr>
<tr>
<td>1230</td>
<td>Lunch</td>
</tr>
<tr>
<td>1330</td>
<td>Working Group sessions: Topics for networking and collaboration</td>
</tr>
<tr>
<td>1530</td>
<td>Afternoon tea</td>
</tr>
<tr>
<td>1600</td>
<td>Working Group sessions continue</td>
</tr>
<tr>
<td>1730</td>
<td>Day concludes</td>
</tr>
<tr>
<td></td>
<td>Evening Free</td>
</tr>
</tbody>
</table>

## Tuesday 28th Sydney (UNSW)

**Accommodation:** The Oaks Maestri Tower, 298 - 308 Sussex Street  
**Seminar venue:** Arcade Room UNSW

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>Science and Policy: A comparison of European and Australian experiences. (60 + 30) <strong>John Schellnhuber &amp; Will Steffen</strong></td>
</tr>
<tr>
<td>1030</td>
<td>Morning tea</td>
</tr>
<tr>
<td>1100</td>
<td>Vulnerability of human systems to abrupt change (60 + 30) <strong>Amanda Lynch, Monash</strong></td>
</tr>
<tr>
<td>1230</td>
<td>Lunch</td>
</tr>
<tr>
<td>1330</td>
<td>Participant-led discussion: Next steps. Maintaining and enhancing collaboration</td>
</tr>
<tr>
<td>1530</td>
<td>Afternoon tea</td>
</tr>
<tr>
<td>1600</td>
<td>Discussion continues</td>
</tr>
<tr>
<td>1730</td>
<td>Discussion concludes</td>
</tr>
</tbody>
</table>

## Wednesday 1st March, Sydney

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0900</td>
<td>Free morning, checkout10am</td>
</tr>
<tr>
<td>1300</td>
<td>Flights home in afternoon/evening</td>
</tr>
</tbody>
</table>
Appendix B: List of Workshop Participants

<table>
<thead>
<tr>
<th>United Kingdom</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>David Brayshaw</strong></td>
</tr>
<tr>
<td><strong>Dr Sarah Keeley</strong></td>
</tr>
<tr>
<td><strong>Dr Suraje Dessai</strong></td>
</tr>
<tr>
<td><strong>Andrew Sole</strong></td>
</tr>
<tr>
<td>Name</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Tiernan Williams</td>
</tr>
<tr>
<td>Douglas McNeall</td>
</tr>
<tr>
<td>Dr Marko Scholze</td>
</tr>
<tr>
<td>Australia</td>
</tr>
<tr>
<td>Dr Agus Santoso</td>
</tr>
</tbody>
</table>
| Dr Cassandra Rowe | Research School of Pacific and Asian Studies  
The Australian National University ACT | Previously based within the School of Geography and Environmental Science, Monash University, and having recently completed my doctoral studies on the Holocene history of vegetation change in the Torres Strait region, I have transferred to the Australian National University and Department of Archaeology and Natural History to work on the Australasian Pollen and Spore Atlas during 2006 and expand my interests in environmental change through northern, seasonal Australia. |
|---|---|---|
| Matthew Brookhouse | School of Resources, Environment & Society  
The Australian National University ACT | After completing my Forestry undergraduate degree and Honours in Dendrochronology I took up a position with the Forest Management branch of the Department of Sustainability and Environment (DSE). During 6 years of employment with DSE I designed and supervised a host of forest inventory programmes across Victoria. I commenced my PhD in 2003 to explore the potential of eucalypts for dendroclimatology. Whilst much of my research is based upon data I collected during my employment in Victoria I am also using datasets from the Australian Alps and Great Dividing Range in New South Wales to examine how climate signals within and between trees, species and sites. |
| Dr Frank Jotzo | Centre for Resource and Environmental Studies  
The Australian National University ACT | Frank Jotzo is an environmental economist specialising in the economics and international policies for greenhouse gas mitigation, including the Kyoto Protocol and options for a future climate treaty, and expanding his research to the economics of adaptation to climate change impacts. Frank works at the Australian National University, having recently submitted his PhD thesis at CRES. He has worked on climate policy since 1998, first at an Australian government agency (ABARE), briefly with a think tank in Indonesia, then at the ANU |
| Dr Rosalie Woodruff | National Centre for Epidemiology and Population Health  
The Australian National University ACT | I completed my PhD on climate and patterns of mosquito-borne disease epidemics in 2003. I am currently a Postdoctoral fellow, and I research the impact of climate change on human health. My principal focus has been on estimating the effects of heatwaves on populations, the future distribution of dengue and malaria, and foodborne disease patterns. I also contribute to the development of risk management activities. |
<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Gab Abramowitz</td>
<td>Department of Physical Geography Macquarie University NSW</td>
<td>Gab Abramowit submitted his PhD in land surface model data assimilation in December 2005 at Macquarie University, Sydney. His collaborative work with scientists at the University of Arizona and CSIRO Atmospheric Research involves the application of artificial neural networks to data assimilation. This work has been submitted to, or published in, Global Change Biology, the Journal of Hydrometeorology and Geophysical Research Letters. His undergraduate degree is in pure mathematics.</td>
</tr>
<tr>
<td>Dr Eun-Pa Lim</td>
<td>School of Earth Sciences University of Melbourne VIC</td>
<td>I finished my PhD last December and am working as a research fellow at the School of Earth Sciences, University of Melbourne. I have been working on the climatology of extra-tropical cyclones and the recent and future changes in the characteristics of these low pressure systems.</td>
</tr>
<tr>
<td>Dr Andrew Marshall</td>
<td>School of Geography and Environmental Science Monash University VIC</td>
<td>My research interests include a relatively broad range of topics in atmospheric and oceanographic modelling and data analysis, with particular interest in climate change, ocean-atmosphere coupling, tropical variability, and forecasting techniques. My current postdoctoral research work aims to improve current understanding of changes in the Australian summer monsoon during the late Quaternary, and underlying forcing mechanisms responsible for such change.</td>
</tr>
<tr>
<td>Dr Cecilia Macfarling</td>
<td>CSIRO Marine and Atmospheric Research VIC</td>
<td>I investigate variations in past atmospheric composition (specifically trace gases such as CO₂, CH₄, N₂O and CO) using air extracted from Law Dome (Antarctica) ice cores. I have compiled high resolution records of these gases for the last 2000 years. I have also measured the CH₄ and CO₂ in ice core air during the early Holocene (9-6 kyr BP) specifically looking at the gas response to the abrupt cold climate perturbation at 8.2 kyr BP. I have been working to use these results to help better constrain the ice core dating at Law Dome during this period. Most recently I have been involved in the CRYOSTAT project, producing gas samples for analysis of halocarbons at UEA.</td>
</tr>
</tbody>
</table>
Appendix C: Group discussion summaries

Discussion notes. 21/2

Discussion of EMIC conference Melbourne 20/02/06
Did we get an understanding of EMICS and surrounding paleo-data / data issues?

Overall consensus: Yes, although the paleo-data issues were better introduced and explained. Was particularly successful in introducing data issues re: Australian continent – long day though

Discussion on the reasons for developing EMICS
• Unbalanced nature of GCMs
• Computing power issues
• Capturing emergent properties
• System phenomena rather than magnitude

Discussion on the needs of paleo-data collectors
• Models needed to fill in gaps in the paleodat record
• More effective communication need to explain possible phenomena seen/looked for in paleo-data records (need to create sensible storylines)
• Inverse need is that to constrain models – modellers need to understand paleo-data processes better.

Possible paleo-data Meta database
• Large effort
• Seen to some extent eg tree ring database
• Spatially sparse in continents such as Australia
• Satellite system examples

Proxy data
• Multiple proxies as a method of validating coupling schemes
• Direct modelling of paleo-data sources (rather than using transform functions

Discussion notes. 22/2

In addition to discussing several questions arising from the previous sessions on Carbon cycle, spatial interpolation and the interaction between palaeo-data and the modelling community discussion was based upon three central themes of modelling scale issues and climate change impacts, understanding what dangerous climate change is and considering the issues of communicating climate change

Impacts and scale
Modelling regional climate change impacts will require significant issues of scaling and other human impacts to be overcome. To overcome scaling issues to provide regional impact scenarios will require the integration of scale terrain data and vegetation response (including classification of vegetation into functional types and models of biological growth, succession and disturbance). Human impacts, such as land cover change, must
also be represented since they affect migration the interaction between land surfaces and
the atmosphere through modifying surface roughness and moisture balances. Human
impacts need to also be included as a dynamic characteristic to account for the
interaction between land-cover change and biological response.

Clearly a great deal of additional data is required to model impacts at the local scale. The
quantity of data required to generate reasonable local scale estimates will ultimately be
dependent upon an end-user defined scale and will require not only downscaling of
global scale models, but an upscaling of biological responses.

Dangerous change?

Determination of climate change is dependent to a large extent upon the quality and
length of climate records. For example, the Western Australia shift in mean rainfall may
in fact be due to multi-decadal variability rather than a genuine change in the system.
Defining change may be facilitated by categorising changes as an increased
severity/intensity of existing conditions, new conditions not observed previously within
an area, but observed elsewhere or development of new conditions or climate scenarios
not witnessed elsewhere. Nevertheless, understanding what category change may fall
into, or indeed whether temporal variation is simply indicative of intrinsic variation,
emphasises the need for reliable palaeo-climate data

Determining what constitutes dangerous climate change is context dependent. In an
anthropogenic sense dangerous climate change may be considered as change that results
in human damage. A change in ecosystem function and provision of ecosystem services
may also be regarded as dangerous. Alternately, dangerous climate change may be a
change that exceeds adaptive capacity of an individual system. This definition, however
requires an understanding of the adaptive capacity of systems. In terms of human
systems this may be determined by economic capacity.

Communication

Determination of dangerous climate change must be made in a subjective fashion and
may require the identification of discontinuities, or tipping points, in the response of
systems. The scientific community has a responsibility to inform the public of these
tipping points and their impacts, since it is community pressure that may be necessary to
move governments to act upon climate change. Thus it is necessary to engage the media,
as the primary conveyor of scientific information to the public, effectively.

The changing way in which the community interacts with the media may mean that the
scientific community needs to explore new avenues for engaging the public.
Irrespective of the form, scientific communication must engage rather than simply
inform the community by bringing the scale of climate change from a large temporal and
spatial scale to a current and local/personal one. Importantly the rise of the internet
provides an effective tool for many-to-many communication as exemplified by the
climateprediction.net project.

In addition to developing imaginative solutions to the problem of informing the public
on climate change there is a primary need to provide only reliable information to
maintain scientific integrity and preserve the apparent trust the public has for scientists.
Importantly the peer review process provides a mechanism to determine what information may be provided to the public to protect scientific integrity.

Discussion notes. 27/2

Two main issues:

A protocol for Modellers and models

- Ensure people who use climate change models understand their limitations
- Calibration and validation are essential
- Rather than a simple metric for measuring model quality, a measure of a models applicability to a particular task was suggested
- Thus a model will vary in its effectiveness between scales (temporal and spatial) and between systems (ecosystems. Human health)
- Who would design this ‘gold standard’? The IPCC was ruled out. An independent body was the preferred option.
- Software and code management was identified as another area where a ‘gold standard’ was needed.
- Varying standards of code management lead to problems with model-run repeatability. It was suggested that model code could be submitted along with a paper to peer reviewed journals and the IPCC.
- Issues where also raised regarding issues of intellectual copyright and the responsibilities of research centres to their funding bodies. E.g. The Hadley Centre an the MOD.

Communication research to policy makers and the public

What are we trying to communicate?

- What is at stake? Impress at the highest and lowest levels the importance of the climate change issue. This is not just another environmental problem.
- What can be done about it; can anything be done about it? Possible solutions; dials on electronic equipment show how much they cost etc.
- It may be important to make connections with the public at the individual level. Portray climate change as something that an individual can affect.
- But not exclusively at this level: re-arranging deckchairs on the Titanic dilemma
- Lovelock and The Revenge of Gaia: had a big effect on the public. It seems that people are interested in abstract ideas and concrete phenomena. In our communication efforts we must jump between these two extremes as appropriate.
- The communication of the importance of climate change to third world countries was also discussed briefly: is it fair for first world countries to expect the third world to also cut emissions. The responsibility in the first instance should be borne by those best able to deal with it.
Appendix D: Media and Publicity

- Feb 21 - Radio Interview, ABC World Today, National (recording available)
  Interviewees: John Schellnhuber

- Feb 21 - Radio Interview, SBS News
  Interviewees: John Schellnhuber

- Feb 21 - TV News Interview, SBS, *story got bumped.*
  Interviewees: John Schellnhuber

- Feb 21 - TV News Interview, WIN News, Canberra and region (tape available)
  Interviewees: John Schellnhuber, Rosalie Woodruff (participant); Will Steffen

  Duration: 1:38mins ‘Young Australian and British scientists have met at the ANU to
  explore the impacts of climate change across the globe’.

  Demographics:
  Male 16+: 13061
  Female 16+: 17163
  All People 16+: 30436

- Feb 25 - Public Lecture, Abrupt Climate Change, Academy of Science Shine Dome,
  Canberra. Presented by John Schellnhuber

  Audience: Approximately 180 people in attendance
Appendix E: Financial Statement

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>STATEMENT OF INCOME AND EXPENDITURE</strong></td>
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<tr>
<td><strong>INCOME</strong></td>
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<tr>
<td>British Council</td>
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<tr>
<td>The Australian National University</td>
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<td>Australian Research Council Network</td>
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<tr>
<td>University of New South Wales</td>
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<td><strong>Total</strong></td>
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<tr>
<td><strong>Balance</strong></td>
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