**Climate Change and the Public Sphere: Mapping individual responses to Australia climate change scenarios and the limits of social adaptation**

By Simon Niemeyer, The Australian National University and Kersty Hobson, The University of Oxford

(NB: This is an early draft. Please do not cite without contacting the authors)

# 1. INTRODUCTION

This paper reports on results from a 3-year Australian Research Council-funded project entitled Climate Change and the Public Sphere (CCPS). The aims of this project were to develop regionally specific climate change scenarios: and utilise these scenarios in interviews with members of the public in the Australian Capital Region, as well as run a deliberative forum on climate change policy options.

Overall, the CCPS project was founded on the rationale that, while there now exists rigorous data on projected changes to the Australian climate, a definite knowledge gap remains regarding possible individual and collective behavioural responses to such changes. National opinion polls indicate waxing and waning levels of public concern around climate change, coupled with variations in amount and tone of media coverage (e.g. seeBoykoff 2007). While opinion polls can provide some indication of public perceptions and prioritizations of climate change relative to other social and environmental issues, they reveal little about potential individual and collective reactions to different climate change futures. Thus, work into public responses to climate change needs to go beyond opinion polling to more in-depth explorations of public values and potential responses (Adger, Brown et al. 2003).

However, such research presents a number of methodological and epistemological challenges. For one, how to effectively present sound information about potential impacts of future climate change has become an area of considerable debate. Despite continuous advances in modelling, there inevitably exist high levels of uncertainty about how climate changes might play out (Lorenzoni and Pidgeon 2006). Yet, sound and trustworthy information is still crucial, with some research suggesting that accurate knowledge about the causes of climate change is positively correlated with pro-environmental behavioural intentions (Bord, O'Connor et al.

2000): a hypothesis made more salient by the often-polarized and misinformed nature of some public media commentary (e.g. (Kitcher 2010): 1232).

Another considerable challenge—in terms of gauging responses to climate change information as a marker of (future or current) adaptive action—is that asking individuals what they think they would do in a certain situation does not capture what they actually do, and will, do. Human adaptive action cannot be predicted because of contingencies in decision-making processes and uncertainty about which potential adaptive capacities can and will be put into practice (e.g. see Berkhout and Hertin 2000; Vincent 2007). However, such limitations do not undermine the necessity of understandings how particular events and approaches to addressing climate change are reacted to and evaluated by the public, here and now (see (Adger and Kelly 1999). Decades of research into public understanding of environmental issues have underscored the importance of situating 'local' knowledge and perceptions as central to future environmental management strategies (Burgess et al 1988). Indeed, the uncertainty surrounding climate change means the nature of the problem itself is open to debate: hence the need to know 'what the stakes really are and the assumptions about the natural *and* social world made by each of the actors involved' (Pellizzoni 2003).

In responses to these challenges, the CCPS project further developed and extended a methodology previously piloted on this subject in the UK in 2003 (see Niemeyer et al 2005). In terms of the arguments of this paper, the key components of this project's methodology were the following.

1. ***Develop regionally specific and visually accessible climate change scenarios***
2. ***Use the above scenarios in face-to-face interviews with individual members of the ACR public to explore and measure their reactions to the scenarios***
3. ***Run a deliberative forum with a sample of participants from 2. To explore the effect that public debate and further information about climate change has on responses***

The remainder of this paper will focus on 1 and 2 above in turn, with a brief discussion of 3 (which is the focus of other papers in preparation).

## *1. Develop regionally specific and visually accessible climate change scenarios*

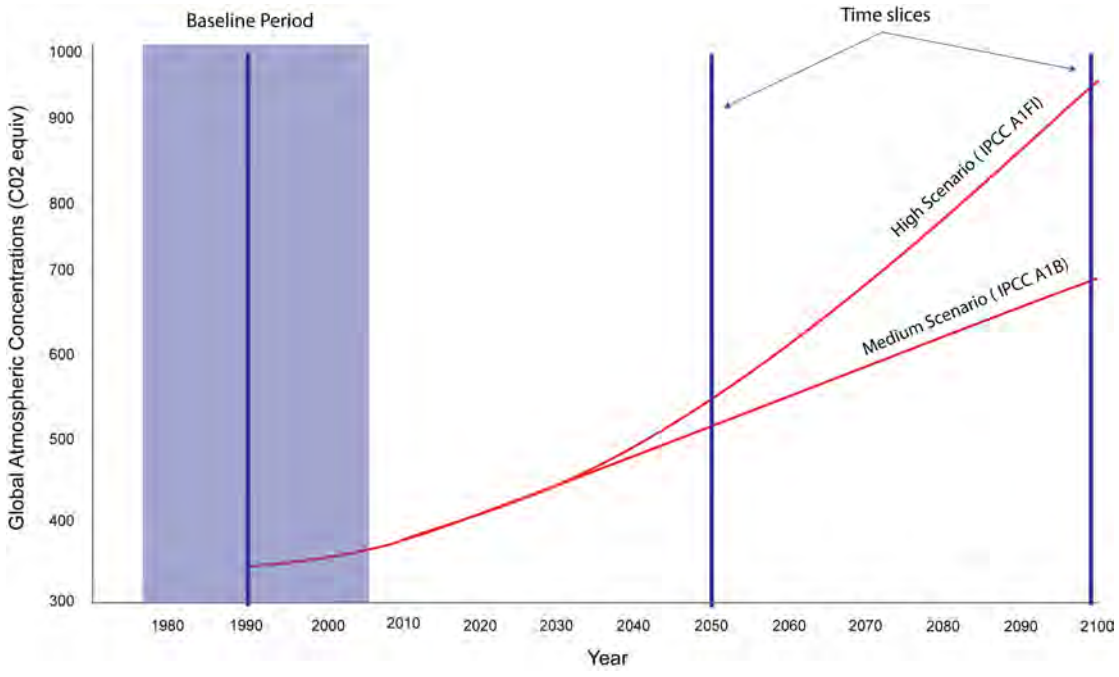
The use of scenarios has become an integral part of the climate change researchers toolkit, from both a scientific and social research perspective (seeRosentrater 2010) for a review of use of scenarios and climate change). Scenarios can be defined as 'plausible stories about how the future might unfold from existing patterns, new factors and alternative human choices' (Raskin 2005:134): stories that can span a range of scales, timeframes and components. They have been utilized for numerous purposes, such as modelling future greenhouse gas emission levels under differing socio-economic 'storylines' (Arnell, Livermore et al. 2004) and/or as tools to build collaborative visions of alternative futures in conjunction with stakeholders 'which bind together communities of decision-makers and enable them to change behaviour in response to changed images of the future' (Berkhout, Hertin et al. 2002).

In this project, the aim was to construct climate scenarios (as opposed to socio-economic scenarios: see (Lorenzoni and Hulme 2009) for discussion of this distinction) to represent impacts of projected climate changes within the ACR up to 2100: and to visually represent these scenarios in the form of diagrams, charts, and map for use in interviews with members of the public from within the ACR. The ACR-scale was chosen because, as Shackley and Deanwood (Shackley and Deanwood 2002) suggest 'there is a better prospect for mobilizing stakeholder interest and concern if climate change impacts can be demonstrated 'on the ground', with acknowledgement of the challenges of down-scaling scenarios to the regional level (see Cohen, Neilsen et al. 2006). To this end, social researchers from the ACR project worked in close conjunction with climate modellers and other natural scientists over the course of 18 months to down-scale national level scenarios to the regional scale.

The scenarios for the ACR were developed using CSIRO's OzClim model, which contains patterns of regional changes in climate projected from 23 different global climate models run by CSIRO and other research centres and archived at the Program for Climate Model Diagnosis and Intercomparison (PCMDI). The model enables users to select from six SRES scenarios (taken from the 'Special Report on Emissions') and two commonly used CO2 concentration stabilisation scenarios to generate projections for any of the available global climate models (IPCC 2000; Stern 2006; Garnaut 2008).

The scenarios and models used to generate them are outlined in Appendix A. In brief, the scenarios presented to participants were based on 'medium' and 'high' emissions trajectories associated with the SRES A1B and the SRES A1FI scenarios respectively. The emissions trajectories and time slice reference points are shown in Figure 1. As a reference point, a baseline scenario for the year 1990 was developed based on the average climate over a 30-year period (1976-2005). The two scenarios were then produced with climate parameters produced for two timeline slices. The first time-slice was 2050. This was the year that participants were asked to situate themselves in during the interview. In addition, it was also decided to add a second time-slice at 2100. The reasons for this were twofold. Firstly, the differences in climatic impact between the two scenarios at 2050 were relatively small and thus likely to produce relatively small differences in response. Second reason was that adding 2100 provided information about the trajectory of change that would be expected under that scenario. In other words, we were asking individuals to respond to the climate that they were experiencing in 2050 as well as the climate that might be expected by 2100 if emissions continued on under that scenario. This approach also sought to address a potential underestimation of perceived impacts that was identified in relation to the earlier Birmingham climate change study (Niemeyer, Petts et al. 2004).

*Figure 1. Emission Scenarios Timeline*



The climate modelling team were then given the task of producing the climatic impact for the two time slices for each scenario. The impacts covered a range of climatic variables relating to temperature, rainfall, growing range for key species and 'climatic domain representation. These parameters are listed below. In most cases the information was produced in map form, except where indicated as 'data', in which case the information was provided as climate data for the main geographical reference point.

**Temperature**

- Annual Mean
- Mean Min and Max (Annual, Monthly, Seasonal) (Data)
- Frost Days
- Hot Days
- Heatwave Days
- Heatwave Length

**Rainfall**

- annual mean
- seasonal &monthly (data)

**Drought**

- Frequency
- Length

**Indicator Species (climatic range)**

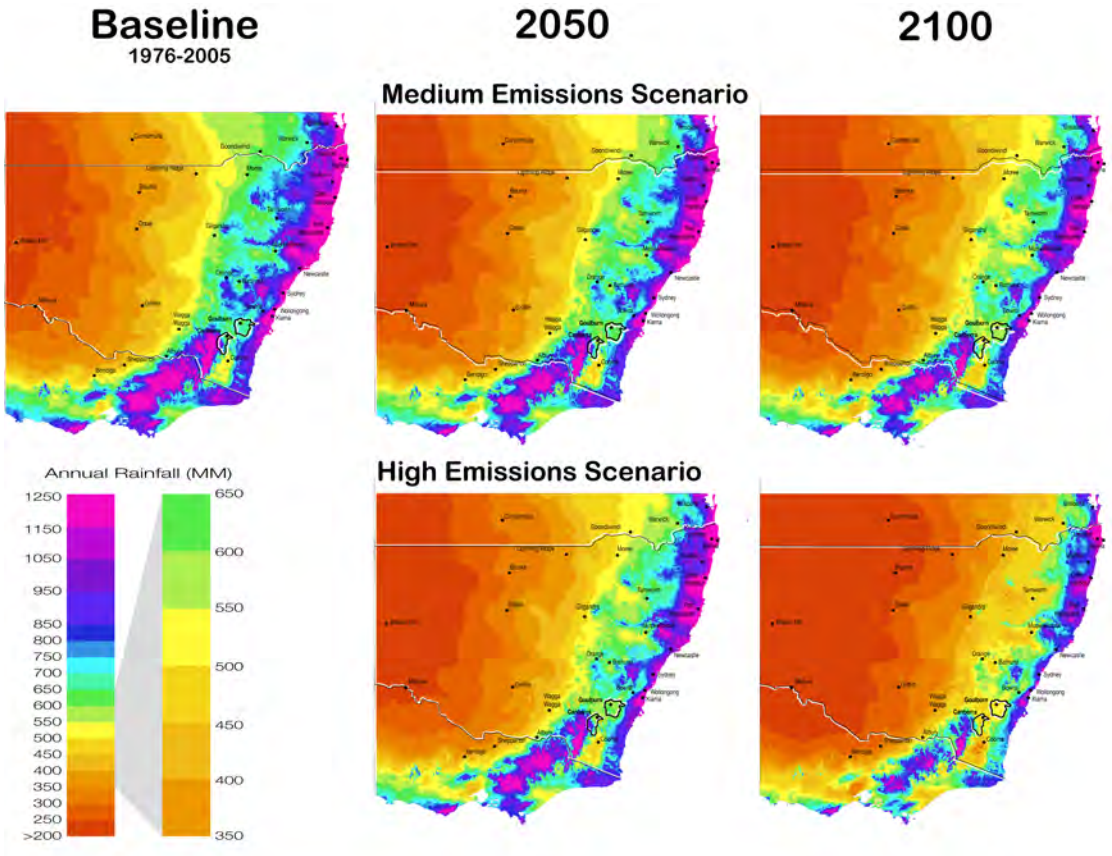
- Grapes
- Redbox

**'Climatic Domain Representation'**

- Combined (six parameters); Temperature and Rainfall

Translating the maps produced by the climate modelling team into a format that could be readily used in the scenario interviews involved cleaning up the raw images produced by the modelling software, simplifying the categories and fine-tuning the colour gradients. An example of a finished set of maps showing annual mean temperature can be found in Figure 2. Each map showed the reference study area and major town centres as reference points.

*Figure 2. Annual Average Rainfall Maps*

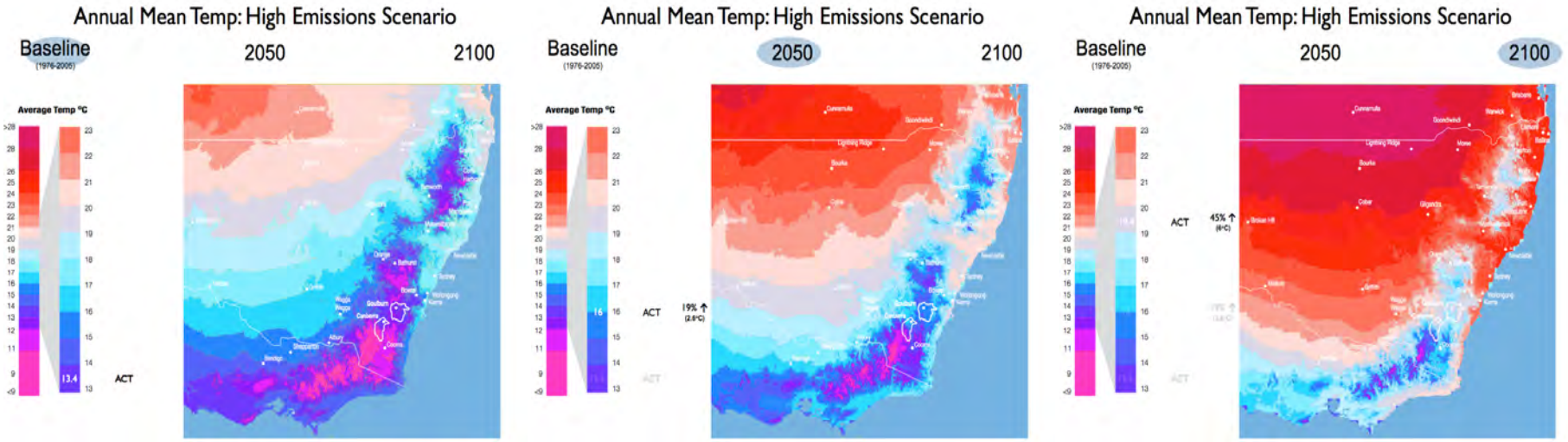



To further enhance the ability to communicate the impacts associated with the scenarios it was decided to animate the maps. This involved animating the transitions between the scenario time slices (baseline to 2050; and 2050 to 2100) so that participants could visualise the changes. The animations also indicate the changes that occur at the reference point (Canberra Airport) by indicating the value for the parameter being shown next to the map legend and moving the reference point along the legend as the slide proceeds to the next time slice.

The figures below show slides for the three time slices for the average annual temperature maps. It can be seen from the slides that the timeframe for that particular slide is indicated at the top of the slide by highlighting the relevant year on the timescale. The left hand side of each slide shows the legend and the relative

value of the climate parameter for the geographical reference point, which slides along the legend as the presentation moves to the next slide. The slides also show the relative change to the baseline value for that parameter as the timeline proceeds.

*Figure 3. Scenario Presentation Slides: Annual Mean Temperature (ACT)*



The data produced by the climate modelling (monthly and seasonal temperature; and monthly and seasonal rainfall) was translated into animated bar graphs using Adobe Flash. An example of the high emissions graphs for the ACT are shown in Figure 4. The graphs begin with the baseline data showing the monthly minimum and maximum temperature as the upper and lower bounds of the bars for each month. The average annual temperature is shown as the line through the bar. As the animation proceeds through each of the time slices the original baseline bar remains in place as a reference point showing the magnitude of change for each month, with the figures showing the change to the average mean temperature for each season shown at the top of the graph.

The final slide shows the summary graph at the end of the animation, where the bars for baseline, 2050 and 2100 are shown alongside one another for reference.

Experience from piloting the data with participants showed that individuals use different strategies when reading and translating the data into meaningful experience. Some individuals preferred using the maps, other preferred the values shown in the animations, while some preferred the use of the graphs. The objective in developing the scenarios was to provide as wide an array of strategies as possible so that the study could accommodate the different needs of individuals

Another strategy to communicate the magnitude of climate impacts was to use a geographic reference point showing where the climate was 'migrating to' under the different scenarios (see Figure 5). Initially the modelling was done to identify a single point on the map representing a position where the climate closely approximated that which the reference point (ACT) would experience under that scenario, based on 6 climate parameters (rainfall and temperature). However, it was not possible to find a close fit within the range shown on the maps in the SE of Australia with a high degree of confidence. So it was decided to represent points on the map showing the best fit for anticipated rainfall and temperature separate, with the addition to the best overall fit possible.

*Figure 4. Annual Temperature Animated Graph (frameshots)*

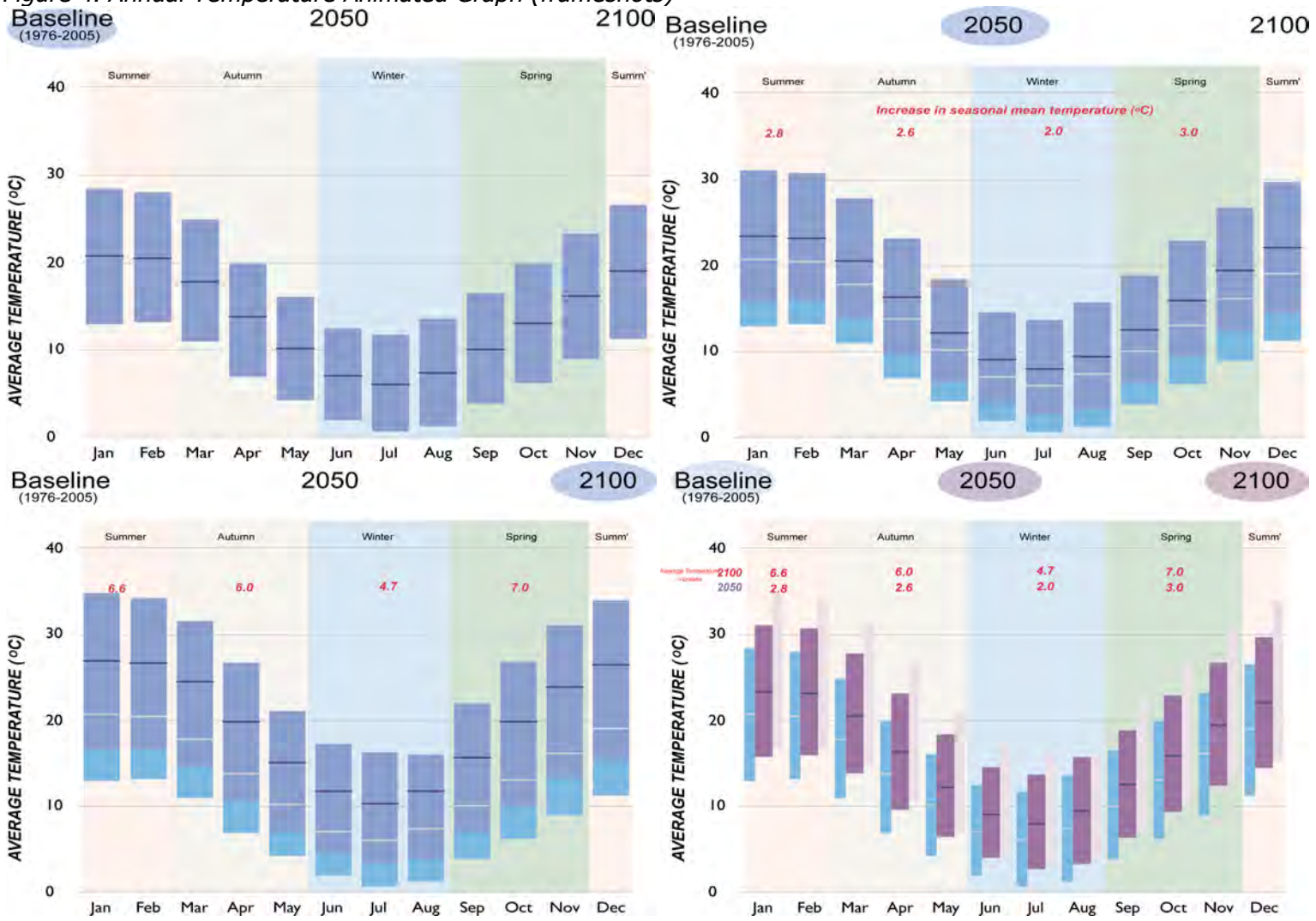


*Figure 5. Climate Domain Representation Slides (ACT High Emissions Scenario)*

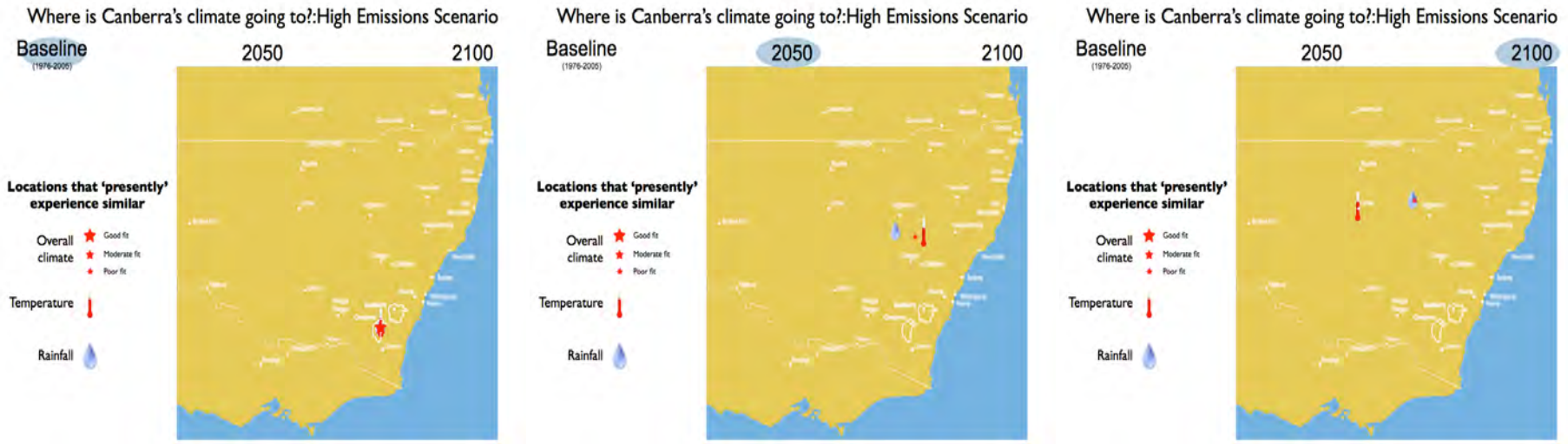



*Figure 6. Climatic Distribution of Signature Plan Species (Blakely's Red Gum; High Emissions Scenario)*

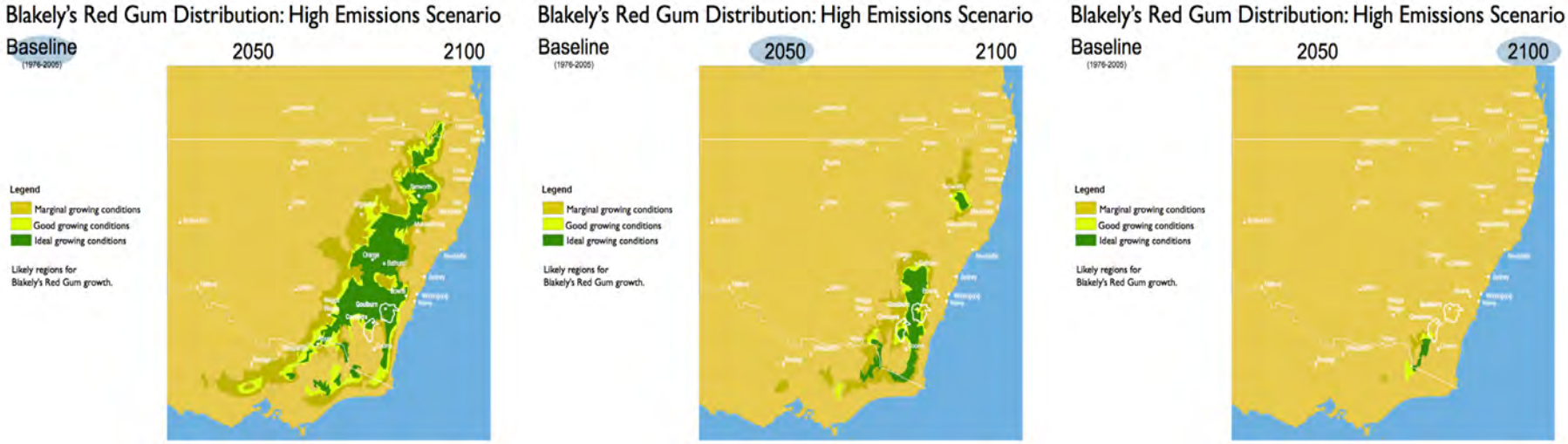


*Figure 7. Suitable Climates for the Production of Wine Grapes (High emissions scenario)*

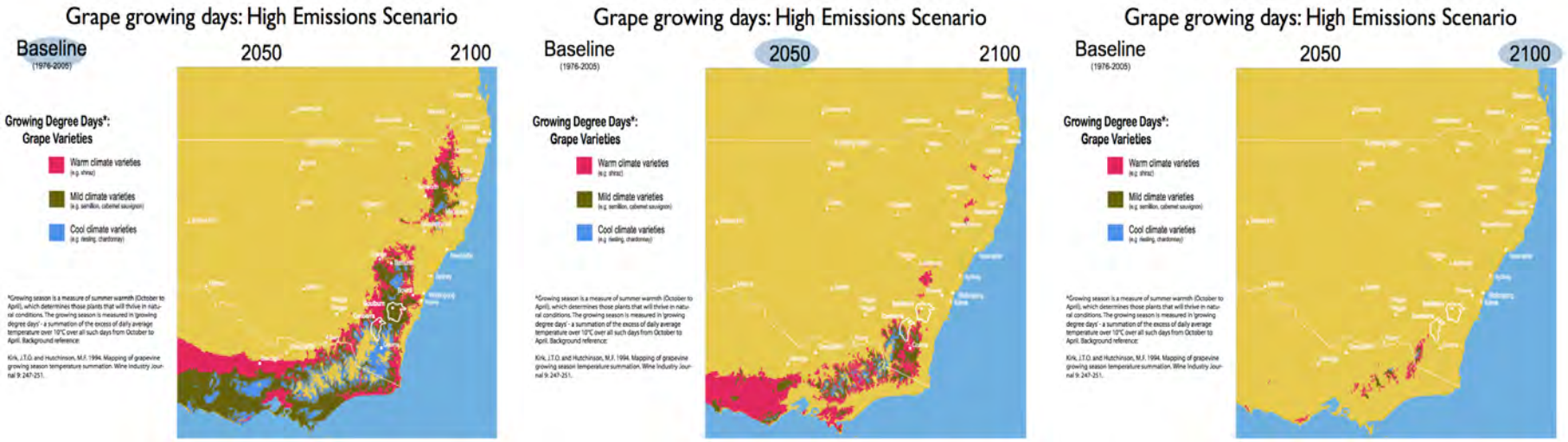


Figure 5 shows the climate of Canberra moving northward under the high emissions scenario, with rainfall and temperature diverging as the scenario progresses. The location of towns on the map provided a useful reference point for participants to develop a meaningful understanding of what sort of change would actually occur under that scenario. For example, most participants knew that Cobar (where the temperature for the ACT migrates to under the 2100 high emissions scenario) is an extremely hot location, which often achieves the highest maximum temperature for the state of New South Wales.

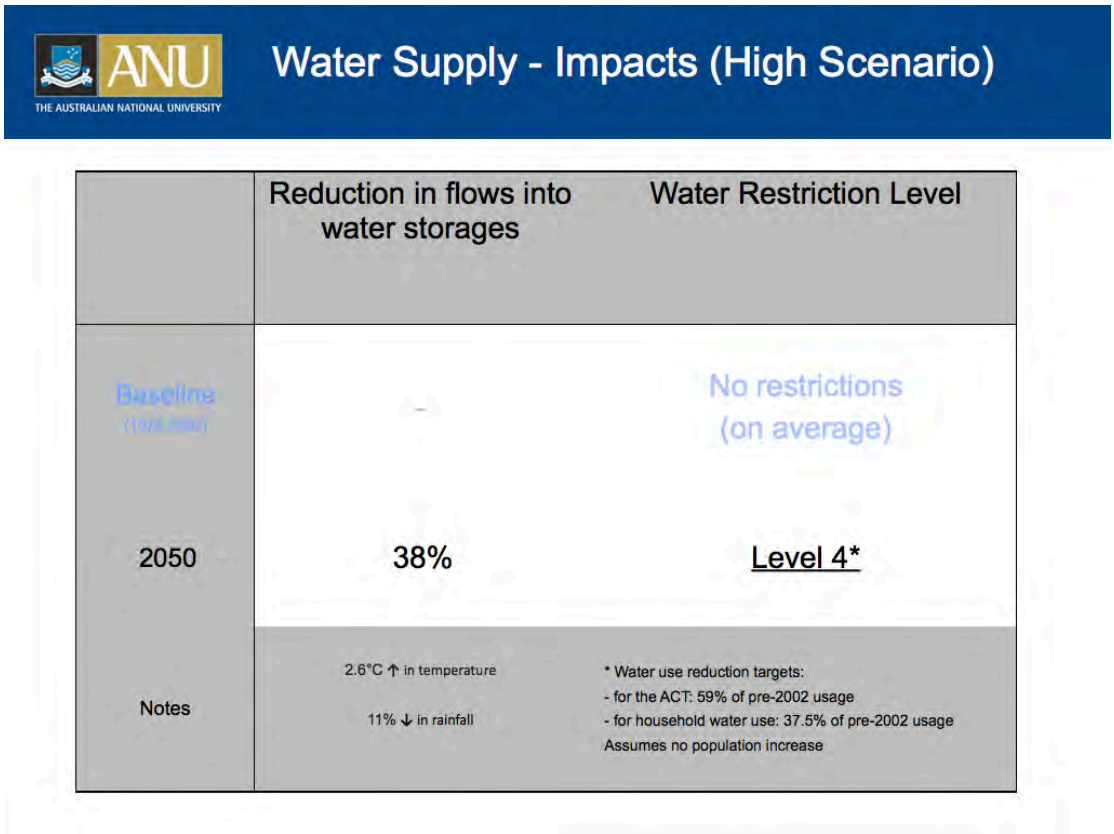
The potential distribution of key species (Blakely's red gum in the case of an existing species that is key to many local ecosystems; and wine grapes, which is the most important agricultural crop in the region) was used to illustrate where in Australia the baseline climate was migrating toward. This was particularly the case for Blakely's red gum, shown in Figure 6, where there is a clear southward migration of the climate southward and into the mountainous regions of SE Australia. The small area of appropriate climatic circumstances in the very highest mountains of the Australian Alps for the high emissions scenario in 2100 was also useful for communicating the displacement of the ecosystems in those regions and the likely extinction of species that currently inhabit them.

The suitability of climate for growing wine grapes was determined by 'grape growing days' (see Figure 7). Under the scenarios this translated into a rapidly diminishing area suitable for growing grapes — again, retreating into the mountainous areas which are predominantly protected as national parks, highlighting the potential for land use conflict. The maps themselves did not turn out to closely match the actual regions where grapes are grown. Some existing growing regions were not shown on the baseline map; and many areas shown as suitable for grapes actually covered regions where there are inappropriate soils etc. Nevertheless, the exercise was useful for communicating the way in which the baseline climate would migrate under each of the scenarios. And those individuals who were informed about and sensitive to the potential for growing grapes were able to calibrate the changes observed in the maps against their understanding of the areas in which grapes are actually grown.

### *1.1.1. Other Climate Impacts*

A range of other impacts were also communicated as part of the scenario presentations. These include impacts associated with water availability, the potential for forest fires (or 'bushfires' to use the local term) and health impacts. The first two in particular were chosen because of their salience in the region as important issues. Water supply shortages have lead to restrictions across the study region. The imposition of water restrictions was well known and understood by all participants, so the scenarios were developed to project the level of water restriction that would be experienced under that scenario in 2050. For example, the water availability slide in Figure 8 shows a 38% decrease in water availability compared to the baseline timeframe, resulting in a level 4 restriction as the average level of restriction experienced.

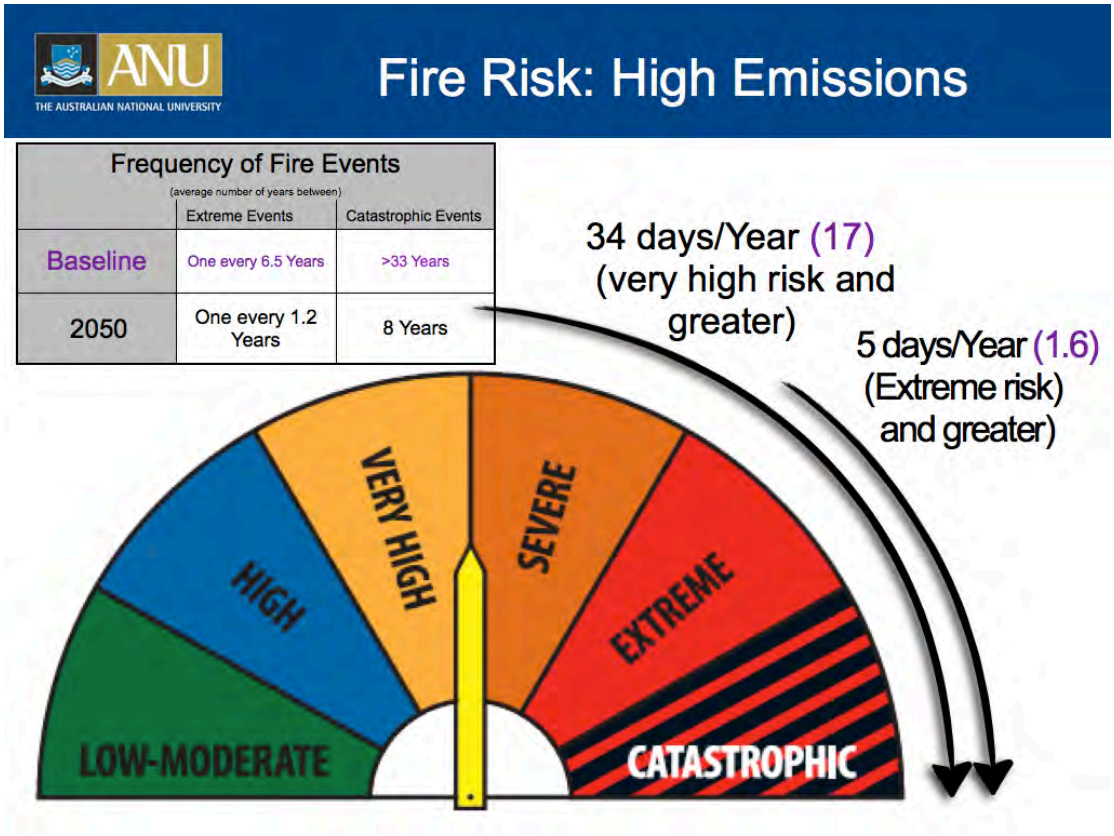
*Figure 8. Water Availability Slide (High Emissions Scenario)*




Bushfires are increasingly important issue in Australia. The study region had experienced a particularly severe bushfire in the summer of 2003 that resulted in the loss of 400 homes in the ACT. The level of fire danger is advertised on road signs that are familiar to all local residents, showing a dial with a pointer within the range

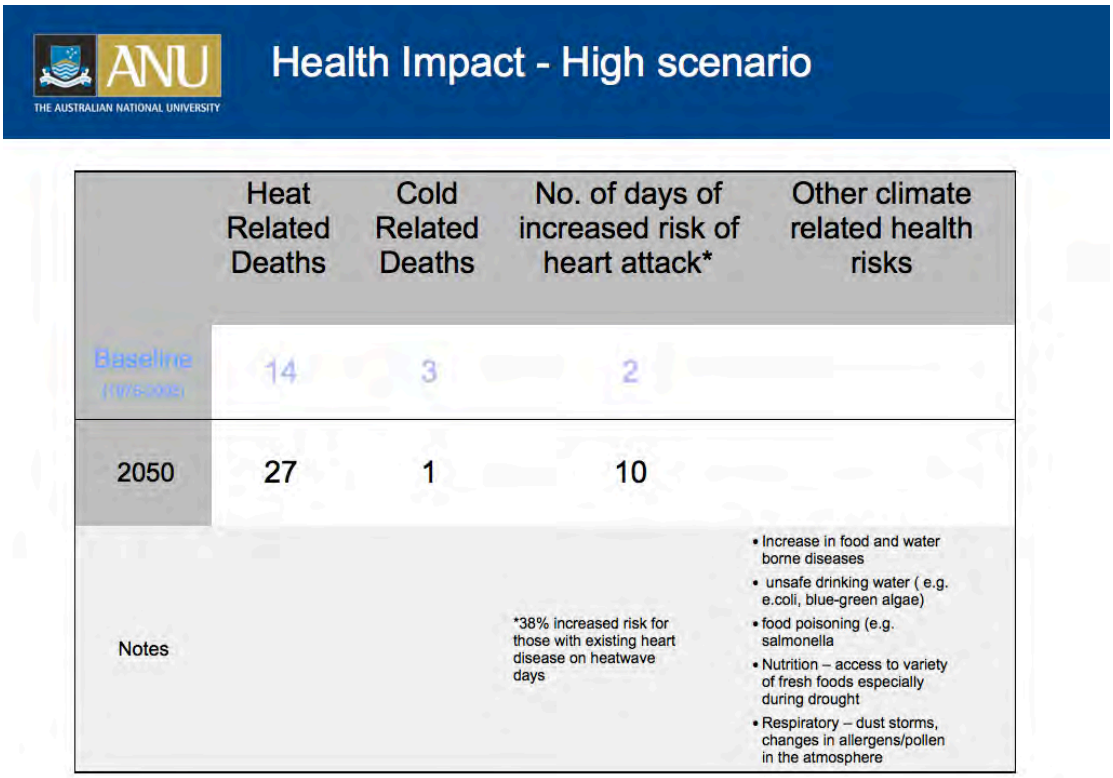
of threat ranging from Low to Catastrophic. This sign was used as a method for communicating the fire risk under each of the scenarios, as shown in Figure 9.

*Figure 9. Fire Risk Slide (ACT; High Emissions Scenario)*




Finally, the health impacts associated with each scenario were presented. Obtaining relevant and plausible figures for health impacts actually proved very difficult. So it was decided to show some of the better developed figures for the anticipated impact at 2050, alongside a general description of the associated impacts, so the participants could develop an understanding of how climate change would be likely to impact on health under that scenario. This was the only departure from a design principle for the scenarios whereby only concrete impacts would be presented.

*Figure 10. Health Impact Slide (ACT; High Emissions Scenario)*




***2. Use the above scenarios in face-to-face interviews with individual members of the ACR public to explore and measure their reactions to the scenarios***

In May 2010 a total of 104 face-to-face interviews were held in the Australian Capital Territory (ACT) and the Goulburn-Mulwaree (G-M) region. Interviewees were recruited through sending out written invitations to participate to 2000 households in the ACR, selected randomly from the electoral roll. Of these, 262 people registered an interest (188 from the ACT, 74 from G-M): of these, the research team were able to interview 104 in the allotted time-frame. The actual participants were selected on a random stratified basis using both attitudinal and demographic criteria. Emphasis was placed on recruiting a wide variety of beliefs about climate change among the participants, which ranged from deep sceptics, to deep concern about the climate change issue. The interviews were conduced over a two-hour period following a pre-established protocol, which is summarised in the table below and discussed in greater detail in the remainder of this section

*Table 1.Protocol for individual face-to-face interviews*

| *1.1.1. Component* | *1.1.2. Data Collected* |
|---|---|
| 1. Introductions and initial opening questions on attitudes to climate change | Qualitative interview data[1] |
| 2. Baseline Opinion Charting=(a)policy preference exercise; (b)Q-sort; and (c)'Willingness to Pay' (WtP) exercise | Quantitative data from Opinion Charting; qualitative conversational data |
| 3. Presentation and Discussion of the 'Medium' Scenario | Qualitative conversational data |
| 4. Repeat Opinion charting minus WtP exercise | Quantitative data from Opinion Charting; qualitative conversational data |
| 5. Presentation and Discussion of 'High' Scenario | Qualitative conversational data |
| 6. Repeat stage 4. | Quantitative data from Opinion Charting; qualitative conversational data |
| 7. Final WtP exercise and semi-structured discussion on experiences and thoughts on taking part in the interview | WtP data; qualitative interview data |

In these interviews, the scenarios discussed above were communicated to participants using iWork '09 KeyNote software. The aim here was to present these scenarios as 'learning' rather than 'truth' machines (Berkhout et al 2002). It was stressed to participants that the scenarios were not to be taken as read, but that they represented plausible climate futures that might be anticipated under the two emissions trajectories constructed for the CCPS project. However, for the purposes of the interview, participants were asked to suspend any disbelief when looking at the scenarios and to try and imagine that they were actually experiencing the change in climate that was being represented in 2050, and that the climate would continue to change in that direction toward 2100. Most participants, apart from a few deep climate sceptics, demonstrated that they were able to imagine themselves

[1] All interviews were recorded, with participants consent. Recordings were continuous throughout the interview, to capture aside comments and reactions of the participants.

in that future that was being presented to them, which is partly indicated by the changes in response to the survey questions being asked of them, which will be discussed below.

As stated above, one of the aims of this project was to explore reactions to the above scenarios, to gauge both current perceptions of climate change as well as possible future behavioural responses. To this end, a specific methodological tool was developed using 'Opinion Charting' based on Q methodology.

### *1.1.3. Opinion Charting*

Opinion charting involves a suite of approaches combining qualitative and quantitative methods to develop an understanding of the dynamics surrounding a particular issue. The opinion charting exercise involves two distinct components. The main component draws on an established method (Q methodology, see Appendix B) that involves participants responding to individual statements pertaining to climate change. The second component involves participants ranking a series of policy options relating to climate change adaptation policies. Analysis of the data combines these components, in conjunction with other observations — such as interview transcripts and dialogue from the deliberative forum.

The Q method component of opinion charting looks beyond aggregate responses to particular questions or statements, as is usually the case for survey research. Instead, it explores the way in which responses interrelate as part of a particular worldview or perspective.[2] For this study we were seeking to identity different discourses relating to climate change and climate change adaptation, with a particular focus on governance. This sort of assumption is implicit in the kind of labelling that is commonly applied to different kinds of positions (Left/Right on the political spectrum, environmentalist versus pro-development etc.). The strength of the approach used in Q methodology is that it does not automatically assume the nature of these positions prior to the analysis. Rather, it seeks to discover how

[2] Repeated studies have found that small numbers of research participants can produce robust and externally valid results, as long as there is a good representation of different perspectives — 'discursive representation', as opposed to descriptive representation of demographic variables (Dryzek and Niemeyer 2008) — because of the tendency for perspectives to be from similar patterns throughout a wider population. Large sample sizes are possible, although, because of the intensive nature of the method the resources required increase substantially, usually with relatively little additional benefit. There is also a large trade-off when combining the analysis with a deliberative event where larger numbers tend to reduce the ability to implement an effective forum.

different positions coalesce around climate change. In other words, the analysis 'discovers' how positions have formed around the issue, rather than making assumptions beforehand about what these positions are likely to be.

Although the methodology can be used to provide a snapshot of an issue, it has also been used in this study as a tool for understanding the changes that might occur as part of a dose-response study — here in relation to different climate change scenarios and resulting from participation in a deliberative forum on climate change adaptation.

The nature of the changes can provide valuable data about the dynamics of the issue; how it might unfold as climate changes; and how this might be different under deliberative conditions. Any observed changes provide insight into the possible differences between positions as they currently stand and how they might evolve under different futures. Part of this involves a kind of dose-response analysis: investigating why observed changes occurred during deliberations and whether these observations reveal aspects of the issue that might be resolvable by specific approaches.

### *1.1.4. Opinion Charting Instrument*

As previously stated, the opinion charting exercise involves two parts: performing a Q sort and a policy ranking option. Thirty-three statements were used in the Q sorting component of the opinion chart, while the policy ranking involved the presentation of seven options. The 33 statements used in the study are listed in Table 2. In addition to the Q sort and option ranking, participants also completed a willingness to pay exercise (not reported on here).

*Table 2: Q Statements from the CCPS Opinion Charting interviews*

| Q Sort Number | Statement |
|---|---|
| 1 | There is not enough information to definitively say that climate change is real. |
| 2 | The response to climate change is not going to be positive. The same mistakes will keep happening. |
| 3 | Climate variation is normal, so why should this be a problem? |
| 4 | More educational programmes are needed to increase public awareness about climate change. |
| 5 | Climate change will not be a problem because there will be technological solutions available. |
| 6 | I don't trust what scientists say about climate change. |
| 7 | I don't trust what I hear about climate change from government. |
| 8 | We need strong political leadership to do something about climate change. |
| 9 | I think it is safe to say climate change is here. |
| 10 | I'm not going to do anything to address climate change because it is not a major issue. |
| 11 | There's not much point in me doing anything to fix this. No-one else is going to. |
| 12 | It's difficult to trust what comes out in the media on the issue of climate change. |
| 13 | It is already too late to do anything, as any action to stop climate change will take a long time to take effect. |
| 14 | I'm not concerned enough to do anything drastic about this, such as participate in political action. |
| 15 | It is unfair that we are going to leave the climate in a mess for future generations. |
| 16 | We should pay for greenhouse emissions. |
| 17 | We can adapt to the coming changes. |
| 18 | It is clear that we are already entering the zone of dangerous climate change. |
| 19 | I care about the planet. |
| 20 | I don't know what to do. I'm very concerned and would like to do something, but I don't have a realistic shortlist of things that would really make a difference. |
| 21 | Australia does not owe it to the rest of the world to reduce emissions and suffer economically. |
| 22 | If Australia reduces greenhouse gases it won't make a difference. That will just shift Australian jobs to other countries. |
| 23 | This is so depressing and is so out of our control. |
| 24 | I believe that the difference we can have as an individual, in Australia, is so minimal that our actions are worthless. |
| 25 | Australia is particularly vulnerable to climate change, and it is in our interest to help find an effective global solution. |
| 26 | We need laws addressing climate change because people are not going to volunteer to change. |
| 27 | I want to do something, but it is too big and too hard. |
| 28 | When I read in the paper that climate change is not true, I start to have doubts about whether it is changing. |
| 29 | Doing something to reduce emissions feels a bit hopeless but I just want to feel that I'm doing the most I can. |
| 30 | The fate of the planet is too important to be left to market forces. |
| 31 | Australia's emissions are tiny, so it's not up to us to act. |
| 32 | Governments should take a far greater role in preparing towns and cities to adapt to the impacts of climate change. |
| 33 | Failure to address climate change is the fault of political leaders. |

### *3. Run a deliberative forum with a sample of participants from 2. to explore the effect that public debate and further information about climate change has on responses*

The final key component of the CCPS methodology was a deliberative forum held at the end May 2010, where 40 individuals who had taken part in the interviews in stage 2 were randomly selected and invited to participate (with 34 attending and completing the forum). The forum ran for 3 consecutive days (Friday 28-Sunday 30 May) then again for 1 day on the following Saturday (5 June). A detailed timetable for these 4 days is shown in Table 3.

The public participants were joined by 15 academics, a project/research team of 7, a professional facilitator, and an array of local policy actors. Overall the aims of this process were to enable participants to learn more about the issues featured in the scenarios through presentations by academic and policy experts on each of the topics. The roles of the speakers, rather than utilizing the 'outreach model' of education, experts functioned more as 'knowledge brokers' (Brand and Karvonen 2007), in an attempt to create a democratic mode of social inquiry and expose the values and assumptions behind science to public scrutiny and input. In addition, the deliberative process aimed to provide the opportunity for participants to debate with each other and question experts further about the facts and values underpinning climate change debates. Thus, whereas the one-to-one interviews provided opportunities for 'instrumental' learning, the deliberative processes created the space to both deepen this learning and also engage in 'communicative learning' (Petts 2007). Finally, a further goal was to work towards making policy recommendations for preferred local and regional adaptive actions. In terms of the latter goal, given the governance, social and environmental differences between the Australian Capital Territory and the Goulburn-Mulwaree region, after the initial two days of deliberation, the groups was split in two. Thus, day 3 was conducted with G-M participants only in the city of Goulburn: and day 4 was conducted with ACT participants only, in Canberra.

**Table 3: Timetable of the CCPS deliberative process**

| *1.1.5* | *1.1.6. Location* | *1.1.7. Activities* | *1.1.8. No. of participants* |
|---|---|---|---|
| 1 | The Australian National University, Canberra | Ice-breaker and setting deliberative ground-rules; Initial Opinion Charting; presentations on the science and socio-economic aspects of climate change; small group-break out sessions and questions to the floor; group meal in the evening | 38 |
| 2 | The Australian National University, Canberra | Presentations on bio-physical impacts and international politics of climate change; group exercise and debate on approaches to adaptation and mitigation | 36 |
| 3 | Goulburn Workers' Club, Goulburn, New South Wales | Small and whole group deliberations on priorities for action; and recommended policy approaches, with on-site feedback from local policy makers; final Opinion Charting; feedback and reflection on process and research | 15 Goulburn-Mulwaree participants |
| 4 | The Australian National University, Canberra | Small and whole group deliberations on priorities for action; and recommended policy approaches, with on-site feedback from local policy makers; final Opinion Charting; feedback and reflection on process and research | 20 ACT participants |

# 2. RESULTS

The results presented below are preliminary at this stage. Analysis is currently ongoing, with the final report on the project due to be completed by the end of 2010.

## 2.1. Climate Change Discourses

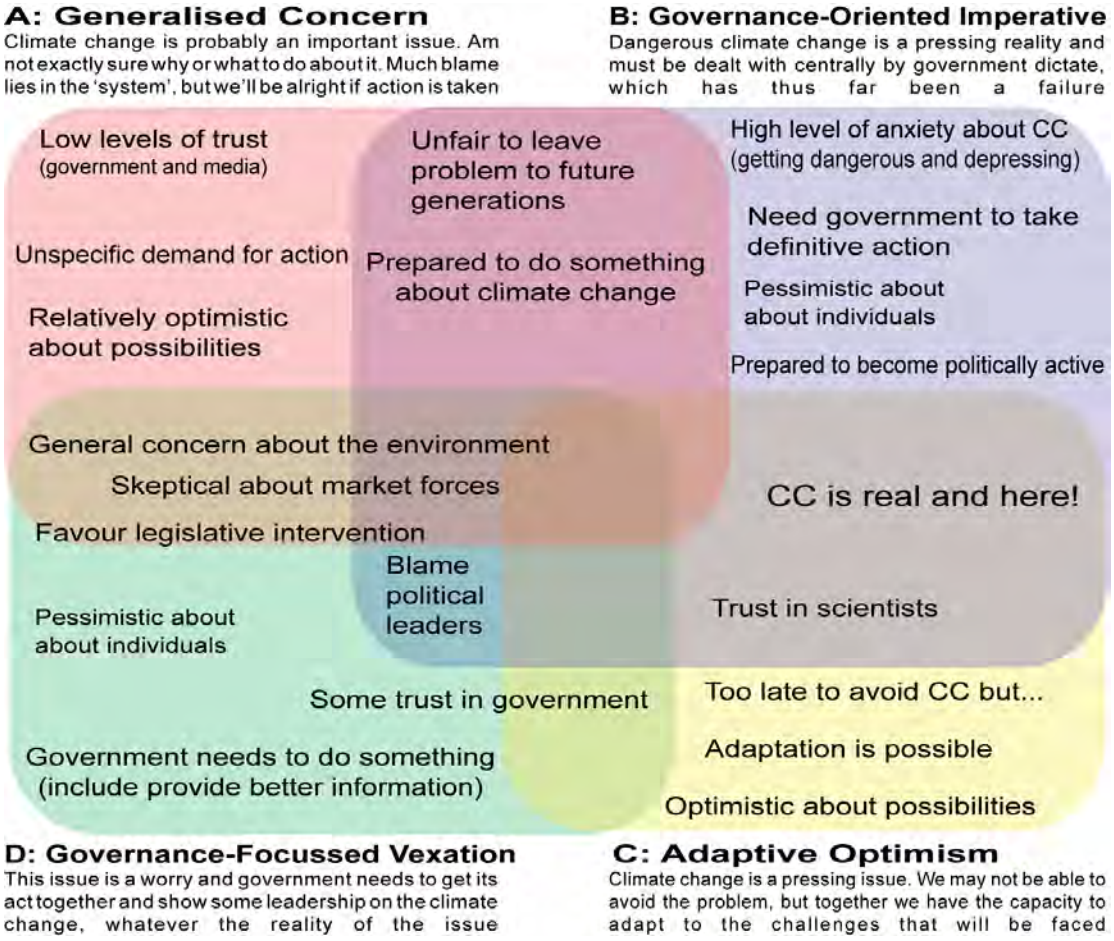
The analysis has identified four climate change discourses among the participants:

A. Generalised Concern
B. Governance-Oriented Imperative
C. Adaptive Optimism
D. Governance-Focussed Vexation

Figure 11 provides a summary of the four discourses in the form of an overlapping Venn diagram. The diagram allocates the themes attributable to each of the discourses according to which discourses they are associated with. The themes themselves are derived from the statements that are associated with the factors according to the z-score (the higher the z-score, the strongly the association of a statement with a discourse). The z-scores for all statements for each of the four discourses are provided in Table 2.

It can be seen from Figure 11 that the four discourses overlap considerable on a number of issues. Not shown in the figure is a 'consensus' that the climate change issue requires strong political leadership. Although the figure shows four discourses, strictly speaking, there are actually five discourses. The final discourse is the inverse of discourse B, representing a strongly sceptical view of both the very existence of climate change and the need to do something about it.

*Figure 11. Climate Change Discourses Diagram*




The layout of the discourses in Figure 11 can be viewed in terms of a number of axes representing shared features of the discourses. For example, dicourses A and B share a relatively unspecific concern about climate change (climate change is probably an important issue in the future, but it is not one at the moment — although that does not mean nothing needs to be done about it). Discourses B and C treat climate change as a more immediate and urgent issue.

The relative urgency of the climate change issue differs between A and B at the concerned end of the spectrum, compared to a relative bonhomie for C and D. This is not to say that C and D are not concerned about the issue. Rather, it is not something that we need to panic about (yet). Discourse C in particular is optimistic that something can be done to adapt to the changes, even if it is too late to do something about them.

There is a governance dimension that distinguishes discourse A and C to D and B. A and C tend not to make heavy demands of government, whereas B and D are

strongly concerned that the government is not doing enough (and discourse B exhibits some anger about this issue). Discourse C is, again, optimistic about what can be done to adapt to climate change without the heavy hand of government.

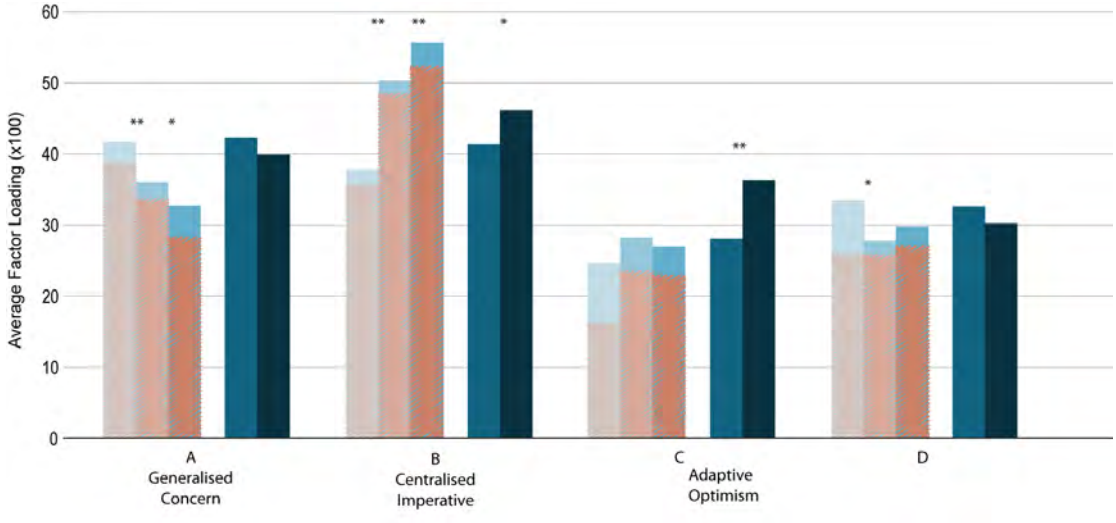
*Table 2. Statement Z-scores for each of the four discourses*

| No. | Statement | A | B | C | D |
|---|---|---|---|---|---|
| 1 | There is not enough information to definitively say that climate change is real. | 0.05 | -1.85 | -2.05 | 1.06 |
| 2 | The response to climate change is not going to be positive. The same mistakes will keep happening. | -0.47 | 0.13 | -0.59 | -0.54 |
| 3 | Climate variation is normal, so why should this be a problem? | -0.08 | -1.51 | -0.54 | -0.90 |
| 4 | More educational programmes are needed to increase public awareness about climate change. | 1.27 | 0.50 | 0.83 | 0.96 |
| 5 | Climate change will not be a problem because there will be technological solutions available. | -0.32 | -1.05 | 1.63 | 0.24 |
| 6 | I don't trust what scientists say about climate change. | 0.07 | -1.32 | -2.07 | -0.67 |
| 7 | I don't trust what I hear about climate change from government. | 0.99 | 0.05 | -0.64 | -0.63 |
| 8 | We need strong political leadership to do something about climate change. | 1.00 | 1.43 | 1.18 | 1.23 |
| 9 | I think it is safe to say climate change is here. | 0.81 | 1.48 | 1.82 | 0.44 |
| 10 | I'm not going to do anything to address climate change because it is not a major issue. | -1.70 | -1.53 | -0.89 | -1.26 |
| 11 | There's not much point in me doing anything to fix this. No-one else is going to. | -1.74 | -0.69 | -0.96 | -0.98 |
| 12 | It's difficult to trust what comes out in the media on the issue of climate change. | 1.62 | 0.08 | -0.04 | 0.10 |
| 13 | It is already too late to do anything, as any action to stop climate change will take a long time to take effect. | -1.58 | -0.44 | 0.48 | -0.96 |
| 14 | I'm not concerned enough to do anything drastic about this, such as participate in political action. | -0.78 | -1.09 | -0.43 | -0.38 |
| 15 | It is unfair that we are going to leave the climate in a mess for future generations. | 1.12 | 1.24 | 0.65 | 0.75 |
| 16 | We should pay for greenhouse emissions. | 0.27 | 0.73 | 0.80 | 0.94 |
| 17 | We can adapt to the coming changes. | 0.59 | -0.56 | 1.95 | 0.75 |
| 18 | It is clear that we are already entering the zone of dangerous climate change. | -0.58 | 1.45 | 0.70 | 0.52 |
| 19 | I care about the planet. | 2.05 | 0.97 | 0.61 | 1.04 |
| 20 | I don't know what to do. I'm very concerned and would like to do something, but I don't have a realistic shortlist of things that would really make a difference. | -0.81 | 0.13 | 0.55 | 0.34 |
| 21 | Australia does not owe it to the rest of the world to reduce emissions and suffer economically. | -0.09 | -0.89 | -0.99 | -1.76 |
| 22 | If Australia reduces greenhouse gases it won't make a difference. That will just shift Australian jobs to other countries. | -0.11 | -0.72 | -0.96 | -1.53 |
| 23 | This is so depressing and is so out of our control. | -1.55 | 0.45 | -1.21 | -0.98 |
| 24 | I believe that the difference we can have as an individual, in Australia, is so minimal that our actions are worthless. | -1.18 | -0.50 | 0.43 | -1.33 |
| 25 | Australia is particularly vulnerable to climate change, and it is in our interest to help find an effective global solution. | 1.05 | 0.90 | 1.07 | 0.75 |
| 26 | We need laws addressing climate change because people are not going to volunteer to change. | 0.56 | 1.14 | 0.17 | 1.60 |
| 27 | I want to do something, but it is too big and too hard. | -1.51 | 0.09 | 0.05 | -0.46 |
| 28 | When I read in the paper that climate change is not true, I start to have doubts about whether it is changing. | -0.16 | -1.19 | -0.85 | -0.78 |
| 29 | Doing something to reduce emissions feels a bit hopeless but I just want to feel that I'm doing the most I can. | 0.51 | 0.35 | -0.11 | 0.49 |
| 30 | The fate of the planet is too important to be left to market forces. | 0.89 | 1.45 | 0.06 | 1.55 |
| 31 | Australia's emissions are tiny, so it's not up to us to act. | -0.82 | -1.03 | -1.18 | -1.74 |
| 32 | Governments should take a far greater role in preparing towns and cities to adapt to the impacts of climate change. | 0.79 | 1.11 | 0.61 | 1.21 |
| 33 | Failure to address climate change is the fault of political leaders. | -0.16 | 0.69 | -0.08 | 0.93 |

## 2.2. Discursive Changes (scenarios and deliberation

There are a number of ways in which the changes to the prevalence of each discourse changes under different stages of the CCPS study can be measured. Here two are used — discourse loading and discourse association. The first uses the factor loadings, which are analogous to a correlation between each individual Q sort and the array of z-scores for each discourse. The average factor loading for each discourse at each stage of the study (baseline, medium scenario, high scenario, followed by pre- and post-deliberation) is shown in Figure 12. The figure shows the results for those participants who finished the deliberative forum (n=34) as the solid bars, compared to the remainder of the participants who only participated in the scenario interviews (cross-hatched bars). The significance of changes between the baseline and medium scenarios and medium and high scenarios, as well as changes between pre- and post-deliberation are indicated by asterisks (*p<0.05, **p<0.01) based on a paired *t*-test for deliberative process participants.

*Figure 12. Average Factor Loadings*




The figure shows a clear migration away from discourse A and toward discourse B as the climate change scenarios increase in severity. There also appears to be a movement away from discourse D. Overall it appears from the figure that the positions have of participants have returned to their baseline status quo prior to deliberation. But this is not quite true, as will be seen.

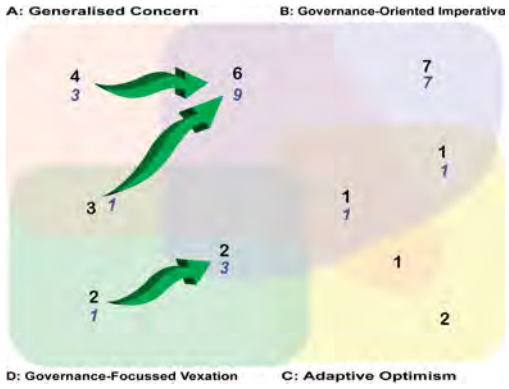
The second way that the changes to discourses can be observed at different stages of the study involves looking at the 'migration' of individuals between the discourses.

This is useful because using aggregate factor loadings does not provide any indication about the nature of the transformations and the particular trends within the overall movements.

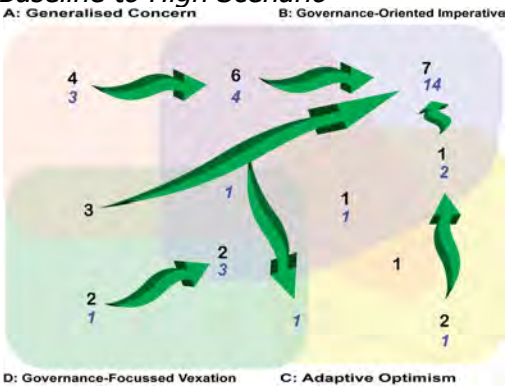
Figure 13 shows four schematic charts that use the discourse Venn diagram to plot the location of individuals and where they have moved to during the interim between different study stages. The top two plots show the migrations from baseline to the medium scenario and baseline to the high scenario. The bottom two plots show baseline to pre-deliberation and pre- to post-deliberation respectively.

*Figure 13.Migrations Between Discourses*

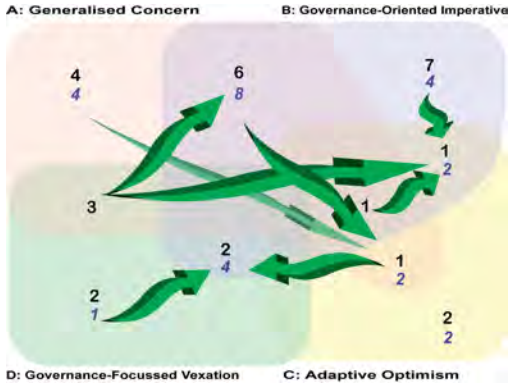
*Baseline to Medium Scenario*



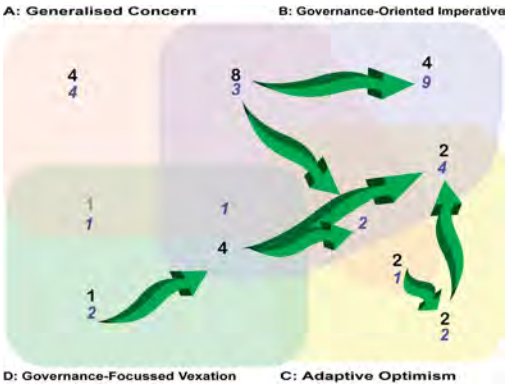

*Baseline to High Scenario*




*Baseline to Pre-deliberation*




*Pre- to Post-deliberation*




The plots tell a similar story to the graph in Figure 12: there is an increasingly strong movement away from A and toward discourse B. In more specific terms there is a general East to Northwest movement away from A and D, clearly reflecting a movement away from the relative ambivalence about the reality of climate change toward a more much stronger sense of urgency. Note that the migration here is toward B and not C, reflecting a relatively high level of alarm and demands from government to act, while at the same time the level of faith in the ability of

democratic institutions to deliver has been undermined by a failure to act. This is a similar dynamic to that observed in the earlier Birmingham study, where the potential for a maladaptive response (not cooperating the regulatory policies, decreasing trust etc.) increased dramatically as the level of climate change became more severe (Niemeyer, Petts et al. 2004).

What is also interesting is that, there is a greater amount of individual movement between the baseline and pre-deliberative stages for the deliberative forum participants than is indicated by the aggregate factor loading changes. Although the actual changes are relatively weak, the 'baseline to pre-deliberation' plot shows a net migration toward discourse C, which has carried on as a result of the deliberative forum.

This movement toward C reflects increasing optimism about the potential for dealing with climate change. This optimism was verbally expressed by participants toward the end of the deliberative forum, even though they were also more aware of the potential for dangerous levels of climate change in their region.

This is not to say that the deliberative forum merely continued the process that was begun by the experience of going through the scenarios as part of the interviews. There was much more going on, far too much to report here. But the results do suggest that the experience of going through the scenarios may have laid the foundations for the deliberative experience.

# 3. DISCUSSION AND CONCLUSION

Given the early stages of analysis of the CCPS project data it is premature to draw definitive conclusions about the implications of the results. (Follow up interviews are currently underway.) What the study has revealed thus far is the utility of meaningful and locally relevant climate change scenarios as tools for developing an understanding of the potential dynamics of the public response and the challenges that might be faced.

The responses to the scenarios suggest the potential for a maladaptive outcome as climate changes, where individuals turn against collective efforts to mitigate the impacts because of a perception of about systemic failures in the system of governance to deal with the climate change problem in the first place. In other words, the failure of government to deal with climate change at time *t* limits the potential for government to mobilise resources to adapt to climate changes at time *t*+1.

This effect is observed in response to the scenarios even though only biophysical parameters are presented. It is interesting to consider the potential outcome if the wider implications of these sorts of responses are built into a second iteration of scenarios, whether there would be a positive feedback further undermining adaptive capacity.

The CCPS study also investigated how responses to the potential for climate change evolved in response to participation in a deliberative forum. The results suggest that, although overall the positions of participants tended to return to the baseline, the very fact that they had been subjected to meaningful scenarios has had an impact on their perceptions about the climate change issue, sowing the seeds for a re-evaluation of responses.

Participation in a deliberative process tended to produce more positive responses to the potential for climate change, with greater optimism among participants about the possibilities for adaptation. This was observed both in the data and in the dialogue among deliberative participants. If resources had permitted, it would have been ideal to re-run the participants through the climate change scenarios to see how this improvement in what could be loosely referred to as 'social capital' has improved the potential for adaptation and climate change governance. Nevertheless, the results do suggest that deliberative capacity improves adaptive capacity.

Future research will seek to further develop these findings by building different social responses into scenarios and more directly testing the impact of different social and institutional settings on public responses. In the meantime, it is clear that the use of scenarios for exploring the public response to climate change and the limits to governance is an important and fertile field of study.

# 4. REFERENCES


Adger, N., K. Brown, et al. (2003). "Governance for sustainability: towards a 'thick' analysis of environmental decisionmaking." Environment and Planning A **35**: 1095-1110.

Adger, W. N. and P. M. Kelly (1999). "Social Vulnerability to climate change and the archietecture of entitlements." Mitigation and Adaption Strategies for Global Change **4**(253-266).

Arnell, N. W., M. J. L. Livermore, et al. (2004). "Climate and socio-economic scenarios for global-scale climate change impact assessments: characterising the SRES storylines." Global Environmental Change **14**: 3-20.

Berkhout, F. and J. Hertin (2000). "Socio-economic scenarios for climate impact assessment." Global Environmental Change **10**: 165-168.

Berkhout, F., J. Hertin, et al. (2002). "Socio-economic futures in climate change impact assessment: using scenarios as 'learning machines'." Global Environmental Change **12**: 83-95.

Blaug, R. (1997). "Between fear and disappointment: critical, empirical and political uses of Habermas." Political Studies **45**: 100–117.

Bord, R. J., R. E. O'Connor, et al. (2000). "In what sense does the public need to understand global climate change?" Global Enviromental Change **9**: 205-218.

Boykoff, M. T. (2007). "Flogging a dead norm? Newspaper coverage of anthropogenic climate change in the United States and United Kingdom from 2003 to 2006." Area **39**(4): 470-481.

Brand, R. and A. Karvonen (2007). "The ecosystem of expertise: complementary knowledges for sustainable development." Sustainability: Science, Practice, and Policy **3**(1): 1-11.

Brown, S. R. (1980). Political Subjectivity: Applications of Q methodology in political science. New Haven, Yale University Press.

Cohen, S., D. Neilsen, et al. (2006). "Learning with local help: Expanding the dialogue on climate change and water management in the Okanagan Region, British Columbia, Canada." Climatic Change **75**: 331-358.

Dryzek, J. S. (1990). Discursive Democracy: Politics, Policy and Political Science. Cambridge, Cambridge University Press.

Dryzek, J. S. and S. J. Niemeyer (2008). "Discursive Representation." American Political Science Review **102**(4): 481–494.

Garnaut, R. (2008). The Garnaut Climate Change Review, Final Report. Cambridge, Cambridge University Press.

IPCC (2000). IPCC Special Report Emissions Scenarios - Summary for Policymakers, A Special Report of the IPCC Working Group III. I. P. o. C. Change, International Panel on Climate Change.

Kitcher, P. (2010). "The Climate Change Debates." Science **328**(4 June ): 1230-1232.

Lorenzoni, I. and M. Hulme (2009). "Beliving is seeing; laypeople's views of future socio-economic and climate change in England and in Italy." Public Understanding of Science **18**.

Lorenzoni, I. and N. F. Pidgeon (2006). "Public Views on Climate Change: European and USA perspectives." Climatic Change **77**: 73-95.

Niemeyer, S., J. Petts, et al. (2004). Understanding thresholds in human behaviour and responses to rapid climate change. Birmingham, Centre for Environmental Research & Training, School of Geography, Earth and Environmental Sciences, University of Birmingham.

Pellizzoni, L. (2003). "Knowledge, Uncertainty and the Transformation of the Public Sphere." European Journal of Social Theory **6**: 327-355.

Petts, J. (2007). "Learning about learning: lessons from public engagement and deliberation on urban river restoration." The Geographical Journal **173**(4): 300-311.

Rosentrater, L. D. (2010). "Representing and using scenarios for responding to climate change." Wiley Interdisciplinary Reviews: Climate Change **1**: 253-259.

Shackley, S. and R. Deanwood (2002). "Stakeholder Perceptions of Climate Change Impacts at the Regional Scale: Implications for the Effectiveness and Local Responses." Journal of Environmental Planning and Management **45**: 381-402.

Stephenson, W. (1953). The study of behavior: Q-technique and its methodology. Chicago, University of Chicago Press.

Stern, N. (2006). The Stern Review on the Economics of Climate Change: Final Report. London, HMRC.

Vincent, K. (2007). "Uncertainty in adaptive capacity and the importance of scale." Global Enviromental Change **17**.

# APPENDIX A. CLIMATE CHANGE SCENARIOS

## 1. Model Description

1. **Global Climate Model** used to generate maps/data: Max Planck: ECHAM5/MPI-OM

2. **Specific Regions:**
    1) ACT (covered in this paper). Reference location: Canberra Airport
    2) Goulburn Mulwaree Local Council Area. Reference location: Goulburn City Centre

3. **Baseline (1990)** – based on data for the 30 period (1976-2005) for each set of maps that are generated. This is a close approximation to the 1990 baseline in OzClim.
4. **Three Emissions Scenarios:**
    - 'Low': Stabilisation of greenhouse concentrations at 450ppm by 2100
    - (equivalent to B1 SRES scenario)
    - 'Medium': A1B
    - 'High': A1FI
5. **Time slices:** Baseline (1990), 2050, 2100 (2020 and 2070 also used for development, but omitted from the study after piloting)
6. **Sensitivities:** Medium sensitivity for low and medium emission scenarios, but high sensitivity for high emissions scenario
7. **Changes across scenarios** generated as actual values (rather than as changes from baseline)
8. **Map coverage:** South Eastern Australia
9. **Maps produced as pdf files:** and amended into a form presentable to the public in adobe illustrator

## 2. List of images and tables generated

1. **Present cases** were produced for each series of maps or tables of figures

2. **Signature species analysis**: impacts of emission scenarios across the time slices on the distribution of:
    i. **Blakely's Red Gum**
    ii. **Wine grapes (as a signature agricultural crop)**

3. **Bioclimatic analyses** for each of the regions (Bega, Goulburn, ACT) across the emission scenarios and time slices (ie current locations of future climates for each of the regions)

- These have been developed using the following six parameters:
    - 1. Annual Mean Temperature
    - 2. Max Temperature of Warmest Period
    - 3. Min Temperature of Coldest Period
    - 4. Annual Precipitation
    - 5. Precipitation of Warmest Quarter
    - 6. Precipitation of Coldest Quarter

4. **Tables of figures and maps** for the range of emissions scenarios for the 2020, 2050, 2070, 2100 time slices:

- 1) **Rainfall** (reported as actual):
    i. annual mean rainfall (maps)
    ii. calendar season rainfall (maps)
    iii. monthly rainfall (excel)
  2) **Temperature** (reported as actual):
    i. annual mean temperatures
    ii. annual mean minimum temperatures
    iii. annual mean maximum temperatures
    iv. mean maximum temperature for mid-summer [ie January] – (see Dot point 4.viii)
    v. mean minimum temperature for mid-winter [ie July] (see Dot point 4.v)
    vi. extreme maximum temperatures [NB. this is the 'Maximum of maximum'/'Maximum of warmest month' in Excel spreadsheet]
    vii. extreme minimum temperatures [NB. this is them'Minimum of minimum' in Excel spreadsheet/Minimum of coolest month]
    viii. mean minimum, mean maximum and mean temperatures for both winter and summer calendar seasons across the scenarios and time slices [If possible as per discussion with Tingbao] [Not received yet/Will only receive if possible]
- [nb: we have seasonal rainfall maps, but not seasonal temperature maps... although we can generate data for these from the excel spreadsheet]

5. **Extreme weather parameters** presented **as maps and table of figures** for each of the scenarios/time slices to include:
    i. **No. of frost days per annum** (less than or equal to 2°C minimum**)**
    ii. **Mean no. of hot days** (over 35°C) per annum (fire risk)
    iii. **No. of heatwave days per annum** (ie any day that occurs in at least a run of three days > 35°C)
    iv. **Mean length of heatwaves**
    v. **Drought parameters:**
        - Length
        - Amount of time in drought (%)

6. **Excel spreadsheet with numerical data for each of the scenarios for each of the time slices for each region** (for point source data for Canberra Airport, Goulburn Airport and Bega AWS):

   i. **Heatwave Day** (Any day that exists in a run of at least three days where the temperature is equal to or greater than 35°C)
   ii. **Heatwave Length (No. of Heatwave days) Hot Days (equal to or greater than 35°C)** = Dot point 4.ii
   iii. **Frost Days (minimum equal to or less than 2°C)**
   iv. **Monthly mean maximum temperature**
   v. **Monthly mean minimum temperature**
   vi. **Monthly mean temperature**
   vii. **Monthly mean rainfall**

# APPENDIX B. Q METHODOLOGY

Q methodology has been demonstrated as a powerful tool for analysis of behaviour (Stephenson 1953; Brown 1980; Dryzek 1990), enabling an exploration of subjectivity that maintains robustness and external validity, particularly with small participant samples.[3] It to both identify the predominant perspectives as well as measure the extent to which particular perspectives influence the subjectivity of individuals at different points in time (such as in relation to different climate change scenarios). The methodology itself does not use the language of perspectives. Rather, the different perspectives around which individuals cluster are referred to in Q method as factors — reflecting the use of (inverted) factor analysis to elucidate these positions. In this report, the term perspectives is used in place of the term factors.

## A Brief Description of Q Method

In short, Q method involves the development of a set of statements reflective of the broader public discourse (or 'concourse' to use the language of Q).

When developing the statements an initial pool of over 200 statements was collected by the research team from sources citing statements within the public sphere in relation to climate change in Australia, such as newspaper opinion pieces and letter to the editor. These were categorised and representative statements selected for piloting. A selection of 48 statements were used for a pilot study for the methodology, which was refined down to 33 statements used in the study proper.

Once the statements used in the survey were finalised, the application of Q method to the study involved four discrete steps:

Step 1: obtaining Q sorts from each participant (in this case both pre- and post-deliberation);

Step 2: extracting factors from the raw data (using inverted factor analysis);

Step 3: applying rotation to the initial factors; and

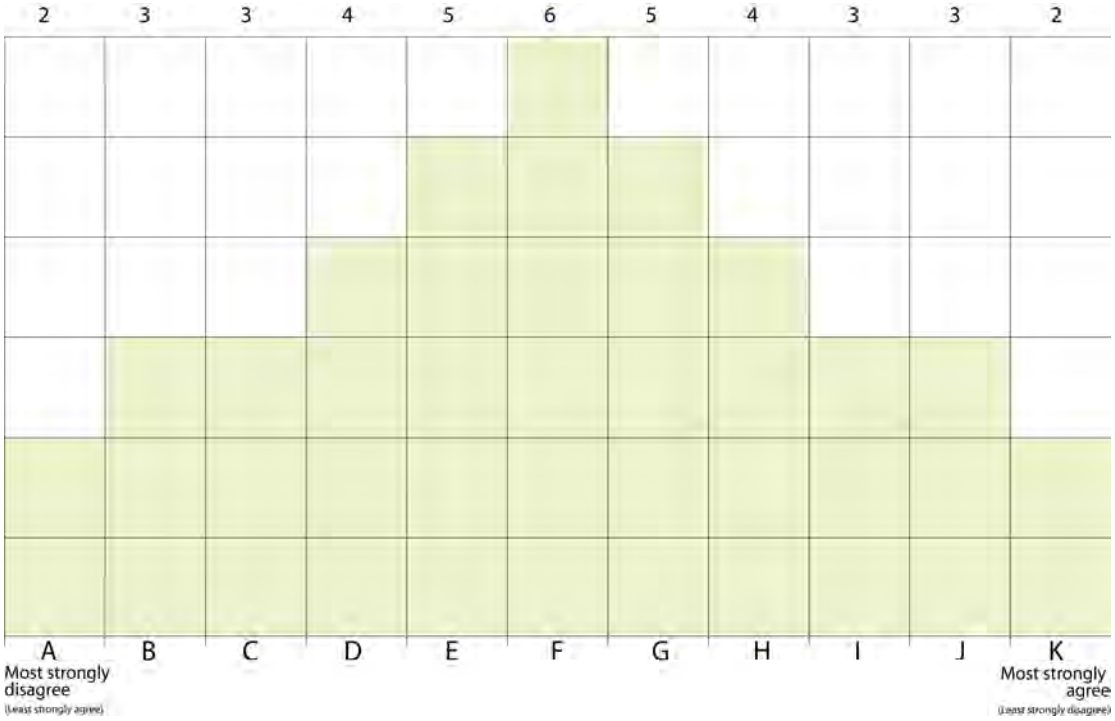
Step 4: interpreting and describing the resulting factors.

[3] It is also one of the few methodologies (particularly among those that are quantitative in nature) that is consistent with discourse theory (Blaug 1997)

*a) Q Sorting*

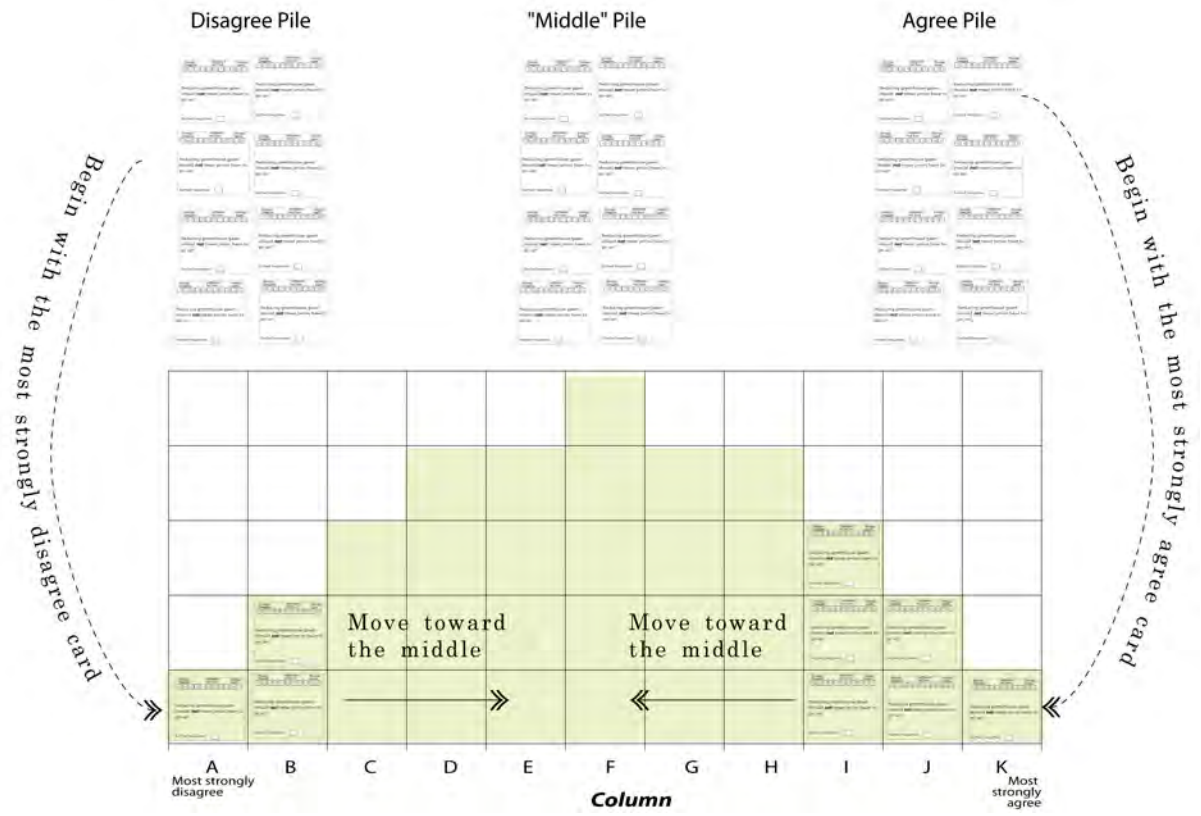
The Q Sorting process involved organising the 33 cards containing the statements used in the study into three 'piles' — disagree, middle (unsure/indifferent), and agree. From these piles the cards were sorted into eleven columns representing an array of responses from 'most disagree' to 'most agree', with column each subject to a maximum quota (referred to as a 'forced' sort), shown in Figure 14 as the shaded area.

*Figure 14 Q sort distribution*




The process usually involved choosing the extreme 'agree' or 'disagree' cards, filling the quota for that column and moving toward the middle until all the cards are placed (see Figure 15).

*Figure 15. Q Sorting Process*




*b) Factor Extraction*

Step 2 involved the extraction of the initial subjective factors using inverted factor analysis. In this case, this was performed using software that has been developed by the Deliberative Democracy and Global Governance Centre (FORQ), which used a Principle Components extraction method.

*c) Judgmental Rotation*

Step 3 Judgmental rotation was not performed on the data, because of the absence of clear criteria for doing so instead, a Varimax rotation was applied to the initial set of four factors.[4]

[4] It is possible to perform this process without recourse to manual rotation using an algorithm that maximises the correlations between factor loadings on subjective and preference factors. The Deliberative Democracy Research Group has produced an algorithm to do this. However, in practice such an automated approach tends not produce high quality results compared to the use of manual rotation and more development is needed.

*d) Factor Interpretation*

The final step of factor interpretation (Step 4) involves translating the results into factor scores, along with knowledge about those individuals that most typify a factor, to develop a description of the contents of the perspective that factor represents.

These factor scores are one of two main quantitative outputs from the Q analysis, the other being factor loadings. Factor scores comprise an array of responses to each of the Q Statements that are typical for that factor. Put another way, if one can imagine an archetypal individual whose position perfectly reflects a particular factor, the responses in that individual's Q Sort would be the same as the corresponding factor score for each statement.

Factor loadings indicate extent of agreement of individuals with a particular factor using a measure that is similar to a correlation coefficient. An archetypal individual, who is in perfect concordance with a factor would result in a factor loading of "1". Alternative factor loading of "-1" indicates perfect disagreement with a factor, and a zero loading that there is no correlation.